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00 Maintenance and General Data

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Introduction

This repair manual microfiche is to assist you in performing the necessary maintenance and repair work expertly and correctly. It must be placed at the disposal of shop foremen and mechanics, and will complement the practical and theoretical training offered by our Service Training Centre.

Since 1985 models there are two repair manuals.

- Repair manual to models
- Repair manual to construction groups

  The Construction Group Repair Manual consists of Groups 11, 12, 13, 23, 24 and 33.
  It is independent of models and describes repairing procedures on removed components and provides testing instructions and troubleshooting tables.

  A Model Repair Manual ('3' Series, '5' Series, '6' Series or '7' Series) contains all construction groups. The descriptions in the above mentioned construction groups refer chiefly to removing and installing or replacing procedures.

There are technical data and nominal value microfiches for specifications and adjusting values.

Application of this repair manual microfiche is in reference to a standard production car free from accident damage and not subsequently modified in any way.

The construction group system has been adopted from the flat rate manual.

The job numbers used in the text are meant for use as cross reference. They will frequently contain job procedures, which must not be used for extension of the flat rates. They are only provided to make finding of repair procedures easier.

The individual page numbering, for example 32 – 6, means:
32 - main group
6 - page number

The special tools essential for correct repair work are summarized on the special tool microfiche, Order No. 01 99 9 699 422. Their use is illustrated in the descriptions of the various repair jobs.

The removal work is described for each repair job in this manual. If installation does not take place in the reverse order of work, an "Installation" note is provided.

In addition to the improvements supplied to you regularly in the form of "Service Information", you are recommended to consult the parts microfiches for additional illustrated data.

BAYERISCHE MOTOREN WERKE AG
SERVICE DIVISION

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General Information

PRECAUTIONS FOR WORKING WITH PARTS CONTAINING ASBESTOS

Inhaling asbestos dust could impair health. Conform with these safety precautions when working with asbestos parts.

- Only work outdoors or in well ventilated rooms.
- Only use manually operated or slow running equipment, with dust extracting equipment if necessary! Only operate fast running equipment with dust extracting attachments.
- Moisten parts prior to machining whenever possible.
- Never blow out brake and clutch parts.
- Moisten dust, fill in containers which can be sealed perfectly and scrap in a manner which prevents danger.
- Asbestos waste and scrapped parts must be collected in perfectly sealed containers marked accordingly and then eliminated without danger for human beings or the environment.

General Information

Important When Disconnecting Battery!

Unscrew ground lead on the ground connection **point when disconnecting** a battery. **Disconnection** will cancel the fault memories of control units. Consequently first read **fault memories** with the tester and print out faults when applicable.

Important With Connected Battery!

Working on components, electric lead connections, etc. could cause faults in the fault **memories** of concerned control units. If a repair job in the repair manual specifies dis**connection** of the battery, always conform with this in the interest of safety.

Windshield Wipers (Wiper Motor)!

Intermittent wiping and wiper speed 1 are switched off by a protector in case of failure. **The protector** remains active even after eliminating the fault. It can be cancelled by **turning the ignition off** (terminals 15 and R) for 3 minutes.

Windshield Wipers (Wiper Contact Pressure Motor)!

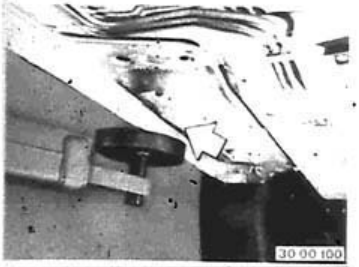
This wiper contact pressure motor is switched off by a protector in case of failure. The **protector** remains active even after eliminating the fault. To cancel the protector,

a) **disconnect** the battery for 30 seconds (caution: all fault memories are cancelled!)
   or
b) **operate** car for automatic cancellation.

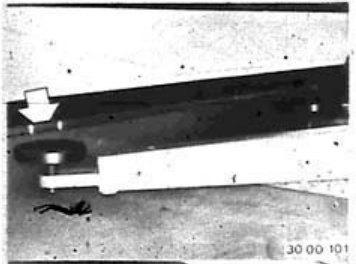
GENERAL INFORMATION

LIFTING CAR WITH A CAR HOIST

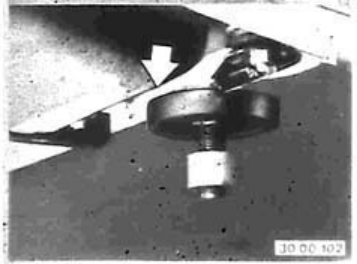
Before driving a car on the platform, make sure that there is sufficient space (clearance) between the hoist and car (if applicable, spoiler or splash guard, etc.).



Car hoists must conform with local and national legislative measures concerning accident prevention and maintenance.
Arms of a car hoist must always be applied only on the reinforced points of the frame members.
Make sure that the underside is not damaged.



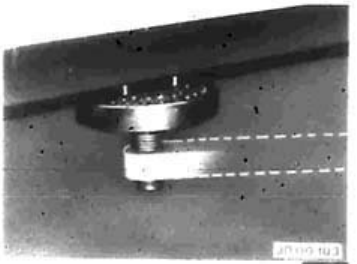
Front:
Apply rubber block of lifting arm on the front perpendicular reinforcement of the frame member, which is also provided for application of the car's jack.



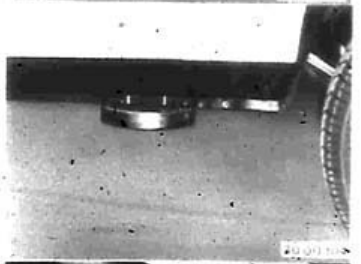
Rear:
Apply rubber block of lifting arm on the rear perpendicular reinforcement of the frame member, which is also provided for application of the car's jack.
Make sure that the underside of the fuel tank is not damaged.

LIFTING CAR WITH A GARAGE JACK

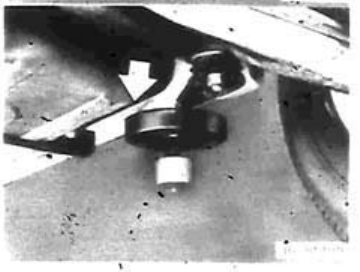
A garage jack may also be only applied for lifting the car on the same take-up points described for the car hoist.
A suitable liner (rubber, wood or plastic) must be used between the jack and car to avoid damage to the undercoating, frame members or floor plate.



Front Take-up Point



Rear Take-up Point



Caution!
Don't damage the fuel tank

TOWING

Always conform with local and national legislative measures concerning the towing of vehicles as applicable

Turn the ignition key to position "1" to unlock the steering wheel and be able to use the turn signals, horn and possibly windshield wipers.

Since the brake booster only works with the engine running, greater force will be required on the brake pedal of cars with a brake booster when the "engine is stopped".

The towing cable should be elastic to protect the towing and towed vehicles. Consequently only use plastic fiber cables or cables with elastic links.

Cars with Automatic Transmission

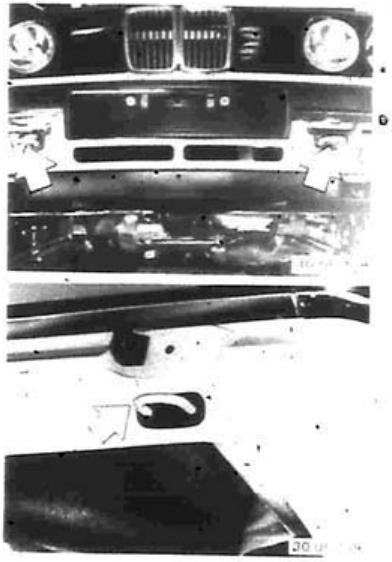
Selector lever in "N"

Max. towing speed:
50 km/h (30 mph).

Max. towing distance:
40 to 50 km (25 to 30 miles).

If the car has to be towed further than 50 km (30 miles) add an extra liter (2 pints) of ATF than the specified oil volume for automatics or remove the propeller shaft. After repairing the car it is absolutely essential to correct the ATF volume to the specified amount.

Important!
Cars with four driven wheels (325 iX) can be towed, if all 4 wheels are on the road or on the towing vehicle. Towing with one axle lifted is permitted only when the rear propeller shaft is removed with the front axle lifted, or the front propeller shaft with the rear axle lifted, since otherwise the central lock would be damaged.
Never run the engine of a car on which a propeller shaft has been removed!



Front Towing Eyes

Rear Towing Eye

BMW MAINTENANCE SYSTEM 00 00 009 Pre-delivery inspection	General information					Important information!
	Repair Manual	Technical Data	Nominal Values	Operating Fluids	Owner's Manual	
Call faults in diagnosis system.						See operating instructions for BMW diagnosis system.
Brief test.						Connect BMW Service Tester.
Check / correct engine oil level.				Gr. 11		Use approved oil.
S 14 Engine: replace spark plugs.	Gr. 12	Gr. 12				
325 iX: Check / correct adjustment of throttle valve drive (not applicable since introduction of M 1.1).	Gr. 13		Gr. 13			
Check fuel pipes, tank and hoses for correct routing, condition and leaks.						Visual inspection.
Check / correct hydraulic fluid level in supply tank for brakes and clutch.				Gr. 34		Use approved brake fluid.
Check connections and lines of brake system for leaks, correct location and damage.						Visual inspection.
Check rim size, tire size and type as well as tire inflation pressure (including spare wheel).		Gr. 36		SI Gr. 36		
Check wheel bolts for specified tightening torque.		Gr. 36				

SI = Service information

BMW MAINTENANCE SYSTEM 00 00 009 Pre-delivery inspection	General information					Important information!
	Repair Manual	Technical Data	Nominal Values	Operating Fluids	Owner's Manual	
Check / correct level and antifreeze concentration of washing fluid in supply tank for windshield and headlights(if installed in car: check / correct level of intensive cleaning fluid in supply tank).					+	
Check operation of windshield wipers/washer and aiming of spray nozzles; remove protective sleeves on wiper blades.					+	
Check acid level and charge of battery (as applicable, in trunk or underneath rear seat), correcting with distilled water when necessary. Charge battery when necessary.				Gr. 61/00	+	
Check lights: headlights/front fog lamps, parking lights, turn signals, tail lights, backup lights, rear fog lights, license plate lights, passenger compartment lights, glove box light, engine compartment light and trunk light.					+	
Check horns, headlight flasher and hazard warning lights.					+	
Check instrument and sign lights.					+	
Check control and warning lights in instrument cluster (ABS, airbag control lamp, etc.) and Check Control.					+	
Check heating, ventilating and blower.	Gr. 64					
Check operation of headlight cleaners and central locks.	Gr. 63				+	
Insert and check operation of cigar lighters.						

BMW MAINTENANCE SYSTEM 00 00 009 Pre-delivery inspection	General information					Important information!
	Repair Manual	Technical Data	Nominal Values	Operating Fluids	Owner's Manual	
Check operation of other special equipment.						
Initialize sender of remote control system.						
Check data plate, vehicle identification and engine numbers.						
Compare ordered car equipment against delivered car equipment.						
Tune in radio station and check shielding with engine running while switching all electric equipment on and off.						
Mount hub caps, if applicable wheel ornamental rings and tailpipe extension.						
Place tools in toolbox and secure jack and wheel bolt wrench.						
Paste label for BMW Emergency Service on lid of toolbox.						
Place owner's manual/service booklet, list of BMW service stations and BMW emergency service stations, spare keys and key case in glove box.						
Stamp and insert service booklet.						

BMW MAINTENANCE SYSTEM 00 00 009 Pre-delivery inspection	General information					Important information!
	Repair Manual	Technical Data	Nominal Values	Operating Fluids	Owner's Manual	

Check operation of engine, clutch, transmission, final drive, steering, foot and hand operated brakes. Cars with rear disc brakes: break in parking brake.

Check function of speedometer with odometer and daily trip recorder, tachometer (Economy Control), clock, temperature and fuel gages.

Check engine, transmission, steering, final drive, dust covers on drive shafts, fuel, clutch and brake systems for leaks.

Remove seat and other protective covers.

Reset the service indicator.

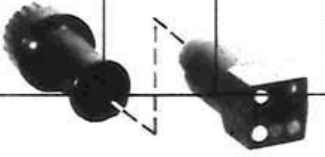
Important!
The service indicator (SI) *must* be reset after completion of the pre-delivery inspection as follows.
Switch off all electrical equipment.
Turn on ignition; do not run engine.
Plug SI-R* with adapter** for large (20-pin) diagnosis socket in diagnosis socket.
Push in and hold recessed, red INSPECTION button – green lamp (function control) comes on.
Red lamp also comes on after approx. 3 sec. and goes out after approx. 12 seconds.
Release inspection button – green lamp goes out.

Gradual introduction of new SI display with clock symbol and only one red diode light since January, 1986. Load and time memories are separated and resetting must be repeated to reset the time memory. The break before the second inspection reset must be at least 10 seconds long, but may be up to 17.5 hours after the first reset.

Check Service Indicator Display:
All five green diode lights must be on.
Yellow and possibly red diode lights as well as INSPECTION sign should go out.

* SI-R = Service Indicator Resetter, Order No. 62 1 100.
** Adapter, Order No. 62 1 140.





BMW MAINTENANCE SYSTEM 00 00 210 BMW Running-in Inspection at 2000 km (1200 mi.)	General Information					Important Information!
	Repair Manual	Technical Data	Nominal Values	Operating Fluids	Owner's Manual	
Call faults in diagnosis system.						
Brief test.						See operating instructions of BMW Service Tester.
Replace engine oil and oil filter at operating temperature.	Gr. 11			Gr. 11	+	Use approved oil.
325 iX: Remove / install splash guard and check / correct adjustment of throttle valve drive (not applicable after introduction of M 1.1).	Gr. 13		Gr. 13			
Check / adjust valve clearance (excluding 324 d, td, S 14 and M 40 engines).	Gr. 11	Gr. 11				
Tighten nuts and bolts of steering, exhaust assembly, brakes and road wheels.		Gr. 18/32 34/36				Correct tightening torque.
Replace oil in manual transmission at operating temperature; check automatic transmission fluid level.	Gr. 23/24			Gr. 23/24	+	Use approved oil.
Replace oil in final drive at operating temperature.		Gr. 33		Gr. 33		Use approved oil.
325 iX: Replace oil in front axle final drive at operating temperature.	Gr. 31					
Replace oil in transfer box at operating temperature.	Gr. 27					
Final inspection with operating safety test, brakes, steering, control and warning lamps as well as check control reports.					+	

BMW MAINTENANCE SYSTEM 00 00 220 BMW Inspection I	General Information					
	Repair Manual	Technical Data	Nominal Values	Operating Fluids	Owner's Manual	Important Information!
Call faults in diagnosis system.						See operating instructions of BMW diagnosis system.
Brief test.						See operating instructions of BMW Service Tester.
Replace engine oil and oil filter at operating temperature.	Gr. 11	Gr. 11		Gr. 11		Use approved oil.
Check / adjust valve clearance (excluding diesels and M 40).	Gr. 11	Gr. 11				
Replace spark plugs.		Gr. 12				
Check coolant hoses for leaks; check / correct coolant level and concentration.				Gr. 17		Replace coolant every 2 years at latest.
Check tightness and condition of all drive belts, tightening when necessary or replacing with separate invoicing.	Gr. 12/32/64					
325 IX: Check / correct adjustment of throttle valve drive (not applicable after introduction of M 1.1).	Gr. 13		Gr. 13			
Air cleaner: replace air filter cartridge. Replace filter cartridge more frequently when car is operated in dusty regions.	Gr. 13					

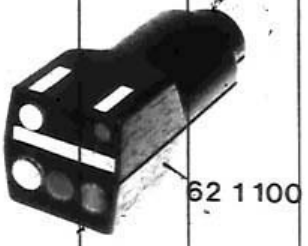
BMW MAINTENANCE SYSTEM 00 00 220 BMW Inspection I	General information					
	Repair Manual	Technical Data	Nominal Values	Operating Fluids	Owner's Manual	Important information!
Check fuel pipes, tank and hoses for correct routing, condition and leaks. BMW Diesel Engine: Drain water trap (replacement intervals depending on country).	Gr. 13/16					
Check condition, routing, suspension and leakage of exhaust assembly.						
Check power steering for leaks; check / correct oil level.	Gr. 32			Gr. 32		Use approved oil.
Check / correct steering play. Check condition of tie rods and front axle joints. Check steering gear, steering linkage and coupling.	Gr. 32	Gr. 32				
Remove and install front and rear disc brake pads. Check total thickness. Replace pads when necessary. Check surface condition of brake discs. Check brake caliper dust covers for leaks. Lubricate centering pins of wheel rims with grease.	Gr. 34/36					Correct tightening torque for road wheel bolts.
Check connections and lines of brake system for leaks, damage and correct location (clean brake liners and drums and check for wear; check wheel brake cylinders and dust covers for leaks). Check movement of parking brake cables. Adjust parking brake.	Gr. 34					
Check / correct hydraulic fluid level in supply tank for brakes and clutch.	Gr. 34			Gr. 34		Use approved brake fluid. *Important!* Replace brake fluid every two years.

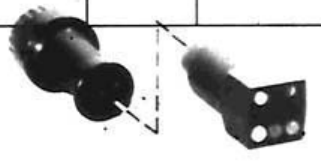
BMW MAINTENANCE SYSTEM 00 00 220 BMW Inspection I	General Information					Important Information!
	Repair Manual	Technical Data	Nominal Values	Operating Fluids	Owner's Manual	
Check / correct tire inflation pressure (including spare wheel). Check condition of tires (if worn unevenly and customer approves, check and correct wheel alignment with separate invoicing).				SI Gr. 36		
Check all gearboxes for leaks.						Visual inspection.
Check lights: parking lights, turn signals, tail lights, stop lights, backup lights, rear fog lights, license plate lights, passenger compartment lights, glove box light, engine compartment light and trunk light.						
Check headlights and front fog lamps.						
Check horn, headlight flasher and hazard warning lights.						
Check instrument and sign lights.						
Check acid level in battery, correcting with distilled water if necessary.				Gr. 61	•	
Check condition and operation of seat belts.	Gr. 72					
Lubricate locks of doors, engine hood and trunk lid with oil or grease and check function.						

SI = Service Information

BMW MAINTENANCE SYSTEM 00 00 220 BMW Inspection I	General Information					Important Information!
	Repair Manual	Technical Data	Nominal Values	Operating Fluids	Owner's Manual	
Check / correct level and antifreeze concentration of washing fluid in supply tank for windshield and headlights. If installed, check / correct level of intensive cleaning fluid in supply tank.					+	
Check windshield wiping/washing system (wiper blades and spray nozzle aiming).					+	
Final inspection with operating safety test: brakes (with rear disc brakes: break in parking brake), steering or power steering, clutch or automatic transmission, coil springs and shock absorbers (visual inspection), control and warning lamps in instrument cluster (ABS, airbag, etc.), check control, mirrors and heater blower. Check operation of power steering.						
Important! Service Indicator (SI) must be reset after inspection I: Switch off all electrical equipment. Turn on ignition – do not run engine. Use SI-R* with adapter** for large (20-pin) diagnosis socket and plug in diagnosis socket. Push in and hold recessed, red INSPECTION button – green lamp (function control) comes on. Red lamp also comes on after approx. 3 sec. and goes out after approx. 12 seconds. Release INSPECTION button – green lamp goes out.						
Gradual introduction of a new SI display with clock symbol and only one red diode light since January, 1986. A clock symbol lights up together with the INSPECTION sign to announce a time-dependent inspection interval and has no influence on the green diode lights. When load and time dependent inspections occur together, resetting must be repeated after 10 seconds to cancel the clock symbol and INSPECTION sign.						
Checking Service Indicator (SI): All five green diode lights must be on. Yellow and possibly red diode lights as well as INSPECTION sign should go out.						

* SI-R = Service Indicator Resetter, Order No. 62 1 100.
** Adapter, Order No. 62 1 140.





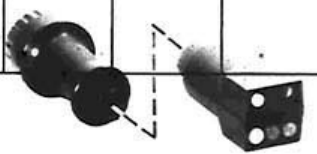
BMW MAINTENANCE SYSTEM 00 00 230 BMW Inspection II = Inspection I + Additional Jobs	General Information					Important Information!
	Repair Manual	Technical Data	Nominal Values	Operating Fluids	Owner's Manual	
Replace oil in rear axle final drive (325 iX: also transfer box and front axle final drive) and automatic transmission at operating temperature.	Gr. 23/24/33			Gr. 23/24/27/33		Use approved oil
Replace fuel filter.	Gr. 16					
Check clutch drive plate for wear.	Gr. 21					
Check play of front wheel bearings.	Gr. 31					
Rear disc brakes: check thickness of parking brake liners, replacing if necessary.	Gr. 34	Gr. 34				
Check condition of dust covers on output shafts and for leaks.						
Replace toothed drive belt (every second Inspection II or every 4 years).	Gr. 11					

BMW MAINTENANCE SYSTEM 00 00 230 BMW Inspection II = Inspection I + Additional Jobs	General Information Repair Manual	Technical Data	Nominal Values	Operating Fluids	Owner's Manual	Important Information!
BMW 324 d: check / correct basic static adjustment of injection pump (not applicable with DDE). Tighten toothed drive belt.	Gr. 11					
Catalytic converter cars: Check function of oxygen sensor in every Inspection II (by calling fault memory in cars with self-diagnosis).	Gr. 11					
Important! Service Indicator (SI) must be reset after Inspection II: Switch off all electrical equipment. Turn on ignition – do not run engine. Use SI-R* with adapter** for large (20-pin) diagnosis socket and plug in diagnosis socket. Push in and hold recessed, red INSPECTION button – green lamp (function control) comes on. Red lamp also comes on after approx. 3 sec. and goes out after approx. 12 seconds. Release INSPECTION button – green lamp goes out. Gradual introduction of a new SI display with clock symbol and only one red diode light since January, 1986. A clock symbol lights up together with the INSPECTION sign to announce a time dependent inspection interval and has no influence on the green diode lights. If load and time dependent inspections occur together, resetting must be repeated after 10 seconds to cancel the clock symbol and INSPECTION sign.						



20 00 005

* SI-R = Service Indicator Resetter, Order No. 62 1 100.
** Adapter, Order No. 62 1 140.



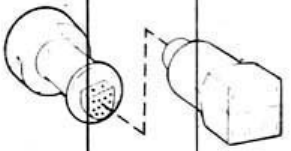
32 00 018

BMW MAINTENANCE SYSTEM 00 00 240 BMW Annual Check / Additional Inspection Points for Inspection I or II	General Information Repair Manual	Technical Data	Nominal Values	Operating Fluids	Owner's Manual	Important Information!
Replace brake fluid every two years.				Gr. 34		Use approved brake fluid.
Replace coolant every two years (invoiced separately).				SI Gr. 00		
Inspect entire body – excluding cavities – for damage from rust. Repair (invoiced separately) and enter inspection and repairs in Service Booklet.						
Check and aim headlights and front fog lamps.	Gr. 63					
If installed: check fire extinguisher every two years (invoiced separately).						
Invoiced separately (e.g. for official inspections):						
Inspect supporting body parts for ruptures and cracks.						
Inspect supporting body parts for corrosion.						
Check completed body repairs for conformance with BMW specifications.						
Check steering: steering locks, bolted connections, steering damper/power steering. Check dust covers on rack-and-pinion steering for leaks.	Gr. 32					
Brakes: check brake master cylinder and brake booster operation and for leaks.	Gr. 34					
Corrections on body, repairs and replacement of parts as well as vehicle inspection in accordance with legislation* are invoiced separately.						
Reset Service Indicator (SI): see Inspection.						
* Check legislation of pertinent country.						
SI = Service Information						

BMW MAINTENANCE SYSTEM 00 00 245 BMW Annual Check	General Information					Important Information!
	Repair Manual	Technical Data	Nominal Values	Operating Fluids	Owner's Manual	
Replace brake fluid every two years.				Gr. 34		Use approved brake fluid.
Replace coolant every two years (invoiced separately).				SI Gr. 00		
Inspect entire body – excluding cavities – for damage from rust. Repair (invoiced separately) and enter inspection and repairs in Service Booklet.						
Check and aim headlights and front fog lamps.	Gr. 63					
If installed: check fire extinguisher every two years (invoiced separately).						
Invoiced separately (e.g. for official inspections):						
Inspect supporting body parts for ruptures and cracks.						
Inspect supporting body parts for corrosion.						
Check completed body repairs for conformance with BMW specifications.						
Check steering: steering locks, bolted connections, steering damper/power steering. Check dust covers on rack-and-pinion steering for leaks.	Gr. 32					
Brakes: check brake master cylinder and brake booster operation and for leaks.	Gr. 34					
Corrections on body, repairs and replacement of parts as well as vehicle inspection in accordance with legislation* are invoiced separately.						

* Check legislation of pertinent country.

SI = Service Information

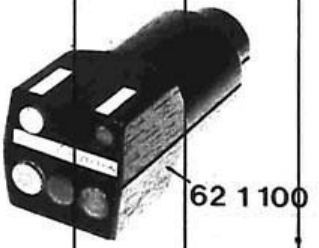
BMW MAINTENANCE SYSTEM 00 00 245 BMW Annual Check	General Information					Important Information!
	Repair Manual	Technical Data	Nominal Values	Operating Fluids	Owner's Manual	
Important! **Service Indicator (SI) must be reset after annual check display (INSPECTION):** **Switch off all electrical equipment.** **Turn on ignition – do not run engine.** **Use SI-R* with adapter** for large (20-pin) diagnosis socket and plug in diagnosis socket.** **Push in and hold recessed, red INSPECTION button – green lamp (function control) comes on.** **Red lamp also comes on after approx. 3 sec. and goes out after approx. 12 seconds.** **Release INSPECTION button – green lamp goes out.** **Gradual introduction of a new SI display with clock symbol and only one red diode light since January, 1986. This clock symbol lights up together with the INSPECTION sign for a time dependent inspection and has no influence on the green diode lights. Resetting must be repeated after 10 seconds when load and time dependent inspections occur together (clock symbol and yellow or red diode light come on), in order to cancel the clock symbol and INSPECTION sign, and reactivate the green diode lights.** **Checking Service Indicator (SI):** **The number of lighted green diode lights is not changed by resetting a time dependent inspection, but the INSPECTION sign and clock symbol must go out.** * SI-R = Service Indicator Resetter, Order No. 62 1 100. ** Adapter, Order No. 62 1 140. Order No. of new SI-R = 62 1 Order No. of adapter for new SI-R = 62 1						

BMW MAINTENANCE SYSTEM 00 00 249 BMW Engine Oil Service	General Information					Important Information!
	Repair Manual	Technical Data	Nominal Values	Operating Fluids	Owner's Manual	
Replace engine oil and oil filter at operating temperature.				Gr. 11		Use approved oil.
324 d, td: Drain water trap.	Gr. 13					
325 iX: Check / correct adjustment of throttle valve drive (not applicable after introduction of M 1.1).	Gr. 13		Gr. 13			

Important!
Service Indicator (SI) must be reset after an Oil Service:
Switch off all electrical equipment.
Turn on ignition – do not run engine.
Use SI-R* with adapter** for large (20-pin) diagnosis socket and plug in diagnosis socket.
Push in and hold yellow OIL SERVICE*** button – green lamp (function control) comes on.
Yellow lamp also comes on after approx. 10 seconds and goes out after approx. 3 seconds.
Release OIL SERVICE button – green lamp goes out.

Checking Service Indicator (SI) After 10 Seconds:
At least one (but more than previously) green diode light must come on. Yellow (possibly red) diode light and OIL SERVICE sign must go out.

Gradual introduction of a new SI display with clock symbol and only one red diode light since January, 1986. All five green diode lights come on after resetting the Oil Service.





* SI-R = Service Indicator Resetter, Order No. 62 1 100.

** Adapter, Order No. 62 1 140.

*** *Caution!*
Resetting with the wrong button cannot be corrected. Service intervals would be mixed up – also refer to BMW Technik information of Group 62.

324 d:
2 x Oil Service between inspection intervals for diesels.

BMW MAINTENANCE SYSTEM 00 00 259 BMW Safety Test	General Information					Important Information!
	Repair Manual	Technical Data	Nominal Values	Operating Fluids	Owner's Manual	
Call faults in diagnosis system and brief test.						See operating instructions of BMW diagnosis system.
Steering Test: Steering gear, linkage, coupling, connections, leaks, oil volume, tightness and condition of drive belt for power steering.	Gr. 32			Gr. 32		Use approved oil.
Brake Test: Brake pads (remove/install wheels, lubricate centers), brake discs, pipes, hoses, connections, fluid level, parking brake cables, parking brake adjustment. With rear brake discs: break in parking brake.	Gr. 34			Gr. 34		
Important! Replace brake fluid every two years at the latest.				Gr. 34		Use approved brake fluid.
Tire and Wheel Rim Test: Condition, specified size and type, tread depth, wear pattern, tire inflation pressure (including spare wheel).		Gr. 36		Gr. 36		
Light Test: Headlights and front fog lamps (also aiming), parking lights, tail lights, backup lights, license plate lights, instrument and sign lights, control and warning lamps (ABS and airbag).	Gr. 63				+	
Signal Test: Horns, turn signals, hazard warning lights, stop lights, headlight flasher and rear fog lights.					+	
Windshield Wiper/Washer Test: Wiper blades, washer (windshield, if applicable headlights), washing fluid tank (level/antifreeze concentration), spray nozzle aiming (windshield, if applicable headlights). If applicable, fill intensive cleaning fluid tank.				Gr. 00	+	
Seat Belt Test: Condition and operation.	Gr. 72					
Remarks: Repairs and adjustments are invoiced separately.						

BMW MAINTENANCE SYSTEM 00 00 400 Special Emission Inspection (ASU)	General Information					Important Information!
	Repair Manual	Technical Data	Nominal Values	Operating Fluids	Owner's Manual	
Connect and disconnect BMW Service Tester. Check engine idle speed, CO level and, if applicable, dwell angle and ignition timing.	Gr. 12/13		Engine test			
If necessary, necessary additional work invoiced separately:						
11 00 540 Check compression of all cylinders (remove/install spark plugs).	Gr. 11					
11 34 505 Adjust valve clearance.	Gr. 11	Gr. 11				
12 11 514 Adjust dwell angle and ignition timing.	Gr. 12					
12 12 521 Replace all spark plugs.	Gr. 12	Gr. 12				
13 00 604 Check engine idle speed and fuel/air mixture, and perform exhaust test (excluding diesel engine models).	Gr. 13		+			
Cars with Self-diagnosis:						
Call faults in diagnosis system.						See operating instructions of BMW diagnosis system.
Brief test.						See operating instructions of BMW Service Tester.

BMW MAINTENANCE SYSTEM 00 00 099 Exchange Engine Inspection	General Information					Important Information!
	Repair Manual	Technical Data	Nominal Values	Operating Fluids	Owner's Manual	
Replace engine oil and oil filter at operating temperature.	Gr. 11	Gr. 11		Gr. 11		
325 IX: Remove and install splash guard.						
Check coolant hoses for leaks; check / correct coolant level and antifreeze concentration.				Gr. 17	+	Use longterm antifreeze and corrosion inhibitor.
Check tightness and condition of all drive belts, tightening when necessary.	Gr. 12/32/64					
Check / adjust valve clearance (excluding diesel and M 40 engines).						
Check engine idle speed and fuel/air mixture, and perform exhaust test (excluding diesel engines).	Gr. 13					

11 Engine

Model 316 / 316i / 318i – **M10** .....

Model 316i / 318i – **M40**.....

Model 318is – **M42** .....

Model 320i / 323i / 325e / 325i – **M20**.....

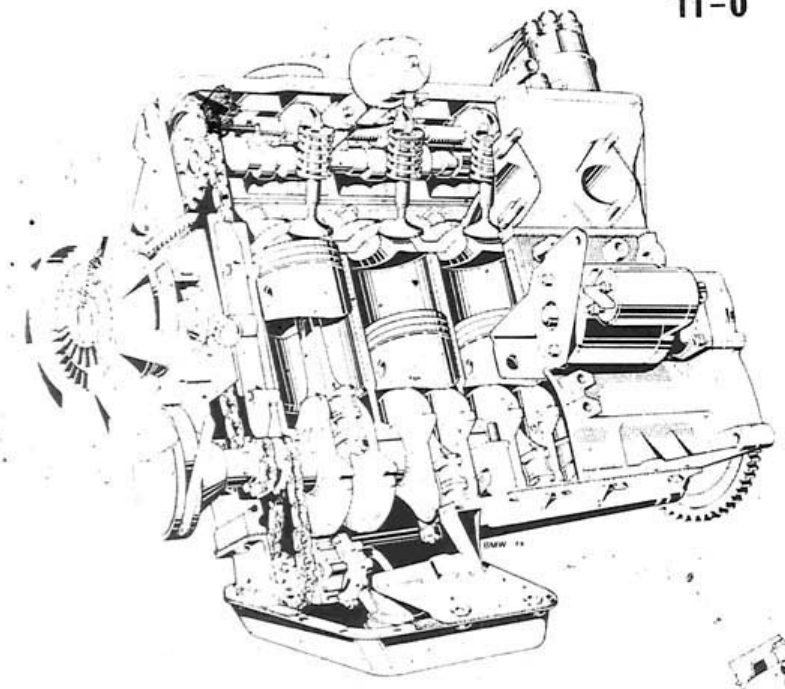
Model 320is – **S14**.....

Model 324d, 324 td – **M21**.....

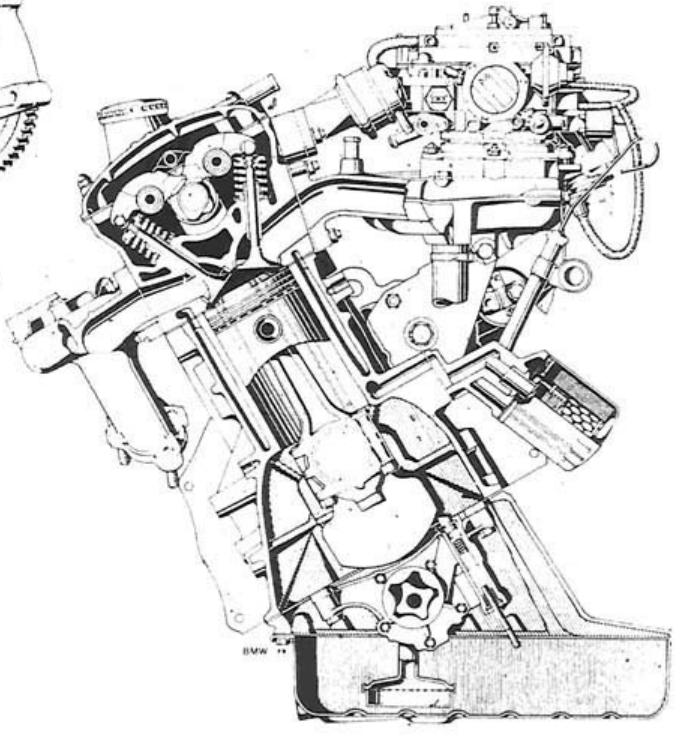
11 Engine

Models: 316 / 316i / 318i – Engine M10

11 00 006	Diagnosis with BMW Service Tester	see Nominal Value Microfiche
	Engine view	11- 0
039	Compression of all cylinders – check	11- 1
050	Engine – remove and install	11- 2
091	Engine – exchange	11- 6
11 12 000	Cylinder head cover – remove and install	11- 6
100	Cylinder head – remove and install	11- 7
11 13 010	Oil pan upper section – remove and install / replace	11- 11
020	Oil pan lower section – remove and install / replace	11- 11
	Emission control – layout drawing	
	BMW 318i – AUS/CH/S – beginning with 1984 models	11- 12
	BMW 318iA – AUS – beginning with 1984 models	11- 13
11 70 009	Emission control – check function	11- 15
11 72 140	Air pulse valves – replace	11- 17
11 74 545	Temperature switch – replace	11- 17
11 76 000	Catalytic converter – convert	11- 18
11 78 010	Oxygen sensor – check	11- 19
510	Oxygen sensor – replace	11- 19

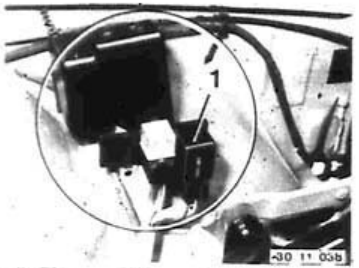


M 10 = Four cylinders
B = Gasoline
18 = Displacement (x 100)
V. = Carburetor
L. = L-Jetronic
A/C/S/U = Australia/Switzerland/Sweden/USA

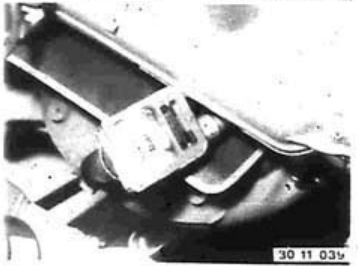


BMW 316 – M 10 B 18 V
316 i – M 10 B 18 L. U
318 i – M 10 B 18 L
318 i – M 10 B 18 L. U (Catalytic Converter)
318 i – M 10 B 18 L. U (Emission Reduction)

11 00 039 CHECKING COMPRESSION OF ALL CYLINDERS



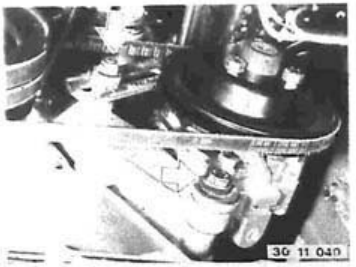
BMW 318 i:
Pull off relay (1) to avoid spill because of constant ejection from fuel injectors while operating the starter.



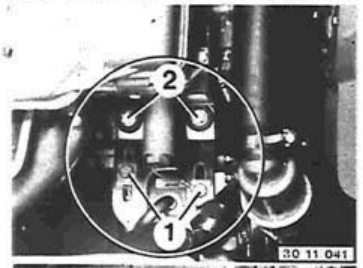
Pull off plug on ignition control unit.
Unscrew spark plugs.
Check compression*.
Installation:
Tightening torque***

* See Specifications
*** See Specifications of Gr. 12

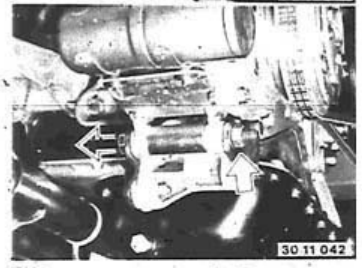
11 00 050 REMOVING AND INSTALLING ENGINE



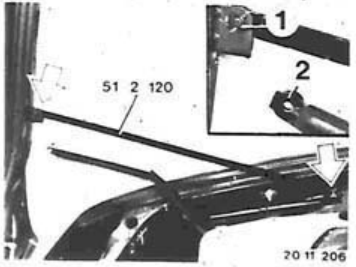
Remove transmission, see Group 23 or 24.
Cars with Power Steering:
Unscrew power steering pump.
Pressure hoses remain connected.
Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.



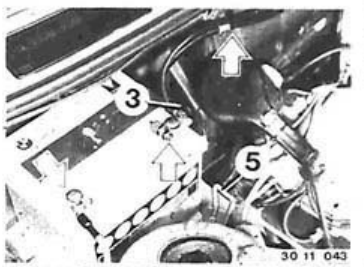
Cars with Air Conditioner:
Loosen bolts (1).
Unscrew bolts (2).



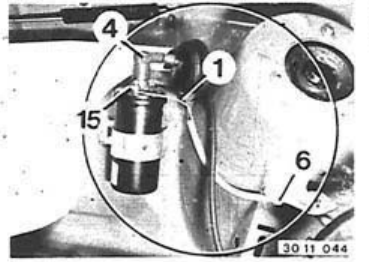
Unscrew bolt and take off compressor.
Refrigerant hoses remain connected.
Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.



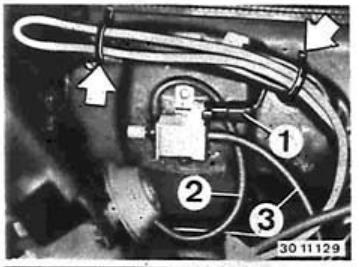
Remove radiator 17 11 000.
Disconnect prop and gas pressure props, and apply Special Tool 51 2 120 to hold engine hood.
Important!
Install fasteners (1).
Installation:
Insert plastic part (2).



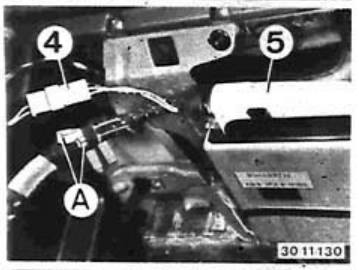
Disconnect negative and positive leads on battery.
Disconnect wire (3).
Unscrew ground wire (5).
Loosen wire straps.



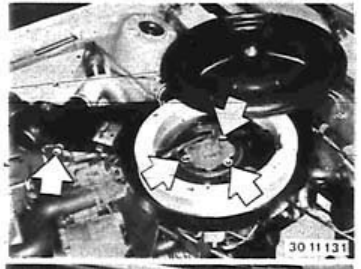
Pull off wire (4) on ignition coil and disconnect wires (1 and 15).
Loosen clips (6).



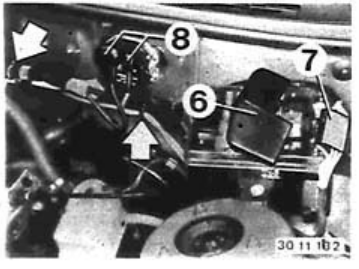
BMW 316:
Loosen wire straps.
Pull off plug (1) and vacuum hoses (2 and 3).
Installation:
Hose (2) to distributor.
Hose (3) to throttle.



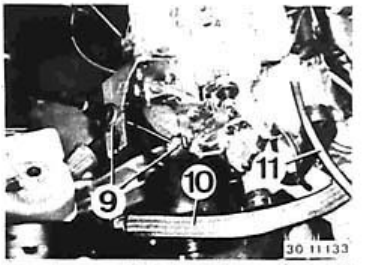
Remove trim panel in glove box.
Disconnect plug (4).
Pull off plug (5) on control unit and push wire harness into engine compartment.
Note:
See 13 00 054 for information on plug connection (A).



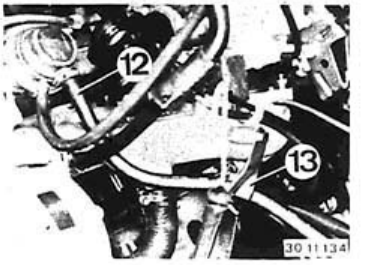
Remove air cleaner, see 13 71 000.



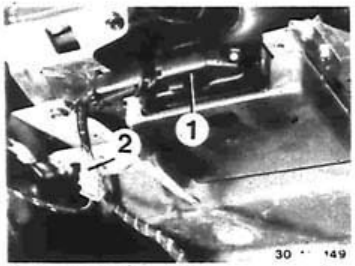
Lift off cap (6).
Lift out and disconnect plug (7).
Pull off plug (8) on ignition control unit.
Loosen wire straps.



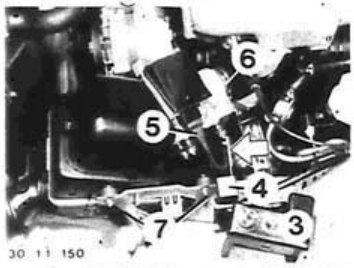
Disconnect throttle cable (9).
Disconnect vacuum hoses (10 and 11).
Installation:
Adjust throttle cable, see 35 41 421.



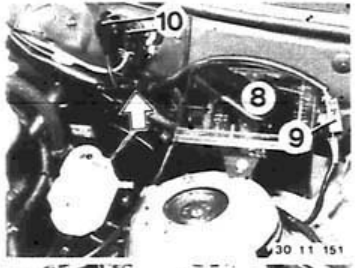
Disconnect fuel hose (12) and lift it out of holder (13).



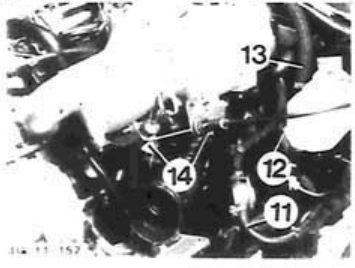
BMW 316 i, 318 i:
Remove trim panel in glove box.
Pull off plug (1) on L-Jetronic control unit.
Disconnect lead (2).
Push wire harness into engine compartment.



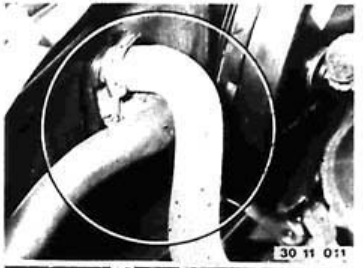
Lift off cap (3) and take out relay (4).
Pull off plug (5).
Loosen hose strap (6).
Loosen nuts (7) and remove air cleaner.



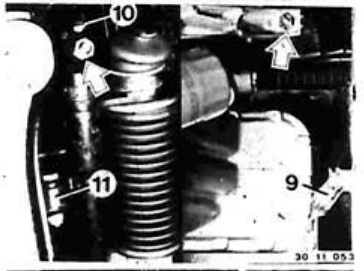
Lift off cap (8).
Lift out and disconnect plug (9).
Pull off plug (10) on ignition control unit.
Loosen wire straps.



Disconnect fuel hoses (11 and 12).
Pull off vacuum hose (13).
Disconnect throttle cable (14).
Installation:
Adjust throttle cable, see 35 41 421.



All Models:
Disconnect coolant hoses.

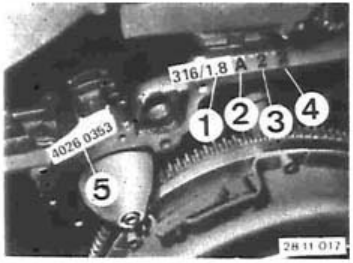


Unscrew ground strap (9) and both engine mounts.
Unscrew engine damper (11).
Installation:
Guide mandrel (10) into bore of axle carrier.
Tightening torque*.



Attach Special Tool on front and rear ends of engine and lift out engine.
Installation:
Adjust ignition timing 12 11 004.
Adjust engine idle speed / CO 13 00 054.

* See Specifications



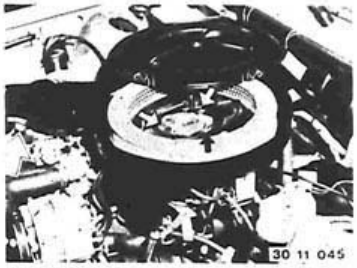
11 00 091 INSTALLING EXCHANGE ENGINE

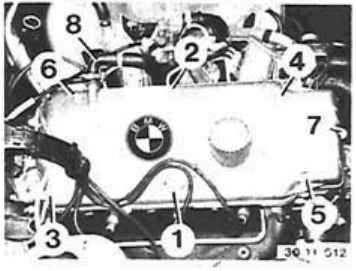
Remove engine 11 00 050.
Exchange Engine Identification on Crankcase:
1 = Type designation****
2 = "A" for exchange; "N" for new
3 = Manufacturing month
4 = Manufacturing year (1982)

Stamp engine number (5).

Drive in supplied oil dipstick guide tube (see 11 43 101) and transfer parts from old engine to exchange engine.
Fill engine with oil***
Important!
Cars with Automatic Transmission:
Remove pilot bearing in crankshaft, see 11 21 571.

Install engine.
If necessary, adjust ignition timing 12 11 004.
Adjust engine idle speed / CO – 13 00 054.





11 12 000 REMOVING AND INSTALLING CYLINDER HEAD COVER

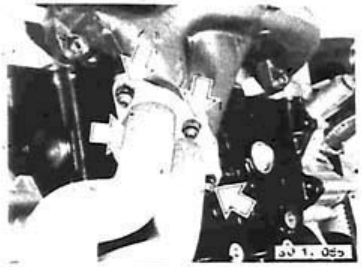
BMW 316:
Remove air cleaner, see 13 71 000.

Detach hose (8).
Remove cylinder head cover.
Installation:
Tighten nuts and bolts in order of 1 through 7.
Tightening torque*.
Also bolt holder for ignition lead.
Check gasket, replacing if necessary.

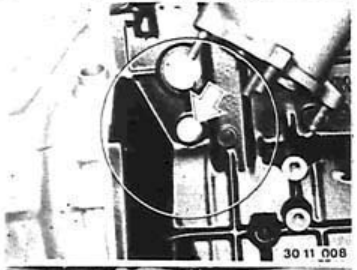
* See Specifications
*** See Service Information of Group 00
**** See BMW Technik + Service Information of Group 11

* See Specifications

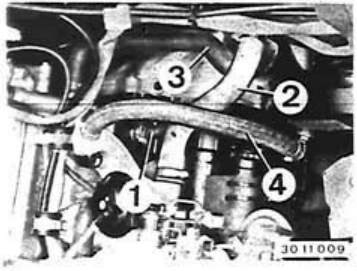
11 12 100 . REMOVING AND INSTALLING CYLINDER HEAD



Unscrew exhaust pipes on exhaust manifold and pipe clamp on transmission.
Installation:
Check gasket, replacing if necessary.
Coat studs with copper paste "CRC"**.
Replace self-locking nuts.
Tightening torque*.



Disconnect battery ground lead.
Unscrew plug and drain coolant.
Installation:
Add coolant*** and bleed cooling system 17 00 039.
Replace engine oil***.

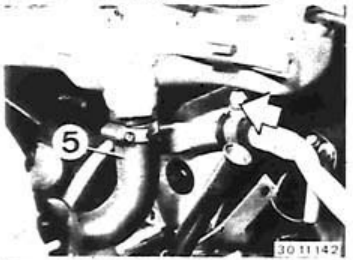


Remove air cleaner, see 13 71 000.
Disconnect coolant hoses (1 ... 3).
Pull off vacuum hose (4).
Installation:
Use new squeeze-hose clamps.

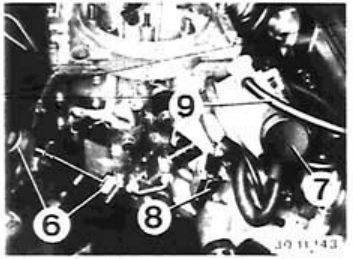
* See Specifications
** Source: HWB
*** See Service Information of Gr. 00



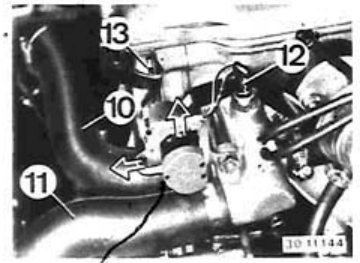
BMW 316:
Disconnect fuel hose (1).
Unscrew holder (2).
Pull off plugs (3 and 4) and loosen clips.
Disconnect wires on alternator and starter.



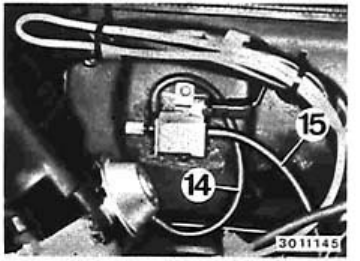
Disconnect water hose (5).
Unscrew intake manifold support.



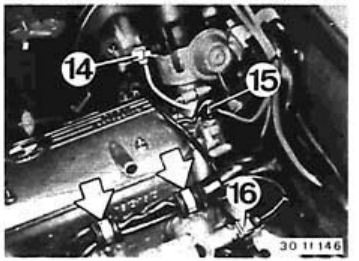
Disconnect throttle cable (6).
Pull off plug (7).
Disconnect plugs (8).
Pull off vacuum hose (9).
Installation:
Adjust throttle cable, see 35 41 421.



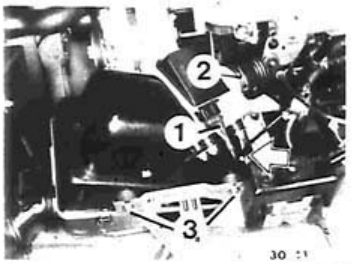
Disconnect water hoses (10 and 11).
Detach diagnosis socket.
Pull off plug (12).
Unscrew ground wire (13).



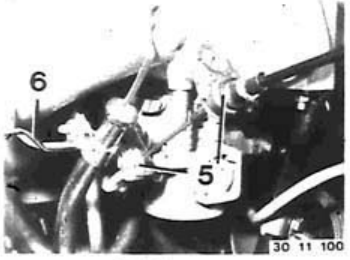
Pull off vacuum hoses (14 and 15).
Installation:
Hose (14) to distributor.
Hose (15) to throttle.



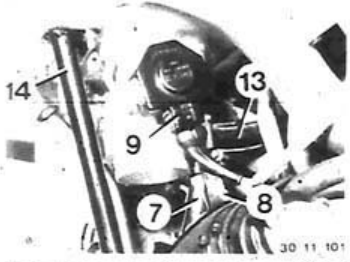
Take off distributor cap and pull off spark plug connectors.
Unscrew plug (14) and pull off plugs (15 and 16).
Disconnect and pull out wire harness.



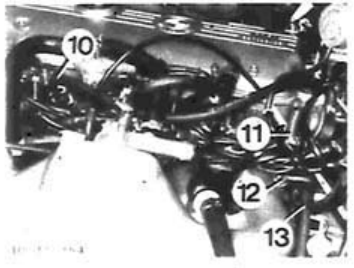
BMW 316 i, 318 i:
Pull off plug (1).
Loosen hose strap (2).
Loosen nuts (3) and remove air cleaner.



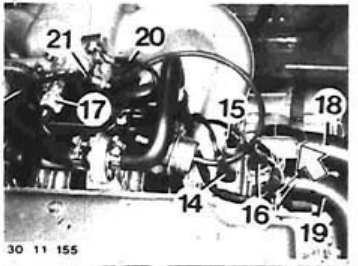
Disconnect throttle cable (5)
Unscrew holder (6).
Installation:
Adjust throttle cable, see 35 41 421



Disconnect water hoses (7 and 8).
Pull off plug (9).
Pull off vacuum hose (13).
Unscrew support (14).



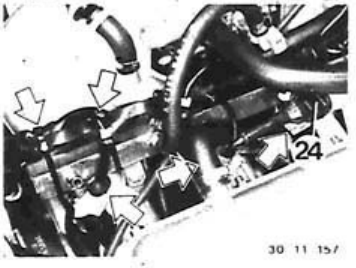
Disconnect fuel hoses (10 and 11).
Unscrew holder (12).
Installation:
Mount ground wire (13) with holder (12).



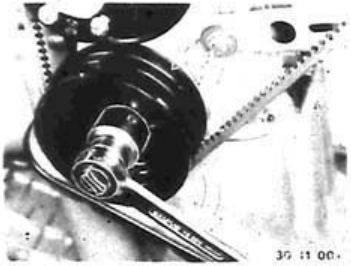
Disconnect diagnosis plug.
Pull off plugs (14 ... 17).
Disconnect wires on alternator.
Disconnect water hoses (18 and 19).
Unscrew ground strap (20).
Cars with Automatic Transmission:
Disconnect throttle cable (21).
Installation:
Adjust throttle cable 24 00 004.



Take off distributor cap and pull off spark plug connectors.
Disconnect plugs (22 and 23).
Disconnect wires.

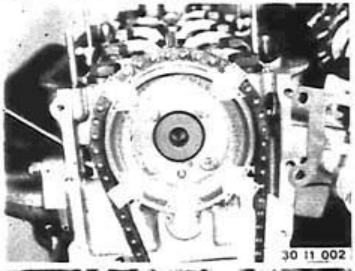


Pull off plug (24).
Disconnect wires on starter.
Pull off plugs on fuel injectors and loosen wire straps.
Pull out wire harness.

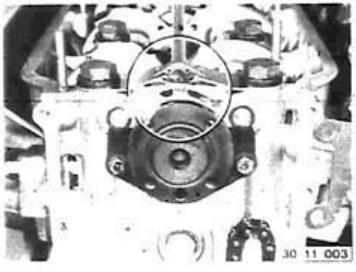


All Models:

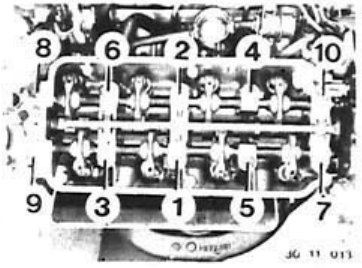
Remove upper timing case cover 11 14 100.
Remove distributor 12 11 060.
Turn cylinder no. 1 to TDC.
Cast tab is then aligned with notch in pulley.



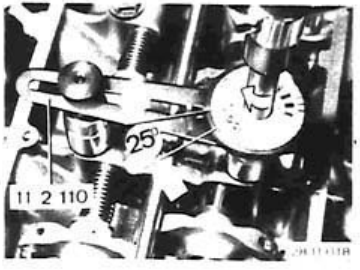
Remove chain tensioner piston 11 31 090.
Take off sprocket.
Caution!
Never crank an engine after removing the timing chain.
Installation:
Mount timing chain that bore for dowel pin faces down.
Tightening torque*.



Installation:
Prior to mounting the cylinder head, turn camshaft that notch in camshaft flange is aligned with cast tab on cylinder head.
Cylinder no. 1 is at TDC.
Install the timing chain in this position, too.



Unscrew cylinder head bolts in order of 10 through 1.
Lift off cylinder head.
Installation:
Keep oil out of cavities since otherwise bolts tightened to the specified torque would not exert sufficient pressure on the cylinder head and in addition the crankcase might crack.
Clean cylinder head bolts.
Lubricate threads and bearing surface of bolt heads with a light coat of oil.
Replace cylinder head gasket, see 11 12 101.



Tighten bolts in order of 1 through 10 in three steps*.
Adjust valve clearance, see 11 34 004.
Adjust ignition timing, see 12 11 004.
Adjust engine idle speed/CO, see 13 00 054.
In the 3rd step (cylinder head cover taken off again after running engine warm) tighten cylinder head bolts to specified torque angle with Special Tool 11 2 110 regardless of the engine temperature.
Note:
Cylinder head bolts are not tightened again after 1,000 km (600 miles).

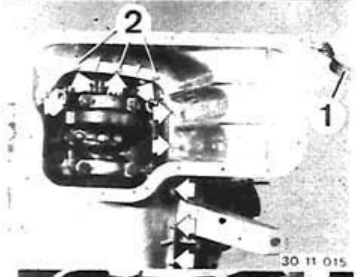
* See Specifications

* See Specifications

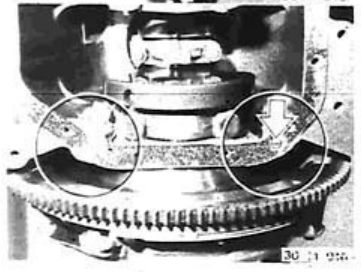


11 13 010 REMOVING AND INSTALLING OR REPLACING OIL PAN UPPER SECTION

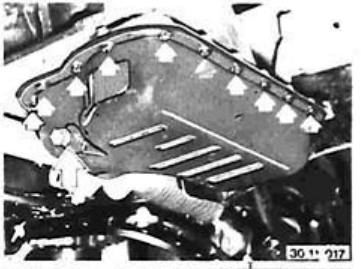
Pull out oil dipstick.
Unscrew oil pan lower section 11 13 020.
Remove oil pump 11 41 000.
Unscrew reinforcement plate.



Unscrew ground strap (1).
Unscrew oil pan bolts and remove oil pan upper section.
Installation:
Install bolts (2) with Loctite No. 270**.



Installation:
Clean sealing surfaces.
Replace oil pan gasket.
Coat mating surfaces on timing case cover and end cover with a brush-on universal sealing compound**.



11 13 020 REMOVING AND INSTALLING OR REPLACING OIL PAN LOWER SECTION

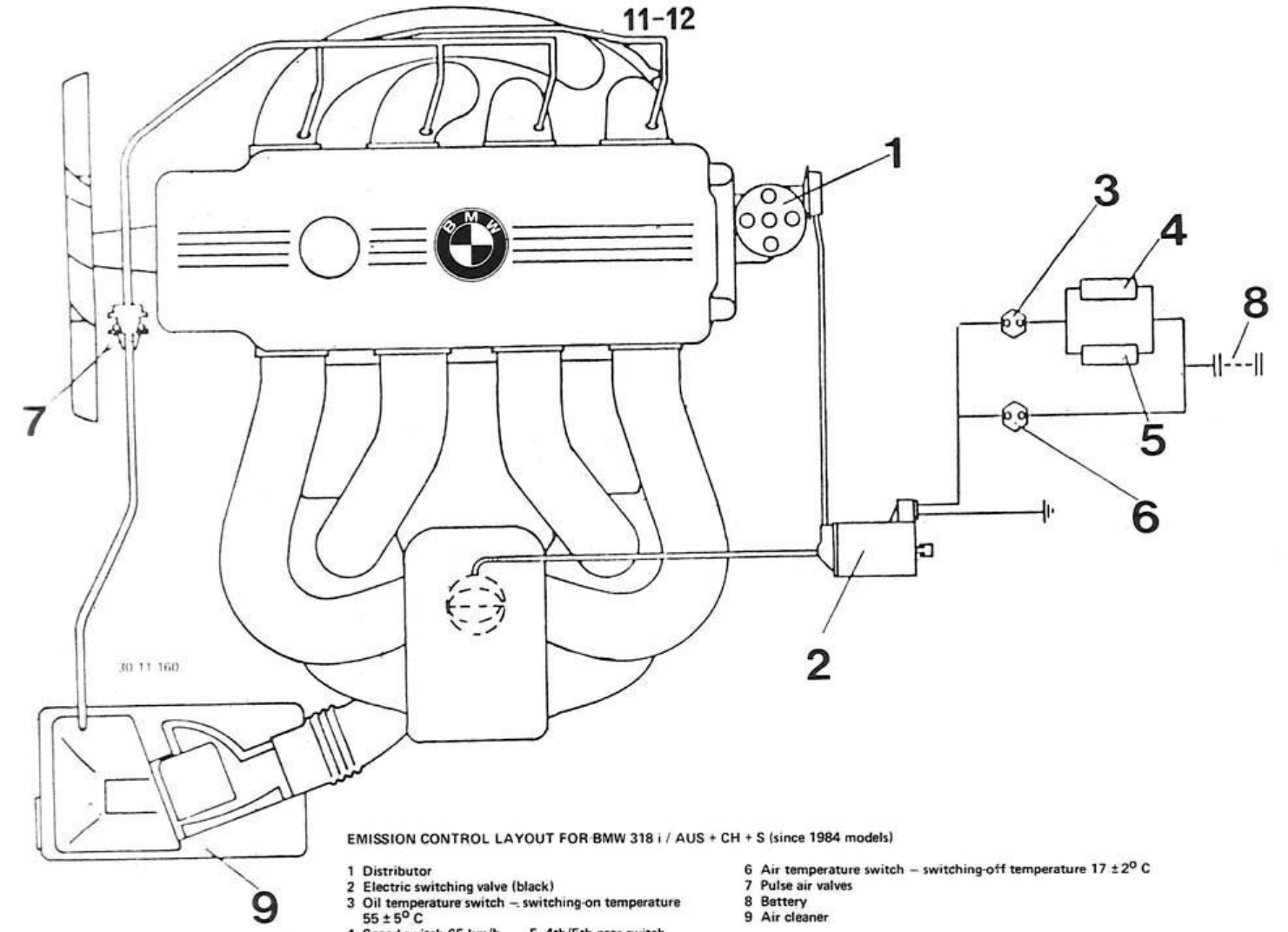
Drain engine oil.
Unscrew oil pan bolts.
Installation:
Add engine oil***.



Take off oil pan.
Installation:
Replace gasket.

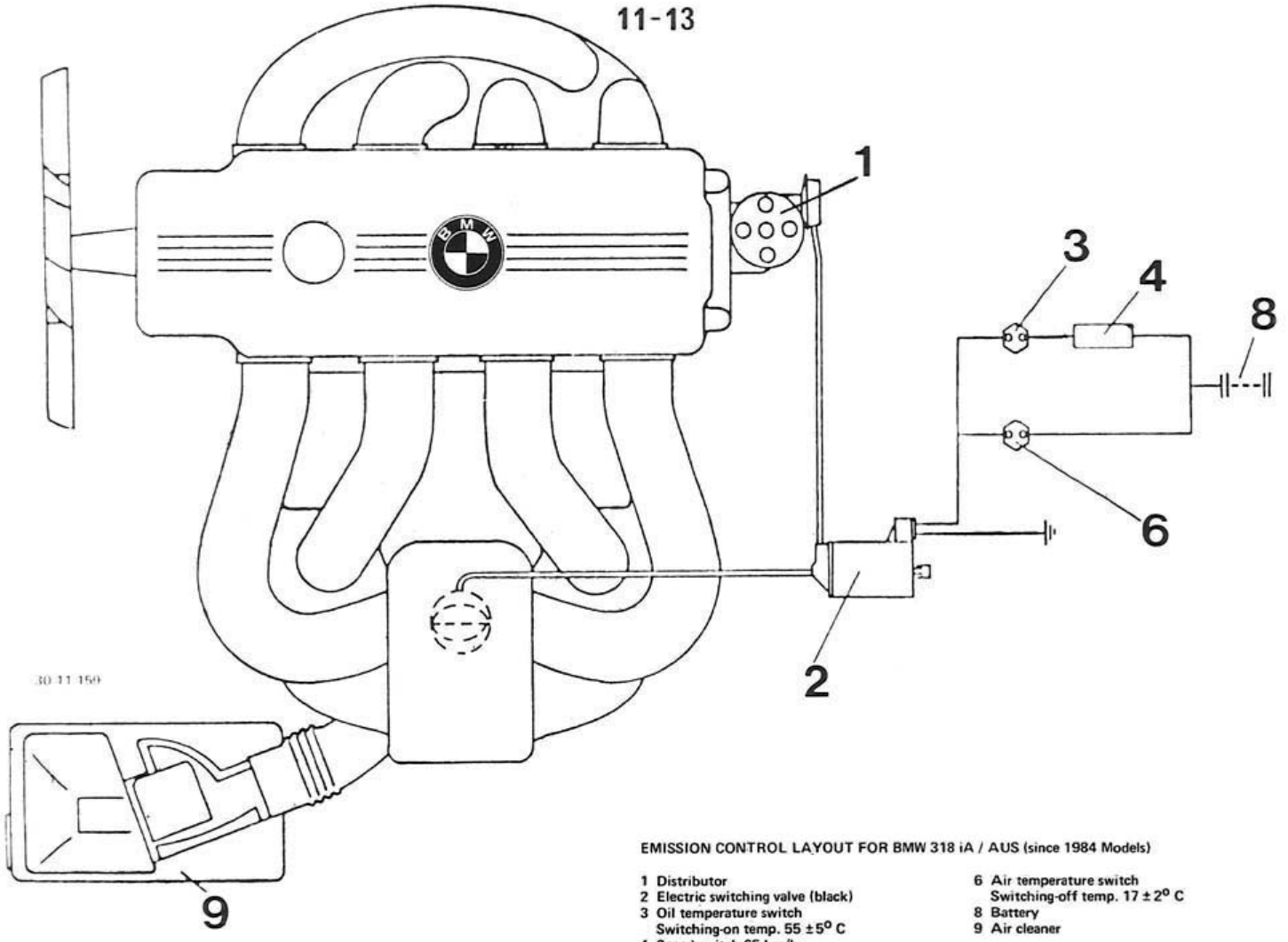
** Source: HWB

*** See Service Information of Group 00



EMISSION CONTROL LAYOUT FOR BMW 318 i / AUS + CH + S (since 1984 models)

1 Distributor
2 Electric switching valve (black)
3 Oil temperature switch – switching-on temperature 55 ± 5° C
4 Speed switch 65 km/h
5 4th/5th gear switch
6 Air temperature switch – switching-off temperature 17 ± 2° C
7 Pulse air valves
8 Battery
9 Air cleaner

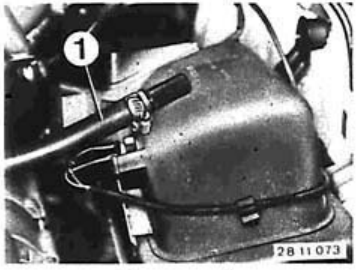


EMISSION CONTROL LAYOUT FOR BMW 318 iA / AUS (since 1984 Models)

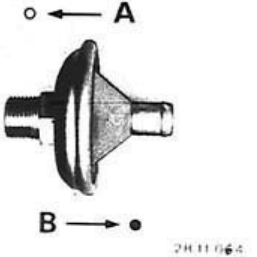
1 Distributor
2 Electric switching valve (black)
3 Oil temperature switch
Switching-on temp. 55 ± 5° C
4 Speed switch 65 km/h
6 Air temperature switch
Switching-off temp. 17 ± 2° C
8 Battery
9 Air cleaner

11 70 009 CHECKING FUNCTION OF EMISSION CONTROL

Pulse Air Valves:
Fresh air is delivered into the exhaust manifold to afterburn exhaust gas and consequently have optimum CO/HC emission.
Fresh air is taken in from the air cleaner via pulse air valves by vacuum, which is produced by pressure pulses in the exhaust manifold.

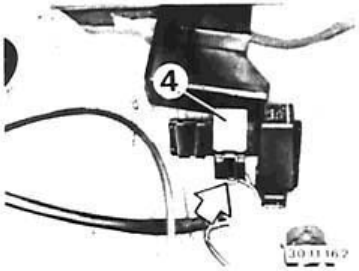


Checking Pulse Air Valves (7):
Check CO level 13 00 054.
The CO level in exhaust gas must always be lower with hose (1) connected on air cleaner than with hose (1) disconnected and plugged – see nominal value microfiche.

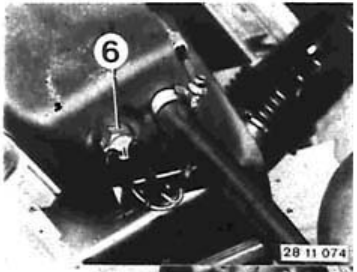


Remove pulse air valves 11 72 140.
Check pulse air valves for leaks by blowing in air.
Valves must be open in exhaust direction (A) and completely closed in direction (B).

Vacuum Advance Control – Since 1984 Mod.:
Vacuum advance control on the distributor is operated by an electric switching valve.
Conditions:
- air temp. below 17° C (63° F)
  or
- oil temp. above 55° C (131° F) and
  - road speed above 65 km/h (40 mph)
    or
  - 4th/5th gear engaged

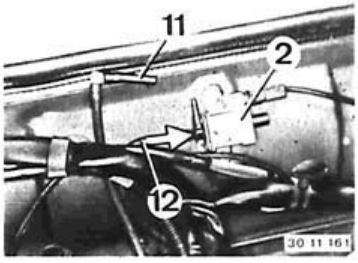


Checking Speed Switch/Switching Relay (4):
Simulate road speeds according to speedometer test, see 62 12 .
Relay switches at road speeds above 65 km/h (40 mph) – brown/red wire produces ground pulse.



Checking Temperature Switches:
Check temperature switches according to table (11 74 040).

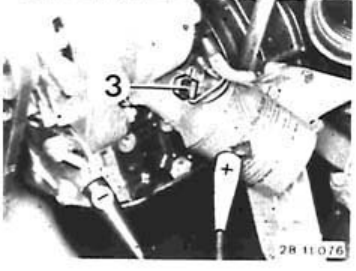
Air temperature switch (6) –
switched off above 17° C (63° F) – no flow.



Checking Black Electric Switching Valve (2):
Engine stopped – ignition on.
Pull off hose (11) on distributor and blow air into hose (12) from the throttle housing.
Electric switching valve switches to air flow:
- at air temp. below 17° C (63° F) or
- with bridged air temperature switch.

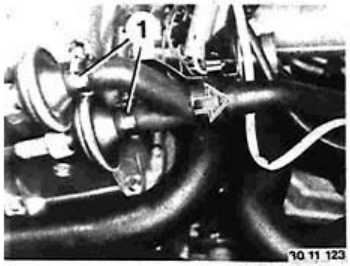


Oil temperature switch (3) –
switched on above 55° C (131° F) – flow.

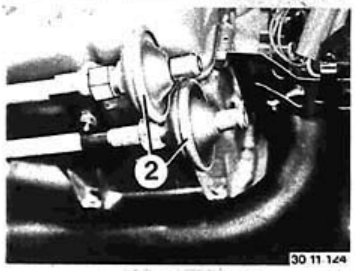


Checking 4th/5th Gear Switch (5):
Engine stopped – ignition on.
Connect green/red wire from oil temperature switch (3) on voltmeter positive (BMW service tester).
Negative = car ground.
Fourth/fifth gear switch is okay, if voltage is displayed with 4th/5th gears engaged.

11 72 140 REPLACING PULSE AIR VALVES



Testing – see 11 70 009.
Loosen clamps (1) and pull off hose.



Unscrew pulse air valve (2).
Installation:
Tightening torque*



Important!
Only install pulse air valves with code 7.209850.01 ...

11 74 545 REPLACING TEMPERATURE SWITCH



Check flow of temperature switch.

Temp. Switch On/Off Temp. in °C	BMW No.	Upper Section Color
17° C (air) 12/17 ±2	1 279 718	blue
55° C (oil) 55/35 ±5	1 706 078	black
70° C (coolant) 70/40 ±5	1 285 018	red

Unscrew temperature switch.
Installation:
Replace seal (1).
Add coolant 17 00 039.

* See Specifications

11 76 000 SERVICE INSTALLING CATALYTIC CONVERTER – In Cars Prepared for Catalytic Converter Operation –

– Operate car on several tanks of unleaded gasoline prior to installation

or

– pump out leaded gasoline**, fill tank with unleaded gasoline and run engine several minutes before installing the catalytic converter and oxygen sensor.

– Fill spare fuel canister with unleaded gasoline.

– Do not perform any test steps with cylinder shutoff when performing the BMW Service Test, see nominal value microfiche.

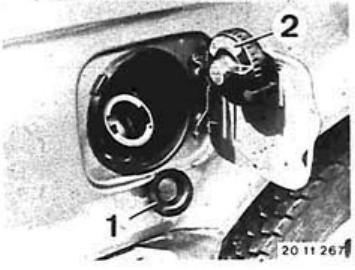
Remove exhaust assembly – see Group 18.
Install catalytic converter – see 11 76 010.
Exchange exhaust carrier on transmission.
Install oxygen sensor – see 11 78 510.

BMW 318 i Before 9/85:
Disconnect green plug on engine wire harness in glove box when operating car with a catalytic converter.



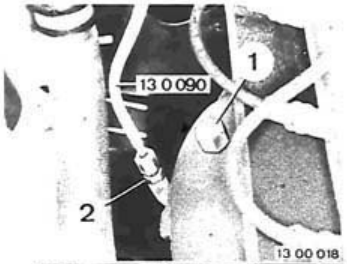
BMW 318 i Since 1986 Model:
Exchange the power divider (black) installed in cars prepared for catalytic converter operation against the ballast resistor (gray) and connect it with the gray plug.

black = 0 280 101 005
gray = 0 280 101 006



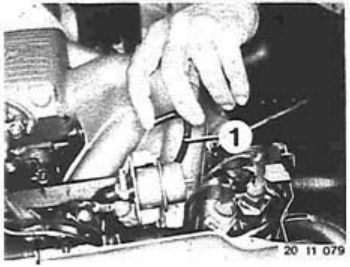
Install reducer (1) in fuel tank filler neck and paste on label (2) (unleaded gasoline).
Adjust engine idle speed and CO level – see Group 13.
Check function of oxygen sensor – see 11 78 010.

** Caution – danger of fire!



11 78 010 CHECKING FUNCTION OF OXYGEN SENSOR

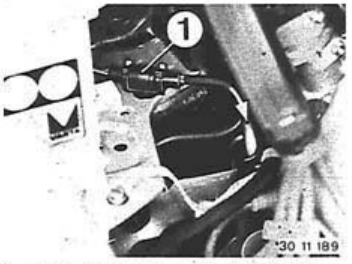
Counterhold on hexagon (2), unscrew plug (1) and screw on Special Tool 13 0 090.
Measure CO level:
Specification: 0.2 to 1.2 % by volume.
Refer to 13 00 054 for additional information.



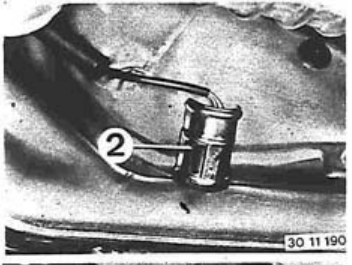
Pull off and plug vacuum hose (1) on pressure regulator.
CO level rises briefly and is regulated back to the original value immediately – oxygen sensor is working properly.
Defective:
Check power supply to oxygen sensor via relay according to the wiring diagram.
Refer to Group 13 for additional information.

11 78 510 REPLACING OXYGEN SENSOR

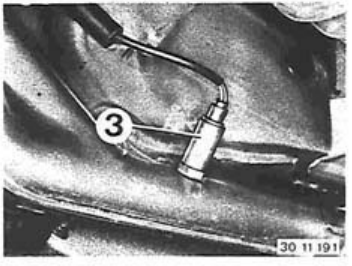
- Do not clean the oxygen sensor and never let it come in contact with a lubricant.
- Only use Anti-Seize** on the threads.
- Protect oxygen sensor when undercoating the car.



Disconnect plug (1).



Pull off plate (2).



Unscrew oxygen sensor (3).
Installation:
Coat threads with Anti-Seize**.
Tightening torque*

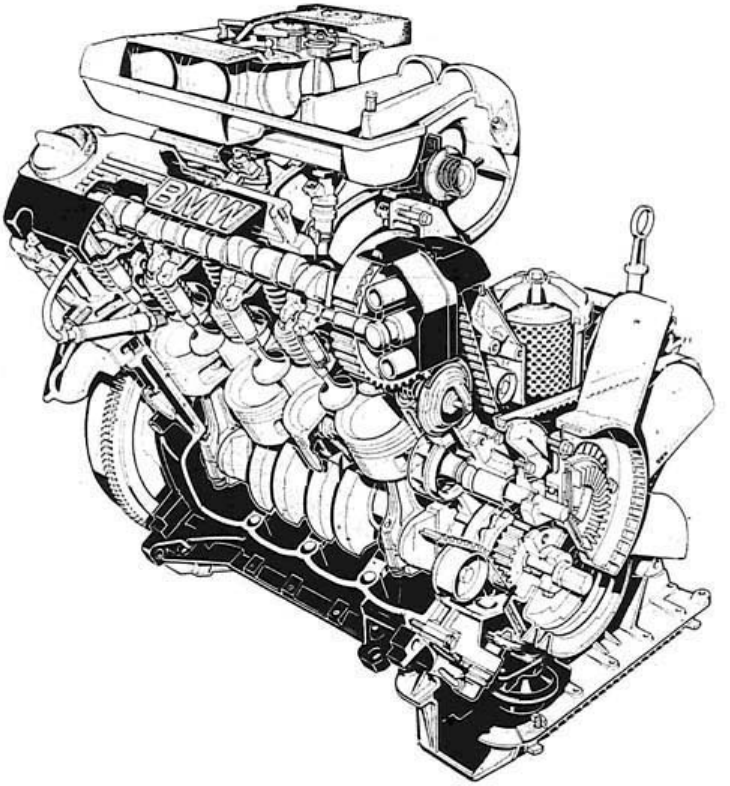
* See Specifications
** Source: HWB

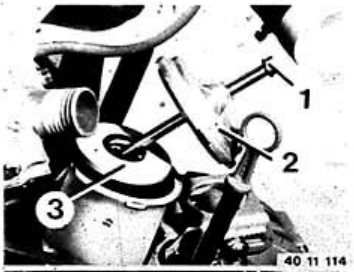
11 Engine

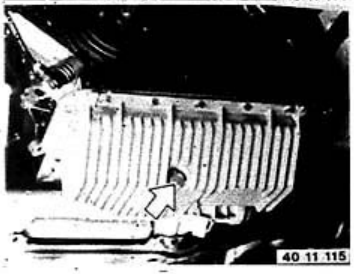
Engine M40

	Engine view (section drawing)	11- 21
00 11 209	Engine oil and oil filter – replace	11- 22
11 00 039	Compression of all cylinders – check	11- 22
050	Engine – remove and install	11- 23
11 12 101	Cylinder head gasket – replace	11- 26
245	Radial oil seal for camshaft – replace	11- 29
11 13 010	Oil pan – remove and install	11- 30
11 14 151	Crankshaft radial oil seal (clutch end) – replace	11- 31
175	Front end cover – remove and install	11- 32
180	Radial oil seal in front end cover – replace	11- 33
11 31 110	Toothed drive belt – replace	11- 34
11 51 000	Water pump – remove and install	11- 37
11 52 000	Fan – remove and install	11- 38
020	Fan clutch – replace	11- 38

SECTION VIEW DRAWING OF M 40 ENGINE





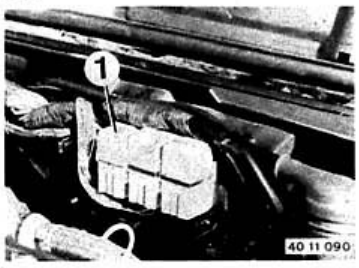


00 11 209 REPLACING ENGINE OIL AND OIL FILTER

Unscrew bolt (1) and take off oil filter cover (2) (oil runs from oil filter into oil pan).
Remove oil filter cartridge (3).

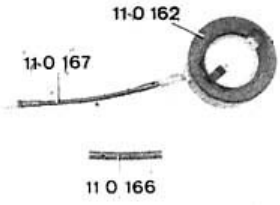
Remove oil drain plug after oil in oil filter housing has drained or draw out oil.

Install new oil filter cartridge.
Mount oil filter cover and tighten bolt with torque of 30 Nm (22 ft. lbs.).
Pour in engine oil.
Start and run engine at high speed (about 2500 rpm) until oil control lamp goes out (about 5 seconds).
Stop engine and check oil level.

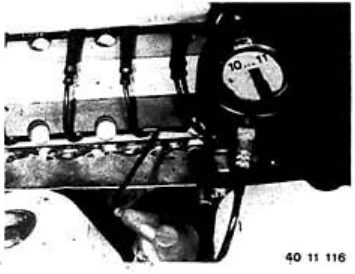


11 00 039 CHECKING COMPRESSION OF ALL CYLINDERS

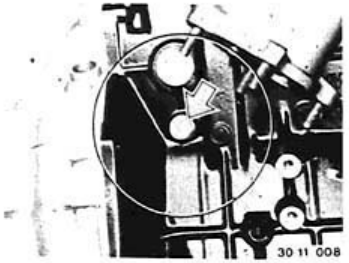
Lift out cover and pull off master relay (1).



Unscrew all spark plugs – see 12 12 011.
Screw Special Tool 11 0 166 in spark plug tapped bore by hand and connect compression tester.

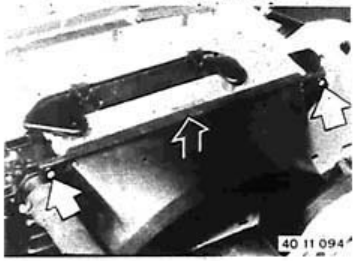


Press down on accelerator pedal and operate starter until the compression stops rising.
The values of all cylinders should not differ by more than 0.5 bar (7 psi).
Nominal value: 10 to 11 bar (142 to 156 psi).



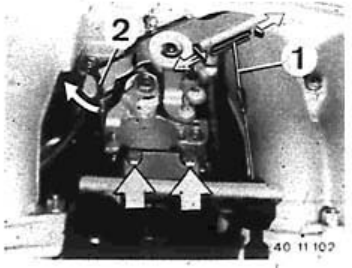
11 00 050 REMOVING AND INSTALLING ENGINE

Remove transmission – see Gr. 23 or 24.
Remove engine splash guard.
Drain coolant.
Fill and bleed cooling system – see Gr. 17.

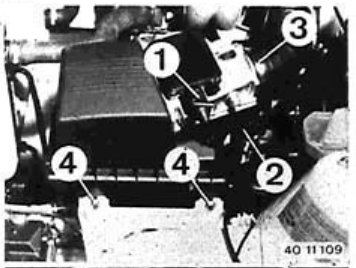


Remove fan – see 11 52 000.
Lift out expansion rivets on left and right sides, and take out fan cowl from above.

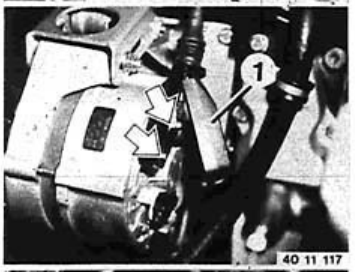
Cars with Air Conditioner:
Unscrew and place air conditioner compressor aside – refrigerant hoses remain connected.
Cars with Power Steering:
Unscrew and suspend power steering pump from car on piece of wire – hydraulic pipes remain connected.



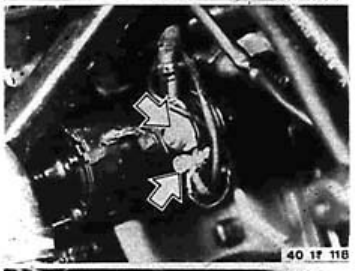
Take off cover and disconnect cables (1) and (2) = cars with automatic transmission.
Unscrew bolts (3) and place cables with holder aside.



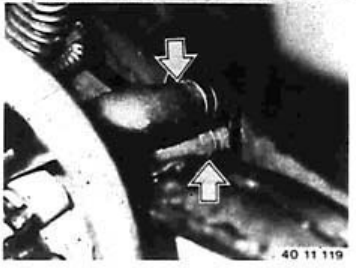
Pull off plugs (1 and 2).
Loosen hose clamp (3) and pull off intake air hose.
Unscrew nuts (4) and remove air cleaner.



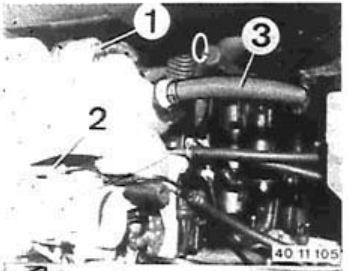
Take off cover (1) and disconnect leads on alternator.



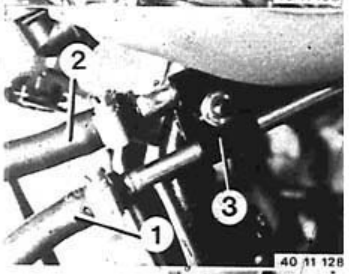
Disconnect leads on starter.



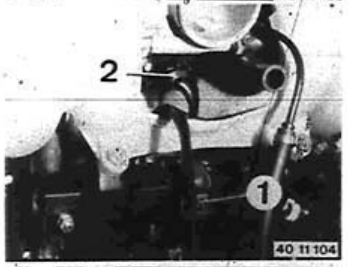
Loosen hose clamps and pull off heater hoses.



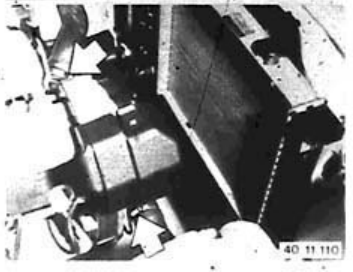
Pull off plug (1) on idle speed control and vacuum hoses (2 and 3).
Note:
Hose 2 – carbon canister
Hose 3 – brake booster



Unscrew fuel pipes (1 and 2).
Unscrew nut and take off holder (3).
Note:
Pipe 1 – feed
Pipe 2 – return



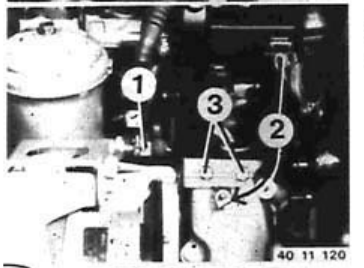
Pull off plugs (1 and 2).
Note:
Plug 1 – fuel injectors
Plug 2 – throttle valve switch



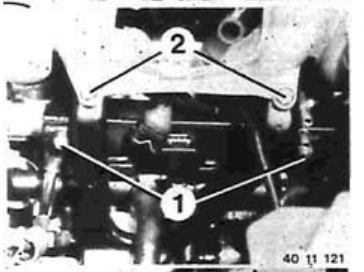
Loosen hose clamps and pull off radiator hoses.



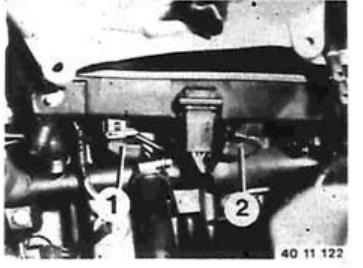
Loosen hose clamp and pull hose off of brake fluid tank.



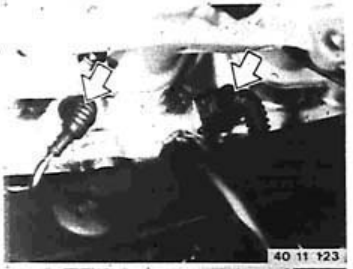
Pull off plug (1).
Loosen clamp (2).
Unscrew bolts (3).



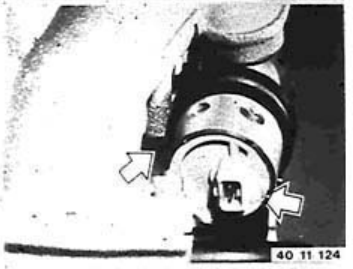
Unscrew nuts (1).
Unscrew bolts (2) and take off manifold support.



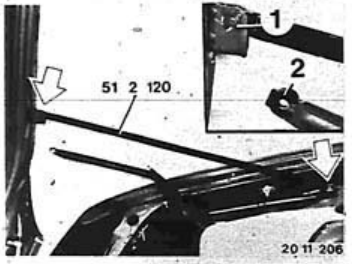
Pull off plugs (1 and 2).
Note:
Plug 1 – reference mark sender
Plug 2 – cylinder identification



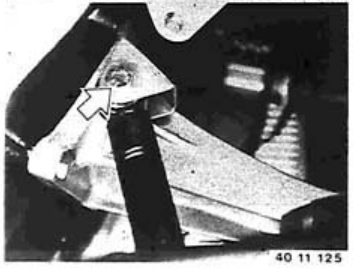
Pull off plugs on temperature sensors.



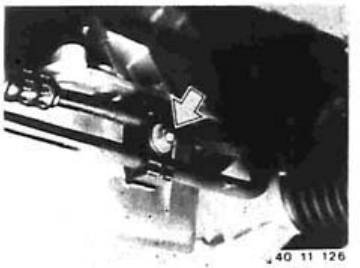
Unscrew idle speed control.



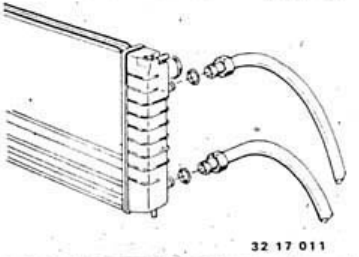
Disconnect prop and gas pressure springs, and install Special Tool 51 2 120.
Caution!
Use retainer (1).
Installation:
Insert plastic part (2).



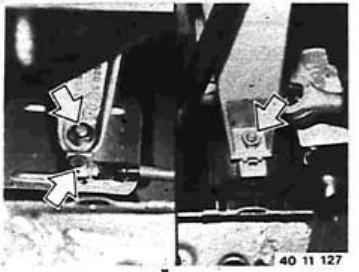
Unscrew engine damper on console.



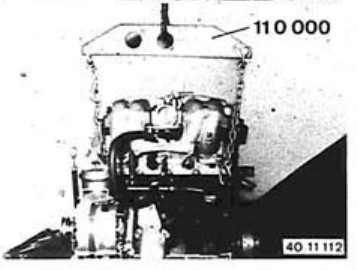
Cars with Automatic Transmission:
Unscrew oil pipes on oil sump.



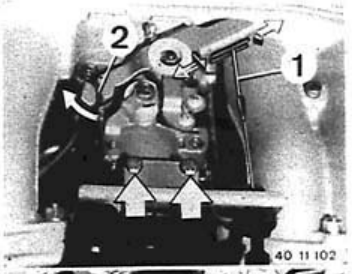
Unscrew oil pipes on oil cooler.
Installation:
Check gaskets, replacing if necessary.
Tightening torque: 25 Nm (18 ft. lbs.).



Disconnect ground lead on engine carrier.
Unscrew left and right engine mounts.
Installation:
Tightening torque for rubber mounts to engine carrier: 45 Nm (32.5 ft. lbs.).



Lift out engine with Special Tool 11 0 000.
Note:
A removed engine with installed hydraulic valve adjusting elements must not remain upside down longer than 10 minutes, since otherwise oil would run out of these elements and they could no longer be used.

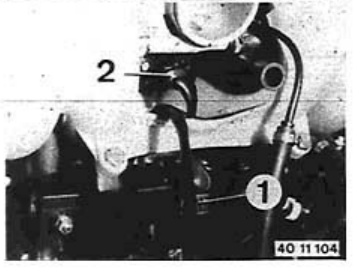


11 12 101 REPLACING CYLINDER HEAD GASKET

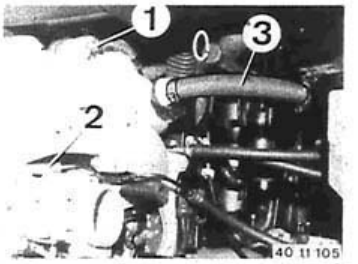
Remove toothed drive belt – see 11 31 110.
Take off cover and disconnect cables (1) and (2) (= cars with automatic transmission).
Unscrew bolts (3) and place cables with holder aside.



Loosen hose clamps and take off intake air hose.
Pull off plug (1) on air flow sensor and plug (2) on tank venting valve.



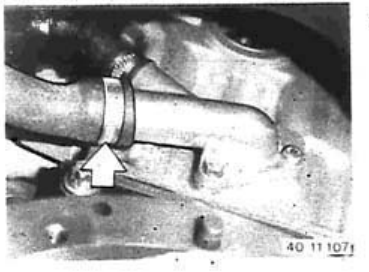
Pull off plugs (1 and 2).
Note:
Plug 1 – fuel injectors
Plug 2 – throttle valve switch



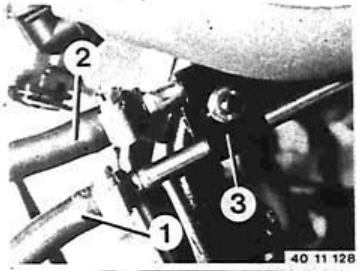
Pull off plug (1) on idle control as well as vacuum hoses (2 and 3).
Note:
Hose 2 – carbon canister
Hose 3 – brake booster



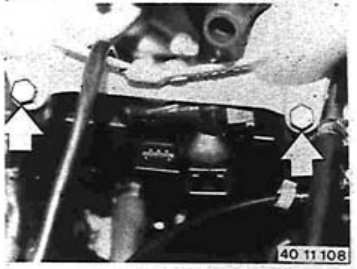
Loosen hose clamp and pull off preheating hose.



Loosen hose clamp and pull off heater hose.



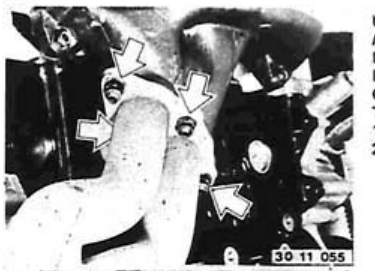
Disconnect fuel pipes (1 and 2).
Unscrew nut and take off holder (3).
Note:
Pipe 1 – feed
Pipe 2 – return



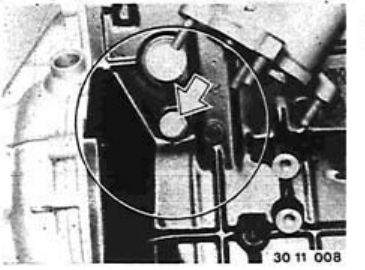
Unscrew mounting bolts for manifold support.



Loosen hose clamp and pull off radiator hose.

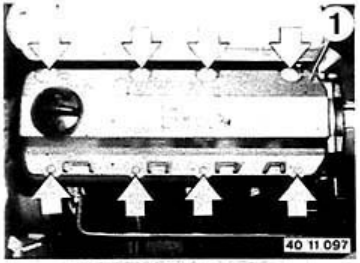


Unscrew exhaust pipe on exhaust manifold.
Installation:
Replace gasket and self-locking nuts.
Replace gasket and self-locking nuts.
Coat threads with copper paste "CRC"**.
Tightening torque:
1. Initial torque 30 Nm (22 ft. lbs.)
2. Final torque 50 Nm (36 ft. lbs.)

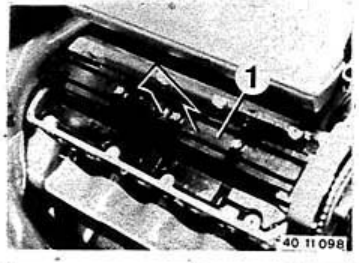


Unscrew plug and let coolant run out of engine.

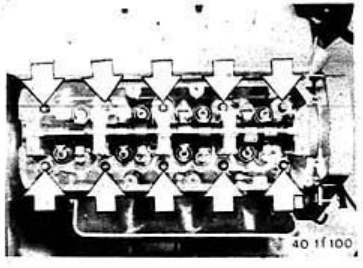
** Source of Supply: HWB



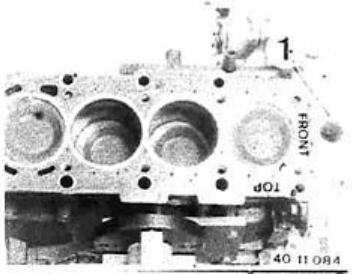
Pull off breather hose (1).
Unscrew bolts from outside to inside and take off cylinder head cover.
Installatiop:
Check gasket, replacing if necessary.
Tighten bolts crosswise from inside to outside.
Tightening torque: 9 Nm (6,5 ft. lbs.).



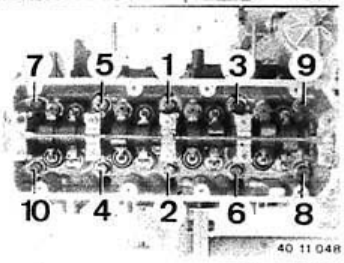
Take off camshaft cover (1).



Unscrew cylinder head bolts from outside to inside and take off cylinder head.



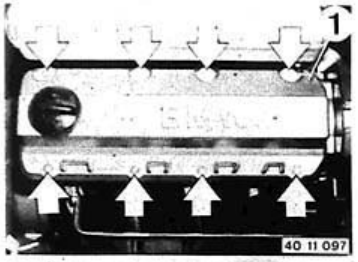
Installation:
Clean sealing surfaces on cylinder head and crankcase, removing pieces of gasket with a gasket remover** and hard wood scraper if necessary, making sure that pieces of gasket do not fall into oil bores or cooling ducts.
Install new cylinder head gasket with "TOP" facing up and "FRONT" facing toothed drive belt end.
Replace o-ring (1).



Mount cylinder head and tighten new bolts (lubricated lightly with oil) in order of 1 to 10 in three steps.
Step 1: 33 Nm (24 ft. lbs.) torque
Step 2: 93° torque angle
Step 3: 93° torque angle
Important!
Cylinder head bolts must always be replaced.
Keep oil out of cavities in engine block (danger of cracking block, wrong tightening torque values).

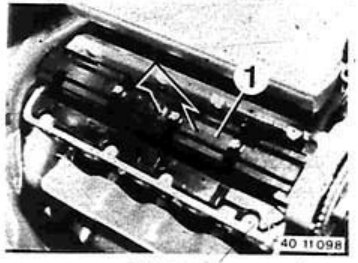


** Source of Supply: HWB

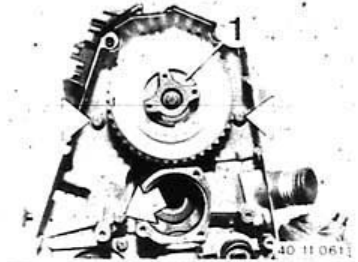


11 12 245 REPLACING RADIAL OIL SEAL FOR CAMSHAFT

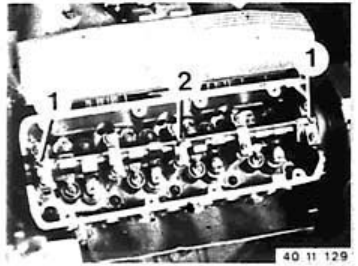
Remove toothed drive belt – see 11 31 110.
Pull off breather hose (1).
Unscrew bolts from outside to inside and take off cylinder head cover.
Installation:
Check gasket, replacing if necessary.
Tighten bolts from inside to outside with torque of 9 Nm (6.5 ft. lbs.).



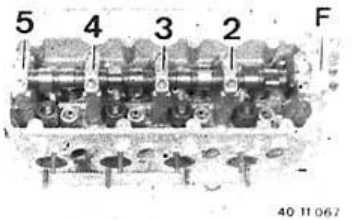
Take off camshaft cover (1).



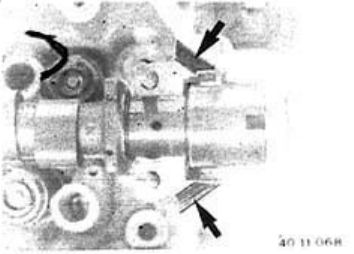
Unscrew camshaft sprocket (1).
Unscrew bolts and take off housing.



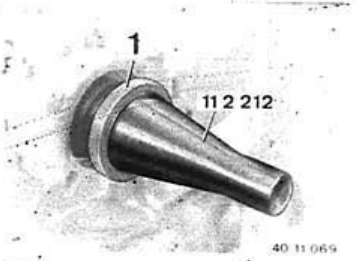
Unscrew bolts (1 and 2) and take off oil pipe.
Installation:
Replace gasket between hollow union bolt (2) and pipe.
Tightening torque:
Bolts (1) = 5.5 Nm (4 ft. lbs.)
Bolt (2) = 11 Nm (8 ft. lbs.)



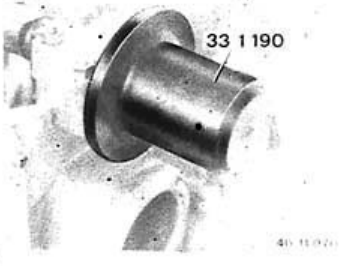
Unscrew camshaft bearing cap (F) and remove radial oil seal.



Apply a thin coat of non-hardening sealing compound** on bearing surface of bearing cap and mount bearing cap.
Installation:
Tightening torque: 11 Nm (8 ft. lbs.).

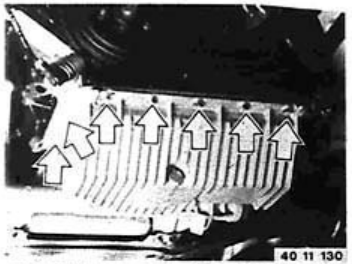


Lubricate sealing lip of new radial oil seal in oil.
Apply Special Tool 11 2 121 on camshaft and push on seal (1) as far as possible.



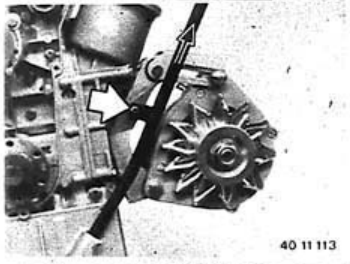
Drive in radial oil seal against stop with Special Tool 33 1 190.

** Source of Supply: HWB

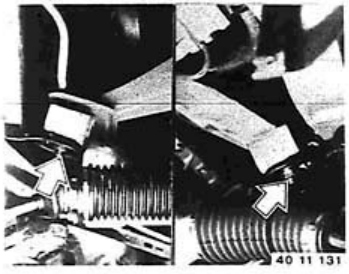


11 13 010 REMOVING AND INSTALLING OIL PAN

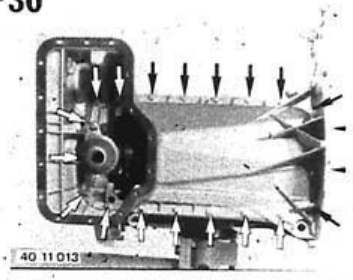
Unscrew engine splash guard.
Drain engine oil – see 00 11 209.
Unscrew bolts and take off lower oil pan section.
Installation:
Replace gasket.
Tighten bolts with torque of 9 Nm (6.5 ft. lbs.).



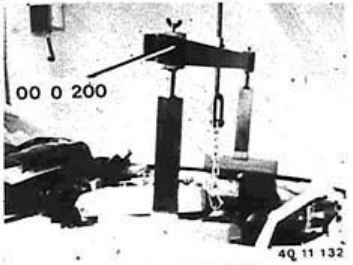
Unscrew bolt and pull out oil dipstick guide tube from above.
Installation:
Check O-rings, replacing if necessary.



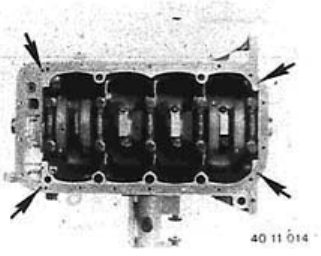
Unscrew nuts of engine mounts on left and right sides.



Unscrew oil pan bolts.
Installation:
Tightening torque: 9 Nm (6.5 ft. lbs.).

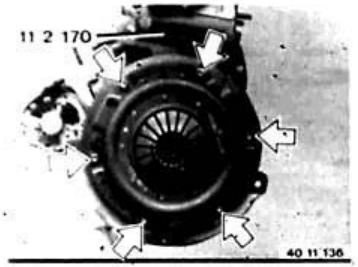


Mount Special Tool 00 0 200 on engine and lift engine enough, that oil pan can be removed forward.



Installation:
Replace gasket.
Fill holes provided for this purpose in the oil pan gasket at the transition of front and rear end covers to the crankcase with a non-hardening sealing compound**.

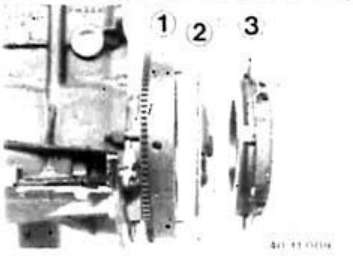
** Source of Supply: HWB



11 14 151 REPLACING CRANKSHAFT RADIAL OIL SEAL (Clutch End)

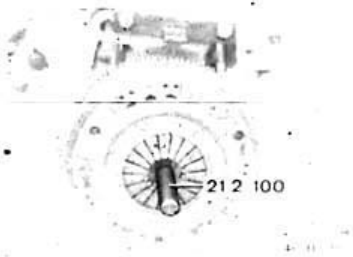
Remove transmission – see Gr. 23/24.

Hold flywheel with Special Tool 11 2 170 and unscrew bolts uniformly. Take off pressure plate and drive plate.



Installation:
1 Flywheel
2 Drive plate
3 Pressure plate

Install drive plate with flatter side facing flywheel.



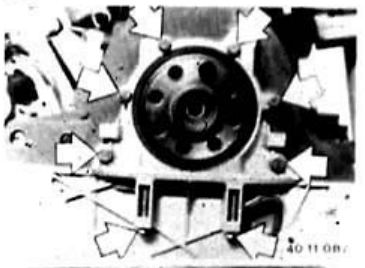
Center drive plate with Special Tool 21 2 100 and tighten bolts uniformly. Tightening torque = 23 Nm (17 ft. lbs.).



Unscrew bolts and take off flywheel.

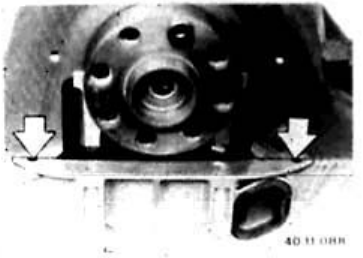
Installation:
Clean threads and install bolts with a bolt cement**.
Tightening torque = 130 Nm (94 ft. lbs.).

** Source of Supply: HWB

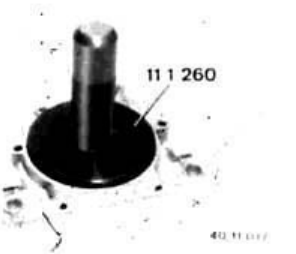


Unscrew bolts and take off end cover.

Note:
Oil pan bolts may be loosened slightly to make removal and installation easier.
If applicable, separate oil pan gasket from cover with a knife.



Installation:
Replace cover gasket, cutting it to length if necessary.
If applicable, replace damaged oil pan gasket.
Apply a thin coat of non-hardening sealing compound** on crankcase/oil pan joints.



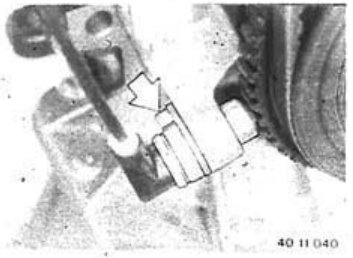
Lift out old radial oil seal and drive in new seal with Special Tool 11 1 260.



Apply Special Tool 11 2 213 on crankshaft.
Lubricate sealing lip of seal with oil.
Mount and bolt cover.
Tightening torque:
M 6 9 Nm (6.5 ft. lbs.)
M 8 22 Nm (16 ft. lbs.)

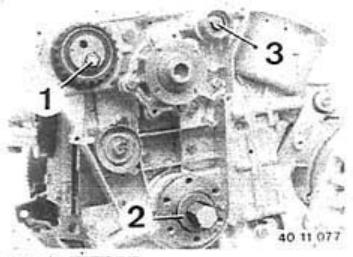
Note:
Watch out for oil pan gasket while mounting cover.

** Source of Supply: HWB



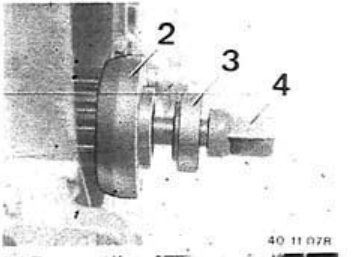
11 14 175 REMOVING AND INSTALLING FRONT END COVER

Remove toothed drive belt – see 11 31 110.
Drain engine oil.
Unscrew reference mark sender.

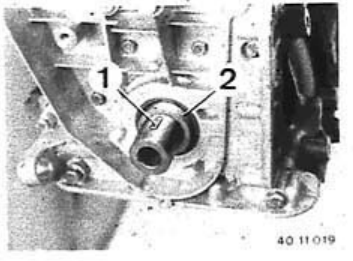


Remove tensioning roller (1), drive gear (2) and steadying roller (3).

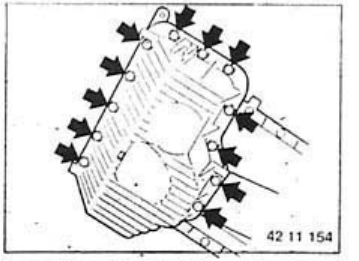
Note:
Use Special Tool 11 2 150 for removal of drive gear (2) – also refer to 11 14 180.



Installation:
Position drive gear (2) that its groove is aligned with woodruff key and install on crankshaft.
Install washer (3) with shoulder against drive gear and tighten bolt (4).
Tightening torque: 310 Nm (224 ft. lbs.).
Screw on nut for tensioning roller only finger tight.

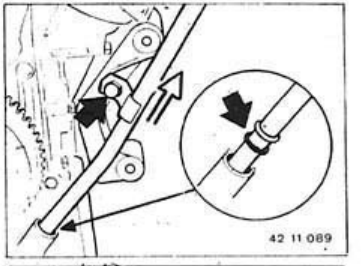


Lift out woodruff key (1) and pull off ring.



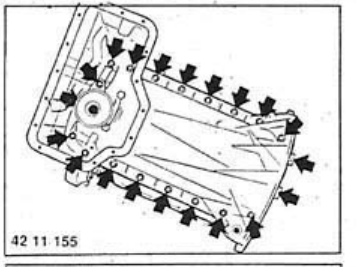
Unscrew bolts and take off lower oil pan section.

Installation:
Replace gasket.
Tightening torque = 9 Nm (6.5 ft. lbs.).

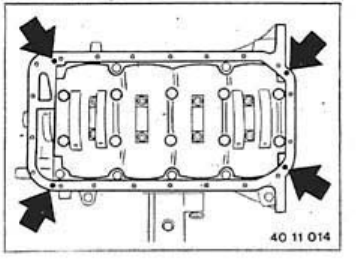


Unscrew and pull out oil dipstick.

Installation:
Replace seal.

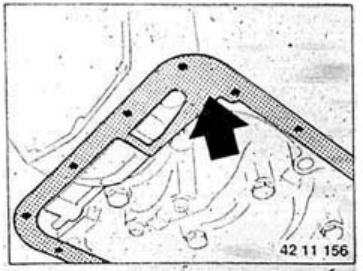


Unscrew bolts and lower oil pan.

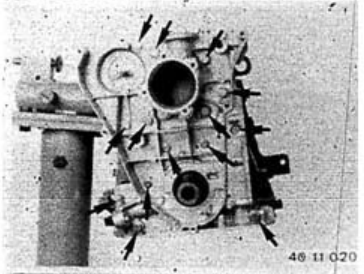


Installation:
Replace gasket.
Apply permanently elastic sealing compound 3 Bond 1207B black** on joints between front timing case and rear end cover.
Tightening torque = 9 Nm (6.5 ft. lbs.).

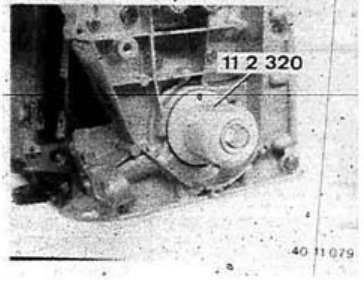
** Source of Supply: HWB



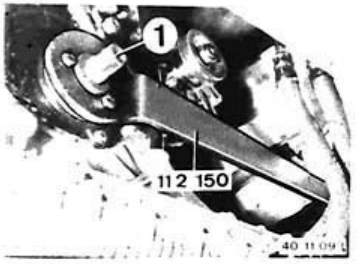
Installation:
Make sure gasket is not installed inversed.



Unscrew all mounting bolts of the end cover and take off cover.

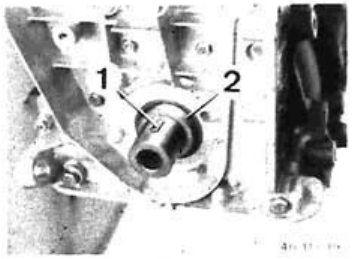


Installation:
Replace O-ring between cover and cylinder head.
Replace cover gasket.
Mount end cover.
Tightening torque:
M 6 = 9 Nm (6.5 ft. lbs.)
M 8 = 22 Nm (16 ft. lbs.)
Drive in new radial oil seal against the stop with Special Tool 11 2 320.
Lubricate sealing lip of radial oil seal with oil.

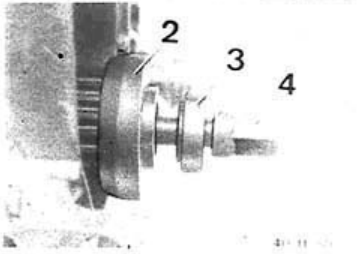


11 14 180 REPLACING RADIAL OIL SEAL IN FRONT END COVER

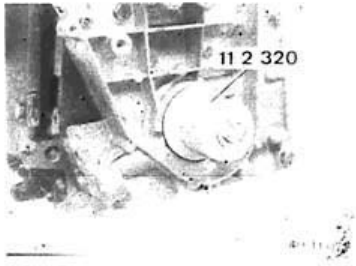
Unscrew engine splash guard.
Hold engine with Special Tool 11 2 150 (don't bear on oil pan) and loosen bolt (1).
Installation:
Tightening torque: 310 Nm (224 ft. lbs.).



Lift out woodruff key (1).
Pull off thrust ring (2), with a double claw puller if necessary.



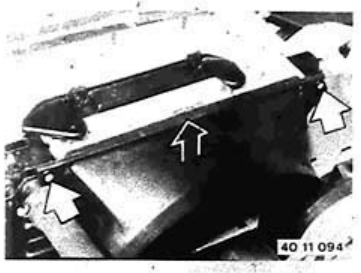
Remove toothed drive belt – see 11 31 110.
Unscrew drive sprocket (2).
Installation:
Align drive sprocket (2) with groove for woodruff key and slide on.
Install washer (3) with shoulder against the drive sprocket and screw on bolt (4) finger tight.



Lubricate sealing lip of new radial oil seal.
Press in radial oil seal against stop with Special Tool 11 2 320.

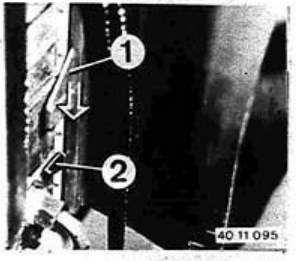


Pull off seal with Special Tool 11 2 310.
Note:
Screw special tool into seal firmly.



11 31 110 REPLACING TOOTHED DRIVE BELT

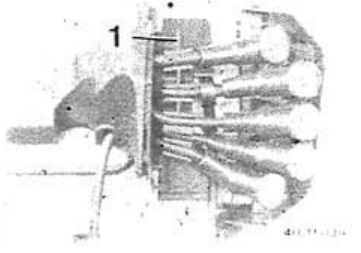
Remove fan (see 11 52 000).
Lift out expander rivets on left and right sides and pull out fan cowl from above.



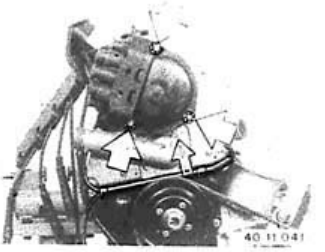
Installation:
Guide left and right tabs (1) into holders (2) while inserting the fan cowl.



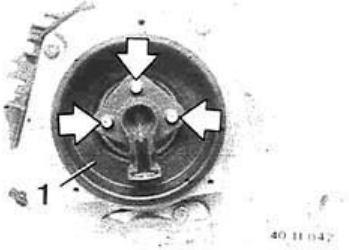
Pull off spark plug connectors.
Take off cover (1) and pry out electric lead duct (2) with a screwdriver.



Installation:
Place ignition leads assorted in guides on insulator (1).

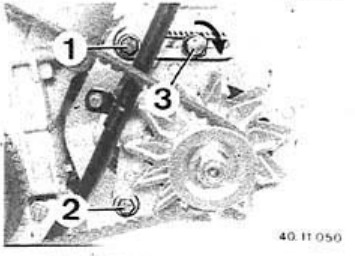


Lift out electric lead duct on face.
Unscrew screws on distributor cap and take off ignition tackle.

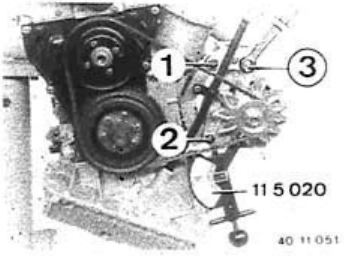


Unscrew screws and take off distributor finger and then remove cover (1) afterwards.

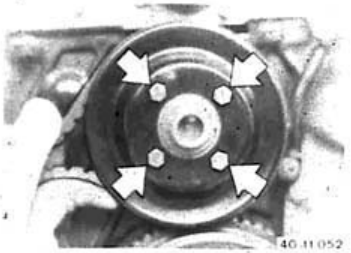
Installation:
Check O-ring on cover, replacing if necessary.



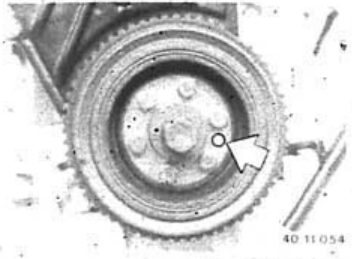
Loosen bolt (1).
Loosen nuts on bolts (2 and 3) and loosen the drive belt by turning bolt (3) in direction of the arrow.
Take off drive belt.



Installation:
Adjust tightness of drive belt by turning bolt (3) in direction of arrow with Special Tool 11 5 020.
Tighten nuts on bolts (3 and 2) and bolt (1).



Counterhold pulley with the drive belt, unscrew bolts and take off pulley.



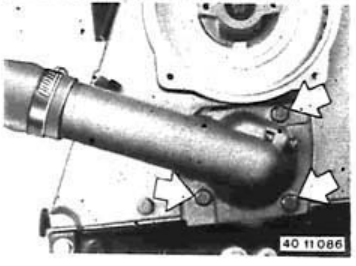
Unscrew bolts on vibration damper and take off vibration damper.

Installation:
Align dowel pin bore in vibration damper with the dowel pin precisely.
Tightening torque = 23 Nm (17 ft. lbs.).



Drain coolant.

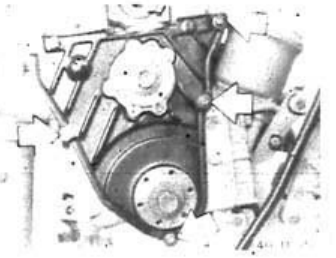
Note:
Fill and bleed cooling system – see Group 17.



Unscrew screws.
Take off thermostat housing and thermostat.

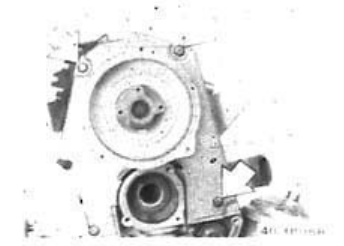


Installation:
Check O-ring (1), replacing if necessary.
Insert thermostat with the O-ring facing the housing.



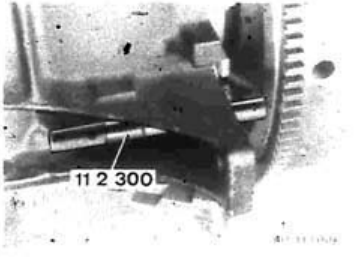
Unscrew screws and take off lower toothed drive belt cover.

Installation:
Check gasket, replacing if necessary.



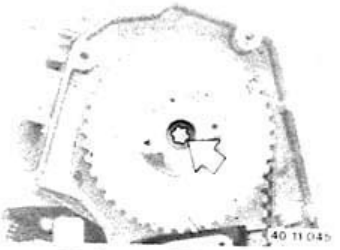
Unscrew screws and take off upper toothed drive belt cover.

Installation:
Check that dowel sleeves are installed and seated correctly in the area of the upper bolts.

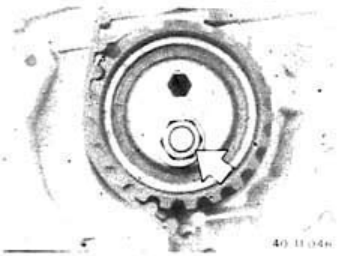


Turn crankshaft to move valves of cylinder no. 1 to TDC.
Hold crankshaft in TDC with Special Tool 11 2 300.

Caution!
Remove special tool before operating the engine.

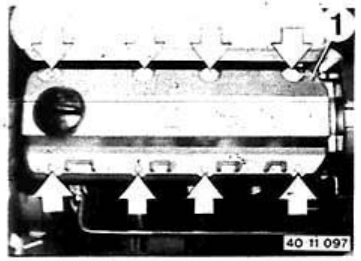


Loosen mounting bolt on camshaft sprocket.



Loosen nut on tensioning roller and take off toothed drive belt.

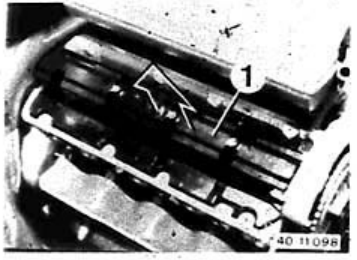
Note:
Always replaced an used toothed drive belt after loosening the tensioning roller, regardless of the mileage.



Installing and Tightening Toothed Drive Belt:

Pull off vent hose, unscrew bolts and take off cylinder head cover.

Installation:
Check gasket, replacing if necessary. Tighten bolts crosswise from inside to outside.
Tightening torque = 9 Nm (6.5 ft. lbs.).

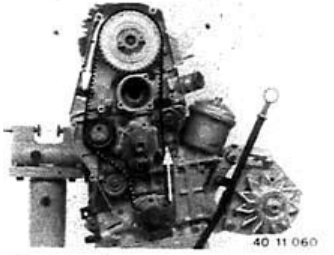


Remove camshaft cover (1).



Installation:
Hold camshaft in TDC position (valves of cylinder no. 4 overlap) with Special Tool 11 3 190.

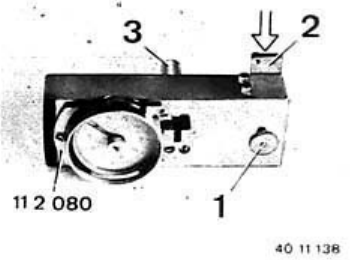
Bolt on camshaft sprocket with an initial torque of 1 to 3 Nm (0.7 to 2.1 ft. lbs.) so that it can still be turned without play and turn in engine's direction of rotation against the stop (tab in groove).



Mount tensioning roller that it can still be turned with a slight tightening torque of approx. 1 Nm (0.7 ft. lbs.).

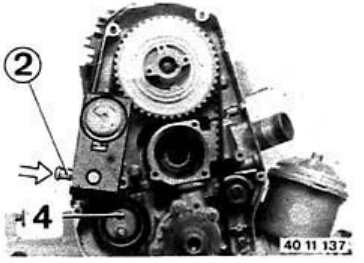
Mount toothed drive belt while pulling from the crankshaft sprocket to the tensioning roller.

Center toothed drive belt on the camshaft sprocket.

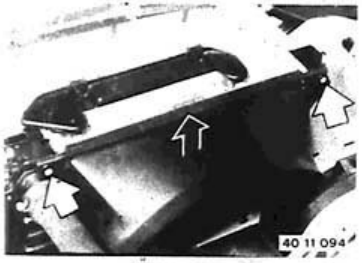


Preparing Special Tool 11 2 080 for Measuring Tightness (also Refer to Operating Instructions for 11 2 080):

Pull up lockpin (1) and move bearing pins to maximum opening width with slide (2).
Set dial gage needle to "0" and line up drag needle with the gage needle.
Apply tester on toothed drive belt in such a manner that the center bearing pin (3) bears in one of the teeth gaps.

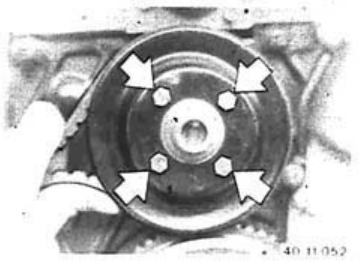


Push in slide (2) until engagment of the lockpin is noticed and adjust the toothed drive belt's tightness by turning the tensioning roller (4).
Specification: 32 ± 2 scale graduations.
Tighten the tensioning roller with 22 Nm (16 ft. lbs.) and the camshaft sprocket with 63 Nm (46 ft. lbs.) torque.

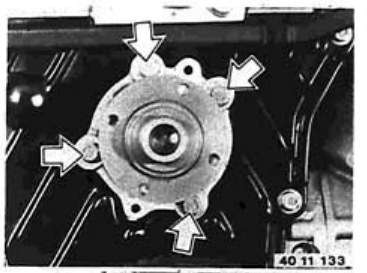


11 51 000 REMOVING AND INSTALLING WATER PUMP

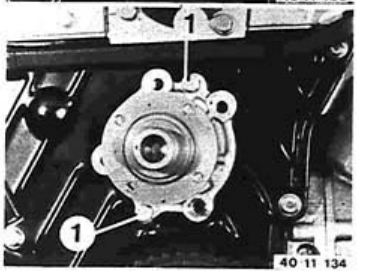
Remove fan – see 11 52 000.
Lift out expansion rivets on left and right sides.
Remove fan cowl from above.



Remove drive belt – see Group 12.
Hold pulley on drive belt.
Unscrew bolts and take off pulley.

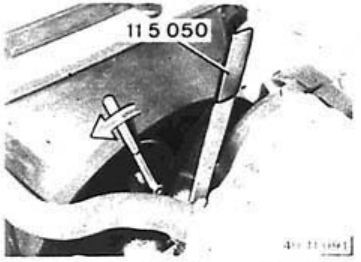


Unscrew bolts.



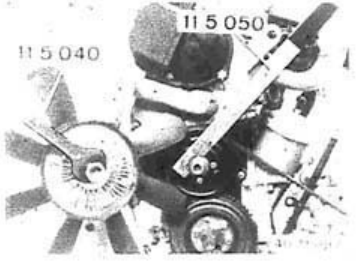
Screw two bolts in tapped holes (1) and press off water pump uniformly.
Installation:
Replace O-ring, coating with a lubricant** to make installation easier.
Tightening torque: 9 Nm (6.5 ft. lbs.).

** Source of Supply: HWB

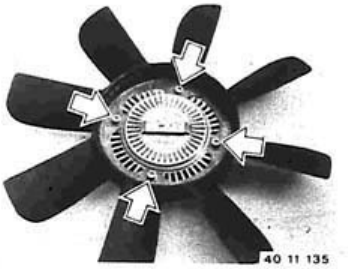


11 52 000 REMOVING AND INSTALLING FAN

Hold pulley with Special Tool 11 5 050 and unscrew coupling nut.
Important!
Left-hand threads – turn nut clockwise to unscrew nut.



Installation:
Tighten fan with Special Tool 11 5 040.
40 Nm (29 ft. lbs.) tightening torque with Special Tool 11 5 040 is equal to a setting of 30 Nm (22 ft. lbs.) on torque wrench.



11 52 020 REPLACING FAN CLUTCH

Remove fan – see 11 52 000.
Unscrew mounting bolts and take off fan clutch.
Installation:
Tightening torque: 9 Nm (6.5 ft. lbs.).

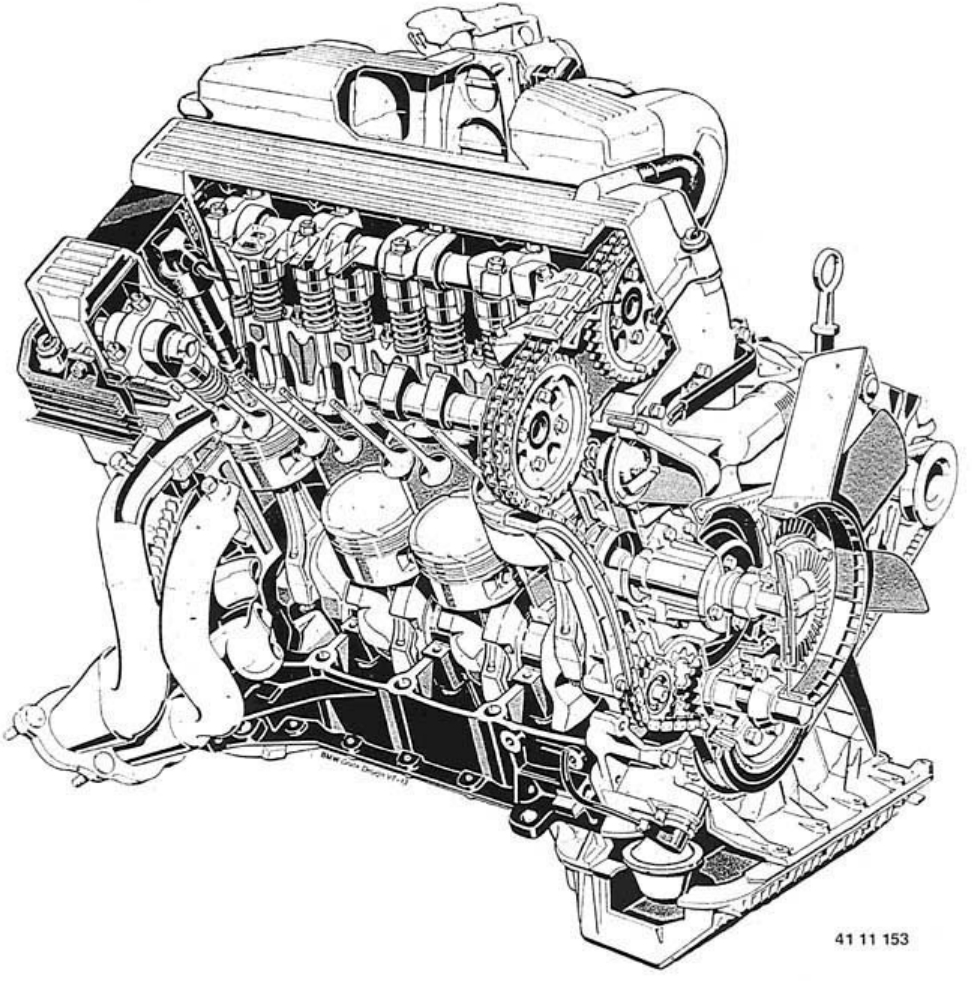
Replace fan clutch, if
a) it has axial or radial play,
b) it is losing oil or
c) is hard to turn (fan of a stopped engine must be easy to turn).

11 Engine

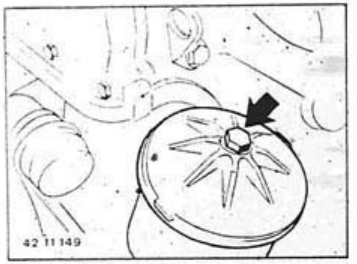
Model: 318is – Engine M42

	View of M42 engine	11-	00/42.0
00 11 . . .	Engine oil and oil filter – replace	11-	00/42.1
11 00 039	Compression – check	11-	00/42.2
050	Engine – remove and install	11-	00/42.3
11 14 115	Timing case, lower – remove and install / seal or replace	11-	14/42.1

SECTION DRAWING OF M 42 ENGINE



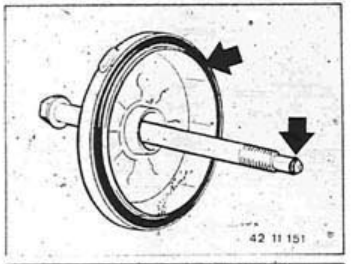
41 11 153



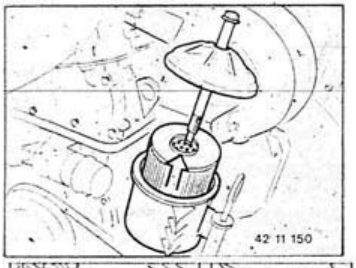
M 42 Engine
00 11 ... REPLACING ENGINE OIL AND OIL FILTER

Unscrew oil filter cover (oil in filter housing runs into oil pan).

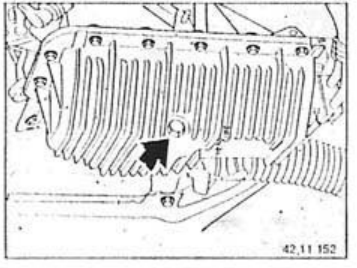
Installation:
Tightening torque = 30 Nm (22 ft. lbs.).



Installation:
Replace seal in cover and on bolt.



Remove oil filter cartridge.

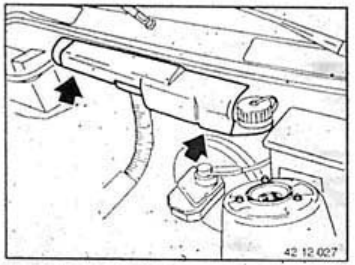


Remove oil drain plug or draw off oil after oil has run out of the oil filter housing.

Installation:
Tightening torque = 32 ± 4 Nm (23 ± 3 ft. lbs.).

Pour in engine oil .
Start engine and run at high speed (approx. 2,500 rpm) until the oil control lamp goes out (approx. 5 seconds).
Stop engine and check oil level (car on level surface).

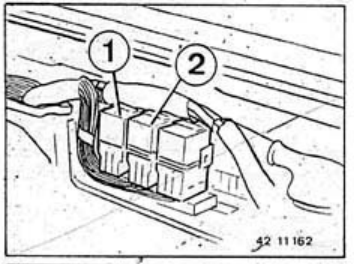
* **Oil grade - see Operating Fluids**
Oil volume - see Specifications



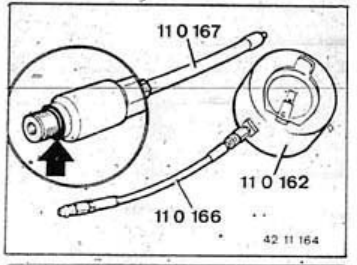
M 42 Engine
11 00 039 CHECKING COMPRESSION

Testing Conditions:
Battery in perfect condition – check acid density if necessary.
Engine temperature = max. 35° C (95° F) coolant temperature.

Remove cover.



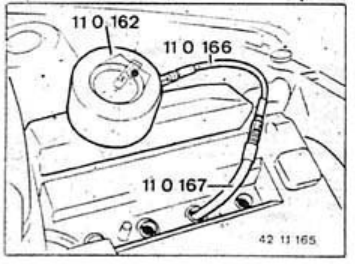
Pull off master relay (1) and fuel pump relay (2).



Unscrew all spark plugs (also refer to 12 12 011).

Screw Special Tool 11 0 166 in tapped bore of spark plug by hand and connect the compression tester.

Note:
Check that seal is in perfect condition.



Floor accelerator pedal and operate starter for so long, until the compression no longer rises.
Value of all cylinders should not differ by more than 0.5 bar (7 psi).
Specification: 10 to 11 bar (142 to 156 psi).

M 42 Engine

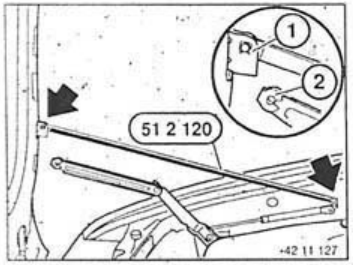
11 00 050 REMOVING AND INSTALLING ENGINE

Disconnect battery ground lead.

Removing Transmission:

Remove transmission – see Group 23 or 24.

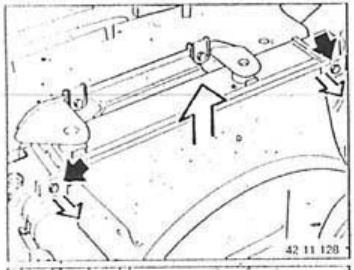
Unscrew splash guard.



Disconnect prop and gas pressure spring, and apply Special Tool 51 2 120.

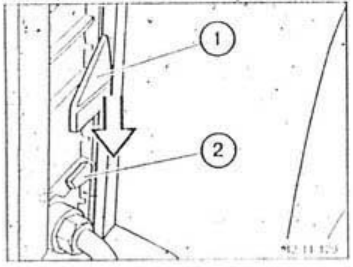
Caution!
Use lock (1).

Installation:
Insert plastic part (2).

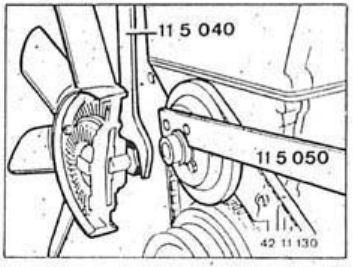


Removing Fan Cowl:

Lift out expander rivets on left and right sides and remove fan cowl from above.



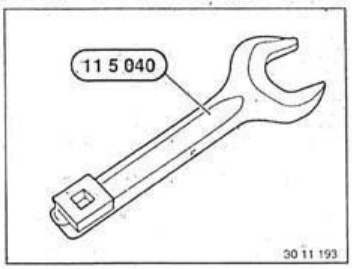
Installation:
Engage left and right tabs (1) in holders (2) while inserting the fan cowl.



Removing Fan:

Counterhold pulley with Special Tool 11 5 050 and unscrew nut on fan.

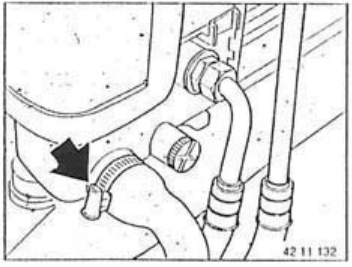
Important!
Left-hand threads – turn nut clockwise to unscrew.



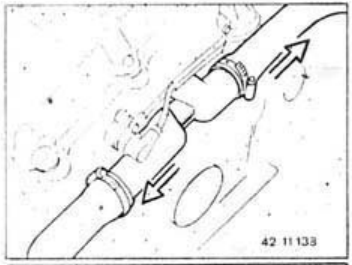
Installation:
Tighten fan nut with Special Tool 11 5 040.
40 Nm (29 ft. lbs.) tightening torque is equal to 30 Nm (22 ft. lbs.) setting on torque wrench.

Disconnecting Coolant Hoses:

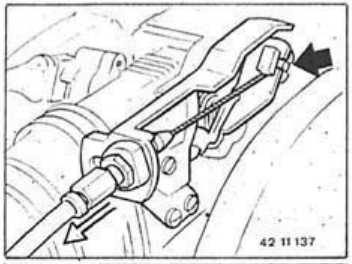
Drain coolant on engine block.



Loosen hose clamp and pull off hose on expansion tank at bottom.

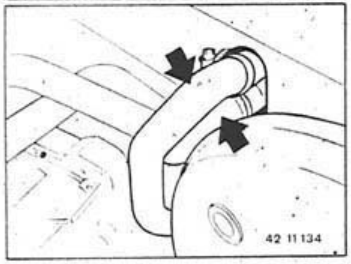


Disconnect coolant hoses on engine.



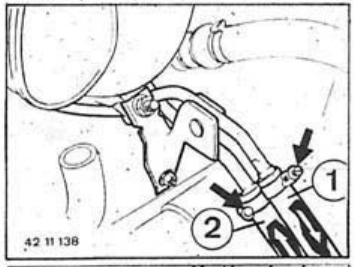
<u>Disconnecting Throttle Cable:</u>

Unclip cable.
Pull out cable with rubber holder.



Disconnect heater hoses on splash wall.

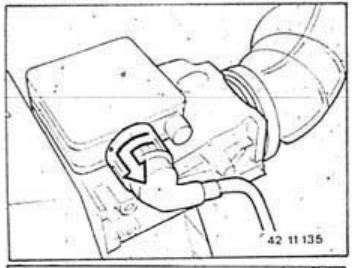
Installation:
Fill and bleed cooling system – see Group 17.



<u>Disconnecting Fuel Pipes:</u>

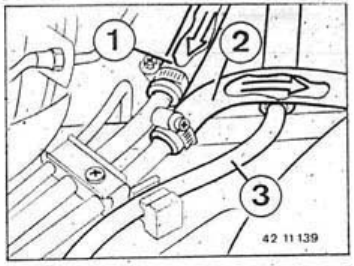
Unscrew fuel pipes.

Installation;
Top (1) = return
Bottom (2) = feed (from filter)



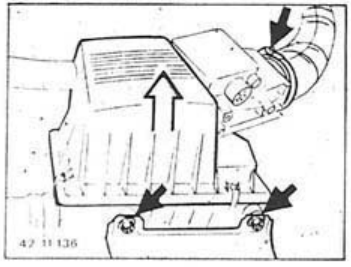
<u>Removing Air Cleaner and Air Flow Sensor:</u>

Disconnect plug.

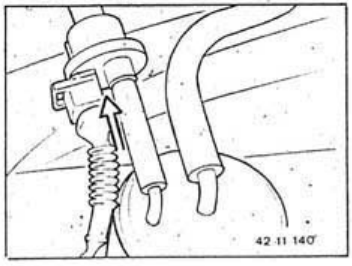


Arrangement of Tank Pipes on Engine Carrier:

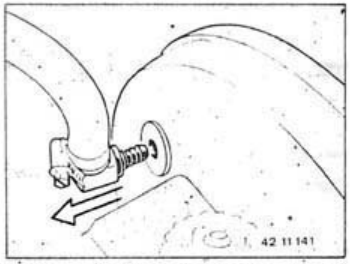
(1) = return
(2) = feed (to filter)
(3) = tank vent



Loosen hose clamp and unscrew mounting screws.
Lift off air cleaner with air flow sensor.

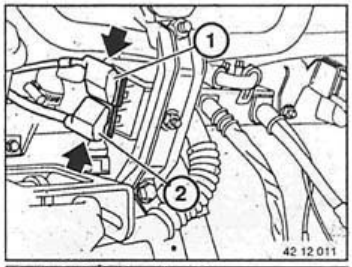


Pull off hose to filter for tank venting.



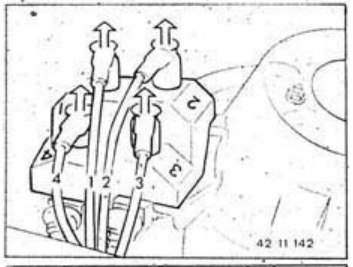
Disconnecting Vacuum Hose for Brake Booster:

Pull out connector on brake booster.



Disconnect both plugs on electric lead duct.

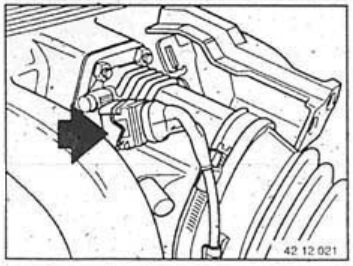
(1) = cylinder identifying sender (constant ignition distributor)
(2) = pulse sender for DME



Disconnecting Engine Wire Harness on Engine:

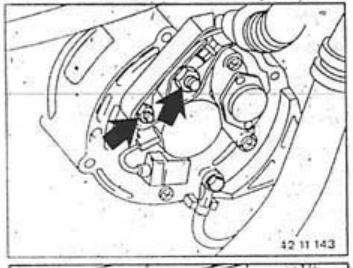
Pull off ignition leads on ignition coil.

Installation:
Numbers for the firing order are located on the leads and cap.

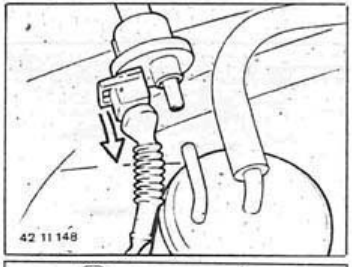


Pull off throttle valve potentiometer pug.

Location:
An throttle valve neck.

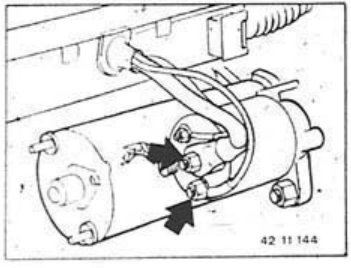


Unscrew connections on alternator.

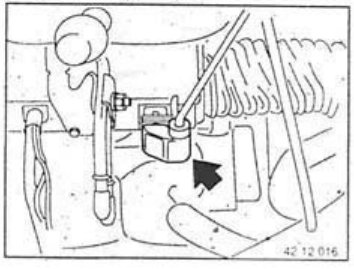


Pull off tank venting valve plug.

Location:
Next to air cleaner.

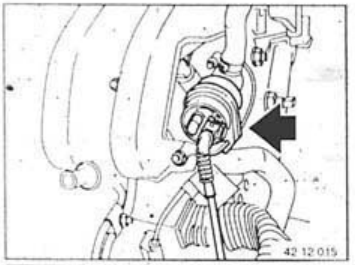


Unscrew connections on starter.



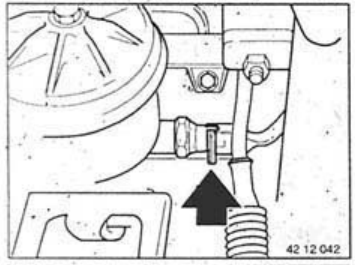
Pull off plug for fuel injectors.

Location:
On end of electric lead duct, close to the fuel pipes.



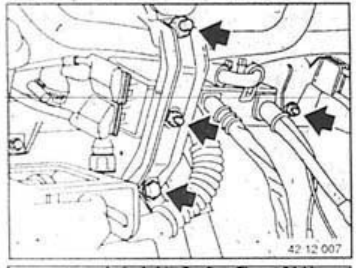
Pull off plug for idle speed control.

Location:
Am rear intake manifold.

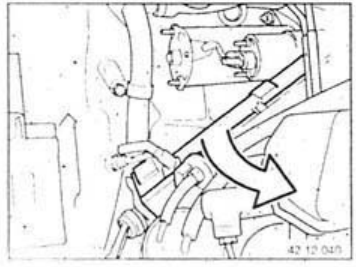


Pull off plug on oil pressure switch.

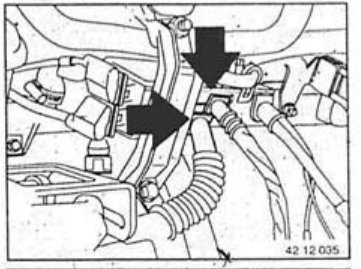
Location:
On oil filter.



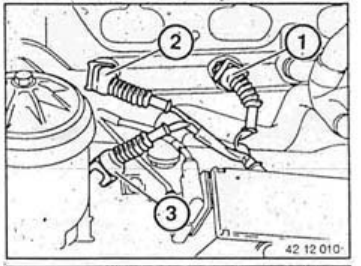
Unscrew supports for intake manifolds front and rear.



Take electric lead duct off of the engine.



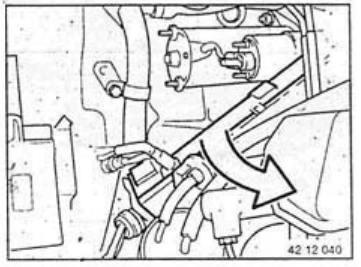
Important!
Make sure that rubber grommets of electric lead openings are clipped in the electric lead duct correctly when mounting the electric lead duct.



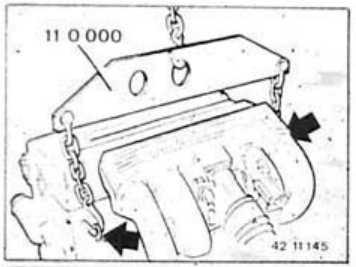
Pull off plugs (1 and 2).

Important!
Don't mix up plugs.

(1) = Coolant temperature gage sender
(2) = Coolant temperature sensor - DME
(3) = Oil pressure switch

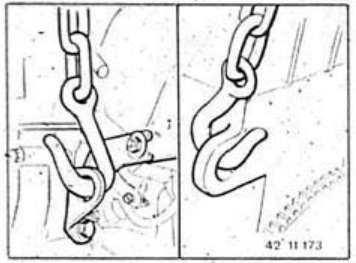


Disconnect electric lead duct and wire harness on engine and lay aside.

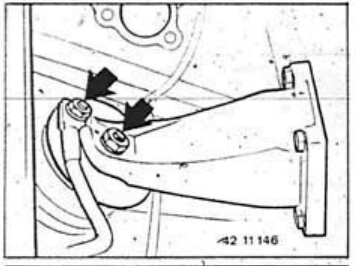


Lifting Out Engine:

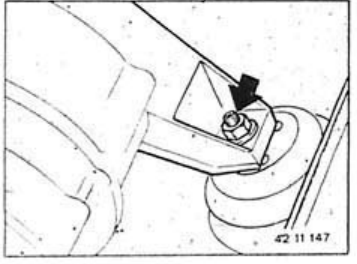
Connect Special Tool 11 0 000 on engine.



Arrangement of Suspension Front and Rear



Unscrew engine mount and ground lead on right-hand side.



Unscrew left engine mount.

Lift out engine.

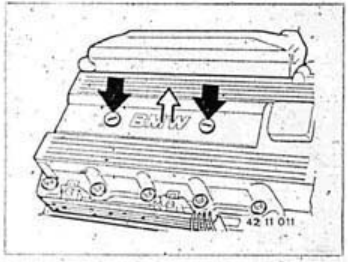
M 42 Engine

11 14 115 REMOVING AND INSTALLING/ SEALING OR REPLACING LOWER TIMING CASE

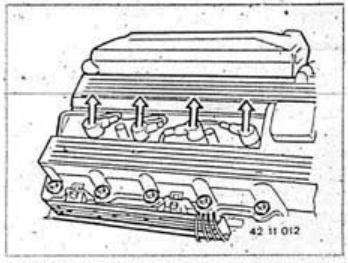
Note:
The timing case can be removed together with the integrated oil pump without removal of the cylinder head by application of Special Tool 11 2 330.
Disconnect battery ground lead.
Remove fan and fan cowl.
Remove splash guard.
Drain coolant.

<u>Removing Cylinder Head Cover:</u>

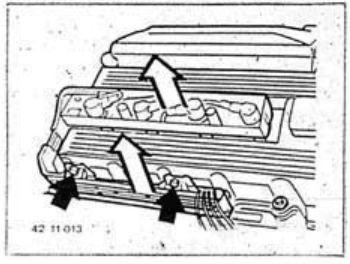
Unscrew cover for ignition coil.

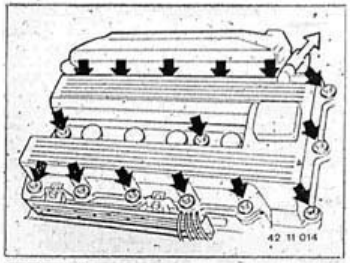


Pull off spark plug connectors.



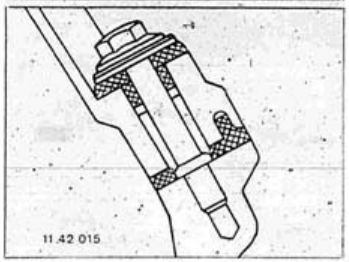
Loosen both nuts.
Lift out complete ignition tackle.



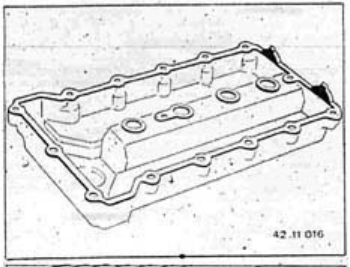


Pull off hose.
Unscrew cylinder head cover.

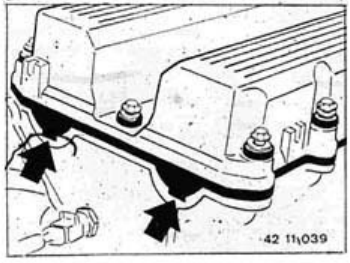
Installation:
Tightening torque .



Note:
The cylinder head cover has rubber mounts and gaskets to separate it from the cylinder head vibrations. Check arrangement of rubber mounts.

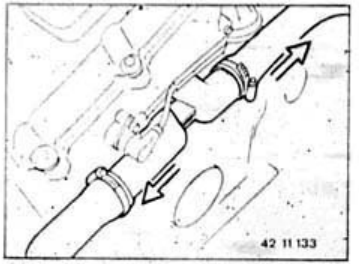


Installation:
Check gaskets, replacing if necessary.



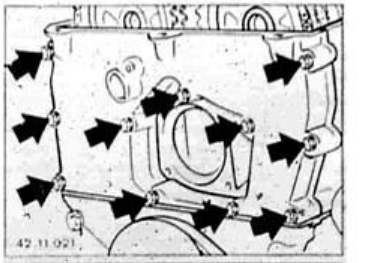
Installation:
Check for correct fit of gasket on back of the cylinder head when mounting the cylinder head cover.

*** See Specifications**

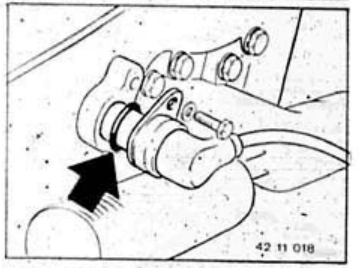


Removing Upper Timing Case Cover:

Disconnect coolant hoses on engine.

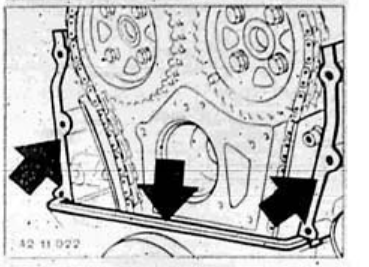


Unscrew upper timing case cover.

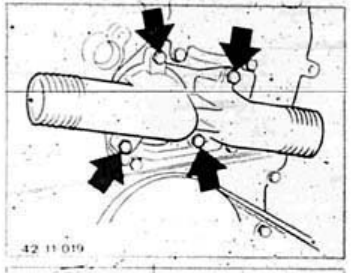


Unscrew sender.

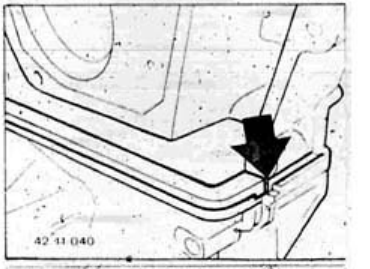
Installation:
Check seal, replacing if necessary.



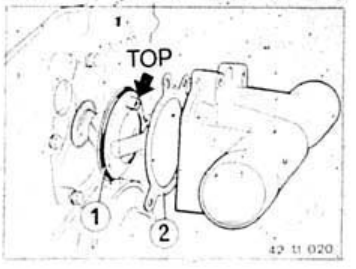
Installation:
Replace gaskets.



Remove thermostat housing and thermostat.

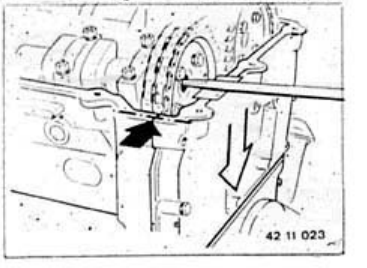


Installation:
Fill butt joints between gaskets with a black permanently elastic sealing compound, 3 Bond 1207B .



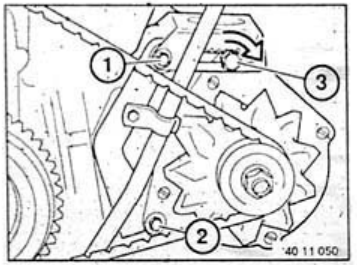
Installation:
Vent faces up.
Replace O-ring.
Coat O-ring lightly with glycerine.

(1) = O-ring
(2) = Gasket



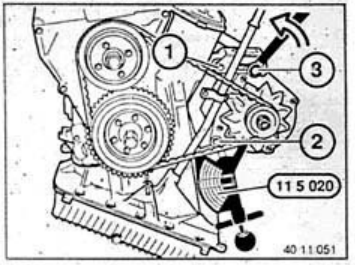
Installation:
Install two bolts.
Press down on timing case until the upper edge of the cover is in the same plane of the cylinder head.
Be careful not to damage sealing surfaces.
Install and tighten all bolts.
Tightening torque .

* **See Specifications**
** **Source of Supply: HWB**

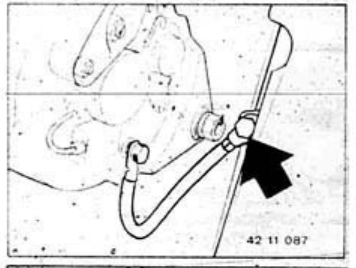


Removing Drive Belt:

Loosen bolt (1).
Loosen nuts on bolts (2 and 3) and loosen the drive belt by turning bolt (3) in direction of the arrow.
Take off drive belt.

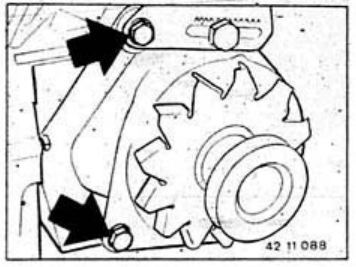


Installation:
Adjust tightness of drive belt by turning bolt (3) in direction of the arrow with Special Tool 11 5 020.
Tighten nut on bolt (3).
Tighten bolts (1 and 2).



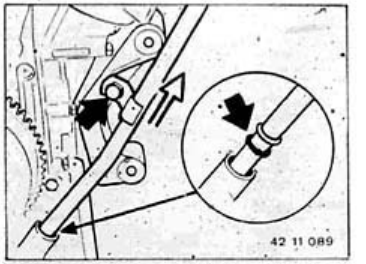
Removing Alternator:

Unscrew ground strap.



Unscrew bolts and take off alternator.

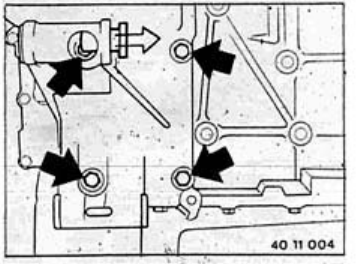
Installation:
Tightening torque = 22 Nm (16 ft. lbs.).



Removing Alternator Console:

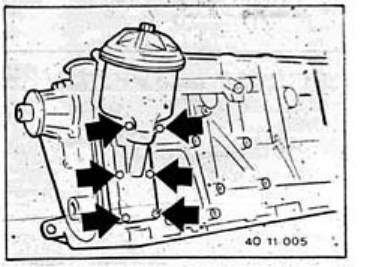
Unscrew and pull out oil dipstick.

Installation:
Replace seal.



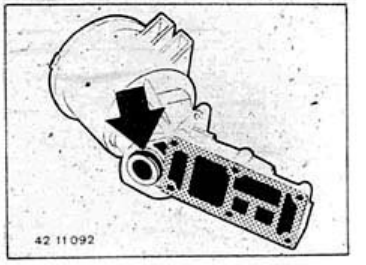
Press out sleeve.
Unscrew bolts and take off console.

Installation:
Tightening torque = 22 Nm (16 ft. lbs.).



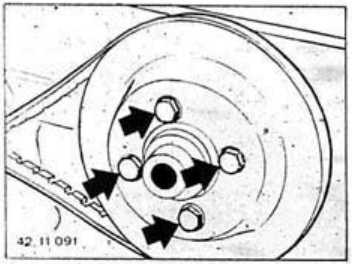
Removing Oil Filter Housing:

Unscrew screws and take off oil filter housing.



Installation:
Replace O-ring and gasket.
Coat O-ring with a lubricant.**
Tightening torque = 9 Nm (6.5 ft. lbs.).

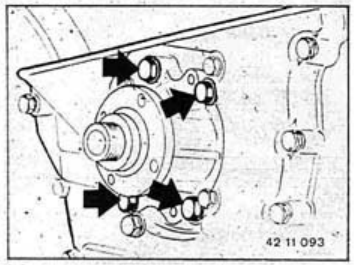
**** Source of Supply: HWB**



Removing Water Pump:

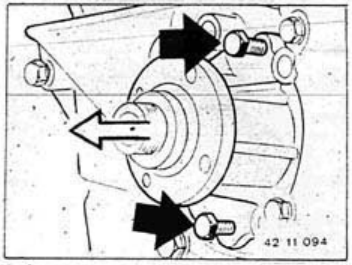
Counterhold pulley with the drive belt and unscrew bolts.

Installation:
Tightening torque = 9 Nm (6.5 ft. lbs.).

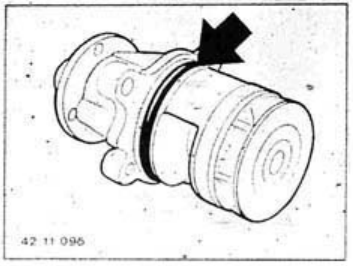


Unscrew bolts.

Installation:
Tightening torque = 9 Nm (6.5 ft. lbs.).

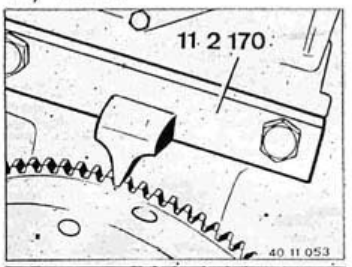


Screw two M 6 screws in tapped bores (1) and press water pump out of the end cover uniformly.



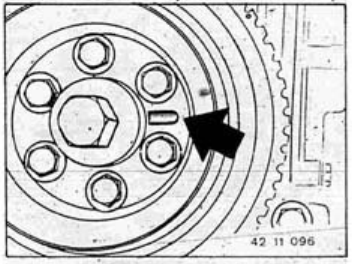
Installation:
Replace O-ring and coat with a lubricant.**
Tightening torque = 9 Nm (6.5 ft. lbs.).

**** Source of Supply: HWB**



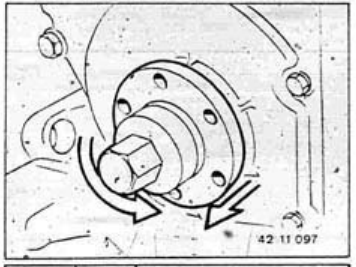
Removing Vibration Damper:

Hold engine with Special Tool 11 2 170.



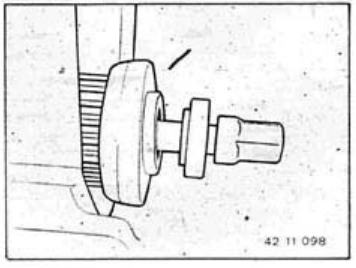
Unscrew bolts on vibration damper and take off vibration damper.

Installation:
Align dowel pin bore in vibration damper with the dowel pin.
Tightening torque = 23 Nm (17 ft. lbs.).

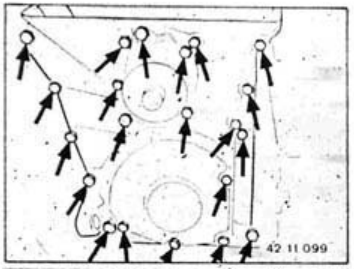


Removing Hub for Vibration Damper:

Hold flywheel with Special Tool 11 2 170.
Unscrew central bolt.
Take off washer and hub.



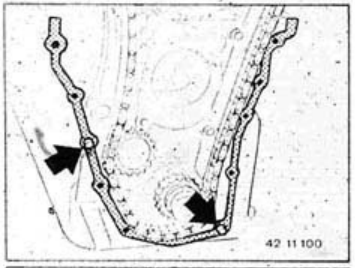
Installation:
Align groove of hub with woodruff key.
Shoulder of washer faces the hub.
Tightening torque of central bolt = 310 Nm (224 ft. lbs.).



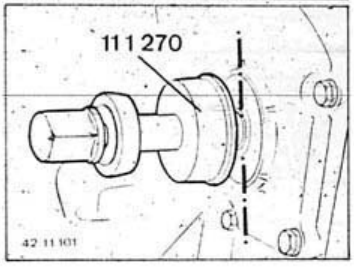
Removing Lower Timing Case Cover:

Unscrew screws.
Lift off timing case cover.

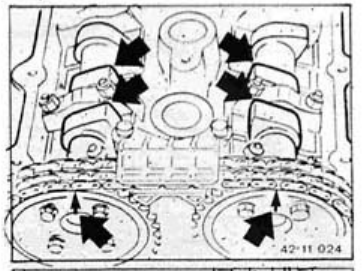
Note:
The timing case cover can also be removed without removal of the water pump.



Installation:
Replace gaskets.
Check dowel sleeves.

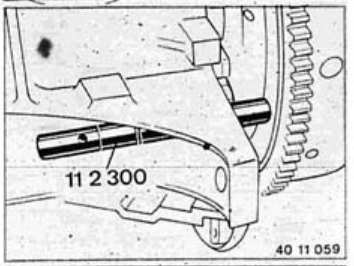


Installation:
Press in new radial oil seal flush with pressure ring from Special Tool 11 1 270 together with the central bolt and washer, with the timing case cover mounted.



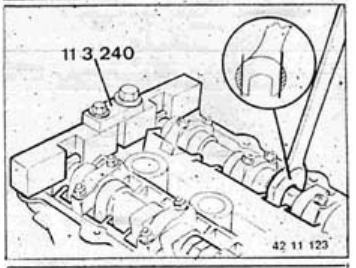
Removing Timing Chain and Guides:

Turn engine in direction of rotation until the peaks of intake and exhaust cams for cylinder no. 1 face each other. Arrows on sprockets face up.



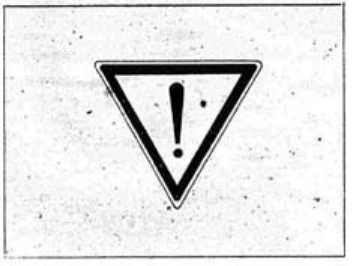
Installation:
Hold crankshaft in TDC position with Special Tool 11 2 300.

Caution!
Remove special tool before operating the engine.

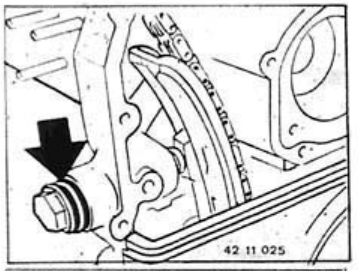


Installation:
Align and hold camshaft with Special Tool 11 3 240.
Camshafts can be turned on the hexagon with a 27 mm wrench.

Important!
Don't damage the bearing bar.
If applicable, grind off sides of fork wrench as shown.



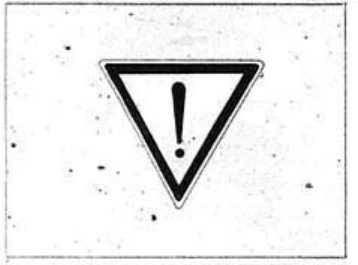
Important!
If the camshaft position has to be corrected so much to have valves for cylinders 1 and 4 move, turn crankshaft about 90° from TDC in engine's direction of rotation first and then turn back again only after turning the camshaft. This prevents contact between valves and pistons.
Install and unlock the chain tensioner after assembling. Press chain tensioner against the timing chain.
Recheck the camshaft adjustment.



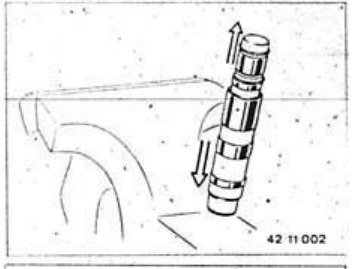
Remove chain tensioner.

Installation:
Tightening torque*.

Caution!
Chain tensioner is without oil as a new part or after disassembling.
To guarantee correct funtioning engine operated initially must be run at 3500 rpm approx. 20 seconds.

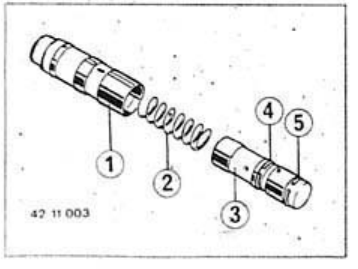


Installation – Important!
The hydraulic plunger of the chain tensioner must be adjusted to the basic position (transporting position of new chain tensioners) prior to installation or each time after loosening the plug.
Reason:
The hydraulic plunger is locked after running out and can no longer be pressed back.
This could cause lack of spring effect and breaking of chain and tensioner.

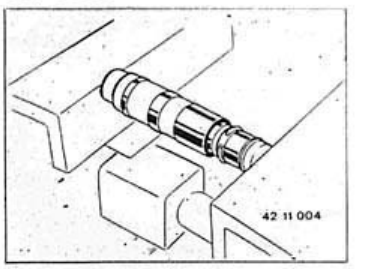


Installation:
Adjusting Hydraulic Plunger to Installed Basic Position:

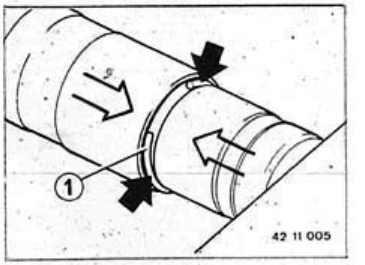
Knock on chain tensioner with the outer sleeve on a hard surface (vise anvil).
This causes the piston to snap out of the arrest.



Installation:
Arrangement of Parts
(1) = Sleeve
(2) = Spring
(3) = Hydraulic piston
(4) = Circlip
(5) = Circlip

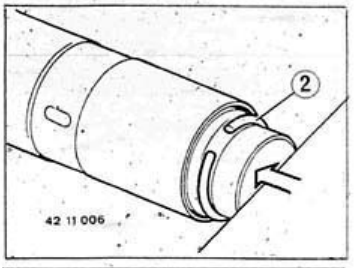


Installation:
Compress and clamp chain tensioner in a vise (fitted with soft jaws).

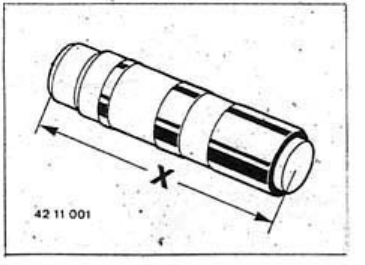


Installation:
Compress chain tensioner.

Important!
Insert circlip (1) in slip bevel of the sleeve.

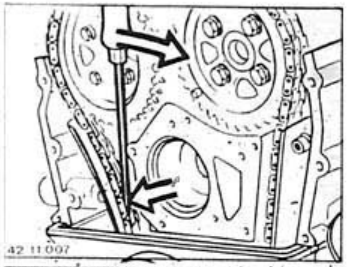


Installation:
Compress chain tensioner further until circlip (2) is heard to engage.
Loosen vise.
The chain tensioner must remain in transporting position.

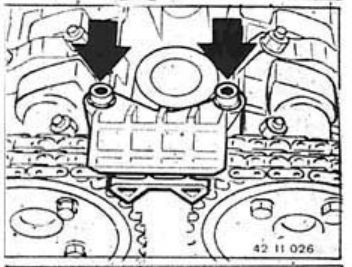


Installation:
The hydraulic piston will run out again, if the "catch point" was exceeded or not reached.
The chain tensioner must then be disassembled again and the procedures repeated.

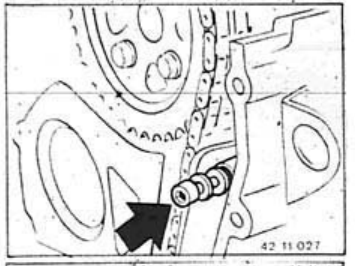
X = 68.5 mm (2.697").



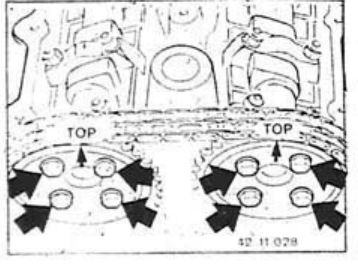
Installation:
Install chain tensioner.
Press the chain tensioning rail against the hydraulic piston briefly until the tensioning element is released.



Unscrew upper chain guide.



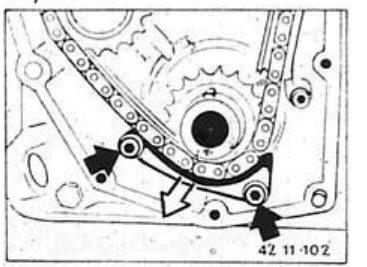
Unscrew top bolt on right chain guide.



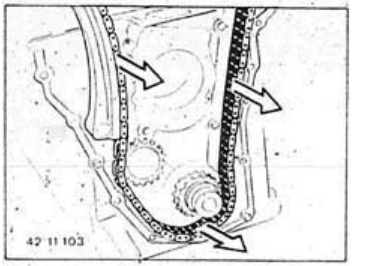
Unscrew chain sprockets.

Installation:
Arrwos on chain sprockets face up.
Tightening torque*.

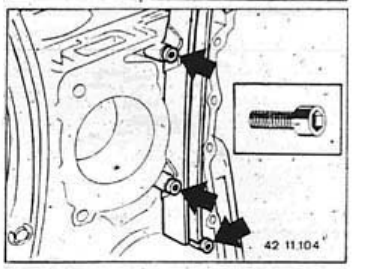
*** See Specifications**



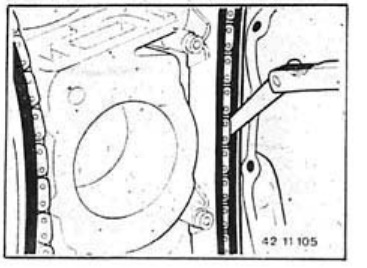
Unscrew lower guide.



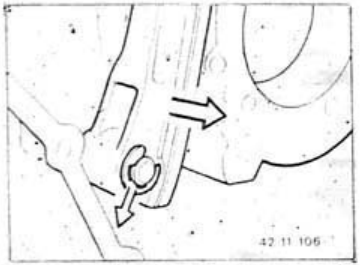
Lift out chain.



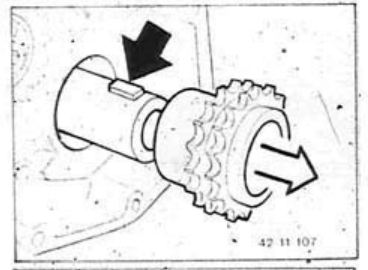
Remove chain guide.



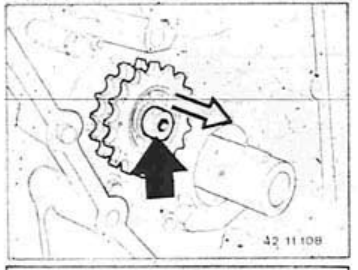
Installation:
Align and bolt down chain guides only after installation of the cylinder head and entire chain system.



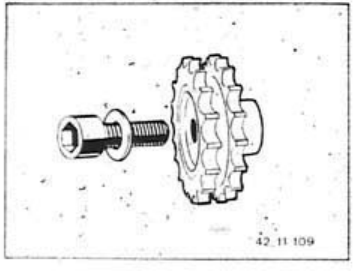
If applicable, remove tensioning rail.



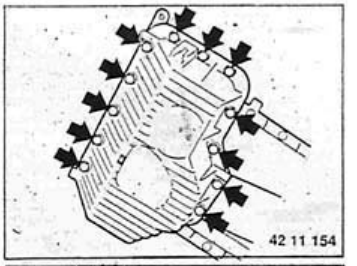
Pull sprocket off of crankshaft.
Lift out woodruff key.



If applicable, remove reversing roller.



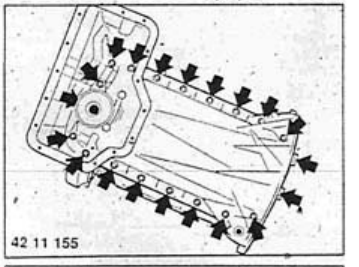
Note:
The reversing roller can only be replaced complete with bearings.



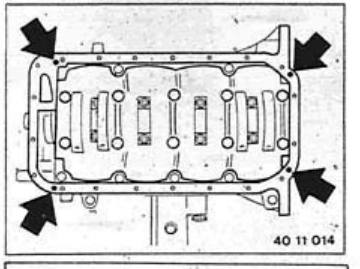
<u>Lowering Oil Pan:</u>

Unscrew bolts and take off lower oil pan section.

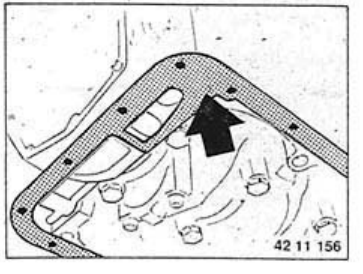
Installation:
Replace gasket.
Tightening torque = 9 Nm (6.5 ft. lbs.).



Unscrew bolts and lower oil pan up to the front axle carrier.

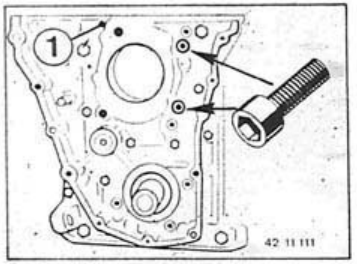


Installation:
Replace gasket.
Fill in joints between the front timing case and rear end cover with a black permanently elastic sealing compound, 3 Bond 1207B**.
Tightening torque = 9 Nm (6.5 ft. lbs.).



Installation:
Don't install the gasket inversed.

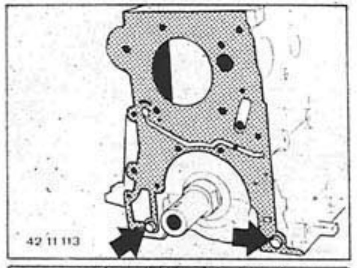
** Source of Supply: HWB



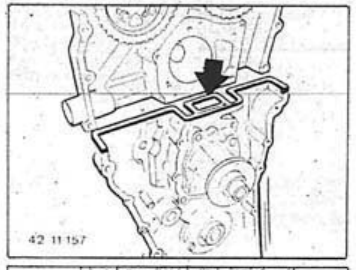
Removing Timing Case with Oil Pump:

Unscrew all bolts.
Lift off timing case.

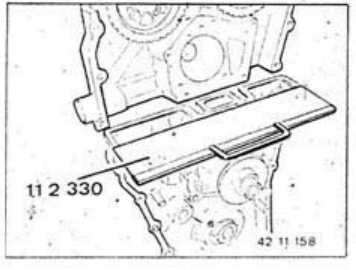
Installation:
Check arrangement of socket head bolts.
Top left bore (1) is not used.
Tighten all bolts uniformly.
Tightening torque*.



Installation:
Replace gasket.
Check dowel sleeves.

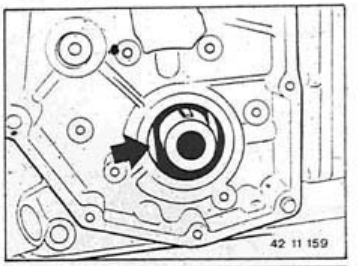


Installation:
Place rubber seal on timing case.

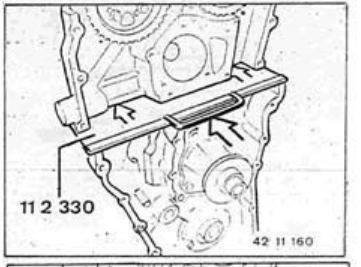


Installation:
Coat top surface of gasket and both sides of Special Tool 11 2 330 with grease.

*** See Specifications**

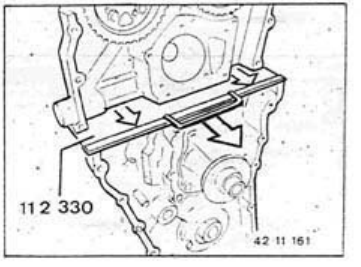


Installation:
Align oil pump with crankshaft.



Installation:
Place Special Tool 11 2 330 on the rubber seal and insert timing case together with the special tool.

Note:
Press up timing case until the oil pump slides on to the crankshaft.



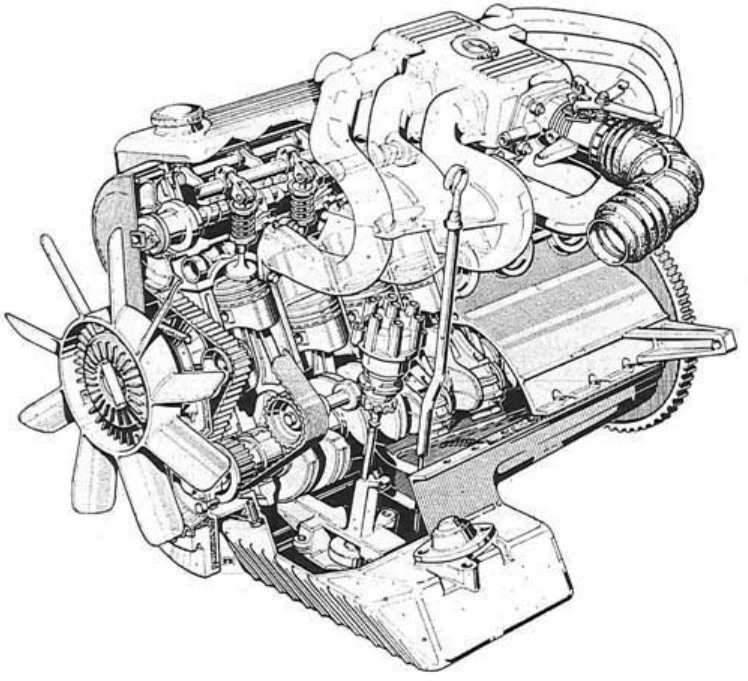
Installation:
Install timing case bolts only finger tight and pull out the special tool carefully.
Recheck seating of the gasket.

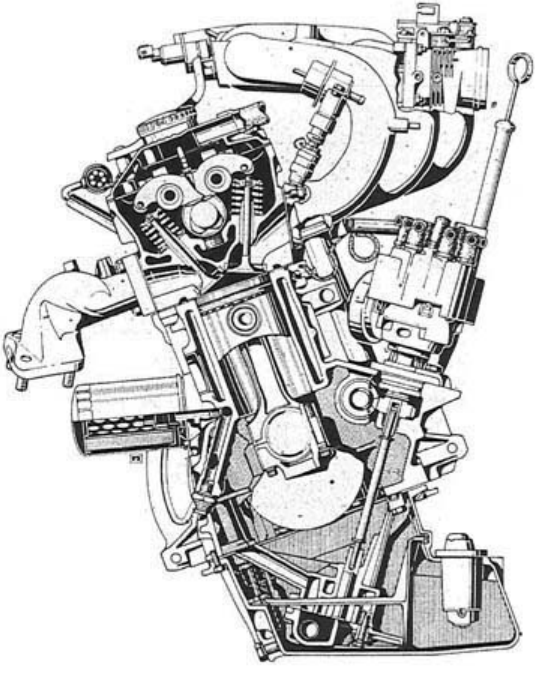
11 Engine

Models: 320i / 323i / 325e / 325i

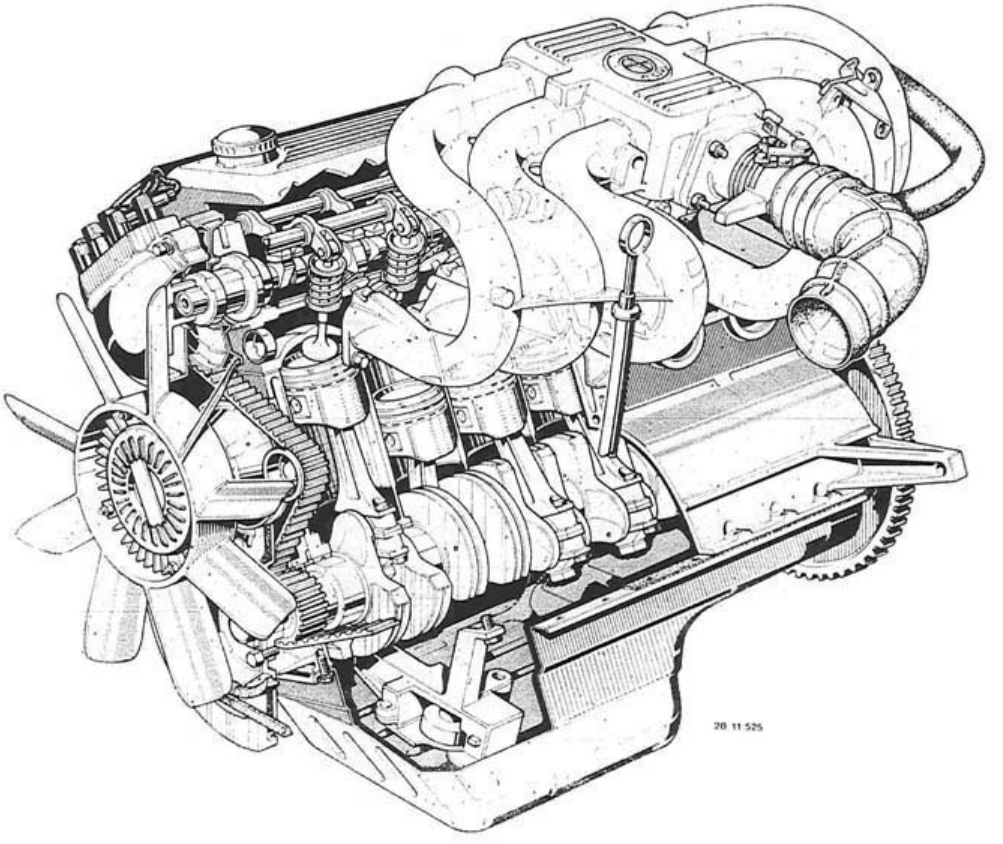
	Engine views	11- 50
11 00 039	Compression of all cylinders – check	11- 51
050	Engine – remove and install	11- 52
050	Engine – remove and install (beginning with 1988 models)	11- 56a
091	Engine – exchange	11- 57
11 11 160	Bearings of oil pump drive shaft – replace	11- 58
11 12 000	Cylinder head cover – remove and install	11- 58
100	Cylinder head – remove and install	11- 59
100	Cylinder head – remove and install (beginning with 1988 models)	11- 65a
11 13 000	Oil pan – remove and install	11- 66
11 31 110	Toothed drive belt – replace	11- 66a
	Emission control system layout drawing	
	BMW 320i / 323i – AUS/CH/S beginning with 1984 models	11- 67
	BMW 320iA / 323iA – AUS/CH/S beginning with 1984 models	11- 68
11 70 009	Emission control function test	11- 71
11 72 140	Pulse air valves – replace	11- 73
11 76 000	Catalytic converter – service install	11- 74
11 78 010	Oxygen sensor function test	11- 74
510	Oxygen sensor – replace	11- 75

M 20 = Small six cylinder
B = Gasoline
20 = Displacement (x 100)
L. = L-Jetronic
A/C/S = Australia/Switzerland/Sweden



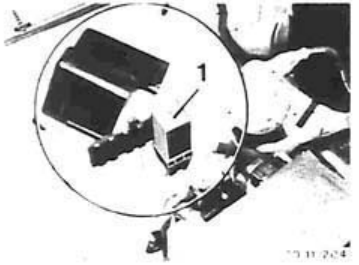


BMW 320 i – M 20 B 20 L
320 i – M 20 B 20 L.A/C/S (Emission Reduction)
323 i – M 20 B 23 L
323 i – M 20 B 23 L.A/C/S (Emission Reduction)



BMW 325 i – M 20 B 25 M.
BMW 325 e – M 20 B 27 M.U (Catalytic Converter)

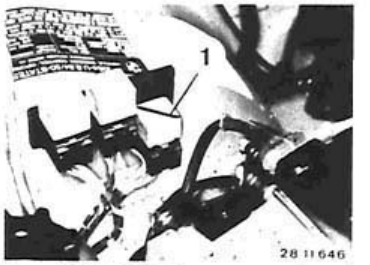
M 20 = Small six cylinder
B = Gasoline
27 = Displacement (x 100)
M. = Motronic
U = USA



11 00 039 CHECKING COMPRESSION OF ALL CYLINDERS

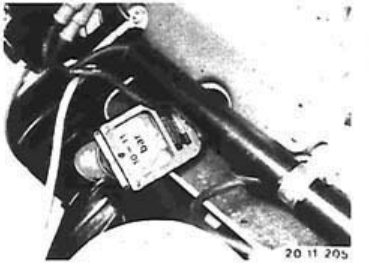
Distributor Engine:

Pull off relay (1) to avoid flooding from constant ejection of fuel injectors while operating the starter.
Pull off plug on ignition control unit.



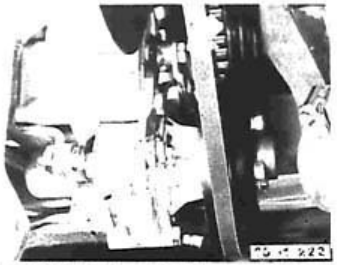
DME Engine:

Pull off master relay (1).



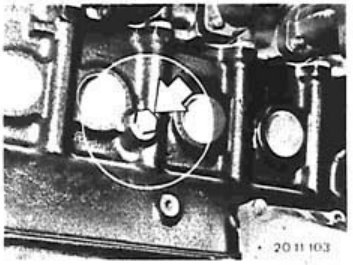
Unscrew spark plugs
Check compression*
Installation:
Tightening torque***

* See Specifications
*** See Specifications of Gr. 12

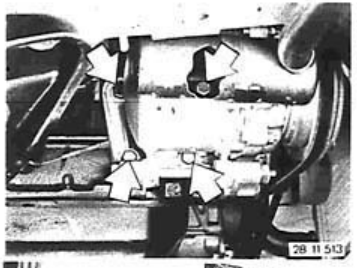


11 00 050 REMOVING AND INSTALLING ENGINE

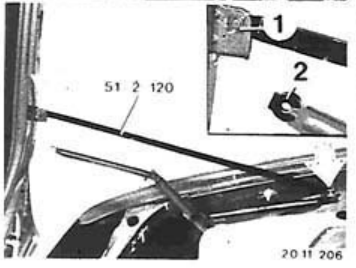
Remove transmission, see Gr. 23 or 24.
Cars with Power Steering:
Unscrew power steering pump.
Pressure hoses remain connected.
Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.



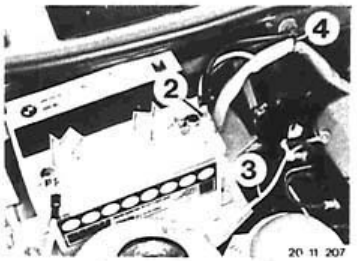
Unscrew plug and drain coolant.
Remove radiator 17 11 000.



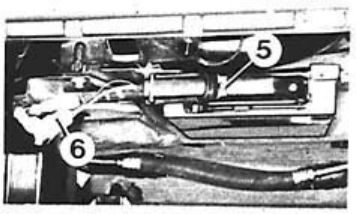
Cars with Air Conditioner:
Unscrew compressor.
Refrigerant hoses remain connected.
Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.



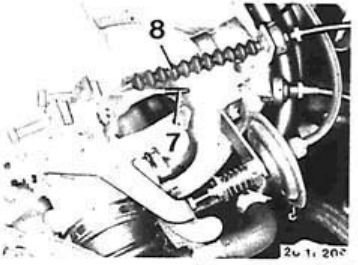
Disconnect prop and gas pressure props, and apply Special Tool 51 2 120.
Caution!
Use locks (1).
Installation:
Insert plastic part (2).



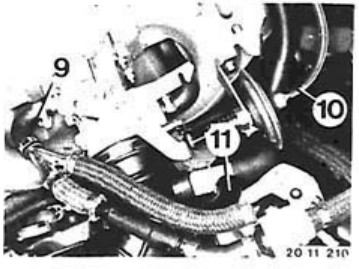
M 20 B 20 / B 23:
Disconnect negative and positive leads on battery.
Disconnect lead (2).
Unscrew ground wire (3).
Loosen wire strap (4).



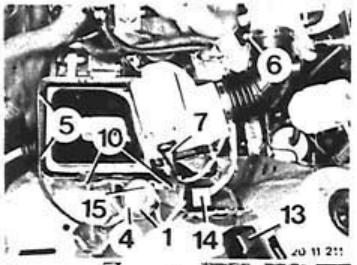
Remove trim panel in glove box.
Pull off plug (5) on control unit.
Disconnect wire (6).
Push out wire harness into engine compartment.



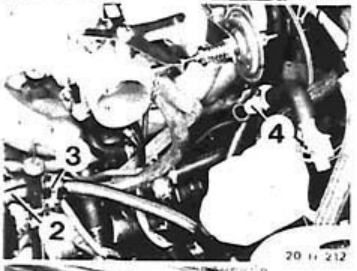
Detach throttle cable (7).
Cars with Cruise Control:
Detach cruise control cable (8).
Installation:
Adjust throttle cable, see 35 41 421.
Adjust cruise control cable, see Group 65.



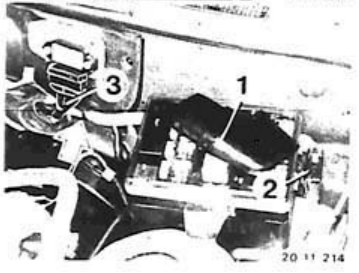
Detach hose (9).
Pull off hoses (10 and 11).



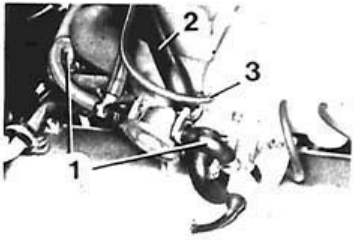
Pull off wire (4) on ignition coil.
Disconnect wires (1 and 15).
Lift off cap (13) and remove relay (14).
Pull off plug (7).
Unscrew wire harness on air cleaner housing.
Loosen clamp (6).
Lift wire (4) out of clamps (5).
Unscrew nuts (10) and remove air cleaner with air flow sensor.



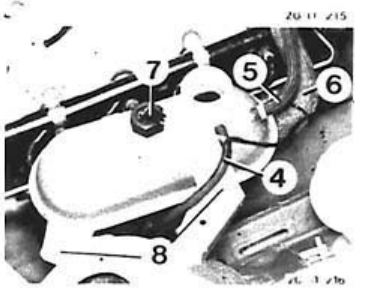
Detach fuel line (2) and holder (3)
Pull off hose (4) on air valve.



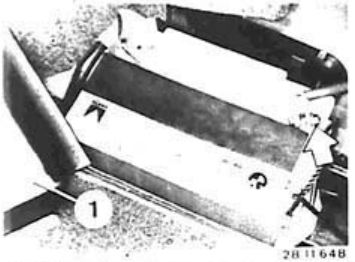
Lift off cap (1).
Lift out and disconnect plug (2).
Remove rubber guard on TCI control unit and pull off plug (3).
Loosen wire straps.



Detach fuel line (1).
Detach hoses (2 and 3).



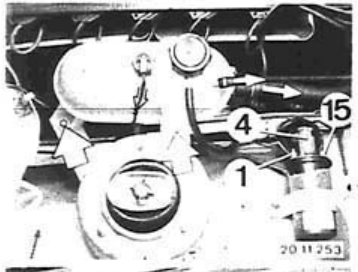
Detach hoses (4 ... 6).
Pull off plug (7).
Unscrew bolts (8) and remove expansion tank.
Installation:
Use new squeeze-hose clamp:



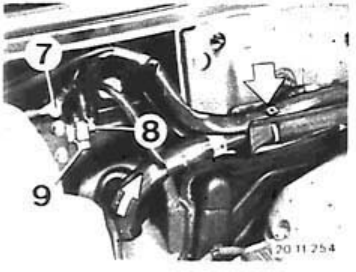
M 20 B 25:
Open trunk lid.
Unscrew cover (1).
Disconnect battery ground lead.



Remove trim panel in glove box.
Pull off plug (2) on control unit.
Disconnect plug (3).
Cars with Automatic Transmission:
Disconnect plug for car wire harness.



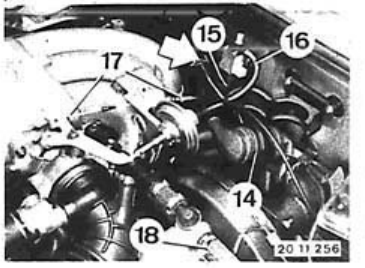
Remove coolant expansion tank.
Pull off wire (4) on ignition coil.
Disconnect wires (1 and 15).
Disconnect wire harness,
Installation:
Use a new squeeze-hose clamp.



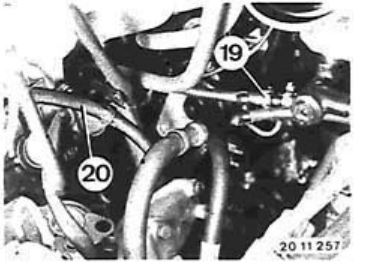
Disconnect wires (7 and 8).
Unscrew positive pole (9).
Loosen wire straps and pull out wire harness into the engine compartment.
Installation:
7 = Engine electrical system
8 = Car electrical system



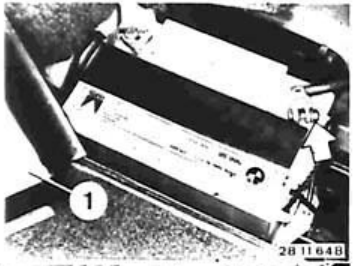
Lift out relay (10).
Pull off plug (11).
Loosen clamp (12).
Disconnect wire harness.
Unscrew nuts (13) and remove air cleaner with air flow sensor.



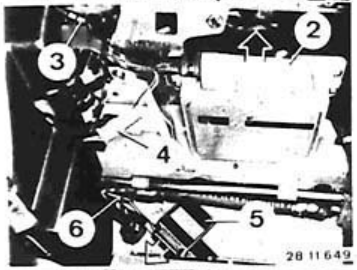
Lift out and disconnect plug (14).
Disconnect wire harness.
Pull off vacuum hoses (15 and 16).
Disconnect throttle cable (17).
Cars with Cruise Control:
Disconnect cruise control cable.
Pull off vacuum hose (18).
Installation:
Adjust throttle cable – see 35 41 421.
Adjust cruise control cable – see Group 65.
Use a new squeeze-hose clamp.
Screw-on cap (14) locks in final position.



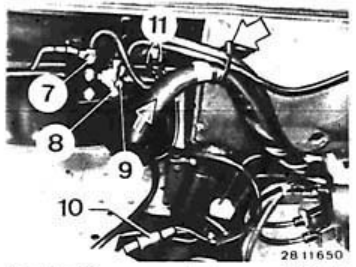
Disconnect fuel lines (19 and 20).



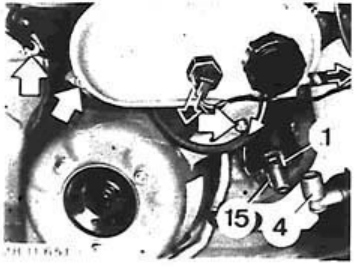
M 20 B 27:
Open trunk lid.
Unscrew cover (1).
Disconnect battery ground lead.



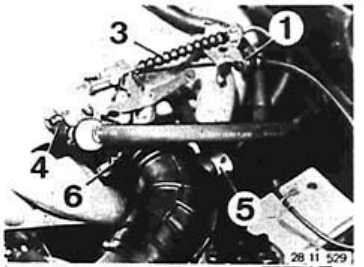
Remove trim panel in glove box.
Pull off plug (2) on control unit.
Disconnect plugs (3 and 4).
Unscrew idle control unit (5) and pull off plug.
Cars with Automatic Transmission:
Disconnect plug (6) for car wire harness.



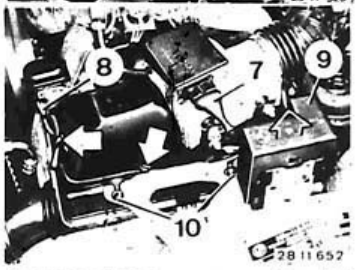
Disconnect wires (7 ... 9).
Lift out and disconnect oxygen sensor plug (10).
Pull off plug (11) on temperature sensor.
Loosen wire straps and pull out wire harness into engine compartment.
Installation:
7 = Engine electrical system
9 = Car electrical system



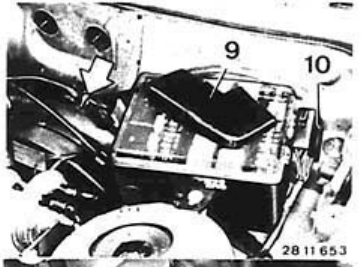
Remove coolant expansion tank.
Pull off wire (4) on ignition coil.
Disconnect wires (1 and 15).
Disconnect wire harness.
Installation:
Use new squeeze-hose clamps.



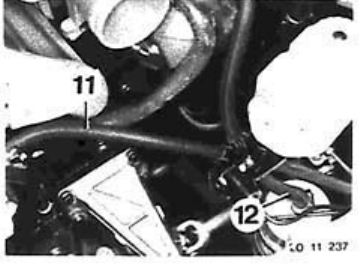
Disconnect throttle cable (1).
Cars with Cruise Control:
Disconnect cruise control cable (3).
Pull off vacuum hose (4) and hose (5).
Loosen clamp (6).
Installation:
Adjust throttle cable, see 35 41 421.
Adjust cruise control cable, see Group 65.



Pull off plugs (7 and 8).
Lift out relay (9).
Disconnect wire harness.
Unscrew nuts (10) and remove air cleaner with air flow sensor.



Pull off cap (9) and disconnect plug (10).
Disconnect wire harness.

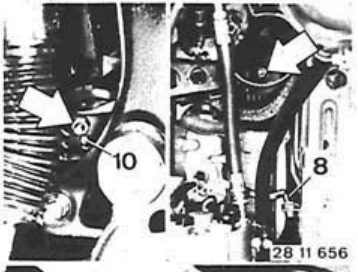


Disconnect fuel lines (11 and 12).

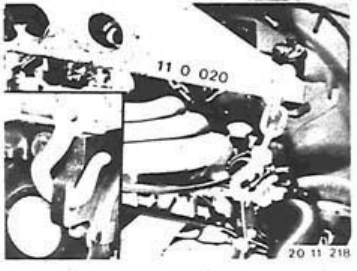


All Models:

Detach water hoses for heater.

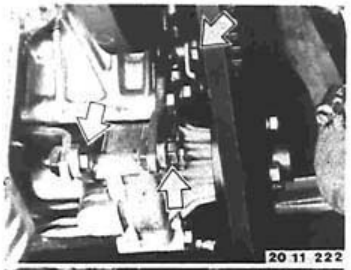


Unscrew ground strap (8) and both engine mounts.
Installation:
Guide mandrel (10) into bore of axle carrier.
Tightening torque .



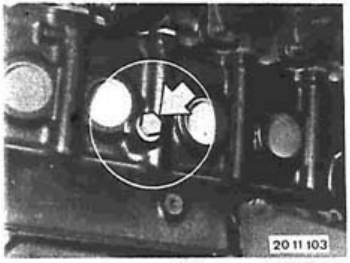
Attach Special Tool 11 0 020 on front and rear ends of engine, and lift out engine.
Installation:
Adjust ignition timing 12 11 004.
Adjust engine idle speed / CO 13 00 054.

* See Specifications

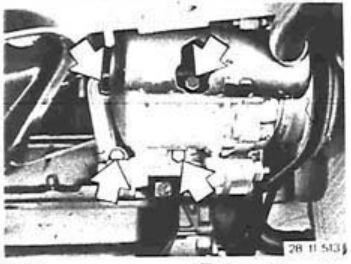


11 00 050 REMOVING AND INSTALLING ENGINE

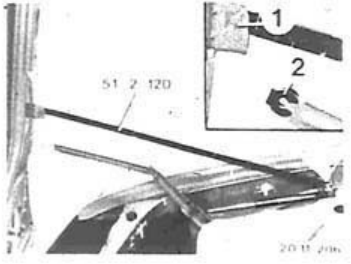
Since 1988 Models:
Disconnect battery ground lead.
Remove transmission - see Gr. 23/24.
Cars with Power Steering:
Unscrew power steering pump.
Hoses remain connected.
Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.



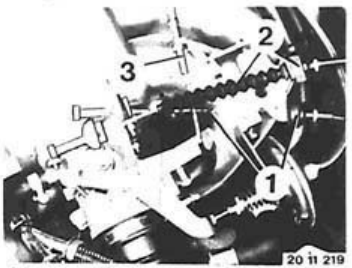
Unscrew plug and drain coolant.
Remove radiator - see 17 11 000.
Remove fan - see 11 52 000.



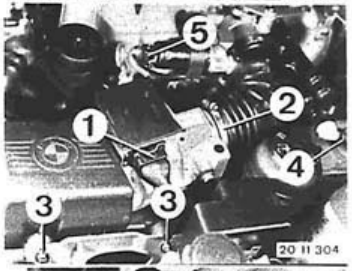
Cars with Air Conditioner:
Unscrew compressor.
Hoses remain connected on compressor.
Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.



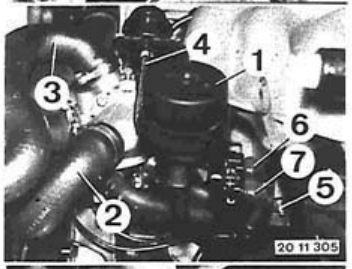
Disconnect support and gas pressure prop, and prop engine hood with Special Tool 51 2 120.
Caution!
Use retainer (1).
Installation:
Insert plastic part (2).



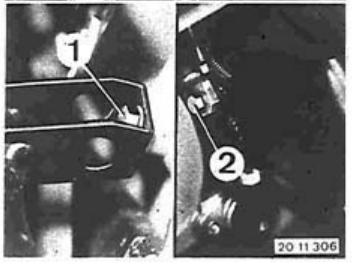
Disconnect throttle cable (1).
Cars with Cruise Control:
Disconnect cruise control cable (2).
Cars with Automatic Transmission:
Disconnect throttle cable (3).
Installation:
Adjust throttle cable - see Gr. 35.
Adjust cruise control cable - see Gr. 65.
Adjust throttle cable - see Gr. 24.



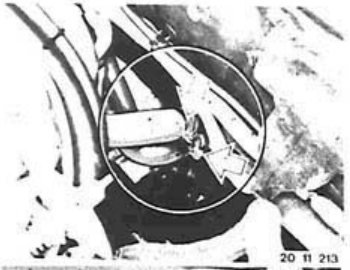
Pull off plug (1).
Loosen clamp (2).
Unscrew nuts (3) and lift out air cleaner with air flow sensor.
Pull off hose (4).
Pull off plug (5).



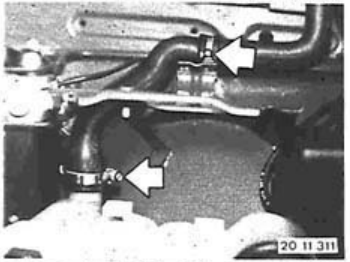
Disconnect diagnosis plug (1).
Disconnect hoses (2 and 3).
Unscrew fuel pipe (4).
Loosen holder (5).
Loosen fuel hose clamp.
Disconnect plugs (6 and 7).
Unscrew holder for oil dipstick guide tube.



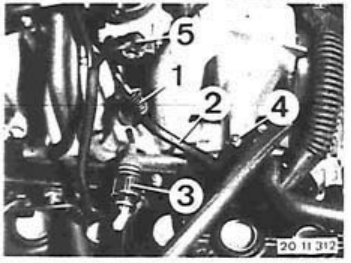
Unscrew bolts (1 and 2) for water pipe and take off water pipe.



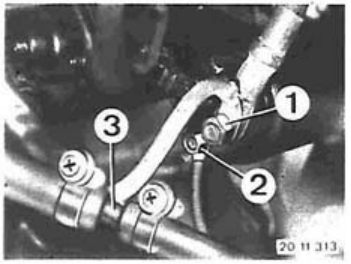
Disconnect water hoses for heater.



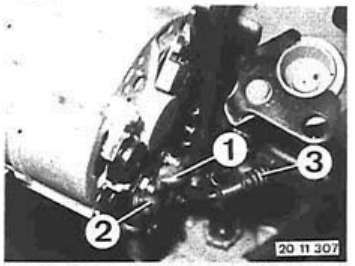
Disconnect coolant hose.



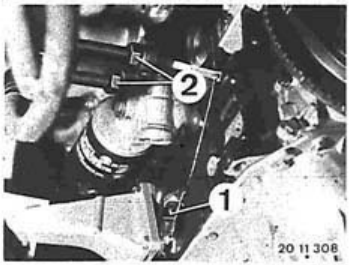
Pull off plug (1).
Pull off fuel hose (2).
Pull off plug (3).
Pull off mounting bolt (4).
Pull off plug (5).



Disconnect electric leads (1 and 2) on starter and lift out starter.
Disconnect fuel pipe (3).



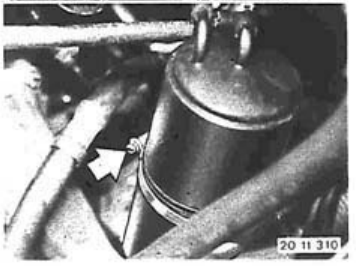
Pull off rubber caps (1 and 2) and unscrew electric leads on alternator.
Disconnect plug (3).



Pull off ignition lead on ignition coil.
Pull off plug (1) on oil pressure switch.
Loosen wire clip underneath distributor and pull out electric leads to left side of engine.
Disconnect pipes (2) for oil cooler.
Installation:
Check gaskets, replacing if necessary.
Tightening torque .

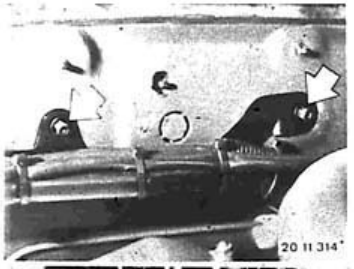


Take off cover on relay box.
Lift out relay with socket and place aside on engine together with wire harness.

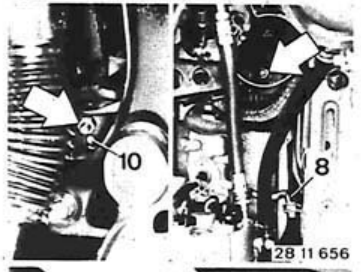


Loosen clamp and remove carbon canister.
Place electric lead connector aside past the oil dipstick guide tube.

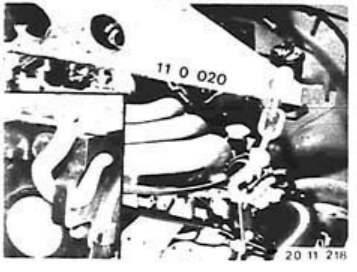
* See Specifications



Unscrew bolts.

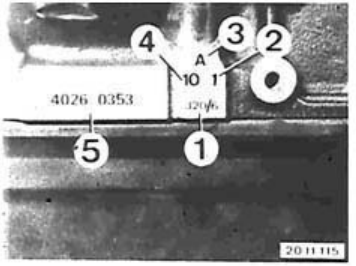


Unscrew ground strap (8) and both engine mounts.
Installation:
Insert guide (10) into bore in axle carrier.
Tightening torque*.



Attach Special Tool 11 0 020 on front and rear ends of engine.
Lift out engine.

* See Specifications



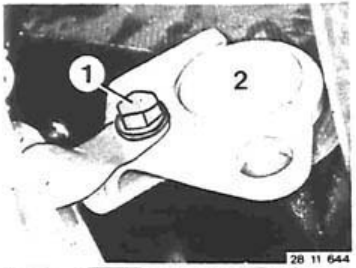
11 00 091 INSTALLING EXCHANGE ENGINE

Remove engine 11 00 050.
Exchange Engine Identification on Crankcase:
1 = Type designation/displacement****
2 = Manufacturing year (1981)
3 = "A" for exchange; "N" for new
4 = Manufacturing month
Stamp engine number (5).

Drive in supplied oil dipstick guide tube (see 11 43 101).
Transfer parts from old to new engine.
Add engine oil***
Important!
Remove pilot bearing in crankshaft of cars with an automatic transmission – see 11 21 571.

Install engine.
Adjust ignition timing 12 11 004.
Adjust engine idle speed / CO – 13 00 054.

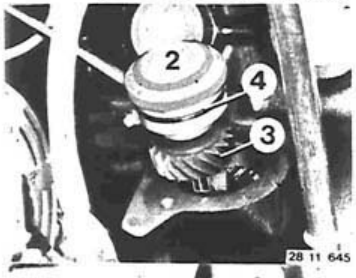
* See Specifications
*** See Service Information of Group 00
**** See BMW Technik and Service Information of Group 11



11 11 160 REPLACING BEARING FOR OIL PUMP DRIVE SHAFT

Remove oil pump 11 41 000.

DME Engine:
Unscrew bolt (1) and take off cap (2).

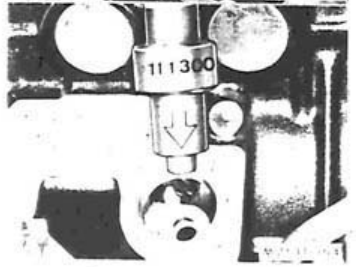


Remove gear (3).
Installation:
Open end of gear shaft faces down.
Check seal (4), replacing if necessary.

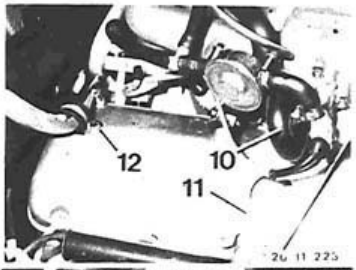


M 20 B 20 / B 23:
Remove distributor, see Group 12.

All Models:
Drive out needle bearing from bottom to top with Special Tool 11 1 310.

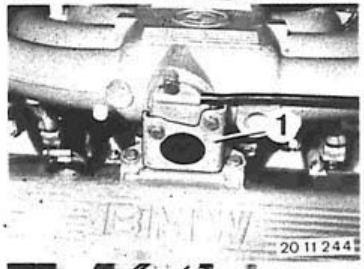


Installation:
Lubricate needle bearing with grease.
Drive in needle bearing against stop with Special Tool 11 1 300.

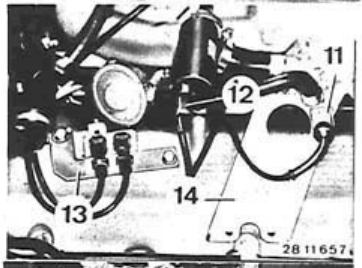


11 12 000 REMOVING AND INSTALLING CYLINDER HEAD COVER

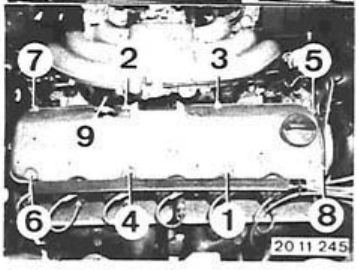
M 20 B 20 / B 23:
Pull off hose (10).
Unscrew support (11).
Unscrew clamp (12).



M 20 B 25:
Unscrew support (1).

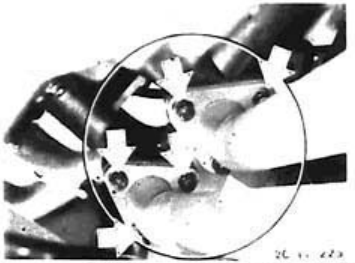


M 20 B 27:
Pull off plugs (11 and 12).
Unscrew holder (13).
Unscrew support (14).



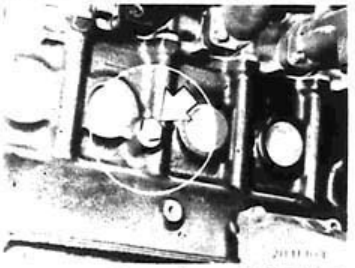
All Models:
Disconnect hose (9).
Unscrew nuts (1 ... 8) and take off cover.
Installation:
Check gasket, replacing if necessary.
Screw on ground strap with nut (6).
Tighten nuts in order of 1 through 8.
Tightening torque*.

* See Specifications

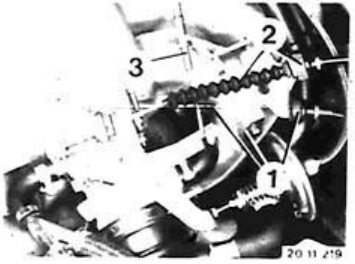


11 12 100 REMOVING AND INSTALLING CYLINDER HEAD

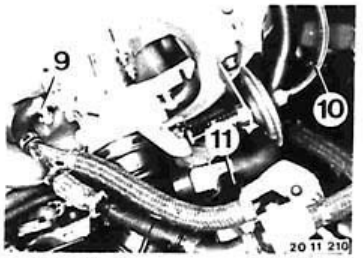
Unscrew exhaust pipes on exhaust manifolds and pipe clamp on transmission.
Installation:
Check gaskets, replacing if necessary.
Coat studs with copper paste "CRC"***
Replace self-locking nuts.
Tightening torque*



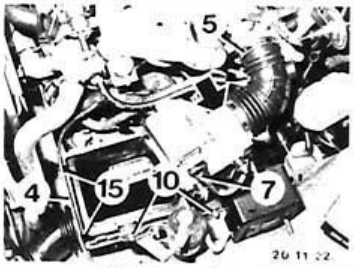
Unscrew plug and drain coolant.
Disconnect battery ground lead.
Installation:
Fill cooling system with coolant*** and bleed 17 00 039.
Replace engine oil***



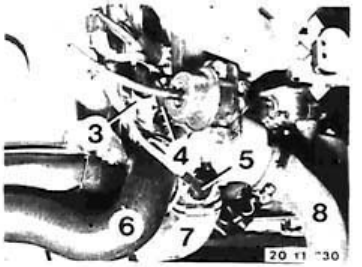
Disconnect throttle cable (1).
Cars with Cruise Control:
Disconnect cruise control cable (2).
Cars with Automatic Transmission:
Disconnect throttle cable (3).
Installation:
Adjust throttle cable, see 35 41 421.
Adjust cruise control cable, see Group 65.
Adjust throttle cable, see Group 24.



M 20 B 20 / B 23:
Detach hose (9).
Pull off hoses (10 and 11).

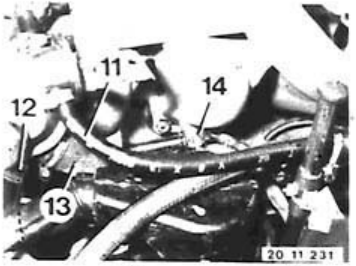


Loosen hose clamp (5).
Pull off plug (7).
Lift wire (4) out of clips (15).
Unscrew wire harness on air cleaner housing.
Unscrew nuts (10) and remove air cleaner with air flow sensor.

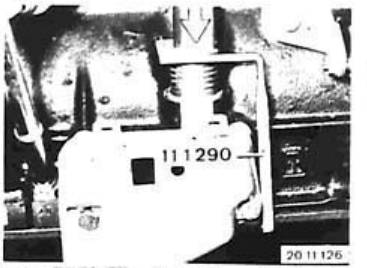


Detach diagnosis socket.
Pull off plugs (3 ... 5).
Detach hoses (6 ... 8).

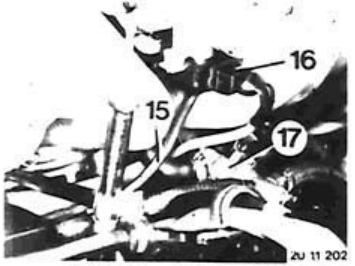
* See Specifications
** Source: HWB
*** See Service Information of Gr. 00



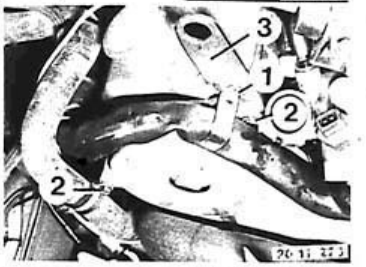
Pull off fuel line (11).
Disconnect water hose (12) for air valve and water hose (13) for heater.
Unscrew nut (14).



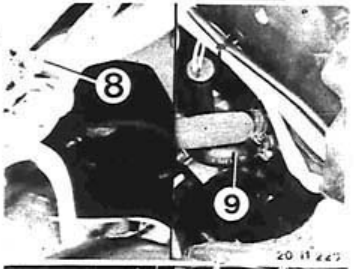
Press down vent tube and arrest with Special Tool 11 1 290.
Installation:
Check seal, replacing if necessary.
Check for correct fit of vent tube after removing Special Tool 11 1 290.



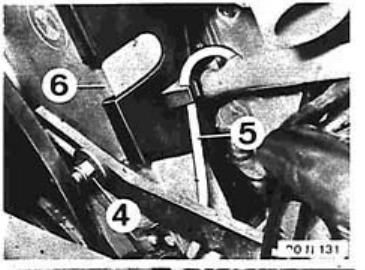
Pull off vacuum hose (15) for distributor and plug (16).
Unscrew holder for air valve (17) on intake manifold.



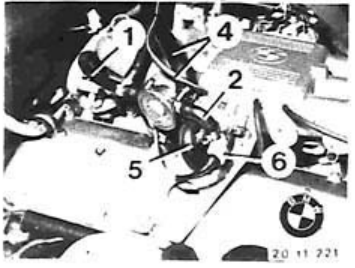
Pull off spark plug connectors.
Remove cylinder head cover 11 12 000.
Loosen clamp (1) and lay ignition leads aside.
Unscrew bolts (2) and remove suspension eye (3).



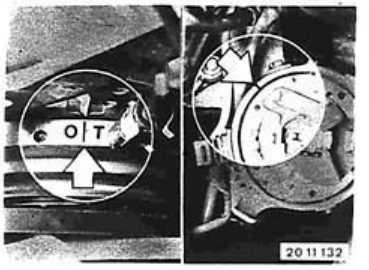
Unscrew holder (8).
Disconnect hose (9).
Pull off plugs on fuel injectors (1/2/3) and oil pressure switch.
Guide out wire harness underneath the intake manifold.



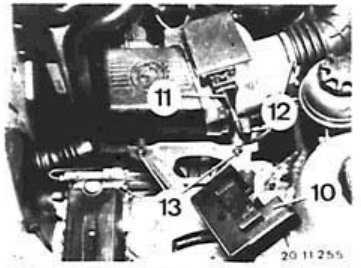
Unscrew nut (4).
Lift out TDC sensor (5).
Remove guard (6).
Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.



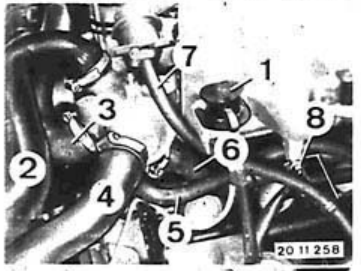
Disconnect fuel lines (1 and 2).
Disconnect air hoses (4 and 5).
Run out air hose (5) underneath intake manifold to the throttle bypass valve.
Pull off plug (6) and plugs on fuel injectors (4/5/6).



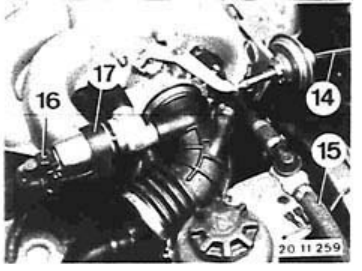
Set cylinder no. 1 to TDC = speed governor aligned with notch in distributor housing.
Caution!
Engine may only be cranked on the adapter after removing the spark plugs.



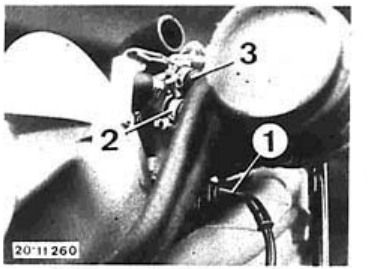
M 20 B 25:
Lift out relay (10).
Pull off plug (11).
Loosen clamp (12).
Disconnect wire harness.
Unscrew nuts (13) and remove air cleaner with air flow sensor.



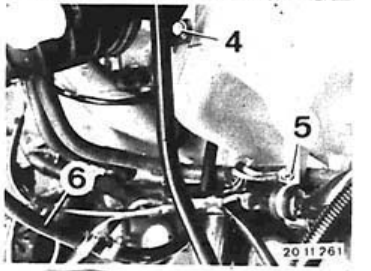
Remove diagnosis plug (1).
Disconnect water hoses (2 ... 6).
Pull off fuel line (7).
Unscrew holder (8).



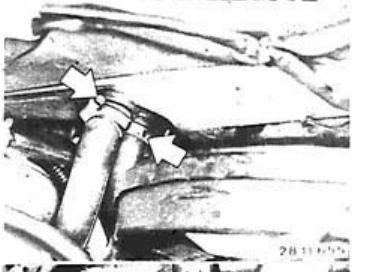
Pull off hose (15).
Pull off plug (16).
Remove idle positioner (17).
Cars with All Wheel Drive:
Pull off hose (14).



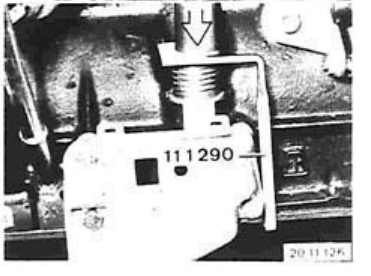
Pull off plug (1).
Disconnect hoses (2 and 3).



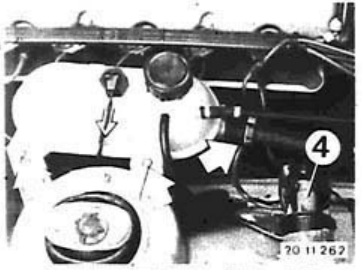
Unscrew oil test pipe (4).
Unscrew holder (5).
Disconnect fuel hose (6).



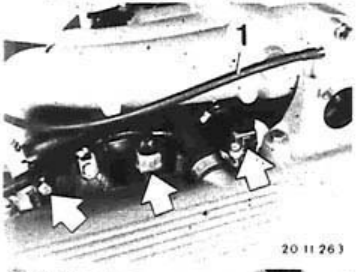
Disconnect water hoses for heater.



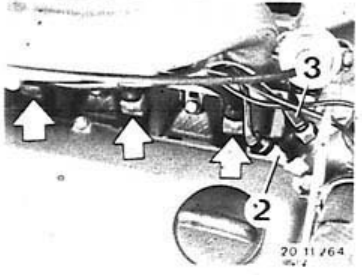
Press down vent tube and arrest with Special Tool 11 1 290.
Installation:
Check seal replacing if necessary.
Check for correct fit of vent tube after removing the Special Tool 11 1 290.



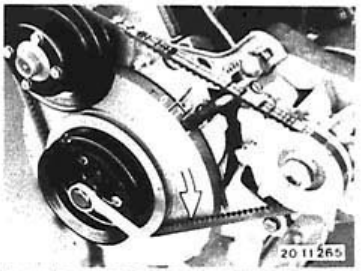
Pull off wire (4) on ignition coil.
Unscrew coolant expansion tank.



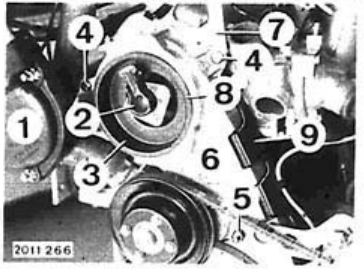
Pull off plugs on fuel injectors 4/5/6 and pull out wire harness.
Cars with All Wheel Drive:
Pull off hose (1).



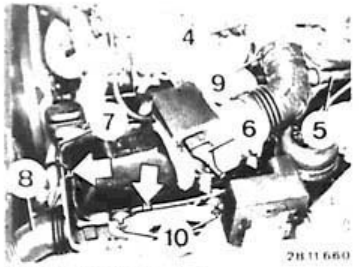
Pull off plugs (2 and 3).
Pull off wires on oil pressure switch.
Pull off plugs on fuel injectors 1/2/3.
Disconnect wire harness and pull through to left side.



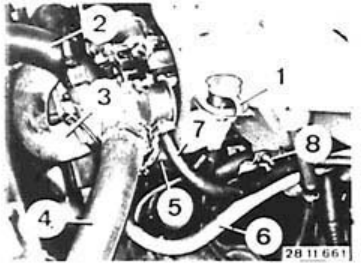
Remove cylinder head cover – 11 12 000.
Turn crankshaft until cylinder no. 1 is set to TDC and valves in cylinder no. 6 overlap.



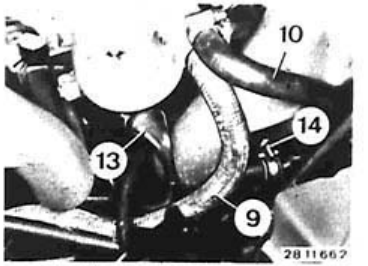
Unscrew distributor cap (1).
Unscrew distributor arm (2).
Remove cover (3).
Unscrew bolts (4).
Unscrew nut (5).
Remove cover (6).
Installation:
Screw on holder (7).
Check rubber ring (8).
Insert rubber cover (9).



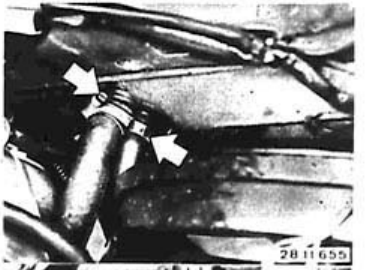
M 20 B 27:
Pull off vacuum hose (4) and hose (5).
Pull off plugs (6 and 7) and disconnect wire harness.
Pull out hose (8) and loosen hose clamp (9).
Unscrew nuts (10) and remove air cleaner with air flow sensor.



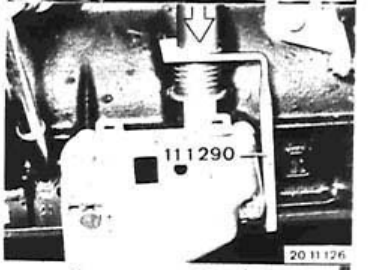
Remove diagnosis plug (1).
Disconnect water hoses (2 ... 6).
Pull off fuel line (7).
Unscrew holder (8).



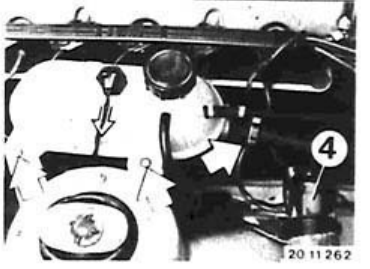
Disconnect hoses (9 10).
Pull off plug (13).
Unscrew holder (14).



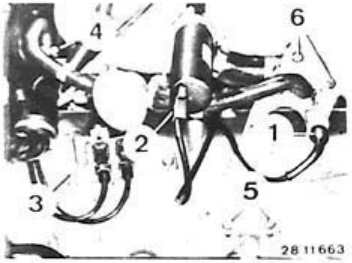
Disconnect water hoses for heater.



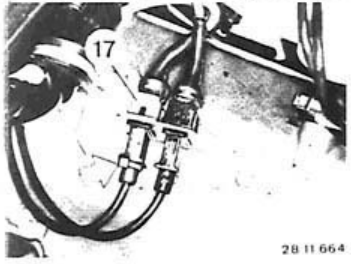
Press down vent tube and arrest with Special Tool 11 1 290.
Installation:
Check seal, replacing if necessary.
Check for correct fit of vent tube after removing the Special Tool 11 1 290.



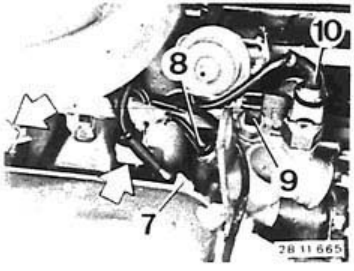
Pull off wire (4) on ignition coil.
Unscrew coolant expansion tank.



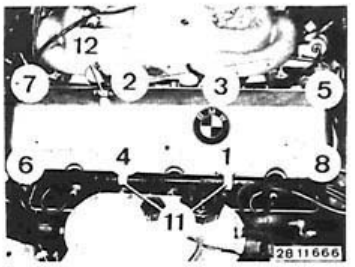
Pull off plugs (1 and 2).
Unscrew holder (3).
Pull off fuel line (4).
Unscrew support (5) with flange (6).
Pull off plugs on fuel injectors (4/5/6).
Installation:
Check gasket, replacing if necessary.



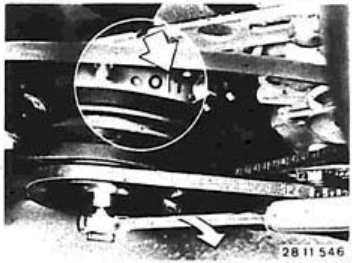
Installation:
Connect DME plugs for reference mark and speed sensor signals in such a manner, that gray plug (17) is connected with a plug marked with a ring.



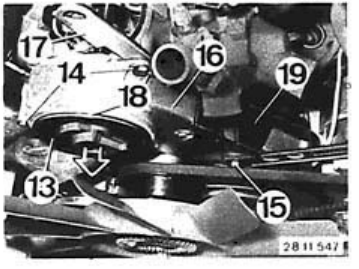
Pull off plugs on fuel injectors (1/2/3) and plugs (7 ... 10).
Pull off wire on oil pressure switch.
Disconnect wire harness and pull out to the left side.



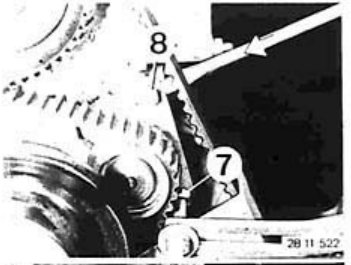
Pull off spark plug connectors.
Disconnect ignition lead tube (11).
Disconnect vent hose (12).
Unscrew nuts (1 ... 8) and take off cylinder head.
Installation:
Check gasket, replacing if necessary.
Tighten nuts in order of 1 through 8.



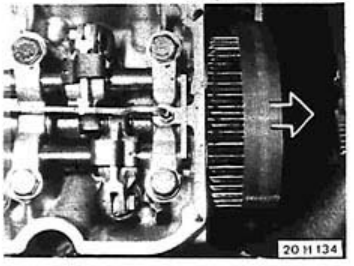
Turn crankshaft to set cylinder no. 1 to TDC = valves of cylinder no. 6 overlapping.
Take off distributor cap.



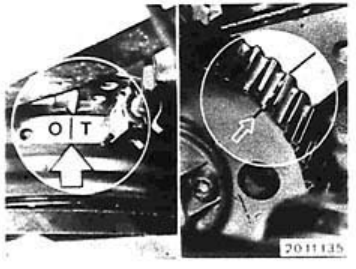
Take off distributor rotor.
Unscrew adapter (12).
Remove cover (13).
Unscrew screws (14).
Unscrew nut (15).
Remove cover (16).
Installation:
Screw on holder (17).
Check rubber ring (18).
Insert rubber cover (19).



All Models:
Loosen bolts (7 and 8).
Press in tensioning roller.
Tighten bolt (8).

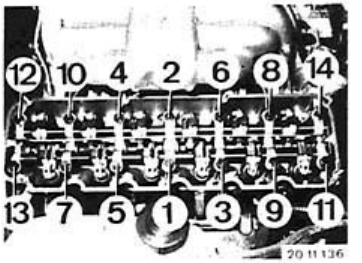


Take toothed drive belt off of camshaft sprocket.
Caution!
Never crank engine after removing belt.
Installation:
Always replace an used belt after loosening the tensioning roller, regardless of the mileage***
Replace toothed drive belt – see 11 31 110.

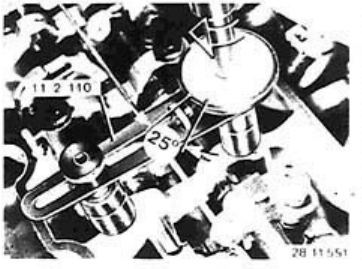


Installation:
Turn in camshaft prior to mounting the cylinder head in such a manner, that mark on camshaft sprocket points to mark on cylinder head.
Cylinder no. 1 is at TDC.
Also install toothed drive belt in this position.

*** See Service Information of Gr. 11

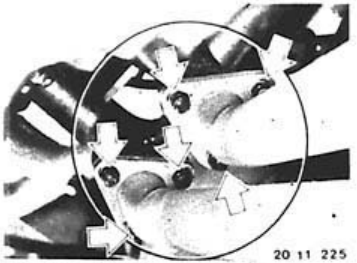


Unscrew bolts in order of 14 through 1 and take off cylinder head.
Installation:
Keep oil out of cavities, since otherwise bolts tightened with specified torque might not exert sufficient force on the cylinder head.
In addition, the crankcase could be cracked.
Clean cylinder head bolts.
Lubricate threads and bearing surfaces of bolt heads with oil lightly.
Replace cylinder head gasket see 11 12 101.



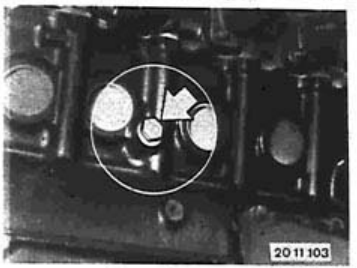
Tighten bolts in order of 1 through 14 in three steps.
Tightening torque*.
Adjust valve clearance – see 11 34 004.
Adjust ignition timing – see 12 11 004.
Adjust engine idle speed and CO level – see 13 00 054.
In the 3rd step (cylinder head cover removed again after running engine warm) tighten the cylinder head bolts to specified torque angle with Special Tool 11 2 110 regardless of the engine temperature.
Note:
Cylinder head does not have to be tightened after 1,000 km (600 miles).

* See Specifications

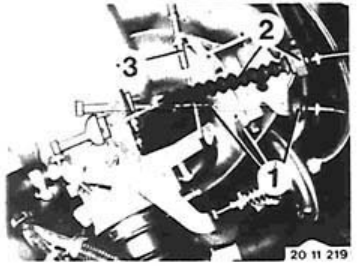


11 12 100 REMOVING AND INSTALLING CYLINDER HEAD

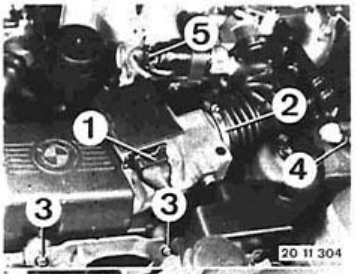
Since 1988 Models:
Disconnect battery ground lead.
Disconnect oxygen sensor plug.
Unscrew exhaust pipes on exhaust manifolds and holder on transmission.
Installation:
Check gaskets, replacing if necessary.
Coat studs with copper paste "CRC"**.
Replace self-locking nuts.
Tightening torque*.



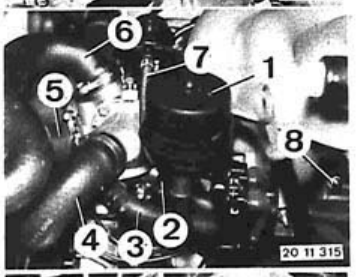
Unscrew plug and drain coolant.
Installation:
Pour in coolant*** and bleed cooling system – see 17 00 039.
Replace engine oil***.



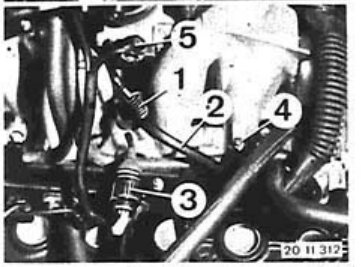
Disconnect accelerator cable (1).
Cars with Cruise Control:
Disconnect cruise control cable (2).
Cars with Automatic Transmission:
Disconnect throttle cable (3).
Installation:
Adjust accelerator cable – see Group 35.
Adjust cruise control cable – see Group 65.
Adjust throttle cable – see Group 24.



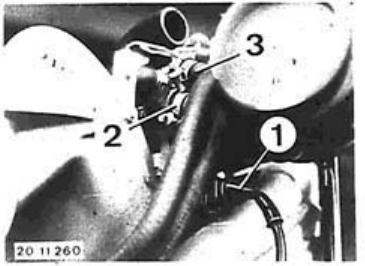
Pull off plug (1).
Loosen clamp (2).
Unscrew nuts (3) and lift out air cleaner with air flow sensor.
Pull off hose (4).
Pull off plug (5).



Disconnect diagnosis plug (1).
Disconnect hoses (2 ... 6).
Disconnect fuel hose (7).
Unscrew holder (8).

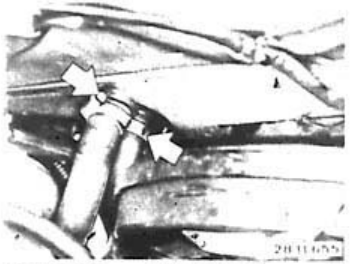


Pull off plug (1).
Pull off fuel hose (2).
Disconnect plug (3).
Unscrew bolt (4).

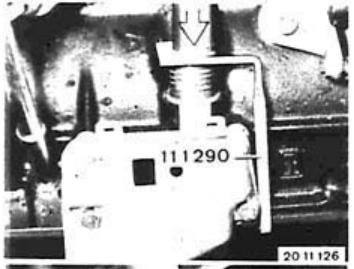


Pull off plug (1).
Disconnect hoses (2 and 3).

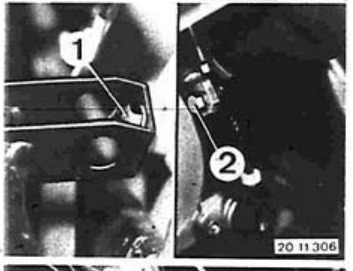
*. See Specifications
** Source of Supply: HWB
*** See Service Information of Gr. 00



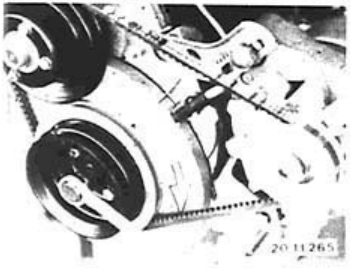
Disconnect water hoses for heater.



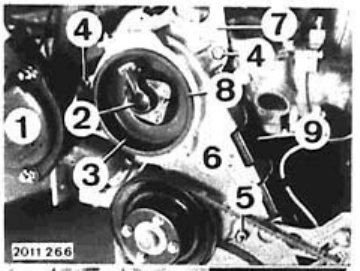
Press down on breather pipe and lock with Special Tool 11 1 290.
Installation:
Check seal, replacing if necessary.
Check for correct seating of breather pipe after removal of Special Tool 11 1 290.



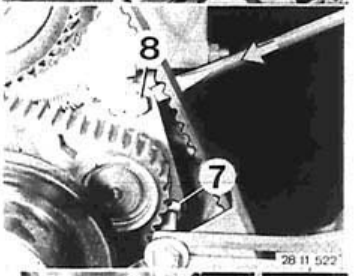
Pull off ignition leads on ignition coil.
Remove fan – see 11 52 000.
Unscrew water pipe mounting bolts (1 and 2) and take off water pipe.



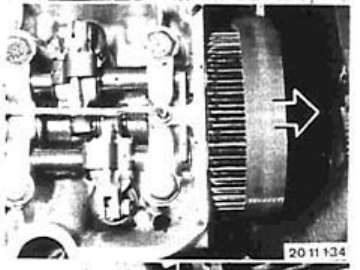
Remove cylinder head cover – see 11 12 000.
Set cylinder no. 1 to TDC by turning crankshaft (valves of cylinder no. 6 overlap).



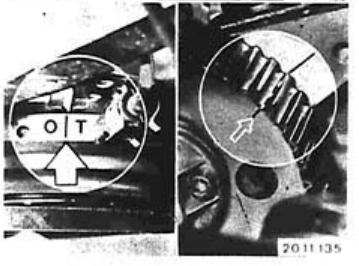
Unscrew distributor cap (1).
Unscrew distributor rotor (2).
Remove cover (3).
Unscrew bolts (4).
Unscrew nut (5).
Remove protective cover (6).
Take off clip underneath distributor and place electric leads in front of pulley.
Installation:
Screw on holder (7).
Check rubber ring (8).
Insert rubber cover (9).



Loosen bolts (7 and 8).
Press in tensioning roller.
Tighten bolt (8).

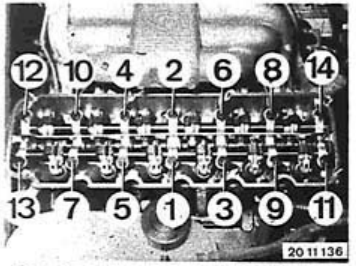


Take toothed drive belt off of camshaft sprocket.
Caution!
Never crank engine after removing belt.
Installation:
Always replace an used toothed drive belt after loosening, regardless of the mileage***.
Replace toothed drive belt - see 11 31 110.



Installation:
Turn in camshaft prior to mounting the cylinder head in such a manner, that mark on camshaft sprocket points to mark on cylinder head.
Cylinder no. 1 is in TDC.
Mount the toothed drive belt in this position.

*** See Service Information of Group 11



Unscrew bolts in order of 14 through 1 and take off cylinder head.

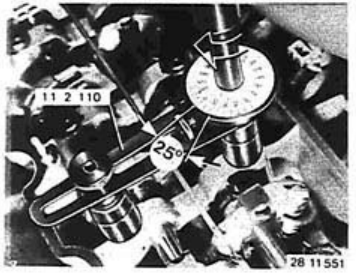
Installation:

Keep oil out of cavities, since otherwise bolts tightened with specified torque might not exert sufficient force on the cylinder head. In addition, the crankcase could be cracked.

Clean cylinder head bolts.

Lubricate threads and bearing surfaces of bolt heads with oil lightly.

Replace cylinder head gasket – see 11-12 101.



Tighten bolts in order of 1 through 14 in three steps.

Tightening torque*.

Adjust valve clearance – see 11 34 004.

Adjust ignition timing – see 12 11 004.

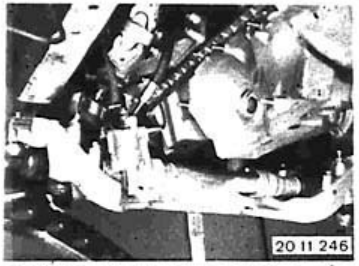
Adjust engine idle speed and CO level – see 13 00 054.

In 3rd step (cylinder head cover removed again after running engine warm) tighten cylinder head bolts to specified torque angle with Special Tool 11 2 110, regardless of the engine temperature.

Note:

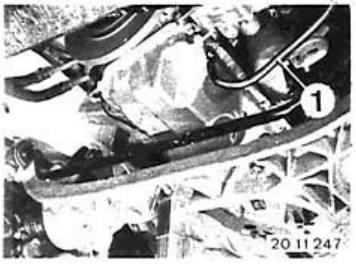
Cylinder head is not retightened after 1,000 km (600 miles).

* See Specifications

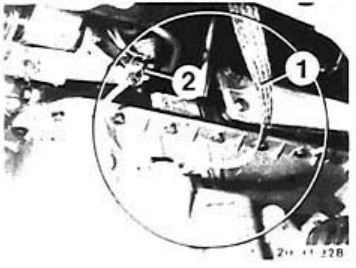


11 13 000 REMOVING AND INSTALLING OIL PAN

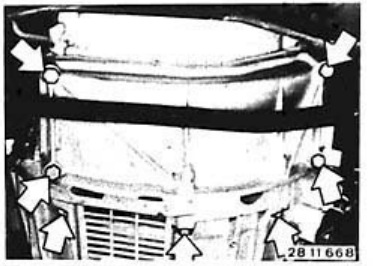
All Wheel Drive:
Lower front axle carrier and remove front axle final drive – see Group 31.



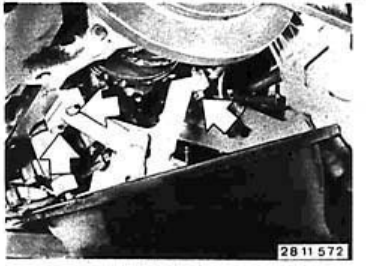
Disconnect ground wire (1).



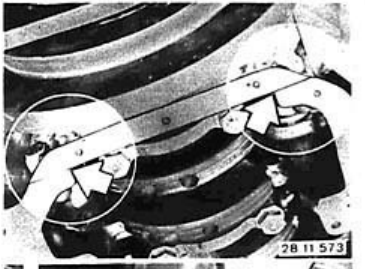
Rear wheel drive:
Unscrew steering gear on front axle carrier, see 32 11 . . ..
Disconnect ground wire (1).
Lift wire (2) out of holder and disconnect.



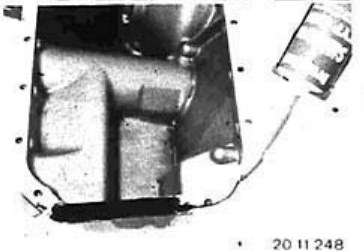
All models:
Unscrew reinforcement plate.
Drain oil.
Installation:
Add engine oil***.



Unscrew oil pan.
Detach pressure relief valve and oil pump.
Remove oil pan.
Installation:
Insert drive shaft for oil pump (see 11 41 000).
Replace gasket.

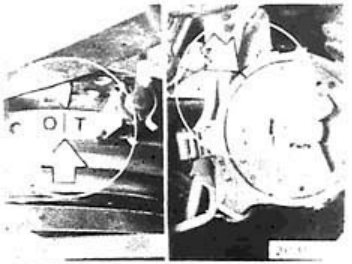


Installation:
Clean sealing surfaces.
Apply coat of brush-on universal sealing compound / Three Bond Silicon 1207** on joint surfaces of timing case cover and end cover.



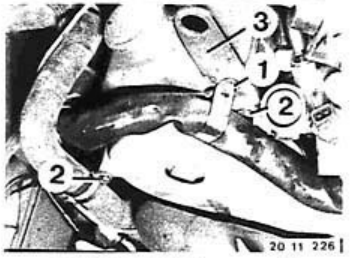
All Wheel Drive:
Oil pan is sealed with Three Bond Silicone 1207**.
Only apply a small amount of this sealing compound and spread it uniformly, to avoid having it get into the engine oil and plugging the oil filter screen.

** Source: HWB
*** See Service Information of Group 00

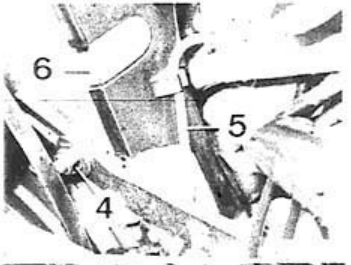


11 31 110 REPLACING TOOTHED DRIVE BELT

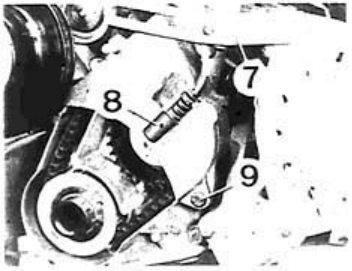
Important!
Always replace an used toothed drive belt, regardless of the mileage, each time the tensioning roller had been loosened***.
Distributor Engine:
Set cylinder no. 1 to TDC – speed governor aligned with notch in distributor housing.



Loosen clamp (1).
Remove bolt (2) and take off suspension eye (3).

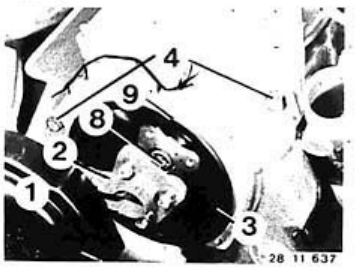


Unscrew nut (4).
Lift out TDC sender electric lead (5).
Remove protective cover (6).
Remove vibration damper – see 11 23 010.

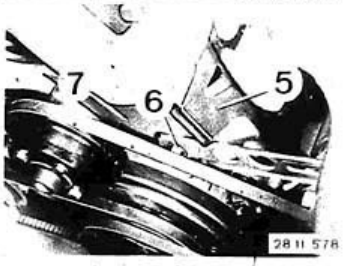


Two Piece Hub/Sprocket:
Remove hub for vibration damper – see 11 23 031.
Swing away clamping bar (7).
Lift out TDC sender (8).
Unscrew bolt (9) and take off protective cover.

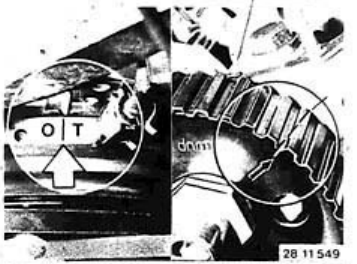
*** See Service Information of Gr. 11



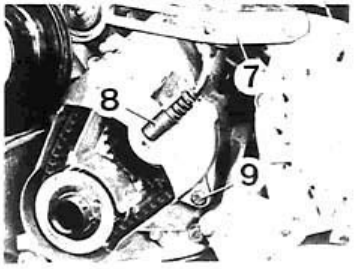
DME Engine:
Unscrew distributor cap (1).
Unscrew distributor rotor (2).
Older Version:
Unscrew adapter (8).
Remove cover (3).
Unscrew bolts (4).
Installation:
Check seal (9), replacing if necessary.
Tightening torque*.



Take off rubber guard (5).
Unscrew nut (6).
Remove protective cover (7).
Install adapter (8).

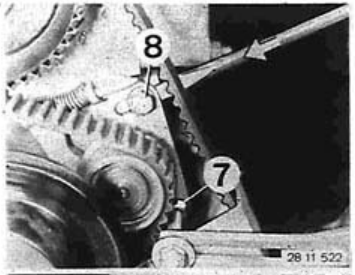


Set cylinder no. 1 to TDC by turning the crankshaft – arrow on camshaft sprocket points to mark on cylinder head.
Remove vibration damper – see 11 23 010.

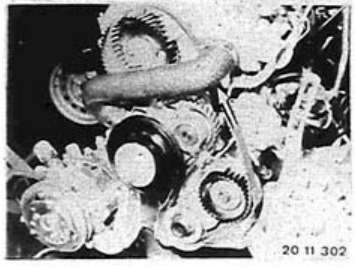


Two Piece Hub/Sprocket:
Remove hub for vibration damper – see 11 23 031.
Swing away clamping bar (7).
Lift out TDC sender (8).
Unscrew bolt (9) and take off protective cover.

* See Specifications

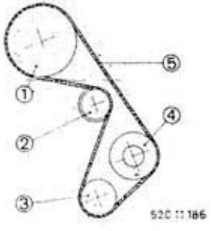


All:
Loosen bolts (7 and 8).
Press in tensioning roller.
Tighten bolt (8).
Take off toothed drive belt.

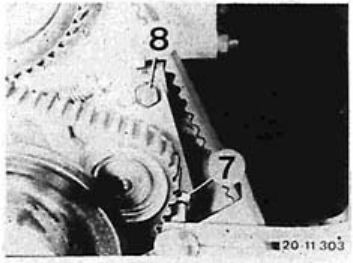


Installation:
There are different toothed belt versions.
1. Sprockets with Square Profile:
   A. Square profile with 111 teeth
   B. Square profile with 110 teeth ("Z 127") with modified spring and tensioning roller with code "Z 127".
2. Sprockets with Semi-round Profile:
   A. Semi-round profile with 128 teeth
   B. Semi-round profile with 127 teeth ("Z 127") and tensioning roller with code "Z 127".

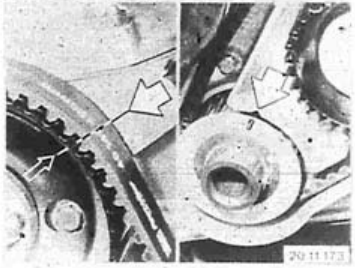
Versions A must be converted to B***.
Install toothed drive belt in opposite direction of engine's turning direction, starting on the crankshaft sprocket.



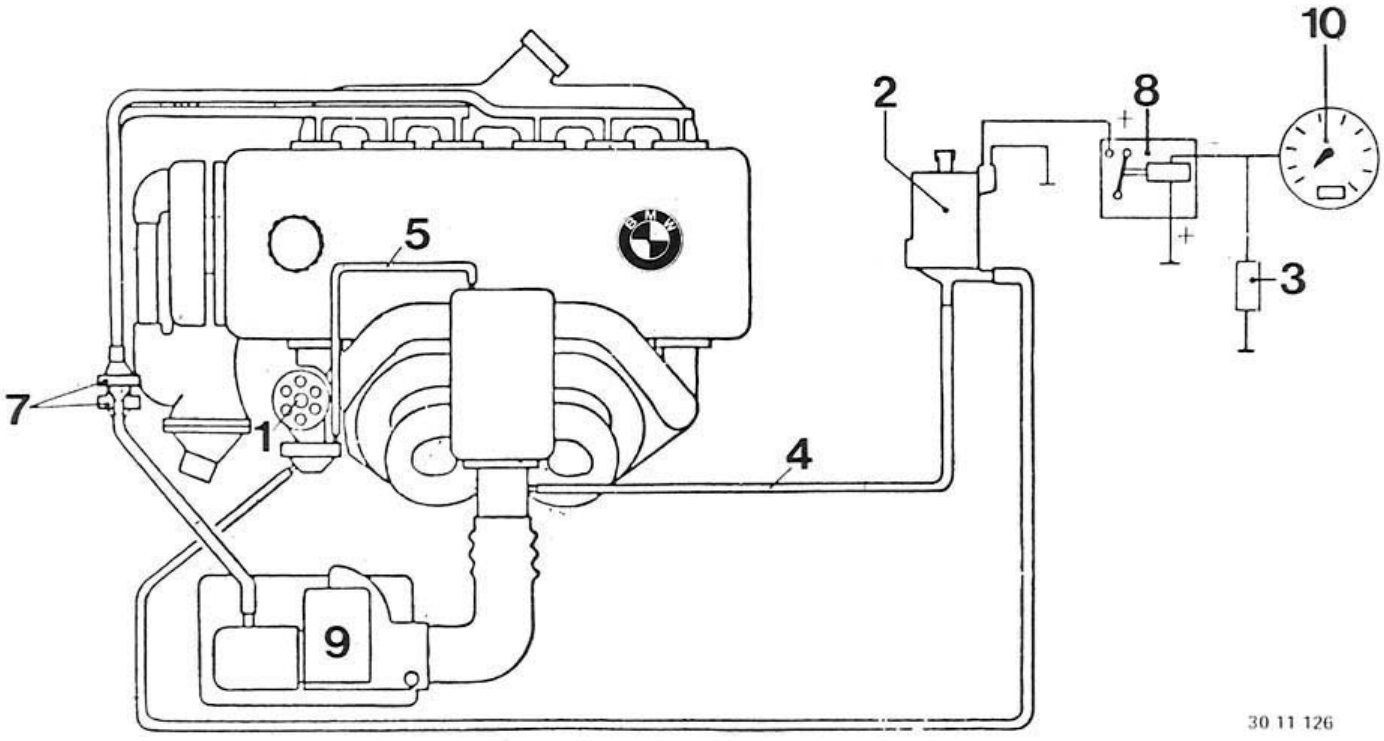
Toothed Drive Belt Assembly:
1 Camshaft sprocket
2 Tensioning roller
3 Crankshaft sprocket
4 Intermediate shaft sprocket
5 Toothed belt



Tightening Toothed Drive Belt:
Loosen bolt (8) – spring force must move the tensioning roller.
Crank engine once in running direction up to TDC mark (toothed drive belt tightened on its own).
Check timing (with crankshaft in TDC position mark on camshaft sprocket must be precisely aligned with mark on cylinder head).
Tighten tensioner (first bolt (8) and then bolt (7)).
Install a label showing date and mileage on the cylinder head cover after finishing work.

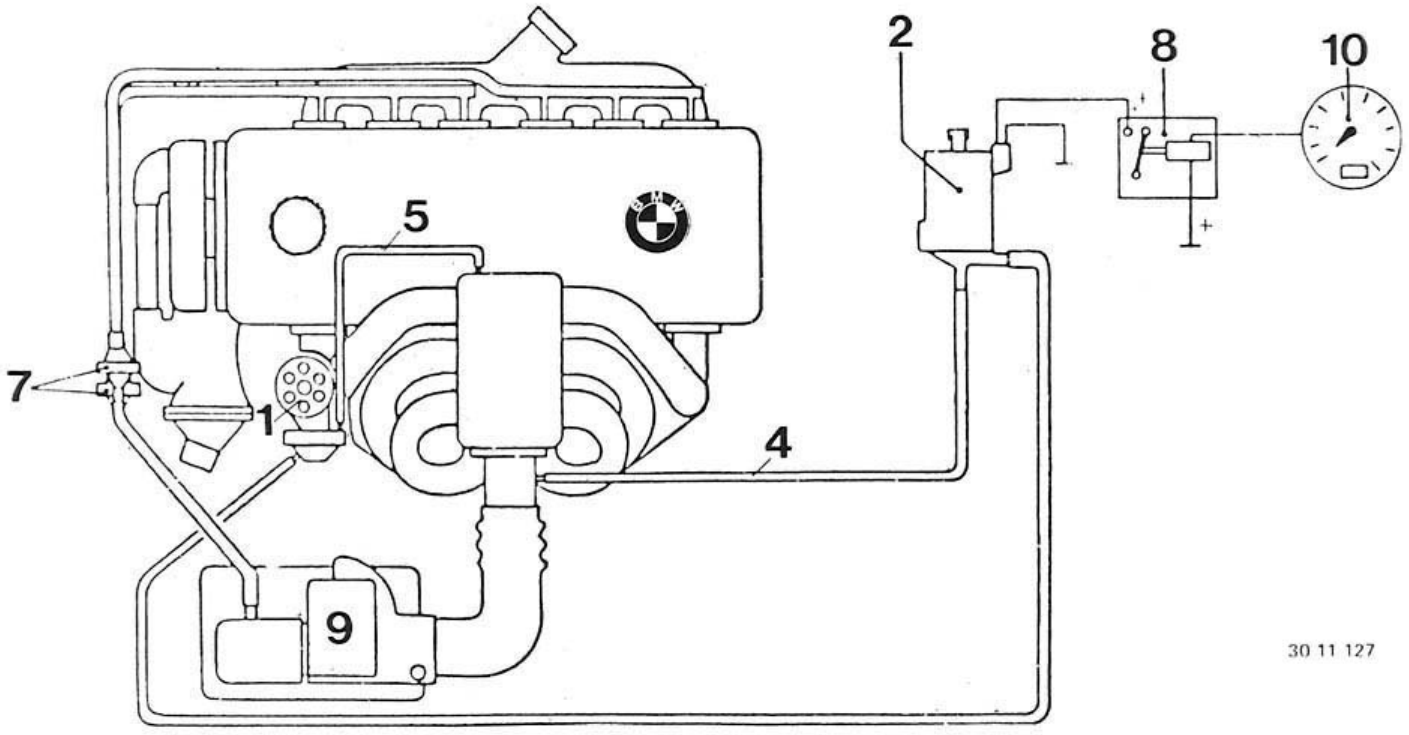


*** See Service Information of Gr. 11



EMISSION CONTROL LAYOUT DRAWING FOR BMW 320 i / 323 i (AUS + CH + S) – since 1984 Models

1 Distributor
2 Electric switching valve (black – 7.20939.13)
3 Fourth/fifth gear switch
4 Vacuum advance control (black)
5 Vacuum retard control (white)
7 Pulse air valves
8 Switching relay
Activated: at road speed > 65 km/h (40 mph) or in 4th/5th gear
9 Air cleaner
10 Speedometer

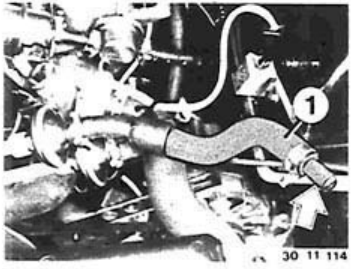


EMISSION CONTROL LAYOUT DRAWING FOR BMW 320 iA / 323 iA (AUS + CH + S) – since 1984 Models

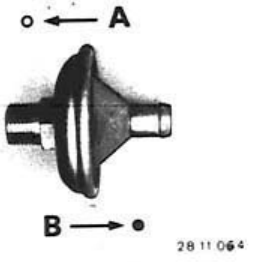
1 Distributor
2 Electric switching valve (black – 7.20939.13)
4 Vacuum advance control (black)
5 Vacuum retard control (white)
7 Pulse air valves
8 Switching relay (activated at road speed > 65 km/h or 40 mph)
9 Air cleaner
10 Speedometer

11 70 009 CHECKING FUNCTION OF EMISSION CONTROL

Pulse Air Valves:
Fresh air is delivered into the exhaust manifolds to afterburn exhaust gas and in this manner reduce CO/HC.
Fresh air is drawn in from the air cleaner via pulse air valves by vacuum, which is produced by pressure pulses in the exhaust manifold.

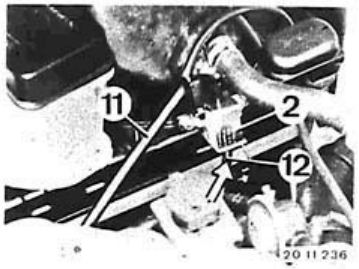


Checking Pulse Air Valves (7):
Check CO level, see 13 00 054.
The CO level in exhaust gas must always be lower with hose (1) connected on the air cleaner, as when hose (1) is disconnected and plugged – see nominal value microfiche.

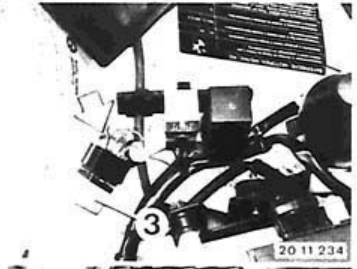


Remove pulse air valves 11 72 140.
Check pulse air valves for leaks by blowing in air.
Air must flow in exhaust direction (A) and valves must be absolutely tight in direction (B).

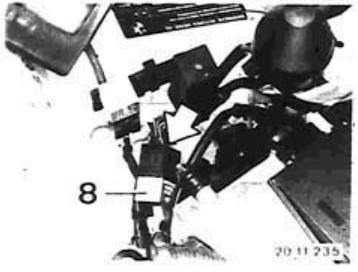
Vacuum Advance Control – Since 1984 Models:
The vacuum advance control on the distributor is operated by an electric switching valve.
Conditions:
– road speed above 65 km/h (40 mph) or
– 4th/5th gear engaged.



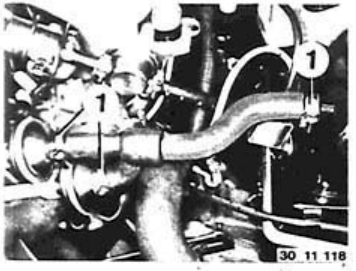
Checking Black Electric Switching Valve (2):
Engine stopped – ignition on.
Pull off hose (11) from distributor and blow air into hose (12) from throttle housing.
Electric switching valve (2) switches to air flow with engaged 4th/5th gears.



Checking Fourth/Fifth Gear Switch / Switching Relay (3):
Engine stopped – ignition on.
The fourth/fifth gear switch is okay, if relay (3) switches with engaged 4th/5th gears – green/red wire produces positive pulses and brown/red wire negative (ground) pulses.

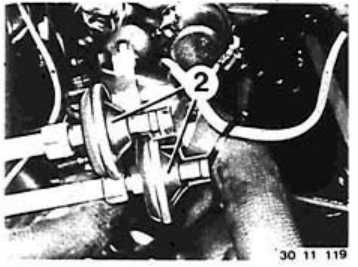


Checking Speed Switch / Switching Relay (8):
Simulate road speeds according to speedometer test, see 62 12 . . ..
Relay (8) switches with road speeds above 65 km/h (40 mph) – brown/red wire produces negative (ground) pulses.



11 72 140 REPLACING PULSE AIR VALVES

Testing – see 11 70 009.
Loosen clamps (1) and pull off hose.



Unscrew pulse air valves (2).
Installation:
Tightening torque*.



20 11 070

Important!
Only install pulse air valves with code 7.20985.00 . . ..

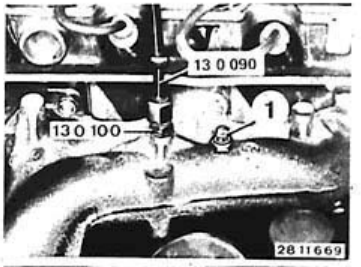
* See Specifications

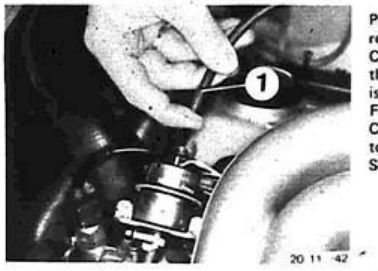
11 76 000 CONVERTING CAR TO CATALYTIC CONVERTER – Cars Prepared for Catalytic Converter –

Drive car on several tanks of unleaded gasoline prior to conversion
or
pump out leaded gasoline** and run engine minutes after filling tank with unleaded gasoline prior to installation of the catalytic converter and oxygen sensor.
Fill fuel canister with unleaded gasoline.
Don't perform any test steps with cylinder shutoff during check with BMW Service Tester – see nominal value microfiche.



Remove exhaust assembly – see Gr. 18.
Install catalytic converter – see Group 18.
Exchange exhaust carrier on transmission.
Install oxygen sensor – see 11 78 510.
Insert adapter (1) in fuel filler neck and install unleaded gasoline label (2).
Adjust engine idle speed and CO level – see Group 13.
Check function of oxygen sensor – see 11 78 010.

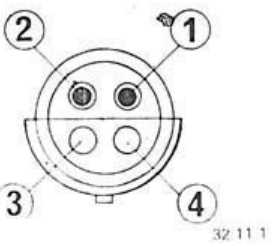




11 78 010 CHECKING FUNCTION OF OXYGEN SENSOR

Up To 11/86 Models:
Unscrew plug (1).
Screw in Special Tool 13 0 100 and connect Special Tool 12 0 090.
Connect BMW Service Tester.
Measure CO level.
Nominal value: 0.2 to 1.2 % by volume.
See 13 00 054 for additional information.

Pull off and plug vacuum hose (1) on pressure regulator.
CO level rises briefly and is regulated back to the original value immediately – oxygen sensor is working.
Faulty:
Check power supply of oxygen sensor via relay to the wiring diagram.
See Group 13 for additional information.



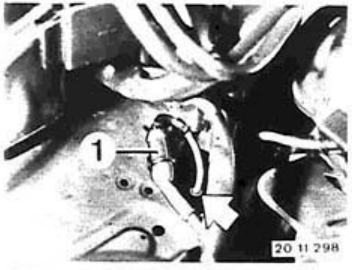
Since 12/86 Models:
A. Checking Heating:
Disconnect oxygen sensor plug.
Connect ohmmeter on 3 and 4 (white lead) and measure resistance.
Nominal value: < 5 ohms.
1 = Plug for sensor ground voltage
2 = Plug for sensor positive voltage
3 = Socket for sensor heating
4 = Socket for sensor heating

B. Checking Signal Voltage:
Perform "oxygen sensor voltage" status call in scope of DME self-diagnosis.
Value is measured at idle speed with oxygen sensor connected and should be between 0.05 and 0.85 V.
Oxygen sensor is not working or is faulty, if a constant voltage between 0.3 and 0.5 V is measured.

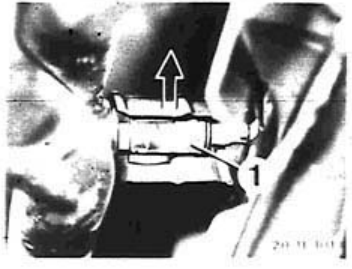
** Conform with fire prevention specifications

11 78 510 REPLACING OXYGEN SENSOR

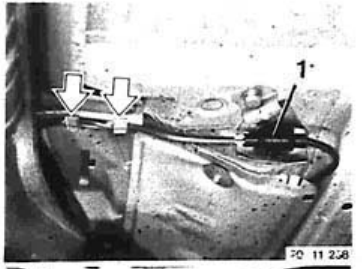
Never clean oxygen sensor or have it come in contact with any lubricants.
Only use Anti-Seize** on threads.
Protect oxygen sensor when undercoating car.



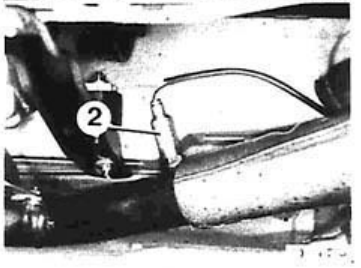
M 20 B 20 / B 25:
Disconnect plug (1) and lift lead out of clip.



Pull off cover and remove oxygen sensor (1).



M 20 B 27:
Disconnect plug (1).
Lift out electric lead.
Installation:
Seal off plug connection (1) against spray water with an universal sealing compound**.



Unscrew oxygen sensor (2).

All Models:
Installation:
Coat threads with Anti-Seize**.
Tighten oxygen sensor with Special Tool 11 7 020.
Tightening torque*.

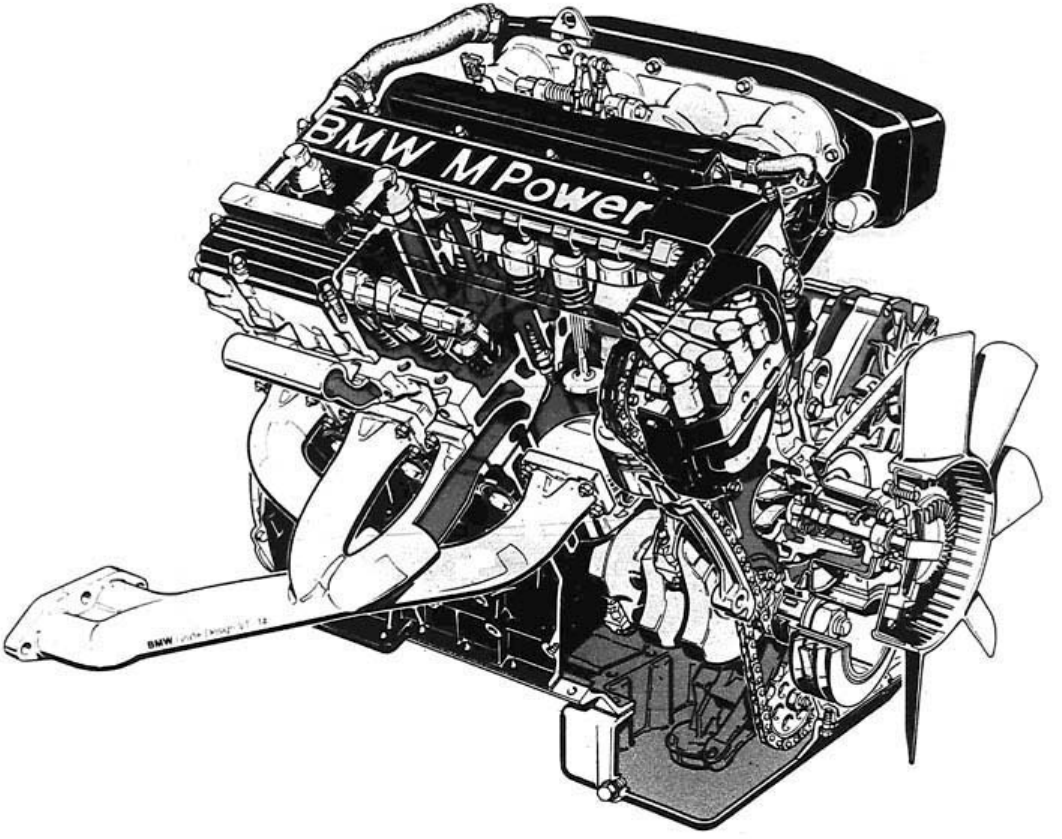
** Source of Supply: HWB

* See Specifications
** Source of Supply: HWB

11 Engine

Engine M3 / 320is

	Engine view	11- 100
11 00 039	Compression of all cylinders – check	11- 101
050	Engine – remove and install	11- 102
11 12 000	Cylinder head cover – remove and install	11- 105
100	Cylinder head – remove and install	11- 106
11 13 010	Oil pan upper section – remove and install	11- 109
020	Oil pan lower section – remove and install	11- 109

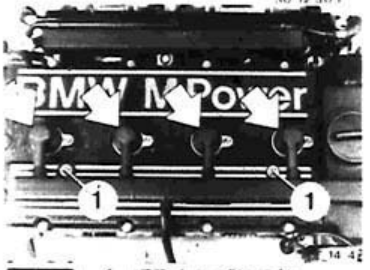


BMW 320 is - Engine S 14 B 20
BMW M 3 - Engine S 14 B 23



11 00 039 CHECKING COMPRESSION OF ALL CYLINDERS

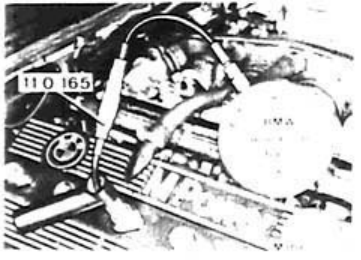
Unscrew trim panel and pull off master relay (2).



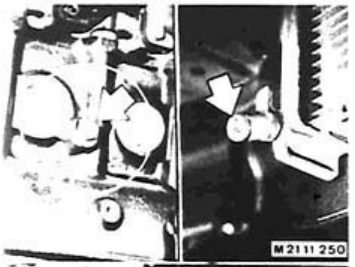
Unscrew nuts (1) on ignition lead pipe and pull off spark plug connectors.



Unscrew spark plugs with Special Tool 12 1 160.
Installation:
Tightening torque: 20 Nm (14.5 ft. lbs.).

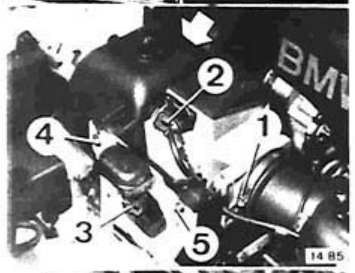


Screw in testing adapter, Special Tool 11 0 165, and connect compression tester.
Press down on accelerator pedal and operate starter until the compression stops rising.
The value of all cylinders should not deviate by more than 0.5 bar (7 psi).
Specification: 10 to 11 bar (142 to 156 psi).

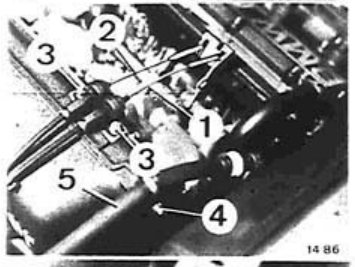


11 00 050 REMOVING AND INSTALLING ENGINE

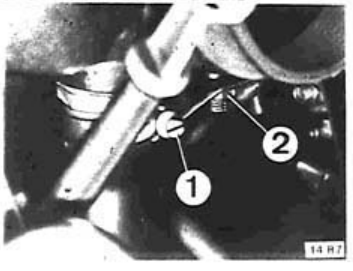
Disconnect battery ground lead.
Remove transmission - see Gr. 23.
Unscrew splash guard.
Drain coolant on engine and radiator.
Installation:
Fill and bleed cooling system - see Gr. 17.



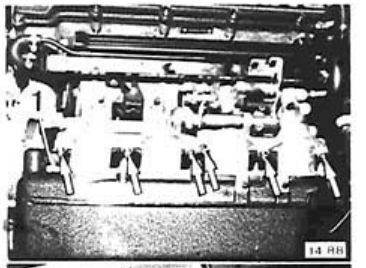
Loosen hose clamp (1) and hose clamp for the intake hose (next to radiator) and pull off hoses.
Pull off plugs (2 and 3) and place electric leads aside.
Loosen nuts (4 and 5) and remove air cleaner.



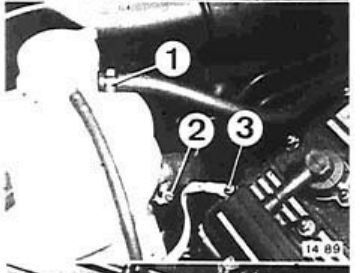
Disconnect throttle cable (1) and cruise control cable (2).
Unscrew nuts (3) on holder and place cables with holder aside.
Unscrew nut (4), pull off clamp and lift vacuum hose (5) out of brake booster.



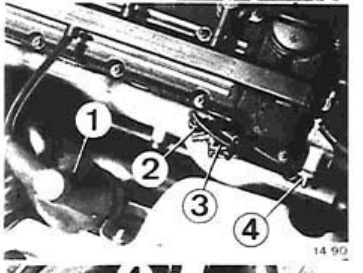
Loosen hose clamp (1) and pull hose off of intake manifold.
Unscrew nut (2) on intake manifold support.



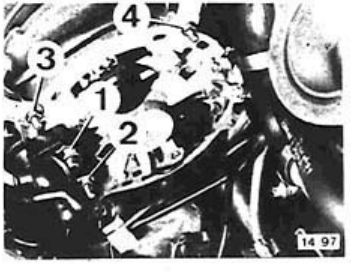
Loosen hose clamp (1) and pull off hose.
Unscrew nuts and take off air intake manifold.
Installation:
Check O-rings, replacing if necessary.
Tightening torque: 9 Nm (6.5 ft. lbs.).



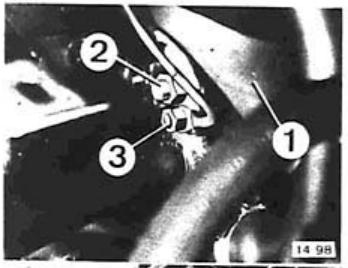
Loosen hose clamps (1 and 2) and pull hoses off of coolant expansion tank.
Unscrew nut (3) and take off ground strap.



Pull ignition lead (1) off of ignition coil.
Pull off plugs (2 and 3).
Unscrew nut (4) and place electric lead on opposite end of engine.



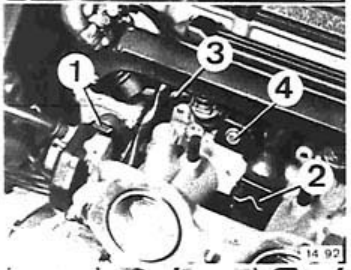
Disconnect electric leads (1 and 2) on alternator.
Unscrew nuts (3 and 4) and take off electric leads.



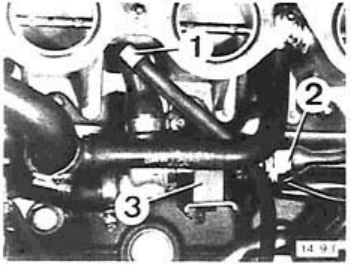
Unscrew cover (1).
Disconnect electric leads (2 and 3) on starter.



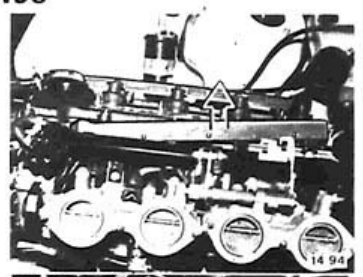
Pull off plugs (1 and 2) and unclip electric leads in holders.
Disconnect electric lead (3) on oil pan (pull off plug and unscrew holder) and take out lead from above.



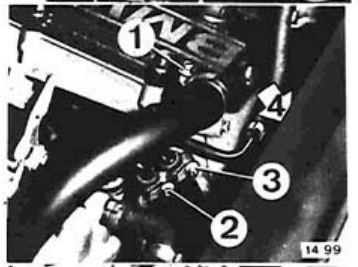
Pull off plugs (1 and 2).
Pull off vacuum hose (3) on pressure regulator.
Unscrew screw (4) and take off electric lead with holder.



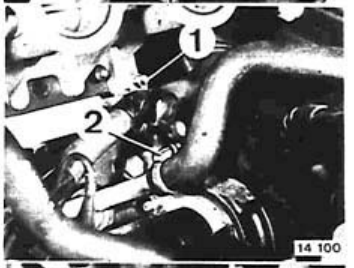
Pull off vacuum hose (1) and pull it out of the intake manifold support.
Pull off plug (2).
Lift out rubber holder (3).
Place idle speed control aside and take the engine wire harness located behind it out of the holders.



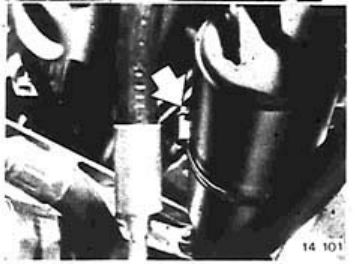
Pull off plug plate on fuel injectors and place aside next to the pressure regulator.



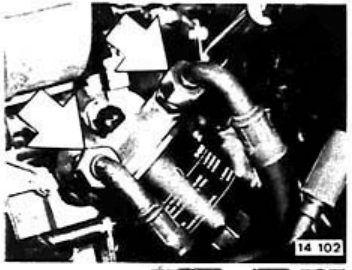
Loosen clamp (1) and pull off breather hose.
Disconnect fuel hoses (2 and 3) on the injection pipe.
Disconnect heater hose (4) on cylinder head.
Installation:
Don't mix up hoses (2 and 3).



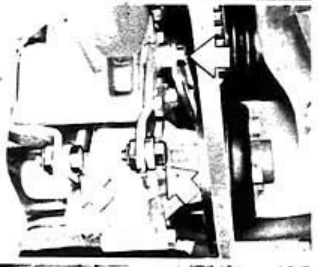
Loosen clamp (1) and place engine wire harness aside.
Loosen hose clamp (2) and pull off heater hose.



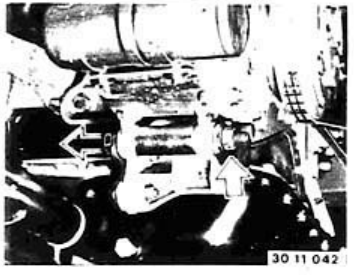
Loosen clamp and place carbon filter aside (hoses can remain connected).



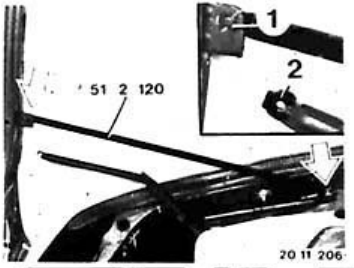
Disconnect both oil cooler hoses on the oil filter housing.
Remove fan - see 11 52 000.
Remove radiator - see Gr. 17.
Disconnect ground lead on oil pan.
Installation:
Tightening torque for oil cooler hose coupling nuts: 35 Nm (25 ft. lbs.).



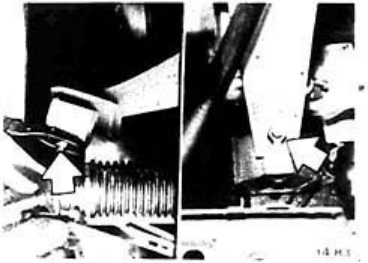
Unscrew power steering pump on holder (hydraulic hoses remain connected) and suspend it from car aside with a piece of wire.
Installation:
Tighten drive belt and check tightness with Special Tool 11 5 021.



Unscrew air conditioner compressor on holder (refrigerant hoses remain connected) and suspend it from car aside with a piece of wire.
Installation:
Tighten drive belt and check tightness with Special Tool 11 5 021.



Disconnect support and gas pressure prop, and prop up engine hood with Special Tool 51 2 120.
Caution!
Use retainer (1).
Installation:
Insert plastic part (2).



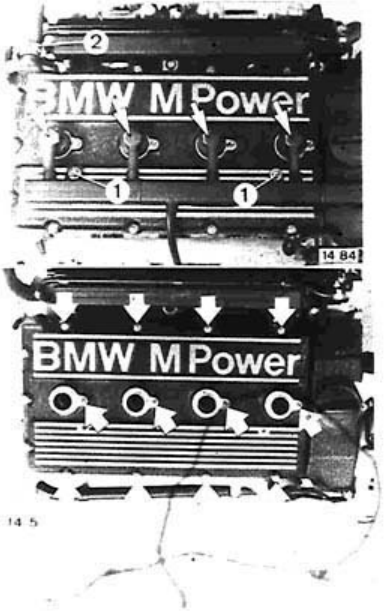
Unscrew engine mounts on front axle carrier.

left -	unscrew at top
	loosen at bottom
right -	loosen at top
	unscrew at bottom

Installation:
Tightening torque: 45 Nm (32.5 ft. lbs.).



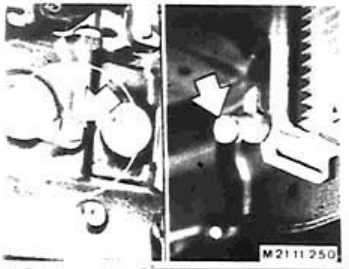
Attach Special Tool 11 0 000 on engine and lift out engine.



11 12 000 REMOVING AND INSTALLING CYLINDER HEAD COVER

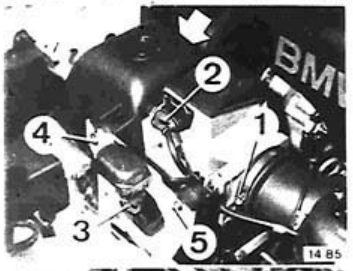
Unscrew nuts (1).
Pull off spark plug connectors.
Take off ignition lead pipe.
Loosen hose clamp (2) and pull off breather hose.

Unscrew nuts and take off cylinder head cover.
Installation:
Check gaskets, replacing if necessary.

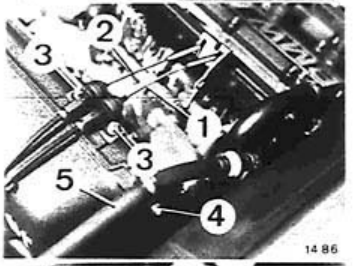


11 12 100 REMOVING AND INSTALLING CYLINDER HEAD

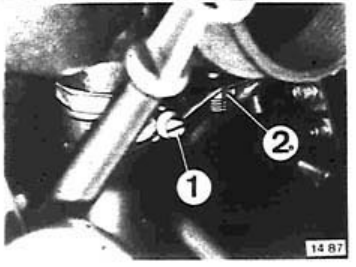
Disconnect battery ground lead.
Unscrew splash guard.
Drain coolant on engine and radiator.
Installation:
Fill and bleed cooling system - see Gr. 17.



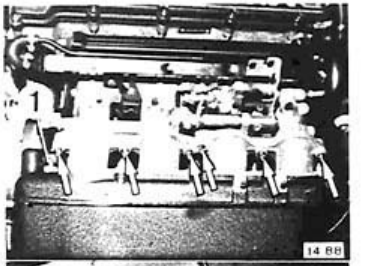
Loosen hose clamp (1) and hose clamp for the intake hose (next to radiator), and pull off hoses.
Pull off plugs (2 and 3) and place electric leads aside.
Loosen nuts (4 and 5) and remove air cleaner.



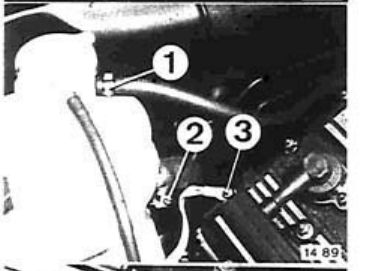
Disconnect throttle cable (1) and cruise control cable (2).
Unscrew nuts (2) on holder and place cables with holder side.
Unscrew nut (3), pull off clamp and lift vacuum hose (4) out of brake booster.



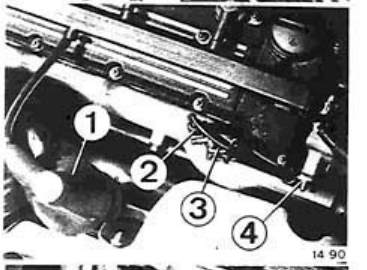
Loosen hose clamp (1) and pull hose off of intake manifold.
Unscrew nut (2) on intake manifold support.



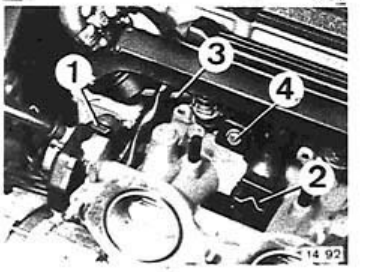
Loosen hose clamp (1) and pull off hose.
Unscrew nuts and take off intake manifold.
Installation:
Check O-rings, replacing if necessary.
Tightening torque: 9 Nm (6.5 ft. lbs.).



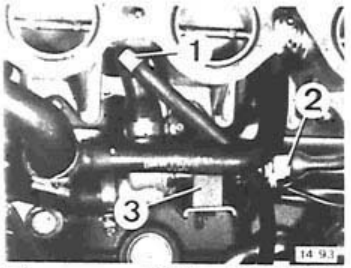
Loosen hose clamps (1 and 2) and pull hoses off of coolant expansion tank.
Unscrew nut (3) and take off ground strap.



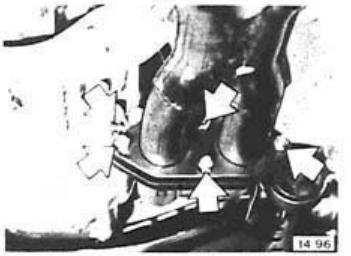
Pull ignition lead (1) off of ignition coil.
Pull off plugs (2 and 3).
Unscrew nut (4) and place electric lead on opposite end of engine.



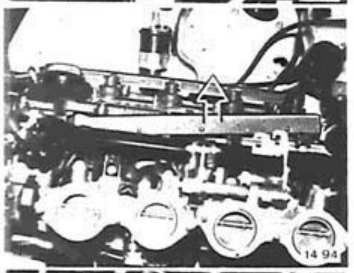
Pull off plugs (1 and 2).
Pull vacuum hose (3) off of pressure regulator.
Unscrew screw (4) and take off electric lead with holder.



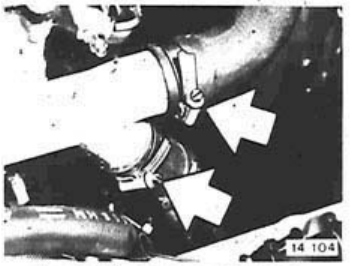
Pull off vacuum hose (1) and plug (2).
Lift ot rubber holder (3).
Place idle speed control aside and take engine wire harness located behind it out of holder.



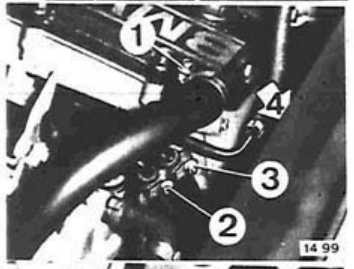
Unscrew flange bolts.
Disconnect oxygen sensor plug.
Installation:
Replace gaskets.
Replace self-locking nuts.
Tightening torque: 50 Nm (36 ft. lbs.).



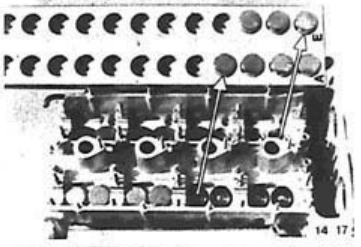
Pull off plug plate on fuel injectors and place aside next to the pressure regulator.



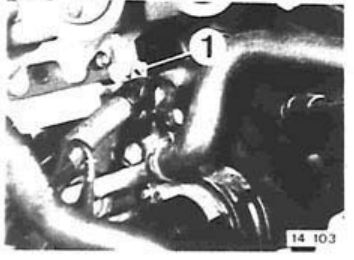
Loosen hose clamps and pull off radiator hoses.



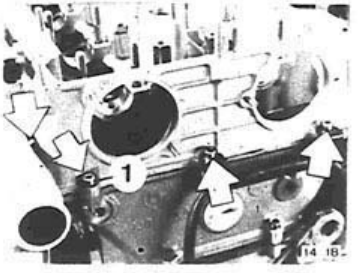
Loosen clamp (1) and pull off breather hose.
Disconnect fuel hoses (2 and 3) on the injection pipe.
Disconnect heater hose (4) on the cylinder head.
Installation:
Don't mix up hoses (2 and 3).



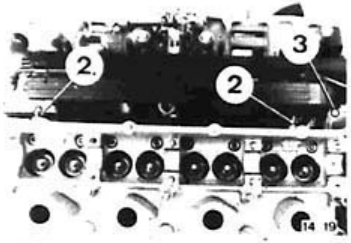
Remove camshaft - see 11 31 000.
Pull out cam followers and place in tray, Special Tool 11 3 030.
Installation:
Install cam followers in same positions.



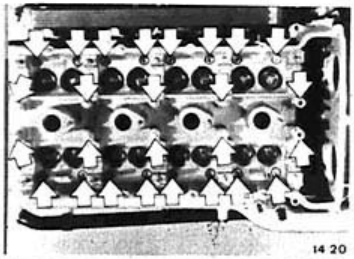
Loosen clamp (1) and pull off of cylinder head.



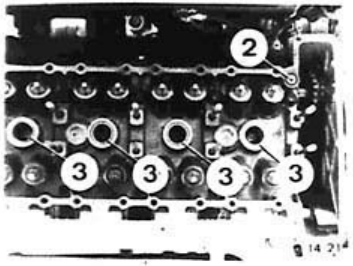
Unscrew bolts.
Installation:
Longer bolt (1) is required to secure the shaft for the upper tensioning rail.



Disconnect pipe (2).
Unscrew bolt (3).



Unscrew timing case.



Installation:
Replace O-ring (2) in oil bore.
Check O-rings (3), replacing if necessary.
Coat sealing surfaces with Three Bond 12 07**.
Tighten bolts uniformly.
Tightening torque:
M 7 = 15 + 2 Nm (11 + 1.4 ft. lbs.)
M 8 = 21 + 1 Nm (15 + 0.7 ft. lbs.)

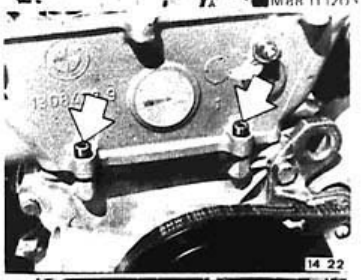


<u>Measuring Play of Cam Followers:</u>
Measure diameter of cam follower with a micrometer.

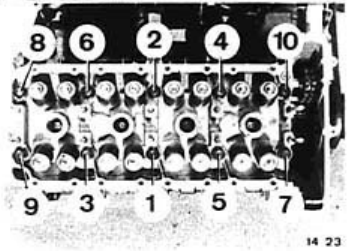
** Source of Supply: HWB



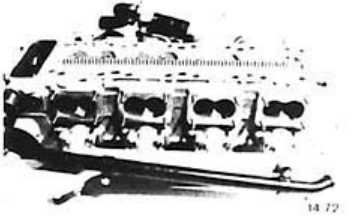
Set internal calipers to zero on the micrometer with the measured cam follower diameter.
Measure diameter of cam follower bore.
Compare measured cam follower play with specified play.
Cam follower play/installed distance:
0.0025 to 0.066 mm (0.0001 to 0.0026").



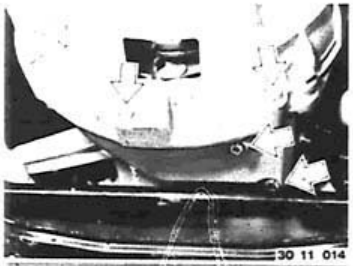
Unscrew bolts.



Unscrew cylinder head bolts in order of 10 through 1 and lift off cylinder head.
Installation:
Clean cavities in crankcase/cylinder head bolts - lubricate cylinder head bolts with oil.
Clean sealing surfaces on cylinder head and crankcase thoroughly - use a gasket remover** and hard wood scraper.
Check levelness with a standard steel ruler.
Replace cylinder head gasket.
Check tensioning rail location while mounting the cylinder head.
Tighten bolts in three steps in order of 1 through 10.
Step 1 = 50 + 2 Nm (36 + 1.4 ft. lbs.).
Step 2 = 80 + 2 Nm (58 + 1.4 ft. lbs.).
Wait 15 minutes!
Step 3 = 100 + 2 Nm (72 + 1.4 ft. lbs.).

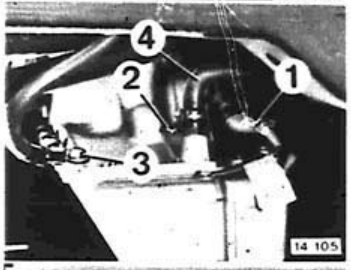


** Source of Supply: HWB

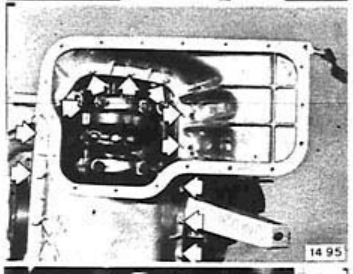


11 13 010 REMOVING AND INSTALLING OIL PAN UPPER SECTION

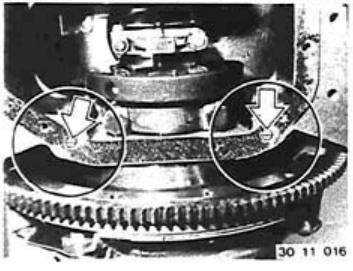
Pull out oil dipstick.
Remove oil pan lower section - see 11 13 020.
Remove oil pump - see 11 41 000.
Unscrew reinforcement shell.



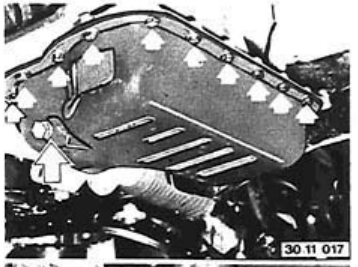
Disconnect plug (1).
Unscrew holder (2) and ground lead (3).
Loosen clamp and pull off breather hose (4).



Unscrew oil pan bolts and remove oil pan upper section.
Installation:
Tightening torque: 10 Nm (7 ft. lbs.).

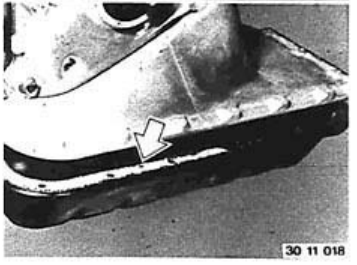


Installation:
Clean sealing surface.
Replace oil pan gasket.
Coat joint on timing case cover and end cover with a brush-on universal sealing compound**.



11 13 020 REMOVING AND INSTALLING OIL PAN LOWER SECTION

Unscrew splash guard.
Drain engine oil.
Unscrew oil pan bolts.
Installation:
Pour in engine oil***.
Tightening torque:
33 Nm (24 ft. lbs.) for oil drain plug
10 Nm (7 ft. lbs.) for oil pan bolts



Take off oil pan.
Installation:
Replace gasket.

** Source of Supply: HWB

*** See Service Information of Gr. 00

11 Engine

Models: 324d, 324td

	Engine view	11- 250
	Working instructions	11- 250a
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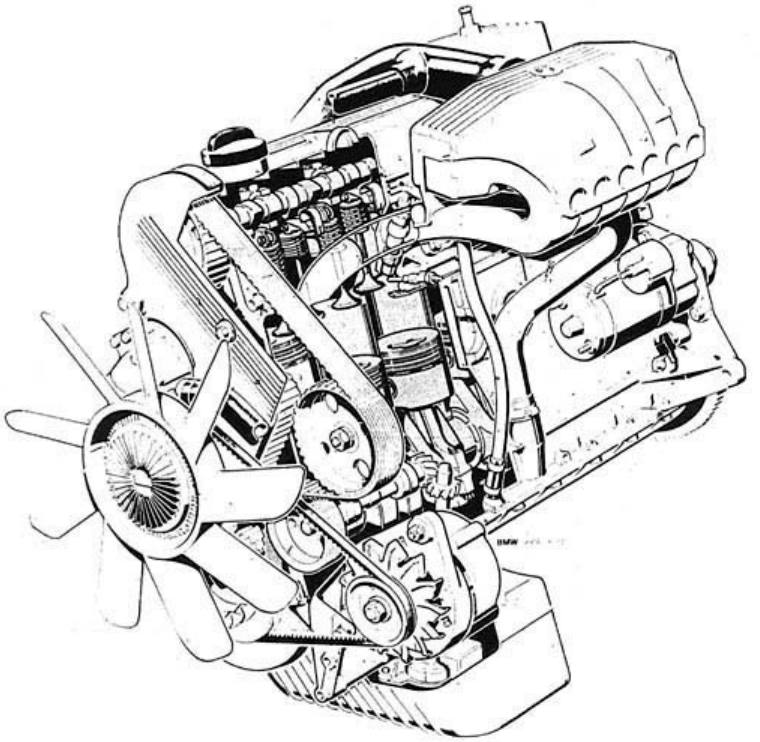
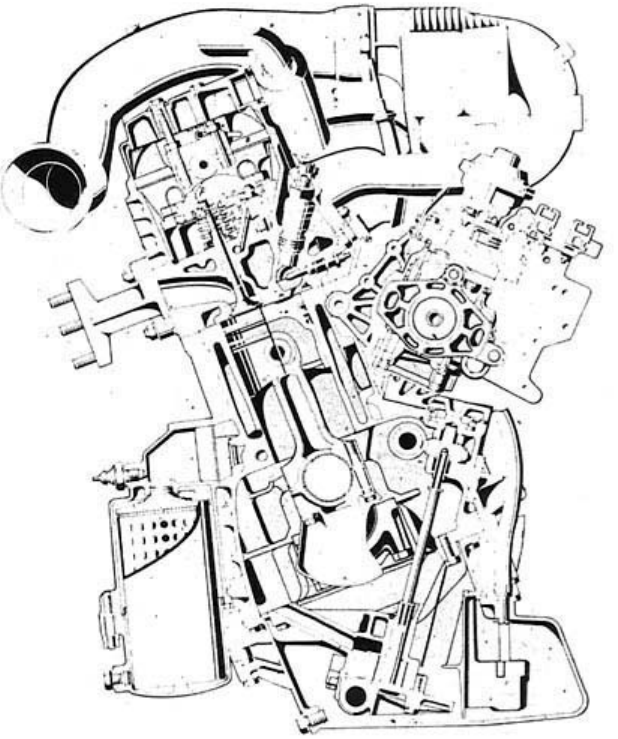
050	Engine – remove and install (BMW 324d)	11- 252
050	Engine – remove and install (BMW 324td)	11- 253a
091	Engine – exchange	11- 254
11 11 160	Bearing for oil pump drive shaft – replace	11- 255
11 12 000	Cylinder head cover – remove and install	11- 255
100	Cylinder head – remove and install (BMW 324d)	11- 256
100	Cylinder head – remove and install (BMW 324td)	11- 258a
11 13 000	Oil pan – remove and install	11- 259
11 61 050	Intake air manifold – remove and install	11- 260
11 65 015	Bearing play of turbocharger – check	11- 261
018	Charging pressure of turbocharger – check	11- 261
020	Turbocharger – remove and install	11- 262
059	Bypass regulator for turbocharger – check and adjust	11- 263
. . .	Charge pressure sensor – check	11- 264
11 66 000	Vacuum pump – remove and install	11- 265

M 21 = Small six cylinder
D = Diesel
24 = Displacement (x 100)
W = Swirl chamber



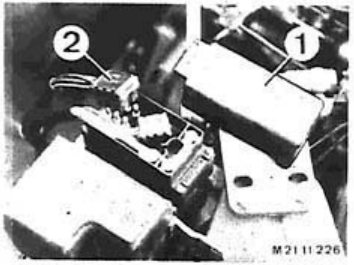


BMW 324 d -- M 21 D 24 W

WORKING INSTRUCTIONS

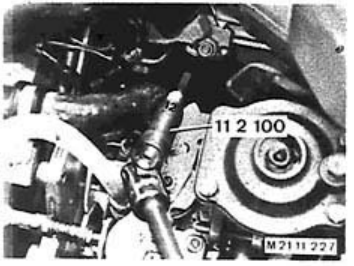
concerning cleanliness on fuel system.

- Clean area around repair point thoroughly – before disconnecting lines, switches, etc..
- Place removed parts on a clean surface only and cover with plastic sheet – never use rags losing lint!
- Cover or insert plugs in open lines and components immediately.
- Only install cleaned parts.
  Take new spare parts out of their packaging only briefly before installation.
- Keep diesel fuel off of coolant hoses – if applicable, wash off immediately with water.

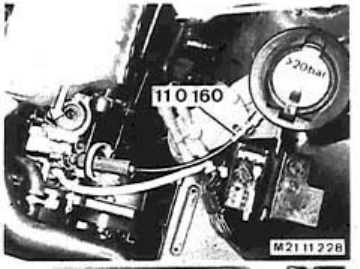


11 00 039 CHECKING COMPRESSION

Testing Conditions:
Battery in perfect condition – check acid density if necessary.
Coolant temperature of engine max. 35° C (95° F).
Lift off cover (1) and pull plug (2) off of pre-heating time control unit (control unit in 324 td cars is on right-hand side of firewall).



Unscrew heater plugs with Special Tool 11 2 100 – see Group 12.
Installation:
Screw in heater plugs with copper paste CRC**.
Tightening torque***.



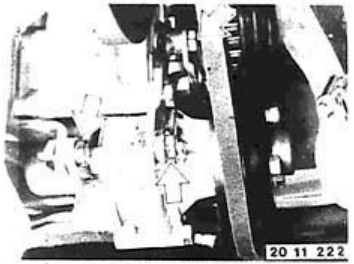
Screw in Special Tool 11 0 160 together with an adapter completely and tighten by hand finger tight.
BMW 324 d:
Press manual stop lever forward and measure compression*.
Note:
Operate starter so long until pressure stops rising – compression tester has deflected.



BMW 324 td:
Pull off master relay (1) and measure compression*.
Note:
Operate starter so long until pressure stops rising – compression tester has deflected.

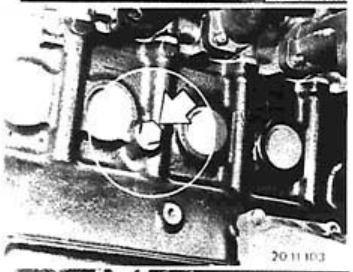
** Source of Supply: HWB
*** See Specifications of Gr. 12 / 23

* See Specifications

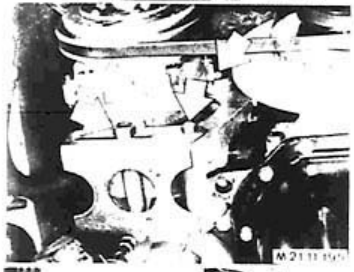


11 00 050 REMOVING AND INSTALLING ENGINE – BMW 324 d –

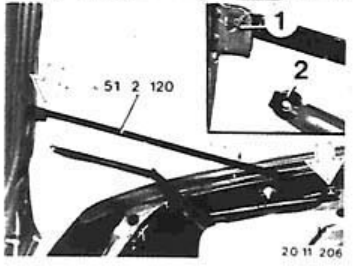
Remove transmission – see Gr. 23 or 24.
Cars with Power Steering:
Unscrew power steering pump – hoses remain connected.
Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.



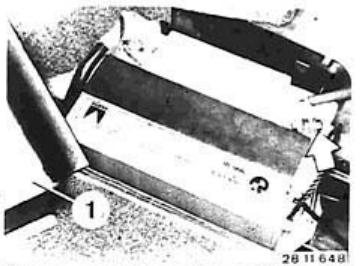
Unscrew plug and drain coolant.
Remove radiator – see 17 11 000.



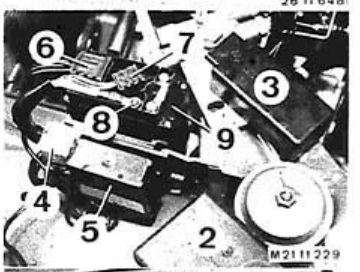
Cars with Air Conditioner:
Unscrew compressor – refrigerant hoses remain connected.
Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.



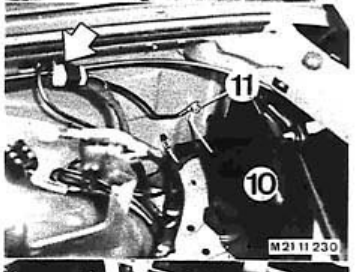
Disconnect prop and gas pressure springs, and hold engine hood with Special Tool 51 2 120.
Caution!
Use retainer (1).
Installation:
Insert plastic part (2).



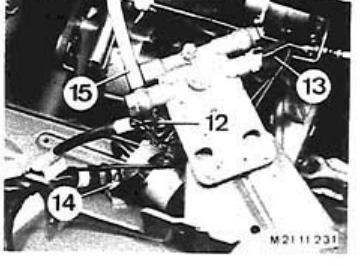
Raise trunk lid.
Take off cover (1) and disconnect ground lead on battery.



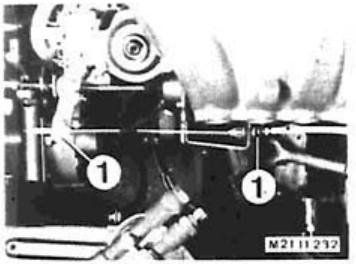
Take off covers (2 and 3).
Lift out relays (4 and 5) and pull off of relay socket.
Pull off plugs (6 and 7).
Unscrew electric lead (8).
Remove preheating time control unit (9).



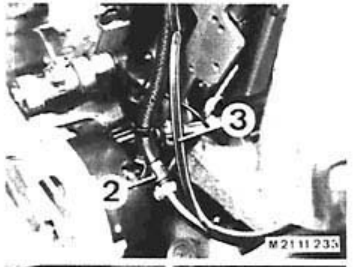
Remove cover (10).
Unscrew ground lead (11) and disconnect electric lead.



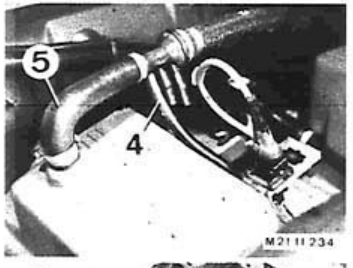
Pull off plugs (12 and 13).
Unscrew wire harness (14).
Disconnect fuel hose (15).
Installation:
Check seals, replacing if necessary.
Bleed fuel system – see 13 51 320.



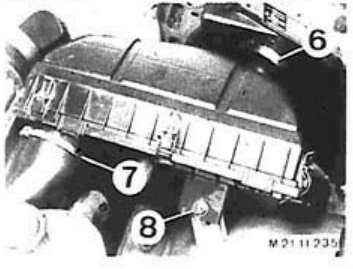
Disconnect throttle cable (1).
Installation:
Adjust throttle cable, see Group 35.



Disconnect fuel hose (2).
Pull off hose (3).



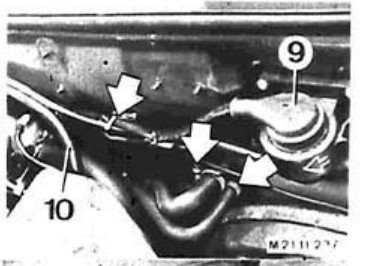
Pull off hoses (4 and 5).



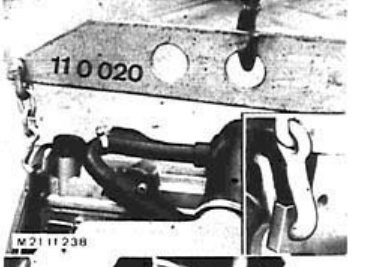
Remove hose (6).
Loosen clamp (7).
Unscrew nut (8) and remove air cleaner.



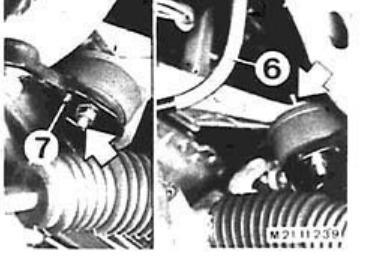
Remove expansion tank
Installation:
Replace squeeze hose clamp



Lift out and disconnect engine plug (9)
Disconnect wires.
Unscrew positive wire (10) on starter.
Disconnect wires.
Disconnect water hoses for heater.
Installation:
Screw on cap (9) locks in final position.

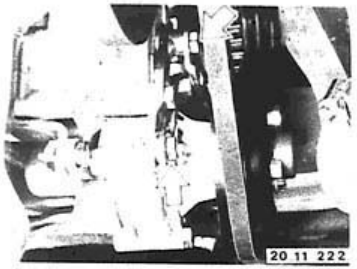


Attach Special Tool 11 0 020.



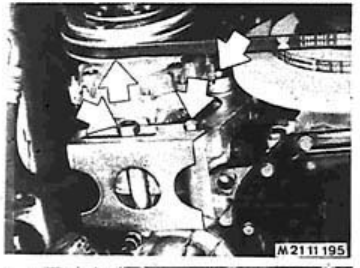
Unscrew ground strap (6) and both engine mounts.
Installation:
Guide mandrel (7) into bore of axle carrier
Tightening torque*.
Check engine operation 13 00 050

* See Specifications

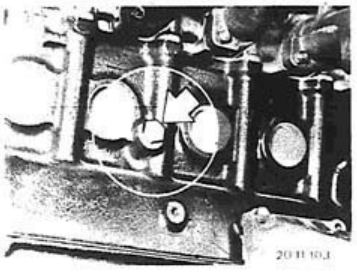


11 00 050 REMOVING AND INSTALLING ENGINE
– BMW 324 td –

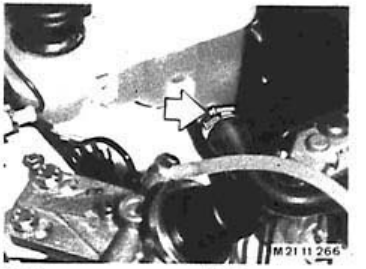
Disconnect battery.
Remove transmission – see Gr. 23 or 24.
Cars with Power Steering:
Unscrew power steering pump – hoses remain connected.
Installation:
Check drive belt tightness with Special Tool 11 5 020.



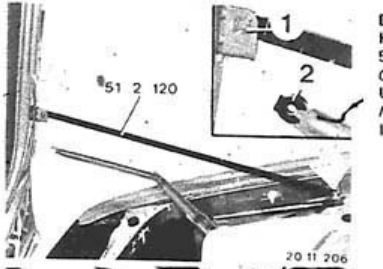
Cars with Air Conditioner:
Unscrew compressor – refrigerant hoses remain connected.
Installation:
Check drive belt tightness with Special Tool 11 5 020.



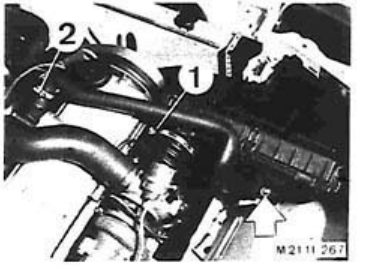
Unscrew bolt and drain coolant.
Remove radiator – see 17 11 000.



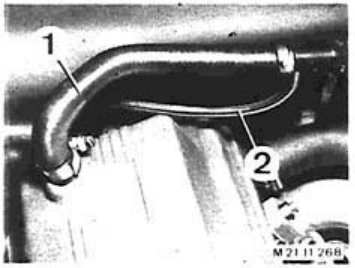
Loosen clamp and pull off coolant hose on expansion tank.



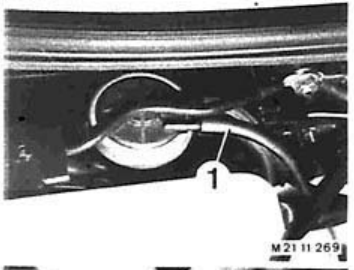
Disconnect prop and gas pressure springs.
Hold up engine hood with Special Tool 51 2 120.
Caution!
Use retainers (1).
Installation:
Insert plastic part (2).



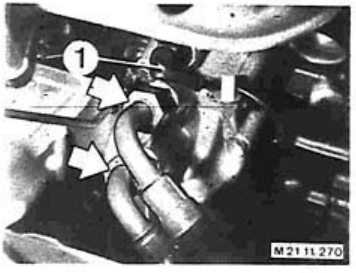
Loosen hose clamps (1 and 2) and pull off hoses.
Unscrew nut and remove air cleaner.



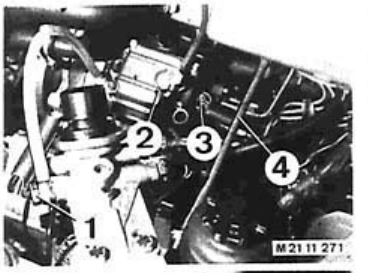
Loosen clamp and pull off hose (1) on cylinder head cover.
Pull off vacuum hose (2).



Pull off vacuum hose (1).



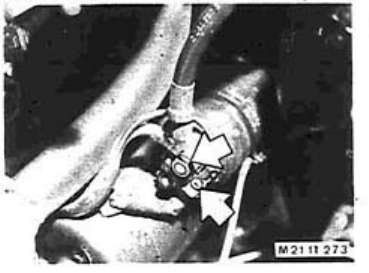
Pull off plug (1) on oil pressure switch and place leads on other side of engine.
Unscrew oil cooler pipes.



Disconnect fuel pipes (1 and 2).
Unscrew nut (3) and take off electric lead.
Pull off vacuum hose (4).
Installation:
Check seals, replacing if necessary.
Bleed fuel system – see 13 51 320.



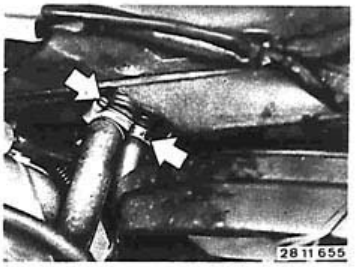
Pull off plug (1) on charging air temperature sensor.
Loosen clamp (2).



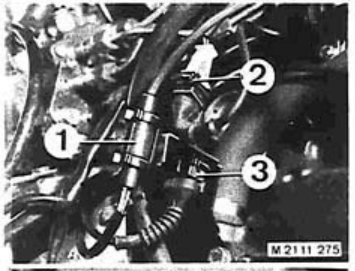
Disconnect connecting wire on starter.



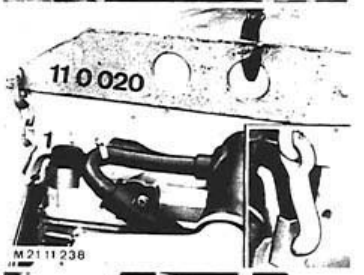
Disconnect plug (1).
Disconnect electric leads (2 and 3) on alternator.
If applicable, disconnect plug for oil level switch.



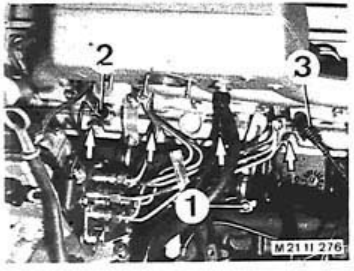
Disconnect heater hoses.



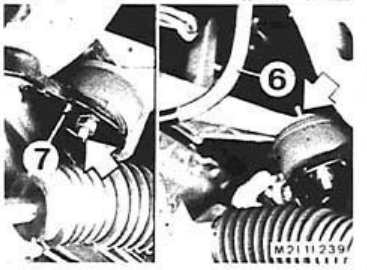
Disconnect plugs (1 ... 3).



Attach Special Tool 11 0 020 on engine.

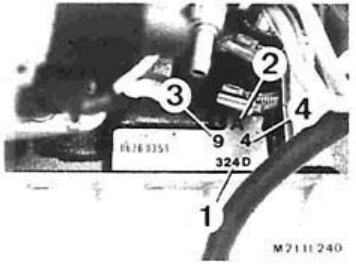


Loosen clamp (1).
Pull off plugs (2 and 3) on temperature sensors.
Disconnect all electric leads on heater plugs.
Cut off wire straps and take wire harness off of engine.



Unscrew ground strap (6) and both engine mounts.
Lift out engine.
Installation:
Insert guide (7) in bore of axle carrier.
Tightening torque*.
Check engine running – see 13 00 050.

* See Specifications



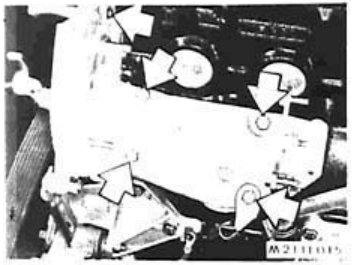
11 00 091 REPLACING ENGINE WITH AN EXCHANGE ENGINE

Remove engine 11 00 050.
Exchange Engine Identification on Crankcase:
1 = Type****
2 = "A" for exchange or "N" for new
3 = Manufacturing month
4 = Manufacturing year (1984)

Die stamp engine number.
Transfer parts from old to new engine.

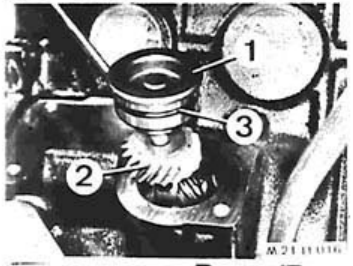
Add engine oil***
Important!
Remove pilot bearing in crankshaft, see 11 21 571, if car has an automatic transmission.
Install engine.
Check static adjustment of injection pump, see 13 51 005.
Check engine operation 13 00 050.

* See Specifications
*** See Service Information of Group 00
**** See BMW Technik and Service Information of Group 11



11 11 160 REPLACING BEARINGS FOR OIL PUMP DRIVE SHAFT

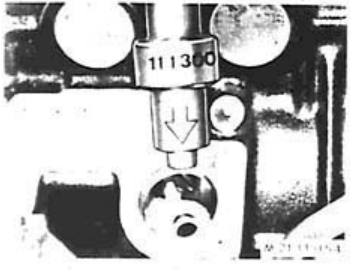
Remove oil pump 11 41 000.
Remove injection pump see Gr. 13.
Unscrew console.



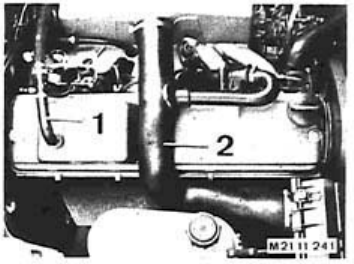
Take off cover (1).
Remove gear (2).
Installation:
Open end of gear shaft faces down.
Checking bearing in cover (1) and seal (3), replacing if necessary.



Drive out needle bearing from bottom to top with Special Tool 11 1 310.

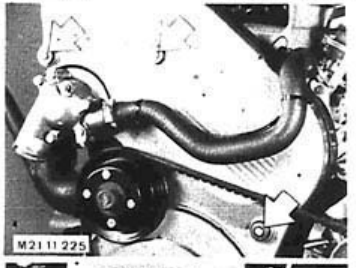


Installation:
Lubricate needle bearing with grease.
Drive in needle bearing against stop with Special Tool 11 1 300.

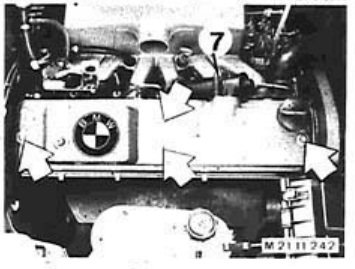


11 12 000 REMOVING AND INSTALLING CYLINDER HEAD COVER

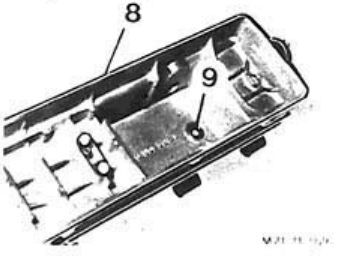
Detach hoses (1 ... 2).



Loosen screws of cover.
Installation:
First tighten screws of cylinder head cover and then protective cover.

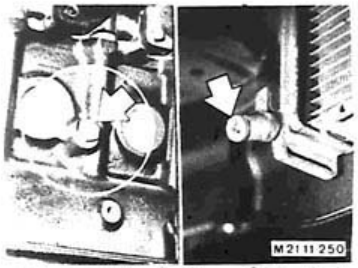


Detach oil trap (7).
Unscrew dowel sleeves and take off cylinder head cover.
Installation:
Screw in dowel sleeves with seals.
Check seal on oil trap, replacing if necessary.



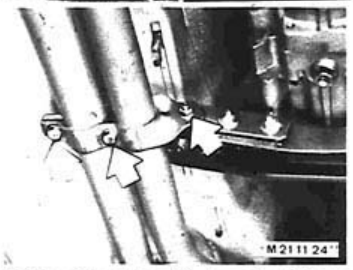
Installation:
Check cylinder head cover gasket (8) and rubber ring (9), replacing if necessary.
Place rubber ring (9) in cover and lubricate with oil.
Tightening torque*.

* See Specifications

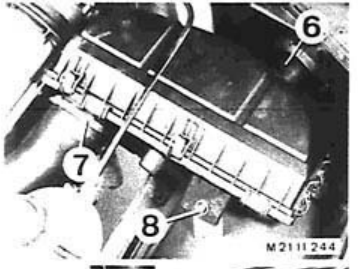


11 12 100 REMOVING AND INSTALLING CYLINDER HEAD – BMW 324 d –

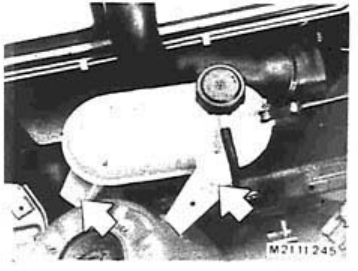
Disconnect battery ground lead.
Drain coolant in engine block and radiator.
Installation:
Pour in coolant*** and bleed cooling system, see Group 17.
Replace engine oil ***



Unscrew pipe clamp on transmission.

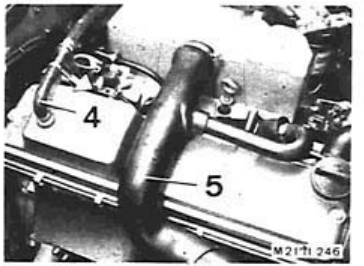


Remove hose (6).
Unscrew clamp (7).
Unscrew nut (8) and remove air cleaner.

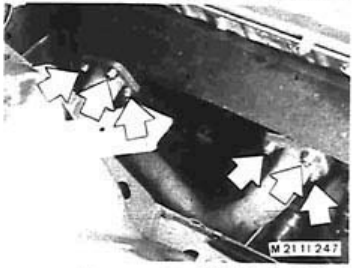


Unscrew expansion tank and place aside.

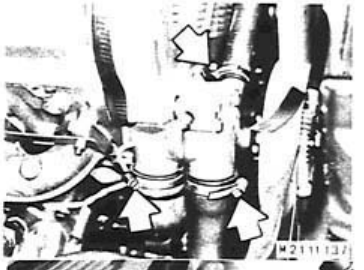
*** See Service Information of Gr. 00



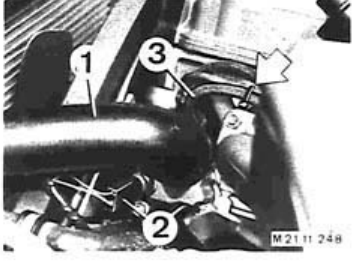
Disconnect hoses (4 and 5)



Unscrew exhaust pipes on exhaust manifold.
Installation:
Check gaskets, replacing if necessary.
Coat studs with copper paste "CRC"**
Replace self-locking nuts.
Tightening torque*.

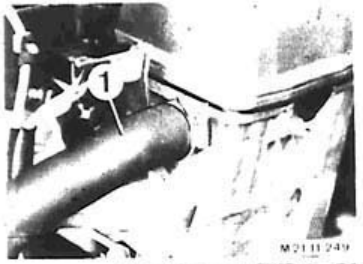


Remove fan, see 11 52 000.
Disconnect hoses.

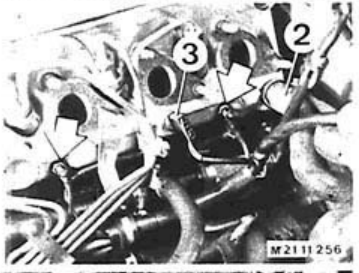


Disconnect hose (1).
Pull off plug (2).
Pull off leak line (3) and unscrew on injection line.

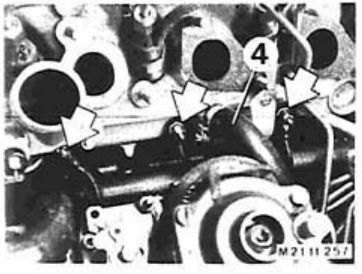
* See Specifications
** Source of Supply: HWB



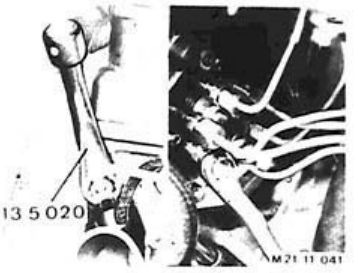
Pull off hose (1).
Remove intake air manifold – see 11 61 050.
Note:
Check/adjust static injection pump setting (see Group 13) before installing the intake manifold.



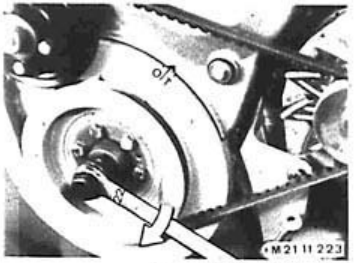
Disconnect hose (2).
Pull off plug (3).
Unscrew wires on glow plugs.



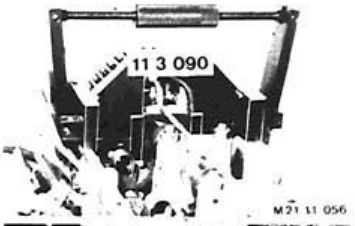
Disconnect hose (4).
Unscrew wires on glow plugs.



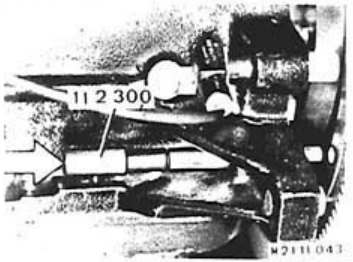
Unscrew injection lines on fuel nozzles and injection pump with Special Tool 13 5 020.
Plug openings with caps.
Take off cylinder head cover, see 11 12 000.
Installation:
Tightening torque = 20 to 25 Nm (15 to 18 ft. lbs.).
Bleed fuel system 13 51 320.



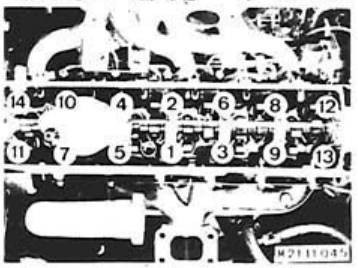
Turn cylinder no. 1 to TDC – cylinder no. 6 overlaps.



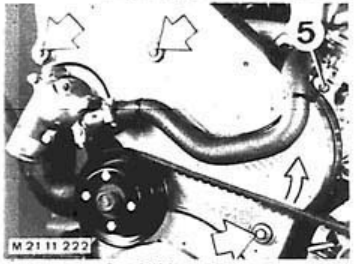
Installation:
Turn camshaft to overlap valves of cylinder no. 6 and hold camshaft with Special Tool 11 3 090 before mounting the cylinder head.
Install and tighten toothed belt, see 11 31 110.



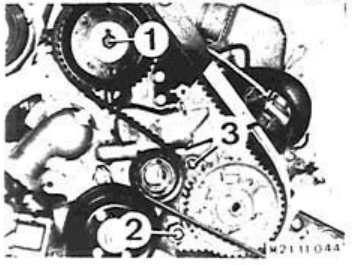
Hold crankshaft with Special Tool 11 2 300.



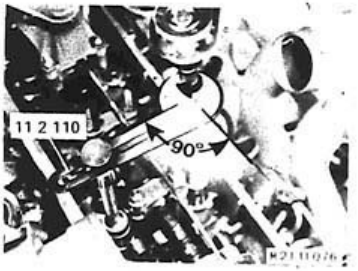
Unscrew bolts in order of 14 through 1 and take off cylinder head.
Installation:
Keep oil out of cavities since otherwise bolts tightened to correct torque might not exert sufficient pressure on cylinder and, in addition, cause cracks in crankcase.
Clean cylinder head bolts.
Lubricate threads and bearing surfaces of bolt heads with light coat of oil.
Replace cylinder head gasket – measure piston protrusion, see 11 12 101.



Detach hose (5) and protective cover.
Installation:
First tighten cylinder head cover and then protective cover.

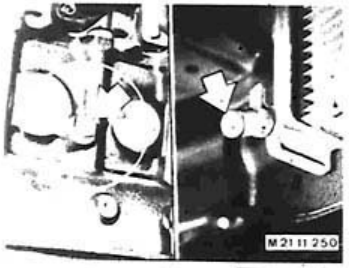


Loosen bolts (1 and 2) and nut (3).
Untighten toothed belt and take off of camshaft sprocket.



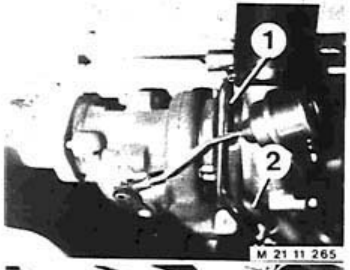
Tighten bolts in 3 steps in order of 1 through 14 to specified torque*.
Adjust valve clearance 11 34 004.
Check static adjustment of injection pump, see 13 51 005.
In 3rd step (cylinder head cover removed again after running engine warm) tighten cylinder head bolts to torque angle* with Special Tool 11 2 110 regardless of engine temperature.

* See Specifications

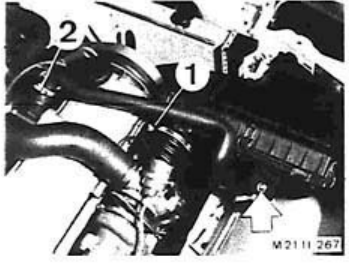


11 12 100 REMOVING AND INSTALLING CYLINDER HEAD
– BMW 324 td –

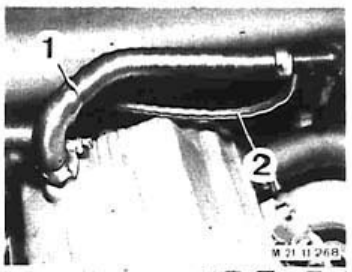
Disconnect battery ground lead.
Drain coolant in engine block and radiator.
Installation:
Pour in coolant*** and bleed cooling system – see Group 17.
Replace engine oil***



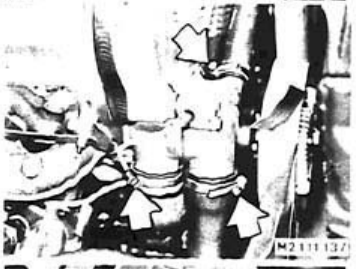
Unscrew exhaust pipe on turbocharger and holder on transmission.
Disconnect pipes (1 and 2) on turbocharger.
Also disconnect pipe (1) on engine block.
Installation:
Check gaskets, replacing if necessary.
Coat studs with copper paste "CRC"***
Replace self-locking nuts.
Tightening torque*



Loosen hose clamps (1 ... 2) and pull off hoses.
Unscrew nut and remove air cleaner.



Loosen clamp and pull off hose (1) on cylinder head cover.
Pull off vacuum hose (2).

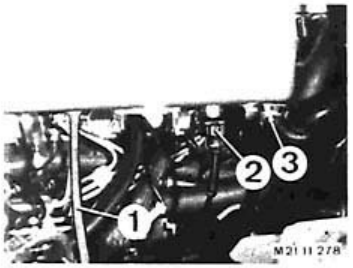


Remove fan – see 11 52 000.
Disconnect coolant hoses on thermostat housing.

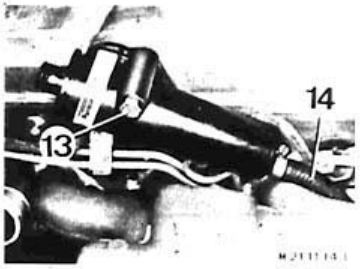


Loosen hose clamp and pull off coolant hose (1).
Pull off leak hose (2) and disconnect on injection pipe.

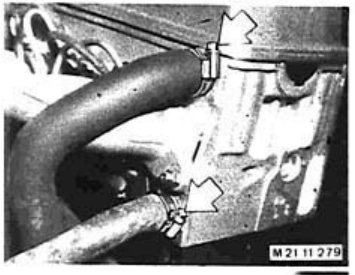
* See Specifications
** Source of Supply: HWB
*** See Service Information of Gr. 00



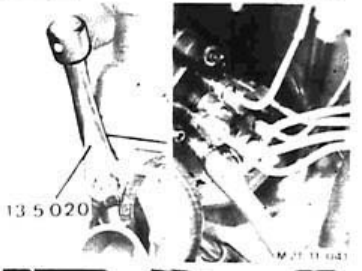
Pull off vacuum hose (1) and plug (2).
Loosen clamp (3).



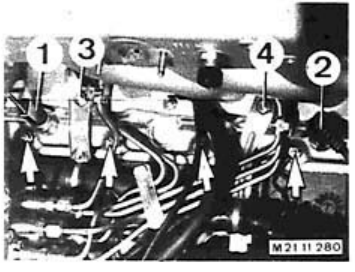
Unscrew oil trap (13)
Pull off hose (14)
Installation
Check seal, replacing if necessary



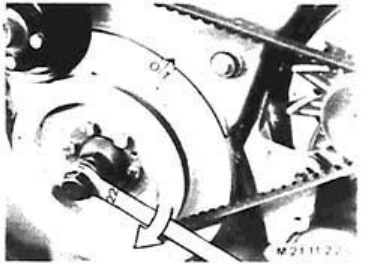
Loosen hose clamps and pull off hoses.



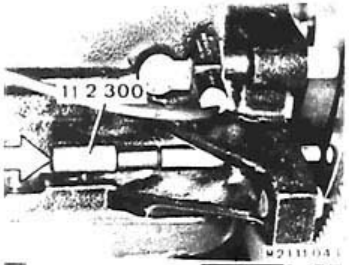
Unscrew injection pipes on fuel injectors and injection pump with Special Tool 13 5 020.
Install protective caps.
Remove cylinder head cover see 11 12 000
Installation
Tightening torque: 20 to 25 Nm (14.5 to 18 ft. lbs.).
Bleed fuel system - see 13 51 320.



Pull off plugs (1 and 2) on temperature sensors.
Unscrew holders (3 and 4) on cylinder head.
Disconnect all leads on heater plugs.



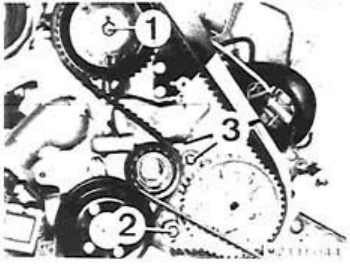
Turn cylinder no. 1 to TDC valve in cylinder no. 6 overlap.



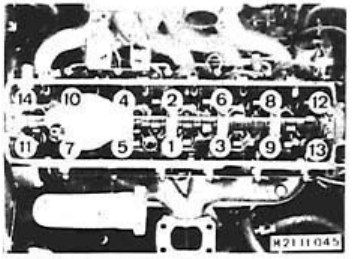
Hold crankshaft with Special Tool 11 2 300.
Caution!
Remove special tool before operating engine again.



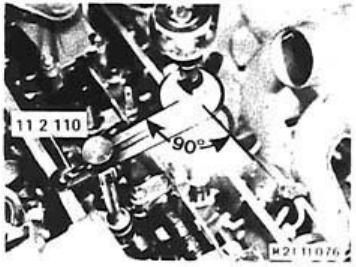
Disconnect hose (5).
Remove protective cover.
Installation:
First tighten the cylinder head cover and then the protective cover.



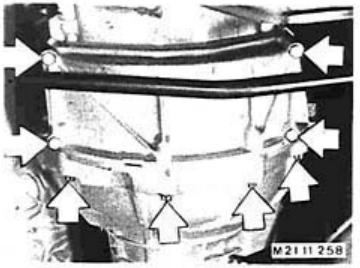
Loosen bolts (1 and 2) and nut (3).
Loosen and take toothed drive belt off of the camshaft sprocket.
Installation:
Install and tighten toothed drive belt – see 11 31 110 in Construction Group Repair Manual.



Unscrew bolts in order of 14 through 1 and take off cylinder head.
Installation:
Keep oil out of cavities (danger of cracking block, wrong torque values).
Clean cylinder head bolts.
Lubricate threads and bearing surfaces of bolt heads with oil lightly.
Replace cylinder head gasket.
Measure piston protrusion see 11 12 101.
Tighten bolts in order of 1 through 14 in three steps.
Tightening torque*
Adjust valve clearance – see 11 34 004.
Check static injection pump adjustment see 13 51 005.
In 3rd step (cylinder head cover removed again after running engine warm) tighten cylinder head bolts to specified torque angle with Special Tool 11 2 110 regardless of the engine temperature.

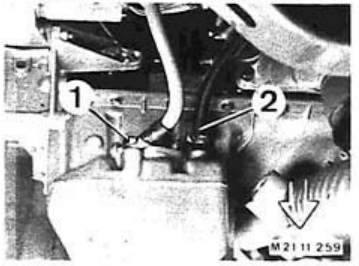


* See Specifications



11 13 000 REMOVING AND INSTALLING OIL PAN

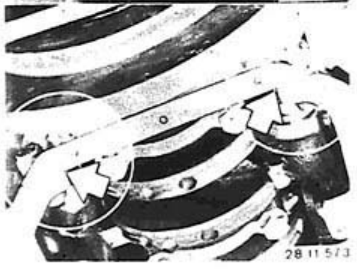
Unscrew reinforcement plate.
Drain oil.
Installation:
Pour in engine oil***.



Unscrew steering gear on front axle carrier, see Group 32.
Disconnect ground wire (1).
Disconnect hose (2).
Unscrew oil pan.

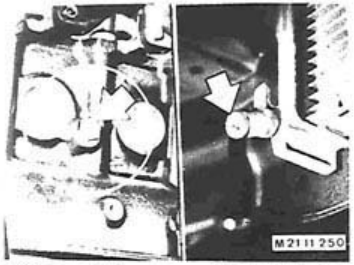


Detach oil pump and remove oil pan.
Installation:
Insert oil pump drive shaft, see 11 41 000.
Replace gasket.



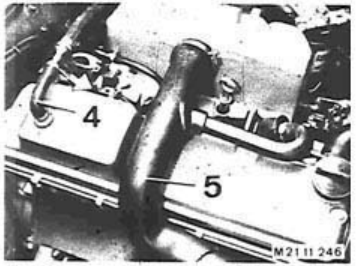
Installation:
Clean sealing surfaces.
Coat mating surfaces on timing case cover and end cover with a brush-on universal sealing compound / Three Bond Silicon 1207**.

** Source: HWB
*** See Service Information of Gr. 00

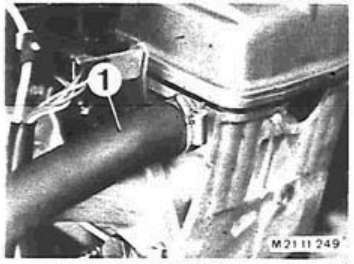


11 61 050 REMOVING AND INSTALLING INTAKE AIR MANIFOLD

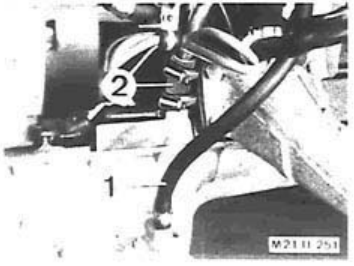
Disconnect battery ground lead.
Drain coolant in engine block and radiator.
Installation:
Pour in coolant*** and bleed cooling system, see Group 17.



Disconnect hoses (4 and 5).

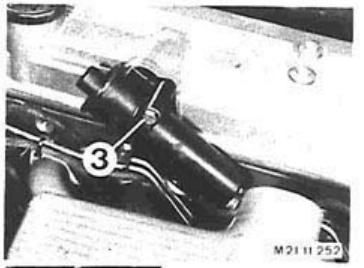


Pull off hose (1).

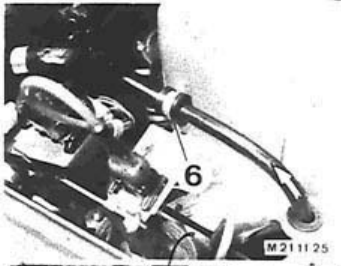


Unscrew hose (1) on oil pan.
Unscrew oil test pipe (2) and pull out from above.

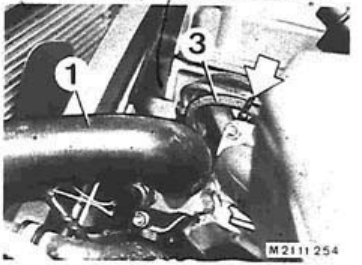
*** See Service Information of Gr. 00



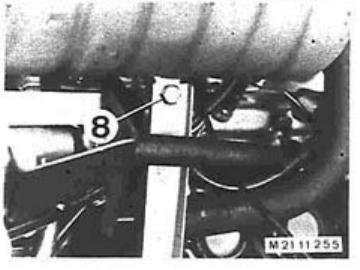
Unscrew oil trap (3) and pull out from above.
Installation:
Check seal, replacing if necessary.



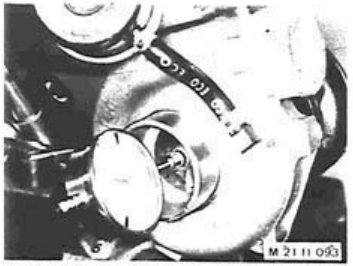
Loosen clamp (6) and disconnect positive wire for starter.

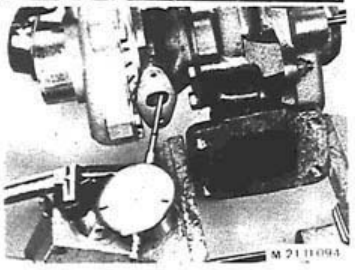


Remove hose (1).
Pull off leak line (3) and unscrew on injection line.



Unscrew manifold support (8) and manifold.
Installation:
Replace gaskets.





11 65 015 CHECKING BEARING PLAY OF TURBOCHARGER

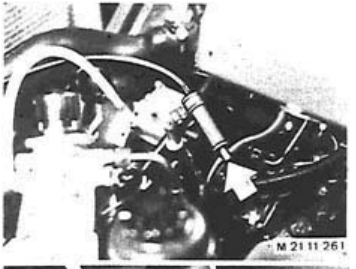
Excessive bearing play could be the cause for excessive oil in the turbocharger (which will be noticed on blue smoke) or noise.
Axial play: max. 0.15 mm (0.006").
Apply dial gage on turbocharger shaft and move shaft from stop to stop without turning.

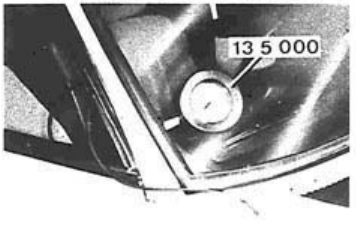
Radial play: max. 0.8 mm (0.031").
Apply dial gage on turbocharger shaft. Move turbocharger shaft from stop to stop on both ends simultaneously while turning.

11 65 018 CHECKING CHARGING PRESSURE OF TURBOCHARGER

Checking on Dynamometer Stand:
Check with help of DDE self-diagnosis (call status lists).

Operate car in load range.
Take charging pressure (absolute value including atmospheric pressure) from the charging pressure sensor display.
Specification: max. 1850 + 50 mbar.





Checking in Test Drive:
Connect pressure tester, Special Tool 13 5 000, between the intake manifold and charging pressure sensor, and place in the passenger compartment.
Make sure that the hose is not pinched.
Check charging pressure by driving car in load range (braking).
Specification:
Measured charging pressure + atmospheric pressure (see 11 65 . . .) = max. 1850 + 50 mbar.

Possible Faults When Charging Pressure Is Not Correct:
Bypass regulator (see 11 65 059).
Charging pressure sensor (see 11 65 ...)
Pressure converter (see 11 65 . . .).
Hose connections (check for leaks with a spray).
Turbocharger (shaft turns too hard, bypass).

M 21 11 3/2

11 65 020 REMOVING AND INSTALLING TURBOCHARGER

The turbocharger receives oil from the engine oil circuit. The following points are important to guarantee sufficient lubrication for the fast running turbocharger.

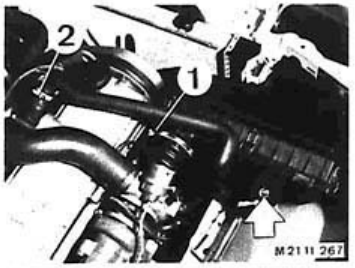
- Engine oil circuit in perfect condition (specified engine oil, oil level, crankcase venting, etc.).
- Engine not raced before building up engine oil pressure (control lamp) – engine also not stopped at high speed (turbocharger keeps on running).
- Engine not started immediately after an oil change, but instead oil pressure built up first by cranking engine with the starter (fuel shutoff electric lead disconnected – see 11 00 039).
- Excessively old engine oil could cause carbonization of the turbocharger. Carbonization could be seen on the turbocharger shaft after removing the oil pipe. In this case the engine oil and oil filter have to be replaced.

Important When Working on Turbocharger:

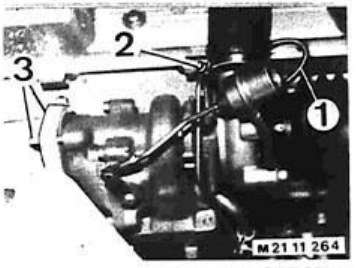
Even the most minute particles of dirt could lead to destruction of the turbocharger – therefore never operate engine without the air filter.

- If the hose on the control valve is disconnected, this could lead to overcharging and destruction of the engine when operated in full load range.

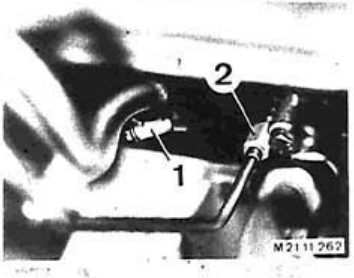
The turbocharger may not be repaired.



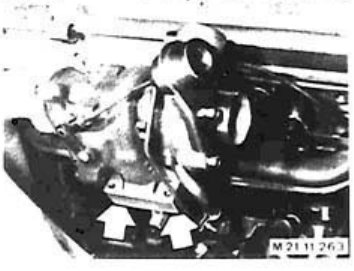
Remove air cleaner.
Disconnect hoses (1 and 2).
Unscrew nut (3) and remove air cleaner housing.



Unscrew exhaust pipe on turbocharger.
Disconnect hoses (1 and 2).
Unscrew nuts (3).
Installation:
Replace self-locking nuts.
Check gasket, replacing if necessary.
Coat studs with copper paste "CRC"**.
Tightening torque*.



Unscrew oil pipes (1 and 2).
Installation:
Replace seals.
Tightening torque*.
Check engine oil level, correcting if necessary.

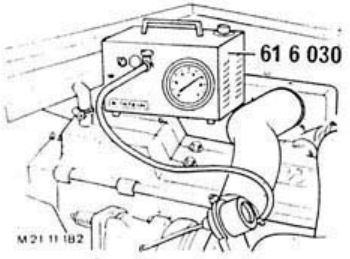


Unscrew bolts and remove turbocharger.
Installation:
Check levelness of sealing surface.
Tightening torque*.

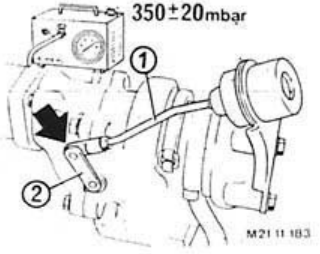
* See Specifications
** Source of Supply: HWB

11 65 059 CHECKING AND ADJUSTING BYPASS REGULATOR FOR TURBOCHARGER

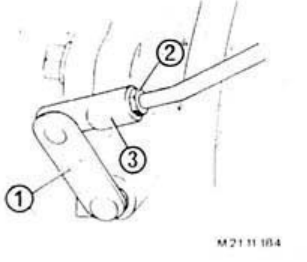
The regulating valve limits charging pressure. A regulating valve opening too early will be noticed by a drop in power and an excessively rich mixture (soot in exhaust gas). A bypass valve opening too late will cause excessive charging pressure.
Excessive charging pressure leads to overheating of the engine.



Checking:
Connect vacuum pump, Special Tool 61 6 030, on the bypass regulator.



Produce a vacuum of 350 +/- 20 mbar with the vacuum pump.
Regulating rod (1) should just barely be moved without tension by the bypass plate lever (2) with this vacuum.



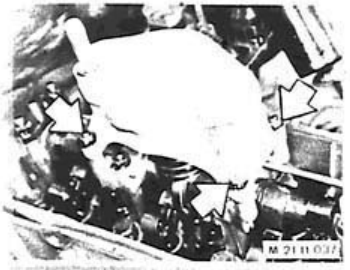
Adjusting:
Disconnect regulating rod on lever (1).
Loosen lock nut (2).
Adjust regulating rod by turning connector (3).

11 65 . . . CHECKING CHARGE PRESSURE SENSOR

The charge pressure sensor can be checked with DDE self-diagnosis by calling the status list. The charge pressure sensor of a stopped engine must display the actual atmospheric pressure.

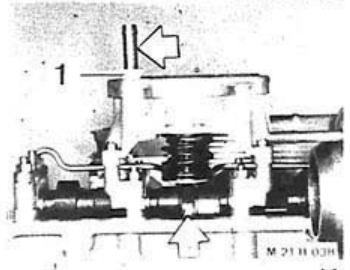
The table shown below contains only reference values. These values must be allocated a tolerance of ± 70 mbar due to fluctuations in the weather situation.

Altitude in mtr.	Atmospheric Pressure in mbar
0	1000
500	950
1000	900
1500	850
2000	800



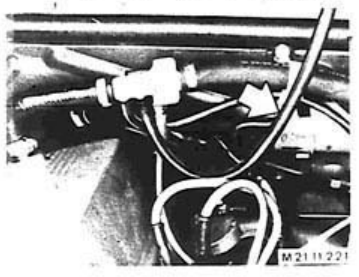
11 66 000 REMOVING AND INSTALLING VACUUM PUMP

Remove cylinder head cover – see 11 12 000.
Turn cam for vacuum pump to face down.
Unscrew nuts and take off vacuum pump.



Installation.
Mount vacuum pump that pipe connector is at rear and cam runs in opening of plunger.
Insert seal (1).

Caution!
Never run engine without mounted vacuum pump – loose cam ring.



Checking Vacuum Pump Pressure and Restrictor:
Connect BMW SERVICE TESTER on restrictor and measure pressure with engine running.

* See Specifications

12 Engine Electrical Equipment

Model: 316 Engine M10 B18 Carburettor
318i M10 B18 Injection
320i M20 B20
325i M20 B25
325e M20 B27

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WORKING INSTRUCTIONS FOR ENGINE ELECTRICAL AND IGNITION SYSTEMS
(TCI = Transistor Coil Ignition and DME = Digital Motor Electronics)

- Always disconnect the battery or interrupt power supply to the control unit and ignition coil when working on the electrical system, charging the battery or welding on the car – danger from primary and secondary voltage in engine and general electrical equipment (e.g. alternator).

  Never start the engine after removing the distributor cap or disconnecting the wire on ignition coil terminal 4 – pull off plug on ignition control unit.

- Never disconnect the battery or wires on the alternator and starter while the engine is running.

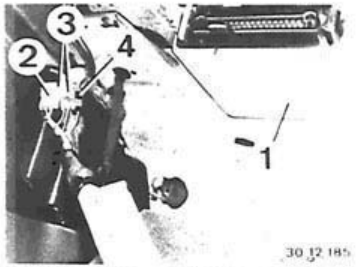
- Only use specified original BMW parts.

  Never connect a shielded capacitor or test lamp on terminal 1 of the ignition coil.

  Never connect terminal 1 of the ignition coil with ground or B +. Consequently when service installing a burglar alarm system, the terminal 1 wire must not be used for starter interlocking.

- Pull off the control unit plug in cars with TCI or the fuel injection master relay (relay 2) in cars with DME when checking the compression.

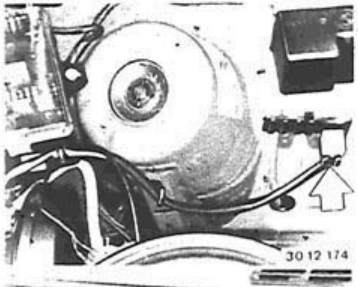
  The secondary (high voltage) side of the ignition system must be shielded with at least 4 k-ohms, whereby the original distributor rotor with 1 k-ohm must be installed. Never use a 5 k-ohm distributor rotor for interference suppression of a radio or communication set!



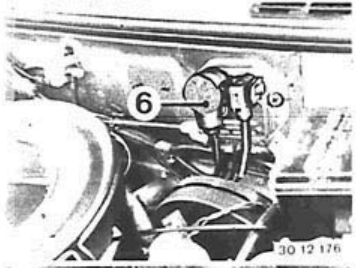
ENGINE ELECTRICAL SYSTEM

BMW 316:

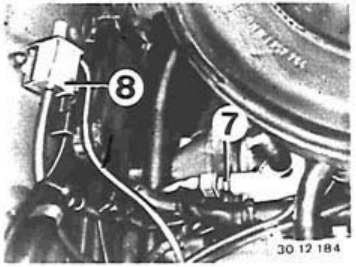
1 Control unit for 2 BE carburetor
2 Plug for main wire harness
3 Plug for speed booster (white)
4 Plug for a/c compressor (black)



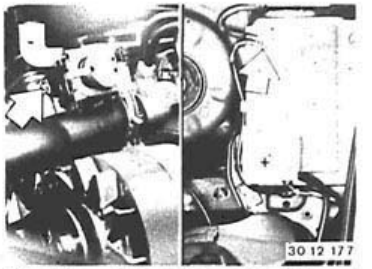
Relay for carburetor control unit.



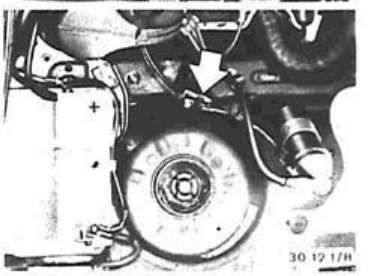
6 TCIi-S control unit
(S = ignition timing retard for starting)



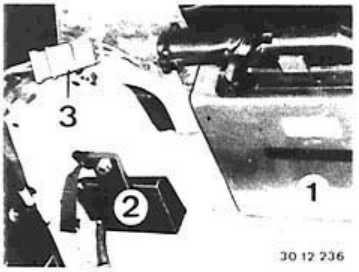
7 Air temperature sensor for 2 BE carburetor
8 Solenoid for ignition switch-over



Ground point for engine electrical system.



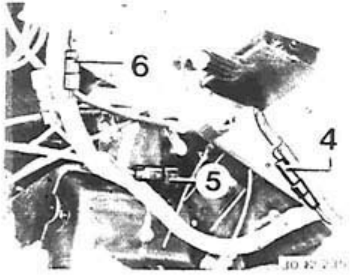
Plug for air conditioner compressor.



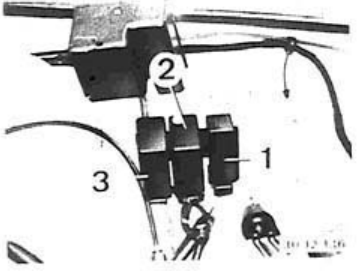
ENGINE ELECTRICAL SYSTEM

BMW 318 i:

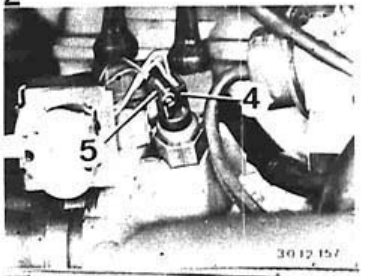
1 Control unit – L-Jetronic (see Gr. 13)
2 Control unit – idle speed regulation (see Gr. 13) .
3 Plug for car electrical system, fuel pump relay



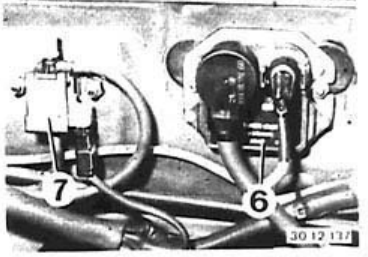
4 Plug (white) for different transmissions (wire colors: green/yellow – yellow/blue)
– disconnected in cars with automatic transmission (mixture leaned)
– connected in cars with manual transmission
5 Plug (black) for air conditioner (wire colors: blue/white)
6 Plug (red) for control unit coding (wire colors: brown/violet)



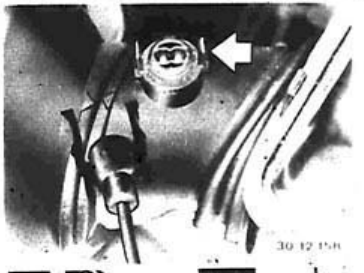
1 Relay for fuel injection, fuel pump
2 Relay for idle speed stabilization (see Gr. 13)
3 Relay for ignition switch-over



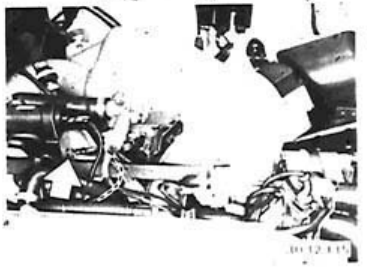
4 Temperature transmitter
5 Temperature switch for ignition switch over and idle speed regulation



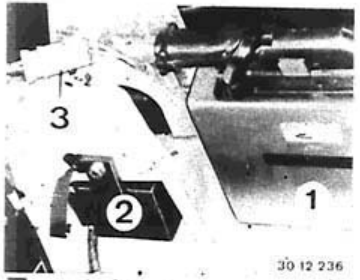
6 Control unit – TSZ-S
7 Ignition switch-over solenoid valve



Air temperature sensor for ignition switch-over



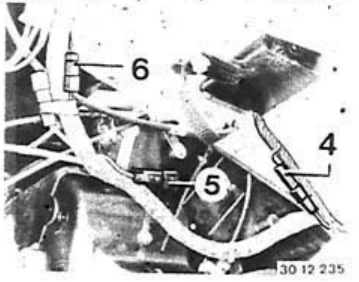
Ground point for engine electrical system



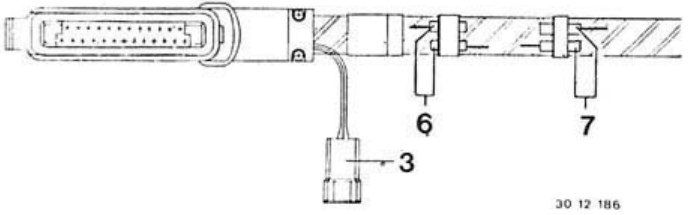
ENGINE ELECTRICAL SYSTEM

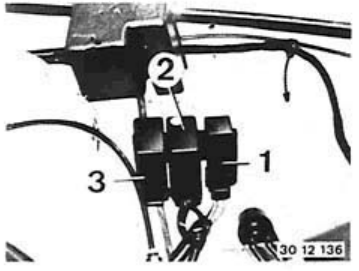
BMW 318 i Cat. Conv.:

1 Control unit – L-Jetronic (see Gr. 13)
2 Control unit – idle speed regulation (see Gr. 13)
3 Plug for car electrical system, fuel pump relay

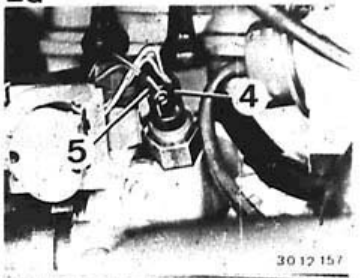


4 Plug for mixture control (white)
– disconnected in cars with automatic transmission (mixture leaned)
– connected in cars with manual transmission (mixture richer)
5 Plug for air conditioner (black)
6 Plug for control unit – coding – plug is always disconnected (red)
7 Plug for catalytic converter (green)
– connected in cars prepared for catalytic converter operation (since 3/85)

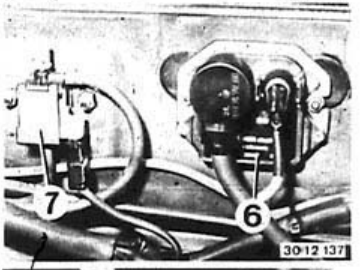




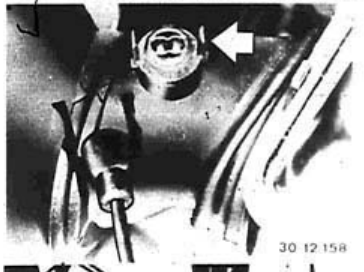
1 Relay for fuel injection, fuel pump and oxygen sensor heating
2 Relay for idle speed regulation (see Gr. 13)
Since 1986 Model:
Making relay – only with air conditioner – switches off coasting shutoff when air conditioner is operated.
3 Relay for ignition switch-over



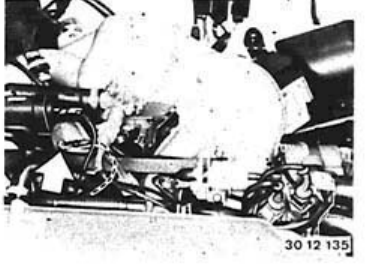
4 Temperature transmitter
5 Temperature switch for ignition switch-over and idle speed regulation



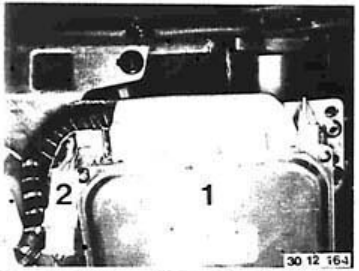
6 Control unit – TSZi-S
7 Ignition switch-over solenoid valve



Air temperature sensor for ignition switch-over

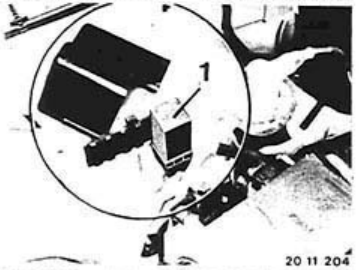


Ground point for engine electrical system

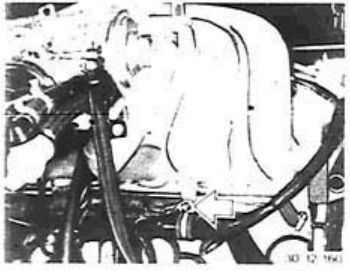


ENGINE ELECTRICAL SYSTEM

BMW 320 i / 323 i:
1 Control unit for L-Jetronic
2 Plug connection for car electrical system and fuel pump relay

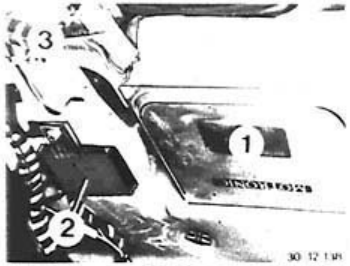


Relay for fuel injection and fuel pump

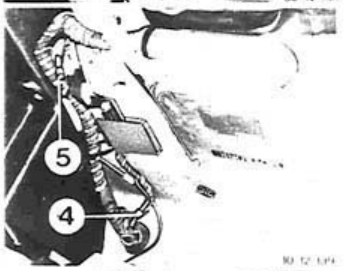


Ground point for engine electrical system

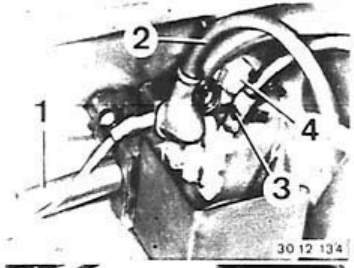
ENGINE ELECTRICAL SYSTEM



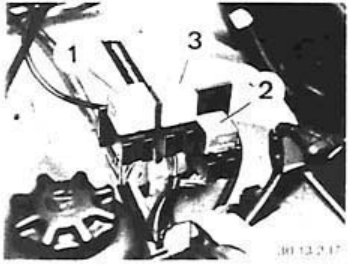
BMW 325 e Cat. Conv. Before 1986 Model:
1 Control unit for L-Jetronic (see Gr. 13)
2 Control unit for idle speed regulation (see Gr. 13)
3 Plug connection for car electrical system, fuel pump relay



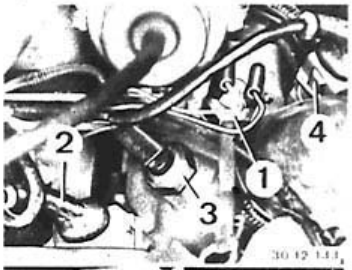
4 Plug connection for mixture control
– disconnected in cars with automatic transmission (leaner mixture)
– connected in cars with manual transmission (richer mixture)
5 Plug connection for air conditioner



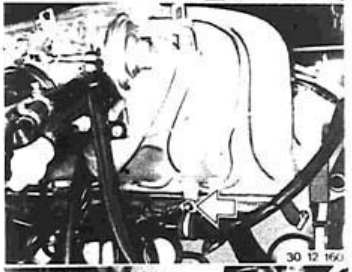
1 Battery positive lead
2 To engine electrical system
3 To car electrical system
4 0° C (32° F) switch for idle speed regulation



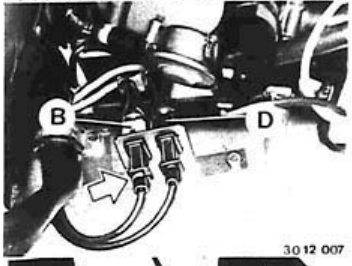
Relay 1 for fuel pump
Relay 2 for fuel injection
Relay 3 for oxygen sensor heating



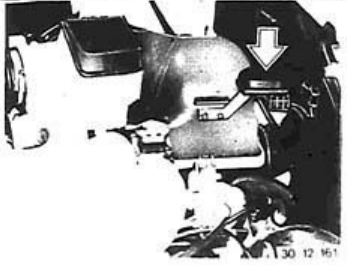
1 Temperature switch for idle speed regulation
2 Coolant temperature sensor for L-Jetronic
3 Temperature transmitter
4 Temperature time switch



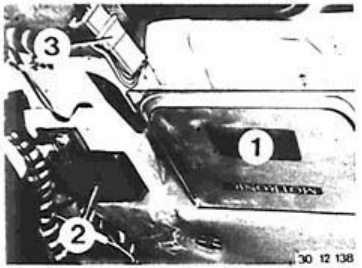
Ground point for engine electrical system



Plug connection for reference mark sensor (B) and speed sensor (D)

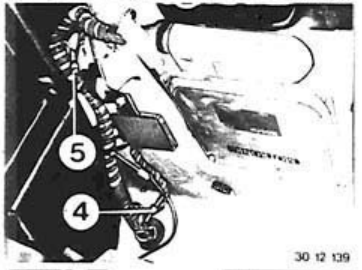


Pressure sensor for partial load enrichment (see Gr. 13 for information)

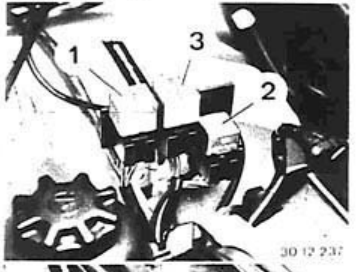


ENGINE ELECTRICAL SYSTEM

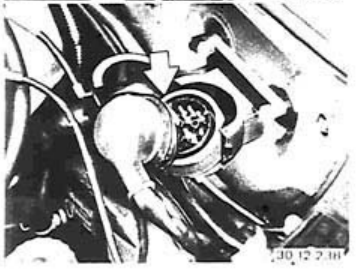
BMW 325 e Cat. Conv. Since 1986 Model:
1 Control unit for DME (see Gr. 13)
2 Control unit for idle speed regulation (see Gr. 13)
3 Plug for car electrical system, fuel pump relay



4 Plug for different transmissions (wire colors: green/yellow – blue/brown)
– disconnected for automatic transmission (leaner mixture)
– connected for manual transmission
5 Plug for air conditioner (wire colors: blue/white)



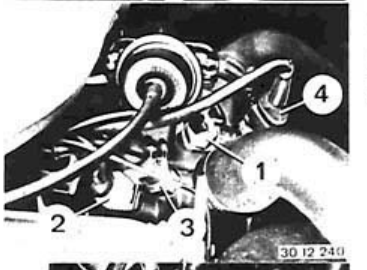
Relay 1 for fuel pump
Relay 2 for DME
Relay 3 for oxygen sensor heating



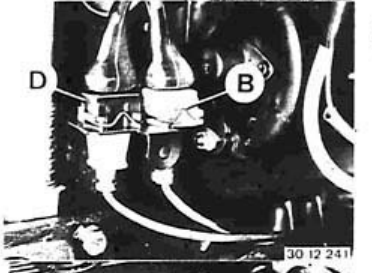
Engine wire harness plug (20 pins)
Installation:
The screw-on cap locks in final position.



Ground point for engine electrical system
Diagnosis plug



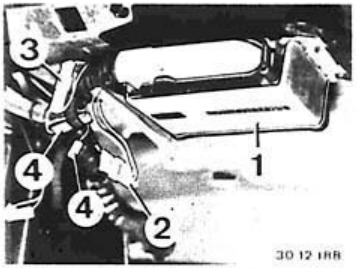
1 Temperature switch 45° C (113° F) for idle speed regulation
2 Coolant temperature sensor for DME
3 Temperature transmitter
4 Temperature time switch



Plug for reference mark sensor B (gray) and speed sensor D



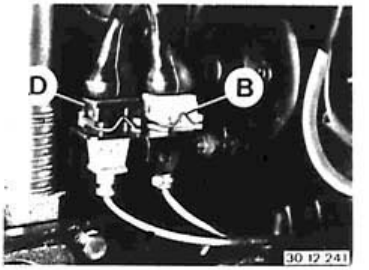
Pressure sensor (see Gr. 13)



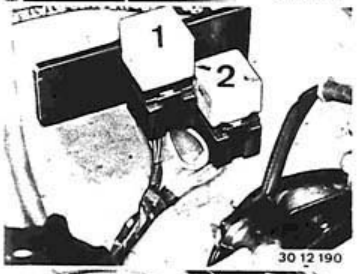
ENGINE ELECTRICAL SYSTEM

BMW 325 i:

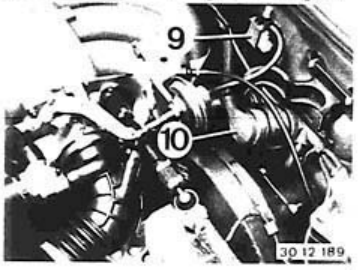
1 Control unit for DME
2 Plug for car electrical system and fuel pump relay (3 pins)
3 Plug for transmission (2 pins)
– disconnected for automatic transmission (leaner mixture)
– connected for manual transmission
4 Plug for injection control (1 pin)



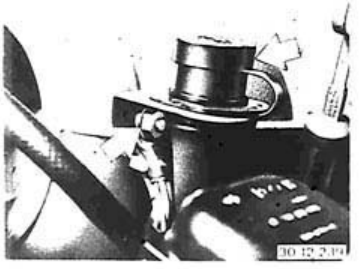
Reference mark sensor (B) gray
Speed sensor (D)



1 Relay for fuel pump
2 Relay for fuel injection

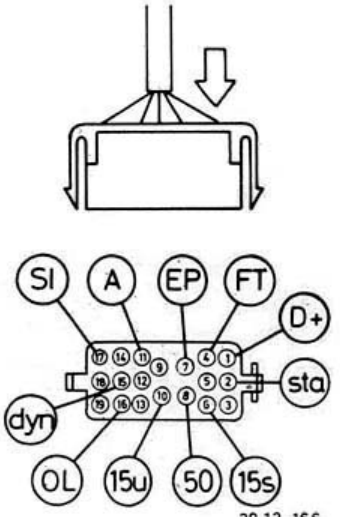


9 Solenoid for throttle valve positioner (only all wheel drive cars)
10 Engine wire harness plug



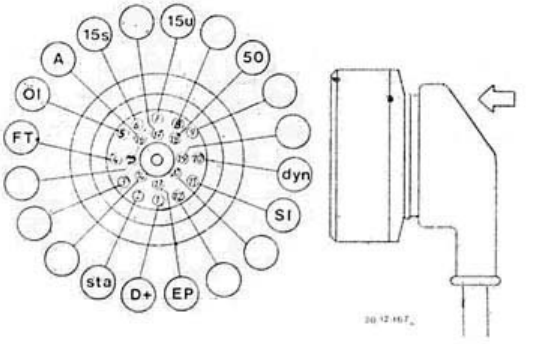
Ground point for engine electrical system.
Diagnosis plug.

CONNECTION PLAN FOR ENGINE WIRE HARNESS PLUG



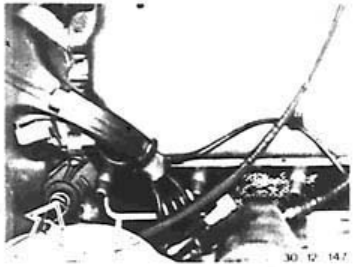
Up to 1985 Models

No.	Term.	Description
1	D+	Alternator charge indicator
2	sta	Oil level - static
3	–	–
4	FT	Coolant temperature gage
5	–	–
6	15 s	Power supply with ignition turned on – fuse protected
7	EP	Electric fuel pump
8	50	Voltage while starting
9	–	–
10	15 u	Power supply with ignition turned on – no fuse protection for wire
11	A	Diagnosis lead for airbag
12	–	–
13	–	–
14	–	–
15	dyn	Oil level - dynamic
16	Öl	Oil pressure
17	SI	Service indicator reset
18	–	–
19	–	–



Since 1986 Models

No.	Term.	Description
1	D+	Alternator charge indicator
2	sta	Oil level - static
3	–	–
4	FT	Coolant temperature gage
5	Öl	Oil pressure
6	15 s	Voltage with ignition turned on – fuse protected
7	15 u	Voltage with ignition turned on – no fuse protection for wire
8	–	–
9	–	–
10	dyn	Oil level - dynamic
11	SI	Service indicator reset
12	–	–
13	EP	Electric fuel pump
14	–	–
15	–	–
16	A	Diagnosis lead for airbag
17	–	–
18	50	Voltage while starting
19	–	–
20	–	–

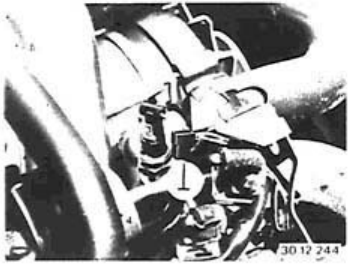


12 11 004 CHECKING AND ADJUSTING IGNITION TIMING
– 4 Cylinder Models –

Caution!
Refer to page 12 - 0 for instructions when working on the engine electrical system.
Testing Conditions:
- Apply the plug-in TDC transmitter.
- Engine at operating temperature
  Oil temperature > 60° C (140° F).
- Distributor/DME control unit number** must agree with specifications on the nominal value microfiche.

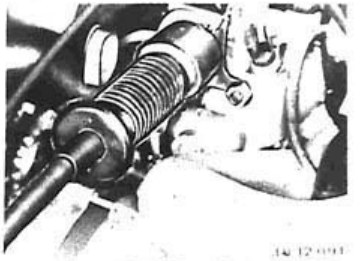
Connect BMW service tester or BMW digital tester to operating instructions.

Models with NOx Control:
The NOx control unit is series connected with ignition control unit as a second control unit.
Operation of the NOx control must be stopped to check the ignition timing.

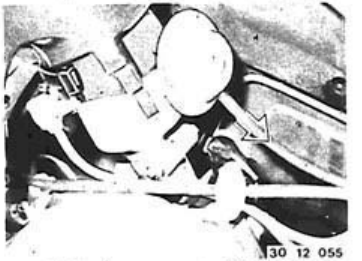


Pull off 4.8 mm (0.189") plug on 17° C (63° F) temperature switch and connect on ground.
Check/adjust ignition timing.
The ignition timing of cars with NOx control will be retarded by approx. 10° at about 1500 rpm.

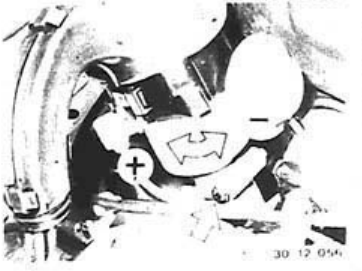
** See Specifications



Checking Dwell Angle:
The dwell angle is given by design and can be checked, but not adjusted.
The ignition control unit is no longer ready for use in case of malfunction.



Checking/Adjusting Ignition Timing*:
Pull off vacuum hose for advance ignition control.



Start and accelerate engine to test speed*.
Check ignition timing*, adjusting if necessary.
Correct by loosening the bolt and turning the distributor accordingly.
+ = ignition timing advanced
– = ignition timing retarded

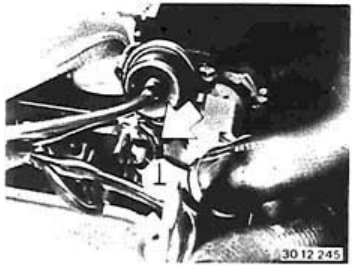
* See Nominal Value Microfiche

12 11 004 CHECKING AND ADJUSTING IGNITION TIMING – 6 Cylinder Models –

Caution!
Refer to page 12 - 0 for instructions when working on the engine electrical system.
Testing Conditions:
- Check for correct installed position of TDC transmitter to the vibration damper.
- Engine at operating temperature = oil temperature > 60° C (140° F).
- Distributor/DME control unit numbers** must agree with specifications on the nominal value microfiche.

Connect BMW service tester or BMW digital tester to operating instructions.

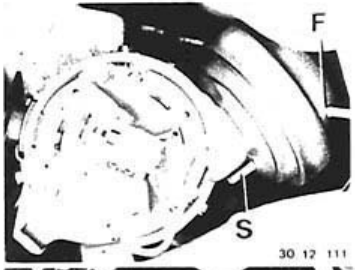
Models with NOx Control:
- The NOx control is integrated in the DME control unit of DME engines with NOx control.
  The ignition timing at idle speed is not influenced.
- The NOx control unit is series connected with the ignition control unit as a second control unit in case of engines with TCI. Operation of the NOx control must be stopped to check the ignition timing.



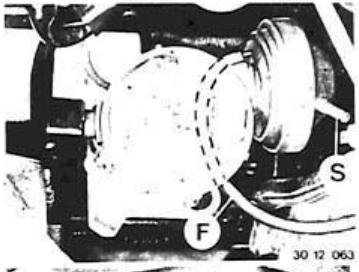
Pull off 4.8 mm (0.189") plug on the 17° C (63° F) temperature switch and connect on ground..
Check/adjust ignition timing.
The ignition timing of cars with NOx control will be retarded by approx. 10° at about 1500 rpm.

** See Specifications

Checking Dwell Angle:
The dwell angle is given by design and can be checked, but not adjusted.
The DME control unit is no longer ready for use in case of malfunction.

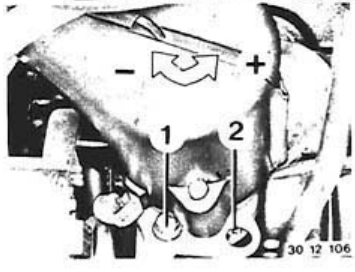


Checking/Adjusting Ignition Timing* – Cars with Distributor Engine:
Pull off vacuum hoses.
F = advance ignition control (black)
S = retard ignition control (black/white)
Cars with Automatic Transmission:
No hose for retard ignition control – connection on vacuum box not used.



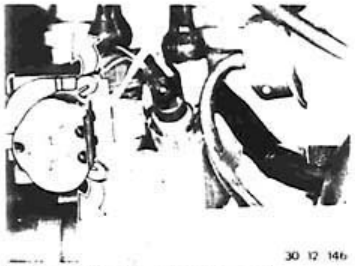
Important!
The ignition control boxes are inversed on distributors with larger diameter vacuum hose connections – see pictures.
F = advance control (black) (4 mm/0.157" dia.)
S = retard control (black/red) (8 mm/0.315" dia.)

DME Engine:
Ignition timing corrections are not possible.



Start and accelerate engine to test speed*.
Check ignition timing*, adjusting if necessary.
Correct by loosening bolt (1) and turning the distributor on splines (2) accordingly.
+ = ignition timing advanced
– = ignition timing retarded

* See Nominal Value Microfiche

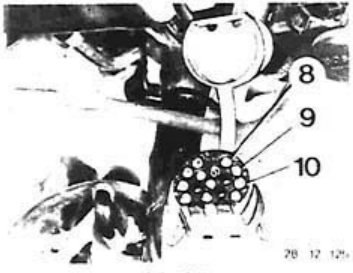


12 11 031 REPLACING TDC POSITION SENSOR

Unlock clips and take diagnosis socket out of holder.

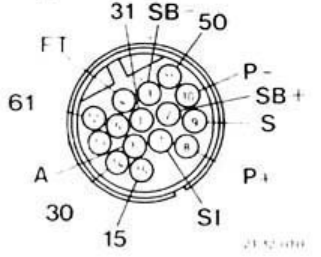


Press female plugs out of chambers (8, 9 and 10) with special tool**.

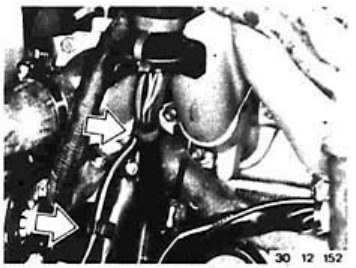


Installation:
Connect new TDC sensor as illustrated.

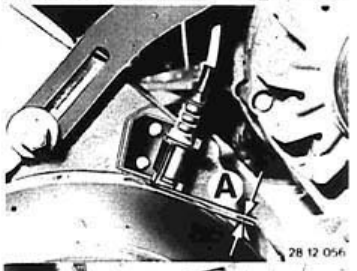
Number	Wire Color
8 (P+)	yellow
9 (S)	shielding
10 (P–)	black



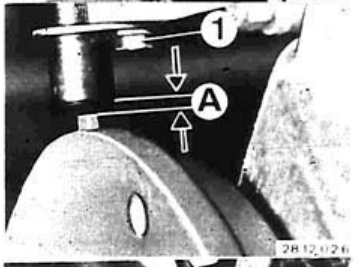
** Source: HWB



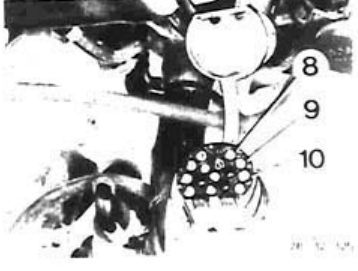
Disconnect wire on wire harness and holder



M 20:
Lift TDC position sensor out of clamp.
Installation:
Make sure sensor fits correctly.
Keep clearance A between sensor and vibration damper to 0.2 ... 2.0 mm (0.008 to 0.079").

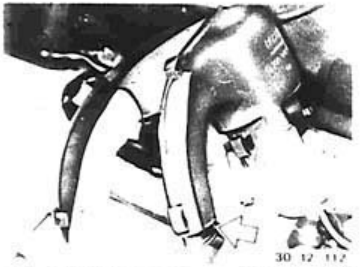


M 30:
Unscrew TDC position sensor on holder (1).
Keep clearance (A) between 0.2 and 2.0 mm (0.008 and 0.079").



Testing:
Measure resistance* on connections 8 and 10
Check insulation between 8 / 9 and 9 / 10.

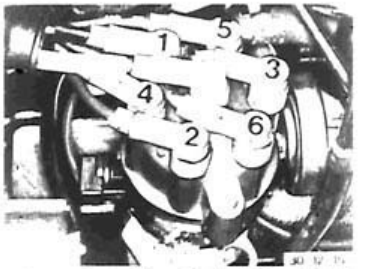
* See Specifications



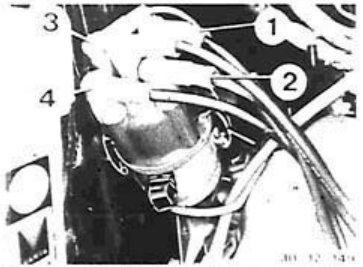
12 11 091 REPLACING DISTRIBUTOR CAP

Caution!
See page 12 - 0 for instructions when working on engine electrical system.

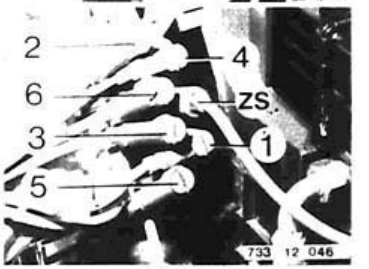
M 10 Engines:
Take off protective cap.
Installation:
Have retaining clips engage correctly.
Attach retaining strap.



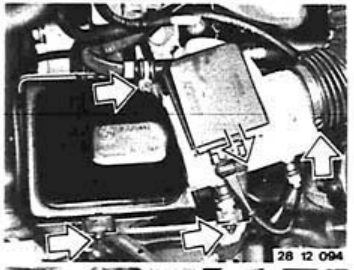
Pull off shielded plugs.
Installation:
Check firing order.



Open retainers and take off distributor cap.
Pull out shielded plugs.
Installation:
Check firing order.



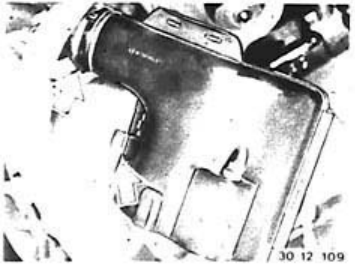
M 20 B 25 / B 27 Engines:
Take off protective cap.
Pull out shielded plugs.
Installation
Check firing order.



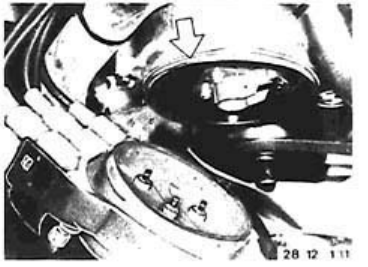
M 20 B 20 / B 23 Engines:
Remove air cleaner with air flow sensor.



Unscrew screws and take off distributor cap.
Caution!
Danger of cutting hands on radiator fins.



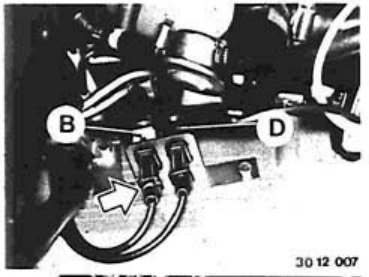
Turn both toggles 90° and take off distributor cap.
Take off protective cap.
Installation:
Mount sealing sleeve with tape.
Install retaining clips.



Installation:
Check seal, replacing if necessary.

12 14 510/ 515 REPLACING SPEED OR REFERENCE MARK SENSOR

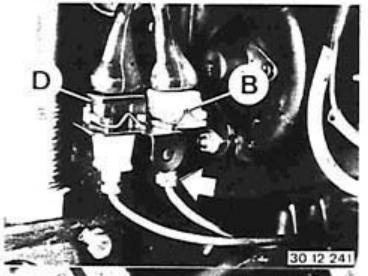
Disconnect plugs.



30 12 007

Before 1986 Models:

Installation:
Connect gray plug of reference mark sensor (B) and plug with tape.



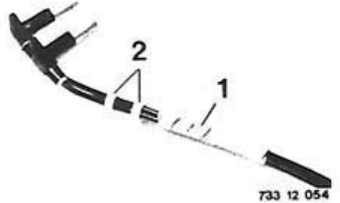
30 12 241

Since 1986 Models:

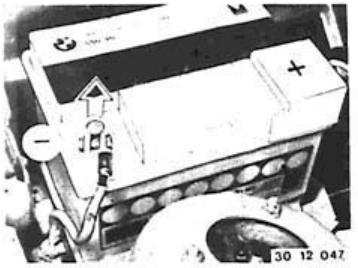
Unscrew sensor on transmission case and pull it out.


30 12 243

Installation:
Transfer protective sleeve with clips.
Lubricate seal with Molykote paste.
Keep grease and dirt off of face of sensor.
Mark new reference mark sensor with tape.

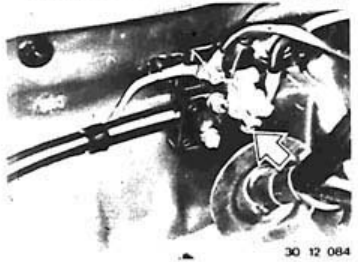


733 12 054

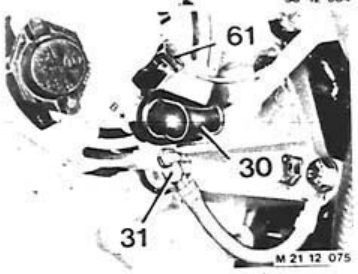


12 31 020 REMOVING AND INSTALLING OR REPLACING ALTERNATOR

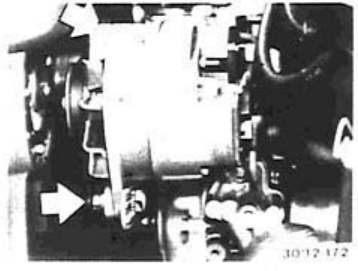
Disconnect battery ground lead.



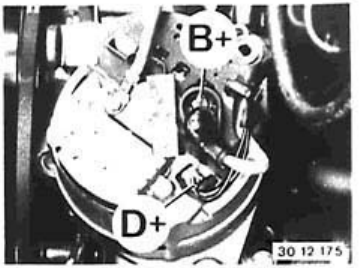
Disconnect battery terminal on connector – only applicable for 325 e/i cars.



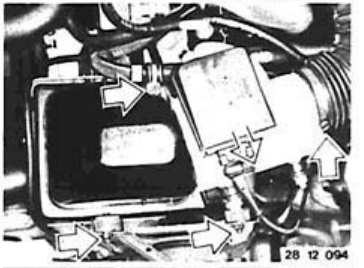
65 A Bosch Alternator:
Disconnect leads on connections B + (term. 30) and D + (term. 61).
Unscrew ground lead (term. 31).



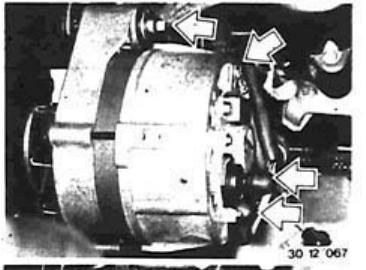
65 A Motorola Alternator:
Unscrew nuts and pull out bolts.
Remove alternator.



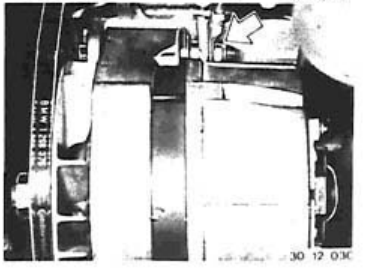
Disconnect connections D + (term. 61) and B + (term. 30).
Installation:
Tighten drive belt see 12 31 299



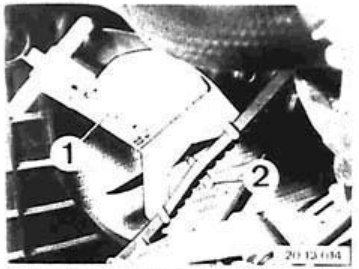
80 A Bosch Alternator:
Remove air cleaner and air flow sensor.
Unscrew holder for engine wire harness



Unscrew nut and remove bolt with tensioning wheel.
Remove leads on connections B + and D +.
Loosen cable clip and disconnect ground lead.

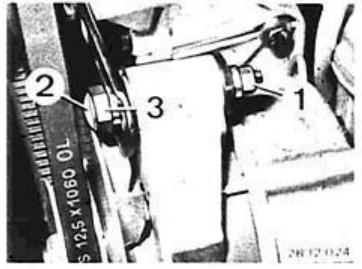


Unscrew nut and pull out bolt.
Remove alternator.
Installation:
Tighten drive belt – see 12 31 299.
Check degasing tank, discharging if necessary – see 12 32 000.

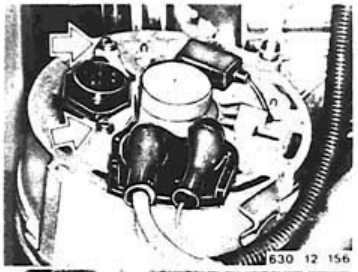


12 31 299 CHECKING / TIGHTENING ALTERNATOR DRIVE BELT

Check drive belt tightness with Special Tool 11 5 020, tightening if necessary.
Pulling hook (2) must be applied in center of teeth.
Gage needle must be located on scale above the green or yellow range.



Tightening Drive Belt:
Loosen nut (1) and turn tensioning wheel (3) with a torque of about 7 Nm (5 ft. lbs.).
Tighten nut (1).
Recheck tightness with special tool tester, correcting if necessary.

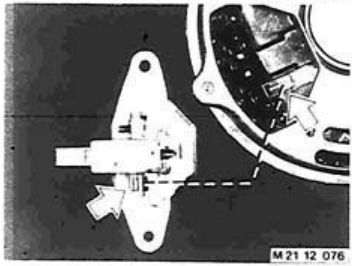


12 32 000 REMOVING AND INSTALLING/ REPLACING VOLTAGE REGULATOR

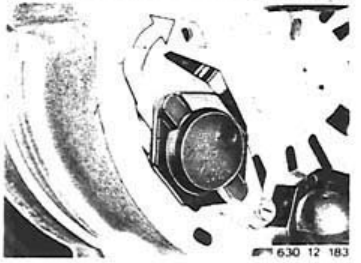
Bosch Alternator:
Unscrew bolts and take off regulator carefully.



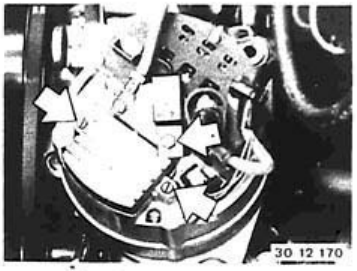
Check slip rings for wear, fine grinding and polishing if necessary.



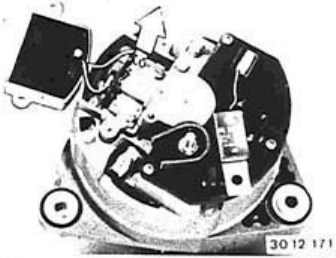
Clean contact surfaces and tension of contact springs, correcting if necessary.



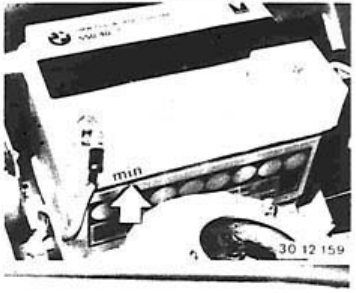
Installation:
First mount regulator with one bolt finger tight, then press regulator to final installed position and finally tighten both bolts.



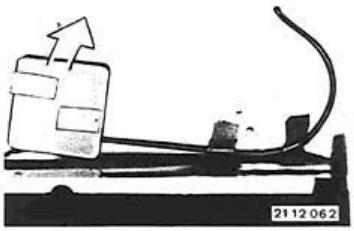
Motorola Alternator:
Remove shielded capacitor.
Unscrew screws.



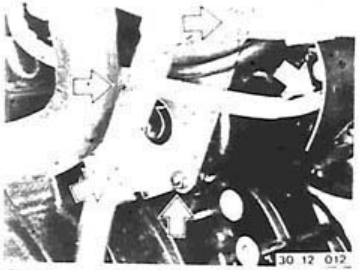
Pull off connecting plug and remove regulator.
Installation:
Wire colors must match colors of the connectors.



Check/correct battery acid level after replacing the voltage regulator.
Check charging current of the alternator with a BMW service tester (Engine Test P 02).



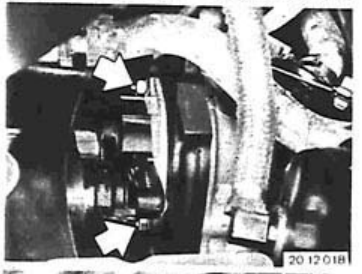
BMW 325 e/i:
Check degasing tank, emptying if necessary.



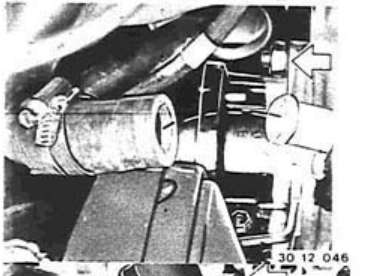
12 41 020 REMOVING AND INSTALLING STARTER

Disconnect battery ground lead.

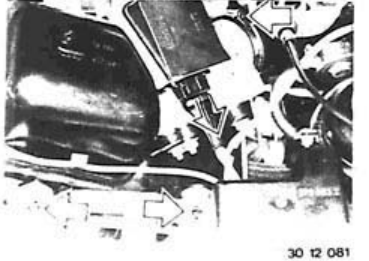
4 Cylinder Models with Carburetor:
Unscrew holder.
Disconnect wires on solenoid switch.
Installation:
Run battery lead through rubber guard.



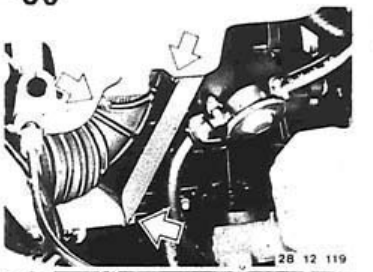
Unscrew nuts and remove starter.



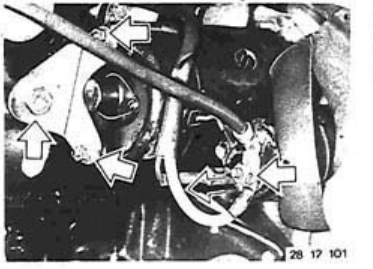
4 Cylinder Models with L-Jetronic:
Drain coolant in engine.
Disconnect hoses for heater.
Unscrew nuts with starter wrench**.
Installation:
Add coolant* and bleed cooling system – see 17 00 039.



Remove air cleaner with air flow sensor.

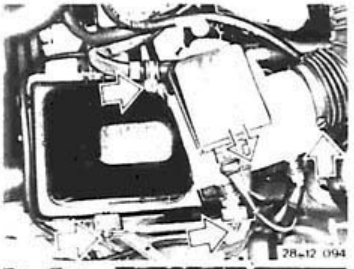


Remove dust cover and support for intake manifold.

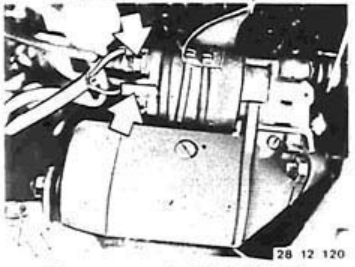


Disconnect wires (term. 30 and 50).
Unscrew support.
Unscrew lower mounting point and take off starter.

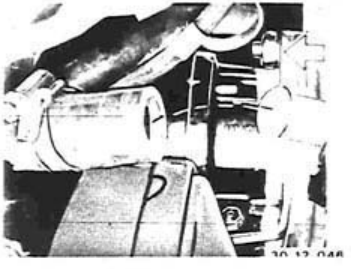
* See Service Information of Gr. 00
** Source: HWB



M 20 B 20 / B 23 Six Cylinder Models:
Disconnect battery ground lead.
Remove air cleaner with air flow sensor.

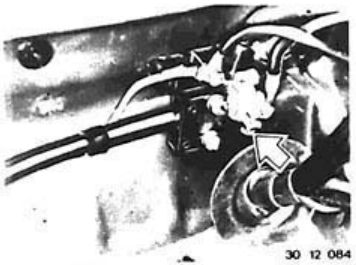


Jobs Performed from Underneath:
Disconnect leads (term. 30 and 50).
Unscrew support and lower mounting point.

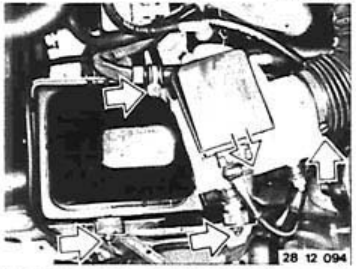


Drain coolant in engine.
Disconnect hoses for heater.
Unscrew nut with starter wrench**.
Remove starter from above.
Installation:
Add coolant* and bleed cooling system – see 17 00 039.

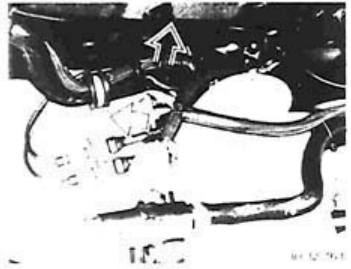
* See Service Information of Gr. 00
** Source: HWB



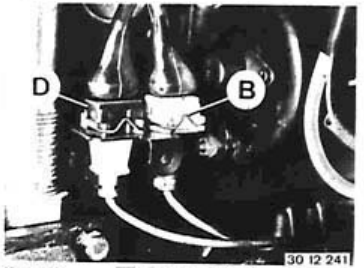
M 20 B 25 / B 27 Six Cylinder Models:
Disconnect positive lead on connector.



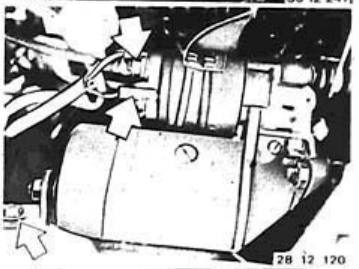
Remove air cleaner with air flow sensor.



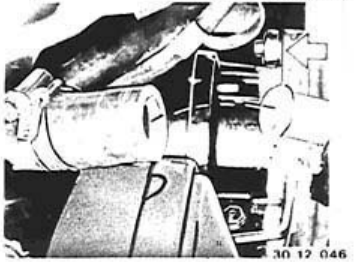
Loosen wire clips and pull up engine wire harness.



Since 1986 Models:
Disconnect plugs for reference mark sensor (B) (gray) and speed sensor (D).

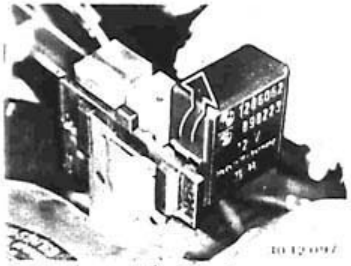


Disconnect leads (term. 30 and 50).
Unscrew support.
Unscrew nut from underneath.
Remove starter.



Drain coolant in engine.
Disconnect hoses for heater.
Unscrew nut with starter wrench**.
Installation:
Add coolant and bleed cooling system – see 17 00 039.

** Source: HWB

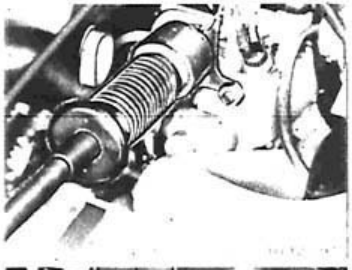


12 63 075 CHECKING IGNITION SWITCH-OVER SYSTEM

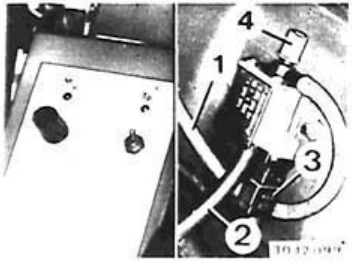
BMW 318 i Cat. Conv.:
Take off protective cap.
Unlock and pull up relay.
Pull off plug.



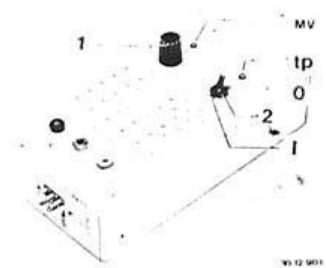
Connect relay (3) and plug (4) on ignition switch-over simulator, Special Tool 12 1 460.
Set switch (1) on simulator to position A.



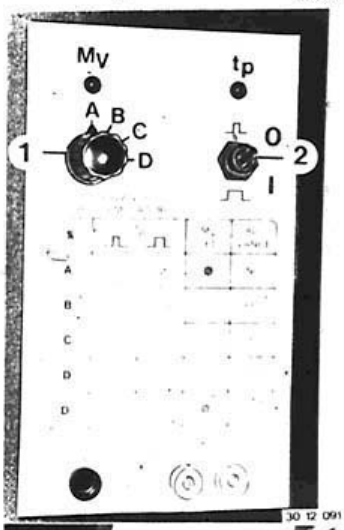
Connect BMW service tester or BMW digital tester.
Perform engine test 06 and ignition timing test.
The ignition timing displayed now will be "RETARDED" approx. 20° on crankshaft by the simulator.



Lamp "MV" on simulator will be on – the solenoid valve is activated.
Hose (1) is charged.
1 To vacuum control on distributor
2 To intake manifold or throttle housing
3 Electric simulator activation

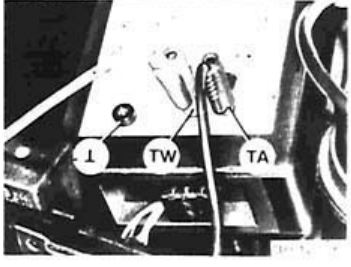


Lamp "tp" (injection signal from L Jetronic control unit) flashes throughout the entire test.
Switch 1 = Test position selector
Switch 2 = Injection signal variator (O/I)



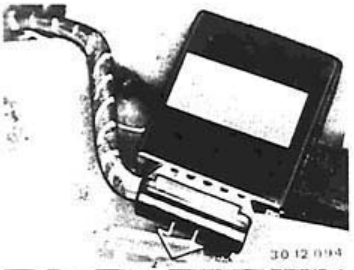
Perform tests A through D in conformance with survey printed on simulator.
Example:
Switch 1 at position D.
Switch 2 at position O.
Lamp MV not on – this means the vacuum control has vacuum.
ADVANCE = Vacuum advance control working
EITHER POSITION = Switch 2 can be in any desired position.

Refer to troubleshooting table for ignition switch-over system, if conditions specified for testing do not occur.

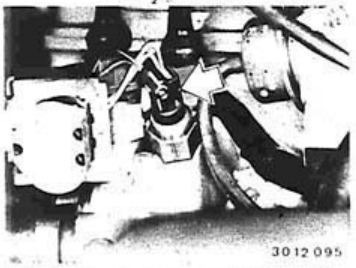


Resistance values* for coolant temperature and intake air temperature sensors can be taken from the plug sockets.
⊥ = Ground
TW = Coolant temperature
TA = Intake air temperature

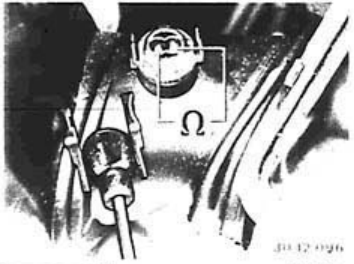
* See Specifications



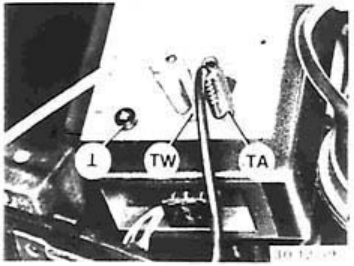
If the coolant temperature switch is tested at a temperature below 45° C (113° F), plug must be pulled off of idle speed control unit (in glove box above L-Jetronic control unit).



Check resistance* of coolant temperature switch.



Check resistance* of intake air temperature sensor.



Temperature sensors remain connected for testing with the simulator.

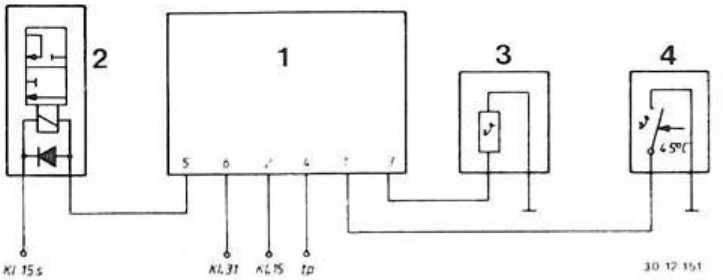
* See Specifications

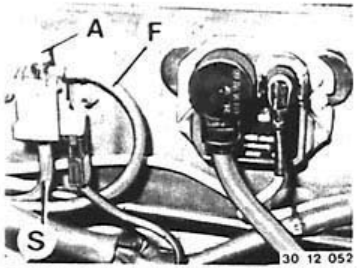
TROUBLESHOOTING IGNITION SWITCH-OVER SYSTEM

Connect ignition switch-over simulator, Special Tool 12 1 460
Run engine at idle speed.

Lamp tp not flashing	– No tp signal from L-Jetronic control unit or no power supply to simulator. L-Jetronic control unit connections or wire harness defective. Engine running erratically or not running.
Lamp MV not on	– No power supply to simulator. Wire harness to simulator defective. Ignition switch-over relay defective.
No advance control	– Ignition switch-over relay defective. Connections or wire harness for solenoid valve defective.
Ignition timing not reached with vacuum activated vacuum control	– Solenoid valve defective. Vacuum hose leaks. Vacuum control defective.

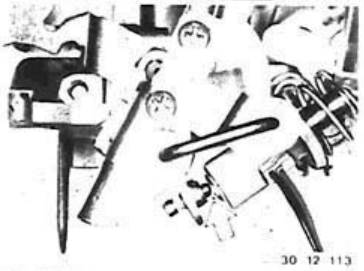
1 Ignition switch-over relay
2 Solenoid valve (red cap)
3 Air temperature sensor
4 Coolant temperature switch



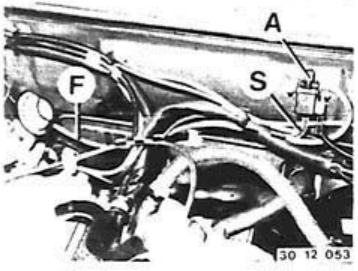


12 63 ... CHECKING SOLENOID VALVE FOR IGNITION SWITCH-OVER

Cars with 2 BE Carburetor:
Connections:
F = To vacuum control
S = To carburetor flange
A = Discharge (red cap)



Checking:
Turn on ignition.
Power is supplied to the solenoid valve with the idle speed switch closed (see figure) and a temperature above 20° C (68° F) (from intake manifold temperature sensor).



Hose F is discharged via cap A at idle speed – no advance control.
Power supply – see wiring diagram and "Troubleshooting 2 BE Carburetor" in Group 13.

See Group 11 for solenoid valves in conjunction with emission reduction.

INSTRUCTIONS FOR WORKING ON IGNITION, DME (DIGITAL MOTOR ELECTRONICS) AND ENGINE ELECTRICAL SYSTEMS

- Always disconnect the battery or unscrew the ground lead on the ground connection point (rear right seat) or interrupt power supply for the ignition coil for any type of work on the electrical system, charging the battery or welding jobs – dangerous high tension voltage! Dangerous high tension voltage in engine and car electrical systems (e.g. on the tachometer).

- The secondary (high tension) side of the ignition system must have a load of at least 4 k-ohms.

- The engine must not be started as long as the distributor cap is removed or the electric lead is disconnected on ignition coil terminal 4.

- Neither shielded capacitors nor test lamps may be connected on terminal 1 of the ignition coil.

- Electric lead of ignition coil terminal 1 must never be connected on ground or B + Therefore the terminal 1 lead may not be used to interlock engine starting when service installing a burglar alarm system.

- Never disconnect the battery or electric leads on the alternator and starter while the engine is running.

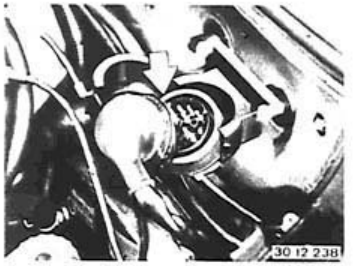
INSTRUCTIONS FOR WORKING ON DIESEL ENGINE ELECTRICAL SYSTEMS

- Always disconnect the battery for any type of work on the electrical system, charging the battery or welding jobs.

- Never disconnect the battery or electric leads on the alternator and starter while the engine is running.

- Only carry out jobs on the electrical system with the ignition turned on after disconnecting the preheating time control unit – in order to prevent destruction of the heater plugs.

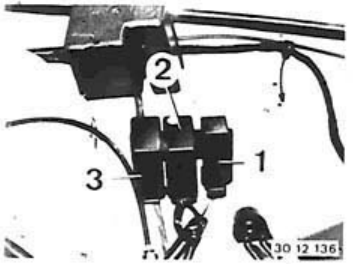
- Only use specified original BMW components.



LAYOUT OF ENGINE ELECTRICAL SYSTEM

BMW 316 i Cat. Conv./M 10:

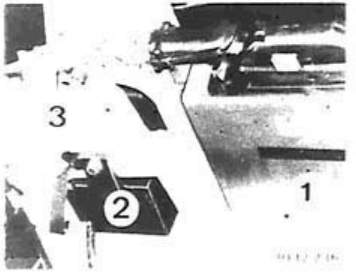
1 Engine wire harness plug



1 Relay for fuel injection, fuel pump and oxygen sensor heating

2 Relay for idle speed stabilization (see Group 13 for information) since 1986 model
Making relay – only with air conditioner switches off coasting shutoff when air conditioner is running.

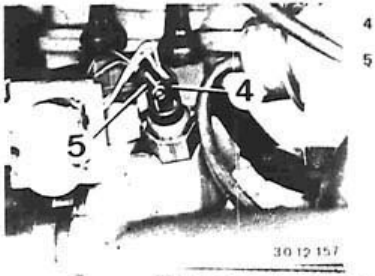
3 Relay for ignition switchover



1 L-Jetronic control unit (see Group 13)

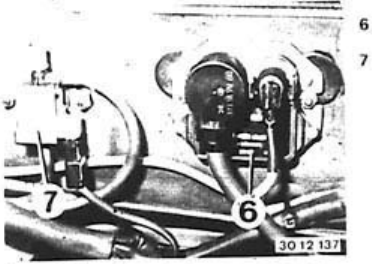
2 Idle speed control unit (see Group 13)

3 Plug for car electrical system fuel pump relay



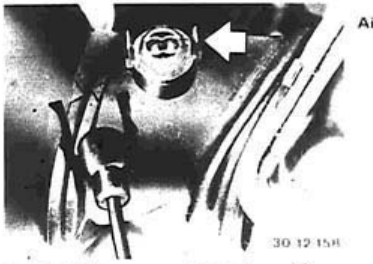
4 Temperature sender

5 Temperature switch for ignition switchover and idle speed control

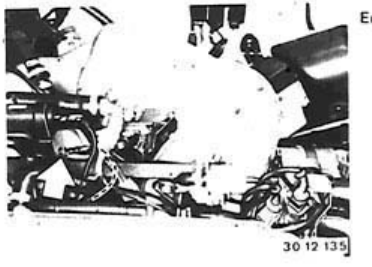


6 Ignition control unit (TCI-S)

7 Solenoid for ignition switchover

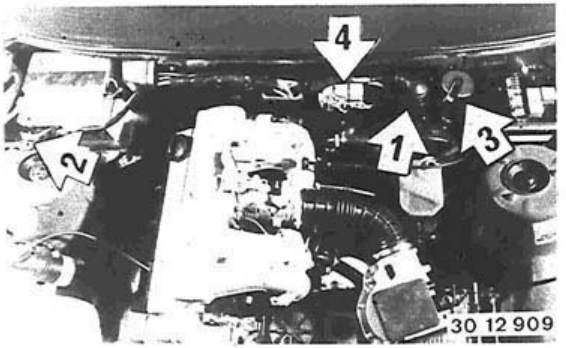


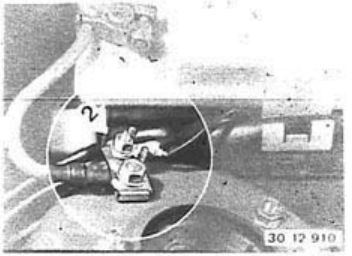
Air temperature sensor for ignition switchover



Engine electrical system ground point

M 40 (M 1.3):



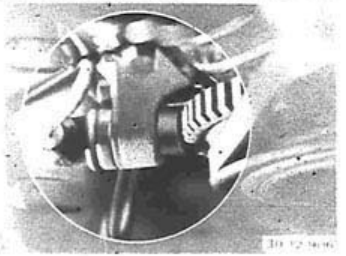


1 Plug

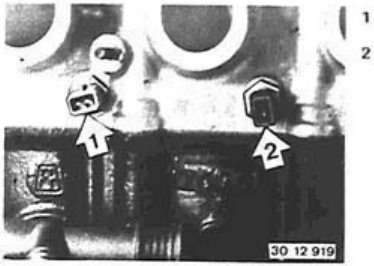
2 Engine electric and electronic ground point

3 Diagnosis socket

4 Relay (DME/electric fuel pump/oxygen sensor)

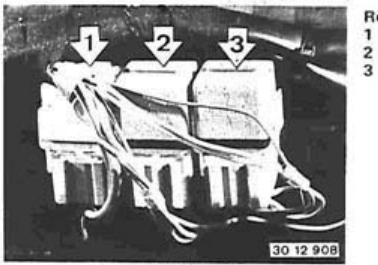


Inductive pulse sender

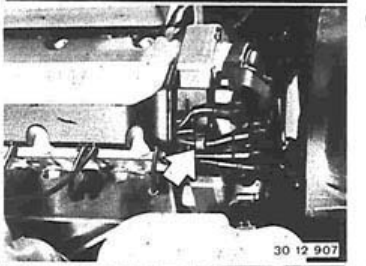


1 Coolant temperature sensor (DME)

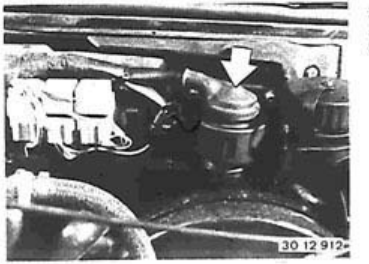
2 Temperature sender



Relay Arrangement:
1 DME
2 Electric fuel pump
3 Oxygen sensor

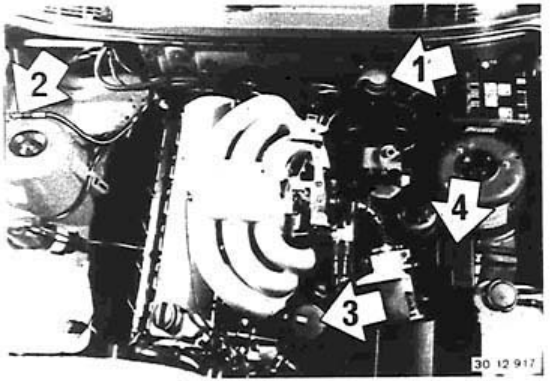


Cylinder identifying sender

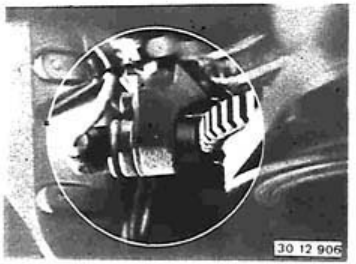


20-pin engine wire harness plug
Installation:
Screwed connector engages in final position.

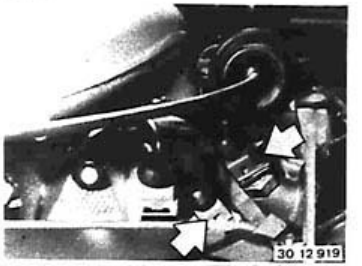
Engine Electrical Equipment Layout
M 20 (M 1.1) 320 i / 325 i



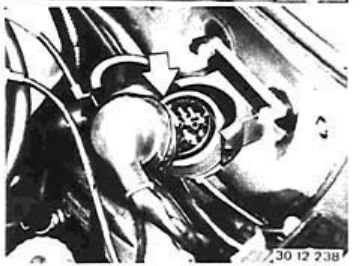
Layout:
1 = Engine wire harness plug
2 = Enine electric/electronic grd. point
3 = Diagnosis socket
4 = Relay connection point
Note:
Touring (Station Wagon) Models:
Battery located at front right.



Inductive pulse sender



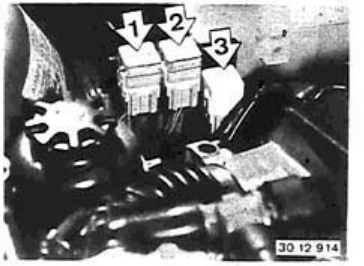
Coolant temperature sensor (DME) (blue)
Temperature gage



20-pin engine wire harness plug
Installation:
Screwed connection engages in final position.

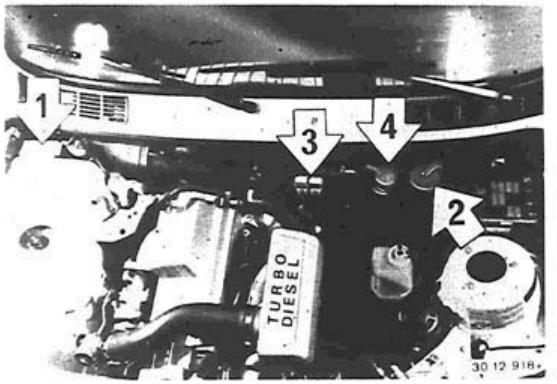


Cylinder identifying sender



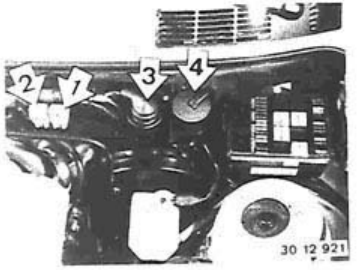
Relay Arrangement:
1 DME
2 Electric fuel pump
3 Oxygen sensor

Location of M 21 Engine Electric Components

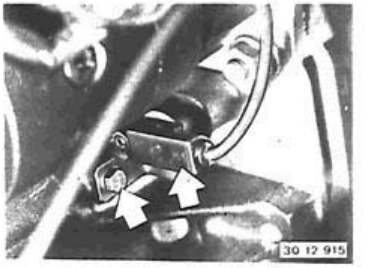


1 Heating time control unit
2 Diagnosis socket
3 Fuel filter heating relay
4 Engine plug

Note:
Battery of "touring" models is located front right.

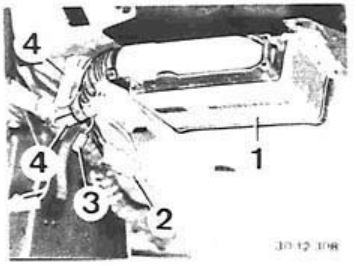


1 Pole mixup protection relay
2 Fuel heating relay
3 Engine plug
4 Diagnosis socket



Speed sender

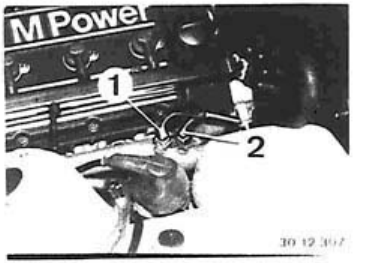
Adjustment – see 12 - 121.



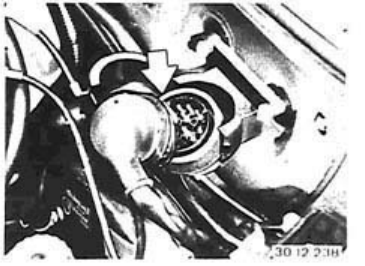
Location of S 14 Engine Electric Components in M3 Models:

Underneath trim panel in glove box.

1 DME control unit (see Group 13)
2 Car wire harness plug conn.
3 Air conditioner plug conn.
4 Fuel version plug conn. (see Group 13)



1 Coolant temperature sensor
2 Temperature gage



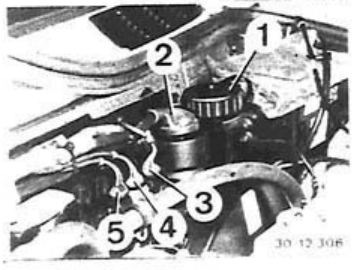
Engine wire harness plug (20 pins)

Installation:
The screwed connection must engage in final position.



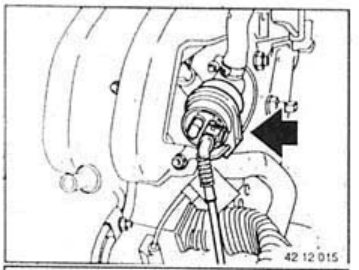
Relays behind trim panel.

1 Fuel pump relay
2 Master relay
3 Tank venting relay



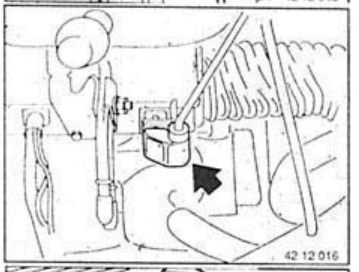
1 Diagnosis socket
2 Engine wire harness plug conn.
3 Position sender plug conn.
4 Reference mark sender plug conn. (gray)
5 Speed sender plug conn.

Location of M 42 Engine Electric Components:



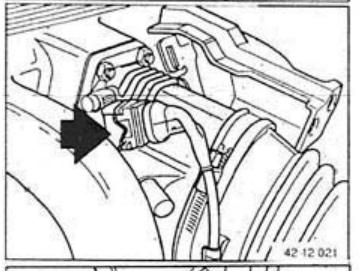
Idle speed control plug

Location:
On rear intake manifold.



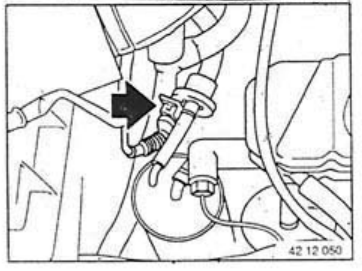
Plug for fuel injectors

Location:
On end of electric lead duct, close to the injection pipes.



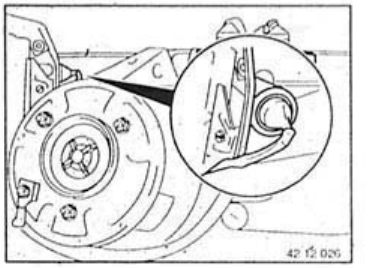
Throttle valve potentiometer plug

Location:
On throttle valve neck.
Nominal values – see Specifications.



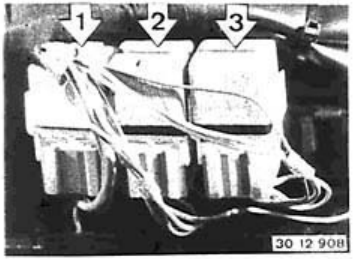
Tank venting valve plug

Location:
Next to air cleaner.



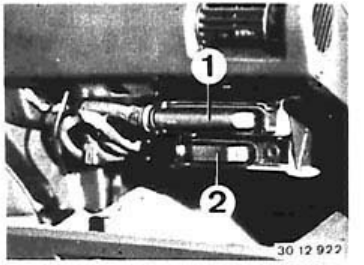
Oxygen sensor plug

Location:
Below battery console.



Location of Relays:

M 40 / M 42
1 Master relay
2 Fuel pump relay
3 Oxygen sensor relay

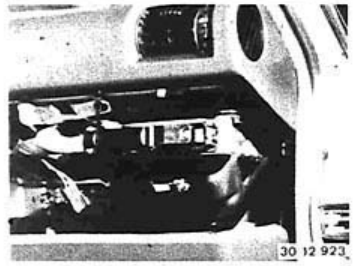


M 21

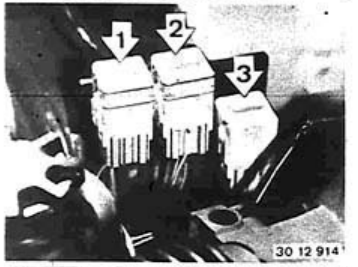
1 = MLG control unit (35 pins)
2 = AS control unit (25 pins)

MLG = Injection rate – combustion air – road speed

AS = Exhaust gas recirculation Beginning of injection



M 40 / M 42
DME control unit (in glove box)

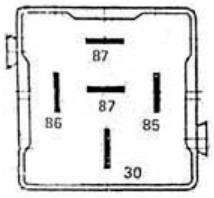


M 20
1 Master relay
2 Fuel pump relay
3 Oxygen sensor relay

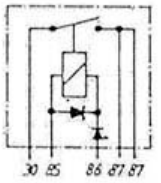


M 20
DME control unit (in glove box)

12 – 106/1



32 12 139



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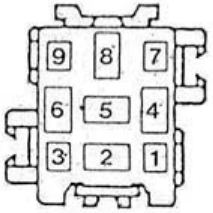
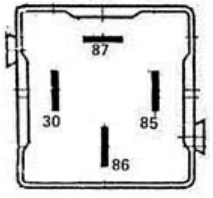


32 12 140

Master Relay: M 40 / M 20 / M 42
(plug conn., circuit diagram, socket)

Socket No.	Pin No.	Wire Colors	Wire Size mm²
2	87	red / white	0.75/4
4	85	brown	0.5
5	87	red / blue	4
6	86	red	0.5
8	30	red	4/0.5



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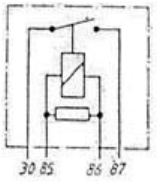

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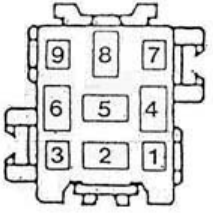
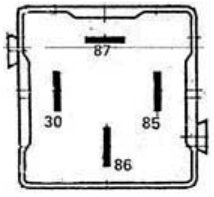


32 12 140

Fuel Pump Relay: M 40 / M 20 / M 42

Socket No.	Pin No.	Wire Colors	Wire Size mm²
2	87	green / violet	1.5/1
4	85	brown / green	0.5
6	30	red	1.5
8	86	red / white	0.75



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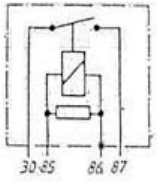

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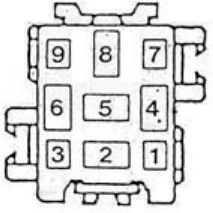
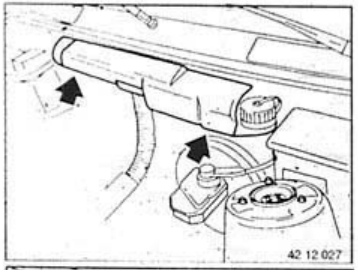


32 12 140

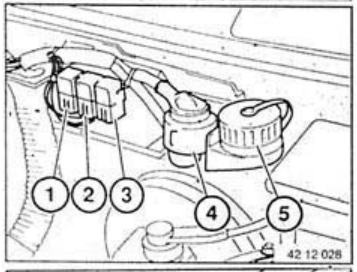
Oxygen Sensor Relay: M 40/M 20/M 42

Socket No.	Pin No.	Wire Colors	Wire Size mm²
2	87	green / blue	0.5
4	85	brown / green	
6	30	green / white	1/0.5
8	86	green / white	0.5

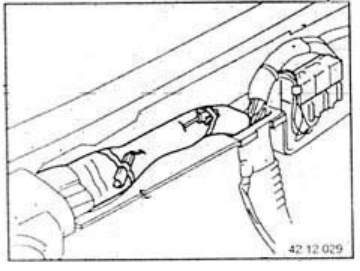


Location of Relays on Engine Compartment Firewall – M 42

Take off cover.



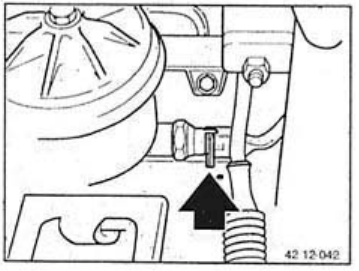
1 Master relay
2 Fuel pump relay
3 Oxygen sensor heating relay
4 Engine plug
5 Diagnosis socket



Plug for catalytic converter provision

Location:
On engine wire harness, on firewall. Black/white lead with single-pin plug receptacle.
Plug connected; catalytic converter not installed, idle speed CO potentiometer is activated.

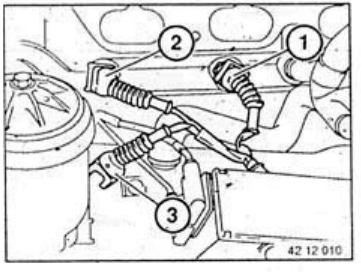
Plug disconnected: catalytic converter installed, idle speed CO potentiometer not activated. CO is regulated via the oxygen sensor.



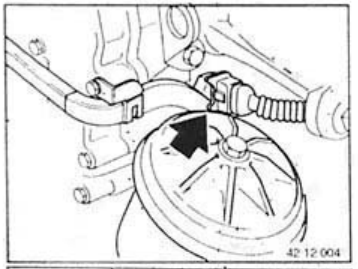
Removing and Installing / Replacing Oil Pressure Switch – M 42

Location:
On oil filter.

Important!
Plug receptacles on wire harness from the oil pressure switch and from the temperature gage sender are identical. Mark one of the plugs with insulating tape when disconnecting both plugs.
Diffference Between Both Plugs:
Lead of the temperature gage sender is guided out of the electric lead duct separately.



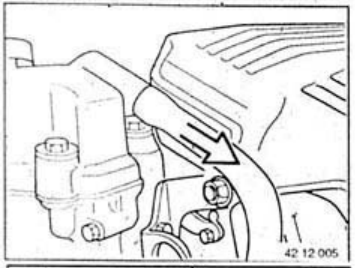
1 Coolant temperature gage sender
2 Coolant temperature sensor - DME
3 Oil pressure switch



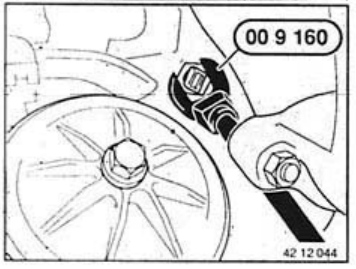
Removing and installing / Replacing Coolant Temperature Sensor for DME – M 42

Coolant temperature sensor

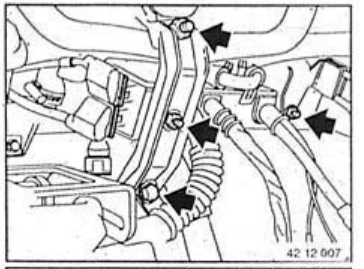
Disconnect plug.



Pull off crankcase venting hose.



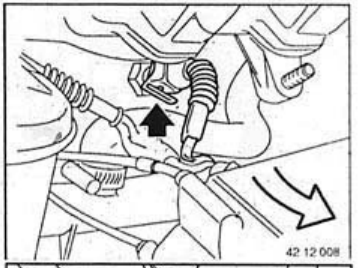
Unscrew with Special Tool 00 9 160.



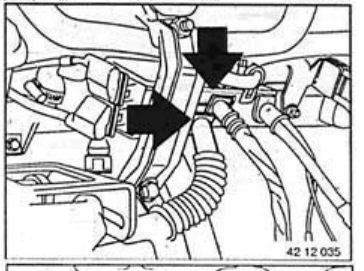
Removing and installing / Replacing Temperature Gage Sender – M 42

Remove complete air cleaner – see Group 13.

Pull off crankcase venting hose.

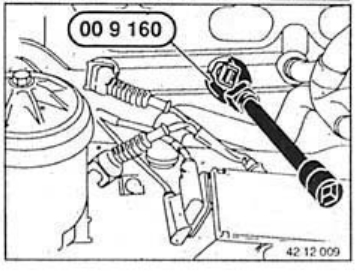


Remove complete intake manifold holder.
Loosen electric lead duct.

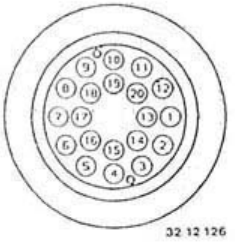


Pull electric lead duct forward.
Disconnect plug.

Caution!
Pulling the electric lead duct forward could cause unclipping of rubber grommets for electric lead openings in the electric lead duct, so that penetrating water would lead to malfunction of the engine electrical system. Consequently always check for correct seating of rubber grommets after installation of the electric lead duct.

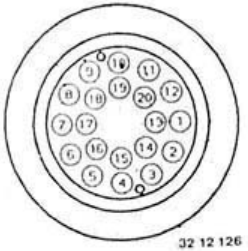


Unscrew with Special Tool 00 9 160.



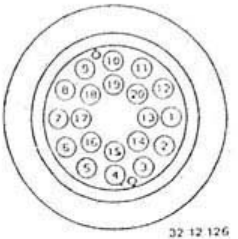
ENGINE PLUG CONNECTIONS (in Installed Position Seen From Above) M 40

Pin No.	Description		Wire Colors
1	D+	Generator charge indicator	blue
2	STAT	Oil level static	blue / white
3	TI	Injection signal	white / black
4	FT	Coolant temperature gage	brown / violet
5	OELD	Oil pressure	brown / green
6	15 S	Voltage with ignition on – fuse protection	green / white
7	15.U	Same as 6, but lead without fuse	green
8	TI	DME control unit / idle speed control	white / black
9	TD	Speed signal	black
10			
11	SI	Service indicator reset	white / green
12	CARB		brown
13	EKP	Electric fuel pump	green / violet
14	TACH	Speedometer signal	black / white
15	BOH	Starter / engine plug	black / green
16	Airb.	Engine plug / diagnosis plug	white / black
17			
18	50	Voltage while starting	black / yellow
19			
20			



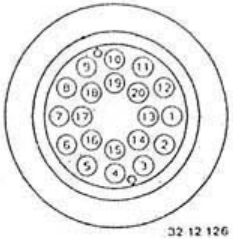
M 42 ENGINE PLUG CONNECTIONS (Top View in Installed Position)

Pin No.		Description	Wire Colors
1	D+	Alternator charge control	blue
2	–	–	–
3	–	–	–
4	FT	Coolant temperature gage	brown / white
5	OELD	Oil pressure	brown / green
6	15 S	Terminal 15 with fuse	green / yellow
7	15 DW	Terminal 15 without fuse	green
8	TI	DME control unit / idle speed control	white
9	TD	Speed signal	black
10	–	–	–
11	SI	Service indicator resetter	white / blue
12	CARB	DME control unit / engine plug	brown
13	EKP	Electric fuel pump	green / violet
14	TACH	Speedometer signal	black / white
15	30H	Signal from starter solenoid	black / green
16	AIRB	Engine plug / diagnosis socket	white / black
17	–	–	–
18	50	Voltage while starting	black / yellow
19	–	–	–
20	ABS	ABS signal	red / yellow



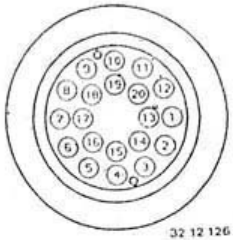
ENGINE PLUG CONNECTIONS (in Installed Position Seen From Above) M 20

Pin No.	Description		Wire Colors
1	D+	Generator charge indicator	blue
2	STAT	Oil level static	green / yellow
3	TXD		
4	FT	Coolant temperature gage	brown / violet
5	OELD	Oil pressure	brown / green
6	15 S	Voltage with ignition on – fuse protection	green / white
7	15 U	Same as 6, but lead without fuse	green
8	TI	DME control unit / idle speed control	white / green
9	TD	Speed signal	black
10	DYN	Oil level dynamic	blue
11	SI	Service indicator reset	white / green
12	CARB	DME control unit / engine plug	green
13	EKP	Electric fuel pump	green / violet
14	TACH	Speedometer signal	black / white
15	P / N	Starter / engine plug	black / green
16	Airb.	Engine plug / diagnosis plug	white / black
17			
18	50	Voltage while starting	black / yellow
19	PGSP		
20	FTM		brown



ENGINE PLUG CONNECTIONS (in Installed Position Seen From Above) M 21 (Diesel)

Pin No.	Description		Wire Colors
1	D+	Generator charge indicator	blue
2	STAT	Oil level static	blue / white
3	TI	Injection signal	white / black
4	FT	Coolant temperature gage	brown / violet
5	OELD	Oil pressure	brown / green
6	15 S	Voltage with ignition on – fuse protection	green / white
7	15 U	Same as 6, but lead without fuse	green
8	TQ	Control unit / engine plug	yellow / white
9	TD	Speed signal	black
10	DYN	Oil level dynamic	violet / green
11	SI	Service indicator reset	white / blue
12	CARB	Fault display only for US models	brown / white
13			
14	TACH	Speedometer signal	blue / yellow
15	P / N	Selector lever position	brown / black
16	Airb.	Engine plug / diagnosis plug	white / black
17	Wass	Water level / sensor / engine plug	brown / white
18	50	Voltage while starting	black / yellow
19	L 2	Preheating control unit / engine plug	brown / blue
20			



ENGINE PLUG CONNECTIONS (in Installed Position Seen From Above) S 14

Pin No.	Description		Wire Colors
1	D+	Generator charge indicator	blue
2	STAT	Oil level static	white
3	TI	Injection signal	white / black
4	FT	Coolant temperature gage	brown / white
5	OELD	Oil pressure	brown / green
6	15 S	Voltage with ignition on – fuse protection	yellow / blue
7	15 U	Same as 6, but lead without fuse	green
8	DWA	Burglar alarm	black / violet
9	TD	Speed signal	black
10	DYN	Oil level dynamic	yellow
11	SI	Service indicator reset	white / blue
12	CARB	Fault display only for US models	gray
13	EKP	Electric fuel pump	green / violet
14	TACH	Speedometer signal	black / white
15	P / N	Selector lever position	brown / black
16	RXD	Self-diagnosis transmitting lead	white / yellow
17	TXD	Self-diagnosis transmitting lead	white / violet
18	50	Voltage while starting	black / yellow
19	Oeltemp	Oil temperature sender	brown / violet
20	FTM	Temperature gage ground	brown / yellow

55-PIN PLUG CONNECTIONS:

Pin Number	M = Ground A = Ouput E = Input	Connections for Control Unit M 1.1
1	A	Ignition term. 1
20	A	–
38	E	Interface ASC (S–ASC/S–DWA)
2	M	Ignition ground
21	A	–
39	E	Programming voltage input
3	A	EKP relay and KW reference
22	A	LLR (ZWD) "closing"
40	E	Switch a/c compressor (S–KO)
4	A	LLR (ZWD) "opening"
23	A	–
41	E	Switch "air cond." (S–AC)
5	A	Tank venting (AKF valve)
24	M	Ground remaining final stages
42	E	Drive range switch (S–FS)
6	A	tD (standard interface)
25	A	–
43	E	–
7	E	Signal LMM
26	M	Ground LMM
44	E	Air temperature TANS
8	E	Cylinder identification
27	E	Terminal 15
45	E	Engine temperature TMOT
9	E	–
28	E	Oxygen sensor signal
46	E	–
10	(2)	Ground oxygen sensor
29	E	Speedometer signal from instr. cluster
47	E	IIG - conn. A, positive
11	E	–
30	M	–
48	M	IIG - conn. B, negative
12	A	Power supply LMM
31	(2)	Ground cylinder identification
49	E	–
13	E/A	Diagnosis call lead (S–DIA, RxD)
32	A	ti (standard interface, KVA)
50	E	Interface MSR (S–MSR)
14	M	Ground fuel injectors
33		–
51	E	Transmission tap (S–GE)
15	A	Fault lamp
34	A	–
52	E	Idle speed switch (S–LL)
16	A	EV group 2 (cyl. 1,3,5)
35	A	–
53	E	Full load switch (S–VL)
17	A	EV group 1 (cyl. 2,4,6)
36	A	DME relay (relay 2)
54	E	Switch - conv. lockup clutch (S–WK)
18	UB	Perm. pos. (supply CMOS–RAM)
37	UB	UB from DME relay
55	E/A	Serial diagnosis lead (TxD)
19	M	Ground electronic of control unit

Pin Number	M = Ground A = Output E = Input	Connections for Control Unit M 1.3
1	A	Ignition term. 1
20	A	Ignition term. 2
38	E	Interface ASR (S–ASR/S–DWA)
2	M	Ignition ground
21	A	–
39	E	Programming voltage input
3	A	EKP relay and KW reference
22	A	LLR (ZWD) "closing"
40	E	Compressor switch (S–KO)
4	A	LLR (EWD/ZWD) "opening"
23	A	Relay 3 ( )
41	E	Switch "air cond." (S–AC)
5	A	Tank venting (or AGR)
24	M	Ground remaining final stages
42	E	Drive range switch (S–FS)
6	A	tD (standard interface)
25		Free-burning (HLM)
43		Idle speed CO potentiometer
7	E	Signal LMM/HLM
26	M	Ground LMM/HLM
44	E	Air temperature TANS/TLADE
8	E	Cylinder ident. or camshaft sender
27	E	Term. 15
45	E	Engine temperature TMOT
9	E	Temperature knock sensor 2
28	E	Oxygen sensor
46		–
10	(2)	Ground oxygen sensor
29	E	Speedometer signal
47	E	DG 2 connection A
11	E	Knock sensor 1
30	M	Sender ground
48	M	DG 2 connection B, shielding
12	A	Power supply LMM or DK-potentiometer
31	(2)	Ground phase signal.
49	E	Simple diagnosis call lead
13	E/A	Diagnosis L lead (S–DIA)
32	A	KV signal (standard interface)
50	E	Interface MSR (S–MSR)
14	M	Ground fuel injectors
33	A	Relay 4
51	E	Transmission tap (S–GE)
15	A	Fault lamp
34	A	–
52	E	Idle speed sswitch (S–LL)
16	A	EV bank 2 (cyl. 1/2)
35	A	–
53	E	Full load switch (S–VL)
17	A	EV bank 1 (cyl. 3/4)
36	A	Master relay
54	E	Switch - conv. lockup clutch (S–WK)
18	UB	Permanent positive
37	UB	UB
55	E/A	Serial diagnosis lead
19	M	Ground electronics

Explanations

S	=	Switch
ASC	=	Automatic Stability Control
DWA	=	Burglar Alarm System
EKP	=	Electric fuel pump
KW	=	Crankshaft
LLR	=	Idle speed control
ZWS	=	Double-coil rotary control
LMM	=	Air flow sensor
HLM	=	Hot wire air mass sensor
IIG	=	Inductive pulse sender
MSR	=	Engine Drag Torque Control
EV	=	Fuel injector

(1)° Imax (0.2 A)/Umax (150 V)

(2) Potential-free ground input

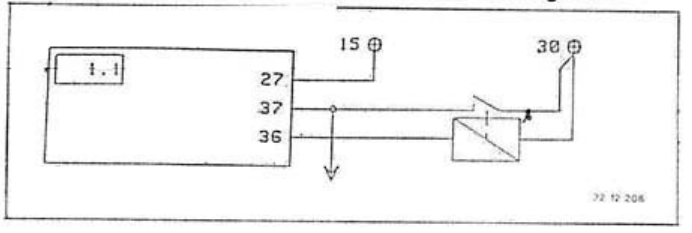
HOLDING CIRCUIT DIAGRAM
(M 1.1, M 1.3)

DME with holding circuit since 12.86 – terminals 27 and 36 used.

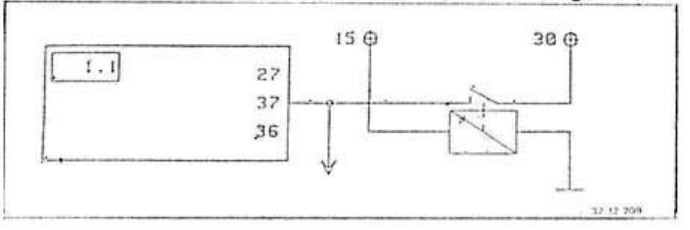
Important!
Control units of cars before 12.86 can not be used in cars since 12.86, since the car wire harnesses are different.

The holding circuit is provided so that Motronic can keep the master relay activated for another 3 seconds after switching off ignition lock term. 15 and with the engine stopped.

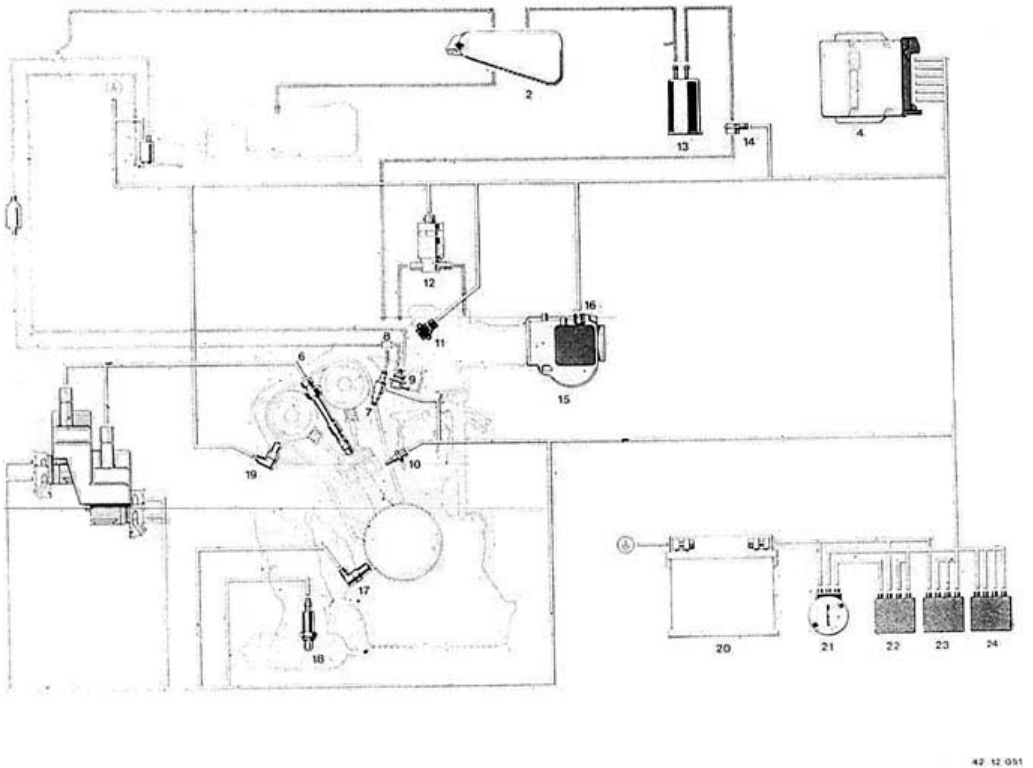
Motronic with Holding Circuit



Motronic without Holding Circuit



DME 1.7 Diagram for M 42



1 Fuel tank and pump
2 Fuel expansion tank
3 Fuel filter
4 DME M 1.7 control unit
5 Separate ignition coil package
6 Spark plug
7 Fuel injector
8 Fuel distribution pipe
9 Fuel pressure regulator
10 Coolant temperature sensor
11 Throttle valve potentiometer
12 Idle speed control
13 Carbon canister
14 Tank venting solenoid
15 Air flow sensor
16 Air temperature sensor
17 Speed and reference mark sender
18 Oxygen sensor
19 Cylinder identifying sender
20 Battery
21 Ignition lock
22 Master relay
23 Fuel pump relay
24 Oxygen sensor heating relay

TESTING MEANS

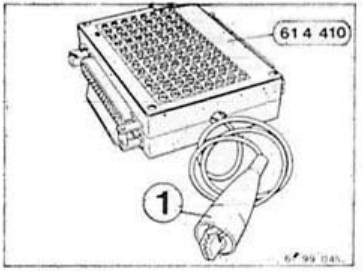
Wiring diagrams are contained in "General Car Electrical System – 3 Series" files.

Only use qualified testing leads, terminals and clips.

88 Pin Test Adapter Set 61 4 410:
Test adapter set consists of 88-pin adapter for troubleshooting on control units with 88-pin connection plates; test lead set with one each black and red test leads.

Multimeter tests can be carried out on periphery and control unit with this test adapter. Control unit must be taken out of holders for testing. Refer to pin connections for testing instructions in detail.

Inside of test box housing is coated with metal to avoid interference. Ground connection (1) must therefore always be connected with vehicle ground.
To keep capacitive and inductive loads as low as possible a printed circuit board is used internally. Consequently overloads (e.g. short circuits) must always be avoided!



DME 1.7 M 42 PIN CONNECTIONS

Connections of 88 Pin Plug Plate on DME Control Unit

If not specified to the contrary in "Testing Information" column, engine running at idle speed

Pin	Type	Description / Function	Connection	Type of Signal	Tester Display	Testing Information
1	A	EFP relay and TR signal CCS reference	EFP relay (ETC CU)	Ground + speed (superimposed)	ON	—
2	—	—	—	—	—	—
3	A	Fuel injectors (1+3)	FI	Ground phased	Injection time ti	Ground = fuel injectors opened, see activating components
4	—	—	—	—	—	—
5	—	—	—	—	—	—
6	M	Ground - fuel injectors	Ground point	Ground	—	—
7	—	—	—	—	—	—
8	A	Fault lamp	Instr. cluster	Ground	—	(only US) If emission fault stored
9	—	—	—	—	—	—
10	—	—	—	—	—	—
11	A	TV potentiometer	TV potentiometer	Pulse width module for ETC	—	—
12	E	TV potentiometer	TV potentiometer	Approx. 0.6 ... 4.2 V	Voltage value	Depending on TV position
13	—	—	—	—	—	—
14	M	Air flow sensor	AFS	Ground	—	—
15	—	—	—	—	—	—
16	E	Camshaft sender	Camshaft sender	Square-wave signal	ON	See status call
17	A	Fuel consumption signal	Instr. cluster	Square-wave signal	Multimeter func. Pulse duration	—
18	—	—	—	—	—	—
19	—	—	—	—	—	—
20	—	—	—	—	—	—
21	—	—	—	—	—	—
22	—	—	—	—	—	—
23	—	—	—	—	—	—
24	A	Ignition - cyl. 3	Ignition coil 3	Primary signal	Oscillograph	Refer to 12-119/3
25	A	Ignition - cyl. 1	Ignition coil 1	Primary signal	Oscillograph	Refer to 12-119/3
26	E	Permanent pos. (term. 30)	B+ conn. point	Battery voltage	—	—
27	A	DME master relay	DME MR term. 85	Ground	ON	Diagnosis not possible if not installed (bridge 30 and 87 on relay)
28	M	Grd. elctr./shield sensors	Ground point	Ground	—	—
29	A	Idle speed control	Idle speed contr.	Square-wave signal	—	—
30	—	—	—	—	—	—

Pin	Type	Description / Function	Connection	Type of Signal	Tester Display	Testing Information
31	—	—	—	—	—	—
32	A	Fuel injectors (2 + 4)	FI	Ground phased	Injection time ti	Ground = fuel injectors opened, see activating components
33	—	—	—	—	—	—
34	M	Grd. remaining final stages	Ground point	Ground	—	—
35	—	—	—	—	—	—
36	A	Tank vent	TVE valve	Ground phased	Closed/open	Activate components Ground = TVE closed
37	A	Oxygen sensor heating	Sensor heating relay	Ground	ON	Ground = sensor heating active
38	—	—	—	—	—	—
39	—	—	—	—	—	—
40	—	—	—	—	—	—
41	E	Air flow sensor signal	AFS	0 ... 5 V	AFS signal Up/Uv and load signal	See status call
42	—	—	—	—	—	—
43	M	Grd. - sender (TV pot., eng. temperature)	TV pot. eng. temp. sensor	Ground	—	—
44	M	Grd. - camshaft sender	Camshaft sender	Ground	ON	See status call
45	—	—	—	—	—	—
46	—	—	—	—	—	—
47	—	—	—	—	—	—
48	A	Air cond. compressor shutoff	Compressor shutoff relay	Ground	—	Ground = compressor off
49	—	—	—	—	—	—
50	—	—	—	—	—	—
51	A	Ignition - cyl. 4	Ignition coil 4	Primary signal	Oscillograph	Refer to 12-119/3
52	A	Ignition - cyl. 2	Ignition coil 2	Primary signal	Oscillograph	Refer to 12-119/3
53	—	—	—	—	—	—
54	E	Battery voltage	MR term. 87	Battery voltage	Voltage value	Call status. Diagnois is not possible if there is no signal. Bridge 30 and 87 on relay.
55	M	Ground - ignition	Ground point	Ground	—	—
56	E	Terminal 15	Ign. coils 1,2,3,4	Battery voltage	—	—
57	—	—	—	—	—	—
58	—	—	—	—	—	—
59	A	+ 5 volts (for AFS)	AFS	5 V	—	—
60	E	Programming voltage inlet	Diagnosis plug	Ground	—	Diagnosis socket cover closed

Pin	Type	Description / Function	Connection	Type of Signal	Tester Display	Testing Information
61	E	Programming voltage test	—	Ground	—	Diagnosis socket cover closed
62	—	—	—	—	—	—
63	E	Clutch lockup switch	ETC	Ground	ON (with engine, running)	If clutch lockup closed See status call
64	E	Transm. engaging switch	ETC	Ground	ON	If engaging active
65	E	Range switch /P/N)	Transm./selector lever switch	Ground	ON	If in P/N position
66	—	—	—	—	—	—
67	E	Inductive pulse sender	Pulse sender/speed position	Square-wave signal	—	Betw. pins 67 and 68 with engine running
68	M	Inductive pulse sender	Pulse sender/speed position	Ground	—	Betw. pins 67 and 68 with engine running
69	—	—	—	—	—	—
70	E	Signal - oxygen sensor	Oxygen sensor	Pulsating voltage up to approx. 1 V	Voltage value	Engine running, at operating temperature
71	M	Ground - oxygen sensor	Oxygen sensor	Ground	—	—
72	—	—	—	—	—	—
73	E	Road speed signal	Instr. cluster	Square-wave signal	km/h	See status call
74	A	TD signal	Instr. cluster	Square-wave signal	—	One signal for each ignition
75	—	—	—	—	—	—
76	E	IS CO potentiometer voltage	AFS	0 ... 5 V	Voltage value	—
77	E	Intake air temperature sensor	Intake air temp. sensor	0 ... 5 V	° C	Depending on temperature
78	E	Engine temperature sensor	Engine temp. sensor	0 ... 5 V	° C	Depending on temperature
79	—	—	—	—	—	—
80	—	—	—	—	—	—
81	E	Burglar alarm switch	BA	Battery voltage	OFF	Battery voltage if BA active
82	—	—	—	—	—	—
83	—	—	—	—	—	—
84	—	—	—	—	—	—
85	E	Air cond. compr. switch	AC compr. relay	Battery voltage	ON/OFF	Battery voltage if compressor ON
86	E	Air cond. switch	AC relay	Battery voltage	ON/OFF	Battery voltage if relay ON
87	E	RxD lead	Diagnosis plug	Battery voltage	—	Diagnosis socket cover closed
88	E A	TxD lead	Diagnosis plug	Ground	—	Diagnosis socket cover closed.

E = Inlet
A = Outlet
M = Ground

Digital Motor Electronics (DME) M 1.7 / Four Cylinder M 42 Engines

New in Comparison with Old DME Control Units:

- 88-pin plug
- Stationary ignition distribution
- Camshaft sender
- Throttle valve potentiometer
- Air conditioner compressor shutoff

Description of DME 1.7 Operation:

DME permit precise control and regulation of fuel injection and ignition even under variable operating conditions. It works additionally in conjunction with other systems, namely

- burglar alarm,
- instrument cluster and
- on-board computer,

which can influence the entire engine timing depending on requirements.

DME performs the following operations, which will be described in detail later.

- Fuel injection timing
- Ignition timing
- Ignition distribution
- Cold start control
- Adaptive idle speed regulation
- Adaptive oxygen sensor regulation
- Adaptive tank venting
- Accelerating enrichment
- Dynamic coasting shutoff
- Catalytic converter protection
- Anti-knock
- Emergency running
- Family curve switchover with EH transmission
- Relay controls
- Self-diagnosis with fault memory

Components Delivering Input Signals to DME Control Unit:

- Pulse sender (speed/position)
- Pulse sender (cylinder identification) camshaft sender
- Air flow sender
- Oxygen sensor
- Idle speed CO potentiometer (without catalytic converter)
- Throttle valve potentiometer
- Temperature sensor (intake air)
- Temperature sensor (engine)
- Road speed sender
- Burglar alarm
- Air conditioner switch
- Air conditioner compressor
- Battery
- Terminal 15
- Programming voltage (version coding)

Outputs on DME Control Unit Wired via Final Stages to Deliver Signals to Following Components:

- Fuel injectors (cylinders 1 + 3)
- Fuel injectors (cylinders 2 + 4)
- Ignition coil 1
- Ignition coil 2
- Ignition coil 3
- Ignition coil 4
- Idle speed control
- Air flow sensor
- Throttle valve potentiometer
- Tank venting valve
- Master relay (control unit power supply)
- Fuel pump relay
- Oxygen sensor heating relay
- Fault lamp (only USA)
- Economy control (instrument cluster)
- Instrument cluster (TD and ti signals)

IDLE SPEED CONTROL, SPEED LIMIT, COLD START CONTROL

Refer to E 34 diagnosis test plan in chapter 1210 DME M 1.3.

TYPES OF INJECTION

Each group of fuel injectors (2 + 4 or 1 + 3) is activated by a final stage (current amplifier). It is therefore possible to divide the injection cycle into groups of cylinders. This guarantees limited engine operation even when one group fails.

Semi-sequential injection:

There is injection in one group of cylinders (2 + 4 or 1 + 3) only once every 720 crankshaft degrees as from an engine speed of 600 rpm. This timing can function only when the DME control unit receives a signal from the camshaft sender (on camshaft sprocket of exhaust valves). Timing remains in semi-sequential injection if the signal is received later.

Parallel injection:

Parallel injection means simultaneous activation of all fuel injectors for each crankshaft revolution and takes place only when the camshaft sender has not put out any signals since starting the engine.
If a signal is put out later, the system switches over to semi-sequential injection as soon as an engine speed of 2500 rpm is exceeded.

IGNITION

Stationary Ignition Distribution:

Each cylinder has its own ignition coil. In this manner the system of rotating ignition distribution is omitted. DME activates each ignition coil separately.

Double Ignition:

Double ignition means activation of the spark plugs for each crankshaft revolution and takes place only when the camshaft sender does not put out signals. Switching over from normal to double ignition, or vice versa, takes place immediately in contradiction to fuel injection.

ANTI-KNOCK FUNCTION

The ignition timing is retarded depending on intake air and engine temperature, in order to prevent self-ignition of the fuel/air mixture in the combustion chamber (knocking).

CATALYTIC CONVERTER PROTECTION

There is danger of overheating the catalytic converter when the catalytic converter protection is active over a long period of time. For this reason the fuel / air mixture is enriched to reduce the exhaust gas temperature.

THROTTLE VALVE POTENTIOMETER

A throttle valve potentiometer is installed instead of a throttle valve switch with idle and full load contacts. This potentiometer must no longer be adjusted, since DME learns the idle speed ignition timing (idle speed switching point) on its own. DME adds a determined value to the learned value. This value must go from the potentiometer to DME in order to be processed as a full load signal in DME.

AIR CONDITIONER COMPRESSOR SHUTOFF

In order to have the entire engine power for drive while moving off, the air conditioner compressor is switched off for up to 7 seconds at road speeds of < 8 km/h (5 mph) and simultaneous full load state.

TANK VENTING FOR MODELS WITH CATALYTIC CONVERTER

OXYGEN SENSOR CONTROL FOR MODELS WITH CATALYTIC CONVERTER

DRIVE AWAY PREVENTION

SELF-DIAGNOSIS

Refer to E 34 diagnosis test plan in chapter 1210 DME M 1.3 for information about the BMW diagnosing system.

ABBREVIATIONS

AFS	Air flow sensor
AT	Automatic transmission
BA	Burglar alarm
CCS	Crankshaft
CMS	Camshaft
CU	Control unit
DME	Digital motor electronics
EFR	Electric fuel pump
EH	Electronic-hydraulic
ETC	Electronic transmission control
FI	Fuel injector
FL	Full load
IS	Idle speed
ISC	Idle speed control
KD	Kickdown
MF	Microfiche
MR	Master relay
MT	Manual transmission
PL	Partial load
RxD	Diagnosis sensing lead
SV	Solenoid valve
TD	Speed signal once each ignition
ti	Injection time
tL	Load signal
TR	Speed signal once each revolution
TV	Throttle valve
TVE	Tank vent
TxD	Diagnosis data lead
U-Batt	Battery voltage
U-Vers	Power supply

ENGINE ELECTRIC/ELECTRONIC BRIEF TEST LIST
– Without Application of Self-Diagnosis –**

This brief test list refers to important points, which are required for correct function of the engine electric/electronics.

Tests are arranged to support each other and therefore should be carried out in the given order.

Testing Requirements:

- Starting system okay (battery charged, starting motor and ignition lock).
- Good ground connections between engine and body and engine wire harness okay.
- Specified gasoline in tank (octane number, leaded/unleaded, not contaminated).
- Engine in good operating condition (timing, compression, etc.).

Preparations:

Connect universal adapter* on DME control unit and wire harness with 55-pin connecting leads.



730 34 121

* Source of Supply: HWB
** Alternatively with BMW Diagnosis Tester

Testing Connections on Universal Adapter	Test	Corrective Measures
Pin 18 / ground (19) Battery positive supply for control unit	Measure voltage ≈ 12 V	Check battery and lead via relay 2 (master relay) to control unit.
Pin 37 / ground (19) Power supply for control unit	Measure voltage with ignition ON > 10 V	Check / repair relay 2 (master relay) and electronics ground point.
Pins 2, 14, 19, 24 / body ground Ground supply for control unit	Measure resistance against battery negative or ground < 1 ohm	Check / repair connections and leads on ground point.
Pins 47 / 48 Inductive pulse sender	Check resistance of sender and plug connection 540 ohms ± 10 % Check speed signal (one signal for each revolution) with an oscilloscope	Repair leads, replacing pulse sender if necessary.
Pin 3 / ground Fuel pump relay activation	Check speed signal with oscilloscope	If pulse sender (pins 47 / 48) is okay, replace DME control unit.

Testing Connections on Universal Adapter	Test	Corrective Measure
Pin 1 (term. 1) / ground Ignition final stage	Crank engine with starting motor and check signal with an oscilloscope. Other Tests: Power supply for ignition coil Ignition coil Distributor and leads Spark plugs	Replace DME control unit, if tests up to this point are okay.
Pins 17 / 14 Final stage of fuel injectors for cyl. 2-4-6 (M20) Final stage of fuel injectors for cyl. 3-4 (M 40)	Check signal with an oscilloscope. Other Tests: . Plug connections and leads for fuel injectors Fuel injectors	Replace DME control unit, if tests up to this point are okay.
Pins 16 / 14 Final stage of fuel injectors for cyl. 1-3-5 (M 20) Final stage of fuel injectors for cyl. 1-2 (M 40)	Check signal with an oscilloscope. Other Tests: Plug connections and leads for fuel injectors Fuel injectors	

DDE OPERATING CONDITION TABLE FOR TROUBLESHOOTING

Faulty Component or Function	Replacement Value	Function Shutoff	Warning Lamp on Continuously	Influence on Operation
Solenoid for injection begin control or wrong inside pressure*	– –	Exhaust gas recirculation Injection begin control	–	Reduced torque – loud needling noise in lower speed range due to emergency injection begin
Program computer in 35-pin injection volume control unit	–	Injection volume control	–	Engine stops
Program computer in 25-pin injection begin control unit	yes	Exhaust gas recirculation Injection begin control and diagnosis	–	Reduced torque – loud combustion noise in lower speed range due to emergency injection begin
Computer coupling Speed and position sender	yes from injection begin sender	– Exhaust gas recirculation Injection begin control	– X	Reduced full load volume Engine might die while running at idle speed Reduced torque Different response behavior Moving off only possible with acceleration
Speed sender and injection begin sender Road speed sender (in rear final drive)	– 0 km/h (0 miles)	Injection rate and injection begin control Road speed control Hesitation damper	X –	Engine stops Strong hesitation in manual shift cars No idle speed boost while driving (manual shift models)
Drive potentiometer and drive for injection rate In injection pump	–	Injection rate control	X X	Engine stops
Fuel temperature sensor	0° C (+ 32° F)	–	–	Slight reduction in engine power
Air temperature sensor	+ 140° C (+ 284° F)	Exhaust gas recirculation	–	Slight impairment of response behavior (pickup)
Coolant temperature sensor	– 20° C (– 4° F) (+ 50° C/+ 122° F for self-cleaning)	Exhaust gas recirculation Exhaust gas recirculation	– –	Possibly brief starting smoke after hot start Increased starting rate stall speed Brief white smoke possible after cold start and poorer response behavior (pickup) with increase in speed
Charge pressure sensor Pedal value sender	980 mbar yes	Charge pressure control –	– –	Reduced torque Driving with constant engine speed 1200 rpm for manuals 1450 rpm for automatics
Injection begin sender (integrated in cyl. no. 4 fuel injector)		Exhaust gas recirculation Injection begin control	X	Reduced torque

* E.g. due to contaminated fuel (paraffine separation = flaking) or fuel tank driven empty possibly after replacement of fuel filter (briefly until filter is filled again).

TROUBLESHOOTING DME 1.7 M 42

Note
Always conform with safety and accident prevention regulations for all tests and work on the engine electric and electronic system.

Caution!
Dangerous high tension on primary and secondary circuits of ignition.

The battery should not be disconnected whenever possible, since otherwise this would cancel the faults stored in memories of all control units.

Disconnect control units on wire harness only with the ignition turned off.

Test electric leads only with disconnected control unit or component plugs.

Testing Means:

Wiring diagrams can be found in "General Car Electrical System - 3 Series" files.
Only use qualified testing leads, terminals and clips.
Use 88-pin test adapter set 61 4 410.
Multimeter

Presentation of a memory-stored fault on screen.

Location of Fault:
The number of a fault refers to the pin connection on the control unit. A fault could be on a component, concerned electric leads or in the control unit.

Type of Fault:
Shorts, breaks, exceeding of ranges or implausible functions are displayed.

Frequency:
Information whether or not (brief fault) a fault exists at the moment of time. Also display of how often the fault was recognized. If the fault no longer exists, the number of times the engine had been started since the last recognition of the fault is displayed.

Recognition During:
Additional fault information about the operating conditions during recognition of a fault.

List of Faults:

Faults stored in memories can be displayed on the tester by selecting 900 (Fault Memory).

No faults stored in memories.

Function disturbed: engine operation not possible.

Troubleshooting:

Requirements:
- Starting system okay (battery charged, ignition switch and starter okay, etc.).
- Ground connections on battery, engine and body okay.
- Specified gasoline in tank.
- Engine in perfect operating condition (timing, compression, etc.).

a) Check power supply for DME control unit according to wiring diagram.

b) Measure input signals.
   - Speed signal from inductive pulse sender at starting speed (see status call).
   - Air flow sensor signals (see status call).

c) Measure output signals.
   - Activation of fuel pump relay according to wiring diagram.
   - Ignition final stage with help of ENGINE TEST test step 10.
   - Fuel injectors - check to component test.

d) Test fuel pressure.
   Technical data – see component testing chapter.

FAULT 1

900 fault memory: 1 electric fuel pump relay

Explanation:
This fault is stored when a short occurs on relay 1 (electric fuel pump) or in control lead to DME control unit pin 1. This fault is recognized only when at least one additional final stage is faulty.

Troubleshooting: as displayed on screen.

FAULT 3

900 fault memory: 3 fuel injectors cyl. 1 + 3

Explanation:
This fault is stored when shorts or breaks occur on fuel injectors for cyl. 1 + 3 or their power supply leads.

Note: The entire fuel injector group is stopped with a short on one fuel injector or its power supply lead. Two cylinders remain in operation.

Troubleshooting: as displayed on screen.

FAULT 8

900 fault memory: 8 fault lamp

Explanation: Only applicable for US models.
This fault is stored when shorts occur on fault lamp or its power supply lead.

Troubleshooting: as displayed on screen.

FAULT 12

900 fault memory: 12 throttle valve potentiometer

Explanation: This fault is stored when shorts or breaks occur on potentiometer or its power supply leads.

Troubleshooting: as displayed on screen. Test values – see component testing.

FAULT 16

900 fault memory: 16 camshaft sender

Explanation: This fault is stored when faulty signals from camshaft sender occurr at speed of > 2500 rpm.

Troubleshooting: as displayed on screen.

FAULT 29

900 fault memory: 29 idle speed control

Explanation: This fault is stored when a short or break occurs in lead to pin 29.

Troubleshooting: as displayed on screen.

FAULT 32

900 fault memory: 32 fuel injectors - cyl. 2 + 4

Explanation: see Fault 3.

FAULT 36

900 fault memory: 36 tank venting valve

Explanation: This fault is stored when a short or break occurs on tank venting valve or its power supply lead.

Troubleshooting: as displayed on screen. Test values – see component testing.

FAULT 87

900 fault memory: 37 oxygen sensor heating relay

Explanation: Fault is stored when a short or break on relay or power supply lead from DME control unit pin 37 is recognized.

Troubleshooting: as displayed on screen.

FAULT 41

900 fault memory: 41 air flow sensor

Explanation: This fault is stored when shorts or breaks occur on air flow sensor or its leads (power supply or signal lead).
Also recognition when Up/Uv value of LMM is no longer in the normal operating range of 0.02 to 0.95.
DME control unit then works with determined replacement values, load signal tL = 3.5 ms (partial load) and 6.0 ms (full load) and ignition timing = 20 crankshaft degrees before TDC.

Troubleshooting: as displayed on screen.
Test air flow sensor with status call 200. Up/Uv value shows the relation betw. potentiometer voltage (slider) and power supply voltage (5 V) in air flow sensor.
Specifications – see component testing.

FAULT 54

900 fault memory: 54 control unit power supply

Explanation: This fault is stored when power supply exceeds 16 V. A drop below 9 V is recognized 3 minutes after starting at the earliest.

Possible Fault Causes:
- Contact resistance on lead connections
- Incorrect drive belt tightness
- Voltage regulator or alternator faulty

Troubleshooting: as displayed on screen.

FAULT 70

900 fault memory: 70 oxygen sensor

Explanation: This fault is stored when a short or break occurs on oxygen sensor or its leads, or when no oxygen senor is installed (cars prepared for catalytic converter). It requires an engine temperature of > 70° C (158° F) over a period of 3 minutes and a load signal of 3.5 ms for 5 seconds.

Troubleshooting: as displayed on screen.
Test values for oxygen sensor – see component testing.

FAULT 73

900 fault memory: 73 road speed signal

Explanation: This fault is stored by DME when following conditions are fulfilled simultaneously.

Engine speed	> 4500 rpm
Load signal	5.0 ms
Road speed signal	3 to 5 km/h (2 to 3 mph)

Troubleshooting: as displayed on screen.

FAULT 76

900 fault memory: 76 idle speed CO potentiometer

Explanation: Valid only for cars without catalytic converter. This fault is stored when shorts or breaks occur on potentiometer or its leads. Replacement value of 2.77 V is used.

Troubleshooting: as displayed on screen. Test values – see component testing.

FAULT 77

900 fault memory: 77 intake air temperature sensor

Explanation: This fault is stored when shorts or breaks occur on temperature sensor or its leads. Recognition of a break requires 3 minutes time after starting and idle speed for at least 30 seconds. Replacement value of 50° C (122° F) is used after recognition of fault.

Troubleshooting: as displayed on screen. Test values – see component testing.

FAULT 78

900 fault memory: 78 engine temperature sensor

Explanation: This fault is stored when shorts or breaks occur on temperature sensor or its leads.
Intake air temperature is used as a replacement value in case of fault, but only for the first 3 minutes after starting when air temperature is < 20° C (68° F). A replacement value of 80° C (176° F) is ready for use in other conditions.

Troubleshooting: as displayed on screen. Test values – see component testing.

FAULT 85

900 fault memory: 85 air conditioner compressor

Explanation: This fault is stored when control unit receives "compressor in operation" (battery voltage on pin 85) and "A/C switch not operated" (0 V on pin 86) signals simultaneously. In this case either pin 86 has a break or there is a short between battery voltage and pin 85.

Troubleshooting: as displayed on screen.

FAULT 100

900 fault memory: 100 final stage

Explanation: This fault is stored when a loose contact occurs on a final stage output. If another final stage fault (Fault Codes 1, 3, 18, 29, 32, 36 or 37) occurs additionally, it can be assumed that fault 100 is identical with one of these faults.

FAULT 200

900 fault memory: 200 DME control unit

Explanation: This fault is stored when the internal self-test finds a fault in the memory modules (manipulated data).

Possible causes: programming fault or disturbed program run-off in DME control unit. This fault will also be stored when programming of the control unit had been manipulated. In this case the locks on the control unit housing will be damaged.

Correction: Test drive car after cancelling the fault memory. DME control unit must be replaced if the fault occurs again.

FAULT 201

900 fault memory: 201 oxygen sensor control

Explanation: This fault is stored in case of excessive deviation in the fuel/air mixture (excessively rich or lean mixture for longer than 12 seconds). It requires an oxygen sensor ready for operation.

Possible Causes of Fault:
- Wrong fuel pressure
- Faulty or carbonized fuel injectors
- Faulty engine temperature sensor
- Wrong air in intake
- Faulty tank venting system
- Dirty spark plug
- Leak in exhaust system in front of oxygen sensor
- Faulty air flow sensor
- Impaired combustion (ignition or compression not okay)

Troubleshooting: as displayed on screen. Test values – see component testing and technical data microfiche.

COMPONENT TESTING DME 1.7 M 42

Note:
Always conform with safety and accident prevention regulations for all tests and work on the engine electric and electronic system.

Caution!
Dangerous high tension on primary and secondary circuits of ignition.

Important!
The battery should not be disconnected whenever possible, since otherwise this would cancel the faults stored in memories of all control units.
Disconnect control units on wire harness only with the ignition turned off.
Test electric leads only with disconnected control unit or component plugs.

Testing Means:

Wiring diagrams can be found in "General Car Electrical System - 3 Series" files.
Only use qualified testing leads, terminals and clips.
Use 88-pin test adapter set 61 4 410. Multimeter

Test values for component testing are listed in the appendix. Refer to technical data microfiche for other specifications.
Removal and installation are described in the repair manual.

SURVEY OF FAULT CODES AND COMPONENT TESTS

Component / Function	Brief Test Input	Fault Code in Memory
DME control unit	–	200
Ignition coils	–	–
Fuel pump relay (relay 1)	100	1
Throttle valve potentiometer	200	12
Tank venting valve	100, 300	36
Air flow sensor	200	41
Camshaft sender	100	16
Oxygen control	100	201
Fault lamp	–	8
Fuel injectors	300	3/32
Sensor heating relay	300	37
Oxygen sensor	100	70
Road speed signal	200	73
A/C compressor shutoff	–	48
DME master relay (relay 2)	100	–
Power supply	200	54
Air conditioner switch	100	–
A/C compressor	100	85
CO potentiometer	200	76
Idle speed control	–	29
Intake air temperature sensor	200	77
Engine temperature sensor	200	78
Speed/position pulse sender	200	–
Ignition timing tap	100	64
Converter clutch	–	63

DME CONTROL UNIT

Function Test:
Different function blocks such as, for example, ignition, injection, oxygen control, etc. can only be tested when necessary input signals are receivede on the control unit first – see pin connections.

FUEL PUMP RELAY (DME Relay 1)

Function Test:
100 - electric fuel pump relay must switch on while starting or running engine (display: ON). In addition with ignition ON electric fuel pump relay is briefly activated by DME in order to build up required fuel pressure prior to starting. Rise in voltage can be measured at fuse 23.

Possible Causes of Fault:
- Lead to DME control unit pin 1 faulty
- Relay 1 or power supply faulty
- Power supply for DME control unit faulty
- No signals from speed/position pulse sender
- No ground potential put out on DME control unit pin 1 while starting and running engine, although above points are okay = control unit is faulty

IDLE SPEED CONTROL (LLS)

Function Test:
300 - Idle speed control is activated with second cycle – plate on idle speed control must open and close fully.

Resistance Test:
Resistance of coil can be measured direct on the component.
See appendix for specifications.

TANK VENTING VALVE

Electric Function Test:
300 - Valve is activated with second cycle. Cycling can be felt with hand.

Leak Test:
Disconnect hoses on valve, connect vacuum supply from Service Tester on the 8 mm connection (note flow direction arrow). Regulate vacuum to 600 mbar and supply 12 V to valve.
Switch off vacuum pump – pressure drop must not exceed 50 mbar after 20 seconds.
In a state without electric current the valve is closed by a check valve to to intake pipe vacuum of 20 mbar.

Activating Phase Test:
100 - Valve is activated at idle speed (display: OFF) and therefore closed. Gradual opening can be observed as soon as oxygen control is active and the speed increased (display: OPEN). Tank vent valve is closed for about 100 seconds between phases of scavenging.
The valve is still kept closed for 3 to 5 seconds after stopping the engine.

AIR FLOW SENSOR (LMM)

LMM Signal Test:
100 - Up/Uv value (Up = potentiometer voltage, Uv = power supply voltage 5 V) indicates the voltage relation resulting from the sensor plate position in LMM. At idle speed the value should be 0.2 to 0.3; at full load it rises to 0.9. A value of 0.02 is displayed when power supply or control lead has a break.

Power Supply Test:
5 V power is supplied to LMM from DME control unit pin 59 (+) and pin 14 (–) with the ignition ON. See wiring diagram for connections on LMM.

CAMSHAFT SENDER

Function Test:
100 - Full bank injection is switched over to semi-sequential injection and double ignition switched off as soon as the control unit receives camshaft sender signals. If the signal comes later, semi-sequential injection is maintained. Switching over from normal to double ignition, or vice versa, takes place immediately in contradiction to fuel injection.
Further testing with multimeter test 23/24. Connect oscilloscope on component plug and operate engine at idle speed. An alternating voltage curve with positive and negative half-waves should appear on the screen.

Resistance Test:
Resistance can be measured direct on the component plug. See appendix for specifications.

OXYGEN CONTROL

Function Test:
100 - Oxygen sensor at operating temperature is required for calling. Engine must be run at least 30 to 40 seconds before regulation cuts in. Engine operation is necessary (50° C/122° F engine temperature at idle speed, 30° C/86° C at partial load). Oxygen control cuts in later at lower outside temperatures. Regulation can compensate wear-caused deviations in fuel/air mixing to a great extent and consequently hide other faults. If applicable, disconnect the oxygen sensor while troubleshooting the fuel/air mixture. Single-pin plug for CO potentiometer in engine wire harness (on firewall) must not be connected.

OXYGEN SENSOR

Function Test:
200 - Requirement for calling is oxygen sensor at operating temperature. The displayed voltage signal is tapped in steps and fluctuates between 0.02 and 0.85 V. A constant value of 0.45 V is displayed when the oxygen sensor is not working or lead to DME control unit has a break. This value is also displayed when no oxygen sensor is installed.

CO POTENTIOMETER (Without Catalytic Converter)

Function Test:
200 - Single-pin plug for CO potentiometer in engine wire harness (on firewall) must be connected. Measure CO. Turn adjusting screw on air flow sensor to adjust to specified value. Basic setting of potentiometer is 2.77 V. Refer to 12-152 for Specifications.

FAULT LAMP "CHECK ENGINE" (only USA)

Function Test:
Fault lamp receives 12 V power supply from control unit as soon as an exhaust relevant fault is detected. It lights up continuously after ignition is turned ON for controlling.

FUEL INJECTORS

Electric Function Test:
300 - Fuel injectors are activated with a frequency of 10 Hz. Pulse time is 1 ms. To avoid the ejection of fuel, activation time must be as brief as possible. Activation can be felt with a hand. Pulses can be checked with a multimeter on the fuel injector plug.

Resistance Test:
Resistance of a fuel injector must be measured direct on the component. Only a complete fuel injector group (2 injectors) can be measured on DME control unit plug. See appendix for specifications.

SENSOR HEATING RELAY

Function Test:
300 - This activation takes place in second cycles. Relay remains switched on in normal operation for so long, until high speeds or load occur.

Possible Causes of Fault:
- Lead to DME control unit pin 37 faulty
- Relay or power supply faulty

CONTROL MASTER RELAY (DME Relay 2)

Function Test:
100 - Master relay is activated on terminal 85 with ground potential after ignition is turned ON or engine runs (display: ON). Relay switches on and supplies rest of control unit with power.

Possible Causes of Fault:
- Lead to DME control unit pin 54 faulty
- Relay 2 or power supply faulty
- Power supply for DME control unit faulty
- Control unit faulty when ground potential is not put out on control unit pin 54, although above points are okay

CONTROL UNIT POWER SUPPLY

100 - Control unit has the voltage displayed at the moment. It should not be less than 10 V.

INTAKE AIR TEMPERATURE SENSOR (In Air Flow Sensor)

Function Test:
200 - Intake air temperature of engine at operating temperature is 50 to 70° C (122 to 158° F) – ambient air temperature 23 ± 5° C (73 ± 9° F).
A display below – 40° C (– 40° F) indicates a break in the temperature sensor or lead to the DME control unit.

Resistance Test:
Connect universal adapter. Measure resistance on connections 77 and 14. Or direct on air flow sensor pins 4 and 5. See appendix for specifications.

ENGINE TEMPERATURE SENSOR (Coolant)

Function Test:
200 - Displayed engine temperature should correspond with the coolant temperature. A value below – 40° C (– 40° F) indicates a break in the temperature sensor or lead to the DME control unit.

Resistance Test:
Connect universal adapter on engine wire harness. Measure resistance on connections 45 and 19. See appendix for specifications.

SPEED / POSITION PULSE SENDER

Function Test:
200 - Speed signals can be called at starting speed on from running engine. Further testing with multimeter test 23/24. Connect oscilloscope on component plug and crank the engine. An alternating voltage curve with positive and negative half-waves should appear on the screen.

Resistance Test:
Resistance can be measured direct on the component plug. See wiring diagram for connections. See appendix for specifications.

Possible Cause of Fault:
If lead, plug and resistance are okay, check distance of pulse sender to incremental wheel on the vibration damper – 0.15 to 1.5 mm (0.006 to 0.059").
Adjusted distance with adjustable holder: 1.0 ± 0.3 mm (0.039 ± 0.012").

THROTTLE VALVE POTENTIOMETER

Function Test:
200 - Operate throttle valve and observe the voltage value. Voltage values approximately between 0.6 (idle speed) and 4.2 (full load) volts. (4.9 V = break)

Resistance Test:
See appendix for specifications.

Installation:
DME control unit must be disconnected from power supply at least 10 seconds after replacement of throttle valve assembly or throttle valve potentiometer.

IGNITION COIL

See 12-212.

Status Call 100		Nominal State
101	Electric fuel pump relay	While starting or running engine = ON
116	Camshaft sender	After coasting shutoff once = ON
127	Master relay	While starting or running engine = ON
136	Tank venting valve	Idling = OFF until timing begins
137	Oxygen sensor heating	With high speed and load = OFF
163	Converter clutch (only EGS)	Speed dependent in 3rd + 4th gear = ON
164	Ignition timing tap (only cars with manual transmission)	At idle speed = OFF, only for downshifts ON briefly
165	Range P/N (only automatics)	Selector lever in P or N = ON
171	Oxygen control	Engine running = ON, if oxygen sensor has operating temperature
181	Burglar alarm switch	Burglar alarm not activated = OFF
185	Compressor control	Compressor relay switched on = ON
186	Air conditioner switch	Switch (defroster, air circ. or air cond.) operated and air volume control wheel not set to 0 = ON

Status Call 200		Nominal Values
212	Throttle valve potentiometer	0.6 (idle) to 4.2 V (full load), 4.9 V = break
241	LMM Up/Uv relation [1]	0.1 to 0.3, break = 0.02
254	Control unit power supply	> 10 V
270	Oxygen sensor voltage (cat) [1]	0.02 to 0.85 V, with break or faulty oxygen sensor = 0.45 V
273	Road speed	Depending on road speed
276	CO potentiometer (no cat.)	Basic setting = 2.77 V
	CO in % by vol. [1] [3]	0.7 ± 0.5
277	Intake air temperature	Depending on ambient temperature, approx. – 40° C (– 40° F) = break
278	Engine temperature	Depending on engine operation, approx. – 40° C (– 40° F) = break
225	Ign. timing in crankshaft degrees before TDC [1]	11 ± 3
274	Engine speed in rpm [1]	
	Idle speed	850 ± 40
	Shutoff speed	6500 ± 40
217	Inj. signal ti in ms [1] [2]	3.2 to 3.9
290	Load signal tL in ms [1]	1.3 to 1.6

1) Oil temperature 60° C (140° F) or coolant temperature 80° C (176° F), no electric power consuming equipment switched on, at idle speed.

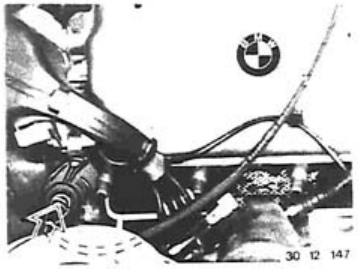
2) Valid with semi-sequential injection.

3) Measured ahead of the catalytic converter – engine test, test step 09.

TECHNICAL DATA – DME 1.7 M 42

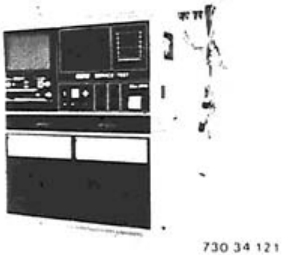
Resistance measured at 23 ± 5° C (73 ± 9° F)

Idle speed control (one coil)	8 ± 2 ohms
Fuel injector	15 to 17 ohms
Fule injector group (2 injectors)	8 ± 0.5 ohms
Speed/position pulse sender	540 ± 60 ohms
Cylinder identifying pulse sender	1.15 to 1.41 k-ohms
Engine temperature sensor	
at 20 ± 3° C (68 ± 5° F) coolant temp.	2.3 to 2.7 k-ohms
at 80 ± 3° C (176 ± 5° F) coolant temp.	0.3 to 0.36 k-ohm
Intake air temperature sensor	
at 20 ± 3° C (68 ± 5° F) air temp.	2.2 to 2.7 k-ohms
at 50 ± 3° C (122 ± 5° F) air temp.	0.76 to 0.91 k-ohm
Tank venting valve	45 ± 20 ohms
Ignition coil	
primary coil	0.4 to 0.8 ohm
secondary coil	not measurable
Throttle valve potentiometer	
idle speed position	4 ± 0.8 k-ohms
full load position	1 ± 0.2 k-ohm



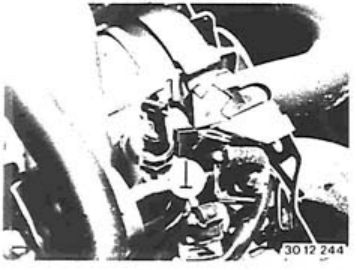
12 11 004 CHECKING AND ADJUSTING IGNITION TIMING – 4 Cylinder / M 10 –

Important!
See page 12 - 0 for instructions for working on engine electrical system.
Testing Conditions:
Pluggable TDC sender installed.
Engine at operating temperature – oil temperature at least 60° C (140° F).
Distributor/DME control unit number** conforms with information on nominal value microfiche.



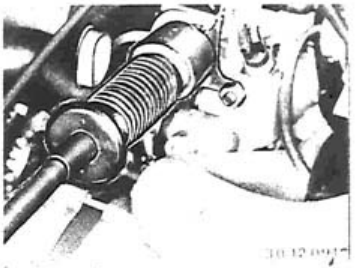
Connect BMW Service Tester or BMW Digital Tester to operating instructions.

Cars with NOx Control:
The NOx control unit is series connected after the ignition control unit as a second control unit. Function of NOx control has to be stopped to check the ignition timing.

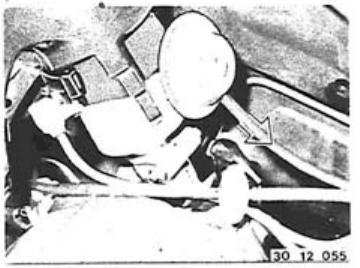


Pull off 4.8 mm (0.189") plug on 17° C (63° F) temperature switch and hold on ground.
Check / adjust ignition timing.
At engine speed of about 1500 rpm NOx control will retard the ignition timing by approx. 10°.

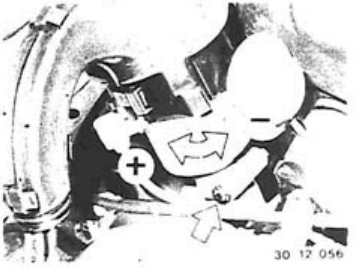
** See Specifications



Checking Dwell Angle:
The dwell angle is given by design and can be checked, but not adjusted.
The ignition control unit is no longer ready for operation in case of malfunction.

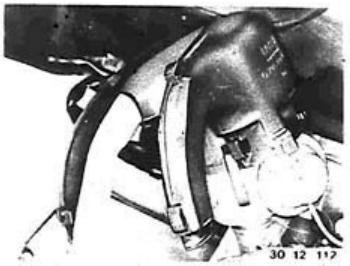


Checking/Adjusting Ignition Timing*:
Pull off vacuum hose for advance control.



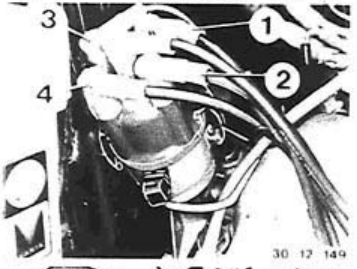
Start and run engine at test speed*.
Check ignition timing,* adjusting if necessary.
Correct by loosening screw and turning the distributor accordingly.
+ = ignition timing advanced
– = ignition timing retarded

* See Nominal Value Microfiche

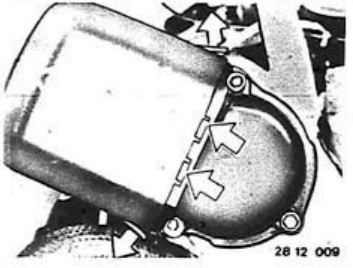


12 11 091 REPLACING DISTRIBUTOR CAP

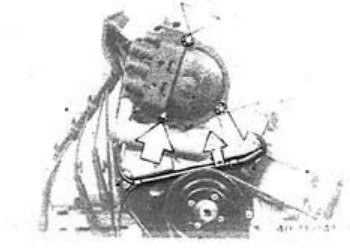
Important!
See page 12 - 0 for instructions for working on engine electrical system.
Engine M 10:
Take off protective cap.
Installation:
Have clips engage correctly.
Install retaining strap.



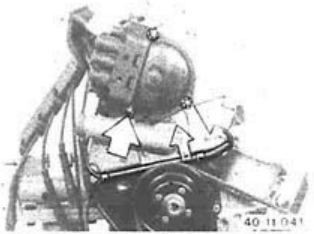
Open clips and take off distributor cap.
Pull out shielded plug.
Installation:
Check firing order.



Engine M 40 / M 20:
Take off cover.
Installation:
Engage cover in holders.
Note:
M 20:
Unscrew water pipe on engine block.



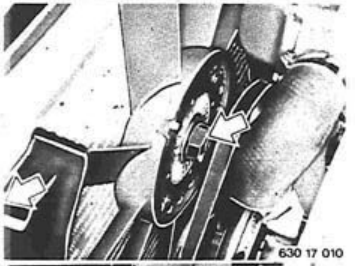
Pull off shielded plug.
Installation:
Numbers on leads and cap (e.g. 5) must be the same.
ZS = Ignition coil
Note:
Firing Order:
M 40: 1, 3, 4, 2
M 20: 1, 5, 3, 6, 2, 4



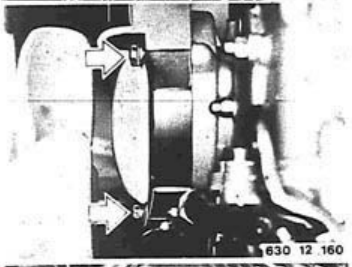
12 11 111 REPLACING DISTRIBUTOR ROTOR

Remove distributor cap – see 12 11 091.

Caution!
Danger of cutting hands on radiator fins.

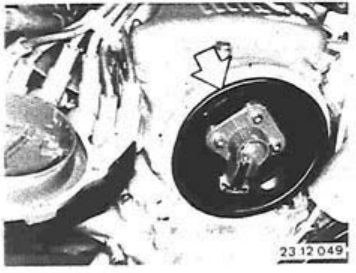


Remove fan – left-hand threads! Use Special Tool 11 5 030 / 040. Unscrew and push up fan cowl.

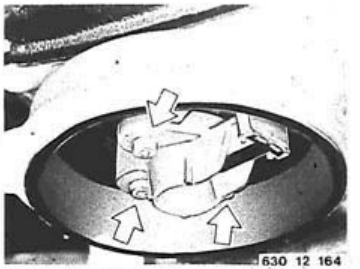


Unscrew screws and take off distributor.

Caution!
Danger of cutting hands on radiator fins.

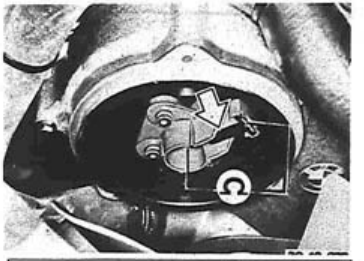


Installation:
Check seal, replacing if necessary.

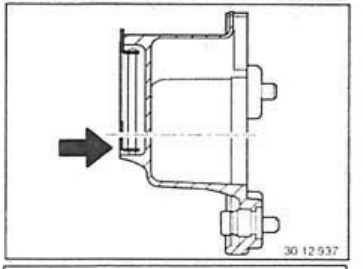


Unscrew screws with 3 mm key.

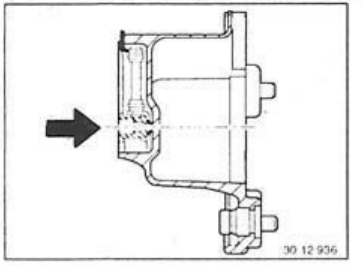
Installation:
Tightening torque*.



Testing:
Measure resistance*.
Check surface and cast compound for cracks and burnt spots.



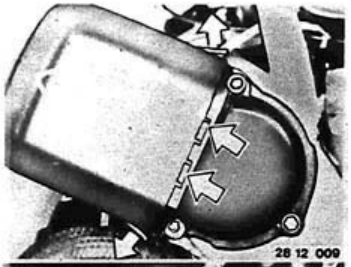
S 14:
Distributor rotor without cavity, with flat contact for terminal 4:
Always make sure that a spring-loaded carbon pin is installed with the distributor cap.



Distributor rotor with cavity:
Only distributor caps with fixed brass pin may be installed.

Caution!
Wrong matching of distributor rotors and distributor caps could lead to damage on distributor cap.

* See Specifications

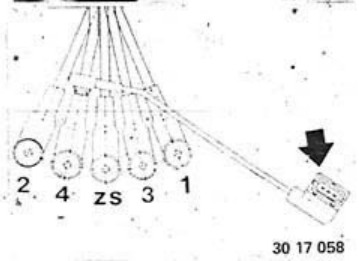


12 12 . . . REPLACING SENDER FOR CYLINDER IDENTIFICATION

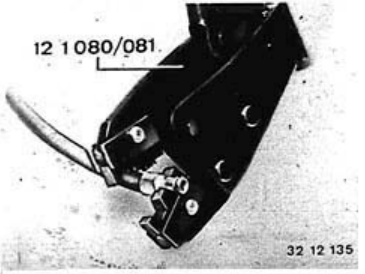
Take off cover.
Pull off shielded plug located on ignition lead of cyl. no. 4 for M 40 or cyl. no. 6 for M 20.
Cut off ignition lead.
Cut off sender on ignition lead.



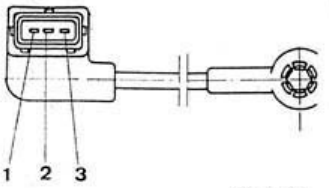
M 20:
Disconnect plug underneath the diagnosis socket.
Take off lead.
Plug on new sender (2).



M 40:
Disconnect plug underneath intake pipe.

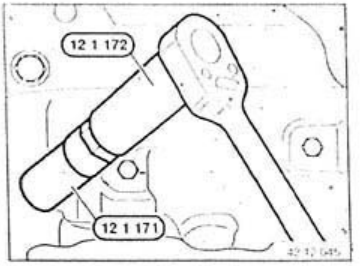


Install shielded plug – see 12 12 072.



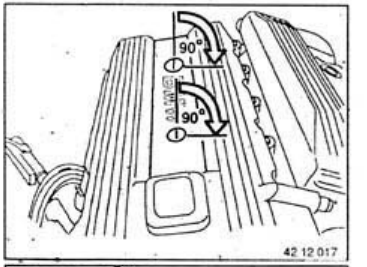
Testing Sender:
Measure resistance of coil between leads (1 and 2)
Nominal value*.

* See Specifications



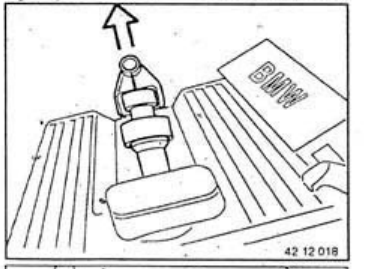
12 12 011 REPLACING SPARK PLUGS M 40

Remove spark plug connectors.
Tighten spark plugs with Special Tools 12 1 171 and 12 1 172.
Check tightening torque* when working without Special Tool 12 1 172.

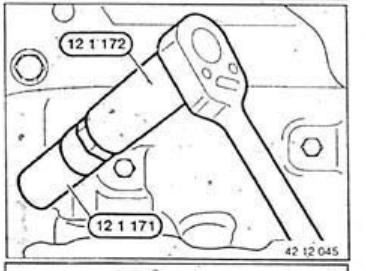


12 12 011 REPLACING SPARK PLUGS M 42

Remove cover on electric lead duct.

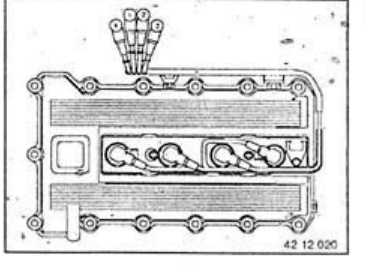


Pull off spark plug connectors.



Unscrew spark plugs with Special Tool 12 1 171.

Installation:
Tighten spark plugs with Special Tools 12 1 172 and 12 1 171.



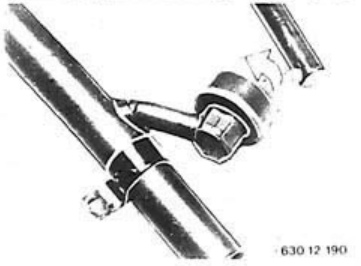
*Routing of Ignition Leads in Cylinder Head Cover

* See Specifications

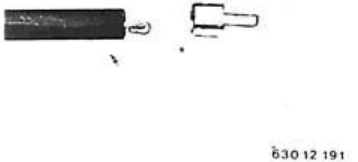

630 12 189

12 12 071 REPLACING ONE SPARK PLUG CONNECTOR

M 3 / M 5 / M 6 Models:
Unscrew ignition lead tube.
Pull out spark plug connectors.
Testing:
Measure shielded resistance*.


630 12 190

Pull off rubber cap toward rear.
Unscrew spark plug connector.
Installation:
Give rubber cap a thin coat of lubricant** to make installation easier.

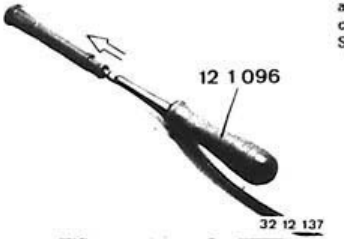

630 12 191

Replacing Connection (Screwed) for Ignition Lead:
Strip the ignition lead insulation by about 12 mm (1/2") with a stripping pliers** after cutting off the connection.
Bend wire at length of about 6 mm (1/4").


12 12 116

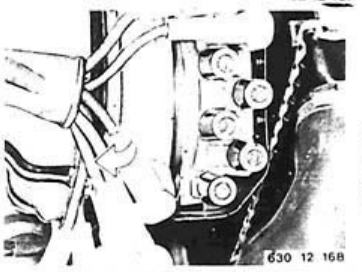
Place connection flush with pliers and press on.

* See Specifications
** Source of Supply: HWB



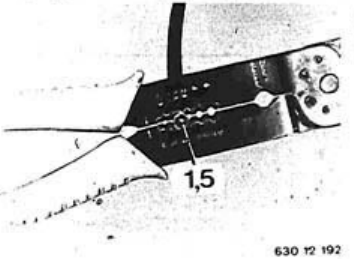
32 12 137

Place ignition lead in Special Tool 12 1 096 and slide into spark plug connector until connection is heard to engage.
Spray with lubricant (12 1 098) if necessary.


630 12 168

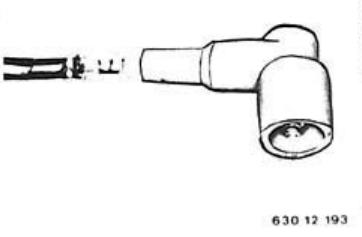
12 12 . . . REPLACING SHIELDED CONNECTOR AND IGNITION LEAD CONTACT
(on Ignition Lead for Ignition Coil or Distributor)

M 3 / M 5 / M 6 Models:
Pull off shielded connector and unscrew on ignition lead.
Testing:
Measure shielded resistance*.



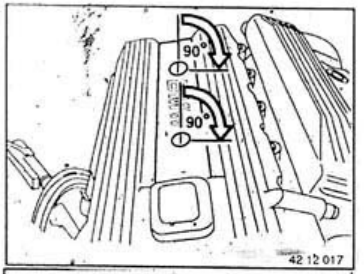
630 12 192

Strip insulation on ignition lead with an insulation stripping pliers** after cutting off the old lead contact.


630 12 193

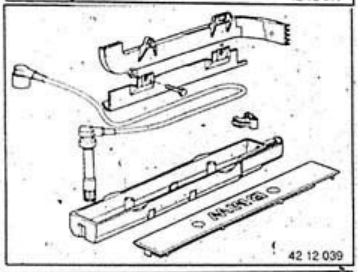
Install new lead contact with pliers for ignition lead contacts**.
Perform tear out test.
Apply a thin coat of lubricant** to make installation easier.
Screw shielded connector on ignition lead.

* See Specifications
** Source of Supply: HWB

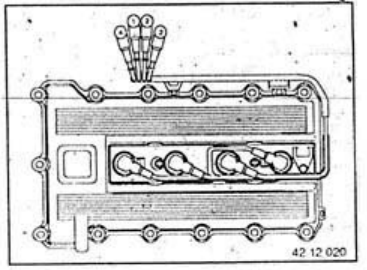


12 12 021 REPLACING ONE IGNITION LEAD – M 42

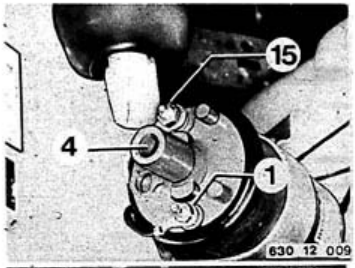
Remove cover on electric lead duct.



Components of Electric Lead Duct

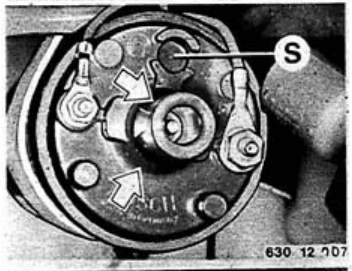


Routing of Electric Leads

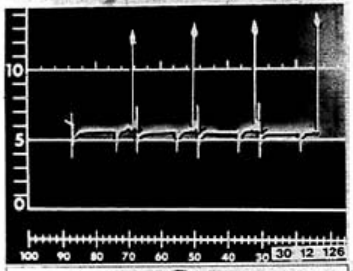


12 13 009 CHECKING IGNITION COIL

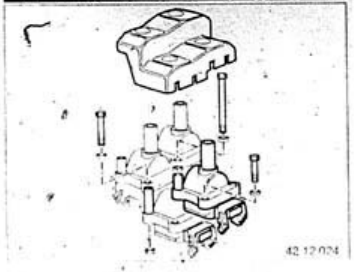
Multimeter Test (M 06):
Measure resistance of primary coil – term. 1/15 = 0.5 ohm ± 10 %
and secondary coil – term. 15/4. = 6 k-ohms ± 10 %.



Inspect connection plate for hairline cracks and traces of burning.
Check plug (S) for tight fit – replace ignition coil if it is pressed out.



Connect BMW SERVICE TESTER on diagnosis socket.
Run engine test step 09.
Observe oscilloscope – ignition voltage = 6 to 14 kV.
Check ignition voltage deviation = < 3 kV.



M 42:
See from page 12-119/2 on.

INSTRUCTIONS FOR WORKING ON DIRECT IGNITION (WITHOUT DISTRIBUTOR) OF M 42 ENGINE

Caution!
Ignition must always be turned off before working on the ignition system. Dangerous high tension occurs when working with the ignition turned on.

Location of Dangerous Tension:
- Ignition coil terminal 4
- Ignition lead
- Spark plug connector
- Spark plug
- Ignition coil term. 1 lead to DME control unit

Ignition must always be turned off before connecting the service or digital tester, primary or secondary adapter and replacing parts of the ignition system.

Testing Instructions:

Firing order: 1 - 3 - 4 - 2

The engine may not be started without a connected secondary circuit, i. e. after disconnection of spark plug connectors on spark plugs and ground connection 4a.

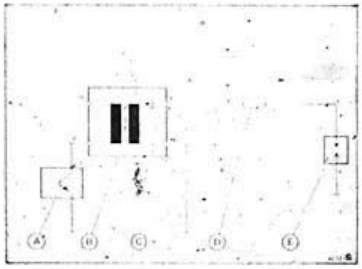
Master relay of DME must be pulled off for the compression test.

Shielded capacitors may not be connected on terminal 1 of the ignition coil.

Terminal 1 of the ignition coil may not be connected with ground or B + (danger of shorting the ignition final stages in the DME control unit).

Multimeter or test lamp may not be connected on terminal 1 while the engine is running.

Caution!
Approx. 350 V tension.



WIRING DIAGRAM FOR STATIONARY IGNITION DISTRIBUTOR OF M 42 ENGINE

A = Control signal for ignition coil from DME

B = Ignition coil

C = Secondary coil ground connection

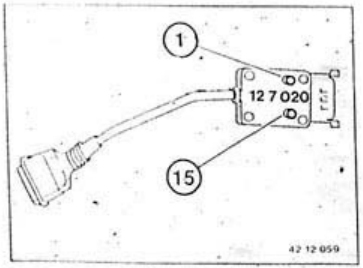
D = Ballast resistor for ignition lead, spark plug connector

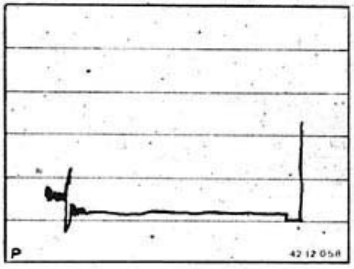
E = Spark Plug

Checking One Ignition Coil of Stationary Ignition Distribution

Check cast compound of primary coil carrier for cracks.
If gray material runs out on edges of the coil carrier, this indicates a faulty ignition final stage in the DME control unit.

Resistance Test:
Primary side: 0.4 to 0.8 ohm nominal value.
The secondary side cannot be tested because of the cascade circuit.





CHECKING PRIMARY SIGNAL FOR DIRECT IGNITION (WITHOUT DISTRIBUTOR)

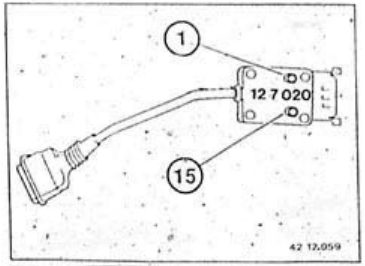
Engine Test Step 05

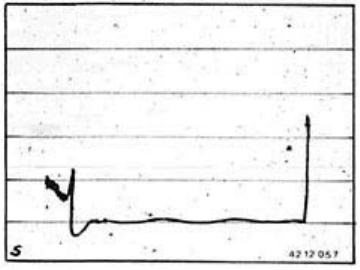
Select four cylinder.
Connect universal adapter lead on tester.
Connect brown clip on vehicle ground. Do not use red inductive clip as only one cylinder is being measured. This is why engine speed display is too low by factor 4.
Connect primary lead adapter 12 7 020 on pertinent ignition coil being tested.

Connect black clip of universal adapter lead on pin 1 of universal adapter.

Produce stationary signal on oscilloscope by pressing button R on the tester.

Note:
Combustion voltage curve on oscilloscope is very erratic as mixture swirl is different on 4-valve engine than on 2-valve engine.





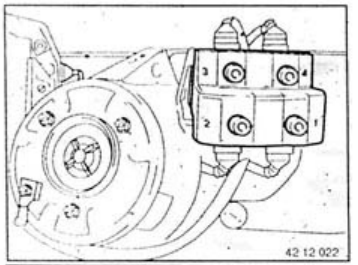
CHECKING SECONDARY SIGNAL FOR DIRECT IGNITION (WITHOUT DISTRIBUTOR)

Engine Test Step 10

Connect capacitive clip (blue) and primary adapter lead 12 7 020 on pertinent ignition lead being measured close to the ignition coil.
Connect black clip of universal adapter lead on pin 1 of primary adapter.

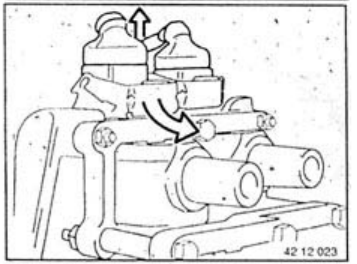
Produce stationary signal on oscilloscope by pressing button R on the tester.

Note:
Display of ignition signals is strongest on ocsilloscope when capacitive clip and black terminal are connected on the same cylinder.
Neighboring ignition leads could cause disturbance on the screen of the oscilloscope.

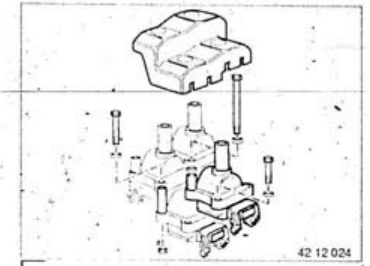


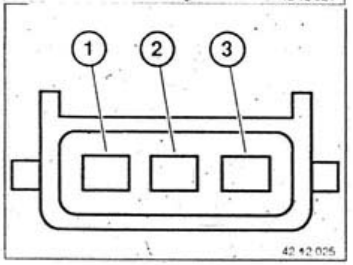
12 13 011 REPLACING ONE IGNITION COIL (Stationary Ignition Lead)

Arrangement of Ignition Coils



Pull off high tension lead.
Take off cap.
Unlock plug.
Pull off plug.





Ignition Coil Plug Pin Connections

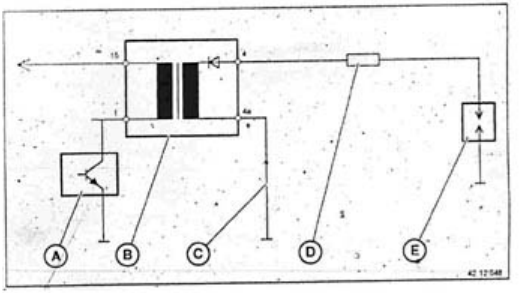
1 = Terminal 15

2 = Terminal 4a

3 = Terminal 1

Wiring Diagram of Ignition Coil, Stationary Ignition Distributor

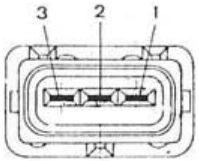
B = Ignition coil





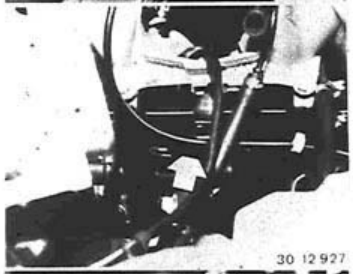
12 14 ... PULSE SENDER

Check pulse sender for tight fit and damage.

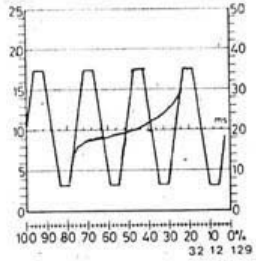


32 12 128

Multimeter Test (M 06):
Disconnect plug.
Measure resistance between 1 and 2 = 520 ohms – ± 5 %.
Perform insulation test = > 100 k-ohms.

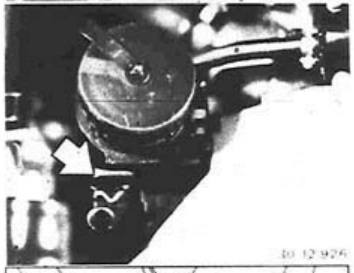


Disconnect plug.
M 40



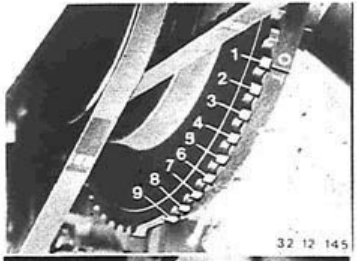
32 12 129

Connect oscilloscope on connections 1 and 2 of pulse sender (M 22/23).
Crank engine with the starter.
Signal shown here should appear on the screen.



Disconnect plug.
M 20

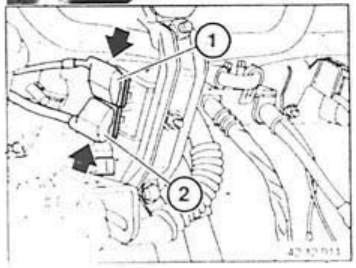
Note:
Pull out protective rail from the side.



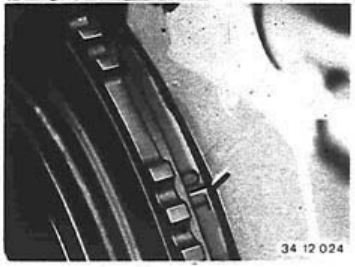
32 12 145

Checking Increment Wheel:
M 30
1. **TDC mark must be in middle of a tooth.**
2. **There must be a gap after 9 teeth counted in engine rotating direction from TDC mark.**

If not, replace vibration damper.

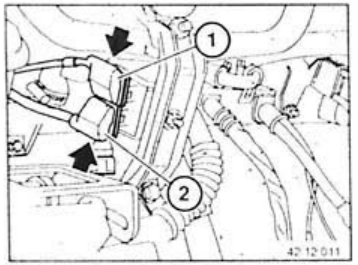


Disconnect plug (2).
M 42



M 20:
1. **TDC mark must be in middle of a tooth gap.**
2. **A large gap must be located after a tooth in engine rotating direction from TDC mark.**

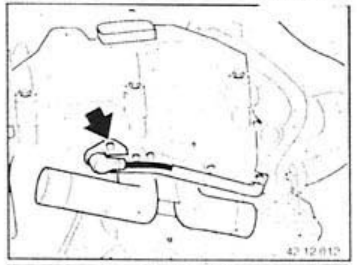
If not, replace vibration damper.



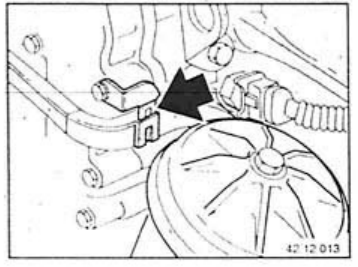
12 14 150 REPLACING CYLINDER IDENTIFYING SENDER (STATIONARY IGNITION DISTRIBUTOR) – M 42

Unplug both plugs on the electric lead duct.

1 Cylinder identifying sender (stationary ignition distributor)
2 Pulse sender for DME



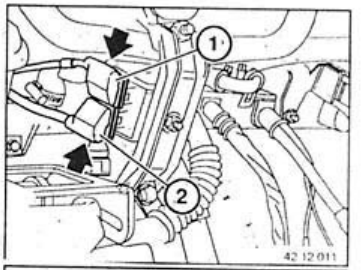
Unscrew screw.



Unclip electric lead guide in holder.

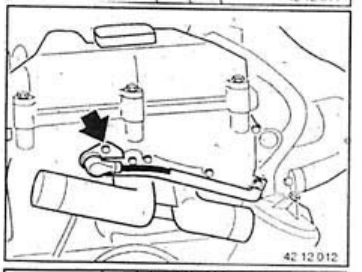
Take electric lead out of holder.

Important!
Check for correct seating of the O-ring when installing the sender.

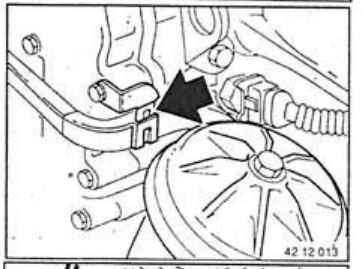


12 14 155 REPLACING PULSE SENDER ON VIBRATION DAMPER – M 42

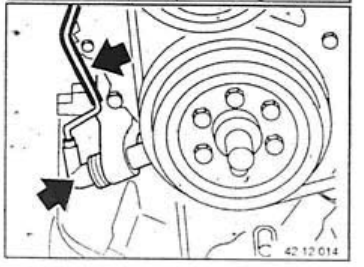
1 Cylinder identifying sender (stationary ignition distributor)
2 Pulse sender for DME



Unscrew screw.



Unclip electric lead guide in holder.

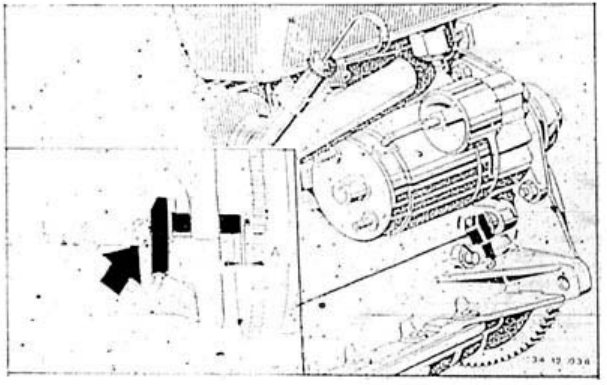


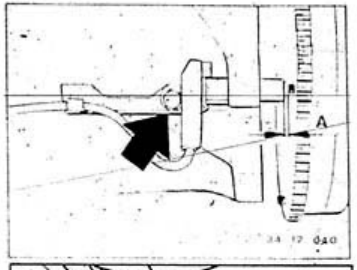
Unscrew screw.
Unclip electric lead on line.

Note:
Clip line in guide rail securey again, so that the line cannot rub on the drive belt.

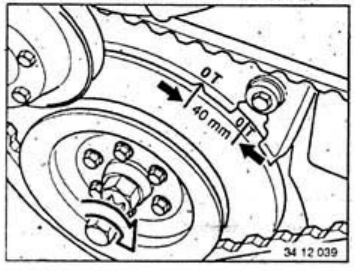
12 14 160 REPLACING AND ADJUSTING SPEED SENDER – M 21

Disconnect plug and line.

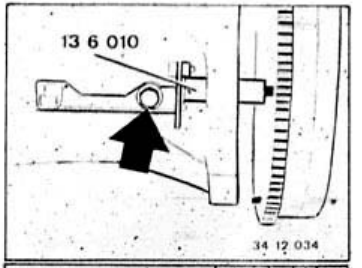




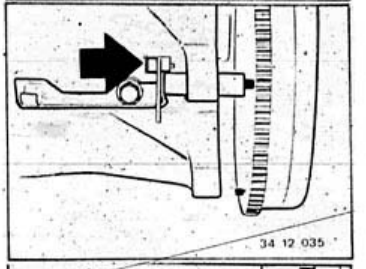
Unscrew holder.



Adjusting:
Turn crankshaft up to 40 mm (1.575") further than the TDC mark.
Check whether the dowel pin of the flywheel can be seen through the take-up bore for the speed sender.

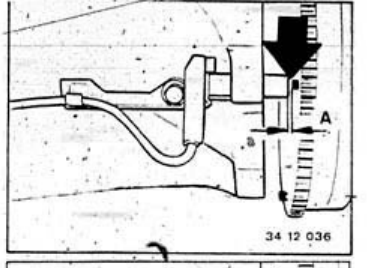


Mount Special Tool 13 6 010 on holder. Mount holder on crankcase and slide forward against the stop. This automatically adjusts distance (A) required between the pin on the flywheel and the speed sender.
(Special Tool 13 6 010 is 1.3 mm (0.051") longer than the speed sender.)
Tighten holder.

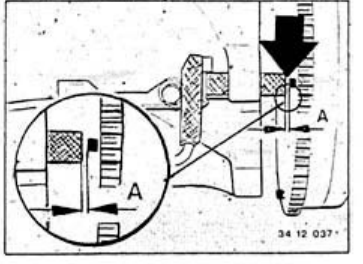


Unscrew Special Tool 13 6 010 on the holder and pull out.

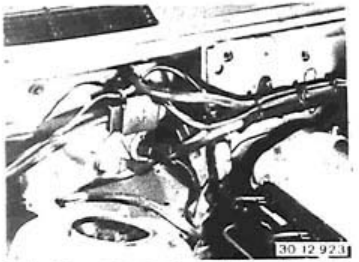
Important!
Holder must no longer be loosened on the engine block. Only loosen and pull out the special tool.



Slide speed sender into holder.
Screw on speed sender.

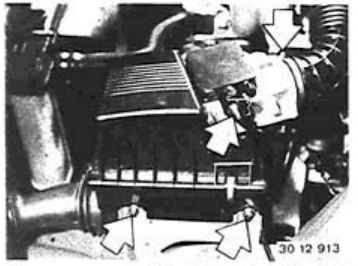


Distance A = clearance between pin on the vibration damper and speed sender.

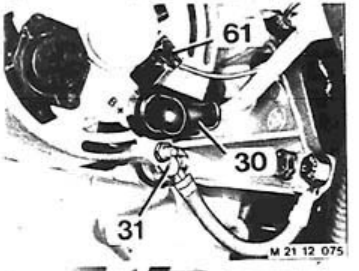


12 31 020 REMOVING AND INSTALLING ALTERNATOR

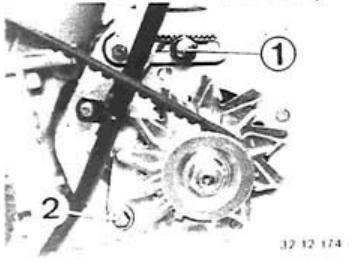
Disconnect battery ground lead (or positive connection point on firewall).



M 40 / M 20 — Removing Air Cleaner and Air Flow Sensor:
Pull off plug.
Loosen hose clamp.
Lift out air cleaner and air flow sensor.



Alternator:
Take off protective cap.
Disconnect electric wires on connections B+ (term. 30) and D+ (term. 61).



Unscrew upper nut and remove bolt with tensioning wheel.
Unscrew lower nut and remove bolt (wires D+ / B+ removed).

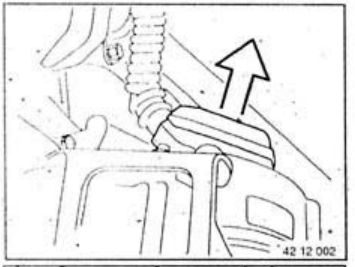


Installation:
Tension drive belt (SR version)* – see 12 31 299.

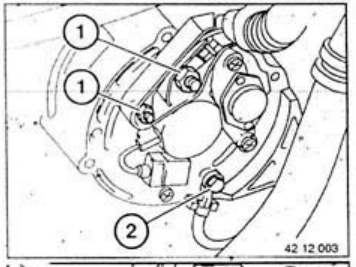
* See Specifications

12 31 020 REMOVING AND INSTALLING OR REPLACING ALTERNATOR – M 42

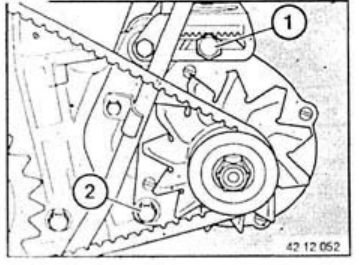
Disconnect battery ground lead.
Remove air cleaner.



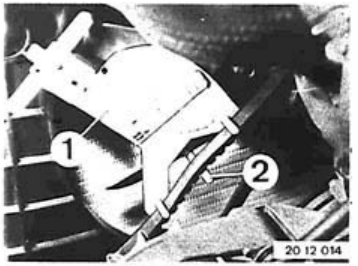
Remove cover on alternator leads.



Disconnect leads (1).
Disconnect ground strap (2).

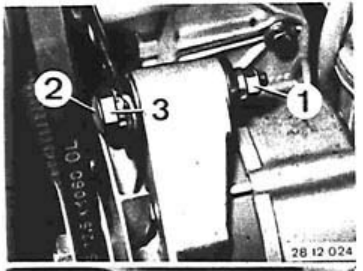


Unscrew mounting bolts.
Take off drive belt.
Tighten drive belt – see 12 31 299.



12 31 299 CHECKING/TIGHTENING ALTERNATOR DRIVE BELT

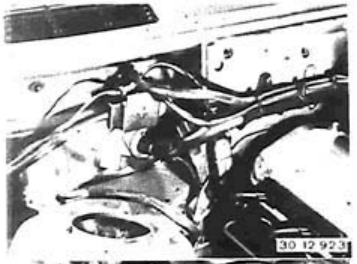
Check tightness of drive belt with Special Tool 11 5 020, tightening if necessary.
Pulling hook (2) must bear in middle of teeth for this purpose. Tester needle must be found on scale above the green or yellow field.



Tightening Drive Belt:
Unscrew nut (1) and turn tensioning wheel (3) with a torque of about 7 Nm (5 ft. lbs.).
Tighten nut (1).
Recheck tightness with the tester, correcting if necessary.



Drive Belt Tightness Tester:
"with new measuring scale" for SR belts.
SR = service reduced.

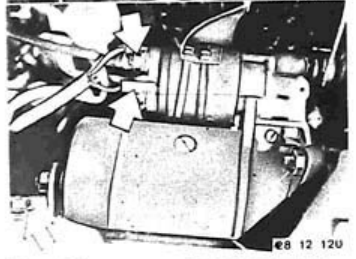


12 41 020 REMOVING AND INSTALLING STARTER

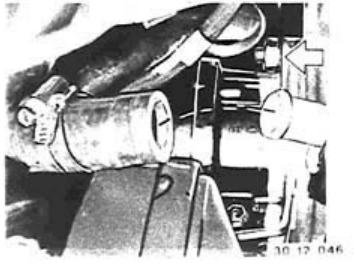
Disconnect battery ground lead (or positive connection on firewall).
Disconnect leads on terminals 30 and 50 of solenoid.



Unscrew nuts.



Unscrew rear mounting bracket.



M 20:
Remove complete air cleaner.
Drain coolant in engine.
Disconnect water hoses on heater.

Installation:
Push starter in to guide pins.
Fill and bleed cooling system – see 17 0 039.

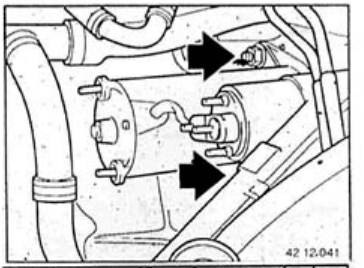
M 21 Diesel:
Unscrew support on intake air manifold.
Disconnect crankcase venting hose.

M 21 Turbocharged Diesel:
Unscrew support on intake air manifold.
Disconnect crankcase venting hose.
Unscrew transmission splash guard.
Drain coolant in engine.
Disconnect water hoses for heater.

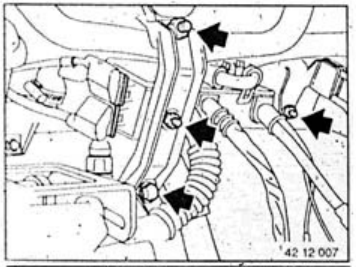
S 14:
Remove complete intake air manifold.
Disconnect coolant return pipe on engine block.

12 41 020 REMOVING AND INSTALLING OR REPLACING STARTER – M 42

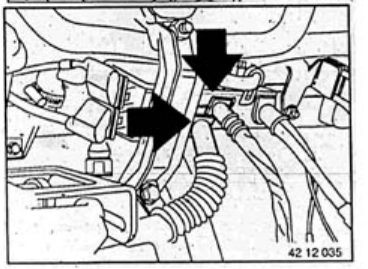
Disconnect battery ground lead.
Remove air cleaner.
Remove intake hose of throttle valve assembly.



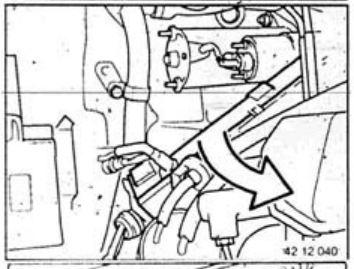
Unscrew bolts.



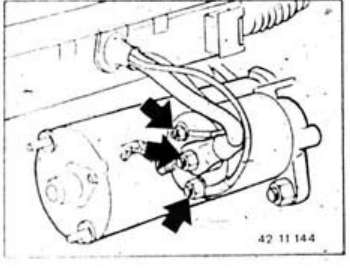
Unscrew support on intake manifold.
Mark plugs on electric lead duct.
Pull plugs off of electric lead duct forward.



Important!
Make sure that the rubber grommets for electric lead openings are clipped in the electric lead duct correctly when installing the electric lead duct. If not, penetrating water could lead to malfunction of the engine electric system.



Turn electric lead duct to the side in direction of the spring strut.

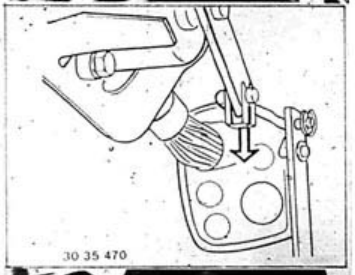


Disconnect leads on starter.

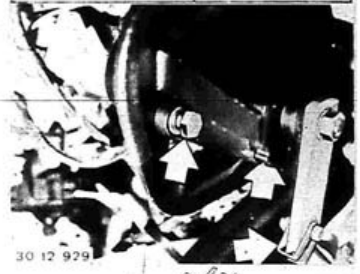


12 72 ... REMOVING AND INSTALLING OR REPLACING PEDAL VALUE SENDER (DDE)

Turn off ignition.
Remove dashboard trim panel at bottom left - see 51 45 . . ..
Disconnect plug.



Pull retainer off of pedal value sender linkage.
Installation:
Adjust pedals - see Group 35.

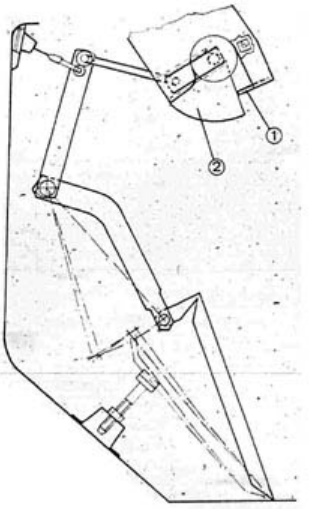


Unscrew both screws.



Installation:
Check whether angle between pedal value sender lever and stop is 83 +/- 1 degrees, correcting if necessary.
Place gage on end of pedal value sender shaft (linkage disconnected).
1 Adapted to pedal value sender shaft end
2 Stop on holder for pedal value sender
3 Lever for pedal value sender
4 Pedal value sender
Gage = Special Tool 12 7 100**

** Source of Supply: HWB



12 72 ... ADJUSTING ACCELERATOR PEDAL WITH ELECTRONIC ENGINE POWER CONTROL

Adjusting Procedures for E 30 td:

1. Idle Speed Position
   Tighten hexagon nut on pedal value sender to specified torque* with an angle of 83 +/- 1 degrees set by the factory between the pedal value sender lever and stop (tighten with support on the pedal value sender lever).

2. Full Load Position
   Manual Transmissions:
   Operate accelerator pedal to the kickdown position in the pedal value sender. Screw knurled head screw against stop on accelerator pedal in this position and lock.

   Automatic Transmissions:
   Operate accelerator pedal to the kickdown position in the pedal value sender. Adjust knurled head screw in this position to have a distance of 6 mm (0.236") between bolt head and accelerator pedal. Position reversing washer on idle stop of holder for transmission reversing. Adjust transmission throttle cable to have 0.25 to 0.5 mm (0.010 to 0.020") distance between the lead seal and adjusting screw. Adjust accelerator pedal throttle cable without tension

1 =Stop
2 =83 degree gage

Important!
Check pedal value sender with a diagnosis tester after adjusting. Connect tester, turn on ignition and move accelerator pedal to idle speed position. Compare actual voltage displayed on tester with specified value, correcting the adjustment if necessary.
Specification:
min. 353 mV
max. 451 mV
Full load max. 3.2 V

* See Specifications.

13 Fuel System

Model 324d / 324td (DDE) .....

Engine M40, M42, M20

Models: 316i, since 9/88 318i, 318is, 320i, 325i .....

13 Fuel System

Model: 324d / 324td (DDE)

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WORKING INSTRUCTIONS CONCERNING CLEANLINESS ON FUEL SYSTEMS

- Clean area around point of repair thoroughly – for example, prior to unscrewing pipe connections, switches, etc..
- Place removed components on clean surfaces only and cover with plastic sheet – never use cloths losing lint!
- Cover or plug open pipes/hoses or components immediately – never work with compressed air.
- Only install cleaned components.
  Take new parts out of their packaging only immediately before installation of same.
- Never let diesel fuel get on coolant hoses – rinse off with water immediately, if necessary.

Explanation of Abbreviations:

DDE = Digital Diesel Electronics

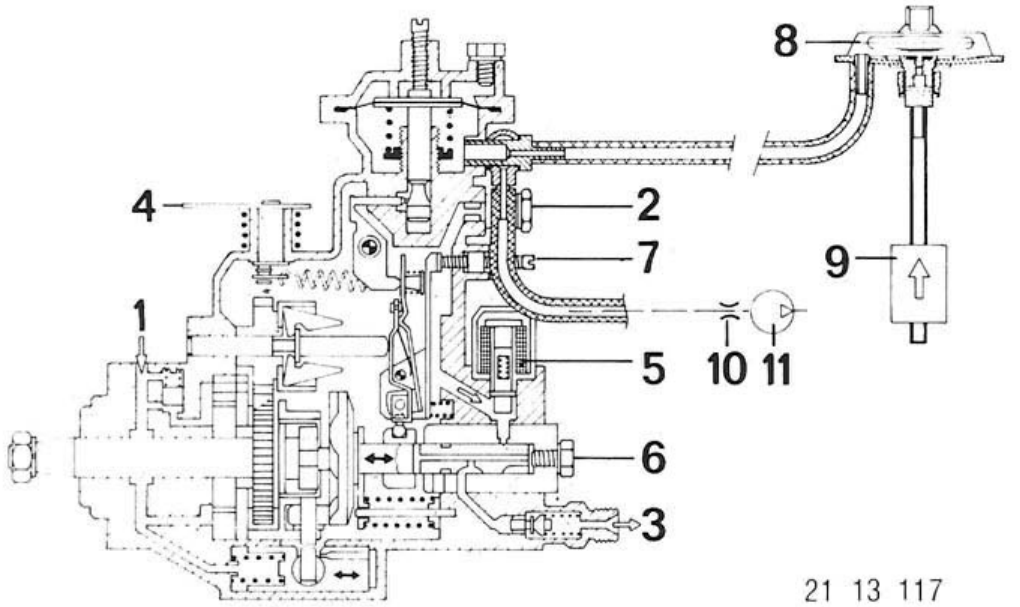
AS = Exhaust gas recirculation, Injection begin control

MLG = Fuel rate, combustion air, road speed

SB = In reference to injection begin

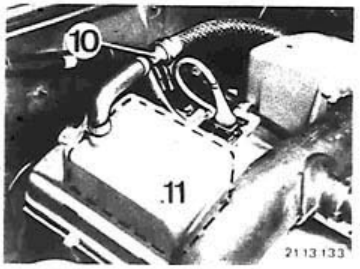
ME = In reference to injection rate

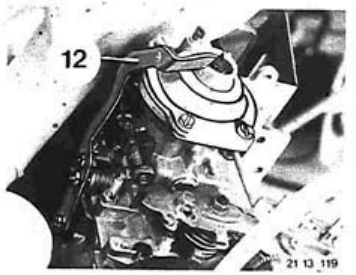
INJECTION PUMP LAYOUT



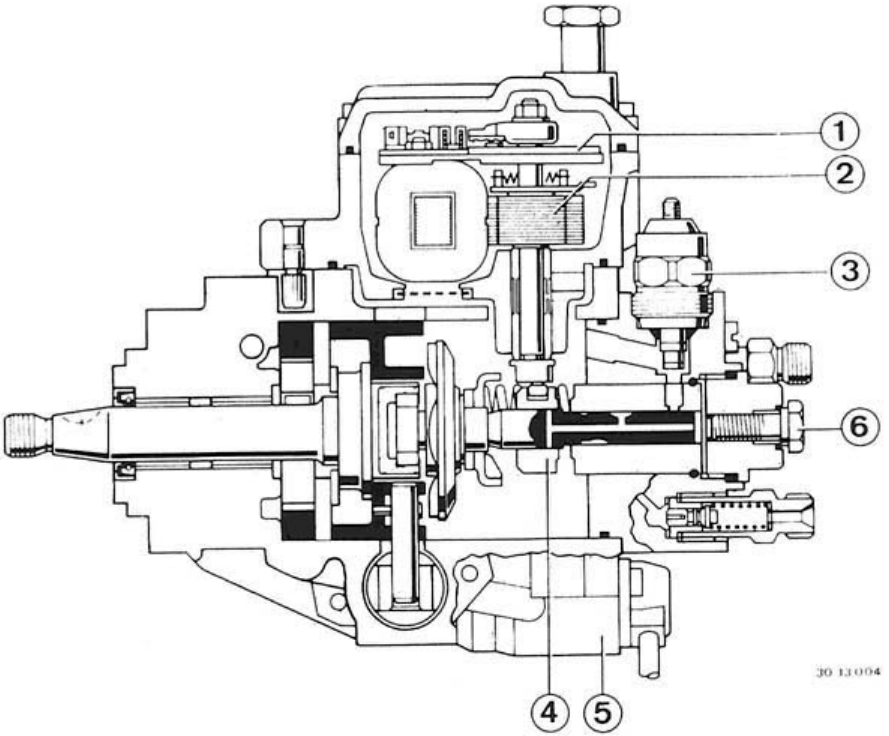
21 13 117

1 Fuel feed
2 Fuel return and leak oil connection
3 Injector connection
4 Speed lever
5 Electric shutoff
6 Plug for high pressure chamber (for static adjustment with dial gage)
7 Bolt for full load injection rate
8 Control unit for absolute pressure
9 Air filter for control unit
10 Orifice in vacuum distributor
11 Vacuum pump
12 Manual stopping lever





LAYOUT DRAWING OF ELECTRONICALLY REGULATED INJECTION PUMP FOR DDE



1 Control valve distance sender
Potentiometer for feedback voltage

2 Drive for injection rate rotating magnet

3 Electric shutoff

4 Control valve

5 Solenoid for injection begin

6 Plug for high pressure chamber
(for static adjustment with dial gage)

TROUBLESHOOTING ENGINE ELECTRIC, FUEL AND INJECTION SYSTEMS

Requirements:
- Starting system in perfect condition (battery voltage, starter, ignition lock, etc.)
- Engine in perfect running condition (timing, compression)
- Specified fuel in tank (without contamination, winterproof)
- Connections plug connections and ground points as on wiring diagram

1. Engine does not start
2. Engine hard to start (coolant temp. 20° C/68° F).
3. Engine surges in idle
4. Warm engine idles erratically
5. Engine misfires while driving
6. Performance unsatisfactory
7. Fuel consumption too high
8. Engine cannot be stopped
9. Engine runs hard, black exhaust smoke in full load
10. Fog-type exhaust smoke
11. Cold engine idles unsatisfactorily
12. Engine speed does not pick up when cold
13. Distributor injection pump too hot
14. Excessive black smoke in full load constant drive
15. Excessive black smoke in acceleration phase

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		Test Position	Job Number
x	x			x	x					x	x									1	Fuel delivery pressure	13 31 028
x	x		x	x	x					x	x									2	Bleed system, check for leaks	13 51 320
x				x			x													3	Electric shutoff	13 51 301
	x	x	x		x	x		x			x									4	Static injection time adjustment	13 51 005
x	x		x		x			x	x											5	Fuel injectors	13 53 800
					x	x		x	x											6	Air cleaner	13 71 001
	x																			7	Preheating	12 21 .../12 23 ...
										x										8	Cold idle speed control	13 00 550
					x															9	Linkage and cable adjustment	13 51 340
		x	x							x										10	Idle adjustment	13 00 050
					x			x				x								11	Fuel return	13 51 000
	x									x	x									12	Cold start system	13 51 310
x	x	x	x	x	x					x		o								13	Pressure valves on injection pump	13 51 290
					x					x										14	Atmospheric pressure dependent contr.	13 51 ...
					x	x														15	Charge pressure dependent control	13 51 ...
x	x			x	x	x		x	x	x	x									16	Injection pump	13 51 001
													x							17	Injection pump correction	13 51 007
														x						18	Injection pump correction	13 51 008
																				19		
																				20		
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TROUBLESHOOTING DIGITAL DIESEL ELECTRONICS (DDE1)

Requirements:
- Starting system OK (battery voltage, starter, ignition lock, etc.)
- Engine mechanically OK (timing, compression)
- Specified fuel in tank (without contamination, winterproof)
- Connections, plugs, wires and ground points checked to wiring diagram.

1. Engine won't start
2. Engine hard to start (coolant temp. 20°C/68°F)
3. Warm engine idles unevenly
4. Misfiring while driving
5. Performance unsatisfactory
6. Fuel consumption too high
7. Engine cannot be stopped
8. Engine runs hard, black exhaust in full load range
9. Foggy exhaust
10. Cold engine idles unsatisfactorily
11. Engine does not pick up when cold
12. Distributor injection pump runs hot
13. Engine stops on its own
14. Engine runs at high idle speed
15. Engine runs with max. 1200 rpm (or 1400 rpm at A)
16. Strong vehicle shake
17. Engine runs at high speed
18. Warning lamp lights up

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		Test Position	Reference
x	x	x	x					x	x											1	Fuel delivery pressure	13 31 028
								x				x								2	Bleed system, check for leaks	13 51 320
x			x			x						x								3	Electric shutoff	13 51 301
x	x	x		x			x	x												4	Injection nozzles	13 53 800
				x	x		x	x												5	Air cleaner	13 71 001
	x																			6	Preheating	12 21 .../12 23 ...
					x			x		x	x									7	Fuel return pump internal pressure	13 51 000
x												x								8	Fuel distributor control unit	13 61 000
			x									x								9	Injection pump (drive potentiometer)	
												x								10	Fuel filter	
				x																11	Pressure conn. for charge press sensor	
							x													12	Inj. begin control unit	13 61 000
													x							13	Accelerator pedal (pedal value sender)	
														x						14	Brake switch	
															x					15	Road speed sender (or wire)	
							x													16	EGR valve (cars with EGR)	
				x												x				17	Speed sender (or adjustment)	12 14 ...
																	x			18	Engine temperature sender	
																				19		
																				20		
																				21		
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																				30		

Refer to BMW diagnosing system and BMW 5 Test Plan for additional trouble-shooting of DDE1.

TROUBLESHOOTING DIGITAL DIESEL ELECTRONICS (DDE2)

Requirements:
- Starting system OK (battery voltage, starter, ignition lock, etc.)
- Engine mechanically OK (timing, compression)
- Specified fuel in tank (without contamination, winterproof)
- Connections, plugs, wires and ground points checked to wiring diagram.

1. Performance unsatisfactory
2. Fluctuating power output
3. Road speed display missing
4. Vehicle shakes
5. Cruise control driving not possible
6. Fuel consumption display fluctuates
7. Engine runs hard (pingles)
8. Black exhaust
9. Engine shutoff in all operating conditions
10. Misfiring, strong shake
11. Engine won't start
12. Insufficient reaction to accelerator pedal
13. Fluctuating idle speed of cold engine
14. Engine runs at high idle speed
15. Black exhaust at high altitude

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		Test Position	Reference
x																				1	Air temperature sensor	
x	x																			2	Fuel temperature sensor	
		x	x	x	x															3	Road speed sender	62 16 ...
x			x			x	x		x	x										4	Injection nozzles	13 53 ...
x						x	x	x												5	Solenoid valve (in injection pump)	
x						x	x	x			x									6	Fuel filter	13 32 ...
x						x	x	x	x	x										7	Injection pump	13 51 ...
x						x	x					x								8	Basic adjustment (static)	13 51 ...
								x			x									9	Fuel heating	12 64 ...
x												x								10	Drive belt tension	11 31 ...
x				x		x	x	x				x		x						11	Control unit, power supply	
				x																12	Brake switch	
x							x													13	EGR valve (cars with EGR)	11 71 ...
x							x													14	EU solenoid valve (cars with EGR)	
x			x				x		x			x								15	Speed sender (or adjustment)	12 14 ...
x			x				x					x								16	Flywheel pins	
								x		x										17	Electric shutoff	13 51 ...
				x																18	Control unit of cruise control	65 71 ...
			x					x												19	Pole mixup protection relay	61 31 ...
													x							20	Accelerator pedal (pedal value sender)	35 41/42 ...
x																				21	Air cleaner	13 72 ...
		x	x	x	x															22	Instrument cluster	62 11 ...
																				23		
																				24		
																				25		
																				26		
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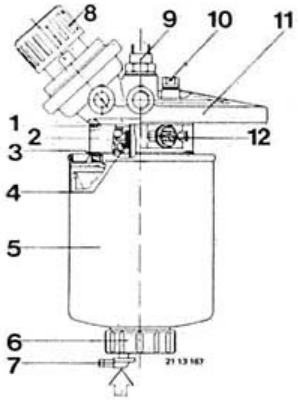
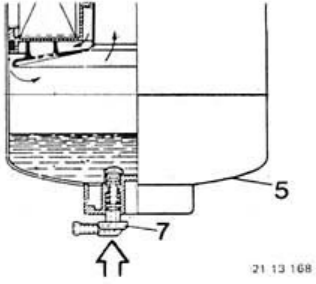
Refer to BMW diagnosing system and BMW 5 Test Plan for additional trouble-shooting of DDE2.



DDE
13 32 000 FUEL FILTER

Note:
Fuel preheating is described in Gr. 12.

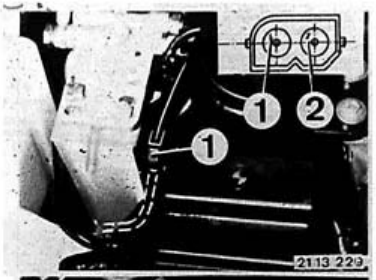
1 Seal
2 Heating element
3 Seal
4 Heating element mounting nut
5 Filter cartridge
6 Cap
7 Drain valve
8 Manual pump
9 5.5° C (42° F) temperature switch
10 Bleeding screw
11 Filter head
12 Heating element electric conn.



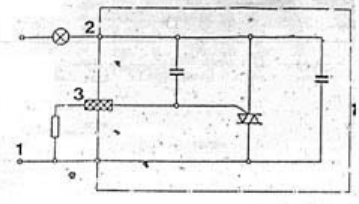
DDE
13 32 050 EMPTYING WATER TRAP IN FUEL FILTER

Unscrew bleeding screw (10).
Press up drain valve and drain until pure diesel fuel runs out.

Unlock cap - turn 90 degrees - of manual pump (8) and pump until fuel runs out at bleeder screw (10).
Tighten bleeding screw (10).
Lock manual pump (8).







13 32 ... CHECKING WATER LEVEL SENSOR

Disconnect plug (1).
Bridge pins 1 and 2 on wire harness with ignition ON.
Indicator lamp with gas station symbol in instrument cluster must light up.

Checking Sensor:
Remove sensor with fuel filter cap.
Connect plug (1).
Submerge sensor in a metal container filled with water, which is connected with vehicle ground.
Ignition ON - indicator lamp in instrument cluster must light up.
Turn off ignition before disconnecting plug.

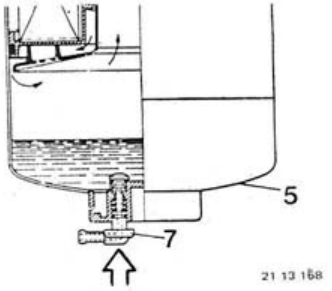
Wiring Diagram for Water Level Warner:

1 Vehicle ground
2 Indicator lamp, 9 to 15 V operating voltage
3 Sensor

Voltage drop at outlet = 1 V.

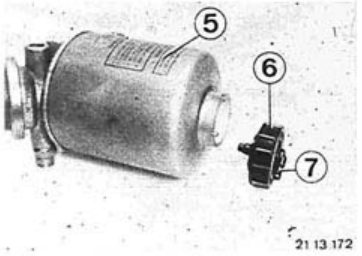
Important!
As from control unit version T 5 or S 1 water level sensor is monitored by diagnosing system (see fault memory).

Note:
Check electric wires to wiring diagram.

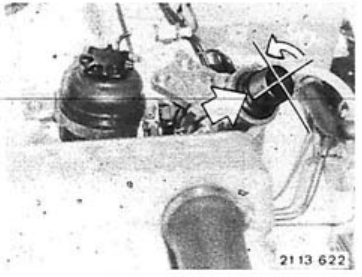


DDE
13 32 051 REPLACING FUEL FILTER

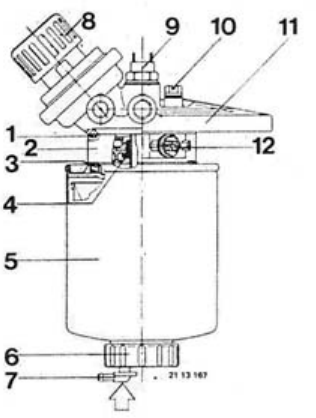
Loosen bleeder screw (10) and drain a small amount of diesel fuel at drain valve (7).
Unscrew filter cartridge (5) – use a standard tool.



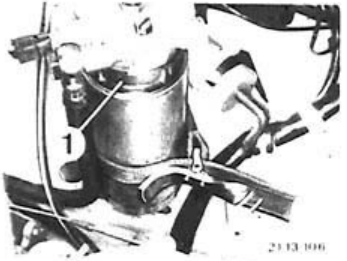
Install cap (6) with drain valve (7) on a new filter.
Installation:
Lubricate seal (3) lightly with oil.
Screw on filter by hand until gasket bears – tighten one half turn afterwards by hand.



Unlock cap of manual pump (8) by turning 90° and pump so long, until diesel fuel runs out of bleeder screw (10).
Tighten bleeder screw (10).
Lock manual pump (8).



1 Seal
2 Heating element
3 Seal
4 Heating element nut
5 Filter cartridge
6 Cap
7 Drain valve
8 Manual pump
9 Temperature switch 5.5° C (42° F)
10 Bleeder screw
11 Filter head
12 Heating element electric conn.



13 32 051 REMOVING AND INSTALLING OR REPLACING FUEL FILTER CARTRIDGE

Unscrew filter cartridge with a standard tool – counterholding on the turning heating unit (1) if necessary.

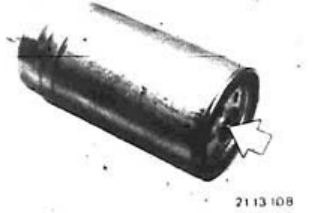
Installation:

Insert a new seal when reusing the filter cartridge.



Replacing:

Unscrew cap (2) and install on new filter cartridge.



Fill new filter cartridge with pure fuel and screw on filter head against stop.

Then tighten by hand with one half turn.

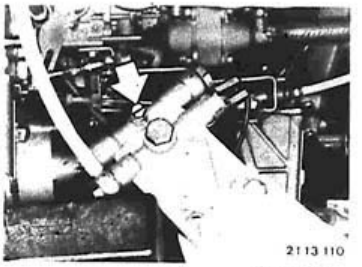


Start and run engine at idle speed.

Bleeding takes place automatically.

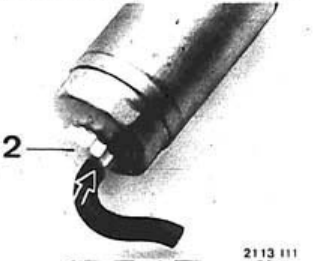
Check filter for leaks, tightening more if necessary.

Feed line must be filled with fuel not having air bubbles.

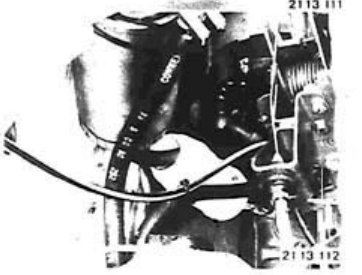


13 32 . . . DRAINING WATER IN FUEL FILTER

Unscrew bleeder screw.



Connect 8 mm (0.315") dia. shaped hose on drain adapter.

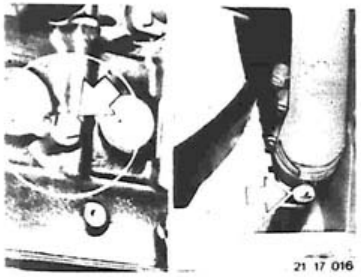


Hold a 0.2 liter (0.4 pint) container underneath shaped hose and loosen cap (2) about one turn.

Drain system until pure diesel fuel runs out.

Then tighten the cap and bleeder screw.

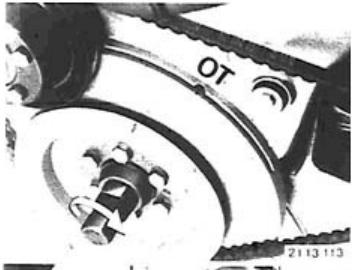
Start engine and run it at idle speed until the feed line is filled with fuel not having air bubbles.


21 17 016

13 51 000 REMOVING AND INSTALLING INJECTION PUMP

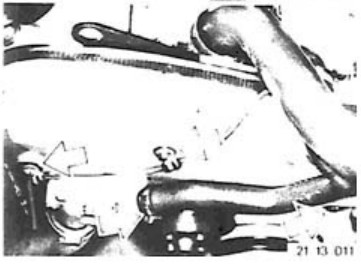
Remove engine splash guard – see 51 47 . . ..
Unscrew drain plugs on engine and radiator.
Drain coolant.
Unscrew and swing away expansion tank.
Installation:
Pour in coolant* and bleed cooling system – see 17 00 039.

Remove intake manifold – see 11 61 . . ..



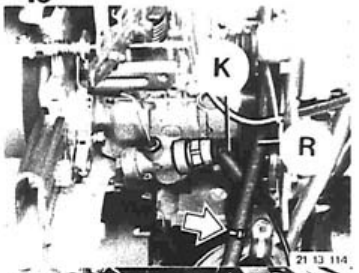
21 13 113

Turn crankshaft to TDC mark (ignition in cylinder no. 1).


21 13 011

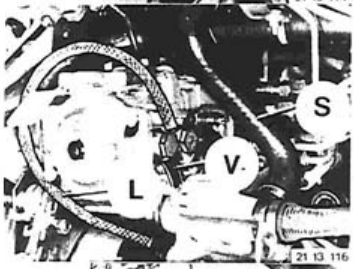
Disconnect water hose.
Loosen drive belt on alternator and unscrew toothed belt cover.

* See Operating Material Folder



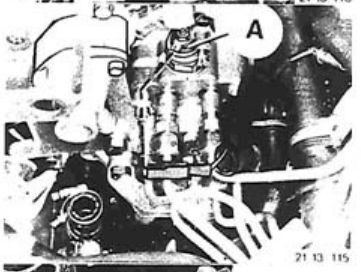
21 13 114

Unscrew connection and mounting of return line (R).
Pull off rubber cap and plug on cold start valve (K).



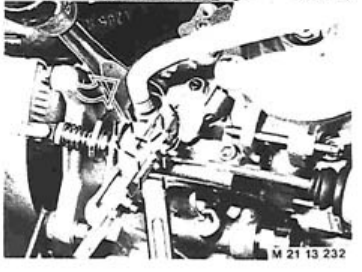
21 13 116

Disconnect hoses for vacuum (V), leak oil (L) and cold starting aid (S).

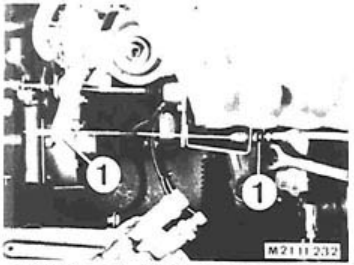


21 13 115

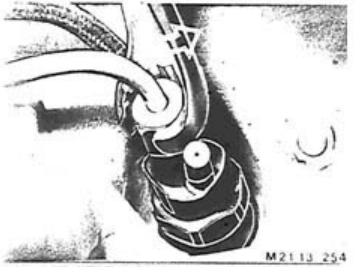
Pull off rubber cap and plug on electric shutoff (A).


M 21 13 232

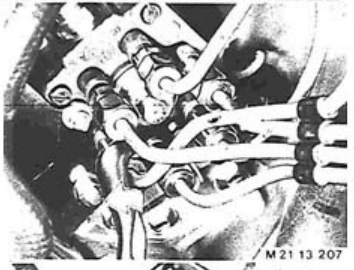
Counterhold on adapter and unscrew fuel feed line with Special Tool 13 5 020.
Plug opening with a protective cap.



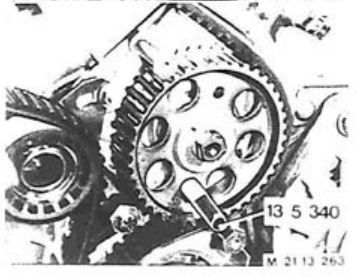
Disconnect cables and take them out of the holders.



Unscrew all coupling nuts on fuel injectors.
Plug openings of fuel injectors with protective caps.
Caution!
Reposition special tool in good time to avoid bending the injection lines.

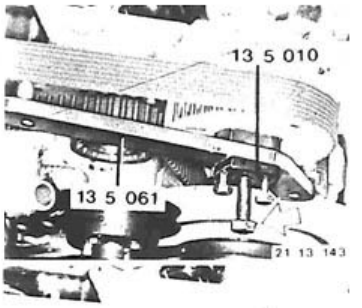


Unscrew coupling nuts on injection pump and take off lines.
Plug openings with protective caps.
Installation:
Tighten the lines beginning with connection 4.
Tightening torque*.

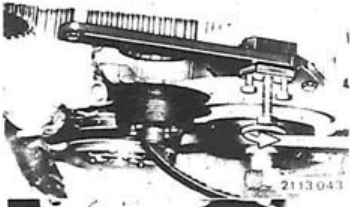


Unscrew nut on toothed belt sprocket.
Hold sprocket with Special Tool 13 5 340.

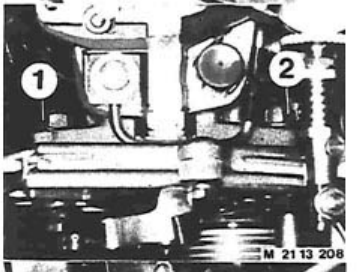
* See Specifications



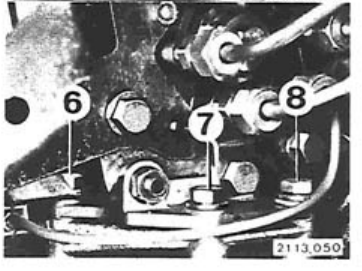
Bolt Special Tools 13 5 061 and 13 5 010 on toothed belt sprocket.
Loosen bolt (see arrow) completely.



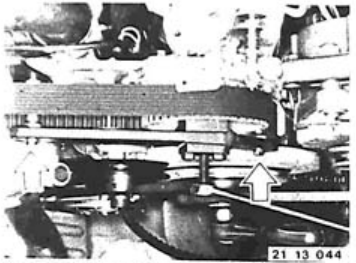
Turn crankshaft slightly until special tool can be bolted.
Use M 6 x 20 bolts.



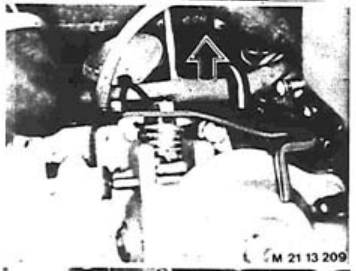
Unscrew nuts (1 and 2).



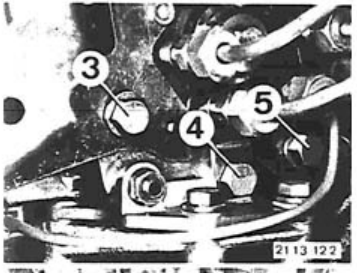
Unscrew bolts (6 ... 8).



Press out injection pump toward rear with Special Tool 13 5 010.



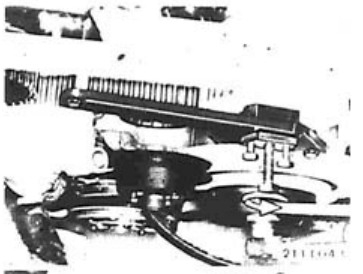
Pull wire harness out of holder.
Take off injection pump.



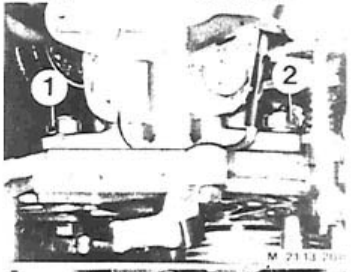
Unscrew nuts (3 ... 5) prior to installation.



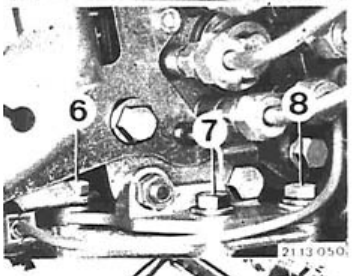
Move injection pump shaft to installed position with Special Tool 13 5 062 – lever faces up.



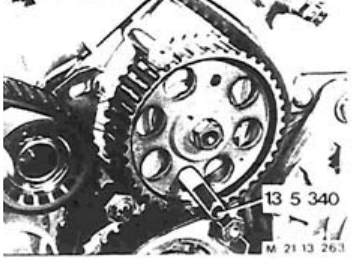
Loosen bolt on puller completely.
Install injection pump – make sure woodruff key does not fall out.



Tighten nuts (1 and 2) loosely.

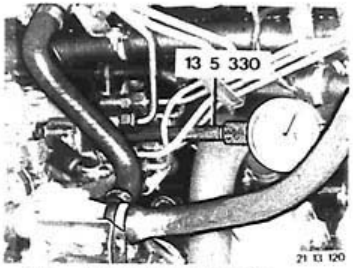


Tighten bolts (6 ... 8).
Remove Special Tool 13 5 010 / 061.

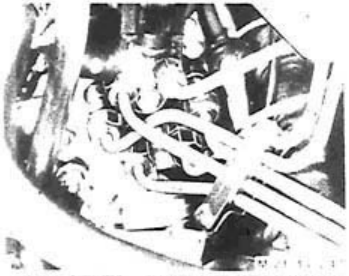


Tighten toothed belt sprocket nut.
Tightening torque*.

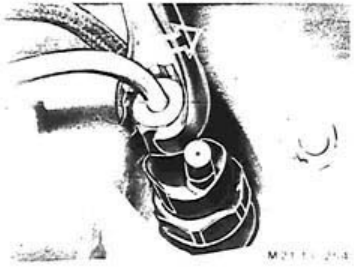
* See Specifications



Adjust injection pump statically – see 13 51 005.



Connect fuel feed line and bleed injection pump – see 13 51 320.

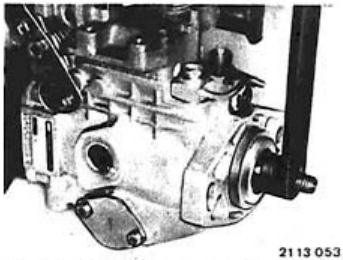


Assemble and then bleed fuel lines – see 13 51 320.
Check idle speed*, correcting if necessary – see 13 00 050.

* See Specifications

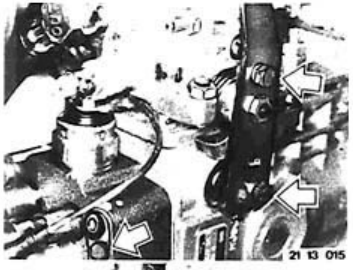
13 51 001 REPLACING INJECTION PUMP

Remove injection pump – see 13 51 000.
Cut open end of bleeding cap on new injection pump.



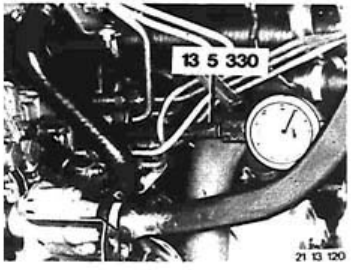
21 13 053

Move injection pump shaft to installed position with Special Tool 13 5 062 lever faces up.



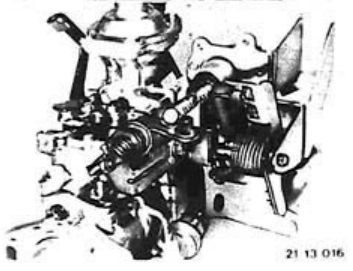
21 13 015

Transfer stopping lever and holder for wire harness.



21 13 120

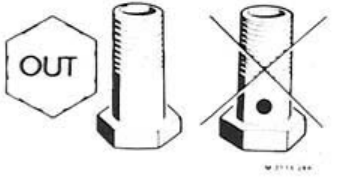
Install and adjust injection pump statically see 13 51 005.
Bleed fuel system – see 13 51 320.
Check idle speed, correcting if necessary see 13 00 050.

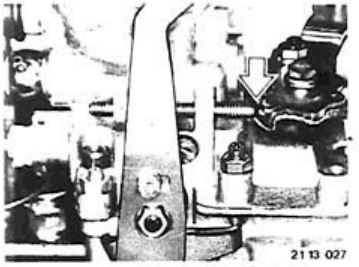


21 13 016

Transfer holder for cable or lever for cars with automatic transmission.

Connect return hose.
Hollow union bolt OUT is matched with an injection pump – don't mix them up.



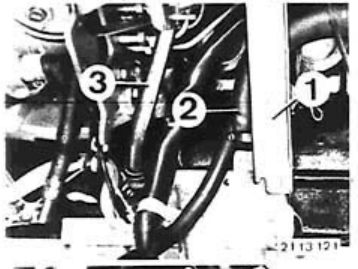


13 51 005 CHECKING/CORRECTING STATIC ADJUSTMENT OF INJECTION

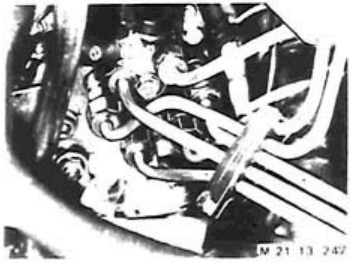
Requirements:
Coolant temperature > 20° C (68° F) or speed lever resting on idle stop.



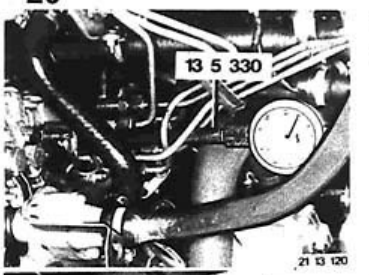
Disconnect battery lead on connector.
Disconnect speed sensor wire plug.



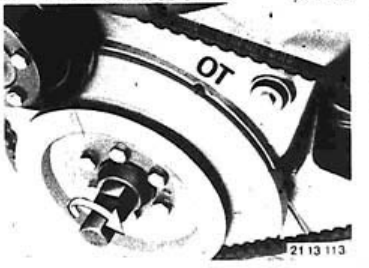
Checking:
Unscrew support (1) for intake manifold and bleeding hose (2).



Unscrew plug.

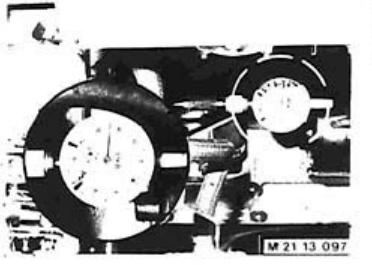


Screw in Special Tool 13 5 330.
Insert dial gage and apply test point with preload. *



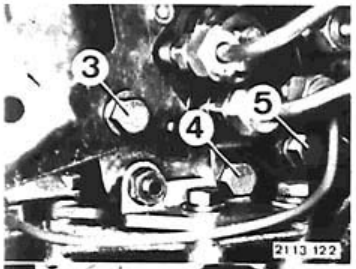
Turn crankshaft clockwise until needle of dial gage stops moving.
Turn scale to zero.
Turn crankshaft further in direction of TDC mark (ignition of cylinder no. 1) until applied Special Tool 11 2 300 engages.

Note:
Do not turn crankshaft counterclockwise – wrong test results.

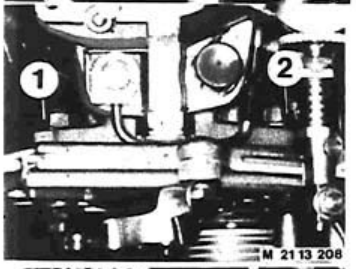


Read value from dial gage.
If test value* is not reached, loosen injection pump and correct static adjustment.

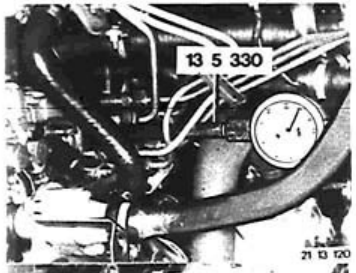
* See Specifications



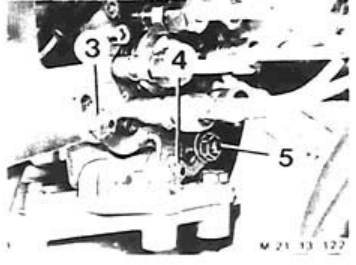
Correcting:
A new adjustment will be necessary, if the test value* can no longer be reached.
To loosen the injection pump, remove the dial gage and holder.
Unscrew bolts (3 ... 5).



Loosen nuts (1 and 2) only one half turn to avoid tension from the toothed belt.

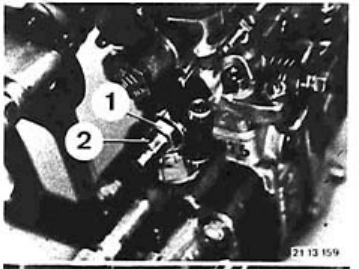


Apply dial gage with holder.
Move injection pump to correct position.
Swinging the injection pump toward the engine = earlier ignition timing point.



Tighten bolts in order of 1 through 5 after finishing adjustments.
Recheck adjustment.

* See Specifications



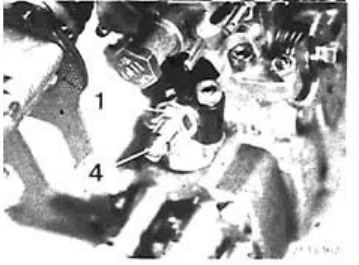
– Full throttle volume correction –
with full throttle smoke above 2500 rpm:
– Check compression – see 11 00 039.
– Adjust valve clearance – see 11 34 004.
– Check static adjustment of injection pump.
Unscrew lock nut (1) and turn back up to lockplate (2).
Lockplate (2) limits the adjustment in direction of "more volume".



The factory adjustment is marked with a notch and serves as an initial basis – remark the initial position if necessary.

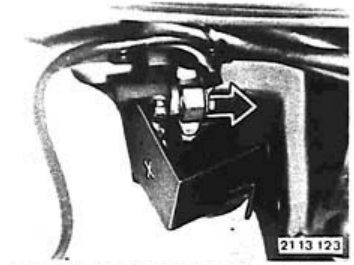


Adjusting screw (3) must be "tightened" 3 and 1/2 turns with Special Tool 13 5 100.
Reference Values:
Screw tightened = "less volume".
Screw loosened = "more volume".
3 and 1/2 turns of the adjusting screw will change the volume by approx. 1.0 mm^3.



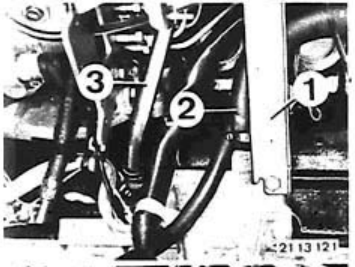
Tighten lock nut (1).
Caution!
Danger of breaking the plastic housing – counterhold on volume screw (4) if necessary!
Make visual inspection after test drive – take back full throttle volume by another 1 mm^3 if necessary.
Lock nut (1) with identification paint**.

** Source: HWB, No. 81 22 9 407 404

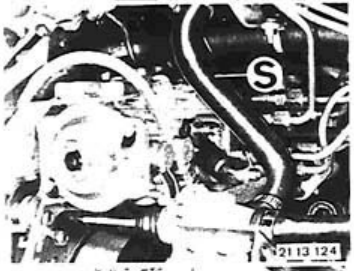


13 51 301 REPLACING ELECTRIC FUEL SHUTOFF

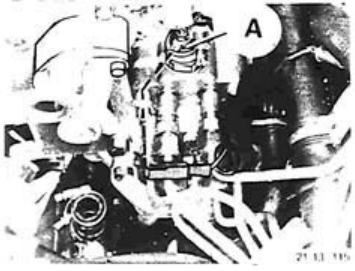
Disconnect battery lead on connecter and remove on starter.



Unscrew support for intake manifold (1), bleeding hose (2) and oil pipe (3).

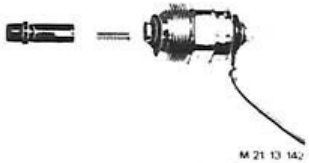


Pinch hoses tight with clamps.
Detach hose (S).



Pull off rubber cap and plug.
Disconnect lug and unscrew shutoff (A).

Watch out for spring and piston while removing – they could fall out.
Installation:
Tightening torque*.

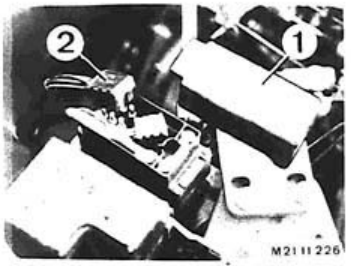




13 51 510 REPLACING ELECTRIC VALVE ON COLD START BOOSTER

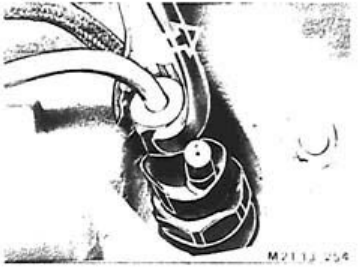
Take off rubber cap and pull off plug.
Unscrew valve – watch out for spring which could fall out.
Installation:
Tightening torque*.

* See Specifications

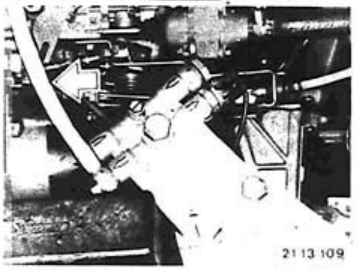


13 51 320 BLEEDING FUEL SYSTEM

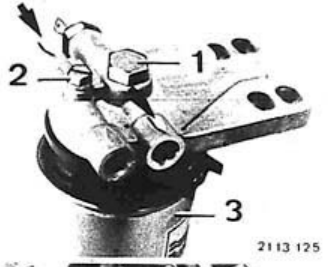
Pull off plug (2) on heating time control unit when bleeding the system for protection of the glow plugs.



Bleeding Injection Lines:
Unscrew all coupling nuts on fuel injectors with Special Tool 13 5 020.
Crank engine with the starter until fuel runs out, checking pressure valves if necessary.
Tighten nuts afterwards.
Tightening torque*.



The fuel feed line and fuel filter are bled during the starting phase.

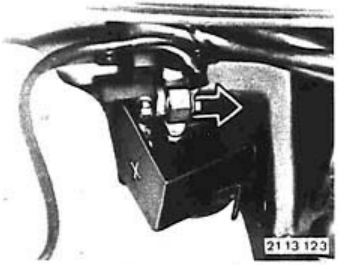


However, this requires that filter cartridge (3) is filled with fuel.
If necessary, unscrew bolt (1) and pour in fuel.
Bolts (1 and 2) must be tightened for bleeding.



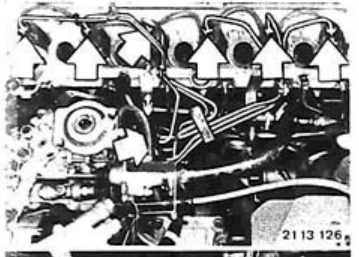
Bleeding Injection Pump:
Loosen plug on high pressure section two turns.
Start engine until fuel runs out, checking electric fuel shutoff if necessary.

* See Specifications

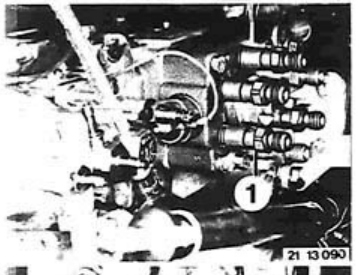


13 51 290 REPLACING PRESSURE VALVES

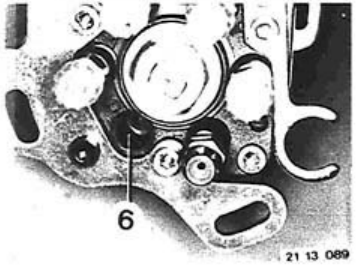
Disconnect battery lead on connector.



Unscrew intake manifold – see 11 61 . . ..
Unscrew all injection lines with Special Tool 13 5 020 and take off complete package.
Plug openings with protective caps.

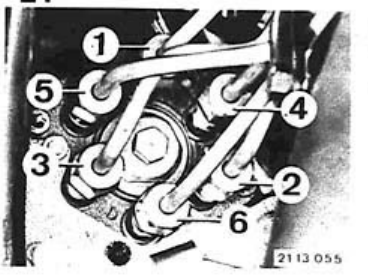


Unscrew pressure valves.
Caution!
Loose parts could fall out.



Lift out washer (6) with a scribe or similar tool.
Installation:
Use new insulators (6).
Tightening torque*.

* See Specifications



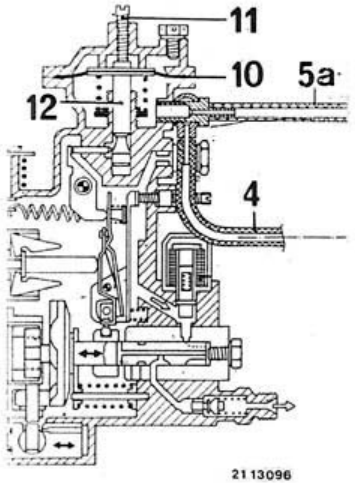
Tighten injection lines in order of 4, 2, 6 and so on.
Tightening torque*.
Tighten lines on fuel injectors only after bleeding.



Arrangement of Parts:
1 Pressure valve holder
2 Pressure valve
3 Pressure valve body
4 Spring
5 Washer
6 Insulator

* See Specifications

13 51 . . . CHECKING ATMOSPHERIC PRESSURE DEPENDENT REGULATION



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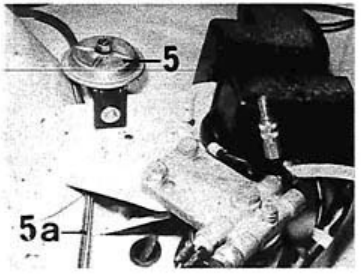
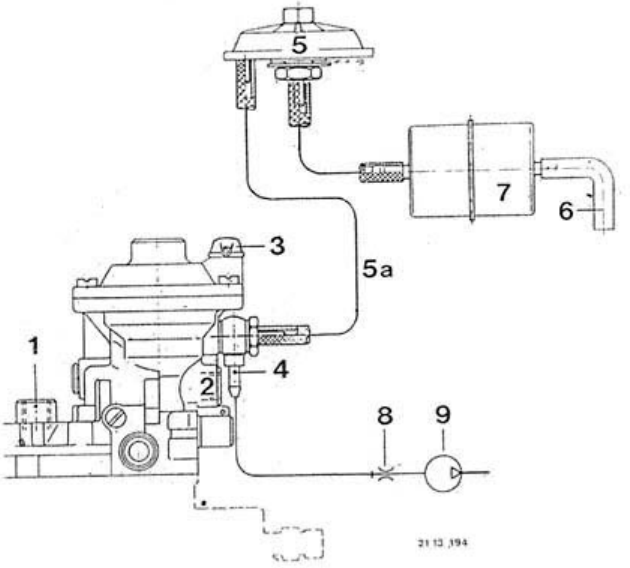
1) Leak Test on Diaphragm:
Plug hose (5a).
Connect vacuum pump on connection (4) and produce 300 to 350 mbar vacuum.
Pulling off the hose on connection (4) will cause pressure pin (12) to move up suddenly against adjusting screw (11).
This is indicated by a loud click.
If diaphragm (10) leaks, the regulation will not work and the injection pump has to be replaced.



2) Function of Control Unit:
Control unit (5) holds the pressure underneath diaphragm (10) at a constant value* continuously.
Example:

Absolute air pressure	980 mbar
Pressure measured in line 5a	– 270 mbar
Constant absolute pressure underneath diaphragm	710 mbar

The vacuum measured in line (5a) will always depend on the absolute air pressure.
Constant Pressure* Not Reached:
Check lines for leaks.
Check flow in filter.
Replace control unit, if necessary.



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1 Fuel feed
2 Fuel return
3 Venting (cap must be unscrewed)
4 Vacuum supply (> 300 mbar)
5 Control unit
6 Elbow hose (must face down)
7 Filter (check direction of flow)
8 Orifice
9 Vacuum pump

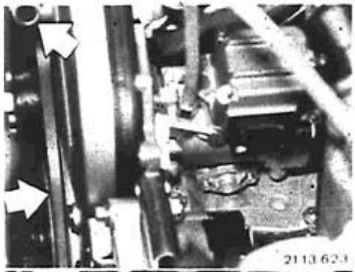
* See Specifications



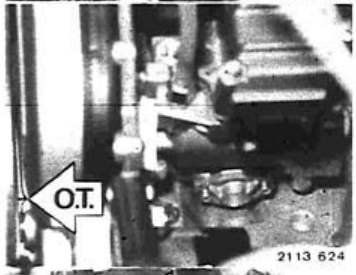
DDE

13 51 000 REMOVING AND INSTALLING INJECTION PUMP

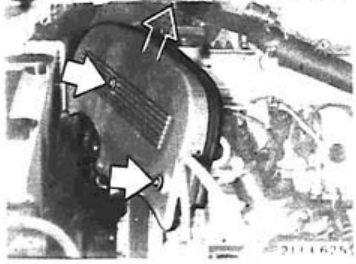
Removing:
Disconnect battery ground lead.
Important!
This will cancel memories of all systems – read memories first.
Unscrew front splash guard.
Unscrew drain plug on radiator.
Drain coolant.
Installation:
Pour in coolant* and bleed cooling system – see 17 00 039.



Disconnect water hoses.
Loosen and take off drive belt on alternator.
Installation:
Tighten drive belt.

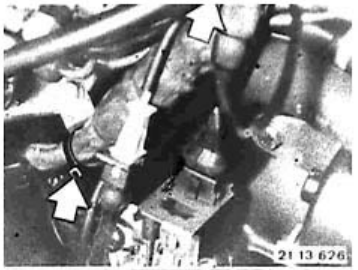


Turn crankshaft to TDC mark (ignition position in cylinder no. 1).

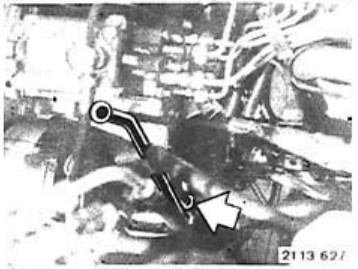


Unscrew toothed drive belt cover.

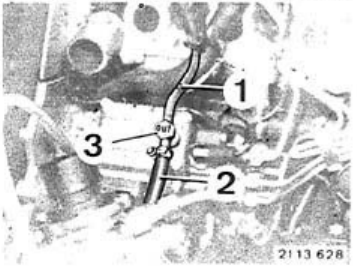
* See Operating Fluid Specifications



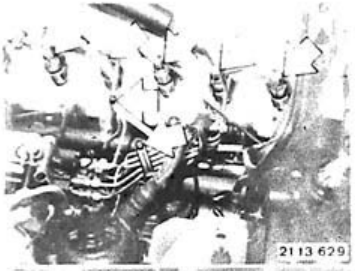
Loosen electric lead holders.



Unscrew holder for oil pipe.



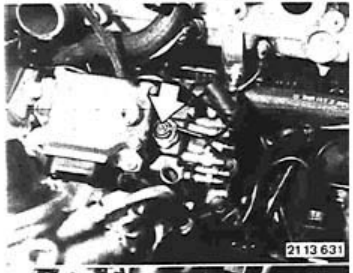
Pull off leak oil hose (1).
Unscrew return pipe (2).
Hollow union bolt (3) is matched with the injection pump.



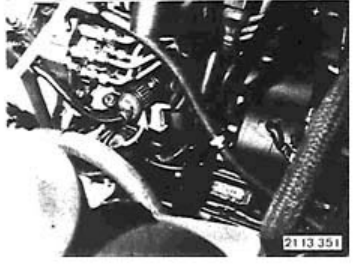
Unscrew spacing holders of injection pipes.
Unscrew all coupling nuts on injection nozzles.
Plug openings in injection nozzles with caps.
Important!
Reposition tool in time to avoid bending the injection pipes.



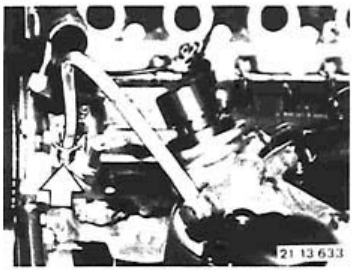
Unscrew coupling nuts on injection pump and pull back pipes.
Plug openings with caps.



Unscrew connection for fuel shutoff.



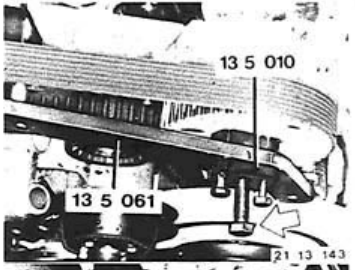
Disconnect wire harness.



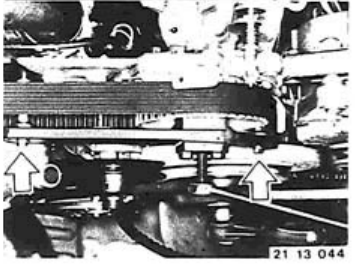
Counterhold on adapter and unscrew pipe with Special Tool 13 5 020.
Plug opening with a cap.



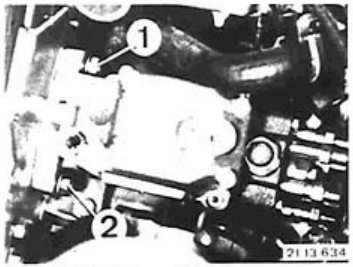
Unscrew nut on toothed belt sprocket.
Hold in position with Special Tool 13 5 340.



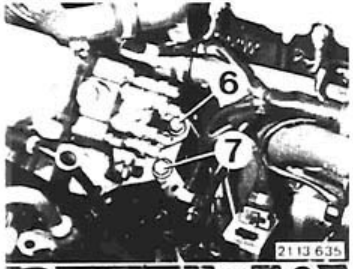
Bolt Special Tools 13 5 061 and 13 5 010 on toothed belt sprocket.
Screw back bolt (see arrow) completely.



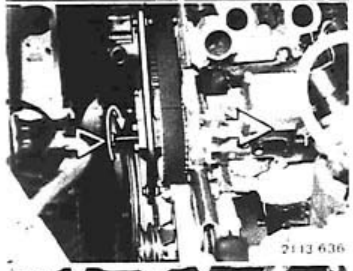
Turn crankshaft further, until special tool can be bolted.
Use M 6 x 20 mm screws.



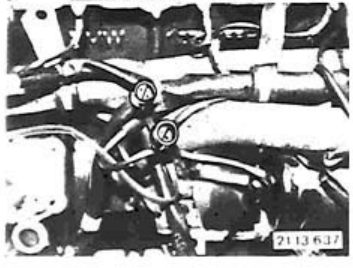
Unscrew nuts (1 and 2).



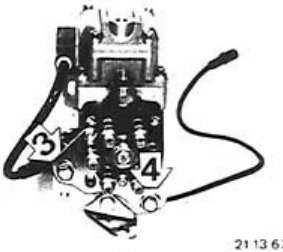
Unscrew bolts (6 and 7).



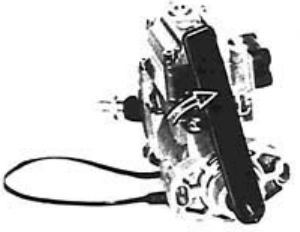
Disengage injection pump toward rear with help of a puller.
Then unscrew bolt completely.



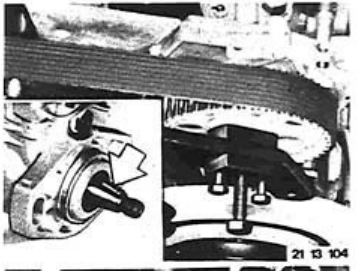
Pull electric lead plug out of holder.
Take off injection pump.
Disconnect plug for solenoid lead.



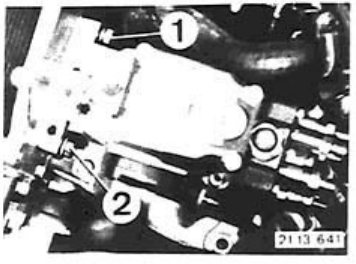
Installing:
Transfer parts – see 13 51 001.
Unscrew nuts (3 and 4) prior to installation.



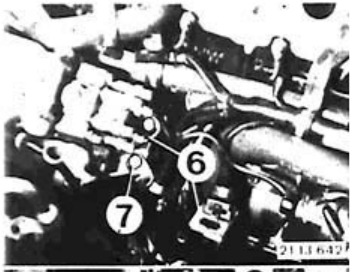
Bring injection pump shaft into installed position with Special Tool 13 5 062.
Rotary lever must be perpendicular in front of felt cam.



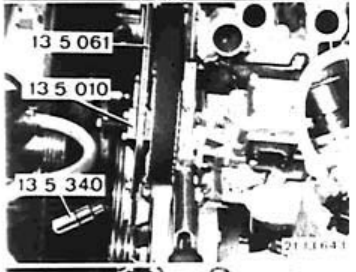
Mount injection pump, being careful that the woodruff key does not fall out.



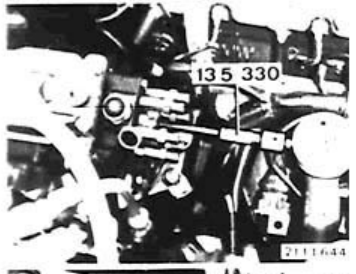
Screw on nuts (1 and 2), but do not tighten to final torque.



Tighten holder (6) and bolt (7).



Remove Special Tools 13 5 010 and 13 5 061.
Mount the drive belt sprocket, using Special Tool 13 5 340 to counterhold.
Tightening torque*.



Adjust injection pump statically – see 13 51 005.



Mount injection pipes, beginning with the tightening at connection (4).
After assembling, bleed fuel system – see 13 51 320 and check idle speed – see 13 00 050 in Construction Group Repair Manual.
Pipes for cylinders 1, 5, 3, 6, 2, 4 to firing order.

* See Specifications

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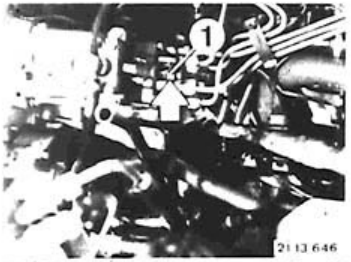
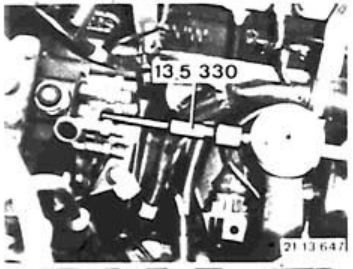
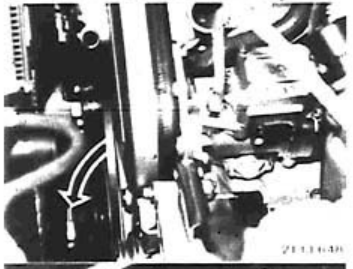
13 51 005 ADJUSTING INJECTION PUMP STATICALLY



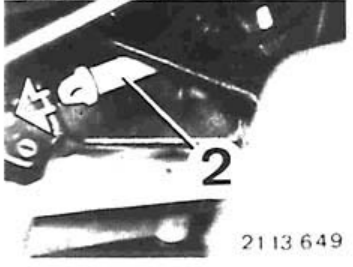
Coolant temperature at least 20° C (68° F).
Unscrew plug (1).
Installation:
Tightening torque*.



Screw in Special Tool 13 5 330.
Mount dial gage with preload.

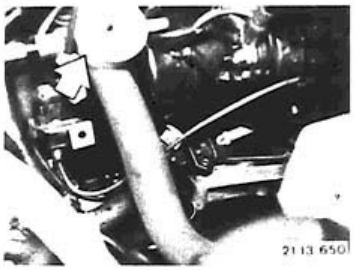


Turn crankshaft clockwise in direction of TDC for cylinder no. 1 (begin about 60 to 90° earlier) until the needle remains at the lowest point for some time.
Set scale of dial gage to zero.

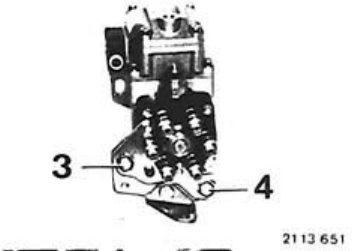


Pull out plug (2).
Turn crankshaft clockwise until Special Tool 11 2 300 engages in bore in flywheel at TDC.
Important!
Don't turn in direction opposite the engine's turning direction – wrong test results.

* See Specifications



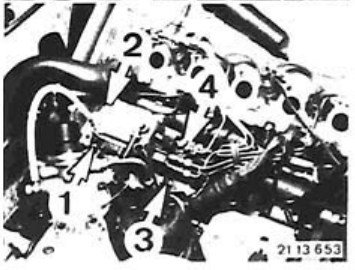
Read amount of distributor piston stroke on dial gage.
Test value: 1.05 ± 0.02 mm (0.0413 ±0.0008").



Adjusting:
Unscrew bolts (3 and 4).



Loosen nuts (1 and 2), but not too much to avoid tension from the toothed drive belt.

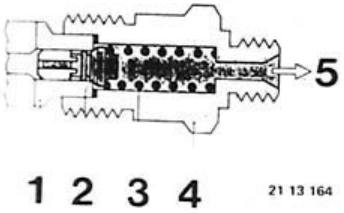


Turn injection pump until dial gage shows the correct value*.
Tighten nuts in order of 1 through 4.
Tightening torque*.
Recheck adjustment.

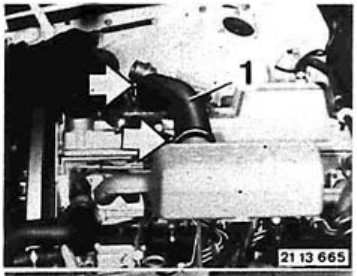
* See Specifications

DDE
13 51 290 REPLACING PRESSURE VALVES

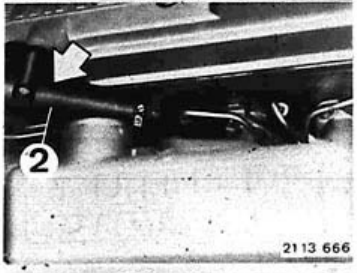
The pressure valve closes the injection pipe to the pump.
It has the task of removing injection pressure from the injection pipe after finishing a delivery phase by removing a defined volume.



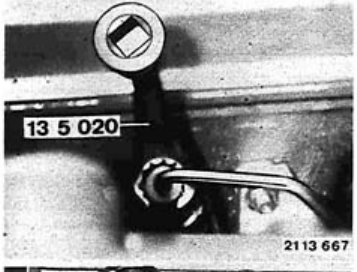
1 Valve carrier
2 Valve piston – valve seat
3 Valve spring
4 Pressure valve holder
5 Injection pipe holder



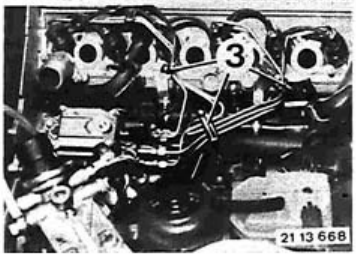
Disconnect battery ground lead.
Important!
This will cancel the memories of all systems, read them first if applicable.
Disconnect hose (1).



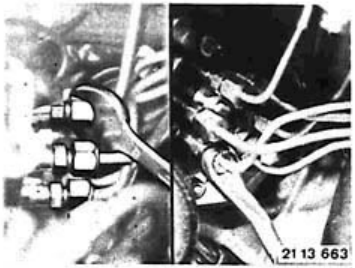
Unscrew oil trap (2).



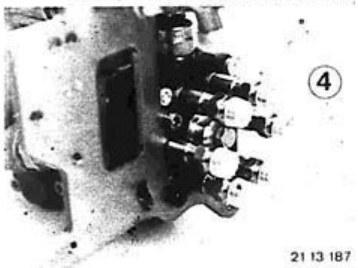
Unscrew injection pipes on injection nozzles with Special Tool 13 50 020.
Install protective caps.
Installation:
Tightening torque: 20 to 25 Nm (14.5 to 18 ft. lbs.).



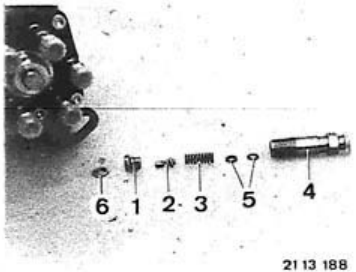
Unscrew spacing holder (3).



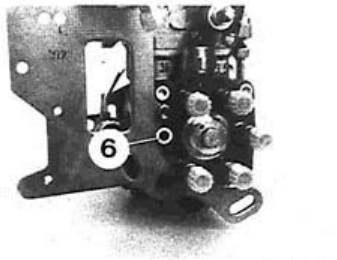
Unscrew injection pipes on injection pump.
Install caps.
Installation:
Tightening torque: 20 to 25 Nm (14.5 to 18 ft. lbs.).



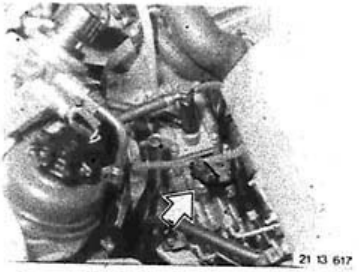
Unscrew pressure valve holder (4).
Caution!
Take off pressure valve holder – parts could fall out.
Parts are matched and must not be mixed up!
Installation:
Tightening torque: 40 ± 2 Nm (29 ± 1 ft. lbs.).



1 Valve carrier
2 Valve piston
3 Valve spring
4 Pressure valve holder
5 Shim(s)
6 Seal

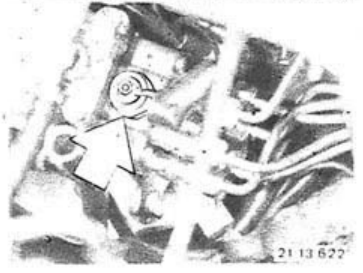


Installation:
Replace seal (6).
Bleed injection system - see 13 51 320.



13 51 300 CHECKING ELECTRIC FUEL SHUTOFF

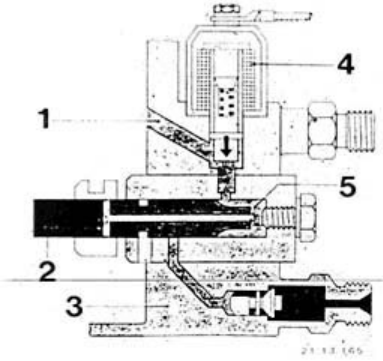
The shutoff receives voltage from the control unit as from ignition key position DRIVE on. A loud click will be heard to indicate this when switching on.



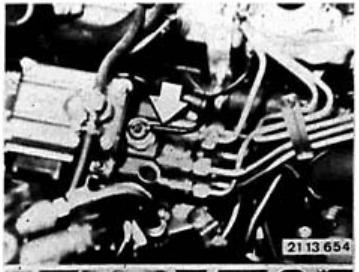
If no click is heard, check power supply to the control unit.
See self-diagnosis for other tests.

13 51 301 REPLACING ELECTRIC FUEL SHUTOFF

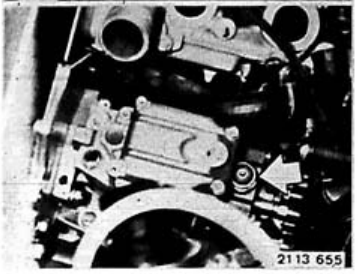
The supply of diesel fuel is interrupted to stop a diesel engine. The shutoff receives electric power from ignition key position DRIVE on.



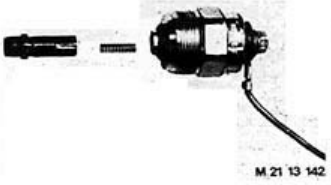
1 Feed bore
2 Distributor piston
3 Distributor head
4 Pulling magnet
5 High pressure chamber



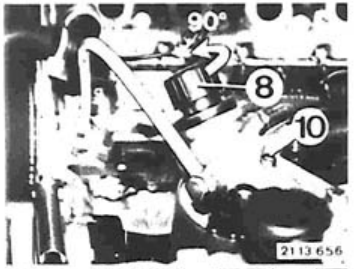
Installation:
Disconnect electric lead on fuel shutoff.



Unscrew fuel shutoff with a 24 mm open-end wrench.
Caution:
Be careful that piston and spring do not fall out!

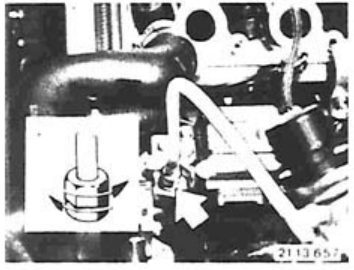


The force of the spring runs the piston out in a state without current -- fuel feed is stopped.
Installation:
Check O-ring for correct seating.
Tightening torque: 20 ± 5 Nm (14.5 ± 3.5 ft. lbs.).

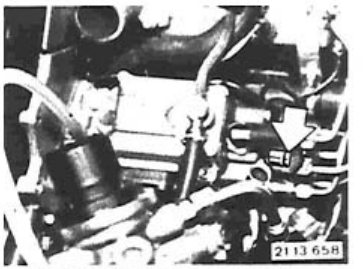


DDE
13 51 320 BLEEDING FUEL SYSTEM

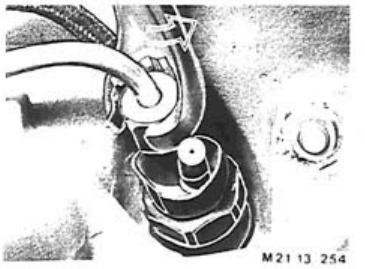
Always begin bleeding procedures on the fuel filter.
Loosen bleeder screw (10).
Unlock cap of manual pump (8) by turning 90° and pump so long, until fuel runs out of the bleeder screw (10).
Lock manual pump (8).



Unscrew coupling nut with Special Tool 13 5 020 while counterholding on adapter, if there is air in the pipe in front of the injection pump.
Operate manual pump on fuel filter until air bubbles escape.



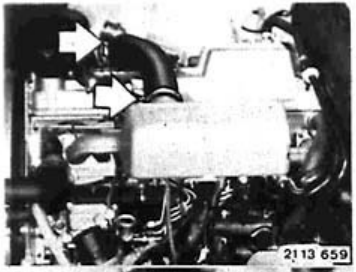
Bleeding Injection Pump:
Unscrew plug two turns.
Crank engine with starter until fuel runs out.
Then tighten plug again.
Tightening torque: 14 + 6 Nm (10 + 4 ft. lbs.).



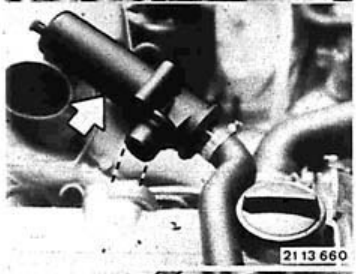
Bleeding Injection Pipes:
Unscrew all coupling nuts on fuel nozzles with Special Tool 13 5 020.
Crank engine with starter until fuel runs out of the pipes.
Tighten nuts again.
Tightening torque: 20 + 5 Nm (14.5 + 3.5 ft. lbs.).

DDE

13 53 320 REMOVING AND INSTALLING COMBINATION FUEL INJECTION NOZZLE



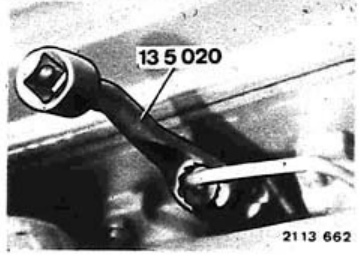
Loosen hose clamps and take off intake air hose.



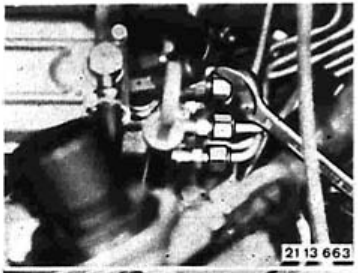
Unscrew oil trap.



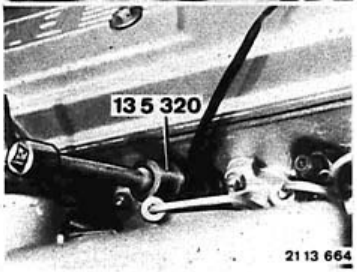
Loosen and remove pipe spacing holder.
Pull off leak oil hoses with a pliers.



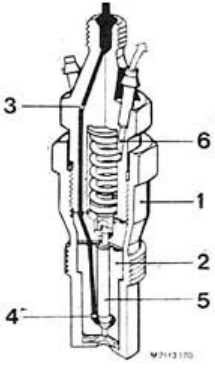
Unscrew coupling nuts with Special Tool 13 5 020.
Note;
Reposition special tool in good time to avoid bending pipes.
Plug openings with caps.



Unscrew coupling nuts on injection pump.
Installation:
Tightening torque*.



Unscrew combination fuel injection nozzle with Special Tool 13 5 320.
Installation:
Bleed injection pipes - see 13 51 320.
See Group 13 in Construction Group Repair Manual for additional information.



Components of Combination Fuel Injection Nozzle:
1 Nozzle holder
2 Nozzle body
3 Feed bore
4 Pressure chamber
5 Nozzle needle
6 Leak oil pipe

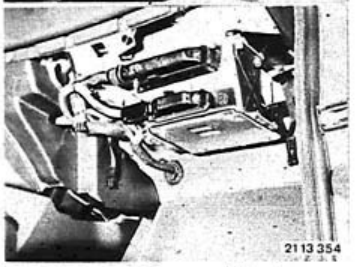
Important!
Never disassemble the fuel injection nozzle with needle movement sensor (electric lead) on cylinder no. 4.

* See Specifications

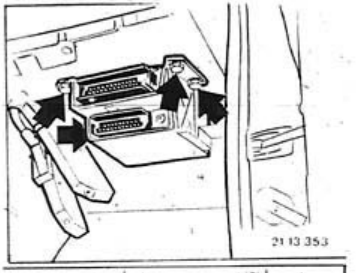


DDE
13 61 000 REMOVING AND INSTALLING CONTROL UNITS

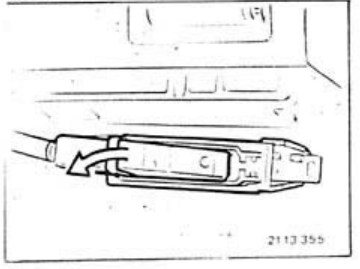
Read fault memories – see BMW diagnosing system.



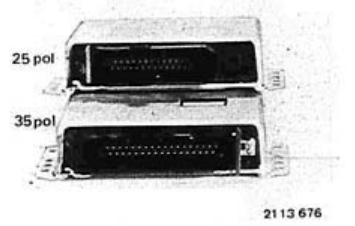
Remove cover in glove box.

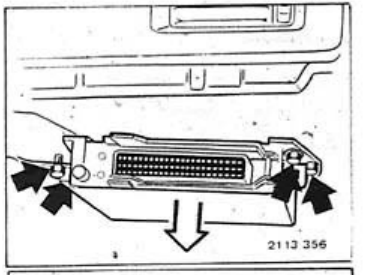


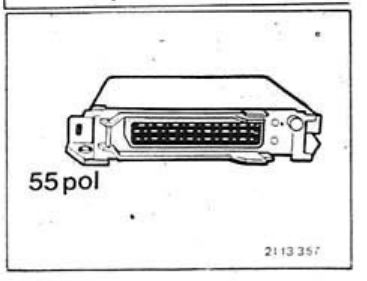
Unscrew screws and remove control units.



Important!
Turn off ignition before disconnection or connection of the multiple-pin plug.







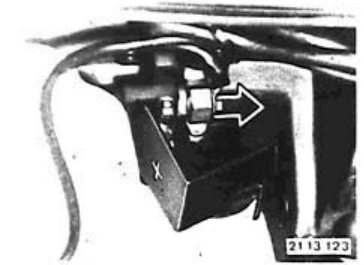
Note:
SB Control Unit
(25 Pin Connection)
Responsible For:
- **Injection begin regulation**
- **Self-diagnosis output**
- **Exhaust gas recirculation**

ME Control Unit
(35 Pin Connection)
Responsible For:
- **Starting injection rate**
- **Injection rate regulation while driving**
- **Smoke limit**
- **Fuel mass correction**
- **Idle speed control**
- **Road speed control**
- **Automatic transmission activation**
- **Charge pressure control**
- **Hesitation suppression**

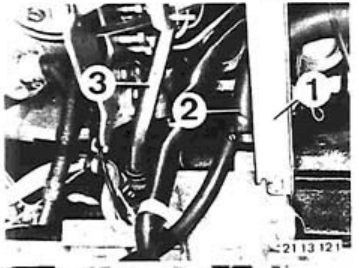
DDE II with One Control Unit (55 Pin Connection with Two Computers)
Computer I:
- **Injection begin regulation**
- **Self-diagnosis output**
- **Exhaust gas recirculation**

Computer II:
- **Injection rate regulation with starting injection rate control and full load injection rate limit**
- **Speed control**
- **Smooth running control and hesitation suppression**
- **Smoke limit and overheating guard**
- **Road speed control**

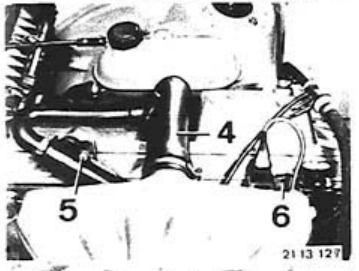
13 53 320 REMOVING AND INSTALLING OR REPLACING COMBINATION FUEL INJECTION NOZZLES



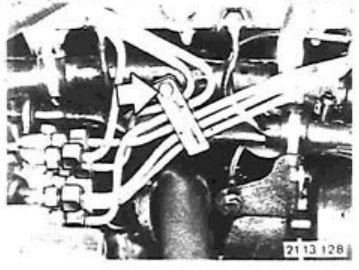
Disconnect battery lead on connector.



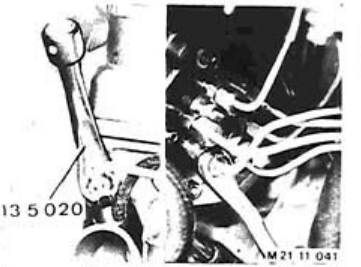
Unscrew following parts:
support for intake manifold (1), vent hose (2), oil test pipe (3), B + wire on starter.



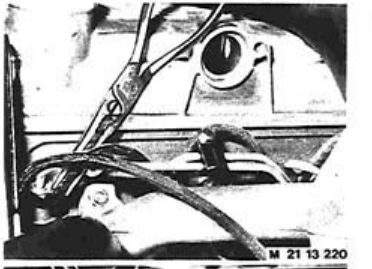
Intake hose (4), oil trap (5), holder for plug (6).



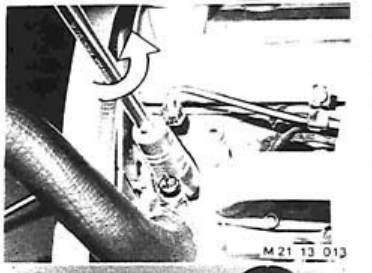
Holder for injection lines.



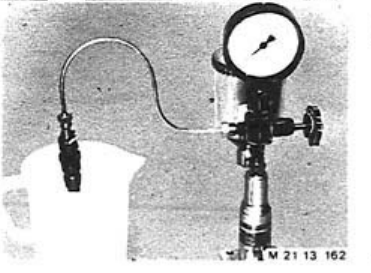
Unscrew coupling nuts in fuel injectors with Special Tool 13 5 020 – only loosen on injection pump.
Plug openings with protective caps.



Pull off all leak oil hoses.

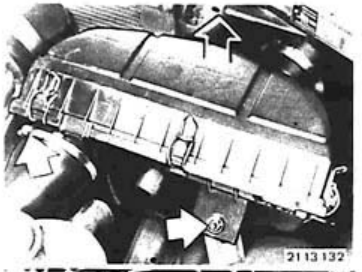


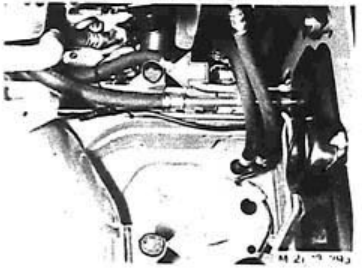
Unscrew combination fuel injection nozzle with Special Tool 13 5 320.
Installation:
Coat threads with copper paste prior to installation.
Check tightening torque* for coupling nuts and combination fuel injection nozzles.
Assemble and then bleed injection lines – see 13 51 320.



Perform test to evaluate injection nozzles – see Construction Group Repair Manual.

* See Specifications

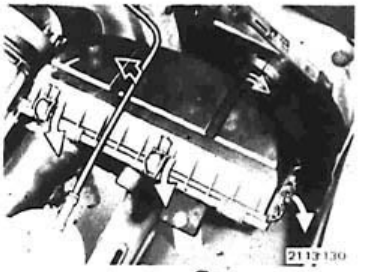




13 71 000 REMOVING AND INSTALLING AIR CLEANER

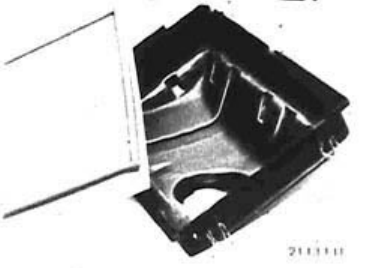
Detach hose and unscrew nut.
Lift out air cleaner.

Installation:
Place air cleaner housing on rubber mounts precisely.



13 72 001 REPLACING AIR FILTER CARTRIDGE

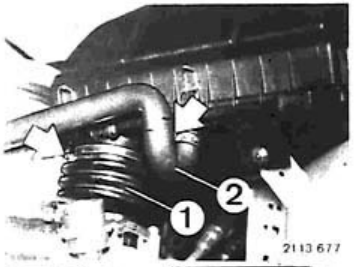
Turn intake funnel 90° and push forward
Open fasteners and lift out cover with filter



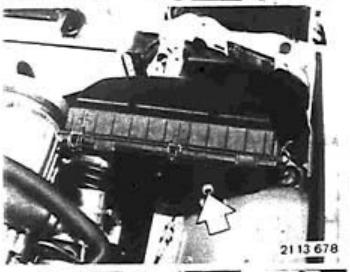
Remove filter cartridge.
Install new filter – check installed position

DDE

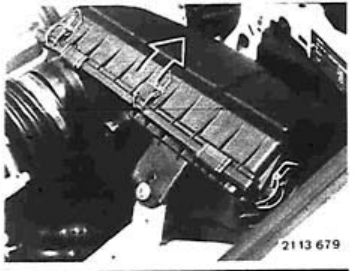
13 71 000 REMOVING AND INSTALLING AIR CLEANER



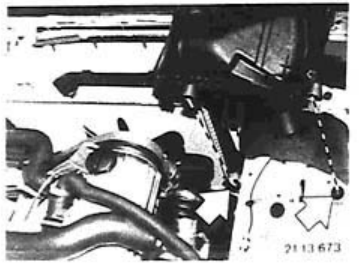
Loosen hose clamps.
Pull off hoses (1 and 2).



Unscrew nut.



Tilt and pull out filter housing.

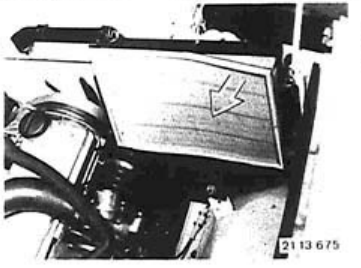


Installation:
Guide in intake neck.
Mount housing on rubber mounts.

13 72 001 REPLACING AIR FILTER CARTRIDGE



Open fasteners and pull up filter cartridge.



Insert filter cartridge.
Guide in intake neck.
Close cover and lock fasteners.

TROUBLESHOOTING DDE WITH BMW DIAGNOSING SYSTEM

Insert diskette, connect BMW Service Tester on diagnosis plug – see operating instructions of BMW DIAGNOSING SYSTEM.

Ignition ON:
Select 01 DDE, if necessary perform brief test (brief test only displays, whether there are faults in the system).
Identification of control units appears on the screen after the control unit has taken on the data transmission.

– SB control unit	
SOFTWARE	* *** ***
– VERSION	***
CODE	* *** *** ***
SOFTWARE	* *** *** ***
MANUFACTURING CODE	***
– ME control unit	
BMW SOFTWARE	* *** ***
– VERSION	***
BOSCH CODE	* *** *** ***
SOFTWARE	* *** *** ***
MANUFACTURING CODE	***

Important!
Not applicable for DDE 2 (since plant shutdown 1988 – one control unit in 324 d).

Note:
When replacing control units, also send in a print of the identification (test code).

Call fault memory by selecting 900, troubleshoot according to screen text.

Status calls can be used for additional help in troubleshooting.

STATUS CALLS 100 FOR ME CONTROL UNIT		REMARKS
111	Brake test switch	Brake pedal pressed = ON
112	Idle switch in pedal value sender	Accelerator pedal pressed more than 9° = ON
116	AC switch	Switch pressed = ON, if air volume control wheel is not at 0
127	Clutch switch	Clutch pedal pressed = OFF

STATUS CALLS 100 FOR SB CONTROL UNIT		REMARKS
151	Switch position rate tap	Position 4 = basic position
152	Switch position idle tap	Position 3 = basic position

STATUS CALLS 200 FOR ME CONTROL UNIT		REMARKS
206	Drive potentiometer	2700...2900 mV at engine idle speed and operating temp., 5000 mV = interruption
209	Speed signal	Depending on wheel speed
213	Pedal value sender	353...451 mV in idle position, 3150...3300 mV in full load position and manual transmission, 3700...3800 mV with automatic transmission
222	AG feedback (only with FGR*)	Break or not installed = 5000 mV
223	Engine temperature	Depends on engine operation – 40°C (104°F) = break
224	Fuel temperature	Depends on injection pump temperature – 40°C (104°F) = break
226	FGR* control panel	5 V = break or not installed = 5 V Control lever in off position = 3.4 ... 3.6 V Front = 0.8 ... 0.9 V Rear = 2.6 ... 2.7 V Up = 1.6 ... 1.9 V Down = 4.1 ... 4.3 V
231	Speed (engine)	Variable
232	Power supply for control unit	at least 12.5 V in idle
234	Charging pressure sensor	Engine stopped = atmospheric pressure Break = 100 mbar

STATUS CALLS 200 FOR SB CONTROL UNIT		REMARKS
203	Injection begin sender	2.2 ... 2.5 V at idle, 5 V = break
204	Air temperature	Depends on ambient temperature – 40° C (104° F = break
205	Power supply for control unit	at least 12.5 V in idle
220	Injection begin actual value	Approx. SB nominal value (2° crankshaft)
230	Injection begin nominal value	3.2 ± 0.5° crankshaft before TDC in idle, engine at operating temperature

Note:
A fault will be reported in the system in the brief test, if cruise control is not installed in car.

See E 34 Car Electric/Electronic Test Plan for additional information.

Electric Shutoff

Function Test:
The electric shutoff is located in the high pressure section of the injection pump and is supplied with voltage (10 V) with the ignition turned on. Fuel feed is stopped, as long as there is no power supply.

D 300 – the electric shutoff can also be switched off and on with the SERVICE TESTER

Electric shutoff resistance in ohms	5 ... 10

* Cruise control

TROUBLESHOOTING DDE II WITH BMW DIAGNOSING SYSTEM

Insert diskette and connect BMW Service Tester in the diagnosis socket – see operating instructions of BMW Diagnosing System.

Ignition ON:
Select 01 DDE, if applicable perform the brief test (brief test only displays, whether or not there are faults in the system).
Identification of control units appears on the screen after the control unit has received the data transmission.

– Control Unit Identification

Software	* *** ***
Version	***
Code	* *** *** ***
Software	* *** *** ***
Manufacturing code	***

Note:
Also send in print of identification (test code) when exchanging control units.

Call fault memory by selecting 900, troubleshoot as displayed on screen.

Status calls can be used as further support of troubleshooting.

Status Call 100 from Control Unit	Remarks
131 Stop light test switch	With operated brake pedal = ON
125 Idle speed switch in pedal value sender	With accelerator pedal operated > 9° = ON
144 Air conditioner switch	With operated switch = ON, if air volume control wheel is not at 0
127 Clutch switch	With operated clutch pedal = OFF
127 P / N switch	In position P / N = ON
151 Volume balance switch pos.	Position 4 = basic position
152 Idle balance switch pos.	Position 3 = basic position

Status Call 200 from Control Unit	Remarks
221 Drive potentiometer	2700 ... 2900 mV at idle speed, engine at operating temperature, 5000 mV = break
229 Road speed signal	Depends on wheel speed
237 Pedal value sender	353 ... 451 mV in idle position, 3150 ... 3300 mV in full load position and manual transmission or 3700 ... 3800 mV in full load position and automatic transmission
222 AG feedback (only with FGR*)	– Break or not installed = 5000 mV
253 Engine (coolant) temperature	Depends on engine operation - 40° C (- 40° F) = break
235 Fuel temperature	Depends on injection pump temp. - 40° C (- 40° F) = break
220 FGR* control panel	5 V = break or not installed Control lever in neutral = 3.4 ... 3.6 V Forward = 0.8 ... 0.9 V Back = 2.6 ... 2.7 V Up = 1.6 ... 1.9 V Down = 4.1 ... 4.3 V
247 Engine speed	Variable
215 Power supply for control unit	> 12.5 at idle speed
260 Atmospheric pressure sensor	Actual atmospheric pressure Break = < 100 mbar
205 Injection begin sender	2.2 ... 2.5 V at idle speed, 5 V = break
252 Air temperature	Depends on ambient temperature - 40° C (- 40° F) = break
256 Injection begin actual value	Approx. SB nom. value (< 2° crksh.)
257 Injection begin nominal value	3.2 ± 0.5° crksh. before TDC at idle speed, engine at operating temp.

Note:
Brief test will report a fault in the system, if cruise control is not installed.

Other information – see car electric/electronic test plan E 34.

Electric Shutoff

Function Test:
The electric shutoff is located in the high pressure section of the injection pump and receives > 10 V power supply with the ignition turned on. Fuel delivery is stopped as long as power is not supplied.

D 300 – the electric shutoff can also be switched off and on from the BMW Service Tester.

Electric shutoff resistance	5 ... 10 ohms

* FGR = Cruise control

COMPONENT TEST

Component	Resistance In Ohms	Testing Temperature In ° C (° F)	Control Unit Pins
Speed sender	840 ... 960 1 ... 1.3 k-ohms	15 ... 30 (59 ... 86) 40 ... 60 (104 ... 140)	13 / 47
Fuel temperature sensor	660 ... 960	15 ... 30 (59 ... 86)	13 / 35
Engine temp. sensor	550 ... 750 300 ... 400	15 ... 30 (59 ... 86) 50 ... 80 (122 ... 176)	13 / 53
Pedal value sender	800 ... 1400	15 ... 30 (59 ... 86)	14 / 33
Pedal value sender switch at idle speed (open as of 9°)	approx. 700	15 ... 30 (59 ... 86)	14 / 25
Drive potentiometer	1700 ... 1900	20 ... 60 (68 ... 140)	14 / 39
Injection rate control	0.3 ... 0.9	20 ... 60 (68 ... 140)	1 / 17
Control panel for FGR Switch position – normal – forward – back – up – down	 – – – – –	 15 ... 30 (59 ... 86) see call 200	
Air temperature sensor	700 ... 900	20 ... 50 (68 ... 122)	13 / 52
Injection begin sender	90 ... 110	15 ... 30 (59 ... 86)	12 / 5
Electric switchover valve EGR	20 ... 40	15 ... 30 (59 ... 86)	8 / 17
Injection control solenoid	10 ... 20	20 ... 60 (68 ... 140)	10 / 17
Electric switchover valve AG/FGR	20 ... 40	15 ... 30 (59 ... 86)	9 / 17
Electric shutoff	5 ... 10	20 ... 50 (68 ... 122)	13 / 34

13 Fuel System

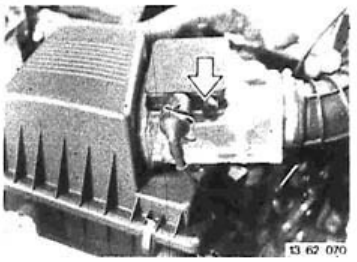
Engine: M40, M42, M20
Models: 316i, since 9/88 318i, 318is, 320i, 325i

13 00 060	Engine idle speed and CO level – check (M40 with catalytic converter)	13- 50
	Engine idle speed and CO level – check (M40 with provisions for catalytic converter)	13- 51
	Engine idle speed and CO level – check (M42 with catalytic converter)	13- 52
	Engine idle speed and CO level – check (M42 with provisions for catalytic converter)	13- 53
	Engine idle speed and CO level – check (M20 with M1.1)	13- 54
	Engine idle speed and CO level – check (M20 with M1.1 Motronic since 9.87 and M1.3)	13- 56
. . .	Engine idle speed – adjust (M20 / 2.0 litres)	13- 57
054	Engine idle speed – adjust / CO level – check (M20 / 2.5 litres)	13- 58
13 31 029	Fuel delivery pressure – check	13- 59
. . .	Fuel delivery rate – check	13- 59
030	Fuel pump – remove and install	13- 60
	Fuel pump – remove and install (M40)	13- 61
13 32 051	Fuel filter – remove and install	13- 62
13 41 000	Idle speed control valve – remove and install (M40)	13- 63
	Idle speed control valve – remove and install (M42)	13- 64
	Idle speed control valve – remove and install (M20)	13- 65
13 51 200	Fuel pressure regulator – remove and install (M40)	13- 66
	Fuel pressure regulator – remove and install (M42)	13- 67
13 54 030	Throttle valve assembly – remove and install (M40)	13- 68
	Throttle valve assembly – remove and install (M42)	13- 69
13 61 000	Control unit (DME) – remove and install	13- 70
13 62 000	Air flow sensor – remove and install (M10)	13- 71
	Air flow sensor – remove and install (M20, M40, M42)	13- 72
531	Coolant temperature sensor – remove and install / check	13- 73
13 63 544	Throttle valve switch – adjust	13- 74
551	Throttle valve switch – remove and install	13- 74
13 64 150	Fuel injectors – remove and install / replace (M40)	13- 75
	Fuel injectors – remove and install / replace (M42)	13- 76
	Troubleshooting DME with BMW diagnostics system (M40)	13- 78
	Troubleshooting DME with BMW diagnostics system (M42)	13- 79
	Fuel / air mixture and engine timing (M42)	13- 80
	Troubleshooting engine electronics	see group 12

13 00 060 CHECKING ENGINE IDLE SPEED AND CO LEVEL - Car with Catalytic Conv.

M 40
Engines with Single Sensor Motronic
M 1.3

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60 deg. C (140 deg. F).
Engine and ignition in perfect working condition.
Connect BMW SERVICE TESTER to operating instructions.
Routine checking is not necessary.
Put in number of cylinders (4) for idle speed engine test step no. 5.

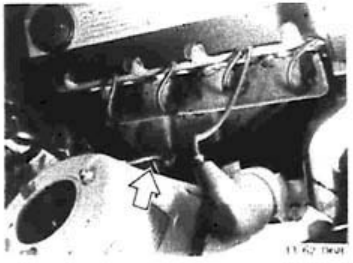


Important!
The position of the air flow sensor adjusting screw must not be changed, since this setting is the basis for oxygen sensor and idle speed control.

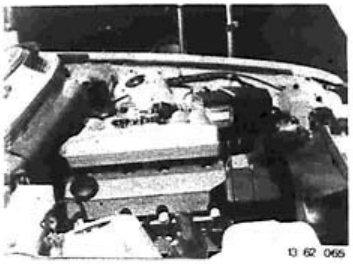
Checking Oxygen Sensor Function (11 78 010):
Unscrew bolt (1).
Connect Special Tools 13 0 090 and 13 0 100 on exhaust manifold.
Switch off the exhaust extraction system for the time of testing.
Disconnect oxygen sensor plug.
Pinch the vacuum hose (not while engine is running) and start the engine - CO level rises.
Connect oxygen sensor -CO level should return to the specified value.
Remove clamp on vacuum hose.

1) Engine Idle Speed
Check engine idle speed**.
See BMW diagnosing system, if specified value is not reached.
Check intake system for leaks.
Note:
There is no adjusting screw for idle speed correction.
The idle speed control valve must be heard and felt distinctly while turning on the ignition.

2) CO Level
Disconnect oxygen sensor plug (not in cars with provisions for cat. conv.).
Unscrew bolts. Connect Special Tools 13 0 090 and 13 0 100 on exhaust manifold. Check idle speed CO level**.
Switch off exhaust extraction system for time of testing.
<u>CO Level Too High:</u>
Check fuel injectors, fuel pressure and coolant temperature sensor.
<u>CO Level Too Low:</u>
Check hoses and connections for idle speed control or locate leaks,



** See Specifications of Gr. 11 and 13



13 00 060 CHECKING ENGINE IDLE SPEED AND CO LEVEL
- Car with Provisions for Catalytic Converter -

M 40
Engines with Single Sensor Motronic M 1.3

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60 deg. C (140 deg. F).
Engine and ignition in perfect working condition.
Connect BMW SERVICE TESTER to operating instructions.
Put in number of cylinders (4) for idle speed engine test step no. 5.
Routine checking is not necessary.



1) Engine Idle Speed
Check engine idle speed**.
See BMW diagnosing system if specified value is not reached.
Check intake system for leaks.
Note:
There is no adjusting screw for idle speed correction.
The idle speed control valve must be heard and felt distinctly while turning on the ignition.

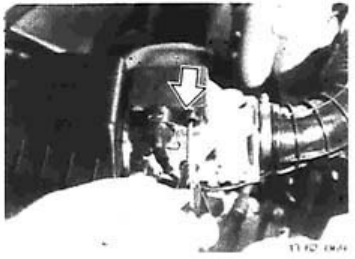
2) CO Level
Unscrew bolts.
Connect Special Tool 13 0 100 in tailpipe or on exhaust manifold.
Check idle speed CO level**.
Switch off exhaust extraction system for the time of testing.
If specified value is not reached, the CO level** of cyl. 1 and 2 or cyl. 3 and 4 can be measured separately for troubleshooting.

** See Specifications of Gr. 11 and 13

If the specified value is not reached and before correcting the CO level, make sure that there are no faults in the engine, ignition or fuel injection.
Excessive CO Level:
Check
- fuel injectors,
- fuel pressure and
- coolant temperature sensor.

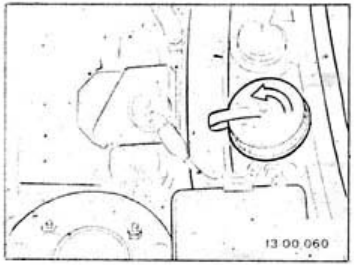
Insufficient CO Level:
- Check hoses and connections for idle speed control or locate leaks.
- Also refer to BMW diagnosing system.





Remove cap with Special Tool 13 1 011.
Adjust the CO level** with a screwdriver applied on the adjusting screw of the air flow sensor.

** See Specifications of Gr. 11 and 13



13 00 060 CHECKING ENGINE IDLE SPEED AND CO LEVEL

M 42
Engines with M 1.7 Motronic

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
Engine and ignition in perfect working condition.
BMW Service Tester connected to operating instructions.
Routine checking is not necessary.
Put in number of cylinders (4) for idle speed engine test step no. 5.

1) Engine Idle Speed

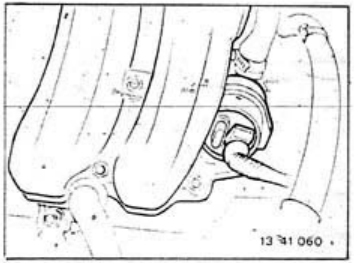
Check engine idle speed.**
See BMW diagnosing system when nominal value is not reached.
Check intake system for leaks.

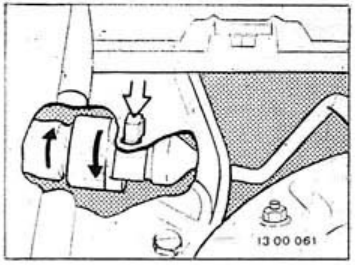
Note:
There is no idle speed adjusting screw. Idle speed control valve must be heard and felt while turning on the ignition.

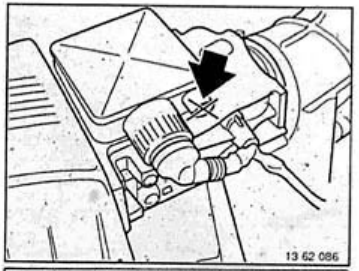
2) CO Level

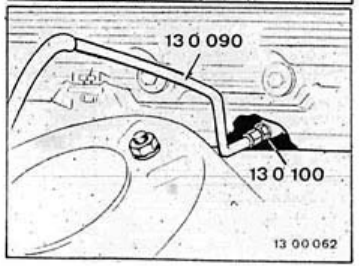
Disconnect oxygen sensor plug (not with catalytic converter provisions). Unscrew screws. Connect Special Tools 13 0 090 and 13 0 100 on exhaust manifold and check the idle speed CO level. Switch off exhaust extraction system for time of testing.**
<u>CO Level Too High:</u>
Check fuel injectors, fuel pressure and coolant temperature sensor.
<u>CO Level Too Low:</u>
Check hoses and connections for idle speed regulation and locate points of leakage.

**** See Specifications of Gr. 11 and 13**





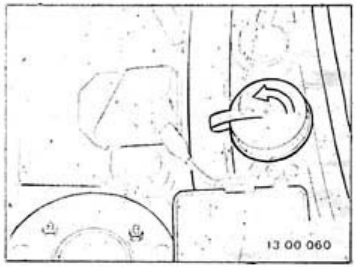




Important!
Corrections cannot be made on the air adjusting screw.

Oxygen Sensor Function Test (11 78 010):

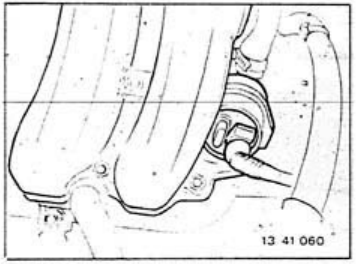
Unscrew screw (1).
Connect Special Tools 13 0 090 and 13 0 100 on the exhaust manifold.
Switch off exhaust extraction system for the time of testing.
Disconnect oxygen sensor plug.
Pinch vacuum hose leading to the fuel pressure regulator with a clamp (not while engine is running) and start the engine – CO level rises.
Connect oxygen sensor – CO level must go back to the nominal value.
Remove hose clamp.



13 00 060 CHECKING ENGINE IDLE SPEED AND CO LEVEL
– Cars with Provisions for Catalytic Converter –

M 42
Engines with M 1.7 Motronic

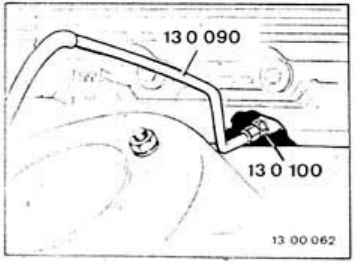
Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
Engine and ignition in perfect working condition.
BMW Service Tester connected to operating instructions.
Put in number of cylinders (4) for idle speed engine test step no. 5.
Routine checking is necessary.



1) Engine Idle Speed

Check engine idle speed.**
See BMW diagnosing system when the nominal value is not reached.
Check intake system for leaks.

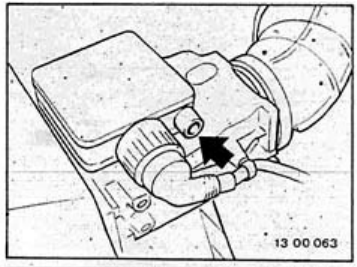
Note:
There is no idle speed adjusting screw. Idle speed control valve must be heard and felt while turning on the ignition.

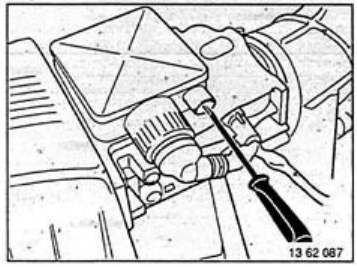


2) CO Level

Unscrew screws. Connect Special Tool 13 0 100 in tailpipe or exhaust manifold.
Check idle speed CO level.**
Switch off exhaust extraction system for the time of testing.
If the nominal value is not reached, the CO level of cyl. 1 through 4 can be measured separately for troubleshooting.**

**** See Specifications of Gr. 11 and 13**





Make sure that there are no faults in the engine, ignition or fuel injection before corrections are made on the CO level adjustment, when the nominal value is not reached.
CO Level Too High:
Check
fuel injectors,
fuel pressure and
coolant temperature sensor.
CO Level Too Low:
Check hoses and connections for idle speed regulation and locate points of leakage.
Also refer to the BMW diagnosing system.

Remove cap with Special Tool 13 1 011. Adjust CO level with a screwdriver applied on the adjusting screw on the air flow sensor.**

**** See Specifications of Gr. 11 and 13**

13 00 060 CHECKING ENGINE IDLE SPEED AND CO LEVEL – Cars with Catalytic Converter or Provisions for Catalytic Converter –

M 20
Engines with M 1.1 Motronic (identified by inductive sender on vibration damper with 58 teeth and one gap)

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
Valve clearance as specified.
Engine and ignition in perfect working condition.
BMW Service Tester connected to operating instructions.
Routine checking is not necessary.



13 41 017

1) Engine Idle Speed

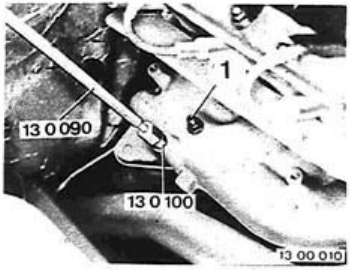
Check engine idle speed.**
See BMW diagnosing system when the nominal value is not reached.
Check intake system for leaks.

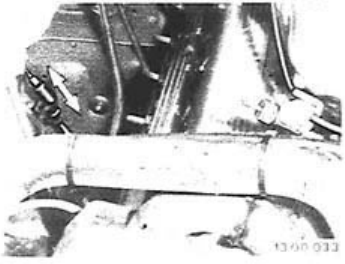
Note:
There is no idle speed adjusting screw.

2) CO Level

Disconnect oxygen sensor plug (not in cars with catalytic converter provisions). Unscrew screws. Connect Special Tools 13 0 090 and 13 0 100 on the exhaust manifold. Check idle speed CO level. Switch off exhaust extraction system for the time of testing.**
<u>CO Level Too High:</u>
Check fuel injectors, fuel pressure and coolant temperature sensor.
<u>CO Level Too Low:</u>
Check hoses and connections for idle speed regulation or locate points of leakage.

** See Specifications of Gr. 11 and 13





Important!
Corrections cannot be made on the air adjusting screw.

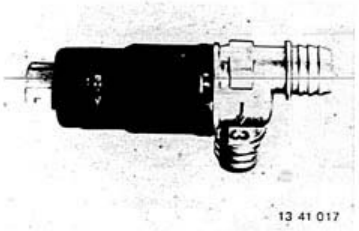
Oxygen Sensor Function Test (11 78 010):

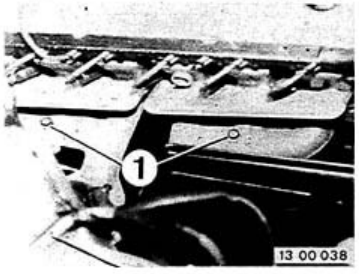
Unscrew screw (1).
Connect Special Tools 13 0 090 and 13 0 100 on the exhaust manifold.
Switch off exhaust extraction system for the time of testing.
Disconnect oxygen sensor plug.
Pinch vacuum hose leading to the fuel pressure regulator with a clamp (not while engine is running) and start the engine – CO level rises.
Connect oxygen sensor – CO level should return to the nominal value.
Remove hose clamp.

13 00 060 CHECKING ENGINE IDLE SPEED AND CO LEVEL – Cars with Catalytic Converter or Provisions for Catalytic Converter –

M 20
Engines with M 1.1 Motronic (identified by inductive sender on vibration damper with 58 teeth and one gap)

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
Valve clearance to specifications.
Engine and ignition in perfect working condition.
BMW Service Tester connected to operating instructions.
Routine checking is not necessary.





1) Engine Idle Speed

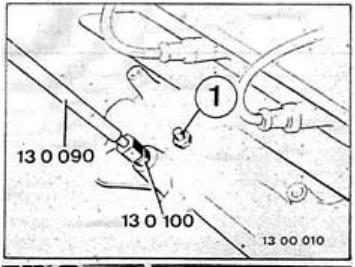
Check engine idle speed.**
See BMW diagnosing system when the nominal value is not reached.
Check intake system for leaks.

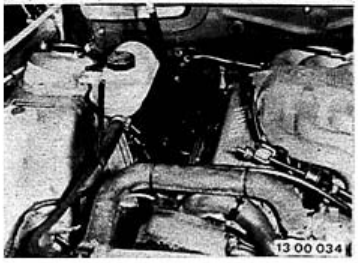
Note:
There is no idle speed adjusting screw.

2) CO Level

Disconnect oxygen sensor plug (not in cars with catalytic converter provisions). Unscrew screws. Connect Special Tools 13 0 090 and 13 0 100 on the exhaust manifold. Check idle speed CO level. Switch off exhaust extraction system for the time of testing.**
CO Level Too High:
Check fuel injectors, fuel pressure and coolant temperature sensor.
CO Level Too Low:
Check hoses and connections for idle speed regulation and locate points of leakage.

**** See Specifications of Gr. 11 and 13**





Important!
Corrections cannot be made on the air adjusting screw.

Oxygen Sensor Function Test (11 78 010):

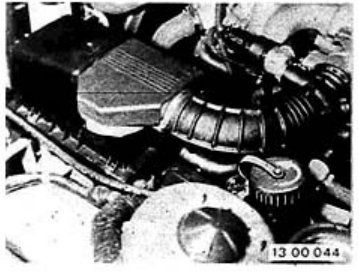
Unscrew screw (1).
Connect Special Tools 13 0 090 and 13 0 100 on the exhaust manifold.
Switch off exhaust extraction system for the time of testing.
Disconnect oxygen sensor plug.
Pinch vacuum hose leading to the fuel pressure regulator with a clamp (not while engine is running) and start the engine – CO level rises.
Connect oxygen sensor – CO level should go back to the nominal level.
Remove hose clamp.


13 00 040

13 00 ... ENGINE RUNNING AND CO LEVEL
– Only Cars with Provisions for Catalytic Converter –

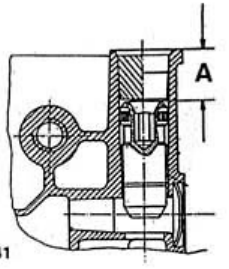
M 20
M 1.1 Motronic Since 9.87 and M 1.3 Motronic

If it had been absolutely necessary to correct the CO level/engine running adjustment on the air flow sensor adjusting screw (1) or if this screw had been maladjusted, the basic adjustment must be checked / restored when converting the car to a catalytic converter or working on the fuel/air mixture system.

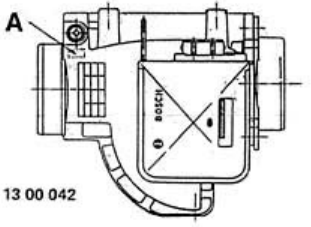

13 00 044

1) Corrections may never be made, if there is a fault in the fuel/air mixture system:

Read self-diagnosing system.
Check intake and fuel systems for leaks.
Check fuel injectors, temperature sensor and fuel pressure – also refer to 13 00 060.



13 00 041



13 00 042

13 00 ... CHECKING BASIC ADJUSTMENT OF AIR FLOW SENSOR ADJUSTING SCREW
– Only Cars with Provisions for Catalytic Converter –
(Anti-tamper Lock in Cars with Catalytic Converter)

M 20
M 1.1 Motronic Since 9.87 and M 1.3 Motronic

Measure distance "A" to the adjusting screw with a depth gage and compare with the value stamped in the air flow sensor, adjusting if necessary.

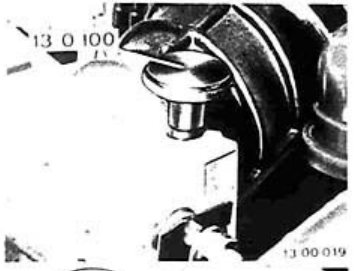
13 00 054 ADJUSTING ENGINE IDLE SPEED

M 20
2.0 Liter Engines
Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
Ignition timing and valve clearance to specifications.
Air filter cartridge in perfect condition.
All electric equipment switched off.
BMW Service Tester connected to operating instructions.
Exhaust extraction system switched off for the time of testing.



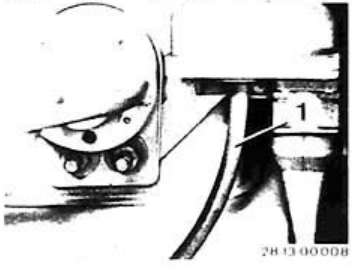
1) Engine Idle Speed

Adjust idle speed* on the air control screw in the bypass bore.



2) CO Level

Make sure that there are no faults in the engine, ignition or fuel injection (see troubleshooting) before correcting the CO level adjustment.
Remove cap with Special Tool 13 1 011.
Adjust the CO level* with Special Tool 13 1 100 applied on the air control screw in the air flow sensor.



Checking Partial Load Enrichment (Before 1984 Annual Plant Shutdown):

Pull off and plug vacuum hose (1).
CO level must rise noticably (approx. 2.5 % by volume).

* See Specifications of Gr. 11

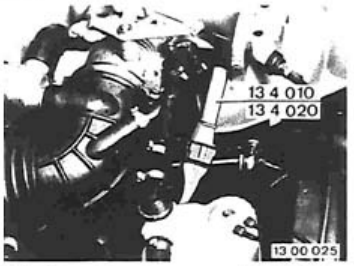
13 00 054 ADJUSTING ENGINE IDLE SPEED / CO LEVEL

M 20
2.5 Liter Engines
Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
Engine, ignition and fuel injection in perfect working condition.
Valve clearance to specifications.
All electric equipment switched off.
Air filter cartridge in perfect condition.
BMW Service Tester connected to operating instructions.

1) Engine Idle Speed

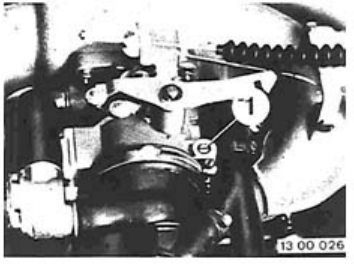
Check engine idle speed*,
Check idle speed control valve when the nominal value is not reached.
Check / correct basic adjustment.
Check intake system for leaks.

Note:
There is no idle speed adjusting screw.

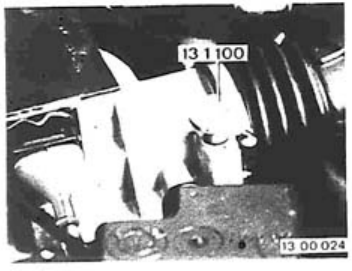


Basic Adjustment for Idle Speed Regulation:

Run engine at idle speed.
Pull off plug on throttle valve switch.
Insert Special Tool 13 4 010 or 13 4 020 in the electric lead plug.
The idle speed control valve is now fixed in the basic adjustment position.



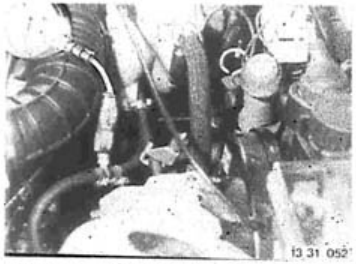
Remove anti-tamper lock.
Adjust engine speed to 760 ± 20 rpm on screw (1).
Install a new anti-tamper lock.



2) CO Level

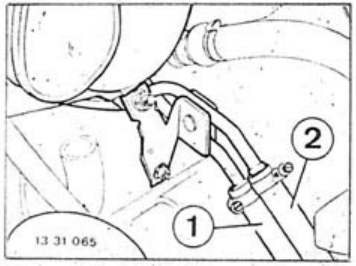
Remove anti-tamper lock with Special Tool 13 1 011.
Adjust the CO level* by applying Special Tool 13 1 100 on the air control screw in the air flow sensor.
Install a new anti-tamper lock.

* See Specifications of Gr. 11 and 13

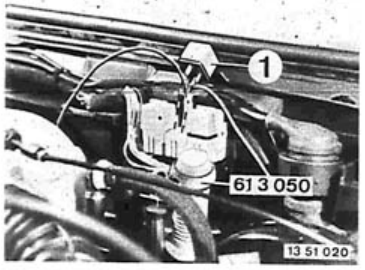


13 31 029 CHECKING FUEL DELIVERY PRESSURE

M 40 / M 42
Install pressure tester 13 3 060 with connecting hose and adapter 13 3 064 in the fuel feed line – in front of the fuel pressure regulator.
Plug fuel return line with Special Tool 13 3 010.

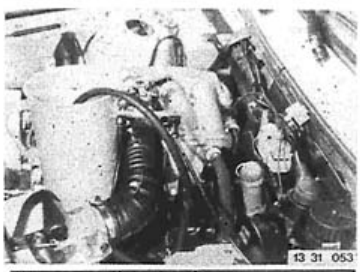


M 42
(1) Feed line
(2) Return line



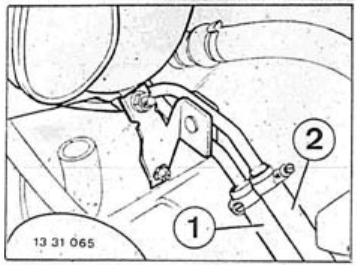
Pull off fuel pump relay (1).
Bridge terminals 87b and 30 with Special Tool 61 3 050.
Check delivery pressure*.

* See Specifications of Gr. 16

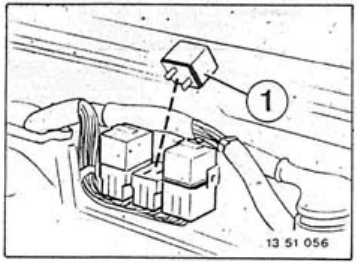


13 31 ... CHECKING FUEL DELIVERY RATE

M 40 / M 42
Unscrew fuel return line, attach an extension hose and hold end of hose in measuring cup 13 3 020.



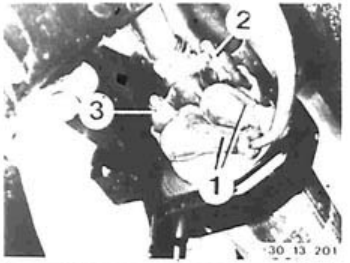
M 42
(1) Feed line
(2) Return line



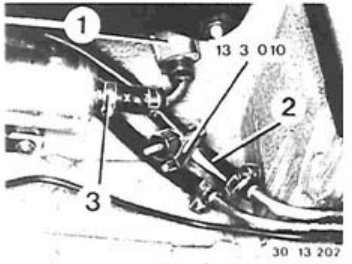
Pull off fuel pump relay (1).
Bridge terminals 87 and 30 with Special Tool 61 3 050.
Check delivery rate*.

* See Specifications of Gr. 16

13 31 030 REMOVING AND INSTALLING FUEL PUMP

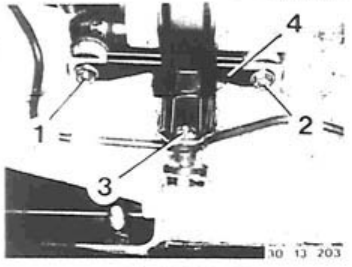


Push back caps (1).
Unscrew nuts (2 and 3) and take off leads.



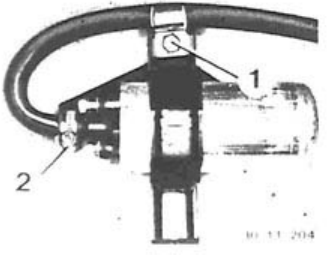
Clamp suction hose (1) and pressure hose (2) with Special Tool 13 3 010.
Loosen hose clamps (3) and pull off hoses.

Note:
Never use squeeze-hose clamps on the pressure hose.

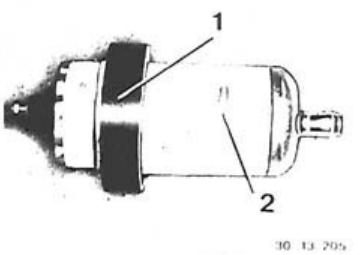


Unscrew nuts (1 ... 3) and take off holder (4).
Remove fuel pump with holder.

Installation:
Check rubber mounts, replacing if necessary.

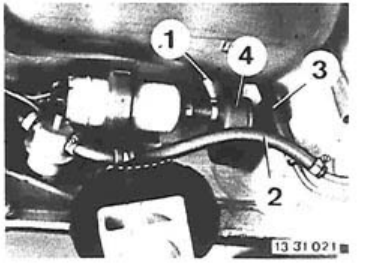


Unscrew bolt (1).
Loosen hose clamp (2) and pull off fuel hose.
Take fuel pump off of holder.



Pull off rubber ring (1).

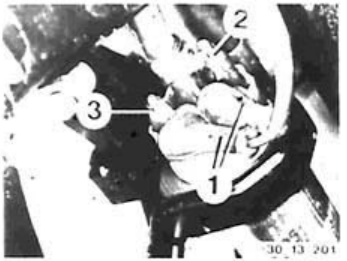
Installation:
Check code number (2)*.



Arrangement of Fuel Pump with Damper Chamber:
1 Suction hose
2 Pressure hose
3 Return hose
4 Damper chamber

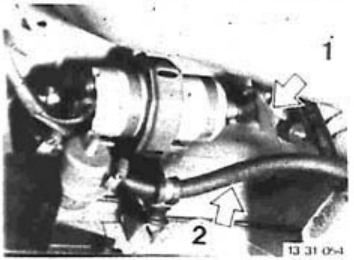
Intank fuel pump since 9/87 – see Group 16.

* See Specifications



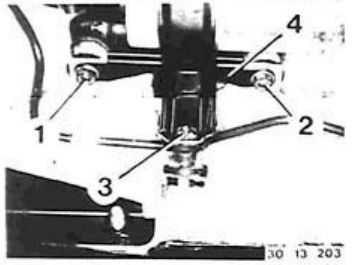
13 31 030 REMOVING AND INSTALLING FUEL PUMP

M 40
Push back caps (1).
Unscrew nuts (2 and 3) and take off leads.



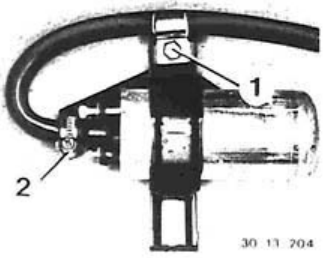
Clamp suction hose (1) and pressure hose (2) with Special Tool 13 3 010.
Loosen hose clamps (3) and pull off hoses.

Note:
Never use squeeze-hose clamps on the pressure hose.

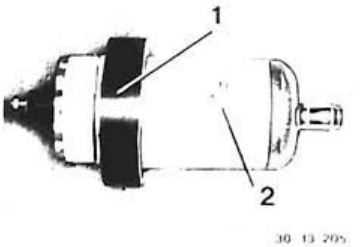


Unscrew nuts (1 ... 3) and take off holder (4).
Remove fuel pump with holder.

Installation:
Check rubber mounts, replacing if necessary.

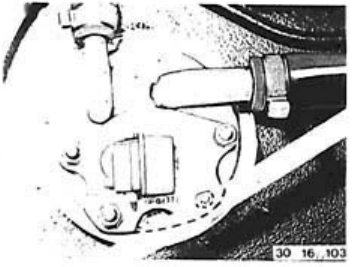


Unscrew bolt (1).
Loosen hose clamp (2) and pull off fuel hose.
Take fuel pump off of holder.



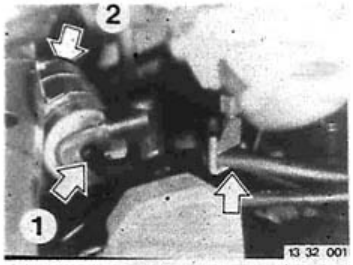
Pull off rubber ring (1).

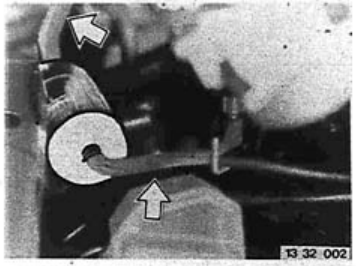
Installation:
Check code number (2)*.

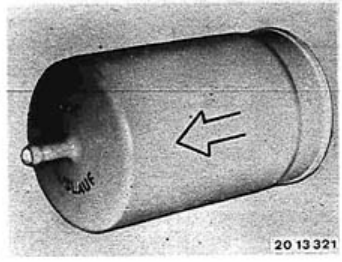


Intank fuel pump since 3/88 or 9/88 and M 42 – see Group 16.

* See Specifications





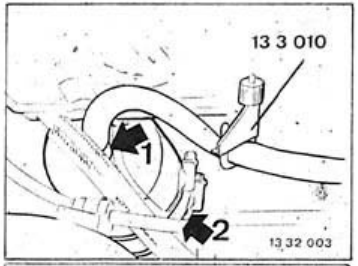


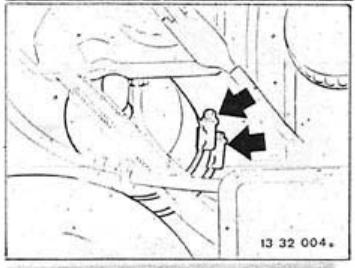
13 32 051 REMOVING AND INSTALLING FUEL FILTER

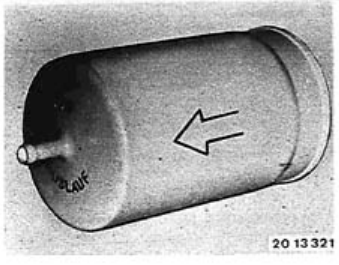
E 30 / M 40 / M 20
Clamp fuel feed hose in front of and behind the filter with Special Tools 13 3 010.
Unscrew bolts.
Loosen hose clamps (1 and 2):

Pull off fuel hoses.
Remove filter.

Installation:
Check direction of flow (arrow).







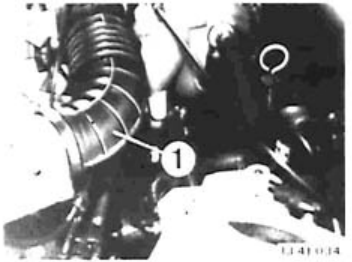
13 32 051 REMOVING AND INSTALLING FUEL FILTER

E 30 / M 42
Clamp fuel feed hose in front of and behind the filter with Special Tools 13 3 010.
Unscrew bolts.
Loosen hose clamps (1 and 2).

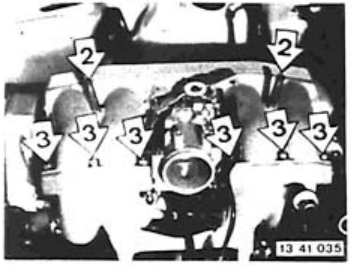
Pull off fuel hoses.
Remove filter.

Installation:
Check direction of flow (arrow).

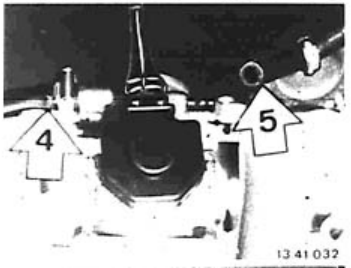
13 41 000 REMOVING AND INSTALLING IDLE SPEED CONTROL VALVE



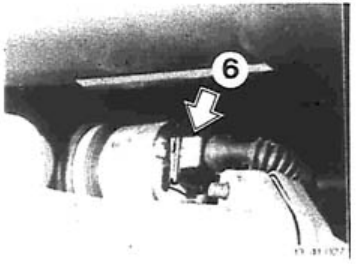
M 40
Disconnect hose (1).



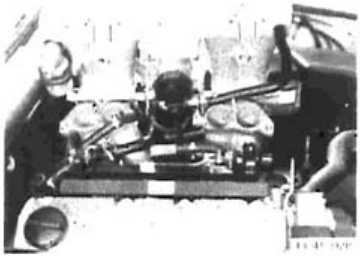
Unscrew bolts (2).
Unscrew nuts (3).



Disconnect hoses (4 and 5).

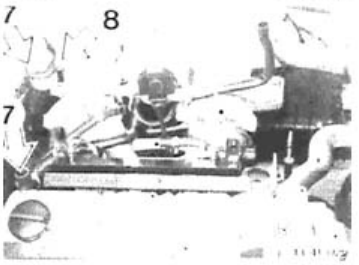


Pull off plug (6).

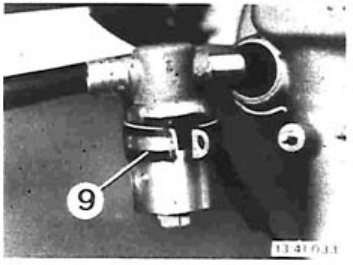


Pull out and tilt up upper section of the intake manifold.

Installation
Replace gasket.



Disconnect hose (7).
Unscrew bolt (8).

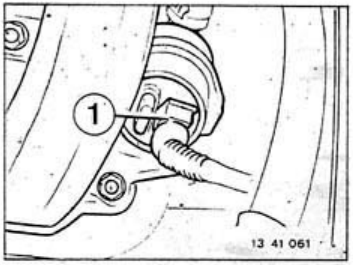


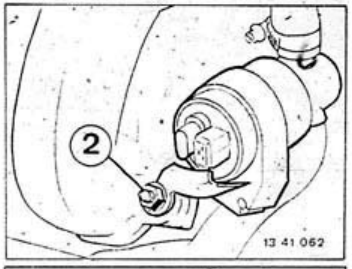
Remove idle speed control valve.

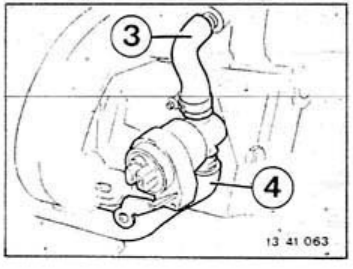
Installation:
Check code number (9).
Check idle speed*.

Testing:
Idle speed control valve must be heard (clicking) and felt while turning on the ignition.
Check electric connections – see BMW self-diagnosis.

* See Specifications of Gr. 11 and 13







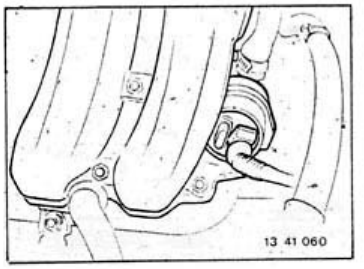
13 41 000 REMOVING AND INSTALLING IDLE SPEED CONTROL VALVE

M 42
Pull off plug (1).

Unscrew nuts (2).

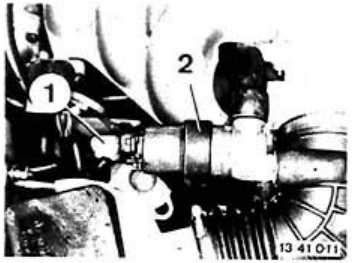
Pull out idle speed control valve, while disconnecting hoses (3 and 4).

Installation:
Check code number.
Check idle speed*.



Testing:
Idle speed control valve must be heard (clicking) and felt while turning on the ignition.
Check electric connections – see BMW self-diagnosis.

* See Specifications of Gr. 11 and 13



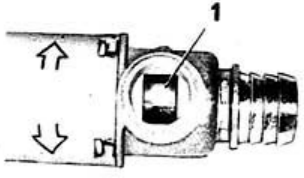
13 41 000 REMOVING AND INSTALLING IDLE SPEED CONTROL VALVE

M 20 B 20
M 20 B 25
Pull off plug (1).
Disconnect strap (2).
Pull idle speed control valve off of hoses and remove.

Installation:
Check code number (1)*.
Check idle speed*.

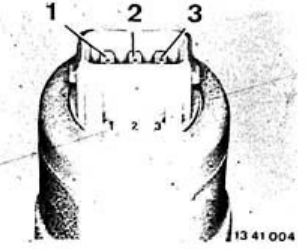


Note:
Operation of the idle speed control valve can be felt by grabbing hold of the valve with a hand (timed power supply).



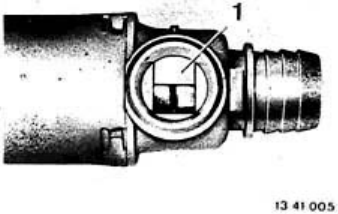
Mechanical Test:

It should be possible to move the rotary piston (1) in the idle speed control valve by turning the idle speed control valve suddenly.



Electric Test:

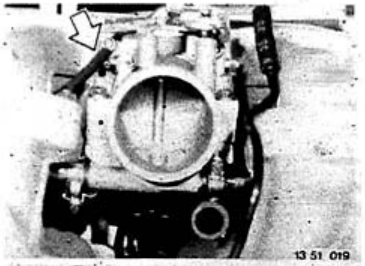
Measure resistance between terminals (1 and 3);
specification= approx. 40 ohms.
Measure resistance between terminals (2 and 1) or (2 and 3);
specification = approx. 20 ohms each.



Dynamic Test:

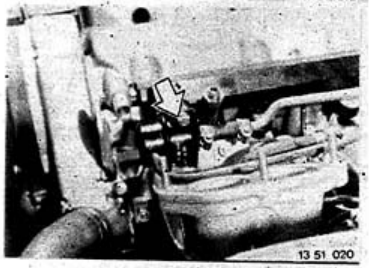
Remove idle speed control valve (plug remains connected).
Open or close rotary piston (1) completely.
Turn on ignition.
Rotary piston must move to and remain in a position equal to about 50 % of the cross section opening.

* See Specifications of Gr. 11 and 13

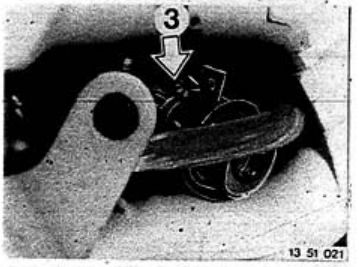


13 51 200 REMOVING AND INSTALLING FUEL PRESSURE REGULATOR

M 40
Pull off vacuum hose (1).

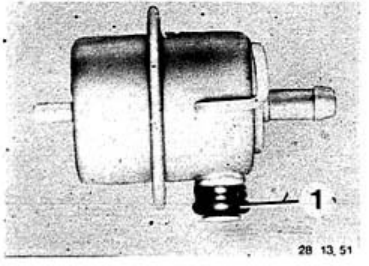


Unscrew bolts (2).
Pull out and turn fuel pressure regulator.



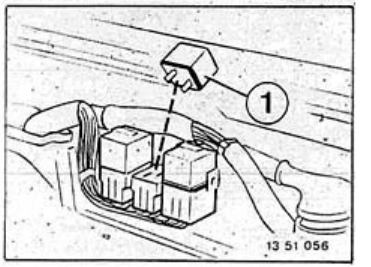
Disconnect fuel hose (3).
Take off fuel pressure regulator.

Installation:
Lubricate seal with clean engine oil which does not contain silicone.
Replace seal (1).
Check code number and manufacturing date.



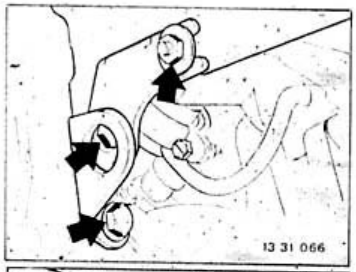


Checking:
Install pressure tester 13 3 060 with connecting hose and adapter 13 3 064 in the fuel feed line – in front of the fuel pressure regulator.



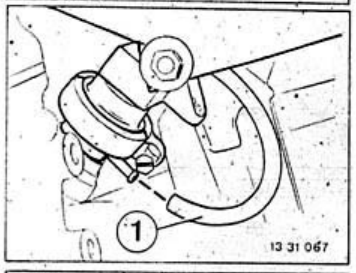
Pull off fuel pump relay (1).
Bridge terminals 87b and 30 with Special Tool 61 3 050.
Read fuel injection pressure*.

* See Specifications or Nominal Value Microfiche

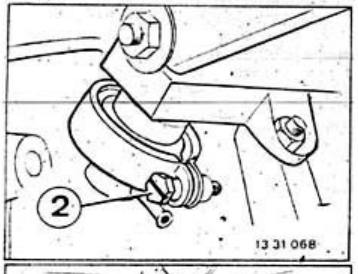


13 51 200 REMOVING AND INSTALLING FUEL PRESSURE REGULATOR

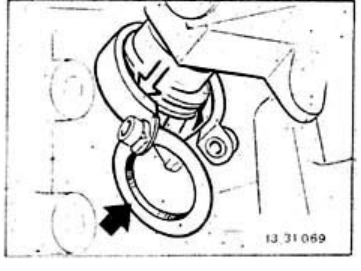
M 42
Unscrew front brace.



Pull off vacuum hose (1).



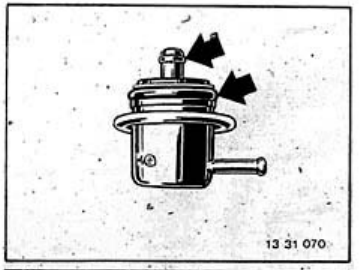
Unscrew and remove bolt (2).



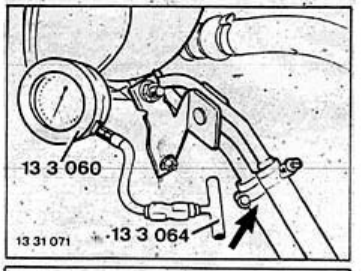
Press off fuel pressure regulator.

Caution!
Seals fit tight, fuel runs out and ring (3) will fall down.

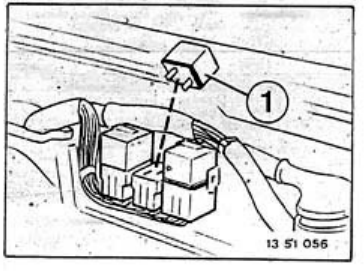
Installation:
Lubricate seals with clean engine oil which does not contain silicone.



Installation:
Replace seal.
Check code number and manufacturing date.

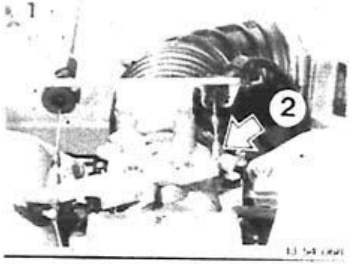


Testing:
Install pressure tester 13 3 060 with connecting hose and adapter 13 3 064 in the fuel feed line – in front of the fuel pressure regulator.



Pull off fuel pump relay (1).
Bridge terminals 87b and 30 with Special Tool 61 3 050.
Read fuel injection pressure*:

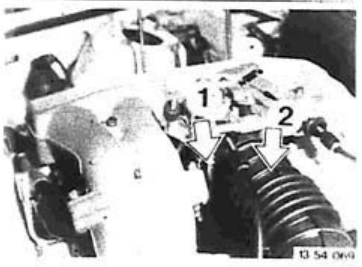
* See Specifications



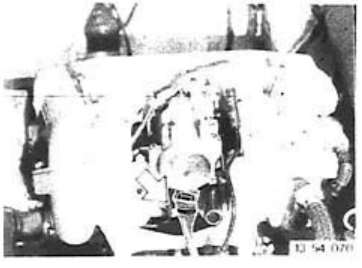
13 54 030 REMOVING AND INSTALLING THROTTLE VALVE ASSY.

M 40
Pull off plastic cap.
Disconnect cables (1 and 2).
1 = to cruise control motor
2 = to accelerator pedal

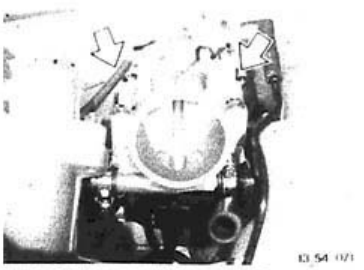
Installation:
Adjust cables – see Groups 35 and 65.



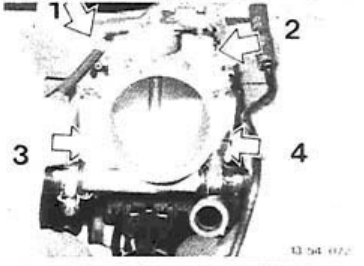
Loosen hose clamp (1) and remove hose (2).



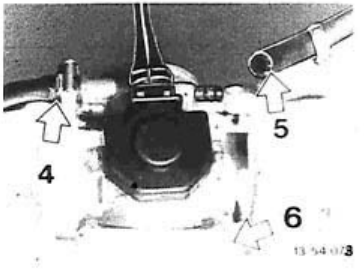
Pull plug (3) off of the throttle valve switch.



Pull off vacuum hoses.

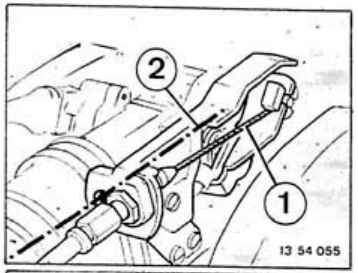


Unscrew bolts (1 ... 4).
Take off throttle valve assembly.



Installation:
Replace gasket (6).

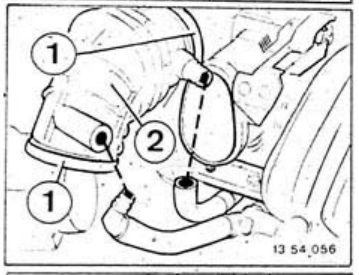
Disconnect hoses (4 and 5).



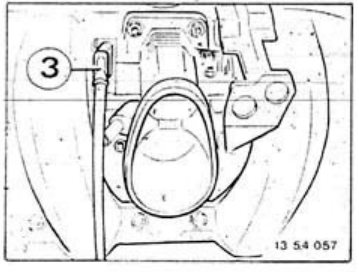
13 54 030 REMOVING AND INSTALLING THROTTLE VALVE ASSY.

M 42
Disconnect cable (1) and, if applicable, cable (2).
1 = to accelerator pedal
2 = to cruise control motor

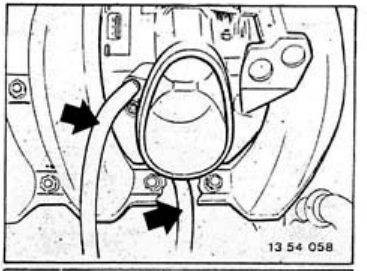
Installation:
Adjust cables – see Groups 35 and 36.



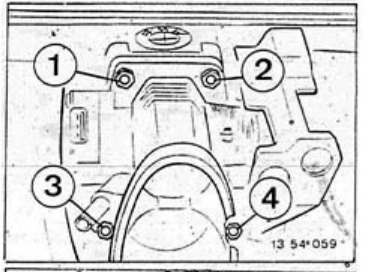
Loosen hose clamp (1) and remove hose (2).



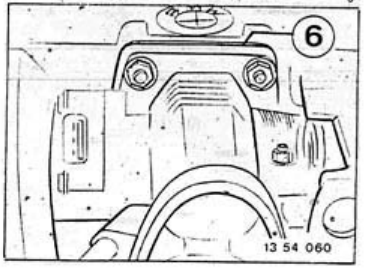
Pull plug (3) off of the throttle valve switch.



Pull off vacuum hoses.



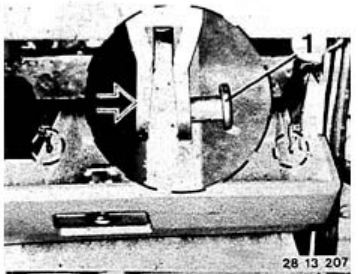
Unscrew bolts (1 ... 4).
Take off throttle valve assembly.



Installation:
Replace gasket (6).

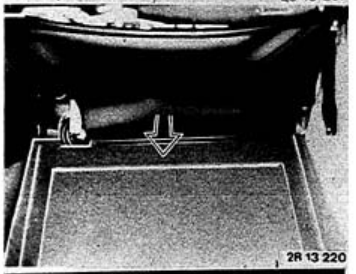
Disconnect hoses (4 and 5).

Important!
Throttle valve adjustments are not possible. The throttle valve assembly must be replaced in case of improper handling.

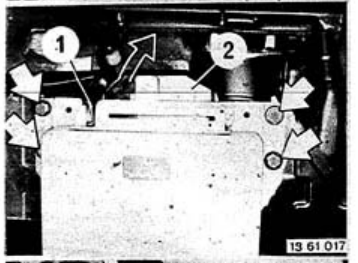


13 61 000 REMOVING AND INSTALLING CONTROL UNIT

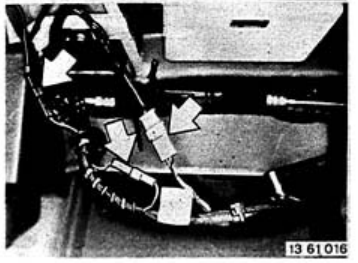
Open glove box.
Pull off pins (1) of both retaining straps.



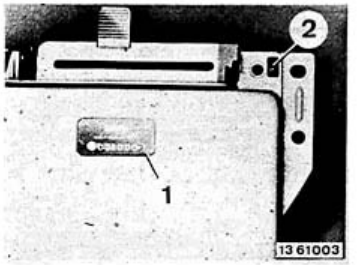
Loosen trim panel.

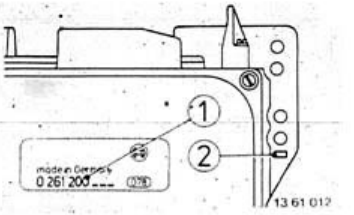


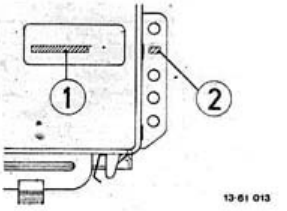
Push back retainer (1) and pull off plug (2).
Unscrew four mounting screws and take out control unit.



See wiring diagram for plug connections.

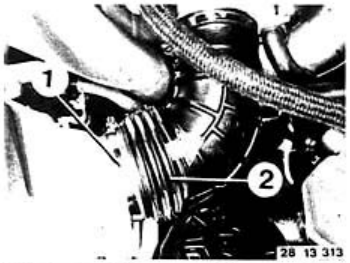






Installation:
Check code number (1)* and manufacturing date (2)*.
Check / adjust engine idle speed* and idle speed CO level*.

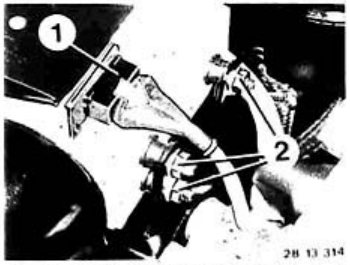
* See Specifications of Gr. 11 and 13



13 62 000 REMOVING AND INSTALLING AIR FLOW SENSOR

M 10

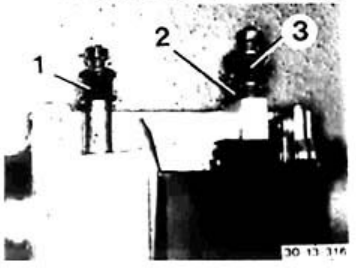
Loosen hose clamp (1) and pull air hose off of the air flow sensor.



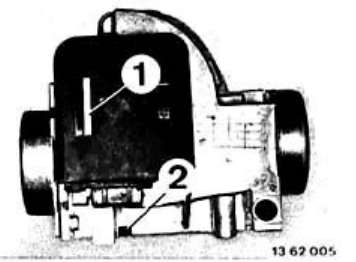
Pull off plug (1).
Loosen nuts (2) and take off air flow sensor.



Installation:
Check seal (1), replacing if necessary.

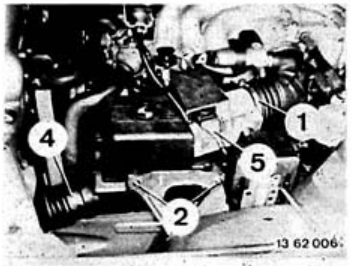


Unscrew dampers (1 ... 3) on air flow sensor.
Check dampers, replacing if necessary.



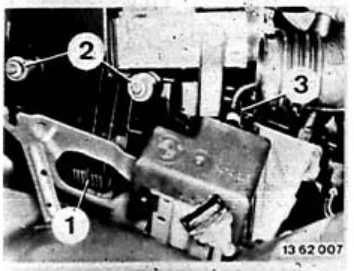
Installation:
Check code number (1)* and manufacturing date (2)*.
Check engine idle speed* and idle speed CO level*.
Check air flow sensor*.

* See Specifications and Nominal Value Microfiche



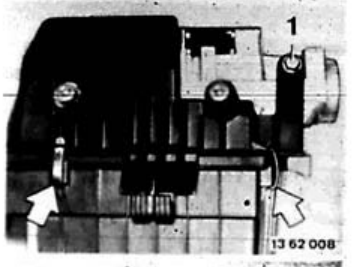
13 62 000 REMOVING AND INSTALLING AIR FLOW SENSOR

M 20
Loosen hose clamp (1).
Loosen nuts (2).
Pull off hose (4).
Pull off plug (5).

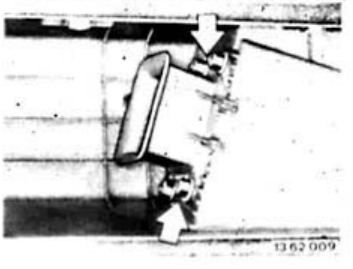


Cut off strap (3).
Take off complete air cleaner.

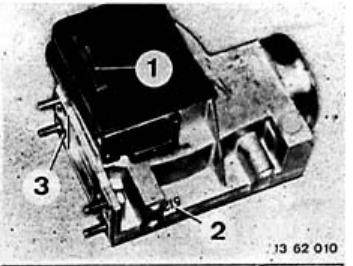
Installation:
Check rubber mount (1) and dampers (2), and make sure of correct seating.



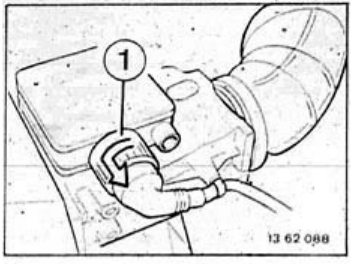
Open four fasteners.
Unscrew screw (1).
Separate housing sections.



Unscrew nuts.



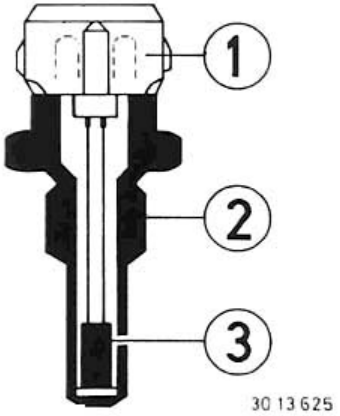
Installation:
Check code number (1)* and manufacturing date (2)*.
Check engine idle speed* and idle speed CO level*.
Check gasket (3).
Check air flow sensor*.



M 40 / M 42
Remove plug (1) with a screwdriver.

Remaining procedures same as M 20.

* See Specifications of Gr. 11 and 13



30 13 625

13 62 531 REMOVING AND INSTALLING/ CHECKING COOLANT TEMPERATURE SENSOR

The temperature sensor measures the engine temperature and sends this information to the control unit as a resistance value.
The resistance value drops with rising temperature (NTC).
1 = Plug connection
2 = Housing
3 = NTC resistor

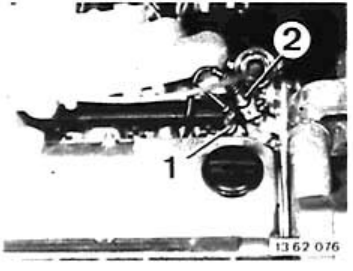
Removing and installing:

Pull off plug (1).
Unscrew temperature sensor.

Installation:
Tightening torque .

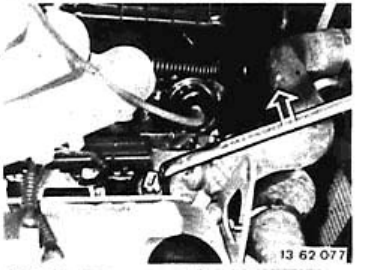


28 13 031

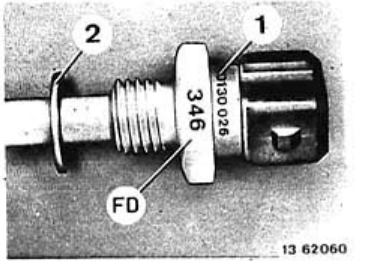


13 62 076

M 20
Pull off plugs (1 and 2).
Lift fuel injector plug plate slightly.


13 62 077

Unscrew temperature gage sender (2).
Unscrew temperature sensor (1).



13 62060

Installation:
Check code number (1) .
Replace seal (2).
FD = Manufacturing date
Fill and bleed cooling system – see Group 17.

Testing:

Connect Jetronic test leads 61 1 440.
Check nominal value with ohmmeter.
To check the entire temperature range, remove and place the temperature sensor in a water bath heated to testing temperature and measure resistance with an ohmmeter.



13 62062

Engines with self-diagnosis – see . BMW diagnosing system (engine temperature).

* See Specifications

* See Specifications



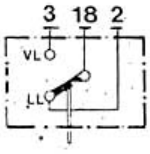
13 63 544 CHECKING AND ADJUSTING THROTTLE VALVE SWITCH

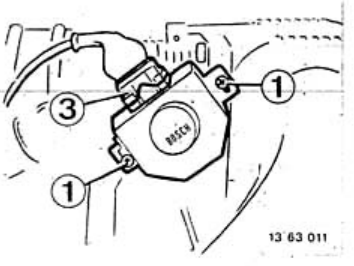
Checking Throttle Valve Switch:
Approximately 0 ohm between connections 2 and 18 with the throttle valve closed.
Approximately 0 ohm between connections 3 and 18 with the throttle valve wide open.

LL = Idle
VL = Full load

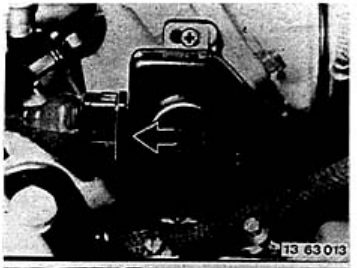
Wiring diagram shows the throttle valve in idle position.

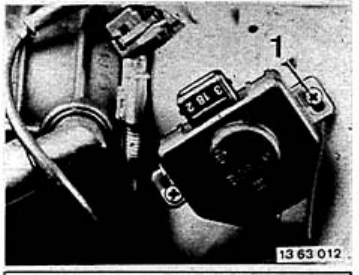
Schaltbild

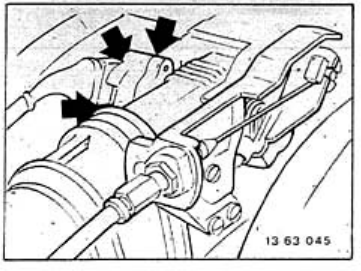




Adjusting:
Remove throttle valve assembly – see 13 54 030.
There should be approximately 0 ohm between connections 2 and 18 with the throttle valve closed.
Adjust by loosening screws (1) and turning the throttle valve switch.
Open throttle valve after adjusting – resistance should rise immediately to ohms.
Resistance should drop back to approximately 0 ohm after releasing the throttle valve.







13 63 551 REMOVING AND INSTALLING THROTTLE VALVE SWITCH

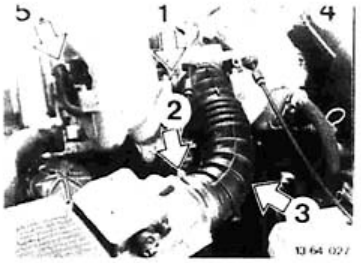
Pull off multiple-pin plug (3).

Remove throttle valve assembly – see 13 54 030.
Unscrew screws (1).
Take off throttle valve switch (2).

Installation:
Check code number (1) .
Adjust throttle valve switch – see 13 63 544.

M 42

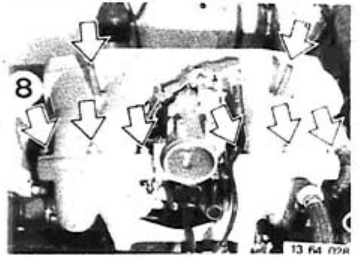
Important!
The throttle valve assembly has to be removed to replace the M 42 throttle valve switch.
The switch does not have to be adjusted (automatic adjustment).



13 64 027

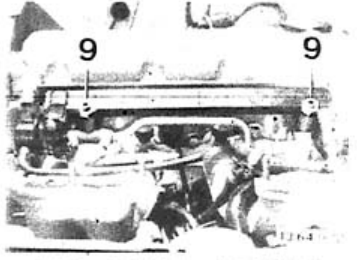
13 64 150 REMOVING AND INSTALLING OR REPLACING ALL FUEL INJECTORS

M 40
Pull off plastic cap.
Loosen hose clamps (1 and 2).
Pull off hose (3).
Disconnect hoses (4 and 5).

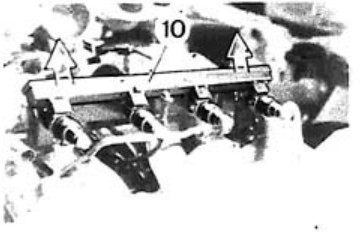


13 64 028

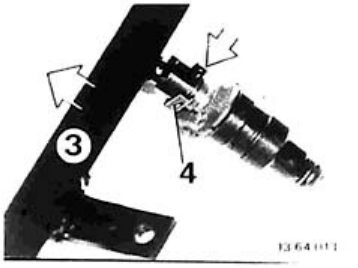
Unscrew bolts.
Unscrew nuts (8).



Pull out and tilt up upper section of the intake manifold.
Unscrew bolts (9).

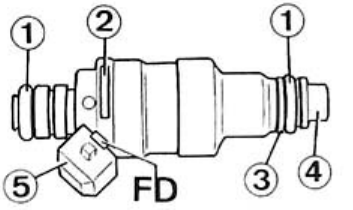


Push up injection pipe (10) until fuel injectors have cleared the guide in the intake manifold.



13 64 011

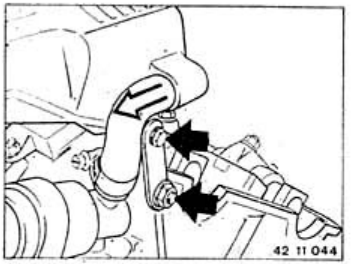
Lift out retainer (2) and pull off fuel injector.



13 64 026

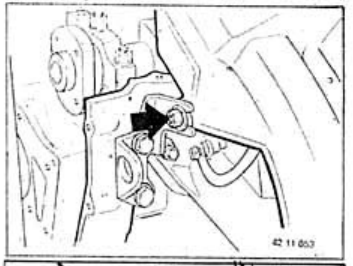
Installation:
Check O-ring (1), replacing if necessary.
Check code number (2)*.
FD = Manufacturing date
Check position of plastic washer (3).
Check color* of plug receptacle (5) or injection nozzle guard (4).
Only coat O-rings with vaseline or SAE 90 gear lube for installation.

* See Specifications

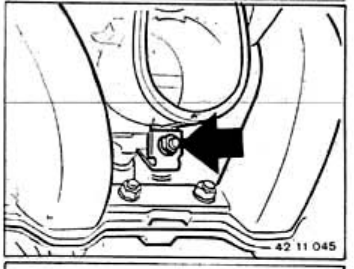


13 64 150 REMOVING AND INSTALLING OR REPLACING ALL FUEL INJECTORS

M 42
Remove upper section of collector.
Unscrew rear brace.
Pull off hose.

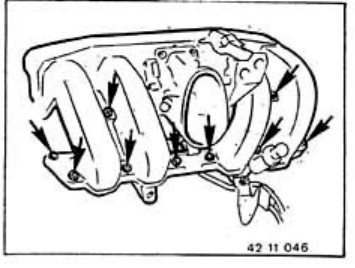


Loosen front brace.

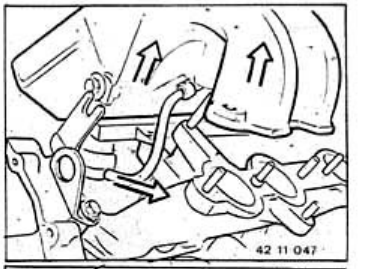


Unscrew holder for preheater.

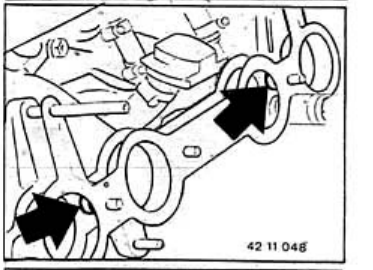
Installation:
If applicable, bend holder for the pre-heater until the bearing surface of the preheater bears on the throttle valve assembly.



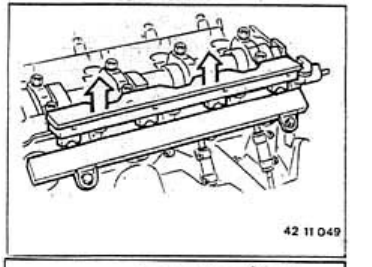
Unscrew screws.



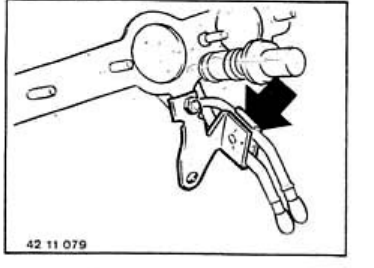
Lift off upper section of the intake manifold.
Pull hose off of the fuel pressure regulator at the same time.



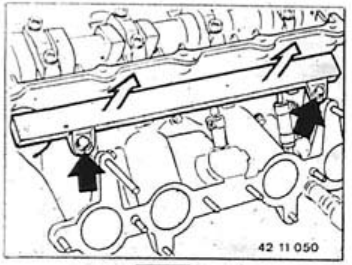
Installation:
Replace gasket.
Check dowel sleeves.



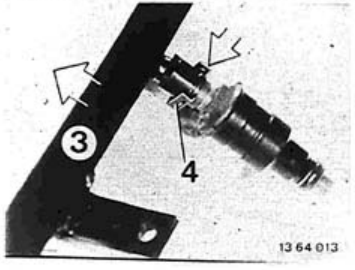
Pull plug plate off of the fuel injectors.



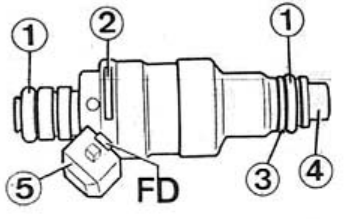
Unscrew clamp.



Unscrew screws.
Pull off injection pipe complete with fuel injectors.



Lift out retainer (2) and pull off fuel injector.



Installation:
Check O-ring (1), replacing if necessary.
Check code number (2)*.
FD = Manufacturing date.
Check position of plastic washer (3).
Check color* of plug receptacle (5) or injection nozzle guard (4).

Important!
Only coat O-rings with vaseline or SAE 90 gear lube for installation.

* See Specifications

TROUBLESHOOTING DME WITH BMW DIAGNOSING SYSTEM (M 40 Engine)

Insert diskette and connect BMW Service Tester in diagnosing socket – see operating instructions of BMW diagnosing system.

Ignition ON:
Select 01 DME, if applicable run off the brief test (brief test only displays, whether or not there are faults in the system).
Identification of control units appears on the screen after the control unit has taken on the data transmission.

01 DME
Control Unit identification

Version E 30, Engine Code M 40 B 16 / M 40 B 18
with or without oxygen sensor
HG type of fuel
CODE check – see Specifications of Parts Microfiche
ECE/D country version

BMW HARDWARE NUMBER	* *** ***
BMW SOFTWARE NUMBER	***
BOSCH HARDWARE NUMBER	* *** *** ***
BOSCH SOFTWARE NUMBER	* *** *** ***
MANUFACTURING CODE	***

Continue to selection survey

Note:
Also send in print of identification (test code) when exchanging control units.

Call fault memory – 900
Status calls can be used for further support of troubleshooting.

STATUS CALLS

Select 100
Electric fuel pump relay activation
Tank venting valve
Oxygen regulation
Oxygen sensor heating
Master relay control
Compressor control
Air conditioner switch
Burglar alarm switch

The switch position shows the ON or OFF position.

Dynamic Status Call

Select 200
Throttle valve potentiometer
Injection signal
Ignition timing
Air flow sensor signal Up/Uv
Control unit power supply
Oxygen sensor power supply (cat. conv.)
Road speed
Engine speed
CO potentiometer (without cat. conv.)
Intake air temperature
Engine temperature
Load signal tL

Engine Type M 40 B 16 / M 40 B 18	
Idle speed	800 ± 40 rpm
CO level* 1) 2)	0.7 ± 0.5 % by volume
Ignition timing 1)	
M 40 B 16	10.5° on crksh. before TDC, 17.2° on crksh. before TDC for cars without catalytic converter
M 40 B 18	12° on crksh. before TDC, 17° on crksh. before TDC for cars without catalytic converter
Load signal tL 1)	2 ms
Injection time ti 1)	2 ... 3 ms
Shutoff speed	6200 rpm
Air flow sensor voltage ratio (Up/Uv)	0.2 ... 0.3 at idle speed
Oxygen sensor voltage	0.05 ... 0.8 V
CO potentiometer	Nominal value in basic position 2.8 V

1) Oil temperature > 60° C (140° F) or coolant temperature > 80° C (176° F), no power consuming equipment switched on, at idle speed.

2) Measured in front of catalytic converter.

Load signal TL (at operating temperature)	Checked in car
Additional information	See Group 12

TROUBLESHOOTING DME WITH BMW DIAGNOSING SYSTEM (M 42 Engine)

Insert diskette and connect BMW Service Tester in diagnosing socket – see operating instructions of BMW diagnosing system.

Ignition ON:
Select 01 DME, if applicable run off the brief test (brief test only displays, whether or not there are faults in the system).
Identification of control units appears on the screen after the control unit has taken on the data transmission.

01 DME
Control Unit Identification

Version E 30, Engine Code M 42 B 18
with or without oxygen sensor
HG type of fuel
CODE check – see Specifications of Parts Microfiche
ECE/D country version

BMW HARDWARE NUMBER	• ••• •••
BMW SOFTWARE NUMBER	•••
BOSCH HARDWARE NUMBER	• ••• ••• •••
BOSCH SOFTWARE NUMBER	• ••• ••• •••
MANUFACTURING CODE	•••

Continue to selection survey

Note:
Also send in print of identification (test code) when exchanging control units.

Call fault memory – 900
Status calls can be used for further support of troubleshooting.

STATUS CALLS

Select 100
Electric fuel pump relay activation
Tank venting valve
Oxygen regulation
Oxygen sensor heating
Master relay control
Compressor control
Air conditioner switch
Burglar alarm switch
Semi-sequential injection (camshaft sender)

The switch position shows the ON or OFF position.

Dynamic Status Call

Select 200
Throttle valve potentiometer
Injection signal
Ignition timing
Air flow sensor signal Up/Uv
Control unit power supply
Oxygen sensor power supply (cat. conv.)
Road speed
Engine speed
CO potentiometer (without cat. conv.)
Intake air temperature
Engine temperature
Load signal tL

Engine Type M 42 B 18

Idle speed	850 ± 40 rpm
CO level* 1) 2)	0.7 ± 0.5 % by volume
Ignition timing 1)	11 ± 3° on crankshaft before TDC
Load signal tL 1)	1.3 ... 1.6 ms
Injection time ti 1)	3.5 ... 3.9 ms
Shutoff speed	6500 ± 40 rpm
Air flow sensor voltage ratio (Up/Uv)	0.2 ... 0.3 at idle speed
Oxygen sensor voltage	0.02 ... 0.85 V
CO potentiometer	Nominal value in basic position 2.0 V

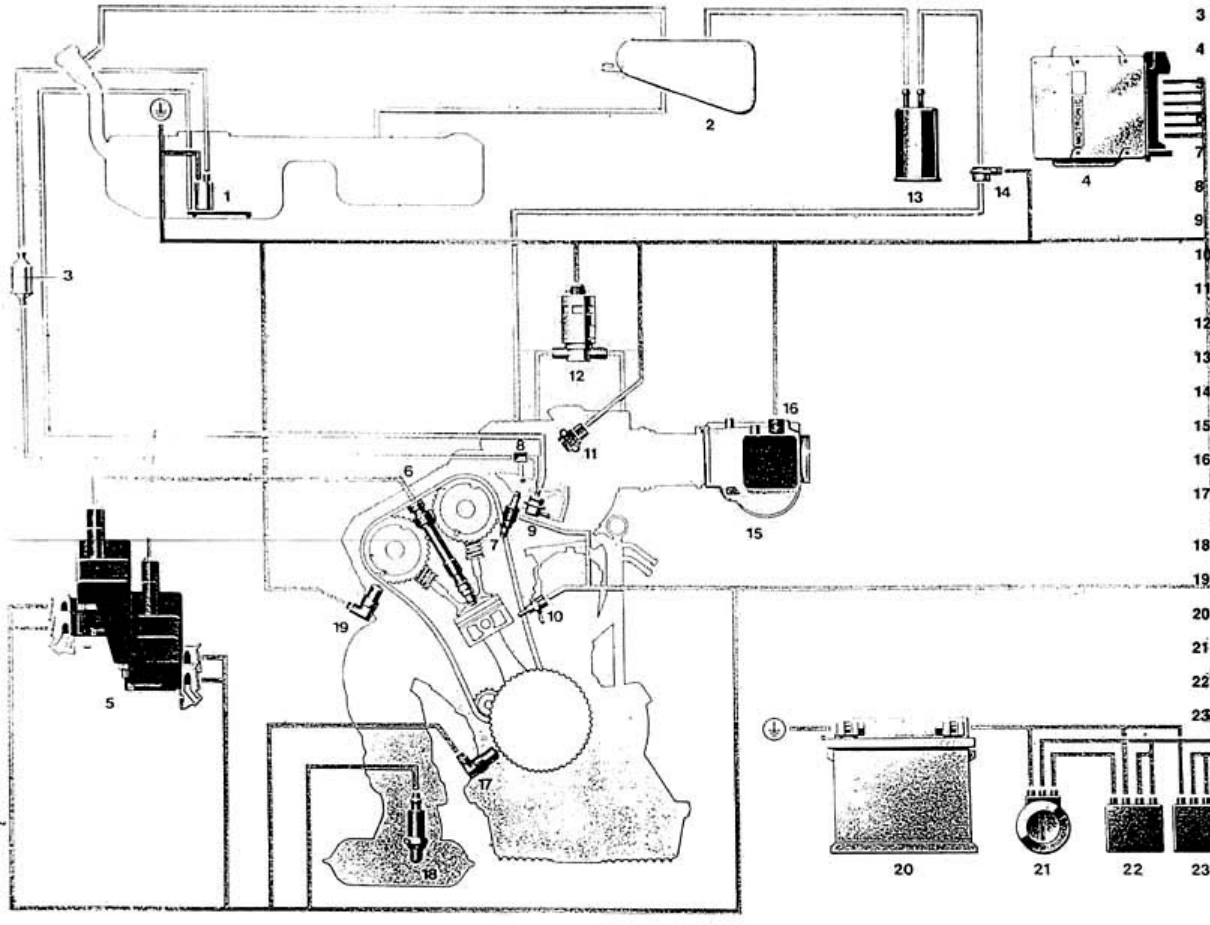
1) Oil temperature > 60° C (140° F) or coolant temperature > 80° C (176° F), no power consuming equipment switched on, at idle speed.

2) Measured in front of catalytic converter.

Load signal TL (at operating temperature)	Checked in car
Additional information	See Group 12

300 Component Activation
Fuel injectors
Tank venting valve
Oxygen sensor relay

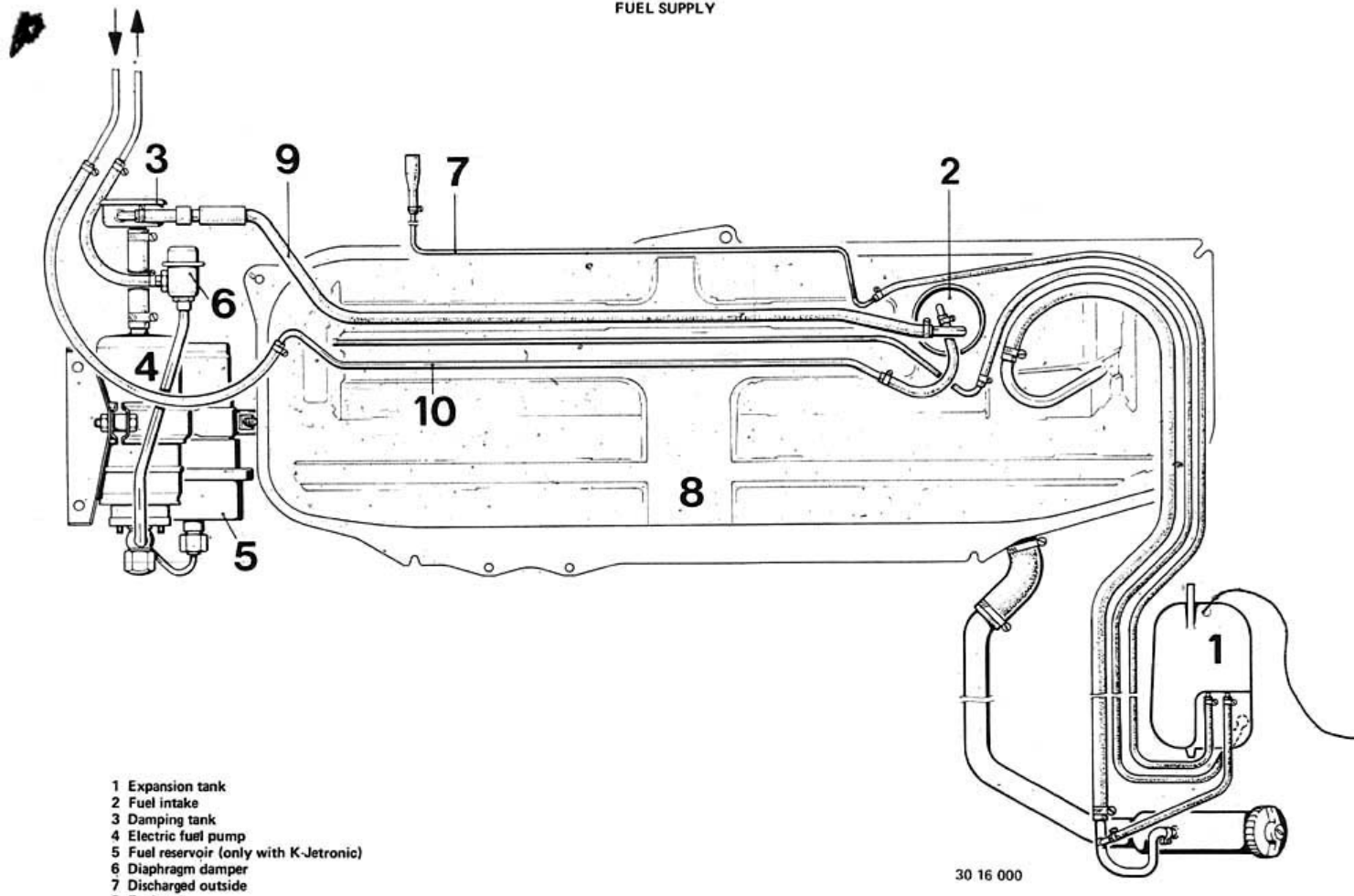
FUEL MIXTURE AND ENGINE TIMING – M 42



1 Fuel tank with pump
2 Fuel expansion tank
3 Fuel filter
4 Control unit DME 1.7
5 Separate ignition coil package
6 Spark plug
7 Fuel injector
8 Fuel distribution pipe
9 Fuel pressure regulator
10 Coolant temperature sensor
11 Throttle valve potentiometer
12 Idle speed control
13 Carbon canister
14 Tank venting solenoid
15 Air flow sensor
16 Air temperature sensor
17 Speed and reference mark sender
18 Oxygen sensor
19 Cylinder identifying sender
20 Battery
21 Ignition lock
22 Master relay
23 Fuel pump relay

16 Fuel Tank and Lines

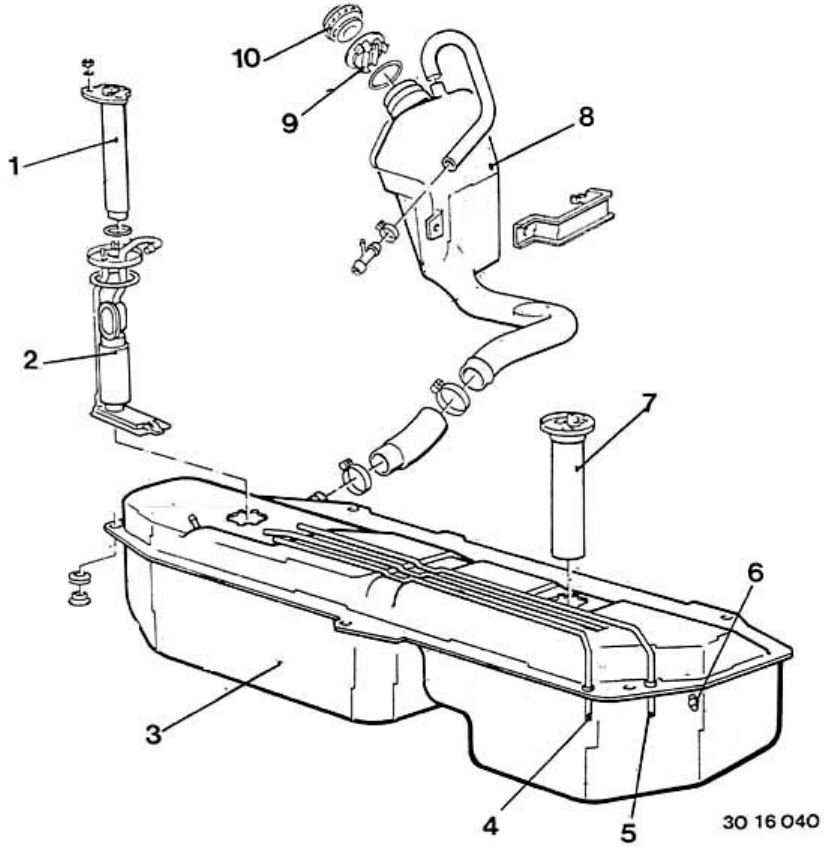
. . .	Fuel supply survey	16- 0
. . .	Fuel tank survey beginning with 1988 models (320i / 325i)	16- 1
16 11 030	Fuel tank – remove and install	16- 2
120	Tank venting expansion tank – replace	16- 4
. . .	Fuel tank venting system – check	16- 5
16 12 000	Fuel level sender – remove and install / replace (without fuel transfer pump)	16- 8
002	Fuel intake – remove and install (with integrated fuel transfer pump)	16- 9
. . .	Fuel level sender and intank pump – remove and install / disassemble (320i / 325i)	16- 10
. . .	Fuel return pipe (320i / 325i beginning with 1988 models)	16- 11
	Additional fuel tank layout drawing	16- 12
16 11 035	Additional fuel tank – remove and install	16- 13
16 14 002	Fuel level sender for additional fuel tank – remove and install	16- 14



1 Expansion tank
2 Fuel intake
3 Damping tank
4 Electric fuel pump
5 Fuel reservoir (only with K-Jetronic)
6 Diaphragm damper
7 Discharged outside
8 Fuel tank
9 Feed hose
10 Return hose

30 16 000

FUEL SUPPLY – SINCE 1988 MODELS 320 i / 325 i



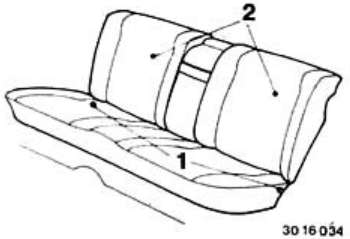
1 Fuel level sender for right chamber
2 Fuel pump
3 Fuel tank
4 Vent pipe (to carbon canister in cars with catalytic converter)
5 Feed pipe
6 Return pipe
7 Fuel level sender for left chamber
8 Expansion tank
9 Filler neck insert (only cars with catalytic converter)
10 Tank cap


30 16 003

16 11 030 REMOVING AND INSTALLING FUEL TANK

Draw out fuel with a scavenging pump**.

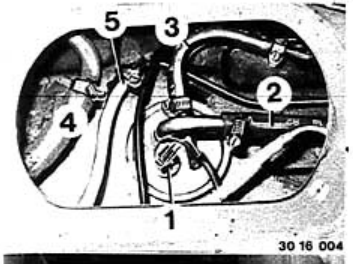
Caution!
Conform with safety precautions and legislation of a pertinent country.



30 16 034

Pull up seat cushion (1) and remove insulation sheet.

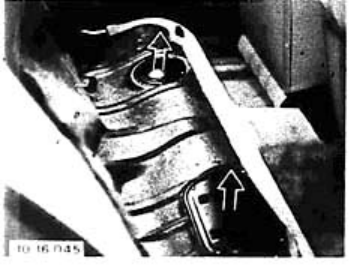
Touring – see 52 20 000.



30 16 004

Unscrew cover.
Pull off plug (1).
Loosen and pull off hoses (2 ... 5).

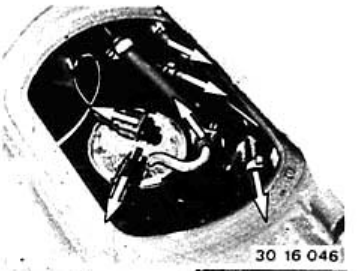
Installation:
Use new hose clamps.


30 16 045

320 I / 325 I Since 1988 Models:

Unscrew both covers.

** Source of Supply: HWB

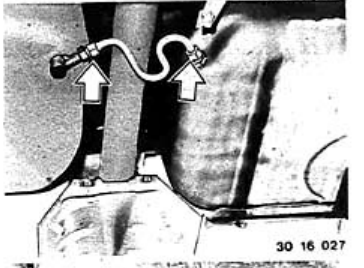

30 16 046

Pull off plugs on fuel level sender and fuel pump.
Disconnect fuel hoses.


30 16 047

Remove fuel level sender or fuel level sending unit.
Draw out remaining fuel through opening for the fuel level sender.

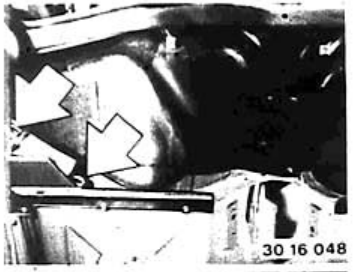
Important!
Draw out fuel through both openings in cars with two fuel level senders.


30 16 027

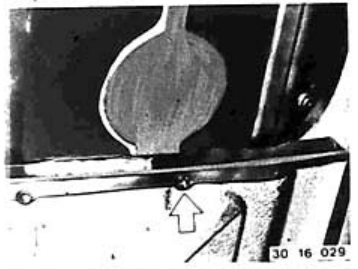
Remove muffler assembly – see 18 12 000.
Unscrew heat shield and connecting pipe.


30 16 023

Remove propeller shaft – see 26 11 000.
Loosen hose clamp and pull off hose.



BMW 320i / 325i Since 1988 Models:
Pull off fuel pipes.
Unscrew fuel filter, if applicable.



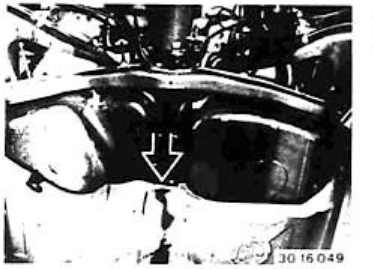
Remove stone guards left and right.



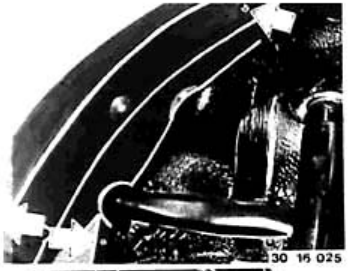
Support tank, if necessary.
Unscrew bolts and nuts.



Take off fuel tank on the right-hand side first.
Loosen and pull off hose (8).
Remove strips of adhesive tape.

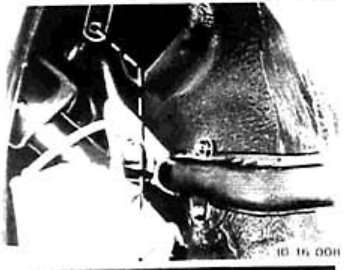


BMW 320i / 325i Since 1988 Models:
Tilt and lift out fuel tank.

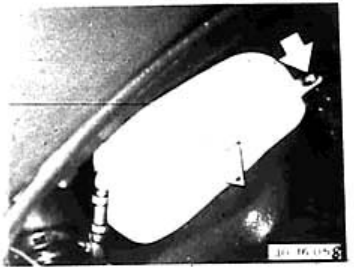


16 11 120 REPLACING EXPANSION TANK FOR TANK VENTING SYSTEM

Remove rear wheel – see 36 10 300.
Unscrew wheel house trim panel.
If applicable, draw off gasoline with a scavenging pump**.

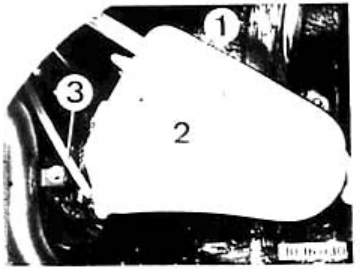


Unscrew expansion tank.
Loosen and pull off hoses.
Installation:
Place pin in guide precisely.
Use new hose clamps.



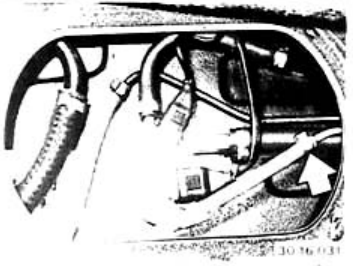
BMW 320i / 325i Since 1988 Models:
Unscrew bolt.
Remove expansion tank.

** Source of Supply: HWB

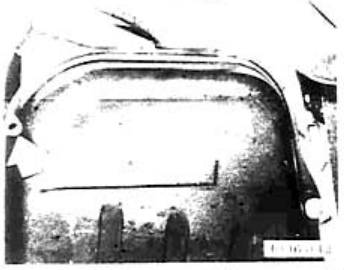


16 11 ... CHECKING VENTING SYSTEM FOR FUEL TANK

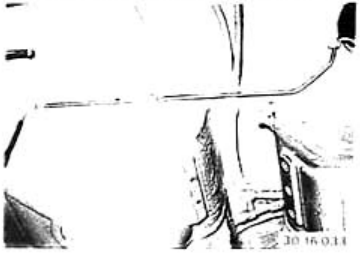
Check connections on expansion tank for tight fit and leaks.
1 Pipe to outdoors
2 Pipe to filler neck
3 Pipe to fuel tank



Check connection for venting pipe.



Checking routing and flow of vent hose.



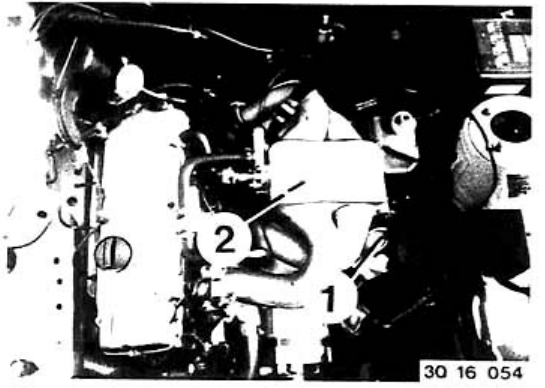
Cars with Catalytic Converter:
Route vent hose in direction of engine in side member area and check flow.

Cars with Catalytic Converter:
If applicable, remove and install / check tank venting valve.

BMW 316i / 318i (M 10)

1 = Carbon canister

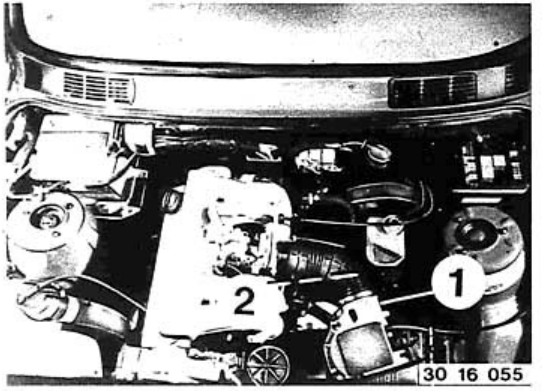
2 = Check valve



BMW 318i / M 40

1 = Carbon canister

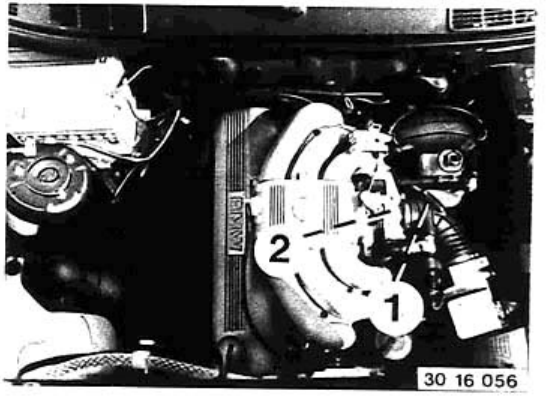
2 = Tank venting valve



BMW 320i / 325e / 325i (M 20)

1 = Carbon canister

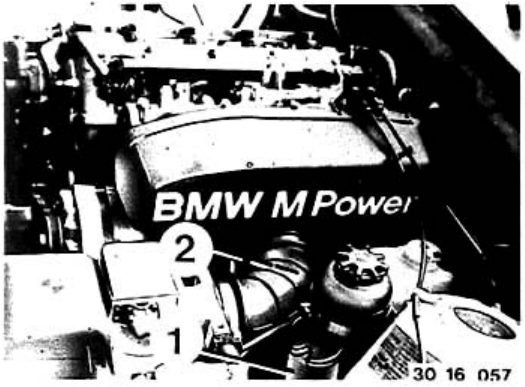
2 = Tank venting valve



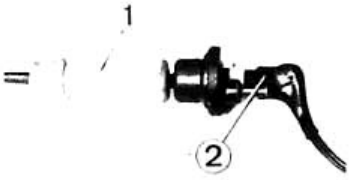
M 3 (S 14)

1 = Carbon canister

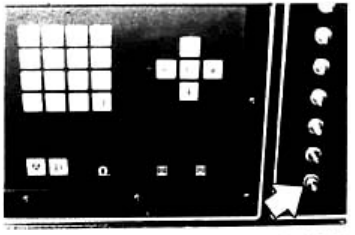
2 = Tank venting valve



Lift out plug for all previously mentioned models.
Pull off hoses.
Lift out tank venting valve.

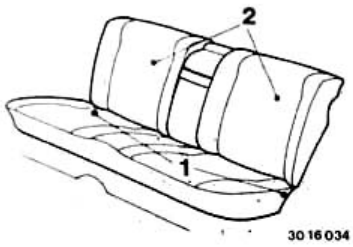


Connect vacuum hose (1) on 0.8 mm (0.031") diameter neck.
Supply 12 V voltage to tank venting valve (2) (lead 61 1 440).



Select multimeter function 21 on BMW Service Tester.
Adjust vacuum to 600 ± 100 mbar.
Then switch off.

Pressure should not drop by more than 50 mbar during the test time of about 20 seconds.
Replace tank venting valve, if pressure drops by more than 50 mbar.



30 16 034

16 12 000 REMOVING AND INSTALLING OR REPLACING FUEL LEVEL SENDER . (Models without Fuel Transfer Pump)

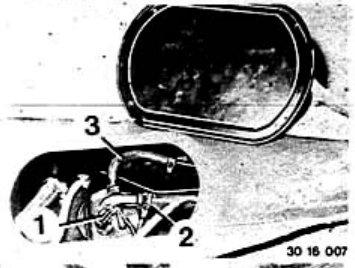
Pull up seat cushion (1) and remove insulation sheet.

Touring – see Group 52.


30 16 113

If the fuel tank is full, draw off or unscrew drain plug and drain approx. 10 liters (2.5 gallons) of fuel.

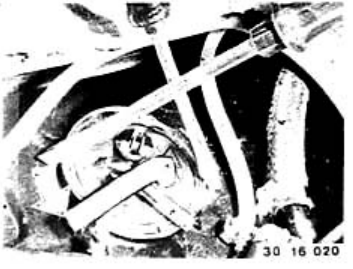
Important!
Conform with safety precautions and legislation of a pertinent country.



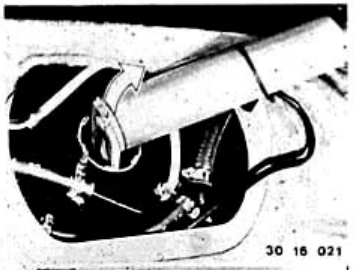
30 16 007

Unscrew cover.
Pull off plug (1).
Loosen and pull off hoses (2 and 3).
Model 316:
Only hose (3).

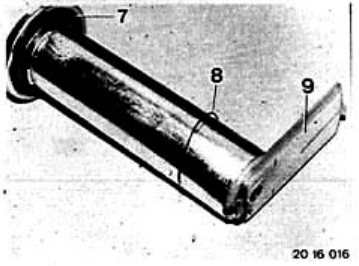
Installation:
Use new hose clamps.


30 16 020

Turn fuel level sender counterclockwise.

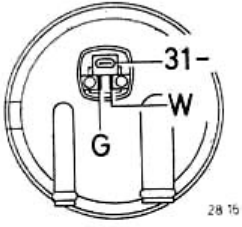

30 16 021

Pull up and take out fuel level sender carefully.



20 16 016

Installation:
Replace seal (7).
Check filter screen (9) for dirt, cleaning if necessary.
Remove retainer (8) before installing a new fuel level sender.



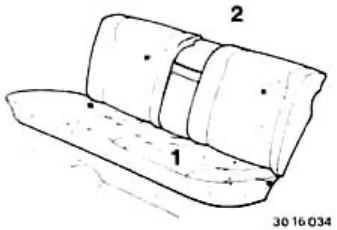
28 16 130

Testing:
Measure resistance* on connections G and 31 (ground) in "EMPTY" and "FULL" float positions.
The resistance curve should not have any interruptions.
Connection W should have ground in "EMPTY" float position.

G = Sender resistor
W = Warning lamp

** Source of Supply: HWB

* See Specifications



30 16 034

16 12 002 REMOVING AND INSTALLING FUEL INTAKE (Models with Fuel Transfer Pump)

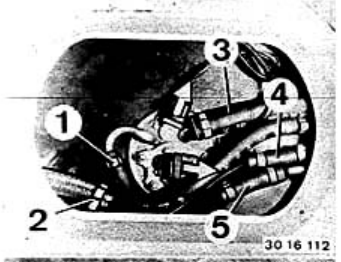
Pull up seat cushion (1) and remove insulation sheet.

Touring – see Group 52.


30 16 003

If the fuel tank is full, draw off or unscrew drain plug and drain approx. 10 liters (2.5 gallons) of fuel.

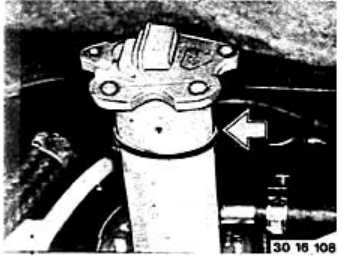
Caution!
Conform with safety precautions and legislation of a pertinent country.



30 16 112

Unscrew cover.
Pull off plug.
Loosen and pull off hoses (1 and 3).

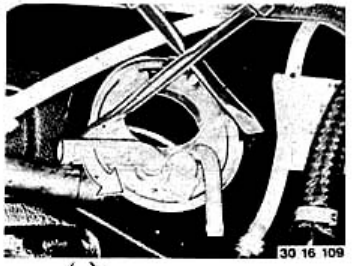
Installation:
Use new hose clamps.


30 16 108

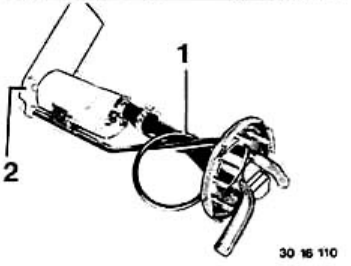
Loosen and pull out fuel level sender slowly.

Installation:
Replace seal.
Remove retainer for transportation when installing a new fuel level sender.

** Source of Supply: HWB

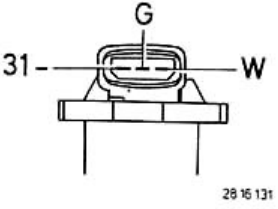

30 16 109

Turn fuel intake counterclockwsie and pull out carefully.



30 16 110

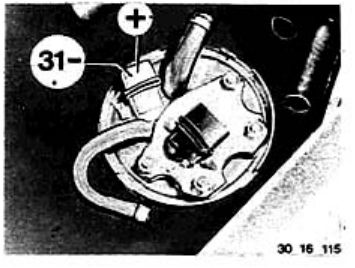
Installation:
Replace seal (1).
Check filter screen (2) for dirt, cleaning if necessary.



28 16 131

Testing:
Measure resistance on connections G and 31 (ground) in "EMPTY" and "FULL" float positions.
The resistance curve should not have interruptions.
Connection W should have ground in "EMPTY" float position.

G = Sender resistor
W = Warning lamp

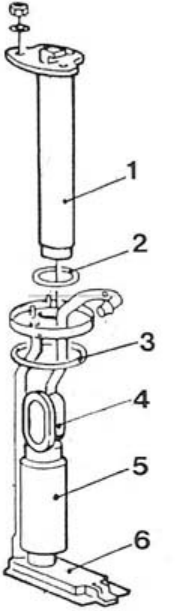


30 16 115

Testing Fuel Transfer Pump:
Measure power consumption of pump.
If applicable, check the delivery pressure .

* See Specifications

16 12 . . . REMOVING AND DISASSEMBLING FUEL LEVEL SENDER AND INTANK PUMP (Models 320 i / 325 i)



30 16 042

Fuel Level Sender and Intank Pump Survey

1 Fuel level sender

2 Gasket

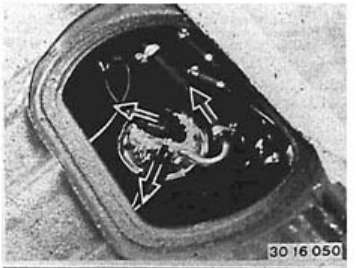
3 Pressure damper

4 Fuel pump

5 Fuel filter screen

Check fuel pump pressure and delivery rate – see Group 13.

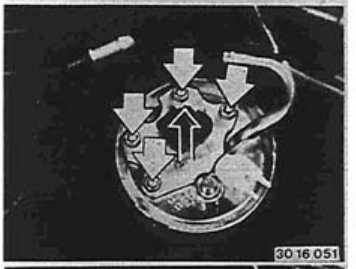
Check fuel level sender – see pages 16 - 8 and 16 - 9.


30 16 050

If the fuel tank is full, draw off some of the fuel with a scavenging pump**.

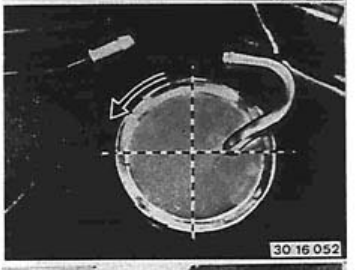
Caution:
Conform with safety precautions and legislation of a pertinent country.

Lift out rear seat cushion – also refer to Group 52.
Loosen insulation sheet partially.
Unscrew cover.
Pull off plug.
Loosen and pull off fuel hose.


30 16 051

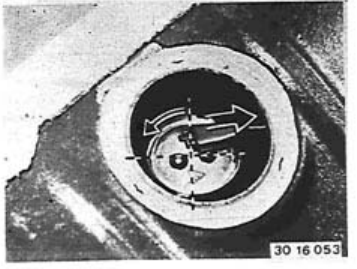
Unscrew screws and pull out fuel level sender slowly.

Installation:
Replace gasket.
Remove retainer for transportation when installing a new fuel level sender.


30 16 052

Turn fuel intake counterclockwise and pull out carefully.

Installation:
Replace gasket.


30 16 053

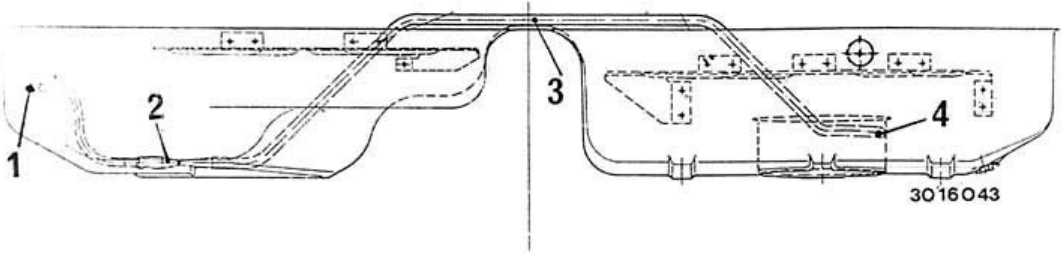
Left Tank Side:
Unscrew cover.
Pull off plug.
Turn fuel level sender counterclockwise and pull out carefully.

Testing:
Measure resistance* between both pins in "EMPTY" and "FULL" float positions.

** Source of Supply: HWB

16 12 . . . FUEL RETURN PIPE
– 320i / 325i Since 1988 Models –

Fuel Tank Survey
(only the bottom tank plate is shown in the side view for better view)



1 = Return pipe in tank (left tank chamber)

2 = Ejector

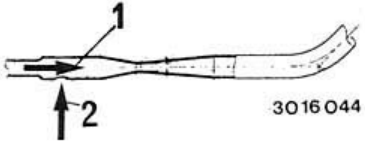
3 = Overflow pipe (right tank chamber)

4 = Splash shell

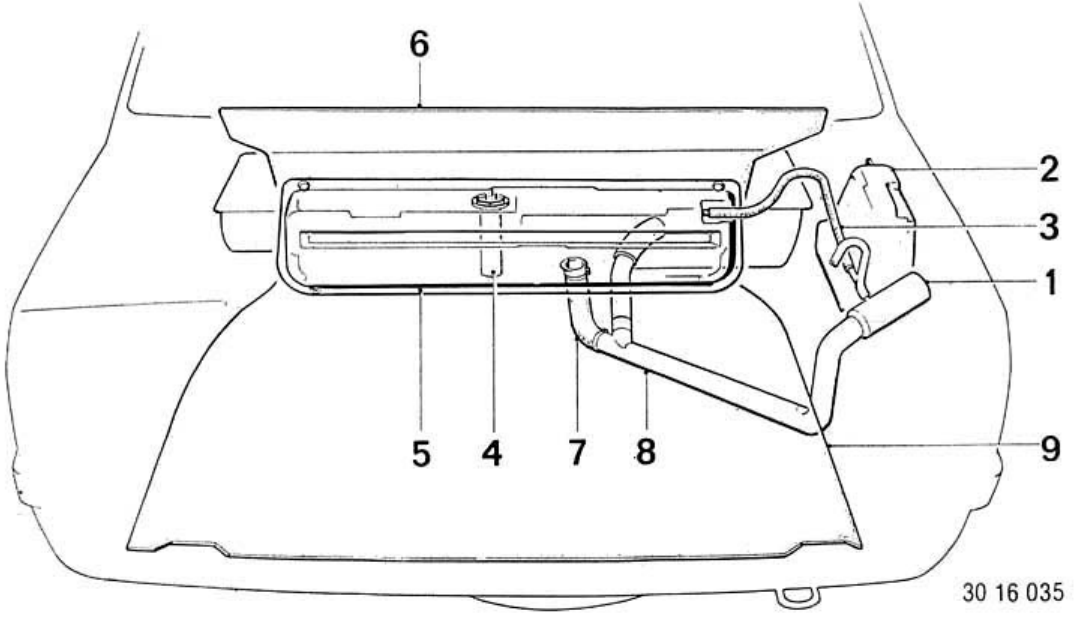
Overflow between the left and right tank chambers functions to the ejector principle.

1 = Fuel return from engine

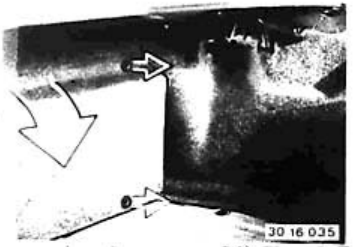
2 = Inlet for fuel from left tank chamber



LAYOUT DRAWING OF ADDITIONAL FUEL TANK

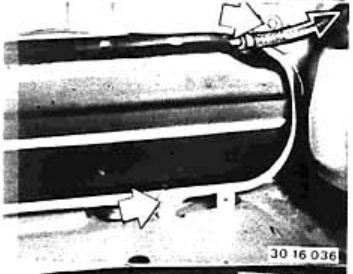


1 Filler neck
2 Expansion tank
3 Bleeder hose
4 Fuel level sender
5 Additional tank
6 Trunk separating wall
7 Molded filling hose
8 Filler pipe
9 Trunk floor plate

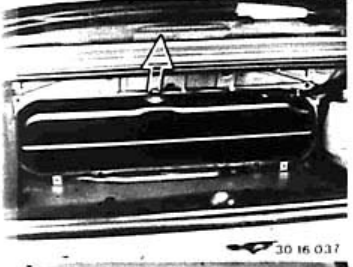


16 11 035 REMOVING AND INSTALLING ADDITIONAL FUEL TANK

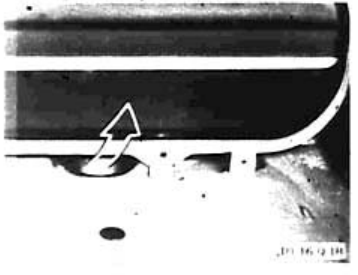
Lift out expansion rivets and take off trim panel.



Unscrew bolts on left and right sides.
Unscrew bleeder hose.

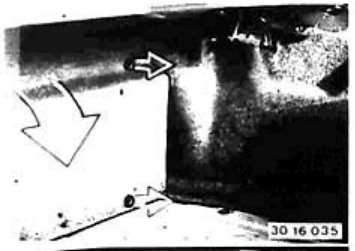


Pull off plug.

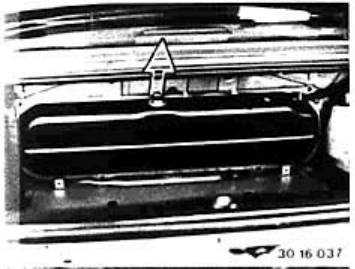


Lift tank.
Lift out sleeve.
Unscrew bolt.
Remove additional tank.

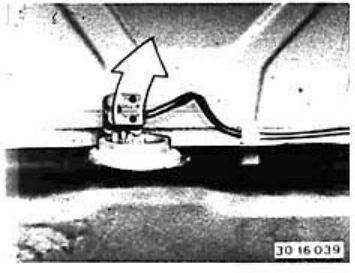
16 14 002 REMOVING AND INSTALLING FUEL LEVEL SENDER FOR ADDITIONAL FUEL TANK



Lift out expansion rivets and take off trim panel.



Pull off plug.



Unscrew and lift out fuel level sender.
Installation:
Use a new seal.
Remove retainer prior to installation of a new fuel level sender.

Testing:
Measure resistance* on connections G and 31 (ground) with float positioned at "EMPTY" and "FULL".
Resistance curve must not have breaks.
Connection W must have ground with float positioned at "EMPTY"
This sender is series connected with the master sender.

* See Specifications

17 Radiator

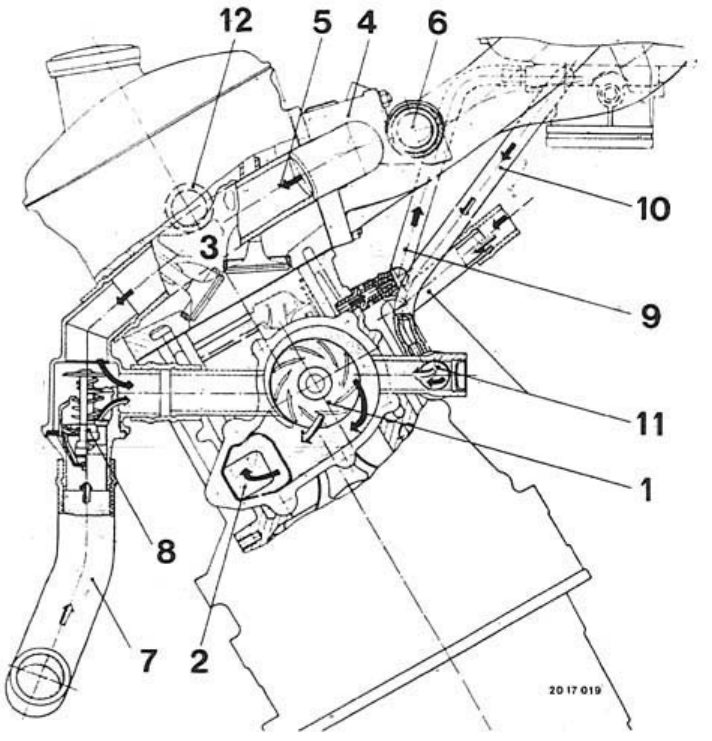
	Coolant circuit	
	4 cyl. – M10	17- 1
	6 cyl. – M20	17- 2
	4 cyl. – M40	17- 3
	6 cyl. – M21	17- 4
17 00 009	Cooling system – check for leaks	17- 5
010	Leaks between cooling system and combustion chamber – check	17- 5
039	Cooling system – bleed	17- 6
17 11 000	Radiator – remove and install	17- 7
100	Expansion tank – replace	17- 8
509	Radiator – flush	17- 8
17 40 000	Additional fan assembly – remove and install	17- 9

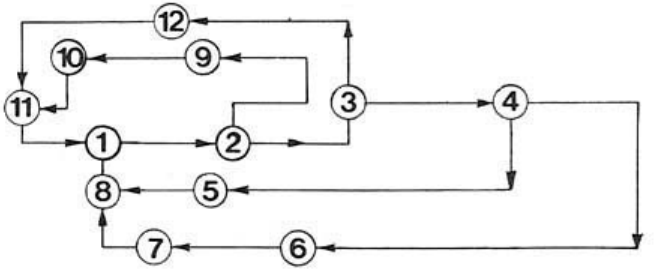
COOLANT CIRCUIT / 4 CYL. ENGINES – M 10

1 Water pump
2 Crankcase
3 Cylinder head
4 Branch flange
5 To thermostat
6 To radiator
7 From radiator
8 Thermostat
9 To throttle heating
10 From throttle heating
11 To water pump, heater return
12 Feed, heater

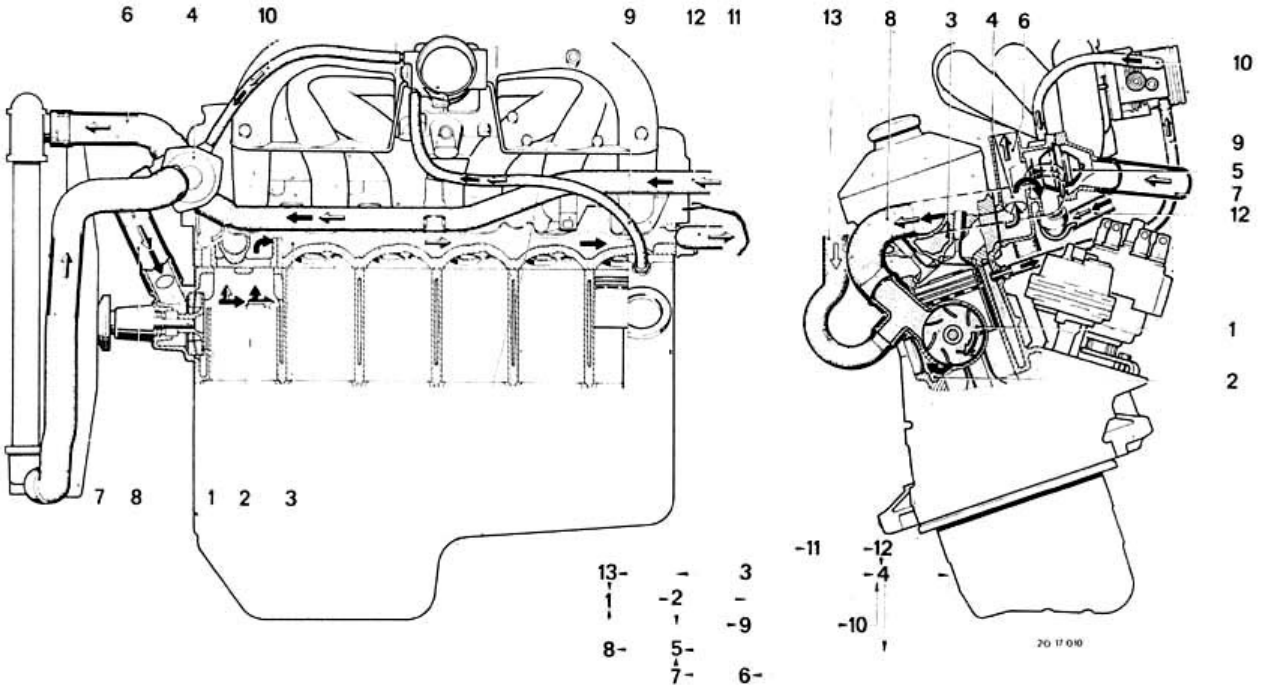
Circuit with closed thermostat

Circuit with opened thermostat





COOLANT CIRCUIT / 6 CYL. ENGINES – M 20

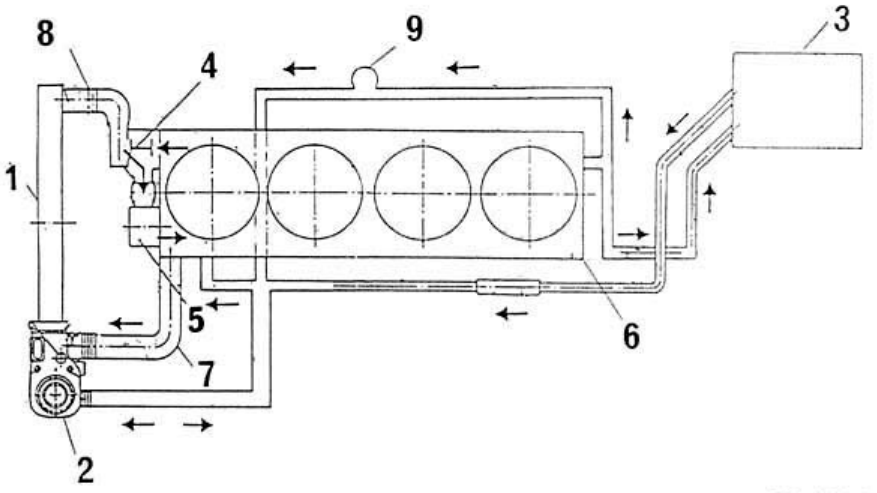


Circuit with closed thermostat

Circuit with opened thermostat

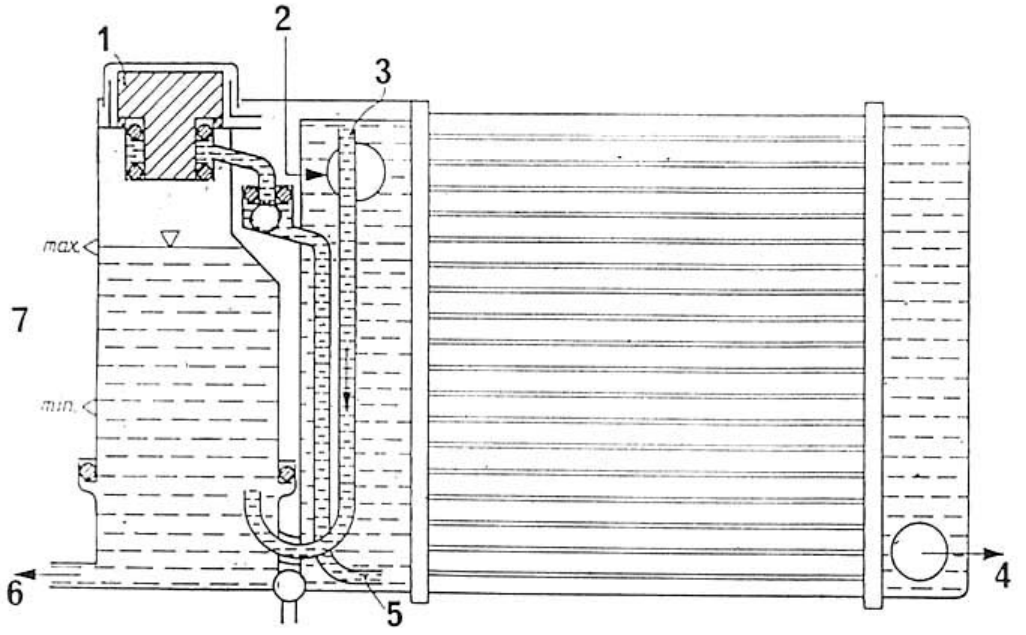
1 Water-pump
2 Crankcase
3 Cylinder head
4 Thermostat housing
5 Thermostat closed
6 Radiator inlet – thermostat open
7 Radiator outlet
8 To water pump
9 Feed, orifice point
10 Return, orifice point
11 To heat exchanger (car heating)
12 Return, heat exchanger
13 To expansion tank

COOLANT CIRCUIT OF FOUR CYLINDER M 40 ENGINE



30 17 055

1 Radiator
2 Integrated expansion tank
3 Heater
4 Thermostat
5 Water pump
6 Engine block
7 Return
8 Feed
9 Throttle valve heating



Cooling Circuit - M 40

1 Cap with pressure relief and vacuum valves

2 From engine

3 Bleeding hose

4 To Thermostat

5 Control hose

6 To water pump

7 Level marks

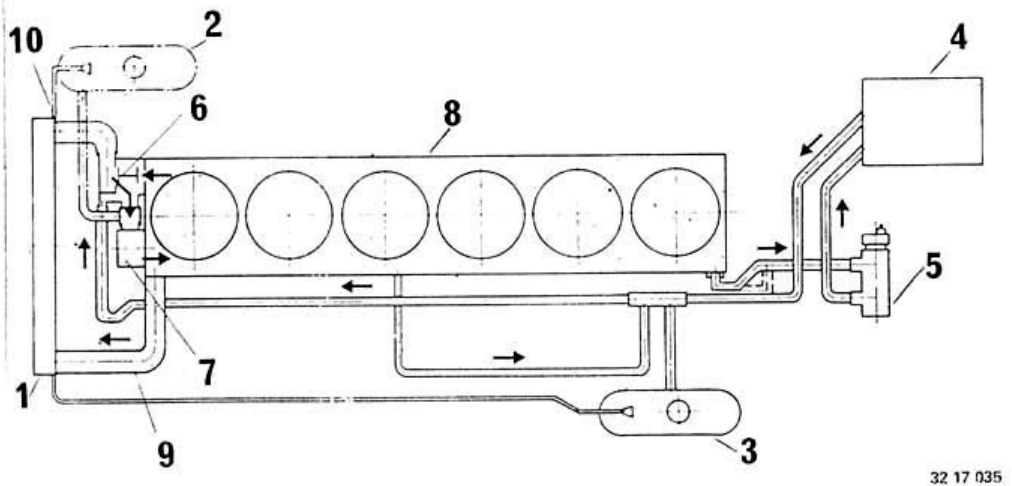
The bypass principle is applied in order to have good air exclusion in the cooling circuit.
Use of a cross-flow radiator permits integration of the bypass expansion tank on the side of the radiator. The tank is designed two-piece in order to have sufficient tank volume. This version permits use of transparent plastic in the area of level marks.

The bleeding hose mouths below the minimum level mark. In this manner air excluded from the bypass tank is prevented from flowing back into the full flow circuit when unscrewing the tank cap.

The pressure relief valve in the tank cap is activated via a control hose by radiator feed pressure.

The cooling system is protected against excessive operating pressure by registering the radiator feed pressure. Pressure protection takes place at approximately the amount of the radiator operating pressure during the after-heating phase. This improves the operating safety of the cooling system and the boiling-over safety while after-heating.

COOLANT CIRCUIT OF SIX CYLINDER M 21 ENGINE

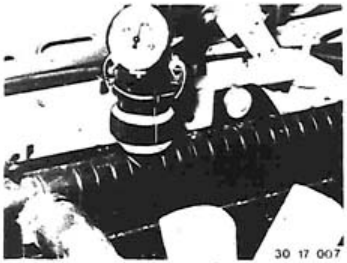


32 17 035

1 Radiator
2 Expansion tank
3 Expansion tank
4 Heater
5 Heater valve
6 Thermostat
7 Water pump
8 Engine block
9 Return
10 Feed

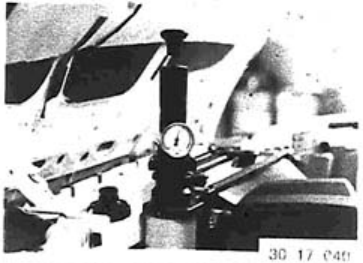
BMW 324 d
BMW 324 td

The 324 d coolant circuit differs from that of a turbocharged diesel engine only in the fact, that the branch pipe to the expansion tank goes direct from the thermostat s elbow hose (instead of from the heater s return pipe).

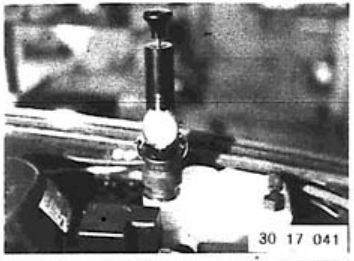

30 17 007

17 00 009 CHECKING COOLING SYSTEM FOR LEAKS

4 Cylinder M 10:
Check on radiator with tester 17 0 002 and adapter 17 0 003.


30 17 040

4 Cylinder M 40:
Check on integrated expansion tank of radiator with tester 17 0 002 and adapter 17 0 005.


30 17 041

6 Cylinder M 20 (Gasoline) and M 21 (Diesel):
Check on expansion tank with tester 17 0 002 and adapter 17 0 005.



30 17 042

S 14 (M 3):
Check on expansion tank with tester 17 0 002.
Note:
If no significant pressure drop (max. 0.1 bar or 1.4 psi) is displayed after 2 mintues, the cooling system does not leak*.

* See Specifications

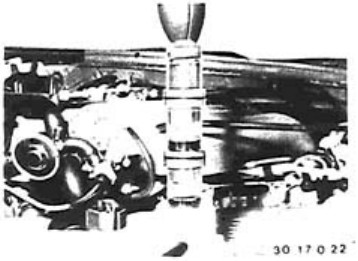

32 17 025

Checking Cooling System Cap:
Check opening pressure* (pressure relief valve) with tester 17 0 002 in conjunction with adapter 17 0 006 and connecting hose 17 7 010.



32 17 003

Checking Vacuum Valve:
Screw cap on tester 17 0 006 and build up vacuum slowly (with Special Tool 61 6 030). Vacuum valve opens with vacuum of about 0,1 bar (13 psi).*
Check gasket.
Lift vacuum valve slightly and check for correct seating, replacing cap if necessary.


30 17 0 22

17 00 010 CHECKING FOR LEAKS BETWEEN COOLING SYSTEM AND COMBUSTION CHAMBER

Fill "cylinder head tester"** and perform test.
Note:
Conform with operating instructions supplied with tester.

* See Specifications
** Source of Supply: HWB

17 00 039 BLEEDING COOLING SYSTEM

4 / 6 Cylinder Models:

Level of Integrated Expansion Tank - M 40

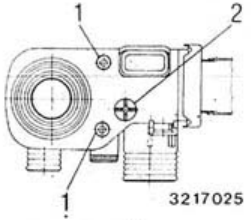
This condition is reached relatively easy by keeping to the following procedures when refilling the system (in a workshop).

Filling the System with Simultaneous Bleeding:
a) on radiator
b) on thermostat housing
(heater open, ignition on, engine not running)

The system is filled until the expansion tank is completely filled with coolant and coolant without air bubbles runs out of both bleeding points.

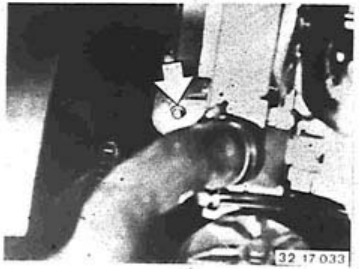
Tighten bleeder screws.

Air still trapped in the system will escape when operating the engine afterwards and cause the coolant level to drop approximately to the specified mark in the expansion tank (engine speed at least 2500 rpm). Slight excessive filling (for example up to the 9th rib from the top) is acceptable.



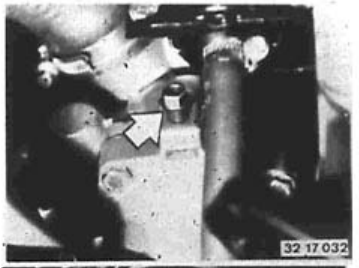
Unscrew M 40 bleeder screw and wait until coolant "without air bubbles" runs out.
Keep adding coolant in expansion tank while bleeding.
Only use specified coolant*.

2 = Bleeder screw on expansion tank

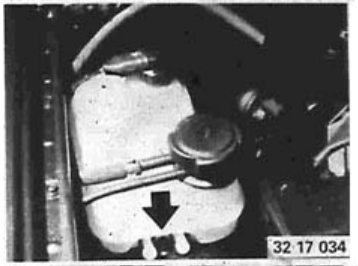


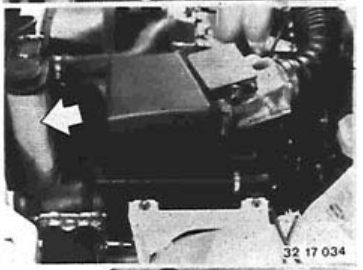
Unscrew M 40 bleeder screw.

* See Service Information of Gr. 00

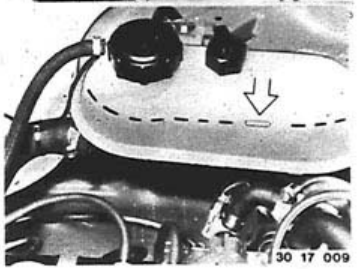


Unscrew M 20/M 21 bleeder screw.



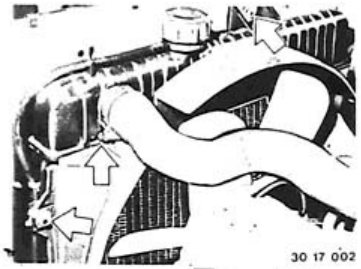


M 40
Mark on tank shows level at about 20 degrees C (68 degrees F).

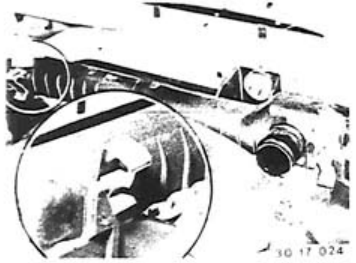


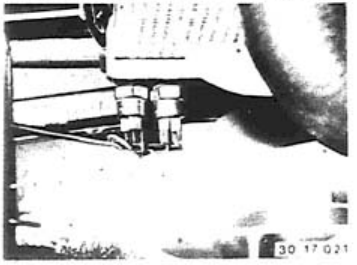
M 20 (Until 1988 Models)
Keep adding coolant in expansion tank while bleeding.
Mark shows level at 20 degrees C (68 degrees F).
Only use specified coolant* and **.

* See Service Information of Gr. 00
** Source of Supply: HWB


30 17 002


30 17 003


30 17 024


30 17 021

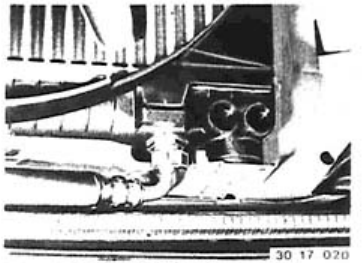
17 11 000 REMOVING AND INSTALLING RADIATOR

4 Cylinder Models:
Unscrew cooling system cap.
Unscrew fan cowl.
Disconnect coolant hoses and drain coolant.
Unscrew mounting bolt and take out radiator from above.
Caution!
Be careful not to cut hands on sharp radiator fins.

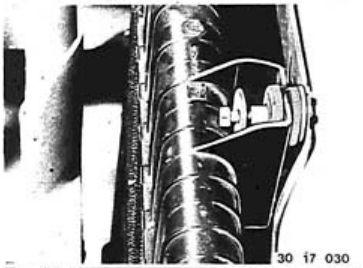
Installation:
Fill with specified coolant**.

6 Cylinder Models:
Take off retainers.
Lift out fan cowl.
Disconnect coolant hoses and drain coolant.

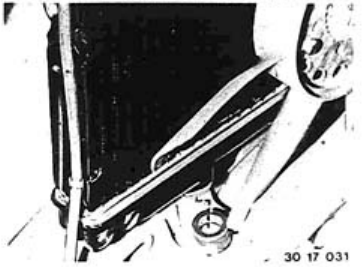
Cars with Air Conditioner:
Pull off plugs on temperature switches.


30 17 020

Cars with Automatic Transmission:
Unscrew oil cooler pipes and plug openings with caps.
Installation:
Tightening torque*.
Check ATF level, correcting if necessary.


30 17 030

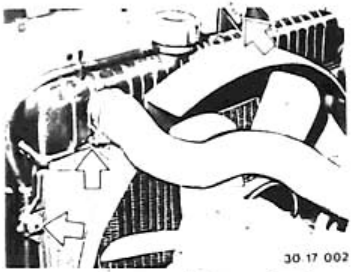
Unscrew bolt and lift out radiator.
Caution!
Be careful not to cut hands on sharp radiator fins.
Installation:
Install washers and sleeve as shown in picture.
Tightening torque*.


30 17 031

Installation:
Mount radiator on rubber mounts precisely.
Fill and bleed cooling system – see 17 00 039.

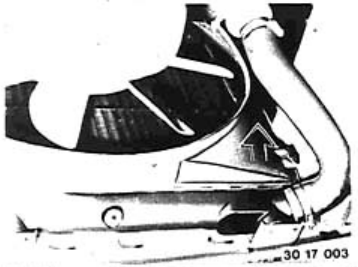
** See Service Information of Gr. 00

* See Specifications



17 11 000 REMOVING AND INSTALLING RADIATOR (1988 Models)

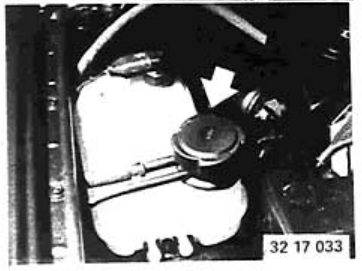
4 Cylinder M 10:
Unscrew radiator cap.
Unscrew fan cowl.
Disconnect coolant hoses and drain coolant (catching in clean container if applicable).
Unscrew mounting bolts and take out radiator from above.



Installation:
Fill with specified coolant* + **.
Caution!
Be careful not to cut hands on sharp radiator fins.

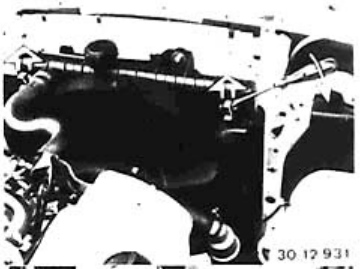


4 Cylinder M 40:
Unscrew cap on integrated expansion tank of radiator.
Note:
Drain plug at bottom left**.

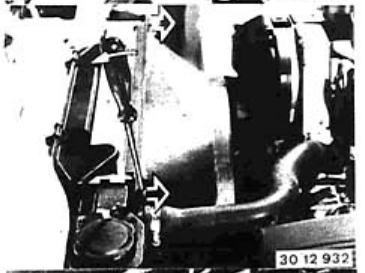


6 Cylinder M 20 / M 21:
Unscrew cap on expansion tank.
Note:
Drain plug at bottom left**.

* See Service Information of Gr. 00
** See Specifications



M 10:
Press fan cowl retainers forward with a slotted screwdriver and pry out upward.
Push fan cowl back.
Also refer to M 21.



Press out fan cowl plugs toward rear.
M 20:
Unscrew splash guard if necessary see 51 47 . . ..
Drain coolant, catching if necessary.
Coolant*.
Drain plug tightening torque**.
Also refer to M 40.

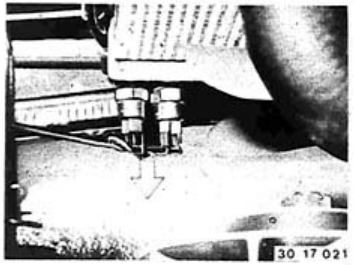


Disconnect coolant hoses.
Detach bleeder hose.
Installation:
Mount coolant hoses**.

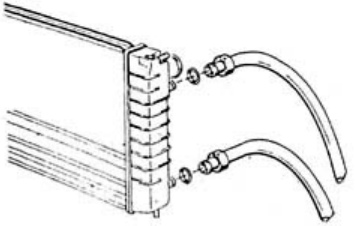


Unscrew upper radiator mounting bolts and lift out radiator.
Installation:
Mount radiator on rubber mounts precisely.
Mount coolant hoses**.
Fill with specified coolant* and bleed – see 17 00 039.

* See Service Information of Gr. 00
** See Specifications



Cars with Air Conditioner:
Pull off plugs on temperature switches.



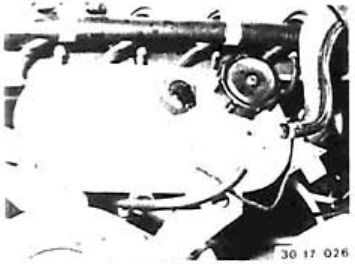
Cars with Automatic Transmission:
Unscrew oil cooler pipes and plug openings with caps.
Installation:
Check ATF level, correcting if necessary.
Tightening torque*.

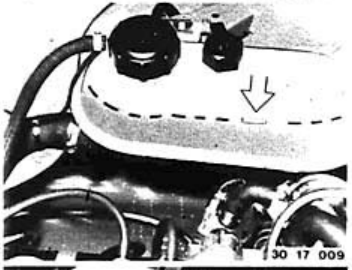
Installation:
Fill and bleed cooling system – see 17 00 039.

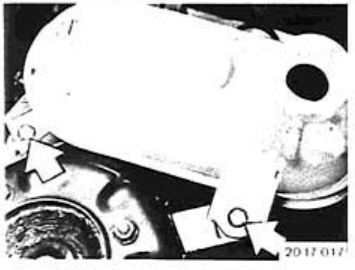


M 40 / M 20:
Unscrew oil cooler pipes and plug openings with caps.
Installation:
Check ATF level, correcting if necessary.
Tightening torque*.

* See Specifications







17 11 100 REPLACING EXPANSION TANK (Before 1988 Models)

Caution!
Unscrew cap only when engine is cold. Drain, catch and dispose coolant.

Pull off plug and disconnect hoses. If applicable, pull off plug for level switch.

Installation:
Use new hose clamps if necessary.

Installation:
Pour in specified coolant* and bleed cooling system – see 17 00 039.
Mark on tank shows full level at approx. 20° C (68° F).

Unscrew screws and take out expansion tank.

Installation:
Tightening torque*.

* See Service Information of Gr. 00
** See Specifications

17 11 509 FLUSHING RADIATOR – Radiator Removed –

If oil has penetrated into the coolant circuit, the radiator and expansion tank will have to be flushed and cleaned with Solvethane**.

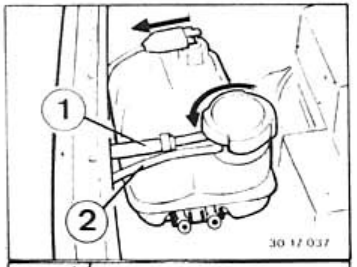
Procedures:

1. Also remove expansion tank in addition to the radiator for M 20/M 21.
2. Pour in about 2 liters (4 pints) of Solvethane.
3. Shake radiator and tank thoroughly and drain after oil has been dissolved.
4. Install cleaned radiator and expansion tank, and connect on coolant circuit.
5. Fill entire cooling system with hot water and flush thoroughly by replacing hot water several times to guarantee removal of solvethane residue.
6. Check drained coolant for traces of oil and, if necessary, repeat step 5. Pour in coolant* and bleed cooling system after finishing the cleaning procedures – see 17 00 039.

Caution!
Solvethane attacks rubber seals, hoses, etc. and consequently must not be permitted to enter or remain in the cooling system.
Always conform with safety precautions for working with Solvethane (printed on cans).

Also refer to Service Information of Group 11.

* See Service Information of Gr. 00
** Source of Supply: HWB

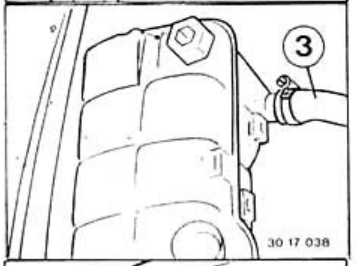


17 11 100 REMOVING AND INSTALLING EXPANSION TANK (Since 1988 Models)

Caution!
Unscrew cap only when engine is cold.
Drain, catch and dispose coolant.

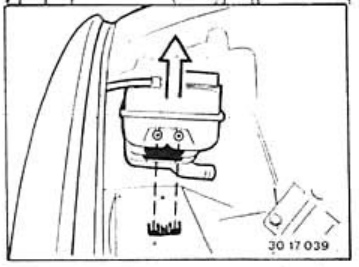
Pull off plug on level switch.
Disconnect hoses (1 and 2).

Installation:
Use new hose clamps.



Disconnect expansion hose (3).

Installation:
Use new hose clamps.
Pour in specified coolant** and bleed cooling system – 17 00 039.



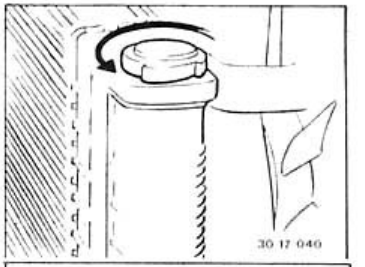
Unclip plastic clips and pull expansion tank out of clamps.



Mark on tank shows coolant level at approx. 20° C (68° F).

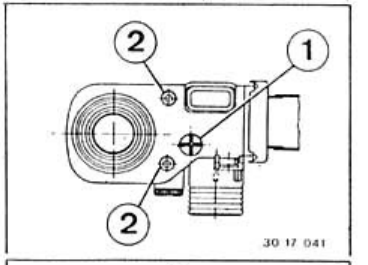
Installation:
Pour in specified coolant** and bleed – see 17 00 039.

* See Specifications
** See Operating Fluids

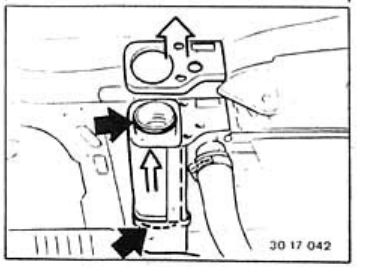


M 40

Caution!
Unscrew cap only when engine is cold.
Drain, catch and dispose coolant.



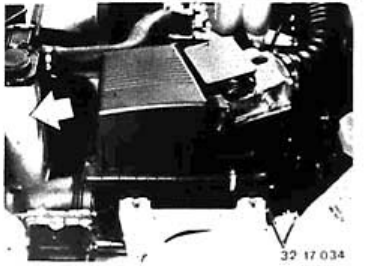
Unscrew bleeder screw (1).
Unscrew mounting screws (2).
Take off upper section.



Pull out expansion tank from above.

Installation:
Replace seals.

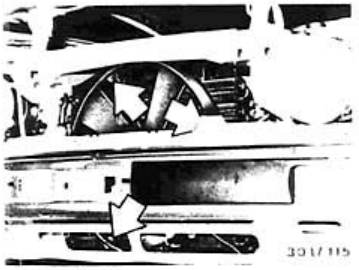
Pour in specified coolant** and bleed – see 17 00 039.



Mark on tank shows coolant level at approx. 20° C (68° F).

Installation:
Pour in specified coolant** and bleed – see 17 00 039.

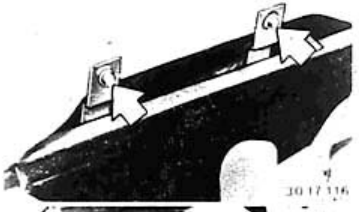
** See Operating Fluids



17 40 000 REMOVING AND INSTALLING ADDITIONAL FAN ASSY.

Remove radiator – see 17 11 000.
Remove all radiator grill sections – see 51 13 070.
Unscrew nuts on additional fan.

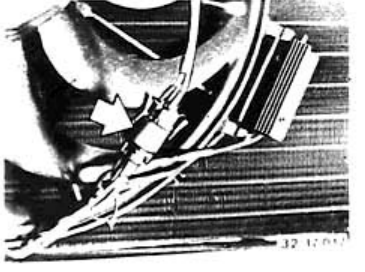
Unscrew condenser.



Take off trim panel.



Disconnect plug.
Pull back condenser and lift out additional fan from above.
Testing:
Power consumption and speed – see Specifications of Group 17.



18 Exhaust System

4 Cylinders M20, M40

18 00 020 Exhaust assembly – remove and install 18- 1
18 12 031 Final muffler – replace 18- 2
041 Primary muffler – replace 18- 2
18 21 011 Pivot sleeves in exhaust carrier – replace 18- 3
18 32 005 Catalytic converter – remove and install / replace 18- 4

4 Cylinders M42

Exhaust system layout 18-00/42.0
18 00 020 Exhaust assembly – remove and install 18-00/42.1
18 12 . . . Exhaust assembly – disassemble 18-12/42.1

4 Cylinders S14, M3

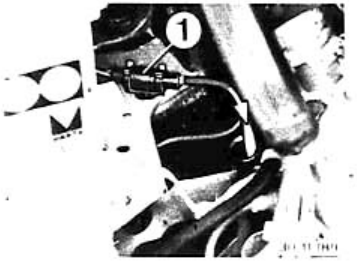
18 00 020 Exhaust assembly – remove and install 18- 5
18 12 031 Final muffler – replace 18- 6

6 Cylinders M20

18 00 020 Exhaust assembly – remove and install 18- 7
18 12 031 Final muffler – replace 18- 8
041 Primary muffler – replace 18- 8
18 21 011 Pivot sleeves in exhaust carrier – replace 18- 9
18 32 005 Catalytic converter – remove and install / replace 18- 10

6 Cylinders M21

18 00 020 Exhaust assembly – remove and install 18- 11
18 12 031 Final muffler – replace 18- 12
041 Primary muffler – replace 18- 12
18 21 011 Pivot sleeves in exhaust carrier – replace 18- 13
Exhaust suspension layout drawings 18- 14



18 00 020 REMOVING AND INSTALLING EXHAUST ASSEMBLY

4 Cylinder M 10 / M 40:
Version with Catalytic Converter:
Disconnect oxygen sensor plug (1).
Pull out plug downward through the protective tube.
Caution!
Oxygen sensor must not be damaged.
Remove oxygen sensor of there is danger of damaging it.
Refer to 11 78 012.

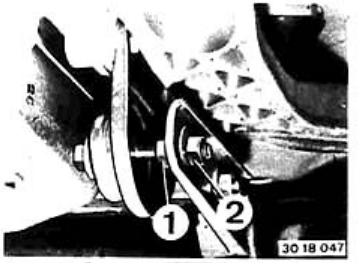


Unscrew exhaust pipe on manifold.
Installation:
Check gasket, replacing if necessary
Replace self-locking nuts.
Coat threads with copper paste CRC**.
Tightening torque*.



Loosen holder for exhaust.
Installation:
Torque* holder only after finishing installation of assembly (danger of tension).

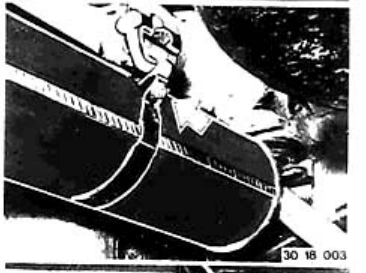
* See Specifications
** Source of Supply: HWB



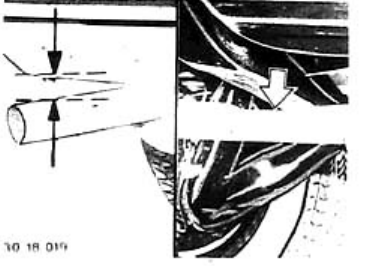
Cars with Automatic Transmission:
Unscrew nut (2).
Installation:
Mount the exhaust carrier without tension by adjusting nut (1).



Disconnect suspension on rear axle carrier – if necessary.
Installation:
Move holder to adjust only after finishing installation of the exhaust assembly and then tighten to correct torque*.



Loosen holder for final muffler.
Installation:
Torque* holder in such a manner, that rubber ring is preloaded.
Preload: 6 mm (0.236").
See exhaust suspension layout drawing.



Take off exhaust assembly.
Installation:
Check spacing to body and rear axle carrier, correcting if necessary.

* See Specifications

18 12 031 REPLACING FINAL MUFFLER

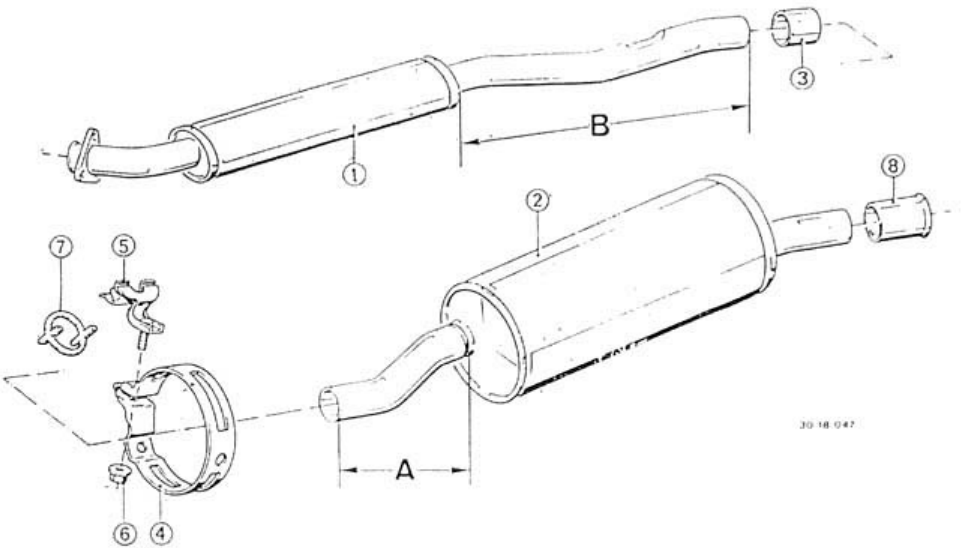
4 Cylinder M 10:
Determine cutting distance (A) on new final muffler (2).
Transfer and mark determined distance to installed final muffler.
Cut off exhaust pipe with Special Tool 00 2 200 and deburr edges.
Remove final muffler – see 18 00 020.
Slide on welding sleeve (3).
Adjust new final muffler to correct installed position and connect with welding sleeve (3).
Important!
Make sure of sufficient spacing to body.
Tack weld welding sleeve (3).
Remove muffler assembly (primary and final mufflers).
Weld welding sleeve (3) all around.

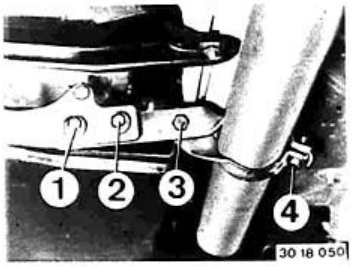
18 12 041 REPLACING PRIMARY MUFFLER

4 Cylinder M 10:
Determine cutting distance (B) on new primary muffler (1).
Transfer and mark determined distance to installed primary muffler.
Cut off exhaust pipe with Special Tool 00 2 200 and deburr edges.
Unscrew primary muffler on flange and remove.
Adjust new primary muffler to correct installed position and connect with welding sleeve (3).
Important!
Make sure of sufficient spacing to body.
Tack weld welding sleeve.
Remove muffler assembly (primary and final mufflers).
Weld welding sleeve (3) all around.
Since 1988 models the part being replaced must be disconnected on the flanges.

Muffler Assembly:

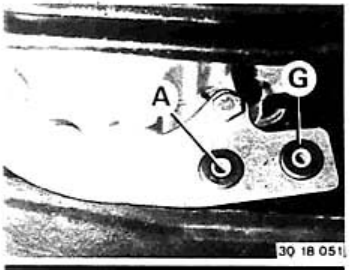
1 Primary muffler
2 Final muffler
3 Welding sleeve
4 Clamp
5 Holder
6 Nut
7 Rubber ring
8 Tailpipe extension



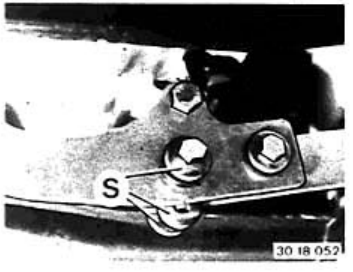


18 21 011 REPLACING PIVOT SLEEVES IN EXHAUST CARRIER

4 Cylinder M 10, M 40:
Unscrew and remove bolts (1 and 2).
Loosen (3 and 4).
Installation:
Tighten bolts and nuts in order of 1 through 4.

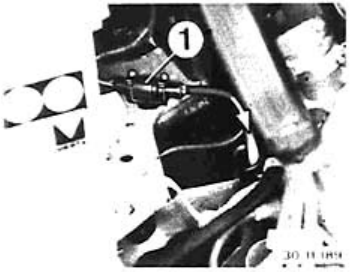


Push in spacers (A) and press out pivot sleeves (G).
Installation:
Coat pivot sleeves with a lubricant for installation of the spacers.



Install washers (S) as shown.
Tightening torque*.

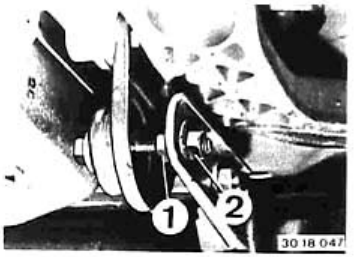
* See Specifications



18 32 005 REMOVING AND INSTALLING OR REPLACING CATALYTIC CONVERTER

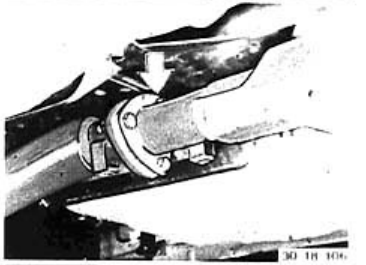
Four Cylinder M 10, M 40:
Disconnect oxygen sensor plug (1).
Pull out plug downwards through protective pipe.

Important!
Oxygen sensor must not be damaged. If danger of damaging oxygen sensor, it must be removed – see 11 78 012.



Cars with Automatic Transmission:
Unscrew nut (2).

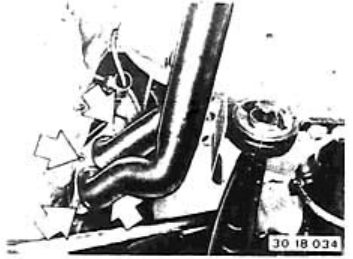
Installation:
Mount exhaust carrier without tension by adjusting nut (1).



Disconnect catalytic converter from final muffler.

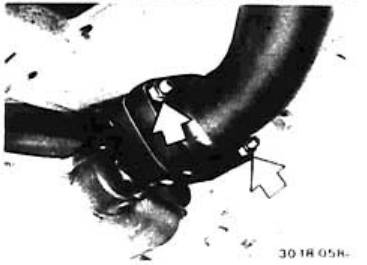
Installation:
Replace gasket and self-locking nuts. Tightening torque*.

Scrapping Information
Used catalytic converters will be accepted and must be returned as warranty parts*.**



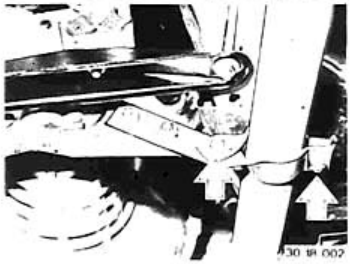
Unscrew exhaust pipe on manifold.

Installation:
Check gasket, replacing if necessary.
Replace self-locking nuts.
Coat threads with copper paste CRC.**



Two Hole Flange Version:

Note:
Turn flange to have maximum ground clearance.



Unscrew exhaust suspension holder.

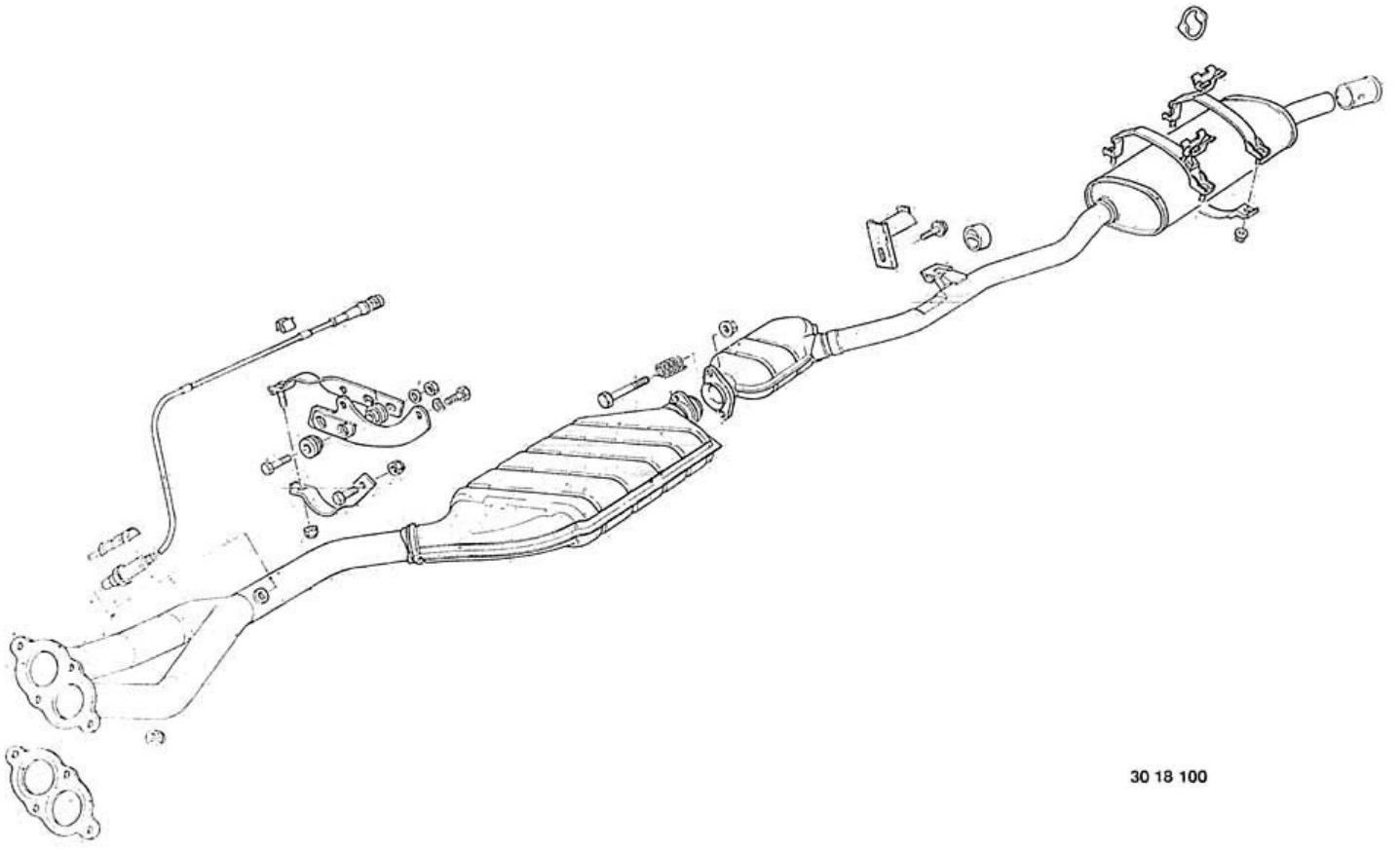
Installation:
Tighten holder to specified torque* only after complete installation.

* See Specifications
** Source of Supply: HWB

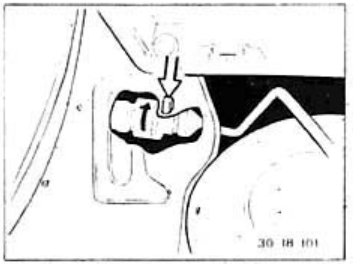
* See Specifications
*** See Service Information

18-00/42.0

EXHAUST ASSEMBLY DRAWING



30 18 100

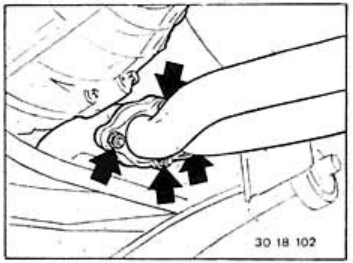


18 00 020 REMOVING AND INSTALLING EXHAUST ASSEMBLY

Model 318 is / M 42:

Disconnect plug for oxygen sensor.
Unclip electric lead in holder.

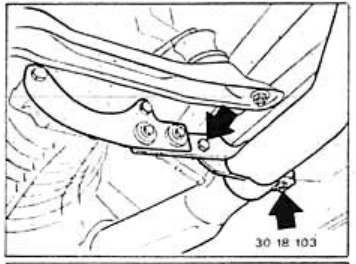
Location:
Underneath battery console.



Unscrew exhaust pipes on manifold.

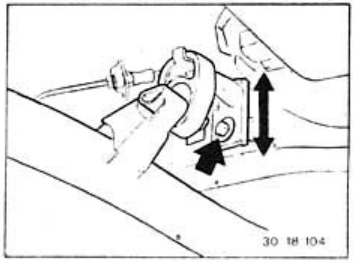
Installation:
Check gasket, replacing if necessary.
Replace self-locking nuts.
Coat threads with copper paste CRC.**

Tightening Procedures:
Step 1 = 30 to 35 Nm (22 to 25 ft. lbs.)
Step 2 = 50 to 55 Nm (36 to 40 ft. lbs.)



Unscrew exhaust pipe on transmission holder.

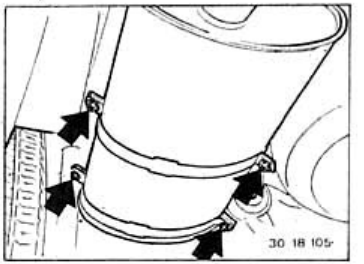
Installation:
Bolt holder only after finishing installation of the complete assembly without tension.
Tightening torque*.



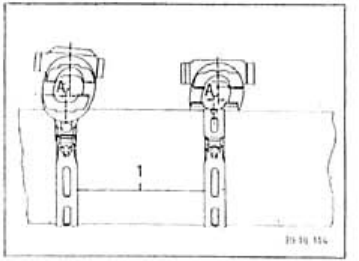
Unscrew holder on rear axle carrier.

Installation:
Align and bolt holder only after finishing installation of the complete exhaust assembly.
Tightening torque*.

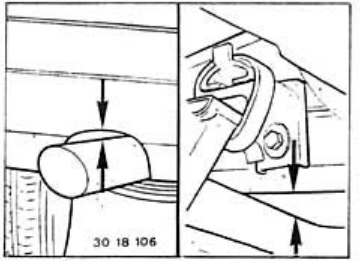
* See Specifications
** Source of Supply: HWB



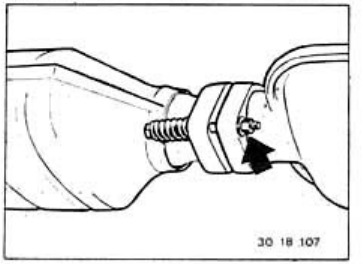
Unscrew holder for final muffler.
Remove exhaust assembly.



Installation:
Slide holder forward until rubber rings are preloaded by 6 mm (0.236").

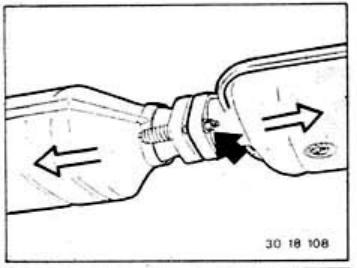


Installation:
Check for sufficient spacing to the body and rear axle carrier – approx. 20 mm (0.787") each.



Installation:
Loosen and then tighten connection between catalytic converter and middle muffler without tension.

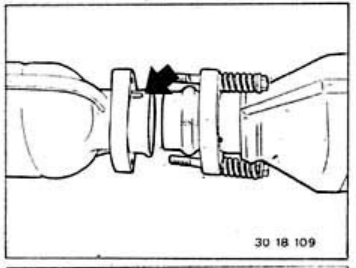
Tightening Procedures:
Press springs (2) flat by tightening nuts (1) uniformly with a torque of 11 to 14 Nm (8 to 10 ft. lbs.). Loosen nuts (1) afterwards by one and one half turns. Flanges must be parallel to each other and springs must not be pressed flat.



18 12 ... DISASSEMBLING EXHAUST ASSEMBLY

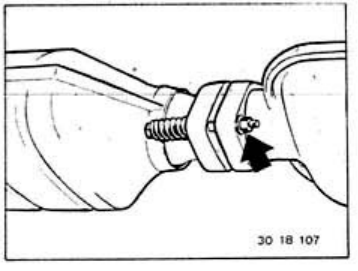
Model 318 is / M 42:

Unscrew flanged connection.
Disconnect exhaust assembly.



Arrangement of Connection:

Important!
Pipe is fitted with a holding tab.
Flange can be pushed on only in one position.



Installation:
Lubricate connection lightly with copper paste CRC.**
Press springs (2) flat by tightening nuts (1) uniformly with a torque of 11 to 14 Nm (8 to 10 ft. lbs.).
Loosen nuts (1) by one and one half turns afterwards.
Flanges must be parallel to each other and springs must not be pressed flat.

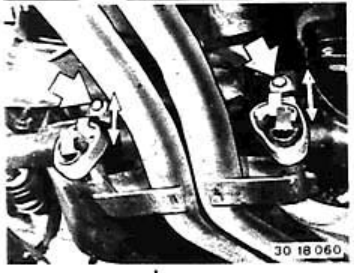
Position of Flanges as Seen Looking Forward

** Source of Supply: HWB

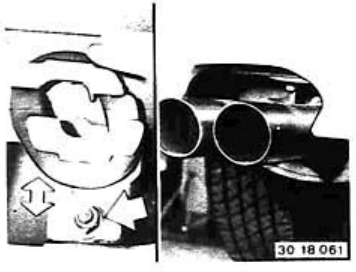


18 00 020 REMOVING AND INSTALLING EXHAUST ASSEMBLY

Engine S 14, M 3:
Unscrew exhaust assembly on flange.
Installation:
Check gasket, replacing if necessary.
Coat threads with copper paste CRC**.
Tightening torque*.



Unscrew holders on rear axle carrier.
Installation:
Adjust and tighten holders only after installation of the complete exhaust assembly.
Tightening torque*.



Unscrew holder for final muffler.
Installation:
Adjust spacing to body by moving holder.
Tightening torque*.

* See Specifications
** Source of Supply: HWB

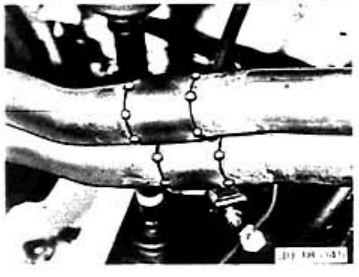
18 12 031 REPLACING FINAL MUFFLER



Engine S 14, M 3:
Remove exhaust assembly – see 18 00 020.
Cut off clamping sleeves at clamping points.
Position clamping sleeves in one direction.



Slide on new sleeves.
Adjust exhaust assembly to correct installed position.
Center sleeves.

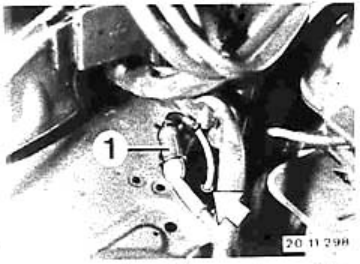


Tack weld sleeves with several spot welds.
Remove primary and final mufflers.
Weld sleeves all around.



18 00 020 REMOVING AND INSTALLING EXHAUST ASSEMBLY

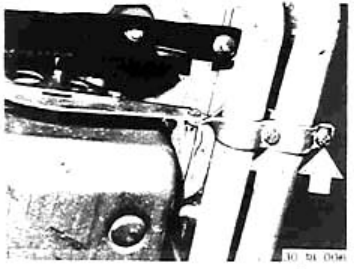
6 Cylinder M 20:
Cars with Catalytic Converter:
Disconnect oxygen sensor plug (1).
Lift out wire harness.
Installation:
Seal plug connection with Three Bond Silicone 1207** to avoid problems with the contacts of the plug.
Floor plate assembly plug installation.



Disconnect oxygen sensor plug (1).
Lift out wire harness.
Right wheel house plug installation.
Important!
Be careful not to damage the oxygen sensor. If there is the possibility of damaging it, remove the oxygen sensor – see 11 78 012.

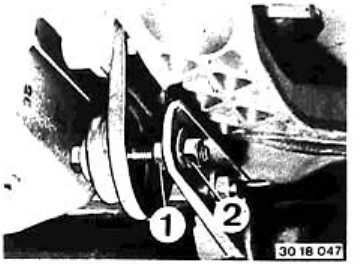


Unscrew exhaust pipes on exhaust manifold.
Installation:
Check gaskets, replacing if necessary.
Replace self-locking nuts.
Coat threads with copper paste CRC**.
Tightening torque*.

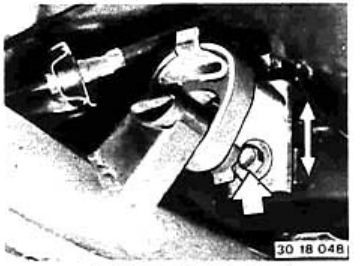


Unscrew exhaust assembly holders.
Installation:
Avoid tension by tightening holders only after installation of complete exhaust assembly.
Tightening torque*.

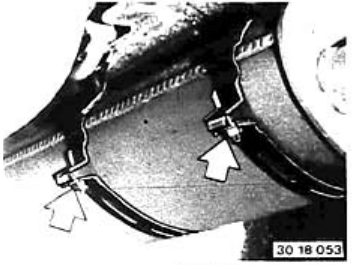
* See Specifications
** Source of Supply: HWB



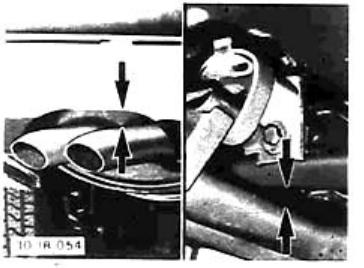
Cars with Automatic Transmission:
Unscrew nut (2).
Installation:
Mount exhaust carrier without tension by adjusting nut (1).



Unscrew holder on rear axle carrier, if necessary
Installation:
Adjust and tighten holder only after installation of complete exhaust assembly.
Tightening torque*.



Unscrew holders for final muffler.
Installation:
Tighten holders that rubber ring is pre-loaded.
Preload = 6 mm (0.236").
Tightening torque*.
(See exhaust suspension layout drawing.)



Take off exhaust assembly.
Installation:
Check installed position.
Make sure of sufficient spacing to body and rear axle carrier.

* See Specifications

18 12 031 REPLACING FINAL MUFFLER

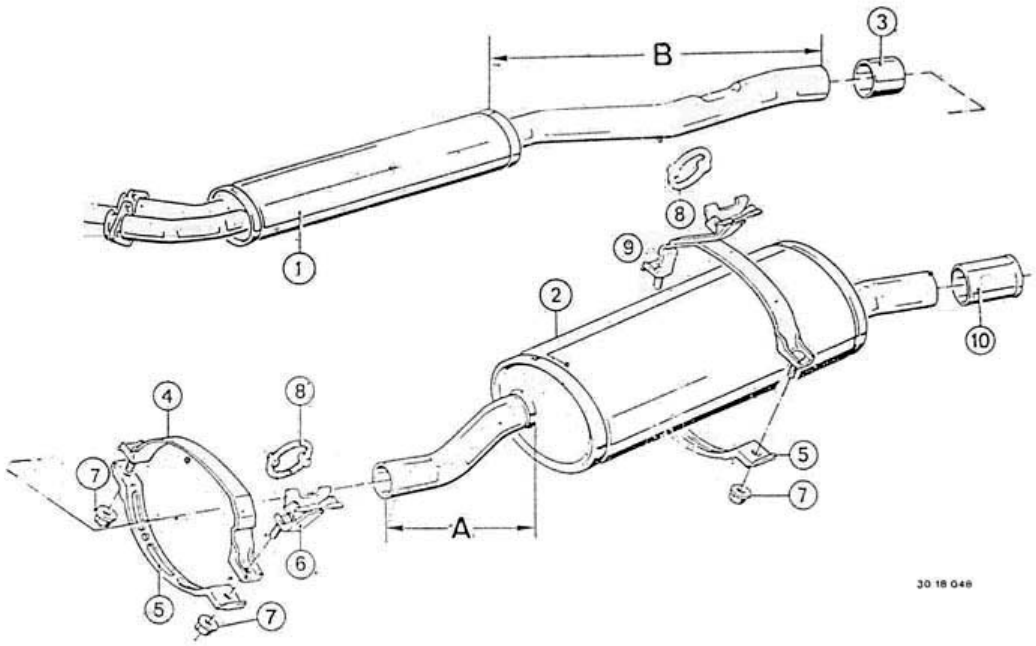
6 Cylinder M 20:
Determine cutting distance (A) on new final muffler (2).
Transfer and mark determined distance to installed final muffler.
Cut off exhaust pipe with Special Tool 00 2 200 and deburr edges.
Remove final muffler – see 18 00 020.
Slide on welding sleeve (3).
Adjust new final muffler to correct installed position and connect with welding sleeve (3).
Note:
Check for sufficient spacing to body.
Tack weld welding sleeve (3).
Remove muffler assembly (primary and final mufflers).
Weld welding sleeve (3) all around.

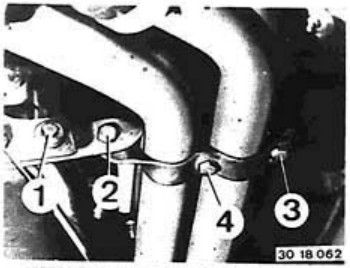
18 12 041 REPLACING PRIMARY MUFFLER

6 Cylinder M 20:
Determine cutting distance (B) on new primary muffler (1).
Transfer and mark determined distance to installed primary muffler.
Cut off exhaust pipe with Special Tool 00 2 200 and deburr edges.
Unscrew primary muffler on flange and remove.
Adjust new primary muffler to correct installed position and connect with welding sleeve (3).
Note:
Check for sufficient spacing to body.
Tack-weld welding sleeve (3).
Remove muffler assembly (primary and final mufflers).
Weld welding sleeve (3) all around.
Since 1988 models a part being replaced must be disconnected on the flanges.

Muffler Assembly:

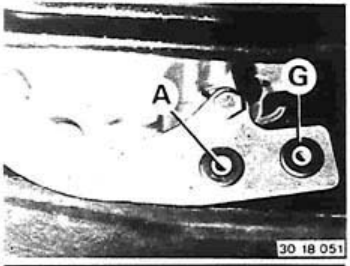
1 Primary muffler
2 Final muffler
3 Welding sleeve
4 Clamp
5 Clamp
6 Holder
7 Nut
8 Rubber ring
9 Clamp
10 Tailpipe extension



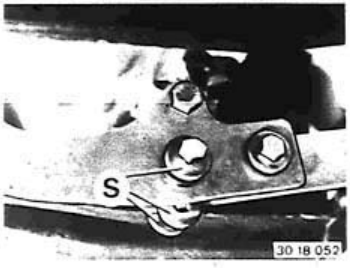


18 21 011 REPLACING PIVOT SLEEVES ON EXHAUST CARRIER

6 Cylinder M 20:
Unscrew bolts (1).
Loosen (2 ...4).
Installation:
Tighten bolts and nuts in order of 1 through 4.



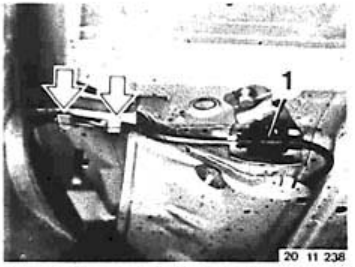
Push in spacers (A) and press out pivot sleeves (G).
Installation:
Coat pivot sleeves with a lubricant for installation of the spacers.



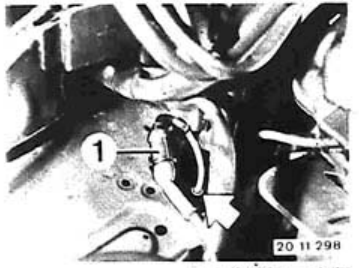
Install washers (S) as shown.
Tightening torque*.

* See Specifications

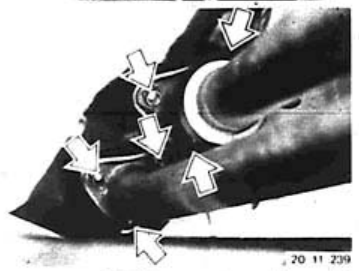
18 32 005 REMOVING AND INSTALLING OR REPLACING CATALYTIC CONVERTER



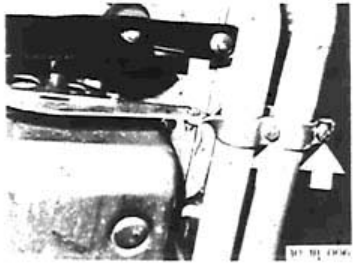
6 Cylinder M 20:
Disconnect oxygen sensor plug (1).
Lift out wire harness.
Installation:
To avoid plug contact problems, seal off plug connection with Three Bond Silicone 1207**.
Floor Assembly Plug Installation



Disconnect oxygen sensor plug (1).
Lift out wire harness.
Right Wheel House Plug Installation

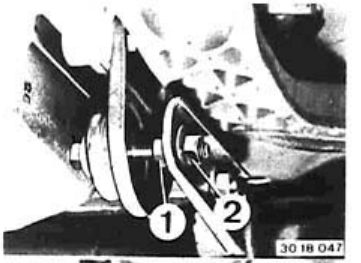


Unscrew exhaust pipes on manifold.
Installation:
Check gaskets, replacing if necessary.
Replace self-locking nuts.
Coat threads with copper paste CRC**
Tightening torque*.

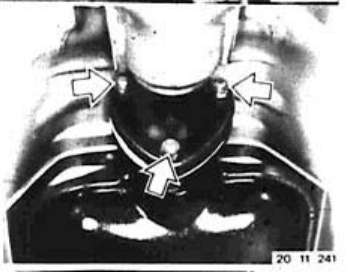


Remove exhaust holder.
Installation:
Mount holder only after finishing installation of catalytic converter (danger of tension)
Tightening torque*

* See Specifications
**Source of Supply: HWB



Cars with Automatic Transmission:
Unscrew nut (2).
Installation:
Mount the exhaust carrier without tension by adjusting nut (1).
Tightening torque*.

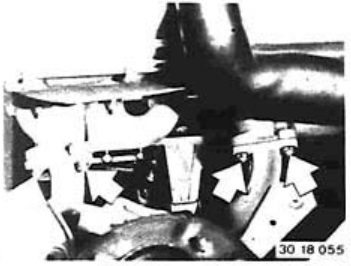


Unscrew catalytic converter on final muffler.
Installation:
Check seals, replacing if necessary.
Replace self-locking nuts.
Tightening torque*.
Three Hole Flange Version



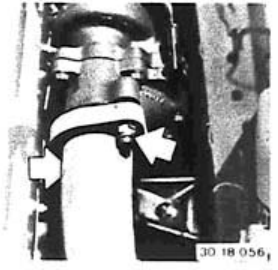
Two Hole Flange Version

* See Specifications

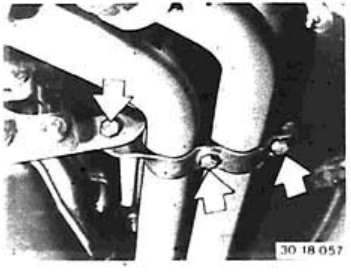


18 00 020 REMOVING AND INSTALLING EXHAUST ASSEMBLY

6 Cylinder M 21:
BMW 324 d:
Remove splash guard.
Unscrew exhaust pipes on manifold.

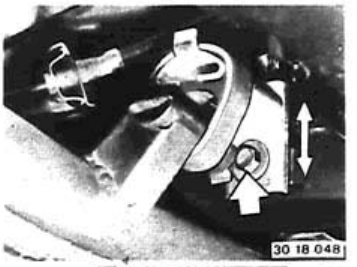


BMW 324 td:
Unscrew exhaust pipe on turbocharger.
Installation:
Check gaskets, replacing if necessary.
Replace nuts.
Coat threads with copper paste CRC**
Tightening torque*.

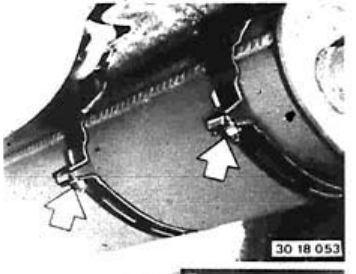


Unscrew holders for exhaust assembly.
Installation:
Avoid tension by tightening holders only after installation of complete exhaust assembly.
Tightening torque*.

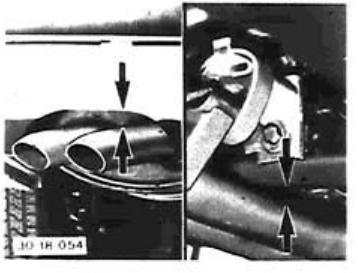
* See Specifications
** Source of Supply: HWB



Loosen holders on rear axle carrier if necessary
Installation:
Adjust and tighten holders only after installation of complete exhaust assembly.
Tightening torque*.



All:
Loosen holders for final muffler.
Installation:
Tighten holders that rubber rings are pre-loaded
Preload = 6 mm (0.236").
Tightening torque*
(See exhaust suspension layout drawing.)



Take off exhaust assembly.
Installation:
Check installed position.
Make sure of sufficient spacing to body and rear axle carrier.

* See Specifications

18 12 031 REPLACING FINAL MUFFLER

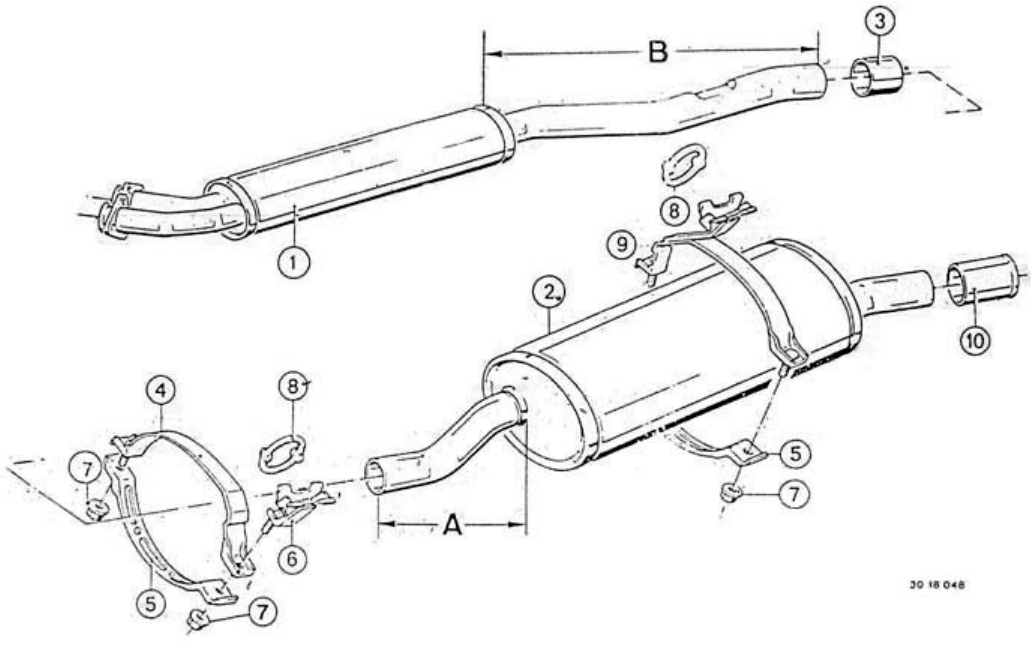
6 Cylinder M 21:
Determine cutting distance (A) on new final muffler (2).
Transfer and mark determined distance to installed final muffler.
Cut off exhaust pipe with Special Tool 00 2 200 and deburr edges.
Remove final muffler – see 18 00 020.
Slide on welding sleeve (3).
Adjust new final muffler to correct installed position and connect with welding sleeve (3).
Note:
Check for sufficient spacing to body.
Tack weld welding sleeve (3).
Remove muffler assembly (primary and final mufflers).
Weld welding sleeve (3) all around.

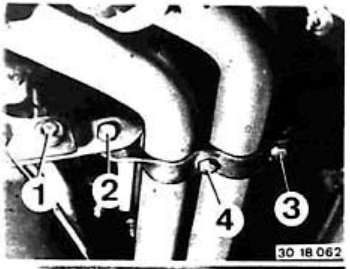
18 12 041 REPLACING PRIMARY MUFFLER

6 Cylinder M 21:
Determine cutting distance (B) on new primary muffler (1).
Transfer and mark determined distance to installed primary muffler.
Cut off exhaust pipe with Special Tool 00 2 200 and deburr edges.
Unscrew primary muffler on flange and remove.
Adjust new primary muffler to correct installed position and connect with welding sleeve (3).
Note:
Check for sufficient spacing to body.
Tack weld welding sleeve (3).
Remove muffler assembly (primary and final mufflers).
Weld welding sleeve (3) all around.

Muffler Assembly:

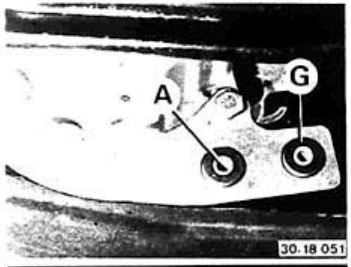
1 Primary muffler
2 Final muffler
3 Welding sleeve
4 Clamp
5 Clamp
6 Holder
7 Nut
8 Rubber ring
9 Clamp
10 Tailpipe extension



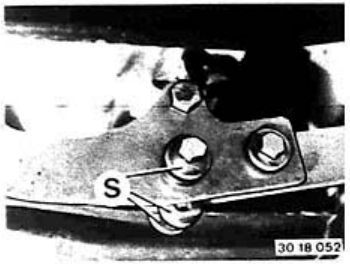


18 21 011 REPLACING PIVOT SLEEVES ON EXHAUST CARRIER

Unscrew bolts (1).
Loosen (2 ... 4).
Installation:
Tighten bolts and nuts in order of 1 through 4.



Push in spacers (A) and press out pivot sleeves (G).
Installation:
Coat pivot sleeves with a lubricant for installation of the spacers.

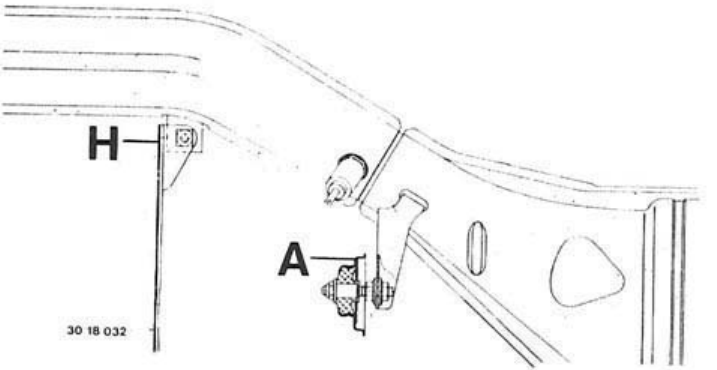


Install washers (S) as shown.
Tightening torque*.

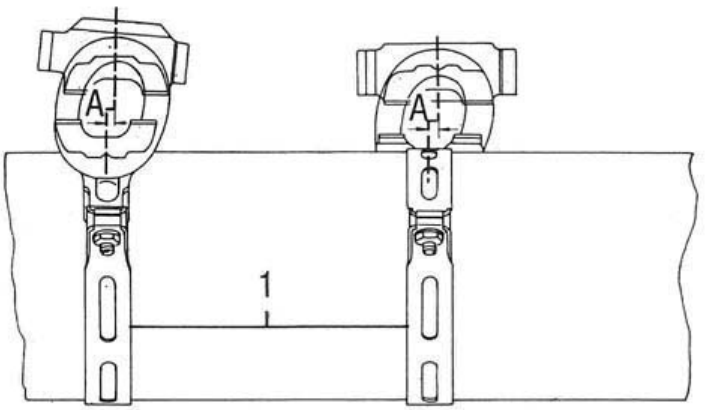
* See Specifications

EXHAUST SUSPENSION LAYOUT DRAWINGS

Installation:
Tighten the exhaust carrier (H or A) only after the exhaust assembly is in correct installed position (danger of tension).
H = Version with manual transmission
A = Version with automatic transmission

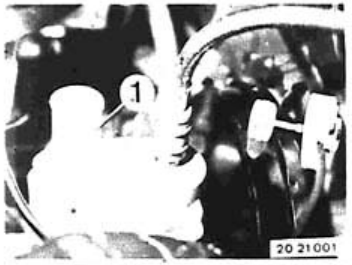


Tighten clamps (1) for the final muffler in such a manner, that rubber suspension parts are pre-loaded.
Preload A = 6 mm (0.236").



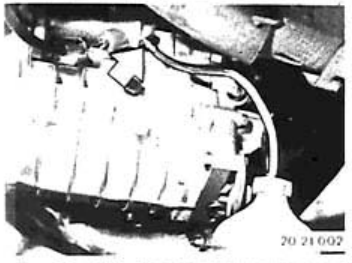
21 Clutch

21 00 006	Clutch – bleed	21- 1
21 11 000	Clutch housing – remove and install	21- 1
21 21 000	Clutch disc – remove and install	21- 2
565	Drive plate – check for lateral runout	21- 4
21 51 000	Clutch release – remove and install / replace	21- 4
21 52 000	Clutch master cylinder – remove and install	21- 5
010	Clutch slave cylinder – remove and install	21- 5
502	Clutch master cylinder – overhaul	21- 6
512	Clutch slave cylinder – overhaul	21- 6
	Troubleshooting clutch	21- 7

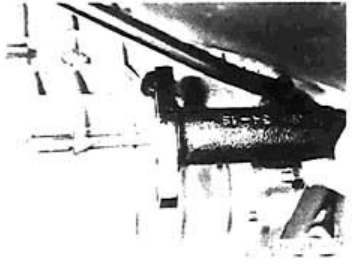


21 00 006 BLEEDING CLUTCH

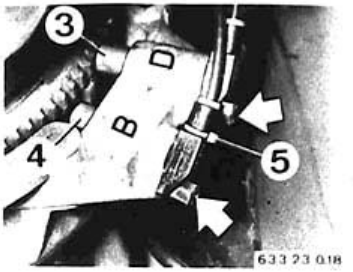
Unscrew cap on brake fluid tank.
Remove float container (1).
Connect bleeder.



Open bleeder screw on clutch slave cylinder until escaping fluid is without air bubbles.
Operate clutch pedal several times during this procedure.

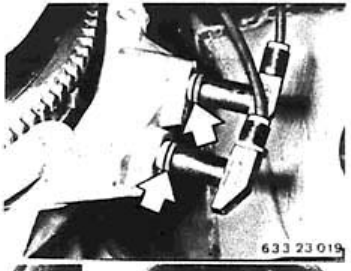


If there is still air in system after repeating the bleeding procedures several times, detach slave cylinder on transmission.
Press push rod against stop in slave cylinder and release slowly.
This will push back any residual air into the tank and guarantee maximum release travel.
Never operate clutch pedal as long as the slave cylinder is removed.

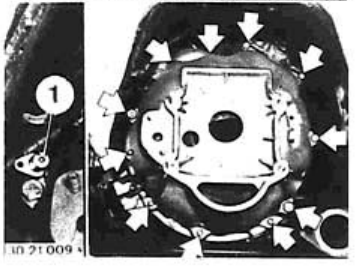


21 11 000 REMOVING AND INSTALLING CLUTCH HOUSING

Remove transmission – see 23 00 022
Remove DME senders.
Important! – Installation:
Check installed position.
Plugs must not be mixed up.
Install speed sensor (3) in bore (D) and reference mark sensor (4) with ring (5) in bore (B).
Engine cannot be started, if plugs are mixed up.

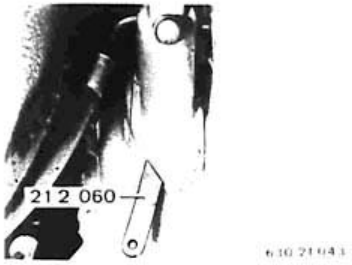


Installation:
Check O-rings.
Install sensors with Molykote Longterm 2.
Important!
Face surface of DME senders must be free of grease and dirt.

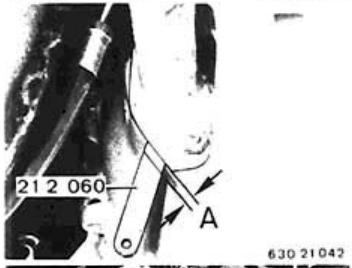


Remove position sender (1).
Unscrew clutch housing.
Use a Torx wrench** to unscrew Torx bolts.
Important! – Installation:
Torx bolts must be installed with washers to avoid an increase in breaking-loose torque.
Tightening torque*.

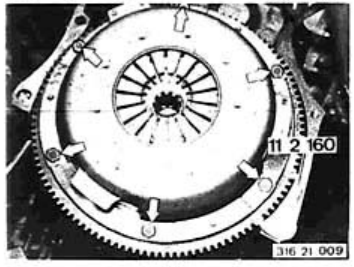
* See Specifications
** Source of Supply: HWB



630 21 041



630 21 042



316 21 009

21 21 000 REMOVING AND INSTALLING CLUTCH DISC

Caution!
Liners contain asbestos - conform with safety precautions (see Group 00).

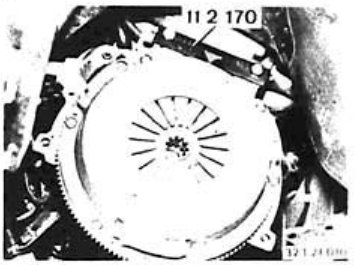
Checking Installed Clutch for Wear:

Clutch liners are okay, if Special Tool 21 2 060 can be pushed into opening of slave cylinder against the stop.

Drive plate is worn and must be replaced when there is a gap of 5 mm (0.197") between Special Tool 21 2 060 and the slave cylinder.

Remove transmission - see 23 00 020 / 022.
Check deviation* at tips of diaphragm springs.
Engine M 10:
Hold flywheel with Special Tool 11 2 160.
Loosen mounting bolts separately 1 to 1 and 1/2 turns until clutch is relaxed.
Take off mounting bolts, clutch disc and drive plate.
Clean clutch parts.
Liners contain asbestos - conform with safety precautions (see general information in Group 00).
Important!
Don't throw or drop clutch disc - improper handling could bend off the three tangential leaf springs, which hold the clutch disc in turning direction. Diaphragm springs would then still introduce lift, but because of the weak leaf springs the pressure ring would not lift sufficiently and the drive plate would not clear.

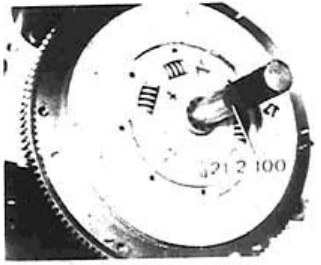
* See Specifications



Engines M 20, M 21, M 40:
Hold flywheel with Special Tool 11 2 170.

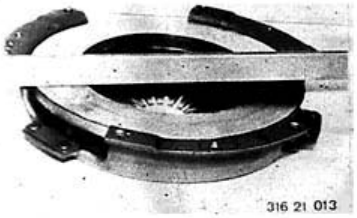


Check drive plate for wear (A)* and cracks, and torsion damper for tight fit of spring elements.
Important! - Installation:
Check transmission end mark on the drive plate.
Note:
The drive plate of the version with a double-mass flywheel is designed rigid without dampers. Torsion dampers are integrated in the flywheel.

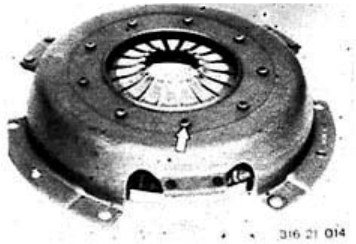


Installation:
Check whether the grooved ball bearing in the crankshaft moves easily, replacing if necessary.
Check flywheel for scoring.
Center drive plate in the flywheel with Special Tool 21 2 100.

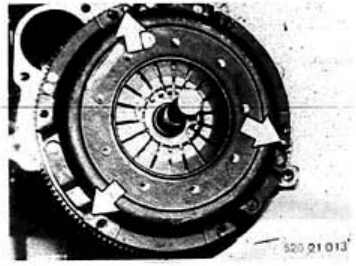
* See Specifications



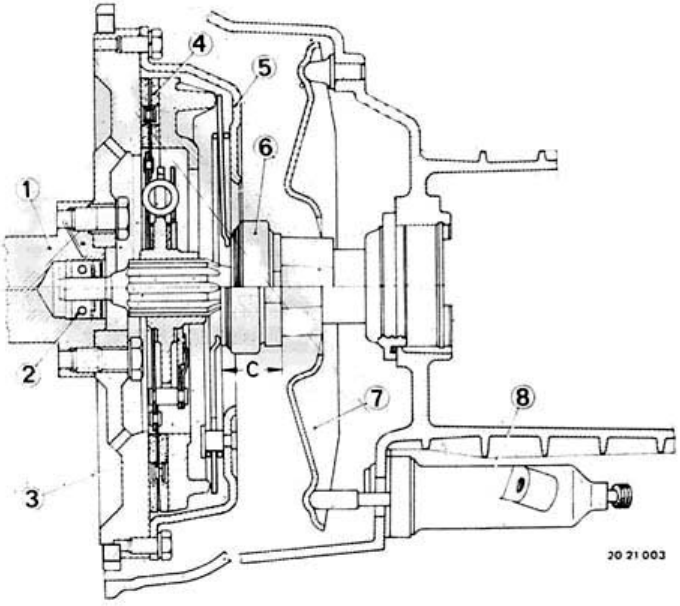
Visually inspect clutch for cracks, wear and burnt spots.
Pressure contact surface must be level.



Visually inspect clutch rivets for wear and tight fit.
Replace a clutch with loose or worn rivets.
Important!
Remove all corrosion inhibitor when installing a new clutch disc.
Note:
The clutch for the version with a double mass flywheel is lower in height.



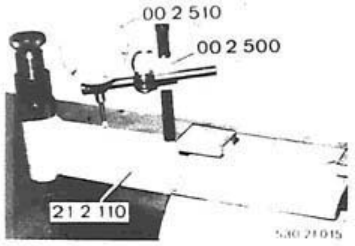
Place clutch disc over dowel pins.
Tighten mounting bolts separately and uniformly to specified torque*.
Give transmission input shaft a light coat of Microlube GL 261** in area of splines and guide pins.



Clutch Assembly:
1 Crankshaft
2 Grooved ball bearing
3 Flywheel
4 Drive plate*
5 Thrust plate*
6 Release*
7 Release lever
8 Clutch slave cylinder

* See Specifications
** Source of Supply: HWB

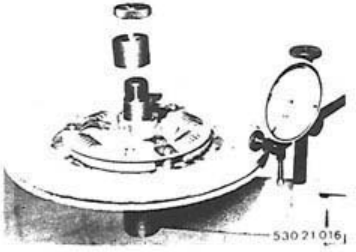
* See Specifications



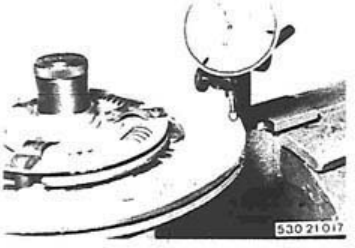
21 21 565 CHECKING DRIVE PLATE FOR LATERAL RUNOUT

– Drive Plate Removed –

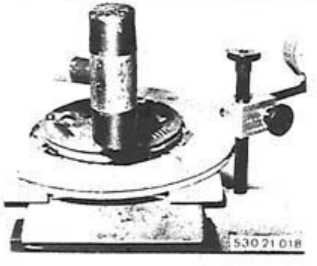
Clamp Special Tool 21 2 110 in a vise.
Mount Special Tools 00 2 510 and 00 2 500.



Clamp drive plate on tester and clean liner with emery cloth.

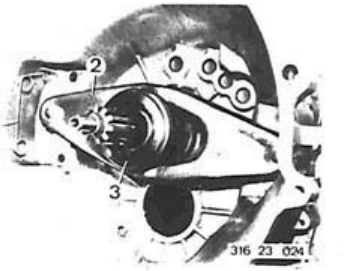


Apply dial gage about 3 mm (0.118") from outer edge.
Turn drive plate and read lateral runout*.



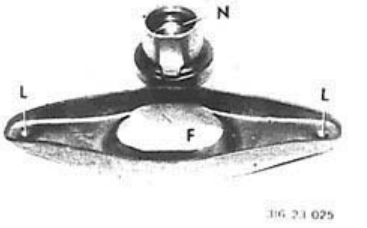
Straighten drive plate by applying knocks from a plastic hammer on take-up points of tester.
Repeat testing procedures.

* See Specifications



21 51 000 REMOVING AND INSTALLING/ REPLACING CLUTCH RELEASE

Remove transmission 23 00 020.
Remove spring (1) and release lever (2) with release (3).

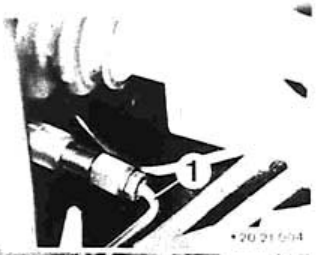


Installation:
Pack lubricating groove (N) with Molykote Longterm 2.
Coat guides (F) and bearings (L) with Molykote Longterm 2.
Non-conformance could cause bearing to seize on guide sleeve.



Check specified height B* and C* of release.

* See Specifications



21 52 000 REMOVING AND INSTALLING CLUTCH MASTER CYLINDER

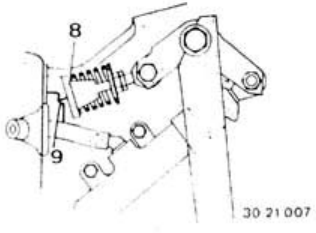
Disconnect line (1) to slave cylinder.



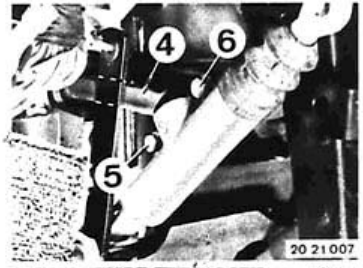
Unscrew cap on fluid tank.
Remove float container (2).
Draw off brake fluid in tank to drop level to connection for filling line.



Detach instrument panel trim at bottom left – see 51 45 180.
Detach piston rod (3) on clutch pedal.
Installation:
Adjust clutch pedal with eccentric bolt (7) – see Group 35.



Important! – Installation:
Version with Over-Center Helper Spring:
Engage over-center helper spring (8) in guide tab (9) on pedal base prior to installation of piston rod (3).

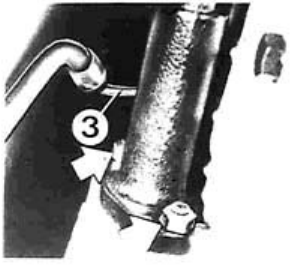


Pull out filling line (4).
Unscrew bolts (5 and 6).
Remove master cylinder.
Installation:
Bleed clutch – see 21 00 006.



21 52 010 REMOVING AND INSTALLING CLUTCH SLAVE CYLINDER

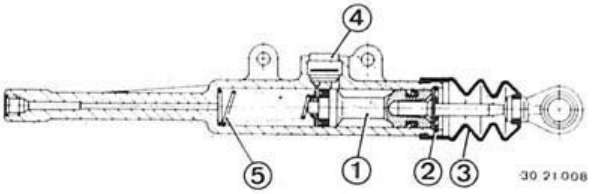
Unscrew cap on fluid tank.
Remove float container (2).
Draw off brake fluid in tank to drop level to connection for filling line.



Detach slave cylinder on transmission.
Remove slave cylinder.
Disconnect line (3).
Note:
Install a 22.2 mm dia. slave cylinder (instead of 20.64 mm dia.) in cars with a double mass flywheel to prevent touching of the release lever when the clutch pedal is floored (also refer to Service Information of Group 21).
Installation:
Bleeder screw faces down.
Install front push rod with Molykote Longterm 2.
Bleed clutch 21 00 006.

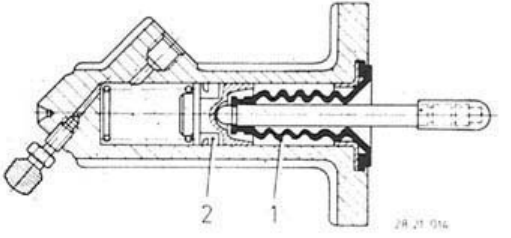
21 52 502 OVERHAULING CLUTCH MASTER CYLINDER
– Removed –

Clean master cylinder and internal parts in alcohol.
Replace entire master cylinder, if cylinder bore has scoring or corrosion.
Install repair kit.
Note:
Only use the repair kit from the manufacturers of the master cylinder.
1 Piston assembly
2 Circlip
3 Cap
4 Plug
5 Spring
Give cylinder bore and grooved rings a light coat of ATE brake cylinder paste*.



21 52 512 OVERHAULING CLUTCH SLAVE CYLINDER
– Removed –

Clean slave cylinder and internal parts in alcohol.
Replace entire slave cylinder, if cylinder bore has scoring or corrosion.
Install repair kit.
Note:
Only use the repair kit from the manufacturers of the slave cylinder.
1 Cap
2 Grooved cup
Retaining ring
Toothed ring
Coat cylinder bore and grooved cup lightly with ATE brake cylinder paste*.



* Source: HWB

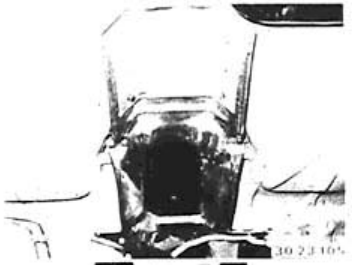
TROUBLESHOOTING CLUTCH

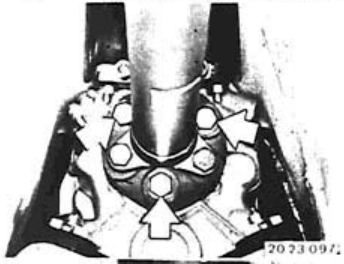
Condition	Cause	Correction
Clutch slips	a) Contact pressure of clutch insufficient	a) Replace clutch 21 21 000
	b) Liner wear* excessive	b) Replace drive plate 21 21 000
	c) Liner covered with oil – transmission or crankshaft seal defective	c) Replace defective seal and drive plate
	d) Clutch overheated	d) Replace clutch 21 21 000
	e) Clutch not an original BMW part	e) Install original BMW parts
Clutch grabs	a) Liners* not as specified	a) Replace drive plate 21 21 000
	b) Liners splattered with oil	b) Replace drive plate 21 21 000
	c) Release pressure one-sided	c) Check release lever
	d) Pressure plate pressing crooked	d) Replace pressure plate 21 21 000
	e) Crankshaft not aligned with transmission input shaft	e) Check centering surfaces of engine and transmission
	f) Engine and transmission suspension defective	f) Replace engine and transmission suspension
	g) Drive plate not an original BMW part	g) Install original BMW part
Clutch will not release	a) Drive plate wrenched excessively or liners broken	a) Replace drive plate 21 21 000
	b) Drive plate lateral runout* excessive	b) Straighten or replace drive plate 21 21 565
	c) Liner rusted on flywheel	c) Clean flywheel, roughen liner with emery cloth
	d) Drive plate seized on transmission input shaft	d) Service drive plate on transmission input shaft and replace damaged parts, if necessary
	e) Pilot bearing for transmission input shaft in crankshaft defective	e) Replace pilot bearing in crankshaft 11 21 571
	f) Air in clutch hydraulic system	f) Bleed clutch 21 00 006
	g) Tangential leaf springs of clutch bent off	g) Replace clutch 21 21 000
Clutch noise	a) Unbalance of clutch and drive plate excessive	a) Replace clutch and drive plate 21 21 000
	b) Torsion damper excessive	b) Replace drive plate 21 21 000
	c) Clutch release defective	c) Replace clutch release 21 51 001
	d) Pilot bearing for transmission input shaft in crankshaft defective	d) Replace pilot bearing in crankshaft 11 21 571
	e) Clutch rivets loose	e) Replace clutch 21 21 000

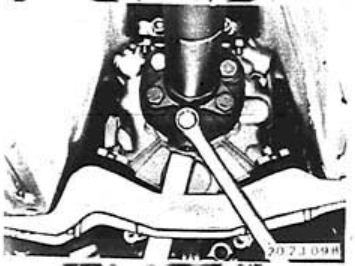
* See Specifications

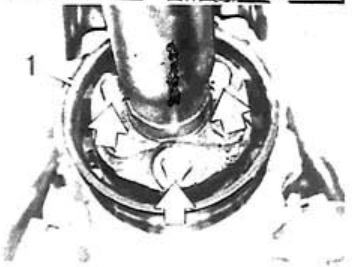
23 Manual Transmission

23 00 020	Transmission – remove and install	23- 1
022	Transmission – remove and install	23- 1
032	Transmission – exchange	23- 3
23 12 . . .	Radial oil seal for output flange – replace	23- 4
. . .	Radial oil seal for selector shaft – replace	23- 5
23 13 010	Vibration damper – remove and install / replace	23- 6
23 71 503	Rubber mounts for transmission suspension	see group 27
	Troubleshooting manual transmission	23- 7









23 00 020/ REMOVING AND INSTALLING 022 TRANSMISSION

Remove exhaust assembly – see 18 00 020.

Model 324 td:
Remove primary and final mufflers.

Cars with Four Wheel Drive:
Remove transfer box – see 27 10 010.

Unscrew heat shield.

Unscrew joint disc on transmission.

Installation:
Always use new stop nuts.

Installation:
Tighten nuts with a standard 17 or 19 mm wrench socket and torque wrench.
Tightening torque*.

Important!
Only tighten nuts on the flange end, whenever possible by design, to avoid tension in the joint disc.

Version with Integrated Vibration Damper (1):

Vibration damper (1) is mounted on the output flange with the pressed-in bolts.
Unscrew nuts on joint disc.

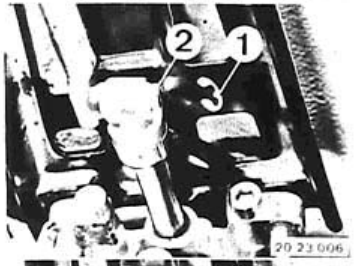
Installation:
Tightening torque*.

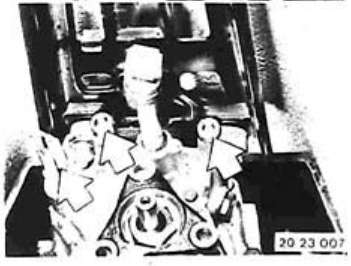
Note:
Joint disc can be pulled off only after lowering the transmission.

* See Specifications









Loosen screwed-on ring (1) several turns.

Installation:
Tighten screwed-on ring (1) with Special Tool 26 1 040 after finishing installation.
Tightening torque*.

Unscrew center mount.

Installation:
Preload center mount forward by distance (A) = 4 to 6 mm (0.157 to 0.236").

Bend propeller shaft down and pull off of centering pin.

Important!
Prevent propeller shaft from falling into joints by suspending it from car on a piece of wire.

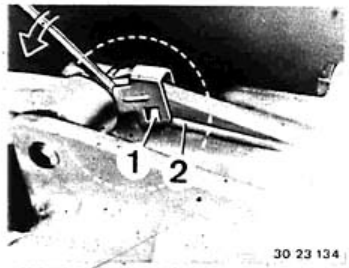
Lift out retainer (1) and take off washer (2).
Pull out shift rod.

Pull off leads on reverse gear switch.
Unscrew shift console on transmission.

Important!
Self-locking bolts – will be difficult to unscrew.

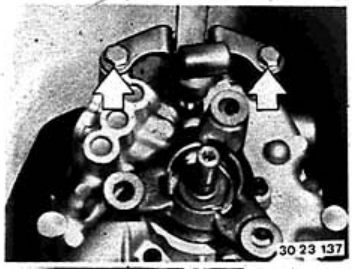
Installation:
Use new bolts.
Make sure that brackets are horizontal to the shift console while tightening (shift lever noise).

* See Specifications

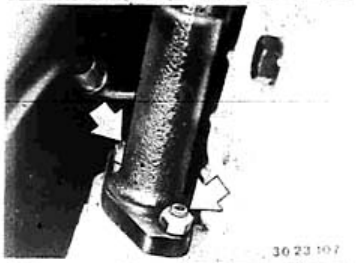


Version with Shift Arm:
Lift spring (1) out of tab (2) on the case with a screwdriver and swing up. Pull out bearing pin.

Installation:
Lubricate bearing pin lightly with Molykote Longterm 2.

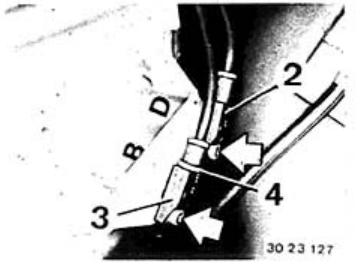


Model M 3:
Unscrew clamp for shift arm on transmission.



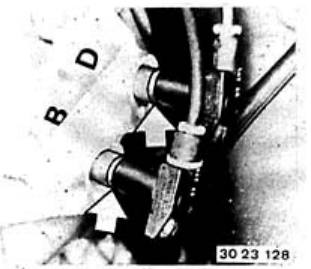
Unscrew clutch slave cylinder on transmission.
Pipe remains connected.

Installation:
Bleeder screw faces down.



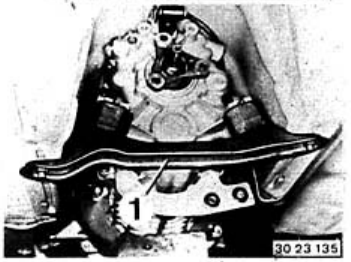
Version with DME:
Unscrew heat shield.
Unscrew bolts.
Pull out speed sender (2) and reference mark sender (3).

Important! – Installation:
Check installed position.
Don't mix up plugs.
Install speed sender (2) without ring in bore D and reference mark sender (3) with ring (4) in bore B.
Engine cannot be started if mixed up.



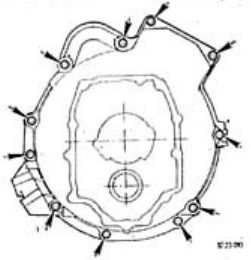
Installation:
Check O-rings.
Install senders with Molykote Longterm 2.

Important!
Face end of DME senders must be without grease and dirt.



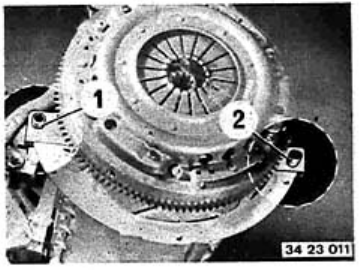
Support transmission.
Remove cross member (1).
Lower transmission to front axle carrier.

Installation:
Center transmission (see Group 26).
Tightening torque*.



Unscrew transmission on engine.
Unscrew Torx bolts with a Torx socket.**
Remove transmission toward rear.

Important! – Installation:
Washers must be used with the Torx bolt version to avoid increasing the breaking-loose torque.
Tightening torque*.

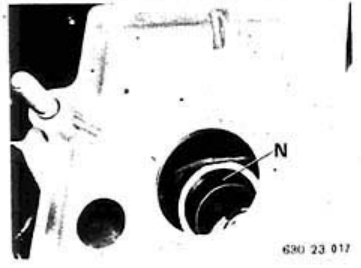


Important!
Check that dowel sleeves (1 and 2) are not missing before installation of the transmission.
As applicable, transfer dowel sleeves from the transmission or use new dowel sleeves.
Coat splines and guide pins lightly with Microlube GL 261.**
Check oil level.

* See Specifications
** Source of Supply: HWB

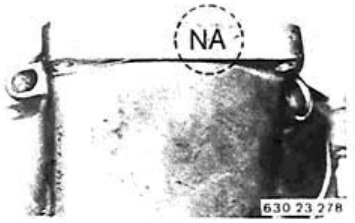


Transmission 265 Sport:
Unscrew transmission on clutch housing and remove toward rear.
Use special ring wrench** to unscrew and tighten nut at top left.



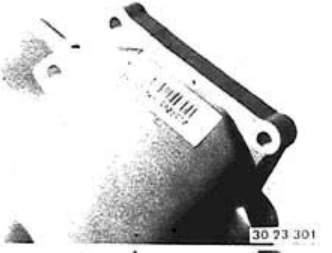
Installation:
Move the release lever to installed position with the clutch slave cylinder.
Align clutch release bearing.
Pack lubricating groove (N) with Molykote Longterm 2.
Non-conformance could cause the bearing to seize on the guide sleeve.
Engage a gear before mounting the transmission.
Guide the transmission's guide sleeve into the release bearing carefully.
Turn the output flange for so long, until the input shaft slides into the drive plate.
Remove clutch slave cylinder again.
Tighten transmission bolts to correct torque*.
Check oil level.

* See Specifications
** Source of Supply: HWB

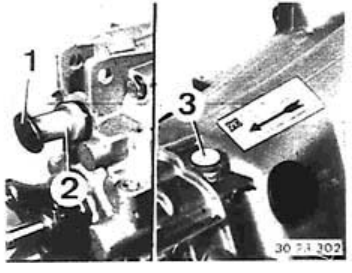


23 00 032 INSTALLING EXCHANGE TRANSMISSION

Remove transmission – see 23 00 020/ 022.
Transmission identification:
BMW code* die-stamped in front case section.



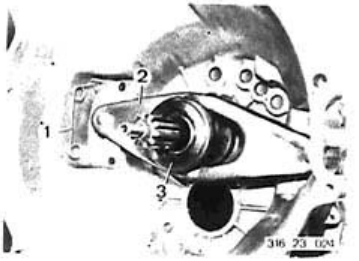
BMW code* label pasted on front case section.



Transmission ZF S 5 - 16:

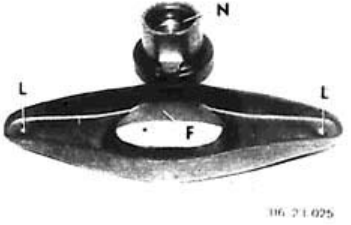
Important!
Mount vent (1) prior to installation of the transmission (red label).
Pull vent (1) and protective sleeve (2) off of the shift shaft.
Lift out cap (3) and install vent (1).

Note:
Only applicable when vent is not mounted.

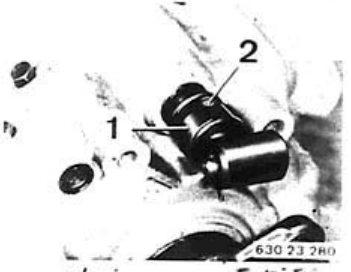


Transfer spring (1) and release lever (2) with release bearing (3).

Note:
Coat transmission input shaft lightly in area of splines and guide pins with Microlube GL 261**.

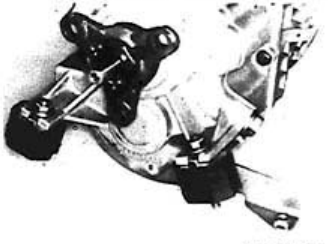


Installation:
Fill lubricating groove (N) with Molykote Longterm 2.
Coat guides (F) and bearings (L) lightly with Molykote Longterm 2.
Non-conformance could cause the bearing to seize on the guide sleeve.



Transfer shift rod joint.
Push back locking sleeve (1).
Drive out cylindrical pin (2).

Note:
Check installed position of shift rod joint – offset end of shift rod joint installed to face right-hand side as seen looking forward.

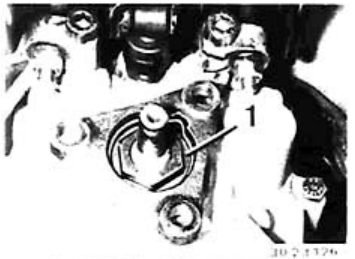


Transfer rubber mounts, exhaust carrier and backup light switch.

Important!
Transmissions are supplied filled with oil since 1.86, so that it is only necessary to check the oil level after installation of the transmission.

* See Parts Catalog

** Source of Supply: HWB

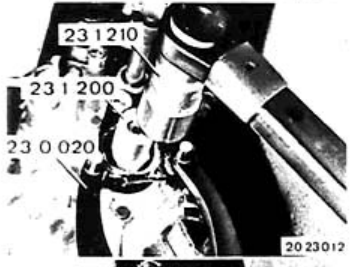


23 12 . . . REPLACING RADIAL OIL SEAL FOR OUTPUT FLANGE

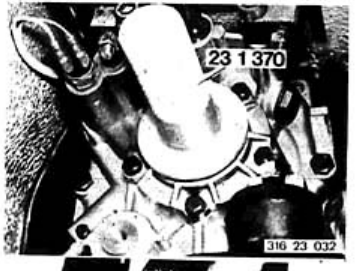
Unscrew propeller shaft at front end and center mount – see 23 00 020/022.
Lift out lockplate (1).
Installation:
Replace lockplate.



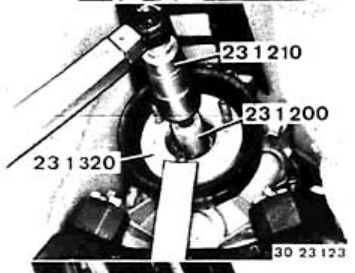
Pull out radial oil seal with Special Tool 00 5 010.



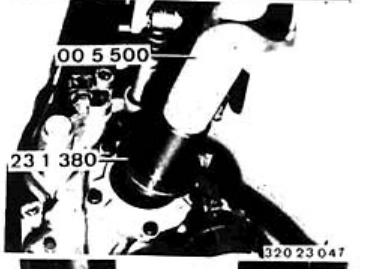
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.
Installation:
Install collar nut with bolt cement**.
Tightening torque*.



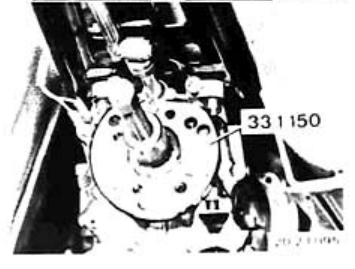
Lubricate sealing lip of radial oil seal with oil.
242 Four Speed Transmission:
Drive in radial oil seal with Special Tool 23 1 370.



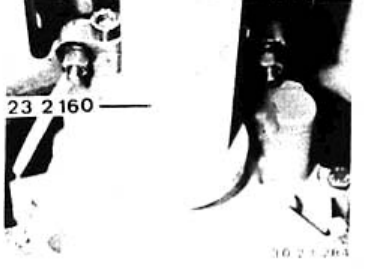
Version with Integrated Vibration Damper:
Hold output flange with Special Tool 23 1 320.



240 / 260 Overdrive Transmissions:
Drive in radial oil seal with Special Tools 23 1 380 and 00 5 500.

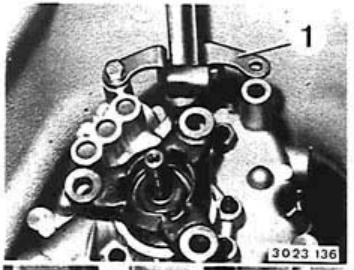


Pull off output flange with Special Tool 33 1 150.



ZF–S 5/16 Transmission:
Drive in radial oil seal with Special Tool 23 2 160.

* See Specifications
** Source: HWB

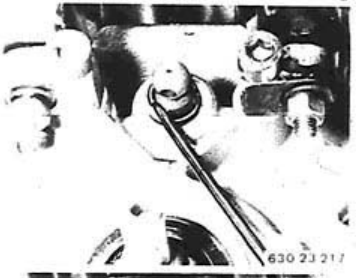


23 12 . . . REPLACING RADIAL OIL SEAL FOR SELECTOR SHAFT

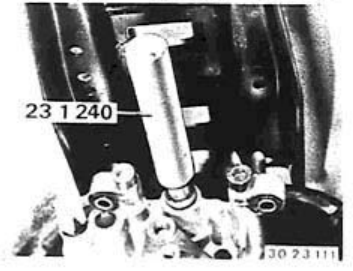
Unscrew propeller shaft – see 23 00 020/022.
Remove drive flange – see 23 12 . . ..
BMW M 3:
Loosen holder (1) on transmission partially before being able to drive out the cylindrical pin for the shift rod joint.



Engage 3rd gear.
Push back locking sleeve (1) and drive out cylindrical pin (2).

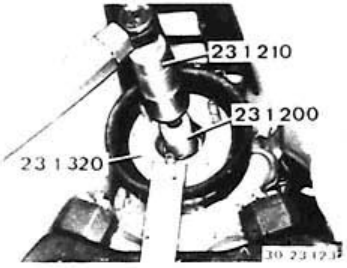


Lift out radial oil seal.



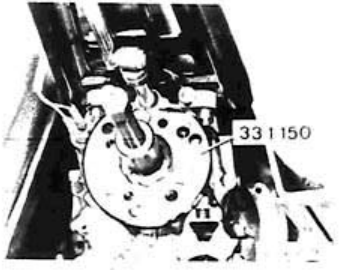
Lubricate sealing lip of radial oil seal with oil.
Drive in radial oil seal with Special Tool 23 1 240.

See 23 12 ... in Construction Group Repair Manual for procedures to replace the radial oil seal for the input shaft.



23 13 010 REMOVING AND INSTALLING OR REPLACING VIBRATION DAMPER

Unscrew front end of propeller shaft and center mount – see 23 00 020 / 022.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 1 320.
Unscrew collar nut with Special Tool 23 1 210.
Installation:
Install collar nut with bolt cement**.
Tightening torque*.



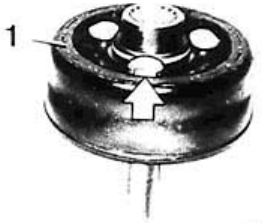
Pull off output flange with Special Tool 33 1 150.



Vibration damper (1) is mounted on the output flange with three staybolts.
Press staybolts out of the output flange.
Insert suitable pieces of round steel stock on both sides.



To avoid damage on threads, screw on the nuts.
Press out staybolts.
Take off vibration damper.



Place bore of output flange on a suitable piece of pipe.
Mount vibration damper (1) with staybolts.
Press in staybolts.
Important!
Staybolts must be pressed in with the flat end facing the vibration damper.

* See Specifications
** Source: HWB

TROUBLESHOOTING MANUAL TRANSMISSION

Condition	Cause	Correction
Oil on clutch bell housing	a) O-ring in guide flange leaks b) Radial oil seal for input shaft leaks c) Gasket on end cover (crankcase leaks) d) Radial oil seal for crankshaft leaks	a) Replace O-ring 23 11 . . . b) Replace radial oil seal 23 12 . . . c) Replace gasket 11 14 611 d) Replace radial oil seal 11 14 611
Oil on output flange	a) Radial oil seal for output shaft leaks b) Radial oil seal for selector shaft leaks	a) Replace radial oil seal 23 12 . . . b) Replace radial oil seal 23 12 . . .
Transmission leaks between front and rear sections	a) Gasket defective	a) Replace gasket 23 11 . . .
Oil on vent	a) Oil level too high b) Wrong oil grade (excessive foaming)	a) Correct oil level b) Replace oil
Gear does not stay in – jumps out	a) Sliding sleeve worn, guide rail defective, springs broken b) Sliding sleeves for 1st/2nd and 3rd/4th gears mixed up c) Shift console loose d) Selector forks worn e) Output flange loose	a) Replace damaged parts 23 23 . . . b) Install sliding sleeves correctly 23 23 . . . c) Tighten shift console 23 00 . . . d) Replace selector forks 23 31 . . . e) Tighten output flange

Condition	Cause	Correction
Shifts hard to make (sticking, scratching)	a) Clutch release insufficient 1. Pedal travel insufficient 2. Drive plate worn 3. Liner seized on flywheel 4. Drive plate seized on transmission input shaft 5. Pilot bearing for transmission input shaft in crankshaft defective 6. Air in clutch hydraulic system b) Thick, viscous transmission oil c) Bushes for selector rod arrest damaged d) Excessive play in shift lever mount e) Selector forks worn f) Sliding sleeve worn	a) 1. Check pedal travel and adjust, if necessary. Remove excessively thick floor mats. Floor clutch pedal when changing gear 35 31 000. 2. Replace drive plate 21 21 000 3. Clean flywheel. Replace drive plate 21 21 000. 4. Service or replace drive plate 21 21 000 5. Replace pilot bearing in crankshaft 11 21 571 6. Bleed clutch 21 00 006 b) Use 10 W 50 engine oil for cold climates or cold transm. c) Replace bushes d) Check shift lever mount (shift console) and replace worn ball shell plates, if applicable 25 11 041 e) Replace selector forks 23 31 . . . f) Replace sliding sleeve 23 23 . . .
Transmission grabs when shifting	a) Clutch release insufficient (see a) above) b) Synchromesh rings or sliding sleeves worn c) Reverse gear: shift break of 3 seconds not made	a) See a) above b) Check synchronization, replace damaged parts 23 23 . . . c) Make shift break
Transmission loud	a) Oil level too low b) Transmission shaft bearings defective c) Gears damaged d) Needle bearing of output or input shaft defective e) Pilot bearing for transmission input shaft in crankshaft defective	a) Correct oil level b) Replace all bearings 23 21 . . . c) Replace gear wheel pair or set 23 21 . . . d) Replace needle bearing 23 21 . . . e) Replace pilot bearing in crankshaft 11 21 571

24 Automatic Transmission

4 HP – 22 H/EH

24 00 006	Selector lever, accelerator linkage and throttle cable – adjust	24- 101
011	Hydraulic pressure values – check	24- 105
022	Transmission – remove and install	24- 106
042	Transmission – exchange	24- 109
24 11 002	Oil sump – remove and install	24- 110
052	Transmission extension – remove and install / seal	24- 110a
24 12 013	Radial oil seal for output flange – replace	24- 111
103	Radial oil seal for manual shift valve shaft – replace	24- 112
24 30 002	Valve body – remove and install	24- 113
24 31 152	Oil filter screen on valve body – remove and install	24- 114
24 32 002	Centrifugal governor – remove and install	24- 114
505	Centrifugal governor – disassemble and assemble	24- 114a
24 34 002	Parking lock pawl – remove and install	24- 115
102	Throttle cable – replace	24- 115
702	Throttle cable spring – replace	24- 116
851	Solenoid valves (all) – replace	24- 117
. . .	Solenoid valve for kickdown downshift locking	24- 117
860	Pressure regulator – replace	24- 117a
870	Pulse sender – replace	24- 117a
24 35 500	Wire harness for automatic transmission – replace	24- 118
502	Wire harness for kickdown downshift locking – replace	24- 118
24 61 500	Control unit for electronic / hydraulic transmission – remove and install / replace	24- 119
012/014	Control unit for downshift prevention – replace	24- 119a
	Troubleshooting automatic transmission 4 HP – 22/H	24- 120
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	AEGS plug connection	24- 144a
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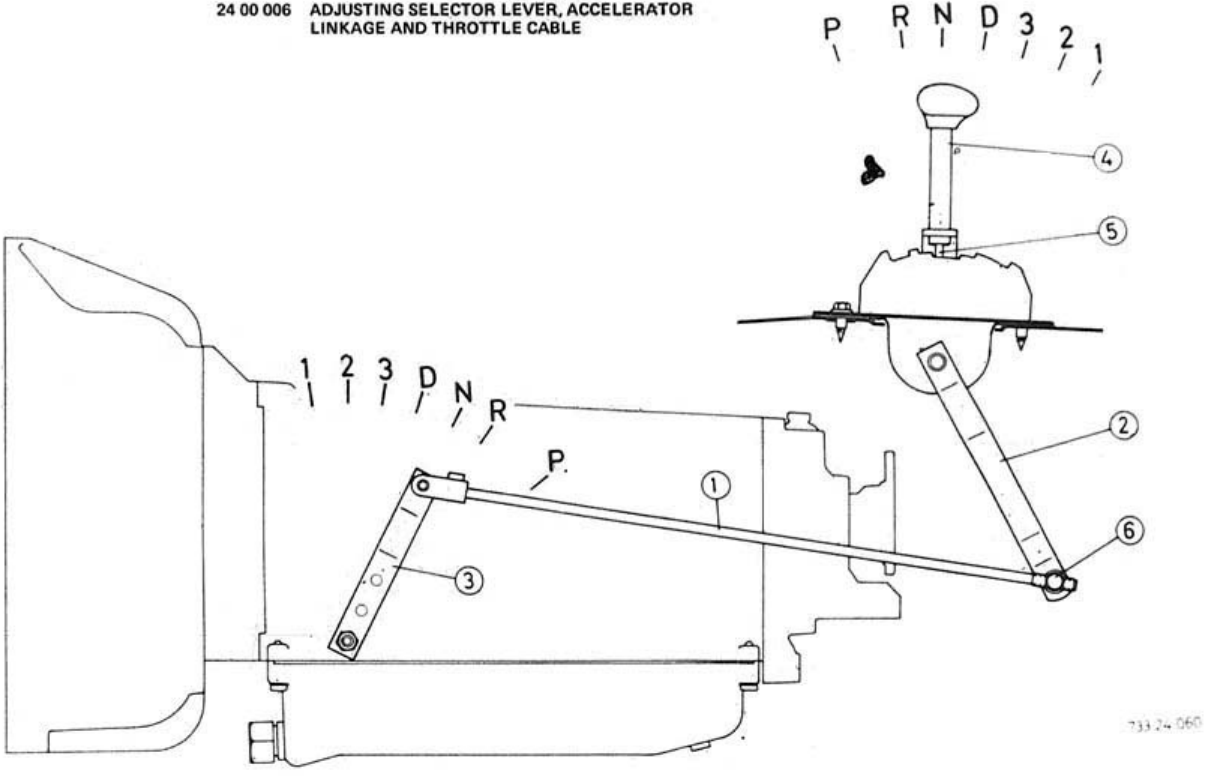
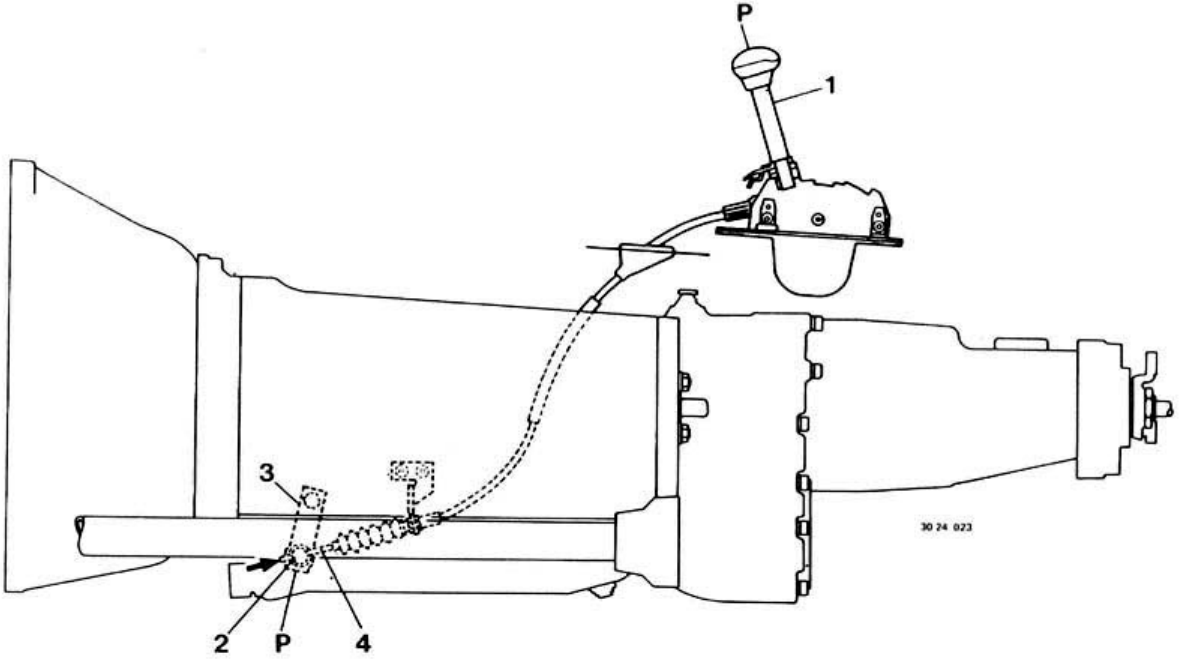
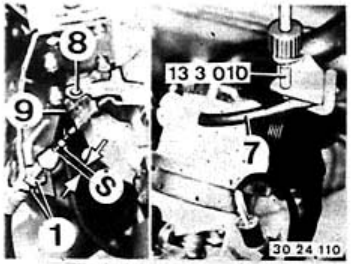
24 00 006 ADJUSTING SELECTOR LEVER, ACCELERATOR LINKAGE AND THROTTLE CABLE

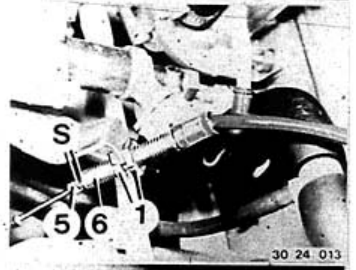


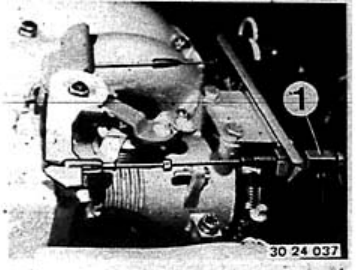
A) Adjusting Selector Lever:
Version with Linkage:
Check tightness of console before making adjustments.
Disconnect selector rod (1) on selector lever lower section (2).
Engage selector lever (3) on transmission in position N.
Press selector lever (4) against stop (5) on shift gate.
Keep changing length of selector rod (1) until pin (6) is aligned with bore in selector lever lower section (2).
Now shorten length of selector rod by 1 turn with pin (6).
Connect and secure selector rod.

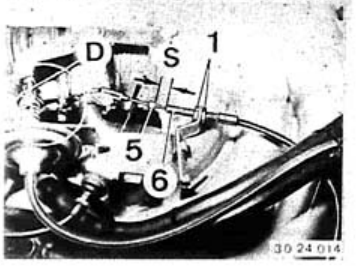


Version with Cable:
Move selector lever (1) to "P".
Loosen nut (2).
Press lever (3) forward (park position).
Press cable rod (4) opposite forward direction.
Clamp cable rod (4) tight with nut (2).
Tightening torque: 10 to 12 Nm (7 to 8.5 ft. lbs.).









B) Adjusting Throttle Cable:
Requirement: full throttle adjustment correct.

Model 316:
Version with 2 BE carburetor.
Start engine.
Clamp venting hose (7) for throttle valve control with Special Tool 13 3 010.
Stop engine.
Throttle valve lever (8) must bear on stop (9).
Adjust play (S) in this position to 0.50 ± 0.25 mm (0.020 ± 0.010") with nuts (1).
Remove Special Tool 13 3 010.

Models 316, 318 I, M 10:
Adjust play (S) in neutral position to 0.50 ± 0.25 mm (0.020 ± 0.010") with nuts (1).

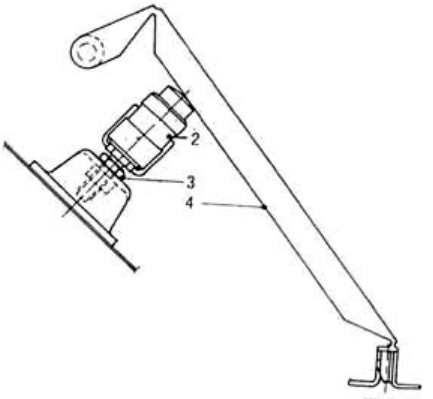
Models 316 I, 318 I, M 40:
Check for correct installed position of throttle cable and tight fit of adjusting screw on holder before adjusting.

Note:
Throttle cable of version with an overhauling element on the throttle valve assembly is adjusted in full throttle position.

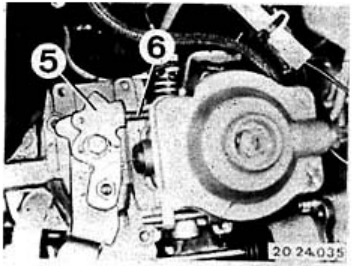
Move throttle valve to full throttle position with an attached throttle cable. Overhauling element must not respond. Adjust the throttle cable full throttle position or kickdown pressure point without play by turning adjusting screw (1).

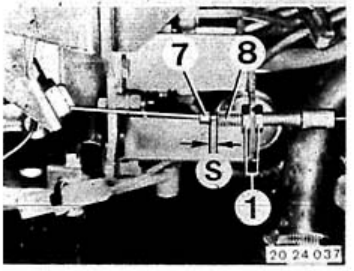
Models 320 I ... 325 I:
Adjust play (S) in neutral position to 0.50 ± 0.25 mm (0.020 ± 0.010") with nuts (1).

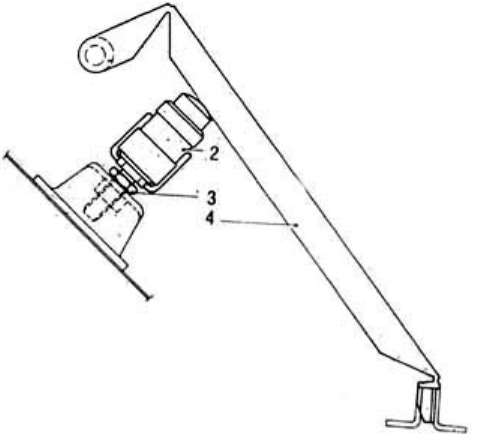
Important!
Version with Throttle Valve Lifter: Throttle valve lift (D) must be pulled to adjust the throttle cable.



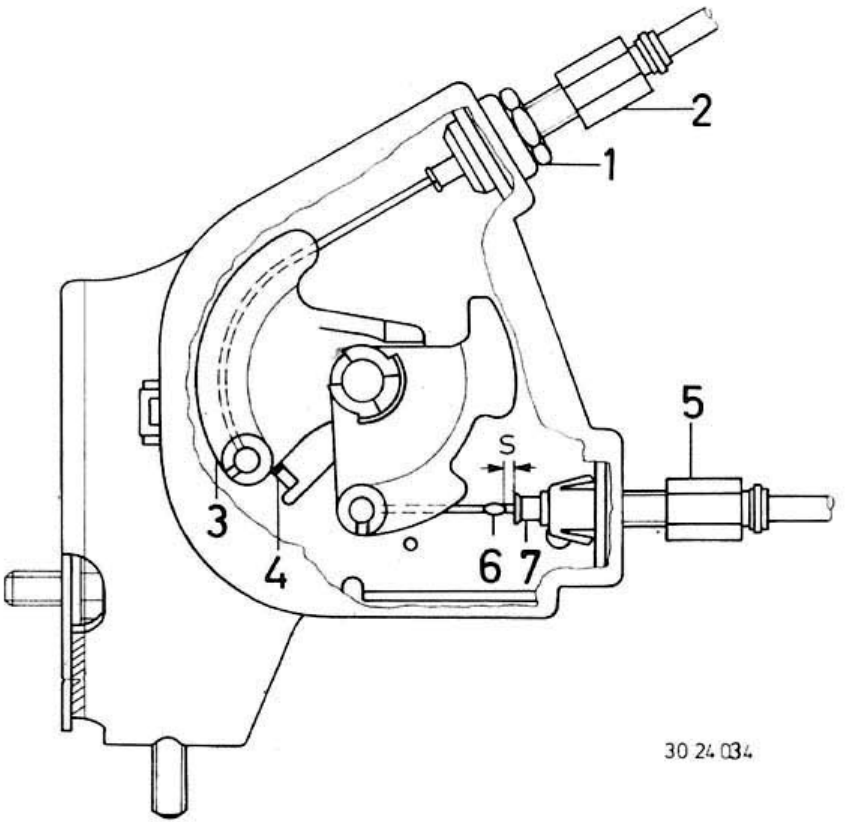
Check kickdown stop (2).
Loosen nut (3) and screw in kickdown stop (2).
Operate accelerator pedal (4) up to the transmission pressure point.
Unscrew kickdown stop in this position until the accelerator pedal bears.
Operate accelerator pedal (4) to kickdown (final position).
Distance (S) from lead seal (5) to end of sleeve (6) must now be at least 44 mm (1.732").



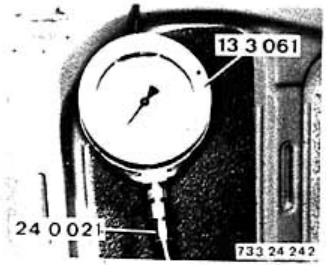




c) Adjusting Throttle Cable (Type 324 d):
Requirement: engine performance adjustment correct.
If applicable, adjust engine performance – see 13 00 050.
Temperature dependent idle speed booster activated.
This means: operating lever (5) must rest on idle stop (6).
Adjust play (S) to 0.50 ±0.25 mm (0.020 ±0.010") with nuts (1).
Check kickdown stop (2).
Loosen nut (3) and screw in kickdown stop (2); press down accelerator pedal (4) to transmission pressure point.
Unscrew kickdown stop in this position until it touches the accelerator pedal.
Press down accelerator pedal (4) to kickdown (final position).
Distance (S) from lead seal (7) to adjusting screw (8) must now be at least 44 mm (1.732").

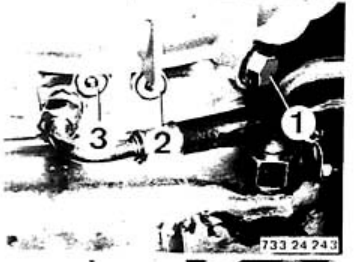


d) Adjusting Throttle Cable
BMW 324 td Since 1988 Models:
Version with Pedal Value Sender:
This requires correct idle speed adjustment.
If necessary, adjust idle speed position – see 12 72 . . ..
Counterhold on nut (1).
Turn adjusting screw (2) until reversing lever (3) bears on stop (4).
Cable must not sag through.
Turn adjusting screw (5) to adjust play (S) between lead seal (6) and sleeve (7) to 0.50 0.25 mm (0.020 ± 0.010").
Check full throttle stop see 12 72 . . ..
Operate accelerator pedal to final position (kickdown).
Distance from lead seal (6) to sleeve (7) must now be at least 44 mm (1.732").



24 00 111 CHECKING HYDRAULIC PRESSURE VALUES

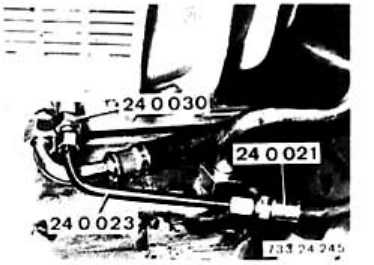
Connect Special Tools 24 0 021 and 13 3 061.



Remove pertinent plugs for testing.
1 Pump pressure
2 Clutch A
3 Converter pressure



A) Pump Pressure:
Mount Special Tool 24 0 070 with seal on transmission.
Connect Special Tools 24 0 023 and 24 0 021.

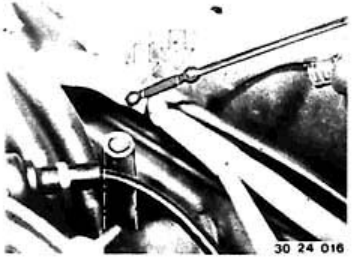


B) Converter Pressure:
Mount Special Tool 24 0 030 on transmission.
Connect Special Tools 24 0 023 and 24 0 021.

Note:
Oil cooler pipe must be loosened for installation of Special Tool 24 0 030 for the adapter version without a hexagon.

Testing:

	Pos.	Gear	Speed in rpm	Pressure in bar (psi)
Pump pressure	D	1	700 ... 1000	5.5 ... 7.7 (78 ... 110)
		2, 3, 4	approx. 2000	4.6 ... 6.0 (65 ... 85)
	R	R	700 ... 1000	11 ... 14 (156 ... 199)
Conv. pressure	D	4	conv. locked	max. 0.7 (10)



Correct the oil level with selector lever in P, transmission at operating temperature and engine running at idle speed.
Park car on level ground or floor.
Oil level for transmission with operating temperature of approx. 80° C (175° F) must be between both marks.
Volume of oil between min. and max. marks = approx. 0.3 liter (0.6 pint).
Never wipe off oil dipstick with a cloth losing lint.

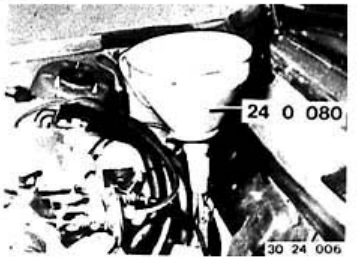


An oil dipstick with a longer measuring tip (1) is standard since 2.85.
This makes it possible to report the oil level in the transmission earlier.
The oil level should not be below ball (2) after a test drive and an oil temperature of 40° C (104° F).
The oil level should be between the min. and max. marks with an oil temperature of approx. 80° C (175° F).
Correct the oil level if necessary.

Note
The new oil dipstick can be installed retroactively.

Important!
Oil Dipstick Version with Arrest:
Oil dipstick can be pulled out only after tilting on the grip.

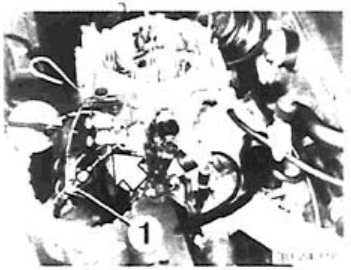




Important!
Oil Level Too High:
Strong foaming, oil splash loss, high temperature when driving fast, oil lost through vent.

Oil Level Too Low:
Valves rattling, foaming, engine slipping in curves, general operating disturbances.

ATF may only be poured in through funnel, Special Tool 24 0 080.

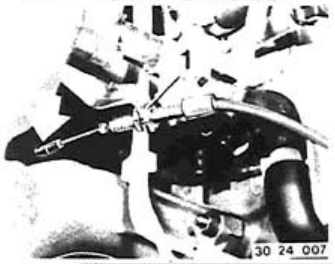


24 00 022 REMOVING AND INSTALLING TRANSMISSION

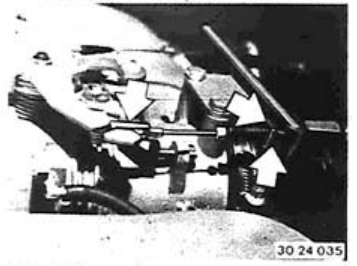
Disconnect battery ground lead.
Unscrew nut (1).
Disconnect throttle cable.

Installation:
Adjust throttle cable of all models – see 24 00 006.

Model 316

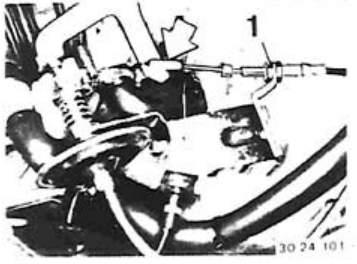


Models 316 i and 318 i
Engine M 10



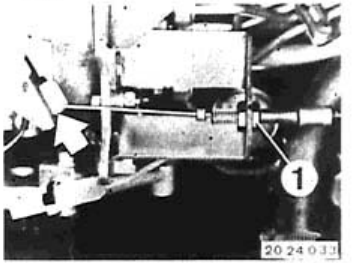
Models 316 i and 318 i
Engine M 40

Disconnect throttle cable.
Compress retainer.
Pull out adjusting screw together with the throttle cable.



Models 320 i, 323 i, 325 e and 325 i

Unscrew nut (1).
Disconnect throttle cable.

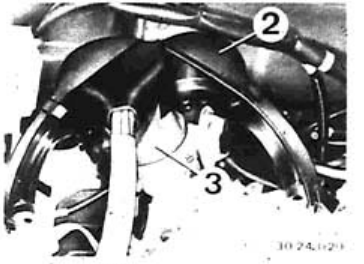


Model 324 d



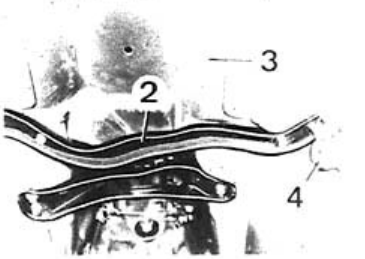
Model 324 d

Take off cap.
Disconnect throttle cable.
Compress retainer.
Pull out adjusting screw together with the throttle cable.



Models 316 and 318 i with Distributor

Remove protective cover (2) and distributor cap (3), to avoid damaging the distributor cap while lowering the transmission.



Only Cars with Splash Guard:
Unscrew splash guard.
Remove exhaust assy. – see 18 00 020.
Model 324 td:
Remove primary and final mufflers.
Model 325 iX:
Remove transfer box – see 27 10 010.
Unscrew connector (2).
Remove heat shield (3).

Installation:
Also mount holder (4).
Tightening torque*.

* See Specifications



Drain ATF.

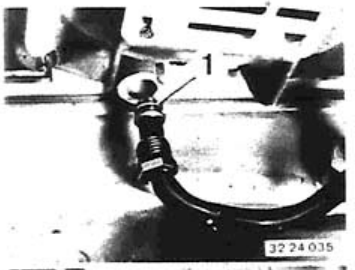
Important!
Never reuse drained ATF.

Installation:
The transmission will have to be disassembled when the ATF has a burnt odor and black color.

Important!
Clean oil cooler and pipes with compressed air and flush twice with ATF, if the transmission was faulty.

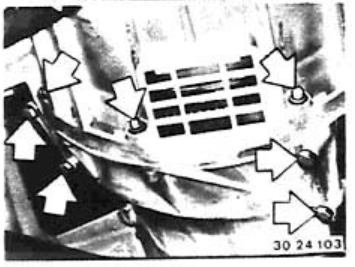
Remove oil filler pipe (1).
Unscrew oil cooler pipes on transmission and plug openings with caps.

Installation:
Tightening torque*:



Version without Adapters:

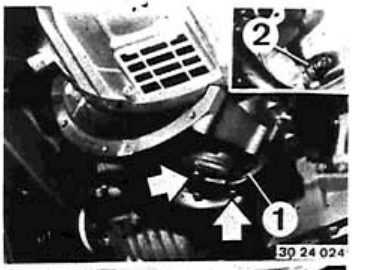
Important! – Installation:
Check O-rings (1).
Replace O-rings if their condition does not permit reusing them.



Remove reinforcement.
Unscrew Torx bolts with a Torx socket**.

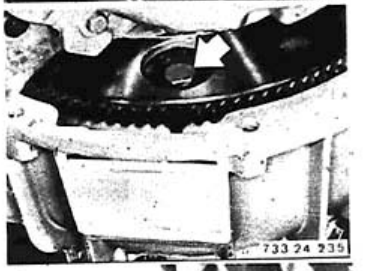
Important! – Installation:
Washers must be used with the Torx bolts to avoid increasing the breaking loose torque.
Tightening torque*.
Lift off grill.

* See Specifications
** Source of Supply: HWB



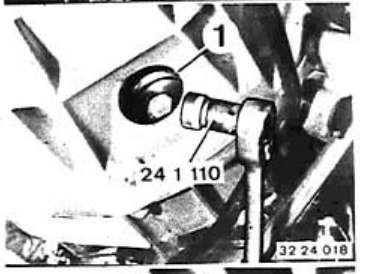
Model 325 IX:
Remove front propeller shaft – see 26 20 000.
Unscrew reinforcement on engine and transmission.
Loosen 2 screws of the oil level switch enough that the reinforcement can be removed after bending holder (1).

Important!
Use spacer (2) between the bolt and case to prevent scraping of Torx bolts on the front propeller shaft.



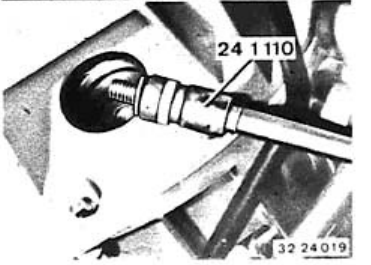
Unscrew torque converter on drive plate at three points.
Turn flywheel for this step.

Important!
Only use size M 10 x 16 mm bolts.
Non-conformance will lead to destruction of the transmission.
Tightening torque*.



Engine M 40:

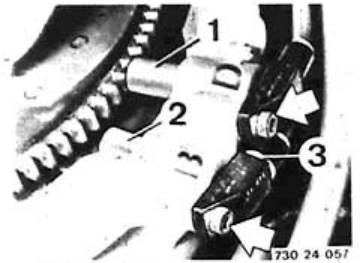
Lift cover out of opening (1) on oil sump.
Unscrew torque converter on drive plate at three points with Special Tool 24 1 110.
Turn flywheel for this step.



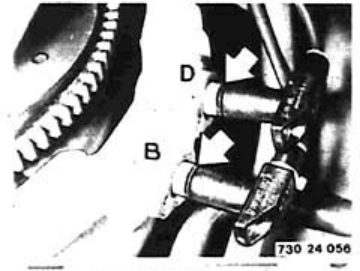
Installation:
Install bolt with Special Tool 24 1 110 and tighten with a torque wrench.
Tightening torque*.

Important!
Only use size M 10 x 16 mm bolts.
Non-conformance will lead to destruction of the transmission.

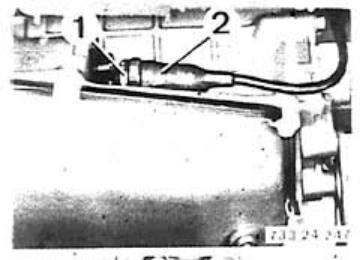
* See Specifications



Cars with DME:
Unscrew bolts.
Pull out speed sender (1) and reference mark sender (2).
Important! - Installation
Check installed position and don't mix up plugs.
Install speed sender (1) in bore (D) and reference mark sender (2) with ring (3) in bore (B).
Engine cannot be started when mixed up.

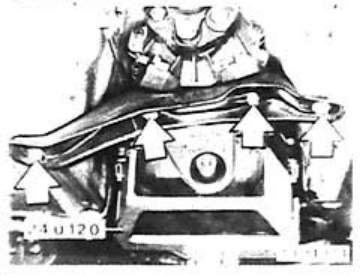


Installation:
Check O-rings.
Install senders with Molykote Longterm 2.
Important!
Keep grease and dirt off of face of DME senders.

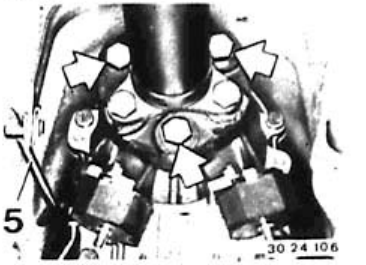


Cars with EH Transmission:
Turn bayonet fastener (1) to the left.
Pull off plug (2).
Lift wire harness out of holders.
Installation:
Connect plug (2) in such a manner that the marks are aligned.

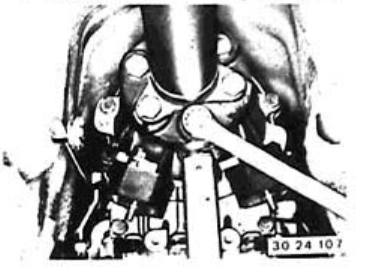
Version with Kickdown Preventer:
Pull off plug.



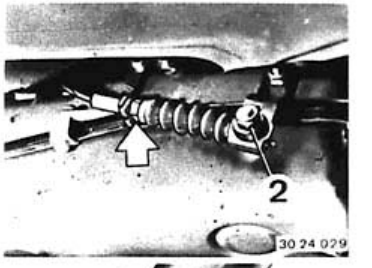
Support transmission with Special Tools 24 0 120 and 00 2 020.
Remove cross member.
Installation:
Center transmission - see Group 26.
Tightening torque*.



Unscrew joint disc on transmission.
Disconnect shift linkage (5).
Installation
Adjust selector lever - see 24 00 006.



Installation:
Replace stop nuts.
Tighten nuts with a standard 17 mm wrench socket and a torque wrench.
Tightening torque*.
Important!
Only tighten the nuts (never bolts) to avoid tension in the joint disc.



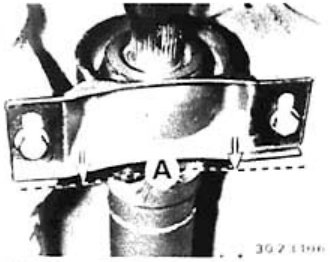
Version with Cable:
Loosen nut (2) (counterhold).
Detach cable on counterholder.
Pull out cable.
Installation:
Tightening torque*.
Adjust shift - see 24 00 006.



Loosen screwed-on ring (1) several turns.
Installation:
Tighten screwed-on ring (1) with Special Tool 26 1 040 after finishing installation.
Tightening torque*.

* See Specifications

* See Specifications



Unscrew center mount.

Installation:
Preload center mount forward by distance A = 4 to 6 mm (0.157 to 0.236").
Tightening torque*.

Bend propeller shaft down and pull off of the centering pin.

Important!
Suspend propeller shaft from car on a piece of wire to prevent it from falling into the joints.

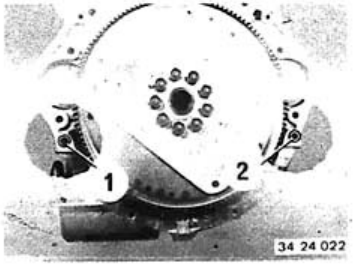


Lower transmission.
Unscrew transmission on engine.
Unscrew Torx bolts with a Torx socket**.

Important! – Installation:
Use washers with Torx bolts to avoid increasing the breaking-loose torque.
Tightening torque*.

Pull transmission off of the engine, pressing off the torque converter at the same time.

Important!
A special tool hoist with mounted transmission may only be moved in completely lowered position.



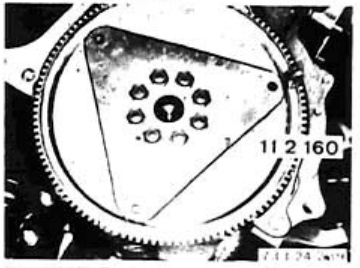
Important!
Check that dowel sleeves (1 and 2) are not missing prior to installation of the transmission.
As applicable, transfer dowel sleeves from the transmission or use new dowel sleeves.

* See Specifications
** Source of Supply: HWB



Important! – Installation:
Check installed position of the torque converter – drive dogs must be located below edge of the case.

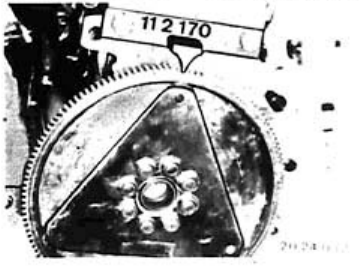
Installation:
Make sure that the torque converter is positioned correctly while installing the transmission; prevent it from slipping out if necessary.



Installation:
Inspect drive plate for ruptures and cracks, replacing if necessary.

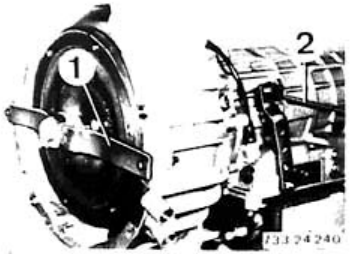
Engine M 10:
Hold flywheel with Special Tool 11 2 160.
Unscrew expansion bolts.

Important!
Replace and install expansion bolts with a bolt cement**.
Only coat the threads.
Clean tapped bores thoroughly.
Tightening torque*.



Engines M 20, M 21 and M 40:
Hold flywheel with Special Tool 11 2 170.

* See Specifications
** Source of Supply: HWB

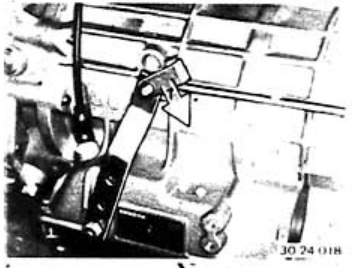


24 00 042 INSTALLING EXCHANGE TRANSMISSION

Remove transmission – see 24 00 022.

Important!
Always clean the oil cooler and pipes with compressed air and flush twice with ATF prior to installation of an exchange transmission.

Transmission code* on data plate.



Version with Shift Linkage:
Transfer transporting holder (1) and linkage (2) with lever.

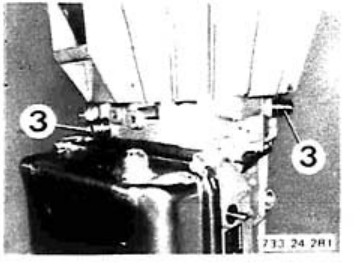
Mount spring clamp from top to bottom.

Important!
Check bearing sleeve.



Version with Shift Cable:
Transfer transporting holder (1), lever (2) and bracket (3).

Transfer rubber mounts and exhaust carrier.



Transfer adapters (3).

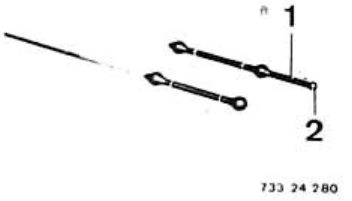
Version with Multiple Tooth Threads:
Unscrew adapters with a 12 mm multiple tooth socket or Torx T 55 socket.

Install seals.
Tightening torque*.

* See Specifications



Important! – Installation
Transmissions are supplied filled with oil since 1.86.
Remove plug from oil sump prior to installation of the oil filler pipe.
Catch escaping ATF in a clean container.
Pour in ATF again after installation of the transmission with help of a funnel, Special Tool 24 0 080.



Check oil level.
An oil dipstick with a longer measuring tip (1) is standard since 2.85.
This makes it possible to have an earlier reporting of the oil level in the transmission.
The oil level should not be below ball (2) after a test drive and with an oil temperature of approx. 40° C (104° F).
The oil level should be between the min. and max. marks with an oil temperature of approx. 80° C (175° F).
Correct the oil level when necessary.

Note:
New oil dipsticks can be installed retroactively.

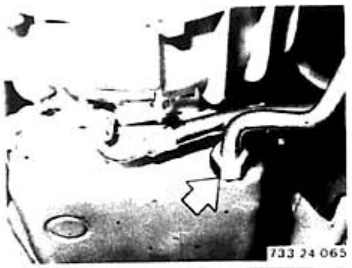
<u>Oil Level Too High:</u>
Strong foaming, splash loss, higher temperature when driving fast, oil lost through the vent.

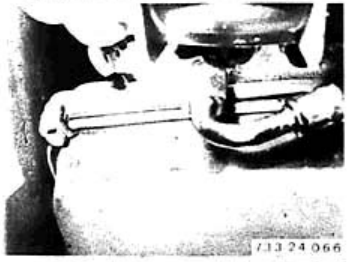
<u>Oil Level Too Low:</u>
Valves rattling, foam, engine slipping, general disturbances.

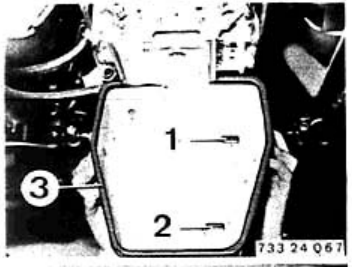


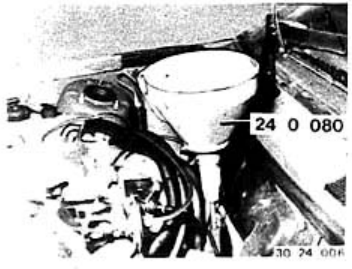
Important!
Oil Dipstick Version with Arrest:

The oil dipstick can be pulled out only after tilting the grip.









24 11 002 REMOVING AND INSTALLING OIL SUMP

Drain oil.

Important!
Never reuse drained oil.

Installation:
The transmission will have to be disassembled, if the oil smells burnt and is black.

Unscrew oil filler pipe on the oil sump.
Unscrew oil sump.

Installation:
Mount oil sump with brackets in such a manner that the short leg presses on the oil sump.
Tightening torque*.

Important!
Both brackets with straight legs must be mounted on the sides.

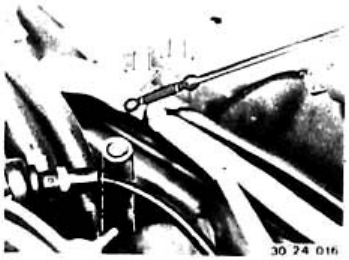
Clean oil pan.

Important!
Place magnets (1 and 2) in the oil sump.
Install gasket (3).

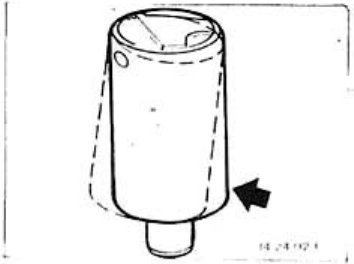
Pour in oil*.

Important!
Only use the funnel, Special Tool 24 0 080, to pour in ATF.

* See Specifications







Test drive car.
Check oil level.
Park car on level floor or ground.
Correct the oil level with the selector lever in P, transmission at operating temperature and engine running at idle speed.
Oil level of transmission at operating temperature = approx. 80° C (175° F) must be between both marks.
Volume of oil between min. and max. marks = approx. 0.3 liter (0.6 pint).

An oil dipstick with a longer measuring tip (1) is standard since 2.85.
This produces an earlier display of the oil level in the transmission.
The oil level must not be below ball (2) after a test drive and with an oil temperature of approx. 40° C (105° F).
The oil level must be between min. and max. marks with an oil temperature of approx. 80° C (175° F).
Correct the oil level, if necessary.

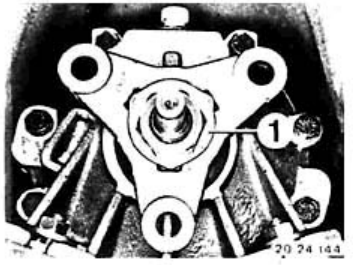
Note:
New oil dipsticks can be installed retroactively.

<u>Oil Level Too High:</u>
Strong foaming, splash loss, higher temperature when driving fast, oil lost through vent.

<u>Oil Level Too Low:</u>
Valves rattling, foaming, engine slipping, general operating disturbances.

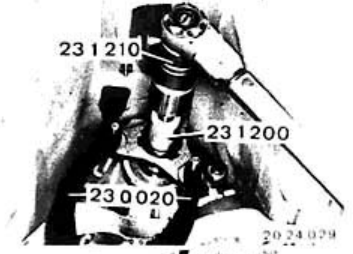
Important!
Oil Dipstick Version with Arrest:

The oil dipstick can be pulled out only after tilting the grip.

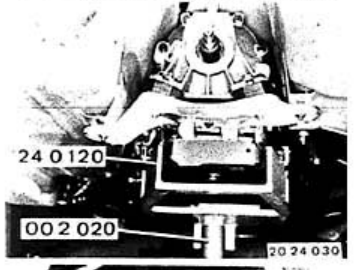


24 11 052 REMOVING AND INSTALLING OR SEALING TRANSMISSION EXTENSION

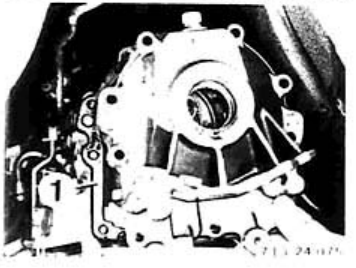
Unscrew propeller shaft - see 24 00 022.
Lift out lockplate (1).



Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.
Pull off output flange.
Installation:
Install collar nut with Hylomar SQ-32 M universal cement.
Tightening torque*.

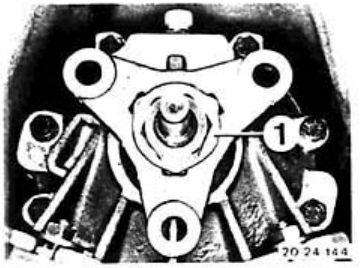


Support transmission with Special Tools 24 0 120 and 00 2 020.
Remove cross member.
Lower transmission.
Installation:
Center transmission - see Group 26.
Tightening torque*.



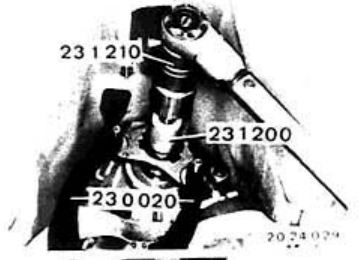
Unscrew transmission extension.
Installation:
Replace gasket (1).
Tightening torque*.

* See Specifications



24 12 013 REPLACING RADIAL OIL SEAL FOR OUTPUT FLANGE

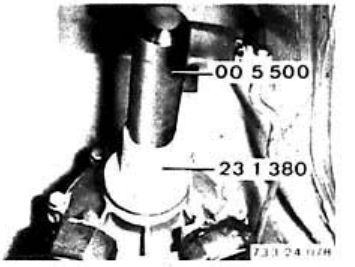
Remove propeller shaft – see 24 00 022.
Lift out lockplate (1).
Installation:
Replace lockplate.



Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210*.
Pull off output flange.
Installation:
Install collar nut with Hylomar SQ - 32 M cement.



Pull out radial oil seal with Special Tool 00 5 010.



Lubricate sealing lip with ATF
Drive in radial oil seal with Special Tools 23 1 380 and 00 5 500.

Replace radial oil seal for torque converter see 24 12 . . . in microfilmed Construction Group Repair Manual.

* See Specifications

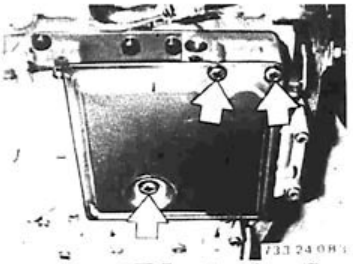


24 12 103 REPLACING RADIAL OIL SEAL FOR MANUAL SHIFT VALVE SHAFT

Unscrew selector lever (1) on transmission.

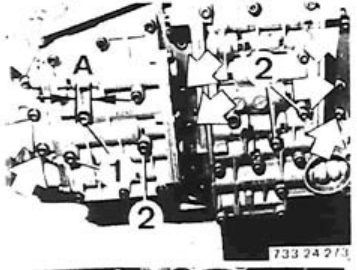


Lift out radial oil seal (2).
Installation:
Lubricate sealing lip with oil (ATF).
Drive in radial oil seal.



24 30 002 REMOVING AND INSTALLING VALVE BODY

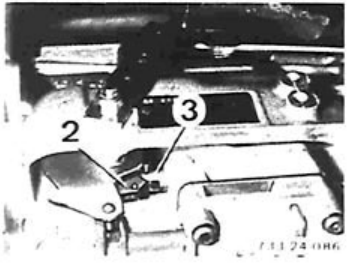
Remove oil sump – see 24 11 002.
Remove oil filter screen.
Installation:
Check length of bolts = 65 mm (2.559").
Tightening torque*.



Remove valve body.
Unscrew Torx bolts with Special Tool 00 2 100.
Important!
Only unscrew bolts with bolt head size A = 12 mm.
Installation:
Bolts differ in length.
Bolts (1) with conical head = 65 mm (2.559") long.
Bolts (2) with flat head = 60 mm (2.362") long.

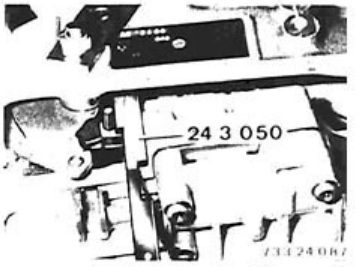


Installation:
Tighten Torx bolts with Special Tools 00 2 100 and 00 2 050.
Tightening torque*

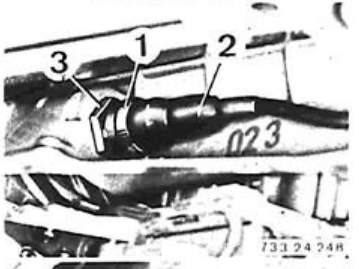


Installation:
Mount valve body that clamp on selector valve can be connected in operating finger of pawl. This requires pulling transmission cable slightly so that throttle cam (2) cannot clamp on throttle pressure valve (3).

* See Specifications



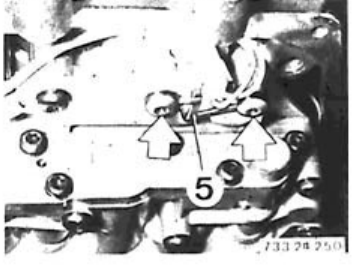
Install valve body and screw in bolts only finger tight.
Align valve body with Special Tool 24 3 050.
If special tool is not available, check that distance from valve body case to pin of throttle pressure piston is 11.5 mm (0.453").
Tighten valve body bolts.



EH Transmission:
Turn bayonet fastener (1) to the left.
Pull off plug (2).
Unscrew nut (3).
Installation:
Connect plug (2) in such a manner that marking lines are aligned.

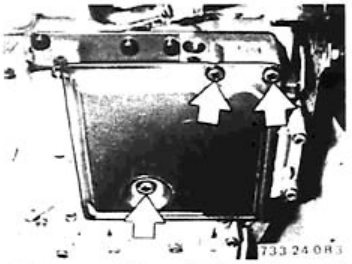


Pull out socket toward inside.
Installation:
Check O-ring (4), replacing if necessary.
Plug in socket with flat side facing out.
Tightening torque*.



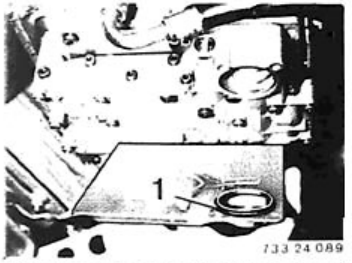
Note:
Also mount pulse transmitter on the valve body.
Tabs on holder (5) must engage in grooves of plug.

* See Specifications

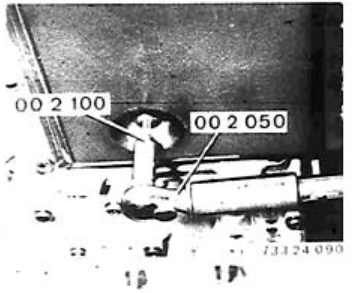


24 31 152 REMOVING AND INSTALLING OIL FILTER SCREEN ON VALVE BODY

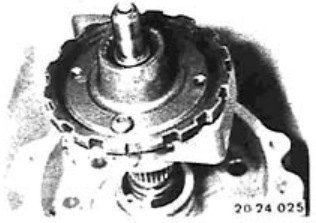
Remove oil sump – see 24 11 002.
Unscrew oil filter screen.
Unscrew Torx bolts with Special Tool 00 2 100.
Installation:
Clean oil filter screen.
Replace an oil filter screen when it starts to gum up with a burnt brown residue.
Tightening torque*.



Check rubber ring (1), replacing if necessary.



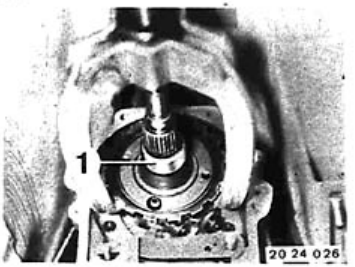
Installation:
Tighten Torx bolts with Special Tool 00 2 100 and a torque wrench.
Tightening torque*.



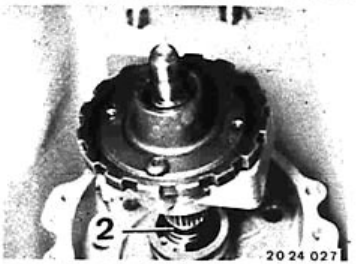
24 32 002 REMOVING AND INSTALLING CENTRIFUGAL GOVERNOR

Remove transmission extension – see 24 11 052.
BMW 325 iX:
Remove transfer box – see 27 10 010.
Pull off parking lock gear with centrifugal governor.

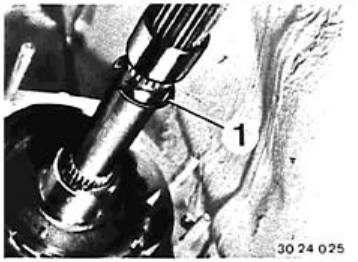
* See Specifications



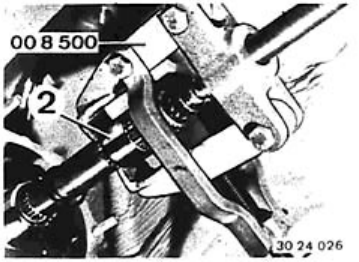
Version with Spacer (1):
Pull off parking lock gear with Special Tool 23 1 050.
Installation:
Heat bearing race (1) to approx. 80° C (175° F) with a hot air blower and slide on to output shaft.



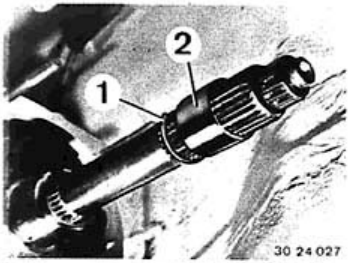
Replace seal (2).
Slide on parking lock gear with centrifugal governor.



BMW 325 iX:
Lift out snap ring (1) and push forward.
Installation:
Replace snap ring.



Pull bearing sleeve (2) off of output shaft with Special Tool 00 8 500.



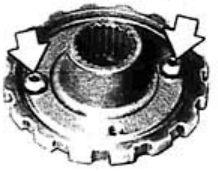
30 24 027

Installation:
Install snap ring (1) in groove of output shaft.
Heat bearing sleeve (2) to approx. 80° C (175° F) with a hot air blower and push on to output shaft against the snap ring.



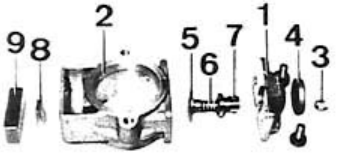
30 24 028

Lift out circlip (3).
Pull off parking lock gear.
EH Transmission:
Remove parking lock pawl – see 24 34 002.


20 24 031

24 32 505 DISASSEMBLING AND ASSEMBLING CENTRIFUGAL GOVERNOR
–Centrifugal Governor Removed–

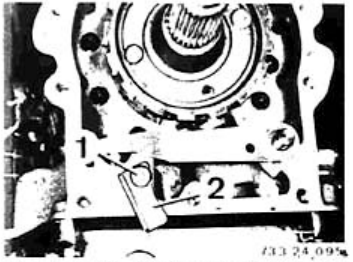
Unscrew parking lock gear on centrifugal governor.
Installation:
Tightening torque*.



733 24 094

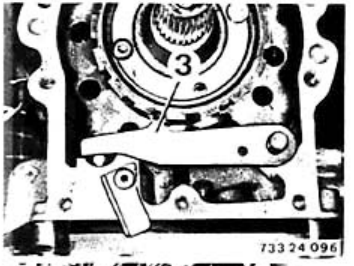
Unscrew cover (1) on housing (2).
Lift out retainer (3) and take off washer (4).
Remove governor plunger (5), spring (6) and governor sleeve (7).
Installation:
Governor plunger must slide easily in the governor sleeve.
Remove spring retainer (8) and balance weight (9).

* See Specifications

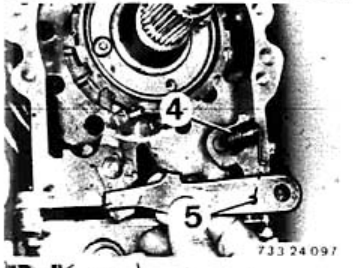


24 34 002 REMOVING AND INSTALLING PARKING LOCK PAWL

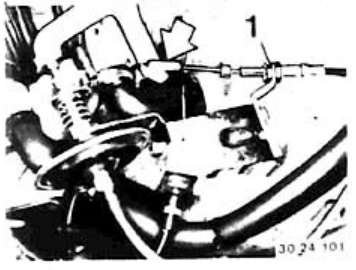
Remove transmission extension 24 11 052.
BMW 325 iX:
Remove transfer box – see 27 10 010.
Loosen bolt (1).
Swing holder (2) down.



Pull off pawl (3).
Caution!
Spring pressure.

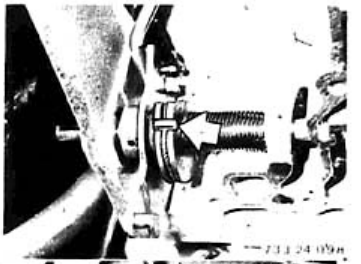


Installation:
Check installed position of spring (4).
It must be possible to connect end of spring (4) in bore (5) of pawl.



24 34 102 REPLACING THROTTLE CABLE

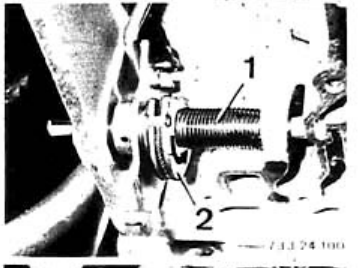
Unscrew nut (1).
Disconnect throttle cable.
(Refer to 24 00 022 for other models).



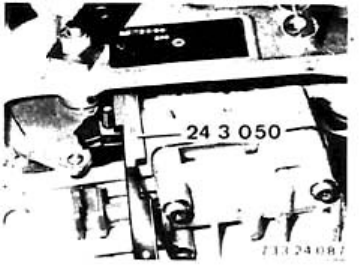
Remove valve body 24 30 002.
Disconnect throttle cable.



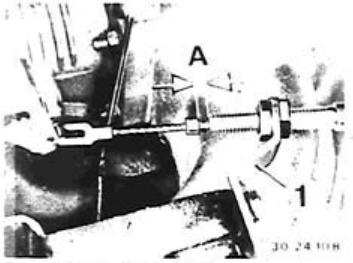
Press throttle cable out of case upwards.
Press new throttle cable into case until retaining tabs engage.



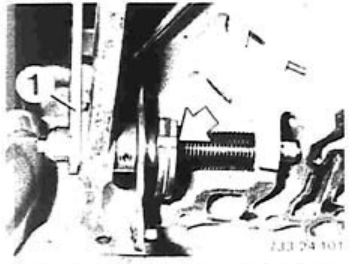
Preload spring (1) by one turn anticlockwise with throttle cam (2).
Connect nipple on throttle cam.



Install valve body.
Insert Special Tool 24 3 050 between valve body case and throttle pressure valve.
Push throttle cam against throttle pressure valve.

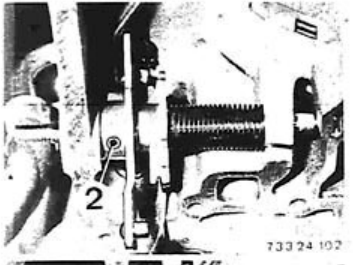


Connect throttle cable in suspension on transmission and holder (1).
Tighten cable.
Squeeze loose lead seal on cable at distance A = 0.25 to 0.50 mm (0.010 to 0.020").
Note:
Lead seal installation is identical for all models.
Adjust throttle cable 24 00 006.

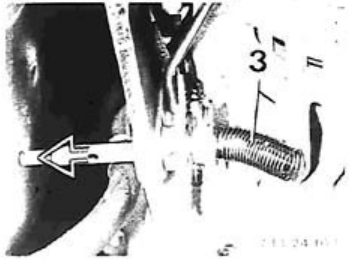


24 34 702 REPLACING SPRING FOR THROTTLE CABLE

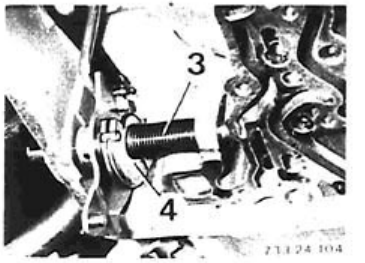
Remove valve body 24 30 002.
Disconnect selector lever (1) on transmission.
Disconnect throttle cable.



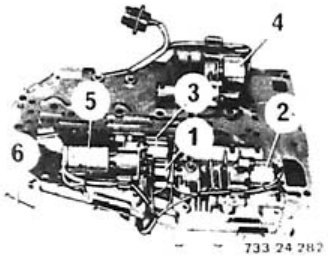
Drive out pin (2) in position N.

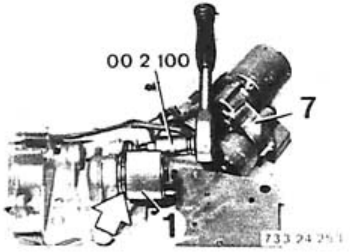


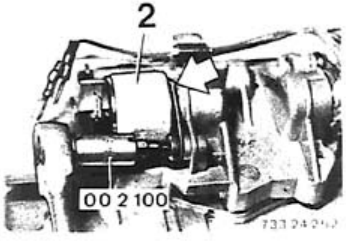
Pull out selector shaft far enough that spring (3) can be removed.



Installation:
Install selector shaft.
Preload spring (3) by one turn anticlockwise with throttle cam (4).
Connect nipple on throttle cam.







24 34 851 REPLACING ALL SOLENOID VALVES
- Valve Body Removed -

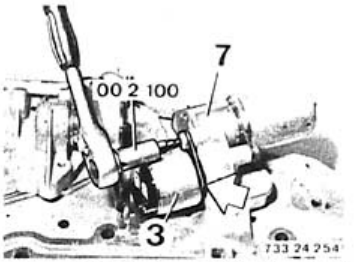
Test to test plan.

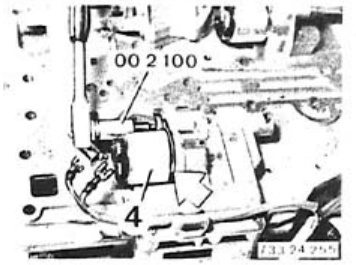
Arrangement:
1 Solenoid, 1st/2nd and 3rd/4th gears
2 Solenoid, 2nd/3rd gears
3 Solenoid, converter lockup clutch
4 Solenoid, reverse gear lock
5 Pressure regulator
6 Pulse sender

a) Solenoid (1), 1st/2nd + 3rd/4th Gears
Unscrew governor housing (7).
Pull off wire plug.
Unscrew Torx bolt with Special Tool 00 2 100.
Take off holder.
Pull out solenoid.
Installation:
Install holder with tabs facing collar on solenoid.
Lugs must have sufficient clearance to housing or arrow on housing must be between lugs.
Tightening torque*.

b) Solenoid (2), 2nd/3rd Gears
Pull off wire plug.
Unscrew Torx bolt with Special Tool 00 2 100.
Take off holder.
Pull out solenoid.
Installation:
Install holder with tabs facing collar on solenoid.
Lugs must have sufficient clearance to housing or arrow on housing must be between lugs.
Tightening torque*

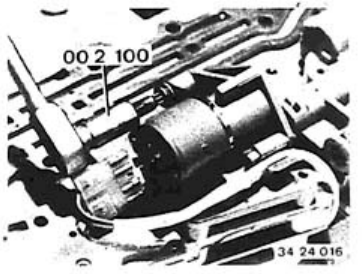
* See Specifications





c) Solenoid (3), Conv. Lockup Clutch
Unscrew governor housing (7).
Pull off wire plug.
Unscrew Torx bolt with Special Tool 00 2 100.
Take off holder.
Pull out solenoid.
Installation:
Install holder with tabs facing collar on solenoid.
Lugs must have sufficient clearance to housing or arrow on housing must be between lugs.
Tightening torque*.

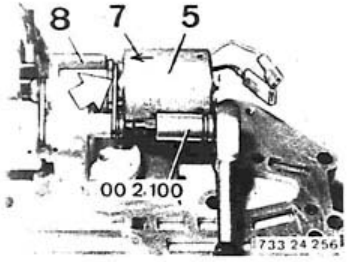
d) Solenoid (4), Reverse Gear Lock
Pull off wire plug.
Unscrew Torx bolt with Special Tool 00 2 100.
Take off holder.
Remove solenoid.
Installation:
Install holder with tabs facing collar on solenoid.
Lugs must have sufficient clearance to housing or arrow on housing must be between lugs.
Tightening torque*.



24 34 ... REPLACING SOLENOID VALVE FOR KICKDOWN DOWNSHIFT LOCKING
- Valve Body Removed -

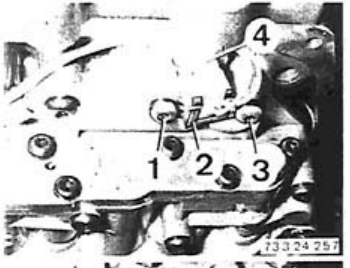
Pull off wire plug.
Unscrew Torx bolt with Special Tool 00 2 100.
Take off holder.
Pull out solenoid.
Installation:
Install holder with tabs facing collar on solenoid.
Tightening torque*.

* See Specifications



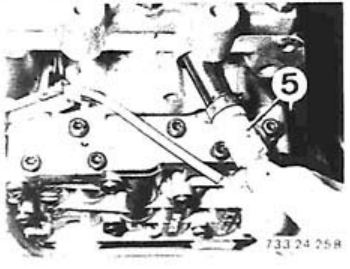
24 34 860 REPLACING PRESSURE REGULATOR
- Valve Body Removed -

Test to test plan.
Pull off wire plug.
Unscrew Torx bolt with Special Tool 00 2 100.
Take off holder.
Pull out pressure regulator (5).
Important! - Installation:
Arrow (7) on pressure regulator must be aligned with rib (8).
Install holder with tabs facing collar on pressure regulator.



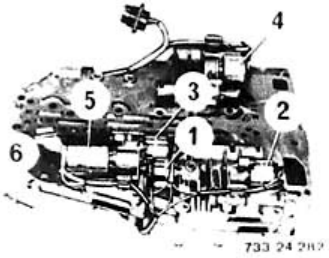
24 34 870 REPLACING PULSE SENDER
- Oil Sump Removed -

Test to test plan.
Unscrew Torx bolts (1 and 3) with Special Tool 00 2 100.
Take off holder (2).
Installation:
Engage tabs of holder (2) in grooves of plug (4).



Pull out pulse sender.
Pull off plug (5).
Installation:
Tightening torque*.

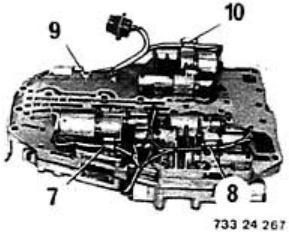
* See Specifications



733 24 267

24 35 500 REPLACING WIRE HARNESS FOR AUTOMATIC TRANSM.

Remove valve body - see 24 30 002.
Pull wire harness female plugs off of solenoids (1 ... 4), pressure regulator (5) and pulse sender (6).
Lift wire harness out of wire clamps.
Installation:
Check wire colors.
Solenoid (1) = gray/violet
Solenoid (2) = green/violet
Solenoid (3) = red/violet
Solenoid (4) = orange/violet
Pressure regulator (5) = blue/violet
Pulse sender (6) = brown/brown
Slide on female plugs against stop and check for tight fit.



733 24 267

Route wire harness and secure in wire clamps (7 ... 10).



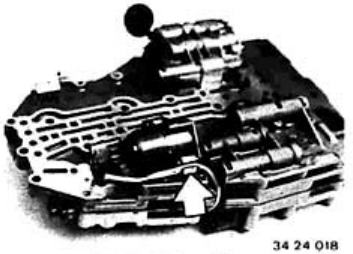
733 24 268

Turn valve body around.
Route wire harness and secure in wire clamps (11 ... 14).

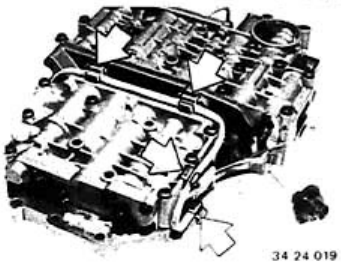

34 24 017

24 35 502 REPLACING WIRE HARNESS FOR KICKDOWN DOWN-SHIFT LOCKING - Valve Body Removed -

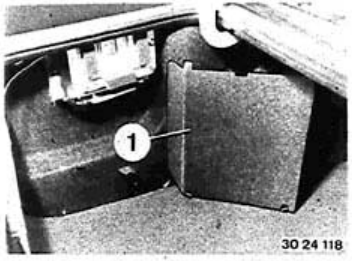
Pull plug off of solenoid.
Lift wire harness out of wire clamps.


34 24 018

Route wire harness and secure in wire clamp.


34 24 019

Turn valve body around.
Route wire harness and secure in wire clamp.



24 61 500 REMOVING AND INSTALLING OR REPLACING CONTROL UNIT (EH)

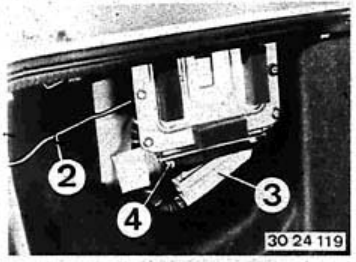
The control unit for an elec./hydr. transmission is located in the trunk behind the left trunk wall trim panel.

Remove trim panel section (1).



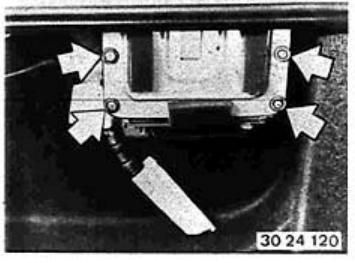
735 24 016

Code is on the data plate.
See Parts Catalog for a cross reference of types and models.

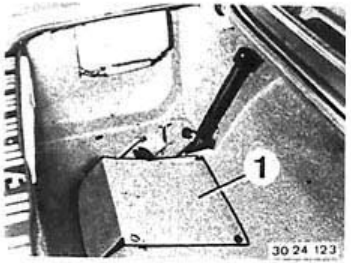


Disconnect ground lead (2) on holder. Pull plug (3) off of the control unit after pushing back spring retainer (4).

Important!
Plug (3) must only be disconnected or connected after the ignition has been turned off.



Unscrew control unit on holder.

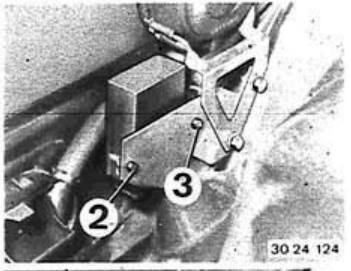


24 61 012/ 014 REPLACING CONTROL UNIT FOR DOWNSHIFT PREVENTION

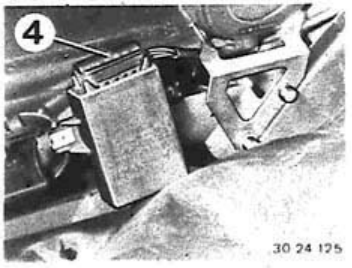
The downshift prevention control unit prevents racing of the engine when operating kickdown in position D and at top speed.
Shifting down from 4th to 3rd gear is prevented by a solenoid in the transmission depending on the signal from the speedometer.
Downshifting is only possible after reducing the road speed.

Location:
Behind left trunk wall trim panel.
Remove trim panel section (1) for the AEGS control unit.
Take out car jack and wheel nut wrench.

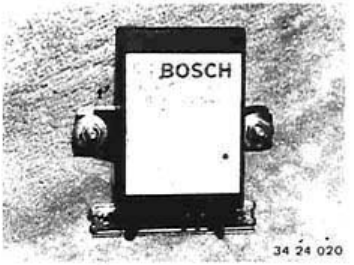
Note:
Downshift prevention control units are omitted since 8.88.
The DME control unit activates the solenoid.



Lift off trunk trim panel as much as necessary.
Unscrew screws (2 and 3).



Remove control unit.
Pull off plug (4).





30 24 126

Downshift Prevention Control Unit Identification:

Transmission H Model	Bosch Number
320 iA before 9.87 320 iCA 325 eA	0 260 002 030
320 iA since 9.87	0 260 002 031
325 iA 325 iCA 325 iXA	0 260 002 020
325 iXA Cat. Conv.	0 260 002 032

Version EH with AEGS:

Transmission EH Model	Bosch Number
320 iA ... 325 iXA	0 260 002 022

Replace kickdown switch – see 35 41 480.
Replace program switch – see 61 31 265.

Condition	Cause	Correction
Position P		
Park will not engage	Selector linkage between selector lever and transmission maladjusted	Adjust selector linkage 24 00 006
	Excessive friction in parking lock mechanism	Replace parking lock parts (connecting rod, pawl) 24 34 002
Park does not hold (slips out)	Selector linkage between selector lever and transmission maladjusted	Adjust selector linkage 24 00 006
Engine cannot be started in N or P	Transmission switch defective	Replace transmission switch 25 16 080
Position R		
No reverse gear	Linkage betw. selector lever and transmission maladjusted	Adjust selector linkage 24 00 006
	Oil screen dirty	Replace oil filter screen Replace transmission if liner bits are found in oil sump
	Clutch B destroyed – in this case also no 3rd gear	Disassemble clutches 24 23 022
	Brake D destroyed – in this case also no engine braking in 1st gear of position 1	Disassemble clutches 24 23 022
	Clutch E destroyed – in this case also no engine braking in 2nd and 3rd gears as well as 1st gear in position 1	Disassemble clutches 24 23 022
	Reverse gear arrest does not cancel	Replace valve body 24 30 002
Slipping or shaking when moving off	Clutch B or E or brake D damaged	Disassemble clutches 24 23 022
Hard engaging jolt P–R or N–R or definite double knock for P–R or N–R shifts (engine speed < 1500 rpm)	Damper B defective – in this case shift 2–3 also not correct	Replace valve body 24 30 002

Condition	Cause	Correction
Backup lights do not come on (electric system okay)	Transmission switch defective	Replace transmission switch 25 16 080
Car moves or creeps	Linkage betw. selector lever and transmission maladjusted	Adjust selector linkage 24 00 006
	Clutch A defective (bonded)	Replace clutch A 24 23 022
Position D		
No power flow	Oil filter screen dirty	Replace oil filter screen 24 31 152 Replace transmission if liner bits are found in oil sump
	Clutch A defective	Replace clutch A 24 23 022
	1st gear one-way clutch slips	Disassemble transmission 24 00 082
	Linkage betw. selector lever and transmission maladjusted	Adjust selector linkage 24 00 006
Slipping or shaking when moving off	Clutch A damaged	Replace clutch A 24 23 022
Hard engaging jolt N–D (engine speed < 1500 rpm)	Clutch A damaged	Replace clutch A 24 23 022
	Damper A defective	Replace valve body 24 30 002
No shift (warm or cold state) 1–2 / 2–1 shifts	Governor dirty	Clean or replace governor 24 32 002
	Shift valve 1–2 seized	Replace valve body 24 30 002
1–2 shifts	Brake C' and/or C defective	Disassemble clutches 24 23 022
2–3 / 3–2 shifts	Governor dirty	Clean or replace governor 24 32 002
	Shift valve 2–3 seized	Replace valve body 24 30 002
2–3 shift	Clutch B defective	Replace clutch B 24 23 022
3–4 / 4–3 shifts	Governor dirty	Clean or replace governor 24 32 002
	Shift valve 3–4 seized	Replace valve body 24 30 002
3–4 shifts	Brake F defective	Disassemble clutches 24 23 022

Condition	Cause	Correction
Car drives in 2nd gear	Governor bushing seized	Clean or replace governor 24 32 002
	Shift valve 1–2 seized	Replace valve body 24 30 002
Car drives in 3rd gear	Governor bushing seized	Clean or replace governor 24 32 002
	Shift valves 1–2 and 2–3 seized	Replace valve body 24 30 002
Car shifts 1–3	Shift valve 2–3 seized	Replace valve body 24 30 002
Shift Points*		
Zero load shift not correct	Governor dirty	Clean or replace governor 24 32 002
	Shift valve sticks	Replace valve body 24 30 002
Full load shift points not correct	Throttle cable maladjusted	Adjust throttle cable 24 00 006
No kickdown shift.		
1–2 / 2–1	Throttle cable maladjusted	Adjust throttle cable 24 00 006
2–3 / 3–2	Throttle cable maladjusted	Adjust throttle cable 24 00 006
4–3	4–3 kickdown valve seized	Replace valve body 24 30 002
Shift Transitions		
Zero load shifts too hard	Damper defective	Replace valve body 24 30 002
	Modulation pressure too high	Replace valve body 24 30 002
	Plates damaged	Disassemble transmission 24 00 082
Full load and kickdown shifts too long	Damper defective	Replace valve body 24 30 002
	Modulation pressure too low	Replace valve body 24 30 002
	Plates damaged	Disassemble transmission 24 00 082
Full load and kickdown shifts too hard	Modulation pressure deviates	Replace valve body 24 30 002
	Damper defective	Replace valve body 24 30 002

* See Specifications

Condition	Cause	Correction
Position 3 / 3rd Gear		
No engine braking effect	Clutch E damaged	Disassemble clutches 24 23 022
Position 2		
Manual downshift 3–2 not correct	Locking valve 2 sticks	Replace valve body 24 30 002
	Governor hesitates	Replace governor 24 32 002
No engine braking effect	Brake C or clutch E damaged	Disassemble clutches 24 23 022
Position 1		
Manual downshift 2–1 not correct	Locking valve 1 sticks	Replace valve body 24 30 002
	Governor hesitates	Replace governor 24 32 002
No engine braking effect	Brake D or clutch E damaged	Disassemble clutches 24 32 022
Torque Converter		
Shift speed not correct	Converter hysteresis valve sticks	Replace valve body 24 30 002
	No 4th gear	Replace valve body 24 30 002
	Governor pressure not correct	Replace governor 24 32 002
Shift transition too hard	Converter damper defective	Replace valve body 24 30 002
	Converter not okay	Replace converter 24 40 003
No shift	Control unit not okay	Replace valve body 24 30 002
	Converter defective	Replace converter 24 40 003
	No 4th gear	Replace valve body 24 30 002

Condition	Cause	Correction
Throttle cable sticks	Nipple disconnected on throttle cam	Replace throttle cable 24 34 102
	Excessive friction in throttle cable sleeve	Replace throttle cable 24 34 102
Throttle pressure piston seized	Throttle pressure piston clamped	Replace valve body 24 30 002
Noise and power flow interruption after long drive	Oil filter screen on valve body dirty	Replace oil filter screen and, if burnt liner bits are found in oil sump, also replace transmission
No forward or reverse drive loud noise	Drive plate between converter and engine torn off	Replace drive plate or converter 11 22 051 or 24 40 003
Noises		
Loud noise in all positions, especially with cold oil. Oil pump intake noise.	Oil level too low	Correct oil level
	Valve body leaks	Replace valve body 24 30 002
Loud, screeching noise depending on speed in all positions, especially with warm oil; occurring after long drives, sometimes accompanied by breaks in power flow	Oil filter screen dirty	Replace oil filter screen and, if burnt clutch liner bits are found in oil sump, also replace transmission
Loud noise when converter closes	Torsion damper defective	Replace converter 24 40 003
Loud engine grumble when converter closes	Engine speed too low, converter shift point not correct	Replace valve body 24 30 002
Leaks		
Oil dripping out of converter bell housing	Seal in pump body damaged	Replace seal 24 31 002
	Pump body leaks	Replace pump assy. 24 31 002
	Converter leaks on welded seam	Replace converter 24 40 003
	Radial oil seal for converter leaks	Replace radial oil seal 24 12 003
Leak between transmission case and oil sump	Oil sump mounting bolts not tightened correctly	Tighten bolts to specified torque*
	Oil sump gasket damaged	Replace gasket 24 11 002
Leak between transfer plate and transmission case (especially in area of pump pressure bore)	Mounting bolts on converter bell housing loose	Tighten bolts to specified torque*
Oil lost through throttle cable connection	O-ring on connection damaged	Replace O-ring or, if necessary, entire throttle cable 24 34 102

* See Specifications

Condition	Cause	Correction
Oil loss on output	Radial oil seal for output flange damaged	Replace radial oil seal 24 12 003
Oil loss through or on vent	Oil level too high	Correct oil level
	Wrong oil (strong foaming)	Replace oil, if necessary remove transmission and drain completely with torque converter
	Vent cover missing	Mount cover or replace vent
	O-ring on vent damaged	Detach transmission extension and replace O-ring
	Lock washer preload insufficient	Replace lock washer
Oil loss on cooler line	Coupling loose	Tighten bolts to specified torque*
	Cooler line damaged	Replace cooler line
	Cooler leaks	Replace cooler 17 11 000
Oil loss in transfer plate	Plug on transfer plate leaks	Tighten plug to specified torque*
		Replace seal.
Leak between transmission case and transmission extension	Mounting bolts loose	Tighten bolts to specified torque*
	Gasket damaged	Replace gasket 24 11 052

* See Specifications

TROUBLESHOOTING AUTOMATIC TRANSMISSION 4 HP 22 / EH

Requirements for Troubleshooting:

a) Engine in good running condition (valves, DME and idle speed okay).

b) Defect indicator, program indicator and position indicator okay.

c) Battery, plugs and ground points okay.

d) ATF level okay.

General instructions to avoid damage on engine, transmission and control units.

a) Never start the engine when the battery is not connected correctly.

b) Never supply power to wrong poles (e.g. battery connections mixed up).

c) Never use a fast charger to start the engine.

d) Disconnect the battery prior to fast charging.

e) Never disconnect the battery while the engine is running.

f) Only use a second 12 V battery and starting leads for outside starting.

g) Always turn off the ignition before disconnecting or connecting plugs on control units.

h) Only high-ohmic testers (BMW SERVICE TESTER) may be used for testing with a connected control unit.

TROUBLESHOOTING AUTOMATIC TRANSMISSION 4 HP 22 / EH

Condition	Cause	Correction
Position P		
Park will not engage	Selector linkage between selector lever and transmission maladjusted	Adjust selector linkage 24 00 006
	Excessive friction in parking lock mechanism	Replace parking lock parts (connecting rod, pawl) 24 34 002
Park does not hold (slips out)	Selector linkage between selector lever and transmission maladjusted	Adjust selector linkage 24 00 006
Engine cannot be started in N or P	Transmission switch defective	Replace transmission switch 25 16 080
Position R		
No reverse gear	Linkage between selector lever and transmission maladjusted	Adjust selector linkage 24 00 006
	Oil filter screen dirty	Replace oil filter screen Replace transmission if liner bits are found in oil sump
	Clutch B destroyed – in this case also no 3rd gear	Disassemble clutches 24 23 022
	Brake D destroyed – in this case also no engine braking in 1st gear of position 1	Disassemble clutches 24 23 022
	Clutch E destroyed – in this case also no engine braking in 2nd and 3rd gears as well as 1st gear in position 1	Disassemble clutches 24 23 022
	Reverse gear arrest does not cancel	Check transmission electronics (see test plan) Replace valve body 24 30 002
Slipping or shaking when moving off	Clutch B or E or brake D damaged	Disassemble clutches 24 23 022
Hard engaging jolt P–R or N–R or definite double knock for P–R or N–R shifts (engine speed < 1500 rpm)	Damper B defective – in this case shift 2–3 also not correct	Replace valve body 24 30 002 Check transmission electronics (see test plan)
Backup lights do not come on (electric system okay)	Transmission switch defective	Replace transmission switch 25 16 080
Car moves or crawls	Linkage between selector lever and transmission maladjusted	Adjust selector linkage 24 00 006
	Clutch A defective (bonded)	Replace clutch A 24 23 022

Condition	Cause	Correction
Position D		
No power flow	Oil filter screen dirty	Replace oil filter screen 24 31 152 Exchange transmission, if liner bits are found in oil sump.
	Clutch A defective	Replace clutch A 24 23 022
	1st gear one-way clutch slips	Disassemble transmission 24 00 082
	Selector linkage between selector lever and transmission maladjusted	Adjust selector linkage 24 00 006
Slipping or shaking while moving off	Clutch A damaged	Replace clutch A 24 23 022
Hard engaging jolt N – D (engine speed < 1500 rpm)	Clutch A damaged	Replace clutch A 24 23 022
	Damper A defective	Replace valve body 24 30 002
No shift (warm or cold state)	Kickdown switch defective (only kickdown shifts)	Replace kickdown switch
– Shift 1–2 / 2–1	Transmission electronics defective	Check transmission electronics (see test plan)
	Solenoid (1) defective (see test plan)	Replace solenoid valve 24 34 851
	Control valve 1–2 / 3–4 seized	Replace valve body 24 30 002
	Shift valve 1–2 seized	Replace valve body 24 30 002
– Shift 1–2	Brake C' and/or C defective	Disassemble clutches 24 23 022
– Shift 2–3 / 3–2	Solenoid (2) defective (see test plan)	Replace solenoid 24 34 851
	Shift valve 2–3 seized	Replace valve body 24 30 002
– Shift 2–3	Clutch B defective	Replace clutch B 24 23 022
– Shift 3–4 / 4–3	Solenoid (1) defective (see test plan)	Replace solenoid valve 24 34 851
	Control valve 1–2 / 3–4 seized	Replace valve body 24 30 002
	Shift valve 3–4 seized	Replace valve body 24 30 002
– Shift 3–4	Brake F defective	Disassemble clutches 24 23 022
	Program switch defective (see test plan)	Replace program switch
– Shift 1–2 Engine speed does not go beyond stall speed in drive and full load	Pulse transmitter defective (see test plan)	Replace pulse transmitter 24 34 870

Condition	Cause	Correction
Car moves off in 2nd gear	Transmission electronics defective	Check transmission electronics (see test plan)
	Solenoid (1) defective (see test plan)	Replace solenoid valve 24 34 851
	Shift valve 1–2 seized	Replace valve body 24 30 002
Car moves off in 3rd gear	Transmission electronics defective	Check transmission electronics (see test plan)
	Solenoid (1 or 2) defective (see test plan)	Replace solenoid valve 24 34 851
	Shift valve 1–2 and 2–3 seized	Replace valve body 24 30 002
Cars shifts 1–3	Shift valve 2–3 seized	Replace valve body 24 30 002
	Transmission electronics defective	Check transmission electronics (see test plan)
	Solenoid (2) defective (see test plan)	Replace solenoid valve 24 34 851
Shift Speeds		
– Zero load shift not okay	Control unit defective	Replace control unit 24 61 000
– Full load shift points not okay	No full load signal	Check throttle switch 13 63 544
– No kickdown shift	Kickdown switch defective	Check/replace switch (see test plan)
– Only zero load shifts	Zero load switch on engine defective	Check/replace zero load switch 13 66 554
– Only kickdown shifts	Kickdown switch defective	Check/replace switch (see test plan)
Shift Transitions		
– Zero load shifts too hard	Control unit defective	Replace control unit 24 61 000
	Damper defective	Replace valve body 24 30 002
	Modulation pressure too high	Replace valve body 24 30 002
	Plates damaged	Disassemble transmission 24 00 082
– Full load and kickdown shifts too long	Control unit defective	Replace control unit 24 61 000
	Damper defective	Replace valve body 24 30 002
	Modulation pressure too low	Replace valve body 24 30 002
	Plates damaged	Disassemble transmission 24 00 082

Condition	Cause	Correction
– Full load and kickdown shifts too hard	Modulation pressure not okay	Replace valve body 24 30 002
	Damper defective	Replace valve body 24 30 002
	Control unit defective	Replace control unit 24 61 000
Position 3 – 3rd Gear		
No engine braking effect	Clutch E damaged	Disassemble clutches 24 23 022
Position 2		
Manual downshift 3–2 not okay	Transmission electronics defective	Check transmission electronics (see test plan)
	Solenoid (2) defective (see test plan)	Replace solenoid valve 24 34 851
No engine braking effect	Brake C' or clutch E damaged	Disassemble clutches 24 23 022
Position 1		
Manual downshift 2–1 not okay	Transmission electronics defective	Check transmission electronics (see test plan)
	Solenoid (1) defective (see test plan)	Replace solenoid valve 24 34 851
No engine braking effect	Brake D or clutch E damaged	Disassemble clutches 24 23 022
Converter Clutch		
Shift speed not okay	Control unit defective	Replace control unit 24 61 000
Shift transition too hard	Converter clutch damper defective	Replace valve body 24 30 002
	Converter not okay	Replace converter 24 40 003
No shift	Transmission electronics defective	Check transmission electronics (see test plan)
	Solenoid (3) defective (see test plan)	Replace solenoid valve 24 34 851
	Converter defective	Replace converter 24 40 003
Converter clutch always locked (engine stops in drive position)	Transmission electronics defective	Check transmission electronics (see test plan)
	Solenoid (3) defective (see test plan)	Replace solenoid valve 24 34 851

Condition	Cause	Correction
General		
Shifts only as position	Transmission electronics defective	Check transmission electronics (see test plan)
	Program switch defective (see test plan)	Replace program switch
Defect indicator lights up	Transmission electronics defective	Check transmission electronics (see test plan)
	Solenoid (2) defective (see test plan)	Replace solenoid valve 24 34 851
Defect indicator lights up while driving	Transmission electronics defective	Check transmission electronics (see test plan)
	Poor contact of plug on transmission	Check plug connection
Noise and finally interruption of power flow after long drive	Oil filter screen on valve body dirty	Only replace filter screen, if there are no burnt clutch liner bits in oil sump; otherwise exchange transmission
No power flow forward or reverse, loud noise	Drive plate between converter and engine torn off	Replace drive plate or converter 11 22 051 or 24 40 003
Noise		
High-pitched noise in all positions, especially when oil is cold, intake noise of oil pump	Oil level too low	Correct oil level
	Valve body leaks	Replace valve body 24 30 002
High-pitched, screeching, speed-dependent noise in all positions, especially when oil is warm, occurring after long drive, sometimes accompanied by interruptions in power flow	Oil filter screen dirty	Only replace filter screen, if there are no clutch liner bits in oil sump; otherwise replace complete transmission
Loud noise when converter clutch is locked	Torsion damper defective	Replace converter 24 40 003

Condition	Cause	Correction
Leakage		
Oil dripping out of converter bell housing	Seal in pump body damaged	Replace seal 24 31 002
	Pump body leaks	Replace complete pump 24 31 002
	Converter leaks on welded seam	Replace converter 24 40 003
	Radial oil seal for converter leaks	Replace radial oil seal 24 12 003
Leak between transmission case and oil sump	Oil sump mounting bolts not tightened to correct torque	Tighten bolts to correct torque*
	Oil sump gasket damaged	Replace gasket 24 11 002
Leak between transfer plate and transmission case (especially in area of pump pressure bore)	Converter bell housing mounting bolts loose	Tighten bolts to correct torque*
Oil loss on transmission plug	O-ring defective	Replace O-ring 24 30 002
Oil loss on output	Radial oil seal on output damaged	Replace radial oil seal 24 12 013
Oil loss through or on vent	Oil level too high	Correct oil level
	Wrong type of oil (strong foaming)	Replace oil if necessary remove transmission and drain total oil including converter
	Vent cover missing	Mount cover or replace vent
	O-ring on vent damaged	Unscrew transmission extension, replace O-ring
	Circlip pre-load insufficient	Replace circlip
Oil loss on cooler line	Loose connection	Tighten bolts to correct torque*
	Cooler line damaged	Replace cooler line
	Cooler leaks	Replace cooler 17 11 000
Oil loss on transfer plate	Plug on transfer plate leaks	Tighten plug to correct torque*
		Replace seal
Leak between transmission case and transmission extension	Mounting bolts loose	Tighten bolts to correct torque*
	Gasket damaged	Replace gasket 24 11 052

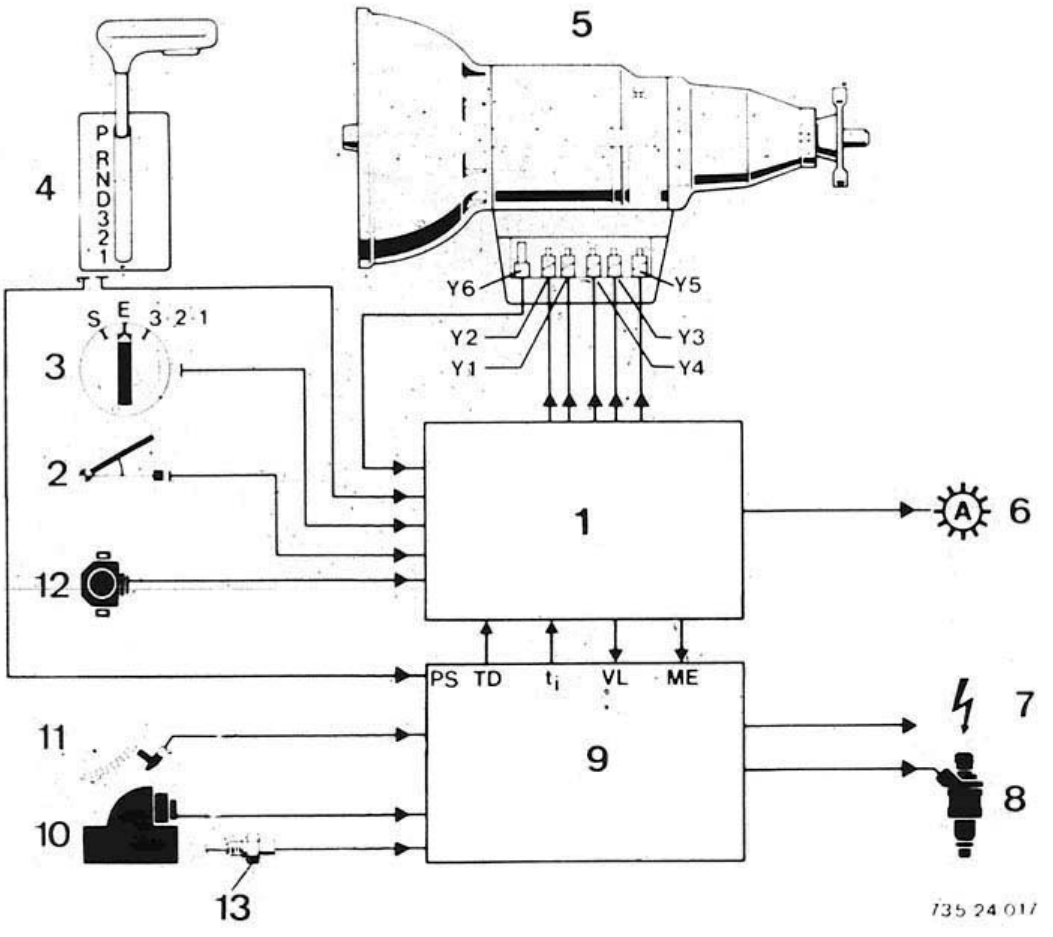
* See Specifications

TROUBLESHOOTING VALVE BODY FOR 4 HP 22 / EH

Condition	Cause	Correction
Position R		
No reverse gear	Solenoid (4) defective (see test plan)	Replace solenoid valve 24 34 851
	Wire to solenoid (4) grounded out (see test plan)	Replace wire harness
	Reverse gear locking valve seized	Replace valve body 24 30 002
	Damper B malfunctions	Replace valve body 24 30 002
No reverse or forward gear	Main pressure valve seized, spring broken	Replace valve body 24 30 002
Insufficient power transmission	Pressure too low in clutch B or E, brake D	Replace valve body 24 30 002
Hard jolt when moving into position R	Damper B malfunctions	Replace valve body 24 30 002
	Modulation pressure too high	
Position D		
No forward gear	Main pressure valve seized, spring broken	Replace valve body 24 30 002
Insufficient power transmission	Pressure too low in clutch A	Replace valve body 24 30 002
No shift function	Pulse transmitter defective (see test plan)	Replace pulse transmitter 24 34 870
	Wire to pulse transmitter grounded out (see test plan)	Replace wire harness
No shift function 1–2 / 2–1	Solenoid (1) defective (see test plan)	Replace solenoid valve 24 34 851
	Wire to solenoid (1) grounded out (see test plan)	Replace wire harness
	Shift valve 1–2, control valve 1–2 / 3–4, pressure reducing valve 1 seized	Replace valve body 24 30 002

Condition	Cause	Correction
Position D		
No shift function 2–3 / 3–2	Solenoid (2) defective (see test plan)	Replace solenoid valve 24 34 851
	Wire to solenoid (2) grounded out (see test plan)	Replace wire harness
	Shift valve 2–3 seized	Replace valve body 24 30 002
No shift function 3–4 / 4–3	Solenoid (1) defective (see test plan)	Replace solenoid valve 24 34 851
	Control valve 1–2 / 3–4 seized	Replace valve body 24 30 002
Shifts 1–2 / 2–3 / 3–4 too long	Pressure regulator defective (see test plan)	Replace pressure regulator 24 34 860
	Wire to pressure regulator grounded out (see test plan)	Replace wire harness
	Damper defective	Replace valve body 24 30 002
	Modulation valve, pressure reducing valves 1 and 2 seized	Replace valve body 24 30 002
Upshifts 1–2 / 2–3 / 3–4 too hard	Pressure regulator defective (see test plan)	Replace pressure regulator 24 34 860
	Modulation valve sticks	Replace valve body 24 30 002
	Damper defective	Replace valve body 24 30 002
Downshift 4–3 too hard	Plate F dirty	Replace valve body 24 30 002
Manual downshifts 4–3 / 3–2 too hard	Damper E or C' defective	Replace valve body 24 30 002

Condition	Cause	Correction
Position 1		
Manual downshift 2→1 not okay	Pressure regulator defective (see test plan)	Replace pressure regulator 24 34 860
	Damper D defective	Replace valve body 24 30 002
	Modulation valve sticks	Replace valve body 24 30 002
Converter Lockup Clutch		
No converter clutch locking	Solenoid (3) defective (see test plan)	Replace solenoid valve 24 34 851
	Converter clutch damper defective	Replace solenoid valve 24 34 851
	Converter pressure valve seized	Replace valve body 24 30 002
	Pressure reducing valve 1 seized	Replace valve body 24 30 002
No converter clutch unlocking	Solenoid (3) defective (see test plan)	Replace solenoid valve 24 34 851
	Wire to solenoid (3) grounded out (see test plan)	Replace wire harness
Main pressure too high in all positions	Pressure regulator defective (see test plan)	Replace pressure regulator 24 34 860
	Main pressure valve seized	Replace valve body 24 30 002
	Modulation pressure too high	Replace valve body 24 30 002



AEGS Wiring Diagram

1	AEGS control unit
2	Kickdown switch
3	Program switch
4	Position switch
5	Transmission
6	Defect indicator
7	Ignition
8	Injection
9	DME control unit
10	Air flow sensor
11	Speed sensor - engine
12	Throttle valve transmitter
13	Temperature sensor
Y1	Solenoid – 1st/2nd and 3rd/4th gears
Y2	Solenoid – 2nd/3rd gears
Y3	Solenoid – CL
Y4	Solenoid – reverse gear lock
Y5	Pressure regulator
Y6	Pulse transmitter
TD	Speed information
ti	Load signal
VL	Full load output
ME	Engine tap (ignition timing)
PS	Position switch

Connections of 35 Pin Plug on AEGS Control Unit

Pin No.		Connection
	1	Solenoid power supply
19		Term. 31 ground
	2	Kickdown
20		Solenoid reverse gear lock
	3	-
21		Speed signal
	4	Position switch N
22		Pressure regulator
	5	Term. 31 ground
23		Shielding
	6	Throttle valve potentiometer -
24		Engine tap/ignition timing
	7	Throttle valve signal (DKs)
25		Solenoid converter lockup clutch
	8	Speed sensor +
26		-
	9	Throttle valve potentiometer +
27		Speed sensor -
	10	-
28		Position switch 2
	11	Injection signal (tI)
29		Position switch 3
	12	-
30		Position switch D
	13	-
31		-
	14	Program switch E
32		-
	15	Program switch M
33		Fault display
	16	Solenoid 1
34		-
	17	Solenoid 2
35		Relay 2 power supply
	18	Position switch 1

MV Solenoid valves

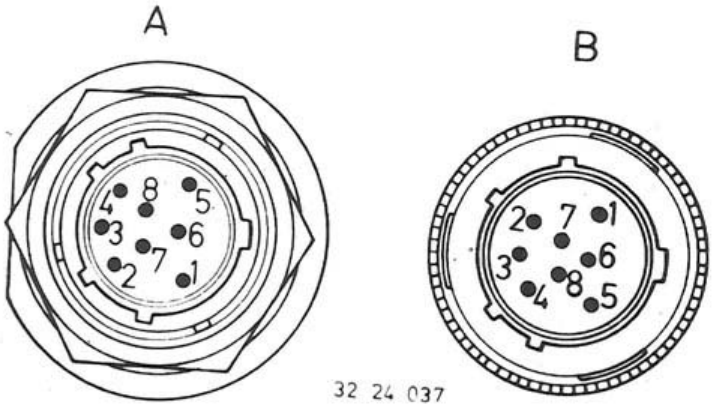
KD Kickdown

DK Throttle valve potentiometer

DKs Throttle valve potentiometer load signal

WK Converter lockup clutch

tI Injection signal

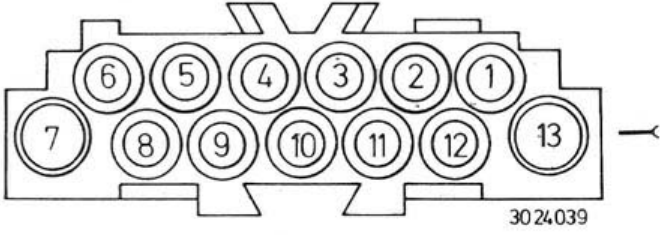


Transmission Wire Harness Plug Connections

A Transmission connection

B Wire Harness connection

Pin 1 Pressure regulator
Pin 2 Solenoid for reverse gear lock
Pin 3 Speed sensor
Pin 4 Speed sensor
Pin 5 Solenoid for 1st ... 4th gears
Pin 6 Solenoid for 2nd/3rd gears
Pin 7 Solenoid for converter lockup clutch
Pin 8 Solenoid +



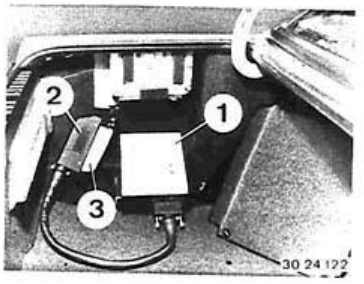
AEGS Plug Connections

Location: inside of firewall on right-hand side

			Wire Colors
1	ME	Engine tap / ignition timing	brown/gray
2	-	-	-
3	TR	Speed signal	black/blue
4	ti	Injection signal	white
5	Battery -		brown
6	P, N		brown/black
7	-	-	-
8	DME +		red/blue
9	WK	Converter lockup clutch	blue
10	DK +	Power supply	orange/black
11	DKs	Throttle valve potentiometer signal	yellow
12	DK -	Throttle valve potentiometer	brown
13	-	-	-

TEST PLAN FOR 4 HP – 22 / AEGS

The control unit for AEGS is located in the trunk behind the left trunk trim panel.
Remove trim panel section.
Caution!
Never disconnect or connect plug (3) with the ignition turned on.
Connect adapter (1), HWB No. 81 12 9 425 091 on plug (3) in conjunction with connecting lead (2), HWB No. 81 12 9 425 092, for all tests / periphery.
Install connecting lead, HWB No. 81 12 9 425 093 between the adapter and control unit for tests in conjunction with the AEGS control unit.



Test Position 1

Requirement for all tests: ground wire okay. Check ground wires 5 and 19 for correct connection. —— no → Break in ground wire. Connection engine wire harness pin 5 to battery – → Repair ground wire to wiring diagram. Make connection.

Signal throttle switch, see 13 63 544.

Explanations for Independent Electronic Transmission Control (AEGS):
There is a comprehensive test of the entire AEGS each time the engine is started.
Turn on ignition.
The yellow defect indicator lamp in the instrument panel will flash twice and must stay on while starting and go out at an engine speed above 450 rpm.

Test Position Defect Indicator	Cause	Correction
Defect indicator does not flash and remains on after starting.	Break in ground wire 5/19. Check voltage between wires 5/19 and 24 with the ignition on. Nominal value: approx. 5 V. AEGS control unit defective.	Repair wire to wiring diagram. Repair wire to wiring diagram. Replace control unit 24 61 000.
Defect indicator flashes, but remains on after starting.	Power supply to AEGS control unit insufficient. Check voltage between wires 5/19 and 35 with the ignition on. Nominal value: > 10 V. Wires to solenoid 1 (Y1), 2 (Y2), reverse gear (Y4) or converter lockup clutch (Y3) have a break or are grounded out. See test plan for checking. No TD signal from DME control unit. No ti signal from DME control unit.	Repair wire to wiring diagram. Repair wires to wiring diagram. Check plug connection (X) and power supply lead to AEGS control unit.
Defect indicator comes on while driving.	Power supply between wires 5/19 and 35 insufficient (drops below 10 V). TD signal stops suddenly. Break in positive wires to solenoids.	Repair wires to wiring diagram. Repair wires to wiring diagram.

Troubleshooting – also refer to Service Information 24 02 85 (422).

Test Position 2

Solenoid Valves

a) Solenoid valve (Y 1) – 1st/2nd and 3rd/4th gears. — no → Wire to solenoid valve damaged/shorted. → Repair wire to wiring diagram.
Resistance test (M 06). Plug receptacles bent. Repair plug receptacles.
Measure resistance between wires 1 and 16. Solenoid valve defective. Replace solenoid valve 24 34 851.
Nominal value: 25 ... 46 ohms.
Note: Specified resistance values for solenoid valves and pressure regulator should be measured with a transmission oil temperature of about 20° C (68° F).

↓

Insulation test (M 06). — no → Wire to solenoid valve damaged/grounded out. → Repair wire to wiring diagram.
Measure resistance between wires 5/19 and 1/16. Solenoid valve grounded out. Replace solenoid valve 24 34 851.
Nominal value: > 500 k-ohms.

↓

b) Solenoid valve (Y 2) – 2nd/3rd gears. — no → Wire to solenoid valve damaged/shorted. → Repair wire to wiring diagram.
Resistance test (M 06). Plug receptacles bent. Repair plug receptacles.
Measure resistance between wires 1 and 17. Solenoid valve defective. Replace solenoid valve 24 34 851.
Nominal value: 25 ... 46 ohms.

↓

Insulation test (M 06). — no → Wire to solenoid valve damaged/grounded out. → Repair wire to wiring diagram.
Measure resistance between wires 5/19 and 1/17.
Nominal value: > 500 k-ohms.

↓

c) Solenoid valve (Y 4) – reverse gear arrest. — no → Wire to solenoid valve damaged/shorted. → Repair wire to wiring diagram.
Resistance test (M 06). Plug receptacles bent. Repair plug receptacles.
Plug pulled off of control unit. Solenoid valve defective. Replace solenoid valve 24 34 851.
Measure resistance between wires 1 and 20.
Nominal value: 25 ... 46 ohms.

Solenoid valve (Y 4) – reverse gear arrest. — no → Wire to solenoid valve damaged/grounded out. → Repair wire to wiring diagram.
Insulation test (M 06). Plug receptacles bent. Repair plug receptacles.
Measure resistance between wires 5/19 and 1/20. Solenoid valve grounded out. Replace solenoid valve 24 34 851.
Nominal value: > 500 k-ohms.

d) Solenoid valve (Y 3) – conv. lockup clutch. — no → Wire to solenoid valve damaged/shorted. → Repair wire to wiring diagram.
Resistance test (M 06). Plug receptacles bent. Repair plug receptacles.
Measure resistance between wires 1 and 25. Solenoid valve defective. Replace solenoid valve 24 34 851.
Nominal value: approx. 25 ... 46 ohms.

Insulation test (M 06). — no → Wire to solenoid valve damaged/grounded out. → Repair wire to wiring diagram.
Measure resistance between wires 5/19 and 1/25. Solenoid valve grounded out. Replace solenoid valve 24 34 851.
Nominal value: > 500 k-ohms.

Test Position 3

Pressure regulator (Y 5). — no → Wire to pressure regulator damaged/shorted. → Repair wire to wiring diagram.
Resistance test (M 06). Plug receptacles bent. Repair plug receptacles.
Measure resistance between wires 1 and 22. Pressure regulator defective. Replace pressure regulator 24 34 860.
Nominal value: 1.8 ... 4.6 ohms.

Insulation test (M 06). — no → Wire to pressure regulator damaged/grounded out. → Repair wire to wiring diagram.
Measure resistance between wires 5/19 and 1/22.
Nominal value: > 500 k-ohms.

Test Position 4

Program switch (S 2).
A magnet return the program switch to position E for each starting procedure.
Resistance test (M 06).
Measure resistance between wires 6 and 14.
Nominal values:
∞ ohms for switch pos. S or 3,2,1
0 ohms for switch pos. E

no → Wire to program switch damaged/shorted. → Repair wire to wiring diagram.
Plug receptacles bent. Repair plug receptacles.
Program switch defective. Replace program switch 61 31 265.

Direct current voltage (M 01).
Measure voltage between black and brown wires (while starting).
Nominal value: > 8 V.

no → Wire damaged. → Repair wire to wiring diagram.

Test Position 5

Kickdown switch.
Resistance test (M 06).
Measure resistance between wires 19 and 2.
R = ∞ ohms.
Accelerator pedal floored (kickdown).
R = approx. 0 ohms.

no → Wire to kickdown switch damaged/shorted. → Repair wire to wiring diagram.
Plug receptacles bent. Repair plug receptacles.
Kickdown switch defective. Replace kickdown switch 35 41 480.

Test Position 6

Position switch (S 1).
Direct current voltage (M 01).
Turn on ignition.
Switch off lights.
Pertinent position lamp on.
Measure voltage betw. wires 19 and 18 Pos. 1,
19 and 28 Pos. 2,
19 and 29 Pos. 3,
19 and 30 Pos. D,
19 and 4 Pos. N.
Nominal value in pertinent position: > 10 V.
All other positions: < 1 V.

no → Wire to position switch damaged/shorted. → Repair wire to wiring diagram.
Position switch defective. Replace position switch.
Display unit defective. Replace display unit.
Fuse no. 9 defective. Replace fuse.
Battery voltage too low. Charge battery.
Plug receptacles bent. Repair plug receptacles.

Test Position 7

Pulse transmitter (Y 6).
Resistance test (M 06).
Measure resistance between wires 8 and 27.
Nominal value: 800 ohms ... 1.6 k-ohms.

no → Wire to pulse transmitter damaged/shorted. → Repair wire to wiring diagram.
Plug receptacle bent/shorted. Repair plug receptacle.
Pulse transmitter defective. Replace pulse transmitter 24 34 870.

↓

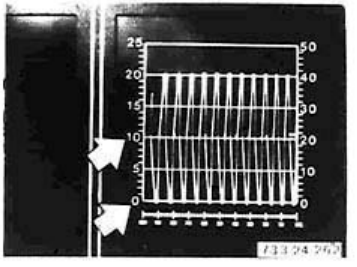
Insulation test (M 06).
Measure resistance between wires 5/19 and 8/27.
Nominal value: > 500 k-ohms.

no → Wire to pulse transmitter damaged/grounded out. → Repair wire to wiring diagram.
Pulse transmitter grounded out. Replace pulse transmitter 24 34 870.

↓

Dynamic test (M 22).
Scope test.
Connect test lead between wires 8 and 27 (see operating instructions for BMW service tester).
Support car on trailing arms.
It should be possible to turn rear wheels easily.
Start engine.
Select position D.
Speed approx. 30 km/h (25 mph).
All sine curves must be uniformly larger than 0 ... 10 (left screen scale).

no → Pulse transmitter defective. → Replace pulse transmitter 24 34 870.
Wire to pulse transmitter damaged/grounded out. Repair wire to wiring diagram.



25 Gear Shift Mechanism

Manual Transmission Shift Layout

- Sheet metal shift console 25- 1
- Aluminium shift console 25- 2

25 11 000 Shift lever – remove and install
- Sheet metal shift console 25- 3
- Aluminium shift console 25- 4
- Four wheel drive 25- 5

003 Shift lever – disassemble and assemble
- Sheet metal shift console 25- 7
- Aluminium shift console 25- 8

081 Shift lever dust cover – replace 25- 8

111 Shift rod joint – replace
- Sheet metal shift console 25- 9
- Aluminium shift console 25- 10
- Four wheel drive 25- 11

211 Shift lever console – replace
- Sheet metal shift console 25- 12
- Aluminium shift console 25- 13

Automatic Transmission Shift Layout

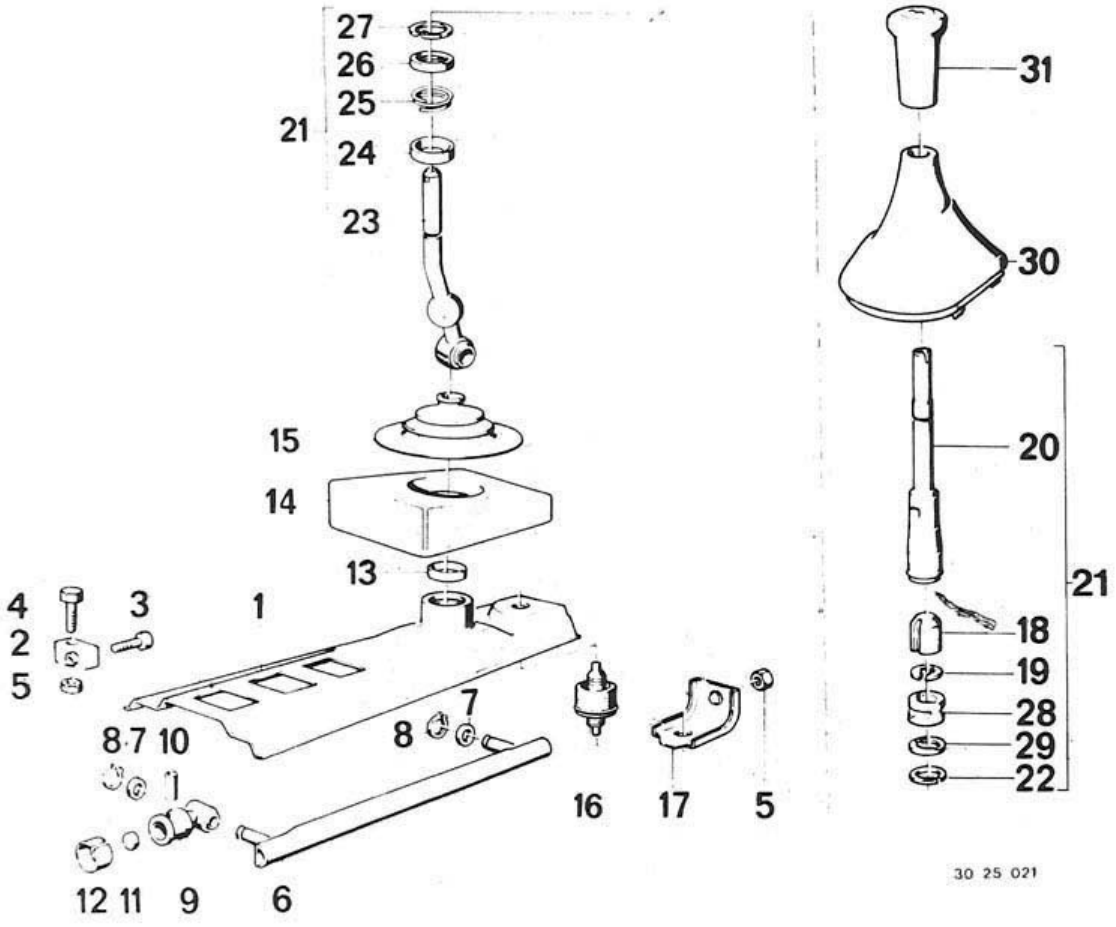
- Version with shift rod 25- 15
- Version with cable 25- 16

25 16 050 Selector lever complete with console – remove and install
- Version with shift rod 25- 17
- Version with cable (four wheel drive) 25- 18

080 Selector lever – remove and install
- Version with shift rod 25- 19
- Version with cable (four wheel drive) 25- 20

202 Cable for gear selection lever – replace 25- 21

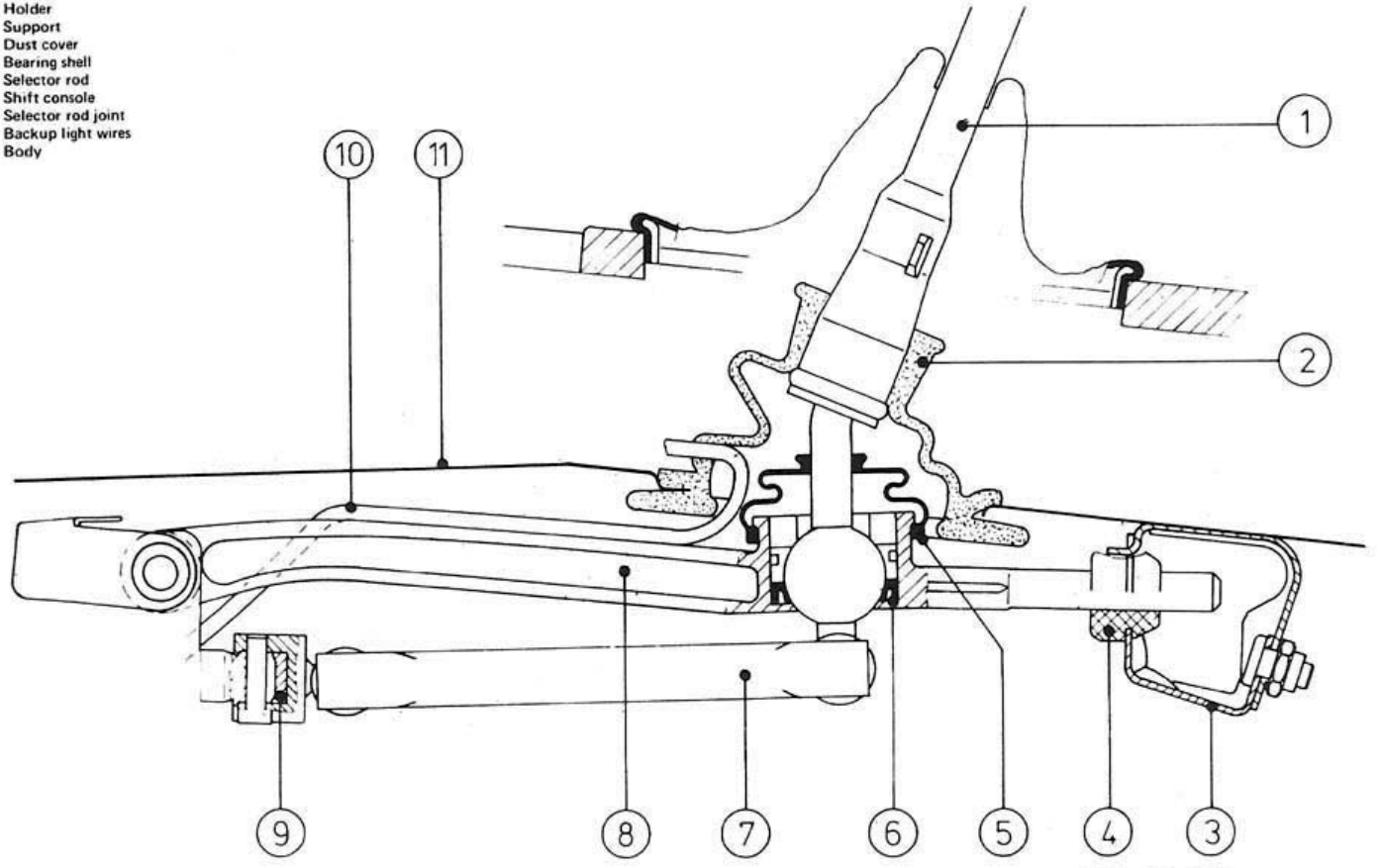
SHIFT LAYOUT FOR MANUAL TRANSMISSION
– Sheet Metal Shift Console –



1 Selector arm
2 Console
3 Bolt
4 Bolt
5 Nut
6 Selector rod
7 Spacer
8 Circlip
9 Selector rod joint
10 Pin
11 Lubricating felt
12 Spring sleeve
13 Lower plate
14 Damper plate
15 Rubber cover
16 Rubber mount
17 Holder
18 Cap
19 Circlip
20 Shift lever upper section
21 Shift lever assembly
22 Circlip
23 Shift lever lower section
24 Upper plate
25 Spring
26 Spacer
27 Circlip
28 Rubber ring
29 Washer
30 Dust cover
31 Shift lever knob

SHIFT LAYOUT FOR MANUAL TRANSMISSION
– Aluminum Shift Console –

1 Shift lever
2 Dust cover
3 Holder
4 Support
5 Dust cover
6 Bearing shell
7 Selector rod
8 Shift console
9 Selector rod joint
10 Backup light wires
11 Body



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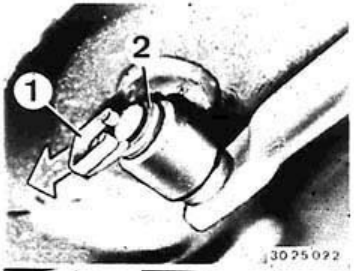
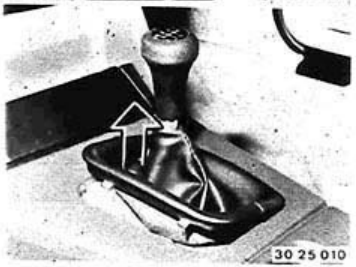
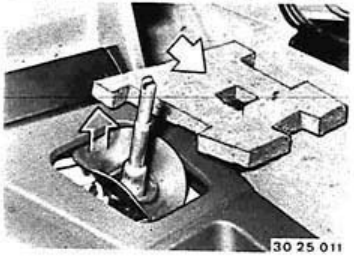


25 11 000 REMOVING AND INSTALLING SHIFT LEVER
–Sheet Metal Shift Console–

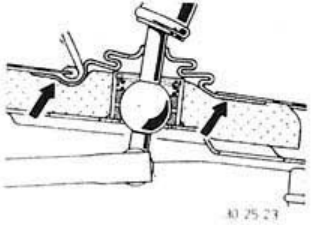
Remove retainer (1).
Take off washer (2).
Pull out shift rod (3).



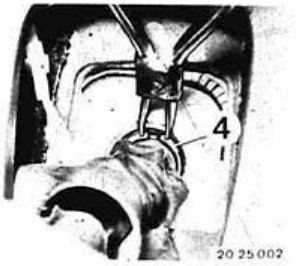
Remove dust cover.



Remove insulating felt.
Pull out cover between body and shift console.



Installation:
Check for correct positioning of cover.



Lift out circlip (4).
Remove shift lever.

Installation:
Lubricate spherical plates with Klüber Polyup GLY 801*.

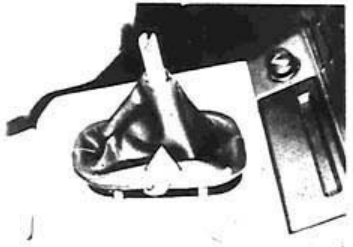
* **Source of Supply: HWB**



25 11 000 REMOVING AND INSTALLING SHIFT LEVER
– Aluminum Shift Console –

Pull off shift lever knob.

Note:
Force required to pull off knob = approx. 40 kp (88 lbs.).



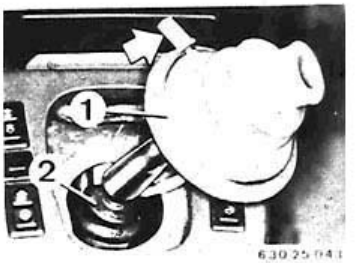
Lift out dust cover.



Model M 3:
Be careful of electric leads for the illuminated shift lever knob version when pulling off.

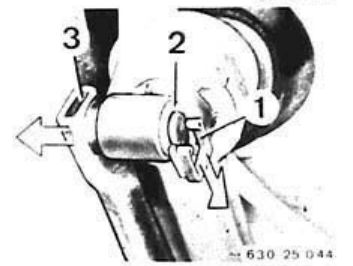


Disconnect plug (1).
Shift lever knob can only be replaced with the electric leads.
This requires pulling the plug out of the dust cover.



Remove felt.
Disconnect plug on electric leads for backup lights.
Unclip dust cover (1) on the body and pull it off of the shift lever.
Disconnect dust cover (2) on the shift console.

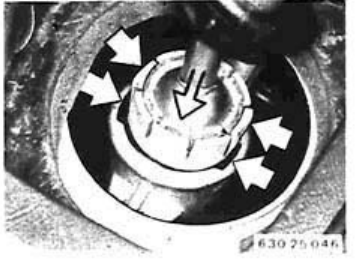
Installation:
Check dust covers.
Make sure of perfect fit.



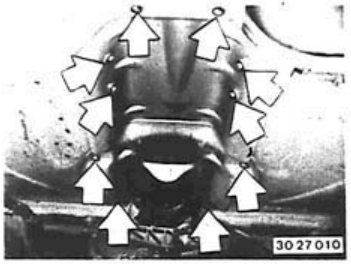
Lift out circlip (1).
Take off washer (2).
Pull out shift rod (3).



Apply Special Tool 25 1 100.
Turn counterclockwise 90°.
Push up spherical plate.
Remove shift lever from above.

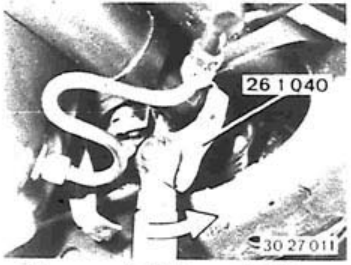


Installation:
Apply spherical plate that tabs on the spherical plate are aligned with openings in the shift console.
Press in shift lever until retaining rabs are heard to engage twice.

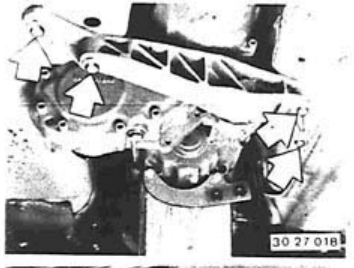


25 11 000 REMOVING AND INSTALLING SHIFT LEVER
– All Wheel Drive –

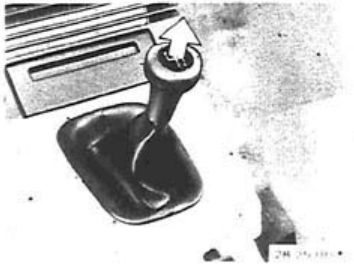
Remove exhaust assembly 18 00 020.
Unscrew heat shields.



Loosen threaded sleeve several turns with Special Tool 26 1 060 or 26 1 040.
Installation:
Tighten threaded sleeve with Special Tool 26 1 060 or 26 1 040 after finishing installation.
Tightening torque*.

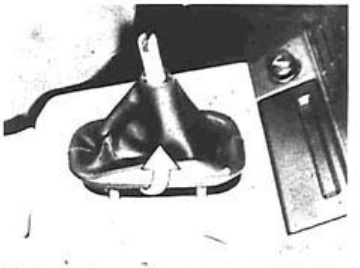


Support transmission.
Unscrew cross member.
Lower transmission to front axle carrier.
Installation:
Check length of bolts.

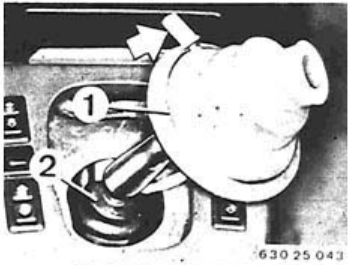


Pull off shift lever knob.

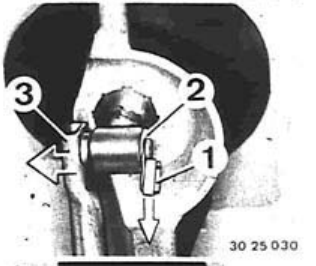
* See Specifications



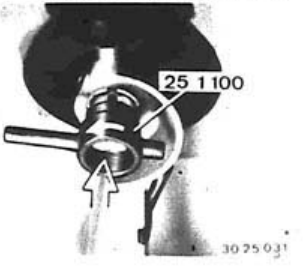
Lift out dust cover.



Remove felt.
Disconnect plug on wires for backup lights.
Unclip dust cover (1) on body and pull off of shift lever.
Disconnect dust cover (2) on shift console.
Installation:
Inspect dust covers.
Check for correct seating.



Lift out circlip (1).
Take off washer (2).
Pull out selector rod (3).

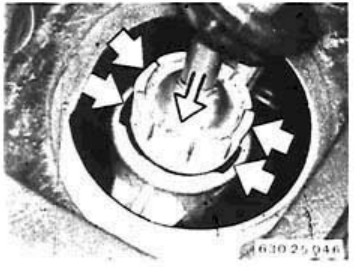


Apply Special Tool 25 1 100.
Turn counterclockwise 90°.
Push up spherical plate.
Remove shift lever from above.



Note:
One side of the toggle must be cut off up to max. 12 mm (0.472") in cars with all wheel drive.

30 25 029



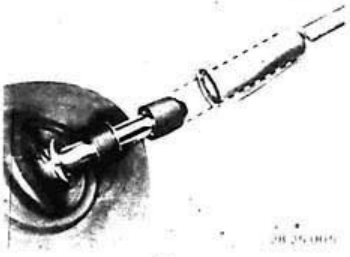
Installation:
Apply spherical plate that tabs on spherical plate are aligned with openings in shift console.
Press in shift lever until retaining tabs are heard to engage twice.



20 25 005

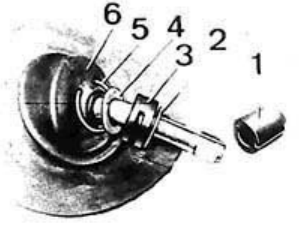
25 11 003 DISASSEMBLING AND ASSEMBLING SHIFT LEVER –Sheet Metal Shift Console–

Remove shift lever – see 25 11 000.
Lift out wire snap ring.



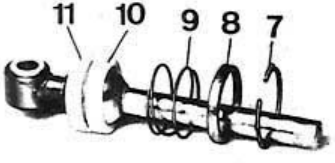
Pull off shift lever upper section.

Installation:
Check installed position.



28 25 002

Pull off cap (1).
Remove circlip (2).
Remove rubber ring (3), washer (4), snap ring (5) and rubber part (6).



20 25 007

Remove circlip (7), spring retainer (8), spring (9), upper spherical plate (10) and lower (ribbed) spherical plate (11).

Installation:
Lubricate spherical plates with Klüber Polyup GLY 801*.

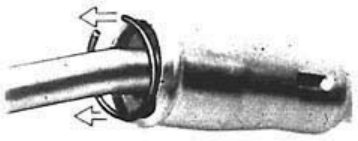
* Source of Supply: HWB



32 25 042

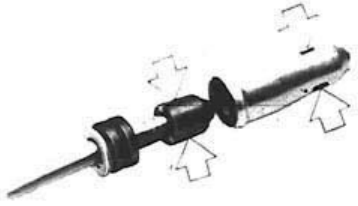
25 11 003 DISASSEMBLING AND ASSEMBLING SHIFT LEVER – Aluminum Shift Console –

New shift levers are installed in some cases beginning with 1988 models and they cannot be disassembled.



32 25 039

Remove shift lever – see 25 11 000.
Lift out wire snap ring.



32 25 040

Pull off shift lever upper section.

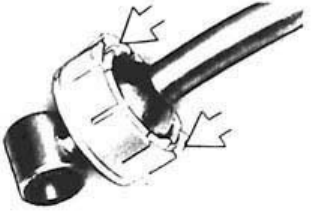
Installation:
Check the installed position.



32 25 041

Pull off cap (1).
Remove circlip (2).
Remove rubber ring (3), washer (4) and snap ring (5).

Installation:
Coat rubber parts with relaxed water to make installation easier.

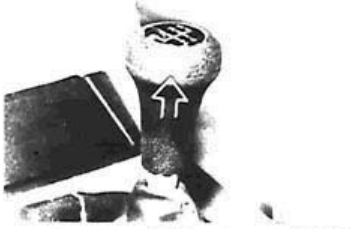


6.01 25 042

Press off bearing plate downward.

Installation:
Lubricate bearing plate and ball with Klüber Polyup GLY 801*.

25 11 081 REPLACING DUST COVER FOR SHIFT LEVER



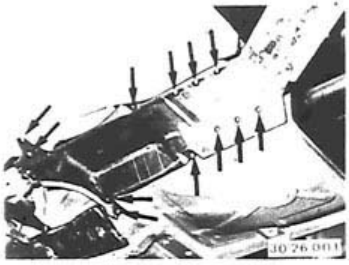
Pull off shift lever knob.

Installation:
Shift lever knob must engage in the twist-preventing lock.
Check position of the shift diagram.



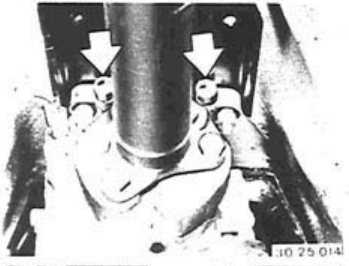
Lift out dust cover.

* Source of Supply: HWB



25 11 111 REPLACING SHIFT ROD JOINT
–Sheet Metal Shift Console–

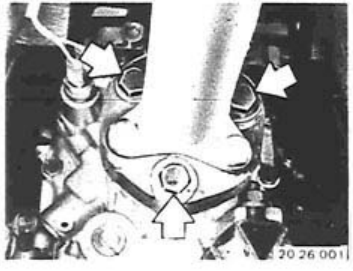
Access to the shift rod joint differs in accordance with the different transmission and propeller shaft versions.
Remove exhaust assy. – 18 00 020.
Remove heat shield with reinforcement carrier.



Version with 4 Speed Transmission:
Unscrew console mounting bolts.

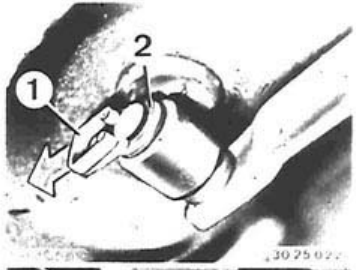
Important!
Self-locking bolts – will be difficult to unscrew.

Installation:
Use new bolts coated with a micro-encapsulating cement.
Tightening torque*.

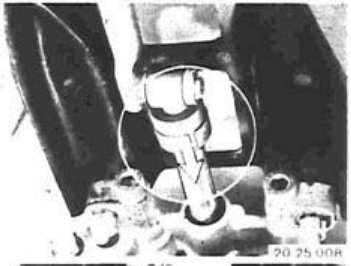


Version with 5 Speed Transmission:
Unscrew propeller shaft on transmission, see 26 11 000.

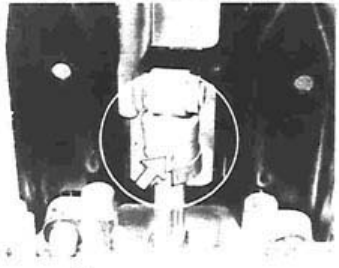
Version with 5 Speed Transmission and Vibration Damper:
Unscrew propeller shaft on transmission, see 26 11 000.
Unscrew output flange with vibration damper on transmission, see 23 12 053.



Engage reverse gear.
Lift out circlip (1).
Take off washer (2).
Pull out shift rod (3).



Push back locking sleeve.



Move shift shaft to 3rd or 5th gear position.
Drive out pin.
Remove shift rod with joint.

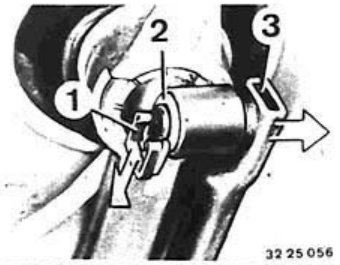
Note:
If shift rod joint has an offset bearing sleeve, install the bearing sleeve offset to the right as seen looking forward. Install offset to the left in cars with a vibration damper and bent shift rod.



Installation:
Lubricate bearing surfaces with Klüber Polyup GLY 801**.

* See Specifications

** Source of Supply: HWB



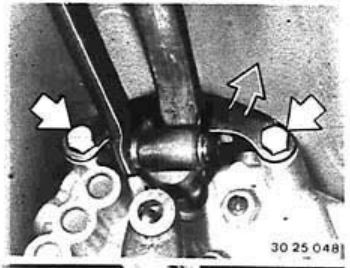
32 25 056

25 11 111 REPLACING SHIFT ROD JOINT – Aluminum Shift Arm –

Unscrew propeller shaft on transmission – see 26 11 000.
Engage reverse gear.
Pull off retainer (1).
Take off washer (2).
Pull out shift rod (3).


32 25 053

Installation:
Check damper in joint, replacing if necessary.


30 25 048

Model M 3:

Loosen bolt of shift arm holder on the left-hand side.
Remove right bolt.
Swing up holder.


32 25 054

Installation:
Offset bearing sleeve to the left as seen looking forward.


32 25 051

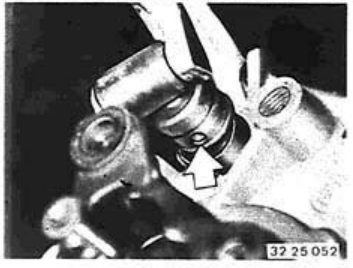
Lift locking sleeve out of groove and slide forward.



32 25 055

Lift out retainer (1).
Take off washer (2).
Pull out shift rod.

Installation:
Inspect rubber rings (3), replacing if necessary.
Lubricate bearing surfaces with Klüber Polyup GLY 801*.


32 25 052

Drive out pin.
Pull out shift rod with joint.

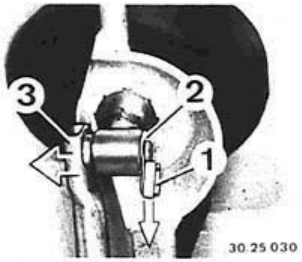


30 25 052

Model M 3:

Lift out retainer (1).
Pull off shift rod with washers (2).

* Source of Supply: HWB



30.25.030

25 11 111 REPLACING SHIFT ROD JOINT
– Four Wheel Drive –

Remove transfer box – see 27 10 010.
Lift out retainer (1).
Take off washer (2).
Pull out shift rod (3).



30.25.047

Lift out retainer (1).
Take off washer (2).
Pull out shift rod.

Installation:
Inspect rubber rings (3), replacing if necessary.
Lubricate bearing surfaces with Klüber Polyup GLY 801*.


30 25 034

Push back locking sleeve.


30 25 035

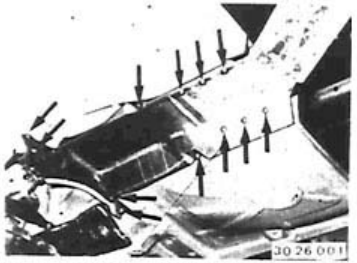
Drive out pin.
Remove shift rod with joint.

Note:
The bearing sleeve is offset to the right as seen looking forward.


32.25.051

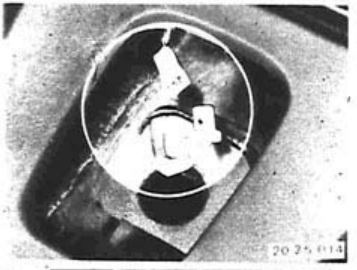
Installation:
Check damper in joint, replacing if necessary.

* Source of Supply: HWB

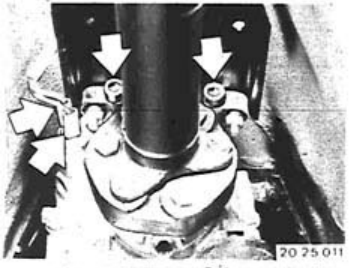


25 11 211 REPLACING SHIFT LEVER CONSOLE
– Sheet Metal Shift Console –

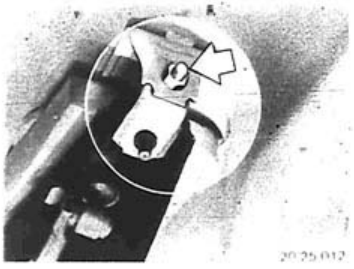
Remove exhaust assembly 18 00 020.
Remove heat shield and reinforcement carrier.
Remove shift lever 25 11 000.



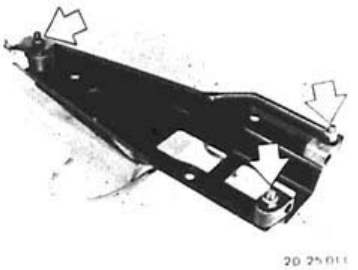
Disconnect plug.



Pull off wires for backup lights.
Unscrew console mounting screws.
Important!
Self-locking screws – will be difficult to unscrew.
Installation:
Use new screws coated with a micro-encapsulated adhesive.
Tightening torque*.

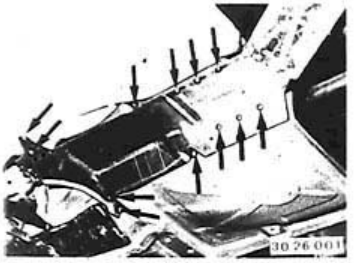


Unscrew mounting bracket.
Installation:
Install the shift lever first to make installation of the rubber cover easier.



Remove console.
Installation:
Check rubber mounts, replacing if necessary

* See Specifications

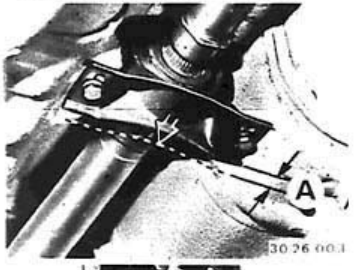


25 11 211 REPLACING SHIFT LEVER CONSOLE
– Aluminum Shift Console –

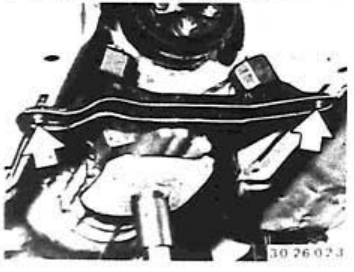
Remove exhaust assembly 18 00 020.
Unscrew heat shield and reinforcement carrier.
Remove shift lever 25 11 000.



Unscrew threaded sleeve several turns with Special Tool 26 1 040.
Installation:
Tighten threaded sleeve with Special Tool 26 1 040 after finishing installation.
Tightening torque*.

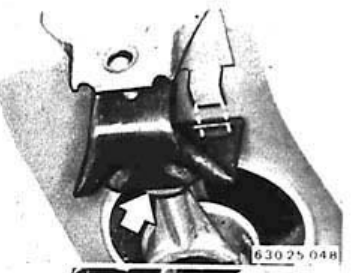


Unscrew center mount.
Installation:
Preload center mount forward by distance A = 4 to 6 mm (0.157 to 0.236").

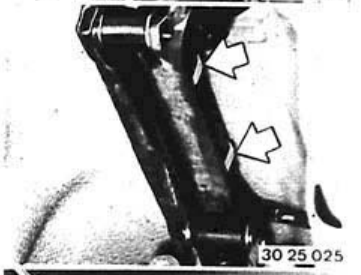


Support transmission.
Unscrew cross member.
Lower transmission to front axle carrier.

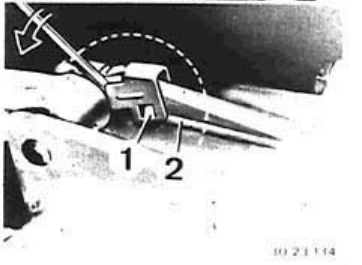
* See Specifications



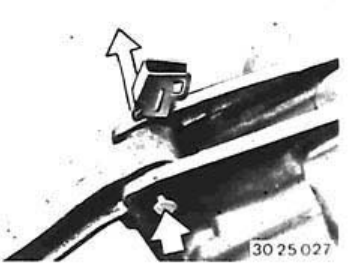
Unscrew bracket.
Installation:
Lubricate support with grease.
Engage bracket in retaining tabs.



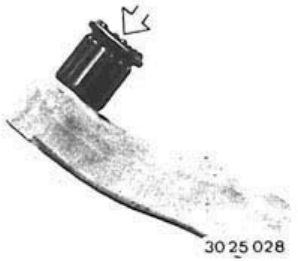
Take wires for backup lights out of holder.



Lift out clip on shaft bolt.
Note:
Clip is accessible with a screwdriver.
Disconnect clip in retaining tab by turning and swing up.

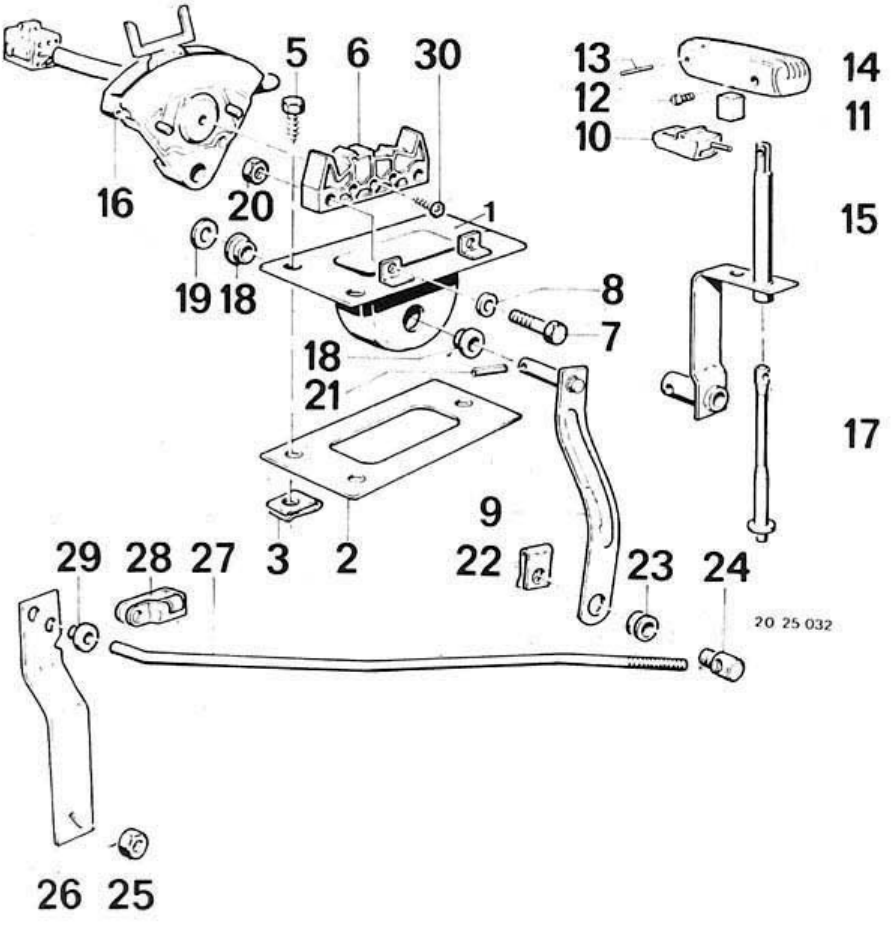


Pull out shaft bolt.
Take off shift console.



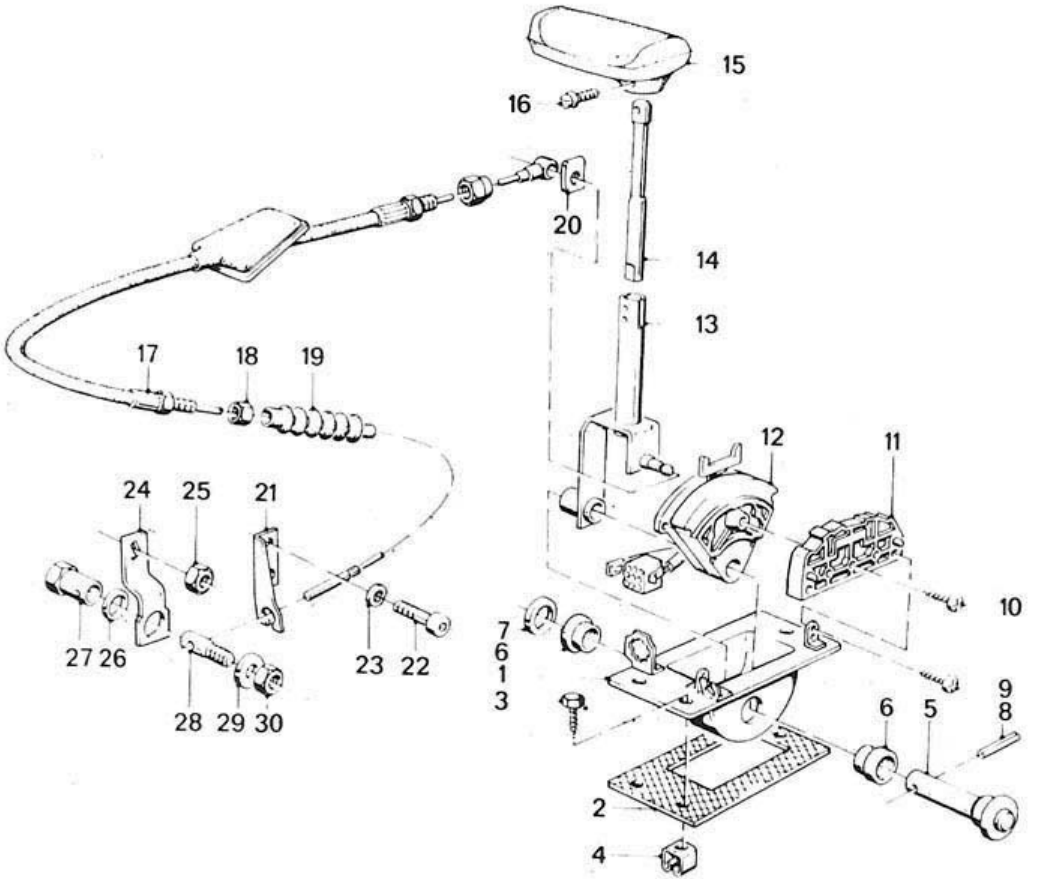
Lubricate bearing sleeve with grease and press it into new console.

SHIFT LAYOUT DRAWING FOR AUTOMATIC TRANSMISSION
– Version with Selector Rod –

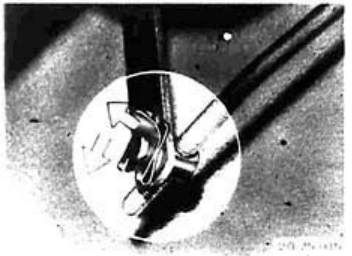


1 Mount
2 Insulator
3 Self-tapping nut
5 Self-tapping screw
6 Shift gate
7 Bolt
8 Washer
9 Selector lever lower section
10 Push button
11 Spring element
12 Stud
13 Cyl. pin
14 Handle
15 Selector lever
16 Transmission switch
17 Pull rod
18 Bearing sleeve
19 Shim
20 Nut
21 Key
22 Retainer
23 Pivot sleeve
24 Shaft pin
25 Nut
26 Selector lever bar
27 Selector rod
28 Spring retainer
29 Sleeve
30 Oval head screw

SHIFT LAYOUT DRAWING FOR AUTOMATIC TRANSMISSION
– Version with Cable / All Wheel Drive Cars –

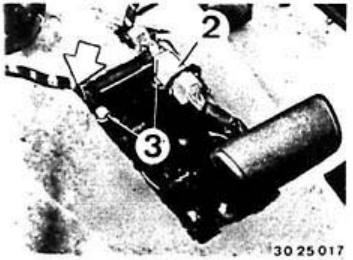


1 Mount
2 Insulator
3 Self-tapping screw
4 Self-tapping nut
5 Shaft
6 Bearing sleeve
7 Shim
8 Key
9 Self-tapping screw
10 Self-tapping screw
11 Shift gate
12 Transmission switch
13 Selector lever
14 Pull rod
15 Handle
16 Stud
17 Cable
18 Nut
19 Dust cover
20 Retainer
21 Holder
22 Screw
23 Washer
24 Transmission lever
25 Nut
26 Washer
27 Sleeve
28 Clamping bolt
29 Washer
30 Nut

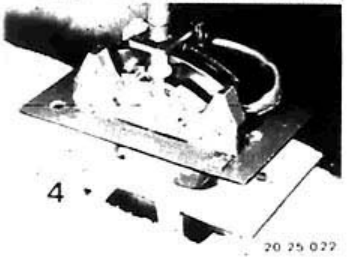


25 16 050 REMOVING AND INSTALLING SELECTOR LEVER COMPLETE WITH BASE
– Version with Shift Rod –

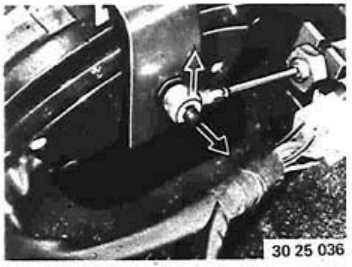
Remove center console – see 51 16 200.
Lift out retainer.
Disengage shift rod.
Installation:
Adjust shift rod – see 24 00 004.



Disconnect plug (2).
Remove bolts (3).
Remove base.
Installation:
Be careful not to pinch the wire harness.

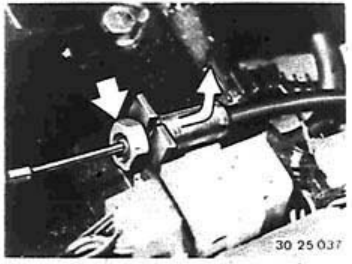


Installation:
Insert insulator (4).

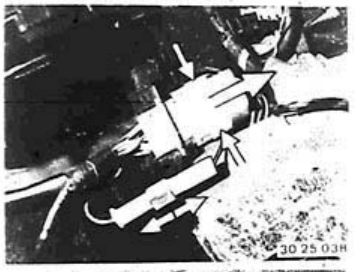


25 16 050 REMOVING AND INSTALLING SELECTOR LEVER COMPLETE WITH BASE
– Version with Cable –
(All Wheel Drive Cars)

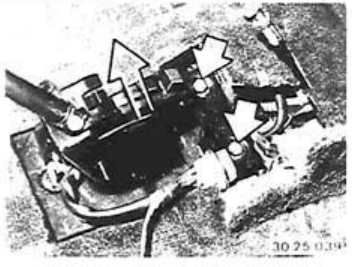
Remove center console – see 51 16 200.
Lift out retainer.
Unscrew eye on pin.
Important!
Don't bend the steel wire.



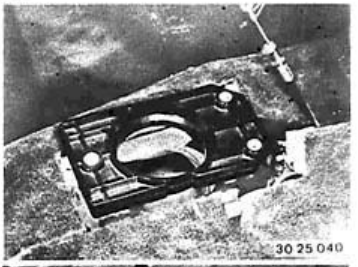
Unscrew nut.
Disengage cable sleeve in holder.



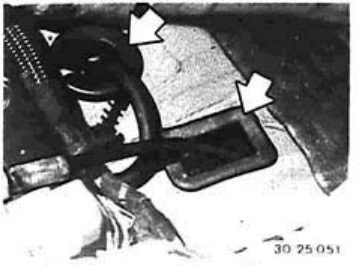
Disconnect plugs.



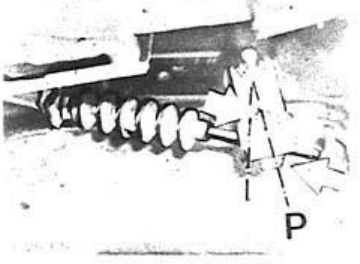
Unscrew bolts.
Remove base.



Installation:
Check installed direction of transfer plate.
Check for correct seating of rubber cover and foam rubber seal.



Installation:
Check for correct seating of rubber seals after finishing installation.



Installation:
Adjust cable.
Shift lever in "P" (most forward position).
Press cable rod opposite forward direction.
Clamp cable rod without tension.
Important!
Tightening torque = 10 to 12 Nm (7 to 9 ft. lbs.).
Don't bend the cable.



20 25 023

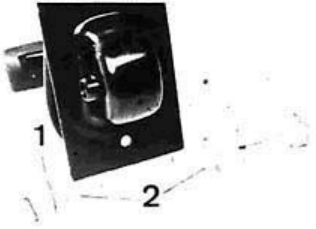
25 16 080 REMOVING AND INSTALLING SELECTOR LEVER
– Version with Shift Rod –

Remove selector lever complete with base – see 25 16 050.
Drive out pin.



30 25 019

Unscrew screw on handle.
Pull off handle.



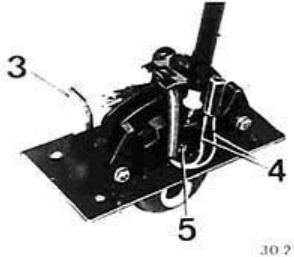
20 25 024

Pull out selector lever lower section.
Remove washer (1) and bearing sleeves (2).
Installation:
Check bearing sleeves, replacing if necessary and lubricating with Molykote Longterm 2.



20 25 028

Installation:
Guide pin of push button into pull rod hole.



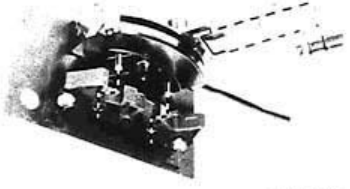
30 25 018

Pull off plug (3).
Disconnect scale light wire (4).
Unscrew screw (5).
Remove transmission switch together with the upper selector lever section.



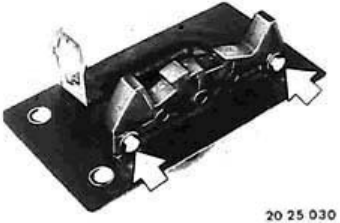
30 25 020

Take pull rod out of selector lever upper section.



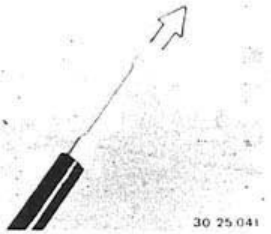
20 25 026

Installation:
Check installed position of transmission switch and drive.



20 25 030

Installation:
Check gate, replacing if necessary.



25 16 080 REMOVING AND INSTALLING SELECTOR LEVER – Version with Cable – (Four Wheel Drive)

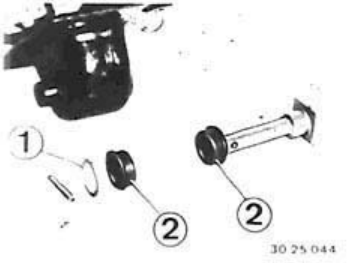
Remove selector lever complete with console – see 25 16 050.
Take pull rod out of upper selector lever section.



Pull display lamp out of holder.
Unclip electric leads.



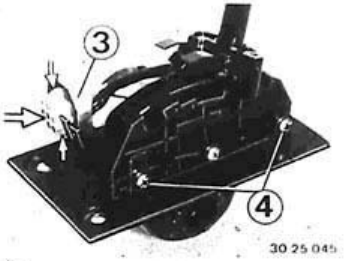
Drive out pin.



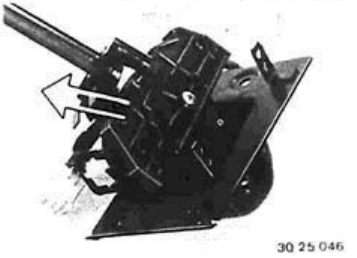
Pull out shaft.
Take off washer (1).
Pull bearing sleeves (2) out of housing.

Installation:
Replace bearing sleeves.
Lubricate bearing surfaces with Klüber Polyup GLY 801*.

* Source of Supply: HWB

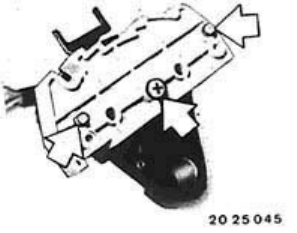


Disconnect plug (3) in holder.
Unscrew screws (4).



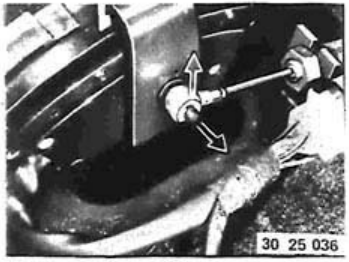
Tilt out shift lever together with transmission switch and shift gate.

Installation:
Swivel on transmission switch engages on the selector lever.



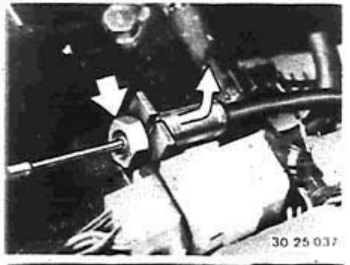
Unscrew shift gate on transmission switch.

Installation:
Make sure that pins on transmission switch engage in bores of the shift gate.



25 16 202 REPLACING CABLE FOR GEAR SELECTOR LEVER

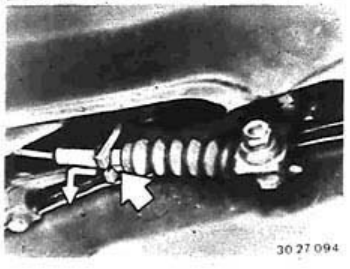
Remove center console - see 51 16 200.
Lift out retainer.
Unscrew eye on pin.
Important!
Don't bend the steel wire.



Unscrew nut.
Disconnect cable sleeve in holder.



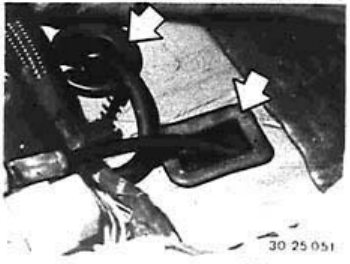
Loosen nuts.
Important!
Don't bend the steel wire.



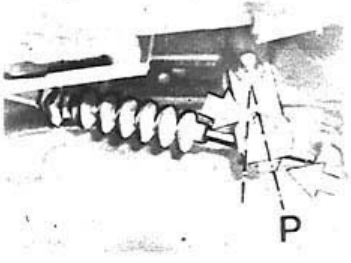
Unscrew nuts.
Push back cable sleeve and take out of holders.
Pull cable out of operating lever.



Pull out rubber grommet and cable from above.



Installation:
Check for correct fit of rubber gaskets after finishing installation.

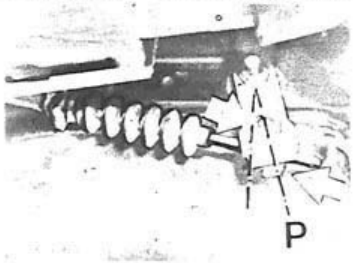


Installation:
Adjust cable.
Selector lever in position "P" (most forward position).
Press cable rod opposite the forward direction.
Clamp down cable rod without tension.
Important!
Tightening torque: 10 to 12 Nm (7.5 to 8.5 ft. lbs.).
Don't bend the cable.



ADJUSTING CABLE FOR GEAR SELECTOR LEVER

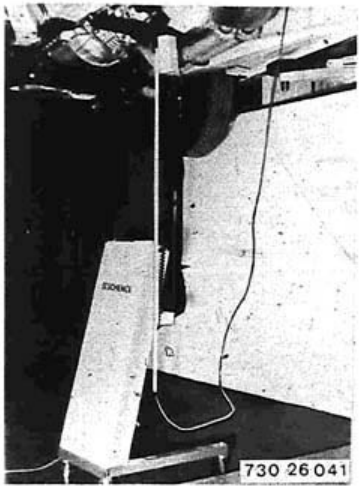
Selector lever in position "P" (most forward position).
Loosen nut until cable rod is cleared.



Selector lever in position "P" (most forward position).
Press cable rod opposite the forward direction.
Clamp down cable rod without tension.
Important!
Tightening torque: 10 to 12 Nm (7.5 to 8.5 ft. lbs.).
Don't bend the cable.

26 Propeller Shaft

	Propeller shaft vibration and noise – eliminate	26- 1
26 11 000	Propeller shaft – remove and install	26- 3
	Propeller shaft – remove and install (four wheel drive)	26- 5
051	Joint disc for propeller shaft, rear – replace	26- 6
	Joint disc for propeller shaft, rear – replace (four wheel drive)	26- 8
160	Constant velocity joint for propeller shaft – replace	26- 8.2
501	Centre for propeller shaft, front – replace	26- 9
26 12 001	Propeller shaft centre mount assembly – replace	26- 10
26 20 000	Propeller shaft, front – remove and install (four wheel drive)	26- 12
020	Sealing cap for propeller shaft, front – replace (four wheel drive)	26- 13
051	Joint disc for propeller shaft, front – replace (four wheel drive)	26- 14
	Troubleshooting propeller shaft	26- 15



ELIMINATING PROPELLER SHAFT VIBRATION AND NOISE

Vibration or Noise:

Requirement:
Propeller shaft in perfect optical condition.
Balance propeller shaft if balance plates are missing or propeller shaft is suspected to have imbalance (refer to instructions supplied with balancing equipment).

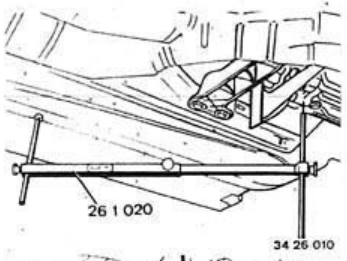
Caution!
A jacked up car may only be test operated when the suspension of the driven wheels is supported (deflection angle of output shafts).
Never exceed the maximum speed specified for a car jacked up or on a dynamometer.
Conform with safety regulations!



Adjust transmission laterally until the special tool gage has the same distance on left and right sides.

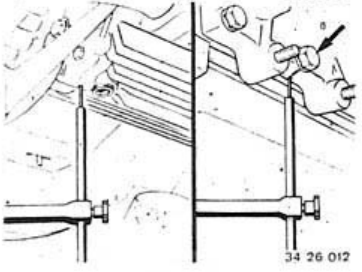
Checking Propeller Shaft Deflection Angle:

Remove exhaust assembly, heat shield and, if applicable, splash guard.

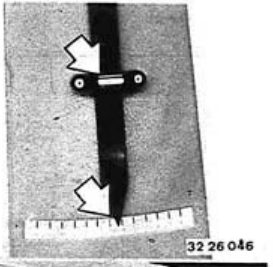


Aligning Propeller Shaft:

Loosen exhaust assembly, engine's rubber mounts and transmission's cross member.
Apply Special Tool 26 1 020.



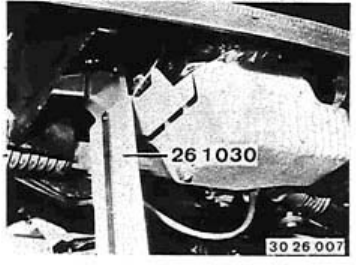
Checkpoints:
Rear bore of engine carrier.
Manual transmissions: center cast rib.
Automatic transmissions: center bolt of transmission extension.
Mark checkpoints with a punch.



Apply Special Tool 26 1 030 on a surface of the engine which is perpendicular or parallel to the crankshaft.

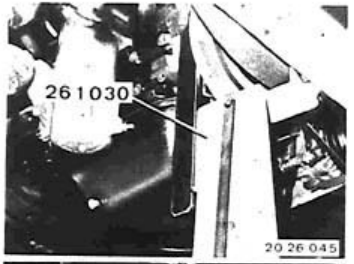
Position the indicator perpendicular with the water level.
Read the number of degrees.

Note:
Always apply the special tool gage with the sacle in the same direction (for example: scale toward right side).
One graduation = 5'.
Position of the car is not important, since only the different angles are compared.

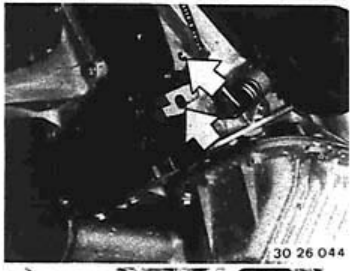


The following bearing surfaces can be used depending on the engine type and version.

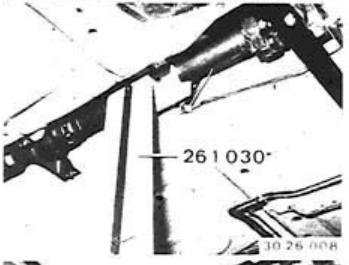
Apply Special Tool 26 1 030 on the oil sump flange and measure inclination of the engine.



Place Special Tool 26 1 030 and a helping rail (steel ruler) on the vibration damper and measure the angle of engine inclination.



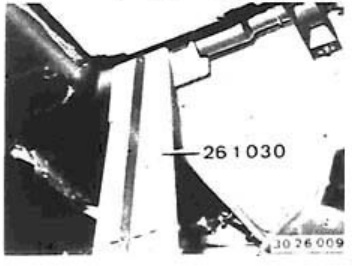
Place Special Tool 26 1 030 and a helping rail (steel ruler) on a level engine block surface which is perpendicular to the crankshaft. (For example: M 40 engine)



Apply gage on propeller shaft front section and measure angle. Measure deflection angle* of joint disc and, if necessary, correct it with shims (up to max. 3 mm / 0.118") on the transmission suspension or center mount.

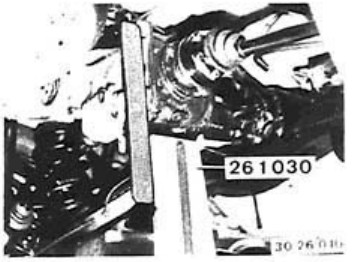
Example:

Engine angle	2° 16'
Propeller shaft angle	- 2° 06'
Joint disc defl. angle	+0° 10'



Apply gage on propeller shaft rear section and measure angle. Determine deflection angle* of center mount and, if necessary, correct it with shims (up to max. 3 mm / 0.118") on transmission suspension or center mount.

* See Specifications



Apply gage on final drive with helping rail (steel ruler) and measure angle. Determine deflection angle* of the universal joint and, if necessary, correct it with shims (up to max. 3 mm or 0.118") on the center mount.

Note:
When correcting a deflection angle by installing shims, remember that the deflection angles of the adjacent joints will also change.
In general joints should have as small as possible deflection angles.

* See Specifications



Hard Movement on Slide:

– Slide on Center Mount –

Important!

The propeller shaft was balanced in assembled state and must not be turned in the slide.

Mark position of propeller shaft sections to each other.

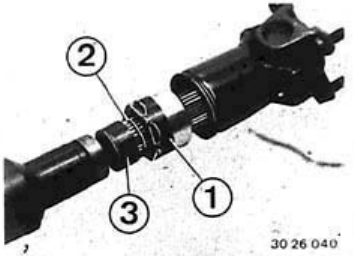
Remove threaded sleeve (1), washer (2) and rubber ring (3).

Check rubber ring, replacing if necessary.

Disconnect propeller shaft on slide.

Clean and lubricate keyway with Molykote Longterm 2**.

Assemble propeller shaft that marks are in one plane.



Hard Movement on Slide:

– Propeller Shaft for All Wheel Drive –

Important!

The propeller shaft was balanced in assembled state and must not be turned in the slide.

Mark position of propeller shaft sections to each other.

Remove threaded sleeve (1), washer (2) and rubber ring (3).

Check rubber ring, replacing if necessary.

Disconnect propeller shaft on slide.

Clean and lubricate keyway with Molykote Longterm 2**.

Assemble propeller shaft that marks are in one plane.

Installation:

Check seal in dust cap, replacing if necessary.

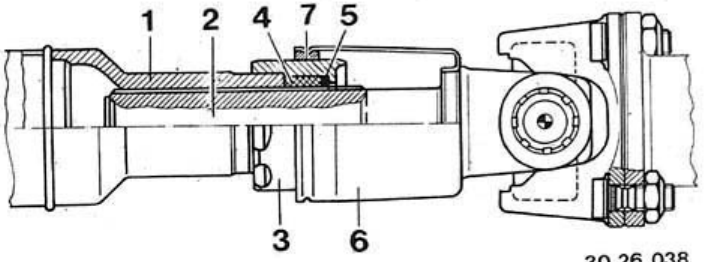




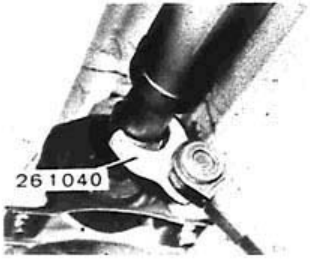
Note:

Propeller shaft sections are mounted in such a manner that universal joints are in one plane.

If the slide had been disassembled by mixtake without marking, it will only mean the possibility of installing the propeller shaft wrong by 180° because of balancing.



1 Front propeller shaft section
2 Rear propeller shaft section
3 Clamping nut
4 Clamp
5 Washer
6 Dust cap
7 Seal



After finishing installation:

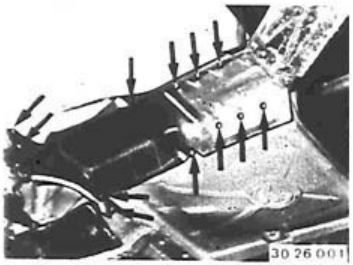
Tighten threaded sleeve with Special Tool 26 1 040.

Tightening torque*.

* See Specifications

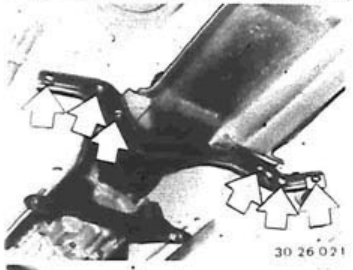
** Source of Supply: HWB

** Source of Supply: HWB



26 11 000 REMOVING AND INSTALLING PROPELLER SHAFT

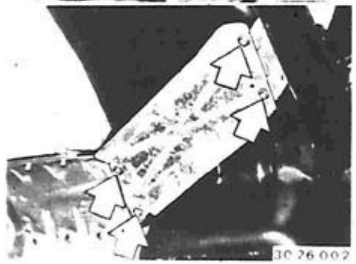
Remove and install primary and final mufflers 18 12 000.
Unscrew heat shield.



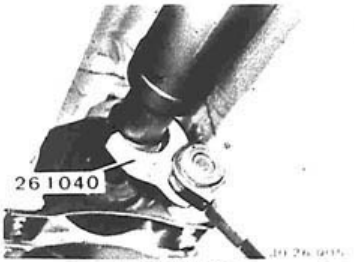
Since 1983 Models:
Unscrew connector.



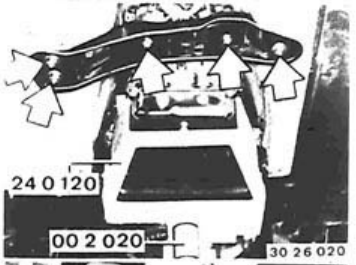
Installation:
Also bolt on holder for oxygen sensor plug on cars with catalytic converter.



Unscrew heat shield.
Installation:
Check for sufficient space between tank and heat shield.



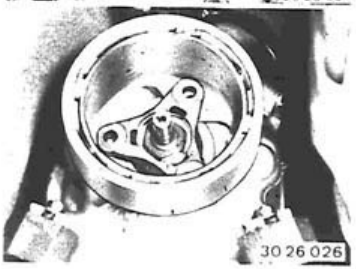
Unscrew threaded sleeve several turns with Special Tool 26 1 040.
Installation:
Tighten threaded sleeve with Special Tool 26 1 040 after finishing installation.
Tightening torque*.



Cars with 4 HP 22 Automatic Transmission:
Support transmission with Special Tools 20 0 120 and 00 2 020.
Unscrew transmission suspension.

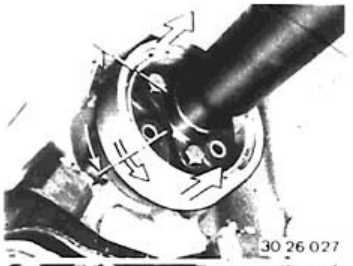


Unscrew propeller shaft on transmission.



Cars with Bolted Vibration Damper (325 i):
The vibration damper is mounted on the output flange on the transmission end.

* See Specifications

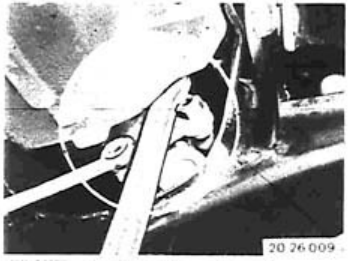


Unscrew propeller shaft on the transmission.
Turn and bear the vibration damper on the joint disc.
The vibration damper is removed together with the propeller shaft.



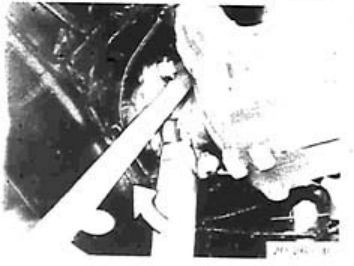
Installation:
Replace stop nuts.
Tightening torque*.

Important!
Only turn nuts or bolts on the flange end whenever possible by design, to avoid tension in the joint disc.



<u>Version with Universal Joint:</u>

Unscrew propeller shaft on rear axle final drive.



Installation:
Replace stop nuts.
Tightening torque*.

* See Specifications



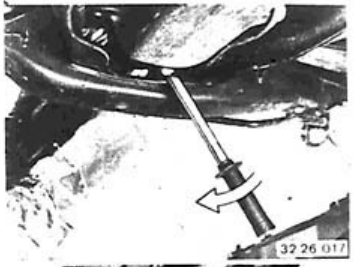
Version with Constant Velocity Joint:

Unscrew propeller shaft on rear axle final drive.

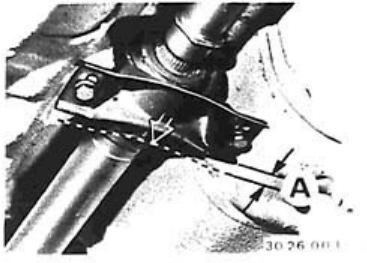


Installation:
Check gasket, replacing if necessary.

Important!
The constant velocity joint is not encapsulated. Protect joint against dirt with the transporting cap or something similar.
Check grease filling*.



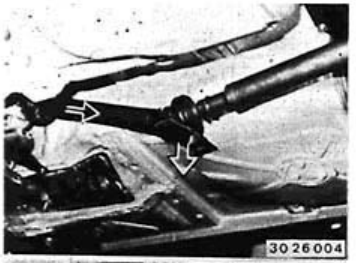
Installation:
Replace stop nuts.
Tightening torque*.



Unscrew center mount.

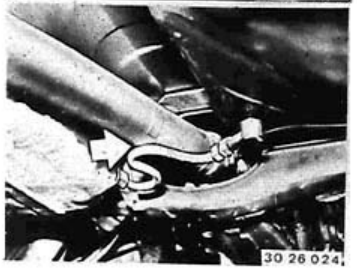
Installation:
Preload center mount forward by distance A = 4 to 6 mm (0.157 to 0.236").

* See Specifications

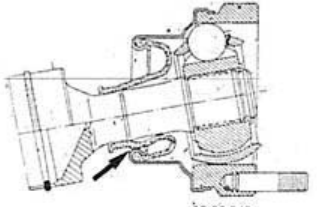


Bend propeller shaft down and pull out of centering pin on the transmission. If applicable, push back propeller shaft on the slide completely.

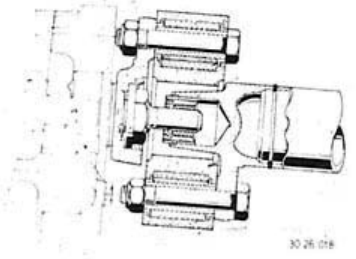
Installation:
Propeller shaft was balanced as an assembly and can only be replaced as such.



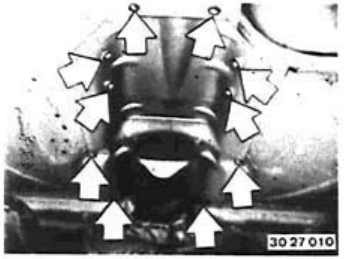
Important!
Don't allow the propeller shaft to bear on the connecting pipe on the fuel tank.



Important!
Don't allow the propeller shaft to fall into the joints. This would damage the rubber cover especially on a constant velocity joint.



Installation:
Check center, lubricating with Molykote Longterm 2 if necessary.
Replace a damaged center.



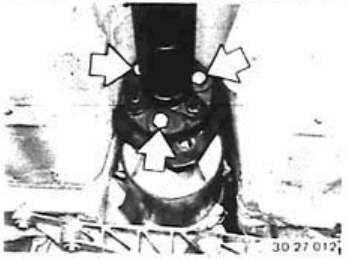
26 11 000 **REMOVING AND INSTALLING PROPELLER SHAFT**
– Four Wheel Drive –

Important!
Never move a car by engine power after removal of the propeller shaft (visco central lock in the transfer box would be damaged).
Remove exhaust assembly – 18 00 020.
Remove heat shields.

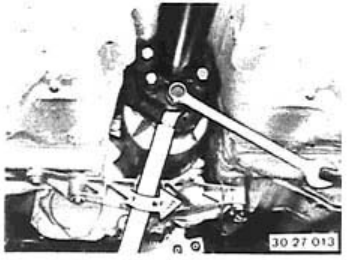


Loosen the threaded sleeve several turns with Special Tool 26 1 060 or 26 1 040.

Installation:
Tighten the threaded sleeve with Special Tool 26 1 060 or 26 1 040 after finishing installation.
Tightening torque*.



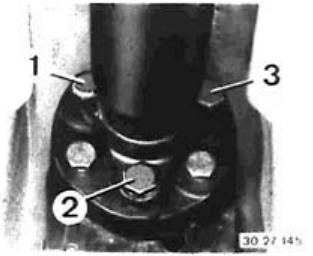
Unscrew propeller shaft on the transfer box.



Installation:
Replace stop nuts.
Tightening torque*.

Important!
Only turn nuts or bolts on flange end whenever possible by design to avoid strain in joint disc.

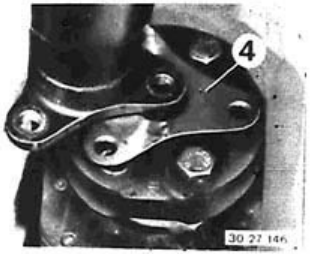
* See Specifications



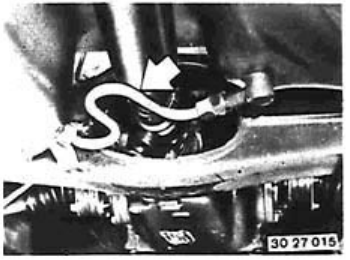
Version without Slide:

Bolts (1 ... 3) must be loosened to take propeller shaft off of transmission.
Joint disc remains on transmission.

Installation:
Tightening torque*.

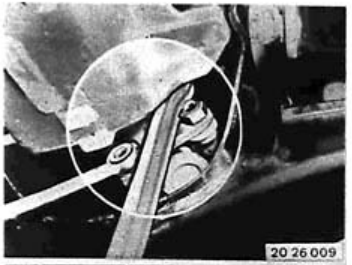


Pull propeller shaft off intermediate flange (4).
Suspend propeller shaft from car on piece of wire.



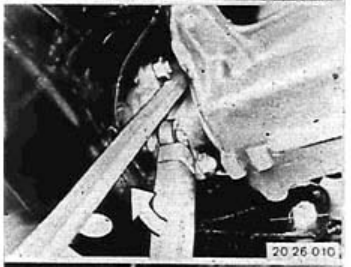
Caution!
Never allow propeller shaft to bear on connection pipe on fuel tank.

* See Specifications



Version with Universal Joint:

Unscrew propeller shaft on rear axle final drive.

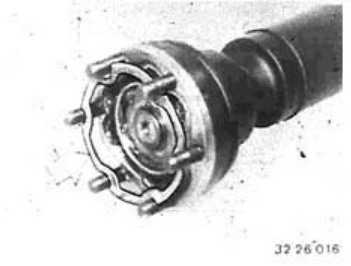


Installation:
Replace stop nuts.
Tightening torque*.



Version with Constant Velocity Joint:

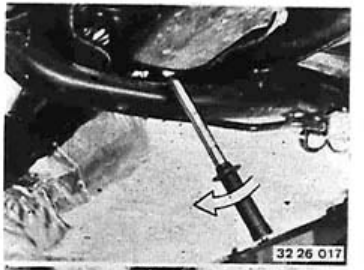
Unscrew propeller shaft on rear axle final drive.



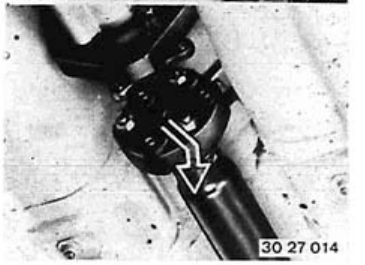
Installation:
Check gasket, replacing if necessary.

Important!
Constant velocity joint is not encapsulated. Protect joint against dirt with transporting cap or something similar. Check grease filling*.

* See Specifications



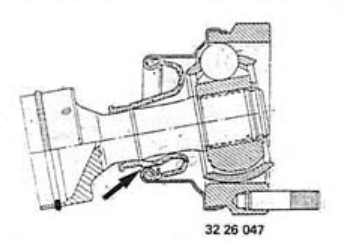
Installation:
Replace stop nuts.
Tightening torque*.



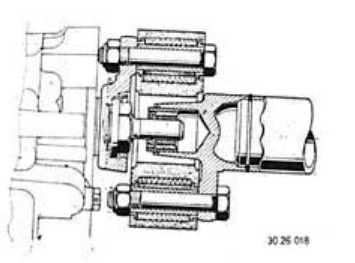
Push propeller shaft together and pull out of center on transfer box.
Remove propeller shaft.

Note!
Propeller shaft was balanced as an assembly and must only be replaced as such.

Caution!
Don't allow propeller shaft to fall on connecting pipe.

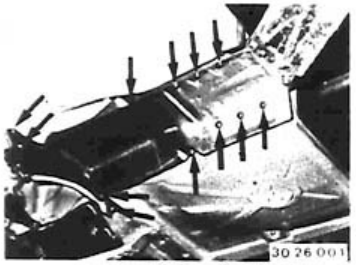


Caution!
Don't allow propeller shaft to fall into joints as this would damage rubber covers especially on constant velocity joints.



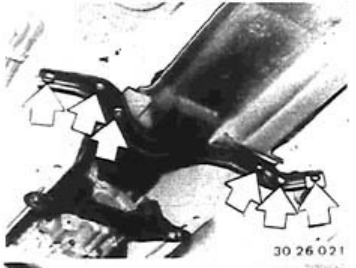
Installation:
Check center, lubricating with Molykote Longterm 2 if necessary.
Replace center if damaged.

* See Specifications



26 11 051 REPLACING JOINT DISC FOR REAR PROPELLER SHAFT

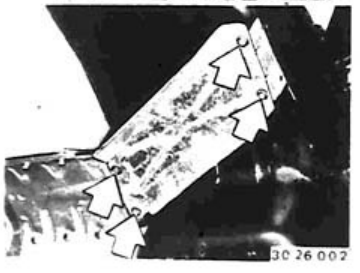
Remove primary and final mufflers 18 12 000.
Unscrew heat shield.



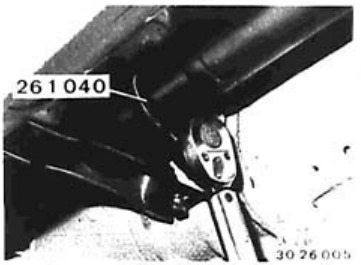
Since 1983 Models:
Unscrew connector.



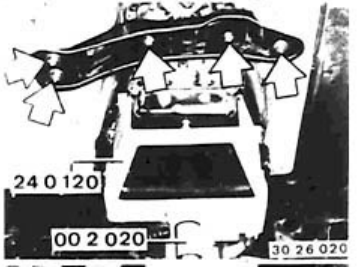
Installation:
Also bolt on holder for oxygen sensor plug on cars with catalytic converter.



Unscrew heat shield.
Installation:
Check for sufficient space between tank and heat shield.



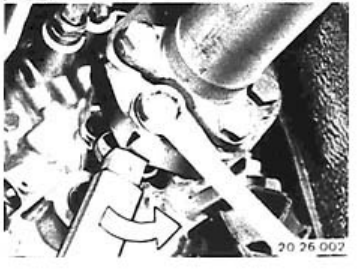
Loosen threaded sleeve several turns with Special Tool 26 1 040.
Installation:
Tighten threaded sleeve with Special Tool 26 1 040 after finishing installation.
Tightening torque*.



Cars with 4 HP 22 Automatic Transmission:
Support transmission with Special Tools 24 0 120 and 00 2 020.
Unscrew transmission suspension.

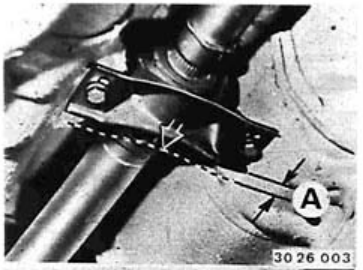


Unscrew propeller shaft on transmission.

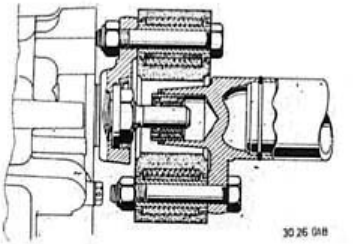


Installation:
Replace stop nuts.
Tightening torque*.
Important!
Only turn on nuts and bolts on flange side whenever permitted by design, to avoid stress in coupling.

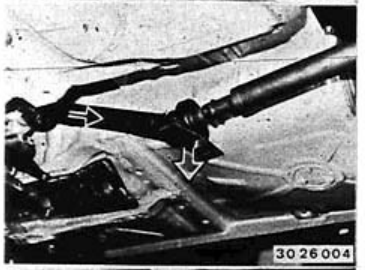
* See Specifications



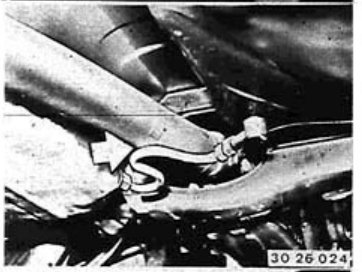
Unscrew center mount.
Installation:
Preload center mount in forward direction A = 4 to 6 mm (0.157 to 0.236").



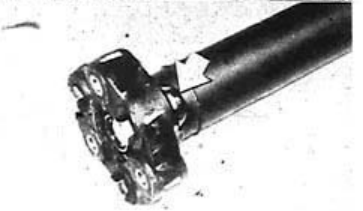
Installation:
Check center, lubricating with Molykote Longterm 2 if necessary.
Replace a damaged center.



Bend propeller shaft down and pull out of centering pin on transmission.
Push propeller shaft together completely on slide if necessary.
Note:
Propeller shaft was balanced in assembled state and may only be replaced as such.
Do not disconnect propeller shaft on slide.

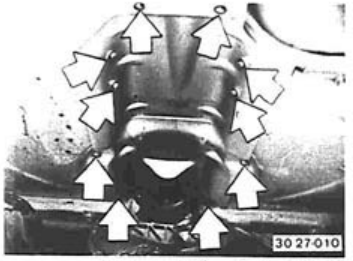


Caution!
Don't let propeller shaft rest on fuel tank connecting line.



Replace coupling.
Install coupling that arrows face flange arms.
Tightening torque*.

* See Specifications



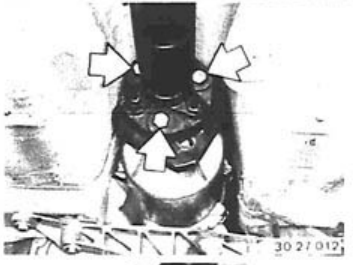
26 11 051 REPLACING JOINT DISC FOR PROPELLER SHAFT (REAR) – Four Wheel Drive –

Remove exhaust assembly - see 18 00 020.
Unscrew heat shield.

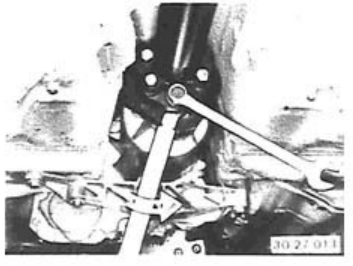


Loosen threaded sleeve several turns with Special Tool 26 1 060 or 26 1 040.

Installation:
Tighten threaded sleeve with Special Tool 26 1 060 or 26 1 040 after finishing installation.
Tightening torque*.



Unscrew propeller shaft on transfer box.



Installation:
Replace stop nuts.
Tightening torque*.

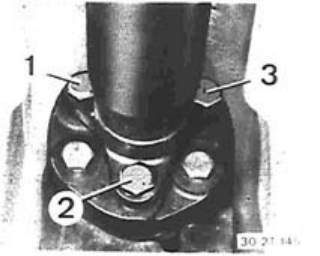
Important!
Only turn nuts or bolts on flange end whenever possible by design to avoid strain in joint disc.

* See Specifications



Push propeller shaft together and pull out of center on transfer box.

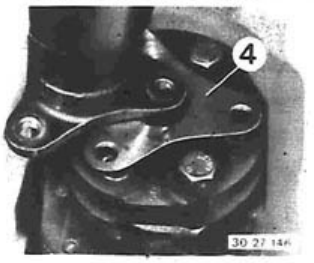
Note!
Propeller shaft was balanced as an assembly and must only be replaced as such.



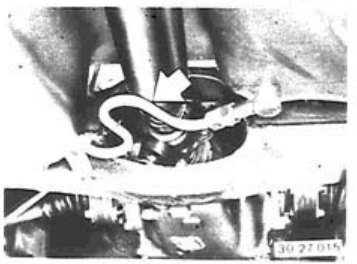
Version without Slide:

Bolts (1 ... 3) must be loosened to remove propeller shaft from gearbox. Joint disc remains on gearbox.

Installation:
Tightening torque*.

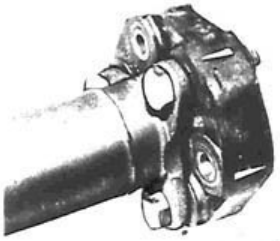


Pull propeller shaft off intermediate flange (4).
Suspend propeller shaft from car on piece of wire.



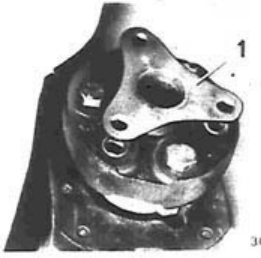
Caution!
Never allow propeller shaft to bear on connection pipe on fuel tank.

* See Specifications



Replace joint disc.
Mount joint disc that arrows point to flange arms.
Tightening torque*.

Caution!
Only turn nuts or bolts on flange end whenever possible by design to avoid strain in joint disc.



Version with Intermediate Flange:

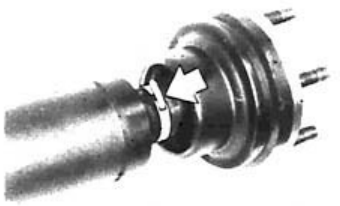
Pull intermediate flange (1) off centering pin.
Check center, lubricating with Molykote Longterm 2 if necessary.
Replace center if damaged.



Unscrew joint disc from transmission.
Replace joint disc.
Mount joint disc that arrows point to flange arms.
Tightening torque*.

Caution!
Only turn nuts or bolts on flange end whenever possible by design to avoid strain in joint disc.

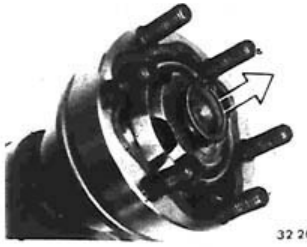
* See Specifications



32 26 035

26 11 160 REPLACING CONSTANT VELOCITY JOINT FOR PROPELLER SHAFT

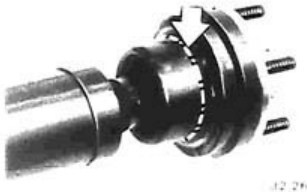
Remove propeller shaft – see 26 11 000.
Remove hose clamp.



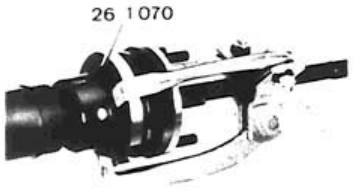
32 26 036

Lift out circlip.

Installation:
Replace circlip.



Saw through metal sleeve along line all around.



Push back sleeve.
Apply Special Tool 26 1 070.
Pull off constant velocity joint with a standard puller.



32 26 039

Fill new constant velocity joint with 80 grams of grease**.

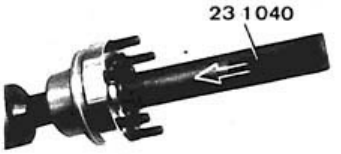
Note:
Don't cant inner race with cage, since balls would fall out.



32 26 040

Clean splines to remove grease and coat with bolt cement**.

Important!
Keep bolt cement out of ball paths.



32 26 041

Drive constant velocity joint on propeller shaft with Special Tool 23 1 040.

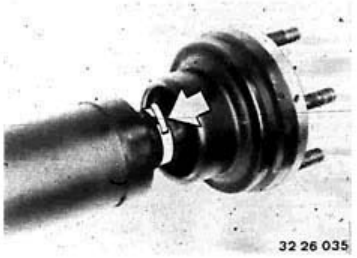


32 26 042

Install circlip.

Note:
Check for correct and tight fit.

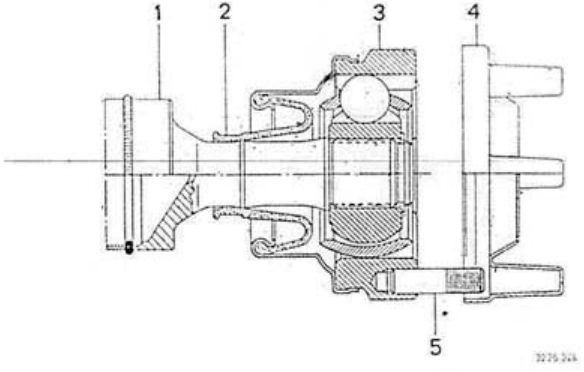
** Source of Supply: HWB



Install hose clamp on dust cover.

Constant Velocity Joint Assembly

1 Propeller shaft
2 Dust cover
3 Constant velocity joint
4 Transporting cap
5 Stud

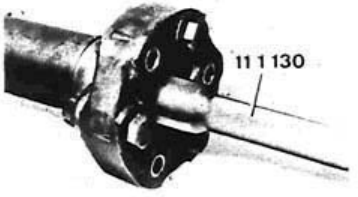


26 11 501 REPLACING FRONT CENTER FOR PROPELLER SHAFT – PROPELLER SHAFT REMOVED –



20 26 018

Pack center with a viscous grease.
Insert a 14 mm diameter mandrel (0.551").
Apply hammer knocks on mandrel to produce pressure and drive out center.



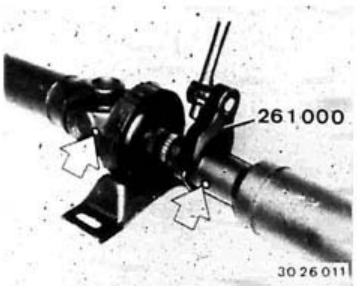
20 26 019

Lubricate center with Molykote Longterm 2 and drive in with Special Tool 11 1 130.
Sealing lip faces out.



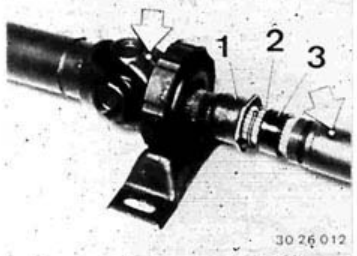
20 26 020

Protrusion A = 4.5 mm (0.177").

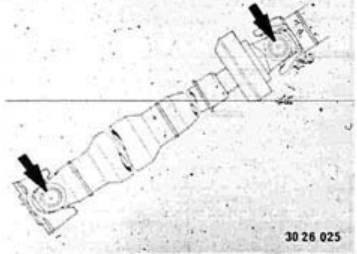


26 12 001 REPLACING PROPELLER SHAFT CENTER MOUNT ASSEMBLY

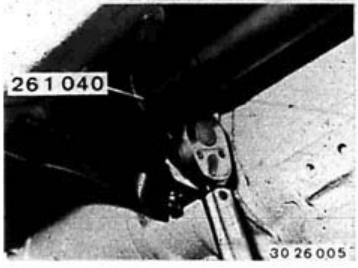
Remove propeller shaft 26 11 000.
Unscrew threaded sleeve with Special Tool 26 1 040.
Pull off front propeller shaft section.
Important!
Propeller shaft was balanced in assembled state and must not be turned in slide.
Punch mark an unmarked propeller shaft.



Installation:
Lubricate slide with Molykote Longterm 2**.
Install threaded sleeve (1), washer (2) and rubber ring (3).
Assemble propeller shaft that punch marks are aligned.

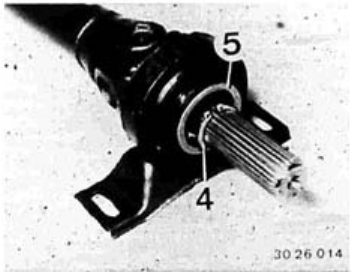


Note:
Propeller shaft sections are installed that universal joints are in one plane.
If slide had been disassembled by mistake without marking, only wrong installation by 180° is possible because of balancing.

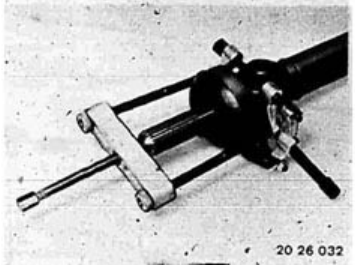


Installation:
Tighten threaded sleeve with Special Tool 26 1 040 after finishing installation.
Tightening torque*.

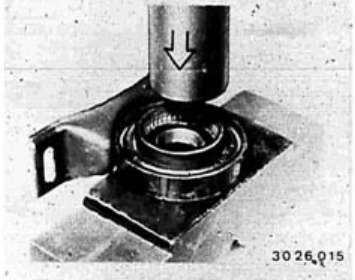
* See Specifications
** Source: HWB



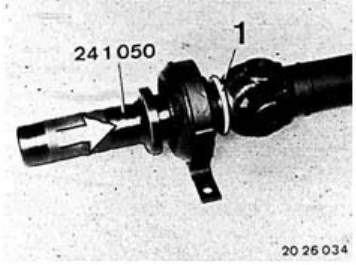
Lift out circlip (4) and remove dust guard (5).



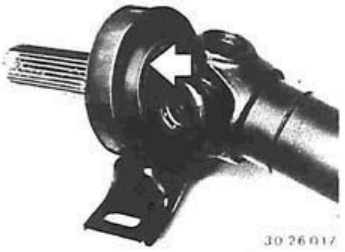
Pull off center mount complete with grooved ball bearing.



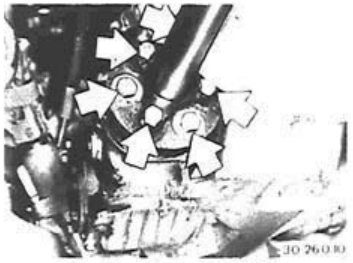
Press grooved ball bearing into center mount.



Install dust guard (1).
Drive on center mount with Special Tool 24 1 050.



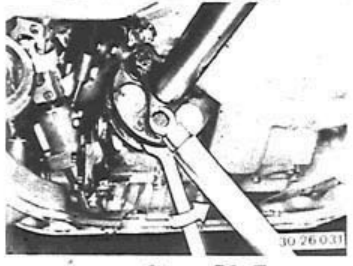
Installation:
Check that dust guard is installed flush with center mount.
Important!
Check that center mount has clearance.



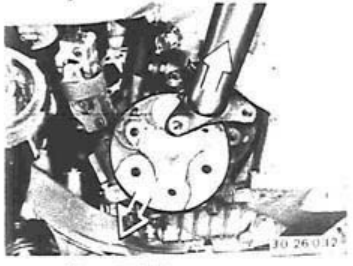
26 20 000 REMOVING AND INSTALLING FRONT PROPELLER SHAFT – All Wheel Drive –

Caution!
Never operate car on its own engine power after removal of the propeller shaft (this would damage the central lock in the transfer box).

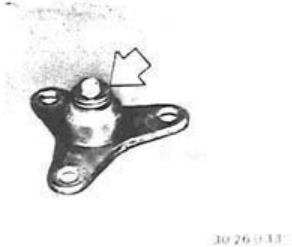
Remove all six bolts.



Installation:
Replace stop nuts.
Tightening torque*.
Important!
Only turn nuts or bolts on flange end whenever possible by design, to avoid tension in joint disc.

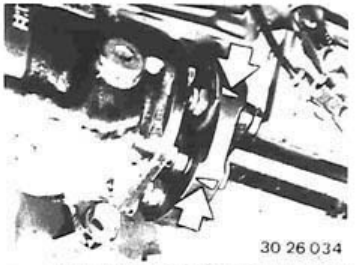


Push back propeller shaft.
Remove joint disc with centering disc.
Installation:
Mount centering disc on flange of propeller shaft.

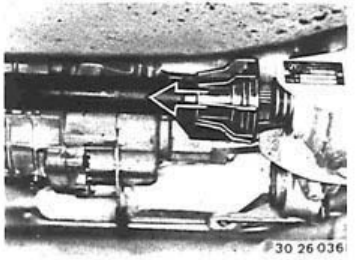


Installation:
Check seal, replacing if necessary.

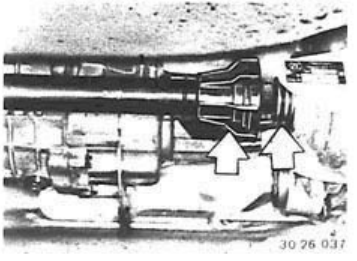
* See Specifications



Installation
Install joint disc that arrows face flange arms.



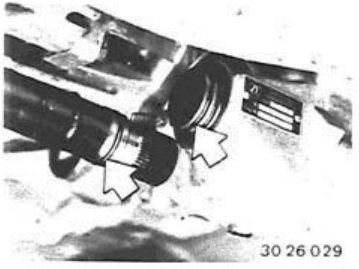
Pull propeller shaft and cap off of transfer box.



Installation:
Check gap and seal, replacing if necessary.
Slide cap on to transfer box after finishing installation.



30 26 028

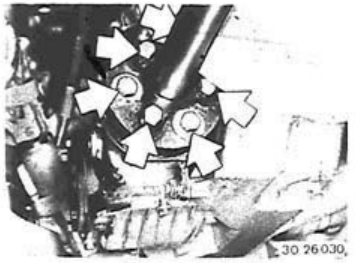


30 26 029

26 20 020 REPLACING CAP FOR FRONT PROPELLER SHAFT
– All Wheel Drive –

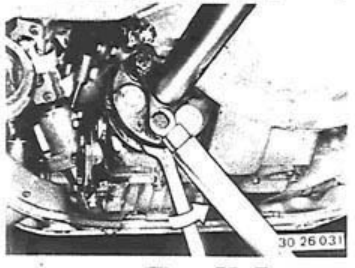
Remove front propeller shaft 26 20 000.
Pull off cap.

Installation:
Check seals on propeller shaft and power divider.

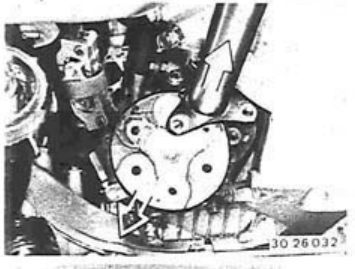


26 20 051 REPLACING JOINT DISC FOR FRONT PROPELLER SHAFT – All Wheel Drive –

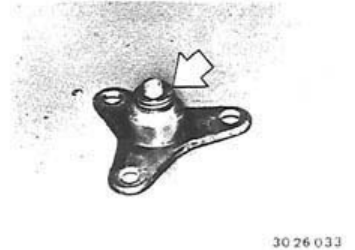
Remove all six bolts.



Installation:
Replace stop nuts.
Tightening torque*.
Important!
Only turn nuts or bolts on flange end whenever possible by design, to avoid tension in joint disc.



Push back propeller shaft.
Remove joint disc with centering disc.
Installation:
Mount centering disc on flange of propeller shaft.



Installation:
Check seal, replacing if necessary.



Installation:
Install joint disc that arrows face flange arms.



Installation:
Slide cap on to power divider after finishing installation.

* See Specifications

TROUBLESHOOTING PROPELLER SHAFT

Condition	Cause	Correction
Drumming (stationary car)	Propeller shaft without influence	Check engine tuning, remove stress in exhaust line
Vibration while moving off forward/reverse (center mount knocking)	Propeller shaft not aligned precisely	Align propeller shaft (S.I. 26 01 77 (235))
	Runout on centering pin, transmission or final drive flanges	Check centering pin and flanges for runout with dial gage – see Specifications; offset or replace final drive flange
	Center mount rubber damaged. Propeller shaft axial compensation.	Replace center mount – 26 12 001. Important! Tighten screw-on bushing to correct torque* with Special Tool 26 1 040.
	Universal joints worn or seized	Check clearance and movement, replacing propeller shaft if necessary – 26 11 000.
	Engine/transmission suspension not okay	Check mounts, aligning or replacing if necessary
	Joint coupling rubber damaged	Replace joint coupling – 26 11 051
Vibration at 40 to 50 km/h (25 to 30 mph)	Propeller shaft not aligned precisely	Align propeller shaft
	Runout on centering pin, transmission or final drive flanges	Check centering pin and flanges for runout with dial gage – see Specifications; offset or replace final drive flange
	Center mount rubber damaged. Propeller shaft axial compensation.	Replace center mount – 26 12 001. Important! Tighten screw-on bushing to correct torque* with Special Tool 26 1 040.
	Universal joints worn or seized	Check clearance and movement, replacing propeller shaft if necessary – 26 11 000.
	Joint coupling rubber damaged	Replace joint coupling – 26 11 051

* See Specifications

TROUBLESHOOTING PROPELLER SHAFT

Condition	Cause	Correction
Drumming from 60 km/h (35 mph) on	Propeller shaft not aligned precisely or installed with stress – axial compensator	Align propeller shaft or check movement of axial compensator, lubricating slide with Molykote Longterm 2 and tightening screw-on bushing to correct torque* if necessary.
	Center damaged	Replace center – 26 11 501
	Runout on centering pin, transmission or final drive flanges	Check centering pin and flanges for runout with dial gage – see Specifications; offset or replace final drive flange.
	Centering error due to worn flange bores (loose bolts)	Replace transmission or final drive flange
	Excessive propeller shaft imbalance; balance plate missing	Balance or replace propeller shaft – see 26 11 000.
	Universal joints worn or seized	Check clearance and movement, replacing propeller shaft if necessary – 26 11 000.
Center mount noise while driving	Center mount not perpendicular to propeller shaft; no or insufficient preload	Preload center mount in forward direction at right angle to propeller shaft.
	Center mount grooved ball bearing not okay	Replace grooved ball bearing – 26 12 001.

* See Specifications

27 Transfer Box

27 10 000	Visco central lock – check in car	27- 1
010	Transfer box – remove and install (manual transmission)	27- 4
010	Transfer box – remove and install (automatic transmission)	27- 7
	Gear set layout for transfer box	27- 11
. . .	Transfer box – disassemble and assemble	27- 12
23 71 003	Rubber mounts for transmission suspension – replace	27- 23
503	Rubber mounts for transmission suspension – replace	27- 25

27 10 000 CHECKING CENTRAL LOCK IN CAR

The condition of a central lock can be checked on a brake test stand with help of the BMW service tester.

Caution!

If only one axle turns in a test on the brake test stand, the central lock will be subjected to strong loads and could be destroyed from excessive heat.

Never exceed the total running time = warm-up time + test time of 60 seconds on the brake test stand.

Make a break of at least 30 minutes after each test cycle. These times are applicable to cold and warm operated cars.

The roller speed of the brake test stand must not exceed 7.5 km/h (4.5 mph).

If the roller speed of the brake test stand without load is not known, it can be determined with a '3' series car with ABS, but without all wheel drive, to the methods described in the testing procedures. In so doing the warm-up phase and measuring the braking force are omitted.



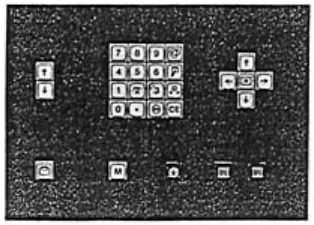
30 27 002

Check tire inflation pressure and tire size.
Park rear wheels of car in test stand rollers.
Front wheels are on floor.
Shift lever in neutral.



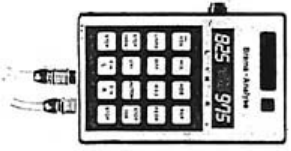
30 27 003

Car must be connected on the BMW service tester, to determine test stand speed (wheel speed) under load.
Switch off electric equipment and ignition.
Connect T-plug (4) between ABS control unit (2) and ABS wire harness (1).



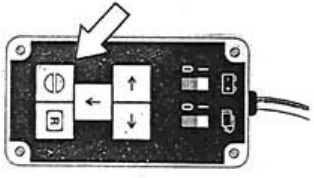
30 27 004

Select test program 03 ABS on BMW service tester.
Select ABS test step 03.
Turn on ignition.



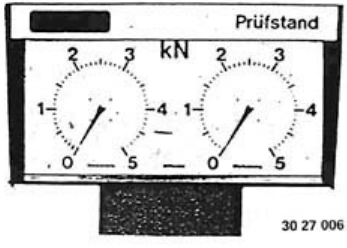
30 27 005

Switch on both rollers of brake test stand.
Run brake test stand approx. 40 seconds (warm-up phase).



30 27 008

Press reset button on BMW service tester after the warm-up time.
The value in ms now appearing at rear left or right is equal to the roller speed.
See diagram.



30 27 006

Read braking force of both wheels on brake test stand and add.

Caution!

Total running time: max. 60 seconds.

Transfer period of time (ms) in diagram.

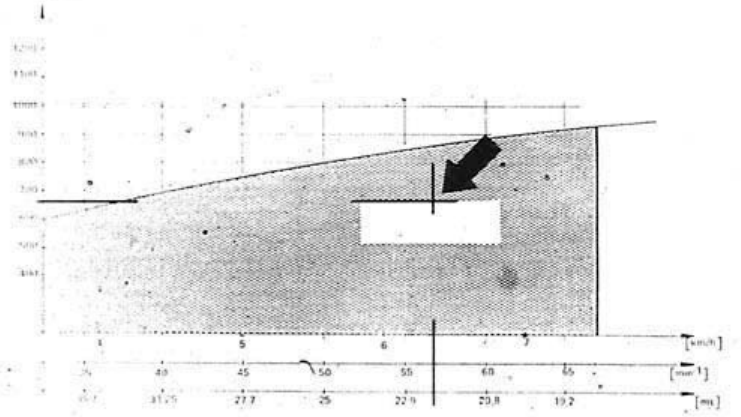
Transfer sum of braking force of both front wheels in diagram.

The condition of the visco central lock is evident from the point of intersection of both lines.

Example:
Pulse wheel period of time: 22 ms.

Braking force of left wheel	300 N (66 lbs.)
Braking force of right wheel	+ 350 N (77 lbs.)
Total braking force	650 N (143 lbs.)

Intersection point of both lines in shaded area.
Visco central lock is faulty.

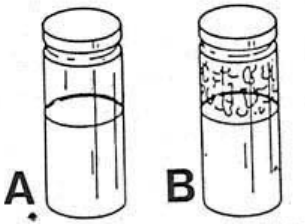


30 27 007

Additional Testing Method:

Normally insufficient locking effect of a visco clutch will be caused by escaping visco liquid.

Visco liquid can be detected in gear lube as described below.

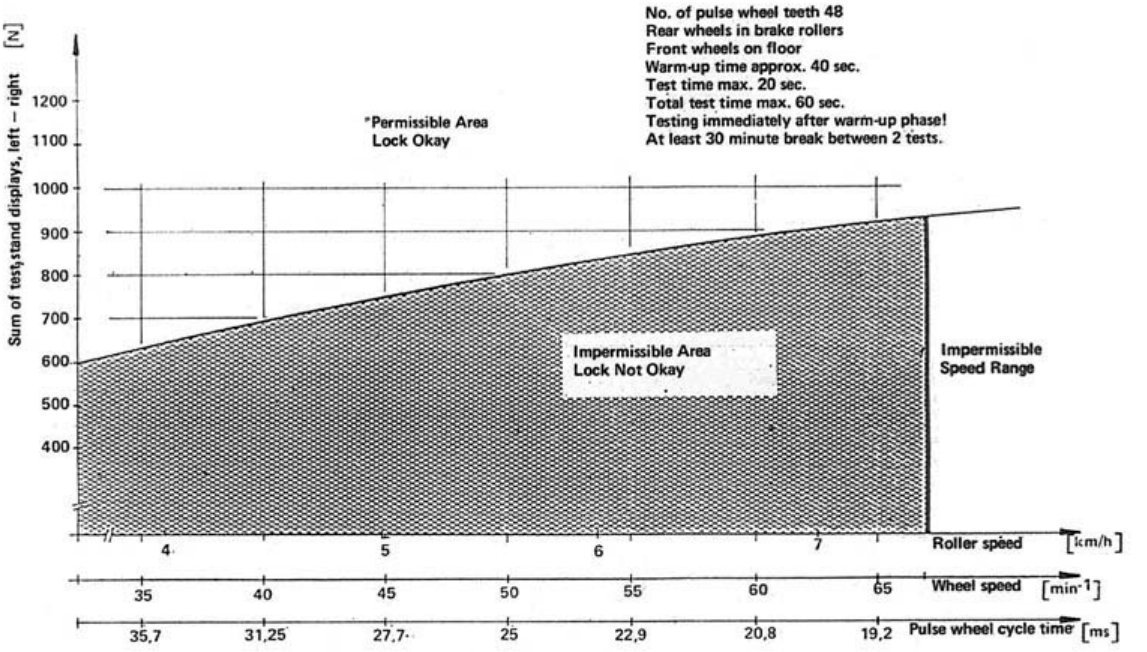


30 27 103

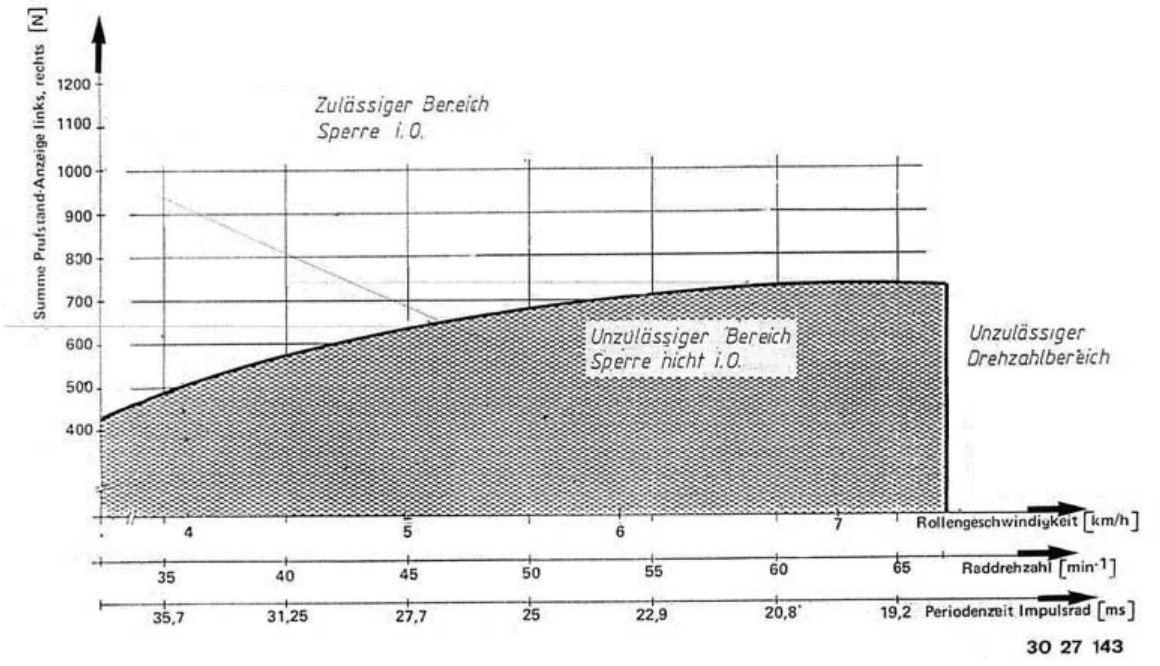
Take an oil sample and pour this oil into a pluggable lab glass or something similar.
Now shake the glass and observe the oil running down the side of the glass after waiting about one minute.
Visco liquid will not mix completely with oil and will run down cloudy due to its greater viscosity.

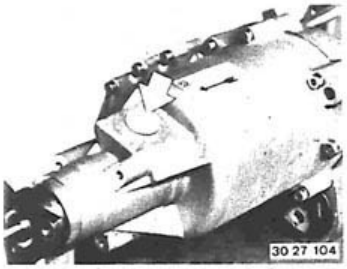
A = Without visco liquid
B = With visco liquid

DIAGNOSING VISCO CENTRAL LOCKS



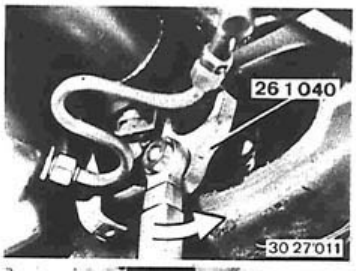
30 27 001


Summe Prüfstand-Anzeige links, rechts [N]
1200
1100
1000
900
800
700
600
500
400
Zulässiger Bereich
Sperre i.O.
Unzulässiger Bereich
Sperre nicht i.O.
Unzulässiger
Drehzahlbereich
4
5
6
7
Rollengeschwindigkeit [km/h]
35
40
45
50
55
60
65
Raddrehzahl [min-1]
35,7
31,25
27,7
25
22,9
20,8
19,2
Periodenzeit Impulsrad [ms]
30 27 143



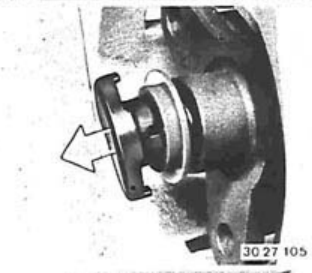
27 10 010 REMOVING AND INSTALLING TRANSFER BOX
– Four Wheel Drive with Manual Transmission –

Note:
When installing a new or exchange transfer box it is important to know that transfer boxes in manual transmission version are supplied filled with oil. Vent bore is sealed off with a plug.

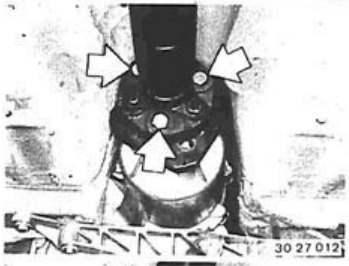


Loosen threaded sleeve several turns with Special Tool 26 1 060 or 26 1 040.

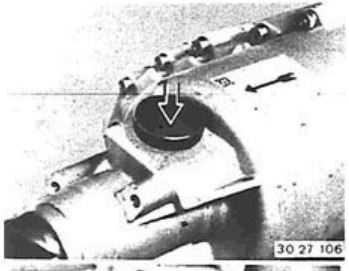
Installation:
Tighten threaded sleeve with Special Tool 26 1 060 or 26 1 040 after completed installation.
Tightening torque*.



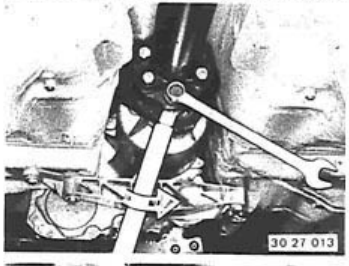
Work vent off protective sleeve of output shaft.



Unscrew propeller shaft on transfer box.

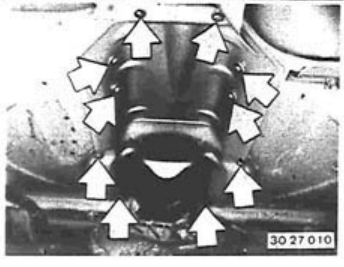


Lift out plug.
Press in vent.
Check oil level after completed installation — also refer to information on label.



Installation:
Replace stop nuts.
Check tightening torque*.

Important!
Only turn nuts or bolts on flange end whenever possible by design to avoid strain in joint disc.



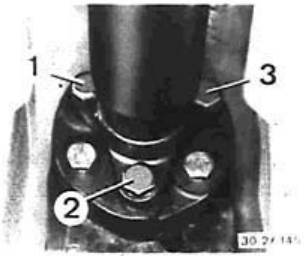
Remove exhaust assembly – see 18 00 020.
Unscrew heat shield.



Push propeller shaft together and pull out of centering pin on transfer box.
Suspend propeller shaft from car on piece of wire.

Note:
Propeller shaft was balanced as an assembly and may only be replaced as such.
Never separate propeller shaft at slide.

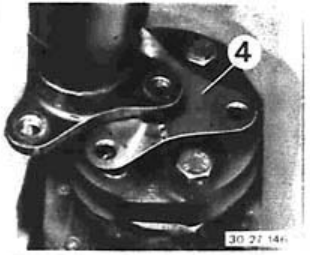
* See Specifications



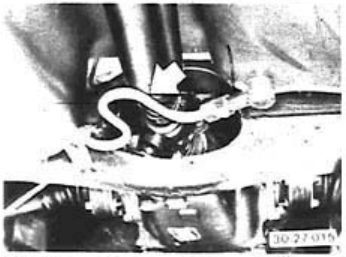
Version without Slide:

Boolts (1 ... 3) must be loosened to remove propeller shaft from transmission.
Joint disc remains on transmission.

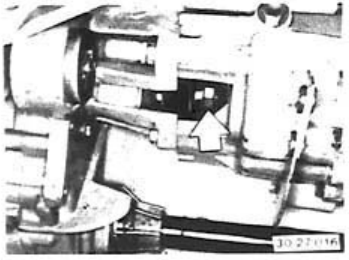
Installation:
Tightening torque*.



Pull propeller shaft off intermediate flange (4).
Suspend propeller shaft from car on piece of wire.

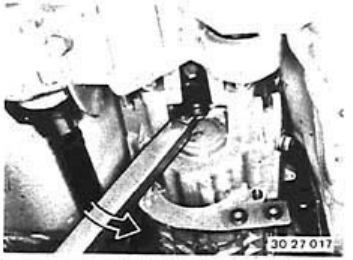


Caution!
Don't allow propeller shaft to bear on connection pipe on fuel tank.



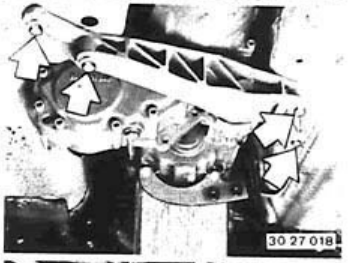
Unscrew joint disc between manual transmission and transfer box from output flange of manual transmission.

* See Specifications



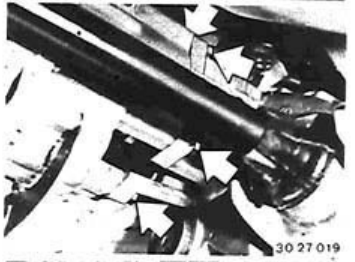
Installation:
Replace stop nuts.
Tightening torque*.

Important!
Only turn nuts or bolts on flange end whenever possible by design to avoid strain in joint disc.



Support transmission from underneath.
Unscrew cross member.

Note:
Different lengths of bolts!



Lower transmission.
Unscrew bolts.

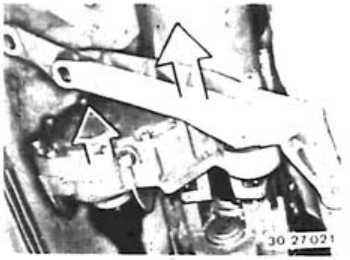
Note:
Upper bolts are accessible with a 17 mm socket, joint and extension in 3/8" version.



Push protective cap forward.

Caution!
Danger of breaking.

* See Specifications



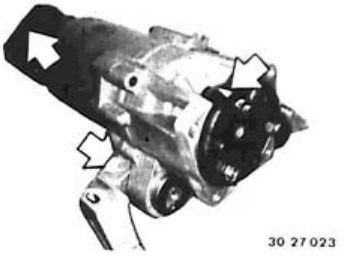
Pull off transfer box from manual transmission and front propeller shaft (weight of transfer box = approx. 25 kg or 55 lbs.).



Installation:
Check dowel sleeves.
Lubricate guide pins and splines of front propeller shaft lightly with Molykote Longterm 2.
Check position of output flange on transmission to joint disc.



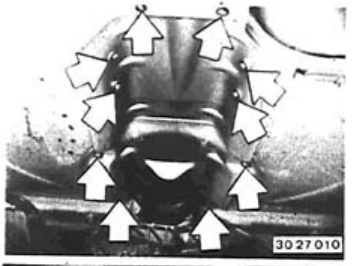
Important!
Check diameter of output shaft journal when exchanging manual transmission. Journal diameter and inside diameter of centering sleeve (1) must be same. If necessary, install different centering sleeve with required inside diameter.



If applicable, remove cross member, joint disc and vibration damper.

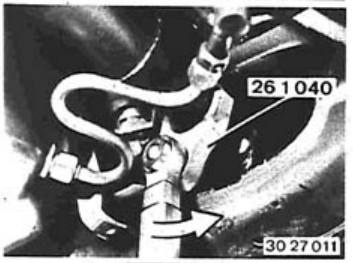
Installation:
Mount joint disc that arrows point to flange arms.
Tightening torque*.
Check and, if necessary, correct oil level after completed installation.

* See Specifications



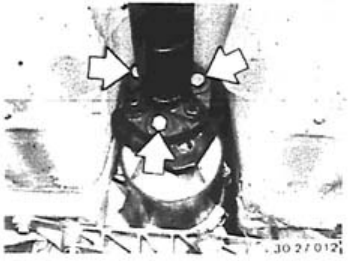
27 10 010 REMOVING AND INSTALLING TRANSFER BOX
– Four Wheel Drive with Automatic Transmission –

Remove exhaust assembly - see 18 00 020.
Unscrew heat shield.

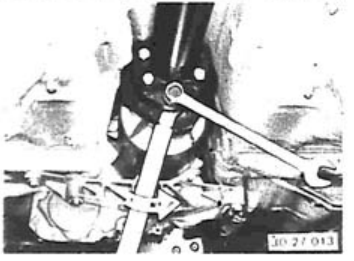


Loosen threaded sleeve several turns with Special Tool 26 1 060 or 26 1 040.

Installation:
Tighten threaded sleeve with Special Tool 26 1 060 or 26 1 040 after completed installation.
Tightening torque*.



Unscrew propeller shaft on transfer box.



Installation:
Replace stop nuts.
Tightening torque*.

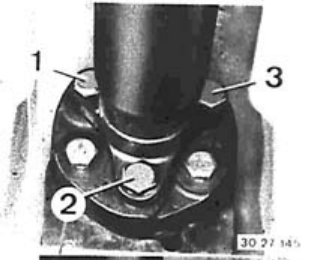
Caution!
Only turn nuts or bolts on flange end whenever possible by design to avoid strain in joint disc.

* See Specifications



Push propeller shaft together and pull out of centering pin on transfer box.
Suspend propeller shaft from car on piece of wire.

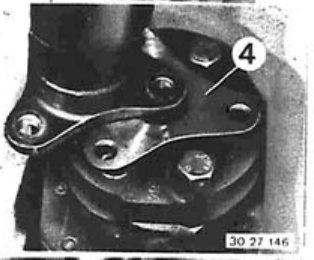
Note:
Propeller shaft was balanced as an assembly and may only be replaced as such.
Never separate propeller shaft on slide.



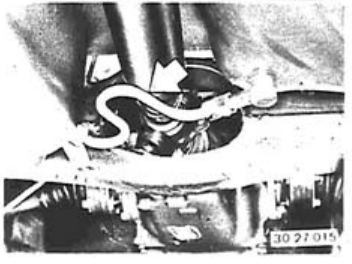
Version without Slide:

Bolts (1 ... 3) must be loosened to remove propeller shaft from transmission.
Joint disc remains on transmission.

Installation:
Tightening torque*.



Pull propeller shaft off intermediate flange (4).
Suspend propeller shaft from car on piece of wire.

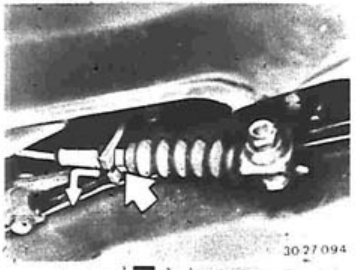


Caution!
Don't allow propeller shaft to bear on connection pipe on fuel tank.

* See Specifications



Disconnecting Cable for Range Selector Lever:
Loosen nuts.
Important!
Don't bend the steel wire.



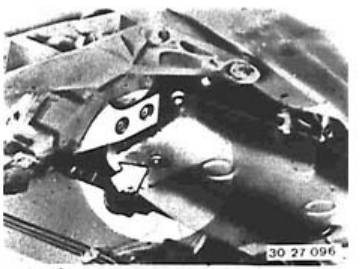
Unscrew nuts.
Push back cable sleeve and disconnect in holder.
Pull cable out of operating lever.



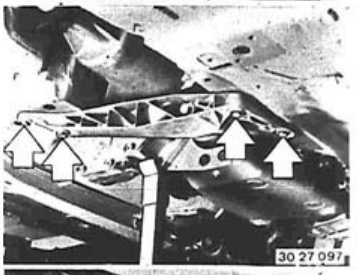
Installation:
Check arrangement of washers.
Check rubber mounts, replacing if necessary.
Adjust shift – see 25 16 050.



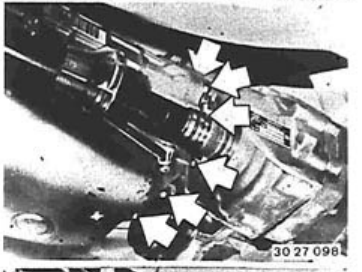
Front Propeller Shaft Section:
Push protective cap forward.



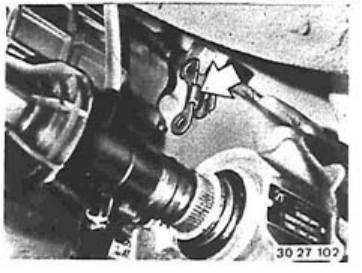
Drain oil in automatic transmission.
Installation:
Fill transmission with ATF – see Group 24.



Support transmission from underneath.
Unscrew cross member.



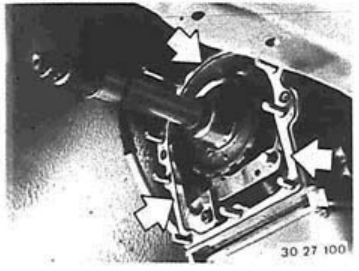
Unscrew nuts (nine) on the transmission/transfer box connection.



Installation:
Also bolt down holder for wires.

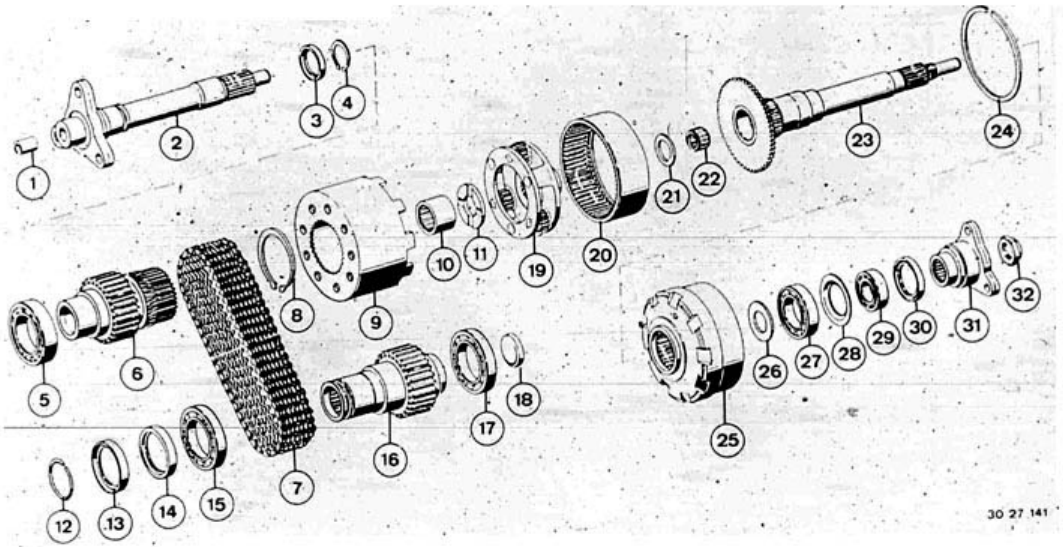


Pull off transfer box toward rear.
Installation:
Mesh splines of front propeller shaft section by turning.

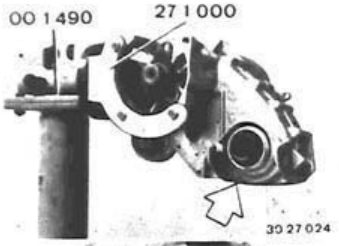


Installation:
Check sealing surfaces.
Replace gasket.
Check dowel pins in transfer box.
Check oil level after finishing installation, correcting if necessary.
Fill automatic transmission with ATF.

TRANSFER BOX GEAR SET LAYOUT DRAWING



1 Centering sleeve
2 Input shaft
3 Shaft seal
4 Circlip
5 Bearing
6 Sprocket shaft
7 Chain
8 Circlip
9 Drive head
10 Needle sleeve
11 Washer
12 Snap ring
13 Radial seal without spring
14 Radial seal with spring
15 Bearing
16 Sprocket shaft
17 Bearing
18 End cap
19 Plant carrier
20 Hollow gear wheel
21 Spacer
22 Needle bearing
23 Output shaft
24 Snap ring
25 Clutch
26 Support
27 Bearing
28 Sensor plate
29 Bearing
30 Shaft seal
31 Output flange
32 Collar nut



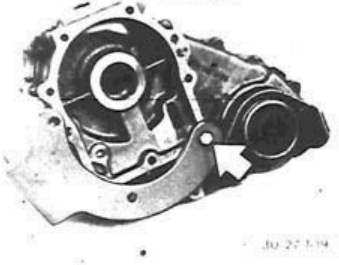
27 10 ... DISASSEMBLING AND ASSEMBLING TRANSFER BOX

Disassembling Transfer Box:

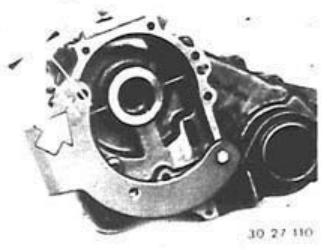
Mount Special Tool 27 1 000 on Special Tool 00 1 490.
Bolt transfer box on Special Tool 27 1 000.
Manual Transmission:
Three M 10 x 4 bolts with nuts.
Automatic Transmission:
Two M 8 x 40 bolts with nuts.
Drain oil.
Old Special Tool 27 1 000 has to be machined for automatic transmission versions.

Drive out the dowel pin.





Screw special tool holder on shown bore with a M 8 x 40 bolt only finger tight.



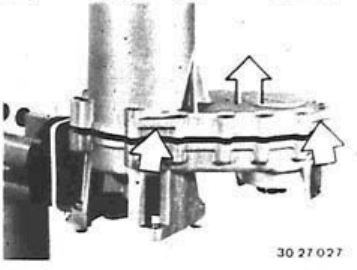
Position holder in such a manner, that a new 10 mm (0.394") dia. hole can be drilled about 5 mm (0.197") away from the old hole.
Mark center point, drill 10 mm (0.394") dia. hole and deburr edges of hole.



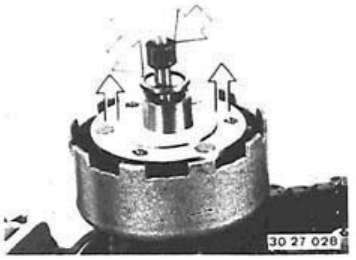
Drive dowel pins out of case at rear



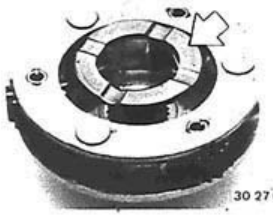
Unscrew all bolts.



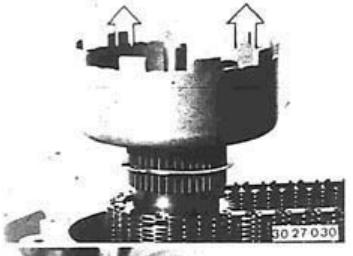
Knock off rear case with uniform knocks from a nylon hammer on the webs.
Lift off rear case.
Remove gasket.



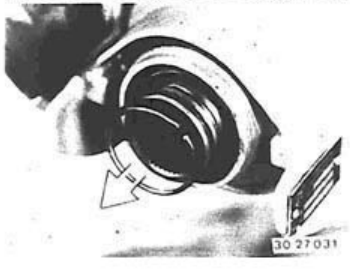
Lift off needle bearing (only manual transmissions), spacer and planet gear set.



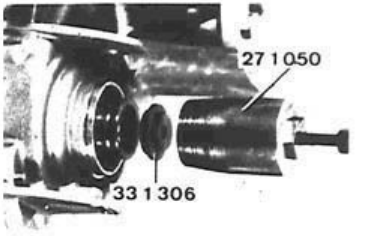
Note:
Check thrust washer in planet gear set.
Oil grooves face the drive shell.



Lift off drive shell.

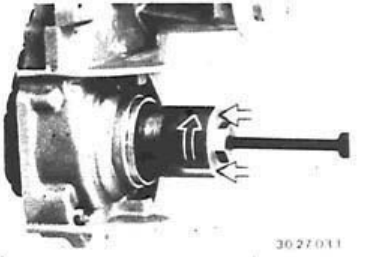


Lift out circlip and O-ring.



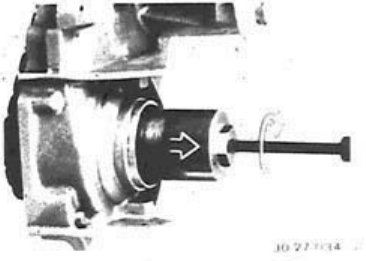
30 27 032

Apply Special Tools 33 1 306 and 27 1 050



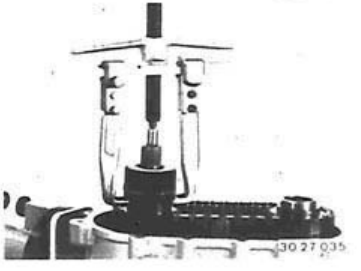
30 27 033

Screw Special Tool 27 1 050 into radial oil seals (two) up to the stop while applying pressure.
Important!
Make sure that the spindle is unscrewed far enough.



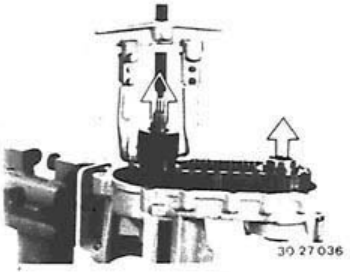
30 27 034

Pull out both radial oil seals by screwing in the spindle.

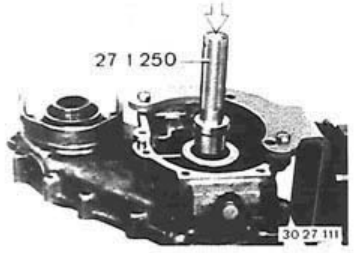


30 27 035

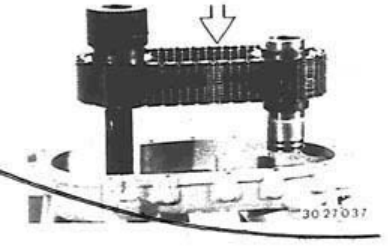
Manual Transmission:
Apply a standard puller



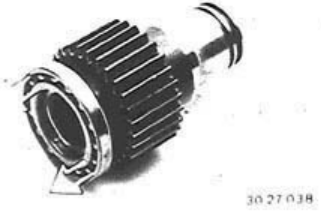
Pull off sprocket, driving off the front drive sprocket with a plastic hammer at the same time.
Important!
Don't cant the chain.



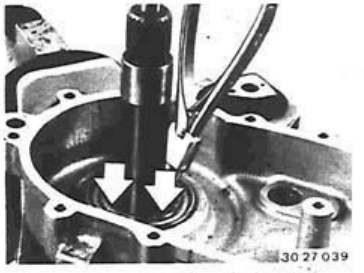
Automatic Transmission:
Insert Special Tool 27 1 250 in the sprocket main shaft.
Drive out both shafts uniformly with a plastic hammer.
Important!
Don't cant the chain.



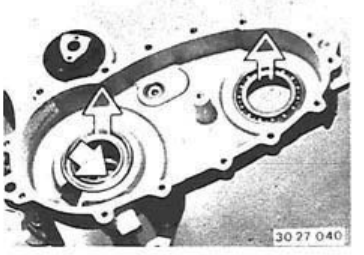
Lift off sprockets with chain.
Note:
Mark running direction of chain, if it can be reused.



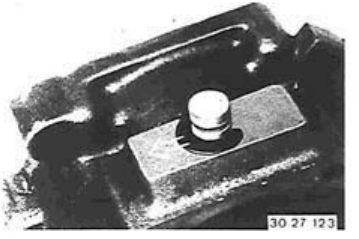
Note:
Grooved ball bearing will remain on the sprocket or in the case, depending on tolerances.
Pull off grooved ball bearing, if necessary.



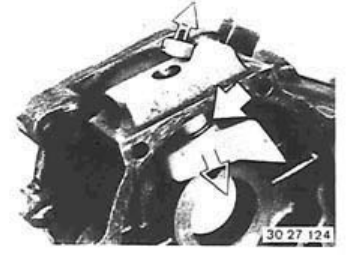
Manual Transmission:
Lift out circlip.
Pull out drive shaft.



Pull out grooved ball bearing, if applicable.
Remove shaft seal (two for automatic transmissions).



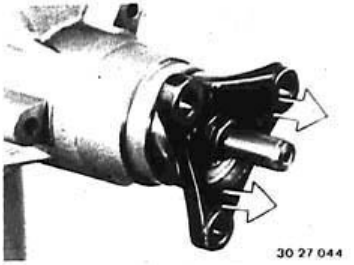
Automatic Transmission:
Pull off clamp.



Pull off cap.
Remove vent.
Check O-ring.



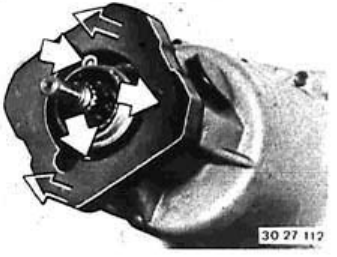
Automatic Transmission :
Pull out needle bearing with Special Tool 00 8 550.



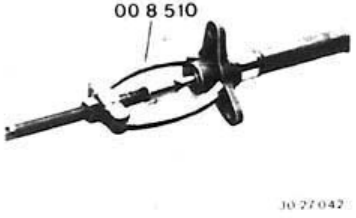
Pull off output flange.



Manual Transmission:
Drive out needle bearing with Special Tool. 23 1 040.



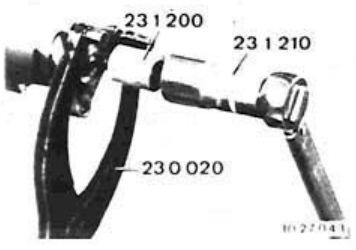
Unscrew damper.



Manual Transmission:
Pull out centering sleeve with Special Tool 00 8 510 together with an expanding sleeve for 14 mm (0.551") diameters.



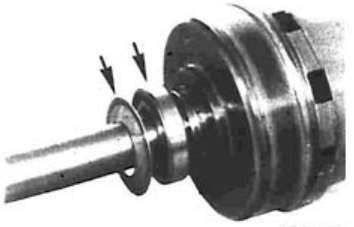
Drive output shaft out of case with a plastic hammer.



Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.



Drive radial oil seal and grooved ball bearing out of case.



30 27 113

Note:
Grooved ball bearing remains on shaft or in case, depending on tolerances.
Lift off washer, if applicable.
Pull off grooved ball bearing.
Curved surface of washer faces the output flange.



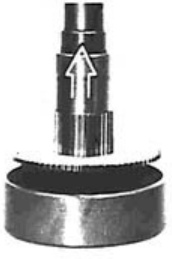
30 27 047

Lift off washer and visco clutch.



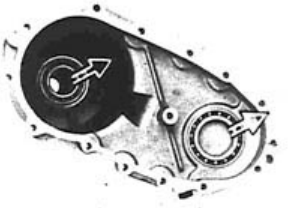
30 27 048

Lift out circlip.



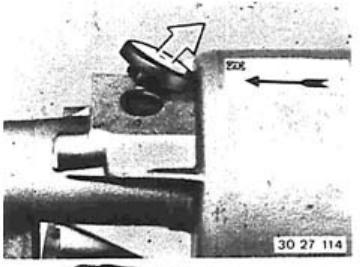
30 27 049

Lift output shaft off of hollow gear wheel.



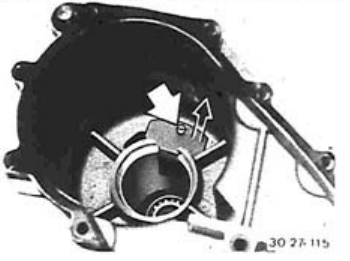
30 27 050

Remove both grooved ball bearings in case.



30 27 114

Lift out vent.



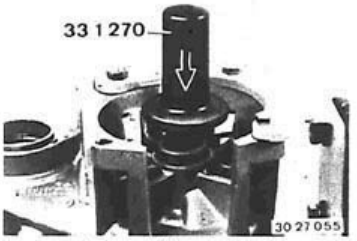
30 27 115

Unscrew oil baffle plate.



Assembling:

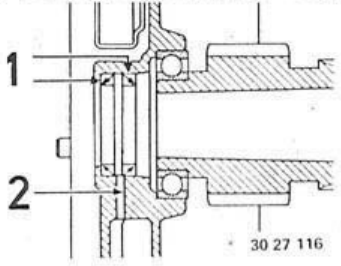
Transfer Box Front Section:
Lubricate all sliding surfaces and seals with the approved grade of oil* when assembling.
Drive in centering sleeve flush with Special Tool 27 1 160.



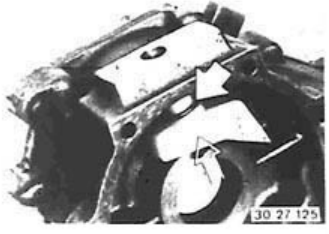
Manual Transmission:
Drive in radial oil seal with Special Tool 33 1 270.



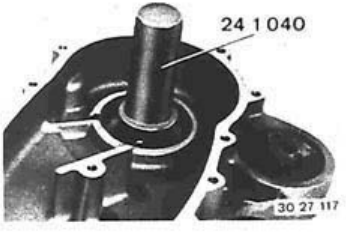
Press in needle bearing with Special Tool 33 1 308.



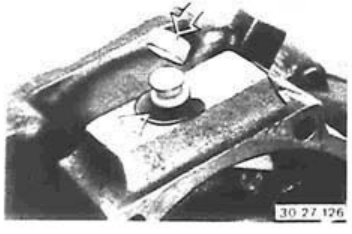
Automatic Transmission:
Two radial oil seals (1) are installed in the version for automatics, one each with its sealing lip facing out and in. Make sure that leak oil bore (2) is not covered.
Radial oil seals can only be installed after disassembling the transfer box.



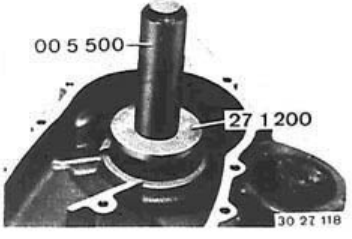
Automatic Transmission:
Place O-ring on vent.
Insert vent.



Automatic Transmission:
Drive in radial oil seal (1) against the stop with Special Tool 24 1 040 - the sealing lip faces out.



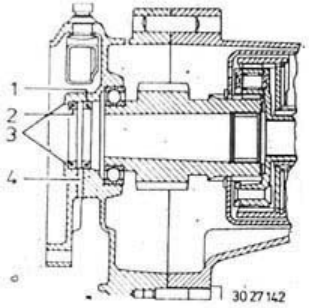
Install clamp.
Install cap.



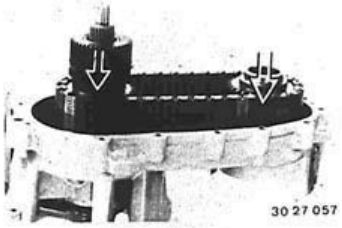
Automatic Transmission:
Drive in radial oil seal (2) with Special Tools 27 1 200 and 00 5 500 - the sealing lip faces in.

* See Operating Fluid Specifications

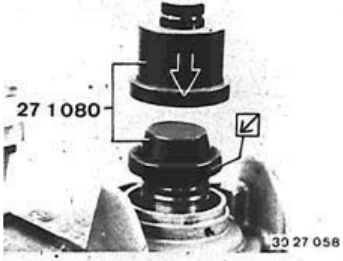
* See Specifications



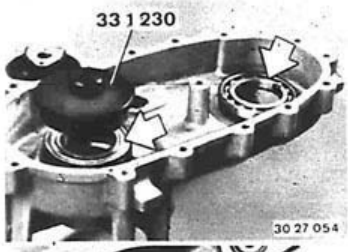
Automatic Transmission:
Bearing collar (3) is omitted on the case since 11.87 for assembling reasons.
Radial oil seals can be installed from the outside.
Check installed position.
Drive in radial oil seal (1) with Special Tools 27 1 270 and 27 1 271 - sealing lip facing IN.
Drive in radial oil seal (2) with Special Tool 27 1 270 - sealing lip faces OUT.
Leak oil bore (4) must not be covered.



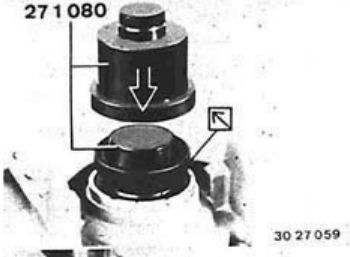
Mount sprockets complete with chain (check running direction if applicable).
Drive both sprockets into bearings with a plastic hammer at the same time.
Important!
Don't cant the chain.



Apply slip sleeve of Special Tool 27 1 080.
Install the first radial oil seal with the sealing lip facing in.
Drive in radial oil seal with Special Tool 27 1 080.

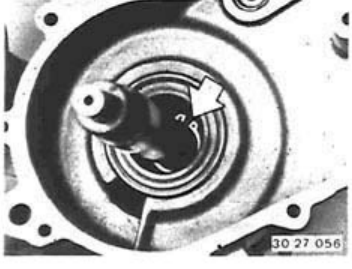


Heat case.
Install both grooved ball bearings with Special Tool 33 1 230.

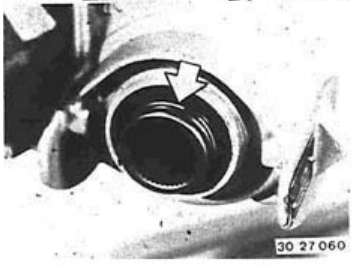


Install the second radial oil seal with the sealing lip facing out.
Drive in both radial oil seals with Special Tool 27 1 080.

Note:
The second radial oil seal is installed without a spiral spring. Parts only supplies radial oil seals with spiral springs. When replacing, it is therefore necessary to remove the spiral spring for the outside radial oil seal.

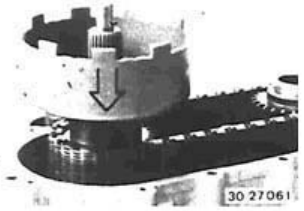


Manual Transmission:
Place input shaft in case.
Install circlip.
Note:
Input shaft is guided only by the radial oil seal or guide pin on the manual transmission.



Install circlip and O-ring.

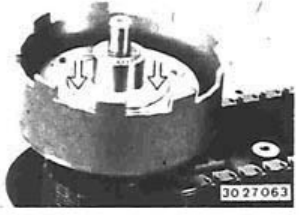
Mount drive shell.



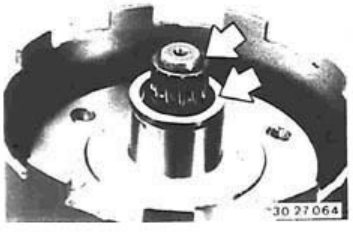
Hold thrust washer in the planet gear set with a small amount of grease.
Note:
Oil grooves face the drive shell.

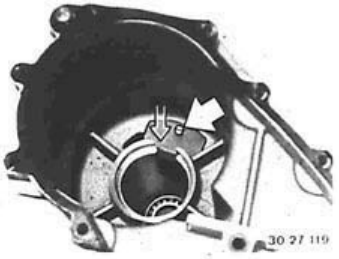


Mount planet gear set.



Install spacer and needle bearing.

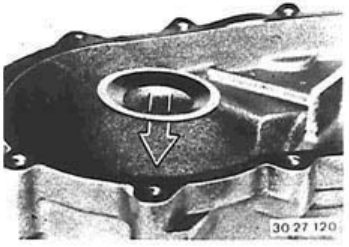




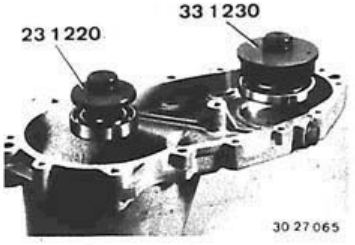
Transfer Box Rear Section:

Install oil baffle plate.
Install bolt with a bolt cement* for locking and sealing.

Note:
The vent is installed only after finishing the assembling procedures and filling some of the oil.



Install washer with curved surface facing down in the ball bearing seat for the main shaft.



Heat rear case section.
Install grooved ball bearing with Special Tool 33 1 230 or 23 1 220.

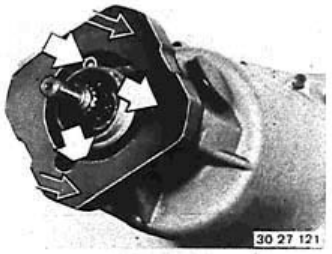


Install grooved ball bearing with Special Tool 32 1 150.

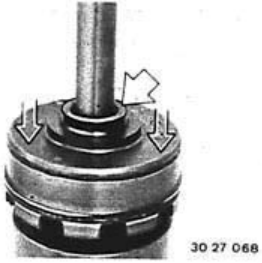
* Source of Supply: HWB



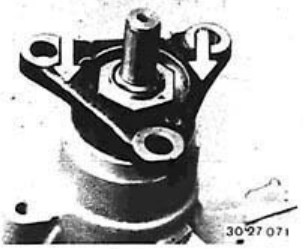
Insert output shaft in hollow gear wheel.
Install circlip.



Mount and screw on damper.



Mount visco clutch and washer.

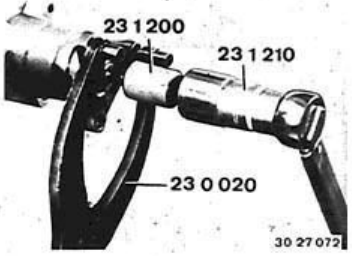


Mount output flange.
Coat threads with a bolt cement**.
Important!
Use a new collar nut.

Screw on new collar nut.



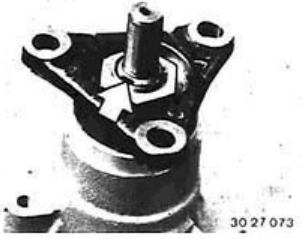
Insert output shaft in case.
Apply Special Tools 27 1 120 and 23 1 300.
Pull output shaft into case.



Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Tighten collar nut with Special Tool 23 1 210.
Tightening torque*.

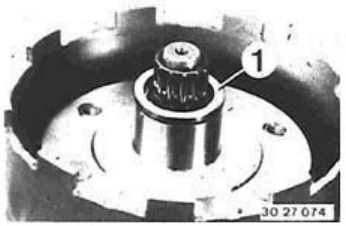


Install radial oil seal with Special Tool 27 1 090.

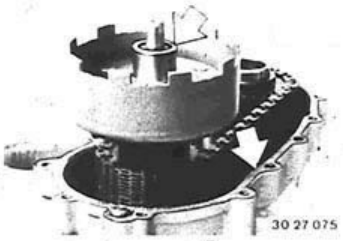


Lock collar nut in the provided recess.

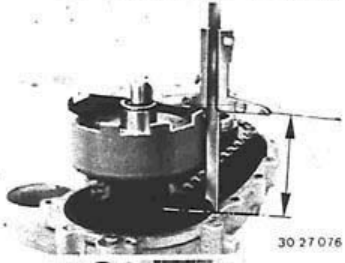
* See Specifications
** Source of Supply: HWB



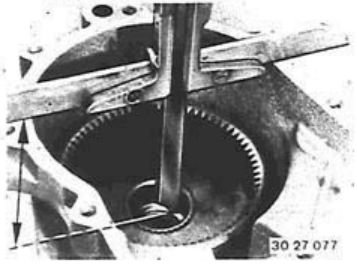
Note:
The thickness of shim (1) has to be determined again, if parts of the input/rear output shaft unit (such as case, bearings, shafts, sprocket, planet gear set, visco clutch or shims) had been replaced.



Install gasket.
Install old shim.



Measure distance from shim to sealing surface on front case section.

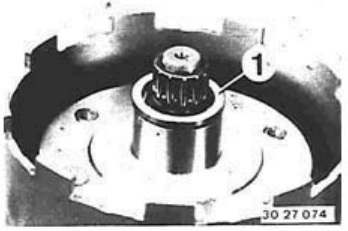


Measure distance from bearing surface for shim to sealing surface on rear case section.

Determine size of gap*.
Example:

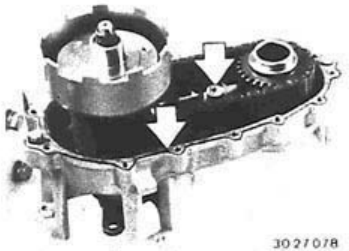
Distance on rear section	101.5 mm (3.996")
Distance on front section –	100.9 mm (3.972")
Size of gap	0.6 mm (0.024")

Note:
The distance on the rear case section must always be larger than that on the front case section, in order to have play between the input and output shafts.

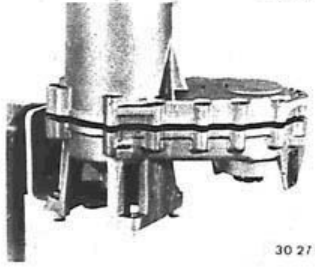


Adjust gap to 0.4 ... 0.6 mm (0.016 to 0.024") by replacing shim (1).
Shims are available from 1.5 to 3.0 mm (0.059 to 0.118") thick in steps of 0.3 mm (0.012").

* See Specifications


30 27 078

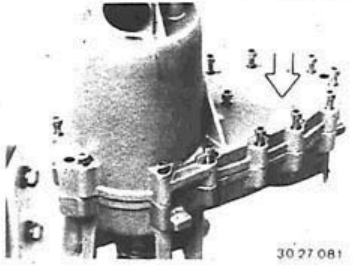
Install gasket and seal.


30 27 079

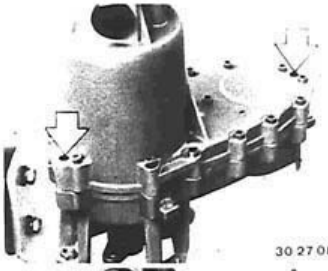
Mount rear case on front case section.


30 27 080

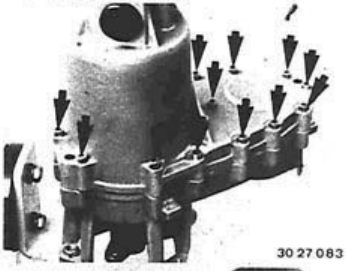
Turn the output flange (while holding the input flange) to have the planet gear set mesh.
Pins on the drive shell must engage in recesses of the visco clutch.


30 27 081

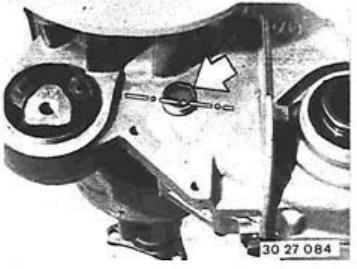
Insert bolts (bolts have different lengths). Drive the case sections together by applying light knocks with a plastic hammer in the front output shaft end area.


30 27 082

Drive in dowel pins.


30 27 083

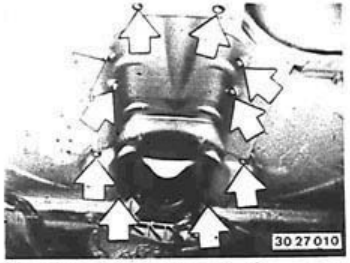
Tighten bolts in several steps.
Tightening torque*.

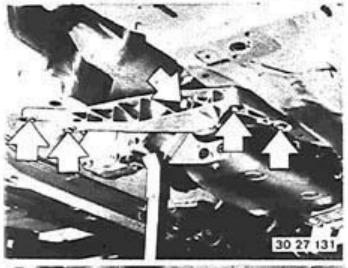

30 27 084

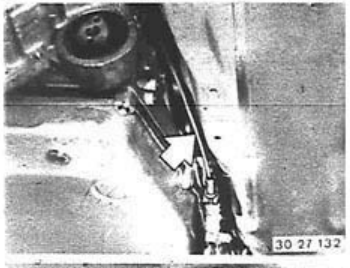
Pour in oil*.

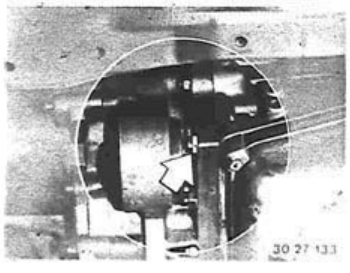
Pour part of the oil (0.06 dm^3) into the vent bore after removing the vent of a removed transmission in case of a completely drained transmission, e.g. after disassembling a transmission. This will guarantee the supply of oil to the rear transmission section when operated initially. The remaining amount of oil should be poured in through the filler neck after installation of the transmission. If too much oil is poured in through the vent, it will flow via the baffle plate to the front axle drive and does not have to be compensated there. Always replace a vent, which has been removed.

* See Specifications









23 71 003 REPLACING RUBBER MOUNTS FOR TRANSMISSION SUSPENSION - Transfer Box Installed- (Cars with Manual or Automatic Transmission)

Remove exhaust assembly and heat shield.

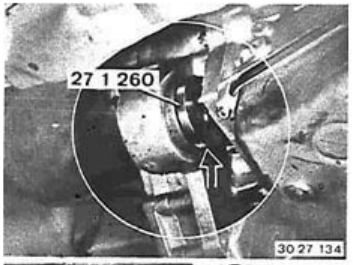
Support transmission from underneath.
Unscrew cross member.
Installation:
Bolts differ in length.
Tightening torque*.

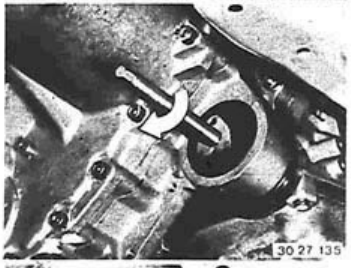
Lower transmission.
Important!
Lower an automatic transmission only enough that the shift operating cable is without tension.

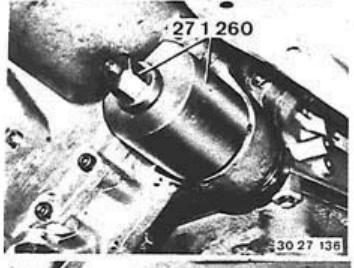
Cars with Automatic Transmission:
Unscrew nut on transfer box/automatic transmission connection.

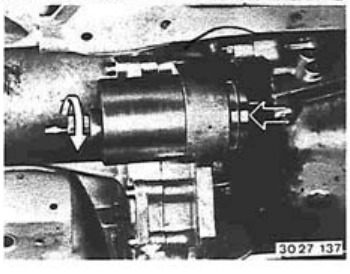
Installation:
Screw on nut again before pressing in a new rubber mount.

* See Specifications









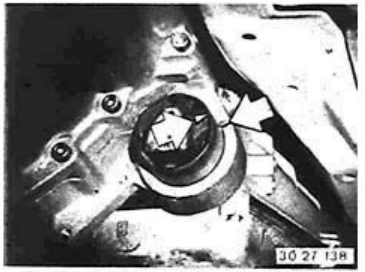
Removal:

Apply plate from Special Tool 27 1 260.

Screw spindle into threads of rubber mount and plate against the stop.

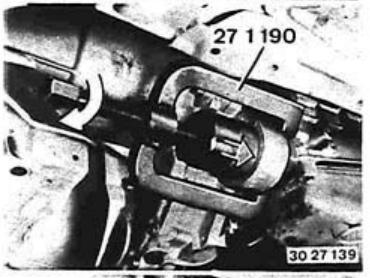
Apply bushing and spindle nut.

Pull out rubber mount.



Installation:

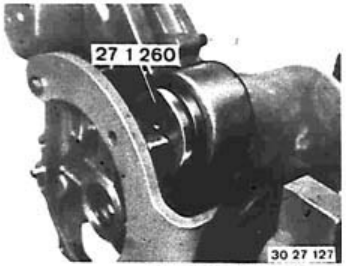
Mount new rubber mount.
Arrow on case must be aligned with mark (bead) on rubber mount.
Protruding inner bushing faces toward the rear.



Apply Special Tool 27 1 190.



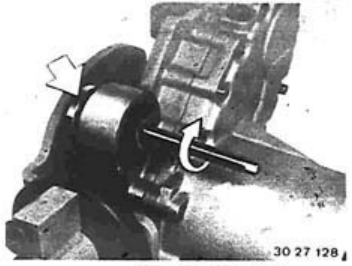
Press in rubber mount flush with the transmission case.



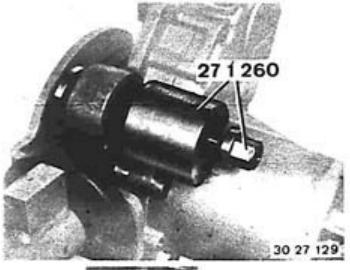
23 71 503 REPLACING RUBBER MOUNT FOR TRANSMISSION SUSPENSION
– Transfer Box Removed –
(Cars with Manual or Automatic Transmission)

Removal:

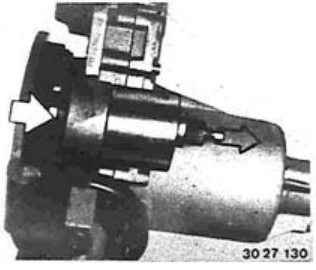
Apply plate from Special Tool 27 1 260.



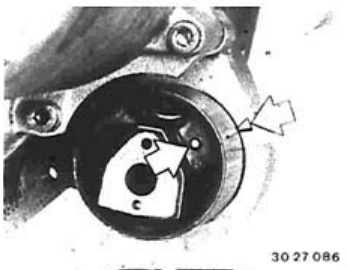
Screw spindle into threads of rubber mount AND plate against the stop.



Apply bushing and spindle nut.

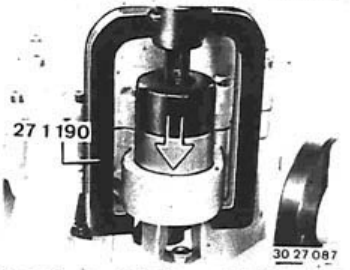


Pull out rubber mount.

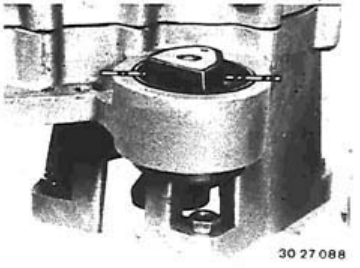


Installation:

Mount new rubber mount.
Arrow on case must be aligned with mark (bead) on rubber mount.
Protruding inner bushing faces back.



Apply Special Tool 27 1 190.



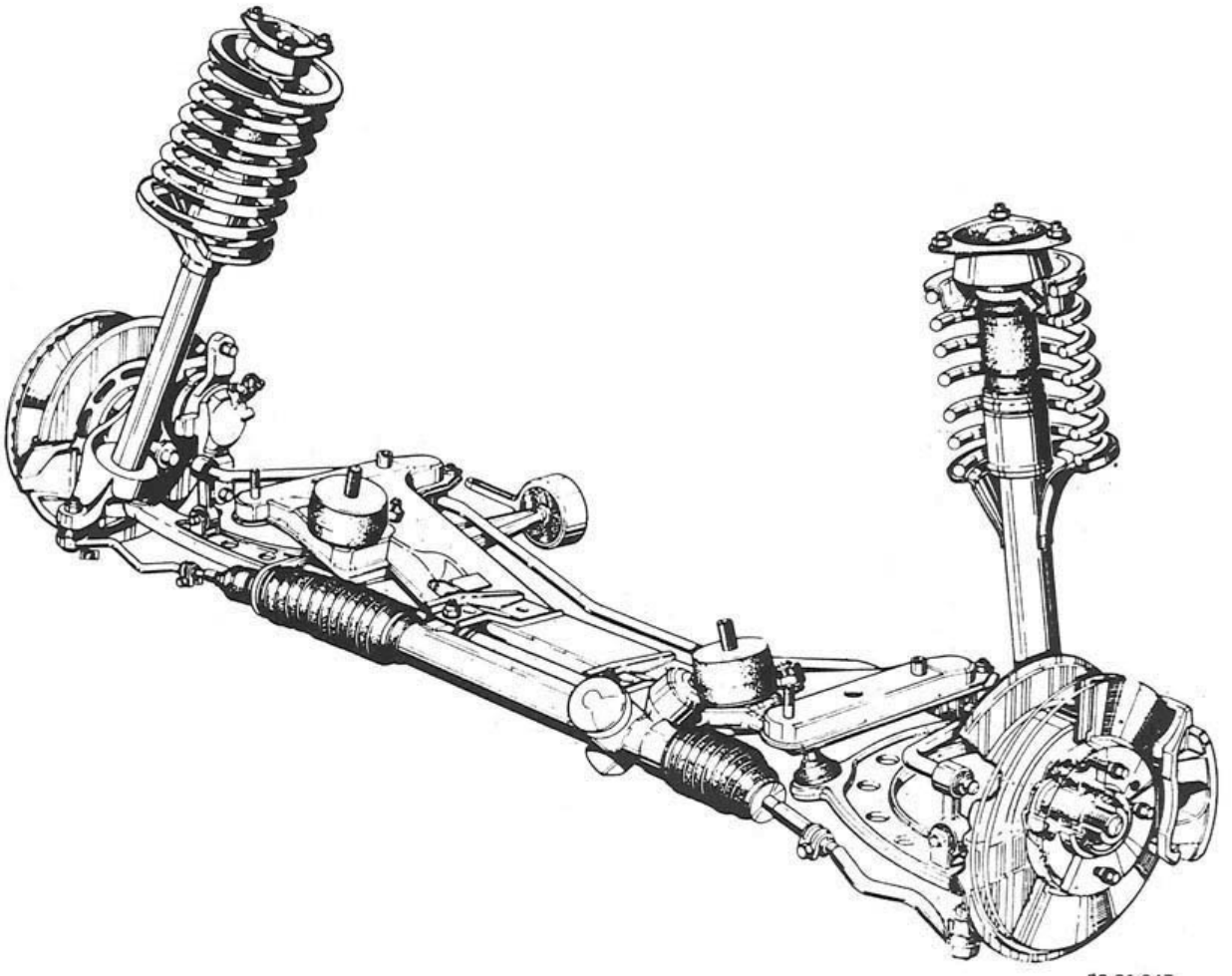
Press in rubber mount flush with transmission case.

31 Front Axle

	Front wheel suspension layout	31- 1
31 10 000	Front axle assembly – remove and install	31- 2
31 11 001	Front axle carrier – replace	31- 4
	Front axle carrier – replace (four wheel drive)	31- 5a
31 12 000	Control arm, left or right – remove and install	31- 6
	Control arm, left or right – remove and install (four wheel drive)	31- 6a
048	Bracket for control arm, left or right – remove and install or replace	31- 7
130	Rubber mounts for control arm, left or right – replace	31- 8
31 21 121	Wheel hub (drive flange), left or right – remove and install (four wheel drive)	31- 9
151	Bearings of wheel hub (drive flange), left or right – replace	31- 9a
180	Bearings (wheel hub) for front wheel – replace (four wheel drive)	31- 10
31 31 000	Spring strut assembly, front, left or right – remove and install	31- 11
	Spring strut assembly, front, left or right – remove and install (four wheel drive)	31- 11a
	Layout of shock absorber with mount and coil spring	31- 12
31 32 001	Shock absorber for front spring strut – replace	31- 13
31 33 001	Spring strut mount – replace	31- 15
100	Coil spring for front spring strut – remove and install or replace	31- 16
. . .	Ride level height – measure and correct	31-16.1
31 35 000	Stabiliser, front – remove and install or replace	31- 17
	Troubleshooting front axle	31- 18
	Troubleshooting shock absorbers	31- 20
	Front axle final drive – general information	31- 21
31 50 000	Front axle final drive – remove and install or replace	31- 22
31 51 010	Shaft seal for drive flange of front axle final drive – replace	31- 23
015	Shaft seal for output shaft, left – replace	31- 25
020	Shaft seal for output shaft, right – replace	31- 25
31 52 505	Drive pinion / ring gear – remove and install (front axle final drive removed)	31- 26
	Drive pinion / ring gear layout	31- 27
510	Bearing for drive pinion – replace (front axle final drive removed)	31- 27
520	Drive pinion and ring gear – replace (front axle final drive removed)	31- 30
31 53 050	Bearing (in console) for output shaft, right – replace	31- 32
500	Differential – remove and install (front axle final drive removed)	31- 33
	Differential bearing layout	31- 34
31 53 510	Differential gears – replace (front axle final drive removed)	31- 34
520	Differential bearings (both) – replace (front axle final drive removed)	31- 37
	Adjustments on front axle final drive	31- 39
31 60 000	Output shaft, left or right – remove and install or replace	31- 45
020	Constant velocity joint (outer) of output shaft – replace	31- 47
021	Constant velocity joint (inner) of output shaft – replace	31- 47
030	Dust cover of output shaft, left or right – replace	31- 48

31-1

FRONT WHEEL SUSPENSION ASSEMBLY DRAWING



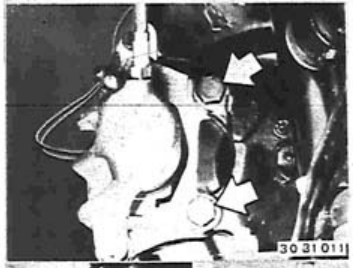
30 31 047

31 10 000 REMOVING AND INSTALLING FRONT AXLE ASSEMBLY

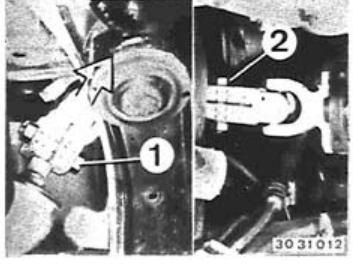
Only Cars With SRS:
Remove steering wheel – see Group 32.
Remove front wheels – see Group 36.
Note:
Check front wheel alignment with an optical tester after installation – see Group 32.



Disconnect plugs for brake pad wear indicator and EDC (see information in Group 37).
Unscrew ground lead.
Disconnect wires and brake hoses in holders on left and right spring struts.
Remove ABS pulse sender – see Group 61.

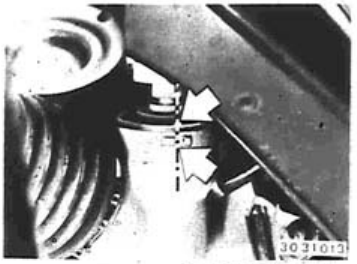


Unscrew left and right brake calipers and suspend from body on pieces of wires.
Brake hoses remain connected.
Installation:
Tightening torque*.

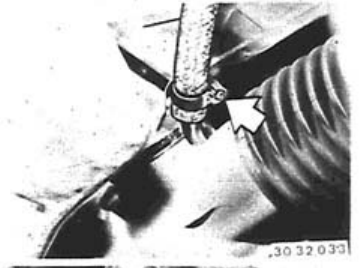


Remove bolt (1).
Loosen bolt (2).
Press steering spindle off of steering gear and remove.
Installation:
Bolt (1) must be located in groove of steering shaft.
Replace self-locking nut.
Tightening torque*.

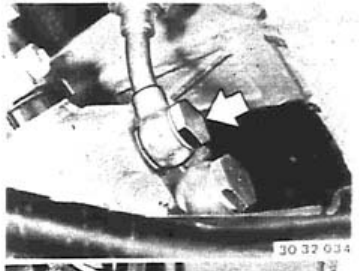
* See Specifications of Gr. 32 and 34



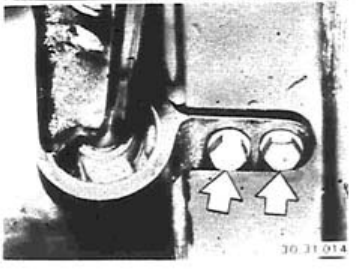
Installation:
Steering wheel and front wheels in straight ahead position. (marks on case and steering shaft aligned).
Mount steering spindle on the steering gear in such a manner, that clamping slot of universal joint is aligned with mark on steering gear.



Cars with Power Steering:
Draw off hydraulic fluid in tank.
Disconnect hydraulic return hose.
Important!
Never reuse drained hydraulic fluid.

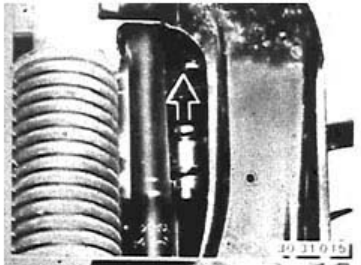


Disconnect pressure hose.
Plug open connections with dust caps.
Installation:
Replace seals.
Tightening torque*.
Fill power steering – see Group 32.

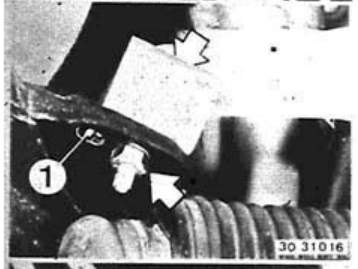


Unscrew holders for left and right control arms.
Remove heat shield for right control arm holder.
Installation:
Tightening torque*.

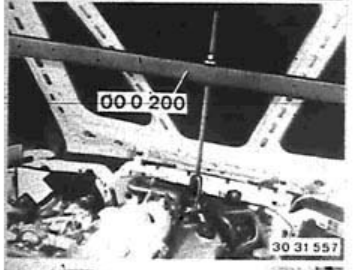
* See Specifications of Gr. 32



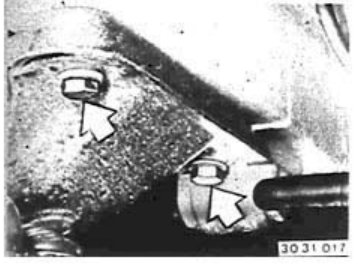
Four Cylinder Models:
Unscrew engine damper on front axle carrier.



Unscrew left and right engine mounts on front axle carrier.
Loosen right engine mount at top.
Installation:
Engine mount turning lock (1) must engage in the bore.
Tightening torque*.

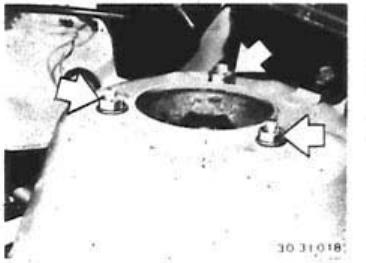


Attach Special Tool 00 0 200 on the engine.
Adapters bear on bolts of side panel walls.
Support front axle carrier from underneath with a shop jack.



Unscrew bolts on left and right sides.
Installation:
Tightening torque*.

* See Specifications of Gr. 11

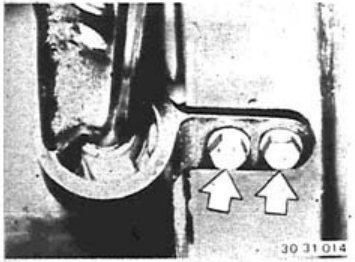


Unscrew nuts on left and right sides.
Lower front axle slowly.
Caution!
Don't let spring struts tilt out or sag through
This would damage the ball joints.
Installation:
Replace self-locking nuts.
Tightening torque*.

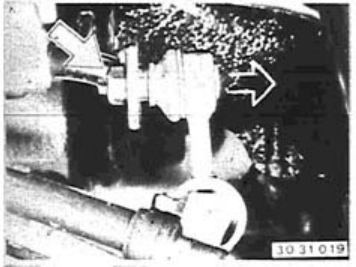
* See Specifications

31 11 001 REPLACING FRONT AXLE CARRIER

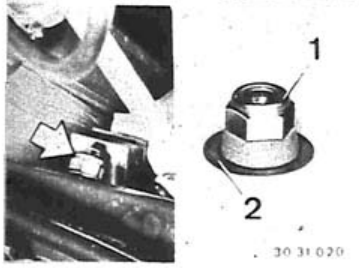
Remove front wheels – see Group 36.
Installation:
Check front wheel alignment with optical tester after installation – see Group 32.



Unscrew brackets for left and right control arms.
Installation:
Tightening torque*.



Unscrew left and right push rods on stabilizer.
Installation:
Tightening torque*.

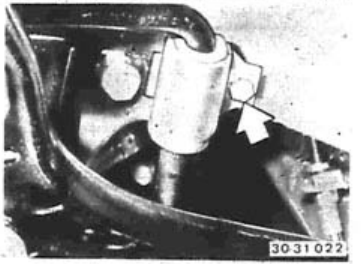


Unscrew nuts on left and right sides.
Installation:
Keep grease off and out of pins and bores.
Install rock nut (1) and washer (2) instead of the standard polystop nut.
Tightening torque*.

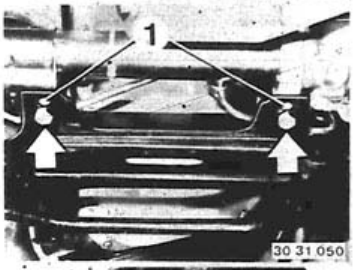
* See Specifications



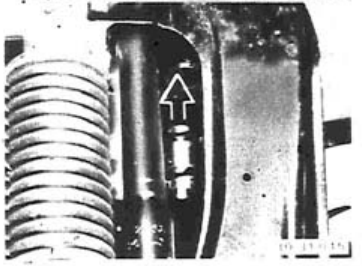
Knock pin loose with a plastic hammer.



Remove stabilizer.
Installation:
Tightening torque*.

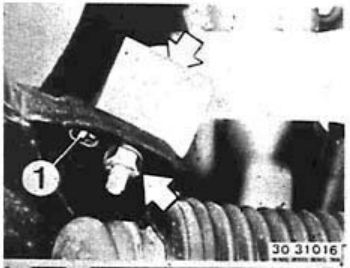


Unscrew steering gear on front axle carrier.
Installation:
Bores (1) are for steering gear without power support.
Replace self-locking nuts.
Tightening torque*.

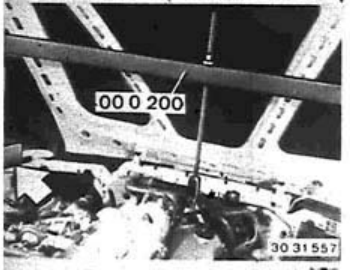


4 Cylinder Models:
Unscrew engine damper on front axle carrier.

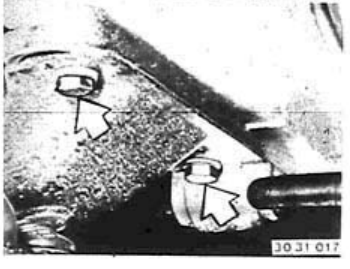
* See Specifications of Group 32



Unscrew left and right engine mounts on front axle carrier.
Loosen right engine mount at top.
Installation:
Engine mount turning lock (1) must engage in bore.
Tightening torque*.



Attach Special Tool 00 0 200 on engine.
Adapters bear on bolts of side walls.



Unscrew left and right bolts.
Remove front axle carrier.
Installation:
Tightening torque*.

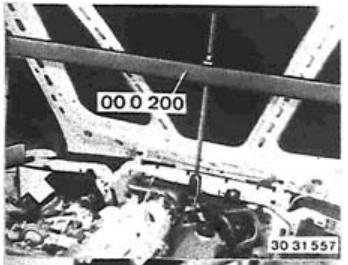
* See Specifications

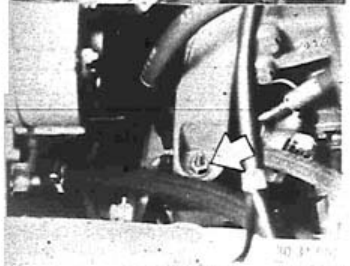
31 11 001 REPLACING FRONT AXLE CARRIER – Four Wheel Drive –

Remove splash guard – see Group 51.
Remove front wheels – see Group 36.
Remove air cleaner – see Group 13.
Draw off hydraulic fluid in tank.

Installation:
Check front wheel alignment after installation – see Group 32.
Bleed power steering – see Group 32.

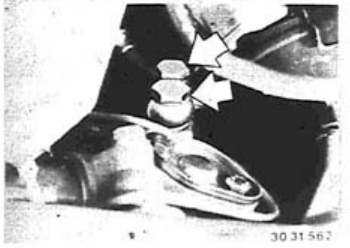
Attach Special Tool 00 0 200 on engine.
Supports bear on bolts of side walls.





Unscrew left and right engine mounts.

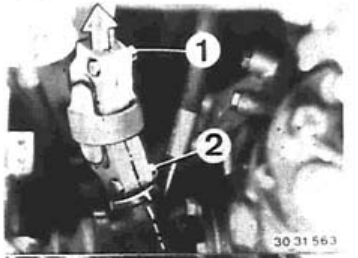
Installation:
Tightening torque*.



Unscrew hydraulic fluid pipes.
Plug openings.

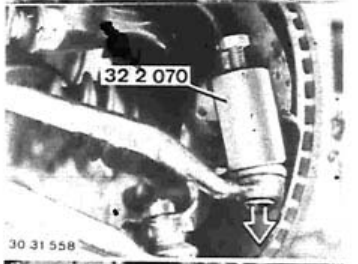
Installation:
Replace gaskets.
Tightening torque*.

* See Specifications of Gr. 31 and 32



Loosen bolt (1).
Remove bolt (2) and pull steering spindle off steering gear.

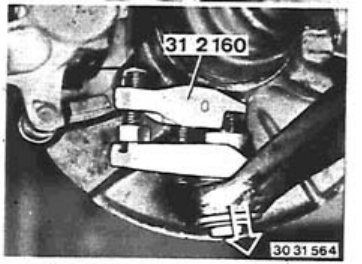
Installation:
Slot of steering spindle faces mark of cap.
Bolt (2) must be in locking groove of steering shaft.
Replace self-locking nuts.
Tightening torque*.



Unscrew left and right nuts and pry off tie rods with Special Tool 32 2 070.

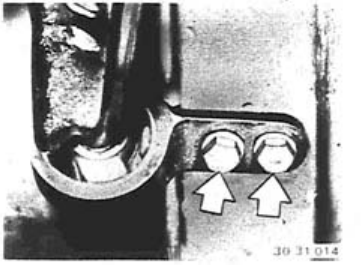
Installation:
Bore and pin free of grease.
Replace self-locking nuts.
Tightening torque*.

Caution!
Don't turn power steering as far as stop – radial oil seal would be damaged.



Unscrew left and right nuts and pry off control arms with Special Tool 31 2 160.

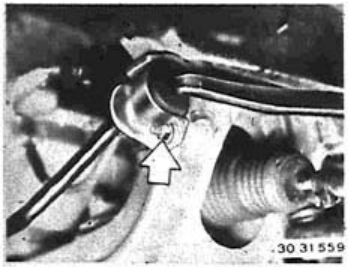
Installation:
Bore and pin free of grease.
Tightening torque*.
Lock nuts with cotter pins.



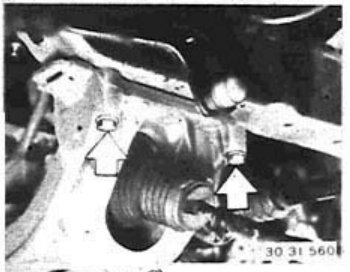
Unscrew brackets for left and right control arms.

Installation:
Tightening torque*.

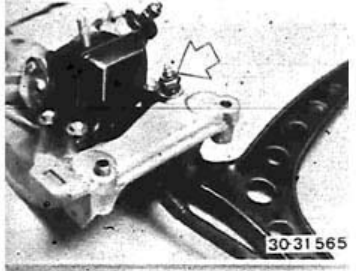
* See Specifications of Gr. 31 and 32



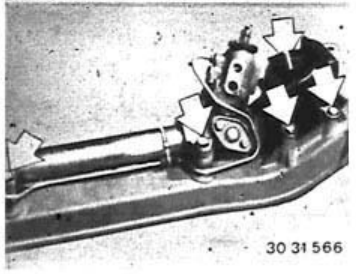
Unscrew left and right stabilizer mounts.



Support front axle carrier with Special Tool 00 2 020 and a workshop jack.
Unscrew bolts and lower front axle carrier.
Installation:
Clean tapped bores.
Always replace and install bolts with a bolt cement**
Tightening torque*.

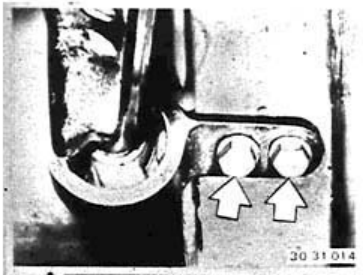


Unscrew both control arms.
Installation:
Mount control arms in installed position, so that rubber parts of tapered joints are not turned wrong.
Replace self-locking nuts.
Tightening torque*.



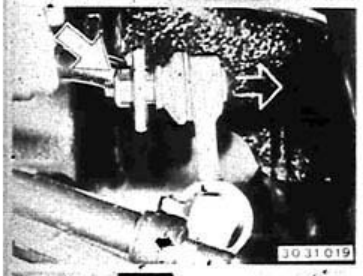
Unscrew engine mounts and steering gear.
Installation:
Replace self-locking nuts.
Tightening torque*.

* See Specifications of Groups 31 and 32
** Source of Supply: HWB

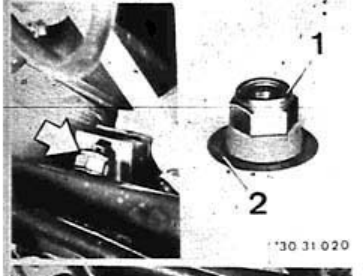


31 12 000 REMOVING AND INSTALLING LEFT OR RIGHT CONTROL ARM

Remove front wheel – see Group 36.
Unscrew holder for control arm.
Installation:
Tightening torque*.



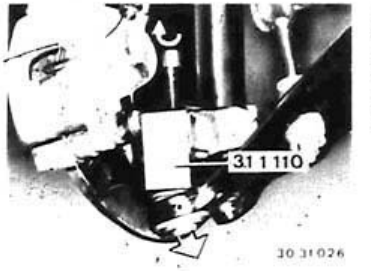
Unscrew push rod on stabilizer.
Installation:
Tightening torque*.



Unscrew nut.
Installation:
Keep grease off of pins and bores.
Install locknut (1) and washer (2) instead of the standard polystop nut.
Tightening torque*.



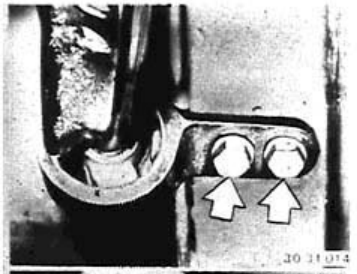
Knock pin loose with a plastic hammer.



Unscrew nut and press off guide joint with Special Tool 31 1 110 (or 31 2 160 for M 3 cars).
Installation:
Keep grease off of pins and bores.
Replace self-locking nut.
Tightening torque*.

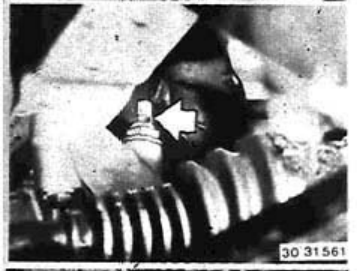
* See Specifications

* See Specifications

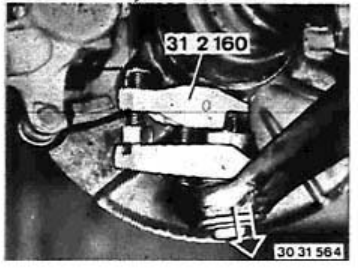


31 12 000 REMOVING AND INSTALLING LEFT OR RIGHT CONTROL ARM
– All Wheel Drive –

Remove front wheel – see Group 36.
Unscrew control arm bracket.
Installation:
Tightening torque*.

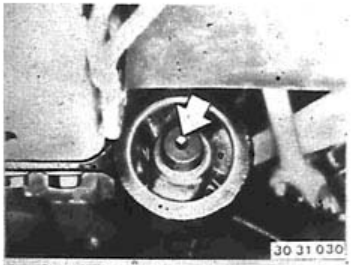


Unscrew nut.
Installation:
Replace self-locking nut.
Tightening torque*.



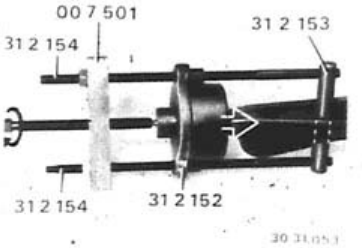
Unscrew nut.
Press off control arm with Special Tool 31 2 160.
Installation:
Keep grease out of bore and off of pin.
Tightening torque*.
Lock nut with cotter pin.

* See Specifications

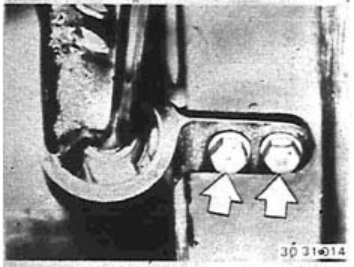


31 2 048 REMOVING AND INSTALLING/ REPLACING BRACKET FOR LEFT OR RIGHT CONTROL ARM

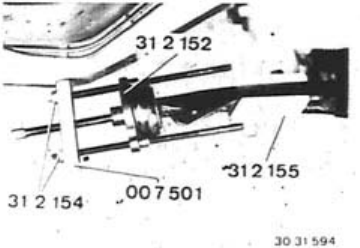
Punch mark center of control arm.



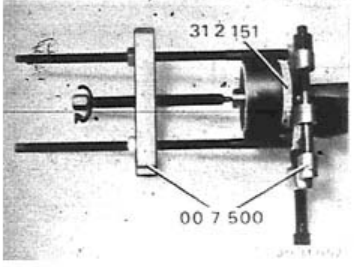
Coat control arm journal with an approved lubricant**.
Engage Special Tool 31 2 153 in control arm bore.
Pull on bracket/mount against stop on control arm with Special Tools 31 2 152/154 and 00 7 501.



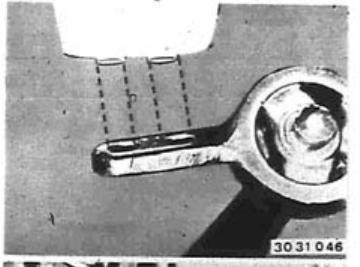
Unscrew control arm bracket.
Remove heat shield, if applicable.
Installation:
Tightening torque*.



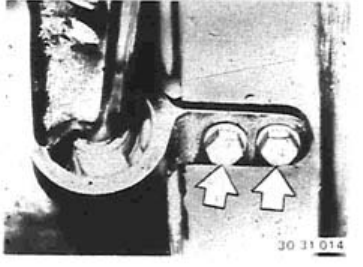
All Wheel Drive:
Use Special Tool 31 2 155 instead of Special Tool 31 2 153.



Pull bracket off of control arm with Special Tools 31 2 151 and 00 7 500.
Important!
Never reuse a rubber mount pulled off of the control arm.
The rubberized inner sleeve will be destroyed when pulled off dry.
Replace rubber mounts 31 12 130.
Always replace left and right mounts and use mounts of same make (visible on mount).



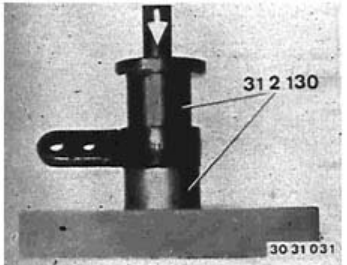
Note:
Centering bores (large diameter) of bracket face engine carrier.

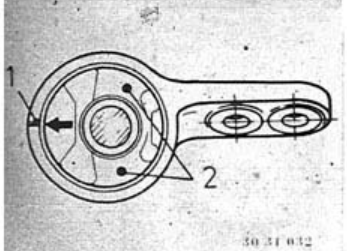


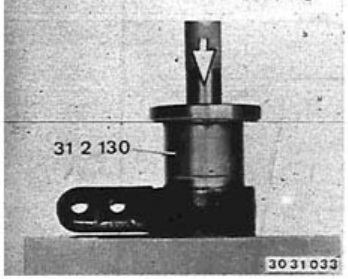
Important!
Bolt bracket on body immediately.
Tightening torque*.
Load down car to normal position*.
Leave car in normal position at least 30 minutes and avoid any suspension movement.
The lubricant will evaporate after 30 minutes, so that the control arm fits tight and is positioned correctly in the rubber mount.
Non-conformance with these procedures could impair handling considerably!

* See Specifications

* See Specifications
** Source of Supply: HWB





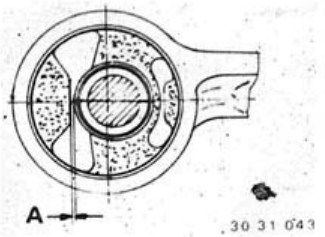


31 12 130 REPLACING RUBBER MOUNT FOR LEFT OR RIGHT CONTROL ARM

Important!
Always replace left and right rubber mounts and use rubber mounts of same make (shown on mounts).
Remove bracket for control arm – see 13 12 048.
Press out rubber mounts with Special Tool 31 2 130.

Installation:
Check installed position!
Arrow on rubber mount points to cast boss (1) on bracket.
Bracket and rubber mount cleaned to remove grease.
Rubber mounts for six cylinder models and M 3 are marked with dot (2) of "orange" paint.

Press ruber mount into bracket flush from bevelled end [redacted] Special Tool 31 2 130.



Checking Rubber Mounts:
Car loaded down to normal position*.
Measure gap (A) with feeler gage blade.
Specification:
A = 0.7 ... 1.7 mm /0.028 ... 0.067").
If measured value deviates from specification, replace rubber mount.

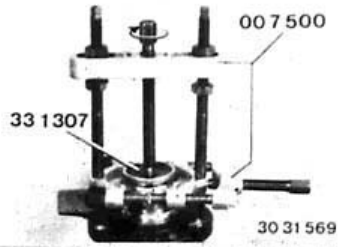
* See Specifications

31 21 121 REMOVING AND INSTALLING LEFT OR RIGHT WHEEL HUB (DRIVE FLANGE)
– All Wheel Drive –

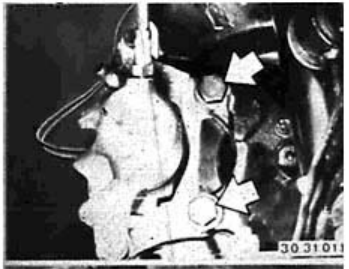
Pulling off the drive flange will destroy the wheel bearing, which must always be replaced.
Procedures are identical with those described in 31 21 151.

31 21 151 REPLACING BEARING OF LEFT OR RIGHT WHEEL HUB (DRIVE FLANGE) – All Wheel Drive –

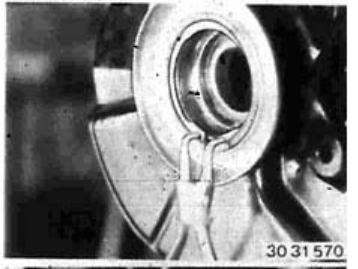
Remove output shaft – 31 60 000.
Mount control arm again finger tight, so that the spring strut is held in position for further procedures.



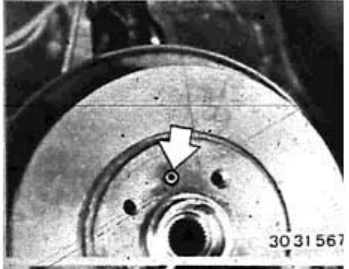
Note:
If applicable, pull bearing inner race off of drive flange with Special Tools 33 1 307 and 00 7 500.



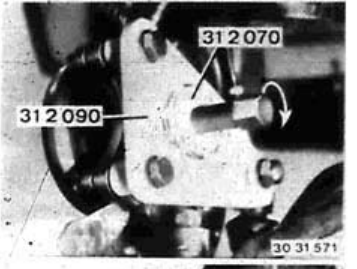
Unscrew brake caliper and suspend from body on a piece of wire.
Brake line remains connected.
Installation:
Tightening torque*.



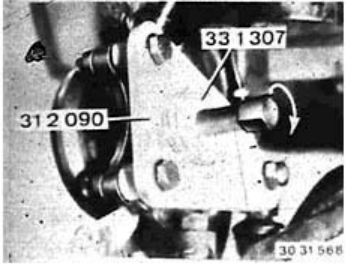
Lift out circlip.



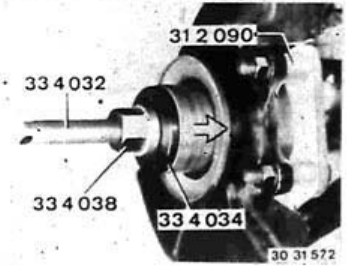
Unscrew brake disc.



Remove Special Tool 31 2 090, apply Special Tool 31 2 070, mount Special Tool 31 2 090 again and press out bearing.
Special Tool 31 2 090 remains installed.

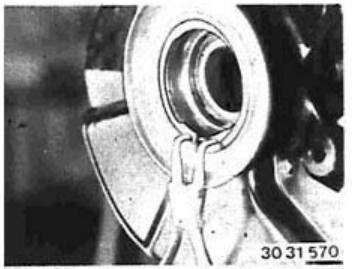


Apply Special Tool 33 1 307.
Mount Special Tool 31 2 090 with the hook attached on tie rod arm and press off the drive flange.

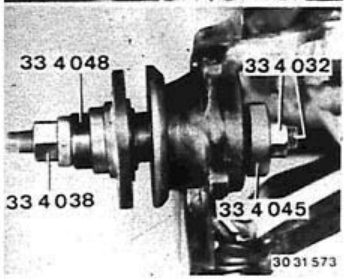


Unscrew spindle of Special Tool 31 2 090 and screw in Special Tool 33 4 032 flush.
Pull in new bearing with Special Tools 33 4 034 and 33 4 038.
Remove Special Tool 31 2 090.

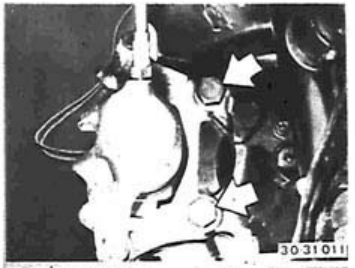
* See Specifications of Group 34



Important!
Install circlip with open end facing down.

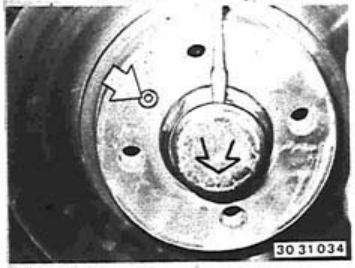


Pull in drive flange with Special Tools 33 4 032 / 038 / 045 / 048.

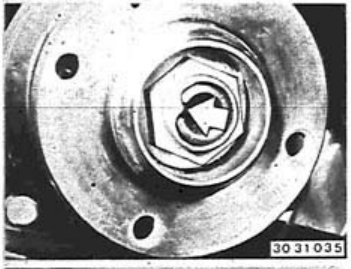


31 2 180 REPLACING BEARING FOR FRONT WHEEL

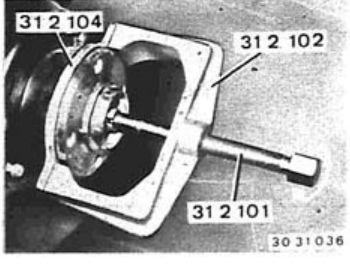
Remove front wheel – see Group 36.
Unscrew and suspend brake caliper from body on a piece of wire, – brake hose remains connected.
Installation:
Tightening torque*.



Unscrew brake disc and take off grease cap.
Important!
Always replace grease caps.
Install new grease cap with cement, HWB No. 81 22 8 407 420.

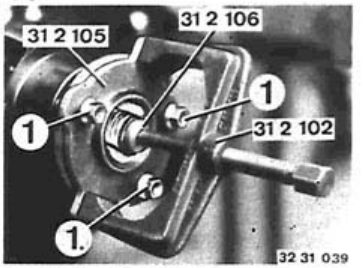


Break the collar nut with a cross chisel and unscrew with Special Tool 11 2 180.
M 3:
Special Tool 31 2 080.
Installation:
Replace collar nut.
Tightening torque*.
Lock collar nut.

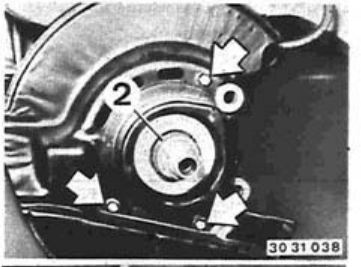


Pull off bearing unit with Special Tools 31 2 101/102/104.
Important!
A pulled off bearing unit must not be reused.

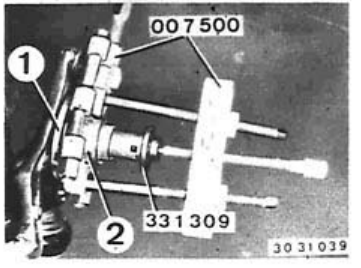
* See Specifications of Gr. 34



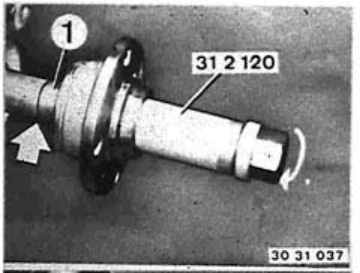
M 3:
Pull off bearing unit with Special Tools 31 2 102/105/106 and wheel bolts (1).
Bearing unit must not be reused.



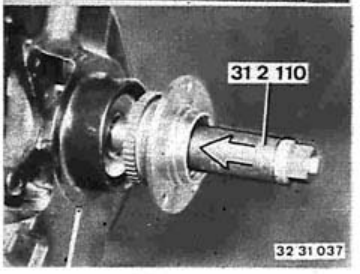
Important!
Remove the guard, if the inside bearing inner race (2) remains on the stub axle after pulling off the bearing unit.



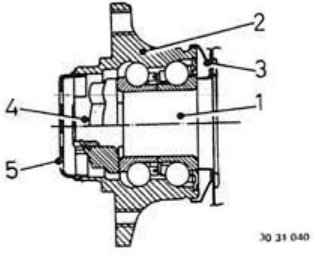
Bend dust guard (1) back and pull off bearing inner race (2) with Special Tool 00 7 500 and Special Tool 33 1 309.
Installation:
Replace dust guard (1).



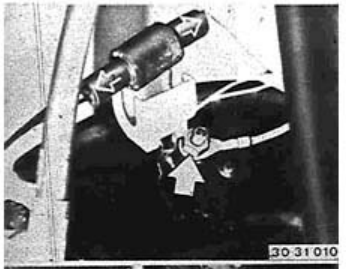
Installation:
If applicable, install guard.
Screw in guide sleeve (1) entire length of threads.
Pull on new bearing unit with Special Tool 31 2 120.
M 3:
Special Tool 31 2 110.



Installation:
M 3:
If applicable, install guard.
Pull on new bearing unit with Special Tool 31 2 110.

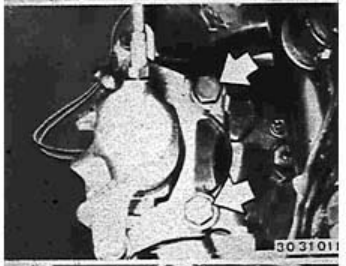


1 Stub axle
2 Wheel hub
3 Dust guard
4 Collar nut
5 Cover



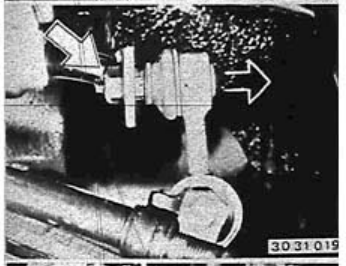
31 31 000 REMOVING AND INSTALLING LEFT OR RIGHT FRONT SPRING STRUT ASSEMBLY

Remove front wheel – see Group 36.
Disconnect plugs for brake pad wear indicator and EDC (see Group 37 for information).
Disconnect ground lead.
Take lead and brake hose out of holder on spring strut.
Remove ABS pulse sender – see Group 61.



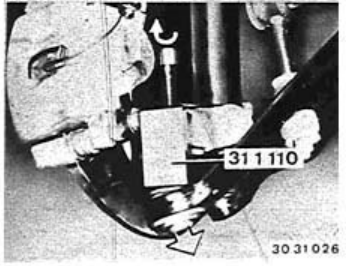
Unscrew and suspend brake caliper from body on piece of wire.
Brake pipe remains connected.

Installation:
Tightening torque*.



Unscrew push rod on stabilizer.

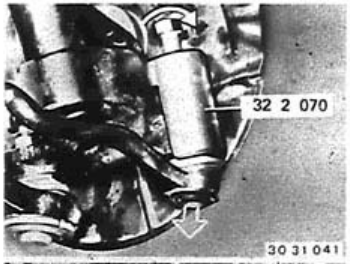
Installation:
Tightening torque*.



Unscrew nut and press off guide joint with Special Tool 31 1 110 or, for M 3, Special Tool 31 2 160.

Installation:
Replace self-locking nut.
Journal and bore cleaned of grease.
Tightening torque*.

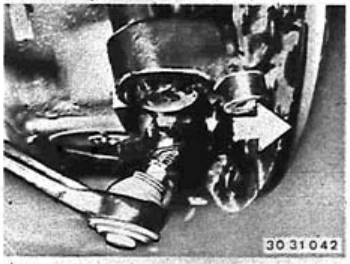
* See Specifications of Gr. 34



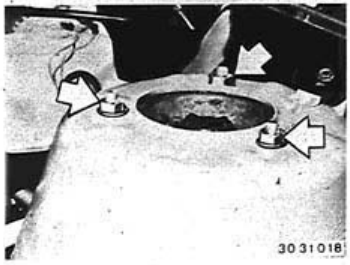
Unscrew nut and press off tie rod joint with Special Tool 32 2 070 or, for M 3, Special Tool 31 2 160.

Installation:
Replace self-locking nut.
Journal and bore cleaned of grease.
Tightening torque*.

Important!
Don't turn power steering as far as stop — this would damage radial oil seal.



Press out and push spring strut over guide joint journal.



Support spring strut from underneath.
Unscrew nuts.

Installation:
Replace self-locking nuts.
Tightening torque*.

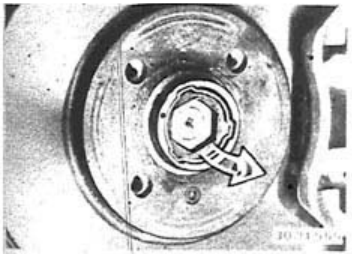
Important!
Only store shock absorbers upright. Shock absorbers with run-in piston rods stored laying down will cause knocking noise when installed again.

Remedy:
Store shock absorber with run-out piston rod upright at room temperature for 24 hours.

* See Specifications of Gr. 32

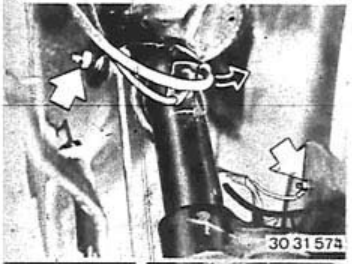
31 31 000 REMOVING AND INSTALLING LEFT OR RIGHT FRONT SPRING STRUT ASSEMBLY – Four Wheel Drive –

Remove front wheel – see Group 36.
Remove ABS pulse sender – see Group 61.



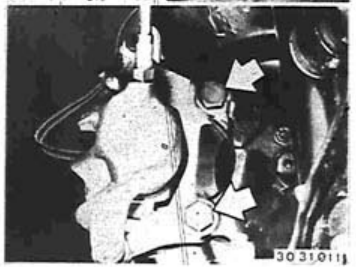
Pry out lockplate with a screwdriver.
Unscrew collar nut.

Installation:
Tightening torque*.
Replace lockplate, knocking it on with Special Tools 00 5 500 and 33 4 050.



Disconnect plug for brake pad wear indicator.
Disconnect ground lead.
Take lead and brake hose out of holder on spring strut.
Unscrew push rod.

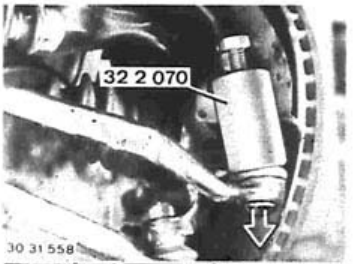
Installation:
Tightening torque*.



Unscrew and suspend brake caliper from body on piece of wire.
Brake pipe remains connected.

Installation:
Tightening torque*.

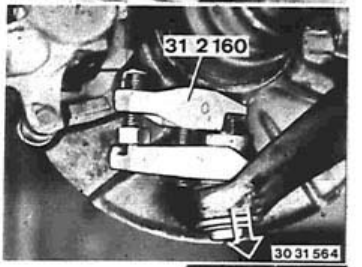
* See Specifications of Gr. 31 + 34



Unscrew nut and press off tie rod joint with Special Tool 32 2 070.

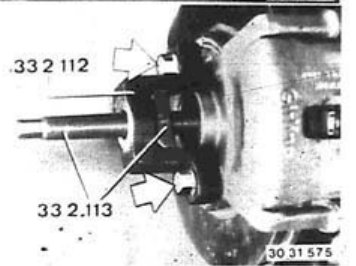
Installation:
Journal and bore cleaned of grease.
Replace self-locking nut.
Tightening torque*.

Important!
Don't turn power steering as far as stop — this would damage radial oil seal.

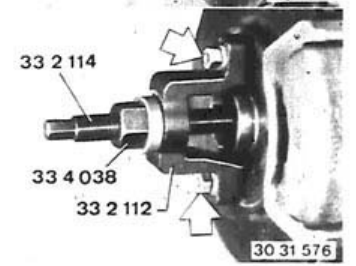


Unscrew nut and press off guide joint with Special Tool 31 2 160.

Installation:
Bore and journal cleaned of grease.
Tightening torque*.
Lock nut with cotter pin.

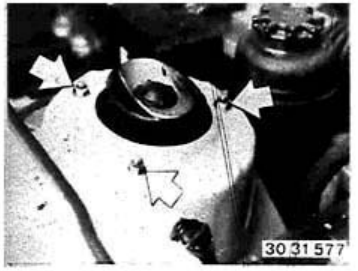


Mount Special Tools 33 2 112 / 113 with two wheel bolts and press off output shaft.



Installation:
Lubricate splines of output shaft lightly with oil and pull in output shaft with Special Tools 33 2 112 / 114 and 33 4 038.

* See Specifications of Gr. 31 + 32

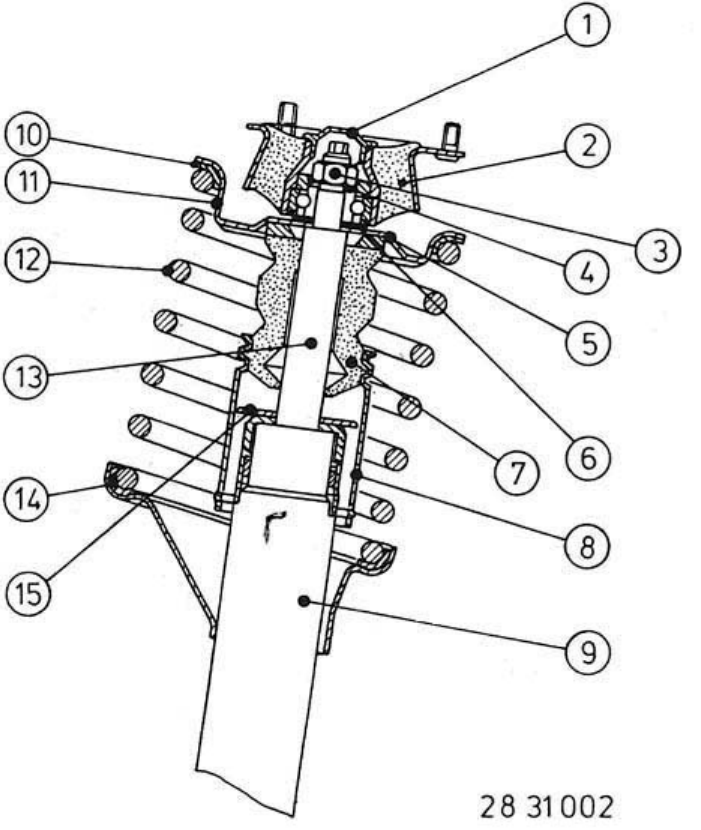


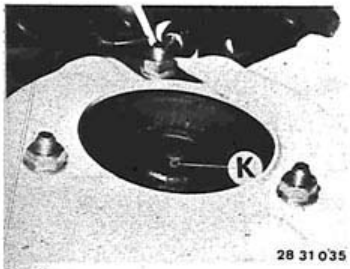
Support spring strut.
Unscrew nuts and take off spring strut.
Installation:
Replace self-locking nuts.
Tightening torque*.

* See Specifications

LAYOUT DRAWING OF SHOCK ABSORBER WITH MOUNT AND COIL SPRING

1 Cap
2 Mount
3 Self-locking nut
4 Washer
5 Insulator
6 Washer
7 Rubber damper
8 Protective tube
9 Spring strut tube
10 Upper rubber ring
11 Upper spring retainer
12 Coil spring
13 Shock absorber piston rod
14 Lower rubber ring
15 Screw-on ring

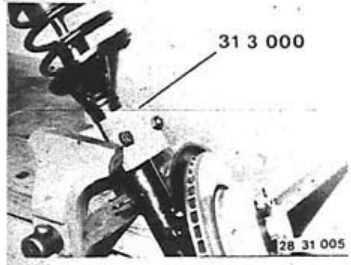




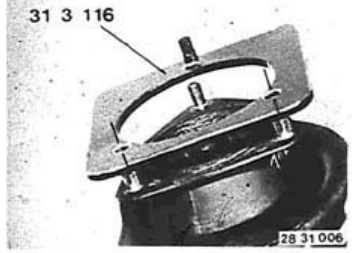
31 32 001 REPLACING FRONT SPRING STRUT SHOCK ABSORBER

Important!
Always replace shock absorbers with ones having same code K.
To know whether shock absorbers have to be replaced, check installed absorbers with a "Shock Tester" or removed in an absorber testing machine.
Also refer to Service Information 37 02 83 (177).

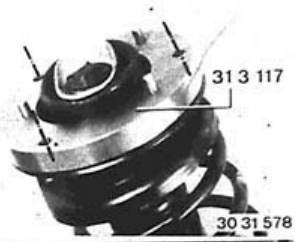
Cars with Electronic Absorber Control (EDC): Refer to information in Group 37.



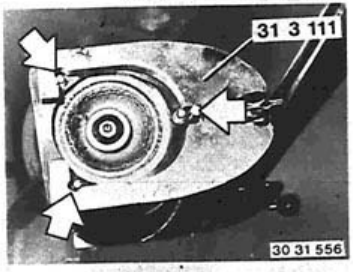
Remove spring strut assembly – see 31 31 000.
Take up spring strut in a vise with Special Tool 31 3 000.



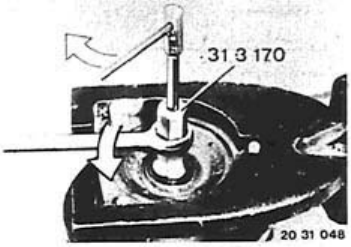
Set up Special Tool 31 3 116 on mount.



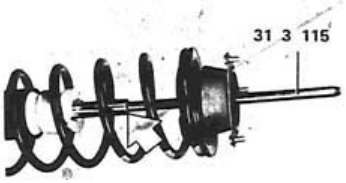
All Wheel Drive Cars:
Set up Special Tool 31 3 117 on mount.



Compress coil spring with Special Tool 31 3 111.
Important!
Pins must fit in openings.



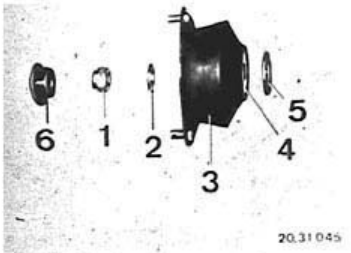
Lift off cap.
Unscrew self-locking nut with Special Tool 31 3 170 – counterholding on the piston rod.
Installation:
Replace self-locking nut.
Tightening torque*.



Take off washer (2).
Screw in Special Tool 31 3 115 entire length of threads.
Release and take off special tool compressor.

28 31 020

* See Specifications



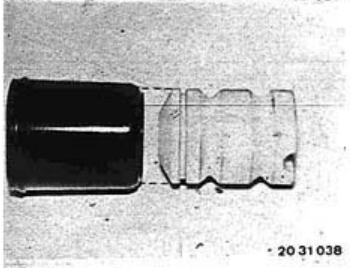
20.31045

Lift off mount.
Installed Order:
1 Self-locking nut
2 Washer with small diameter
3 Mount
4 Insulator
5 Washer with large diameter
6 Cap
Concave surface of insulator (4) faces the mount.

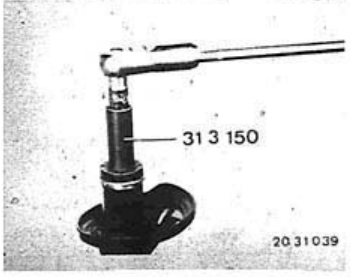

730 31 057

Lift off upper spring retainer with rubber ring and coil spring.

Installation:
Inspect upper and lower rubber rings, replacing if necessary.
End of coil spring must bear on the shoulders in the lower and upper spring retainers.


20 31 038

Installation:
Inspect protective tube and damper or rubber sleeve, replacing if necessary.

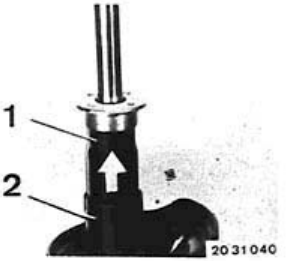


20.31039

Unscrew screw-on ring with Special Tool 31 3 150 or 31 3 180.

Installation:
Tightening torque*.

* See Specifications



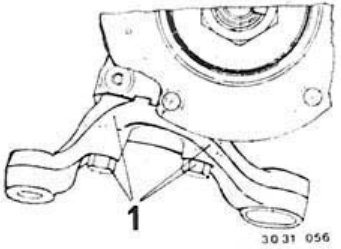
20 31 040

Pull out shock absorber (1).

Installation:
Remove old oil in spring strut pipe (2).
Fill with engine oil** before installing a new shock absorber.
Oil volume*.
The engine oil is required to transfer heat from the shock absorber to the spring strut pipe.

Important!
Oil must not be filled in a gas pressure single-pipe front wheel cartridge, recognized on the piston rod diameter = at least 33 mm (1.299") – also refer to Service Information of Group 37.

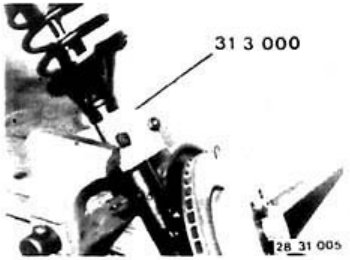
Only store shock absorbers standing upright. Storing shock absorbers in horizontal position with the piston rods run in could lead to noise when used in a car again.
Remedy:
Store shock absorbers standing upright and with the piston rods run out at room temperature for 24 hours.



30 31 056

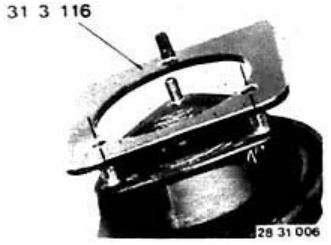
M 3 with EDC:
Install bolts (1) with a bolt cement (source of supply: HWB).
Tightening torque*.

* See Specifications
** See Operating Fluids



31 33 001 REPLACING SPRING STRUT MOUNT

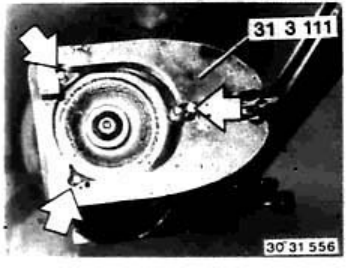
Remove spring strut assembly – see 31 31 000.
Take up spring strut in a vise with Special Tool 31 3 000.
Important!
If a correction mount (see Group 32) is used, install a new mount with the same code.



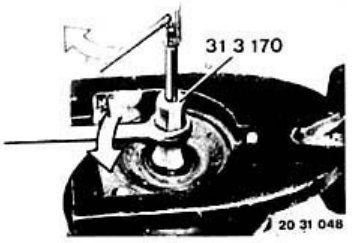
Set up Special Tool 31 3 116 on mount.



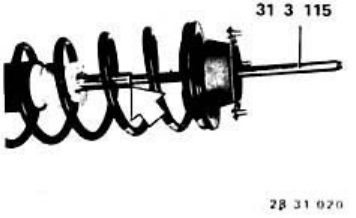
All Wheel Drive Cars:
Set up Special Tool 31 3 117 on mount.



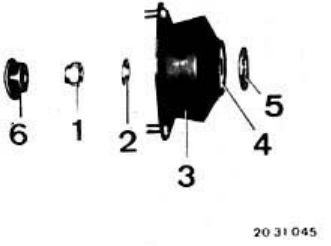
Compress coil spring with Special Tool 31 3 111.
Important!
Pins must fit in openings.



Pull off cap.
Unscrew self-locking nut with Special Tool 31 3 170.
Installation:
Replace self-locking nut.
Tightening torque*.



Remove washer (2).
Screw in guide sleeve 31 3 115 entire length of threads.
Release and remove special tool compressor.

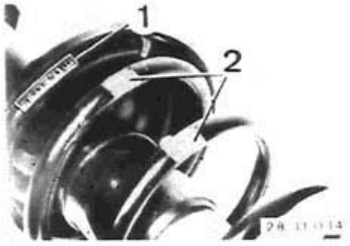


Lift off mount.
Installed Order:
1 Self-locking nut
2 Washer with small diameter
3 Mount
4 Seal
5 Washer with large diameter
6 Cap
Internal curved surface of seal (4) faces the mount.



Lift off upper spring retainer with rubber ring and coil spring.
Installation:
Check upper and lower rubber rings, replacing if necessary.
Ends of coil spring must rest on shoulders in lower and upper spring retainers.

* See Specifications



28 11 013

31 33 100 REMOVING AND INSTALLING/ REPLACING LEFT OR RIGHT FRONT SPRING STRUT COIL SPRING

Remove spring strut mount 31 33 001.
Remove upper spring retainer with rubber ring and coil spring.

Important!

Only install pairs of springs on one axle with same BMW number (1) (on end of spring) and same color code (2) (either with or without a red paint stripe).
Refer to spare part microfiche for cross reference of springs and vehicle types as well as, if applicable, special equipment (air conditioner, sport suspension, etc.) and introduction dates.

The BMW number on the spring can be used to find the spare part number and therefore the spring belonging to a vehicle type as shown on the spare part micorfiche.
Example:

1. Spring with red color code:
   Number on spring, e.g. 1 125 332
   Add 1 = part number = 1 125 333
2. Spring without red color code:
   Number on spring, e.g. 1 125 332
   Add 2 = part number = 1 125 334

Installation:
Install upper rubber ring* with thickness (A) for coil springs with red color code.
A = 9 mm (0.354").



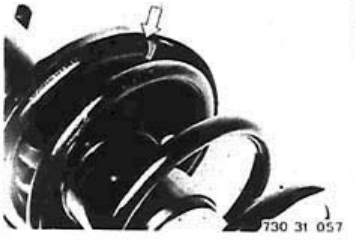
28 31 011

* See Specifications of Gr. 31



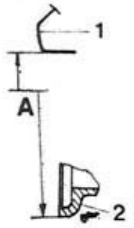
20 31 038

Installation:
Check protective tube and rubber damper, replacing if necessary.



730 31 057

Installation:
Check upper and lower rubber rings, replacing if necessary.
Ends of coil spring must rest on shoulders in lower and upper spring retainers.



28 32 091

31 33 ... CHECKING AND CORRECTING HEIGHT

- Load down car to normal position*.
- Measure actual height (A) from wheel house lower edge (1) to rim flange (2) at wheel center height. Determine the mean value of each wheel after lifting and lowering the car body, and then the mean value of the axle.
- Determine any deviation from the nominal height value*.
- Identify the install springs - see 31 33 100.
- Find correction spring in the table. The numbers are height deviation (nominal values in mm) between the pertinent springs.

Example:

The car is equipped with coil springs having BMW No. 112 6 516 and is, for example, 7 mm (0.275") too deep due to so many optional extra equipment parts.
The nominal height* is reached by installing springs with BMW No. 112 7 282 (see 31 33 100 for information on determining part numbers).

Table for
316, 318 i, 320 i, 323 i, 324 d/until 1988 Models
325 3 until 1987 Models

A = Equipment after correction

B = Equipment of delivered car

a = Adjusted higher

b = Adjusted lower

Information:
Thick spring ring for coil springs with a red stripe.
Thin spring ring for coil springs without a red stripe.
The height can be adjusted additionally by ± 5 mm (0.197") by exchanging these spring rings.

B \ A (a / b)	1 127 935	1 126 397	1 127 279	1 126 516	1 127 282	1 128 349	1 129 880	1 125 341	1 127 503	1 125 726
1 127 935		±6	+14	+20						
1 126 397	-6		+8	+14	+21					
1 127 279	-12	-7		+7	+14	+20				
1 126 516		-12	-7		+7	+14	+20			
1 127 282			-12	-7		+7	+13	+19		
1128 349				-12	-6		+6	+11	+16	
1 129 880					-11	-5		+4	+9	+15
1125 341						-9	-4		+4	+10
1127 503							-8	-4		+6
1125 726								-10	-6	

* See Specifications

Table for
Four Wheel Drive Cars

See 31 33 . . . above for explanations.

Information:
Only install coil springs without red stripes together with (thick) spring rings 1 124 322.
Additional height corrections with rubber rings are not possible.

a \ b	A: 1 127 282	1 128 349	1 129 880	1 125 341	1 127 503	1 125 726	1 126 904
B: 1 127 282		+7	+12	+16			
1 128 349	-7		+5	+9	+14		
1 129 880	-13	-6		+4	+9	+15	
1 125 341		-10	-5		+5	+11	+18
1 127 503			-9	-5		+6	+14
1 125 726				-12	-7		+8
1 126 904					-15	-9	

Four Wheel Drive Cars with M-Technik

See 31 33 . . . above for explanations.

a \ b	A: 1 133 542	1 133 543	1 133 544
B: 1 133 542		+ 7	+ 14
1 133 543	- 7		+ 7
1 133 544	- 15	- 7	

Table for Convertibles

See 31 33 ... above for explanations.

a \ b	A: 1 132 073	1 131 937	1 131 940	1 131 943	1 131 946	1 132 674
B: 1 132 073		+8	+15	+22		
1 131 937	-9		+8	+15	+21	
1 131 940	-17	-8		+7	+14	+21
1 131 943		-17	-8		+7	+14
1 131 946			-16	-8		+7
1 132 674				-15	-7	

Convertibles with M-Technik

a \ b	A: 1 131 327	1 131 027	1 131 030	1 131 330	1 131 333	1 132 742	1 133 461
B: 1 131 327		+ 7	+ 14	+ 20			
1 131 027	- 8		+ 7	+ 14	+ 20		
1 131 030	- 15	- 7		+ 7	+ 13	+ 19	
1 131 330		- 15	- 7		+ 6	+ 13	+ 19
1 131 333			- 14	- 7		+ 6	+ 13
1 132 742				- 14	- 7		+ 6
1 133 461					- 13	- 6	

Table for:
M-Technique Sport Suspension; not for Convertible, Four Wheel Drive and Touring

Explanations – see 31 33 . . ..

a \ A / b \ B	1 130 037	1 130 040	1 130 043	1 130 046	1 130 049	1 130 054	1 133 462
1 130 037		+8	+15	+21			
1 130 040	-8		+8	+15	+20		
1 130 043	-16	-8		+7	+14	+19	
1 130 046		-15	-7		+7	+14	+19
1 130 049			-14	-7		+7	+13
1 130 054				-14	-7		+6
1 133 462					-13	-6	

Table for:
M-Technique Sport Suspension Touring

Explanations – see 31 33 . . ..

a \ A / b \ B	1 130 037	1 130 040	1 130 043	1 130 046	1 130 049	1 130 054	1 133 462
1 130 037		+8	+15	+21			
1 130 040	-8		+8	+15	+20		
1 130 043	-16	-8		+7	+14	+19	
1 130 046		-15	-7		+7	+14	+19
1 130 049			-14	-7		+7	+13
1 130 054				-14	-7		+6
1 133 462					-13	-6	

Table for
325 i until 1988 Models;
325 e since 1987 Models;
Sport Suspension 316, 318 i, 320 i;
324 d since 1987 Models

See 31 33 . . . above for explanations.

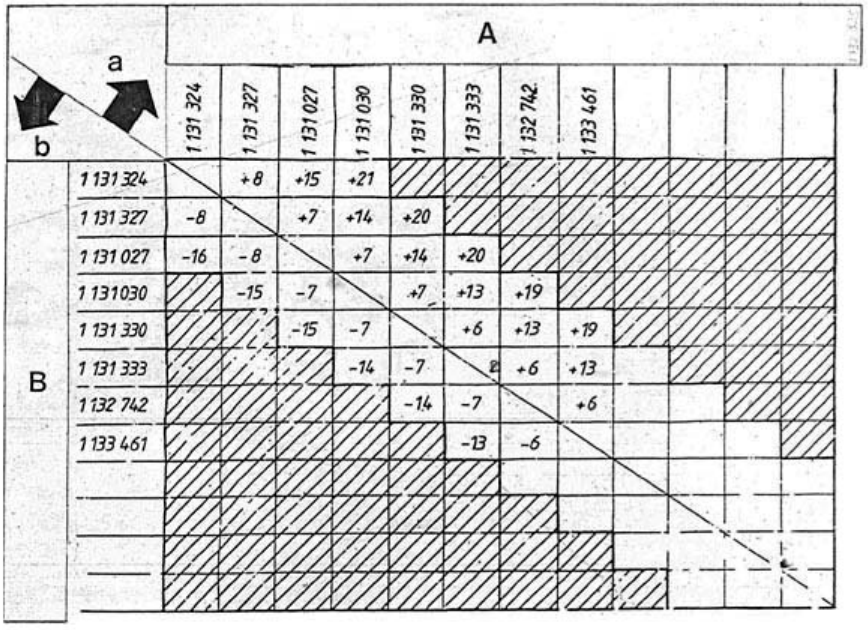
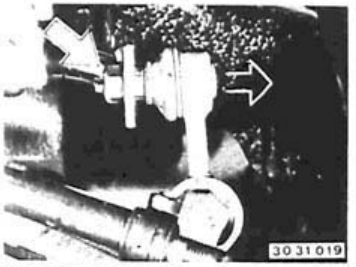


Table for
316 I, 318 I, 320 I, 325 e,
325 I, 324 d, 324 td since 1988 Models

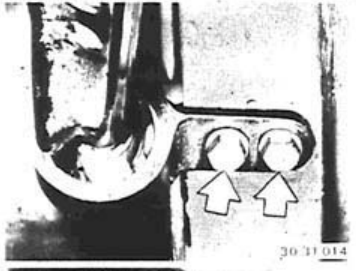
See 31 33 ... above for explanations.

a / b	A: 1 131 327	A: 1 131 027	A: 1 131 030	A: 1 131 330	A: 1 131 333	A: 1 132 742	A: 1 133 461
B: 1 131 327		+ 7	+ 14	+ 20			
B: 1 131 027	- 8		+ 7	+ 14	+ 20		
B: 1 131 030	- 15	- 7		+ 7	+ 13	+ 19	
B: 1 131 330		- 15	- 7		+ 6	+ 13	+ 19
B: 1 131 333			- 14	- 7		+ 6	+ 13
B: 1 132 742				- 14	- 7		+ 6
B: 1 133 461					- 13	- 6	



31 35 000 REMOVING AND INSTALLING OR REPLACING FRONT STABILIZER

Disconnect thrust rods on stabilizer at left and right sides.
Installation:
Tightening torque*.



Disconnect left bracket for control arm.
Installation:
Tightening torque*.



Disconnect left and right stabilizer mounts.
Remove stabilizer.
Installation:
Tightening torque*.

* See Specifications

TROUBLESHOOTING FRONT AXLE

Condition	Cause	Correction
Grinding noise (louder in curves)	Wheel bearings defective	Replace wheel bearings (wheel hub)
Vibration	Wheels unbalanced	Balance wheels
	Wheel rim lateral/radial runout	Replace rims, if necessary
	Tire lateral runout	Match or replace tires
	Output shaft defective	Replace output shaft
Steering wheel shake	Wheels unbalanced	Balance wheels
	Wheel rim lateral/radial runout	Replace rims, if necessary
	Shock absorber effect insufficient	Replace shock absorbers
	Control arm rubber mounts defective	Replace control arm rubber mounts
	Output shaft defective	Replace output shaft
Rattling noise	Shock absorber cartridge loose in spring strut	Tighten threaded ring (inspect threads)
	Ball joints of control arms worn	Replace control arms
	Stabilizer rubber mounts worn	Replace rubber mounts
	Front axle carrier mounted loosely on body	Tighten bolts (inspect threads)
Load change knock	Backlash excessive	Adjust backlash
	Output shaft defective	Replace output shaft
Acceleration or deceleration noise	Backlash excessive or insufficient	Adjust backlash
Oil loss	Radial oil seals leak	Replace radial oil seal
	Vent plugged	Clean vent
	Oil grade* incorrect	Replace front axle final drive oil

* See Service Information of Gr. 00

TROUBLESHOOTING FRONT AXLE

Condition	Cause	Correction
Body wipping long time after driving over rough road	Shock absorbing performance insufficient (see Troubleshooting Shock Absorbers)	Replace shock absorbers
Body rising up when driving on rough road for long time	Shock absorbing performance insufficient (see Troubleshooting Shock Absorbers)	Replace shock absorbers
Car lifting while accelerating	Shock absorbing performance insufficient (see Troubleshooting Shock Absorbers)	Replace shock absorbers
Wheels jumping even on normal road surface	Shock absorbing performance insufficient (see Troubleshooting Shock Absorbers)	Replace shock absorbers
Car breaks out while braking	Shock absorbing performance insufficient (see Troubleshooting Shock Absorbers)	Replace shock absorbers
Unsafe in curves (skidding) due to insufficient directional stability	Shock absorbing performance insufficient (see Troubleshooting Shock Absorbers)	Replace shock absorbers

TROUBLESHOOTING SHOCK ABSORBERS

The condition of shock absorbers can only be checked with a Shock Tester or in a shock absorber testing machine.

Condition	Cause	Correction
Shock absorbers knocking through (bottoming)	a) Rubber damper defective	a) Check rubber damper, replacing if necessary
	b) Shock absorbing performance insufficient	b) Replace shock absorbers
Shock absorber noise	a) Shock absorber cartridge loose	a) Tighten screw-on ring – inspect threads
	b) Newly installed shock absorber had been stored laying down with its piston rod run in	b) Store shock absorber standing upright with its piston rod run out at room temperature 24 hours
	c) Shock absorber shot	c) Replace shock absorbers
Poor car handling	a) Shock absorber performance insufficient	a) Replace shock absorbers
Bald (flat) spots on tires	a) Shock absorbers shot	a) Replace shock absorbers

FRONT AXLE FINAL DRIVE

Type of Teeth:	Gleason hypoid spiral teeth, spiral direction right, – Code F 86 on ring gear and pinion –
Ratio*:	On data plate (oil sump)
Oil grade:	See Operating Fluids
Oil volume*:	Pour in oil slowly – recheck oil level about 30 seconds after the first overflow.

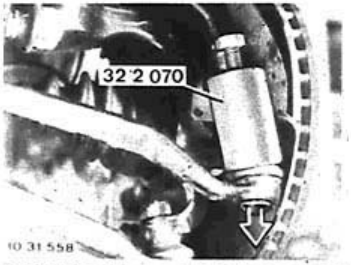
Breaking-in After Exchanging or Repairing Front Axle Final Drive:

The same breaking-in procedures and oil change interval for new cars are applicable. Up to 1,000 km (600 miles) the max. permissible road speed is 2/3rds of the top road speed. The driver must be informed about this with a label or tag.

* See Specifications

31 50 000 REMOVING AND INSTALLING OR REPLACING FRONT AXLE FINAL DRIVE

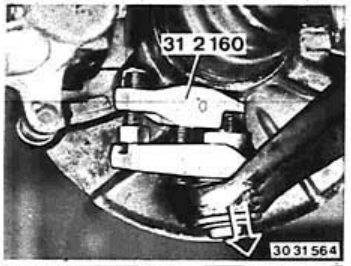
Remove front propeller shaft – see Group 26.
Remove left front wheel – see Gr. 36.
Remove splash guard – see Group 51.



Unscrew left nut and press off tie rod with Special Tool 32 2 070.

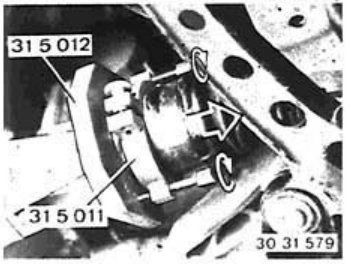
Installation:
Bore and journal cleaned of grease.
Replace self-locking nut.
Tightening torque*.

Important!
Don't turn power steering as far as stop — this would damage radial oil seal.



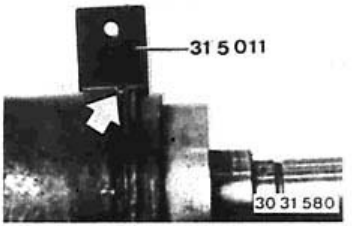
Unscrew left nut and press off control arm with Special Tool 31 2 160.

Installation:
Bore and journal cleaned of grease.
Tightening torque*.
Lock nut with cotter pin.

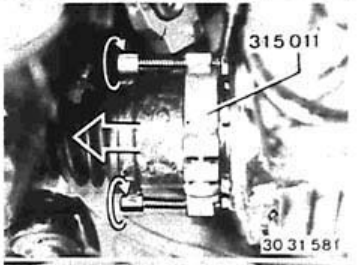


Pull right output shaft out of front axle final drive about 15 mm (0.591") with Special Tools 31 5 011 / 012.
Screw in pressure spindles alternately.

* See Specifications

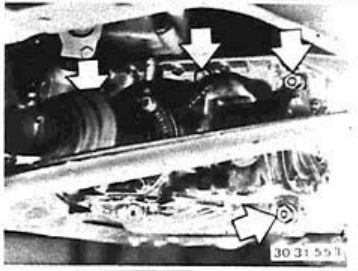


Note:
Ring of Special Tool 31 5 011 bears in groove of shaft.



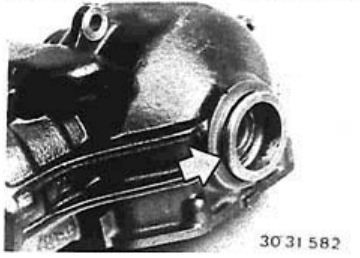
Pull off left output shaft with Special Tool 31 5 011.
Pressure spindles bear on heads of bolts.
Screw in pressure spindles alternately.
Press out spring strut until output shaft slides out of front axle final drive.

Installation:
Refer to 31 60 000.



Unscrew nut and take off front axle final drive.

Installation:
Tightening torque*.

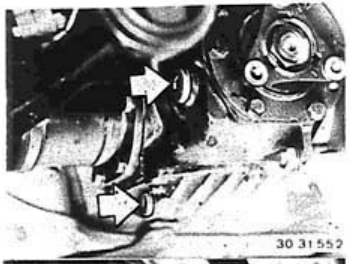


Note:
Replace round seal.

* See Specifications

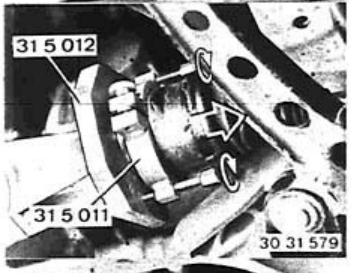
31 51 010 REPLACING SHAFT SEAL FOR DRIVE FLANGE OF FRONT AXLE FINAL DRIVE

Remove splash guard – see Group 51.
Remove front propeller shaft – see Group 26.



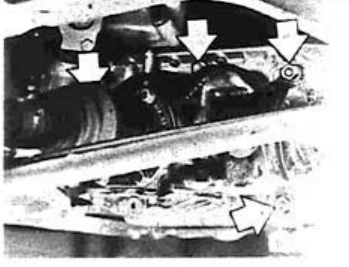
Drain final drive oil.

Installation:
Fill final drive oil**.
Tightening torque*.



Pull right output shaft out of front axle final drive about 15 mm (0.591") with Special Tools 31 5 011 / 012.

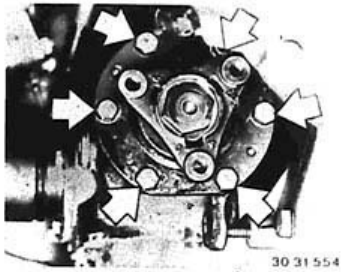
Installation:
Refer to information for output shaft.



Unscrew nuts and press front axle final drive away from engine oil pan about 10 ... 15 mm (0.394 ... 0.591").

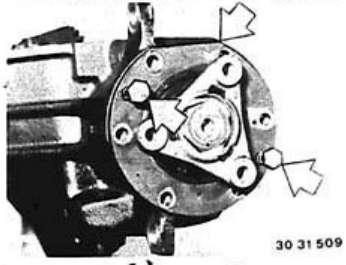
Installation:
Tightening torque*.

* See Specifications
** See Operating Fluids

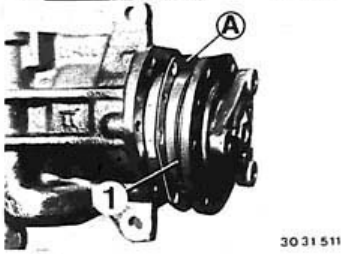


Unscrew bolts.

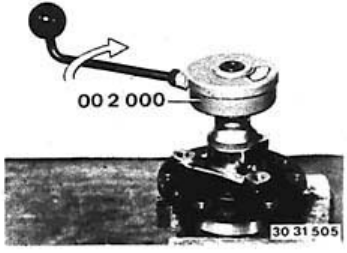
Installation:
Flat surface of pinion faces flat surface on case.
Tightening torque*.



Pull pinion out of case by screwing in two M 8 x 30 bolts uniformly.
If both tapped bores are not accessible, pinion must be knocked out of case with a plastic-hammer.

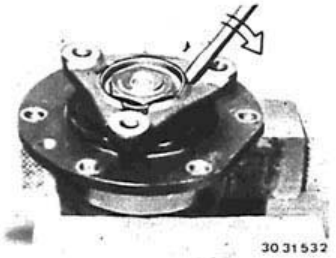


Installation:
Install old shim (A) and new seal (1).

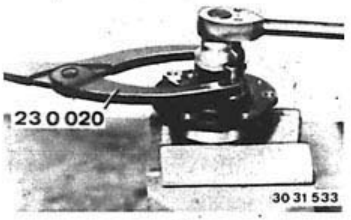


Clamp pinion in aluminum jaw vise. Measure friction torque with Special Tool 00 2 000 while turning uniformly and note value.

* See Specifications



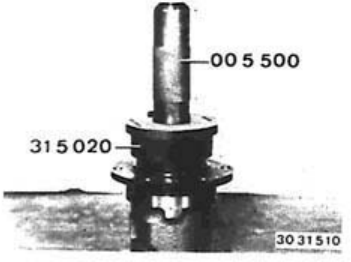
Lift out lockplate with a screwdriver.



Hold flange with Special Tool 23 0 020 and unscrew collar nut.
Take off flange.
Note:
Replace flange, if bearing surface on flange for the shaft seal is scored seriously.

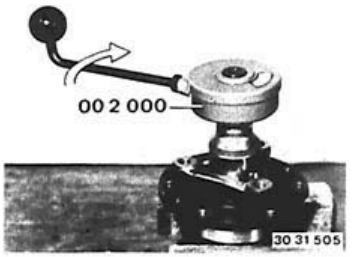


Pull out shaft seal with Special Tools 00 5 010 and 33 1 309.



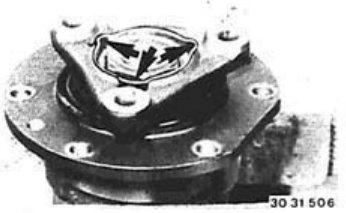
Dip shaft seal in gear lube* and drive in against stop with Special Tools 00 5 500 and 31 5 020.

* See Specifications



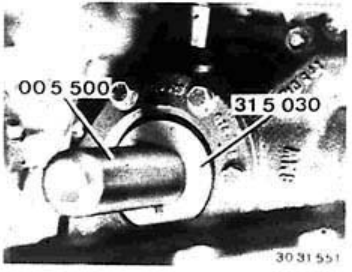
Mount flange and tighten collar nut in steps until previously measured friction torque + 0.2 Nm (1.4 ft. lbs.) for new shaft seal is reached.

Install and lock new lockplate.



31 51 015 REPLACING SHAFT SEAL FOR LEFT OUTPUT SHAFT

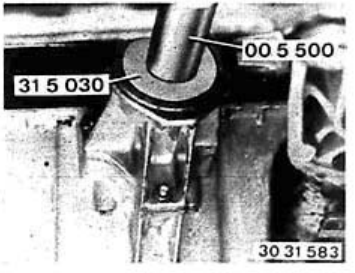
Remove output shaft 31 60 000, however only loosen collar nut of output shaft.



Lift out shaft seal.
Dip new shaft seal in gear lube and drive in against stop with Special Tools 31 5 030 and 00 5 500.

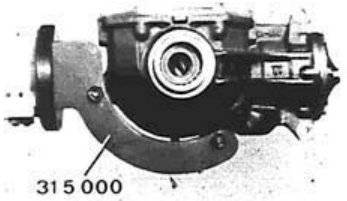
31 51 020 REPLACING SHAFT SEAL FOR RIGHT OUTPUT SHAFT

Remove output shaft 31 60 000



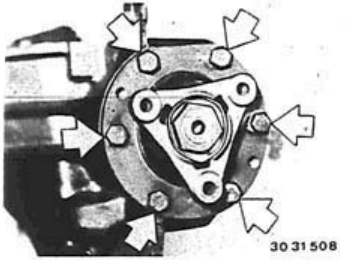
Lift out shaft seal.
Dip new shaft seal in gear lube and drive in against stop with Special Tools 31 5 030 and 00 5 500.

31 52 505 REMOVING AND INSTALLING PINION
– Front Axle Final Drive Removed –



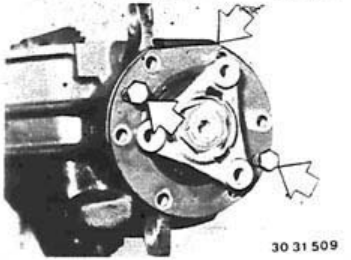
30 31 507

Take up front axle final drive in assembly stand with Special Tool 31 5 000.


30 31 508

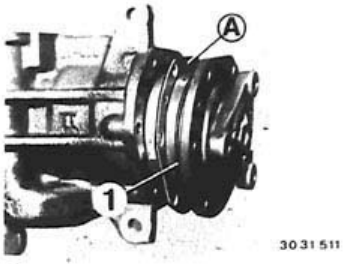
Unscrew bolts.

Installation:
Tightening torque*.


30 31 509

Pull pinion out of case by screwing in two M 8 x 30 bolts uniformly.
If both tapped bores are not accessible, pinion must be knocked out of case with a plastic hammer.

Installation:
Flat surface of pinion faces flat surface on case.

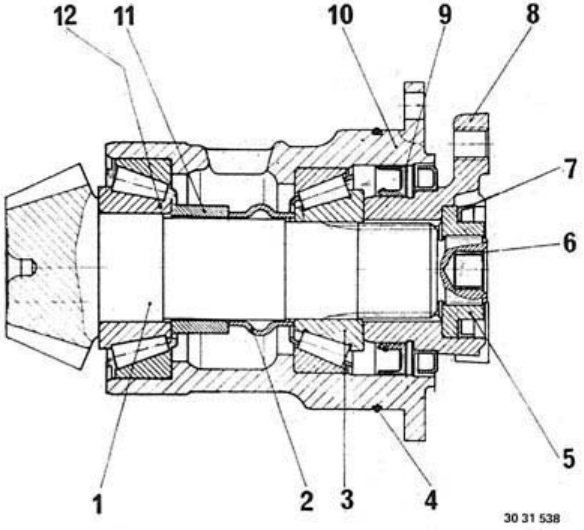


30 31 511

Measure and note thickness of shim (A).

Installation:
Replace round seal (1).

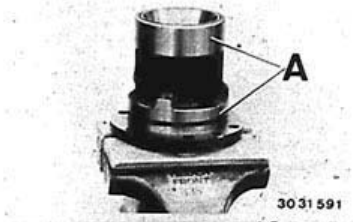
* See Specifications



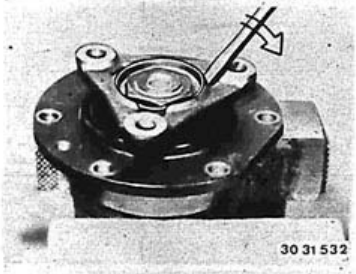
1 Bevel gear
2 Bushing
3 Tapered roller bearing
4 O-ring
5 Collar nut
6 Centering sleeve
7 Lockplate
8 Flange
9 Shaft seal
10 Case
11 Bushing
12 Tapered roller bearing

31 52 510 REPLACING BEARINGS FOR DRIVE PINION
– Front Axle Final Drive Removed –

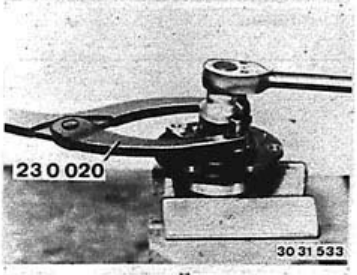
Always replace both bearings.
Remove drive set of front axle final drive – 31 52 505.
Important!
Surfaces A are finish machined (fit) – be careful not to damage them.



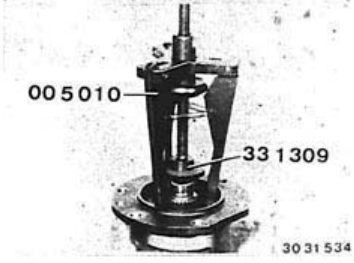
Clamp drive set in a vise fitted with aluminum jaws.
Lift out lockplate with a screwdriver.

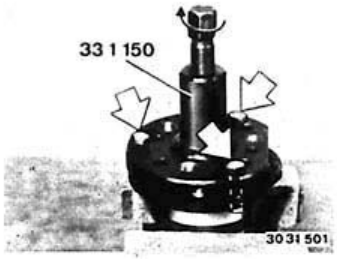


Hold flange with Special Tool 23 0 020 and unscrew collar nut.
Take off flange.
Note:
Replace flange, if shaft seal bearing surface on flange is scored seriously.



Pull out shaft seal with Special Tools 00 5 010 and 33 1 309.





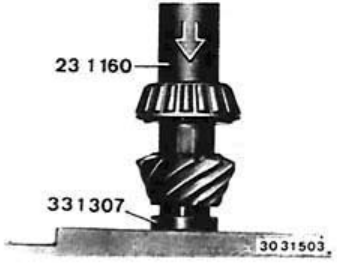
Bolt down Special Tool 33 1 150 with M 8 x 30 bolts and nuts.
Press off bevel gear.



Take off bushing (1) and spacer (2).



Pull off tapered roller bearing with Special Tools 31 5 090 and 33 1 301.



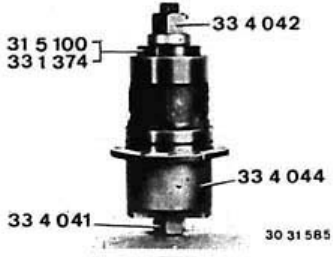
Press on new bearing with Special Tools 23 1 160 and 33 1 307.



Install spacer (2) and new bushing.



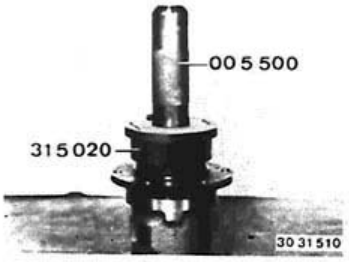
Press both bearing outer races out of case with Special Tools 33 1 370, 33 4 041 and 33 4 042 / 044.



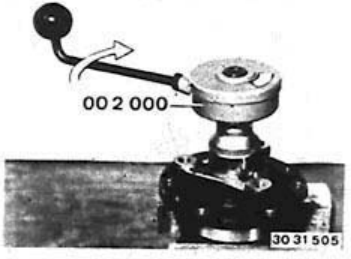
Press in new bearing outer races with Special Tools 31 5 100, 33 1 374 and 33 4 041 / 042 / 044.



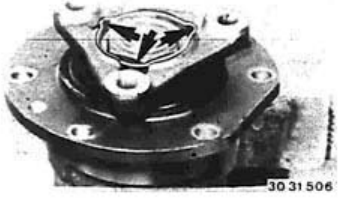
Slide bevel gear into case (1).
Drive in new bearing with Special Tool 23 1 160 far enough that rollers have light contact on bearing outer race.



Dip new shaft seal in gear lube and drive in against stop with Special Tools 31 5 020 and 00 5 500.



Mount flange and tighten collar nut in steps until specified friction torque* is reached, turning uniformly with Special Tool 00 2 000.
Replace bushing and repeat adjusting procedures, if friction torque is exceeded.

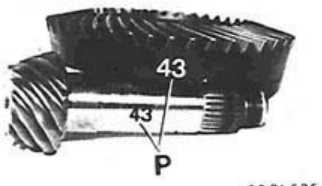


Install and lock new lockplate.
Important!
Because of new bearings, it is necessary to adjust
a) ring gear/pinion block distance,
b) backlash of ring gear and
c) tooth contact pattern.
See adjustments on front axle final drive.

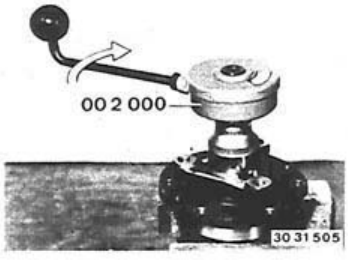
* See Specifications

31 52 520 REPLACING DRIVE PINION AND RING GEAR –Frt. Axle Final Drive Removed–

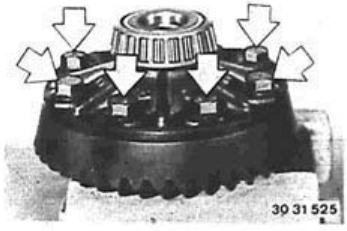
Disassemble drive set and replace drive pinion. Procedures are identical with those for replacing bearings for drive pinion – 31 52 510.



Important!
Drive pinion and ring gear were matched in a special machine for maximal quiet running. The pair code (P), e.g. 43, is electrically inscribed in the drive pinion and ring gear. Never install ring gear and drive pinion with different pair codes (P) together.



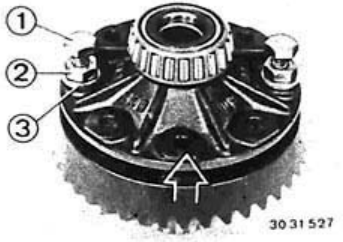
Remove drive set 31 52 505.
Measure friction torque with Special Tool 00 2 000 while turning uniformly and note value.
The friction torque must be adjusted to this friction torque value + 0.2 Nm (0.14 ft. lbs.) for new shaft seal, when reusing the bearings.



Remove differential 31 53 500.
Clamp differential in a vise fitted with aluminum jaws.
Unscrew bolts.



Place differential on Special Tool 33 1 309.
Screw two M 10 x 50 bolts in tapped bores against stop.
Loosen ring gear on differential case by applying alternate knocks on both bolts.



3031527

Pull new ring gear on to differential case by tightening both nuts uniformly.
1 = M 10 x 50 bolt
2 = Washer
3 = M 10 nut



3031528

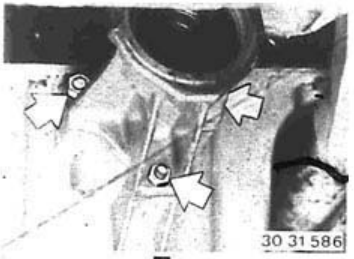
Always replace bolts.
Install new bolts with bolt cement** and tighten in order of 1 through 8.
Tightening torque* and torque angle*.

Important!
Adjust front axle final drive:
a) Ring gear/pinion block distance
b) Backlash
c) Tooth contact pattern
See adjustments on front axle final drive.

* See Specifications
** Source of Supply: HWB

31 53 050 REPLACING BEARING (IN CONSOLE) FOR RIGHT OUTPUT SHAFT

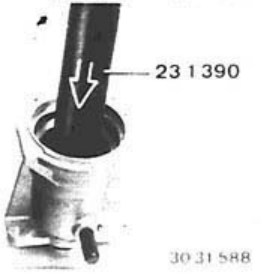
Remove output shaft 31 60 000.



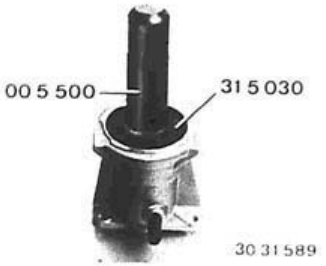
Unscrew console.
Installation:
Replace seal.
Tightening torque*.



Pull off bearing with Special Tools 00 8 550 and 31 5 012.



Press in new bearing with Special Tool 23 1 390.

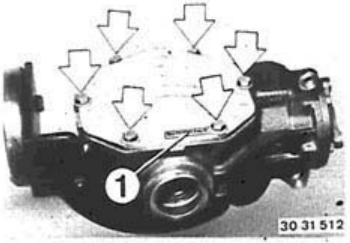


Dip new shaft seal in gear lube and drive in against stop with Special Tools 00 5 500 and 31 5 030.

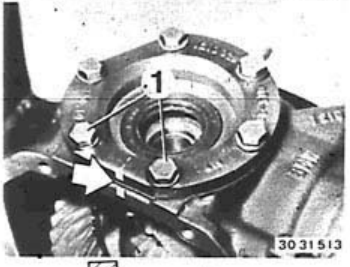
* See Specifications

31 53 500 **REMOVING AND INSTALLING DIFFERENTIAL**
– Front Axle Final Drive Removed –

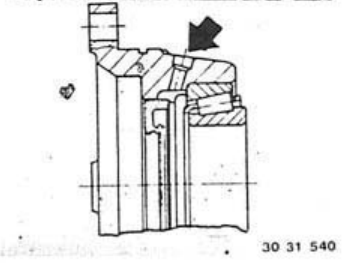
Remove drive set for front axle final drive – 31 52 505.



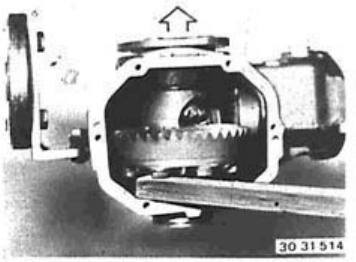
Unscrew bolts and take off oil pan,
Installation:
Replace gasket.
If applicable, clean sealing surfaces on case and oil pan.
Reinstall data plate (1).
Tightening torque*.



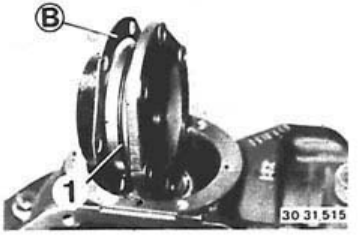
Mark position of bearing cover to case.
Unscrew bolts.
Installation:
Install bolts (1) with a bolt cement**.
Tighten bolts while turning tapered roller bearings simultaneously.
Tightening torque*.



Note:
Bore in cover faces up in installed position of case.



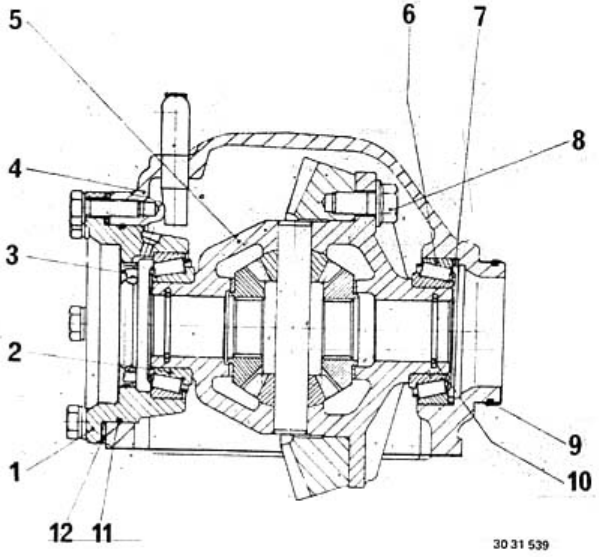
Push up differential with a piece of wood and take off bearing cover.



Measure and note thickness of shim (B).
Remove differential
Installation:
Replace seal (1).

* See Specifications
** Source of Supply: HWB

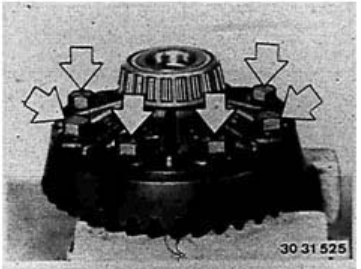
DIFFERENTIAL BEARINGS



1 Bearing cover
2 Tapered roller bearing
3 Shaft seal
4 Case
5 Differential case
6 Bearing outer race
7 Shim
8 Ring gear bolt
9 O-ring
10 Circlip
11 O-ring
12 Shim

31 53 510 REPLACING DIFFERENTIAL GEARS
– Front Axle Final Drive Rmvd. –

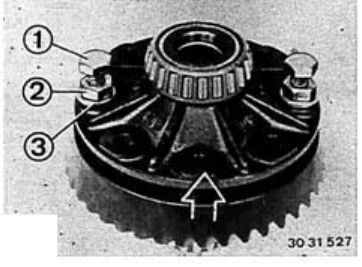
Remove differential for front axle final drive – 31 53 500.



Clamp differential in vise fitted with aluminum jaws.
Unscrew bolts.



Place differential on Special Tool 33 1 309.
Screw two M 10 x 50 bolts into tapped bores against stop.
Loosen ring gear on differential case by applying alternating knocks on the bolts.

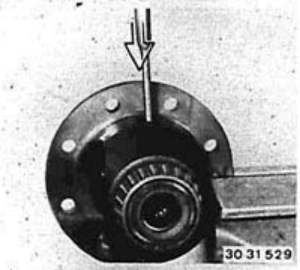


Installation:
Clean tapped bores of ring gear with a tapper.
Pull ring gear on to differential case by tightening both nuts uniformly.
1 = M 10 x 50 bolt
2 = Washer
3 = M 10 nut

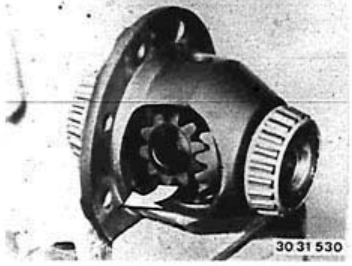


30 31 528

Installation:
Always replace bolts.
Install new bolts with bolt cement** and tighten in order of 1 through 8.
Tightening torque* and torque angle*.

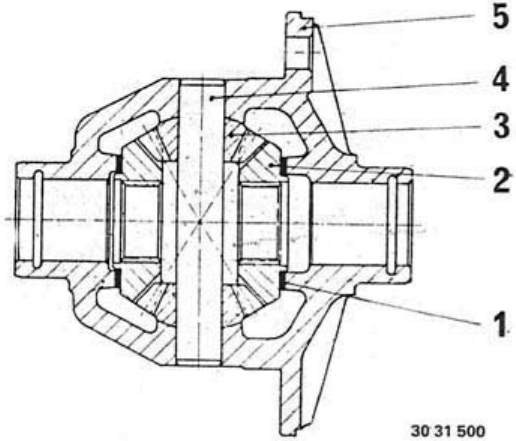

30 31 529

Drive out differential gear shaft with a mandrel.


30 31 530

Turn out differential gears.

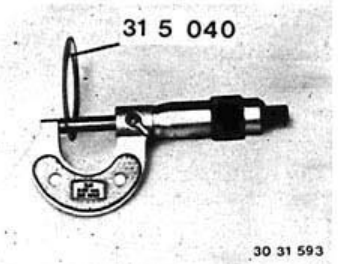
New differential gears must be adjusted with shim (1), whereby there must still be a play of 0.01 to 0.07 mm (0.0004 ... 0.0028").



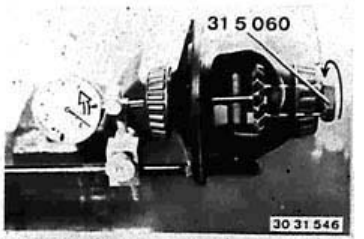
30 31 500

1 Shim
2 Shaft gear
3 Differential gear
4 Differential gear shaft
5 Case

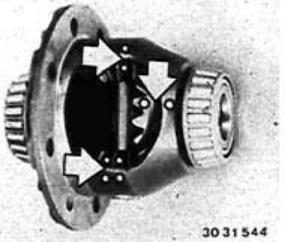
* See Specifications
** Source of Supply: HWB



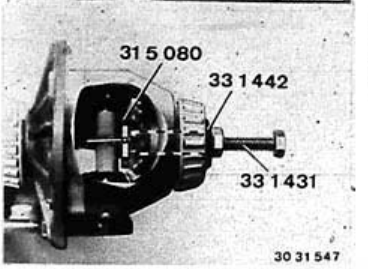
Measure thickness of washer (Special Tool 31 5 040) on four different points with a micrometer and note largest value.
For example: 1.30 mm (0.051").
Install new shaft gear and washer (Special Tool 31 5 040) in differential case.



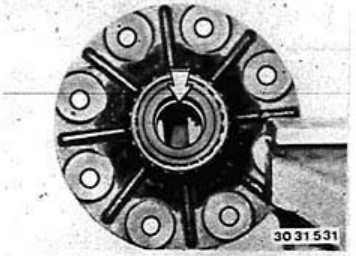
Turn shaft gear at least once with Special Tool 31 5 060.
Observe dial gage and determine maximum deflection in counterclockwise direction.
Set dial gage to zero in this position.



Install new differential gears and drive in differential gear shaft flush.
Mark position of differential gears and shaft gear to case.



Apply Special Tool 31 5 080 (flat surface facing dial gage point).
Screw in Special Tools 33 1 431 / 442 and move shaft gear against block by tightening nut.

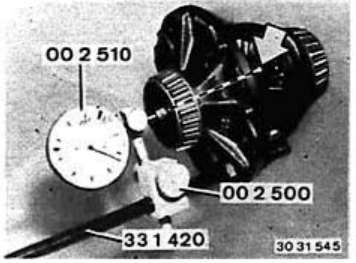


Press open end of circlips into groove and knock circlip out of groove with one blow.

Read dial gage and note value, e.g. 0.30 mm (0.012").
Correct shim thickness comes from:

circlip thickness, e.g.	1.30 mm (0.051")
+ read value, e.g.	+ 0.30 mm (0.012")
	1.60 mm (0.063")
– specified play (0.01 to 0.07 mm) (0.0004 ... 0.0028")	– 0.02 mm (0.001")
= shim thickness (available in steps of 0.05 mm (0.002"))	1.58 mm (0.062")

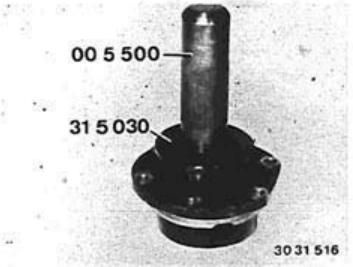
Important!
Mark shim for shaft gear.
Determine shim for second shaft gear – assemble differential.



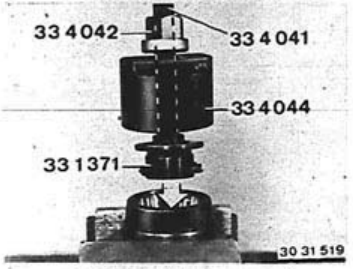
Mount dial gage 00 2 510 with Special Tools 00 2 500 and 33 1 420.
Apply gage needle on shaft gear with pre-load.

31 53 520 REPLACING BOTH BEARINGS FOR DIFFERENTIAL
– Front Axle Final Drive Removed –

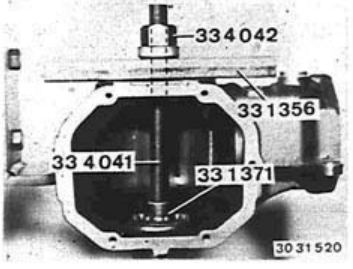
Always replace both bearings.
Remove differential for front axle final drive – 31 53 500.



Drive shaft seal out of bearing cover.
Installation:
Replace shaft seal.
Dip new shaft seal in front axle final drive gear lube* and drive in with Special Tools 00 5 500 and 31 5 030.

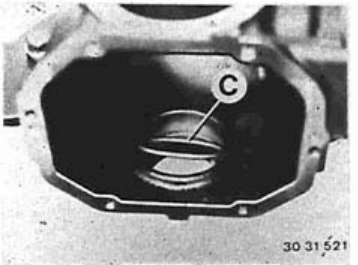


Clamp bearing cover in vise fitted with aluminum jaws.
Pull out bearing outer race with Special Tools 33 1 371 and 33 4 041 / 042 / 044.

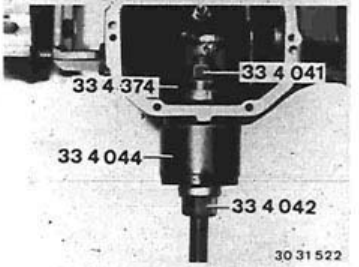


Pull out bearing outer race with Special Tools 33 1 356 / 371 and 33 4 041 / 042.

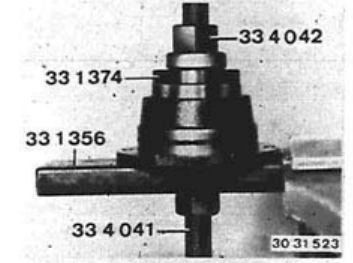
* See Operating Material Specifications



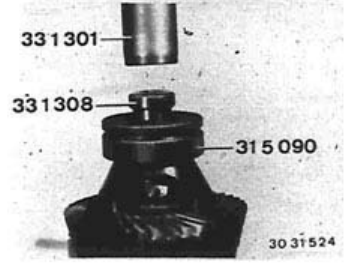
Measure and note thickness of shim (C).



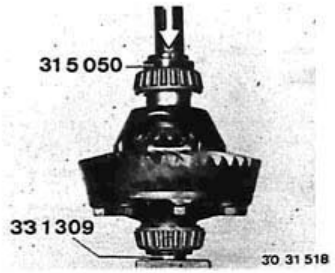
Install shim (C) and pull in bearing outer race with Special Tools 33 1 374, 33 4 041 / 042 / 044.



Pull in bearing outer race with Special Tools 33 1 356 / 374 and 33 4 041 / 042.



Clamp differential in vise fitted with aluminum jaws.
Pull off both tapered roller bearings with Special Tools 33 1 301 / 308 and 31 5 090.



Press on tapered roller bearings with Special Tools 33 1 309 and 31 5 050.

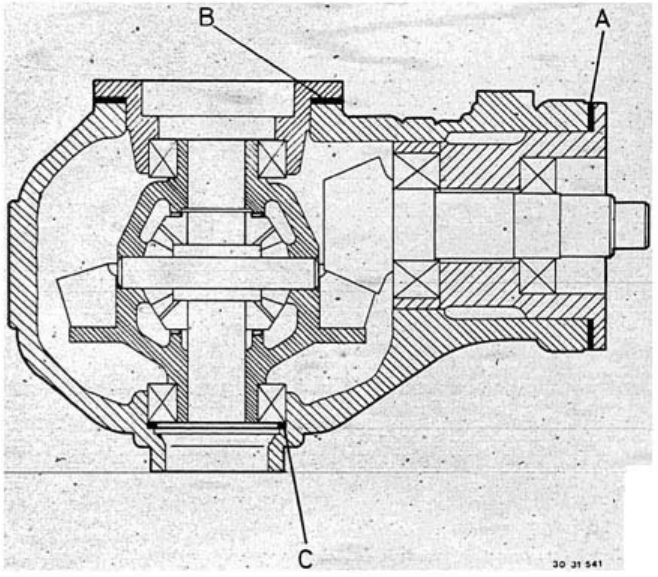
Important!
Adjustments necessary because of new bearings:

a) Friction torque of tapered roller bearings
b) Backlash of ring gear
c) Tooth contact pattern

See adjustments on front axle final drive.

ADJUSTMENTS ON FRONT AXLE FINAL DRIVE

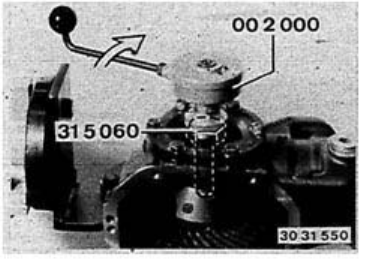
Adjustments are made with shims A, B and C, which are available in appropriate thicknesses.



A = Shim for block distance adjustment
B and C = Shim for differential bearing friction torque adjustment
Shim for backlash adjustment

1. Friction Torque Adjustment of Differential Tapered Roller Bearings:

Dip bearings in gear lube**.
Install differential with the originally installed shim (B).

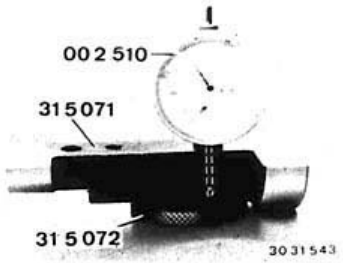


Measure friction torque with Special Tools 31 5 060 and 00 2 000, while turning uniformly.
Nominal value*.
Friction Torque Excessive.
Install thicker shim (B) until nominal value* is reached.
Friction Torque Insufficient:
Install thinner shim (B) until nominal value* is reached.
Shims are available in steps of 0.03 (0.0012"), 0.02 (0.0008") and 0.01 mm (0.0004").

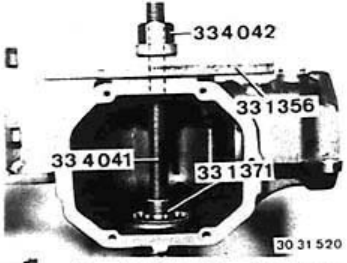
Add thicknesses of shims (B + C).
This total thickness must be maintained while adjusting the backlash afterwards.

* See Specifications
** See Operating Material Specifications

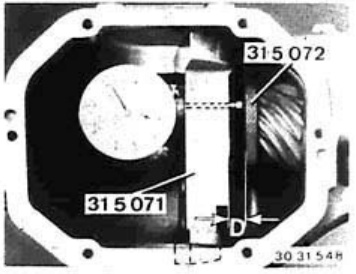
2. Block Distance Adjustment from Ring Gear and Pinion



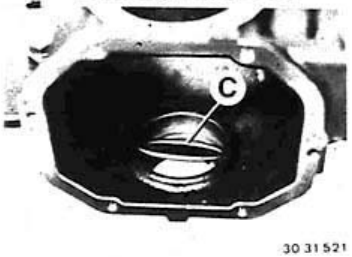
Mount dial gage 00 2 510 in Special Tool 31 5 071.
Apply Special Tool 31 5 072 and set dial gage to zero with pre-load.



Pull out bearing outer race with Special Tools 33 1 356 / 371 and 33 4 041 / 042.



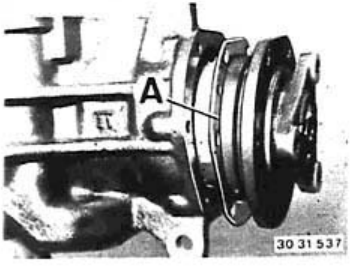
Place Special Tool 31 5 072 on pinion.
Insert Special Tool 31 5 071 in case bores.
Read distance (D) to special tool gage and note value, for example:
D actual = 3.90 mm (0.153").



Important!
Measure and note thickness of shim (C).



Determine D target.
D target = 4.00 mm / 0.157" (predetermined basic distance) + e or - e, e.g. - 2 (plus/minus sign and number indicating 100ths mm are engraved in pinion).



Install drive set with the originally installed shim (A), e.g. A = 1.80 mm (0.071"), and bolt.

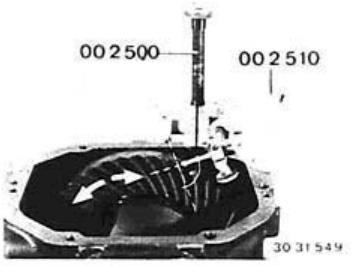
Example:
D target = 4.00 mm - 0.02 mm = 3.98 mm
(0.157" – 0.001" = 0.156")

Determine shim thickness.
Example:

Installed shim (A)	1.80 mm (0.071")
+ D target	+ 3.98 mm (0.156")
	5.78 mm (0.227")
– D actual	– 3.90 mm (0.153")
Shim thickness (A)	1.88 mm (0.074")

Max. deviation from determined shim thickness = ±0.01 mm (0.0004").
This means in our example, for instance, a shim with a thickness of 1.89 mm (0.0744") must be installed.

Shims are available in appropriate thickness steps.



3. Backlash Adjustment for Ring Gear/Pinion

Mount dial gage 00 2 510 and Special Tool 00 2 500, with dial gage point at right angle to tooth, and measure play.
Nominal value*.

Backlash excessive = install thicker shim (C).
Backlash insufficient = install thinner shim (C).
Change shims until nominal value is reached.
Note:
The difference between the actual backlash and nominal backlash*, multiplied by the factor 1.15, produces the amount of which shim (C) must be thicker or thinner.
Example:

Measured backlash	0.19 mm (0.0075")
– specified min. play	0.06 mm (0.0024")
Difference	0.13 mm (0.0051")

Difference x factor =
0.13 mm x 1.15 = 0.15 mm or
0.0051" x 1.15 = 0.0059".

The thickness of installed shim (C), e.g. 2.01 mm (0.079"), must be increased by 0.15 mm (0.006").
Shims are available in thickness steps of 0.03 mm (0.0012").

Important!
The total thickness of shims (B + C) must not be changed.
If, for example, the thickness of shim (C) is reduced, the thickness of shim (B) must be increased by the same amount, or vice versa.

Check the tooth contact pattern to control the ring gear/pinion adjustment.

* See Specifications

4. Tooth Contact Pattern

Type of teeth – Gleason.
Coat ring gear with printer's ink.
Turn differential several times in both directions and stop ring gear suddenly with a piece of wood.

BASIC INFORMATION FOR TOOTH CONTACT PATTERN ADJUSTMENTS

Gleason Teeth

A Correct tooth contact pattern without load.

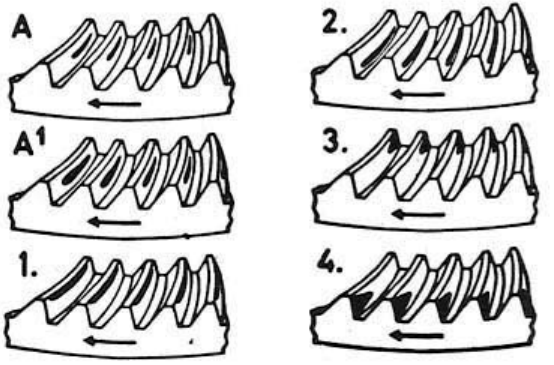
A 1 Loads will displace the tooth contact pattern slightly more toward the outside. Moving the ring gear will mainly change the backlash and also the tooth contact pattern in longitudinal direction of the teeth.
Moving the drive pinion will change the tooth contact pattern in direction of tooth height, while the backlash will be changed only slightly.
Here are the four basically wrong tooth contact patterns, which normally occur in combination and the knowledge of which will make practical adjustments easier.

1. High, narrow tooth contact pattern (head) on ring gear.
Move drive pinion toward ring gear axis and possibly correct backlash by pressing ring gear away from drive pinion.

2. Deep, narrow tooth contact pattern (base) on ring gear.
Move drive pinion away from ring gear axis and possibly correct backlash by pressing ring gear closer.

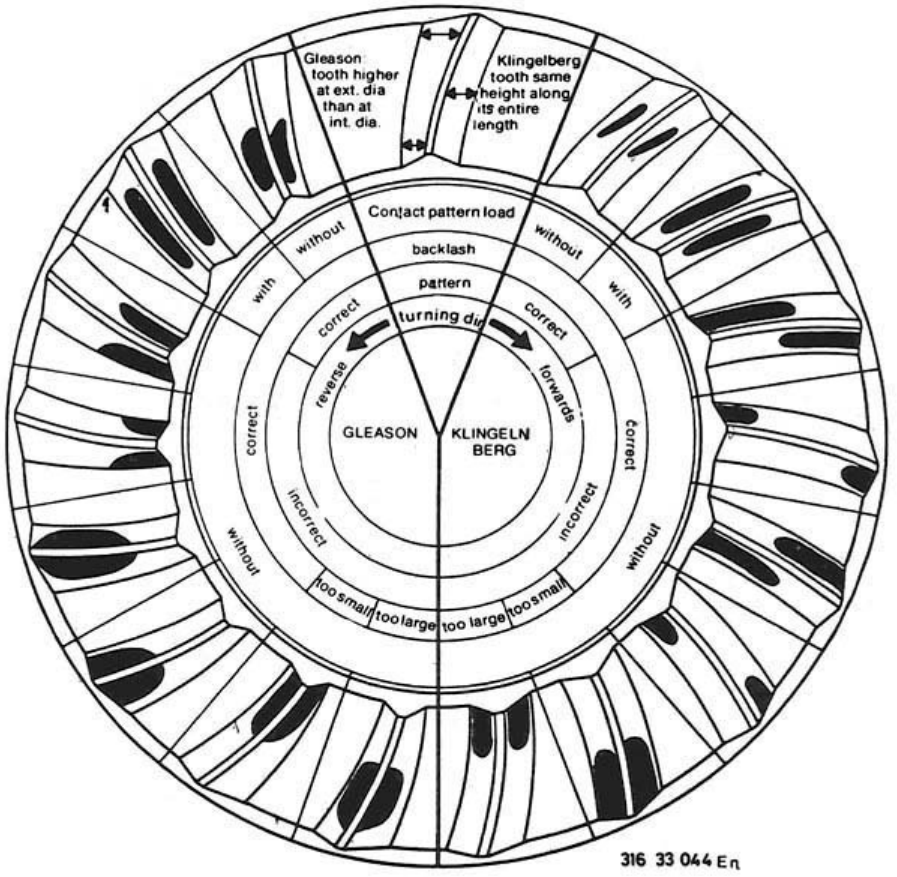
3. Brief tooth contact pattern on small tooth end (tip) of ring gear.
Move ring gear away from drive pinion. If applicable, move drive pinion closer to ring gear axis.

4. Brief tooth contact pattern on large tooth end (heel) of ring gear.
Move ring gear closer to drive pinion. If applicable, move drive pinion away from ring gear axis.



28 33 030

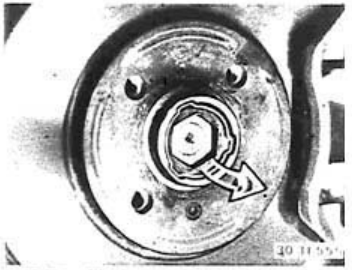
Adjustment of contact pattern



31 60 000 REMOVING AND INSTALLING OR REPLACING LEFT OR RIGHT OUTPUT SHAFT

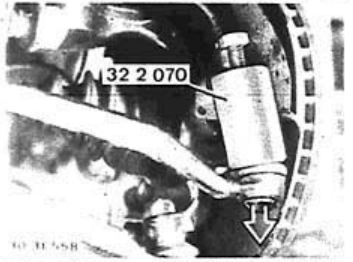
Remove front wheel – see Group 36.
Drain final drive oil.

Installation:
Fill final drive oil**.
Tightening torque*.



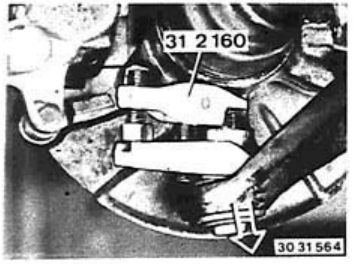
Pry out lockplate with a screwdriver.
Unscrew collar nut.

Installation:
Tightening torque*.
Knock on new lockplate with Special Tools 33 4 050 and 00 5 500.



Unscrew nut and press off tie rod with Special Tool 32 2 070.

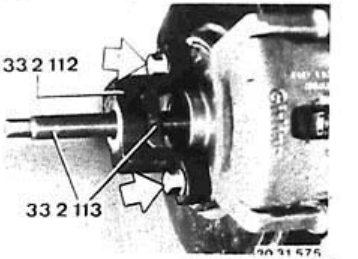
Installation:
Replace self-locking nut.
Tightening torque*.



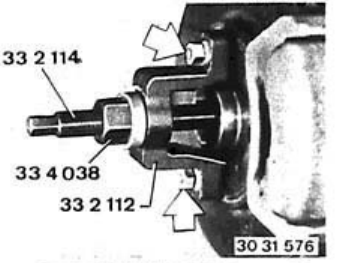
Unscrew nut and press off control arm with Special Tool 31 2 160.

Installation:
Tightening torque*.
Lock nut with cotter pin.

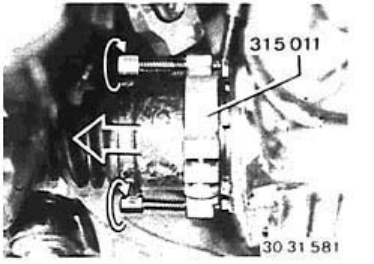
* See Specifications
** See Operating Fluids



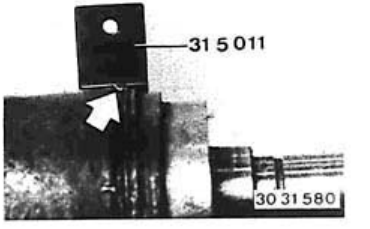
Mount Special Tools 33 2 112 / 113 with two wheel bolts and press off output shaft.



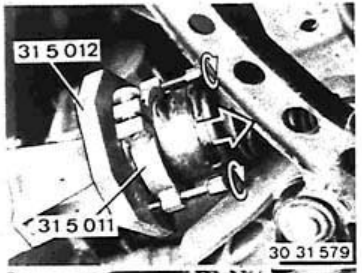
Installation:
Lubricate splines of output shaft lightly with oil and pull in with Special Tools 33 2 112 / 114 and 33 4 042.



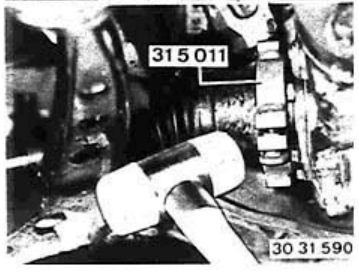
Left Side:
Pull off output shaft with Special Tool 31 5 011.
Pressure spindles bear on heads of bolts.
Screw in pressure spindles alternately.



Note:
Ring of Special Tool 31 5 011 bears in groove of shaft.



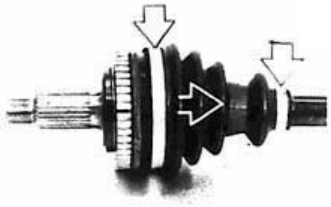
Right Side:
Apply Special Tool 31 5 012 and pull off output shaft with Special Tool 31 5 011. Screw in pressure spindles alternately.



Installation:
Slide output shafts into front axle final drive until circlip in case engages in groove of shaft.
If necessary, apply knocks on Special Tool 31 5 011 with a plastic hammer to drive in shaft until circlip engages.

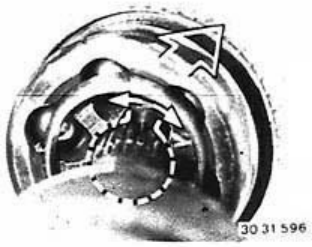
31 60 020 REPLACING ONE CONSTANT VELOCITY JOINT (OUTER)
31 60 021 REPLACING ONE CONSTANT VELOCITY JOINT (INNER) OF OUTPUT SHAFT

Remove front output shaft 31 60 000.



30 31 595

Loosen both hose clamps and pull dust cover off of joint.



30 31 596

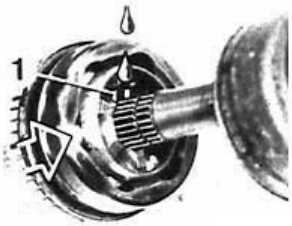
Spread open circlip and drive joint off of the shaft with a plastic hammer.



30 31 597

Constant Velocity Joint (Outer):
Add about half of the grease in a 80 gr. tube .

Constant Velocity Joint (Inner):
Add grease from a 80 gr. tube.



30 31 598

Clean and remove grease on splines of shaft and joint.
Coat splines of shaft completely with Loctite No. 270.
Drive joint on to shaft with a plastic hammer until circlip (1) engages.

Outer Joint:
Add remaining amount of grease in joint.

Inner Joint:
Add grease of 70 gr. tube in joint.

31 60 030 REPLACING ONE DUST COVER OF LEFT OR RIGHT OUTPUT SHAFT

Procedures are identical with those described in 31 60 020/021.
Clean joint to remove the old grease.
Do not disassemble a joint or let it fall apart.

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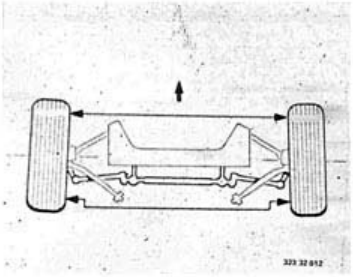
Information:

Steering Gear:
Damage could occur on the steering gear from jolt-type loads in accidents or accident-similar operating conditions. Always conform with factory specifications for reasons of safety – see Service Information 32 01 88 (828).

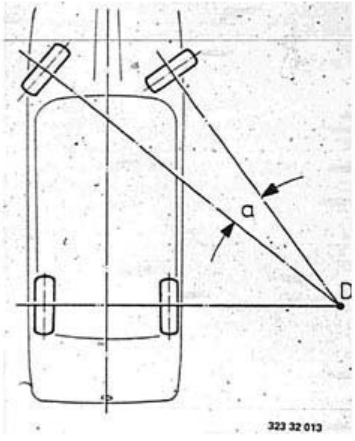
Steering Gear:
Steering rattle, variable steering ratio – see Service Information 32 04 87 (803).

GENERAL INFORMATION AND DEFINITIONS



Toe

is the reduction in distance of front of front wheels to rear of front wheels. Toe prevents the wheels from running apart while driving and consequently wheel shimmy and grinding, excessive tire wear, excessive loads on steering linkage and joints as well as hard steering of car. Toe is measured in "straight ahead position".

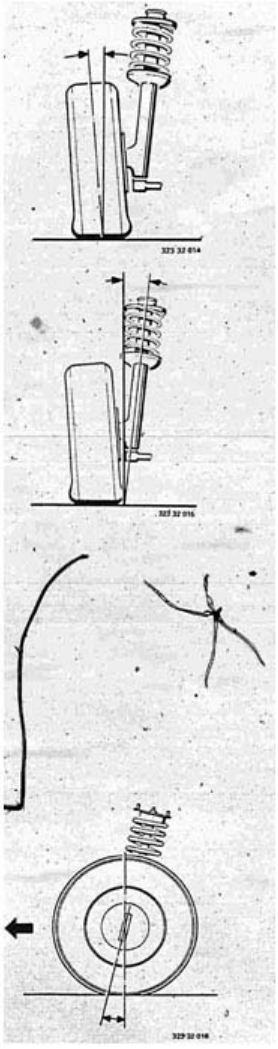


Toe Difference Angle

is the angular position of the wheel on the inside of a curve to the wheel on the outside of a curve when driving in a curve. The steering is designed that the angular position of the wheels changes as steering lock progresses. The toe difference angle provides information on the pertinent operation of the steering trapezoid for left or right steering lock from the center position. A correctly adjusted toe difference angle produces equal values for left and right lock in due consideration for plant tolerances.

a = Toe difference angle

D = Turning circle center point



Camber

is the inclination of the wheel to the car's axial plane, measured in the car's lateral plane with "straight ahead drive".

King Pin Inclination

is the angle, by which the king pin is inclined inward from a perpendicular line to the lateral axis of the car.
The king pin inclination produces returning forces, which return the road wheels and steering wheel to straight ahead after driving through a curve or around a corner.

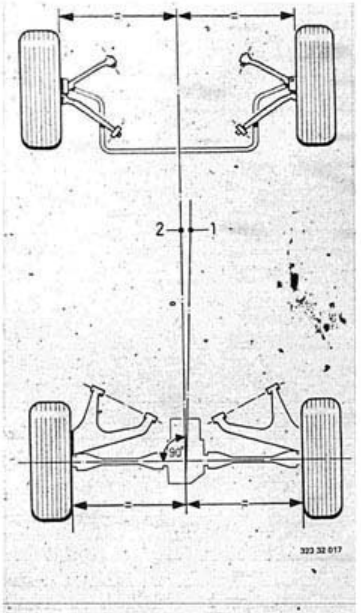
Camber and king pin inclination determine the location of the wheel contact point with the road surface. King pin inclination reduces the leverage, on which frictional forces are engaged, which makes it easier to turn the wheels to left or right lock. In addition, the jolts from rough road surfaces do not have strong influence on the steering.

Caster

is the inclination of the king pin* in forward direction as seen from the side.

The wheels are pulled and not pushed because of caster. In a similar manner to king pin inclination, when driving in curves or around corners returning forces are produced to help return the wheels to straight ahead position.

* The "king pin" is equal to a line through the center point of the spring strut mount and control arm ball joint.

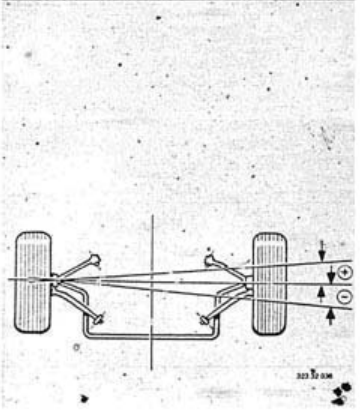


Geometrical Axis 1

is the bisecting line of an angle from the total rear wheel toe. Front wheel measurements are taken in reference to this axis.

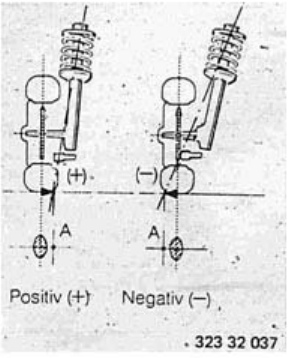
Symmetrical Axis 2

is a center line running through the front and rear axles.



Wheel Offset

is the angle, by which one front wheel is displaced more toward front or rear than the other front wheel.



Scrub Radius / Wheel Offset

is the distance from the center of the wheel contact surface to the intersection point of an extension of the kingpin*.
Scrub radius is influenced by camber, kingpin inclination and wheel offset.

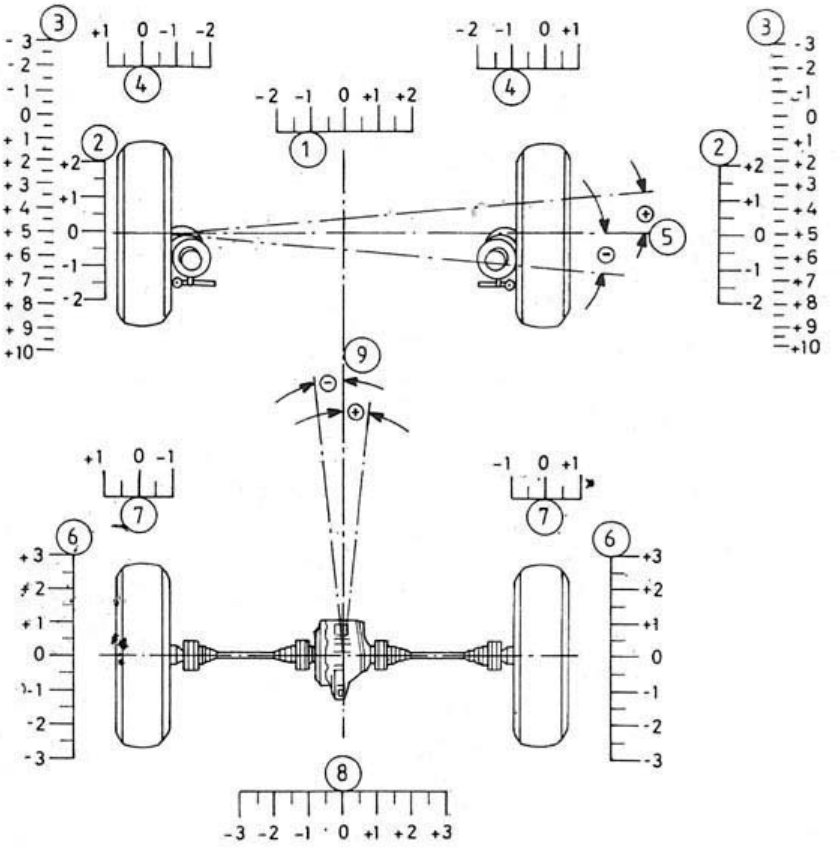
* The "king pin" is equal to a line through the center point of the spring strut mount and control arm ball joint.

32 00 ... CHECKING AND ADJUSTING FRONT AND REAR WHEEL ALIGNMENT WITH OPTICAL TESTER

Requirements Prior to Checking Wheel Alignment:

1. Good, uniform tire treads.
2. Specified tire inflation pressure**.
3. Wheel rims in perfect condition*.
4. Specified wheel bearing play*.
5. Car brought to normal position*.
6. Specified height*.

Check actual values with an optical tester.
Fill in test sheet.
Nominal values*.

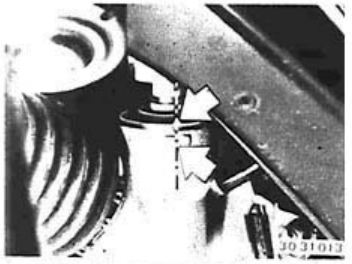


1 = Toe
2 = Camber
3 = Caster (with 10° or 20° wheel lock)
4 = Toe difference angle (with 20° wheel lock)
5 = Wheel offset
6 = Camber
7 = Rear wheel position
8 = Toe
9 = Geometrical axis

* See Specifications of Gr. 31/32/33/36
** See Service Information of Gr. 36

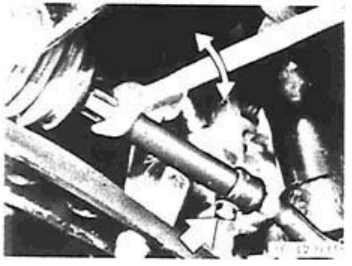
TROUBLESHOOTING FRONT WHEEL ALIGNMENT

Condition	Cause	Correction
1 Toe deviation	a) Car not in normal position b) Tie rod(s) bent c) Track arm on spring strut deformed d) Tie rod ball socket joints on steering gear or wheel end worn e) Rubber mount in control arm defective f) Ball socket joints in control arm defective	a) Height level, see Specifications of Group 31 b) Replace tie rod(s) c) Replace spring strut d) Replace ball joint e) Replace rubber mount f) Replace control arm
2 Camber deviation Camber is given by design and cannot be adjusted.	a) Rubber mount in control arm defective b) Control arm deformed c) Spring strut deformed d) Guide joint worn e) Suspension sag excessive f) Front axle carrier deformed g) Wheel house deformed (spring strut mount holder deformed) h) Distortion in floor assembly (engine carrier) i) Unfavorable summary of tolerances	a) Replace rubber mount b) Replace control arm c) Replace spring strut d) Replace control arm e) Height level, see Specifications of Group 31 Replace coil springs f) Replace front axle carrier g) Repair front end h) Repair body i) Install eccentric mounts, see camber correction
3 Caster deviation Caster is given by design and cannot be adjusted.	a) Control arm bent b) Spring strut deformed c) Wheel house deformed d) Distortion in floor assembly (engine carrier)	a) Replace control arm b) Replace spring strut c) Repair front end d) Repair body
4 Toe difference angle deviation	Assuming camber and caster are correct: a) Tie rods not adjusted uniformly b) Track arm on spring strut bent	a) Adjust toe on left and right sides to same value b) Replace spring strut
5 Wheel offset deviation (alignment tester Type F 1600)	Assuming front wheels have equal single toe to geometrical axis: a) Front axle carrier deformed b) Engine carrier deformed c) Control arm deformed	a) Replace front axle carrier b) Repair body c) Replace control arm



32 00 . . . ADJUSTING TOE AND TOE DIFFERENCE ANGLE

Position steering gear in straight ahead (marks on case and steering shaft aligned).



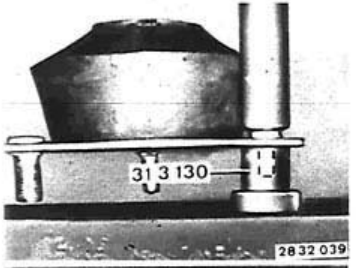
Loosen bolts of tie rods.
Adjust toe on left and right wheels to nominal value* by turning the tie rods.
Installation:
Make sure that ball joints and dust covers are not twisted.
Tightening torque*.

* See Specifications

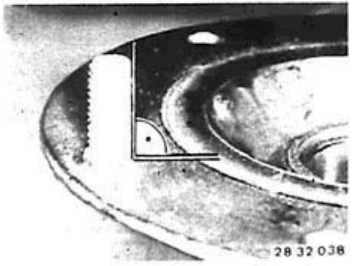
Correcting Camber:
If necessary because of the summation of unfavorable tolerances, correct front wheel camber by installing eccentric mounts for ± 30' correction.

Important!
Changes in vehicle geometry (axis – body) caused by accident must never be eliminated with this measure.

Example:	
Nominal camber value	– 10' ... – 1° 10'
Actual camber value	– 1° 30'
Correction	+ 30'
New actual value	– 1°



Eccentric mounts are marked with + and – at bores.
Press knurled bolts depending on situation (see example) into "+" or "–" bores with Special Tool 31 3 130.



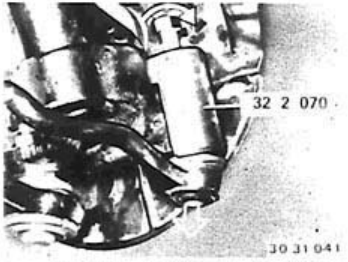
Important!
Knurled bolts must be vertical and flush in mount.
Replace front spring strut mount 31 33 001.

TROUBLESHOOTING REAR WHEEL ALIGNMENT

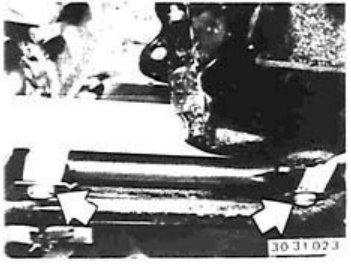
Condition	Cause	Correction
6 Camber deviation	a) Rubber mounts on rear axle carrier defective	a) Replace rubber mounts
	b) Rubber mounts on final drive defective	b) Replace rubber mounts
	c) Silent blocks in trailing arms defective	c) Replace silent blocks
	d) Rear axle carrier deformed	d) Replace rear axle carrier
	e) Trailing arms deformed	e) Replace trailing arms
	f) Distortion in floor assembly	f) Repair body
7 Rear wheel positioning incorrect	a) Rear axle carrier displaced laterally	a) Check rubber mounts on rear axle carrier, replacing if necessary
	b) Distortion in floor assembly	b) Repair body
8 Toe deviation	a) Rear axle carrier deformed	a) Replace rear axle carrier
	b) Trailing arms deformed	b) Replace trailing arms
	c) Silent blocks in trailing arms defective	c) Replace silent blocks
	d) Rubber mounts on rear axle carrier defective	d) Replace rubber mounts
	e) Suspension sag excessive or car not in normal position	e) Height level see Specifications of Group 33 Replace coil springs if necessary
	f) Unfavorable summation of tolerances	f) Install eccentric silent blocks, see 33 22 561
9 Deviation in geometrical axis (alignment tester Type F 1600)	Assuming total rear wheel toe is correct:	
	a) Distortion in floor assembly	a) Repair body

32 11 000 REMOVING AND INSTALLING STEERING GEAR ASSEMBLY

Remove and install front wheels 36 10 340.
Remove and install steering spindle 32 31 070.
Note:
Check toe after installation – see 32 00 004.



Unscrew nuts and press left and right tie rods off of spring struts with Special Tool 32 0 070.
Installation:
Clean pins and bores to remove grease.
Replace self-locking nuts.
Tightening torque*.



Unscrew steering gear on front axle carrier.
Installation:
Mount steering gear in front bores of front axle carrier.
Replace self-locking nuts.
Tightening torque*.

* See Specifications



32 13 006 FILLING AND BLEEDING POWER STEERING

1. Filling with Stopped Engine:
   Fill oil tank up to "MAX" mark on oil dipstick.
2. Bleeding:
   Turn steering wheel two times each against left and right locks.
3. Check oil level with engine stopped.
   Add hydraulic fluid* until level is at "MAX" mark.

* See Specifications

32 13 060 REMOVING AND INSTALLING POWER STEERING GEAR – Four Wheel Drive –

Procedures are identical with those for replacing the front axle carrier – see 31 11 001.

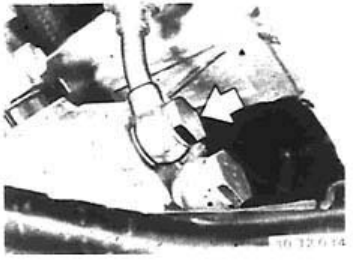
32 13 060 REMOVING AND INSTALLING POWER STEERING GEAR

Remove front wheels – see 36 10 340.
Remove steering spindle – see 32 31 070.
Note:
Check toe after installation – see 32 00 004.
Important!
Don't turn power steering as far as stop as this would damage radial oil seal.

Draw hydraulic fluid* out of tank.
Unscrew hydraulic fluid return pipe.

Important!
Never reuse the drained oil.

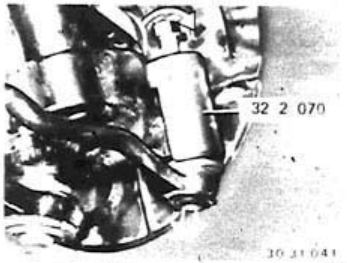




Unscrew pressure pipe.
Plug connections with dust caps.

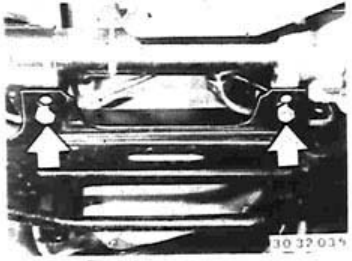
Installation:
Replace seals.
Tightening torque*.

* See Specifications



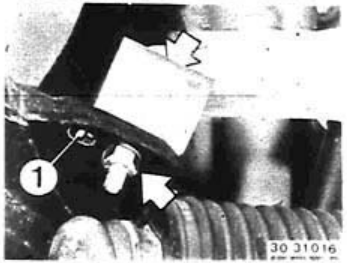
Unscrew left and right nuts and press tie rods off of tie arms with Special Tool 32 0 070.
M 3:
Special Tool 31 2 160.

Installation:
Pins and bores free of grease.
Replace self-locking nuts.
Tightening torque*.



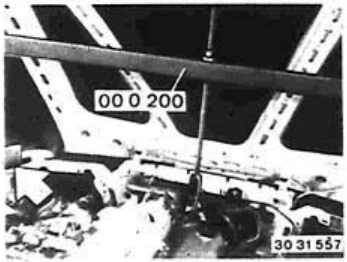
Unscrew steering gear on front axle carrier.

Installation:
Mount steering gear on rear bores.
Replace self-locking nuts.
Tightening torque*.
Fill power steering – see 32 13 006.



If applicable, unscrew additional left and right engine mounts.

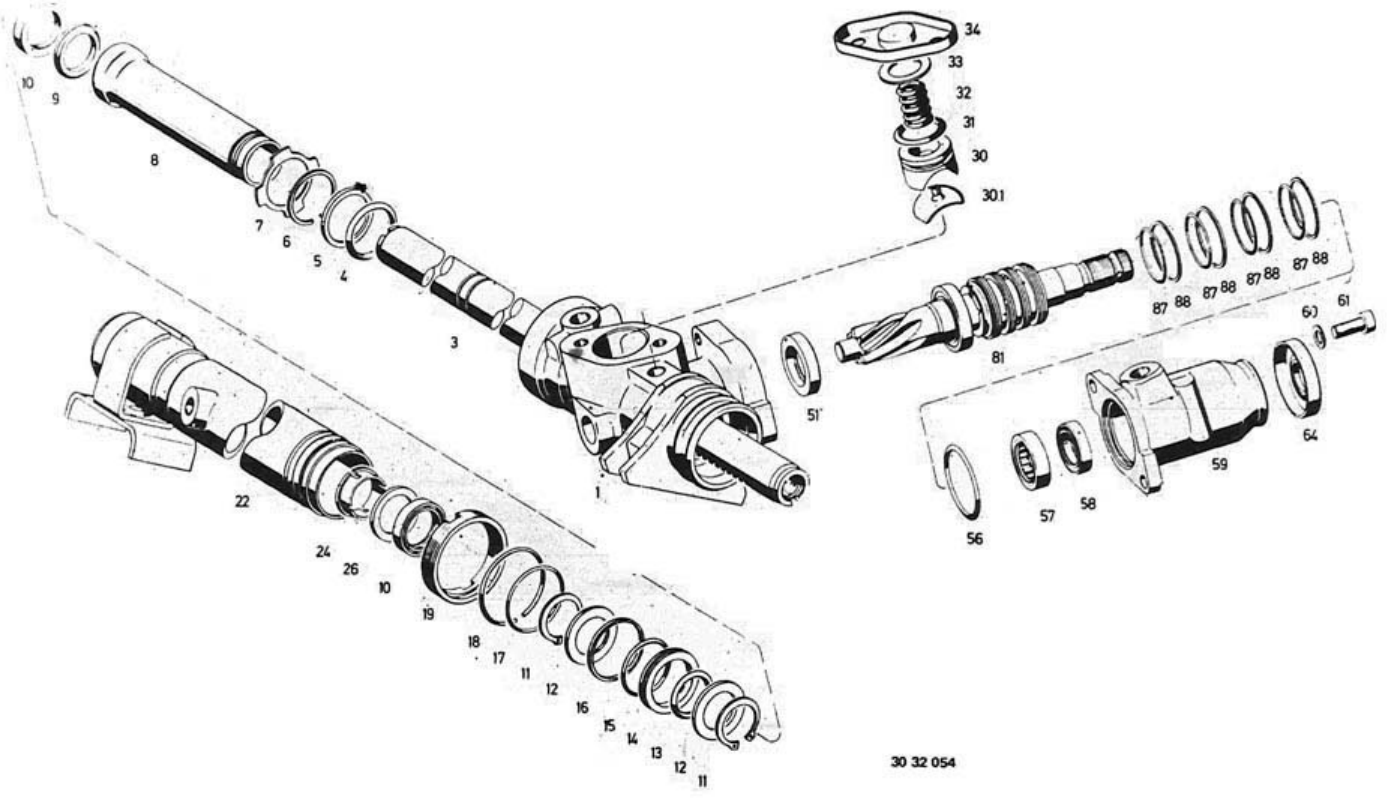
Installation:
Twist-preventing lock (1) of engine mount must engage in the bore.
Tightening torque*.



Attach Special Tool 00 0 200 on the engine and pull up engine about 5 cm (2"). Supports bear on the bolts of the side walls.
Remove steering gear.

* See Specifications

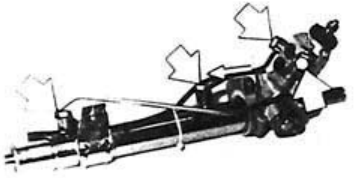
STEERING GEAR – CODE NO. 78 32 ... ...



1 Case
3 Rack
4 Round seal
5 Spacer
6 Snap ring
7 Friction ring
8 Spacer
9 Thrust ring
10 Seal
11 Circlip
12 Washer
13 Round seal
14 Piston
15 Round seal
16 Piston ring
17 Round seal
18 Snap ring
19 Round nut
22 Cyl. tube
24 Bearing sleeve
26 Thrust ring
30 Pressure piece
30.1 Plastic sheet insert
31 Round seal
32 Spring
33 Spacer
34 Cover
35 Bolt
51 Radial oil seal
56 Round seal
57 Bearing race
58 Radial oil seal
59 Valve housing
60 Washer
61 Bolt
64 Dust cap
81 Valve body
87 Round seal
88 Seal

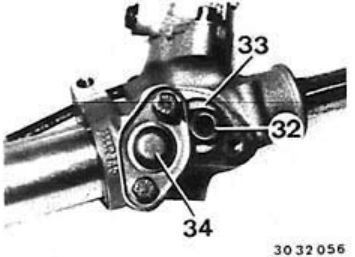
32 13 503 DISASSEMBLING/ASSEMBLING POWER STEERING GEAR – POWER STEERING GEAR REMOVED

Remove and install tie rods 32 21 251.
Working on steering gears requires utmost care and cleanliness.



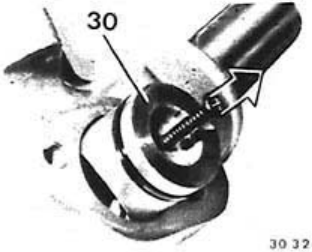
30 32 055

Disconnect lines.
Pull off leak oil line.



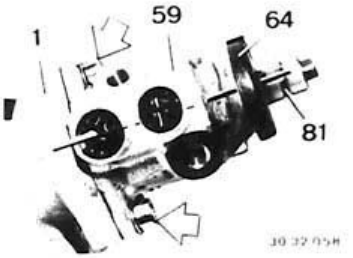
30 32 056

Unscrew bolts.
Take off cover (34), spring (32) and washer (33).



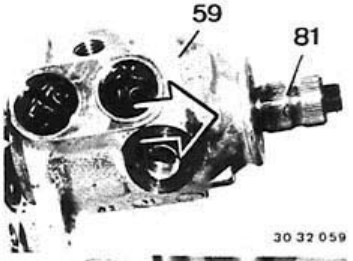
30 32 057

Screw self-tapping screw in bore and pull out pressure piece (30).



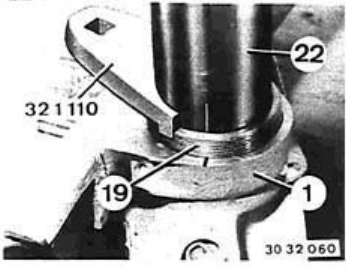
30 32 058

Pull protective cap (64) off of steering spindle stub.
Turn steering to straight ahead (take half of total steering wheel turns).
Mark position of steering spindle (81), valve housing (59) and case (1) to each other in this position.
Unscrew bolts.



30 32 059

Pull steering spindle (81) and valve housing (59) out of case.



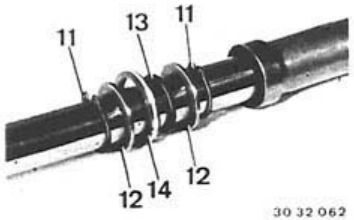
30 32 060

Mark position of cylindrical tube (22) and case (1) to each other.
Unscrew round nut (19) with Special Tool 32 1 110.
Remove cylindrical tube.

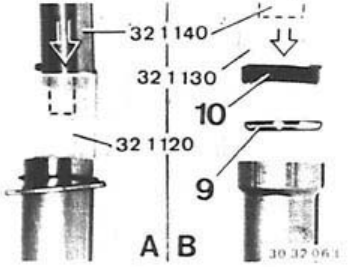


30 32 061

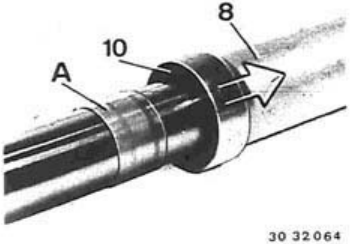
Pull rack (3) out of case.



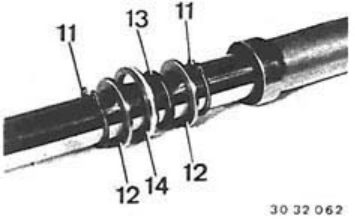
Take off circlip (11), washers (12), piston (14) and round seal (13).
Pull off cylindrical tube on rack.



A) Knock out seal (10) with Special Tool 32 1 120 / 140.
B) Insert support (9) with chamfer facing down.
Knock in seal (10) against stop (open end facing up) with Special Tool 32 1 130/ 140.
Coat sealing lip with hydraulic fluid*.

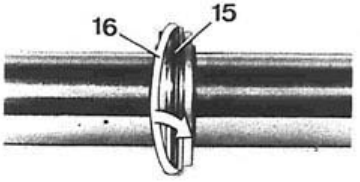


Fill cuts in rack with grease (A) to avoid damage on seal (10).
Slide cylindrical tube (8) on to rack.
Remove grease.

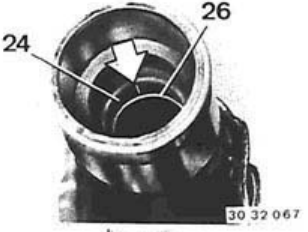


Replace round seal (13).
Insert washers (12), piston (14) and circlips (11).

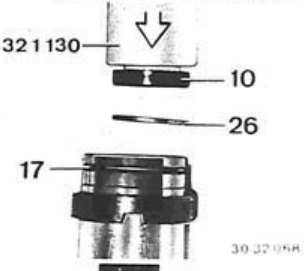
* See Operating Material Specifications



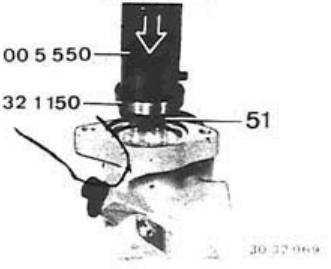
Replace round seal (15) and piston ring (16), and coat with hydraulic fluid*.



Apply screwdriver in slot of bearing sleeve (24) and knock out support (26) with seal (10).



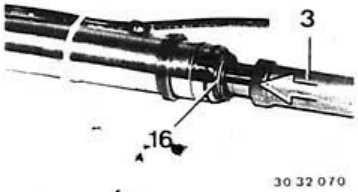
Insert support (26) and knock in seal (10) against stop (open end facing up) with Special Tool 32 1 130 / 140.
Replace round seal (17).



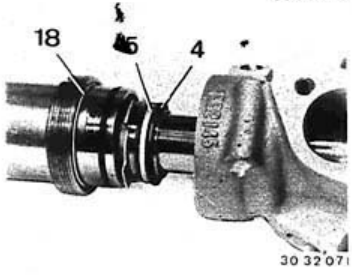
Knock in radial oil seal (51) against stop (open end facing up) with Special Tools 32 1 150 and 00 5 500.
Fill sealing lip with grease*.

* See Operating Material Specifications

Guide rack (3) into cylindrical tube.
Caution!
Don't damage piston ring (16).

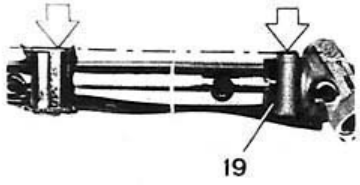


30 32 070



30 32 071

Replace spacer (5) and round seal (4).
Lubricate splines of rack with grease*.
Measure and note diameter of snap ring (18).
Guide cylindrical tube into body.



30 32 072

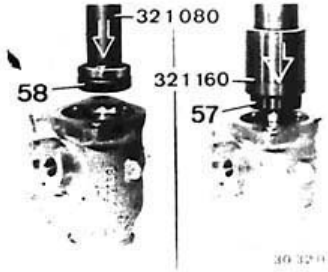
Align mounting flanges horizontally – check marks – and tighten ring nut (19).
Tightening torque depends on wire gauge diameter of snap ring (18).
2.5 mm (0.098") dia. = 120 Nm (87 ft. lbs.).
3.5 mm (0.138") dia. = 150 Nm (108 ft. lbs.).
Lock ring nut with a punch mark.



30 32 073

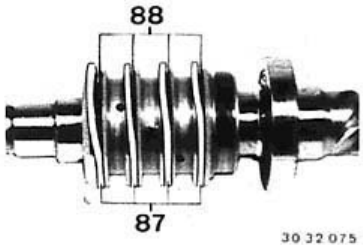
Pull valve body (81) out of valve housing (59).

* See Operating Material Specifications



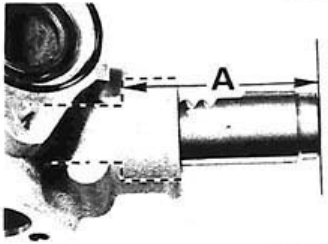
30 32 074

Knock out radial oil seal (58) with Special Tool 32 1 140.
Knock in new radial oil seal (58) against stop (open end facing in) with Special Tool 32 1 080 and coat with hydraulic fluid*.
Knock in bearing (57) against stop with Special Tool 32 1 160.



30 32 075

Replace round seals (87) and seals (88) located underneath, and coat with hydraulic fluid*.



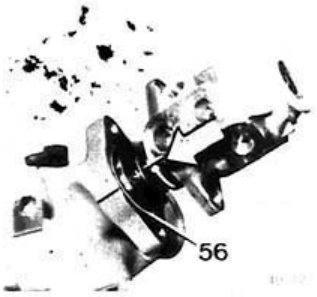
30 32 076

Set rack (3) to straight ahead position.
Distance A from end of rack to stop in cylindrical tube is 72 mm (2.835") for both left and right sides.

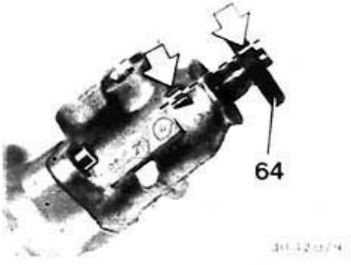

30 32 077

Dip pinion splines in grease* and install pinion in body.
The marks made prior to disassembling must align.

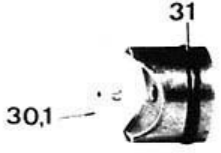
* See Operating Material Specifications



Replace round seal (56).
Slide valve housing over valve body carefully to avoid damaging the seal and tighten bolts.
Tightening torque = 17 to 20 Nm (13 to 14 ft. lbs.).

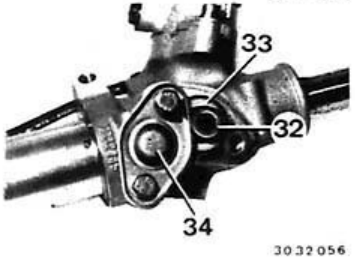


Pack protective cap (64) with grease* and mount on steering spindle with steering gear in center position.
Tab of protective cap faces mark on valve housing.



30 32 080

Replace plastic sheet inlet (30.1) and round seal (31).



3032056

Insert pressure piece (30), spring (32) and spacer (33), and bolt down with cover (34).
Tightening torque = 17 to 20 Nm (13 to 14 ft. lbs.).

* See Operating Material Specifications



30 32 081

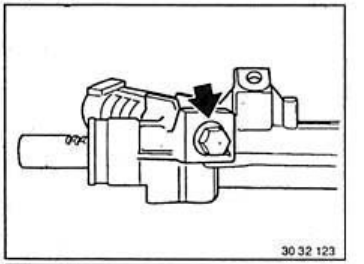
Replace round seals of hollow union bolts and screw on lines.
Tightening torque = 20 Nm (14 ft. lbs.).

Complete installation of steering gear and then check its operation.

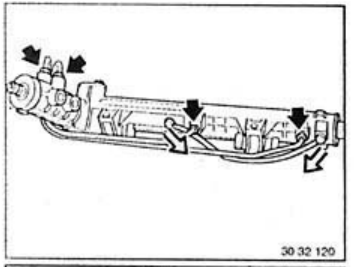
32 13 503 DISASSEMBLING AND ASSEMBLING POWER STEERING GEAR (Code No. 7832 955 139) – Power Steering Gear Removed)

Remove tie rods – see 32 21 251.

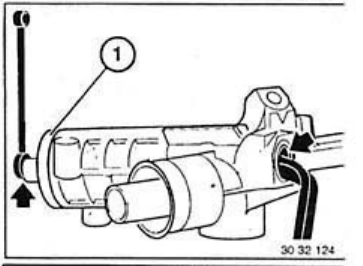
Work on steering gear must always be carried out carefully and with absolute cleanliness.



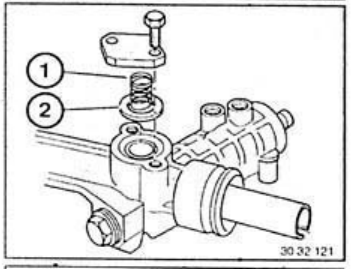
Unscrew plug.



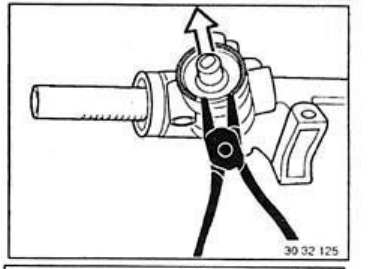
Unscrew pipes.
Pull off leak oil pipe.



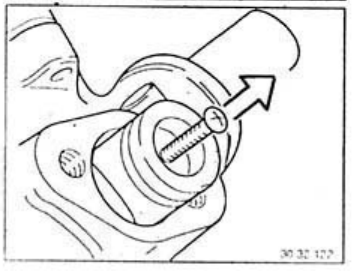
Pull cap (1) off steering spindle.
Unscrew nut, while counterholding on double-flats of steering spindle.



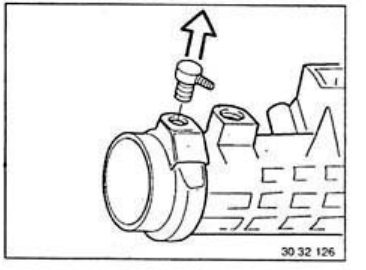
Unscrew cap.
Take off spring (1) and washer (2).



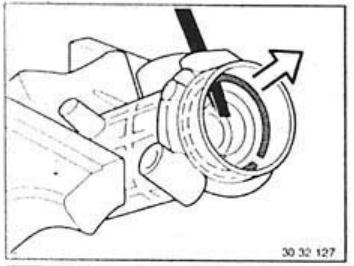
Lift out circlip.
Pull steering spindle out of case.



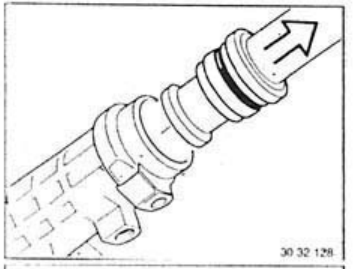
Screw self-tapping screw in bore and pull out pressure piece.



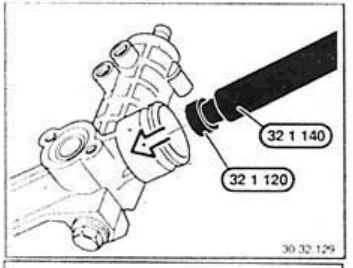
Pull off connector for leak oil pipe.



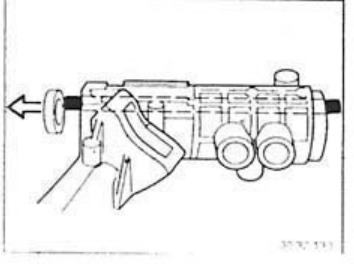
Unlock circlip through bore of leak oil pipe and pull out of case.



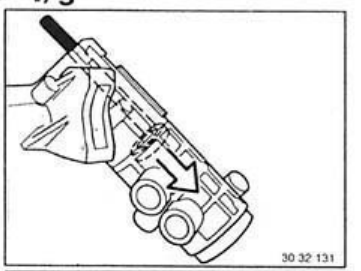
Pull rack out of case.



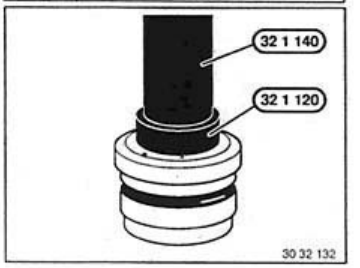
Drive radial oil seal out of case with Special Tools 32 1 140 / 120.



Drive bearing out of case with a punch.

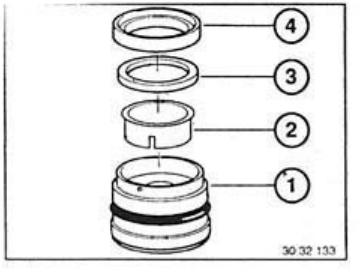


Drive radial oil seal out of case with a punch.



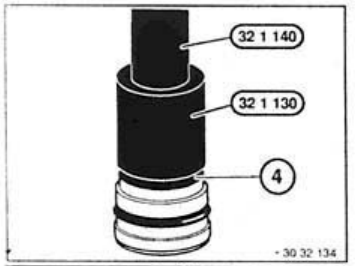
Drive radial oil seal out of bearing sleeve with Special Tools 32 1 140 / 120.

Clean all parts thoroughly.
Coat new seals with hydraulic fluid*.

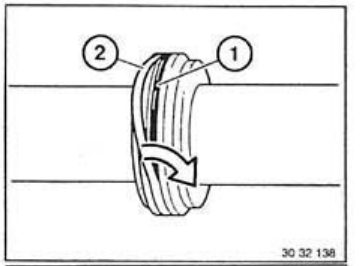


Replace seal (1).
Place new plastic sleeve (2) and support washer (3) in bearing sleeve.

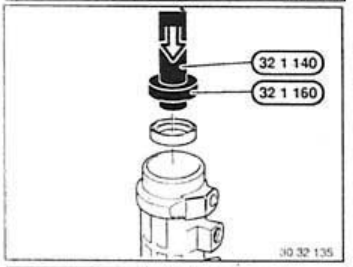
* See Operating Fluids



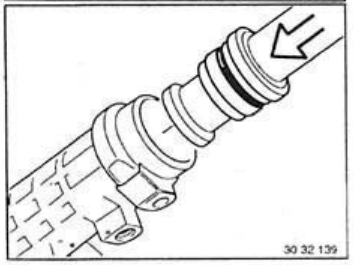
Drive in radial oil seal (4) – open end facing up – as far as stop with Special Tools 32 1 140 / 130.



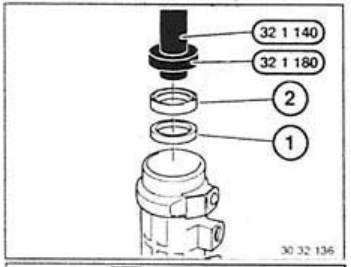
Replace round seal (1) and piston ring (2).



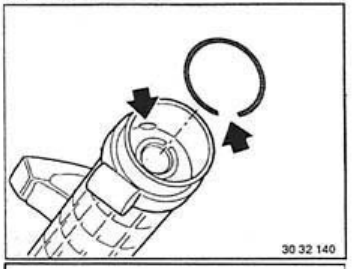
Drive in radial oil seal – open end facing up – as far as stop with Special Tools 32 1 140 / 160.



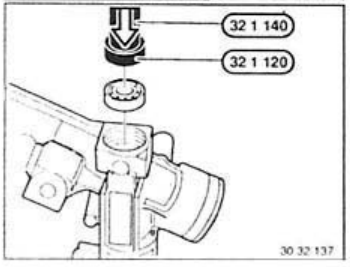
Guide rack into case carefully. Place bearing sleeve on rack.



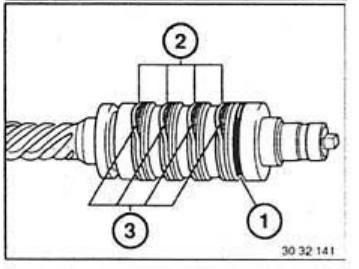
Insert support washer (1).
Drive in radial oil seal (2) – open end facing up – as far as stop with Special Tools 32 1 140 / 180.



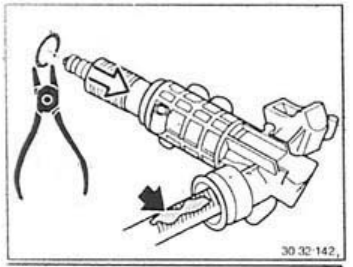
Install circlip with open end opposite leak oil bore.



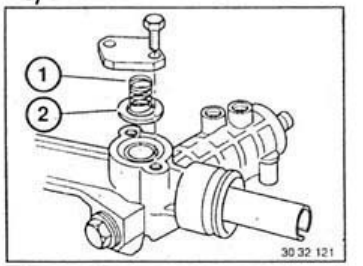
Drive in bearing as far as stop with Special Tools 32 1 140 / 120.



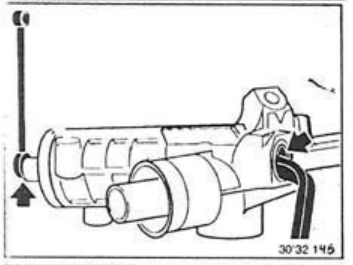
Replace seal (1).
Replace piston rings (2) and O-rings (3) located underneath.



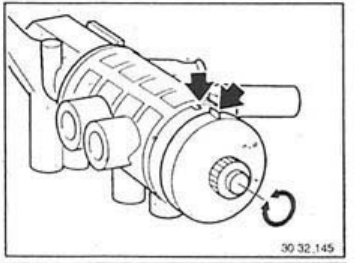
Lubricate teeth on rack and pinion with grease*.
Guide steering head into case and insert circlip.



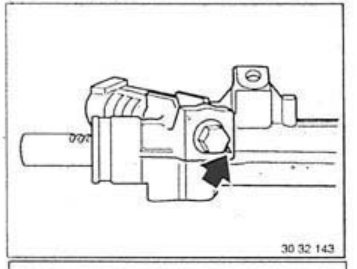
Insert pressure piece with spring (1) and washer (2).
Screw on cap.



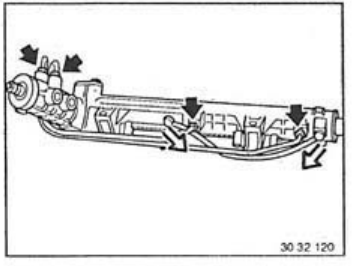
Replace and tighten self-locking nut with 17 Nm (12 ft. lbs.) torque.



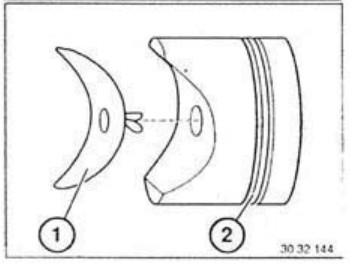
Move steering gear to straight ahead driving position by determining half of total turns.
Install new protective cap in this position.
Mark on cap must be aligned with mark on case.



Tighten plug with 32 Nm (23 ft. lbs.) torque and lock by punching.

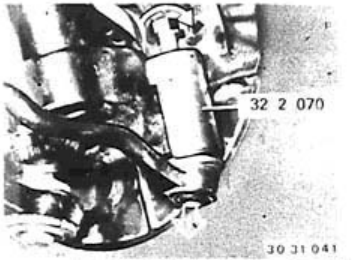


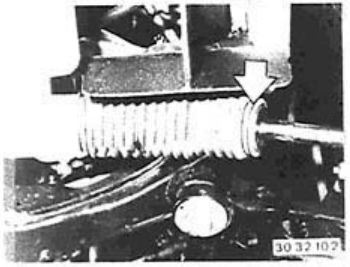
Install connector for leak oil pipe.
Screw on leak oil pipe and pressure pipes.
Tightening torque = 8 Nm (6 ft. lbs.).

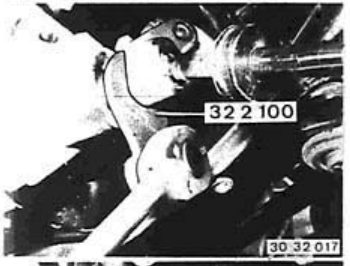


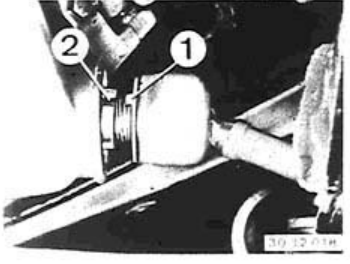
Replace foil insert (1) and seal (2).

* See Operating Fluids









32 21 251 REPLACING LEFT OR RIGHT TIE ROD

Remove front wheel – see Group 36.
Unscrew nut and press tie rod end off track arm with Special Tool 32 0 070 or, for M 3, with Special Tool 31 2 160.

Installation:
Replace self-locking nut.
Journal and bore cleaned of grease.
Tightening torque*.
Adjust toe – see 32 00 004.

Loosen retaining strap.

Installation:
Check dust cover, replacing if necessary.

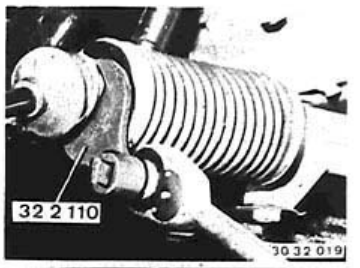
Important!
Don't turn power steering as far as stop as this would damage radial oil seal.

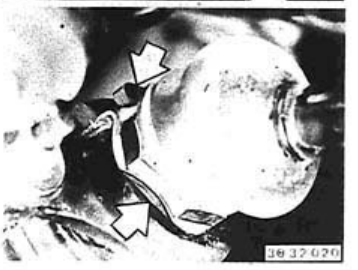
Unlock lockplate.
Remove tie rod with Special Tool 32 2 100.

Caution!
Unlock lockplate with a pliers (never with a hammer) to avoid damaging rack and bearings.

Installation:
Replace lockplate.
Shoulder (1) of lockplate bears in opening (2) of rack.
Tightening torque*.

* See Specifications



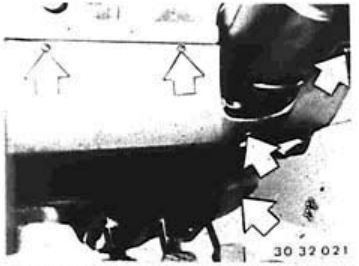


Version with Steering Damper:

Unlock lockplate.
Remove tie rod with Special Tool 32 2 110.

Installation:
Replace lockplate.
Shoulder of lockplate bears in opening of damper bracket.
Tightening torque*.
Lock lockplate by bending with water pump pliers.

* See Specifications

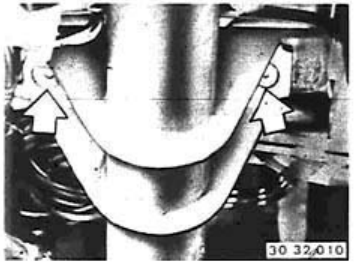


32 31 001 REPLACING STEERING COLUMN CASING UPPER SECTION

Remove and install steering wheel 32 33 000.
Disconnect battery ground lead.
Remove instrument panel trim.

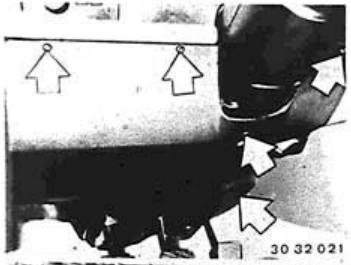


Remove steering column casing lower section.



Remove shear-off screws with a chisel.
Take off steering column casing upper section.
Transfer cover for ignition lock.
Installation:
Tighten Torx shear-off screws up to point of shearing off.

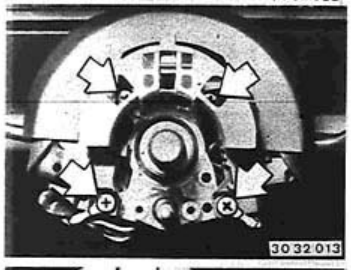
32 31 061 REPLACING (UPPER) STEERING SPINDLE



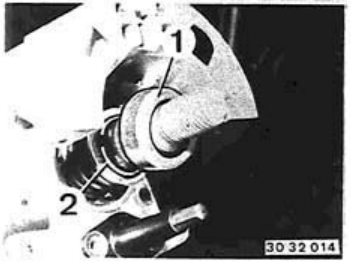
Disconnect battery ground lead.
Remove and install steering wheel 32 33 000.
Remove instrument panel trim.



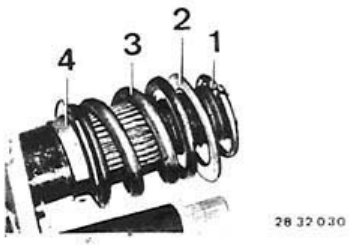
Remove steering column casing lower section.



Disconnect turn signal and wiper switch.

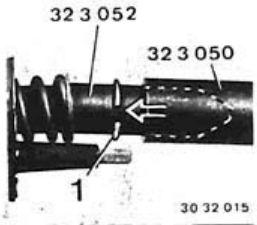


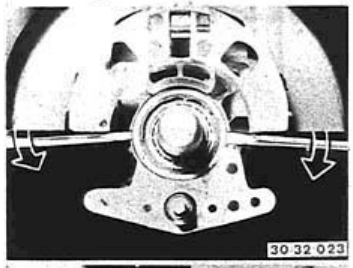
Remove collar ring (1).
Installation:
Notch of collar ring (1) must lock snap ring (2).



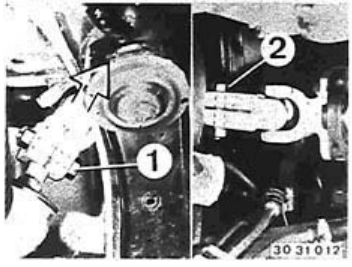
Remove snap ring (1), washer (2), spring (3) and ring (4).
Installation:
Stem of ring (4) faces bearing.

Installation:
Install snap ring (1) with Special Tools 32 3 052 and 23 3 050 (knock from hammer and steering spindle held on bottom).



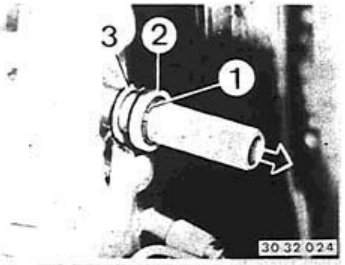


Lift out steering spindle bearings with a screwdriver.
Installation:
For steering spindles with groove in area of bearing, insert and lightly coat O-ring with grease.
Drive in bearing with Special Tool 00 5 550.

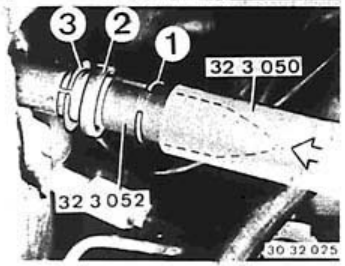


Remove bolt (1) and loosen bolt (2).
Press steering spindle off of steering gear and remove.
Installation:
Bolt (1) must be located in locking groove of steering shaft.
Replace self-locking nuts.
Tightening torque*.

* See Specifications



Pull steering spindle out of bearing.
Remove snap ring (1), collar ring (2) and ring (3).
Pull out steering spindle from above.



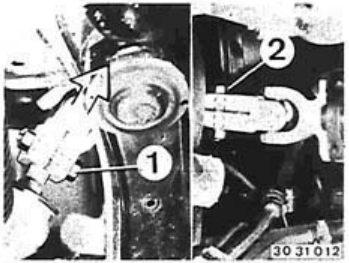
Installation:
Notch of collar ring (2) must lock snap ring (1).
Stem of ring (3) faces bearing.
Install snap ring with Special Tools 32 3 052 and 32 3 050.

If applicable, shove steering spindle down and drive out bearings.
Drive in bearings with Special Tool 00 5 550.

32 31 070 REMOVING AND INSTALLING OR REPLACING LOWER STEERING SPINDLE

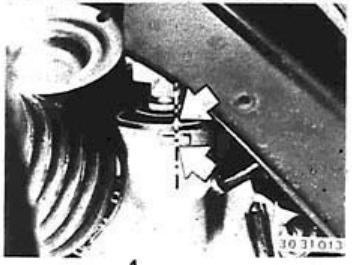
The entire steering spindle should always be replaced when a coupling or universal joint is faulty.
Remove steering wheel – see 32 33 000.

Installation:
Mount steering wheel in straight ahead position.

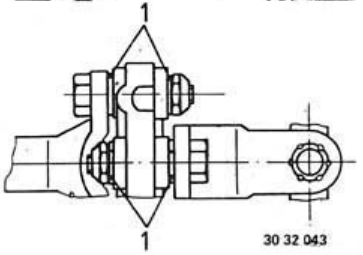


Remove bolt (1) and loosen bolt (2).
Press steering spindle off of steering gear and remove.

Installation:
Bolt (1) must be located in the locking groove of the steering shaft.
Replace self-locking nuts.
Tightening torque*.

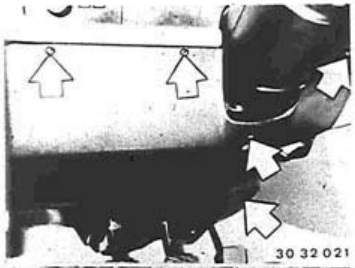


Installation:
Steering wheel and front wheels positioned straight ahead (marks on housing and steering shaft aligned).
Mount steering spindle on steering gear in such a manner that the slot of the universal joint is aligned with the mark on the steering gear.



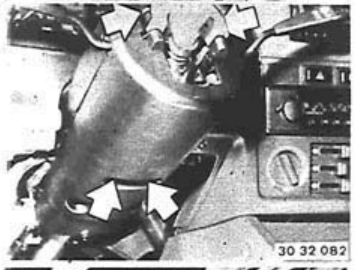
Make sure spring washers (1) are installed between coupling and steering spindle or universal joint when assembling a new steering spindle.
Tightening torque*.

* See Specifications



32 31 090 REMOVING AND INSTALLING STEERING COLUMN

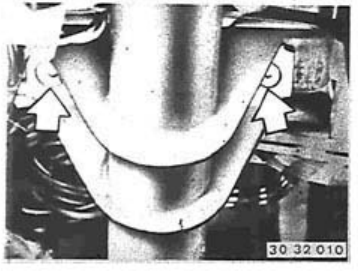
Disconnect battery ground lead.
Remove steering spindle – see 32 31 070.
Remove steering wheel – see 32 33 000.
Remove instrument panel trim bottom section.



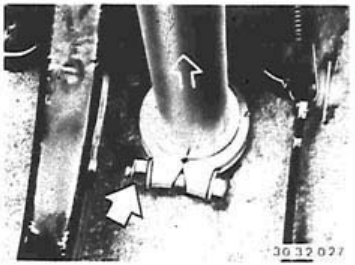
Remove lower section of steering column casing.



Disconnect central electric wire plug.



Remove shear-off screws with a chisel.
Take off upper section of steering column casing.
Installation:
Tighten shear-off screws until heads shear off.



Loosen clamp and remove steering column.

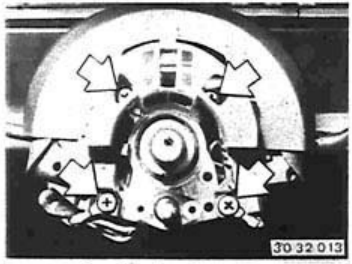
32 31 171 REPLACING BOTH STEERING SPINDLE BEARINGS

Procedures are identical with those for replacing upper steering spindle – see 32 31 061.

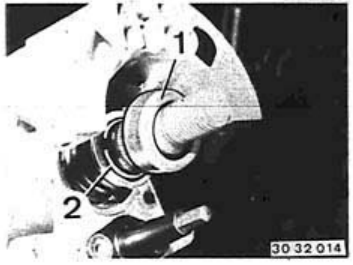


32 32 001 REPLACING STEERING LOCK ASSEMBLY

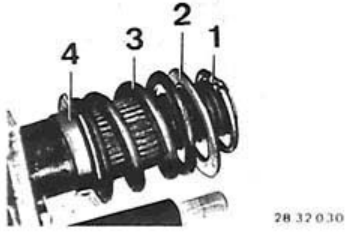
Disconnect battery ground lead.
Remove and install steering wheel 32 33 000.
Remove steering column casing lower section.



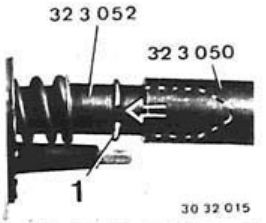
Disconnect turn signal and wiper switch.



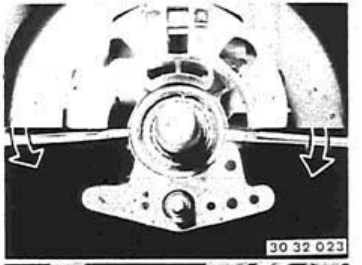
Remove collar ring (1).
Installation:
Notch of collar ring (1) must lock snap ring (2).



Remove snap ring (1), washer (2), spring (3) and ring (4).
Installation:
Stem of ring (4) faces bearing.



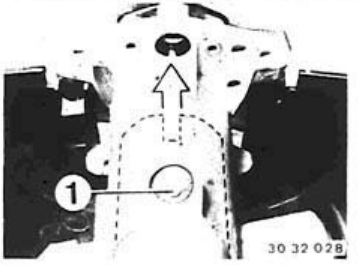
Installation:
Install snap ring (1) with Special Tools 32 3 052 and 32 3 050 (hammer knock).



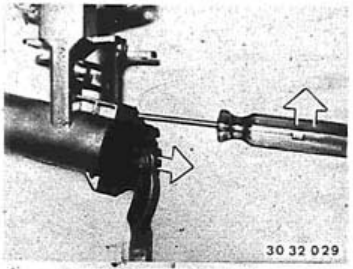
Lift out steering spindle bearings with a screwdriver.
Installation:
Drive in bearings with Special Tool 00 5 550.



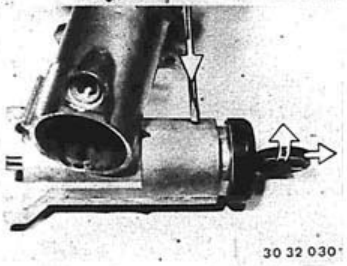
Disconnect central electric plug.



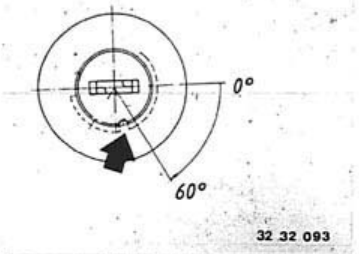
Remove shear-off screw (1) with a chisel.
Pull steering lock with casing upper section off of outer tube.
Installation:
Tighten Torx shear-off screws.



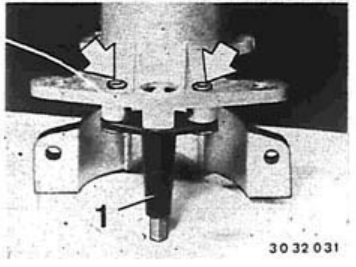
Press down locking hook and remove ignition/ starter switch.
Installation:
Check position of ignition/starter switch and steering wheel lock.



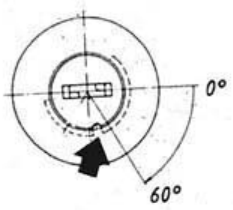
Press down lock with a screwdriver.
Turn key to point of locking and pull out lock cylinder.



Since 1987 Models:
Insert ignition key in lock cylinder and turn to position "R" = 60°.
Push a 1.2 mm (3/64") dia. wire into bore of cylinder and pull out the lock cylinder.



Drill out rivets and bolt carbon contact (1) on new steering lock.



32 32,093

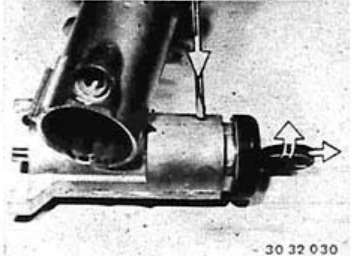
32 32 050 REMOVING AND INSTALLING OR REPLACING STEERING LOCK CYLINDER

Insert ignition key in lock and turn lock cylinder to "R" = 60°
Push a 1.2 mm (3/64") dia. wire into bore of the cylinder and pull out the lock cylinder.



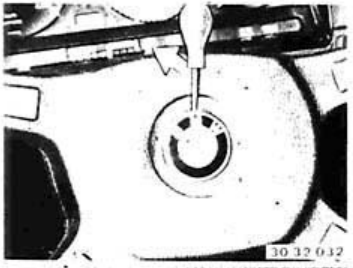
30 32 082

If There is No Bore in Lock Cylinder:
Remove steering wheel — see 32 33 000.
Remove steering column casing lower section.
Disconnect battery ground lead.



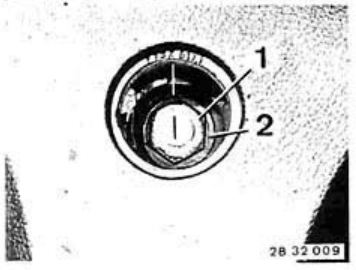
30 32 030

Press down lock with a screwdriver.
Turn key to point of locking and pull out lock cylinder.

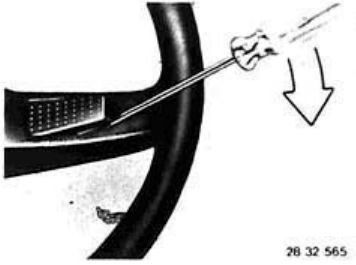


32 33 000 REMOVING AND INSTALLING STEERING WHEEL

Lift off BMW emblem.

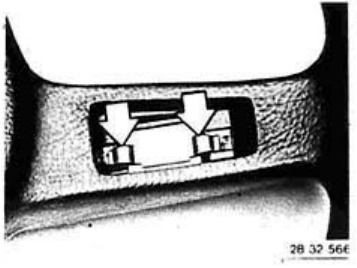


Mark position of steering wheel to steering spindle.
Unscrew nut (1) and remove washer (2).
Important!
Steering wheel can only be pulled off after unlocking steering lock.
Installation:
Replace self-locking nut.
Tightening torque*.



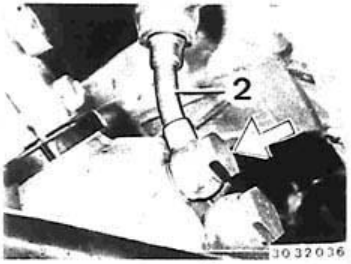
32 33 041 REPLACING HORN BUTTON ON STEERING WHEEL

Lift off horn button carefully with a screwdriver.



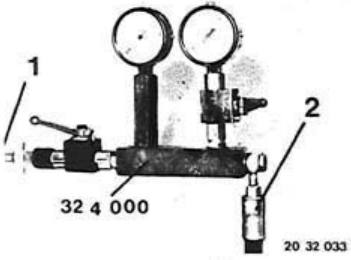
Installation:
Insert spring contact with arcs facing up.

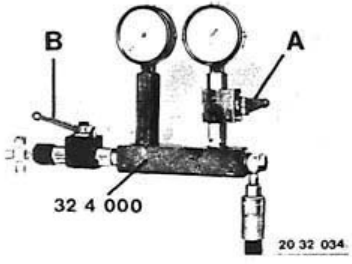
* See Specifications



32 41 009 CHECKING FUNCTION OF POWER STEERING PUMP – ENGINE AT OPERATING TEMPERATURE –

1. Checking Power Steering Pump:
Detach pressure line (2) on steering gear and connect on tester 32 4 000.
Connect pressure line (1) of tester 32 4 000 on steering gear.
Installation:
Tightening torque*.
Bleed power steering 32 13 006.



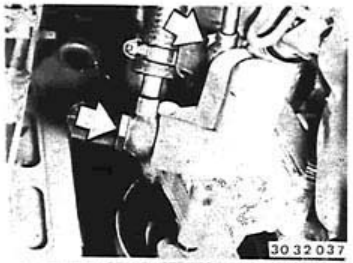


Test:
Valve (A) must always be closed for high pressure testing (would damage pressure tester).
Open valve (B) and bleed power steering 32 13 006.
With engine running shut valve (B) for max. 10 seconds and read pressure.
Rated pump pressure* must be reached within ± 10 %.
If this pressure is not reached, check drive belt tightness 32 41 109.
Recheck.
If pressure is still not reached, replace power steering pump 32 41 060.



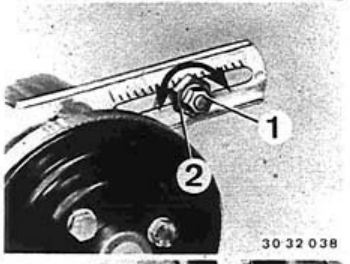
2. Checking Power Steering:
Run engine.
Pull steering wheel against final left lock with a force of 100 N (22 lbs.) about 5 seconds; use a force meter.
Read pressure from tester 32 4 000.
Repeat same test on right lock.
If pressure values are less than the previously measured pump pressure, replace steering gear 32 13 060.

* See Specifications

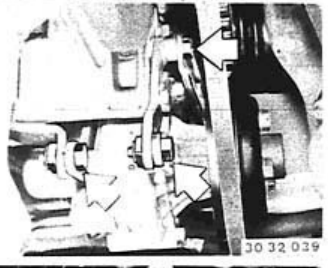


32 41 060 REMOVING AND INSTALLING POWER STEERING PUMP

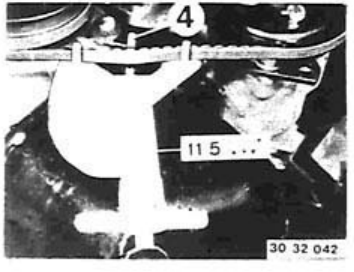
Draw off hydraulic fluid in tank.
Disconnect lines.
Plug connections with dust caps.
Installation:
Replace seals.
Tightening torque*.
Check for sufficient space between hoses and body-mounted parts.
Important!
Never reuse drained oil.



Loosen nut (1) and relax drive belt by turning toothed element (2).

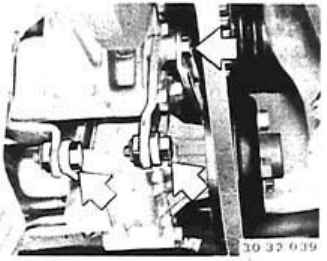


Unscrew bolts and take off pump.
Installation:
Tighten drive belt before tightening bolts.



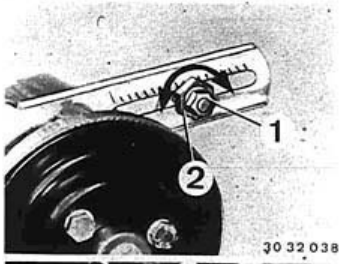
Tightening Drive Belt:
Tighten toothed element to torque of 8 ... 8.5 Nm (5.8 ... 6.1 ft. lbs.) and lock with nut.
Check or correct drive belt tightness with tester 11 5 . . ..
Hook (4) rests on tip of tooth.
Bleed power steering 32 12 006.

* See Specifications

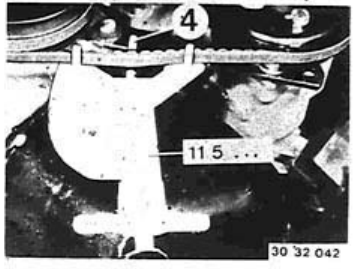


32 41 109 TIGHTENING POWER STEERING PUMP DRIVE BELT

Loosen bolts.

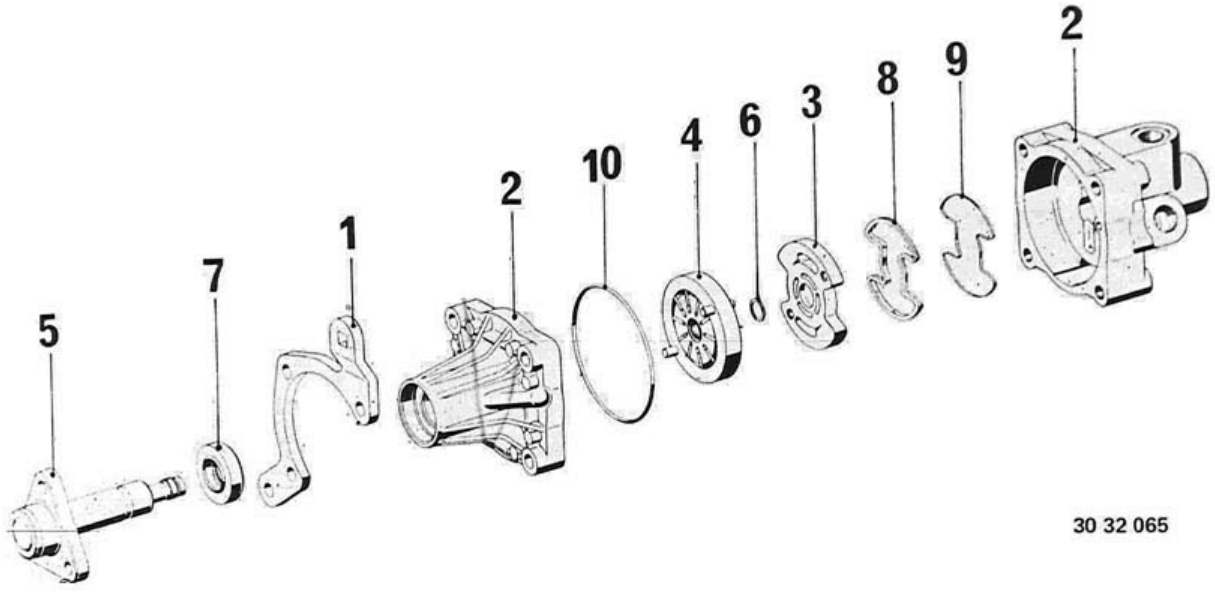


Loosen lock nut (1).
Tighten toothed element (2) to torque of 8 ... 8.5 Nm (5.8 ... 6.1 ft. lbs.) and tighten lock nut again.



Check or tighten drive belt with tester 11 5 . . . .
Hook (4) rests on tip of tooth.
Tighten bolts.
Important!
Check for sufficient space between hoses and body-mounted parts, making corrections on hose connections if necessary.

POWER STEERING PUMP – CODE NO. 7681 955 . . .

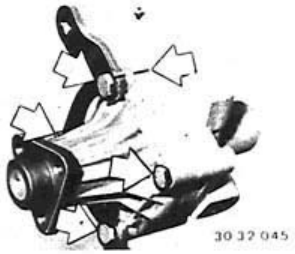


30 32 065

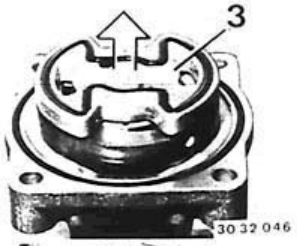
1 Holder
2 Body
3 Face plate
4 Rotor
5 Shaft
6 Snap ring
7 Radial oil seal
8 Seal
9 Guide
10 O-ring

32 41 553 DISASSEMBLING/ASSEMBLING POWER STEERING PUMP – PUMP REMOVED –

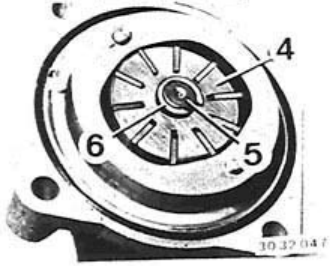
Power steering pump code no.: 7681 955 .
Absolute cleanliness is required for working on power steering pumps.



Mark position of holder (1) to pump body (2).
Unscrew bolts and separate body.

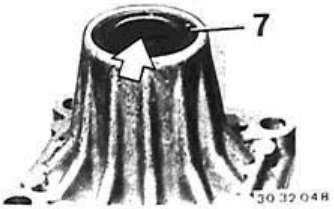


Take off face plate (3).

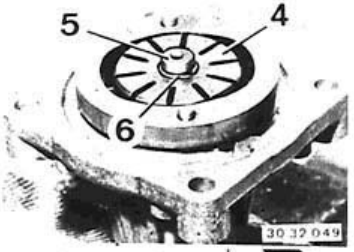


Press down on rotor (4) on shaft (5).
Remove circlip (6) and pull shaft out of body.
Remove rotor (4) with blades.

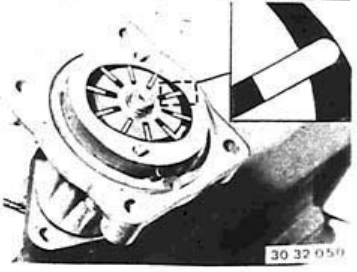
Assembling:
Clean and lubricate all parts with hydraulic fluid.
Replace radial oil seal (7) – sealing lip faces in and pack space between sealing lip and dust lip with grease.



Guide shaft (5) into body.
Install rotor (4) – undercut for snap ring facing up – and insert snap ring (6) in radial groove of shaft.

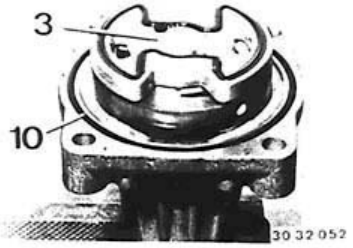


Insert blades with polished, rounded-off outside surfaces facing cam ring.
Make sure that blades move easily.

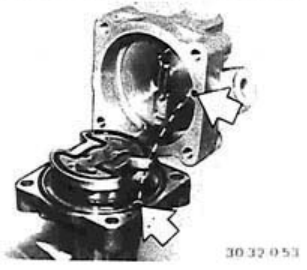


Insert seal (8) – wide end facing down – and guide (9) in face plate (3).





Install face plate (3) on dowel pins.
Replace O-ring (10).



Mount body that bores match and bolt down with holder.
Tightening torque: 16 to 19 Nm (12 to 13 ft. lbs.).

Check operation after installation of power steering pump.

TROUBLESHOOTING POWER STEERING PUMP

Condition	Cause	Correction
Noise	a) Insufficient hydraulic fluid in system	a) Eliminate leak and add hydraulic fluid.
	b) Pump drawing in air through leaking intake hose connections	b) Check/tighten intake hose connections. Replace seals if necessary.
	c) Pump drawing in air through pump shaft	c) Replace radial oil seal or, with strongly scored pump shaft, replace pump.
	d) Intake hose bent sharply/crushed	d) Route intake hose correctly.
Pressure too low	a) Drive belt loose	a) Tighten drive belt.
	b) Seal or support ring in pump faulty	b) Install set of new seals.
	c) Pump worn	c) Replace pump.
Pump leaks	a) Seals in pump faulty	a) Install set of new seals.

AIRBAG (SUPPLEMENT RESTRAINT) SYSTEM

COMPONENTS

a) Airbag steering wheel with impact shell and padded cap, in which airbag, gas generator and ignition pill are integrated.

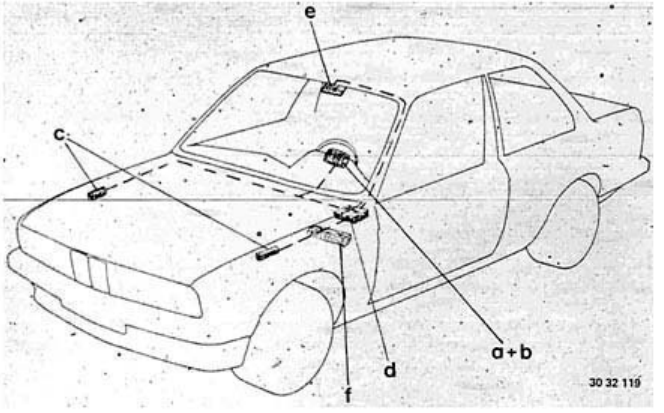
b) Contact ring – guarantees power supply to ignition pill.

c) Two crash sensors (front left and right on wheel house) and safety switch (left).

d) Electronic diagnosis unit underneath dashboard trim panel with integrated safing sensor (prevents unwanted activation).

e) Airbag control lamp integrated in Check Control.

f) Knee guard.



DESCRIPTION

The airbag does not replace fastening the seat belts!

The system is activated by sensors, whereby there must be car deceleration equal to a direct head-on collision of at least 18 km/h (11 mph) against a solid (non-giving) obstacle.

The electric circuit is made and a gas generator ignited. This causes sudden burning of a solid fuel mixture, which in turn releases a non-poisonous gas to completely inflate the folded airbag in the airbag steering wheel within approximately 30 milliseconds.

The crash inflated airbag reduces the severity of injury to the head and upper part of the body in head-on collisions. Discharging takes place through two holes on the side of the airbag facing away from the driver.

MONITORING

The airbag system is monitored continuously by a diagnosis unit from ignition switch position 1 on. The airbag control lamp comes on and goes out again after about 6 seconds to show that the system is ready for use.

If there is a detected fault in the system, a fault display will be as follows depending on the diagnosis unit:

A Control lamp on continuously – see Troubleshooting A

B Control lamp flashes (about 5 minutes) and then remains on continuously – see Troubleshooting B.

SAFETY REGULATIONS FOR HANDLING "AIRBAG" GAS GENERATORS

Non-conformance with these instructions could lead to unwanted activation of the system and injury.

The airbag unit is a pyrotechnical object. Handling, transporting and storing are subject to "legislation concerning explosive materials" (Explosive Substance Laws of Sept. 13, 1976).

The specifications listed below are in reference to the Federal Republic of Germany. There must always be conformance with pertinent legislation in other countries.

1. Transporting:

1.1 It is forbidden to transport airbag gas generators in the passenger compartment of a car!

1.2 Company level transportation must always be in the trunk (luggage compartment) or cargo room of a vehicle and in packed state – the quantity of units is limited to 50.

2. Storing:

2.1 The maximum permitted quantity of "airbag" gas generators in one working room is twenty (20).

2.2 Storage of up to 200 units is permitted in a suitable and lockable room.

2.3 Airbag generators must be stored in packaging suitable for transportation.

3. Installation and Removal:

Airbag components and plugs can be recognized immediately on the orange color code.

Tests and installation/removal may only be performed by personnel with qualified training in BMW service.

Working on the "airbag restraint system" always requires the battery to be disconnected, the negative pole to be covered and the airbag plug (steering column) to be disconnected. If work on airbag system has to be interrupted, the airbag gas generator must not be left laying around without supervision.

Components of the airbag restraint system may not be repaired, but must always be replaced.

Conformance with the following points is essential.

- Never treat the airbag unit with cleaning solutions or grease.
- Never subject an airbag unit to temperatures above 100° C (212° F).
- Airbag units, front sensors and electronic diagnosis units, which have fallen down from a height of 0.5 meter (1 and 1/2 feet) or more, cannot be installed in cars again.
- The airbag restraint system can only be checked electrically in the car, see "Trouble-shooting", and only with testers shown in pertinent section.
- Airbag units may only be stored with the upholstered side facing up, since if the generator of an airbag facing down would be ignited, the generator would be catapulted up and cause injury.
- The ignition pill of airbag gas generators must never be aimed at persons regardless of circumstances.

Procedures for Repairs and After Accidents:

Always disconnect the battery, cover the negative pole or terminal and disconnect both plugs of front sensors in engine compartment and the airbag plug (steering column), to be sure that power supply to the airbag gas generator is interrupted, prior to performance of body straightening work or welding work with an electric welder. Also refer to other instructions in this repair manual.

After Accidents:

If the airbag had been activated, always replace all components with exception of wiring when not damaged.

4. Scrapping "Airbag" Vehicles:

In accordance with accident prevention regulations "airbag" gas generators must be rendered unusable prior to scrapping. This is necessary since the gas generator is a pyrotechnical object and could cause injury if activated incorrectly (for example with a torch during scrapping). Airbag gas generators must be ignited in the vehicles meant for scrapping from the outside and with doors of vehicles closed. The igniter, Special Tool 62 1 270, developed by BMW must be used for this purpose.

Non-ignited generators are a source of danger (also for the environment)!

1. Remove lower section of steering column casing and disconnect airbag plug (orange).
2. Connect airbag plug and igniter together.
3. Connect igniter on a 12 V battery placed 10 meters (32 feet) away from car.
4. Keep as far away from car as the length of the igniter's lead – always stand in front of car (this also concerns other persons).
5. Operate switch of igniter.

Caution!
The burning off of the solid fuel will heat the airbag unit – danger of burning hands!
Wash hands after touching ignited generators!

TROUBLESHOOTING A – Indicator Lamp On Continuously – (Cipro Diagnosis Unit)

The "airbag system" employs a fault detector and memory, even for briefly occurring faults. If the "airbag indicator lamp" does not go out after starting, there could be one or more faults. A flashing code from the indicator lamp will help only personnel with qualified training in BMW service to pinpoint and eliminate the faults.

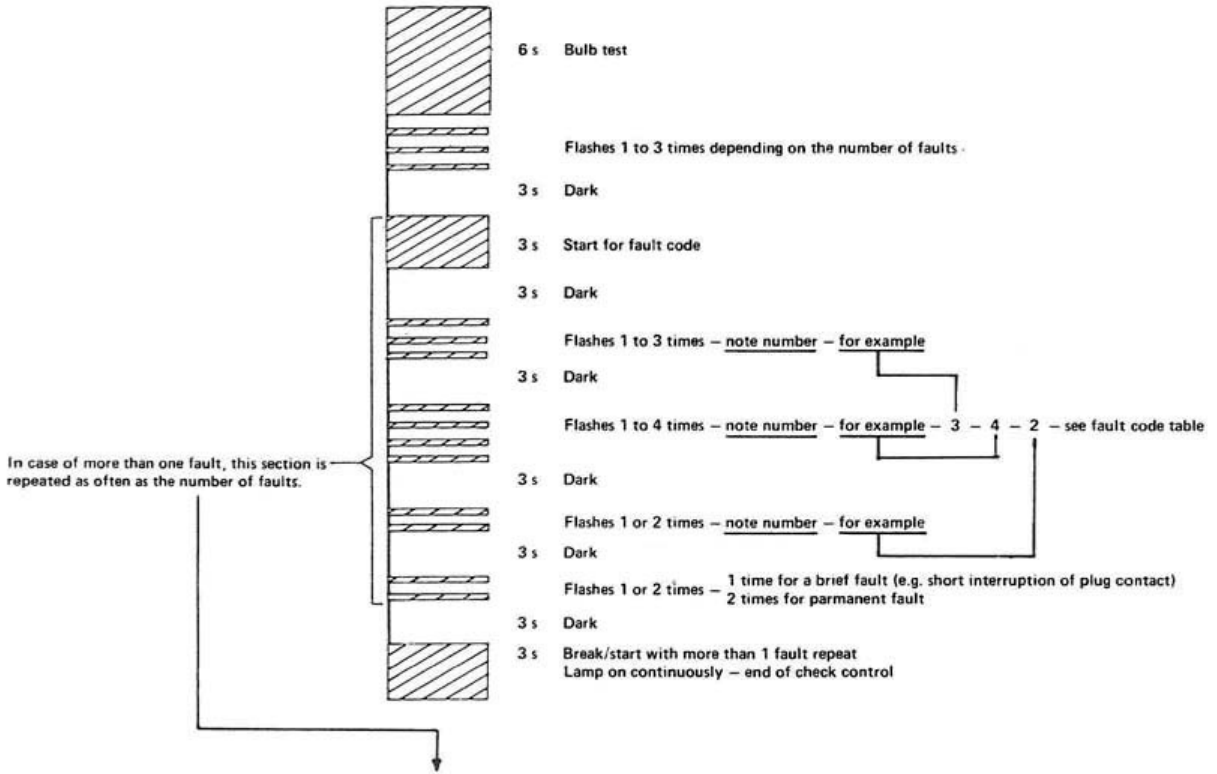
The flashing code can be called by performing the following procedures and as often as desired.

A) Turn off the ignition.

B) Connect airbag diagnosis plug 62 1 250 in the engine diagnosis socket (pins 1 and 6 are bridged), use adapter 62 1 140 if necessary.

C) Turn the ignition lock to position 1.

Flashing code will now run off and the number of flashes must be counted.



DEFECT CODE TABLE

1	1	1	=	B
1	1	2	=	A
1	4	1	=	H
1	4	2	=	G
2	1	1	=	K
2	1	2	=	J
2	2	1	=	M
2	2	2	=	L
2	3	1	=	O
2	3	2	=	N
2	4	1	=	Q
2	4	2	=	P
3	1	1	=	S
3	1	2	=	R
3	2	1	=	U
3	2	2	=	T
3	3	1	=	W
3	3	2	=	V
3	4	1	=	Y

Example: 3 – 4 – 2 = X – see defect code X in testing instructions

TESTING INSTRUCTIONS A

After finishing the flashing code call, always disconnect the battery for troubleshooting and cover the negative pole or terminal. Make tests with a BMW Service Tester or Digital Tester II at room temperature. Using different testers could activate the airbag. Pull off the airbag diagnosis plug.

After finishing repairs the last step would be connecting the battery again and checking the function of the system.

If there was a brief defect, cancel the memory of the diagnosis unit by disconnecting and connecting the battery. Check pertinent parts for tight fit and damage with the ignition on. Replace pertinent parts, if a fault is displayed.

Fault Code A or B =

Higher or lower resistance in gray-white/gray wire to airbag unit.

Disconnect plug for diagnosis unit. Connect airbag test plug 62 1 260 and check wire with an ohmmeter. 3.0 to 5.0 ohms? — yes

- Fault Code A: Measure resistance of wire against car ground. Resistance 200 to 600 ohms? — yes — See Fault Code H.
  - no: Replace diagnosis unit.
- Fault Code B: Replace diagnosis unit.

no

Disconnect plug (behind cap on steering column). Connect airbag test plug 62 1 260 and check wire with an ohmmeter. 3.0 to 5.0 ohms? — yes — Replace wire.

no

Take airbag unit out of steering wheel and pull off plug. Connect wires of airbag test plug 62 1 260 and measure resistance on disconnected plug with two test points. 1.4 to 1.8 ohms? — yes — Replace airbag unit.

no

Replace contact ring.

Defect Code H = G =

Insulation of power supply wire to SRS unit against ground or against positive insufficient.

↓

Visual inspection of wires and plugs for cracks, dirt and moisture, replacing if necessary.

Defect Code K = J =

Insulation of power supply wire to left sensor against ground or against positive insufficient. — / → or break in wire (only J or L)

↓

Visual inspection of wires and plugs for cracks, dirt (salt film) and moisture, replacing if necessary.

↓

Disconnect 4-pin plug on diagnosis unit and measure wire resistance.

9.5 to 10.5 k-ohms? — yes → Replace diagnosis unit.

↓ no

Defect Code M = L =

Right sensor – see K + J above.

Defect Code O =

Insufficient ground connection between sensors or diagnosis unit and body.

↓

Visual inspection of mounting parts and plugs for corrosion, replacing if necessary.

↓

Disconnect plug on front sensor and measure resistance of front sensor.

9.5 to 10.5 k-ohms? — yes → Replace wire.

↓ no

Defect Code N + H + K =

Left front sensor closed.

↓

Replace left front sensor.

Defect Code N + H + M =

Right front sensor closed.

↓

Replace right front sensor.

Defect Code N + V + K =

See K.

Defect Code N + V + M =

See M.

Defect Code Q, P, S, R, U, T, W, Y, X =

Defect in diagnosis unit.

↓

Replace diagnosis unit.

↓

Replace front sensor.

32-55.1

TROUBLESHOOTING B – Control Lamp Flashes (Siemens Diagnosis Unit)

The "airbag system" employs a fault detector and memory, even for briefly occurring faults. If the "airbag control lamp" flashes after starting (about 5 minutes) and remains on afterwards, there could be one or more faults. The flashing code via the control lamp or BMW DIAGNOSING SYSTEM will help only personnel with qualified training in BMW service to pinpoint and eliminate the faults.

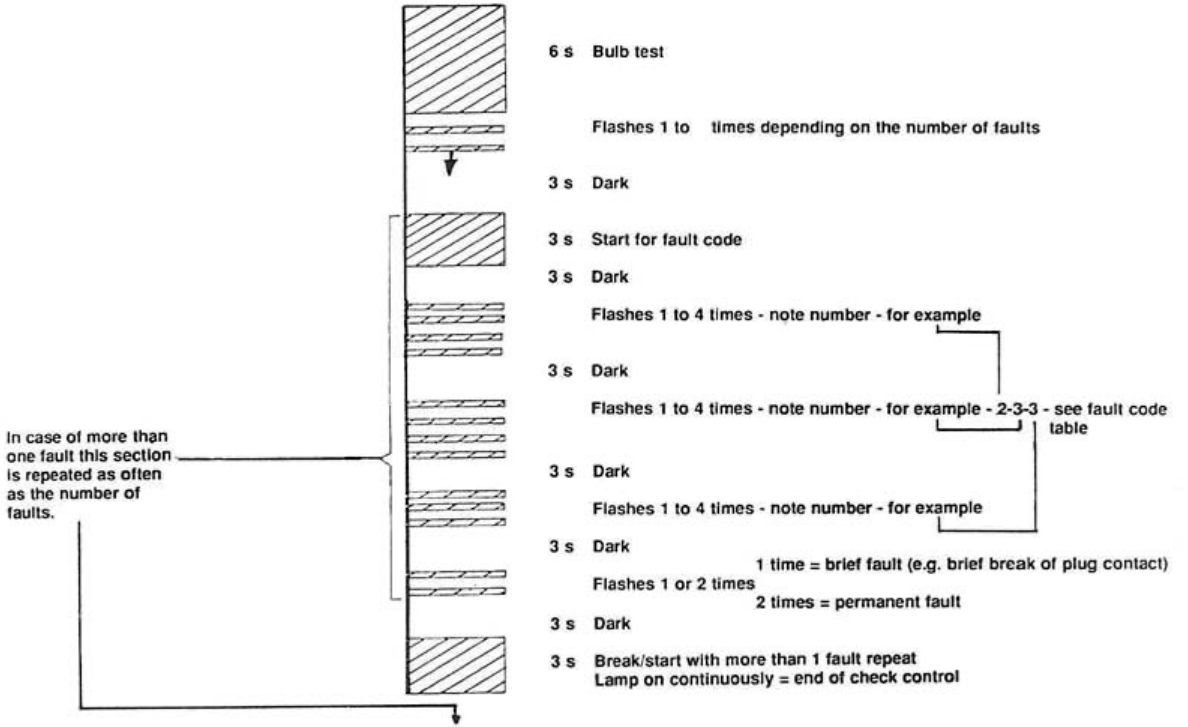
The flashing code can be called by performing the following procedures and as often as desired.

A) Turn off ignition.

B) Connect airbag diagnosis plug 62 1 290 to operating instructions.

C) Turn ignition lock key to position 1.

Flashing code will now run off and the number of flashes must be counted.



FAULT CODE TABLE

1 - 1 - 1 = 07
1 - 1 - 3 = 03
1 - 1 - 4 = 18
1 - 2 - 1 = 08
1 - 2 - 4 = 05
1 - 3 - 1 = 13
1 - 3 - 2 = 01
1 - 3 - 4 = 20
1 - 4 - 3 = 04
2 - 1 - 1 = 08
2 - 1 - 4 = 02
2 - 2 - 1 = 11
2 - 2 - 4 = 06
2 - 3 - 1 = 15

Example: 2 - 3 - 3 = 04 see fault code 04 in test plan

2 - 3 - 4 = 20
2 - 4 - 1 = 02
2 - 4 - 2 = 03
3 - 1 - 1 = 10
3 - 1 - 4 = 19
3 - 2 - 1 = 13
3 - 2 - 2 = 01
3 - 2 - 3 = 04
3 - 2 - 4 = 19
3 - 3 - 1 = 13
3 - 3 - 2 = 03
3 - 3 - 4 = 20
4 - 1 - 1 = 11
4 - 1 - 3 = 03
4 - 1 - 4 = 19
4 - 2 - 1 = 15
4 - 3 - 1 = 15
4 - 3 - 4 = 20
4 - 4 - 3 = 17

TESTING INSTRUCTIONS B

After finishing the flashing code call, always disconnect the battery for troubleshooting and cover the negative pole or terminal. Make tests with a BMW Service Tester or Digital Tester II at room temperature. Using different testers could activate the airbag.

After finishing repairs the last step would be connecting the battery again and cancelling the faults with the airbag diagnosis plug in accordance with operating instructions.

If there is a brief fault, cancel the memory of the diagnosis unit. Check pertinent parts for tight fit and damage with the ignition on. Replace pertinent parts, if a fault is displayed.

Fault Code 01= Ignition capacitor faulty

Replace capacitor.
Clean contact suafces.

Fault Code 02 = Diagnosis unit malfunctions

Tighten diagnosis unit mounting screws (ground connection).
Cancel fault.
Replace diagnosis unit, if fault code 02 is displayed again.

Fault Code 03 = Insufficient insulation of driver's airbag power supply wire

Visually inspect driver's airbag power supply wire and plug connection for cracks, moisture and dirt.
Replace power supply wire when necessary.

Fault Code 04 = **Driver's airbag power supply wire faulty**

Disconnect 2-pin plug X 4 on diagnosis unit. Connect test leads. Measure resistance.
3.0 to 5.0 ohms?

— yes — **Replace diagnosis unit.**

no

Disconnect 2-pin plug X 5 on steering column. Connect test leads and measure resistance.
3.0 to 5.0 ohms?

— yes — **Replace wire between plugs X 4 and X 5.**

no

Connect ends of test lead. Take off impact plate. Pull off plug. Measure resistance on disconnected plug with test points.
1.4 to 1.8 ohms?

— yes — **Replace impact plate.**

no

Replace contact ring.

Fault Code 05 / 07 / 08 =	Left crash sensor faulty	=	Replace left crash sensor
Fault Code 06 / 10 / 11 =	Right crash sensor faulty	=	Replace right crash sensor

Fault Code 13 = Insufficient resistance in left crash sensor power supply wire

↓

Visually inspect power supply wire and plug connections for cracks, moisture and dirt (film of salt), replacing wire if necessary.

↑

Fault Code 15 = Insufficient insulation in right crash sensor power supply lead

Fault Code 17 = Warning lamp shorted

|

Disconnect 6-pin plug X 6 on diagnosis unit. Is there power flow between vehicle ground and pin 6 (measure toward lamp)? — yes — Check power supply wire for warning lamp. Replace power supply wire or lamp as applicable.

|

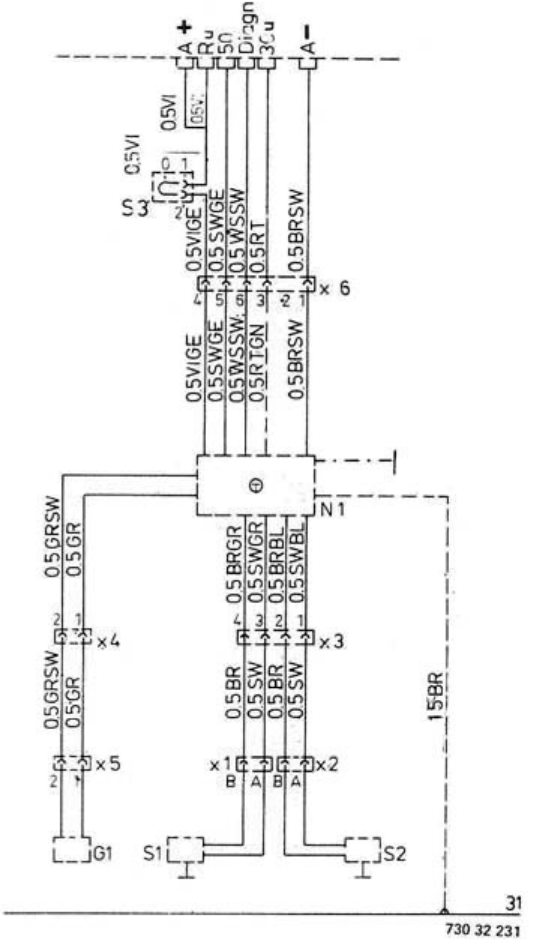
no

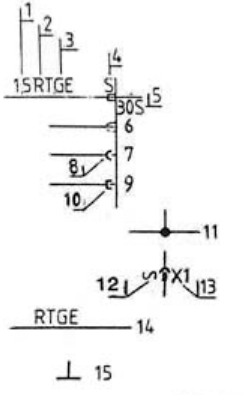
|

Replace diagnosis unit.

Fault Code 18 =	Warning lamp faulty	=	Replace warning lamp.
Fault Code 19/20 =	Diagnosis unit faulty	=	Replace diagnosis unit.

WIRING DIAGRAM





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Explanation of Wiring Diagram Codes:

1 = Wire cross section size in mm²
2 = Basic wire color
3 = Spiral wire color
4 = Socket number
5 = Terminal designation
6 = Screwed connection (wire connector)
7 = Round male plug
8 = Round female plug
9 = Flat male plug
10 = Flat female plug
11 = Soldered point or connector
12 = Socket number
13 = Plug designation
14 = Wires without size data always 0.75 mm²
15 = Ground

Wire Color Codes:

BL blue
BR brown
GE yellow
GN green
GR gray
RT red
SW black
VI violet
WS white
TR transparent

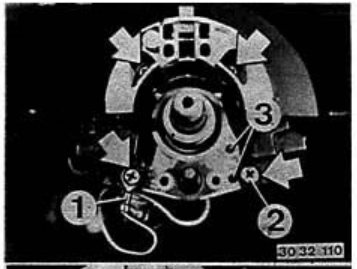
A (+, –) check control
G1 Generator driver
N1 SRS electronics
S1 Front sensor, left
S2 Front sensor, right
S3 Safety switch

X1 Plug - front sensor left
X2 Plug - front sensor right
X3 Plug - electronics
X4 Plug - generator electronics
X5 Plug - generator steering column
X6 Plug - wire harness center section

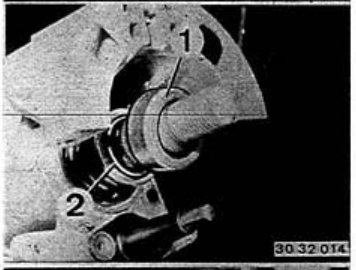
– – – Electronics - Cipro
–.–.– Electronics - Siemens

32 31 090 REMOVING AND INSTALLING COMPLETE STEERING COLUMN (AIRBAG)

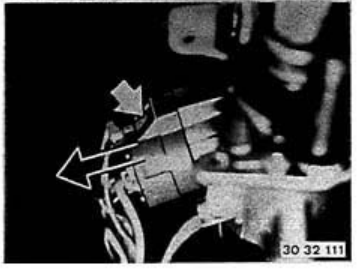
Caution!
Observe safety regulations!
Remove instrument panel trim at bottom left – 51 45 180.
Remove steering wheel – 32 33 000.



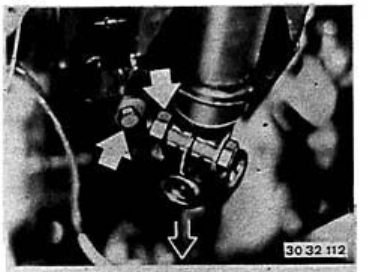
Remove flasher relay.
Pull off plug on horn contact.
Remove switch.
Installation:
Mount both ground wires (1).
With cruise control switch screw (2) = M 5 x 15.
Tabs of switch must engage in bore (3).



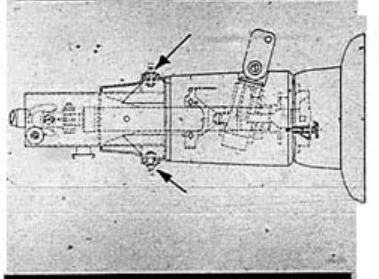
Take off collar (1).
Installation:
Recess of collar (1) locks circlip (2).



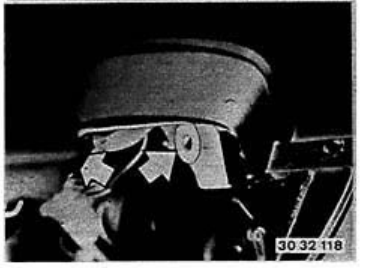
Press down locking hooks and take off ignition switch.



Unscrew bolt.
Remove clamping bolt and pull joint off of steering spindle.
Installation:
Clamping bolt must be in locking groove of steering spindle.
Replace self-locking nut.
Tightening torque*.

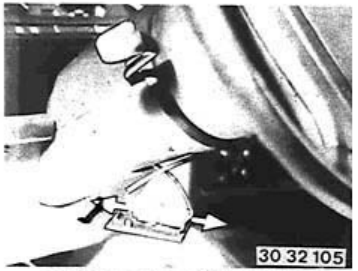


Remove both shear-off screws with a chisel or similar tool.
Take off steering column.



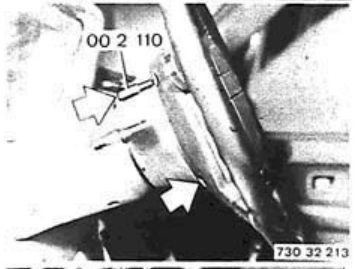
Installation:
Use spacer.
Pull up steering column completely.

* See Specifications



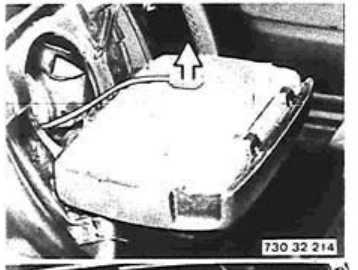
32 33 000 REMOVING AND INSTALLING STEERING WHEEL (AIRBAG)

Caution!
Conform with the safety percautions! Disconnect the battery and cover the negative pole or terminal.
Lift cap out of the lower steering wheel casing section and disconnect the plug.



Unscrew four bolts with Special Tool 00 2 110.

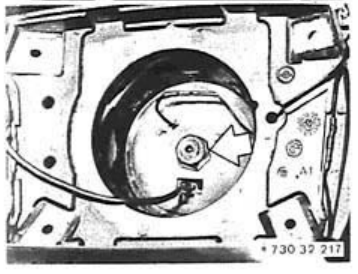
Installation:
Tightening torque*.
If the airbag unit is mounted with 2 bolts, tighten the "right" bolt first as seen looking forward.



Pull off plug and remove the airbag unit.

Caution!
The airbag unit must always be laid aside (in trunk of car) with the impact pad facing up.

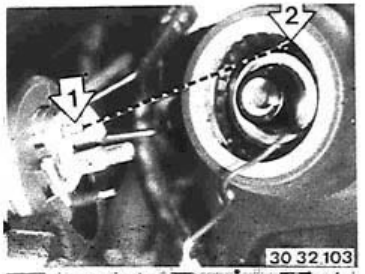
Installation:
Be careful not to clamp the leads.



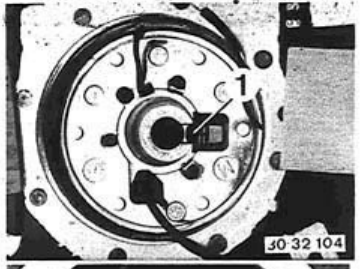
Turn the steering wheel to straight ahead position (marks on steering gear and steering spindle aligned).
Unscrew and remove nut with washer.

Important!
The steering wheel can only be pulled off after unlocking the steering lock.

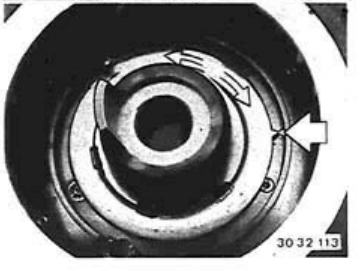
* See Specifications



Installation:
Lock pin (1) must engage in opening (2).
Replace self-locking nut.
Tightening torque*.



Note:
Loosening the nut will activate spring lock (1), which holds the contact ring in center position.

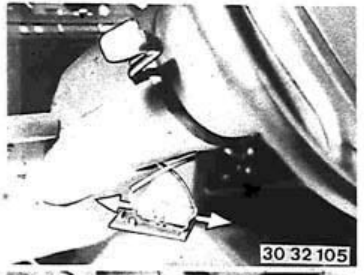


Adjusting Center Position if Necessary:
Press down spring (1), turn the contact ring against the left or right stop and then turn it back about 3 turns until the arrows for the center position are aligned.
Now release spring (1).

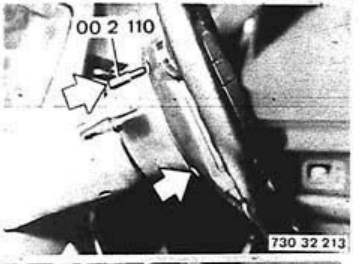
* See Specifications

32 34 020 REMOVING AND INSTALLING OR REPLACING AIRBAG UNIT

Caution!
Conform with the safety precautions! Disconnect the battery and cover the negative pole or terminal.

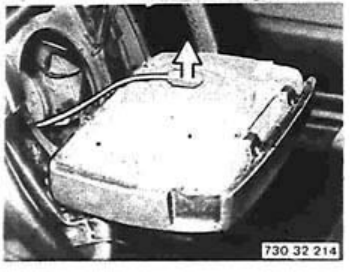


Lift cap out of the lower steering wheel casing section and disconnect the plug.



Unscrew four bolts with Special Tool 00 2 110.

Installation:
Tightening torque*.
If the airbag unit is mounted with 2 bolts, tighten the "right" bolt first as seen looking forward.



Pull off the plug and remove the airbag unit.

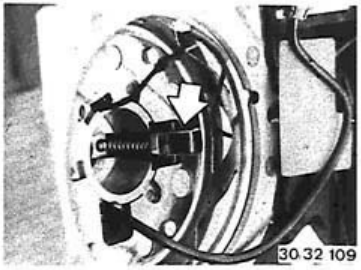
Caution!
The airbag unit must always be laid aside (in trunk of car) with the impact pad facing up.

Installation:
Be careful not to clamp the leads.

* See Specifications

32 34 510 REPLACING CONTACT RING (AIRBAG)

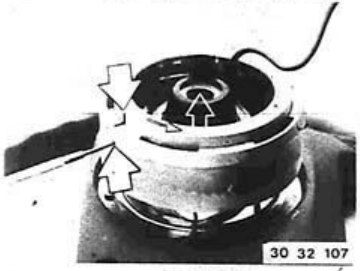
Caution!
Observe safety regulations!
Remove steering wheel 32 33 000.


30 32 109

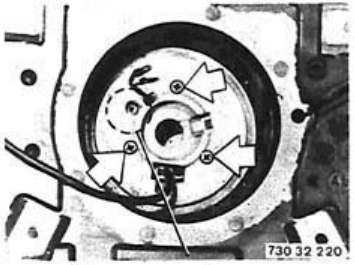
Lift out lock with a screwdriver.
Installation:
Place spring on lock and insert in bore
Press down lock until it engages.


30 32 106

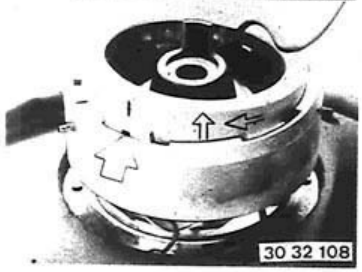
Pull off casing.
Installation:
Lubricate slip ring for horn with grease.


30 32 107

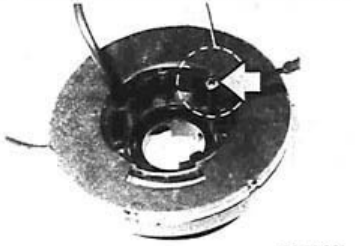
Mark position of circlip to hub.
Unscrew three studs, press down circlip, turn and remove.


730 32 220

Disconnect plug.
Unscrew bolt and take off contact ring.


30 32 108

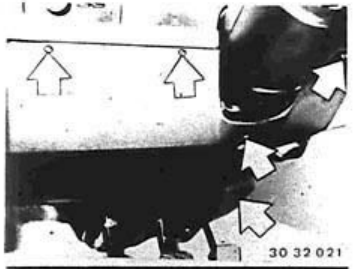
Installation:
Place circlip in hub, turn and pull up.
Studs must be located in openings of circlip.


730 32 221

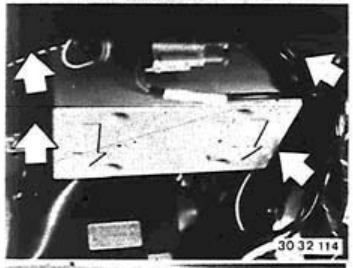
Important!
A new contact ring is locked in center position with a screw.
This screw must be removed after the contact ring has been bolted on the steering wheel.

65 77 010 REMOVING AND INSTALLING OR REPLACING AIRBAG DIAGNOSIS UNIT

Caution!
Conform with the safety precautions! Disconnect the battery and cover the negative pole or terminal.

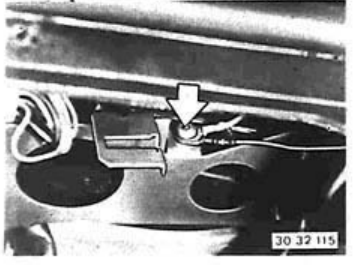


Remove dashboard trim panel.



If applicable, remove ABS control unit. Unscrew nuts and disconnect plug.

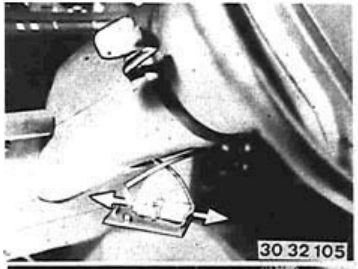
Installation:
Arrow on diagnosis unit faces forward.



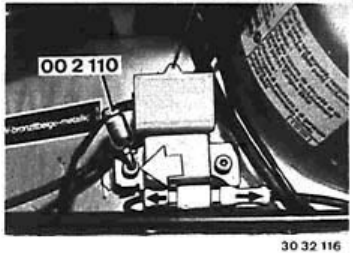
Disconnect ground lead on the central ground point.
Remove the diagnosis unit.

65 77 020 REMOVING AND INSTALLING OR REPLACING ONE AIRBAG CRASH SENSOR

Caution!
Conform with the safety precautions! Disconnect the battery and cover the negative pole or terminal.

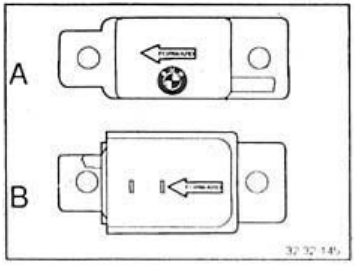


Lift the cap out of the lower steering wheel casing section and disconnect the plug.



Disconnect the plug and unscrew the bolts with Special Tool 00 2 110.

Installation:
The arrow faces forward.
Tightening torque*.

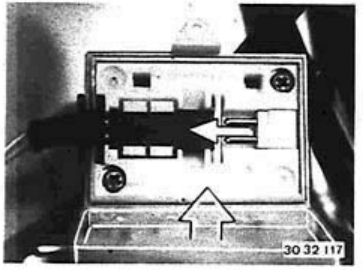


Crash sensors in shape "A" must always be replaced in pairs by sensors of shape "B".
Crash sensors in shape "B" can be replaced separately.

* **See Specifications**

65 77 040 REPLACING AIRBAG SAFETY SWITCH

Caution!
Observe safety regulations!
Disconnect battery and cover negative pole or terminal.
Open cover.
Take off plug.
Unscrew screws.
Note:
Opening the cover destroys the safety switch, which then has to be replaced.



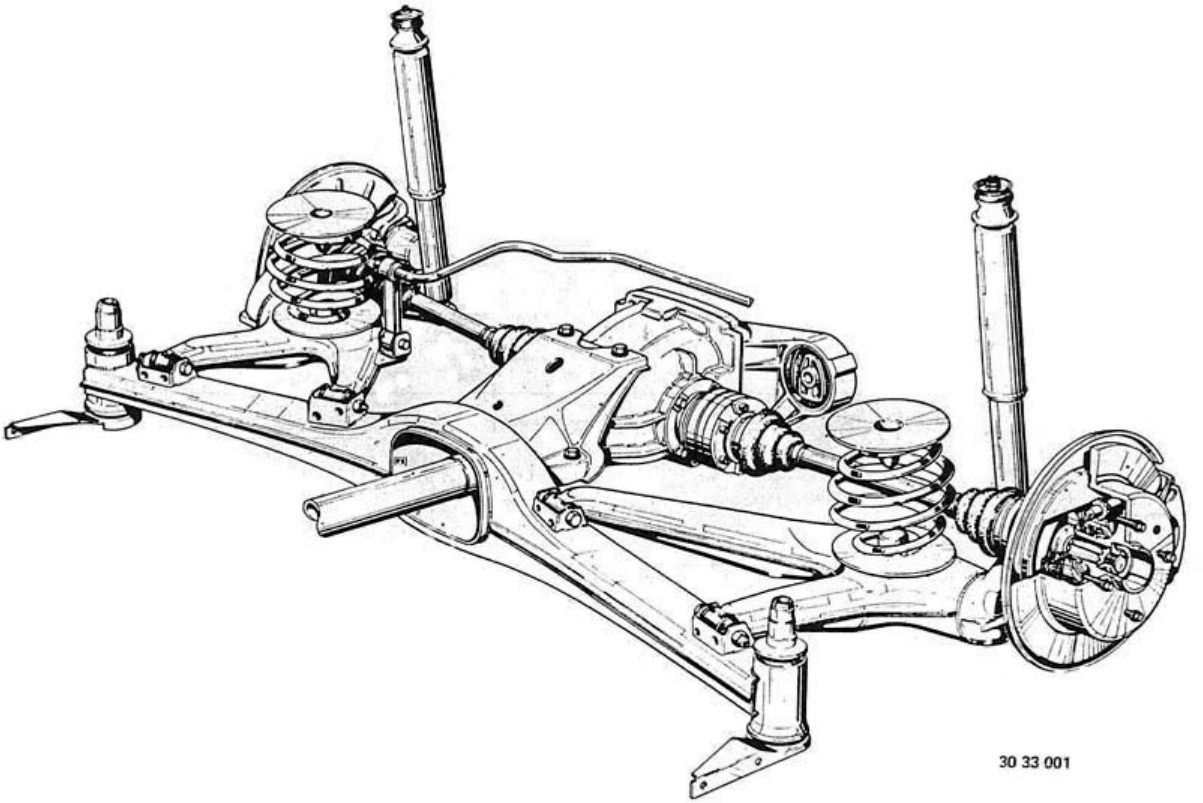
Screw on safety switch.
Insert plug.
Push contact bridge to plug.
Close cover.

33 Rear Axle

	Rear axle – layout drawing	33- 0
	Visco rear axle lock – check in car (325iX)	33- 0/1
33 10 010	Final drive – remove and install	33- 1
	Running-in procedures after replacing or repairing final drive	33- 1
33 11 151	Shaft seal for drive flange – replace	33- 2
33 17 001	Rubber mounts for final drive – replace	33- 3
33 21 000	Output shaft – remove and install	33- 4
031	Dust cover – replace	33- 5
33 31 000	Rear axle carrier assembly – remove and install	33- 6
33 32 000	Trailing arm assembly – remove and install	33- 7
021	Trailing arm – replace	33- 8
561	Silent blocks – replace	33- 8
33 33 071	Rubber mounts for rear axle carrier – replace	33- 13
33 41 151	Wheel bearings and shaft seal – replace	33- 14
33 52 000	Shock absorbers – remove and install	33- 16
33 53 000	Barrel spring – remove and install	33- 17
	Rear axle – troubleshoot	33- 18

33 – 0

REAR AXLE LAYOUT DRAWING
15° AXLE



30 33 001

(325 IX): Checking Viscous Rear Axle Lock in Car:

Condition of viscous lock can be checked on brake test stand with BMW SERVICE TESTER.

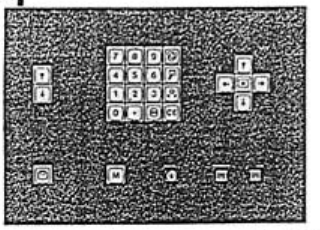
Caution!
If only one wheel turns during test on brake test stand, viscous lock is subjected to strong loads. This could lead to destruction due to excessive heat.

Total operation time = warming up time + test time = 40 seconds on brake test stand must not be exceeded.

Break of at least 30 minutes is required after each test. This time is applicable to both cold and warm-run cars.

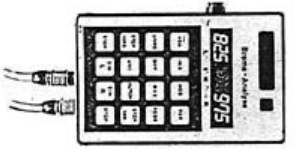
Cylinder speed of brake test stand must not exceed max. 7.5 km/h (4.5 mph).

If cylinder speed of brake test stand is not known, it can be determined with methods described in test for a 3 series car with ABS, but without for wheel drive. In so doing warm-up phase and braking force are omitted.



30 27 00

Select Test Program 03 ABS on BMW SERVICE TESTER.
Select ABS Test Step 03.



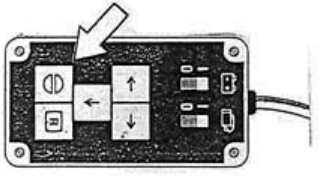
30 27 005

Switch on one brake test stand cylinder and let it run about 30 seconds (warm-up phase).



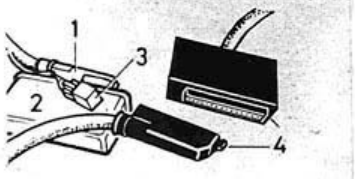
30 27 002

Check tire pressure and tire size.
Do not set brake test stand to automatic.
Drive car on test stand with its rear wheels on cylinders.
Switch off ignition.
Front wheels on floor.
Shift lever in 1st gear.



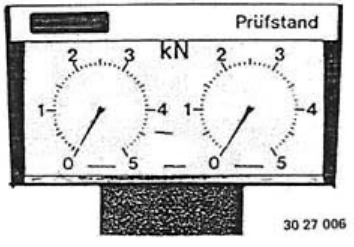
30 27 008

Press confirmation button on BMW SERVICE TESTER after warm-up time.
Value now displayed in ms is the cylinder speed for left or right rear.
See diagram.



30 27 003

Car must be connected on BMW SERVICE TESTER to determine test stand speed (wheel speed) under load.
Switch off electric equipment items and ignition.
Connect T-connector (4) between ABS control unit (2) and ABS wire harness (1).



30 27 006

Read braking force of left or right wheel on brake test stand.

Important!
Total operation time = max. 40 seconds.

33 – 0/2

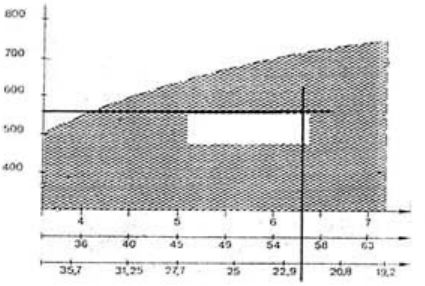
Enter period of time (ms) in diagram.
Enter braking force (on brake test stand) in diagram.

Condition of visco lock is seen at point of intersection of both lines.

Example:
Period of time for pulse wheel: 22 ms.

Braking force of left or right wheel:
550 N (121 lbs.).

Intersection point of both lines in shaded area:
visco lock faulty.



Tire size: 220/60 195/65 195/60
Final drive ratio: 3.64
No. of pulse wheel teeth: 48
Rear wheels in brake stand rollers
Front wheels on floor
Ignition off
1st gear
Only 1 rear wheel driven
Warm-up time approx. 30 sec.
Testing time max. 10 sec.
Total testing time 40 sec.
Tested immediately after warm-up time 30 minutes between two tests

Sum of test stand displays, left – right [N]

900
800
700
600
500
400

Permissible Area
Lock Okay

Impermissible Area
Lock Not Okay

Impermissible Speed Range

4 5 6 7

Roller speed [km/h]

36 40 45 49 54 58 63

Wheel speed [min⁻¹]

35,7 31,25 27,7 25 22,9 20,8 19,2

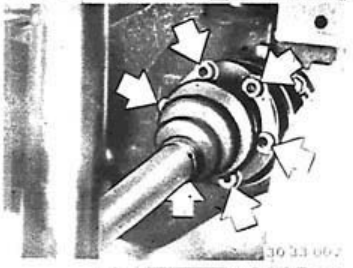
Pulse wheel cycle time [ms]

32 33 005

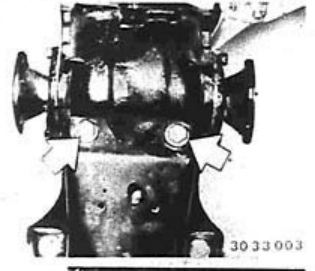


33 10 010 REMOVING AND INSTALLING FINAL DRIVE

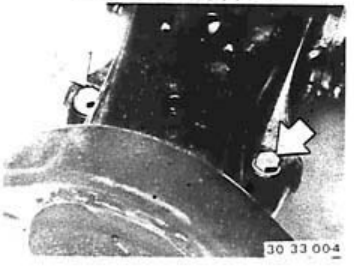
Unscrew propeller shaft bolts.
Installation:
Replace self-locking nuts.
Tightening torque*.



Unscrew output shafts and suspend from car on pieces of wire.
Installation:
Tightening torque*.

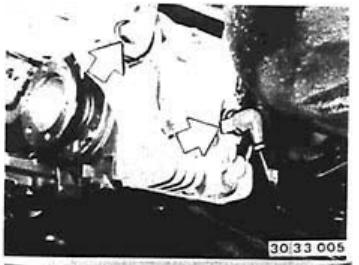


Unscrew bolts at top.
Installation:
First locate final drive on rear axle carrier with the top bolts.
Tightening torque*.

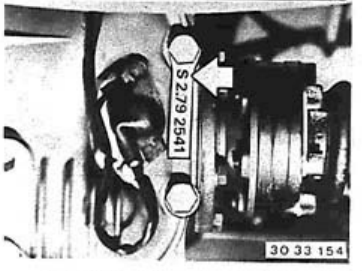


Support final drive with a garage jack.
Unscrew front bolts on left and right sides.
Installation:
Tightening torque*

* See Specifications



Pull off electric leads on speedometer pulse sender.
Unscrew rubber mount bolt and lower the final drive.
Installation:
Replace self-locking nut.
Tightening torque*.
Check oil level, correcting only with approved final drive gear lube - see Group 33 in Operating Fluids.
Amount of oil*.



Installation:
When replacing, check final drive ratio* and final drive version.
Ratio digits are stamped on data plate (1).

BREAKING-IN PROCEDURES AFTER REPLACING OR REPAIRING FINAL DRIVE

Strict conformance with these breaking-in procedures is required for preloading the tapered roller bearings.

During the first 1,000 km (600 miles) the car must be driven at different engine speeds and road speeds, but never faster than 2/3rds of the max. permissible speed in 4th gear (direct). For cars with a five speed manual transmission (with overdrive) 2/3rds of the max. permissible speed in 4th gear will be applicable to 5th gear.

If there is no conformance with these breaking-in procedures, there could be seizure between the tapered rollers and inner race guide band, which in turn will cause a continuous noise, overheating and oil leakage.

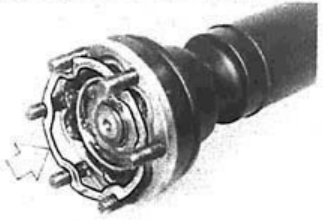
Install tag or label for next oil change in view of the driver.

* See Specifications



Version with Constant Velocity Joint:

Unscrew propeller shaft on rear axle final drive.

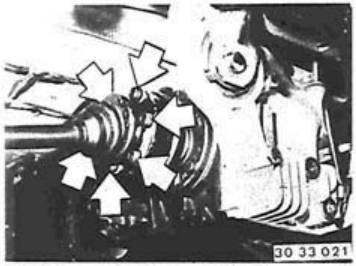


32 26 016

Installation:
Check gasket, replacing if necessary.
Replace stop nuts.
Tightening torque*.

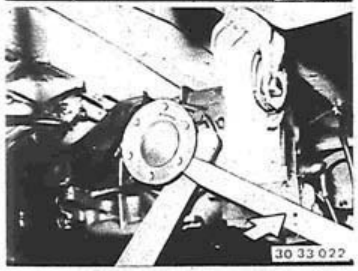
Important!
The constant velocity joint is not encapsulated. Protect the joint against dirt with a transporting cap or something similar.
Check grease filling*.

* See Specifications of Gr. 26

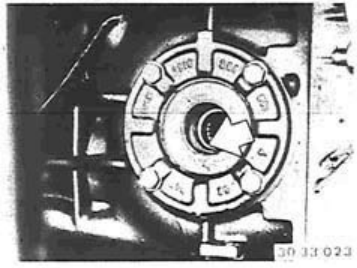


33 11 151 REPLACING SHAFT SEAL FOR DRIVE FLANGE

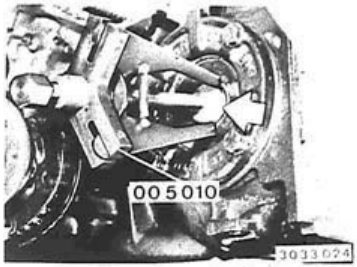
Unscrew output shaft on drive flange and suspend it on a piece of wire.
Installation:
Use washers.
Tightening torque*.



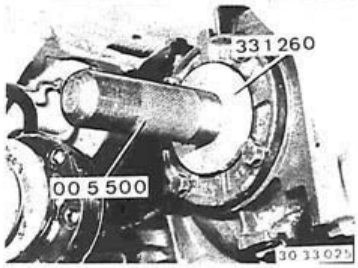
Press off drive flange with tire irons.



Installation:
Prior to installation of drive flange, place wire snap ring (1) in groove of differential case that both ends of wire snap ring are recessed in groove.
This will prevent lateral bending of ring.
Press in drive flange by hand and turn slightly until wire snap ring is heard to engage.
Replace stretched wire snap rings.

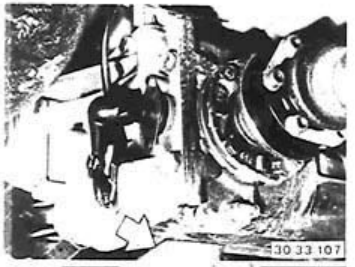


Pull out shaft seal with Special Tool 00 5 010 in conjunction with a pressure piece.



Installation:
Dip shaft seal in final drive oil.
Drive in shaft seal against stop with Special Tool 33 1 260 or 33 1 230.
Replace drive flange with a seriously scored bearing surface.

* See Specifications

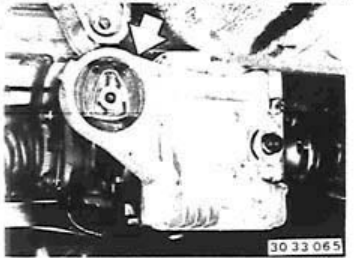


33 17 001 REPLACING RUBBER MOUNT FOR FINAL DRIVE

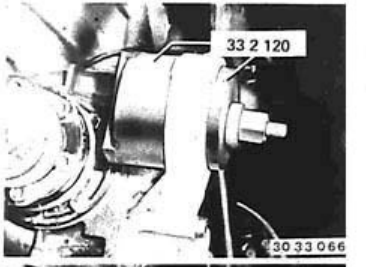
Loosen nuts on rear axle carrier.
Support final drive.
Installation:
Replace self-locking nuts.
Tightening torque*.



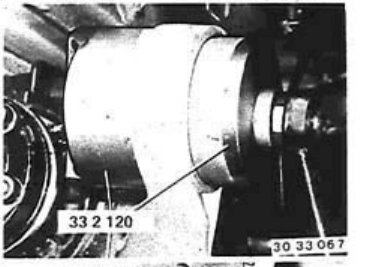
Pull off wires on speed pulse transmitter.
Remove rubber mount mounting bolt.
Installation:
Replace self-locking nut.
Tightening torque*.



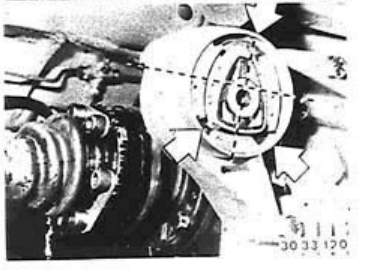
Lower final drive:



Press out rubber mount with Special Tool 33 2 120.
Note:
Rubber mount is eccentric.
Make sure special tool is applied correctly.

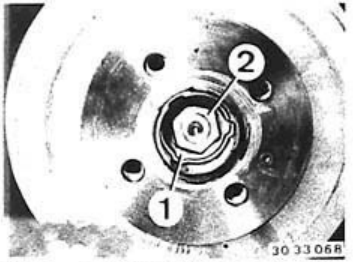


Pull in rubber mount with Special Tool 33 2 120.



Important!
Check installed position of rubber mount.

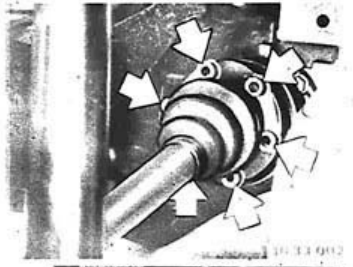
* See Specifications



33 21 000 REMOVING AND INSTALLING OUTPUT SHAFT

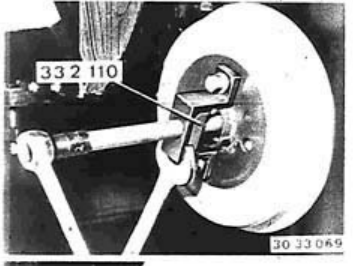
Remove wheel – see Group 36.
Lift out lockplate (1).
Unscrew nut (2).

Installation:
Lubricate bearing surface of nut with oil.
Tightening torque*.
Replace lockplate.

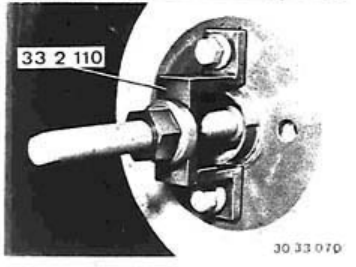


Unscrew output shaft on rear axle final drive.

Installation:
Tightening torque*.

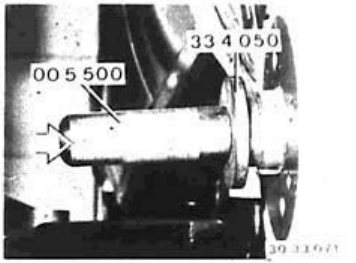


Press off output shaft with Special Tool 33 2 110.
(Spindle 33 2 111, bridge 33 2 112, is replaced by 33 2 116)
Special Tool 33 2 113 is replaced by 33 2 117 and use wheel bolts.

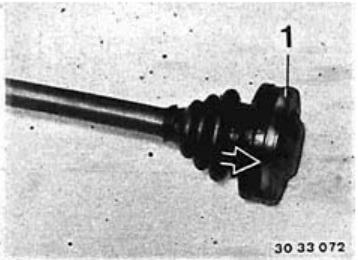


Pull in output shaft with Special Tool 33 2 110, by first screwing in spindle 33 2 114 completely.
Use bridge 33 2 116 and nut 33 2 115.

* See Specifications .

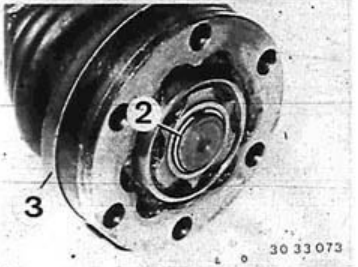


Drive in lockplate with Special Tools 33 4 050 and 00 5 000.

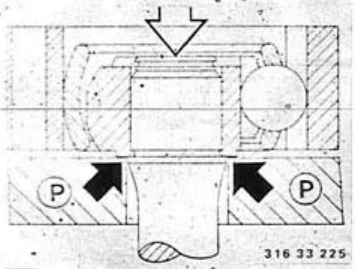


33 21 031 REPLACING DUST COVER

Remove output shaft 33 21 000.
Important!
Don't mix up the thicker output shafts and joints for the BMW 325 i.
Press off sealing cover (1).
Loosen straps.



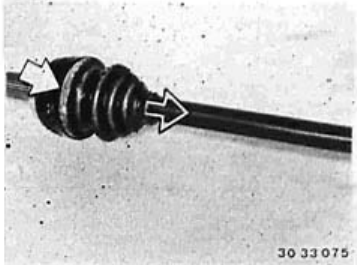
Remove circlip (2).
Press off cap (3) and dust cover.



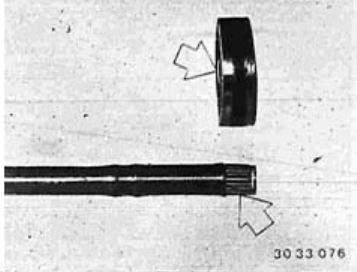
Press output shaft out of constant velocity joint.
Important!
Ball hub must rest on counterpressure plate (P).
Do not disassemble joint if not absolutely necessary.
Check joint for dirt or damage.



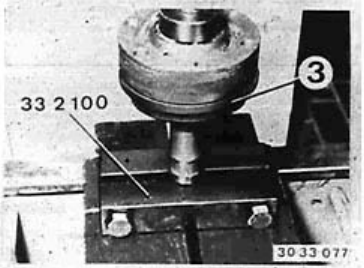
If the joint has to be disassembled (dirty), first electrically inscribe position of ball hub, ball cage and joint to each other on face.
Absolute cleanliness is important during assembly work.



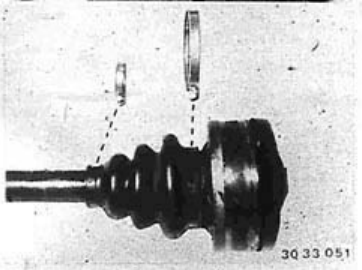
Pull wheel end dust cover off and on over the output shaft.
Slide transmission end dust cover over splined shaft.
Important!
Be careful not to damage new dust covers.
Protect it from the sharp edges on the splined shaft with a suitable sleeve.
Use repair kit.



Clean splines of joint to remove grease.
Coat splines with Loctite No. 270.
Caution!
Keep Loctite out of ball surfaces.

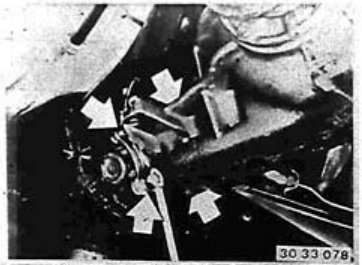


Press on joint and cap (3), while holding the output shaft with Special Tool 33 2 100.
Install circlip.



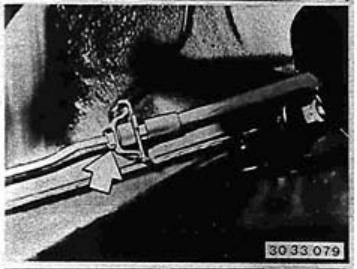
Pack joint and dust cover with grease*.
Clean sealing surfaces for dust cover to remove grease.
Coat large diameter end of dust cover with an adhesive* and mount with new clamps.
Seal and install sealing cover with Curil.

* See Specifications

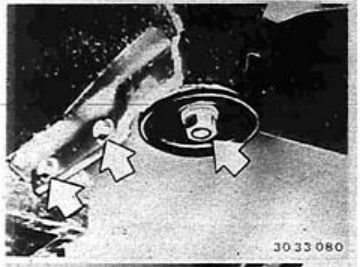


33 31 000 REMOVING AND INSTALLING REAR AXLE CARRIER ASSY.

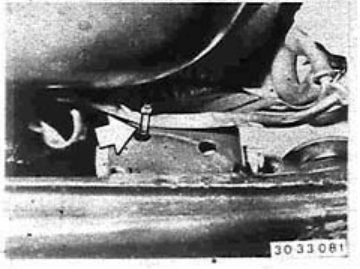
Remove primary and final muffler assembly – 18 12 000.
Remove heat shield.
Unscrew propeller shaft and center mount of propeller shaft – see 26 11 000.
Installation:
Replace self-locking nuts.
Tightening torque*.



Remove parking brake lever.
Draw off brake fluid with a syringe, reserved exclusively for use with brake fluids.
Disconnect brake lines on left and right sides.
Installation:
Tightening torque*.
Add brake fluid*.
Bleed brakes.

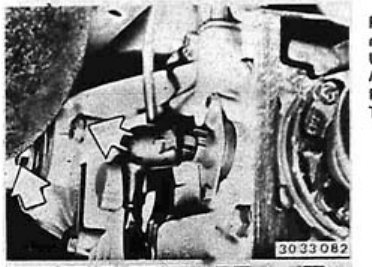


Support rear axle.
Unscrew left and right thrust struts.
Installation:
Replace self-locking nuts.
Tightening torque*.
Note:
Remove rear seat cushion (see 52 20 000) to replace the staybolts.
Remove rear side trim panel of convertible models – 51 43 000.

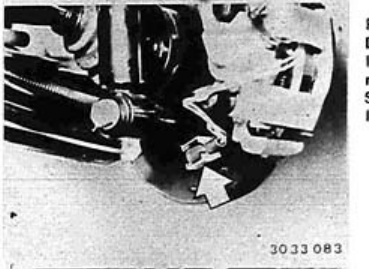


If applicable, unscrew wire clamp on rear axle carrier.

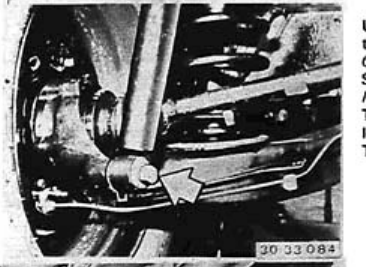
* See Specifications



Pull off wires on pulse transmitter - speedometer.
Unscrew rubber mount bolt.
Installation:
Replace self-locking nut.
Tightening torque*.



Rear Disc Brakes:
Disconnect brake pad wear indicator plug.
If applicable, unscrew stabilizer on left and right sides.
Support both trailing arms.
If applicable, let car rest on road wheels.

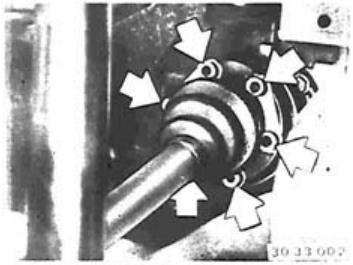


Unscrew left and right shock absorbers on trailing arms.
Caution!
Shock absorbers act as retaining straps.
Installation:
Tighten mounting bolts after car has been lowered and is resting on its wheels.
Tightening torque*.



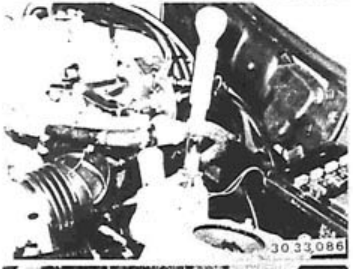
Lower rear axle carrier.
Pull parking brake cables out of protective tube.
Important!
Rear axle springs will be loose.

* See Specifications

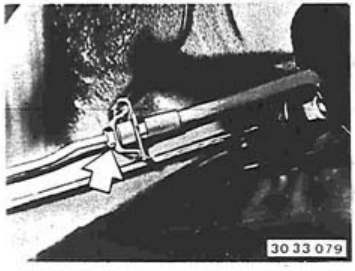


33 32 000 REMOVING AND INSTALLING TRAILING ARM ASSEMBLY

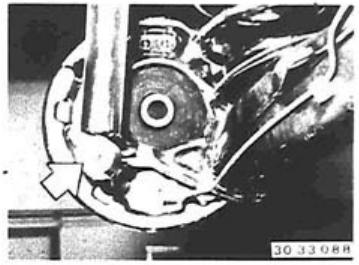
Remove rear wheel – 36 10 300.
Operate parking brake.
If necessary, remove output shaft 33 21 000.
Installation:
Tightening torque*.



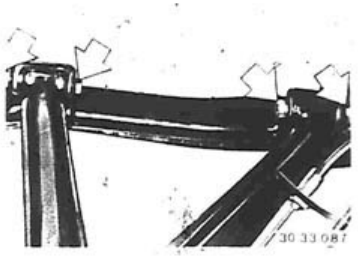
Remove parking brake lever – 34 41 000.
Draw off brake fluid in tank with a syringe reserved exclusively for brake fluids.
Remove filter screen sleeve.
Installation:
Add brake fluid* and bleed brakes.



Disconnect brake line.
Installation:
Tightening torque*.



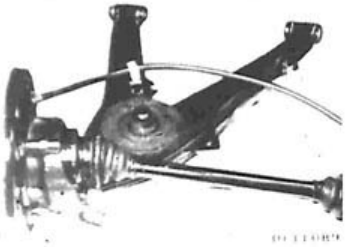
Support trailing arm.
Unscrew shock absorber and lower trailing arm.
Installation:
Tightening torque*.



Unscrew trailing arm on rear axle carrier.
Installation:
First guide in bolt for inner bracket.
Important!
Tighten bolts with car in normal position**.
Tightening torque*.

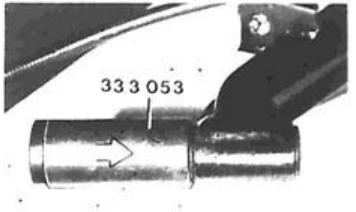
* See Specifications

* See Specifications
** See Specifications of Group 32



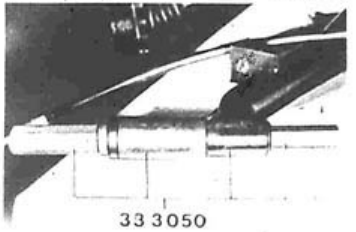
33 32 021 REPLACING TRAILING ARM

Remove trailing arm – see 33 32 000.
Replace wheel bearings and shaft seals – see 33 41 151.
Transfer guard.

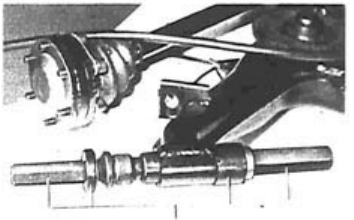


33 32 561 REPLACING BOTH SILENT BLOCKS – Trailing Arm Removed

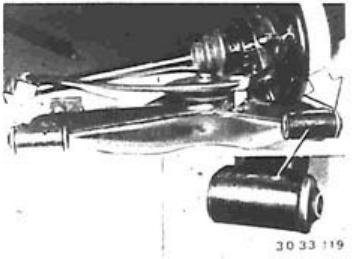
Coat collar in Special Tool 33 3 053 with water and push over bead of silent block.



Pull out silent block with Special Tool 33 3 050.

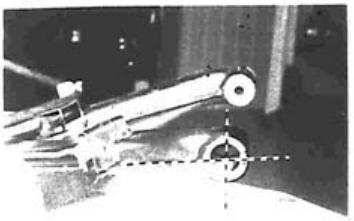


Coat new silent blocks with diluted Cresta, lubricating oil II or relaxed water.
Pull in silent blocks with Special Tool 33 3 050 using thrust disc (1) and sleeve (2) with 2 tabs.



Installation:
Collar end of each silent block faces out.

Eccentric silent blocks could be installed to correct the rear axle toe deviation caused by summation of unfavorable tolerances.
Important!
Changes in alignment geometry caused by damage in an accident may never be "eliminated" with this measure.



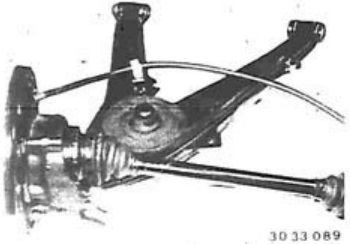
Mark horizontal position of trailing arm to trailing arm eye.

Check rear wheel alignment with optical tester 32 00 054.
Determine correction value.
Example:

Actual value, left, rear	+ 2.5 mm (0.098")
Nominal value, left, rear	+ 2.0 mm (0.079")
Correction value	– 0.5 mm (0.019")

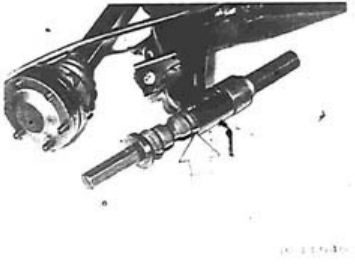


Use pertinent angle displacement from following diagram.
Connect numbers for toe correction on both sides of silent block with lines.

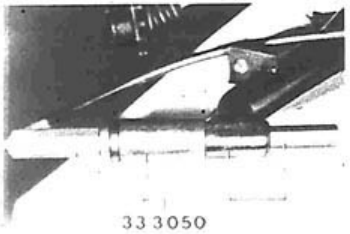


30 33 089

Remove rear wheel 36 10 300.
Remove and install semi-trailing arm 33 32 000.



Coat silent block with diluted Cresta, lubricating oil II or relaxed water.
Apply silent block on trailing arm that drawn line aligns with mark on trailing arm and pull in with Special Tool 33 3 050.
Mount trailing arm and check rear wheel toe.



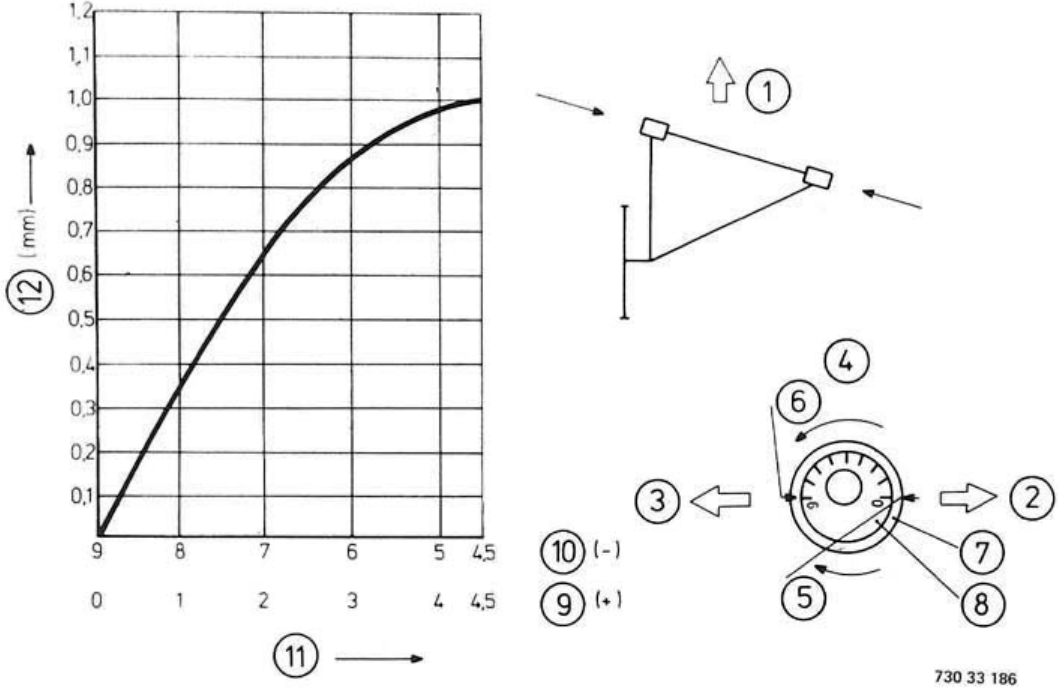
33 3050

Pull out silent block with Special Tool 33 3 050.

If the adjustment on the outer silent block is not sufficient, an eccentric silent block could also be installed on inside.

CHANGING TOE ON "LEFT" WHEEL

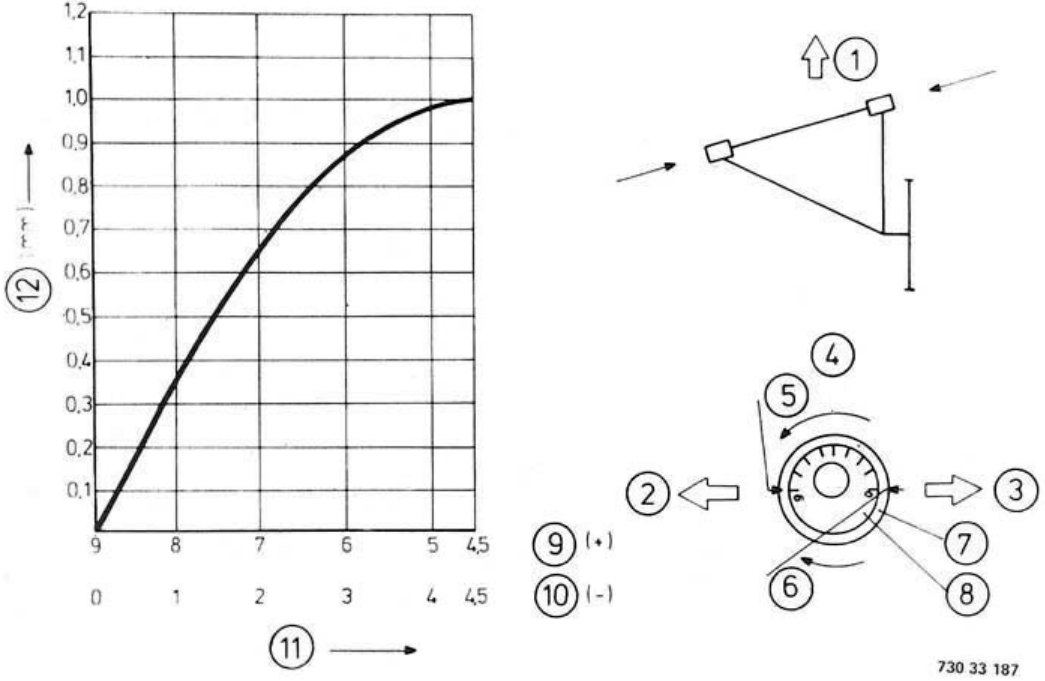
1 = Forward direction
2 = Forward direction, inner silent block
3 = Forward direction, outer silent block
4 = Pressing in note
5 = Reading point – toe increase
6 = Reading point – toe decrease
7 = Trailing arm eye
8 = Silent block
9 = Toe increase
10 = Toe decrease
11 = Displacement angle
12 = Toe change



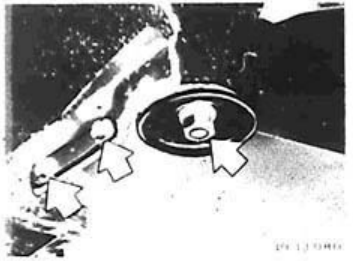
730 33 186

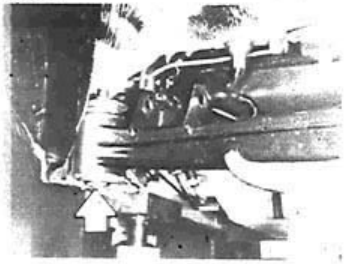
CHANGING TOE ON "RIGHT" WHEEL

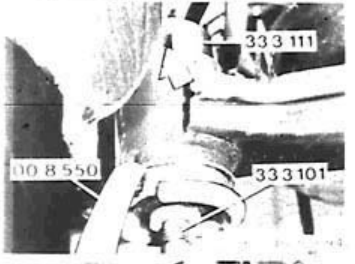
1 = Forward direction
2 = Forward direction, inner silent block
3 = Forward direction, outer silent block
4 = Pressing in note
5 = Reading point – toe increase
6 = Reading point – toe decrease
7 = Trailing arm eye
8 = Silent block
9 = Toe increase
10 = Toe decrease
11 = Displacement angle
12 = Toe change

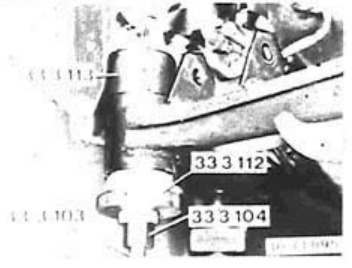


730 33 187









33 33 071 REPLACING RUBBER MOUNTS FOR REAR AXLE CARRIER

Remove rear seat cushion – 52 20 000.
Convertibles:
Remove side trim panel – 51 43 000.
Support trailing arm.
Unscrew strut.

Installation:
Use washers.
Replace self-locking nuts.
Tihtening torque*.

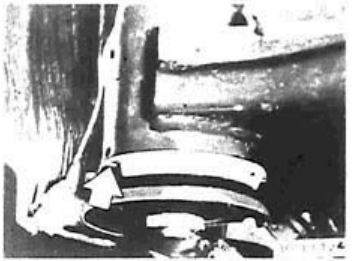
Knock out studs upwards.

Important!
Don't damage the threads.
If applicable, cut off protruding rubber at the openings.

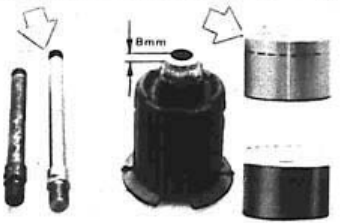
Place Special Tool 33 3 111 on the rubber mount between the body and rear axle carrier, and screw in Special Tool 33 3 101. Heat the rear axle carrier on the rubber mount take-up to make removal easier.
Important!
Flat sides of Special Tool 33 3 111 must face in direction of the openings. Apply Special Tool 00 8 550 with its claws in the openings, bolt down with Special Tool 33 3 101 and pull out the rubber mount.

Place Special Tool on edge of bushing between the body and rear axle carrier, and screw in Special Tool 33 3 103. Coat the rubber mount with Circolight** and apply on the rear axle carrier, pulling it in with Special Tool 33 3 104.

* See Specifications
** Source of Supply: HWB

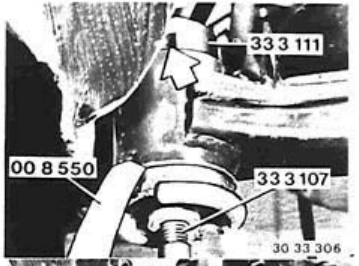


Installation:
Check installed position of rubber mount opening in the rear axle carrier.



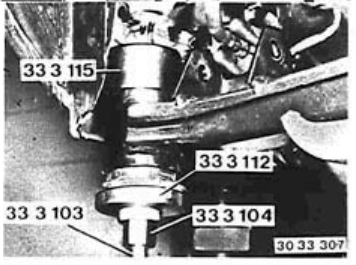
30 33 308

325 iX:
Rubber mount is 8 mm (0.315") higher.



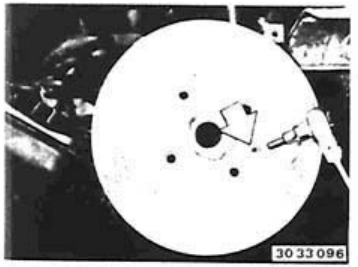
30 33 306

Longer Special Tool 33 3 107 is required for pulling out in conjunction with Special Tools 33 3 111 and 00 8 550.



30 33 307

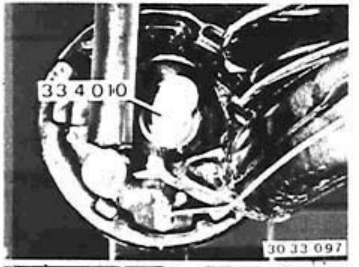
New Special Tool 33 3 115 is required for pulling in the rubber mount in conjunction with Special Tools 33 3 103, 33 3 112 and 33 3 104.



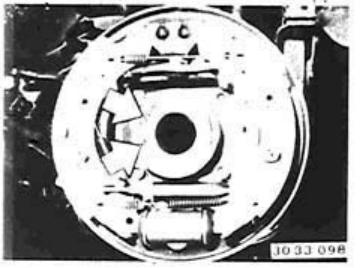
33 41 151 REPLACING WHEEL BEARINGS AND SHAFT SEAL

Remove output shaft assembly – 33 21 000.
Remove brake drum,

323 i, 325 e/i and ABS:
Remove brake disc.
Unscrew exhaust assembly.



Drive out rear axle shaft with Special Tool 33 4 010.



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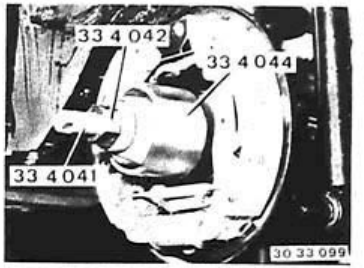
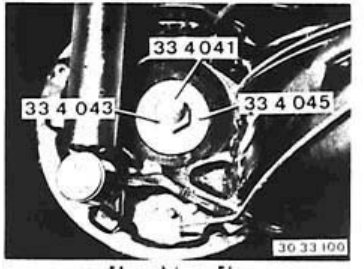
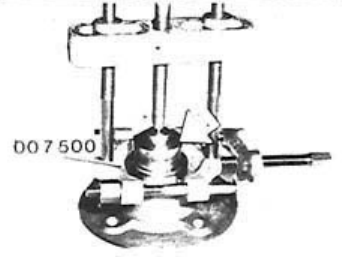


Pull out wheel bearing with Special Tool 33 4 040.
323 i, 325 e/i and Cars with ABS from 1986 Models on:
Use Special Tool 33 4 031.



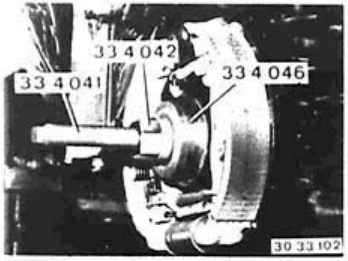
Use Special Tool 33 4 045.



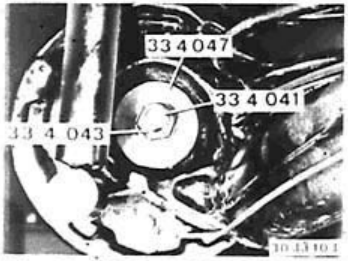
If applicable, pull inner bearing shell off of rear axle shaft with Special Tool 00 7 500 and a thrust piece.



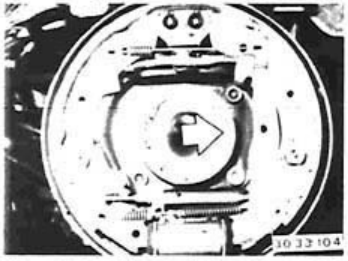
323 i, 325 e/i and Cars with ABS from 1986 Models on:
Use Special Tools 33 4 090 and 33 1 307.



Pull in wheel bearing assembly with Special Tool 33 4 040.
Use Special Tool 33 4 049 for 323 i, 325 e/i and cars with ABS since 1986 models.



Use Special Tool 33 4 047.



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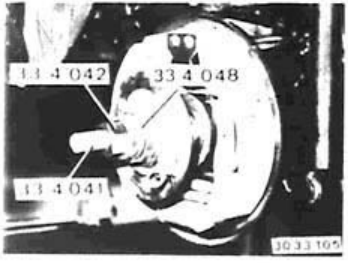
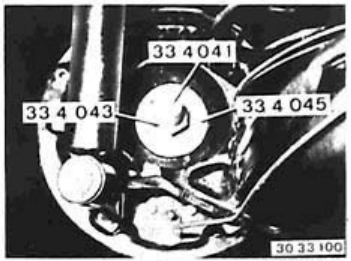
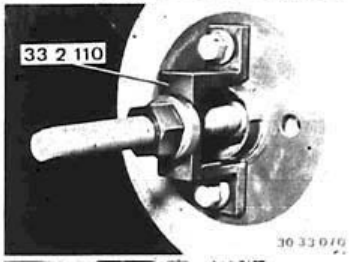


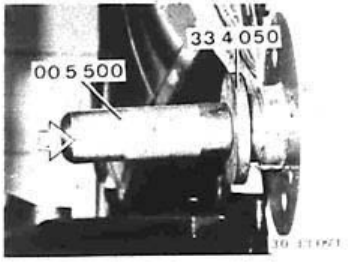
Pull in stub axle with Special Tools 33 4 040 and 33 4 048.



Use Special Tool 33 4 045.

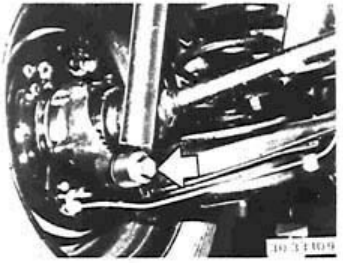


Install and pull in output shaft with Special Tool 33 2 110.
Tightening torque*.



Drive in lockplate with Special Tools 33 4 050 and 00 5 000.

See Specifications

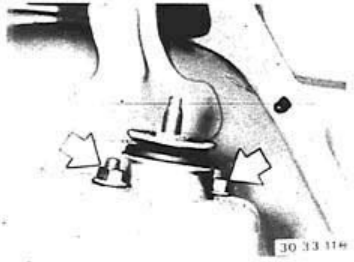


33 52 000 REMOVING AND INSTALLING REAR SHOCK ABSORBERS

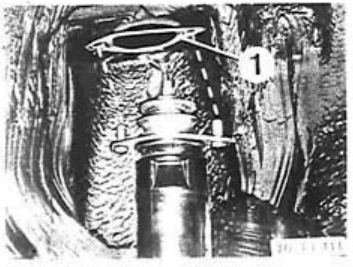
See Group 37 for cars with ride level control.
Support semi-trailing arm (or have road wheel rest on floor).
Unscrew shock absorber on semi-trailing arm.

Caution!
Shock absorber acts as a retaining strap. Do not remove the support or lift the car, to avoid damage on constant velocity joints.

Installation:
Tighten shock absorbers with car loaded down to normal position**.
Tightening torque*.



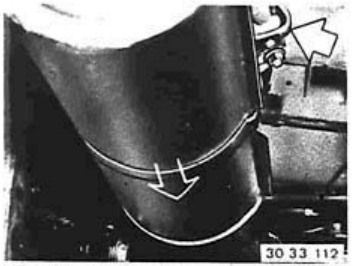
Remove trun trim panel partially - see Group 51.
Additional for Touring Models:
Remove side backrest - see Gr. 52.
Remove seat belt reels - see Gr. 72.
Unscrew centering shell on wheel house.
Installation:
Replace self-locking nut.
Tightening torque*.



Remove shock absorber.
Important!
Replace gasket (1).

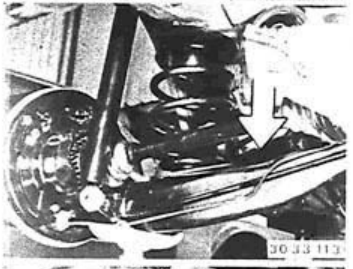
* See Specifications
** See Specifications of Gr. 32

Important!
Always store shock absorbers standing upright. If shock absorbers are stored laying down with their piston rods run in, they will cause knocking noise when used in car.
Remedy:
Store shock absorbers with run out piston rods standing upright at room temperature for at least 24 hours.

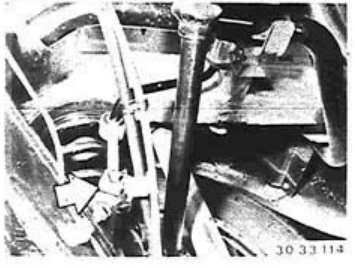


33 53 000 REMOVING AND INSTALLING OR REPLACING LEFT OR RIGHT BARREL SPRING

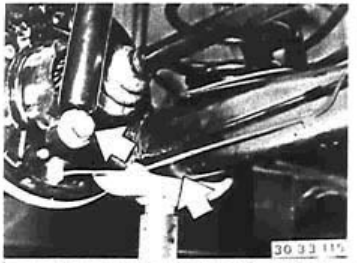
Disconnect exhaust assembly and suspend from car with a piece of wire.



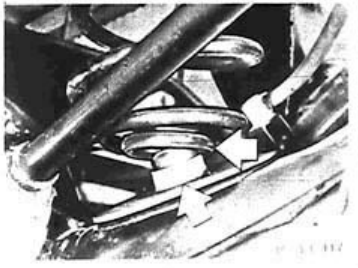
Unscrew final drive rubber mounts and push down, holding down with a wedge of wood or similar item.



Disconnect stabilizer, if applicable.



Support trailing arm.
Caution!
Don't damage the brake line.
Unscrew shock absorber on trailing arm.



Important!
Only lower trailing arm enough that spring can be removed.
Lowering too far could cause damage on output shaft joints.
Installation:
Check position of spring strut.
Important!
Check springs for surface damage.
Replace damaged springs.

Only install springs with same BMW number*, same color code* and correct rubber ring*.

* See Specifications

TROUBLESHOOTING REAR AXLE

Condition	Cause	Correction
Load change knock	Backlash excessive Output shaft faulty Play in propeller shaft slide	Adjust backlash – see 33 12 551 Replace output shaft – see 33 21 000 Install slide with Loctite No. 75
Traction or compression noise	Backlash excessive or insufficient	Adjust backlash – see 33 12 551
Drumming	Propeller shaft Rubber mounts on rear axle carrier faulty	See "Troubleshooting Propeller Shaft" Replace rubber mounts – see 33 33 071
Oil loss	Radial oil seals leak Vent clogged Wrong oil grade*	Replace radial oil seals Clean vent, see Service Information of Gr. 33 Replace final drive oil
Vibration	Imbalance of wheels Ouput shaft faulty Propeller shaft	Balance wheels or replace rims Replace output shaft – 33 21 000 See "Troubleshooting Propeller Shaft"
Rattling noise	Shock absorbers installed loose Upper shock absorber rubber ring faulty Lower shock absorber rubber ring faulty Rubber mounts on rear axle carrier faulty Shock absorbers faulty or worn	Tighten shock absorbers Replace rubber ring Replace shock absorber – see 33 52 100 Replace rubber mounts – see 33 33 071 Check shock absorbers, see Service Information of Group 37, or replace shock absorbers – see 33 52 000.
Grinding noise only when driving in curves	Wheel bearings faulty	Replace wheel bearings – see 33 41 141

* See Operating Fluids

34 Brakes

34 00 009	Brakes – test on dynamometer	34- 1
519	Brakes – check (high and low pressure tests)	34- 1
046	Brakes – bleed	34- 2
047	Brakes – bleed (ABS)	34- 2
34 10 014	Parking brake – adjust	34- 3
34 11 000	Front brake pads – remove and install	34- 4
520	Front brake calliper – remove and install	34- 4
220	Front brake discs – remove and install	34- 5
599	Front brake discs – check for runout and thickness deviation	34- 5
667	Front brake discs – fine grind	34- 5
34 21 530	Brake shoes of rear wheel – remove and install	34- 6
600	Wheel brake cylinder – remove and install	34- 7
200	Rear brake pads – remove and install	34- 8
745	Rear brake calliper – remove and install	34- 8
812	Rear brake calliper – overhaul	34- 8a
320	Rear brake disc – remove and install	34- 9
879	Rear brake disc – check for runout and thickness deviation	34- 9
947	Rear brake discs – fine grind	34- 9
	Brake lines routing plan	34- 9a
34 31 000	Tandem brake master cylinder – remove and install	34- 10
012	Tandem brake master cylinder – overhaul	34- 11
104	Brake light switch – adjust	34- 11a
34 32 361	Brake lines – replace	34- 12
381	Brake hose, front – replace	34- 12
451	Brake hose, rear – replace	34- 12
34 33 000	Brake booster with tandem brake master cylinder – remove and install	34- 13
000	Brake booster – replace	34- 14
051	Check valve for brake booster – replace	34- 14
071	Vacuum hose for brake booster – replace	34- 14
34 34 099	Brake force regulator – check	34- 15
100	Brake force regulator – remove and install	34- 15a
34 41 000	Parking brake lever – remove and install	34- 16
100	Parking brake cable – remove and install	34- 16
	Parking brake cable – remove and install (rear disc brakes)	34- 17
200	Parking brake shoes – remove and install	34- 17
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	ABS indicator lamp – description and check	34- 24
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	General information for repairs and brake system	34- 24
34 50 000	ABS – check function	34- 25
34 51 520	ABS hydraulic control unit – remove and install or replace	34- 25
34 52 510	ABS electronic control unit – replace	34- 26
61 11 530	ABS wire harness – replace	34- 26
	Acceleration pickup – description and task (325iX)	34- 28
34 52 520	Acceleration pickup – remove and install or replace	34- 29
	Acceleration pickup for ABS – adjust	34- 29
61 12 510	Pulse sender (for ABS), front – remove and install or replace	34- 31
522	Pulse sender (for ABS), rear – remove and install or replace	34- 31
61 31 570	Relays on hydraulic control unit (for ABS) – replace	34- 32
62 99 080	ABS indicator lamp – replace	34- 32
	ABS wiring diagram	34- 33
	AS wiring diagram for 325iX (four wheel drive)	34- 34
	ABS troubleshooting	34- 35
	ABS additional test for 325iX (four wheel drive)	34- 45

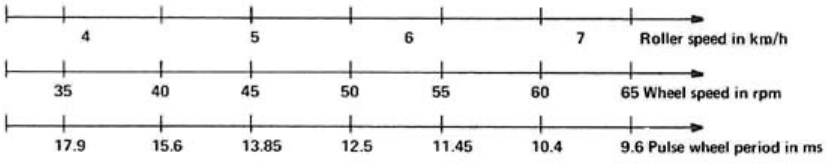
34 00 009 BRAKE TEST ON TEST STAND

Inspect condition and treads of tires and also check/correct tire inflation pressure prior to testing the brakes.

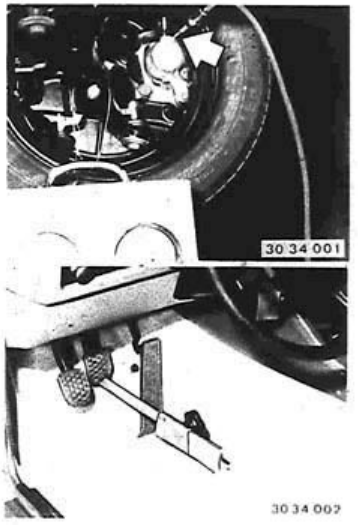
The brakes should have operating temperature, i.e. brake discs/drums should be warm and dry by way of braking the car several times.

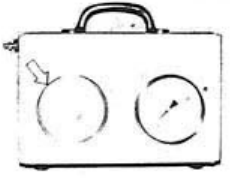
Comply with operating instructions supplied with pertinent test stand in order to avoid damage on the car or system as well as injury of personnel.

Important!
Cars with four driven wheels (325 iX) must not be tested on a brake test dynamometer longer than 60 seconds or faster than 7.5 km/h (4.5 mph), in order to avoid damaging the central lock. In other words the total testing time for the front axle, rear axle and parking brake must not exceed 60 seconds. If testing has to be repeated, wait at least 30 minutes to have the central lock cool down.
If not specified and guaranteed by the manufacturers, the precise roller speed of a brake test dynamometer must be checked with a '3'-series car fitted with ABS, but without all wheel drive. Drive car on to dynamometer, connect BMW service tester and see ABS nominal value microfiche for connections. Select ABS test step 03 dynamic/speed sensor and switch on the dynamometer. Conversion of displayed ms:








730 34 013

34 00 519 CHECKING SERVICE BRAKES IN HIGH AND LOW PRESSURE TESTS

High Pressure Leak Test:
Perform test on both brake circuits.
1. Brake circuit front left and right
2. Brake circuit rear left and right
Unscrew bleeder screw.
Connect and bleed pressure tester.
Do not run engine.

Apply load* on brake pedal and hold brake pedal down with a pedal prop.
Max. pressure drop after 2 minutes is 8 %.
Important!
High pressure leak test must be performed with the engine stopped.

Low Pressure Test:
Perform test on both brake circuits.
Release pedal prop that test pressure in brake system is 2 to 5 bar (28 to 71 psi).
Car and tester must remain still, since movement would cause incorrect test results.
Pressure should remain constant during 5 minute test.
If pressure drops considerably, inspect all rubber parts.
Bleed brake calipers and wheel brake cylinders after finishing test.

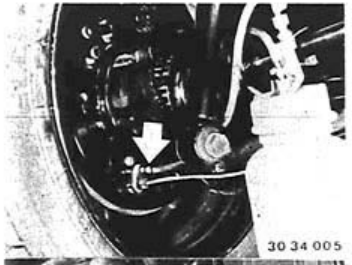
* See Specifications



34 00 046 BLEEDING BRAKES

Brake fluid* must be replaced every 2 years.
Brake fluid is hygroscopic and consequently takes on moisture in air through vent hole in brake fluid tank. This could drop brake fluid boiling point from + 240° C (464° F) to + 160 ... 180° C (320 ... 356° F).
Check gasket (arrow).

Caution!
Keep brake fluid off of painted car parts.
Brake fluid damages paint finish.
Connect bleeder on brake fluid tank.
Conform with operating instructions supplied with bleeder.
Charging pressure must not exceed 2 bar (28 psi).



Rear Wheel Brakes (Drums):

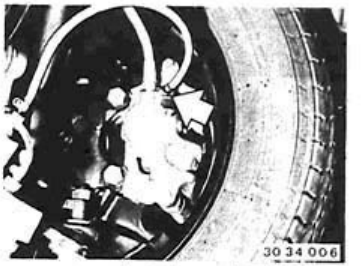
Connect bleeder hose with bottle on bleeder screw.
Unscrew bleeder screw.
Tighten bleeder screw when escaping brake fluid is without air bubbles.



Rear Wheel Brakes (Discs):

Connect bleeder hose with bottle on bleeder screw.
Unscrew bleeder screw.
Tighten bleeder screw when escaping brake fluid is without air bubbles.

See Gr. 34 of Operating Fluids for approved brake fluids



Front Wheel Brakes:

Connect bleeder hose with bottle on bleeder screw.
Unscrew bleeder screw.
Tighten bleeder screw when escaping brake fluid is without air bubbles.

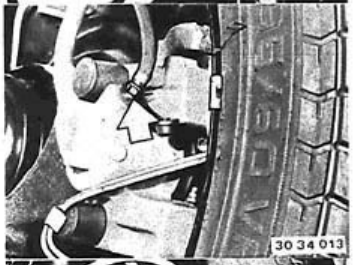


34 00 047 BLEEDING BRAKES FOR ABS

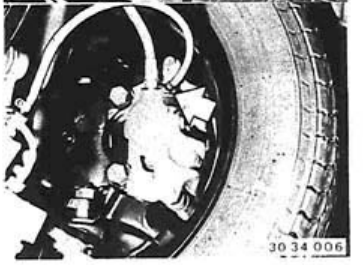
Connect bleeder on brake fluid tank.
Conform with operating instructions supplied with bleeder.

Important!
Do not use air flushing.

Press and hold brake pedal down.



Connect bleeder hose with bottle on bleeder screw and open bleeder valve on wheel brake, beginning at rear right.
Release brake pedal and operate 12 times as far as stop.

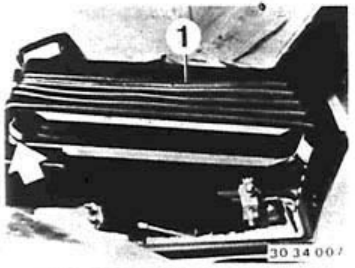


Hold brake pedal in down position.
Shut bleeder valve.
Release brake pedal.
Repeat bleeding on rear left, front right and front left.

34 10 014 ADJUSTING PARKING BRAKE

Requirements:
Both parking brake cables move easily and automatic slack control functions correctly.
Parking brake needs to be adjusted when the parking brake lever can be pulled up by more than 8 teeth.

Discs:
Note:
The parking brake system, which is completely independent of the service brakes, is only subjected to limited wear since the parking brake will not be needed during normal car operation. This consequently reduces the friction torque, e.g. caused by corrosion of brake drums or contamination of liners.
The force required for operating will increase proportionally.
To acquire optimal parking brake efficiency, it will normally be sufficient to drive the car from the parking lot to the workplace max. 400 meters (1300 feet) with the parking brake applied (pull up lever until resistance is felt and then one further catch) before adjusting the parking brake.



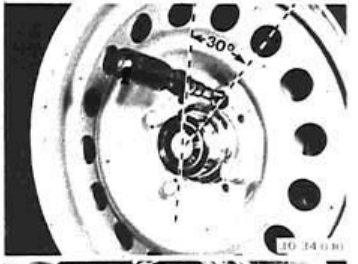
Lift out front clamp.
Pull off rubber cap (1).
Disconnect rear clamp.



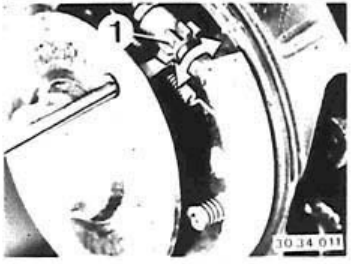
Unscrew adjusting bolts (2).



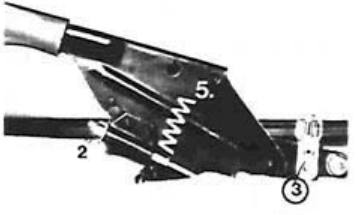
Drums:
Operate brake pedal several times.
Basic clearance will be adjusted automatically.
This is indicated by a clicking noise on the rear wheels.
Function of automatic slack control can be checked through a wheel bolt bore.



Unscrew one wheel bolt on each rear wheel and remove.
Turn wheels that each tapped bore is approx. 30° behind the perpendicular on top.
Installation:
Tightening torque*

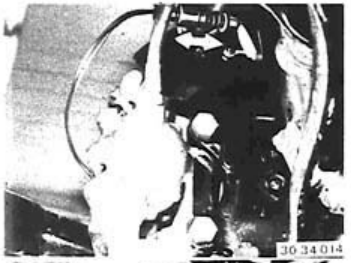


Turn adjusting nut (1) with a screwdriver to move out the parking brake shoes and prevent the brake disc from turning.
Then loosen adjusting nut by 3 or 4 threads.
Left adjusting nut turned up to tighten.
Right adjusting nut turned down to tighten.
Brake disc must turn easily.



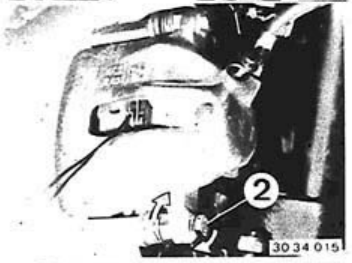
Brake Cable Adjustment:
Pull up parking brake lever by 5 teeth and adjust adjusting nuts (2) enough that left and right rear wheels can just be turned and both uniformly.
Release parking brake lever and check whether wheels can be turned easily.
The indicator lamp should go out when the parking brake is released with the ignition on.
Adjust switch (3), if necessary.

* See Specifications

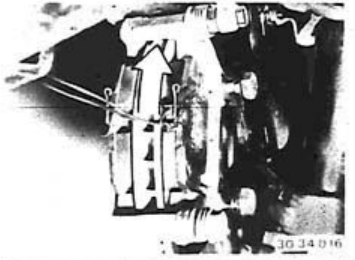


34 11 000 REMOVING AND INSTALLING FRONT BRAKE PADS

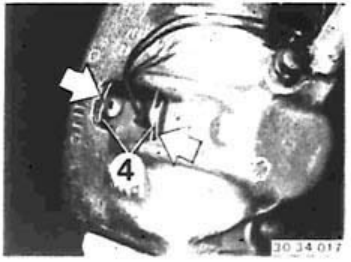
Remove front wheels – see 36 10 300.
Pull off brake pad wear indicator plug on left side.



Unscrew bolt (2).
Important!
Replace self-locking bolt.
Counterhold on guide pin.
Installation:
Tightening torque*.



Turn up brake caliper.
Remove brake pads.



Installation:
Check pads and pad thickness*.
Push back brake pistons completely.
Important!
Be careful not to damage dust cover on brake piston when assembling.
Check dust cover.
Check installed position of springs (4).

* See Specifications



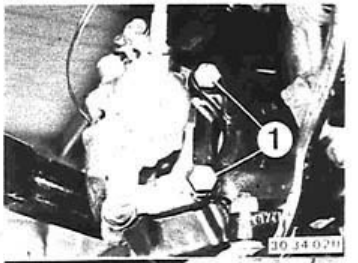
30 34 018

Drive out pin of brake pad wear indicator carefully.
Check circlip (5) when reusing.
Replace pad wear indicators with ground off plastic part.

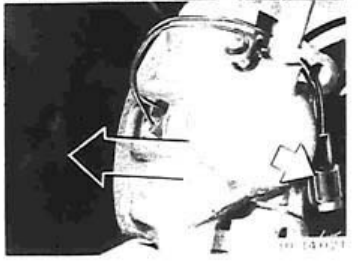


34 11 520 REMOVING AND INSTALLING FRONT BRAKE CALIPERS

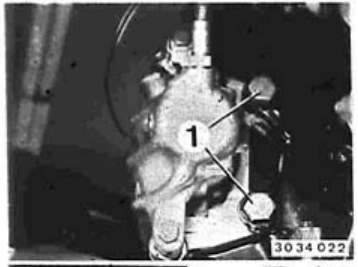
Remove front wheel – see 36 10 300.
Draw off brake fluid with a syringe which is used exclusively with brake fluid.
Disconnect brake line.
Installation:
Bleed brakes – see 34 00 046/047.



Unscrew caliper mounting bolts (1).
Installation:
Tightening torque*.

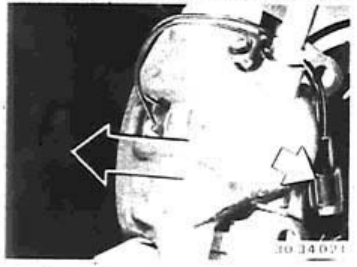


Pull off brake pad wear indicator plug on left side.
Pull off caliper toward rear.
Installation:
Make sure of-correct location of brake pad wear indicator wires with tab of dust cap – rubbing of the wires on the wheel rim must always be prevented.

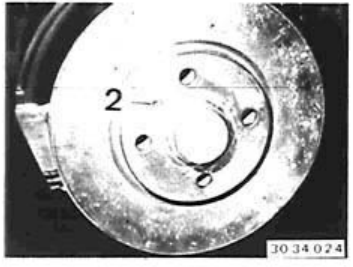


34 11 220 REMOVING AND INSTALLING FRONT BRAKE DISCS

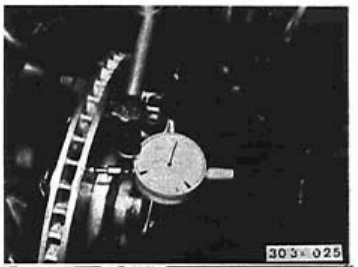
Remove front wheels 36 10 300.
Unscrew caliper mounting bolts (1).
Installation:
Tightening torque*.



Unplug brake pad wear indicator on left side.
Pull off caliper toward rear and suspend with a piece of wire.

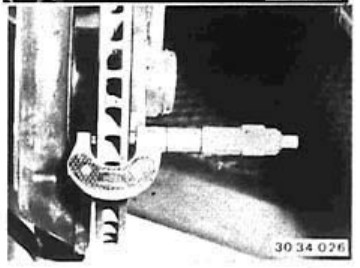


Unscrew bolt (2).
Take off brake disc.
Tool: wrench socket 34 1 020.

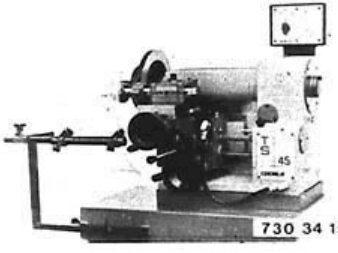


34 11 599 CHECKING FRONT BRAKE DISCS FOR RUNOUT AND DEVIATION IN THICKNESS – Front Wheels Removed

Requirement: wheel bearings okay
Mount dial gage holder and check lateral runout of brake disc with dial gage.
Note:
Mount brake disc with two M 12 x 1.5 bolts.



Measure deviation in thickness* within braking surface at about 8 points with a micrometer.

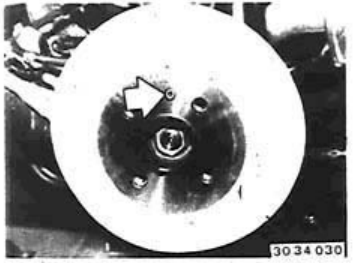


34 11 667 FINE GRINDING FRONT BRAKE DISCS – Brake Discs Removed –

Important!
Always fine grind both sides of both brake discs on one axle.
Check minimum thickness*.
After grinding to final size* one more brake pad set may be installed and worn to limits (see wear limit*).
Installation:
Even if only one brake disc has to be replaced, always replace both brake discs of one axle.

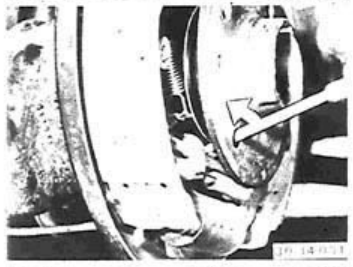
* See Specifications

* See Specifications

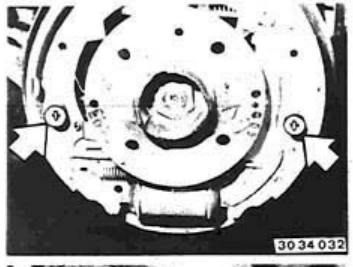


34 21 530 REMOVING AND INSTALLING BRAKES SHOES OF REAR WHEEL

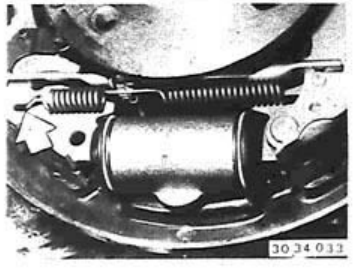
Remove rear wheel.
Unscrew bolt.



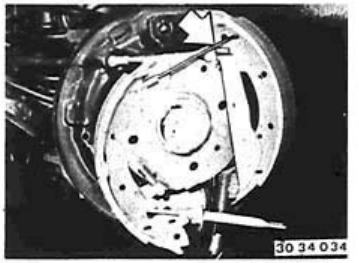
Remove brake drum by loosening parking brake cables and unscrewing automatic slack control enough that brake drum can be pulled off.



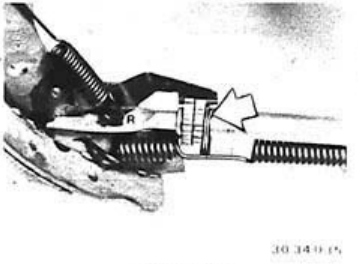
Push in return springs and turn 90°.



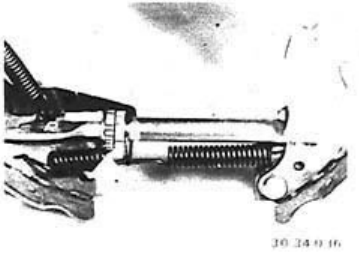
Disconnect bottom return spring at front.
Pull brake shoes out of wheel brake cylinder
Disconnect top return spring at front.
Remove front brake shoes with automatic slack control.



Disconnect parking brake cable.
Remove rear brake shoes.
Replace brake shoes by exchanging.
See Service Information of Group 34.
Installation:
Always replace all four brake shoes and use same make*.
Also replace return springs and thermo clip when replacing brake shoes.



Arrangement of Automatic Slack Control:
Adjusting pinion on left side has right-hand threads (R) and left-hand threads (L) on right side.
Thermo clip must engage (arrow).
Note bends of return springs.

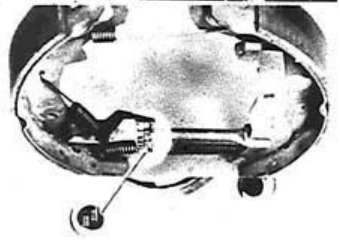


Unscrew adjusting pinion.
Check function and movement of automatic slack control.
If applicable, clean and give threads of push rod a light coat of grease.

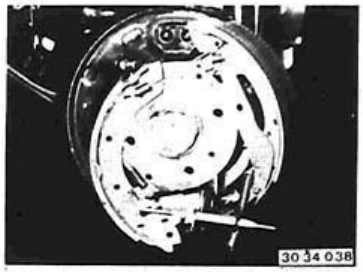
* See Specifications



If brakes have to be bled, this must be done before adjusting the parking brake.

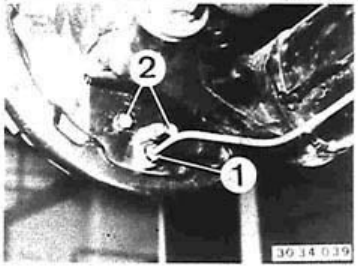


Adjust basic clearance by operating brake pedal.
A click will be heard on the rear wheel brakes until reaching the basic clearance.
Adjust parking brake 34 10 014.

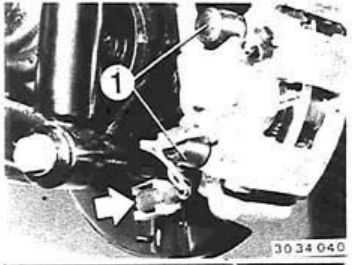


34 21 600 REMOVING AND INSTALLING WHEEL BRAKE CYLINDER

Remove and install brake shoes 34 21 530.
Draw off brake fluid with a syringe which is used exclusively with brake fluids.
Installation:
Bleed brakes 34 00 046.

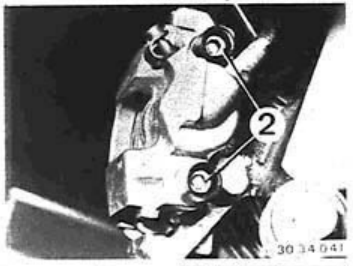


Unscrew brake line (1) and bolts (2) on wheel brake cylinder.

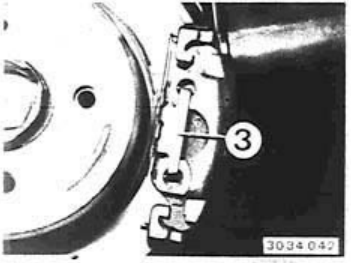


34 21 200 REMOVING AND INSTALLING REAR BRAKE PADS

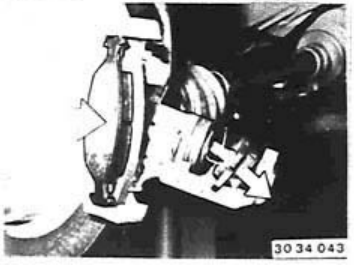
Remove rear wheels.
Press off plastic caps (1).
Right Side:
Pull off brake pad wear indicator plug.



Unscrew guide bolts (2).
Installation:
Check condition of guide bolts and threads, replacing guide bolts if necessary.
Tightening torque*.

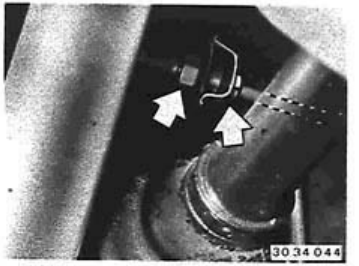


Press out clip (3).
Pull off caliper toward rear.



Remove outer brake pad.
Inner brake pad is located in piston (4) with a spring.
Installation:
Push back pistons completely.

* See Specifications

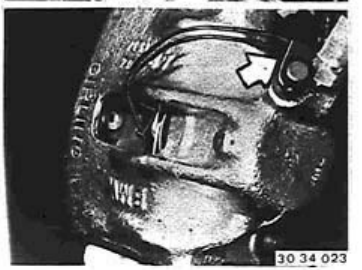


34 21 745 REMOVING AND INSTALLING REAR BRAKE CALIPER

Remove rear wheel.
Draw off brake fluid with a syringe which is used exclusively with brake fluids.
Disconnect brake line.
Installation:
Bleed brakes – see 34 00 046/047.



Unscrew bolts (1).
Right Side:
Pull off brake pad wear indicator plug.
Pull off caliper toward rear.
Installation:
Tightening torque*.



Important!
Check routing and securing of wire for brake pad wear indicator.
Check for secure holding with tab of dust cap.
Rubbing of wire on wheel rim must always be avoided.

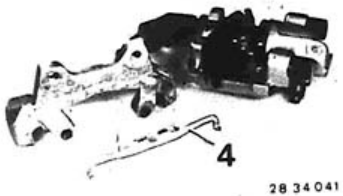
* See Specifications

34 21 812 OVERHAULING REAR BRAKE CALIPER
– Use Repair Kit –



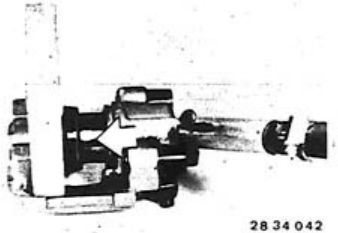
28 34 040

Remove rear brake caliper – 34 21 220.
Press off plastic caps (1).
Unscrew guide bolts (2).



28 34 041

Disassemble caliper.
Remove brake pads.
Installation:
Press brake pad toward outside fully prior to installing spring (4).


28 34 042

Press off rubber cap and clamping ring.
Place a liner (hard wood, hard felt or similar material) in caliper recess to protect piston.
Press out piston with compressed air applied through connection bore.
Caution!
10 bar (140 psi) air pressure is equal to a force of about 1250 N (275 lbs.).

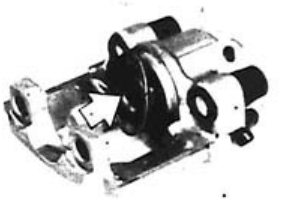


28 34 043

Check guide sleeves (5), using guide sleeves in repair kit if necessary.


28 34 044

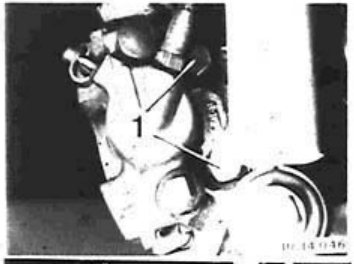
Remove seal carefully with a plastic needle.
Clean cylinder bores and parts with alcohol and dry with compressed air.
Inspect cylinder bore, piston and flange surfaces for damage thoroughly.
Machining of cylinder bores and pistons is not approved.
Installation:
Give all parts a light coat of ATE brake cylinder paste before installing.


28 34 045

Pull rubber cap on to piston first.
Do not cant piston.
Press in piston with a piece of hard wood.

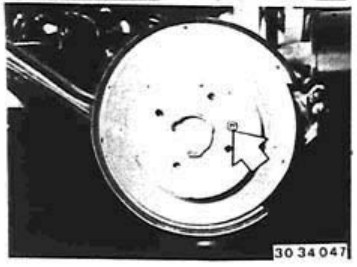

28 34 046

Pull rubber cap over edge of cylinder bore and secure with clamping ring.
Assemble caliper.



34 21 320 REMOVING AND INSTALLING REAR BRAKE DISC

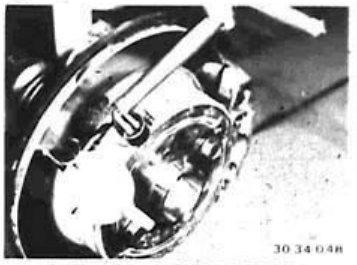
Remove rear wheel.
Unscrew bolts (1).
Installation:
Tightening torque*.



Pull off caliper toward rear and suspend on a piece of wire.
Brake line remains connected.
Unscrew bolt and take off brake disc.

Important!
Always replace both brake discs of one axle, even if only one disc has to be replaced.
Adjust parking brake – 34 10 014.
Breaking In Parking Brake After Replacing Brake Discs:
Car must be broken in in three phases.

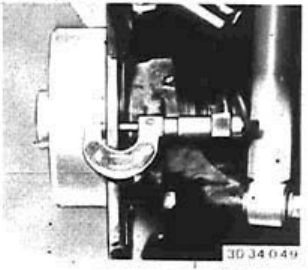
Phase 1:	5 full stop braking actions from 50 km/h (30 mph).
Phase 2:	Let brakes cool down.
Phase 3:	5 additional braking actions from 50 km/h (30 mph).



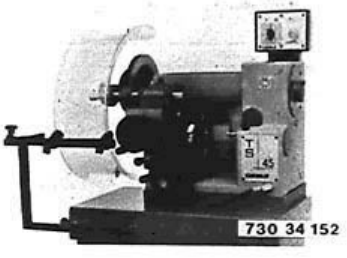
34 21 879 CHECKING REAR BRAKE DISC FOR RUNOUT AND DEVIATION IN THICKNESS

– Rear Wheel Removed –

If necessary, remove caliper 34 21 220.
Mount brake disc with two bolts.
Mount dial gage holder and check lateral runout* of brake disc with dial gage.



Measure deviation in thickness* within braking surface at about 8 points with a micrometer.
Installation:
Tightening torque*.



34 21 947 FINE GRINDING REAR BRAKE DISCS

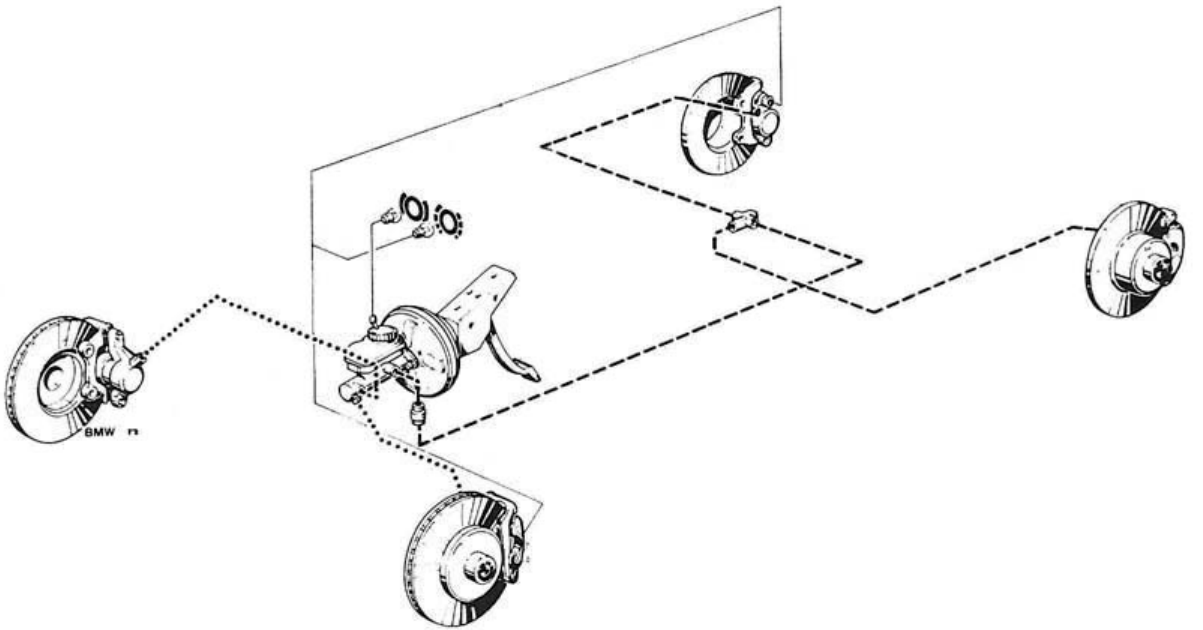
– Brake Discs Removed –

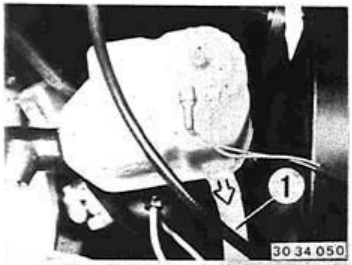
Important!
Always fine grind both sides of both brake discs on one axle.
Check minimum thickness*.
One more set of brake pads may be installed and used to wear limits* after machining discs to the final size*.
Installation:
Always replace both brake discs of one axle, even if only one brake disc has to be replaced.

* See Specifications

* See Specifications

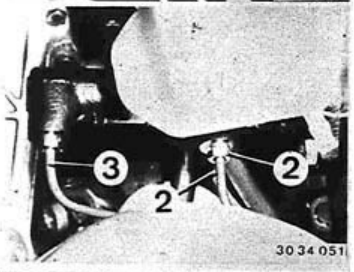
BRAKE LINE ROUTING LAYOUT – E 30



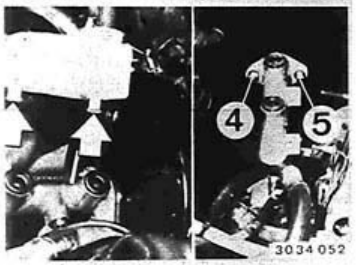


34 31 000 REMOVING AND INSTALLING BRAKE MASTER CYLINDER

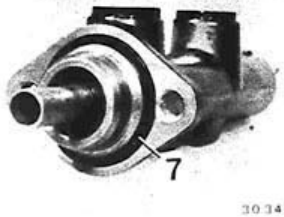
Draw off brake fluid in tank with a syringe reserved exclusively for brake fluids.
Pull off plug.
Pull off clutch hydraulic hose (1).
Installation:
Bleed brakes 34 00 046 / 047.



Unscrew brake lines (2 and 3).



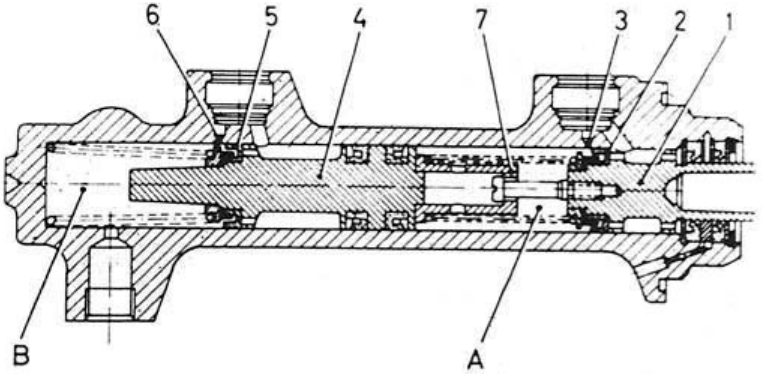
Pull off tank.
Unscrew mounting screws (4 and 5).
Installation:
Check rubber seal and connections.

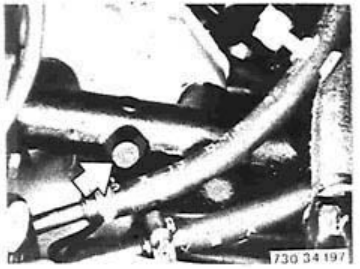


Installation:
Check rubber ring (7).
The building up of vacuum will be impaired, if sealing is not perfect.

Description of Tandem Brake Master Cylinder Operation:
Operating the brake pedal moves pistons (1 and 4) forward.
Primary cups (2 and 5) pass over compensating bores (3 and 6).
Now there is equal pressure in chambers A and B.

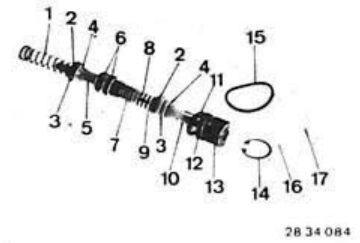
Dual Circuit System:
Chamber A is for front right and left.
Chamber B is for rear right and left.
The failure of a brake circuit will cause considerable increase in brake pedal travel.
If the second brake circuit fails, piston (1) uses the pressure building up in chamber A to move piston (4) in pressureless chamber B against the tandem brake master cylinder housing and to provide function of the first brake circuit.
If the first brake circuit fails, piston (1) in the pressureless chamber A is pressed against spring loaded cap (7) and the second brake circuit has full operation by way of chamber B.





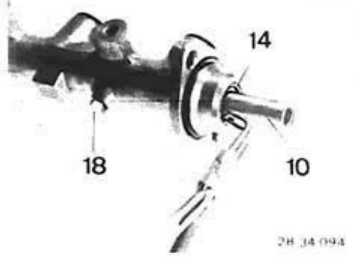
34 31 012 OVERHAULING BRAKE MASTER CYLINDER

Remove master cylinder 34 31 000.
No replacement parts are available for brake master cylinders with a recessed stop pin (ABS).



28 34 084

Important!
Use repair kit:
(1) spring, (2) support ring, (3) primary cup, (4) filler ring, (5) intermediate piston, (6) separating cup, (7) stop sleeve, (8) spring, (9) screw, (10) push rod piston, (11) stop washer, (12) secondary cup, (13) plastic sleeve, (14) circlip, (15) seal, (16) aluminum seal and (17) silicone grease.

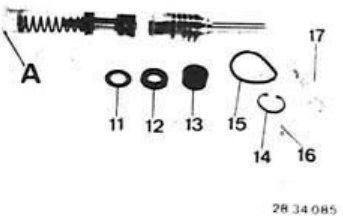


28 34 094

Apply light pressure on push rod piston (10), lift out circlip (14) and unscrew stop screw (18).
Release push rod piston (10) slowly and pull it out.

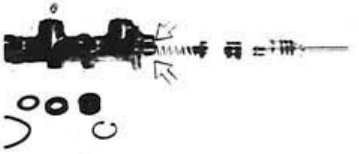

28 34 083

Remove intermediate piston by knocking housing lightly on a piece of wood.
Clean cylinder housing and other parts not included in the repair kit with alcohol and dry with compressed air.
Tandem brake master cylinders with surface damage in the cylinder bore may not be reused.
Check that all connecting, compensating and after-running bores are clean.

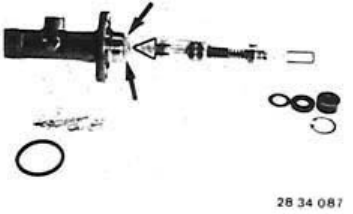


28 34 085

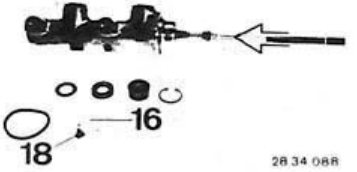
Give cylinder bore a very thin coat of ATE brake cylinder paste.
Remove large plug from assembly sleeve.
Slide short neck part on to long neck pipe far enough that stop washer (11), secondary cup (12), plastic sleeve (13), circlip (14), seal (15), aluminum seal (16) and silicone grease (17) can be removed.
Remove small plug.


28 34 086

Clamp cylinder housing in a vise fitted with soft (aluminum) jaws.
Guide assembly sleeve with long neck pipe into cylinder bore.

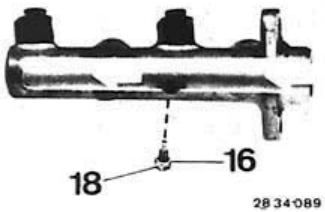

28 34 087

Slide stepped short neck pipe into cylinder bore against shoulder and hold in this position.



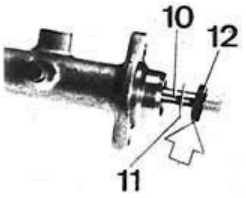
28 34 088

Press contents of assembly sleeve into cylinder bore carefully with a suitable mandrel, until the intermediate piston touches bottom of the cylinder.



28 34 089

Hold intermediate piston against stop and screw in bolt (18) with a new aluminum seal (16).
Tighten stop bolt (18) with a torque of 5 to 8 Nm (3.5 to 5.5 ft. lbs.).

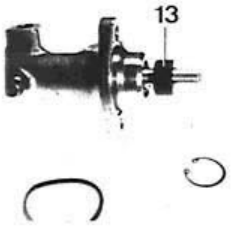


28 34 090

Release push rod piston (10) carefully.
Slide on stop washer (11).
Coat secondary cup (12) with silicone grease and install.
Let short stepped end of assembly sleeve protrude and slide over secondary cup (12).
Hold cup with two fingers.

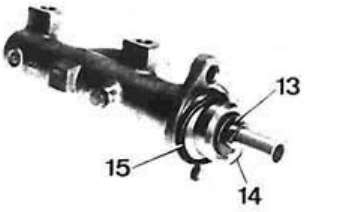

28 34 091

Adjust secondary cup flush with long neck pipe and slide complete assembly sleeve into cylinder bore.
Slide in long neck pipe carefully until resistance is felt.



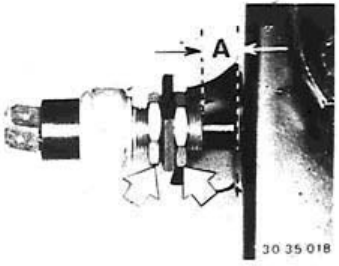
28 34 092

Hold long neck pipe and pull back short neck pipe.
Remove complete assembly sleeve.
Give plastic sleeve (13) a light coat of silicone grease and slide on to push rod piston in cylinder bore.



28 34 093

Press in push rod piston (10) and plastic sleeve (13).
Install circlip (14) with a special circlip pliers.
Circlip must have perfect fit in groove of cylinder bore.
Install new seal (15) before attaching on the vacuum brake booster.



30 35 018

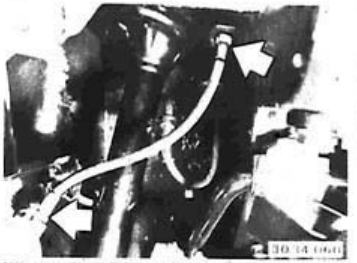
34 31 104 ADJUSTING BRAKE LIGHT SWITCH

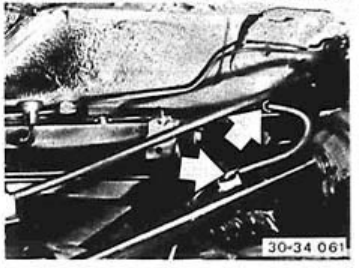
Adjust brake light switch with nut (1) and locknut (2) that distance (A) = 5 to 6 mm (0.197 to 0.236") of contact button is visible when the brake pedal is released.

34 32 361 REPLACING ALL BRAKE LINES

Brake lines are now only available in straight version and supplied in correct length with connecting nipples.

The removed brake pipe should be used as a template for bending.
Use bending tool**
Do not damage surface finish of pipes.
Do not bend pipes sharply or attempt to bend back an incorrectly bent brake pipe.
Also refer to Service Information of Gr. 34.





34 32 381 REPLACING FRONT BRAKE HOSE

Draw off brake fluid in tank with a syringe used exclusively with brake fluids.
Disconnect brake hose.
Installation:
Never twist brake hose while installing.
Bleed brakes – 34 00 046 / 047.
Tightening torque*.

34 32 451 REPLACING REAR BRAKE HOSE

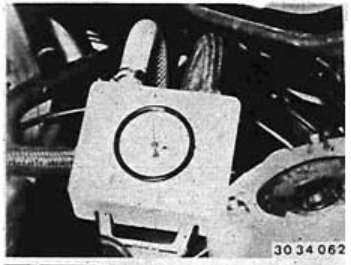
Draw off brake fluid in tank with a syringe used exclusively with brake fluids.
Disconnect brake hose.
Installation:
Never twist brake hose while installing.
Bleed brakes – 34 00 046 / 047.
Tightening torque*.

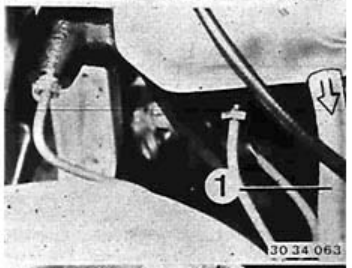
** Source: HWB

* See Specifications

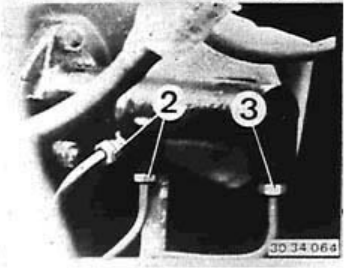
34 33 000 REMOVING AND INSTALLING BRAKE BOOSTER WITH TANDEM BRAKE MASTER CYL.

Checking Operation:
Operate brake pedal 10 times with engine stopped. Hold brake pedal down and start engine. System is okay if brake pedal gives.
If brake pedal does not give, the defect could be in check valve, vacuum hose or rubber ring between tandem brake master cylinder and brake booster. Engine's vacuum could be insufficient or filter screen of brake booster completely clogged with dirt.
Checking Engine Vacuum for Brake Booster:
Disconnect vacuum hose on brake booster
Install vacuum tester 34 3 100 between brake booster and check valve. Check available vacuum when releasing accelerator, going from an engine speed of 3000 rpm with engine at operating temperature.
Min. value = – 0.35 bar (5 psi).
Repeat test several times.
Minimum value with specified idle speed and engine at operating temperature:
– 0.50 bar (7 psi).

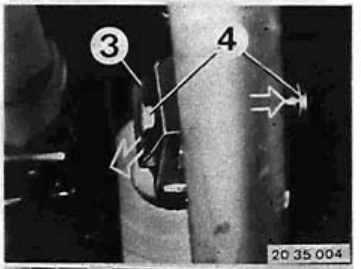




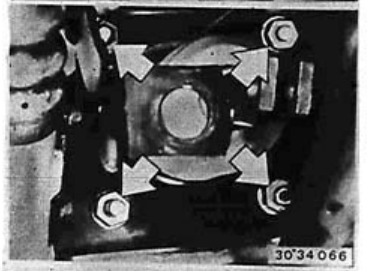
Draw off brake fluid in tank with a syringe used exclusively with brake fluids.
Pull off plugs.
Pull off hose (1) for clutch.



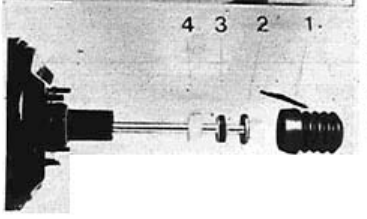
Disconnect brake lines (2 and 3).
Brake line 2:
front left
front right = 1st brake circuit
Brake line 3:
rear right
rear left = 2nd brake circuit



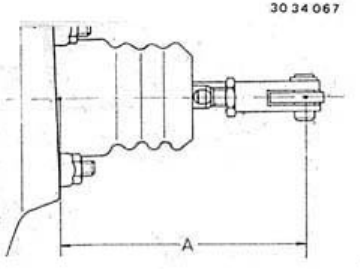
Remove instrument panel trim at bottom left 51 45 180.
Disconnect spring.
Press off clip (3) and pull out shaft (4).



Disconnect brake booster on pedal assembly base.
Take off brake booster with master cylinder toward front.
Installation:
Tightening torque*.
Adjust stop light switch 34 31 104.
Bleed brakes – 34 00 046 / 047.

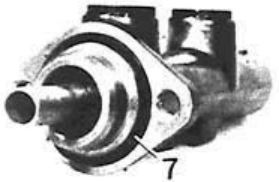


If filter screen in brake booster is clogged with dirt, remove cap (1), holder (2), damper (3) and filter (4).
Installation:
Clean damper (3) and filter screen (4).
Offset slots of damper (3) and filter screen (4) by 180° to each other.



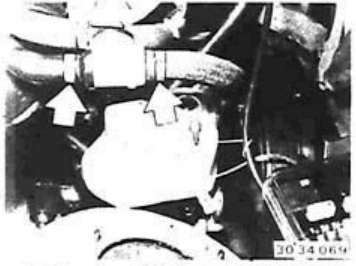
Basic adjustment distance A on piston rod = 125 mm (4.921").
Adjust brake pedal – see Group 35.

* See Specifications



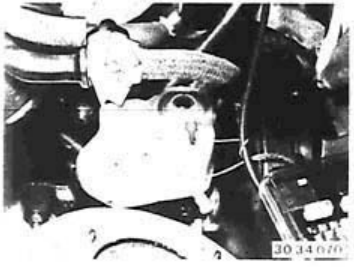
34 33 000 REPLACING BRAKE BOOSTER

Remove brake booster with tandem master cylinder 34 33 000.
Unscrew tandem master cylinder on brake booster.
Installation:
Tightening torque*.
Check rubber ring (7) between tandem master cylinder and brake booster, if necessary.

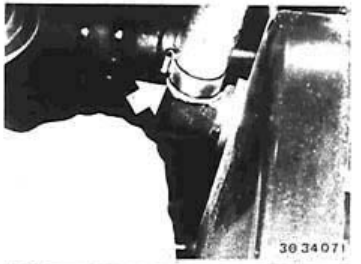


34 33 051 REPLACING CHECK VALVE FOR BRAKE BOOSTER

Disconnect vacuum hoses on check valve (1).
Installation:
Replace clamp if applicable.

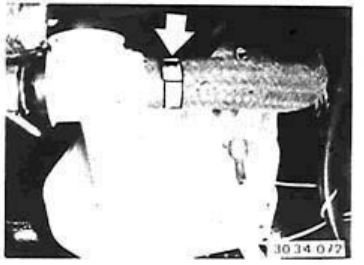


Loosen clamps and take off check valve.
Installation:
Arrow or black side faces intake manifold.
Replace clamps if applicable.



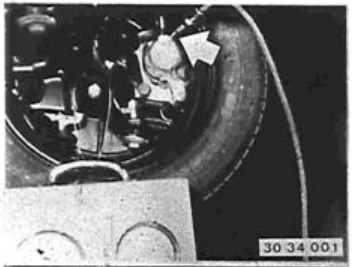
34 33 071 REPLACING VACUUM HOSE FOR BRAKE BOOSTER

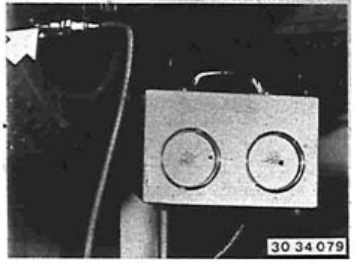
Disconnect vacuum hose on brake booster.
Installation:
Replace clamp if applicable.



Disconnect vacuum hose on check valve (1).
Installation:
Replace clamp if applicable.

* See Specifications

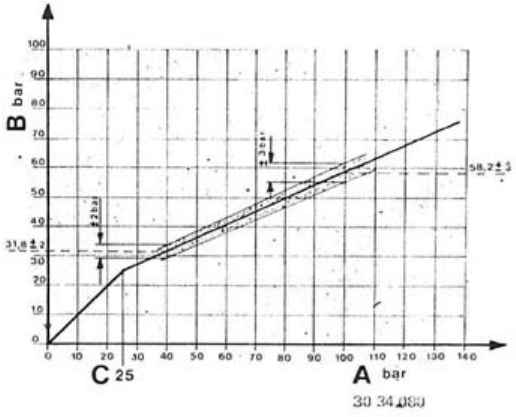




34 34 099 CHECKING FUNCTION OF BRAKE FORCE REGULATOR

Remove and install front wheel 36 10 300.
Remove and install rear wheel 36 10 320.
Connect one high pressure meter in front axle brake circuit.
Bleed high pressure meter.

Connect second high pressure meter on rear wheel brake bleeder screw.
Bleed high pressure meter.



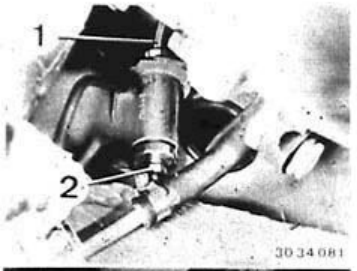
Operate brake pedal firmly at least 5 times.
Hold brake pedal pressed down with a pedal prop.
Up to a pressure of 25 bar (355 psi) both high pressure meters should display the same value.
As from a pressure of 25 bar (355 psi) the pressure of the rear wheel brake cylinder should drop according to the diagram.
A = Inlet pressure
B = Outlet pressure
C = Switching over pressure
Example:
Inlet pressure (= front axle pressure)

Pressure I	Pressure II
40 bar (569 psi)	100 bar (1422 psi)

Outlet pressure (= rear axle pressure)

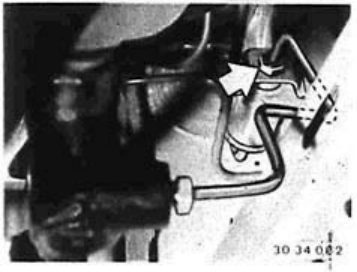
Pressure I	Pressure II
31.8 bar (452 psi)	58.2 bar (828 psi)

If necessary, take mean value from three measurements.
If measured values deviate from specified values, replace the brake force regulator.

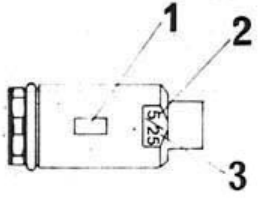


34 34 100 REMOVING AND INSTALLING BRAKE FORCE REGULATOR

Draw off brake fluid in tank with a syringe used exclusively with brake fluids.
Unscrew lines (1 and 2).
Installation:
Tightening torque*.
Bleed brakes 34 00 046 / 047.



Take off clamp and brake force regulator.

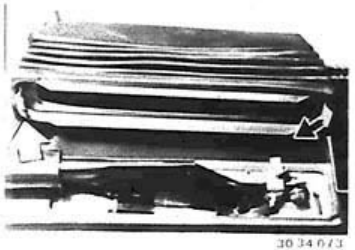


30 34 083

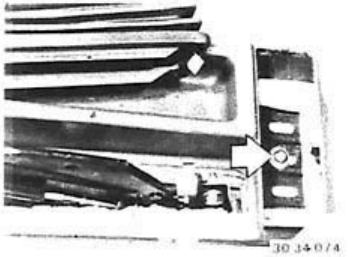
Check identification when replacing the brake force regulator.
(1) Calendar day / year number
(2) Reduction = (e.g. 0.45)
(3) Switching-over pressure

* See Specifications

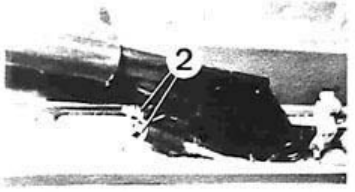
34 41 000 REMOVING AND INSTALLING PARKING BRAKE LEVER



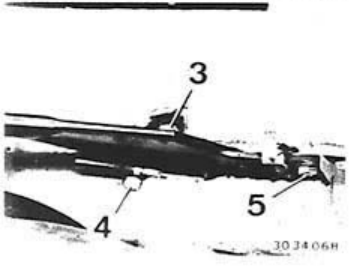
Take off rubber cap (1) by pulling up clamp at front and lifting out at rear.



Lift out rear ashtray.
Unscrew bolt.
Disconnect console by pushing back and remove.

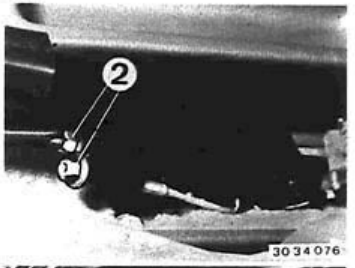


Unscrew nuts (2) on parking brake cables.



Unscrew bolts (3 ... 5).
Remove parking brake lever.

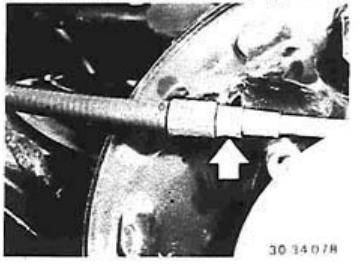
34 41 100 REMOVING AND INSTALLING PARKING BRAKE CABLE



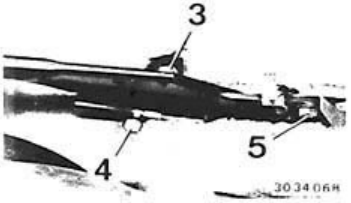
Remove and install brake shoes 34 21 530.
Take rubber cap off of parking brake lever by pulling up clamp at front and lifting out at rear.
Unscrew nuts (2) on parking brake cable.



Disconnect parking brake cable on semi-trailing arm.

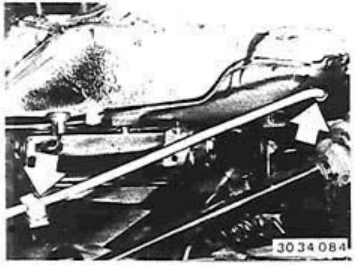


Compress locking clamp.
Disconnect parking brake cable on brake backplate and pull out.
Installation:
Make sure clamp fits correctly.

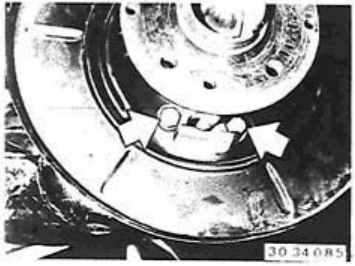


34 41 100 REMOVING AND INSTALLING PARKING BRAKE CABLE
– Rear Disc Brakes –

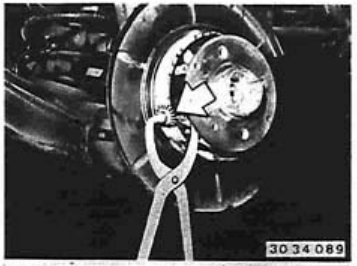
Remove expansion lock for parking brake shoes – see 34 41 250.
Remove parking brake lever – see 34 41 000.
Installation:
Adjust parking brake – see 34 10 014.



Disconnect parking brake cable on swing arm.
Pull parking brake cable out of protective pipe.
Installation:
Cable holder must bear on the protective pipe.



Unscrew support for parking brake cable.
Pull out parking brake cable.

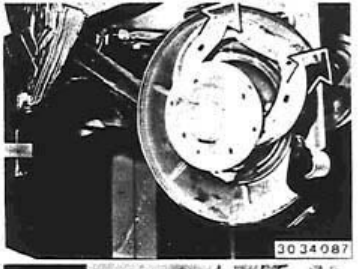


34 41 200 REMOVING AND INSTALLING PARKING BRAKE SHOES

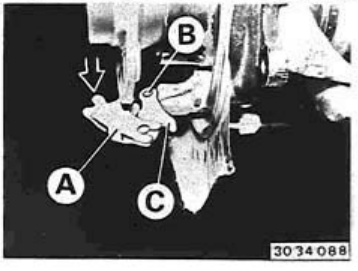
Remove rear brake disc see 34 21 300.
Disconnect lower return spring with a brake spring pliers.
Installation:
Check return spring, replacing if necessary.
Adjust parking brake – see 34 10 014.



Turn spring retainers 90° with Special Tool 34 4 000 and disconnect.



Spread brake shoes apart at bottom and lift out from above.
Parking Brake Breaking-in Program After Replacing Liners:
Car must be broken in in three phases.
Phase 1: Car stopped 5 times from 50 km/h (30 mph) with max. deceleration.
Phase 2: Brakes cooled off.
Phase 3: Car stopped 5 more times from 50 km/h (30 mph).



34 41 250 CHECKING / REMOVING AND INSTALLING EXPANSION LOCK

Remove parking brake shoes see 34 41 200.
Pull off part A toward rear.
Press out pin B.
Pull out part C.
Installation:
Apply a thin coat of Molykote Paste G on sliding surfaces and pin.
Adjust parking brake - see 34 10 014.

Condition	Cause	Correction
Brakes pull to one side	a) Tire inflation pressure incorrect b) Uneven tire tread wear c) Oil on pads/liners d) Pad/liner type not as specified e) Caliper recesses dirty f) Guide bolts dirty or damaged g) Rear wheel alignment maladjusted h) Corrosion in calipers of wheel cylinders i) Shock absorbers without action k) Pad of one caliper worn l) Pad glazed	a) Correct tire inflation pressure b) Change or replace tires c) Replace brake pads/liners and eliminate cause d) Replace brake pads/liners e) Remove, clean and install calipers f) Replace guide bolts g) Check wheel alignment h) Remove and install, repair or replace calipers or wheel cylinders i) Check or replace shock absorbers k) Replace brake pads and check calipers l) Replace brake pads and check calipers
Brakes excessively hot while driving	a) Compensation bore in master cylinder clogged b) No play between push rod and master cylinder piston c) Rubber parts swollen from contact with wrong type of brake fluid d) Vent hole in brake fluid tank clogged e) Corroded calipers f) Cross spring broken g) Parking brake lever not released fully	a) Check or replace master cylinder b) Adjust push rod c) Overhaul or replace master cylinder d) Clean brake fluid tank e) Remove and install, repair or replace calipers f) Replace cross spring g) Check parking brake and parking brake cables, repairing if necessary
Braking effect insufficient inspite of great force on pedal Brake pedal travel normal short long	a) Brake pads oil splattered or burnt; wrong type of brake pads b) Brake booster malfunctions – engine vacuum insufficient c) One brake circuit failed due to leaks or damage	a) Replace brake pads b) Check power brake system – check engine (valves, cylinder head, gasket, etc.) c) Check brake system for leaks

TROUBLESHOOTING BRAKES

Condition	Cause	Correction
Brake pedal motion too soft and spongy	a) Air in brake system b) Insufficient brake fluid in brake fluid tank c) Overheated brake fluid – vapor lock due to excessive water content in brake fluid or excessive brake loads	a) Add or replace brake fluid and bleed brakes b) See a) c) See a)
Brake pedal travel excessive even though brakes have been bled and adjusted	a) Primary cup in master cylinder damaged b) Separating cups on floating piston of tandem brake master cylinder leak c) Leak in brake system	a) Overhaul or replace brake master cylinder b) See a) c) Check brake system for leaks
Uneven pad wear	a) Wrong type of brake pads b) Caliper recesses dirty, caps damaged c) Corrosion in calipers or wheel cylinders d) Rubber ring for piston control swollen	a) Replace brake pads b) Remove and install, repair or replace calipers or wheel cylinders c) See b) d) See b)
Brake pads worn at angle	a) Wheel bearing play excessive b) Brake disc not aligned with caliper c) Corrosion in calipers or wheel cylinders d) Brake disc wear angular e) Pads worn less than minimum thickness f) Spring force insufficient g) Guide bolts damaged	a) Replace wheel bearings b) Check caliper installation c) Remove and install, repair or replace calipers or wheel cylinders d) Grind or replace brake discs e) Replace brake pads f) Replace spring g) Replace guide bolts

Condition	Cause	Correction
Seized brake pads, pad does not move off of brake disc	a) Dirty caliper recesses, damaged protective caps b) Corrosion in calipers c) Compensation bore in master cylinder clogged	a) Remove and install, repair or replace calipers b) Remove and install, repair or replace calipers c) Overhaul or replace master cylinder
Brakes squeal or rattle	a) Wrong type of pads b) Dirty caliper recesses c) Spring force insufficient d) Brake disc not aligned with caliper e) Brake disc runout f) Excessive thickness difference within braking surface g) Brake drums out-of-true h) Knocking brake drums i) Dirt and dust in brake drums k) Liner wear excessive or one-sided l) Rust edges on brake discs m) Pad loose n) Wheel bearing play excessive	a) Replace brake pads b) Remove and install, clean calipers c) Replace springs d) Check caliper installation e) Check brake disc runout, replacing if necessary f) Measure brake disc thickness; grind or replace discs g) Grind or replace brake drums h) Grind or replace brake drums i) Clean and check brake drums k) Replace brake shoes l) Grind or replace brake discs m) Replace brake pads n) Replace wheel bearings
Brake pedal dead travel excessive	a) Wheel bearing play excessive b) Brake disc not aligned with caliper c) Brake disc runout d) Excessive thickness difference within braking surface e) Brake system leaks f) Air in brake system g) Pads/liners not specified type h) Automatic brake shoe slack control malfunctions	a) Replace wheel bearings b) Check caliper installation c) Check brake disc runout, replacing discs if necessary d) Measure brake disc thickness; grind or replace discs e) Check brake system for leaks f) Bleed brake system g) Replace brake pads and/or liners h) Remove and install brake shoes; repair slack control

Condition	Cause	Correction
Seized pistons in caliper	a) Caliper recesses dirty, caps damaged b) Brake disc not aligned with caliper c) Corrosion of pistons in calipers or wheel cylinders	a) Remove and install, repair or replace calipers b) Check caliper installation c) Remove and install, repair or replace calipers or wheel cylinders
Pulsating effect on brake pedal	a) Wheel bearing play excessive b) Brake disc not aligned with caliper c) Brake disc runout d) Excessive thickness difference within braking surface	a) Replace wheel bearings b) Check caliper installation c) Check brake discs for runout, replacing if necessary d) Measure brake disc thickness and grind or replace discs
Parking brake effect insufficient	a) Oil on brake shoes b) Excessive dead travel between brake shoes and brake drums c) Excessive dead travel in cables d) Cables maladjusted e) Corroded transmitting elements	a) Replace brake liners and eliminate cause b) Adjust parking brake c) See b) d) See b) e) Remove and install parking brake and spreader locks; check cables, replacing if necessary

1. ANTIBLOCK SYSTEM (ABS) – DESCRIPTION AND DESIGN

Description:

The basis of a braking action is the friction between the tires and road surfaces.
To brake a vehicle the tires have to transmit a frictional force to the road surface. In so doing there will be slip between the tires and road surface, i.e. the tire peripheral velocity will be slower than the road speed of the vehicle.

Figure 730 34 112 shows the relation between the frictional force and slip for a typical case on a dry road surface. The transmitted braking force reaches its maximum value in shaded area A. This is also the control range of ABS. When a wheel is locked, i.e. when there is 100% slip, the frictional force will normally be lower than when a wheel is rolling.

Consequently the ABS must control the brake pressure in the wheel brake cylinder in such a manner that the slip remains in the shaded area, because here the highest frictional force is available.

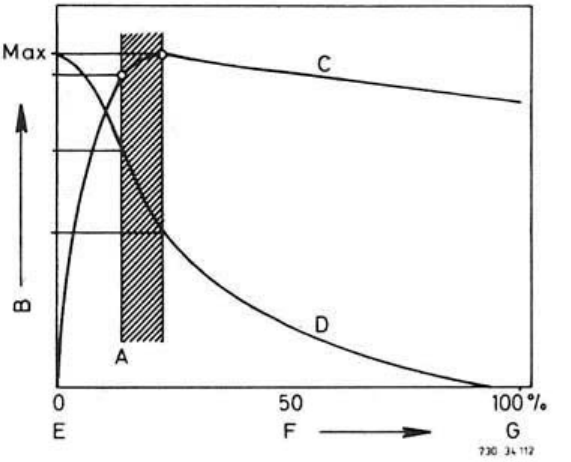
At the same time there will then be sufficient lateral cornering force to guarantee steering and directional stability.

The amount of slip, with which there is maximum frictional force, and the amount of frictional force itself depend chiefly on the tires (type, treads, rubber composition), the road surface (material, surface condition, wet, ice), the road speed and the slip angle of the wheels.

The ABS detects the frictional conditions between the tires and road surface prevailing at the moment. It automatically adjusts to each change in road surface/tire relation and makes use of the highest coefficient of friction, without that the vehicle slips or skids because of wheel locking.

Non-uniform friction conditions between the separate wheels will be held under control just as also instantaneous changes in the road surfaces, e.g. through patches of ice.

BRAKING AND LATERAL FORCES IN RELATION TO SLIP



A = ABS operating range
B = Braking and lateral force
C = Braking force
D = Lateral force
E = Rolling wheel
F = Slip
G = Locked wheel

DESIGN

The ABS consists of a control unit, hydraulic unit, speed sensors and a wire harness. Components are described separately below.

Speed Sensors:
Each speed sensor has a gear wheel, which runs past the permanently magnetized edge of the speed sensor and is installed in the wheel hubs.
The rotary motion of the wheels is recorded by inductive sensors and an electric signal is sent to the electronic control unit.

Electronic Control Unit:
The electronic control unit is located in the passenger compartment on left side underneath instrument panel. In a small multi-channel electronic computer accelration, decelration and slip factors are derived from the electric signals of the speed sensors, which are proportional to the wheel velocity. By logical connection of these factors there are control commands for the electromagnetically operated valves in the hydraulic unit.

The signal processing in the computer determines the control behavior of the system. The expected degree of dependability is based on digital engineering with highly integrated circuitry.

The control unit contains electronic monitoring circuits, which control the function prior to each trip and the ABS wire harness with equipment constantly during a trip. If the control unit detects a defect in the wire harness or electrical part of the equipment, the monitoring circuit will switch off the ABS and guarantee normal use of the brake system. An ABS indicator lamp reports this condition to the driver.

Hydraulic Unit:
The hydraulic unit is located in the engine compartment and was added to the conventional brake system.

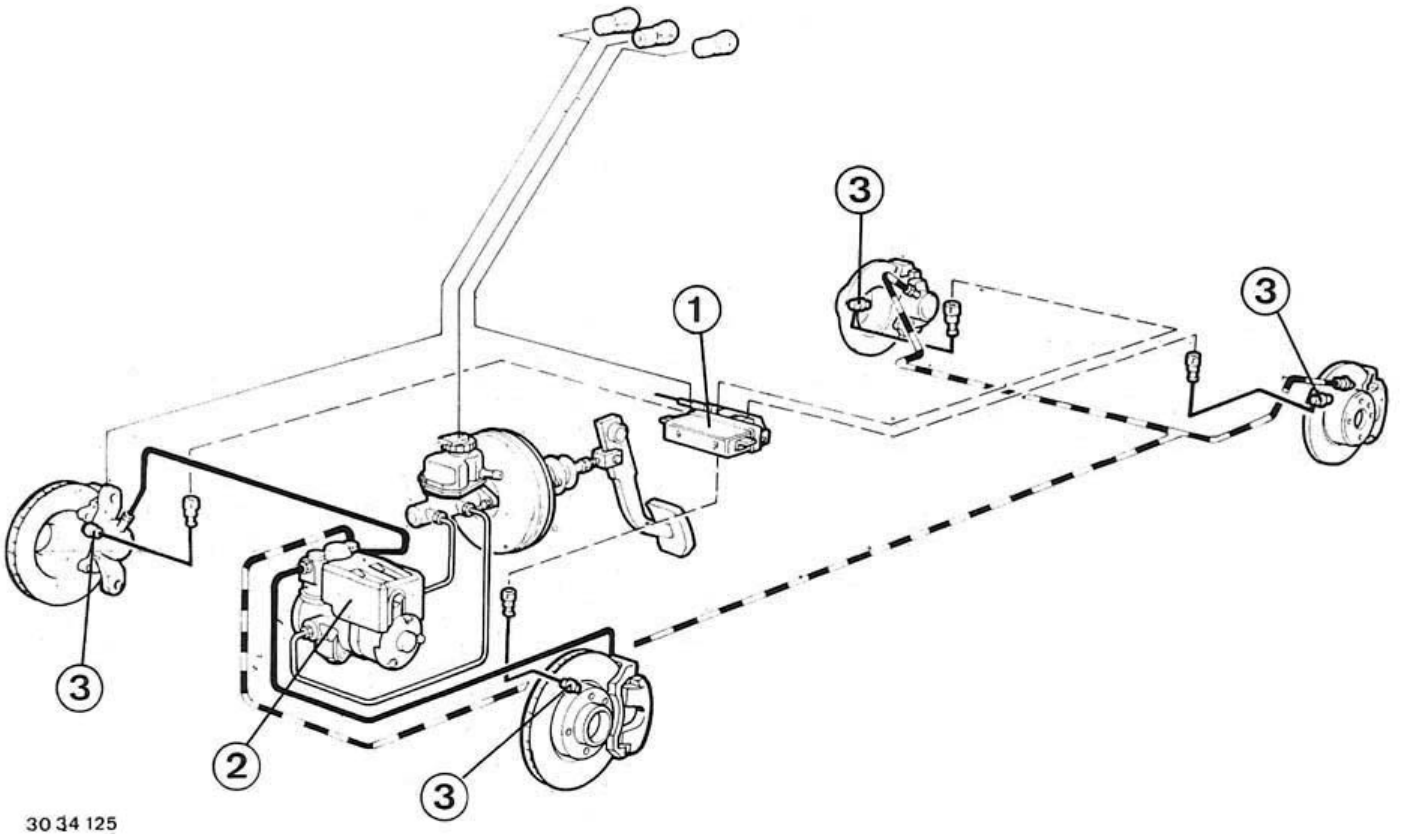
To control the brake pressure in the wheel brake cylinders, the brake hydraulic unit has threeway valves which permit three brake pressure conditions.

Pressure build-up, pressure holding and pressure drop. These three pressure phases adapt themselves in the sequences and length to the requirements of the desired control characteristic and power flow between the road surface and tires. In principle the control procedures are as follows.
As soon as a wheel deceleration or slip indicates the locking of a wheel, the brake pressure is first held. If the wheel still tends to lock, the pressure will be dropped so long until the wheel accelerates or the slip limit is exceeded. Afterwards the pressure is raised again and the control phases begin from new.

An electrically driven return delivery pump returns the brake fluid taken from the wheel brake cylinder while dropping the pressure to the appropriate brake circuit.
The pump is designed as a two-piston pump so that the circuits of a dual brake circuit system remain fully separated.

Wire Harness:
The control unit is connected with the speed sensors and electric part of the hydraulic unit via a special wire harness for the sake of signal input and order output as well as electric power supply.

ABS LAYOUT DRAWING



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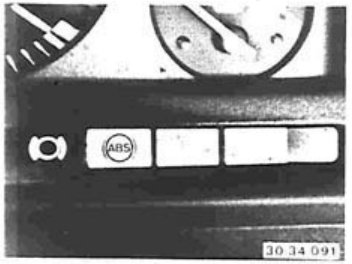
1 = Electronic control unit
2 = Hydraulic unit
3 = Pulse sensor



DESCRIPTION OF AND CHECKING ABS INDICATOR LAMP

ABS indicator lamp lights up after switching on ignition.
Indicator lamp should go out when engine has started and ABS is okay.

Procedures are repated each time ignition is switched off and on.

Causes for faulty indication (indicator lamp doesn't light up, doesn't go out or comes on while driving – even occasionally – can be found with help of BMW SERVICE TESTER and brake test stand (dynamometer).

Important!
Each started step must be finished completely without a break!

Control unit will automatically switch to "normal braking" where there is electric or electronic faults in ABS.
This means car can still be braked, but without control (wheel could lock!).
Faulty system will be indicated by a continuously lighted ABS indicator lamp in instrument panel.

325 iX (Cars with Four Wheel Drive):
If ABS indicator lamp lights up while driving, first measure resistance in acceleration sensor and electric wire (see 34 52 000) before testing ABS.

Check throttle valve adjustment (see 13 54 130) in case of impaired comfort, e.g. hesitation or stalling of engine during ABS regulation.

ABS of 325 iX cars may not be tested on brake test stand (Test Steps 8, 9 and 10).

GENERAL INFORMATION ON REPAIRS AND BRAKE SYSTEM

Basically ABS does not require servicing, however, pay attention to the following points when working on cars with ABS.

a) Disconnect plug on electronic control unit (ignition switched off) when welding with electric welder.

b) When painting, electronic control unit can be subjected to max. 95° C (203° F) briefly or max. 85° C (185° F) for a longer period (about 2 hours).

c) Battery terminals must be tightened perfectly on end poles of battery after reinstallation of removed battery.

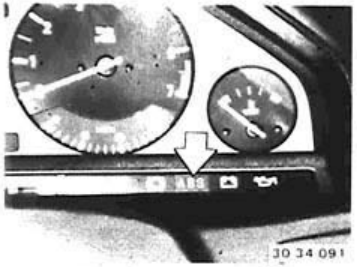
d) After replacement of hydraulic unit, control unit, pulse senders or wire hraness as well as after work which meant contact with ABS equipment (e.g. accident damage repairs), entire ABS must be checked with BMW SERVICE TESTER.
It is important that brake pipes and hoses are routed correctly.

e) After each job on brake system, brakes must be bled and high / low pressure tests performed.
Check all connections for leaks.

f) Brake cleaning solutions must always be kept out of brake system when cleaning brake components with brake cleaners.
Chlorinated hydrocarbons contained in many brake cleaning products of various manufacturers would lead to corrosion of brake components. Even most minute traces of brake cleaner residue must be avoided.

Note:
Only use cleaners* approved by BMW.

* Source of Supply: HWB

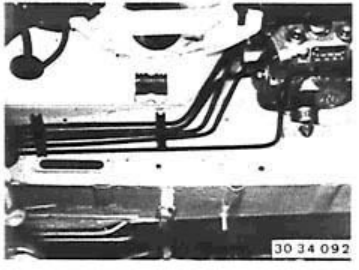


34 50 000 CHECKING OPERATION OF ABS

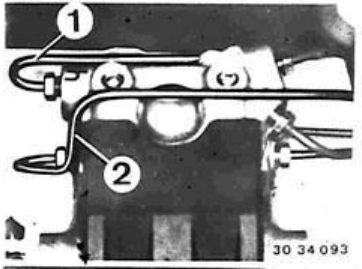
An electronic circuit in the control unit monitors ABS constantly.
Operation must be checked when ABS indicator lamp does not go out, comes on while driving or does not come on when turning on the ignition or after performing jobs on ABS.
See special note for 325 iX.



Operation is checked with the BMW service tester.
Connect tester on wire harness and control unit with a suitable plug.
See connection plan on ABS nominal value microfiche.
Important!
Each step of test must be finished completely, without taking a break.

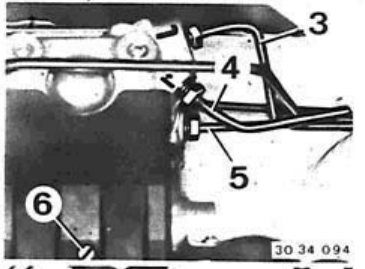


Servicing ABS.
Basically the ABS does not require servicing. Check brake lines to and from the hydraulic unit for correct routing and leaks together with the general brake system.

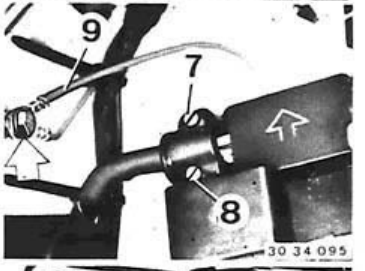


34 51 520 REMOVING AND INSTALLING/ REPLACING HYDRAULIC UNIT ASSEMBLY FOR ABS

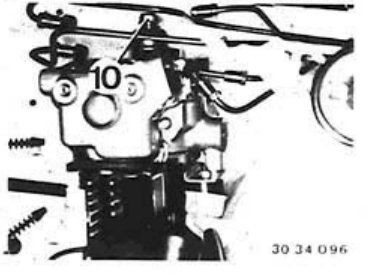
Disconnect battery ground lead.
Remove air cleaner 13 71 000.
Remove headlight cover.
Disconnect lines (1 and 2).
Installation:
Line (1) = to brake force regulator, rear.
Line (2) = to brake master cylinder, rear.
Caution!
Catch escaping brake fluid and keep it off of clothes and painted surfaces.



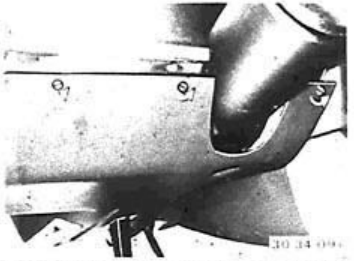
Disconnect lines (3 ... 5).
Unscrew bolt (6) and remove cover.
Installation:
Line (3) = to left front brake caliper.
Line (4) = to right front brake caliper.
Line (5) = to front brake master cylinder.
Don't mix up lines (mark if necessary).
Important!
Keep lines and connections clean (insert plugs).



Unscrew bolts (7 and 8).
Pull off multiple-pin plug.
Disconnect ground wire (9).

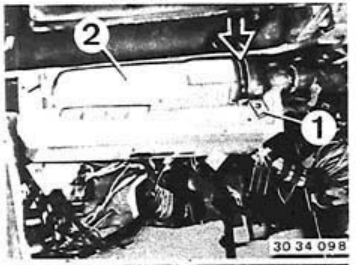


Loosen nut (10).
Pull up and remove hydraulic unit.
Installation:
Bleed brake system for ABS – 34 00 047
Check operation of ABS with BMW service tester – 34 50 000.

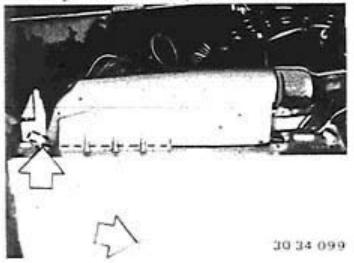


34 52 510 REPLACING CONTROL UNIT FOR ABS

Detach instrument panel trim at bottom left.
Caution!
Turn off ignition before removing or installing control unit.

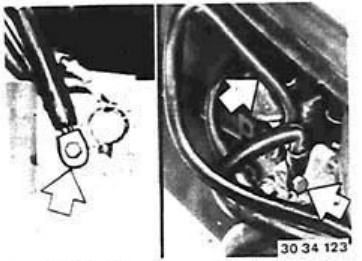


Push back clamp (1) and pull out multiple-pin plug (2) to the right, and then disconnect to the left.
Unscrew control unit on body.



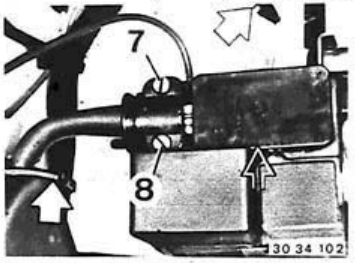
Check for correct connections when replacing a control unit.
Multiple-pin plug has a tab on its left side, for which the control unit must have an opening.
Important!
Only use a control unit with the specified code number*.
Installation:
First engage left side of plug and then press right side into clamp.
Check operation of ABS.

* See Specifications

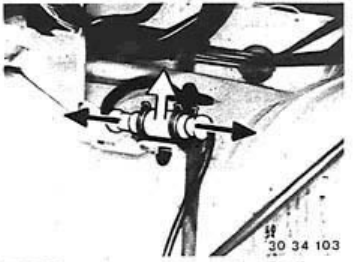


61 11 530 REPLACING WIRE HARNESS FOR ABS

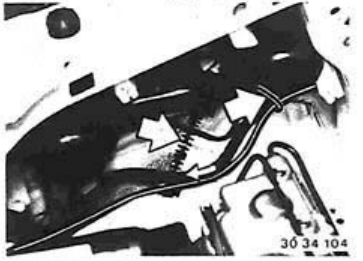
Disconnect battery ground lead.
Disconnect lead on battery positive terminal and lay back to left side in engine compartment.
BMW 325 e / 325 i:
Disconnect negative lead from battery support point on engine compartment firewall.



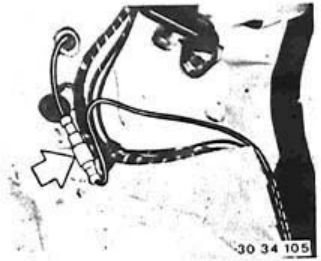
Take off cover on hydraulic unit.
Unscrew bolts (7 and 8).
Pull off multiple-pin plug on hydraulic unit carefully (plastic pins).
Loosen wire clip.



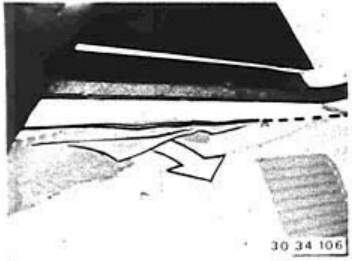
Remove covers for left and right headlights.
Disconnect both plugs for pulse sensors in engine compartment.
Loosen wire clips.



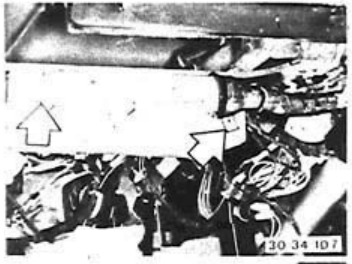
Pull in right wire to left side of engine compartment.



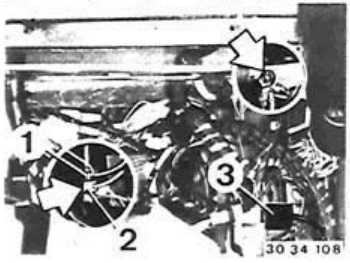
Remove both front seats 52 10 000.
Remove rear seat 52 20 010.
Disconnect both plugs for rear pulse sensors.



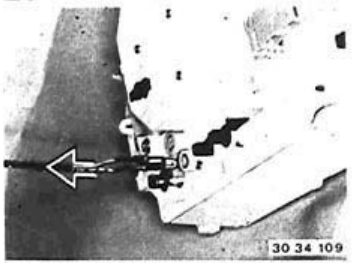
Detach carpets and trim panels as required.
Lay back left and right wires forward.



Detach instrument panel trim at bottom left.
Pull off multiple-pin plug on control unit.
Installation:
First engage left side of plug and then press right side into clamp.



Disconnect ground wire on body.
Pull off plugs (1 and 2).
Pull off electronic relay (3).



Pull indicator lamp with holder out of instrument cluster.



Remove fuse box.
Push wire harness into passenger compartment.

DESCRIPTION AND DUTY OF ACCELERATION PICK-UP (325 iX)

Description:

In the acceleration pick-up there are two mercury switches, one each for forward and reverse drive, which are installed in longitudinal direction of car at an angle to the horizontal.
The series connected mercury switches provide closed contact in horizontal position (resistance less than 1 k-ohm).

Negative acceleration (braking) of the car or inclination of the acceleration transmitter will displace the mercury filling and cause the contact to open (resistance greater than 2.5 M-ohms).

The glass tube is inclined in such a manner, that braking deceleration of 35 to 45 % is necessary to open the contact.
The braking deceleration value for forward drive can be simulated by inclining the acceleration pick-up from 19.5 to 24° (with Special Tool 34 5 150 this is equal to 26.5 to 33.0 mm (1.043 to 1.299")).
The switching point for reverse drive does not have to be adjusted.

Duty:

BMW 325 iX (all wheel drive) is the first standard production car to have permanent all wheel drive with constantly switched central and rear axle locks and also a continuously effective ABS.

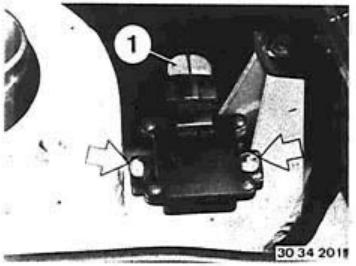
So that all three systems can be effective simultaneously, a sensor is required to provide information on the road condition (higher or lower traction).

The acceleration pick-up performs this duty in the BMW 325 iX (all wheel drive).

The ABS control unit will decide between various data fields depending on the switch condition (open or closed mercury switches), and consequently consider the traction condition of a street or road.

Defective Indicator:

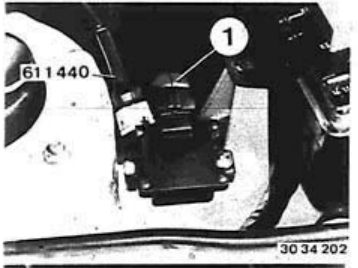
If an open switch condition (resistance greater than 2.5 M-ohms) is reported to the ABS control unit over a period of time longer than 20 seconds, the ABS switches off and reports this to the driver with a warning lamp in the instrument cluster.



34 52 520 REMOVING AND INSTALLING OR REPLACING ACCELERATION PICK-UP

Replacing:

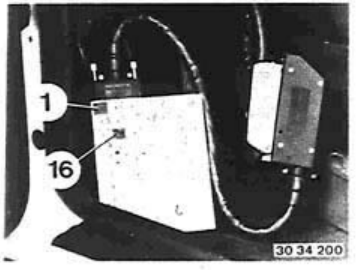
Pull off plug (1).
Remove shear-off screws (only drilling out is approved).
Installation:
Adjust acceleration pick-up.



34 52 000 CHECKING ACCELERATION PICK-UP FOR ABS

Checking (Switch):

Pull off plug (1).
Connect Jetronic test lead 61 1 440 on acceleration pick-up.
Connect ohmmeter (M 06) of BMW service tester.
Nominal value: less than 1 k-ohm.



If Necessary, Checking (Switch with Wire and Plug):

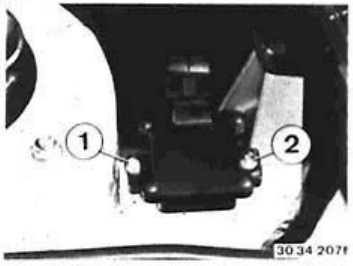
Connect universal adapter* on wire harness from ABS control unit.
Measure resistance between connections (1 and 16).
Nominal value: less than 1 k-ohm.
Ignition must be turned off while measuring.

* Source of Supply: HWB

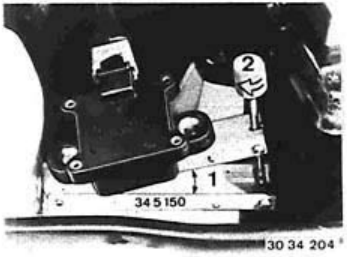
(cont. of 34 52 520)
Acceleration Pick-up for ABS:

Adjusting

Requirements:
Car parked on level ground (workshop floor).
Car including trunk empty.
Fuel tank full (or equal weight in trunk).
Tire inflation pressure correct.

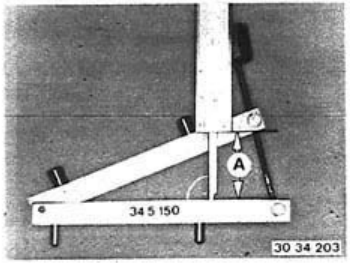


If the measured actual value is smaller than the nominal value, install the shim on mounting point (1).
If the measured actual value is larger than the nominal value, install the shim on mounting point (2).



Place Special Tool 34 5 150 with acceleration pick-up (in installed position) and test lead 61 1 440 on console in car.
Connect ohmmeter (M 06) of BMW service tester with test lead.
Nominal value: less than 1 k-ohm.
Increase angle (1) of special tool with screw (2) so long, until ohmmeter displays more than 2.5 M-ohms.

Install shim of determined thickness between the console and special tool.
Recheck switching point.
If switching point is now within tolerances, remove special tool and install acceleration pick-up with shim and shear-off screws.
Tighten shear-off screws and lock by shearing off the heads.
Tightening torque: 6 to 8 Nm (4.5 to 5.5 ft. lbs.)



Remove Special Tool 34 5 150 and measure distance (A).
Compare actual value with nominal value table.
If measured value is within tolerances, install acceleration pick-up without shim.
If measured value is not within tolerances, determine thickness of shim.
Examples:

Actual value	35.6 mm (1.401")
Maximum value	33.0 mm (1.299")
Min. shim thickness	2.6 mm (0.102")

or

Actual value	35.6 mm (1.401")
Minimum value	26.5 mm (1.043")
Max. shim thickness	9.1 mm (0.358")

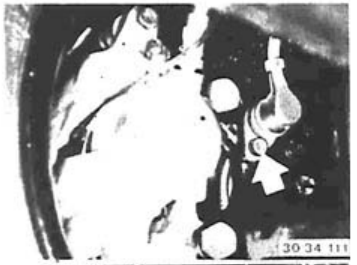
Nominal Value Table

For adjusting acceleration pick-up in car and checking acceleration pick-up.



	Distance "A" in mm
Permissible switching tolerance of acceleration pick-up in car	26.5 ... 33.0

A maximum of one wedge and three shims (a = 1 mm / 0.039") may be used on one mounting bolt to correct the switching point of the acceleration pick-up in the car.
If the switching point of an acceleration pick-up in the car is beyond the maximum shim range, the console must be corrected.
The wedge, Part No. 34 51 1 156 827, is equal to 4.9 ... 5.3 mm (0.193 to 0.209").



61 12 510 REMOVING AND INSTALLING/ REPLACING ONE FRONT PULSE (SPEED) SENSOR FOR ABS

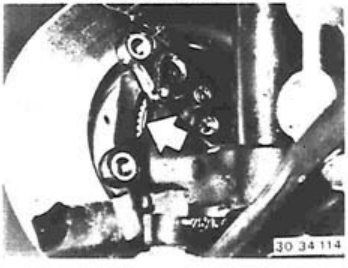
Turn off ignition.
Unscrew socket head screw.



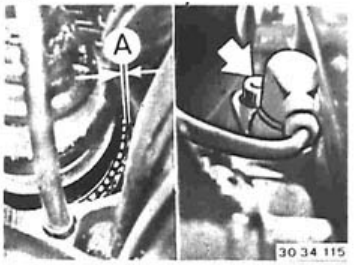
Pull out pulse sensor.
Installation:
Check pulse sensor for damage, replacing if necessary.
Lubricate pulse sensor and housing with Molykote Longterm 2 before installing.
Spacing is given for pulse sensors by the take-up bores.



When replacing pulse sensor, disconnect plug in engine compartment and push wires through downward.
Lift wires out of holders.
Check operation of ABS – 34 50 000.

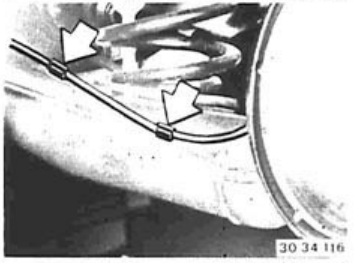


Removing and Installing/Replacing Front Pulse Wheel for ABS:
The front pulse wheel can only be replaced together with the bearing assembly.
See "Replacing Wheel Hub – 31 21 180".

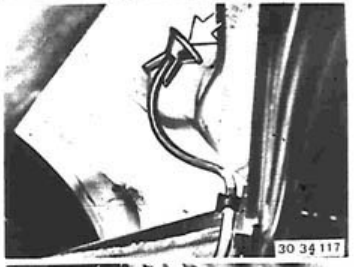


61 12 522 REMOVING AND INSTALLING/ REPLACING ONE REAR PULSE (SPEED) SENSOR FOR ABS

Turn off ignition.
Remove rear wheel 36 10 300
Unscrew socket head screw.
Installation:
The distance* between pulse sensor and pulse wheel (A) is given by design and cannot be adjusted.
However, it is necessary to visually inspect pulse wheel for dirt or damage.



Lift wires out of holders.
Pull out pulse sensor.
Installation:
Check pulse sensor for damage, replacing if necessary.
Lubricate pulse sensor and housing with Molykote Longterm 2.

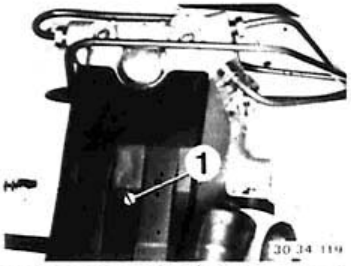


When replacing pulse sensor, remove rear seat 52 20 010.
Disconnect plug for pulse sensor.
Pull out rubber grommet and wires.
Disconnect pulse sensor.
Important!
Don't damage rubber grommet.



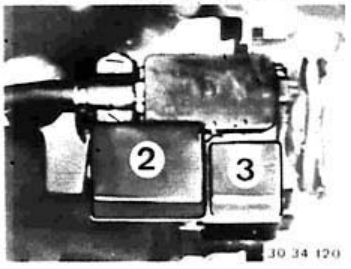
Removing and Installing/Replacing Rear Pulse Wheel for ABS:
The rear pulse wheel can only be replaced together with the rear output shaft.
See "Removing and Installing Output Shaft – 33 21 000".

* See Specifications

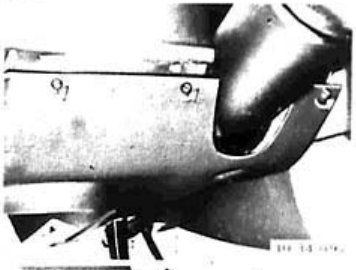


61 31 570 REPLACING RELAY ON ABS HYDRAULIC CONTROL UNIT

Unscrew screw (1).
Pull off cover.

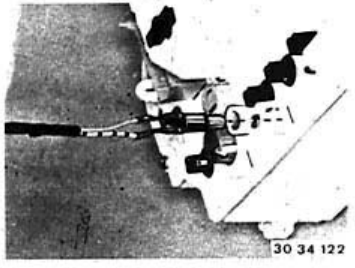


Pull out motor relay (2) or valve relay (3).

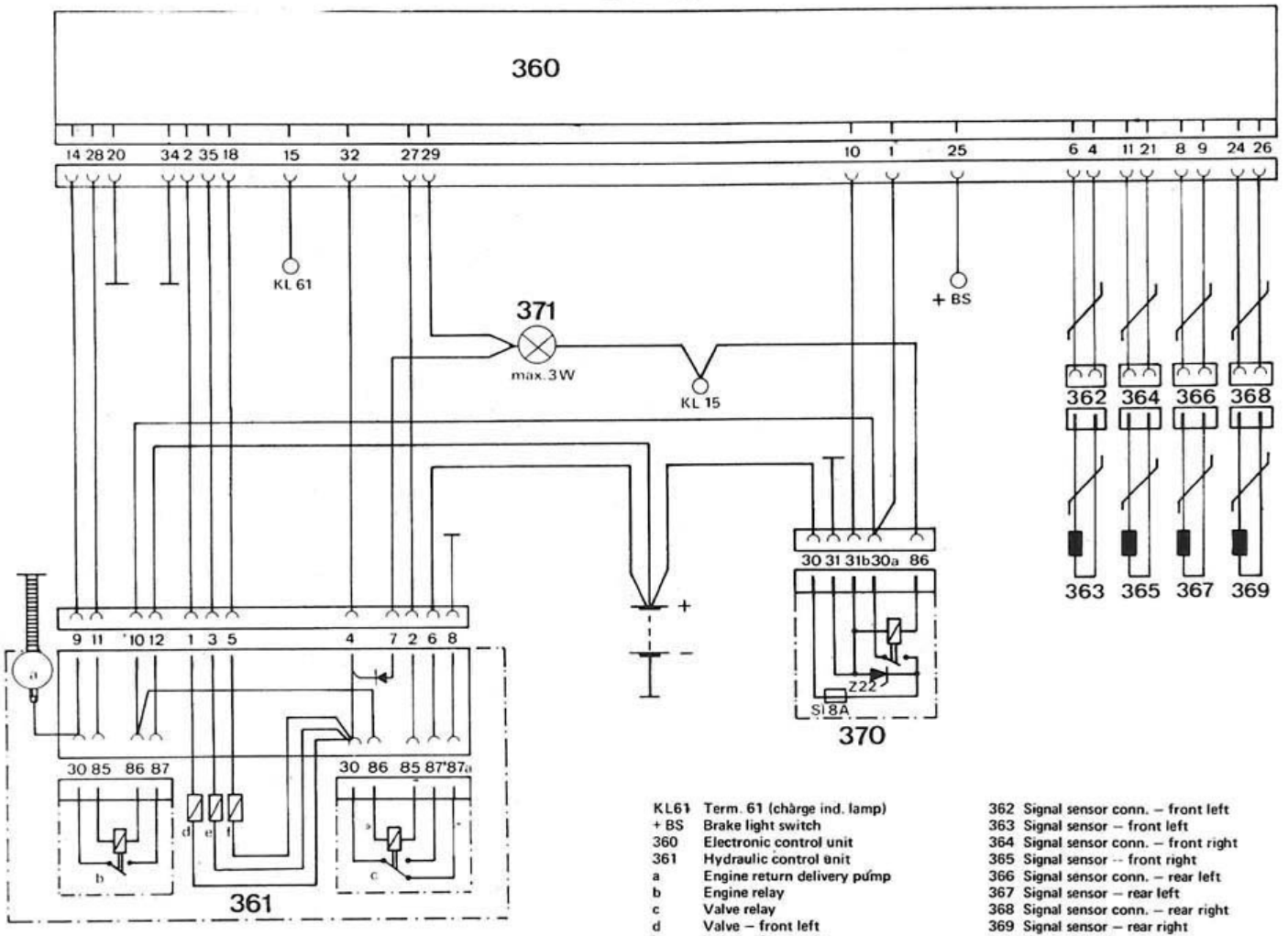


62 99 580 REPLACING INDICATOR LAMP FOR ABS

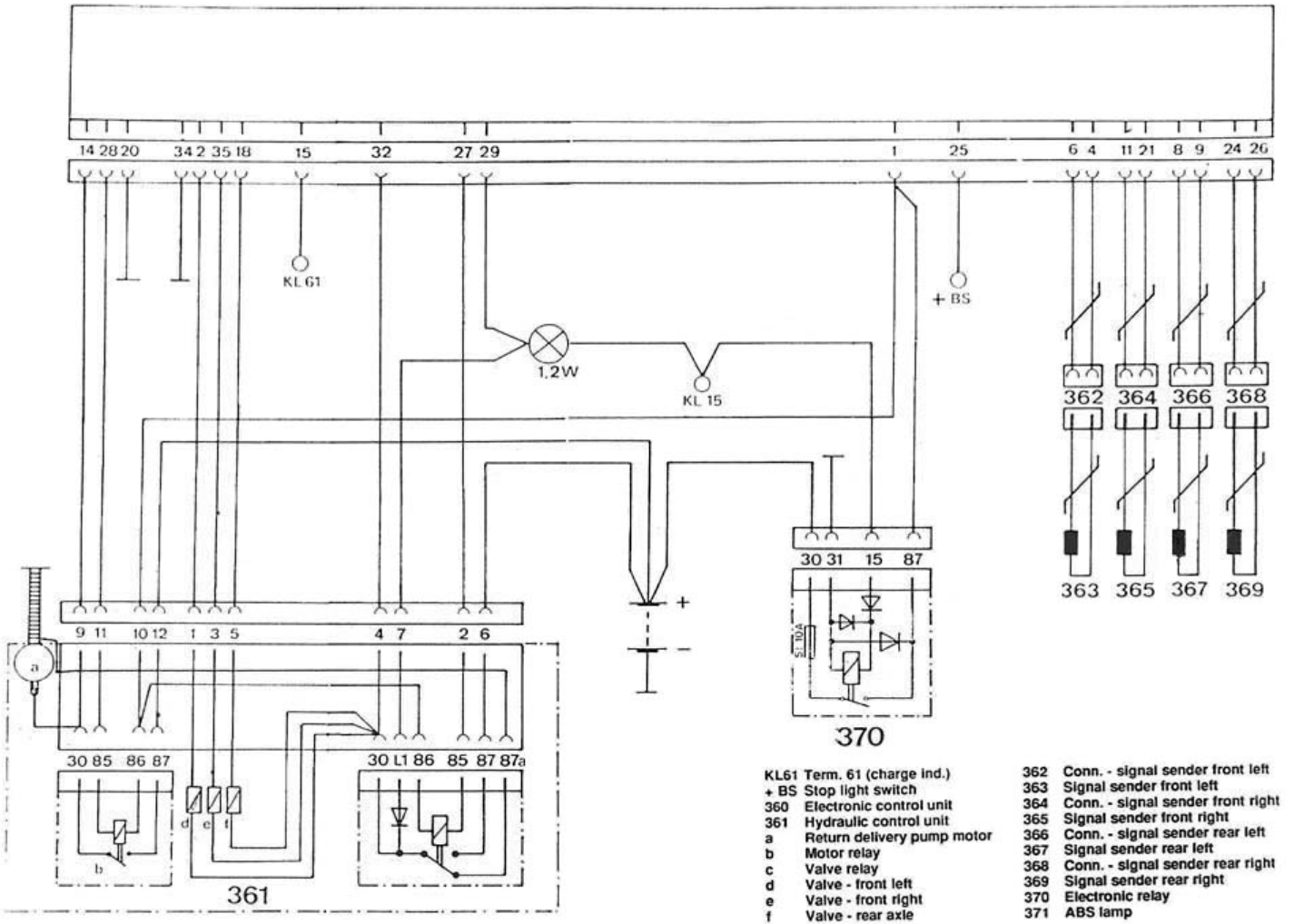
Remove instrument panel trim at bottom left.



Pull indicator lamp and holder out of instrument cluster.

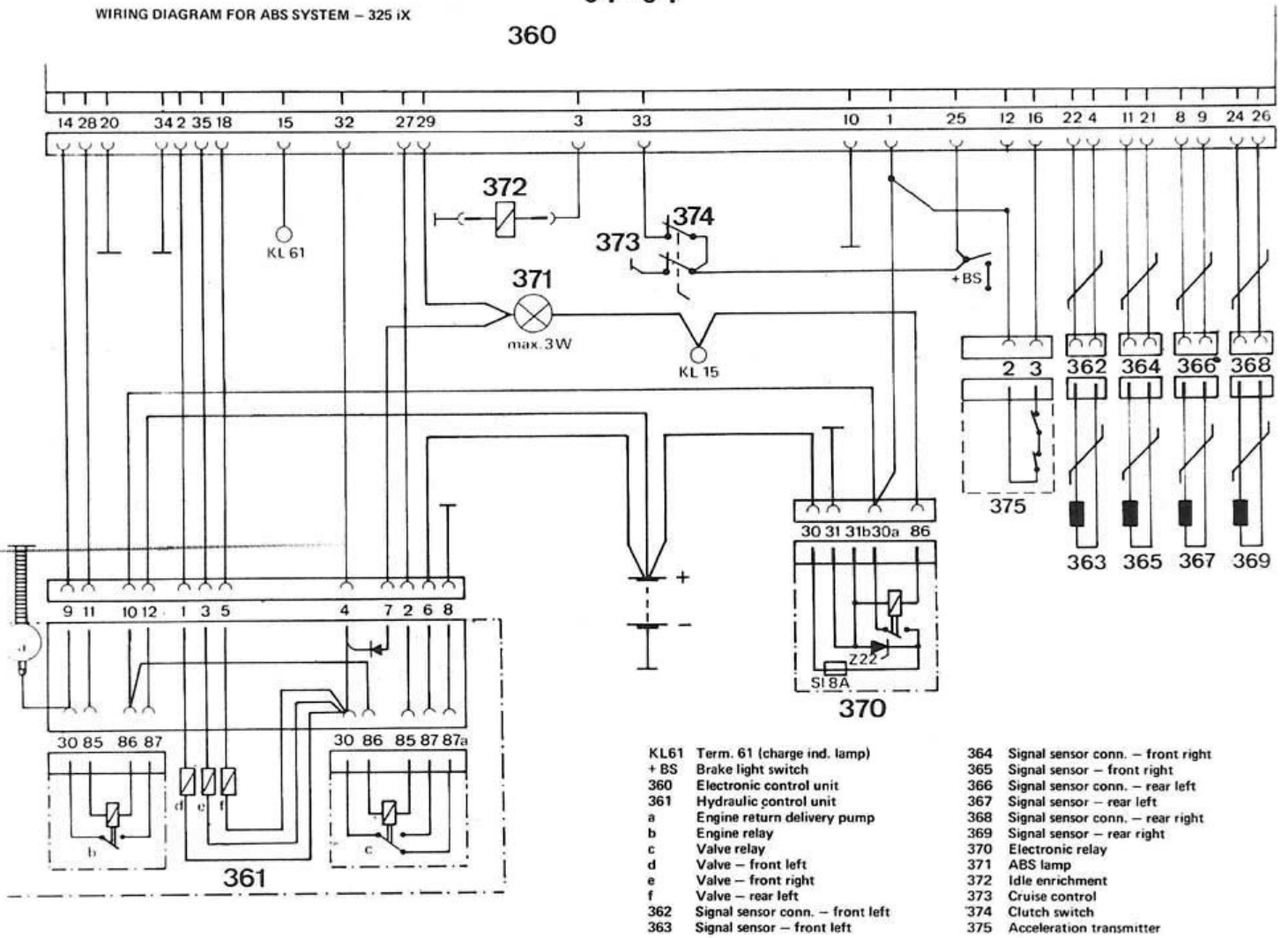


KL61	Term. 61 (charge ind. lamp)
+ BS	Brake light switch
360	Electronic control unit
361	Hydraulic control unit
a	Engine return delivery pump
b	Engine relay
c	Valve relay
d	Valve – front left
e	Valve – front right
f	Valve – rear axle
362	Signal sensor conn. – front left
363	Signal sensor – front left
364	Signal sensor conn. – front right
365	Signal sensor – front right
366	Signal sensor conn. – rear left
367	Signal sensor – rear left
368	Signal sensor conn. – rear right
369	Signal sensor – rear right
370	Electronic relay
371	ABS lamp

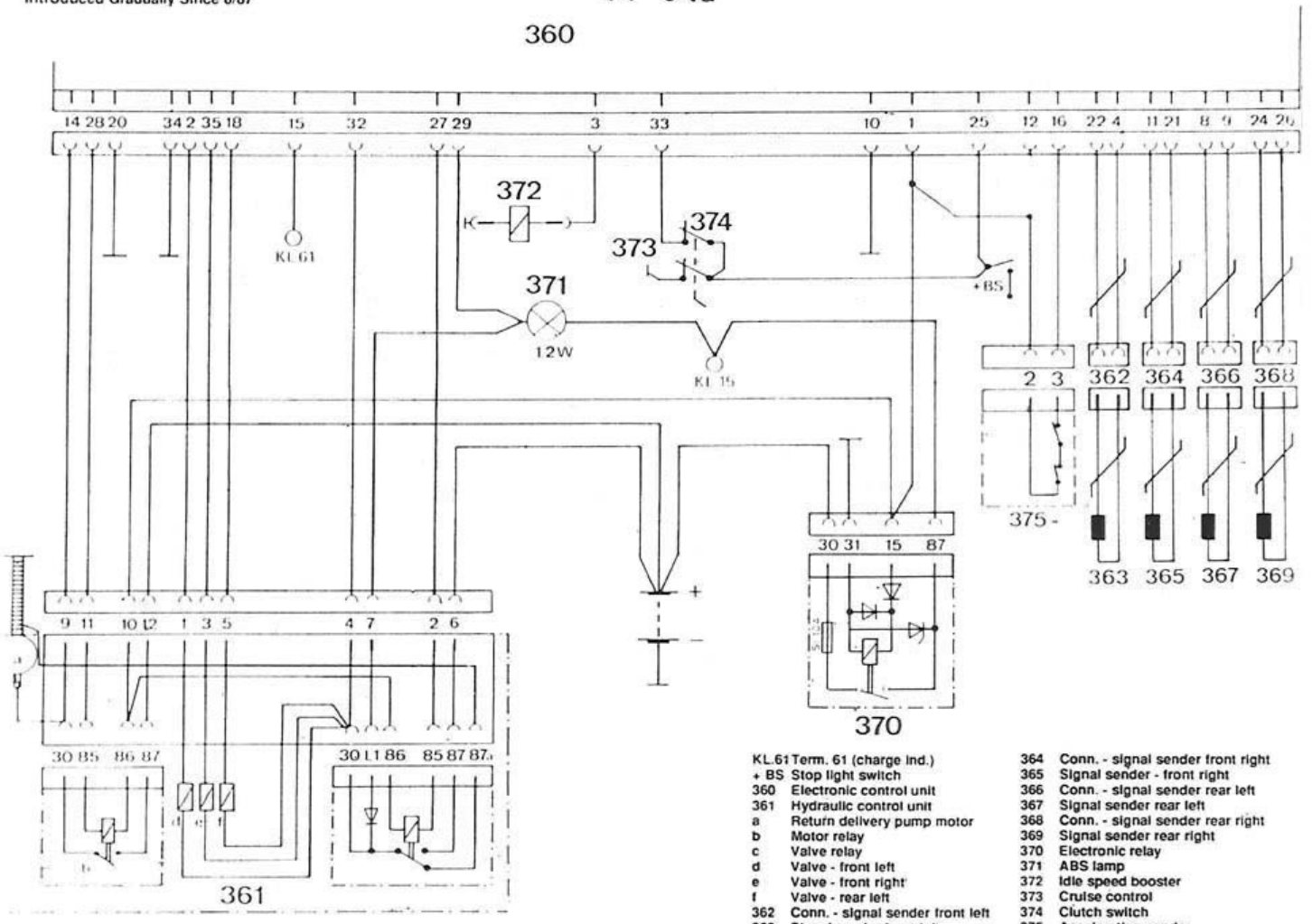


KL61	Term. 61 (charge ind.)
+ BS	Stop light switch
360	Electronic control unit
361	Hydraulic control unit
a	Return delivery pump motor
b	Motor relay
c	Valve relay
d	Valve - front left
e	Valve - front right
f	Valve - rear axle
362	Conn. - signal sender front left
363	Signal sender front left
364	Conn. - signal sender front right
365	Signal sender front right
366	Conn. - signal sender rear left
367	Signal sender rear left
368	Conn. - signal sender rear right
369	Signal sender rear right
370	Electronic relay
371	ABS lamp

WIRING DIAGRAM FOR ABS SYSTEM – 325 iX



KL61	Term. 61 (charge ind. lamp)	364	Signal sensor conn. – front right
+ BS	Brake light switch	365	Signal sensor – front right
360	Electronic control unit	366	Signal sensor conn. – rear left
361	Hydraulic control unit	367	Signal sensor – rear left
a	Engine return delivery pump	368	Signal sensor conn. – rear right
b	Engine relay	369	Signal sensor – rear right
c	Valve relay	370	Electronic relay
d	Valve – front left	371	ABS lamp
e	Valve – front right	372	Idle enrichment
f	Valve – rear left	373	Cruise control
362	Signal sensor conn. – front left	374	Clutch switch
363	Signal sensor – front left	375	Acceleration transmitter



KL.61	Term. 61 (charge ind.)	364	Conn. - signal sender front right
+ BS	Stop light switch	365	Signal sender - front right
360	Electronic control unit	366	Conn. - signal sender rear left
361	Hydraulic control unit	367	Signal sender rear left
a	Return delivery pump motor	368	Conn. - signal sender rear right
b	Motor relay	369	Signal sender rear right
c	Valve relay	370	Electronic relay
d	Valve - front left	371	ABS lamp
e	Valve - front right	372	Idle speed booster
f	Valve - rear left	373	Cruise control
362	Conn. - signal sender front left	374	Clutch switch
363	Signal sender front left	375	Acceleration sender

TROUBLESHOOTING ABS

E 30 - 1989 Models - Overvoltage Protection Relay Omitted (Excluding 325 IX, Now Integrated in Control Unit

Test Step	Tested	Troubleshoot, If Nominal Values Not Reached	Job Position
01 Wire harness Speed sensors	Speed sensors (DF)	Turn off ignition for single tests, control unit not connected.	Group 34
	front left	1. Check front left plug connection (visual inspection). 2. Disconnect front left plug, DF display must be > 999 k-ohms; DF display lower: fault in wire harness. 3. Check flow in leads 4 and 6 (325 iX: 22): bridge front left plug on wire harness end, DF display must then be < 1 ohm; DF display higher: fault in wire harness. 4. Measure resistance at plug on speed sensor end (M 06). Nominal value nit reached: replace front left speed sensor.	 61 11 530 61 12 510
	front right	1. and 2. as above, however, right front plug connection. 3. Check flow in leads 11 and 21: bridge right front plug on wire harness end, DF display must then be < 1 ohm; DF display higher: fault in wire harness. 4. As above: replace right front speed sensor.	 61 11 530 61 12 510
	rear left	1. and 2. as above, however, left rear plug connection. 3. Check flow in leads 8 and 9: bridge left rear plug on wire harness end, DF display must then be < 1 ohm; DF display higher: fault in wire harness. 4. As above: replace left rear wire harness.	 61 11 530 61 12 520
	rear right	1. and 2. as above, however, right rear plug connection. 3. Check flow in leads 24 and 26: bridge right rear plug on wire harness end, DF display must then be < 1 ohm; DF display higher: fault in wire harness. 4. As above: replace right rear speed sensor.	 61 11 53 61 12 520
	Speed sensor resistance to ground	1. Visual inspection for lead and wire damage (connection to car ground – insulation resistance). 2. Disconnect speed sensor plugs in order for reading > 999 k-ohms: replace corresponding speed sensor.	 61 12 510/520
	Speed sensor resistance to B +	3. Display remains < 999 k-ohms: fault in wire harness. Also refer to Test Step 03 when testing speed sensors! Bridge connections 30a and 86 on the electronic relay plug.	61 11 530
	Safety lamp	Display > 80 ohms: ABS control lamp fault or poor contact. Check or replace lamp. Check connections on lamp and term. 15. Display < 10 ohms: check leads 1 and 29 for ground out. Measure between conn. 86 on electronic relay plug and lead 29 on control unit plug. If "Wrong Connection" is displayed, repeat test with the diagnosis plug connected (better ground connection with the tester).	62 99 080

Test Step	Tested	Troubleshoot, If Nominal Values Not Reached	Job Position
02 Wire harness Relays Valves		Turn off ignition for single tests, control unit not connected.	Gr. 34
	Valve relay coil resistance	Check plug connections on hydraulic unit (plugs, relays). Replace valve relay. Measured value reading > 100 ohms: break in wire to valve relay. (from ignition switch wire 27, wires in hydraulic unit) Measured value reading: < 50 ohms = short circuit in wire to valve relay (wires 1 and 27, wires in hydraulic unit).	61 31 570 61 11 530 34 51 520
	Motor relay coil resistance	Check plug connections on hydraulic unit (plugs, relays). Replace motor relay. Measured value reading > 58 ohms: break in wire to motor relay (from ignition switch wire 28, wires in hydraulic control unit). Measured value reading < 34 ohms: short circuit in wire to motor relay (wires 1 and 28, wires in hydraulic unit).	 61 31 570 61 11 530 34 51 520
	Valve resistanc	Specifications not reached on all three valves: First check wire 32 for breaks or short circuit. Pull off plugs on hydraulic unit.	
	front left	Measure resistance direct on hydraulic unit between wires 1 and 4. Specification not reached: replace hydraulic unit. Check wire 2 from hydraulic unit plug to control unit plug for breaks or short circuit.	 34 51 520 61 11 530
	front right	Measure resistance direct on hydraulic unit between wires 3 and 4. Specifications not reached: replace hydraulic unit. Check wire 35 from hydraulic unit plug to control unit plug for breaks or short circuit.	 34 51 520 61 11 530
	rear	Measure resistance direct on hydraulic unit between wires 5 and 4. Specifications not reached: replace hydraulic unit. Check wire 18 from hydraulic unit plug to control unit plug for breaks or short circuit.	 34 51 520 61 11 530
	(rear right)	Measured resistance in wire harness adapter (4a), no measured value from car. Repeat test with connected diagnosis plug for "wrong connection" display (better ground connection with tester.)	

Test Step	Tested	Troubleshoot, If Nominal Values Not Reached	Job Position
03 Dynamic speed sensor test	Speed sensors (DF)	Wire harness and control unit connected.	Gr. 34
	front left front right rear left rear right	1. Cycle time Cycle time < specified value: gear turns too fast. Cycle time > specified value: gear turns too slow.	
		a) Visual Inspection: Excessive clearance between speed sensor and pulse gear. Speed sensor loose or dirty, check installation.	 61 12 510 61 12 520
		Check arrangement of gear with gauge. Hold opposite wheel on rear axle. Replace speed sensor.	 61 12 510 61 12 520
		2. Pulse Gear rotation not uniform enough. Check pulse gear teeth (condition, dirt). Check clearance between speed sensor and pulse gear. Replace pulse gear.	 61 12 510 61 12 520

Test Step	Tested	Troubleshoot, If Nominal Values Not Reached	Job Position
04 Dynamic voltage		*Caution!* Turn off ignition before pulling off a plug and measuring resistance!	Group 34
	Voltage between leads 1 and 10.	Ignition turned on. Engine running. Battery charged, check. Voltage drop checked at: battery connections (+ and –), term. 15 and from ignition lock to electronic relay connection, from relay to control unit lead 1.	
	Stab. voltage betw. leads 12 and 10	Check function of electronic relay. 325 iX: check lead 10 ground connection. If applicable, connect universal adapter (available from HWB) between car wire harness and adapter (4a). Bridge terminals 10 and 19 only for this test step. Replace control unit. Also refer to test line 2 of Test Step 05.	34 52 510
	Valve relay home contact voltage drop	1. Replace valve relay. 2. Ground connection has excessive transition resistance or break. 3. Check flow in following leads: lead 8 from ground to hydraulic unit plug, from hydraulic unit lead 8 to lead 87a, flow from lead 4 to valve relay term. 30, from lead 4 to multiple pin plug (control unit) lead 32.	61 31 570
	Valve relay opening contact voltage drop	1. Replace valve relay. 2. Check flow in following leads: lead 6 from term. B + to hydraulic unit plug, from lead 6 to valve relay lead 2 to multiple pin plug (control unit) lead 27, from hydraulic unit lead 2 to valve relay lead 85, from lead 86 (valve relay) to lead 86 (motor relay) and lead 10, from hydraulic unit lead 10 to electronic relay term. 30a or 30 without overvoltage protection relay to DME master relay term. 87a.	61 31 570
	Motor relay operating contact voltage drop.	1. Replace motor relay. 2. Check ground terminals of pump motor for tight fit and transition resistance. 3. Check flow in following leads: from term. B + to hydraulic unit plug lead 12, from multiple pin plug (control unit) lead 14 to hydraulic unit plug lead 9 in hydraulic unit to motor relay term. 30 and positive terminal on pump motor. 4. Pump motor faulty: replace hydraulic unit.	34 51 520.
	Safety circuit lamp, diode	Check lead 29 from multiple pin plug (control unit) to hydraulic unit plug for breaks and voltage drop. Check plug connection on control lamp. Valve relay plugged in. Pull off hydraulic unit plug. Diode test between leads 7 and 4 (M 09) – replace hydraulic unit.	34 51 520.
		Diode now in the valve relay beginning with 1988 models / replace valve relay / test between pin 30 and lead 1.	

Test Step	Tested	Troubleshoot, If Nominal Values Not Reached	Job Position
05 Dyn./Ground/ Overvoltage/ Bits		Caution! Turn off ignition before pulling off a plug and measuring resistance.	Group 34
	Voltage between leads 1 and 10	Ignition turned on. Engine running. Battery charged, check.	
	Ground lead 10	Check ground connection below dashboard on left side. Check flow of multiple pin plug on wire harness (control unit) lead 10 to ground connection. Replace connections on electronic relay.	61 11 530
	Ground lead 20	Check ground connection below dashboard on left side. Check flow of multiple pin plug on wire harness (control unit) lead 20 to ground connection.	61 11 530
	Ground lead 34	Check ground connection below dashboard on left side. Check flow of multiple pin plug on wire harness (control unit) lead 34 to ground connection.	61 11 530
	Lead 14 / return delivery pump ground	Check ground connection on battery console. Check ground connection on return delivery pump. Check flow in ground lead. Check flow in multiple pin plug on wire harness (control unit) lead 14 to plug on hydraulic unit and lead 9 to term. 30 in hydraulic unit. If there is a power flow break: replace wire harness. Flow in leads okay: replace hydraulic unit, also refer to Test Step 08 - ABS Pump.	61 11 530 34 51 620
	Overvoltage protection	Replace electronic relay (check previous points!).	34 52 510
		Overvoltage protection is integrated in the ABS control unit beginning with 1989 models.	
	Test cycle	Replace control unit (check previous points!).	34 52 510
		If motor relay only switches (clicks) at intervals without that the pump motor runs, the voltage will briefly drop excessively due to the high switching on power at the power supply leads from the battery. Repeat test with the engine running. See Test Step 04 as well as Test Steps 06 and 07.	
	Fault simulation	Replace control unit (check previous points!).	34 52 510

Test Step	Tested		Troubleshoot, If Nominal Values Not Reached	Job Position
06 Control unit/ simulation – front wheels				Gr. 34
	Voltage between wires 1 and 10		Turn on ignition. Run engine. Battery charge, check.	
	(solenoid)		Due to high switching on power, possibly repeat test with engine running.	
	left pressure	build-up	Replace control unit and repeat test step.	34 52 510
		drop hold	If in test steps 08, 09 and 10 valves do not switch or pump does not run: replace hydraulic unit.	34 51 520
	right pressure	build-up	Due to high switching on power, possibly repeat test step with engine running.	
		drop	Replace control unit and repeat test step.	34 52 510
		hold	If in test steps 08, 09 and 10 valves do not switch or pump does not run: replace hydraulic unit.	34 51 520
			Only the pressure building-up and pressure holding phases (2 A) can be checked in 325 iX cars because of the changed activation times in the control unit. Irregular values will be displayed on adapter B in switch position (5 A).	
			It might be necessary to repeat this test step to reach the nominal values due to the high switching-on power and short switching phase.	

Test Step	Tested	Troubleshoot, If Nominal Values Not Reached	Job Position
07 Control unit/ simulation – rear wheels			Gr. 34
	Voltage between wires 1 and 10	Turn on ignition. Run engine. Battery charged, check.	
	(solenoid) pressure build-up drop hold	Due to high switching on power, possibly repeat test step with engine running. Replace control unit and repeat test step. If in test steps 08, 09 and 10 valves do not switch or pump does not run: replace hydraulic unit.	34 52 510 34 51 520
		Only the pressure building-up and pressure holding phases (2 A) can be checked in 325 iX cars because of the changed activation times in the control unit. Irregular values will be displayed on adapter B in switch position (5 A). It might be necessary to repeat this test step to reach the nominal values due to the high switching-on power and short switching phase.	

Test Step	Tested	Troubleshoot, If Nominal Values Not Reached	Job Position
08 ABS return delivery pump			Gr. 34
	Voltage between wires 1 and 10	Ignition turned on. Engine running. Battery charged, check.	
	Front left right left/right Rear left/right	Due to high switching on power, possibly repeat test step with engine running. Refer to test steps 05, 06 and 07. Testing the ABS requires the conventional brake system to be okay: bled properly, brake line connections tight, brake pads okay, master and wheel cylinders okay. Watch uniformity of wheels on one axle. Observe relation between wheel – reading.	
		Brake lines mixed up on hydraulic unit. Replace hydraulic unit.	34 51 520
		This test step may not be performed on a dynamometer for 325 iX cars, since the total loading time for the central lock in the transfer box must not exceed 60 seconds at a wheel speed of max. 7.5 km/h (4.5 mph). Refer to brake test dynamometer in 34 00 009.	

Test Step	Tested	Troubleshoot, If Nominal Values Not Reached	Job Position
09 Hydraulic unit pressure drop			Gr. 34
	Voltage between wires 1 and 10	Turn on ignition. Run engine. Battery charged, check.	
	Front left right left/right Rear left/right	Due to high switching on power, possibly repeat test step with engine running. Refer to test steps 05, 06 and 07. Testing the ABS requires the conventional brake system to be okay: bled properly, brake line connections tight, brake pads okay. Watch uniformity of wheels on one axle.	
		Replace hydraulic unit.	34 51 520
		This test step may not be performed on a dynamometer for 325 iX cars, since the total loading time for the central lock in the transfer box must not exceed 60 seconds at a wheel speed of max. 7.5 km/h (4.5 mph). Refer to brake test dynamometer in 34 00 009.	

Test Step	Tested	Troubleshoot, If Nominal Values Not Reached	Job Position
10 Hydraulic unit pressure build-up pressure hold			Gr. 34
	Voltage between wires 1 and 10	Turn on ignition. Run engine. Battery charged, check.	
	Front left right left/right Rear left/right	Due to high switching on power, possibly repeat test step with engine running. Refer to test steps 05, 06 and 07. Testing the ABS requires the conventional brake system to be okay: bled properly, brake line connections tight, brake pads okay. Watch uniformity of wheels on one axle.	
		Check lines to and from hydraulic unit for leaks. Replace hydraulic unit.	34 51 520
		This test step may not be performed on a dynamometer for 325 iX cars, since the total loading time for the central lock in the transfer box must not exceed 60 seconds at a wheel speed of max. 7.5 km/h (4.5 mph). Refer to brake test dynamometer in 34 00 009.	

ABS FAULT 325 IX (ABS Lamp Comes On After Repeated Cancellation By Restarting Engine)

CONDITION (Diagnosed After Engine Stopped)	CAUSE	CORRECTION
Lamp immediately after starting engine	Hydraulic unit, operating voltage, power supply. Acceleration sender has ground contact.	Service Tester Check PIN 16 of ABS wire harness plug for gound contact.
Lamp 15 to 20 seconds after starting engine (car stopped, engine running)	Break in "idle boost" current path.	Break in ground connection between ABS wire harness plug PIN 3 and solenoid valve.
Lamp at high engine speed in stopped car (or long afterrunning ABS control after stopping car) (> 1 second).	Dispersion in sensor leads.	Check electric lead routing of ABS sensors.
Lamp after exceeding speed of about 12 km/h ((7.5 mph).	Return delivery pump, electronics.	Service Tester
Lamp about 15 to 20 seconds after moving off (road speed > 3 km/h or 1.85 mph).	Break in acceleration sender current path.	Pin 16 to Pin 1 of ABS wire harness plug or connections 2 and 3 of acceleration sender - check plug connection in particular -.
Lamp after moving off frequently (road speed > 12 km/h or 7.5 mph).	Sensor fault (break in wire).	Service Tester
	Excessive voltage fluctuation in speed boost activation.	Difference in voltage between Pin 3 on ABS control unit and Pin 50 on Motronic control unit/nominal value: < 0.5 V. Check part number of Motronic control unit, see Service Information of Group 34.

35 Pedals

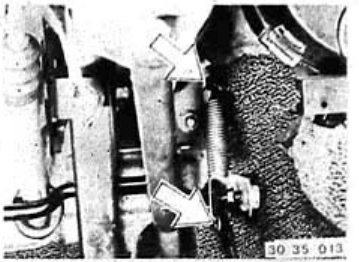
35 11 000	Console for pedals – remove and install	35- 1
	Clutch, brake and accelerator pedals – layout drawings	35- 3
35 21 000	Brake pedal – remove and install	35- 4
35 31 000	Clutch pedal – remove and install	35- 5
35 21 011	Brake pedal bearing sleeve – replace	35- 6
35 31 011	Clutch pedal bearing sleeve – replace	35- 6
35 41 000	Accelerator pedal – replace	35- 6.1
030	Accelerator pedal shaft – remove and install	35- 7
421	Accelerator cable – replace / adjust	35- 8
	Accelerator cable adjusting procedures	35- 9
480	Kickdown switch – replace (EH transmission)	35- 9

RHD

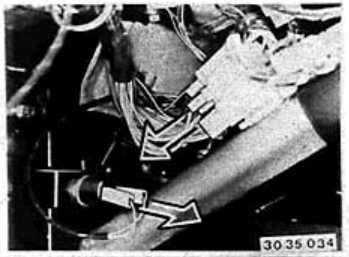
	See instructions of LHD for jobs not listed	
	Pedal layout drawings	35- 1R
	Clutch and brake pedal adjusting distances	35- 2R
	Pedal side spacing control distances	35- 3R
35 11 000	Console for pedals – remove and install	35- 4R
. . .	Console for brake booster – remove and install	35- 7R
35 21 . . .	Reversing lever, left – replace	35- 8R
. . .	Reversing lever, right – replace	35- 8R
. . .	Brake operation pull rod – replace	35- 9R

35 11 000 REMOVING AND INSTALLING CONSOLE FOR PEDALS

Disconnect battery ground lead.
Remove dashboard trim panel at bottom left – see Group 51.

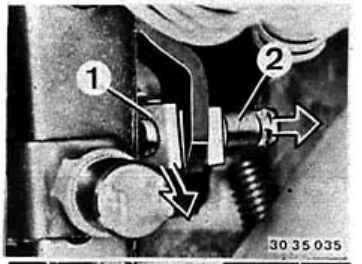


Disconnect accelerator pedal return spring on pedal.

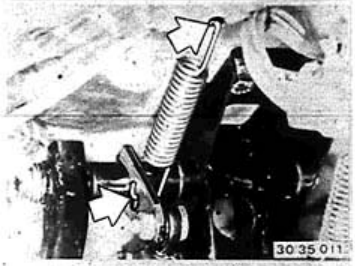


Pull off plug on stop light switch.
Pull off central electric plug on steering column.

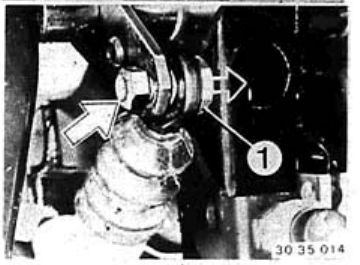
Note:
Since 1987 models: pull off plug of stop light switch – see Group 61.



Press off clamp (1) on brake linkage.
Pull out shaft (2).

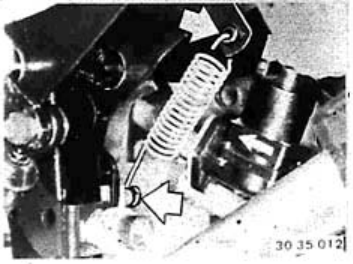


Version with Clutch Pedal Return Spring:
Disconnect clutch pedal return spring on body.

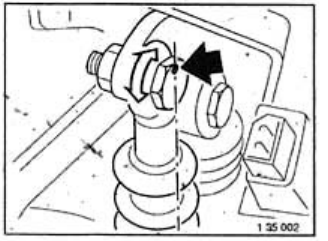


Unscrew nut and pull out eccentric (1).

Installation:
Install setscrew with Molykote Long-term 2.
Tightening torque*.

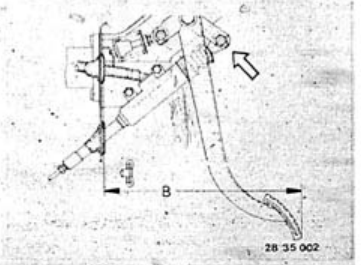


Disconnect brake pedal return spring on pedal.



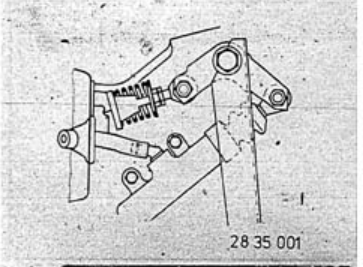
Installation:
Procedures for Adjusting Eccentric Bolt of Clutch Pedal:
Turn eccentric bolt until the dot on the eccentric bolt is opposite the clutch master cylinder.

* See Specifications

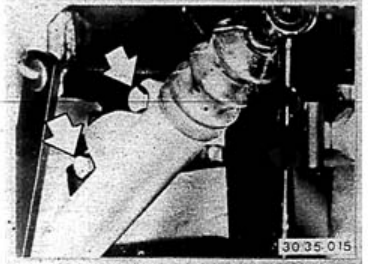


Installation:
Distance (B)* must be reached.
If distance (B)* cannot be reached with the described adjusting procedures, turn the eccentric bolt 180°.

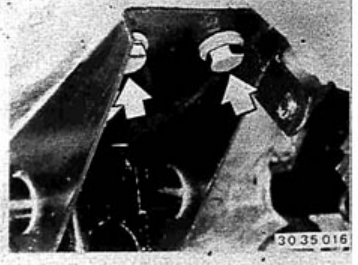
Important!
Intermediate positioning of the eccentric bolt is not approved!
Tightening torque*.



Installation:
Cars with over-center spring – check the installed position.



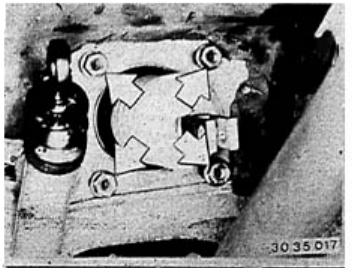
Unscrew master cylinder on the pedal console.



Unscrew bolts.

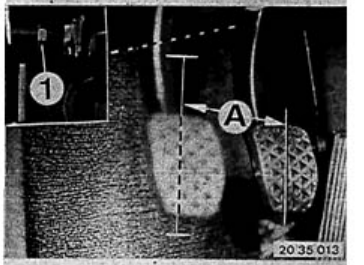
Installation:
Tightening torque*.

* **See Specifications**

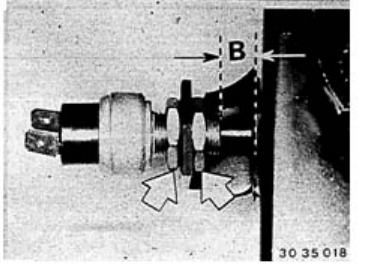


Unscrew console on the engine compartment wall.

Installation:
Tightening torque*.



Installation:
Adjust brake pedal height on brake linkage (1) (see brake pedal layout drawing).
Tightening torque*.



Installation:
Adjust stop light switch.

B = 5 to 6 mm (0.197 to 0.236").

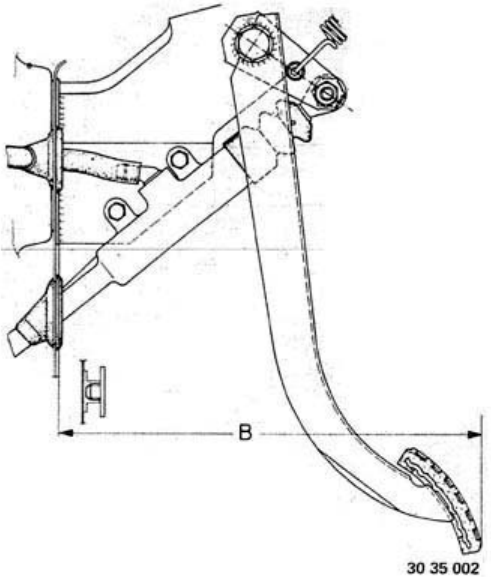
Stop Light Switch Since 1987 Models: See Group 61 for adjusting as well as removing and installing procedures.

Check function of stop lights.

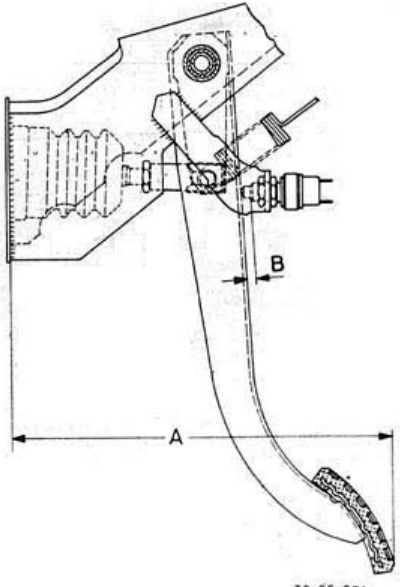
* **See Specifications**

Top Dead Center Spring

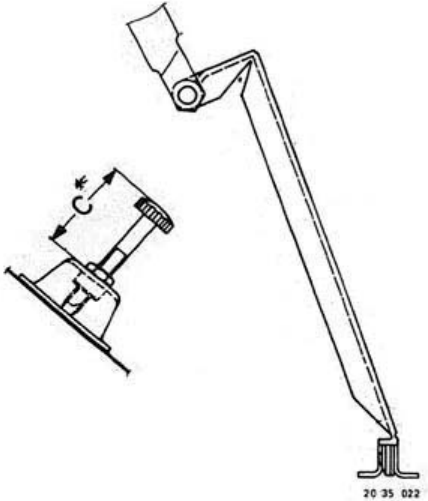
LAYOUT DRAWINGS OF CLUTCH, BRAKE AND ACCELERATOR PEDALS



30 35 002



30 35 001

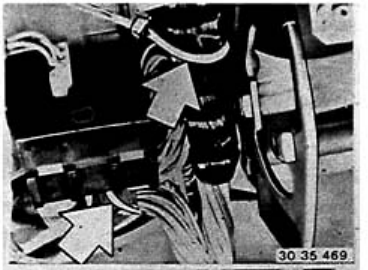


20 35 022

* See Specifications
** See Group 34

35 21 000 REMOVING AND INSTALLING BRAKE PEDAL

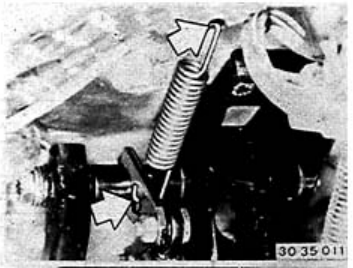
Remove dashboard trim panel at bottom left – see Group 51.



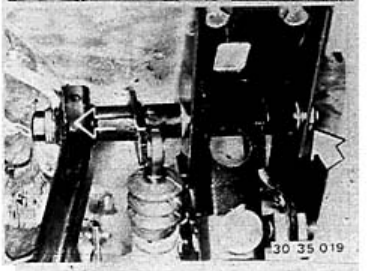
Cars with Pedal Value Sender:
Cut off straps and pull wire harness down.

Note:
Pedal value is shown removed for better understanding.

Installation:
Check for correct routing – wire harness must not rub on any parts of the car!

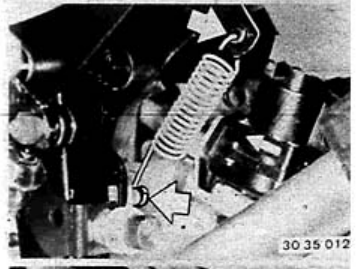


Version with Clutch Pedal Return Spring:
Disconnect clutch pedal return spring on body

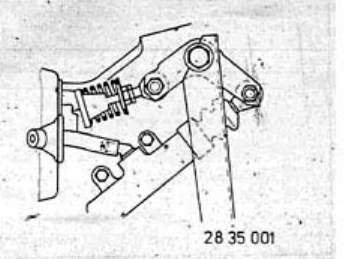


Unscrew nut.
Pull out shaft and take off pedal.

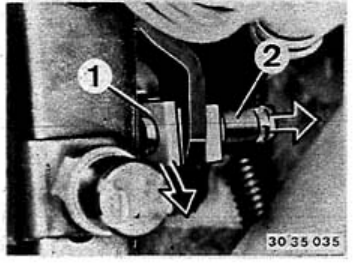
Installation:
Replace self-locking nut.
Tightening torque*.



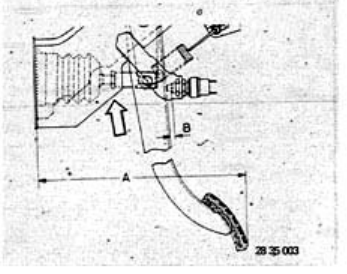
Disconnect brake pedal return spring on pedal.



Installation:
Cars with over-center spring – check for correct installed position.



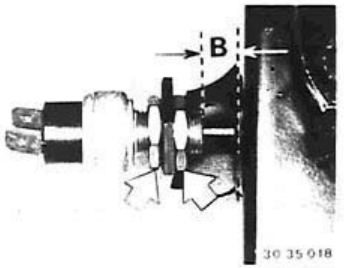
Press off clamp (1) on brake linkage (1)
Pull out shaft (2).



Installation:
Adjust brake pedal height to distance (A)* on the brake master cylinder push rod.

Important!
Travel must be limited in the brake master cylinder and must not be limited by, for example, the stop light switch (distance "B").

* See Specifications



Installation:
Adjust stop light switch.

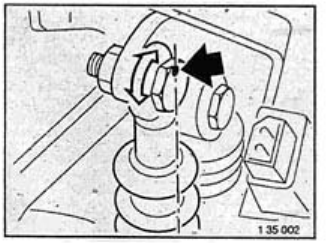
B = 5 to 6 mm (0.197 to 0.236").

Stop Light Switch Since 1987 Models:
See Group 61 for adjusting as well as removing and installing procedures.

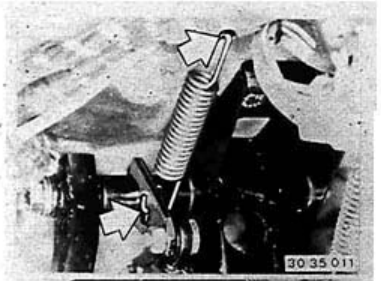
Check function of stop lights.

35 31 000 REMOVING AND INSTALLING CLUTCH PEDAL

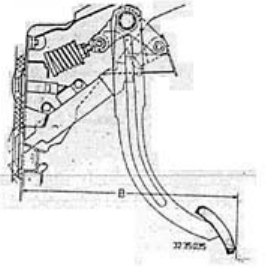
Remove dashboard trim panel at bottom left – see Group 51.



Installation:
Adjusting Procedures for Eccentric Bolt of Clutch Pedal:
Turn eccentric bolt until the dot on the eccentric bolt is opposite the clutch master cylinder.



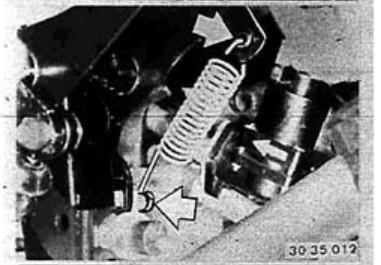
Version with Clutch Pedal Return Spring:
Disconnect clutch pedal return spring on body.



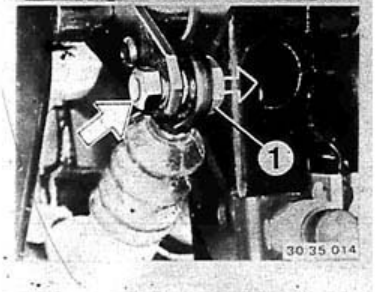
Installation:
Distance (B)* must be reached.
If distance (B)* cannot be reached with the described adjusting procedures, turn the eccentric bolt 180°.

Important!
Intermediate positioning of the eccentric bolt is not approved!

Tightening torque*.

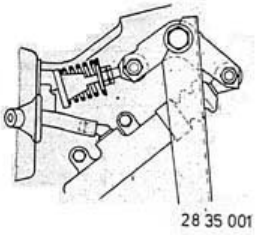


Disconnect brake pedal return spring on pedal.



Unscrew nut and pull out eccentric (1).

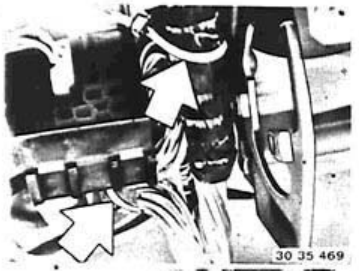
Installation:
Install eccentric bolt with Molykote Longterm 2.
Tightening torque*.



Installation:
Cars with over-center spring – check for correct installed position.

* See Specifications

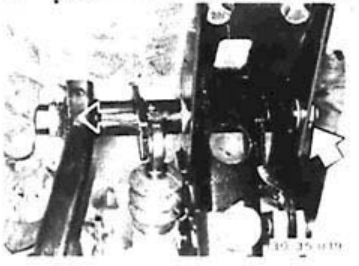
* See Specifications



Cars with Pedal Value Sender:
Cut off straps and pull wire harness down.

Note:
Pedal value sender is shown removed for better understanding.

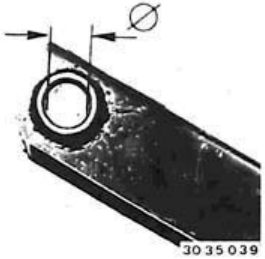
Installation:
Check for correct routing – wire harness must not rub on any car parts.



Unscrew nut.
Pull out shaft and take off pedal.

Installation:
Replace self-locking nut.
Tightening torque*.

* See Specifications



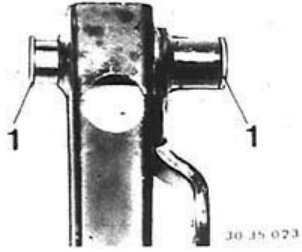
35 21 011 REPLACING BEARING SLEEVE FOR BRAKE PEDAL

35 31 011 REPLACING BEARING SLEEVE FOR CLUTCH PEDAL

Remove pedal 35 21 000 or 35 31 000.

Pedal with Injection Molded Bearing Sleeve:

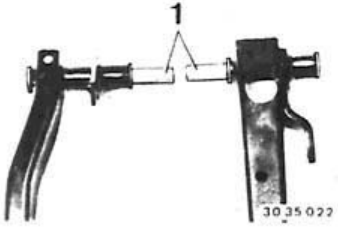
Replace pedal if worn.
If pedal movement is difficult, drill or ream out bearing sleeve to diameter of 14.2 + 0.1 mm (0.559 + 0.004").
Lubricate bearing surface with grease*.



Pedal with Press-fit Bearing Sleeves:

Identification:
Bearing sleeves on left and right sides protrude into guide tube by only about 17 mm (0.669").
Press out bearing sleeves (1) for brake and clutch pedals.

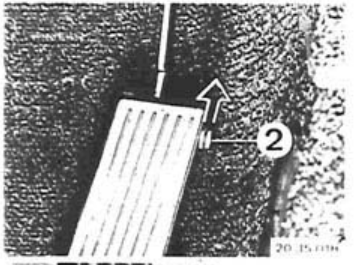
Installation:
Lubricate spacing sleeve with grease*.



* See Specifications.

35 41 000 REPLACING ACCELERATOR PEDAL

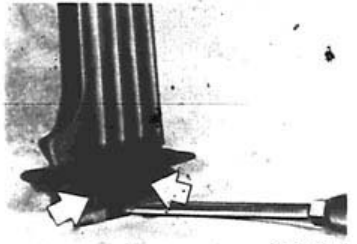
Important!
Always replace a removed accelerator pedal with a new part.
Clips of the old part could be damaged and lead to the accelerator pedal sliding out of the collar.
This in turn could lead to an accident!



Press off clamp (2).
Disconnect pedal.

Installation:
Lubricate sliding surface on the accelerator pedal shaft lightly with grease*.

Important!
Check for correct seating of clamp (2).



Press down on carpet, bend clips forward and lift out the accelerator pedal from above.



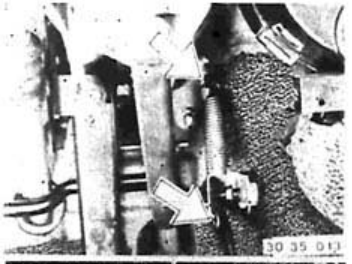
Installation:
Install accelerator pedal with the pocket inserted in the collar on the floor plate and have clips engage.

Important!
Recheck for correct engagment of the clips.

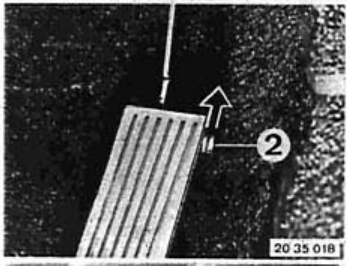
* See Specifications

35 41 030 REMOVING AND INSTALLING ACCELERATOR PEDAL SHAFT

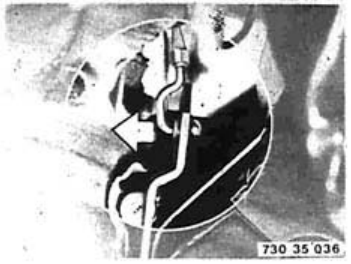
Remove dashboard trim panel at bottom left – see Group 51.



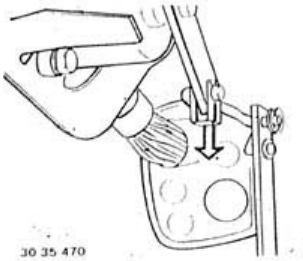
Disconnect accelerator return spring on pedal.



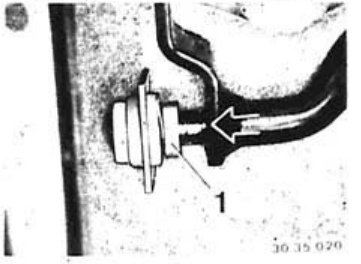
Press off clamp (2).
Disconnect pedal.



Disconnect cable on pedal.



Cars with Pedal Value Sender:
Pull retainer off of the push rod.
Disconnect push rod.



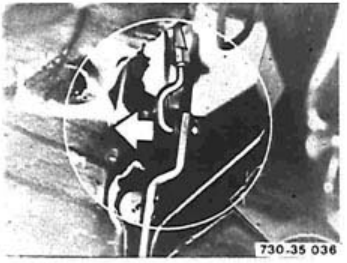
Pull off clamp (1).
Push shaft to the left and remove.

Installation:
Check bearing sleeves, replacing if necessary.
Lubricate all sliding surfaces lightly with grease*.

* See Specifications

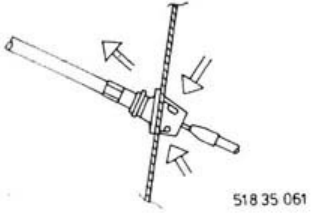
35 41 421 REPLACING / ADJUSTING ACCELERATOR CABLE

Remove dashboard trim panel at bottom left – see Group 51.

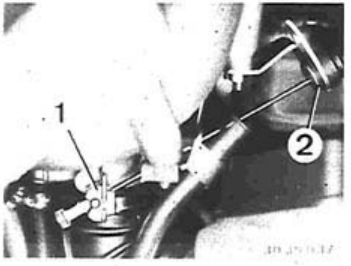


Disconnect cable on pedal.

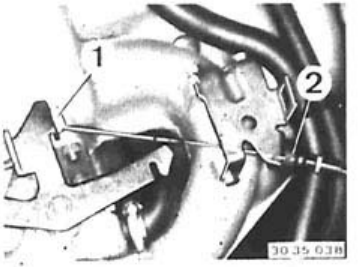
Installation:
Inspect rubber grommet, replacing if necessary.



Compress locking hooks and pull cable out of the engine compartment wall.



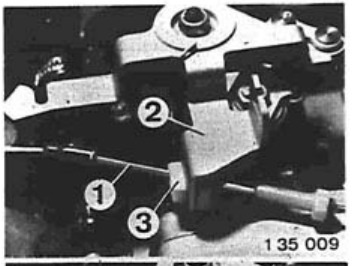
BMW 318 i (M 10):
Press operating nipple (1) out of the throttle valve lever and disconnect the adjusting screw with rubber pad on holder (2).



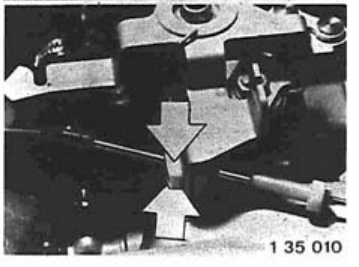
BMW 325 e:
Press operating lever (1) out of the throttle valve lever.
Disconnect rubber pad on holder (2).



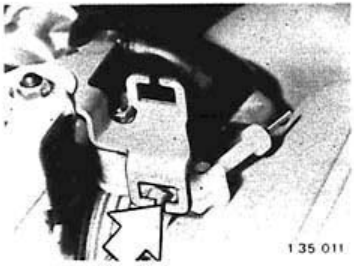
Take nipple off of the cable.



BMW 325 i:
1 Accelerator cable
2 Throttle valve lever
3 Holder

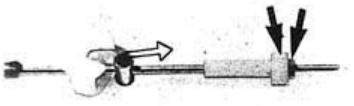


Unclip holder of accelerator cable in the throttle valve lever.

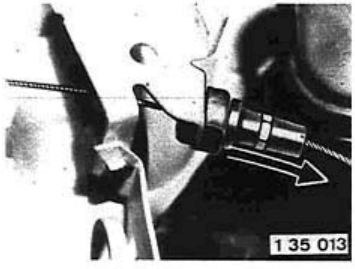


Remove accelerator cable downward through the slot in the throttle valve lever.

Take nipple of accelerator cable out of the holder.
Unscrew locknut and knurled nut.



1 35 012



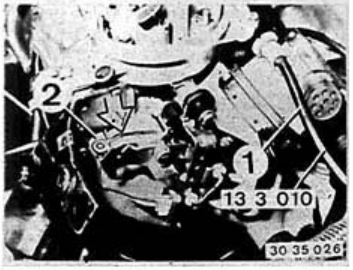
Take accelerator cable out of the holder.

ACCELERATOR CABLE ADJUSTING PROCEDURES

Manual Transmission:

1. Accelerator pedal on neutral stop.

2. Throttle valve in neutral position (automatic choke switched off).



316 Since 1984 Models:
Start engine and clamp vented hose (1) of the throttle valve drive with Special Tool 13 3 010.
Stop engine.

Important!
The throttle valve lever must bear on stop (2).

3. Adjust the cable to remove tension. Remove Special Tool 13 3 010.

4. Turn adjusting screw on full throttle stop of pedal console that there is still 0.5 mm (0.020") play on the full throttle stop of the throttle valve. Unscrewing the adjusting screw one and one half turns = 0.5 mm (0.020") play.

Automatic Transmission:

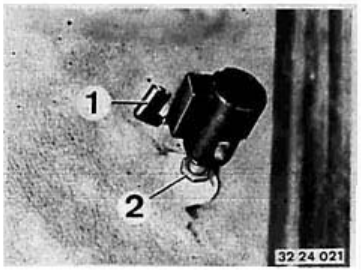
1.–3. same as for manual transmission.

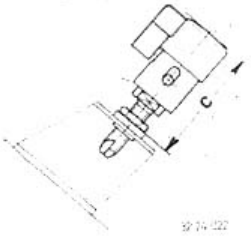
4. * Check control distance C* of the full throttle stop.

5. Adjust full throttle stop that there is still 0.5 mm (0.020") play on full throttle stop of the throttle valve in kickdown position (pedal pressed beyond full throttle stop). Unscrewing the full throttle stop one and one half turns = 0.5 mm (0.020") play.
Lock with the M 8 nut.

6. Check the pressure point for automatic transmission – see 24 00 004.

* See Specifications





Automatic Transmission with Overhaul Element:

1.–3. same as for manual transmission.
4. Operate accelerator pedal up to full throttle position.
5. Adjust full throttle stop to remove tension while accelerator pedal is operated.
6. Operate further than full throttle stop; overload stop on throttle valve assembly must not bear. If necessary reduce travel of full throttle stop and repeat the adjustment.

35 41 480 REPLACING KICKDOWN SWITCH (EH Transmission)

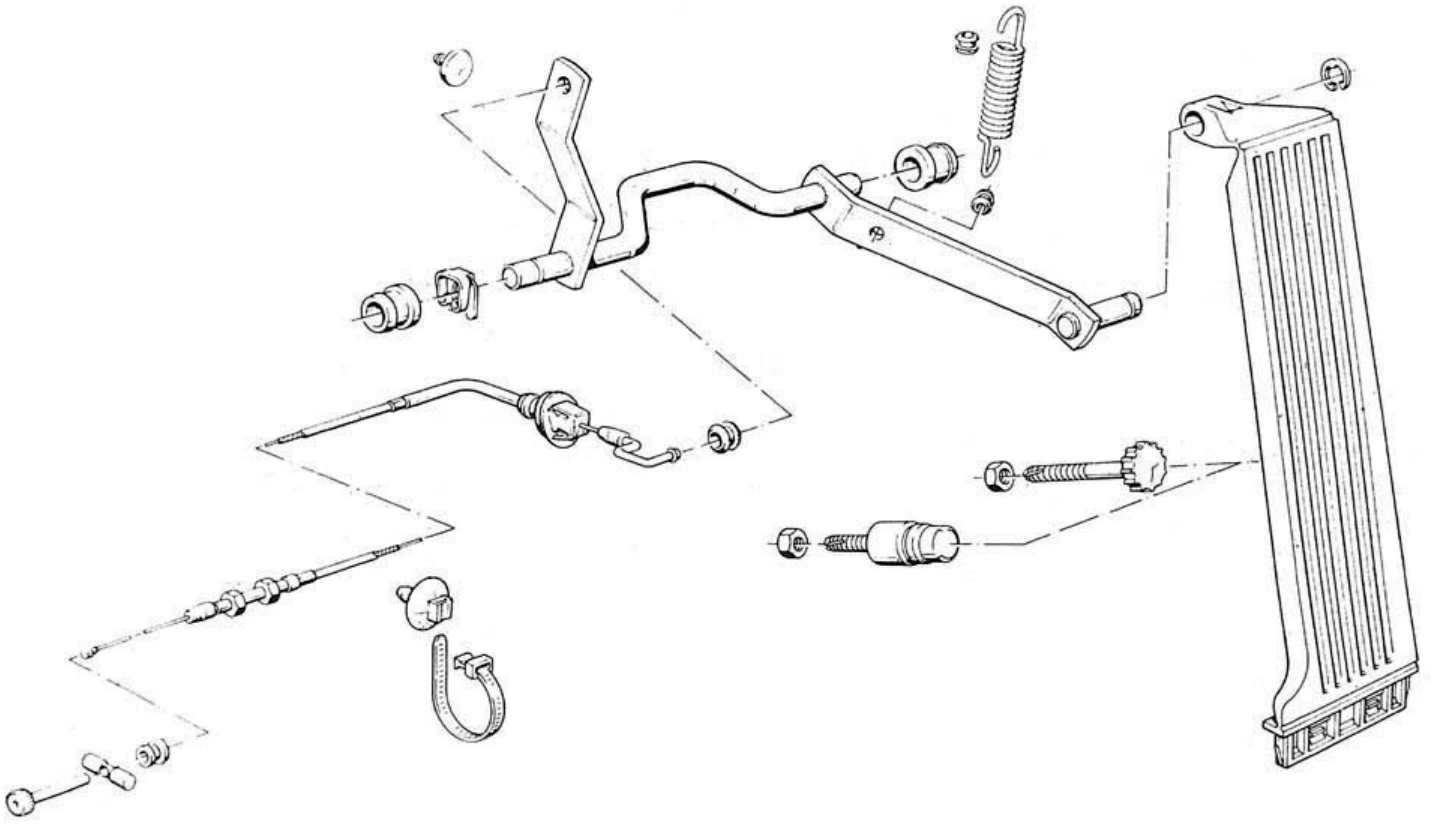
Test – see BMW Test Plan in Gr. 24.
Pull off flat plug (1).
Unscrew nut (2).
Unscrew switch.

Installation:
Adjust the nut to control distance C*.
Make final adjustment after installation.

* See Specifications

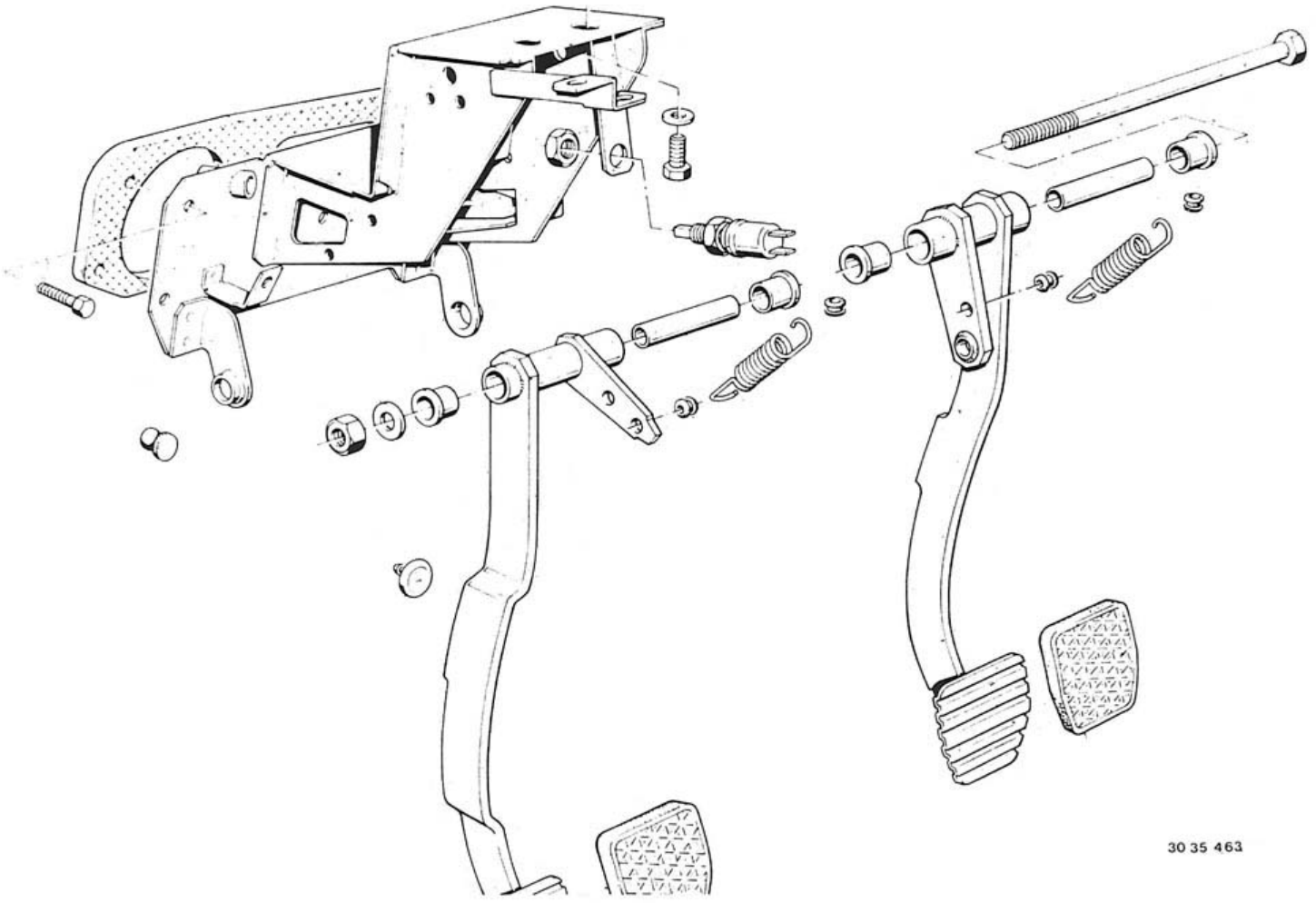
35-1a R

ACCELERATOR PEDAL LAYOUT DRAWING
– RHD –



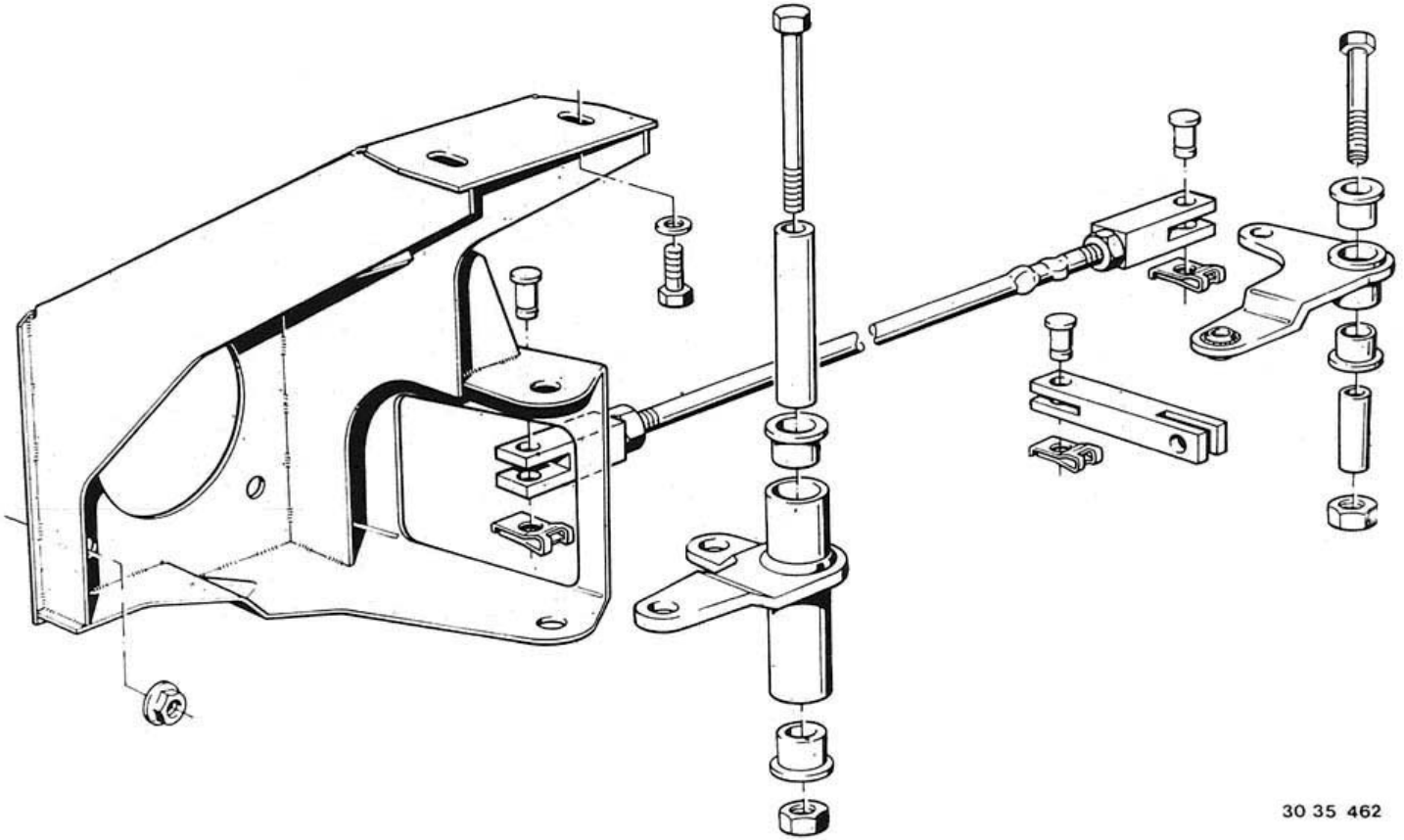
30 35 461

PEDAL ASSEMBLY LAYOUT DRAWING (DRIVER'S SIDE)
– RHD –



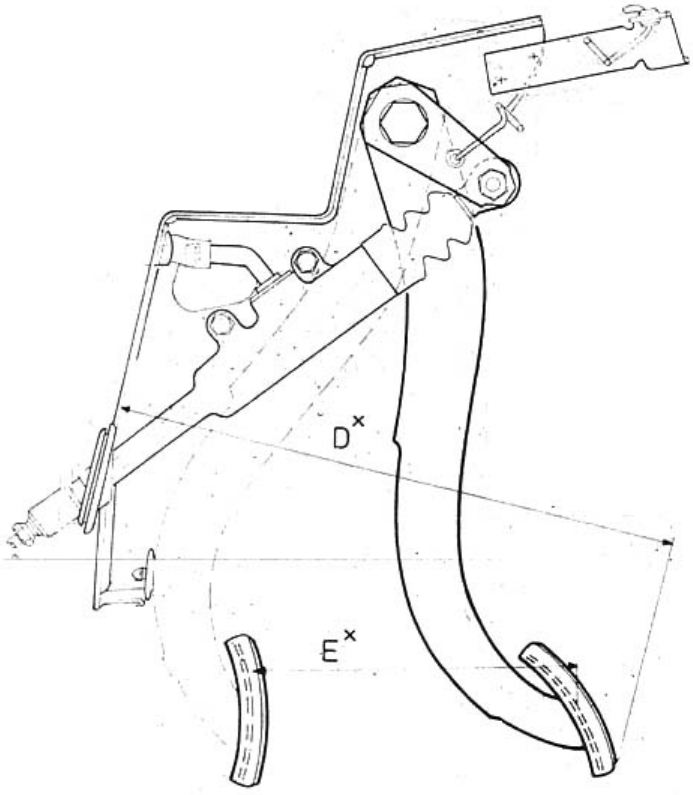
30 35 463

PEDAL ASSEMBLY LAYOUT DRAWING (PASSENGER'S SIDE)
– RHD –



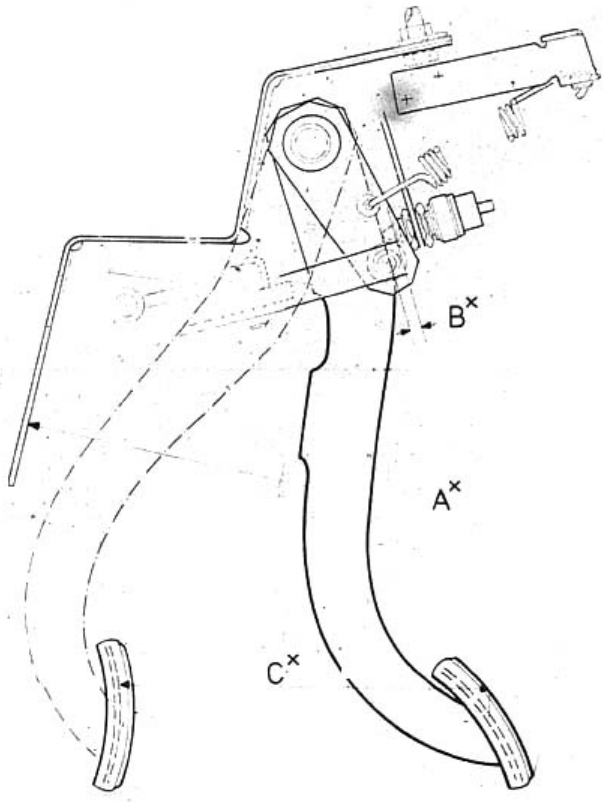
30 35 462

CLUTCH PEDAL ADJUSTING DISTANCE
– RHD –



30 35 434

BRAKE PEDAL ADJUSTING DISTANCE
– RHD –

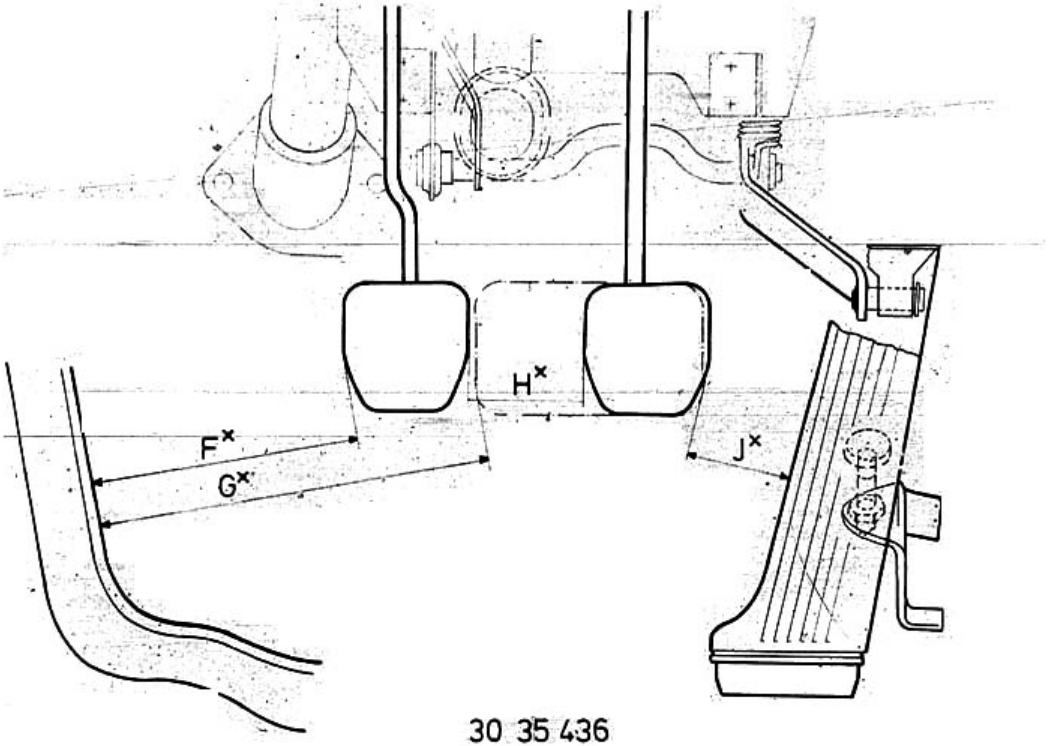


30 35 435

* See Specification

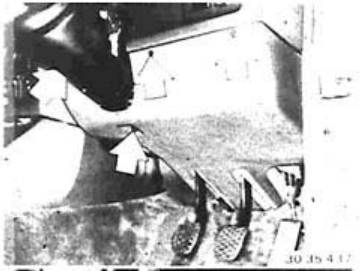
35-3 R

CONTROL DISTANCE FOR ACCELERATOR PEDAL SIDE CLEARANCE
– RHD –



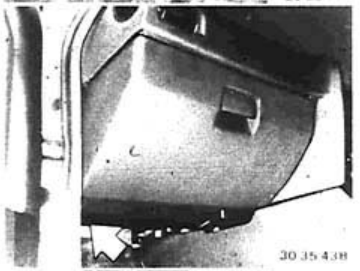
30 35 436

* See Specifications

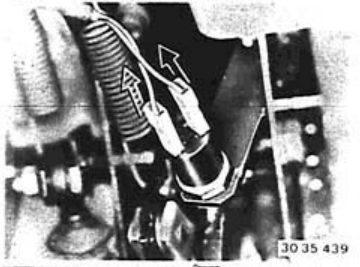


35 11 000 REMOVING AND INSTALLING CONSOLE FOR PEDALS – RHD –

Disconnect battery ground lead.
Remove dashboard trim panel at bottom right – see Group 51.

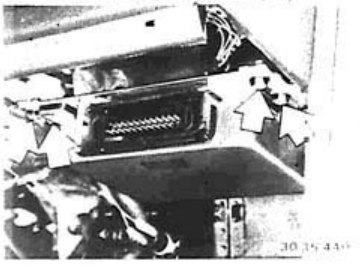


Remove left glove box.

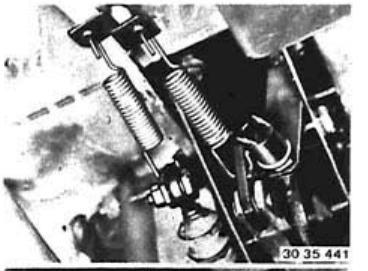


Pull off electric leads on stop light switch.

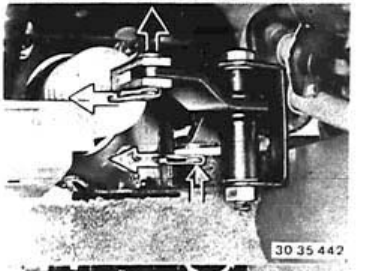
Note:
Pull off plug of stop light switch since 1987 models – see Group 61.



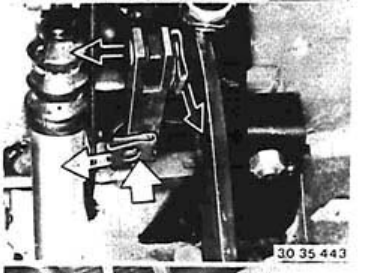
If applicable, unscrew control unit.



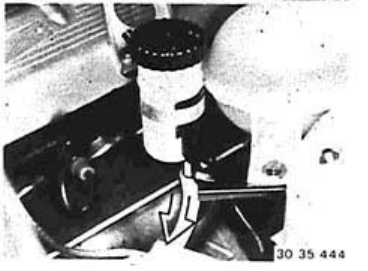
Disconnect return springs for brake and clutch pedals.



Unscrew left reversing lever on the pull rod and master cylinder.



Remove pressure piece between the brake pedal and reversing lever.

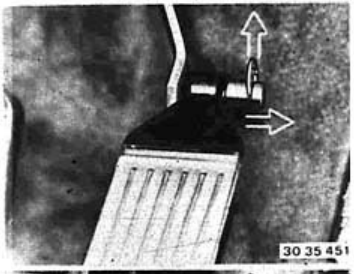


Draw off brake fluid.
Pull hose off of the supply tank.

Note:
Plug the hose.



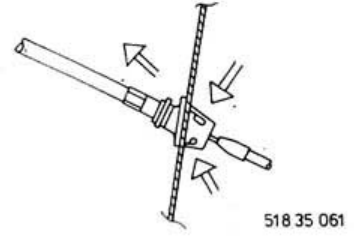
Unscrew line on clutch master cylinder.
Note:
Plug openings.



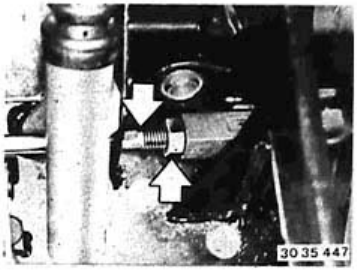
Disconnect shaft on accelerator pedal.



Disconnect accelerator cable.



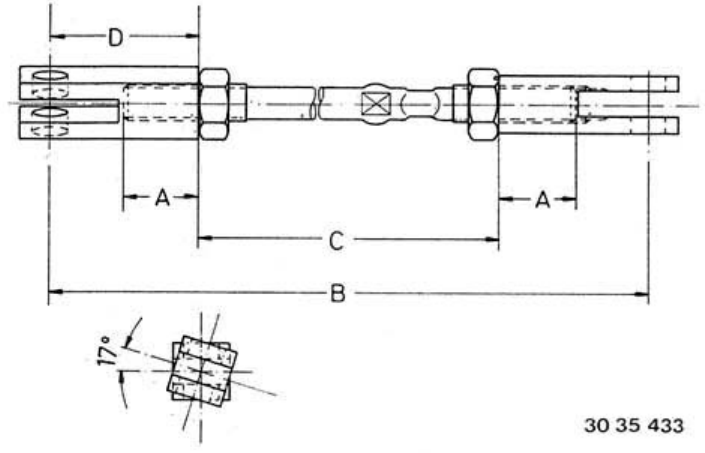
Compress locking hook and press cable out of pedal base.



Loosen locknut.
Turn pull rod out of pivot and push back to left.
Installation:
Tightening torque*

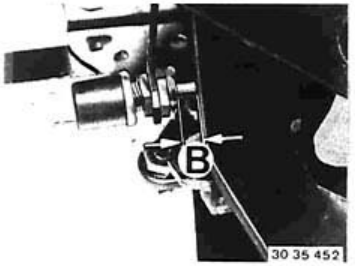
Installation:
Adjust position of brake pedal** with the pull rod.
Basic Pull Rod Adjustment:

A)	Important safety distance	
	Min. screwed-in depth	21 + 1 mm (0.872 + 0.039")
B)	Basic adjustment distance	722.5 ±1 mm (28.445 ±0.039")
C)	Helping distance	639.5 ±1 mm (25.177 ±0.039")
D)	Distance from bore to end of pivot	41.5 mm (1.634")



30 35 433

* See Specifications
** See Brake Pedal Adjusting Distance and Specifications



Installation:
Adjust the stop light switch.

Distance B = 5 to 6 mm (0.197 to 0.236")

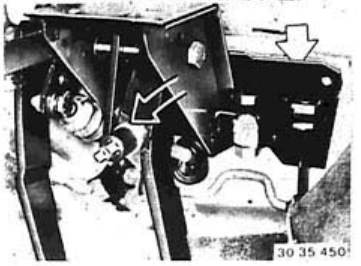
Stop Light Switch Since 1987 Models: See Group 61 for adjusting as well as removing and installing procedures.

Check function of stop lights.



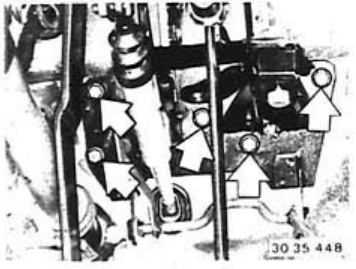
Unscrew bolts. *

Installation:
Tightening torque*.



* **Remove console.**

Installation:
Check gasket, replacing if necessary.

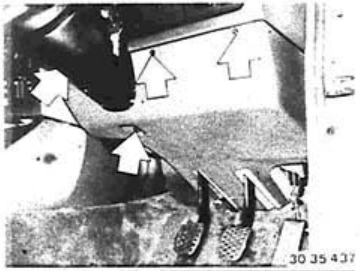


Unscrew bolts.

Installation:
Tightening torque*.

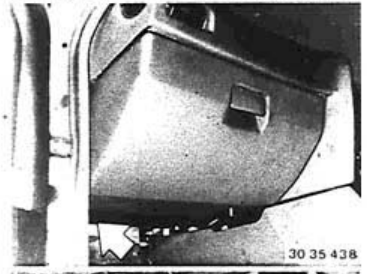
* **See Specifications.**

* **See Specifications**

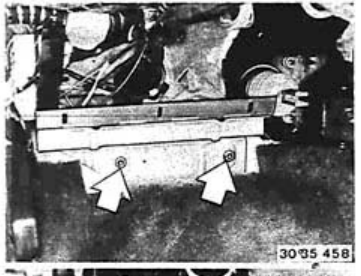


35 11 ... REMOVING AND INSTALLING BRAKE BOOSTER CONSOLE – RHD –

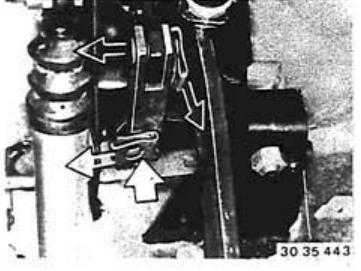
Disconnect battery ground lead.
Remove instrument panel trim at bottom right.



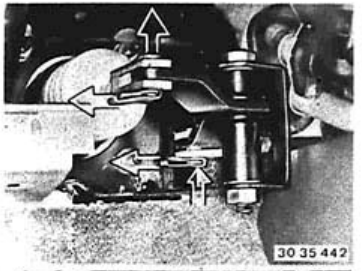
Remove left glove box.



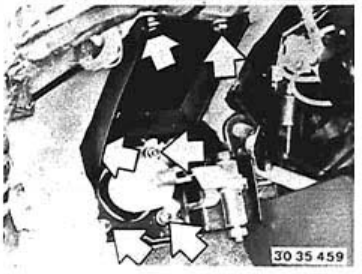
Remove console for glove box.



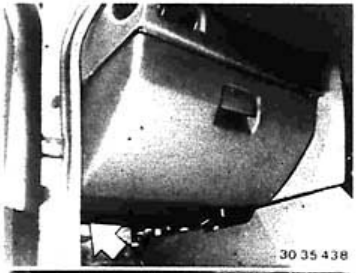
Remove thrust piece between brake pedal and operating lever.



Disconnect left operating lever on pull rod and master cylinder.
Push pull rod to the right as far as possible.

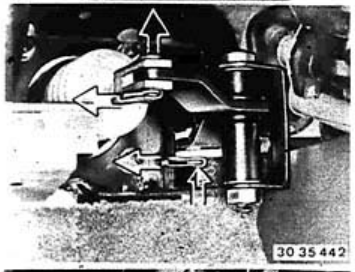


Unscrew bolts.
Remove console.
Installation:
Check brake pedal position, adjusting if necessary.

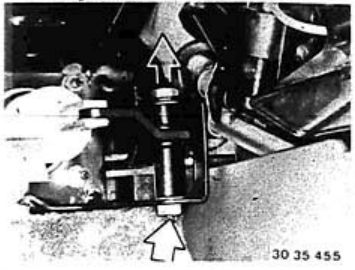


35 21 . . . REPLACING LEFT OPERATING LEVER – RHD –

Remove left glove box.



Disconnect left operating lever on pull rod and master cylinder.

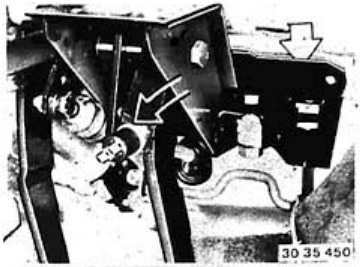


Remove bolt.
Remove operating lever.
Installation:
Tightening torque*.



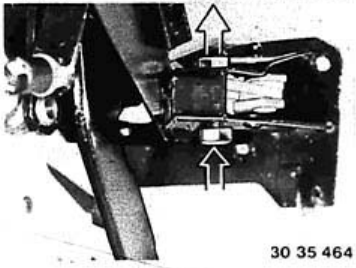
Press out spacing sleeve and bearing sleeves.
Installation:
Check bearing sleeves, replacing if necessary.
Lubricate all sliding surfaces with grease**.

* See Specifications
** Source: HWB

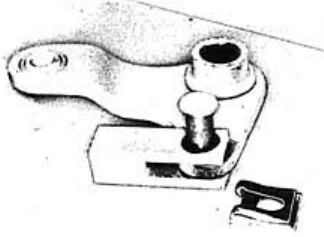


35 21 . . . REPLACING RIGHT OPERATING LEVER – RHD – (Pedal Assembly Removed)

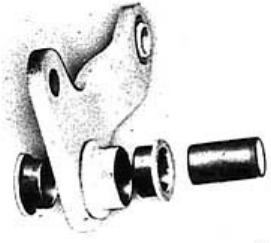
Remove pedal base assembly, see 35 11 000.



Remove bolt.
Remove operating lever.
Installation:
Tightening torque*.

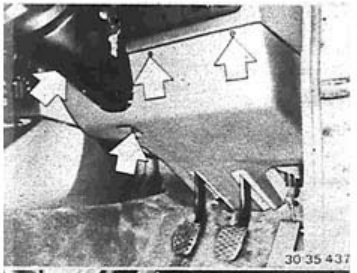


Remove pivot.
Installation:
Check installed direction of bearing pin.



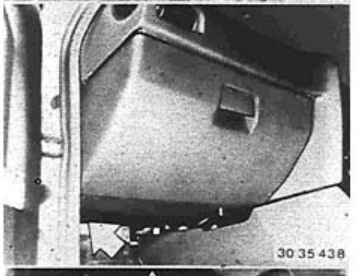
Press out spacing sleeve and bearing sleeves.
Installation:
Check bearing sleeves, replacing if necessary.
Lubricate all sliding surfaces with grease**.

* See Specifications
** Source: HWB

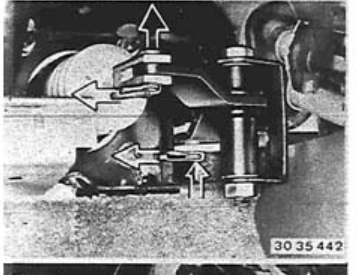


35 21 . . . REPLACING PULL ROD FOR BRAKE OPERATION – RHD –

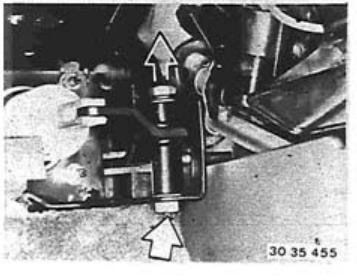
Disconnect battery ground lead.
Remove instrument panel trim at bottom right.



Remove left glove box.

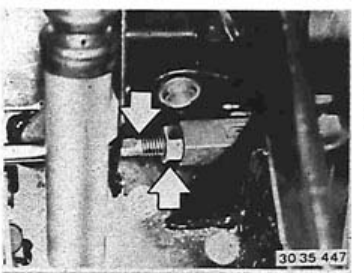


Disconnect left operating lever on pull rod and master cylinder.

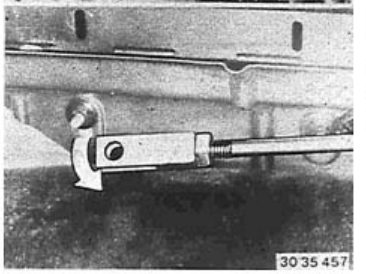


Remove bolt.
Remove operating lever.
Installation:
Tightening torque*.

* See Specifications



Loosen locknut.
Turn pull rod out of pivot.
Unscrew locknut.
Installation:
Adjust pull rod*.
Tightening torque*.

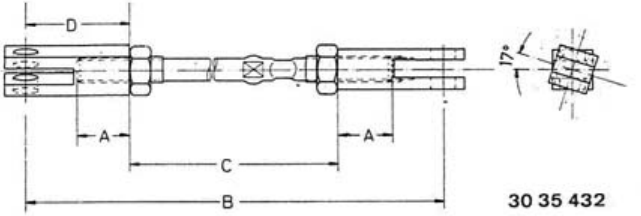


Unscrew left pivot.
Important!
Left-hand threads.
Installation:
Check min. screwed in depth* and tightening torque*.

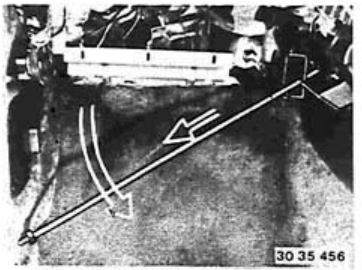
Installation:
Adjust position of brake pedal* with the pull rod.

Basic Pull Rod Adjustment:

A) Important safety distance
Min. screwed-in depth 21 ±1 mm (0.872 ±0.039")
B) Basic adjustment distance 722.5 ±1 mm (28.445 ±0.039")
C) Helping distance 639,5 ±1 mm (25.177 ±0.039")
D) Distance from bore to end of pivot 41.5 mm (1.634")

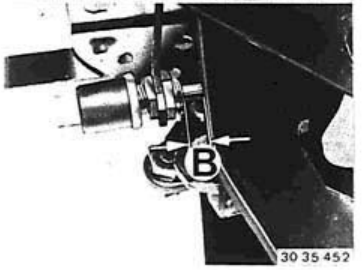


* See Brake Pedal Adjusting Distance or Specifications



Pull out the pull rod downward and to the left.

Installation:
Make sure that the pull rod can move without restriction.



Installation:
Adjust the stop light switch.

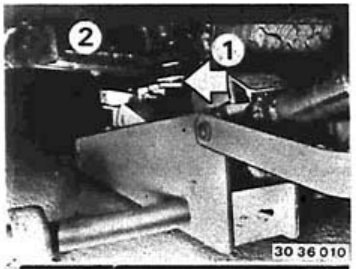
Distance B = 5 to 6 mm (0.197 to 0.236")

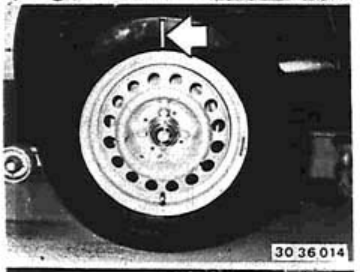
Stop Light Switch Since 1987 Models:
See Group 61 for adjusting as well as removing and installing procedures.

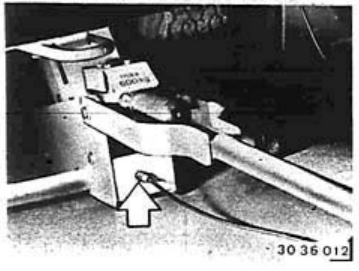
Check function of stop lights.

36 Wheels and Tires

36 10 030	Front wheels – balance dynamically and electronically on car	36- 1
080	Rear wheels- balance dynamically and electronically on car	36- 1
090	Front and rear wheels – balance dynamically and electronically (325iX)	36- 2
. . .	Front or rear wheel – check for lateral and radial runout (wheel removed)	36- 5
300	Front or rear wheel – remove and install	36- 6
508	Wheel – balance dynamically (wheel removed)	36- 7
715	Wheel rim – check for lateral and radial runout	36- 8
	Tire – replace	36- 9
	Tire – mount with a modern mounting machine	36- 10
36 13 . . .	Wheel bolt lock – install subsequently	36- 12







36 10 030 BALANCING BOTH FRONT WHEELS ON CAR DYNAMICALLY AND ELECTRONICALLY

Important!
Always first balance the wheels stationary precisely prior to electronic (finish) balancing.
Apply measuring support for balancing on control arm end (1) (up to 5" rims).
Use a suitable holding fork or additional fork (see Service Information or Workshop Equipment and Planning Documents)
From 5 1/2" rims on:
Apply the measuring support without an additional fork on control arm (2).
Lift car with the measuring support.

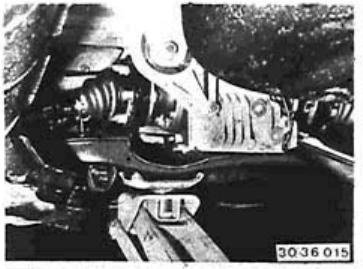
Paste adhesive tape or make a chalk mark, both 3 to 4 cm (1.181 to 1.575") long, on the outside of the tire being balanced, opposite the valve.

Connect leads for test sender
Important!
Balance wheels to operating instructions supplied with pertinent balancing machine.
Balancing must be carried out on firm under ground (concrete floor without basement).
Also refer to Service Information of Group 36.

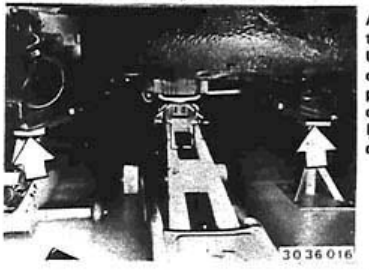
If a value of more than 15 grams is displayed for finish balancing of a wheel, the possible causes (e.g. inaccurate stationary balancing, centering, etc.), also refer to Service Information 36 0 483 (196), must be eliminated prior to finish balancing and before rechecking the finished wheel.

36 10 080 BALANCING BOTH REAR WHEELS ON CAR DYNAMICALLY AND ELECTRONICALLY

Important!
Always first balance the wheels stationary precisely prior to electronic (finish) balancing.
Paste a strip of adhesive tape or make a chalk mark, both 3 to 4 cm (1.181 to 1.575") long, on outside of the tire being balanced, opposite the valve.



Use wedges on the front wheels.
Apply jack at middle of car on the rear axle carrier and lift the car.

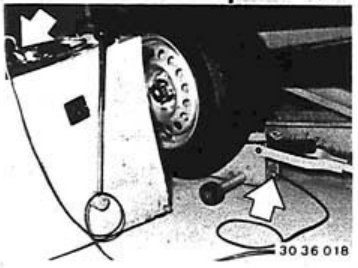


Apply measuring support underneath the trailing arm of the wheel being balanced.
Use an unsprung support on the trailing arm of the running wheel (be careful of brake pipes and hoses), in order to suppress the oscillation from the final drive.
Lower the jack and place it underneath the differential with slight pressure.

Check, whether it is possible to turn the wheels easily.

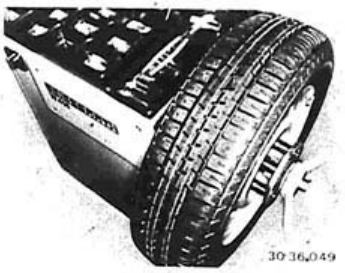


Balance with engine power in fourth gear at approx. 100 km/h (60 mph).
This requires a smooth running engine without misfiring, closed doors, engine hood and trunk lid and a driver sitting in car as calm as possible.
The exhaust extraction hose must not bear on the tail panel.



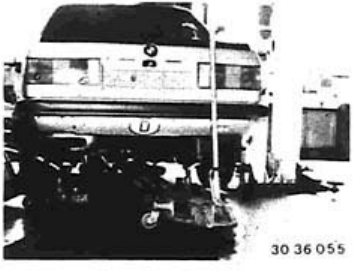
Connect leads for test sender.
Important!
Balance wheels to operating instructions supplied with pertinent balancing machine.
Balancing must be carried out on a firm underground (concrete floor with basement).
Also refer to Service Information of Group 36.

If a value of more than 15 grams is displayed for finish balancing of a wheel, the possible causes (e.g. inaccurate stationary balancing, centering, etc.), also refer to Service Information 36 0 483 (196), must be eliminated prior to finish balancing and before rechecking the finished wheel.



36 10 090 BALANCING FRONT AND REAR WHEELS DYNAMICALLY AND ELECTRONICALLY

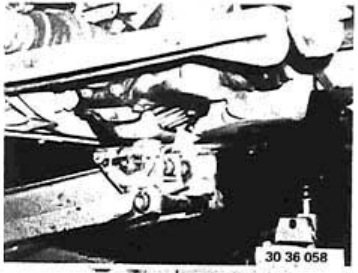
325 iX:
Important!
This car has four driven wheels.
Finish balancing requires that all four wheels can be turned freely and the car must be jacked up and supported safely.
Balance all wheels stationary precisely first prior to the electronic (finish) balancing – see 36 10 508.



Park car on four measuring supports for the finish balancing of 325 iX models.
When using only two measuring supports, two other identical and lateral moving supports must be used on the other axle.

Important!
Check the deflection angle of the final drive end joint.

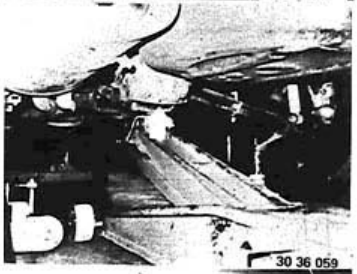
Balancing must be carried out on a firm underground (concrete floor without basement). Car must be level after jacking up and it must be possible to turn all wheels easily.
Also refer to Service Information of Group 36.



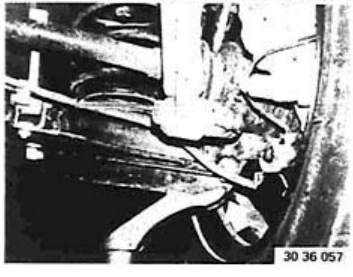
Apply a jack with light pressure underneath the middle of the front final drive, in order to suppress oscillation from the front final drive.



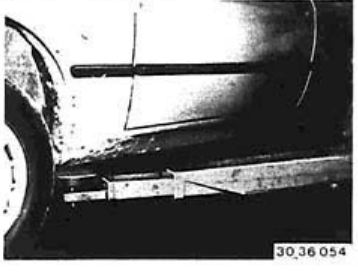
If applicable, lift car on a two-pillar hoist. Apply measuring supports underneath the front axle on each wheel carrier/control arm joint, using a suitable holding fork or additional fork (see Service Information or Workshop Equipment Planning Documents).



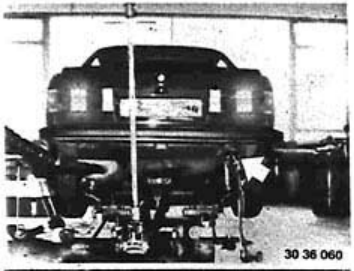
Apply a jack with light pressure underneath the middle of the rear final drive, in order to suppress oscillation from the rear final drive.



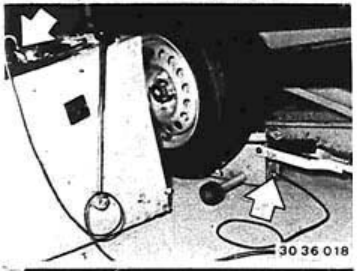
Apply measuring supports underneath the rear axle on each trailing arm as close as possible to the wheel, using a suitable holding fork or additional fork (see Service Information or Workshop Equipment Planning Documents).



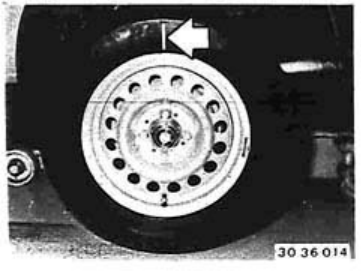
Lower arms of the lifting platform until they are still clear, however, they must never touch the body during balancing procedures (resonance oscillation).



Secure a steel cable on the rear towing eye to hold the car.
This cable must not be drawn tight because of possible wrong test readings.
Begin balancing on the front wheels.

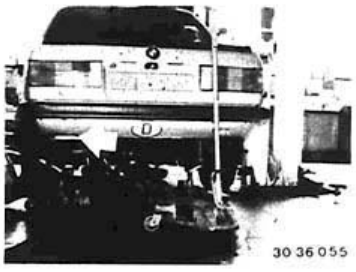


Connect leads for test sender.
Conform with operating instructions supplied with the equipment.



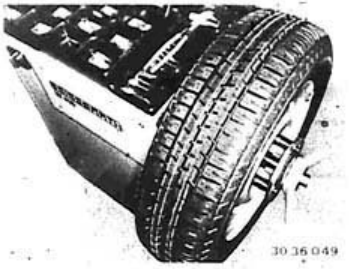
Paste a strip of adhesive tape or make a chalk mark, both 3 to 4 cm (1.181 to 1.575") long, on the outside of the tire being balanced, opposite the valve.

Adjust the finish balancer to correct sensitivity (to operating instructions) prior to balancing.
Since the degree of sensitivity for the balancing of a wheel cannot be transfered to a different wheel or even a different car, it must be determined separately for each wheel.



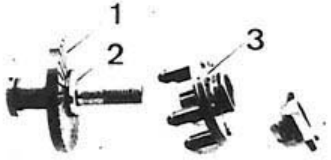
Balance with engine power in fourth gear at 100 km/h (60 mph).
This requires a smooth running engine without misfiring, closed doors, engine hood and trunk lid and a driver sitting as quietly as possible in the car.
The exhaust extraction hose must not touch the tail panel.

Stop the wheels carefully after testing.
Repeat test, after mounting balance weights at the displayed positions.
If a value of more than 15 grams is displayed for a finish balanced wheel, the possible causes (e.g. inaccurate stationary balancing) must be eliminated and the finished wheels rechecked.



36 10 ... CHECKING FRONT OR REAR WHEEL FOR LATERAL AND RADIAL RUNOUT
- Wheel Removed -

Remove wheel - see 36 10 300.
Mount wheel on balancing machine.
Wheel must be mounted on the balancing machine in the same manner as mounted on the car (valve facing down), to avoid tension.



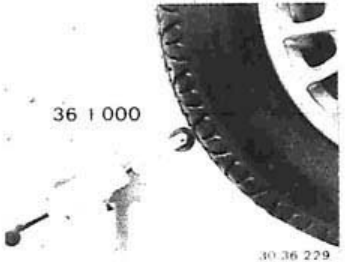
Use pertinent center supplied with the balancing machine.

1 =Basic flange

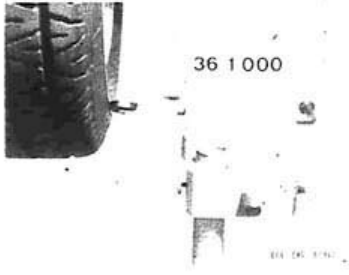
2 =Center

3 =Type flange

Also refer to Workshop Equipment Documents.



Set up Special Tool 36 1 000 on running surface of tire.
Turn wheel by hand and measure maximum radial runout* of tire.
Note:
Special tool must be perpendicular to the tire's running surface.



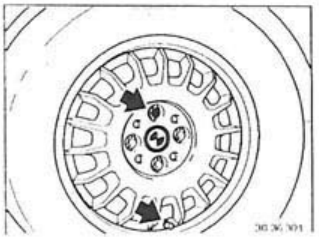
Set up Special Tool 36 1 000 on side of tire.
Turn wheel by hand and measure maximum lateral runout* of tire.
Note:
Special tool must be perpendicular to the side of the tire.
Don't measure on a lettered surface!

* See Specifications

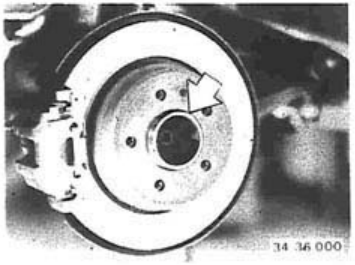
36 10 300 REMOVING AND INSTALLING FRONT OR REAR WHEEL

Important!
Wheel was balanced electronically – conform with the following procedures to avoid loading mistakes and imbalance.

- Loosen wheel bolts.
- Position wheel with valve facing down and mount in same position.
- If several wheels have to be removed at the same time, mark the mounting position of wheels on the tires (with chalk, for example).
- Mark wheel to wheel hub position (to avoid loading mistakes).
- Mark wheel lock to wheel (to avoid imbalance).
- Unscrew wheel bolts..

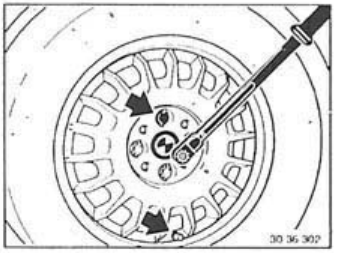


Installation:
Clean the wheel center collar and bearing surfaces of the wheel rim to remove dirt and old grease, and coat the center with Plastilube**, before mounting a wheel.
Inspect wheel bolt threads and tapers for wear, replacing the wheel bolts if necessary.
Lubricate wheel bolt threads lightly with grease, but keep grease off of the tapers for installation.

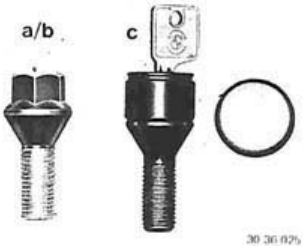


Important!
When mounting wheels on M 3 cars it is necessary to consider the clearance on the brake caliper (incorrect wheel installation could cause damage or displacement of the pad retainers in the brake calipers).

** See Operating Fluids



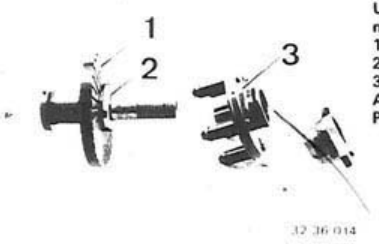
Tighten the wheel bolts crosswise.
Tightening torque*.
If new wheel rims are installed for the first time. recheck the tightening torque* after 1,000 km (600 miles).
Install a pertinent label to remind the driver of this.



a) Wheel bolt - galvanized
b) Wheel bolt - black chrome plated
c) Wheel bolt - black chrome plated and lockable (special equipment)

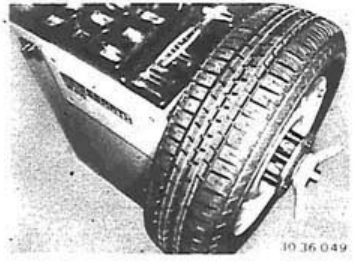
36 10 508 BALANCING WHEEL DYNAMICALLY – Wheel Removed –

Remove old balance weights, stones in treads and large pieces of dirt.
Check tire inflation pressure, condition of tire (damage, cuts, flat spots caused by not using car with hot tires for a long time).
If necessary, check wheel and tire for radial and lateral runout – see 36 10 209.



Use a suitable center of pertinent balancing machine.
1 Basic flange
2 Center
3 Type flange
Also refer to Workshop Equipment and Planning Documents.

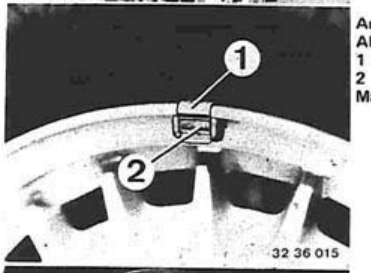
Important!
To avoid clamping arrors, the wheel must be mounted on the balancing machine in the same manner (e.g. valve facing down) as mounted afterwards on the car.



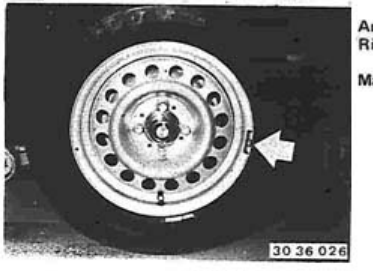
Balance wheel to operating instructions of pertinent balancing machine.



Aluminum Wheel Rims:
Press the side of the tire away from the rim flange slightly at an appropriate point with a tire clamp** and insert a holder.
Remove the tire clamp and push a balance weight underneath the holder until it engages.



Arrangement of Balance Weight for Cast Aluminum Rims:
1 Spring Holder
2 Balance Weight
Max. imbalance per wheel and side*.



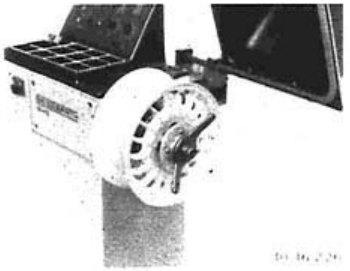
Arrangement of Balance Weights for Steel Rims:

Max. imbalance per wheel and side*.

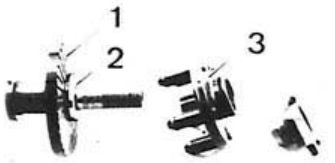
* See Specifications
** Source of Supply: Workshop Equipment and Planning Documents

36 10 715 CHECKING WHEEL RIM FOR RADIAL AND LATERAL

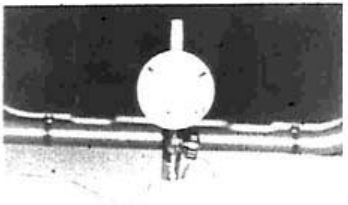
Remove wheel – see 36 10 300.
Take tire off of wheel rim.
Remove old balance weights.
Remove dirt on rim well and rim flange.



Mount wheel rim on balancing machine.

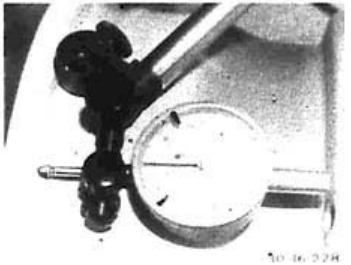


Use a suitable center of pertinent balancing machine.
1 Basic flange
2 Center
3 Type flange
Also refer to Workshop Equipment and Planning Documents.



Apply dial gage tip on rim well.
Turn wheel by hand and measure max. radial runout*.
Measure on both sides of rim well.
Note:
Dial gage must be perpendicular to the rim well.

* See Specifications



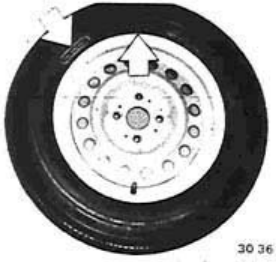
Apply dial gage tip on rim flange.
Turn wheel by hand and measure max. lateral runout*.
Measure on both rim flanges.
Note:
Dial gage must be perpendicular to the rim flange.

Important!
Avoid clamping errors when mounting wheel afterwards – see 36 10 508.

* See Specifications



28 36 023



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REPLACING TIRES

Refer to operating instructions supplied with pertinent tire mounting machine for correct mounting of tires. However, also make sure that the machine is in perfect condition and that the wheel rim and tire are not damaged.

General Tire Removing / Mounting Instructions

Removing:
Begin removal of a tire at the valve.
After pressing the tire off of the rim flange, remove balance weights, press tire bead into well and coat thoroughly with tire mounting paste**. Clean wheel rim thoroughly and inspect rim for damage before mounting tire. The valve and valve insert must be replaced each time a tubeless tire is removed and installed.

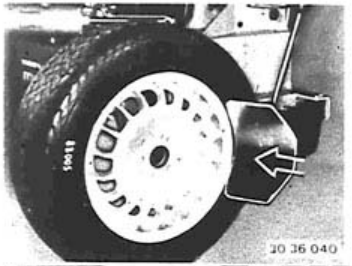
Important!
Loosen the tire on the inside and outside by applying the pressing-off horn on the bead periphery at several points before pressing off the tire. Should it be difficult to press off the tire, pry the tire away from the rim flange as far as poss-ible with the pressing-off horn and then apply tire mounting paste between the tire and rim flange. Repeat this step around the complete periphery of the tire.
Then press of the tire completely.

Greater pressing-off force is required for "TD tires" due to the bead toe seat. It is necessary to loosen tire on inside and outside at several points around the bead periphery with the pressing-off horn prior to pressing off.
Caution!
TD bead toe could jump out of Denloc groove suddenly and cause pressing-off horn to knock in!

Mounting:
Coat tire bead with tire mounting paste**.
Make sure tire is mounted on correct side, especially in case of asymmetric tires. The "outside" of these tires is marked.
Mount tire with as little as possible stress on the beads, since otherwise there would be danger of damaging the tire or TD bead toe of TD tires.
First of all let the tire bead – coming from the well – jump over the hump of the rim shoulder.
Inflate the tire in steps while observing continuously.
Maximum "jump-over pressure" = 3.3 bar (47 psi).
If the tire is not seated on the rim correctly, increasing the inflation pressure will not improve the tire seating!
Instead it will be necessary to press off both tire beads, apply another coat of tire mounting paste and to inflate the tire again.
Increase the inflation pressure slowly until the tire "settles" only when the beads bear on the rim shoulders correctly.
Maximum "settling pressure" = 4.0 bar (57 psi).
Refer to Service Information of Group 36 for approved tires, tire sizes and wheel rims as well as special equipment.

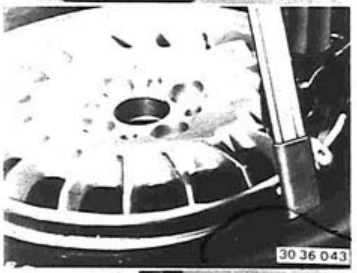
We must point out that TD tires may be mounted only on TD rims!
Incorrect mounting of TD tires on rims of other design (even TR!) could cause tire damage, which in turn could lead to tire blowout while driving car.
Such tires may never be reused, not even on TD rims!

** Source of Supply: HWB

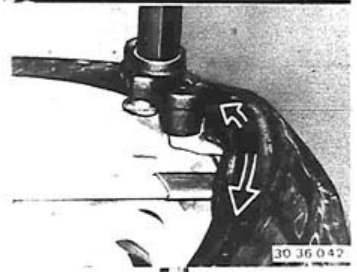


Mounting Tires with a Modern Mounting Machine

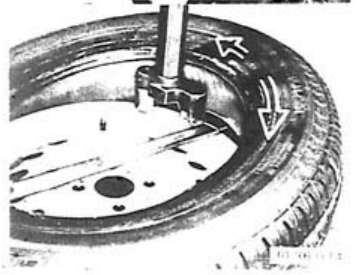
Unscrew valve and deflate the tire.
Press off tire bead from rim flange all around on outside and inside with pressing-off horn of the machine.
If tire beads fit too tight, first only loosen tire from flange at several points with the pressing-off horn prior to the actual pressing-off.
Push both tire beads into rim well completely until they are loose.
Pull off balance weights on rim and clean rim to remove large pieces of dirt.
Coat tire beads with mounting paste.
Clamp wheel on mounting machine.
Narrow rim shoulder always faces up.



Swing mounting pillar into position or fold and let it engage.
Adjust mounting head, whereby it must be pressed on the rim edge fully and turn down the lever for the clamp; normally the distance of the mounting head will set in automatically.
Valve should be about 10 cm (4") to the right of the mounting head.
Lift tire bead over mounting finger with tire irons.
Use coated or shrink-fit hose covered tire irons for aluminum rims.



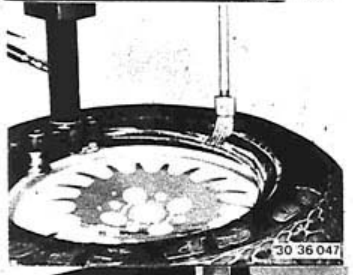
Let mounting machine run back a short distance (counterclockwise) so that the tire bead can slide fully on to the mounting finger.
Then let mounting machine run forward (clockwise) a short distance.
In so doing always check, whether the bottom bead is fully in the well and the tire is given enough time to move.
Stop the machine and let it run back slightly, if the bead clamps.



Now also lift the bottom bead over the mounting finger with the tire iron, if the upper bead is pulled off of the rim.
Let machine run back a short distance again and then forward (clockwise) briefly, until there is complete separation of the tire from the rim.



Release lock and tilt back or swing away the mounting pillar.
Unclamp and clean the rim.
Replace the valve.
Coat the rim flange and tire beads with mounting paste.
Clamp the rim on the mounting machine.
Slide on the tire with the lower bead over the rim flange partially.
Valve is 10 cm (4") to the right of the mounting head.



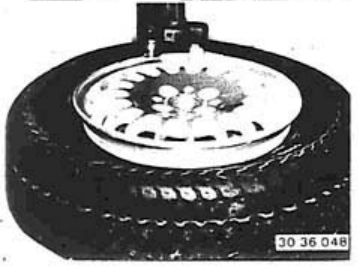
Swing or tilt the mounting pillar into position and lock.
Check adjustment of the mounting finger, readjusting if necessary and clamp.
Press the tire underneath the mounting finger by hand.
Tire bead should seat in the roller next to the mounting finger.
Let the mounting machine run forward (clockwise) a short distance.
The lower tire bead will drop into the well.



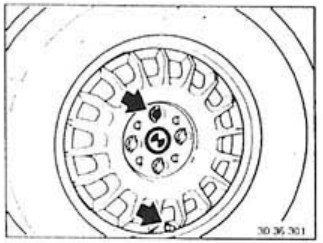
Press the upper tire bead underneath the mounting finger.
Tire bead should seat in rollers next to the mounting finger.

Important!
Don't pinch or damage the bead.

Run the mounting machine forward (clockwise) a short distance, while checking that the lower tire bead remains in the well.

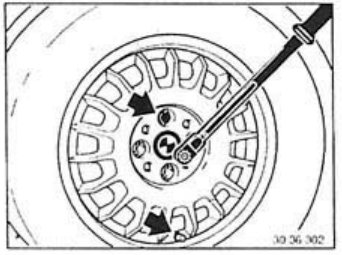


After mounting, first release the clamps and then inflate the tire (without valve insert).
Increase the pressure in steps to 3.3 bar (47 psi) (spring pressure).
If the tire bead does not slide on to the rim edge all around, do not increase the pressure.
Instead the tire must be deflated and the tire bead pressed off, then coat the tire bead and rim flange with mounting paste again and inflate again to 3.3 bar (47 psi) pressure.
If tire beads seat on rim flange correctly, increase the inflation pressure to max. 4.0 bar (57 psi) to have the tire "settle".
Screw in the valve insert and correct the tire inflation pressure.



36 13 . . . SERVICE INSTALLING WHEEL BOLT LOCK

Loosen wheel bolts.
Lift car that wheel has cleared ground.
Loosen wheel bolts until wheel can be turned on the wheel hub.
Turn wheel to have the valve face down.
Remove top wheel bolt and install the wheel bolt lock.



Imbalance could be produced by play in the center and the wheel's own weight.
This imbalance is reduced to a minimum through installation of the somewhat heavier wheel bolt lock, in the top wheel bolt position.

Tighten the wheel bolts crosswise finger tight in this position (wheel bolt lock at top, valve at bottom.
Lower car and tighten the wheel bolts crosswise.
Tightening torque*.

Wheels must be finish balanced, if a customer complains about wheel imbalance after installation of a wheel bolt lock.

* See Specifications

37 Integrated Suspension Systems

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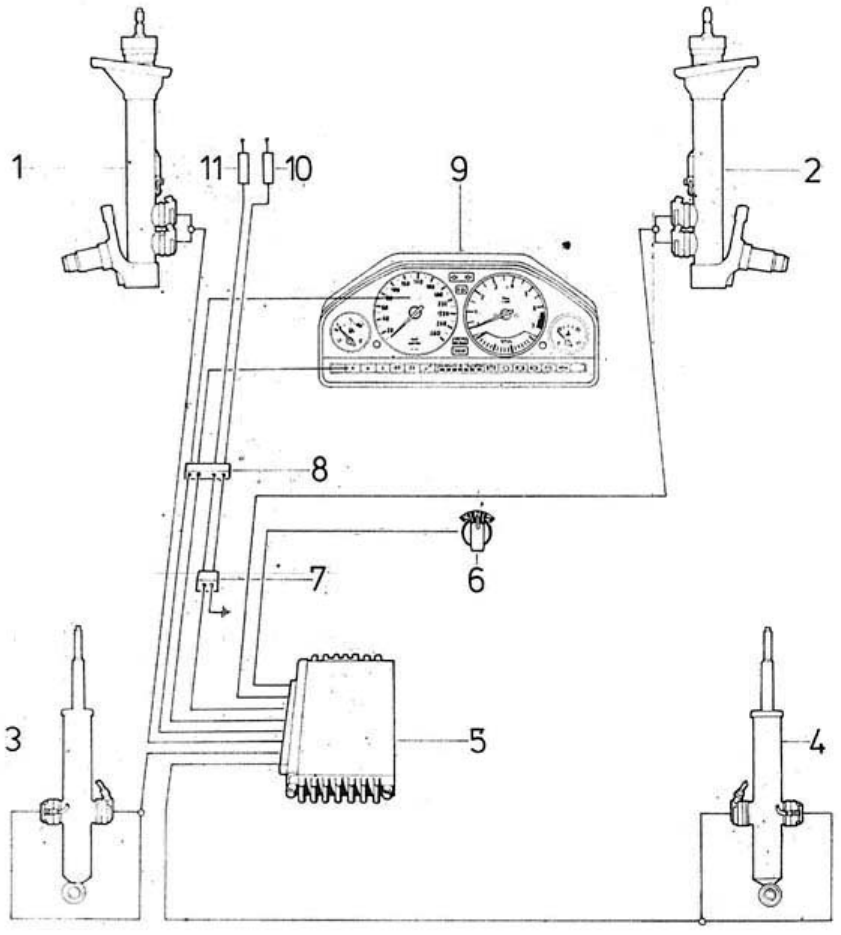
DESCRIPTION OF ELECTRONIC ABSORBER CONTROL (EDC)

Three different shock absorber settings (comfort, normal and sport) can be selected with a switch in the middle console. The shock absorber selection is indicated with control lamps in the instrument cluster. An additional control lamp (absorber symbol) indicates faults in the electrical system. The system monitor control lamp goes out about 1.5 seconds after turning on the ignition. Fault reports can be cancelled after elimination of the cause by turning the ignition off and on.

Shock absorber settings (bump and rebound stages) are controlled by solenoids on the double-pipe gas pressure shock absorbers. The control unit monitors the same setting of all shock absorbers. In case of a fault in the electrical system there is automatic switchover to sport for safety's sake (all solenoids are without current). There is also switchover to sport, if a speedometer signal is missing (car stopped; Vo limit, time delay approx. 1.5 sec.). The system switches back to the selected shock absorber setting as soon as there is a signal again (moving off) within approximately 0.05 seconds.

There is speed-dependent regulation in the comfort position. There is automatic switchover from comfort to normal setting at a road speed of about 110 km/h (68 mph). It switches back to comfort when the road speed drops below about 100 km/h (62 mph).

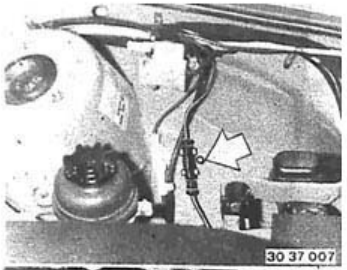
Automatic switchovers are not displayed by the control lamps, since the control lamps only show the position of the selector switch.



30 37 016

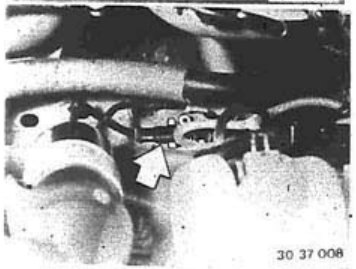
EDC LAYOUT DRAWING

1 Shock absorber front left
2 Shock absorber front right
3 Shock absorber rear left
4 Shock absorber rear right
5 EDC control unit (left in trunk)
6 Selector switch (center console)
7 Power saving relay (left underneath instrument panel)
8 Main/center wire harness plug connection (left underneath instrument panel)
9 Instrument cluster
10 Fuse no. 21 (fuse box)
11 Fuse no. 26 (fuse box)

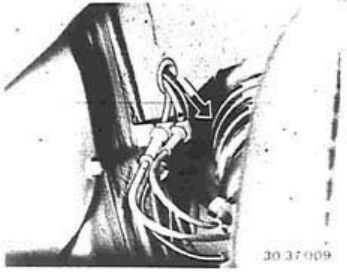


37 . . . . REPLACING FRONT SHOCK ABSORBERS WITH EDC

Disconnect plug (remove left spring strut shock absorber).

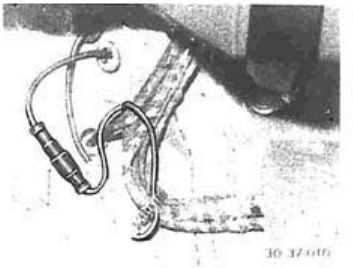


Disconnect plug (remove right spring strut shock absorber).



Guide electric wire through hole.
See Group 31 for other removal procedures.

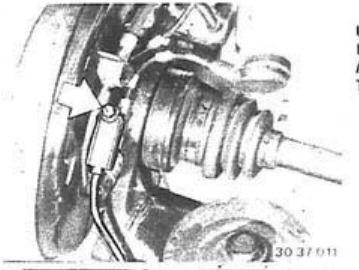
Important!
Covers on solenoids must not be opened.
Shock absorbers cannot be disassembled.
Don't place absorbers on valves or their connections.
Recommendation:
Replace both shock absorbers of one axle.



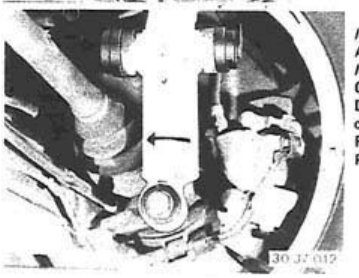
37 . . . . REPLACING REAR SHOCK ABSORBERS WITH EDC

Remove rear seat cushion – see Group 52.
Disconnect left or right plug underneath the insulation sheet and guide electric wire through hole in floor plate.

Remove left or right wheel – see Group 36.



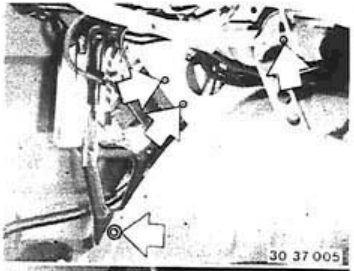
Unscrew wire connector (Y-piece).
Loosen electric wire clips.
Installation:
Tightening torque: 3.5 Nm (2.5 ft. lbs.).



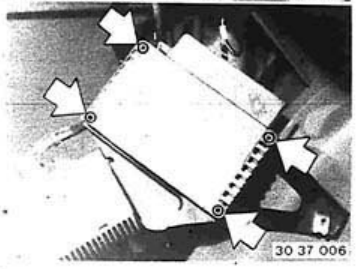
Installation:
Arrow on absorber faces forward.
Important!
Covers on solenoids must not be opened.
Don't place absorbers on valves or their connections.
Recommendation:
Replace both shock absorbers of one axle.

37 . . . . . REPLACING EDC CONTROL UNIT

Turn off ignition.
Remove left trunk trim panel.
Pull off plug on control unit.



Unscrew screws for equipment carrier.
Pull out and turn equipment carrier.



Unscrew screws for control unit.

Important!
Ignition may only be turned on again after control unit has been screwed firmly on the car's ground point.

37 . . . . . REPLACING EDC SELECTOR SWITCH

Procedures are identical with those for replacing program switch of EH transmission – see 61 31 265.

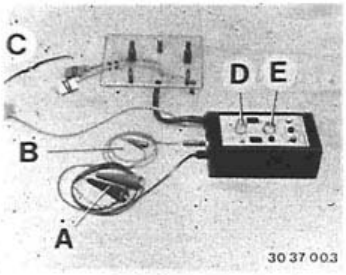
37 . . . . . REPLACING POWER SAVING RELAY

Turn off ignition.
Remove instrument panel trim at bottom left – see 51 45 180.



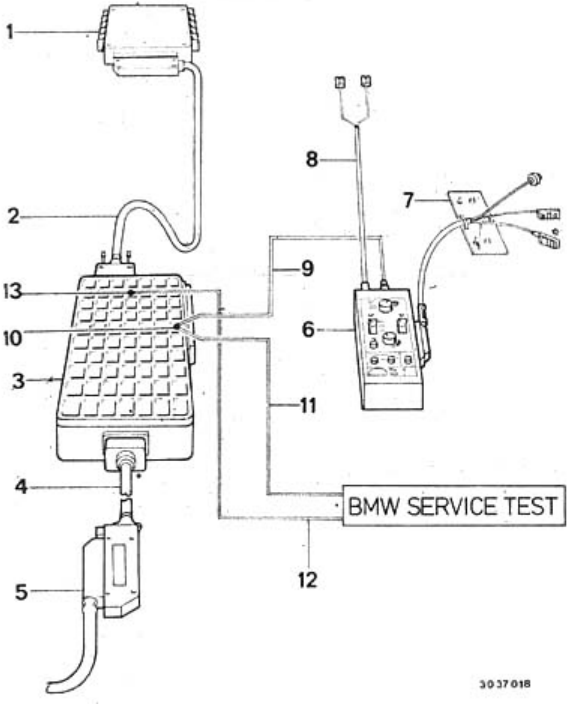
Pull out power saving relay.

37 . . . . CHECKING EDC SHOCK ABSORBERS WITH SHOCK TESTER



Connect 35-pin connecting lead on universal adapter*.
Connect connecting lead on simulator*.

A Power supply 12 V
B Frequency output
C Instrument cluster connection (model 3 wire harness)
D Knob
E Regulator



Turn off ignition.
Remove left trunk trim panel.
Connect universal adapter, simulator and BMW Service Tester as shown.

1 Control unit
2 35-pin connecting lead (plug) for universal adapter
3 Universal adapter
4 35-pin connecting lead (jack) for universal adapter
5 Car wire harness for EDC control unit
6 Simulator
7 Wire harness for model 3 (not used)
8 12 V power supply for simulator
9 Simulator frequency output (yellow jack)
10 PIN 35 on universal adapter
11 BMW Service Tester (yellow) terminal
12 BMW Service Tester (black) terminal
13 PIN 11 on universal adapter

Install universal adapter with 35-pin connecting leads between wire harness and EDC control unit.
Connect simulator power supply on 12 V source.
Connect simulator frequency output (yellow jack) on PIN 35 of universal adapter (model 3 wire harness remains unused).
Connect BMW Service Tester with frequency measuring multimeter function on universal adapter.
(yellow conn. term. on PIN 35)
(black conn. term. on PIN 11)

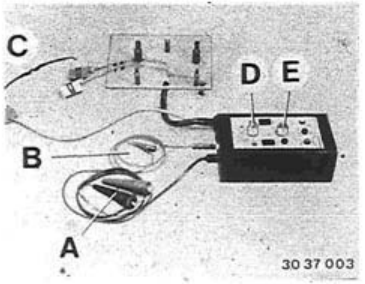
Set simulator knob (D) to km/h.
Turn back simulator regulator (E) to stop.
Set EDC selector switch to K.
Turn on ignition (display control lamp K on).
(control unit operating volatge > 11.5 V)
(measured between PIN 2 and PIN 11)
Switch on simulator.
Adjust frequency to about 15 Hz with regulator (D).
Do not change this setting and disconnect BMW Service Tester.
Switch through shock absorber settings with the selector switch (loud click heard when switching from K to N and N to S).
Check shock absorbers with Shock Tester (to operating instructions supplied with tester).
Nominal values*.

* Source of Supply: HWB

* See Service Information of Gr. 37

37 . . . . . CHECKING ROAD SPEED DEPENDENT ABSORBER SWITCHOVER

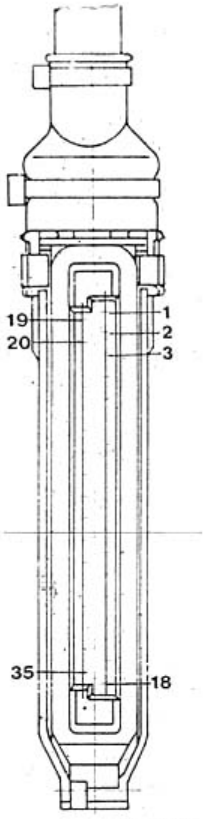
Connect 35-pin universal adapter, simulator and BMW Service Tester (see "Checking EDC Shock Absorbers with Shock Tester").



Set simulator knob (D) to km/h.
Turn back simulator regulator (E) to point shortly before stop.
Set EDC selector switch to K.
Turn on ignition (display control lamp K comes on).
Control unit operating voltage > 11.5 V. (measured between PIN 2 and PIN 11)
Turn up simulator regulator (E) until solenoids switch (loud click).
Nominal value: approx. 150 Hz (≙ approx. 110 km/h or 68 mph).

Turn down simulator regulator (E) again until solenoids switch again.
Nominal value: approx. 135 Hz (≙ approx. 110 km/h or 68 mph).
Requirement: no fault report (absorber symbol control lamp off).
Also refer to M 3 EDC Troubleshooting.

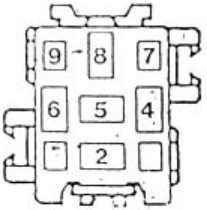
Note:
Control lamps do not also switchover.



30 37 014

CONNECTIONS OF 35 PIN EDC CONTROL UNIT PLUG

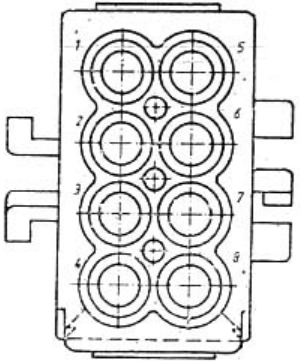
From PIN		Routed To			Wire Color	mm²
1	Power saving relay socket		chamber 2		red/gray	1.5
2	Power saving relay socket		chamber 2		red/gray	1.5
3	Solenoid plug	front left	chamber C		white	0.5
4	Solenoid plug	front right	chamber C		white	0.5
5	Solenoid plug	rear left	chamber C		white	0.5
6	Solenoid plug	rear right	chamber C		white	0.5
7/8/9/10	Not used					
11	Car ground				brown	1.5
12	Car ground				brown	1.5
13/14/15/16/17/18	Not used					
19	Solenoid plug	front left	chamber A (normal)		red	0.5
20	Solenoid plug	front right	chamber A (normal)		red	0.5
21	Solenoid plug	rear left	chamber A (normal)		red	0.5
22	Solenoid plug	rear right	chamber A (normal)		red	0.5
23	Solenoid plug	front left	chamber B (comfort)		yellow	0.5
24	Solenoid plug	front right	chamber B (comfort)		yellow	0.5
25	Solenoid plug	rear left	chamber B (comfort)		yellow	0.5
26	Solenoid plug	rear right	chamber B (comfort)		yellow	0.5
27	Not used					
28	Center main wire harness plug (comfort control lamp)			chamber 1	gray/violet	0.75
29	Center main wire harness plug (normal control lamp)			chamber 2	gray/white	0.75
30	Center main wire harness plug (sport control lamp)			chamber 3	gray/black	0.75
31	Center main wire harness plug (fault control lamp)			chamber 4	gray/yellow	0.75
32	Not used					
33	Selector switch plug (normal switch contact position)				gray/white	0.75
34	Selector switch plug (sport switch contact position)				gray/black	0.75
35	Center main wire harness plug (road speed signal)			chamber 6	blue/yellow	0.75



32 61 055

CONNECTIONS OF POWER SAVING RELAY SOCKET RECEPTACLES

Receptacle	Routed To		Wire Color	mm²
1/3/5/7/9	Not used			
2	Control unit plug pins 1 and 2 (35-pin)		red/gray	2.5
4	Main wire harness plug	receptacle 8	red/gray	2.5
6	Vehicle ground		brown	0.5
8	Main wire harness plug	receptacle 7	green/red	0.75



30 37 015

CONNECTIONS OF MAIN WIRE HARNESS PLUG RECEPTACLES

Receptacle	Routed To		Wire Color	mm²
1	(comfort control lamp)	PIN 28 control unit plug (35-pin)	gray/violet	0.75
2	(normal control lamp)	PIN 29 control unit plug (35-pin)	gray/white	0.75
3	(sport control lamp)	PIN 30 control unit plug (35-pin)	gray/black	0.75
4	(fault control lamp)	PIN 31 control unit plug (35-pin)	gray/yellow	0.75
5	Not used			
6	(speed signal/instr. cl.)	PIN 35 control unit plug (35-pin)	blue/yellow	0.75
7	(term. 15 via fuse 16)	power saving relay socket receptacle 8	green/red	0.75
8	(term. 30 via fuse 16)	power saving relay socket receptacle 4	red/gray	2.5

TROUBLESHOOTING EDC M 3

Testing Requirements:
Battery charged (> 12 V), fuses 16 and 26 okay (fuse box),
power saving relay okay (behind instrument panel trim bottom left)

Perform tests with BMW Service Tester, universal adapter with 35-pin plugs and simulator (Source of Supply: HWB).

A. Fault Lamp On (Absorber Symbol)

– Turn off ignition.
– Remove left trunk trim panel.

Important!
Always turn off ignition before disconnecting wire harness plug on control unit.

– Connect universal adapter on EDC wire harness (control unit remains disconnected).

Do pins 11 and 12 have ground? —— no ——→ Repair wire.

yes

Measure resistance between

Pins	Shock Absorber
3 and 19 3 and 23	front left
4 and 20 4 and 24	front right
5 and 21 5 and 25	rear left
6 and 22 6 and 26	rear right

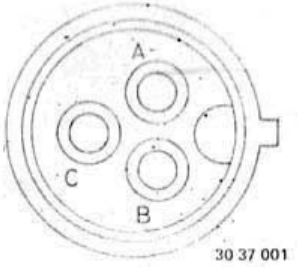
Is nominal resistance of 1.8 to 2.5 ohms measured? —— yes ——▶ Check wire harness, see B, C pin and receptacle connections/replace control unit if necessary.

no

Disconnect pertinent wire plug connection in engine compartment or underneath rear seat cushion.
Measure resistance between plug pins

C and A

C and B



30 37 001

Top View of Disconnected Plug

Is nominal resistance of 2 ohms ± 10 % measured with 20° C (68° F) coil temperature? —— no ——▶ Replace absorber – see Replacing EDC Shock Absorbers in Group 37.

yes

Repair connecting wires for control unit; see control unit plug pin connections.

B. Control Lamps Do Not Switch Over; No Fault Report

– Connect universal adapter on EDC wire harness, see A.

Do pins 1 and 2 have operating voltage of > 11.5 V? — no → Repair wire, see pin and receptacle connections.

yes

12 V voltage on

Pins	Control Lamp
28 – 11 (ground)	Comfort
29 – 11	Normal
30 – 11	Sport
31 – 11	Fault

Control lamps on? — no → Replace light bulb or repair wire.

yes

Set selector switch to K.

Measure resistance between car ground and pin 33.
Nominal resistance: ∞

Set selector switch to N.
Nominal resistance: approx. 0.25 ohm

Measure resistance between car ground and pin 34.
Nominal resistance: ∞

Set selector switch to S.
Nominal resistance: approx. 0.25 ohm

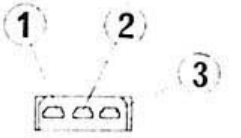
Are nominal resistance values measured? — yes → Check wire harness, see A, C, pin and receptacle connections/ replace control unit if necessary.

no

Remove center console and pull off plug on selector switch.

Measure power flow between

Pin	Wire Plug
34	1
33	2
Car ground	3



30 37 002

Top View of Disconnected Wire Plug

Does power flow through wires. — no → Repair wires.

yes

Replace selector switch.

C. Shock Absorbers Do Not Switch Over, Control Lamps Switch Over (K / N / S)

Check EDC shock absorbers with Shock Tester.
If necessary, check road speed dependent shock absorber switchover.

Can shock absorbers be switched over? —— no → Single absorber does not switch over. → Replace shock absorber.

All shock absorbers do not switch over. → Check operating power supply of > 11.5 V on pins 1 and 2, repairing if necessary or replace control unit.

yes

Connecting wire between instrument cluster and control unit, see pin and receptacle connections, check/repair (road speed signal pin 35).

Do absorbers fulfill nominal values*? —— no → Replace absorbers.

* See Specifications

RIDE LEVEL CONTROL / CIRCULATING SYSTEM

Description

Ride control has the task of keeping the rear end of the car at a certain level regardless of the payload (up to maximum axle load). A piston-type pump bolted on the power steering pump provides the system with necessary pressure. The flow of oil produced permanently by the pump is distributed to the line leading to the pressure reservoirs and a return line by a mechanically operated regulating valve depending on payload and ride level. Ride level information for the regulating valve is taken from the rear axle stabilizer. Loading the car causes the suspension to bottom and in turn the stabilizer to turn. A control valve in the regulating valve is turned to lift position with help of a lever with regulating rod. The turning of the stabilizer is reduced as the rear end of the car lifts, which in turn means that the control valve in the regulating valve is also turned back to normal position continuously. After reaching the nominal ride level the control valve will be back in normal position and the oil flows direct into return (circulation).

After reaching the maximum permissible rear axle load, a pressure safety valve in the regulating valve prevents a further increase of pressure in spring struts and pressure reservoirs, so that the rear end of an overloaded car will drop.

The stabilizer is turned in opposite direction when unloading the car. The control valve in the regulating valve is turned to lower position, so that the oil under pressure in spring struts and pressure reservoirs can flow into return. The control valve will be back in normal position after reaching the nominal ride level.

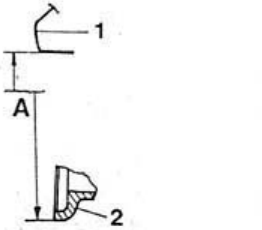
A low pressure valve in the regulating valve prevents dropping the pressure in spring struts and pressure reservoirs below the minimum pressure while lifting the car.

The oil forced out by piston rods of single-pipe shock absorbers is pushed back and forth between the spring struts and pressure reservoirs while driving each time the suspension of rear wheels bottoms and rebounds. The gas cushion of the pressure reservoirs is then compressed and released alternately, producing the effect of gas pressure struts, which is applied parallel to the coil springs of the spring struts.

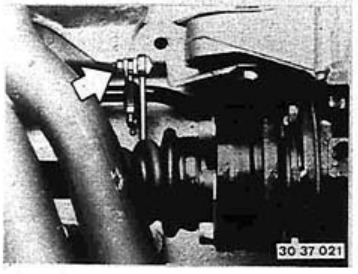
37 .. ... FILLING AND BLEEDING PROCEDURES

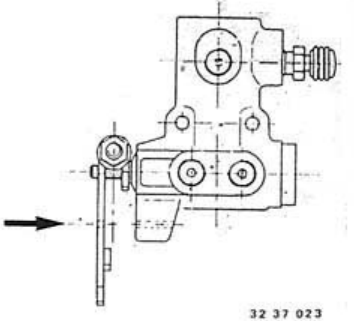
Pour in hydraulic oil* until the level is approx. 25 mm (1") below the upper edge of the tank.
Start engine.
Load down car with 200 kg (440 lbs.) in trunk close to the tail panel (middle).
Turn steering wheel three time from lock to lock.
Stop engine.
Lift rear axle until the wheel clear ground.
Check oil level in tank after about two minutes and, if necessary, correct (specification: approx. 25 mm (12) below upper edge of tank).
Check line connections for leaks.

* See Operating Fluids of Gr. 37



28 32 091





32 37 023

37 12 010 ADJUSTING CAR RIDE LEVEL HEIGHT

Load down car with at least 200 kg (440 lbs.) in middle of trunk (close to wall). Place rear wheels on rotating plates of the wheel alignment tester. Block front wheels. Move shift lever into neutral and release the parking brake lever. Start engine. Measure the "actual car ride level height" (A) between wheel house lower edge (1) and rim flange (2) at wheel middle height after regulation of height control has been concluded.
Specifications*.

Deviation from Specifications:
Unscrew the regulating rod on the regulating lever (stabilizer).
Tightening torque*.
Adjust specified height* on the regulating lever with the engine running.

Higher = lever moved forward
Lower = lever moved back

Stop the engine after reaching the specified height and hold in middle position with a shortened 3 mm (0.118") dia. drill bit (arrow).
In so doing do not move the lever beyond the neutral position in the "lowering" direction.
Tighten regulating rod joint in the slot of the lever.
Tightening torque = 9 Nm (6.5 ft. lbs.).
Check for correct seating of the ball pin on the lever.

Remove the drill bit.

Important!
The lever must not be disconnected on the regulating valve.

* See Specifications

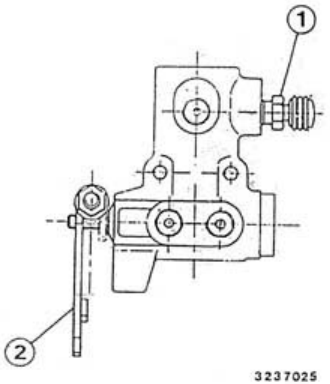
37 12 110 REMOVING AND INSTALLING OR REPLACING LEFT OR RIGHT REAR SHOCK ABSORBER

Remove trunk trim panel and radio speaker – see Group 51.
Remove backrest – see Group 52.
Remove seat belt reel – see Group 72.
Remove wheel – see Group 36.

Installation:
Conform with filling and bleeding procedures and check pipe/hose connections for leaks.

Unscrew pressure discharging screw (1) on the regulating valve and discharge the pressure.

Note:
Place a tray underneath.
The bolt on lever (2) must never be loosened!



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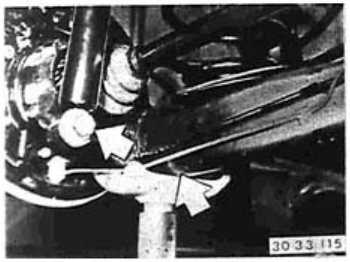

30 33 115

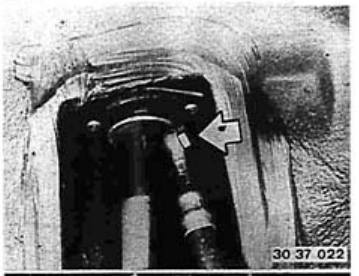
Support the trailing arm.

Important!
Don't damage the brake pipe.

Unscrew mounting bolt.

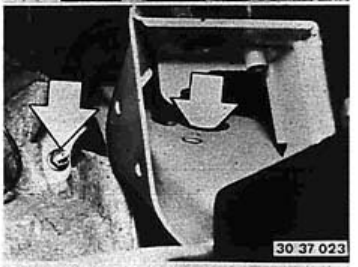
Installation:
Tightening torque*.
Check for correct seating of pipe in holder on the shock absorber.

See Specifications of Gr. 33.


30 37 022

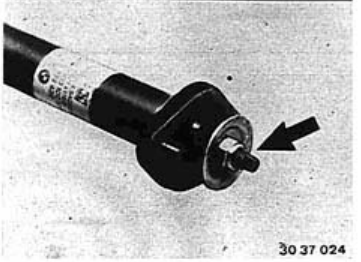
Clean the pipe connection (absolute cleanliness is mandatory).
Unscrew connecting pipe on the shock absorber.

Installation:
Replace seals.
Tightening torque*.


30 37 023

Unscrew the mount bolts.

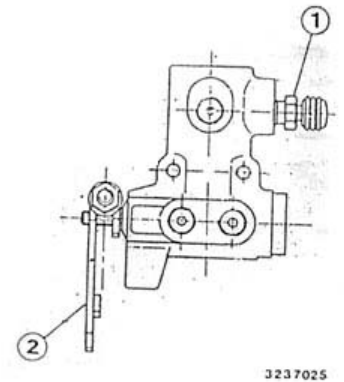
Installation:
Replace self-locking nuts.
Tightening torque*.


30 37 024

Pull off rubber cap.
Unscrew bolt and take off mount.

Installation:
Replace self-locking nut and gasket.
Tightening torque*.

* See Specifications of Gr. 33 and 37



37 12 210 REMOVING AND INSTALLING OR REPLACING RIDE LEVEL REGULATING VALVE

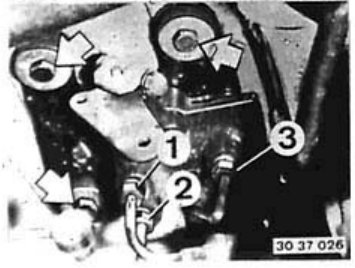
Unscrew pressure discharging plug (1) on regulating valve and discharge pressure.

Note:
Place a pan underneath to catch oil.
Never loosen the clamping bolt on lever (2).

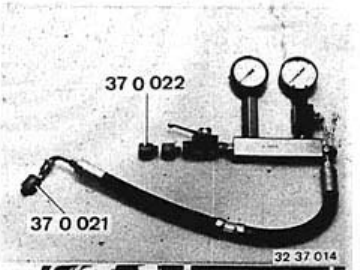
Installation:
Conform with filling and bleeding procedures and check pipe connections for leaks.
Adjust ride level height - see 37 12 010.



Unscrew regulating rod on valve lever.
Installation:
Tightening torque: 8.8 Nm (6.4 ft. lbs.).

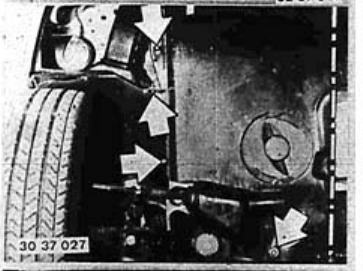


Unscrew pipes (1 ... 3).
Unscrew mounting bolts and take off ride level regulating valve with holder.
Installation:
Tightening torque: 14.3 Nm (10.3 ft. lbs.).

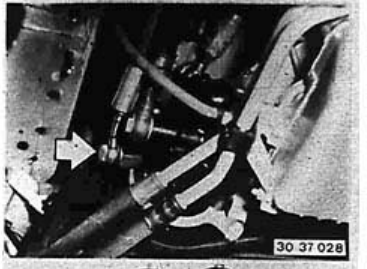


37 21 005 CHECKING FUNCTION OF RIDE LEVEL CONTROL PUMP

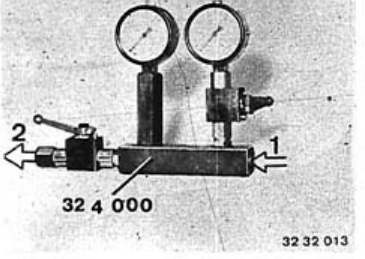
Assemble tester, Special Tool 32 4 000.
Connect adapter on tester.



Unscrew bolts and take off splash guard.



Unscrew bolt.
Installation:
Replace seals.
Tightening torque: 31.2 Nm (22.5 ft. lbs.).
Check pipe connections for leaks and correct the hydraulic fluid level**.

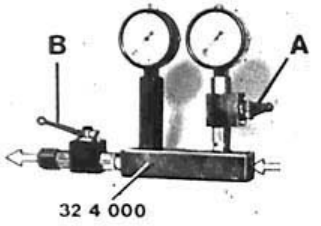


Connect tester.

1 = Pump connection

2 = Pipe connection to regulating valve

** See Gr. 37 In Operating Fluids



32 32 014

A =Shutoff valve (low pressure - 0 to 15 bar / 0 to 213 psi)

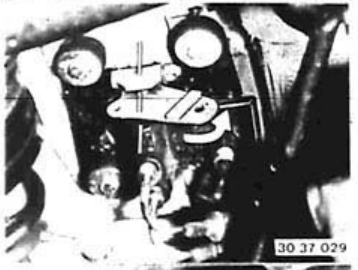
Caution!
Shutoff valve (A) must always be closed for high pressure tests - tester could be damaged.

B =Shutoff valve (high pressure - 0 to 150 bar / 0 to 2130 psi)

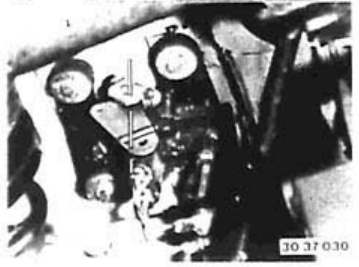
Open valve (B).
Close valve (A).



Unscrew nut and disconnect regulating rod on stabilizer.
Start the engine.

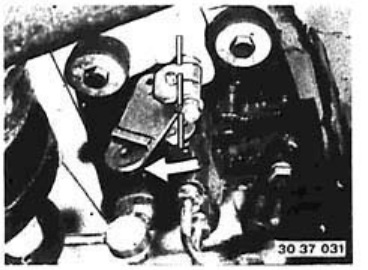


Regulating up position = lever moved forward.
Maximum pressure*.
(rear end of car lifted)



Normal position = lever in middle position.
Circulating pressure*.

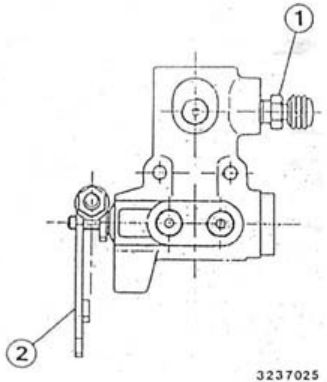
* See Specifications



Regulating down position = lever moved back.
Circulating pressure*.
(rear end of car lowered)

Remove pressure tester.

* See Specifications



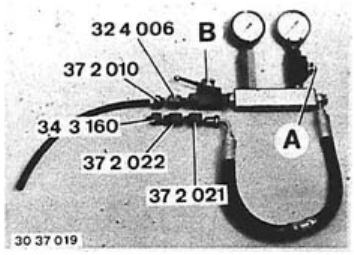
37 21 030 REPLACING LEFT OR RIGHT PRESSURE RESERVOIR

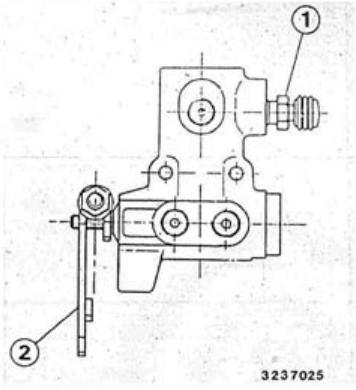
Loosen pressure discharging plug (1) on regulating valve and discharge the pressure.

Note:
Place a pan underneath to catch oil. Never unscrew clamping screw on lever (2).

Installation:
Conform with filling and bleeding procedures and check pipe connections for leaks.

Remove spare wheel and pressure reservoir cover.





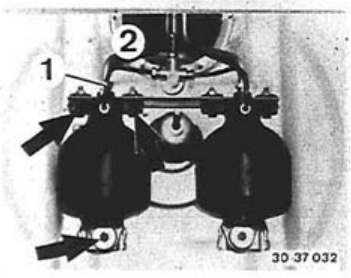
37 21 500/ 37 21 501 CHECKING CHARGING PRESSURE IN LEFT OR RIGHT PRESSURE RESERVOIR

Assemble tester, Special Tool 32 4 000. Connect adapter on tester. Close shutoff valves (A and B).

Loosen pressure discharging plug (1) on regulating valve and discharge the pressure.

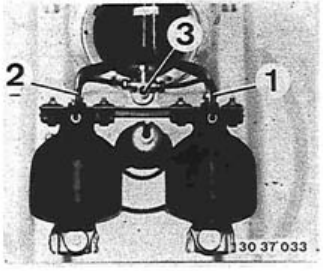
Note:
Place a pan underneath to catch oil. Never unscrew the clamping screw on lever (2).

Installation:
Conform with the filling and bleeding procedures.



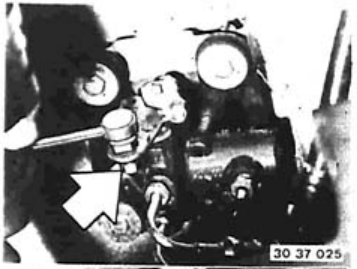
Unscrew pipes (1 and 2).
Unscrew mounting bolts.
Take off pressure reservoir.
Installation:
Replace rubber mounts, if necessary.
Tightening torque*.

*** See Specifications**



To check the left pressure reservoir, unscrew bolt (3) and pipe (1) completely and connect the tester, pushing the adapter aside for this purpose.
Installation:
Tightening torque*.

*** See Specifications**

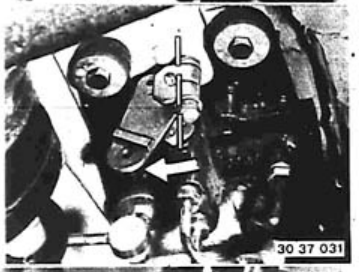


Unscrew nut and disconnect regulating rod on the regulating lever.
Installation:
Tightening torque*.

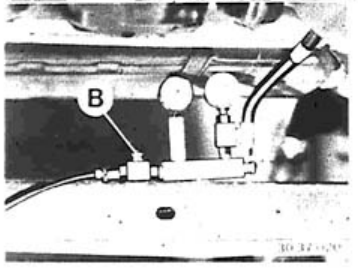


Start engine and regulate the system in lift direction (lever on regulating valve moved forward).
Maximum pressure*.
(ride level regulating valve)

Stop the engine.



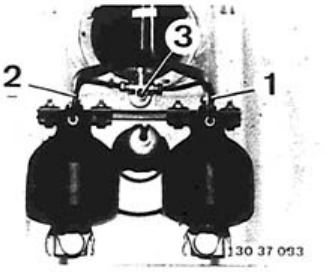
Regulate the system back to lowering position.
Minimum pressure*.
(ride level regulating valve)



Open shutoff valve (B) slowly and let hydraulic oil run into a pan.
The pressure, at which the pressure gage drops suddenly to 0, is the gas charging pressure* of the pressure reservoir.
Repeat the test.

* See Specifications

Remove the tester.
Connect pipe (1) again.
Installation:
Tightening torque*.



Checking Right Pressure Reservoir:
Discharge the pressure.
Unscrew pipe (2) and connect the tester, pushing the adapter aside for this purpose.
Now perform test in the same manner as for the left pressure reservoir.
Installation:
Tightening torque*.

* See Specifications

TROUBLESHOOTING RIDE LEVEL CONTROL

CONDITION	CAUSE	CORRECTION
Measured car ride level height too high or too low	a) Level height adjustment incorrect b) Regulating linkage mounted incorrectly	a) Adjust level height - see 37 12 010 b) Check/repair regulating linkage installation and adjust level height - see 37 12 010
Rear end of car drops below nominal level height when loaded and with engine running.	a) Car overloaded b) Hydraulic fluid level too low c) Regulating linkage mounted incorrectly d) Delivery line damaged e) Insufficient pump pressure f) Ride level regulating valve faulty g) Spring strut shock absorbers faulty	a) Check payload, reducing it to max. axle load if applicable b) Check/correct hydraulic fluid level c) Check/repair regulating linkage installation and adjust level height - see 37 12 010 d) Check and repair/replace delivery line e) Check pump - see 37 21 005, repair or replace - see Group 32 f) Check ride level regulating valve - see 37 21 500/501 (reservoir pressure test) or replace - see 37 12 210 g) Check absorbers (shock tester) or replace - see 37 12 100
Rear end of car does not rise/drop to nominal level after removing payload	a) Regulating linkage mounted incorrectly b) Delivery/return line damaged c) Ride level regulating valve faulty d) Spring strut shock absorbers faulty e) Insufficient pump pressure	a) Check/repair regulating linkage installation and adjust level height - see 37 12 010 b) Check and repair/replace delivery/return line c) Check ride level regulating valve - see 37 21 500/501 (reservoir pressure test) or replace - see 37 12 210 d) Check absorbers (shock tester) or replace - see 37 12 100 e) Check pump - see 37 21 005, repair or replace - see Group 32

TROUBLESHOOTING RIDE LEVEL CONTROL (Continued)

CONDITION	CAUSE	CORRECTION
Line between pressure reservoir and shock absorber damaged	a) Ride level regulating valve faulty b) Gas charging pressure loss in pressure reservoir	a) Check ride level regulating valve - see 37 21 500/501 (reservoir pressure test) or replace - see 37 12 210. b) Check pressure reservoir - see 37 21 500/501 or replace - see 37 21 030.
Car's suspension harder than normally	a) Gas charging pressure loss in pressure reservoir	a) Check pressure reservoir - see 37 21 500/501 or replace - see 37 21 030.
Insufficient shock absorber performance, rattling in rear axle	a) Spring strut shock absorbers faulty	a) Check absorbers (shock tester) or replace - see 37 12 100.

41 Body

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Body Jobs on CONVERTIBLES

This section only describes special repairs for convertibles. Repairs, which are identical or practically identical with those for sedans and/or four wheel drive models, are not described here.

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Body Jobs on BMW touring models

This section only describes special repairs for touring cars. Repairs, which are identical or practically identical with those for sedans and/or four wheel drive models, are not described here.

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41 - 001

INTRODUCTION

This repair manual for body jobs is supplied for skilled workers and consequently it is assumed, that persons referring to this manual will be well qualified, conscientious workers with the necessary amount of responsibility.

Instructions are therefore limited to information on factory approved repair methods as well as related tips and working aids.

The described body repair jobs refer to the complete or partial replacement of parts with original BMW replacement parts or sections of replacement parts. Straightening and dent removal must be adapted to a pertinent damage scope. Concerned welding and spot welding seams must be inspected and, if necessary, repaired.

Refer to the cut out parts for the quantity and location of welding spots, inert gas welded seams and brazed connections. Use inert gas plug welding instead of spot welding in non-accessible areas.

Most pictures show a rough, unpainted bodyshell. Remove or cover all car parts, which are in the repair zone and are in danger of being subjected to heat, sparks or dust.

Disconnect the ground lead on the battery or body connection point. Protect electric leads against dangers of mechanical or thermal influence.

Conform with safety precautions for cars with an airbag system (SRS).

Conform with fire and accident prevention regulations.

Welding can be performed after removal of control units, if
- there is guarantee of about 1 meter (3 feet) distance between welding and ground connections and
- there is guarantee of good electric connection between welding and ground points (no rubber mounts or anything similar).

If not, thermal development must be considered especially in case of autogen welding (decisions must be made for each individual case).

In spite of continuous quality control in welding by the factory, it is still possible that some welded points could be faulty. They will be repaired in the factory subsequently, either with inert gas spot welding or, when not accessible, with 15 mm (0.590") long inert gas welded seams on the flange end. Consequently repaired welded seams on the body do not always indicate repairs by a third party.

For example: left engine carrier member resistance spot welded - right engine carrier member welding repaired with inert gas welding.

Important!
The steering gear must be inspected and maybe replaced after an accident or accident-similar driving conditions - see Service Information 32 01 88 (828).

Seal off all sealing seams, sealed in original state, with a body sealing compound. Replace damaged anti-drumming insulation.
Seal new sheet metal parts or the cavities, seams, creases and folds produced by new sheet metal parts with a body sealing compound immediately.

Source of supply for workshop equipment, aids, sealing materials, cements and similar products: HWB (a Business Division of BMW AG).

REMOVING PVC MATERIAL IN REPAIR ZONE

Corrosion inhibition after repairing begins already with the professional removal of PVC undercoating, anti-drumming compound and seam sealing compound in the repair zone.

Remove PVC material with a rotating steel brush, or heat PVC to maximum 180° C (355° F) with a hot air blower and scrape off with a spatula.
Burning off the PVC material or heating it above 180° C (355° F) with a gas flame torch or similar tool would produce strong corrosion-promoting hydrochloric acid.
Health impairing vapors would also be set free.
New undercoating would not have sufficient adhesion on burnt PVC material and consequently undersurface rusting would be possible.

WELDING GALVANIZED SHEET METAL

Hot galvanized and galvanized sheet metal is used to a greater extent for components of the body, which are especially subject to corrosion.

Conformance with the following points is necessary when working with these parts.
The welding smoke contains poisonous zinc oxide, so that especially good extraction is necessary in the welding bay.
Do not grind off zinc coat for resistance spot welding and inert gas welding.
The zinc coat, however, must be ground off for brazing jobs.

If at all possible welded connections should be made with resistance spot welding.
Welding current is boosted by at least 10 % as compared with blank sheet metal.
Apply as high as possible electrode contact force (make break out test on sample sheet metal).
A coat of spot welding paste can be applied for better sealing.

Inert gas welding should be preferred to autogen welding in areas not accessible for resistance spot welding, because of the lower heat dispersion.
Machining or forming of galvanized sheet metal in warm state is normal.
Make sure of thorough extraction of poisonous vapors.
Remove burnt residual zinc completely.
Align, grind down and tin out visible joints as normally.
Coat ground off zink coat ed surfaces with zinc dust paint.

RECOMMENDED WORKING METHODS AND TOOLS

1. Cutting Out Damaged Parts:

Determine the location of mating surfaces with help of the replacement part before beginning with the work. Cut out damaged part roughly within the mating surfaces.

Caution!
Don't damage sheet metal located underneath.

Remove sealing compound, anti-drumming compound and, if applicable, paint to neutralize the connection points. Drill out spot welding. Make sure holes are drilled in the cut out part while drilling. Don't drill in the connection flanges remaining for installation of the new part.

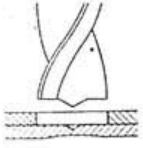
Grind off welded seams with a disc grinder carefully. Heat brazed connections with an autogen gas torch (don't heat excessively!). Lift off scrap metal. Remove residual brazing solder with a steel brush. Straighten and grind all connection points thoroughly.

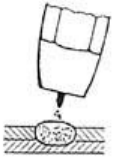
2. Installing New Parts:

Prepare connection points to pertinent repairing instructions.

Always perform repairs, which concern the suspension points of the engine, transmission, axles or running gear, on a straightening bench with the attachments belonging to the car type. There are also attachments for different body parts. Check curvature and dimensions of windshield and rear window by installing an original window. Refer to pertinent drawings for the gaps of doors, engine hood and trunk lid.

Coat mating surfaces intended for resistance spot welding with zinc dust paint. Only remove the protective paint from galvanized replacement parts. Drill 8 mm (0.315") dia. holes with same spacing as the drilled out welded spots in connections not accessible for the spot welding tongs and insert gas plug weld.





Produce inert gas welded seams according to the part cut out.

Produce brazed connections with as little as possible heat dispersion and without excessive heat. Procedures deviating from standard connections will be described in the repair manual. Grind down welded seams visible on outside surfaces.

Caution!
Don't grind down the sheet metal too thin.

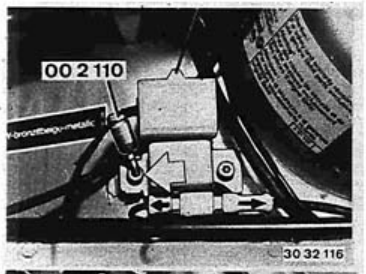
Straighten and tin out irregularities. Tinning out is supposed to prepare the surface to such an extent, that only a coat of fine filler has to be applied prior to spraying on paint.

Seal off all welding seams, which had been sealed in original state, with a body sealing compound. Replace damaged anti-drumming compound. Seal new sheet metal parts or the cavities, seams, creases and folds produced by new sheet metal parts with a body cavity sealing compound immediately.

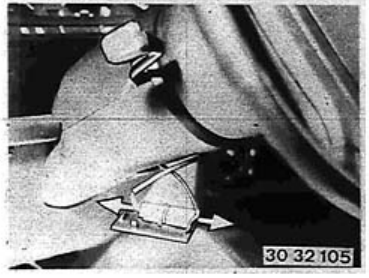
Source of supply for workshop equipment, aids, sealing materials, cements and similar products: HWB (a Business Division of BMW AG).

SAFETY PRECAUTIONS FOR CARS WITH AN AIRBAG WHEN WORKING ON BODY

Disconnect both poles of car's battery before working with an electric welder.
Cover battery poles.



Disconnect plugs of both front sensors (C).



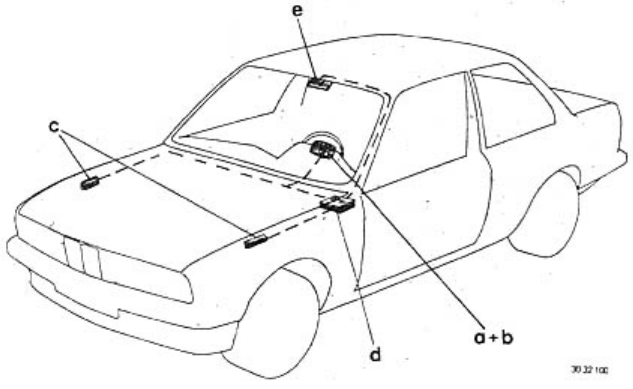
Lift cap off of steering wheel casing lower section and disconnect plug.

Parts of the airbag system may not be heated above 100° C (212° F), not even briefly.

If there is danger that working on the body could subject parts of the airbag system to strong vibrations, they should be removed as a precautionary measure.

In case of deformations or when installing the holders for both crash sensors on the front wheel houses on left and right sides, make sure that the holders are aligned parallel to the car's longitudinal axis precisely.

Also refer to the repairing and safety regulations concerning the airbag system in Group 32.



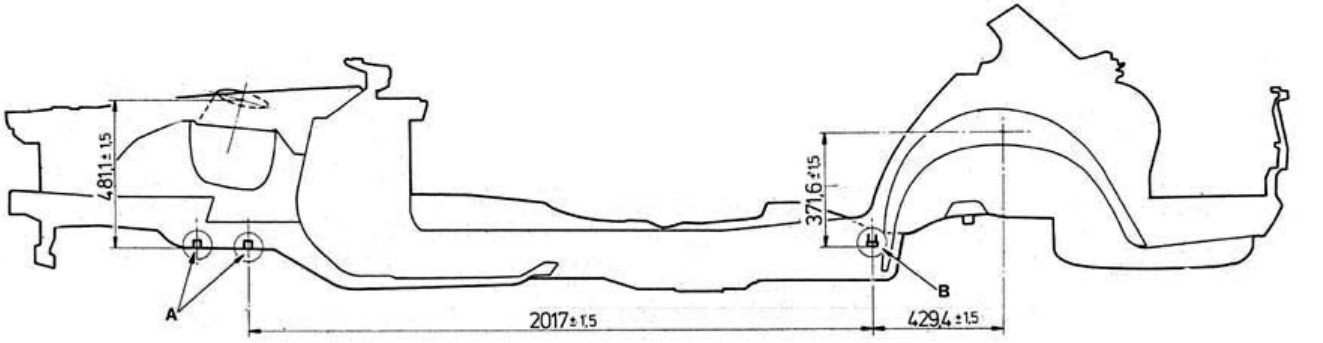
Components:

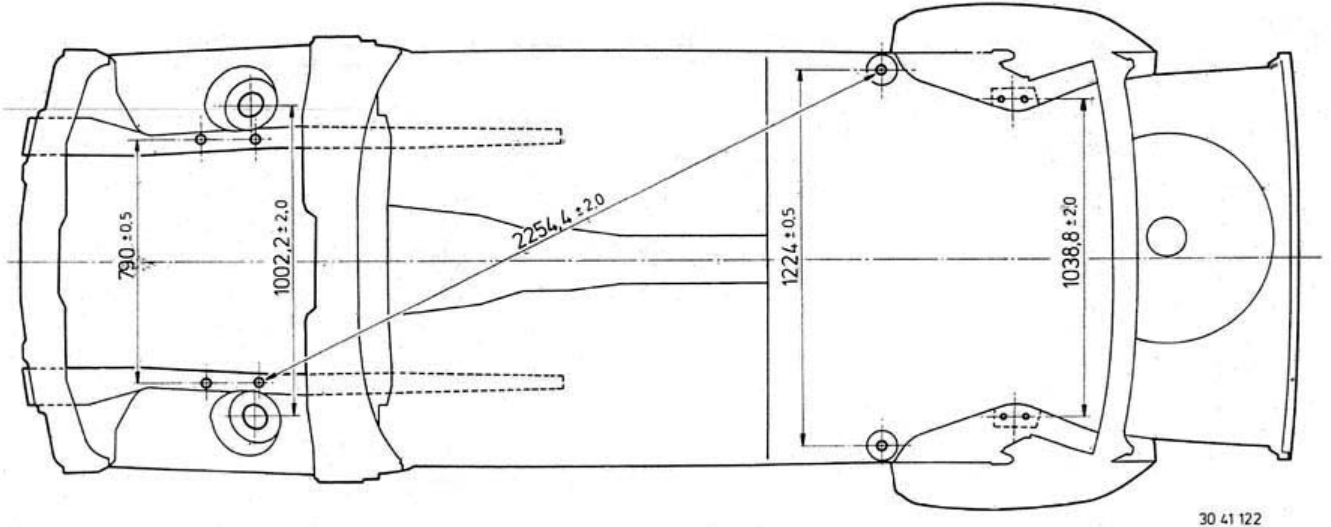
a) Airbag steering wheel with impact shell and impact pad, in which airbag, gas generator and ignition pill are integrated.
b) Contact ring – guarantees power supply to ignition pill.
c) Two crash sensors (left and right front on wheel house) and safety switch left.
d) Electronic diagnosis unit (instrument panel trim left) with integrated safing sensor (prevents unwanted activation).
e) Airbag indicator lamp integrated in check control unit.

41–004

FRAME ALIGNMENT CONTROL DIMENSIONS – BMW '3' Series / E 30
– Sedans and Convertibles –
A Front axle take-up
B Rear axle take-up
All dimensions in mm

Note:
Only use the following values for a rough inspection, Repairs can only be carried out correctly with the approved set of attachments and a straightening bench.

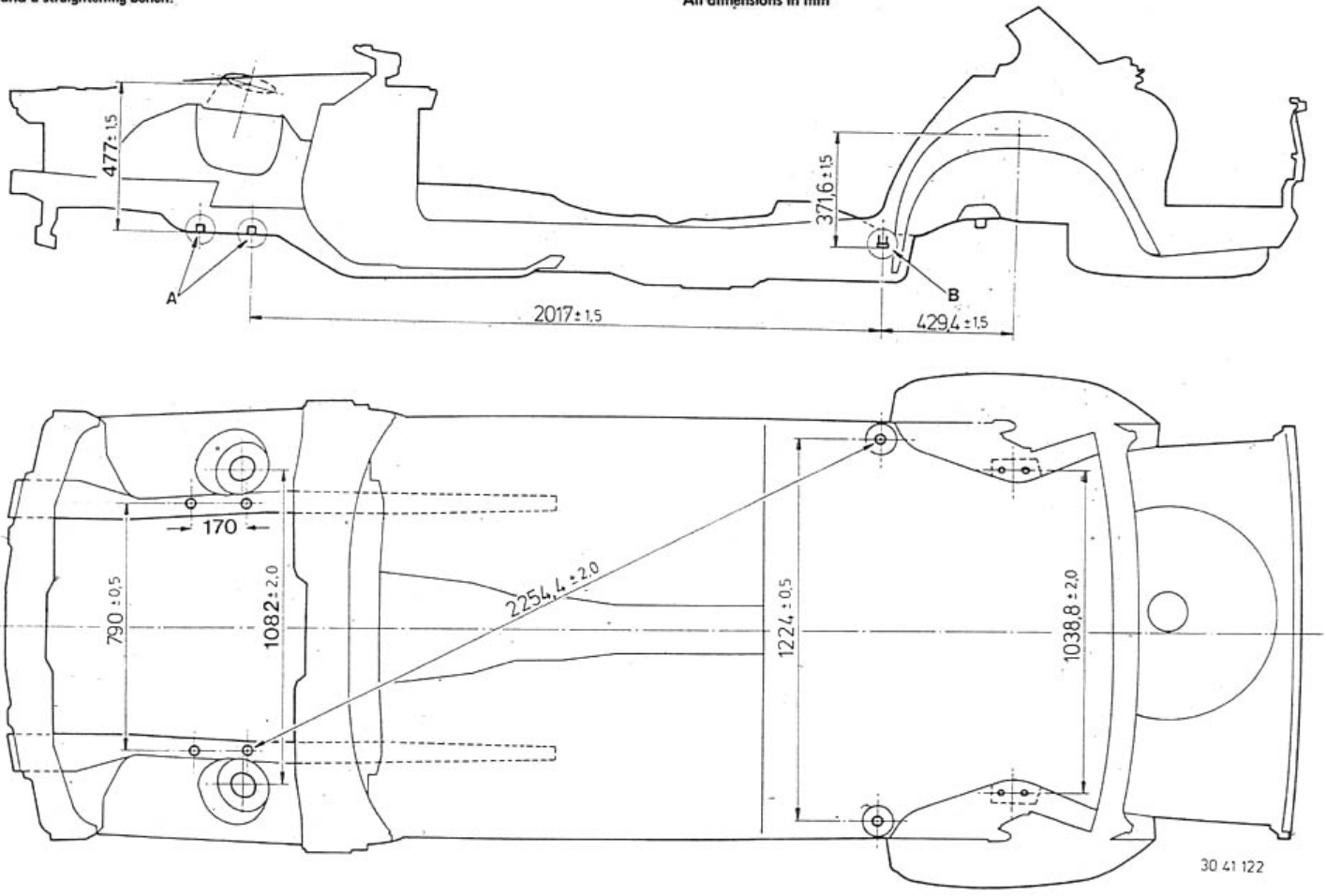


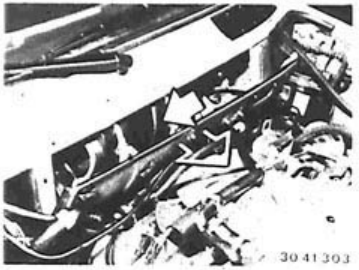


30 41 122

Note:
Only use the following values for a rough inspection. Repairs can only be carried out correctly with the approved set of attachments and a straightening bench.

FRAME ALIGNMENT CONTROL DIMENSIONS – BMW '3' Series / E 30
– All Wheel Drive Cars –
A Front axle take-up
B Rear axle take-up
All dimensions in mm



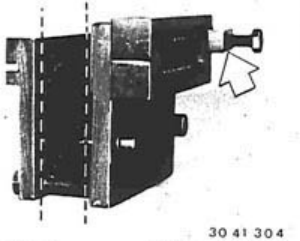


DIE-STAMPING CHASSIS NUMBER

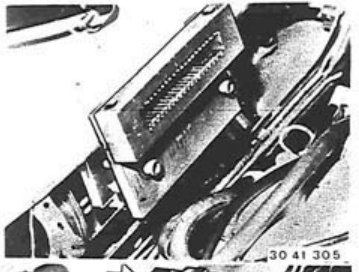
If the die-stamped chassis number has to be removed while repairing the car body, it must be die stamped again.

Note:

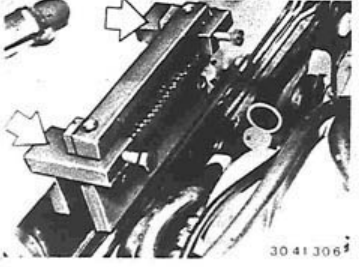
Die stamping of chassis number is also possible after car has been assembled, but then cover on wall and cover for blower motor have to be removed.



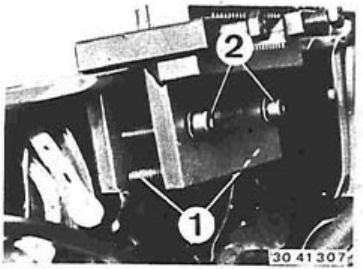
Assemble Special Tool 41 1 001 that smooth side of baseplate faces stamp guide.
Screw in bolts only so far, that Special Tools 41 1 003 can still be inserted later.



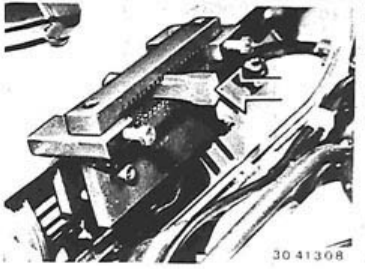
Apply special tool fixture and place baseplate on surface for chassis number.



Insert Special Tools 41 1 003 on left and right sides and clamp down.



Align baseplate to be parallel to stamp guide with bolts (1).
Push up special tool fixture completely.
Tighten bolts (2).



Stamp Digits 41 1 002:
Insert digits in special tool separately and die stamp chassis number.
When replacing parts of body or complete body in a workshop, die stamp "+" in front of and behind chassis number instead of BMW emblem for clear identification.

REPAIRING BODY PARTS MADE OF GLASS FIBER REINFORCED PLASTICS

Limited damage on parts made of glass fiber reinforced plastics, e.g. trunk lid of M 3 cars, can be repaired with the described repairing method.

There is chiefly application of two methods for the production of glass fiber reinforced plastic parts in standard car production.

SMC = Sheet Moulding Compound = processing method with polyester resin saturated sheets (prepegs), which are then hardened with application of pressure and heat. Prepegs are a sheetlike, free-flowing base compound consisting of glass fibers, fillers and unsaturated polyester resin.

BMC = Bulk Moulding Compound = injection moulding method with application of heat and high pressure producing a sauerkraut-similar compound, in other words a compound which is not sheetlike.

Identification:

Strong solid parts, insensitive to solvents. Flame test: crispy charcoaled, yellowish red, strongly sooting flame. Consequently only damage, which has no influence on the stiffness and strength of mounting points, may be repaired.

POSSIBLE REPAIRING

Possible Repairing Limitations:

In extreme driving conditions body parts will be subjected to strong vibrations and wind pressure or suction. Consequently only damage, which has no influence on the stiffness and strength of mounting points, may be repaired.

Example – Trunk Lid for E 30 / M 3 Cars:

Broken off or torn corners and damage on the outer panel may be repaired. Repairs may not be carried out on the supporting inner panel elements and threaded inserts of mounting points. Replace a part when in doubt.

Repairing glass fiber reinforced plastic parts will considerably depend on the type of damage, preparation of the damaged zones and qualification as well as perfection of the work. It is recommended to practice repairs on parts no longer required in order to have sufficient experience.

The company approved ultraviolet hardening repair system* is distinguished by the following advantages in application as compared with conventional two-component resins.

1. Single component system, no mixing or mixing errors.
2. No waste, since excessive material will not hardened when not subjected to light and can be reused.
3. Very long application time in closed rooms (only slight influence from light entering the room through closed windows); fast hardening after ultraviolet radiation (direct sunshine, ultraviolet lamp*).
4. Glass sheets pre-impregnated, no air inclusions.
5. Easy moulding of impregnated glass sheets without dirtying hands.
6. Uniform handling of entire repair system from resin to finish filler.
7. Brushes and other tools can be stored until needed again without washing them when light is kept off of them (covered with aluminum foil, placed in boxes, or in a similar manner).

Tool Requirements:

Hand tools and equipment already used for working with sheet metal can be applied as material removing tools. It is only necessary to purchase an ultraviolet lamp* required for hardening of the resin.
Cutting and grinding tools must be sharp and must not smear. The use of unsuitable tools will subject the material surface to excessive heat and cause "polished" spots. Only repair plastic parts at room temperature.

* Source of Supply:

Plastic Materials:

Lothar Reif GmbH
Relo-Kunststoffe
Kolpingstr. 2
D-7850 Lörrach
Phone: 07621 / 40360
Telex: 0773516

Ultraviolet Lamp:

HWB (A Business Division of BMW AG)

SAFETY PRECAUTIONS WHEN REPAIRING GLASS FIBER REINFORCED PLASTIC PARTS

Grinding dust must be removed on site with suitable extraction and a vacuum cleaner or machines with integrated extraction.
Protective goggles and a mask must be worn during grinding operations.

Conform with the following points when working with and storing polyester resins.

Personal Protective Equipment:

Gloves, goggles.

Working Hygiene:

Good ventilation and regular washing of hands; no contact with food.

First Aid:

Take off dirty clothes immediately. If dust has gotten in eyes, rinse out thoroughly with water and go to a physician. Dab coated skin and wash thoroughly with water and soap. If great amount of vapors are inhaled, go outdoors in the fresh air and, if necessary, visit a physician.

Information on Toxicology:

Systems containing styrol will irritate eyes, skin and the respiratory track. No damaging effects are known from decades of use as long as handling is correct.

Measures in Case of Fire:

Fire extinguishing agents: water mist (no water stream), powders, foam, CO_2 and halon.

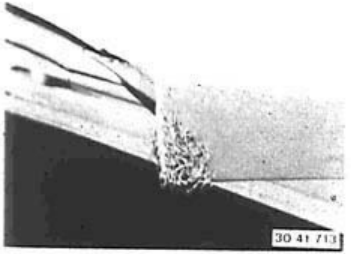
Scrapping:

Never let it get into drink water systems.
It can be brought to a normal refuse station after hardening.

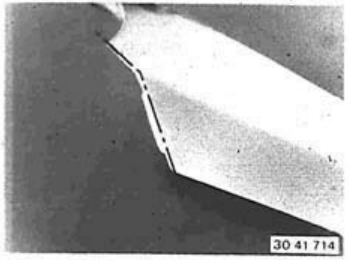
REPAIRING GLASS FIBER REINFORCED PLASTIC PARTS

Assumed Damage:
Damaged Corner on Trunk Lid;

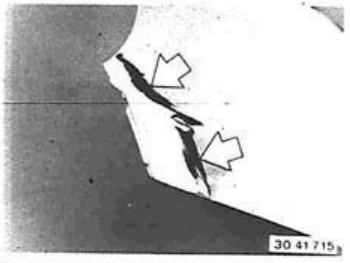
Note:
The following repairing instructions can only describe general procedures.
Procedures must be adapted to the pertinent type of damage.
See the introduction for additional information.



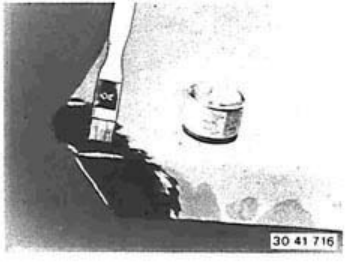
Grind off damaged corner until firm, non-fibrous laminate is visible.
Note:
Grind off that much further, if gasoline, oil or something similar has penetrated into the damaged area.

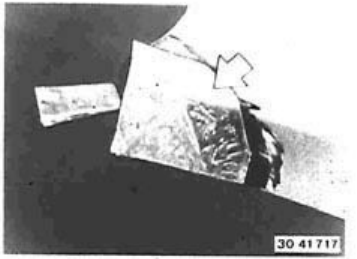


Grind mating surfaces in flat-flowing transition.
Note:
The plastic surface has a graphite coat to make it conductive for the painting method used in standard production.
Grind off the graphite coat outside of the damaged area.
Clean ambient area with atcetone.

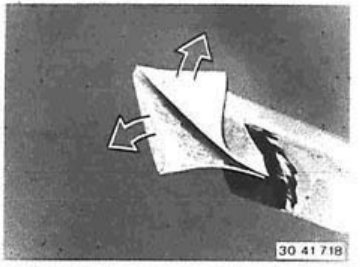


Coat mating surfaces with an adhesion agent.

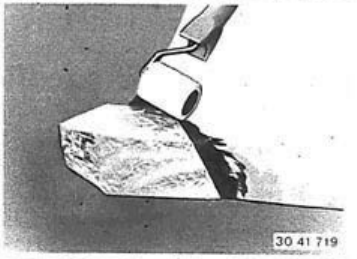




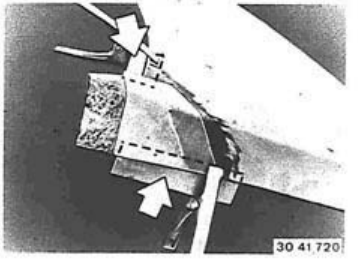
Remove repair bandage from aluminum foil and cut off to size.
Important!
Material hardens in sunshine.
Close aluminum bag immediatly to keep out light.



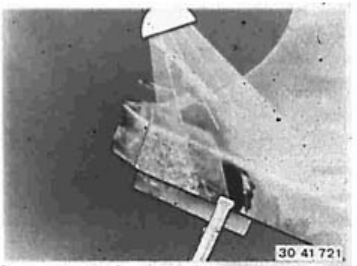
Pull off transparent plastic sheet on one side.



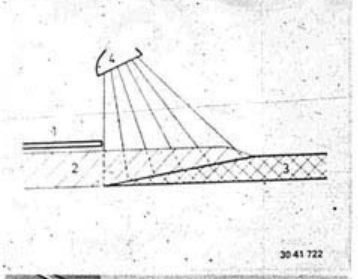
Place repair bandage on damaged surface and mold.
Press out air bubbles.
Use a rubber roller, if necessary.



If applicable, cover inside of damaged surface with the pulled off sheet and keep it stretched by applying strips of metal or plastic until hardening is finished.

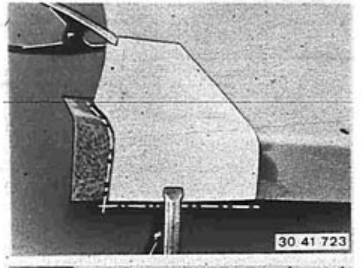


Aim an ultraviolet lamp on damaged surface.
The hardening time will depend on the lamp version, scope and strength of laminate.
Gain experience by making tests, if necessary.
Hardening time for 1 mm (0.039") coat = approx. 2 minutes.
Important!
Chemical reaction produces heat, which could lead to self-destruction of the laminate.
If necessary, interrupt the ultraviolet lamp treatment occassionally.

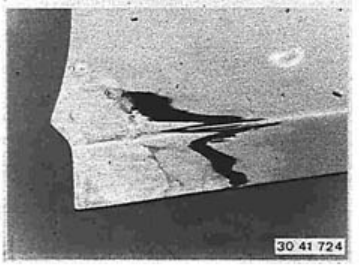


Note:
Ultraviolet radiation is only effective when applied direct. There is no hardening in zones of shade or on covered laminate. This can be exploited, in that some sections are covered and only certain surfaces are hardened, or are cemented. The remaining sections can then be molded and hardened separately.

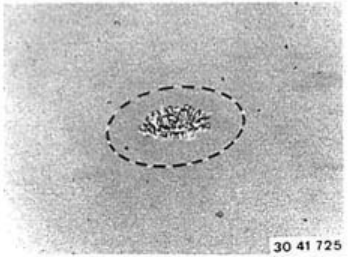
1 Cover
2 Repair material
3 GFP part
4 Ultraviolet lamp



Pull off foil.
Build up laminate to final thickness by cutting repair bandages to size, hardening and grinding inbetween as necessary.
Important!
Remove foil between layers. Harden the laminate with an ultraviolet lamp. Transfer the edge shape with a paper template from the other side.



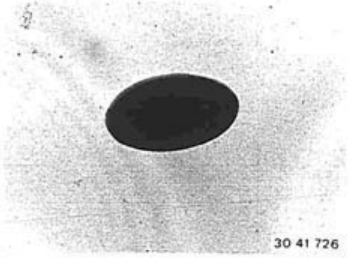
Grind inside and outside of repaired area.
Remove irregularities with a glass fiber putty.


30 41 725

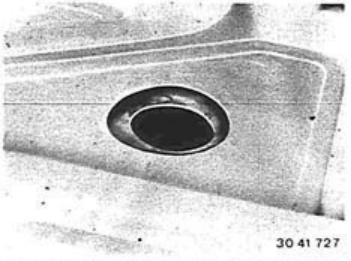
REPAIRING GLASS FIBER REINFORCED PLASTIC PARTS

Assumed Damage:
Hole or Damaged Laminate in Outer Trunk Lid Panel Between Reinforcement Ribs:

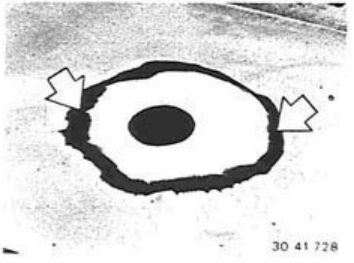
Note:
The following repairing instructions can only describe general procedures.
Procedures must be adapted to the pertinent type of damage.
See introduction for additional information.


30 41 726

Cut out damaged area until firm, non-fibrous laminate is visible.
Note:
Grind off that much further, if gasoline, oil or something similar has penetrated into the damaged area.


30 41 727

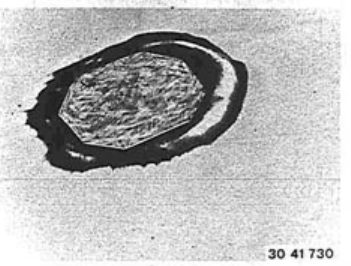
Note:
The trunk lid consists of inside and outside panels.
If both panels are damaged, cut out the damaged area on the inside a little larger.


30 41 728

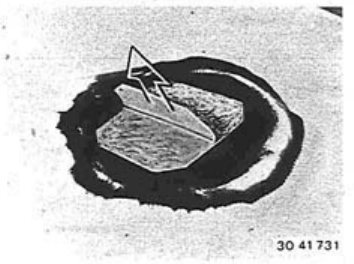
Grind mating surfaces in flat-flowing transition.
Note:
The plastic surface has a graphite coat to make in conductive for the painting method used in standard production.
Grind off the graphite coat outside of the damaged area.
Clean ambient area with atcetone.


30 41 729

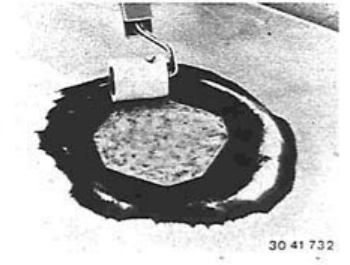
Coat mating surfaces with an adhesion agent.


30 41 730

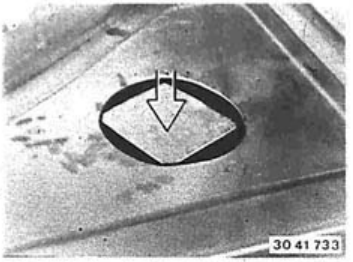
Remove repair damage from aluminum foil and cut off to size.
Important!
Material hardens in sunshine.
Close aluminum bag immediately to keep out light.


30 41 731

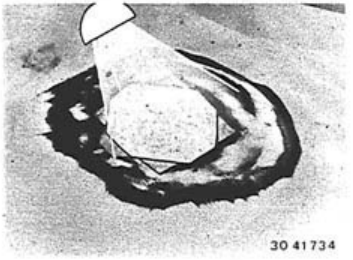
Pull off transparent plastic sheet on one side.


30 41 732

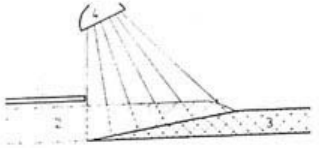
Place repair bandage on the damaged surface and press on all around.
Press out air bubbles.
Use a rubber roller, if necessary.



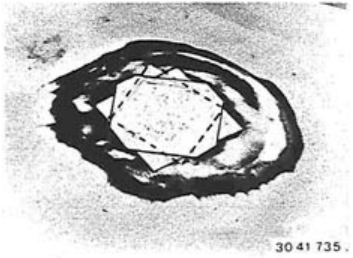
Note:
In case of large damage, cover the inside of the hole with the pulled off sheet and hold it with a piece of metal or something similar until hardening is finished.



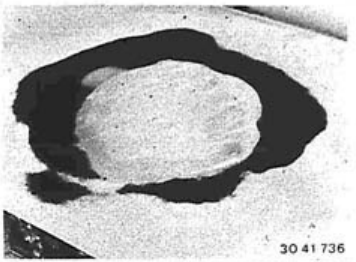
Aim an ultraviolet lamp on the damaged surface.
The hardening time will depend on the lamp version, scope and strength of laminate.
Gain experience by making tests, if necessary.
Hardening time for 1 mm (0.039") coat = approx. 2 minutes.
Important!
Chemical reaction produces heat, which could lead to self-destruction of the laminate.
If necessary, interrupt the ultraviolet lamp treatment occassionally.



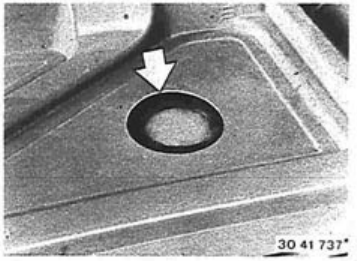
Note:
Ultraviolet radiation is only effective when applied direct. There is no hardening in zones of shade or on covered laminate. This can be exploited, in that some sections are covered and only certain surfaces are hardened, or are cemented. The remaining sections can then be molded and hardened separately.
1 Cover
2 Repair material
3 GFP part
4 Ultraviolet lamp



Pull off foil.
Build up laminate to final thickness by cutting repair bandages to size, hardening and grinding inbetween as necessary.
Important!
Remove foils between layers.
Harden the laminate with an ultraviolet lamp.



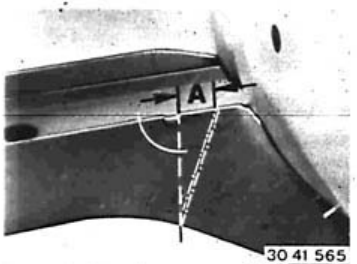
Grind the repaired area.
Remove irregularities with a glass fiber putty.



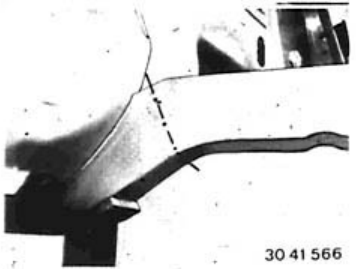
Repair the inside panel to the instructions for the outside.

41 11 011/ 001 REPLACING RIGHT / LEFT FRONT ENGINE CARRIER (PARTIAL REPLACEMENT) WITH WHEEL HOUSE – All Wheel Drive –

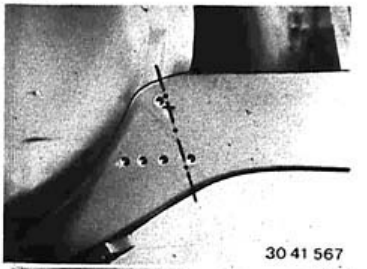
Refer to information on page 41 - 001.
Remove or disconnect following parts:
ground lead on battery, bumper, wheel house trim top and bottom, all radiator grill sections, engine hood lock, engine hood release, front spoiler, all headlights, front fog lamps if applicable, both bumper brackets, horns, heater wall seal, entrance cover strips, front seat, instrument panel trim, carpet on A pillar, passenger compartment carpets partially, footwell insulation sheet partially, brake booster with brake master cylinder if applicable, fuel filter, ignition coil, brake lines partially, engine, front axle with transmission, engine compartment wires partially, radiator trim, data plate.
Check and adjust front wheel alignment.
Remove both side panels.
Remove front panel with front wall – see 41 33 001.
Remove wheel house – see 41 14 021.
Note:
If the console holding the ABS acceleration pick-up is straightened or welded on the left wheel house, the acceleration pick-up must be adjusted afterwards.
See Group 34 (ABS – All Wheel Drive) for adjusting procedures.



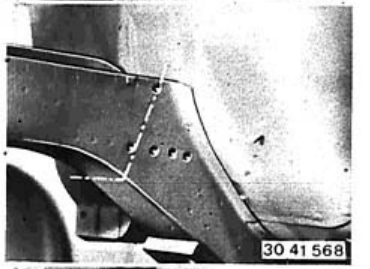
Mark cut according to sketch.
A = 30 mm (1.181")



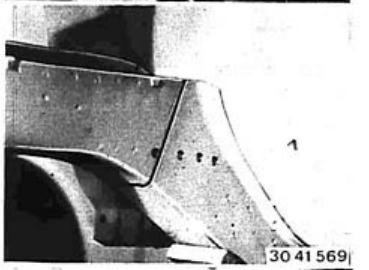
Transfer determined cut to outside.



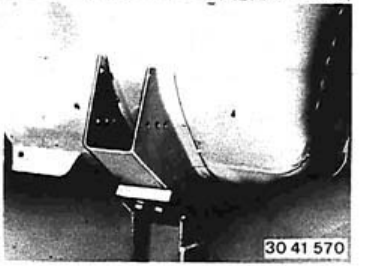
Drill out spot welds.



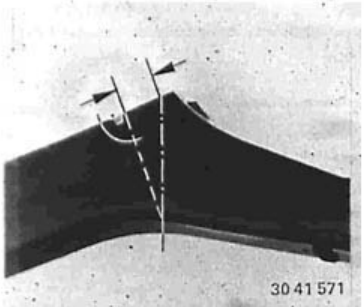
Drill out spot welds.



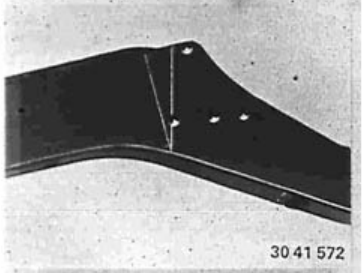
Cut through engine carrier on side and bottom.
Important!
Be careful not to damage metal sheet on inside.



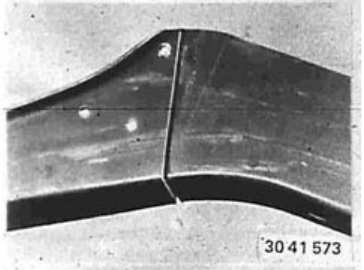
Lift off engine carrier front section.
Straighten and grind mating surfaces.



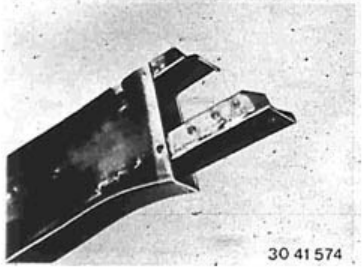
Transfer cut to new engine carrier.
Note:
Consider width of joint.



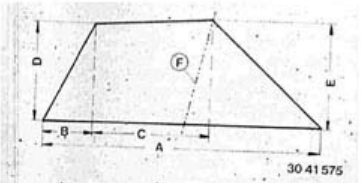
Drill out spot welds on inside and outside.



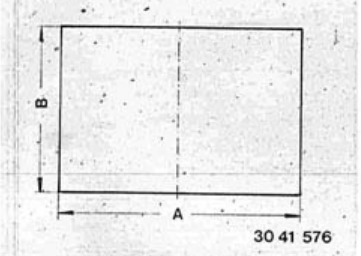
Cut through engine carrier on side and bottom.
Important!
Be careful not to damage sheet metal on inside.



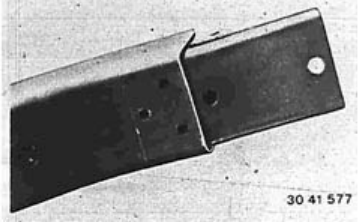
Straighten and grind mating surfaces.



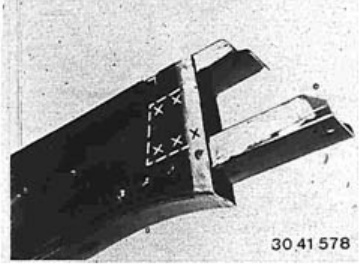
Prepare two sheet metal reinforcements for sides to sketch.
Sheet metal thickness = 1.8 mm (0.071").
A = 120 mm (4.724")
B = 21 mm (0.827")
C = 50 mm (1.968")
D = 44 mm (1.732")
E = 47 mm (1.850")
F = Cutting line on engine carrier



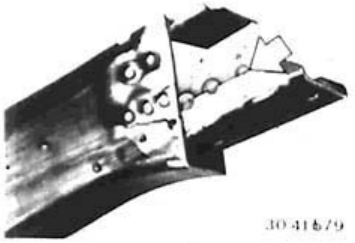
Prepare sheet metal reinforcement for bottom to sketch.
Adapt to curvature of carrier.
Sheet metal thickness = 1.8 mm (0.071").
A = 55 mm (2.165")
B = 80 mm (3.150")



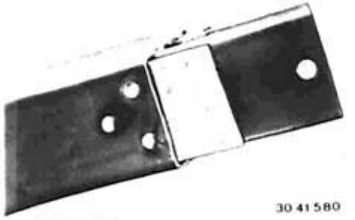
Mark location of and drill holes for plug spot welding in new engine carrier.



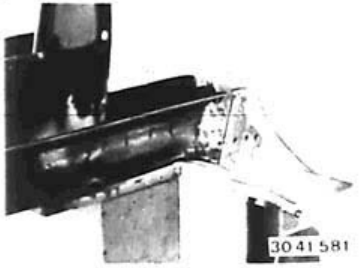
Match shape of reinforcement plates on inside and outside of new engine carrier.
Drill holes for plug spot welding.



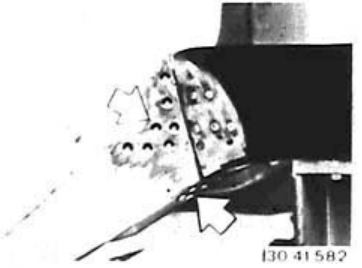
Slide in reinforcement plates half their distance and plug spot weld.
Tack weld ends on available reinforcement slightly.



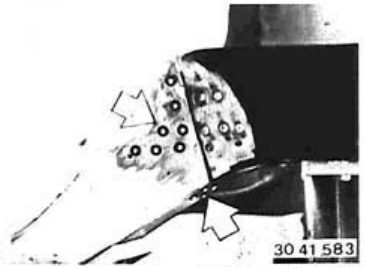
Slide in bottom reinforcement plate half its distance and plug spot weld.



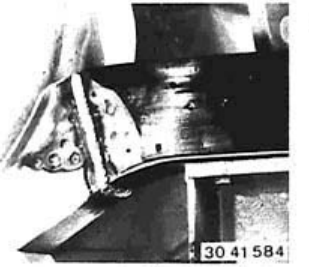
Set up car on straightening bench.
Fit in engine carrier.



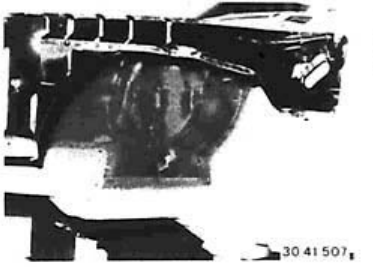
Drill holes for plug spot welding in area of reinforcements.
Note:
Reinforcement plates must bear on engine carrier.



Plug spot weld all reinforcements through provided holes.



Inert gas weld the joint.



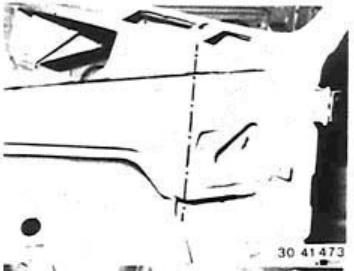
Install wheel house and front wall.
Coat all joints with body sealing compound*
Spray out wheel house with anti-drumming compound*

* See Specifications

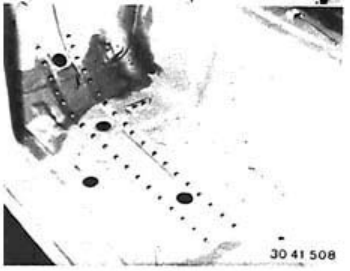
41 11 015 REPLACING LEFT FRONT ENGINE CARRIER (WITH WHEEL HOUSE)

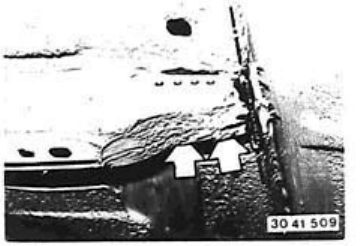
Refer to information on page 41 - 001.
Remove or disconnect following parts. Battery on ground pole, bumper, upper and lower wheel house trim panels, all radiator grill sections, engine hood lock and catch, front spoiler, all headlights, front fog lamps when applicable, both bumper brackets, two-tone horns, heater wall seal, entrance cover, front seat, dashboard trim panel; carpet on A pillar, carpet in passenger compartment partially, footwell insulation sheet partially, brake booster with master cylinder, fuel filter, ignition coil, brake pipes partially, engine, front axle with transmission, engine wire harness partially, radiator trim panel and data plate.
Remove both side panels.
Remove front panel with front wall – see 41 33 001.
Installation:
Check and adjust front wheel alignment.

Remove wheel house – see 41 14 021.

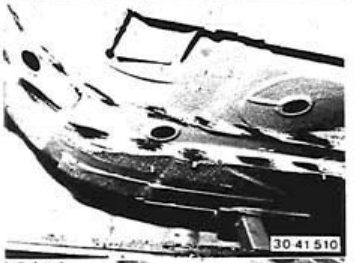


Uncover spot welding seams on inside of car.
Drill off welding spots.

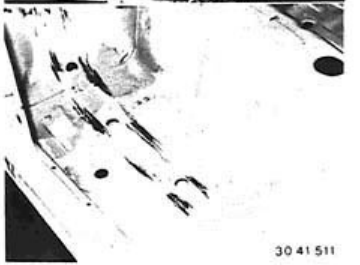




Uncover points of connection on end of engine carrier.
Drill off welding spots.
Grind off welding seam.
Remove engine carrier.



Straighten and grind points of connection.



Straighten and grind points of connection.

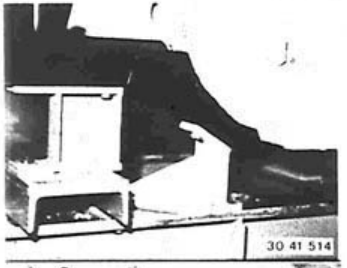


Grind points of connection on new engine carrier.



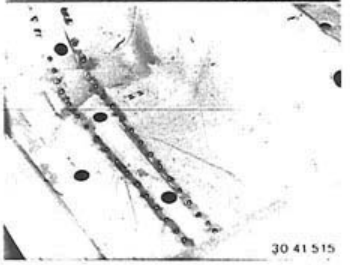
30 41 513

Drill holes for plug spot welding in engine carrier at rear.



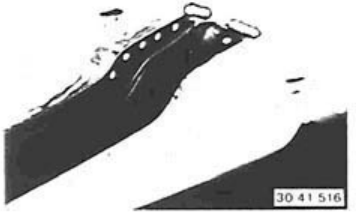
30 41 514

Set up car on straightening bench.
Install engine carrier.



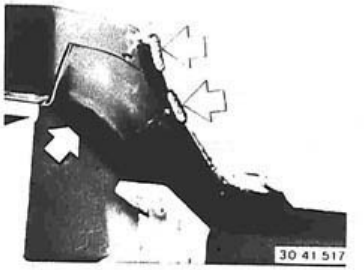
30 41 515

Plug spot weld engine carrier from the passenger compartment.



30 41 516

Plug spot weld engine carrier at rear on sides.
Weld rear with two inert gas welding seams.



30 41 517

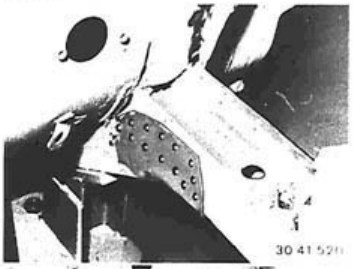
Seal engine carrier on inside and outside of separating wall with short inert gas welding seams.

Install wheel house – see 41 14 021.
Seal all welding seams with joint sealing compound*.
Replace damaged anti-drumming compound*.

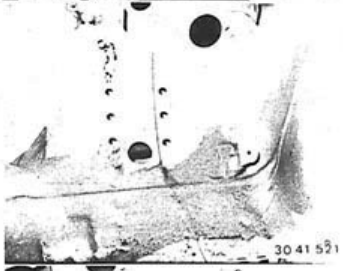
* Source: HWB

41 11 026 REPLACING ENGINE CARRIER FRONT SECTION AND LEFT FRONT CENTER SECTION (WITH WHEEL HOUSE)

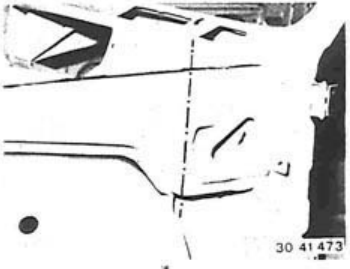
Refer to information on page 41 - 001.
Remove or disconnect following parts:
ground lead on battery, bumper, upper and lower wheel house trim, all radiator grill sections, engine hood lock, engine hood release, front spoiler, all headlights, front fog lamps if applicable, both bumper brackets, horns, heater wall seal, entrance cover strip, front seat, instrument panel trim, carpet on A pillar, passenger compartment carpets partially, footwell insulation sheet partially, brake booster with brake master cylinder, fuel filter, ignition coil, brake lines partially, engine, front axle and transmission, engine compartment wire harness partially, radiator trim and data plate.
Check and adjust front wheel alignment.
Remove both side panels.
Remove front panel with front wall – see 41 33 001.



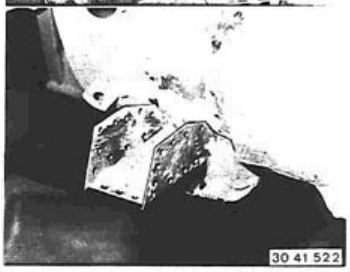
Make joint accessible.
Drill out spot welds.



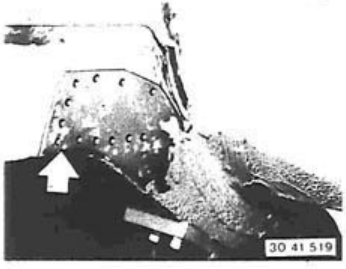
Drill out spot welds.
Lift off engine carrier.



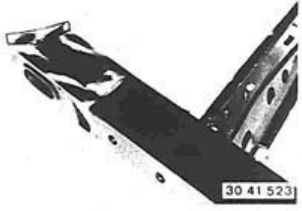
Remove wheel house – see 41 14 021.



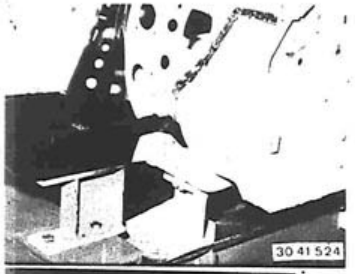
Straighten and grind mating surfaces.



Make joints accessible.
Drill out spot welds.



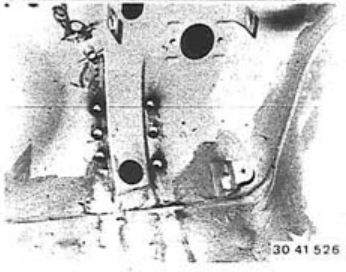
Grind mating surfaces on new engine carrier.



Set up car on straightening bench.
Set up engine carrier.



Plug spot weld engine carrier through provided holes.



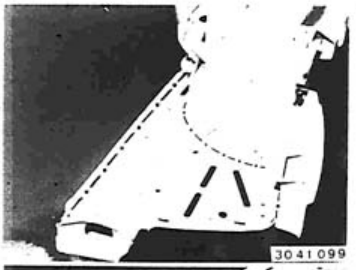
Plug spot weld engine carrier through provided holes.

Install wheel house – see 41 14 021.
Seal all welding seams with joint sealing compound*.
Replace damaged anti-drumming compound*.

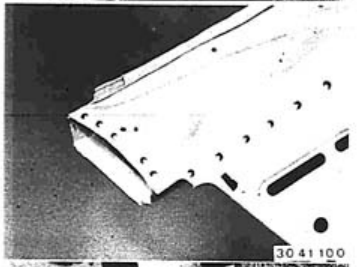
* Source: HWB

41 11 043/044 REPLACING LEFT/RIGHT ENGINE CARRIER FRONT SECTION WITHOUT WHEEL HOUSE

Refer to information on page 41 - 001.
Remove or detach following parts.
Disconnect battery ground lead.
Remove grill, headlights, front fog lights, two-tone horns, engine hood lock, data plate and radiator.
Disconnect wire harness partially.
Remove engine hood complete with hinges, see 41 61 000 / 41 61 050.
Remove front bumper, see 51 11 000.
Remove both front side panels, see 41 35 000.
Remove front panel complete with front wall, see 41 35 000.



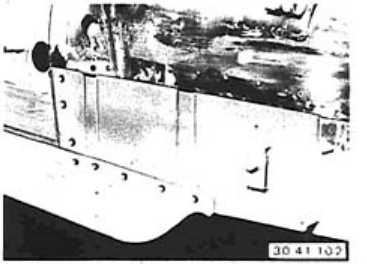
Cut out cover along line.



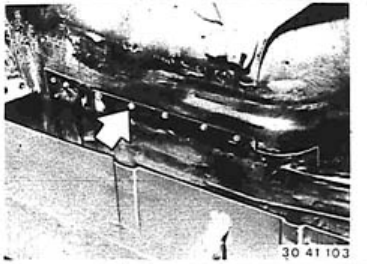
Drill off welded spots.



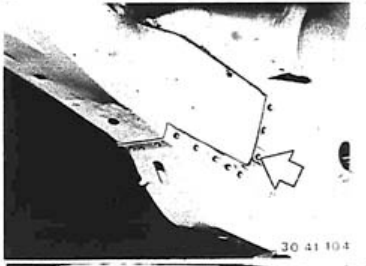
Cut off holder.



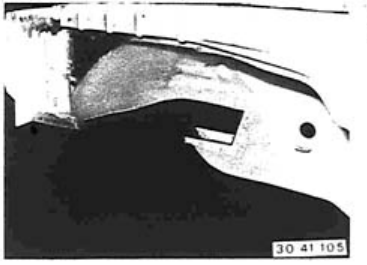
Drill off welded spots.



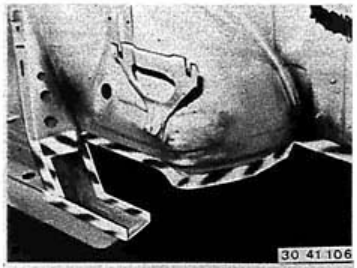
Drill off welded spots.



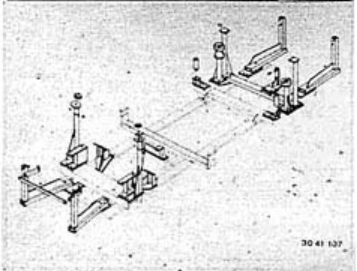
Drill off welded spots.
Remove engine carrier front section.



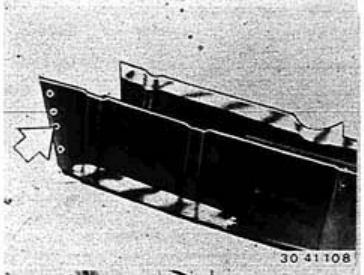
Remove scrap metal.
Straighten and grind mating surfaces.



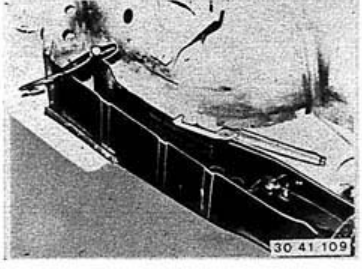
Remove scrap metal.
Straighten and grind mating surfaces.
Coat mating surfaces intended for spot welding with zinc dust paint.



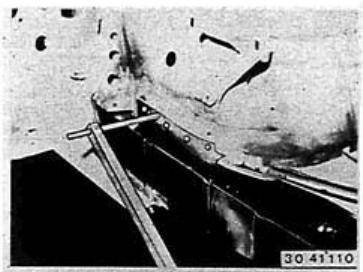
Set up car on straightening bench.



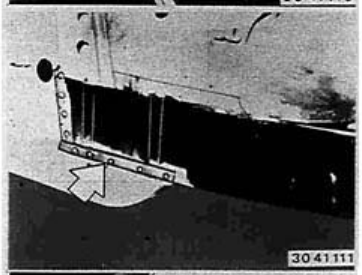
Grind and coat mating edges on new engine carrier front section with zinc dust paint.
Drill holes for plug spot welding in area of wheel house support.



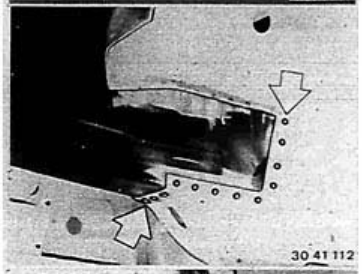
Install and clamp new engine carrier front section.



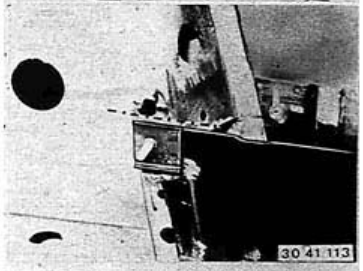
Spot weld engine carrier front section on wheel house.



Inert gas plug weld engine carrier front section on wheel house support and engine carrier.



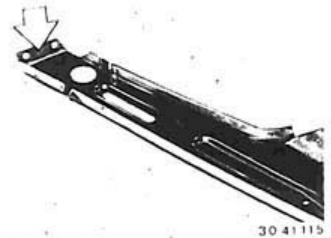
Inert gas plug weld engine carrier and wheel house from outside.



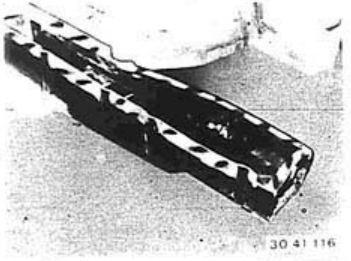
Weld on holder.
Check position.



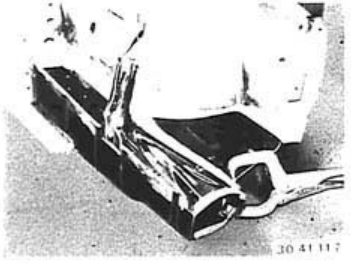
Grind and coat mating surfaces on cover plate with zinc dust paint.



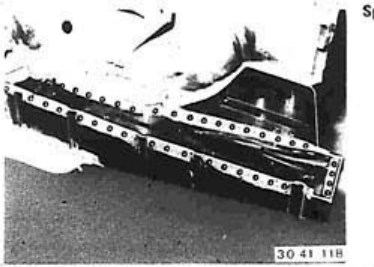
Drill holes for inert gas plug welding in wheel house/support joint.



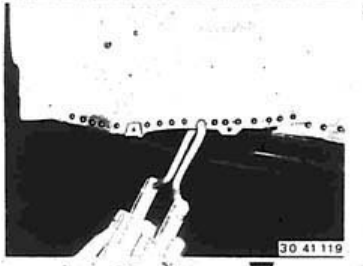
Grind and coat mating surfaces with zinc dust paint.



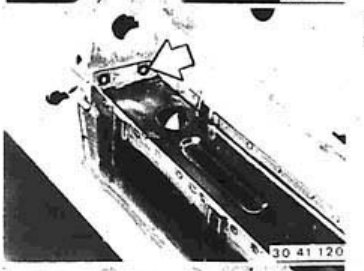
Install and clamp end plate.



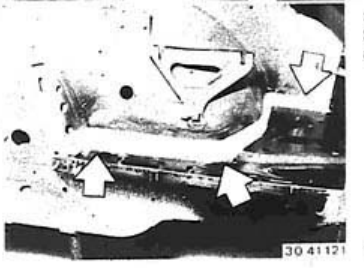
Spot weld end plate.



Spot weld end plate on wheel house.



Inert gas plug weld end plate on wheel house support.

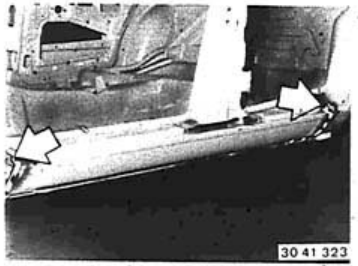


Seal joints with body sealing compound*. Spray out wheel house in engine acrrier with anti-drumming compound*.

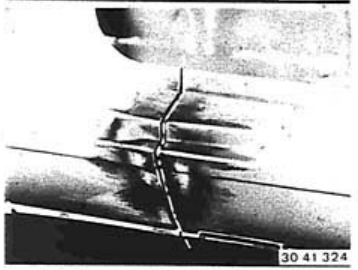
* Source: HWB

41 11 101 REPLACING LEFT OR RIGHT SIDE MEMBER COVER – Four Door Model –

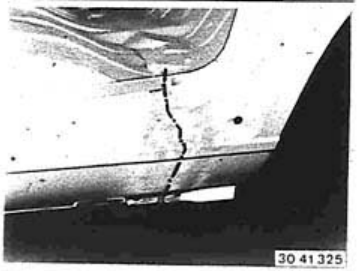
Refer to information on page 41 - 001.
Remove or disconnect following parts: rear door, front seat, B pillar plate, seat belt, entrance cover strip, front and rear cover plates, front and rear door edge guards partially, carpet partially, rear seat cushion, mounting parts, strut and fuel tank.


30 41 323

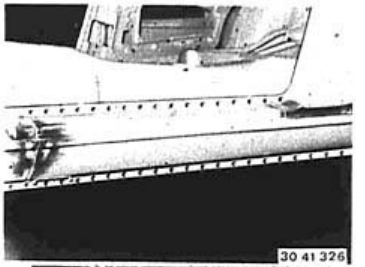
Uncover connections.
Remove brazing solder.


30 41 324

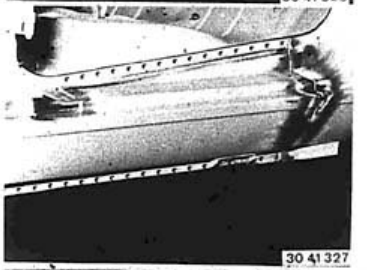
Cut through cover at front.


30 41 325

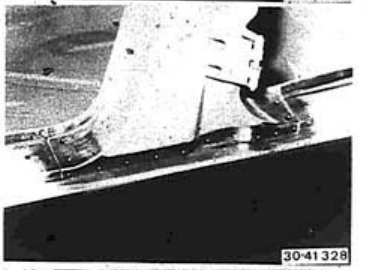
Cut through cover at rear.


30 41 326

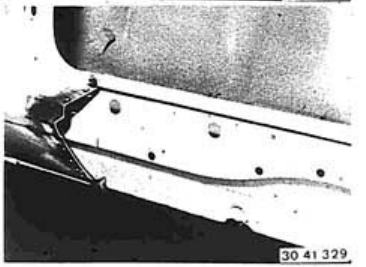
Drill out spot welds.


30 41 327

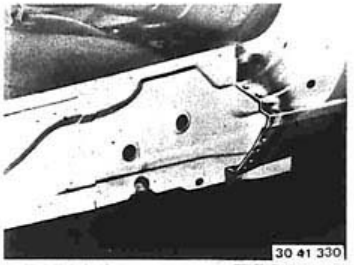
Drill out spot welds.


30 41 328

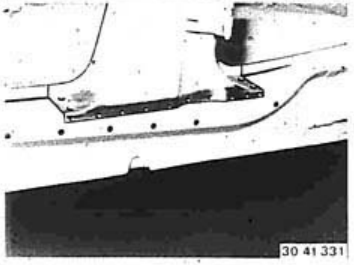
Drill out spot welds on B pillar.
Lift off cover.


30 41 329

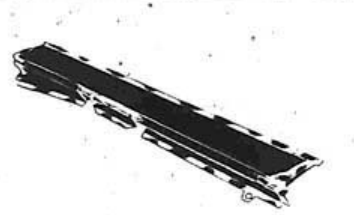
Drill off scrap metal.
Straighten and grind mating surfaces.
Coat mating surfaces required for spot welding with zinc dust paint.



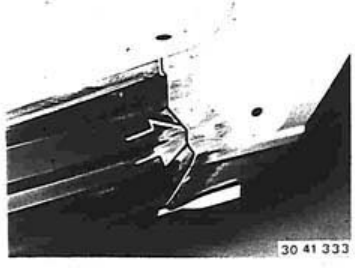
Drill off scrap metal.
Straighten and grind mating surfaces.
Coat mating surfaces required for spot welding with zinc dust paint.



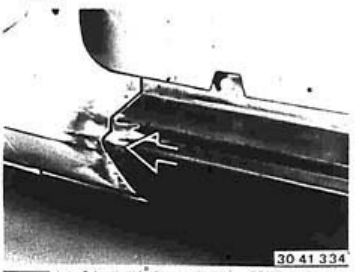
Straighten and grind mating surfaces on B pillar.



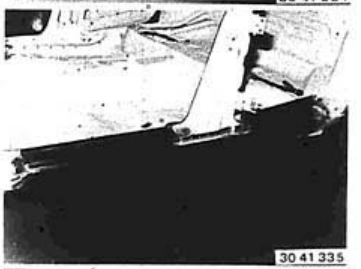
Grind mating surfaces on new cover.
Coat mating surfaces required for spot welding with zinc dust paint.



Slide rear end of new cover underneath side panel approx. 25 mm (1") further than necessary.
If necessary, drill out several spot welds on side panel.



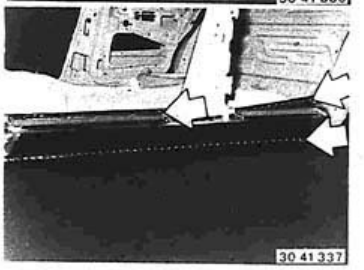
Push up cover at front and slide it underneath the A pillar connection.



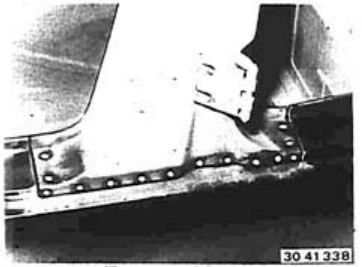
Straighten and tack weld cover.



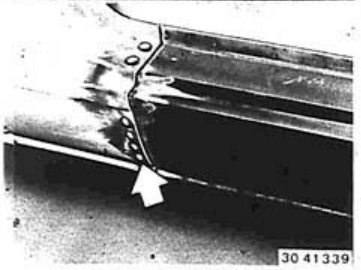
Install front and rear doors, and check gaps.



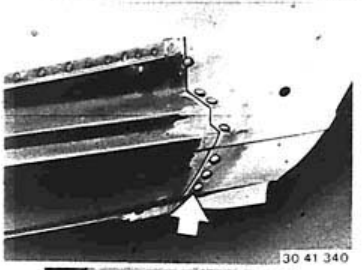
Spot weld cover at top and bottom.



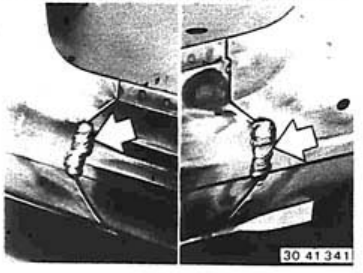
Plug spot weld B pillar connection.



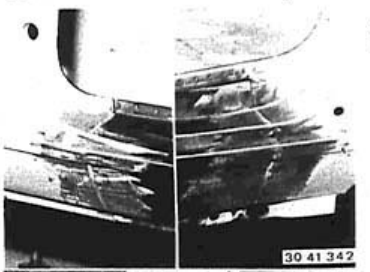
Plug spot weld A pillar connection.



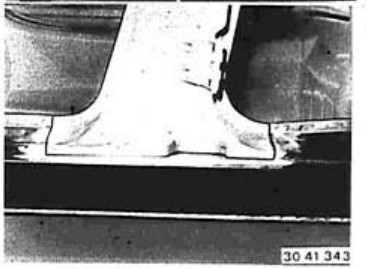
Plug spot weld C pillar connection.



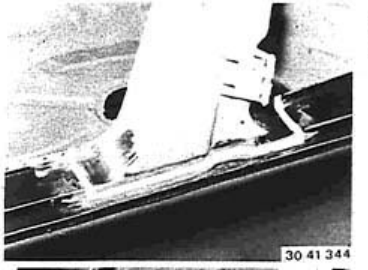
Braze edge for A pillar connection and C pillar butt joint.



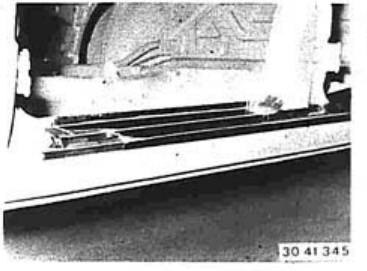
Grind down joints.
Tin out joints, if necessary.



Grind down joint.



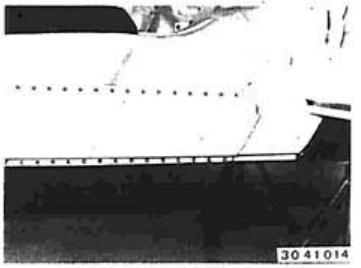
Coat joints on B pillar connection with joint sealing compound.



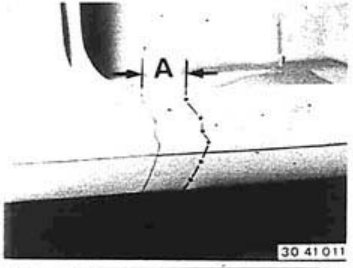
Spray anti-drumming compound on bottom of cover.

41 11 121 REPLACING COVER FOR LEFT OR RIGHT SIDE MEMBER (PARTIAL REPLACEMENT WITHOUT REMOVAL OF DOOR)

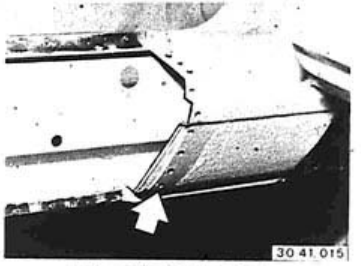
Refer to information on page 41 - 0.
Remove front seat 52 10 000.
Remove inner and outer entrance rail plates, edge guard of front door opening, and seat belt on entrance rail.
Fold back carpet partially.



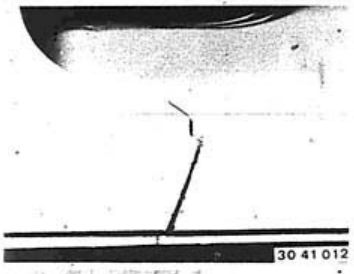
Drill out spot welds.
Lift off cover.



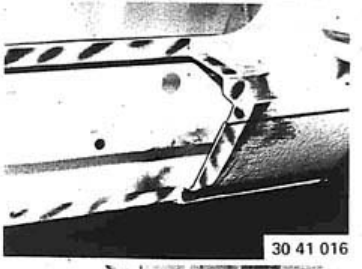
Mark cutting lines.
Cutting line must be at least distance A = 30 mm (1.181") away from B pillar connection.



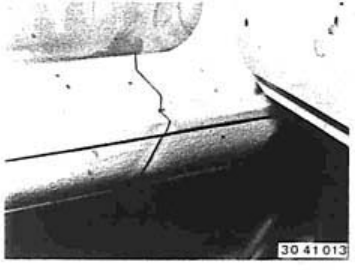
Drill out spot welds.
Remove scrap metal.
Note:
Cover is brazed along edge.



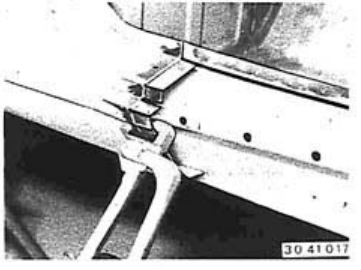
Cut-through cover.



Straighten and grind mating surfaces.
Coat surfaces for spot welding with zinc dust paint.

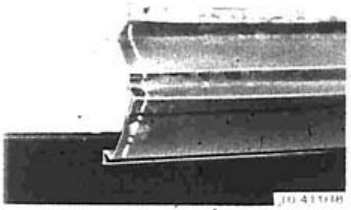


Cut through cover on connection of A pillar.

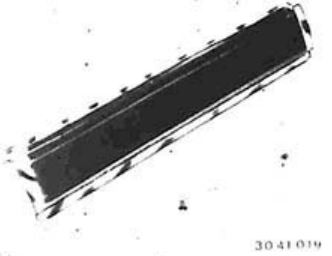


Make cut in rear of connecting surfaces and shoulder with a shouldering pliers.

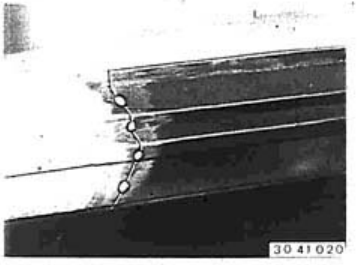
Cut new cover to size to match mating surfaces and fit in.



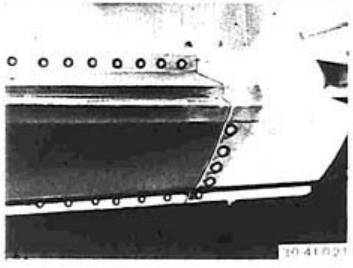
Grind mating surfaces.
Coat surfaces for spot welding with zinc dust paint.



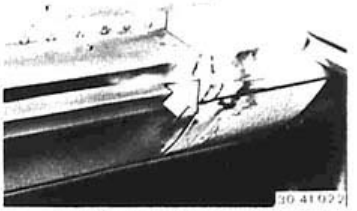
Insert and tack weld cover.



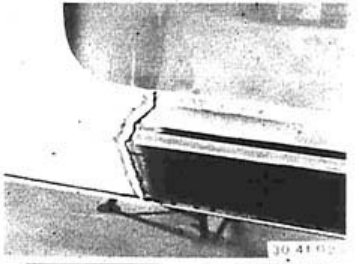
Spot weld cover at top and bottom.
Plug spot weld front through standard bores.



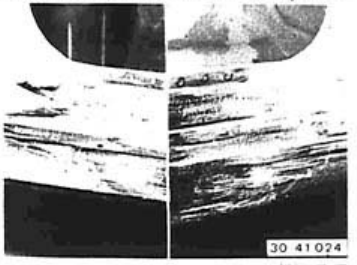
Braze gap on edge.



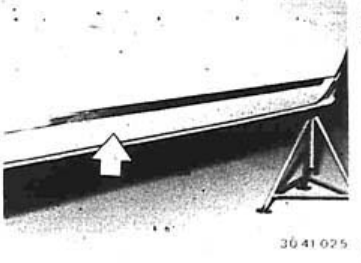
Inert gas weld rear of mating surface.



Grind and tin mating surfaces.



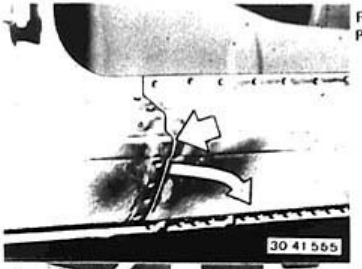
Spray an anti-drumming compound* on bottom of cover.



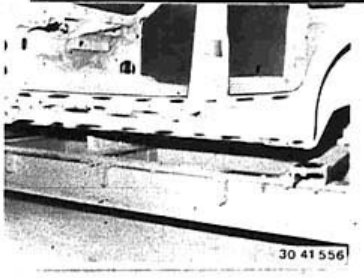
* Source: HWB

41 11 510 REPLACING COVER FOR LEFT OR RIGHT SIDE MEMBER (REAR SIDE PANEL REMOVED) – TWO DOOR MODEL –

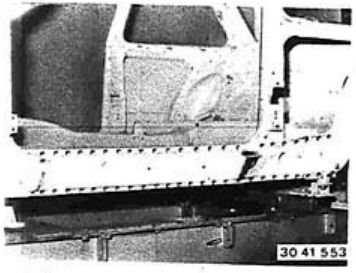
Refer to information on page 41 - 001.
Remove or disconnect following parts:
ground lead on battery, rear bumper, left tail light assembly, trunk mats, wall trim, left wheel house trim, tail panel trim, trunk lid seal, rear window complete with rubber frame, side window, rear seat cushion and backrest, front seat, side trim panel, hatrack, entrance cover strip, front door pillar carpet, passenger compartment carpets partially, roof liner partially, seat belt, door pillar trim, front door seals, door striker, C pillar air extraction mask, rear side panel rubbing strip, left wheel house cover, fuel tank complete, brace on floor assembly and wire harness in trunk partially.



Remove brazing solder.
Pull out cover underneath front door pillar.



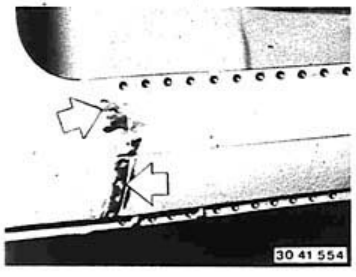
Straighten and grind mating surfaces.
Coat mating surfaces needed for spot welding with zinc dust paint.



Remove side panel – see 41 35 101.
Make joints accessible.
Drill out spot welds.

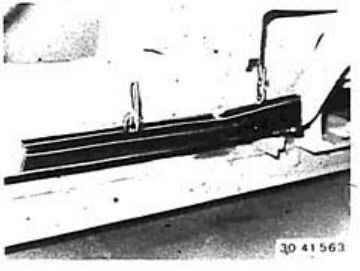


Grind mating surfaces on new cover.
Coat mating surfaces needed for spot welding with zinc dust paint.

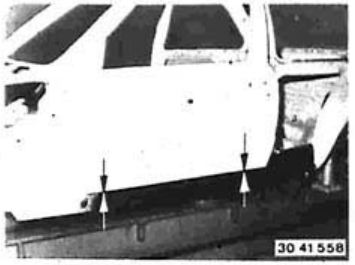


Drill out spot welds.

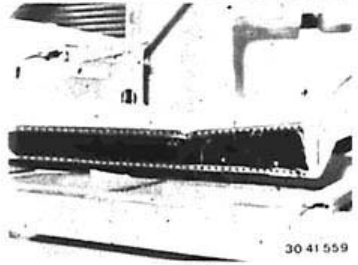
30 41 557



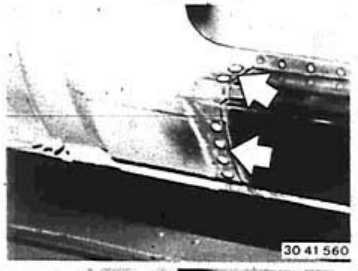
Set up and clamp cover.



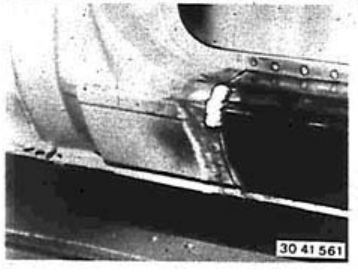
Install door and check gap.
Also clamp on rear side panel if necessary.



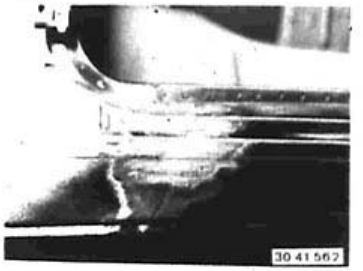
Spot weld cover.



Plug spot weld joint with door pillar.



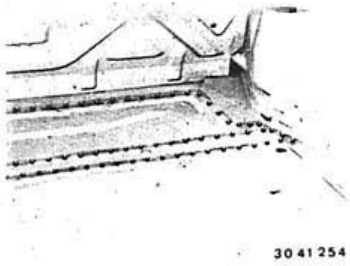
Braze joint along edge.



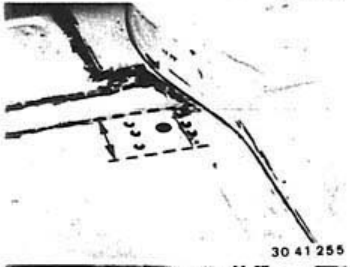
Grind down joints, tinning if necessary
Spray anti drumming compound on cover after installation of rear side panel

41 12 535 REPLACING TRUNK FLOOR PLATE ASSEMBLY –TAIL PANEL REMOVED

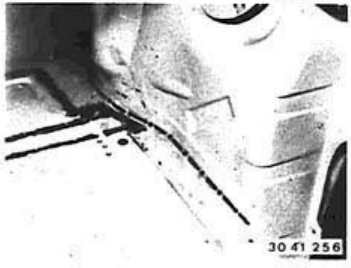
Refer to information on page 41 - 001.
Remove or disconnect following parts: final drive, right wheel house cover, fuel filler neck, complete fuel tank and, if applicable, heavy layer mat.


30 41 254

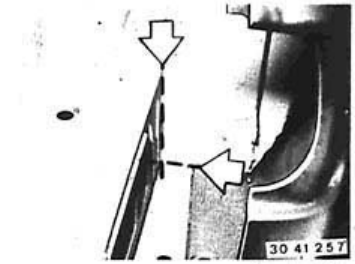
Clear mating surfaces.
Drill off welded spots.


30 41 255

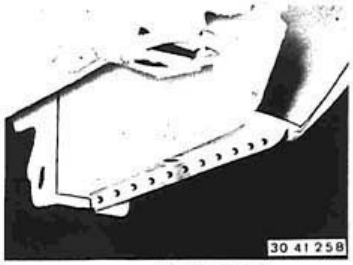
Drill off welded spots along side members toward rear by approx. 80 mm (3.150").


30 41 256

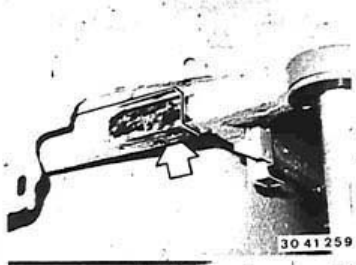
Cut off trunk floor plate on left and right wheel houses.


30 41 257

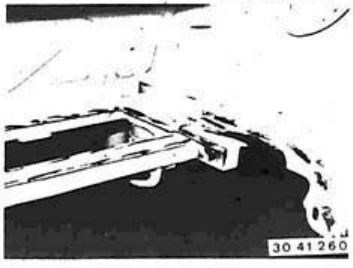
Cut off trunk floor plate on left and right wheel houses.


30 41 258

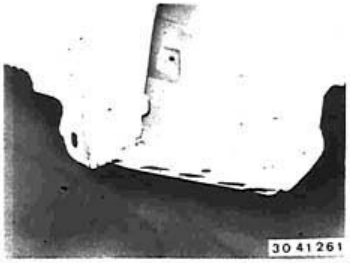
Clear and drill off welded spots.


30 41 259

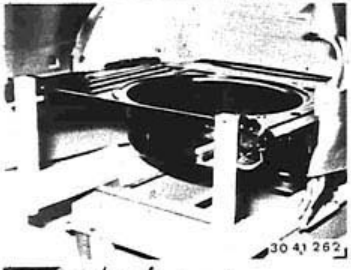
Clear mating surfaces of left and right side members.
Drill off welded spots.
Lift off trunk floor plate complete with side members.


30 41 260

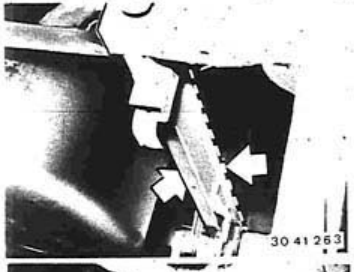
Remove scrap metal.
Straighten and grind mating surfaces.



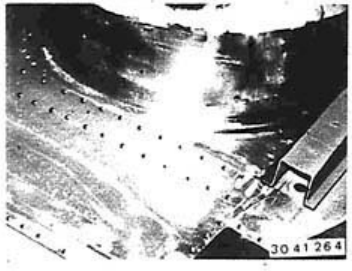
Remove scrap metal.
Straighten and grind mating surfaces.
Coat mating surfaces intended for spot welding with zinc dust paint.



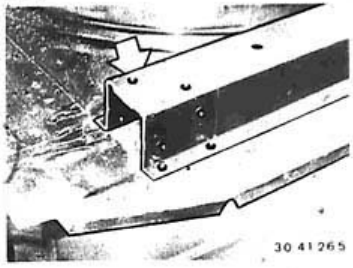
Set up car on straightening bench.
Fit in trunk floor plate.



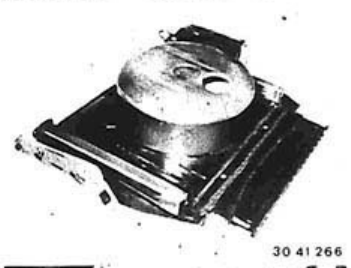
Mark location of cross member on trunk floor plate.



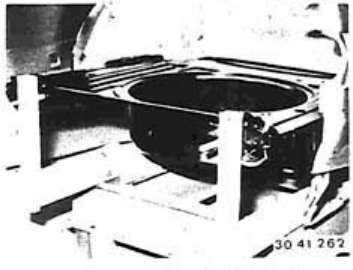
Lift off trunk floor plate.
Drill holes for plug spot welding in mating surfaces not accessible for spot welding.
Spacing of holes = 40 mm (1.575").



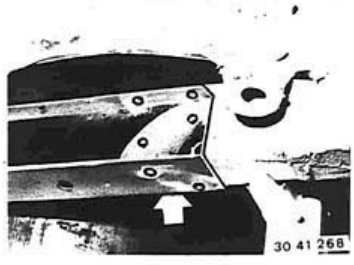
Drill holes for plug welding in mating surfaces of side members.
Note:
Drill holes on flange of side members through trunk floor plate as well.



Grind down all mating surfaces.
Coat mating surfaces intended for spot welding with zinc dust paint.

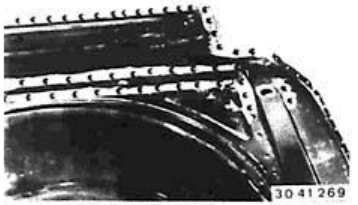


Install trunk floor plate and straighten according to straightening bench.

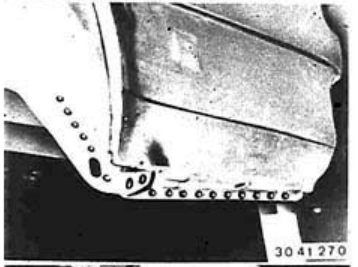


Plug spot weld both side members.

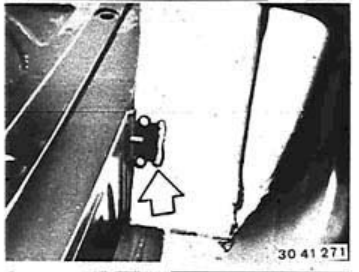
Plug spot weld front of trunk floor plate, on cross member, side members and wheel houses.



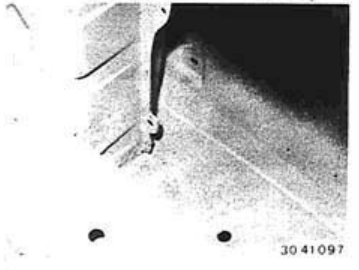
Spot weld cross panel on wheel houses.
Spot weld side panels.



Weld on reinforcement bracket.



Install tail panel.
Seal off all joints at top and bottom with a body sealing compound*
Spray an anti-drumming compound* on underside of car, wheel houses and bottom of tail panel.

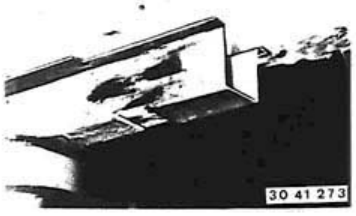


* Source: HWB

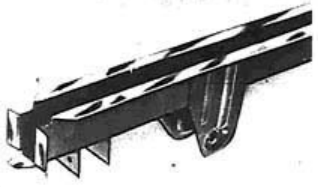
41 12 545 REPLACING CROSS MEMBER ON TRUNK FLOOR PLATE – TRUNK FLOOR PLATE REMOVED –



Refer to information on page 41 - 001.
Cut off cross member along line.

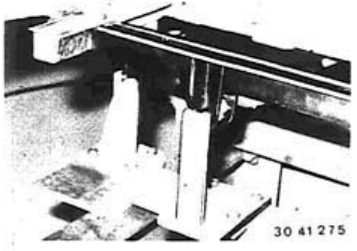


Remove scrap metal.
Straighten, grind and coat mating surfaces with zinc dust paint.

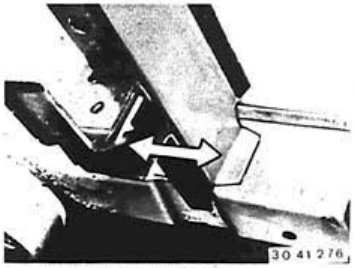


30 41 274

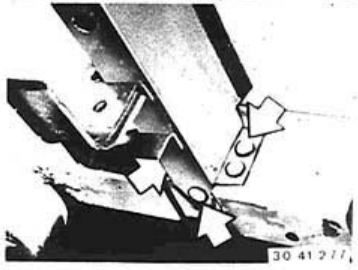
Grind mating surfaces on new cross member and coat with zinc dust paint.



Install cross member with straightening bench attachment and clamp.



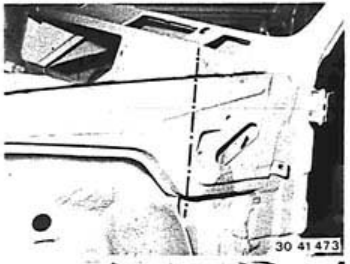
Align cross member in height, toward front and rear, according to seams in side members.



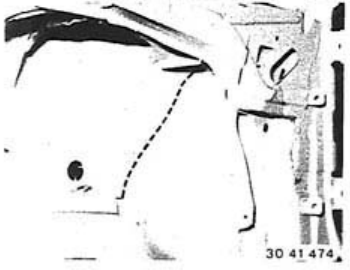
Spot weld cross member on left and right sides.

41 14 021 REPLACING LEFT FRONT WHEEL HOUSE

Refer to information on page 41 - 001.
Remove or disconnect following parts. Battery ground lead, bumper, upper and lower wheel house trim, all radiator grill sections, engine hood lock and catch, front spoiler, all headlights, if applicable front fog lamps, both bumper brackets, two-tone horns, heater wall seal, entrance cover strip, front seat, dashboard trim panel, carpet on A pillar, passenger compartment carpet partially, footwell insulation sheet partially, brake booster with master cylinder, fuel filter, ignition coil, brake pipes partially, engine, front axle with transmission, wire harness in engine compartment partially, radiator trim and data plate.
Unscrew both side panels.
Remove front trim panel with front wall – see 41 33 001.
Installation:
Check and adjust front wheel alignment.



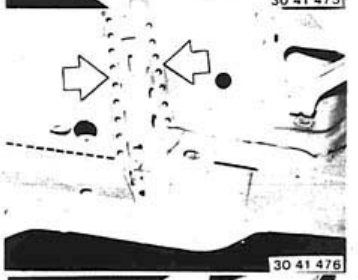
Cut off wheel house along line.



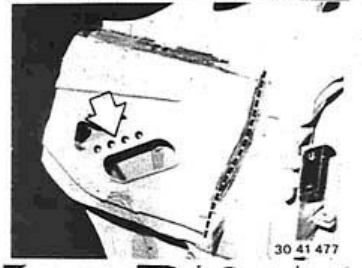
Cut off wheel house on engine compartment wall.



Cut off wheel house on end plate.



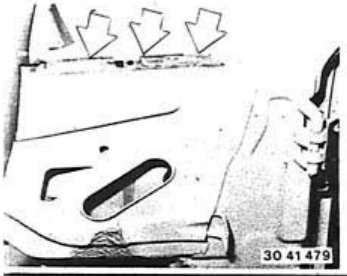
Cut off wheel house on engine carrier.
Drill off wheel house support.
Lift off wheel house.



Drill off welding spots.
Grind off welding seams.



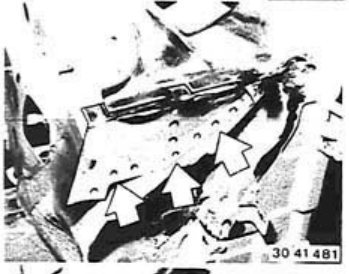
Remove joint sealing compound.
Drill off welding spots.



Remove brazing solder.
Lift off end plate.



Cut off holder for end plate.



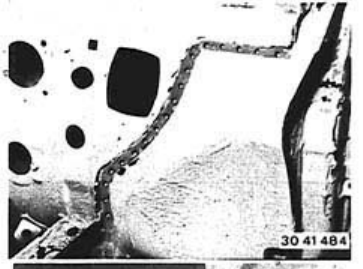
Drill out spot welds.
Remove scrap metal.



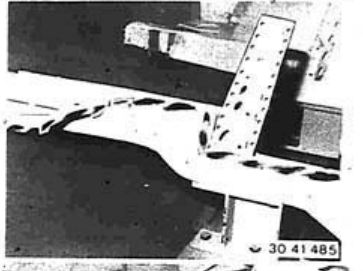
Remove scrap metal.
Straighten and grind mating surfaces.



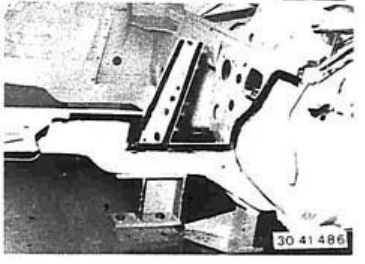
Remove scrap metal.
Straighten and grind mating surfaces.



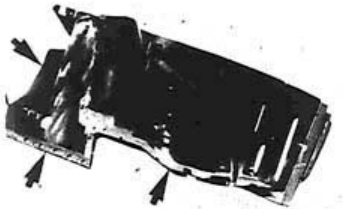
Drill holes for plug spot welding in area of engine compartment wall.



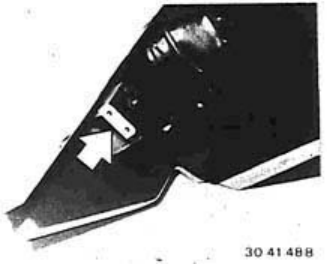
Remove scrap metal.
Straighten and grind mating surfaces.



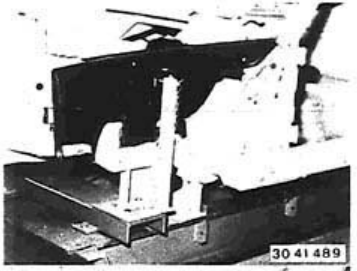
Coat all mating surfaces with zinc dust paint.



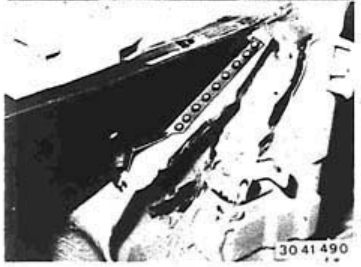
Grind and coat mating surfaces with zinc dust paint.
Drill holes for plug spot welding in area of engine carrier.



Drill holes for plug spot welding in holder for engine hood lock.



Set up car on straightening bench.
Install, align and tack weld new wheel house.



Spot weld wheel house on heater separating wall.

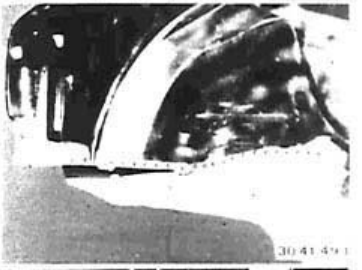


Plug spot weld areas not accessible for spot welding tongs.

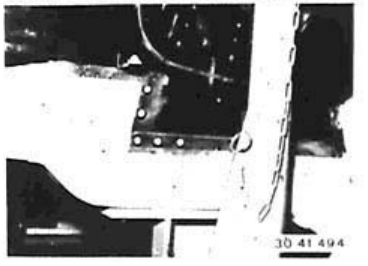


Spot weld wheel house on engine carrier.

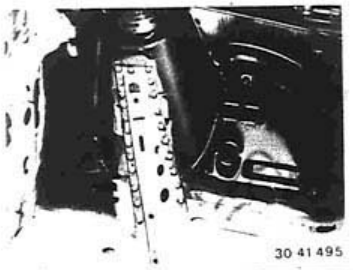




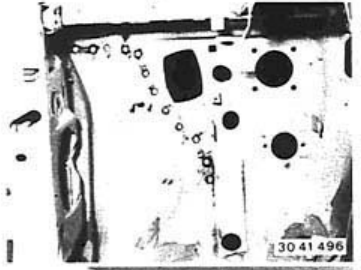
Spot weld wheel house on end plate



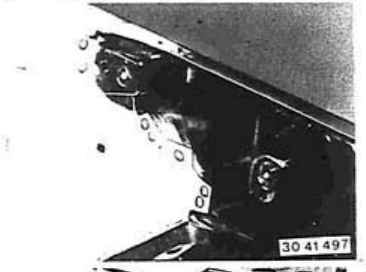
Plug spot weld wheel house through provided holes.



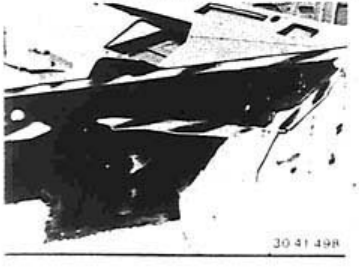
Plug spot weld support on wheel house.



Plug spot weld in area of engine compartment wall from the passenger compartment.



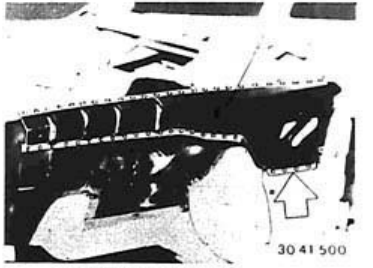
Plug spot weld engine hood lock holder and heater separating wall on wheel house.



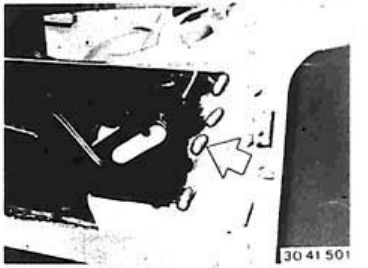
Grind mating surfaces for end plate.
Coat mating surfaces needed for spot welding with zinc dust paint.



Grind mating surfaces on end plate.
Coat mating surfaces needed for spot welding with zinc dust paint.



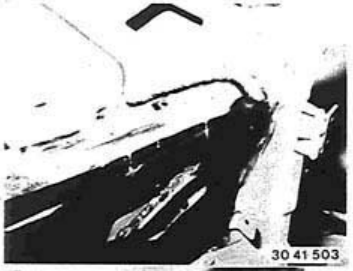
Install and spot weld end plate.



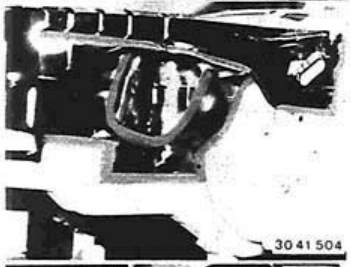
Inert gas weld end plate in A pillar area.



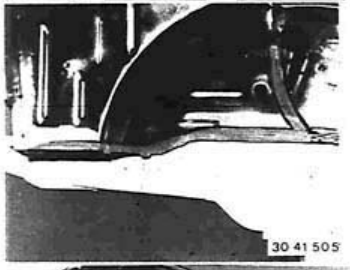
Plug spot weld the heater separating wall joint.



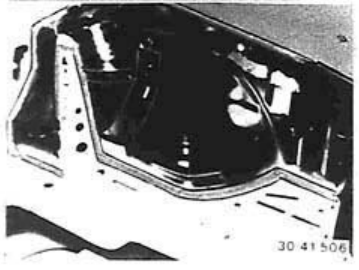
Braze wheel house and end plate on cowl panel.



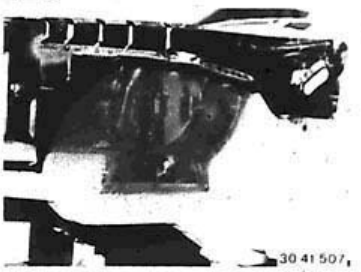
After Installation of Front Panel:
Seal mating surfaces with a body sealing compound.



Seal mating surfaces with a body sealing compound.



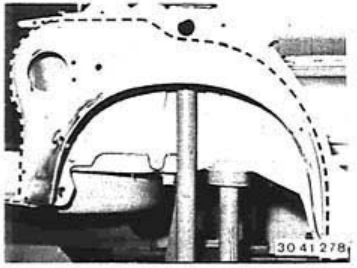
Seal mating surfaces with a body sealing compound.



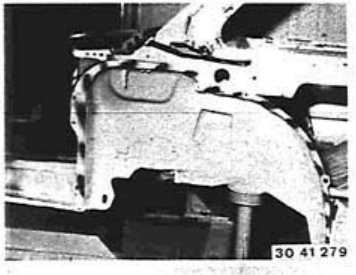
Spray out wheel house with an anti drumming compound.

41 14 132 REPLACING RIGHT REAR WHEEL HOUSE OUTER SECTION AND SIDE PANEL (PARTIAL REPLACEMENT UP TO WINDOW LINE)

Refer to information on page 41 - 001.
Replace right rear side panel (partial replacement up to window line) 41 35 291.



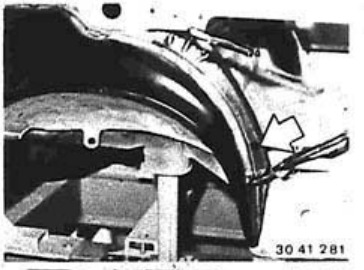
Drill off welded spots.
Lift off wheel house outer section.



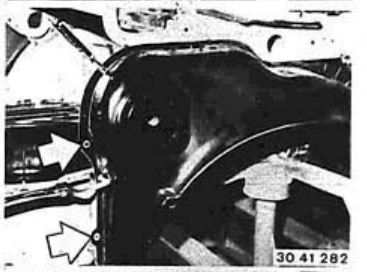
Straighten and grind mating surfaces.
Coat surfaces intended for spot welding with zinc dust paint.



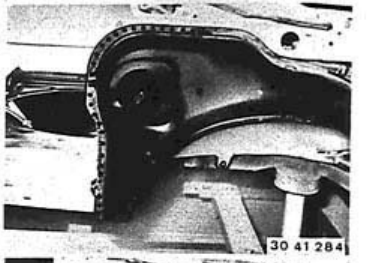
Grind and coat mating surfaces on new wheel house outer section with zinc dust paint.



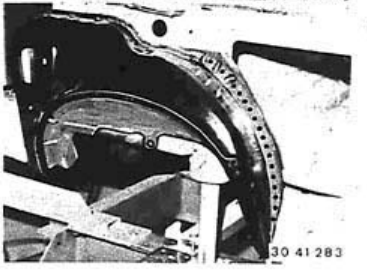
Clamp on wheel house outer section and align with dowel pin bores.



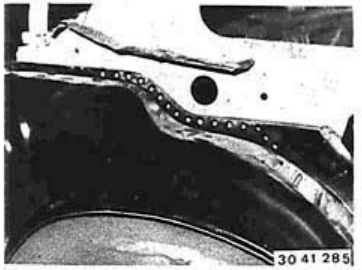
Clamp on wheel house outer section and align with dowel pin bores.
If applicable, tack weld wheel house outer section and install side panel to check.



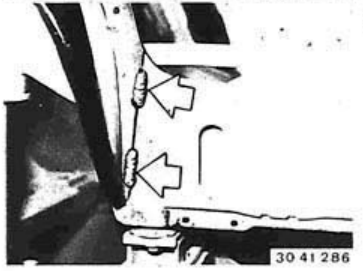
Spot weld wheel house outer section on inside.



Spot weld wheel house outer section on inside.



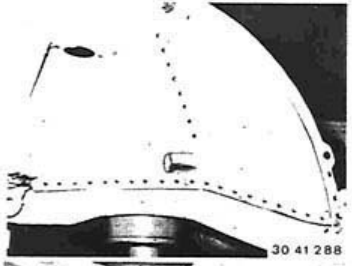
Plug spot weld mating surfaces not accessible for normal spot welding.



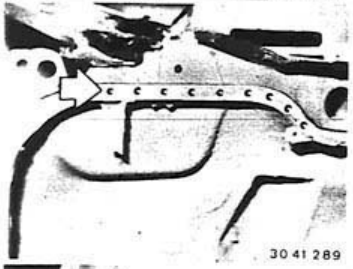
Inert gas weld wheel house outer section on cover for side member,

41 14 181 REPLACING RIGHT REAR WHEEL HOUSE ASSEMBLY AND SIDE PANEL

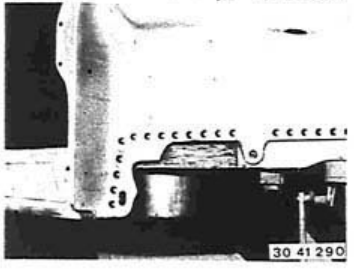
Refer to information on page 41 - 001.
Replace right rear wheel house outer section and side panel (partial replacement up to window line) 41 14 132.
Also remove rear axle carrier assembly or, if applicable, trailing arm assembly.



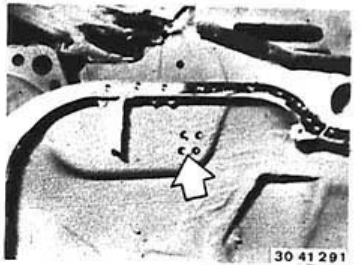
Clear and drill off welded spots.



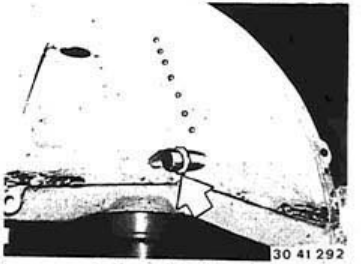
Clear and drill off welded spots.



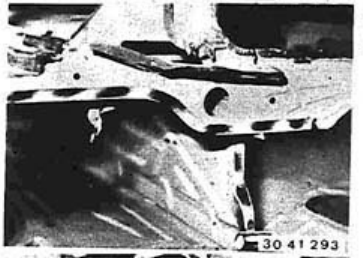
Clear and drill off welded spots.



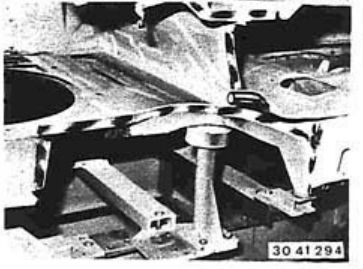
Drill off welded spots for hinge support



Remove brazing solder from tube for vent line.
Take off wheel house.



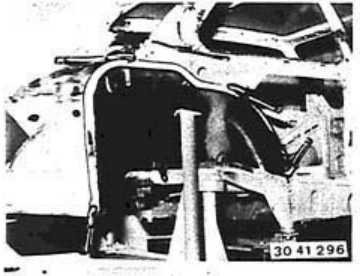
Straighten and grind mating surfaces.
Coat surfaces intended for spot welding with zinc dust paint.



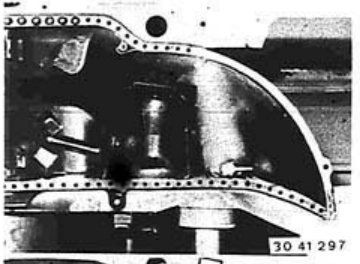
Straighten and grind mating surfaces.
Coat mating surfaces intended for spot welding with zinc dust paint.


30 41 295

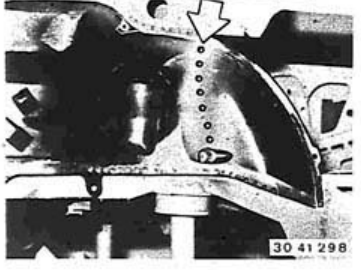
Grind mating surfaces on new wheel house inner section.
Coat mating surfaces intended for spot welding with zinc dust paint.


30 41 296

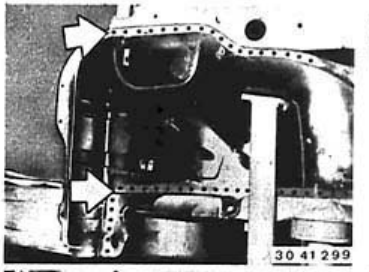
Set up car on straightening bench.
Fit in wheel house.


30 41 297

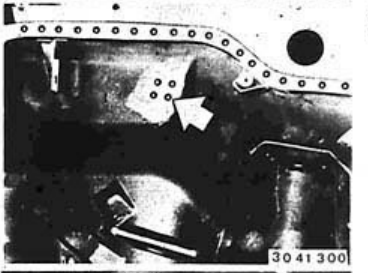
Spot weld wheel house.


30 41 298

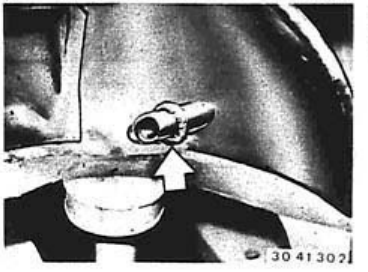
Spot weld wheel house.


30 41 299

Spot weld wheel house.
Inert gas plug weld mating surfaces which are not accessible forspot welding.


30 41 300

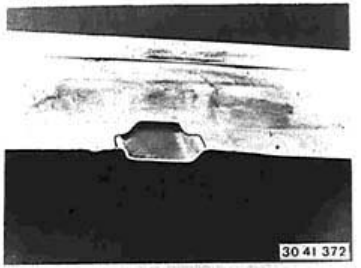
Spot weld trunk lid hinge support or use plug spot welding when necessary.


30 41 302

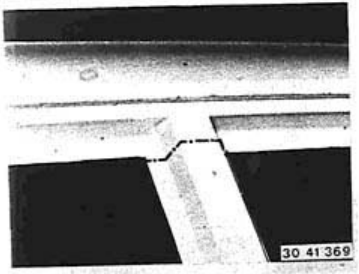
Braze tube for tank vent.
Grind and prepare mating surfaces for wheel house outer section.

41 21 051 REPLACING LEFT OR RIGHT CENTER DOOR PILLAR
— Four Door Model —

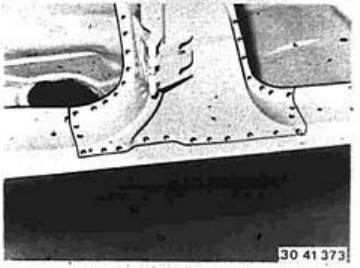
Refer to information on page 41 - 001.
Remove or disconnect following parts:
rear door, front seat, B pillar plate, seat belt, front and rear entrance cover strips and plates, front and rear door edge guards partially, carpet on entrance, roof liner partially, rear seat cushion and backrest.



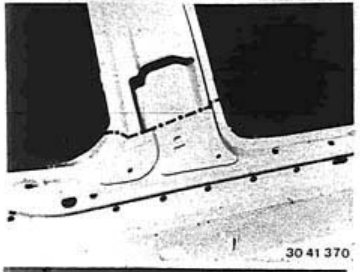
Remove scrap metal.
Straighten and grind mating surfaces.



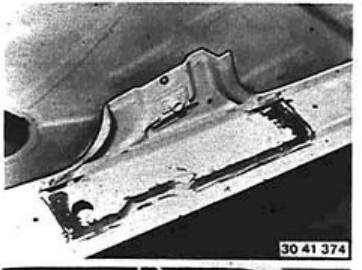
Saw through B pillar along line.



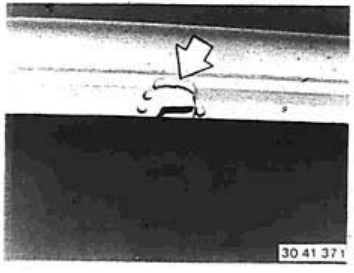
Drill out spot welds.
Lift off rest of B pillar metal on outside.



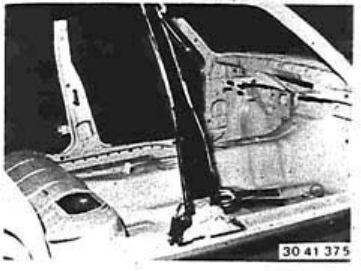
Saw through B pillar on cutting point in opening of end plate.



Remove scrap metal on end plate.
Straighten and grind mating surfaces.
Coat mating surfaces required for spot welding with zinc dust paint.



Drill out spot welds.
Heat brazing solder.
Remove scrap metal.
Note:
Apply a coat of heat protecting paste on the roof and rain molding, to avoid any damage to the roof panel paint finish.



Grind and coat mating surfaces on end plate required for spot welding with zinc dust paint.
Install, align and tack weld end plate.


30 41 351

Grind mating surfaces on new B pillar.
Coat mating surfaces required for spot welding with zinc dust paint.


30 41 352

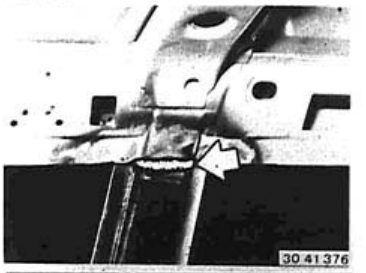
Drill holes for plug spot welding in mating surfaces required for plug spot welding.


30 41 353

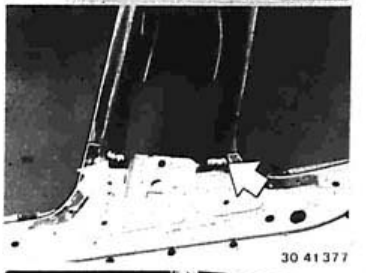
Install and tack weld B pillar.


30 41 354

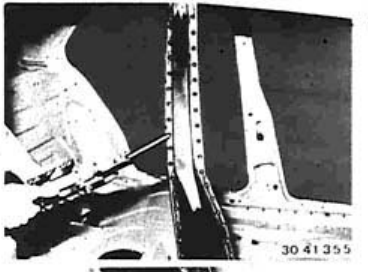
Install rear door and check gaps.


30 41 376

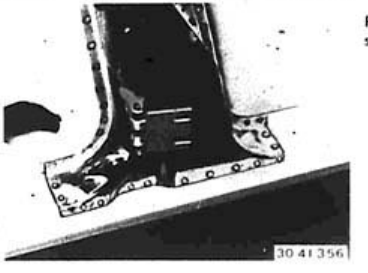
Inert gas weld end plate on roof frame.


30 41 377

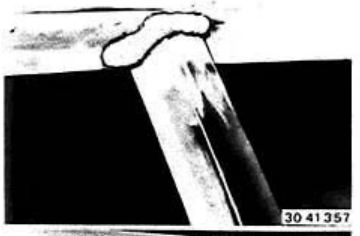
Inert gas weld end plate on connection at bottom.


30 41 355

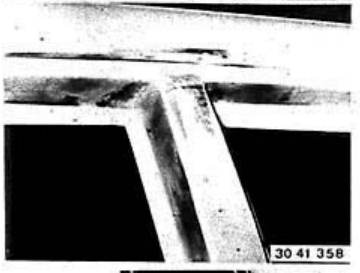
Spot weld B pillar on end plate.


30 41 356

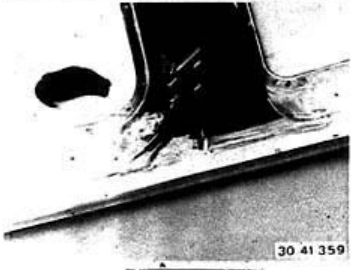
Plug spot weld connection on cover for side member.



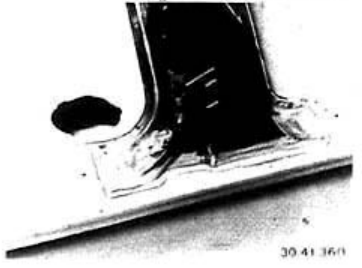
Braze connection on roof frame.
Note:
Apply a coat of heat protection paste on roof and rain molding, to avoid any damage to the roof panel paint finish.



Grind down joints.



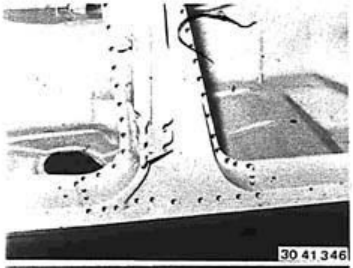
Grind down joints.



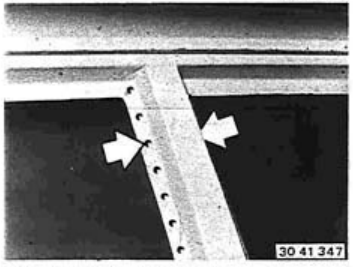
Coat joints on side member cover with a joint sealing compound.

41 21 . . . REPLACING LEFT OR RIGHT CENTER DOOR PILLAR OUTSIDE SECTION
– Four Door Model –

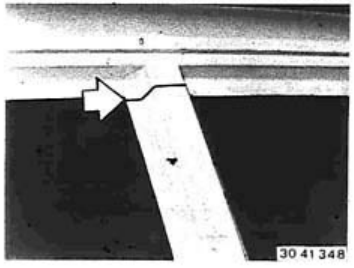
Refer to information on page 41 - 001.
Remove or disconnect following parts: rear door, front seat, B pillar plate, seat belt, entrance cover strips and plates front and rear, front and rear door opening edge guards partially, carpet on entrance, roof liner partially, rear seat cushion and backrest.


30 41 346

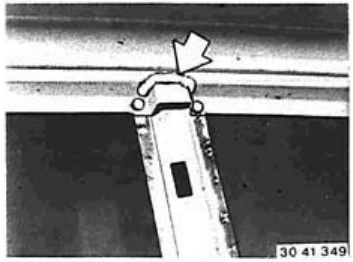
Drill out spot welds.


30 41 347

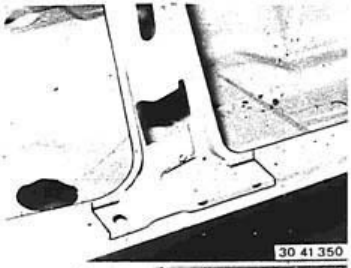
Drill out spot welds.


30 41 348

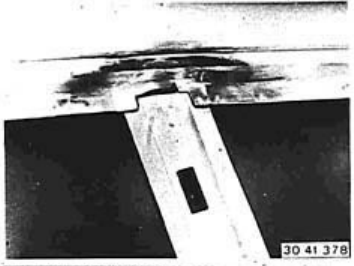
Saw through B pillar along line.
Caution!
Don't damage the end plate.
Lift off B pillar.


30 41 349

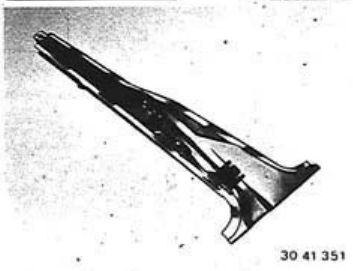
Heat brazing solder.
Remove scrap metal.
Note:
Apply a coat of heat protection paste on roof and rain molding, to avoid any damage to the roof panel paint finish.


30 41 350

Straighten and grind mating surfaces.
Coat mating surfaces required for spot welding with zinc dust paint.


30 41 378

Straighten and grind mating surfaces.
Coat mating surfaces required for spot welding with zinc dust paint.


30 41 351

Grind mating surfaces on new B pillar.
Coat mating surfaces required for spot welding with zinc dust paint.



30 41 352

Drill holes for plug spot welding in mating surfaces required for plug spot welding.



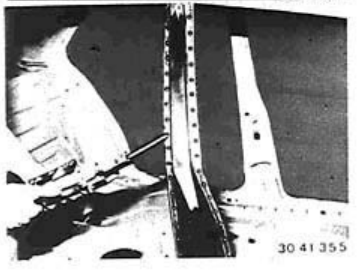
30 41 353

Install and tack weld B pillar.



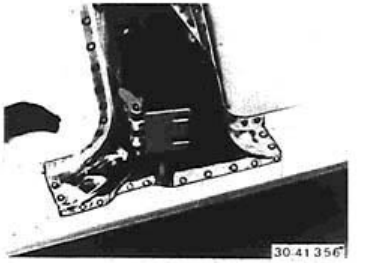
30 41 354

Install rear door and check gaps.



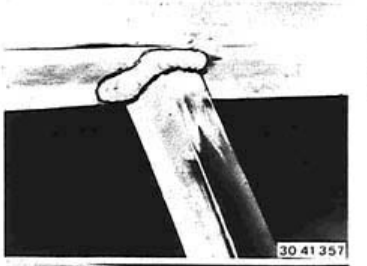
30 41 355

Spot weld B pillar on end plate.



30 41 356

Plug spot weld connection on side member cover.

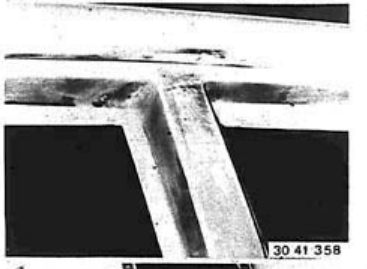


30 41 357

Braze connection on roof frame.

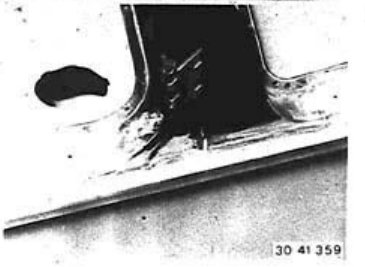
Note:

Apply a coat of heat protection paste on roof and rain molding, to avoid any damage to the roof panel paint finish.



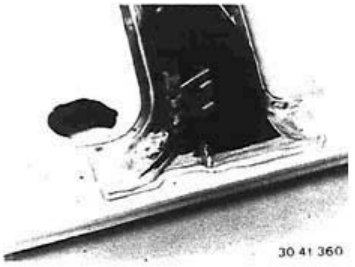
30 41 358

Grind down joints.



30 41 359

Grind down joints.

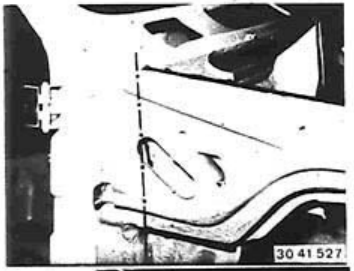


Coat joints on side member cover with a joint sealing compound.

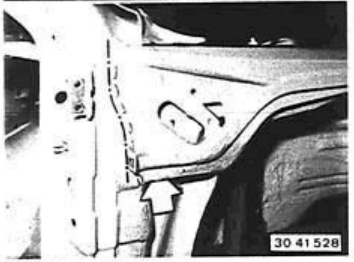
41 21 501 REPLACING LEFT OR RIGHT FRONT DOOR PILLAR
– Front Side Panel Removed –

Refer to information on page 41 - 001.

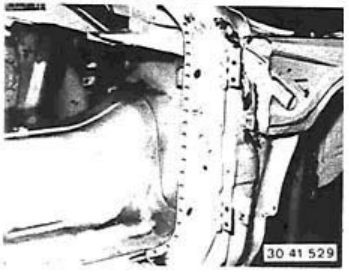
Remove or disconnect following parts:
ground lead on battery, roof ornamental strip, front seat, entrance cover strip, entrance cover plate, instrument panel trim, engine hood release lever partially, door pillar carpet, passenger compartment carpets partially, air inlet grill on cowl panel and windshield with rubber frame



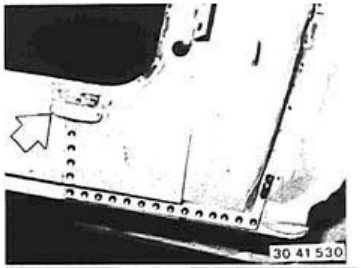
Cut through end plate along line.



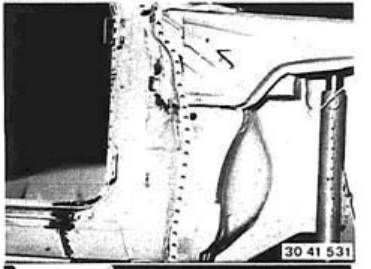
Grind off welding seams.
Drill out spot welds from underneath.
Remove end plate section.



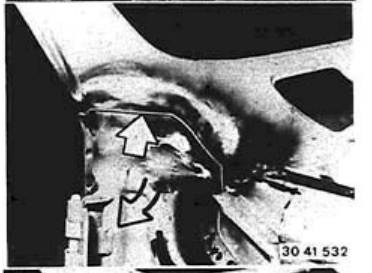
Make joints accessible.
Drill off spot welding seam.



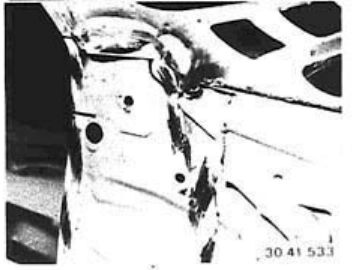
Drill out spot welds.
Remove brazing solder.



Drill out spot welds.

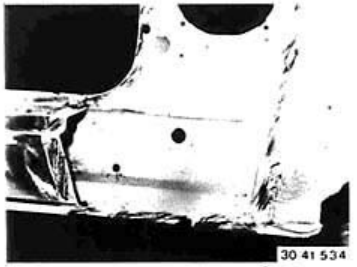


Remove brazing solder.
Lift off door pillar.

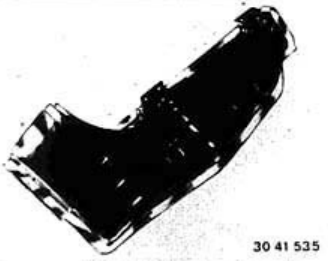


Remove scrap metal.
Straighten and grind mating surfaces.
Coat mating surfaces needed for spot welding with zinc dust paint*.

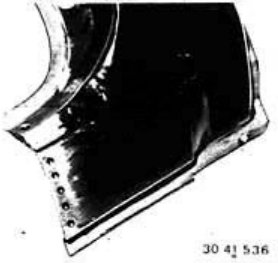
* Source: HWB



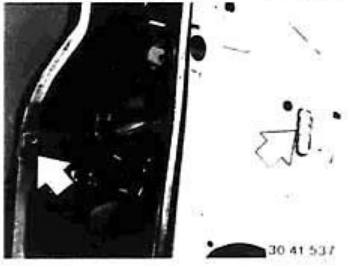
Remove scrap metal.
Straighten and grind mating surfaces.
Coat mating surfaces needed for spot welding with zinc dust paint.



Grind mating surfaces on new door pillar.
Coat mating surfaces needed for spot welding with zinc dust paint.

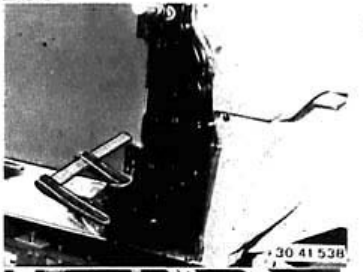


Drill holes for plug spot welding at joint with entrance.

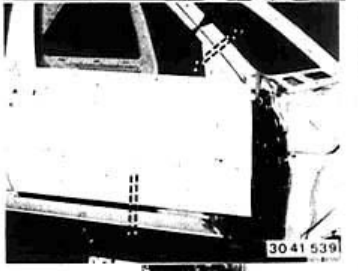


Use insulating tape* on bearing surface for reinforcement.

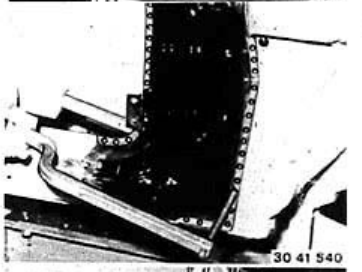
* Source: HWB



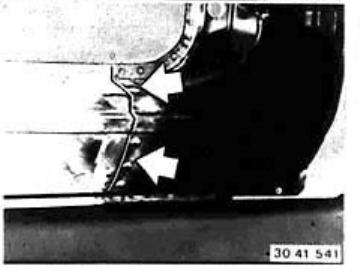
Clamp and align door pillar.
Tack weld at several points.



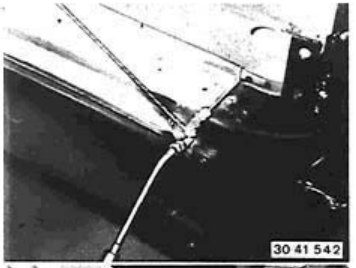
Install door and check gap and plane to entrance and cowl panel.
Note:
Use washers if door is too low.



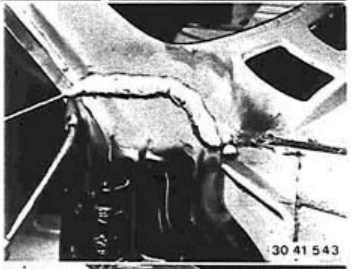
Spot weld door pillar.



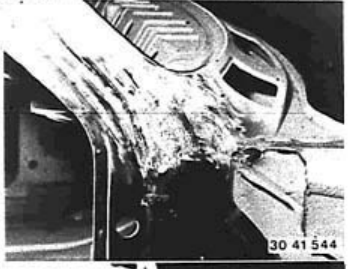
Plug spot weld joint with entrance.



Braze outside edge on entrance.



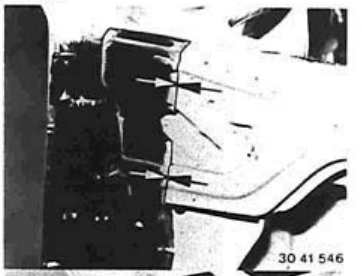
Braze joint with cowl panel.



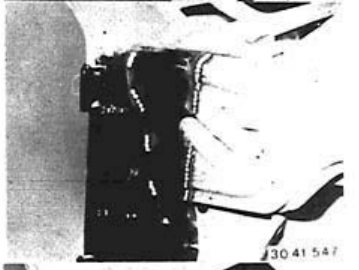
Grind mating surface.



Install new end plate.
Determine location of cut for partial replacement.



Grind mating surfaces on partial replacement section and fit in.



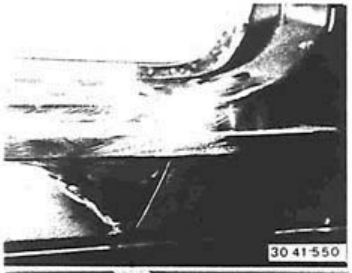
Inert gas weld partial replacement section.



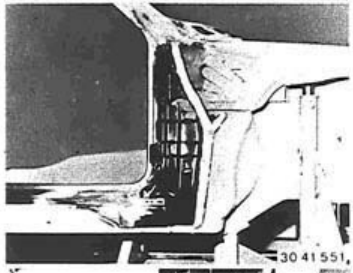
Braze in cowl panel area.



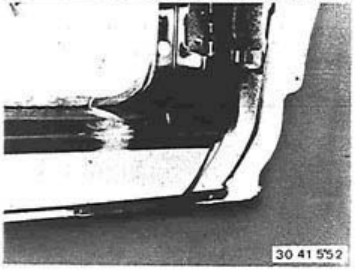
Grind mating surface, tinning if necessary.



Grind mating surface, tinning if necessary.



Seal all joints with a joint sealing compound*.

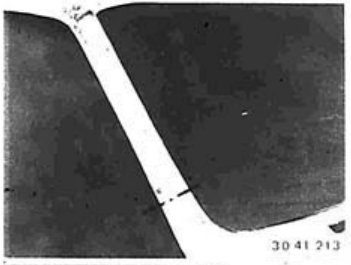


Replace anti-drumming coat on entrance and in wheel house.

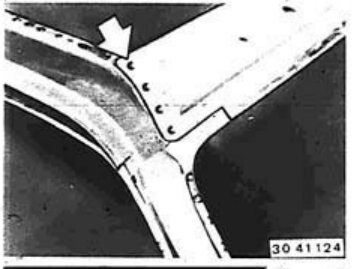
* Source: HWB

41 22 501 REPLACING LEFT OR RIGHT ROOF FRAME
– ROOF PANEL REMOVED –

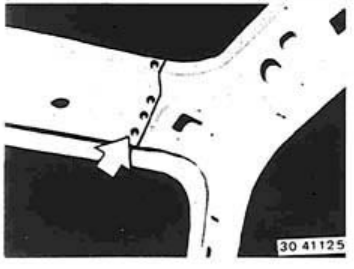
Refer to information on page 41 -001.
Remove or disconnect following parts: instrument panel trim, grill on bottom of cowl, front door, front bumper, front side panel.
Important!
Support car from underneath that roof frame is without pressure.



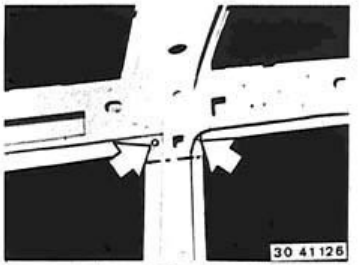
Cut off roof frame along line.



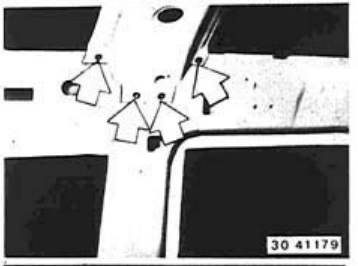
Drill off welded spots on roof frame at front.



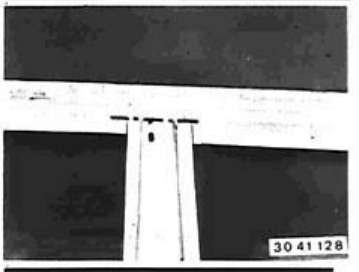
Drill off welded spots on inside.



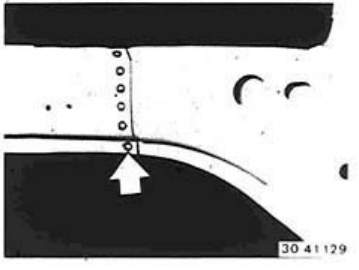
Cut off B pillar end plate on roof frame.
Drill off welded spots.



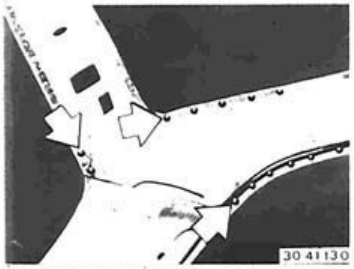
Drill off left and right roof braces.
Note:
Roof braces are installed after installation of roof panel.



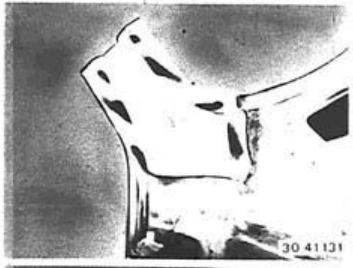
Cut off brazed connection between roof frame and B pillar.



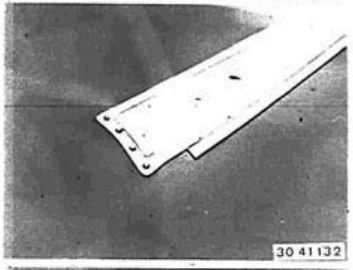
Drill off roof frame on C pillar.



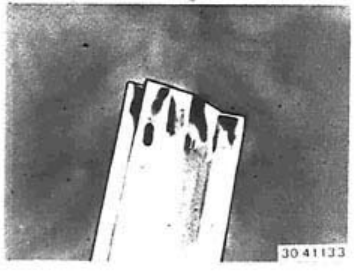
Drill off welded spots.



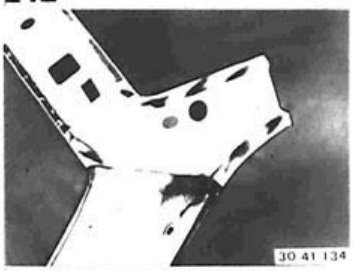
Remove scrap metal.
Straighten and grind mating surfaces.



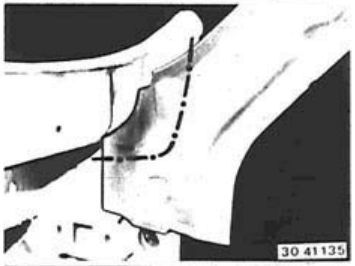
Remove scrap metal.
Straighten and grind mating surfaces.



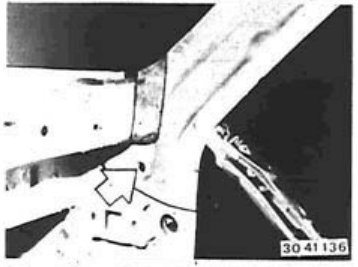
Remove scrap metal.
Straighten and grind mating surfaces.



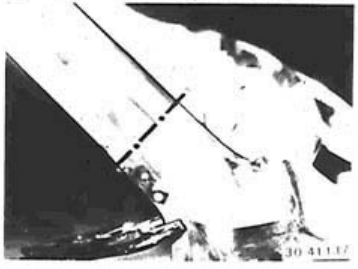
Remove scrap metal.
Straighten and grind mating surfaces.



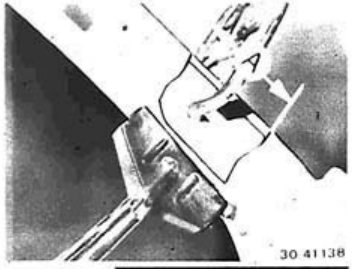
Cut new panel for cowl to size, that hole in new part can be aligned with old hole.



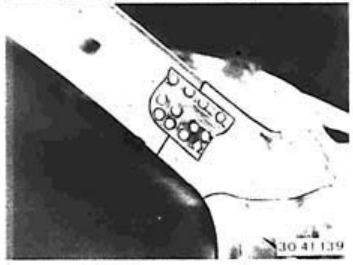
Clamp on panel and align according to hole and seams.



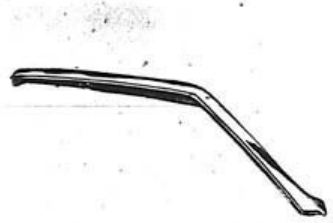
Mark cutting point on panel.
Take off and cut panel to size.
Grind mating surfaces.
Coat mating surfaces intended for spot welding with zinc dust paint.



Make up reinforcement A = approx. 40 mm (1.575") from remaining panel and fit in.



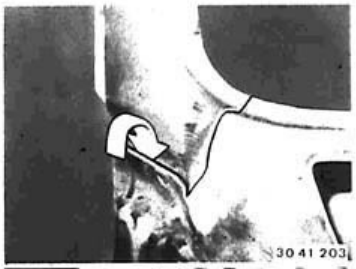
Grind down reinforcement.
Coat mating surfaces with zinc dust paint.
Spot weld panel on reinforcement.



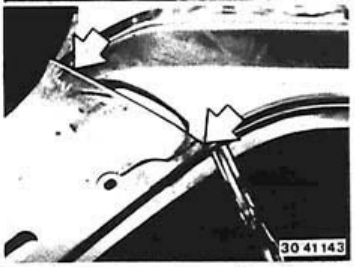
Grind mating surfaces on new roof frame.
Coat mating surfaces intended for spot welding with zinc dust paint.



Install and clamp down roof frame complete with cowl, tack welding if necessary.



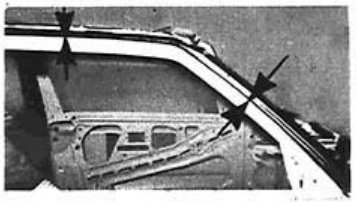
Note:
Make sure cowl panel grabs behind connection for A pillar.



Note:
Roof frame grabs underneath rear side panel.



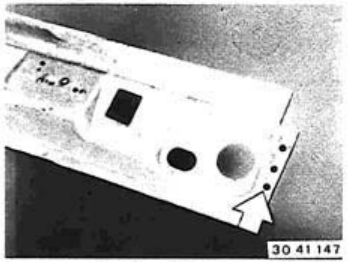
Install windshield with several pieces of rubber frame.
Make sure of uniform clearance and same curvature between glass and body opening.



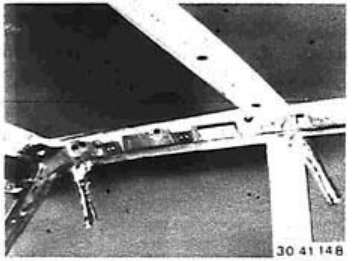
Install door and check door gap.


30 41 146

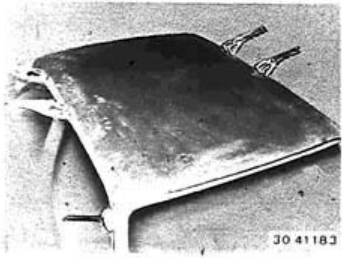
Grind mating surfaces on cover plate.
Coat mating surfaces intended for spot welding with zinc dust paint.


30 41 147

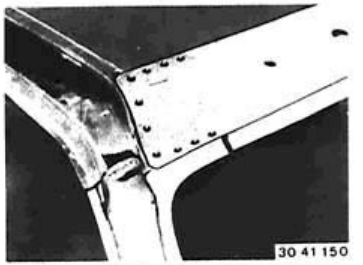
Drill holes for plug spot welding in rear mating surface.


30 41 148

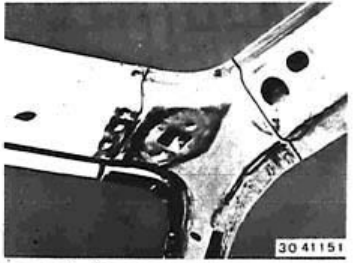
Install and clamp cover plate.
If necessary, install roof brace to check roof frame.


30 41 183

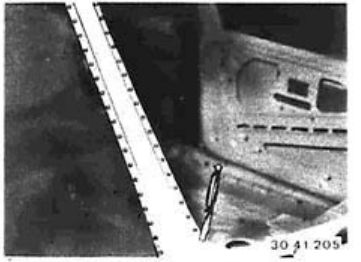
Install and clamp outside roof panel.
Check seat of outside roof panel.
Lift off outside roof panel again.


30 41 150

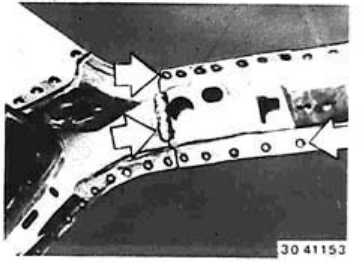
Plug spot weld or spot weld front roof frame with roof frame on sides.


30 41 151

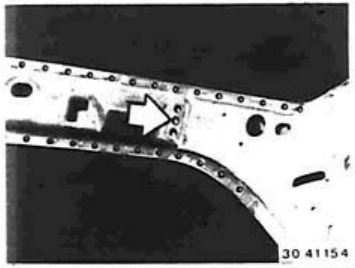
Plug spot weld or spot weld front roof frame with cowl panel and roof frame on sides.


30 41 205

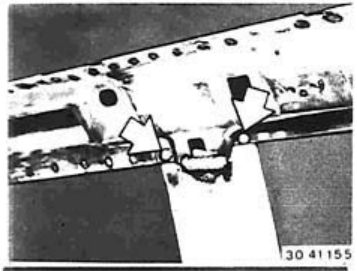
Spot weld cowl panel on cowl.


30 41 153

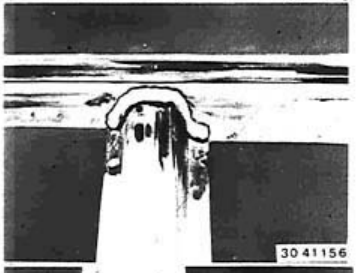
Spot weld end plate.
Inert gas weld mating surface to cowl panel.



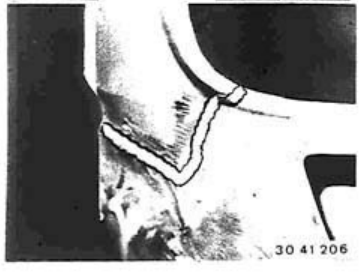
Spot weld end plate and C pillar on side frame.
Plug spot weld mating surface for C pillar.



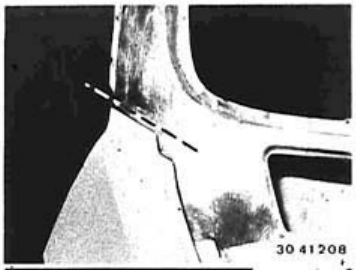
Spot weld or inert gas weld B pillar.



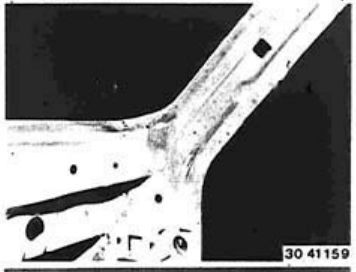
Braze B pillar on outside.



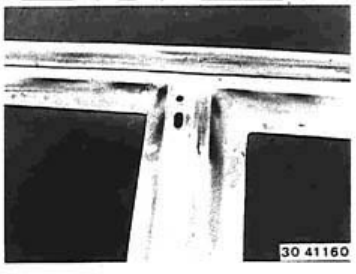
Braze joint on A pillar.



If necessary, tin out joint on A pillar.
Match contour on front side panel.



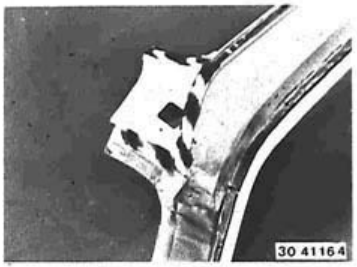
Grind mating surface.



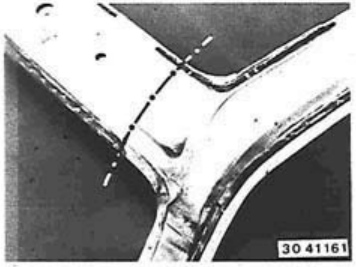
Grind mating surface.
Note:
Coat blank metal parts with zinc dust paint before installing outside roof panel.

41 22 541 REPLACING FRONT ROOF FRAME
– ROOF PANEL REMOVED –

Refer to information on page 41 - 001.



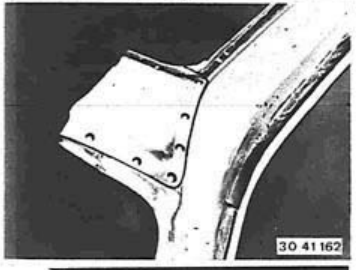
Remove scrap metal.
Straighten and grind mating surfaces.
Coat mating surfaces intended for spot welding with zinc dust paint.



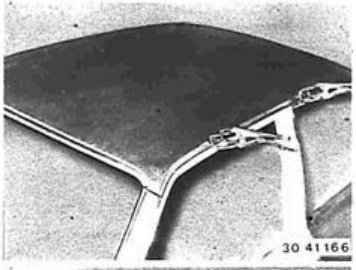
Cut through roof frame on left and right sides.



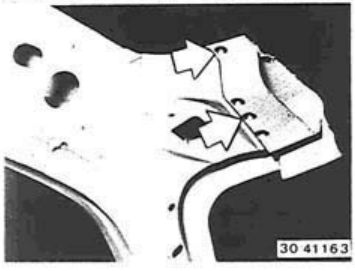
Grind mating surfaces on new parts.
Coat mating surfaces intended for spot welding with zinc dust paint.



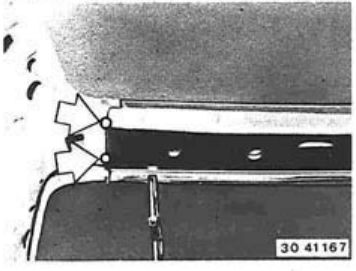
Drill out welded spots on left and right sides.



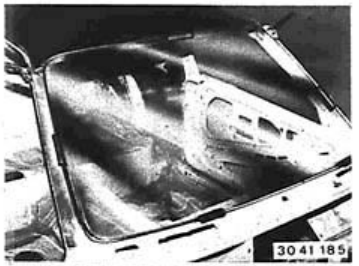
Install and clamp roof panel.



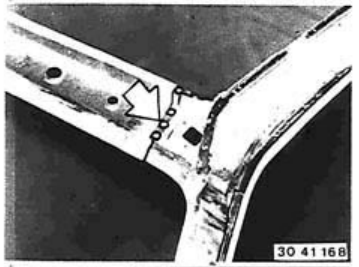
Drill off welded spots.



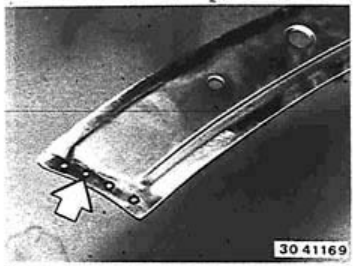
Install and tack weld roof frame inside section.



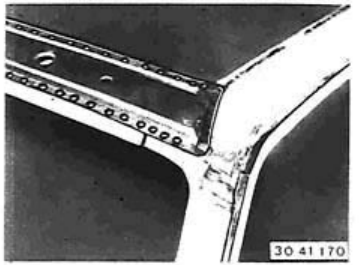
If necessary, install windshield with several pieces of rubber frame.
Check for uniform clearance and same curvature between glass and body opening edge.



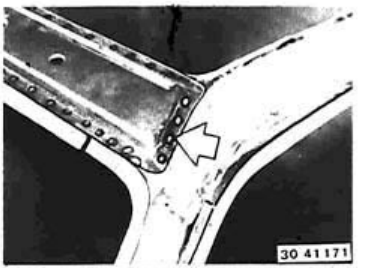
Lift off roof panel.
Spot weld roof frame inside section.



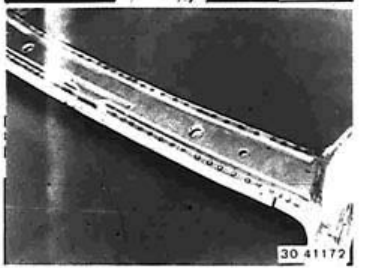
Drill holes in roof frame outside section for inert gas plug welding.



Clamp on and spot weld roof frame outside section.



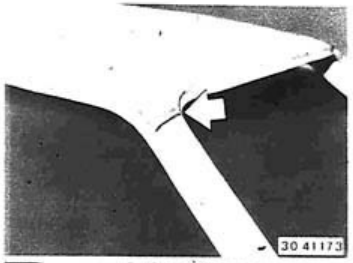
Plug spot weld at provided holes.



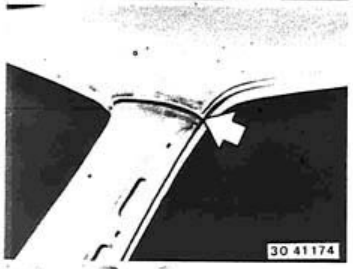
Straighten and grind mating surfaces.
Coat blank metal parts with zinc dust paint before installing roof panel.

41 31 001 REPLACING ROOF PANEL (WITHOUT SUN ROOF)

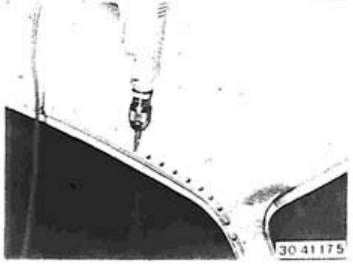
Refer to information on page 41 - 001.
Remove or disconnect following parts: battery ground lead, windshield and rear window with rubber frames, rear seat cushion and backrest, rear side trim panels, rear side windows, hatrack, both sun visors, A and B pillar plates, edge guards as req., roof liner with braces, inside lights, inside mirror, grab handles, seat belts as req., check control, front top trim, both roof ornamental strips.



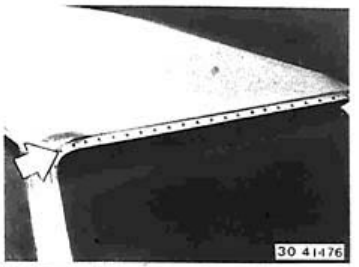
Clear front joints.
Remove brazing solder.



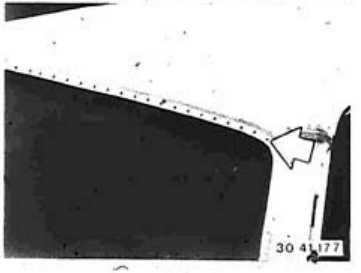
Clear rear joints.
Remove brazing solder.



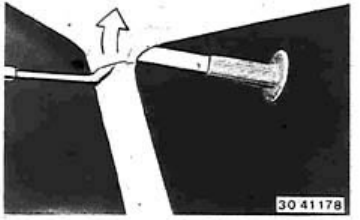
Drill off welded spots on rain molding.
Note:
The spot welded seam is gradually replaced by a roll welded seam.
If applicable, cut off roof panel.
Grind off scrap metal after lifting off the roof panel.



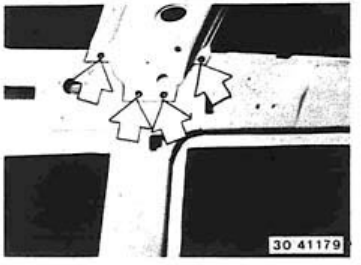
Drill off welded spots in window opening.



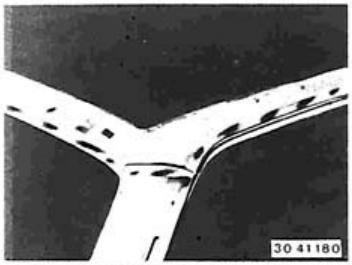
Drill off welded spots on rear window frame.



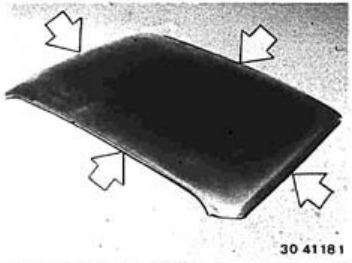
Lift off roof panel.



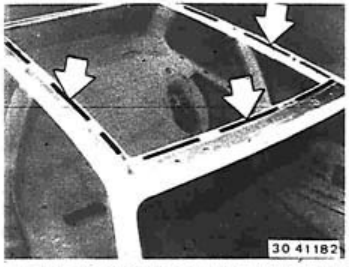
Cut out roof brace on left and right sides.



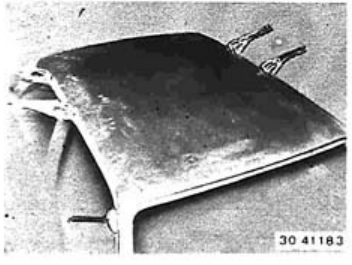
Straighten and grind mating surfaces.
Coat mating surfaces intended for spot welding with zinc dust paint.



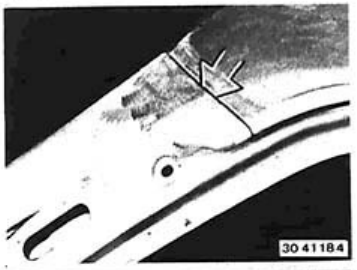
Grind mating surfaces on new roof panel.
Coat mating surfaces intended for spot welding with zinc dust paint.



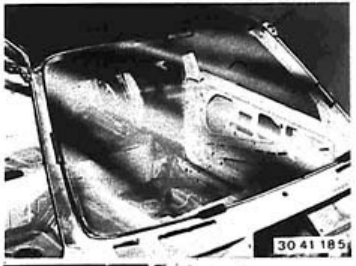
Paste Terostat tape on roof frame.



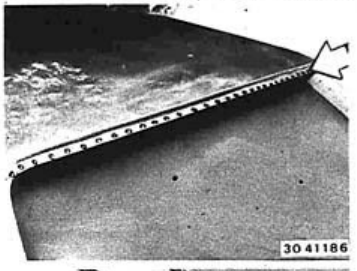
Install and clamp roof panel.



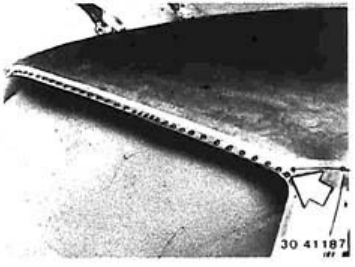
Note:
Roof panel grabs underneath C pillar.
Check clearance and transition to C pillar, correcting if necessary.



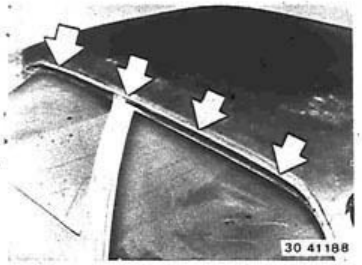
Install windshield and rear window with several pieces of rubber frame.
Check for uniform clearance and same curvature between window panes and body opening edges.



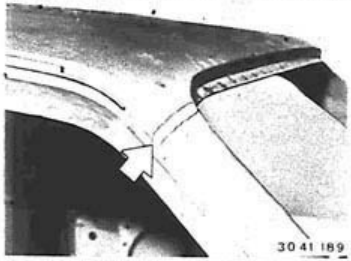
Spot weld roof panel in windshield opening.



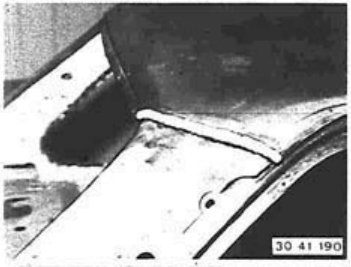
Spot weld roof panel in rear window opening.



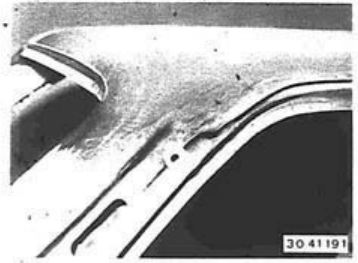
Spot weld roof panel on left and right rain moldings.



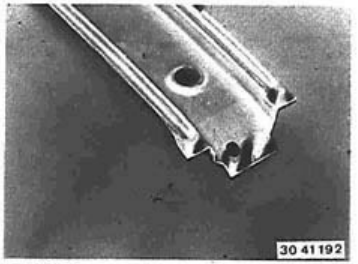
Braze cowl joints on left and right sides.



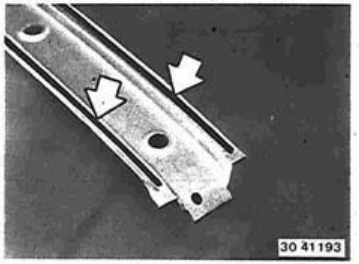
Braze C pillar joints on left and right sides.



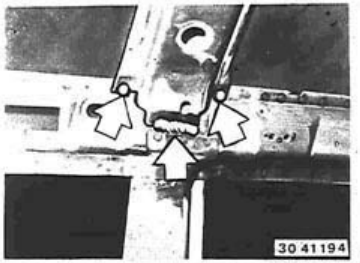
Grind front and rear joints, tinning out if necessary.



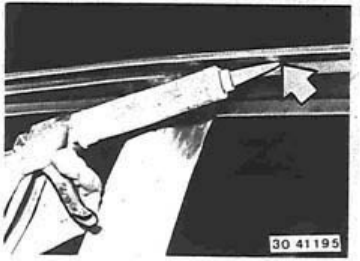
Grind mating surfaces on roof brace.



Paste Terostat tape on bearing surfaces of roof panel.



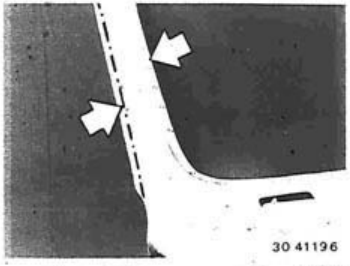
Install roof brace and press against roof panel lightly.
Weld on roof brace on left and right sides.
Use inert gas welder.



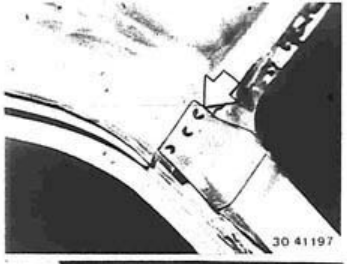
Seal joint between roof frame and roof panel with a body sealing compound.

41 32 515 REPLACING LEFT OR RIGHT COWL PANEL
– ROOF PANEL REMOVED –

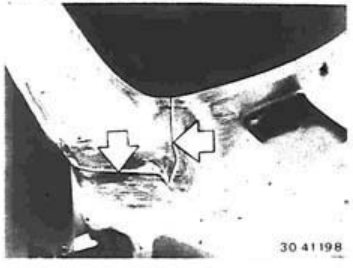
Refer to information on page 41 - 001.
Remove or disconnect following parts: instrument panel trim, grill on bottom of cowl, front door, front bumper, front side panel.


30 41196

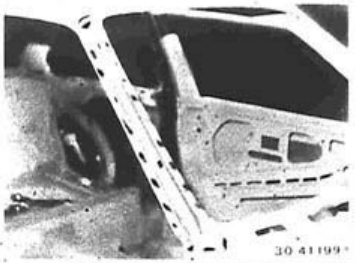
Drill off welded spots on window opening.
Cut off panel on outside.


30 41197

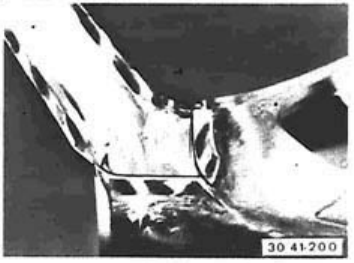
Drill off welded spots on roof.frame joint.


30 41198

Clear joint surface.
Remove brazing solder.
Take off cowl panel.


30 41199

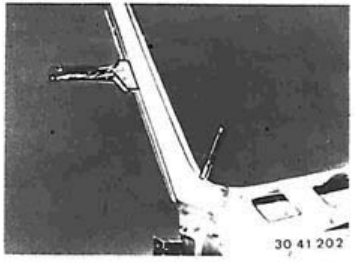
Remove scrap metal.
Straighten and grind mating surfaces.
Coat mating surfaces intended for spot welding with zinc dust paint.


30 41200

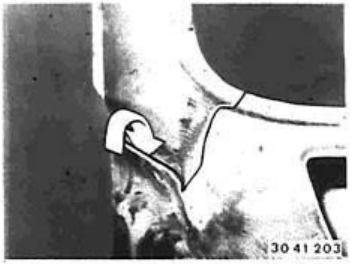
Straighten and grind mating surfaces.


30 41 201

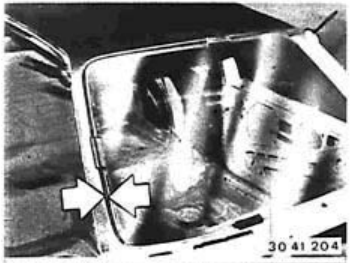
Grind mating surfaces on new cowl.
Coat mating surfaces intended for spot welding with zinc dust paint.


30 41 202

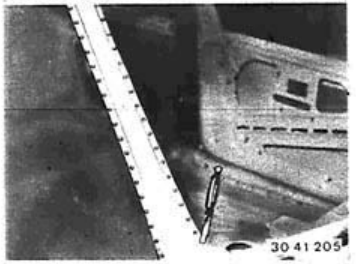
Install and clamp cowl panel, tack welding lightly in window opening.



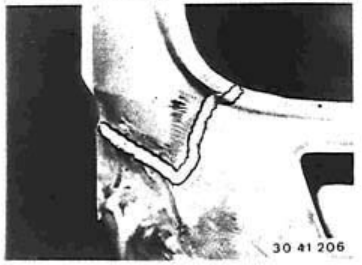
Note:
Make sure cowl panel grabs underneath connection for A pillar.



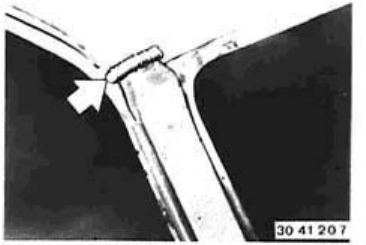
Install roof panel.
Install windshield with several pieces of rubber frame.
Check for uniform clearance and same curvature between glass pane and body opening.



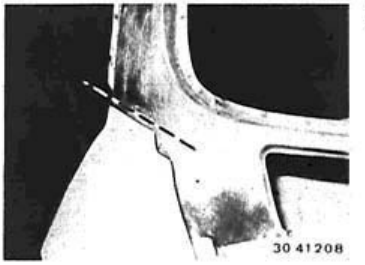
Spot weld cowl panel.



Braze connection on A pillar.



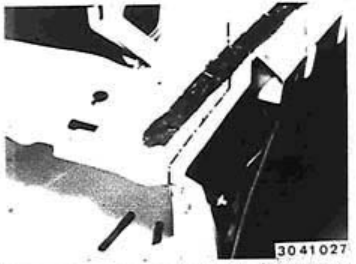
Inert gas weld top joint



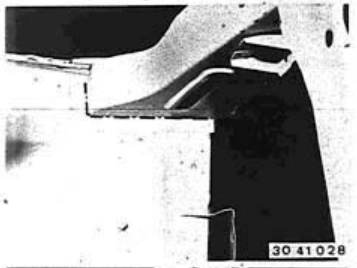
If necessary, tin out connection on A pillar. Match contour on front side panel.

41 33 001 REPLACING FRONT PANEL COMPLETE WITH FRONT WALL

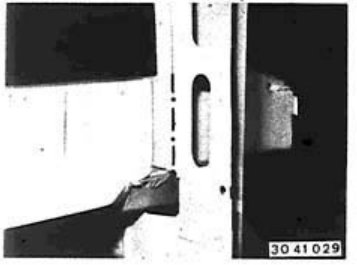
Refer to information on page 41 - 001.
Remove or disconnect following parts.
Disconnect battery ground lead.
Remove radiator grill, headlights, front fog lamps, two-tone horns, engine hood lock, data plate and radiator.
Disconnect wire harness partially.
Remove engine hood complete with hinges, see 41 61 000 / 41 61 050.
Remove front bumper, see 51 11 000.
Remove both front side panels, see 41 35 000.



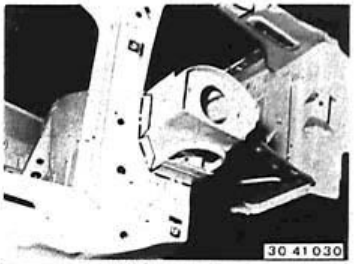
Cut off front wall on wheel house.



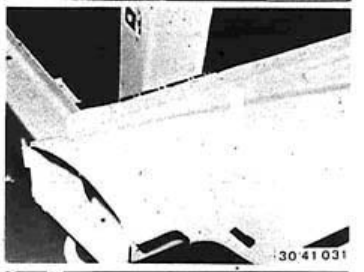
Cut off front wall on wheel house.



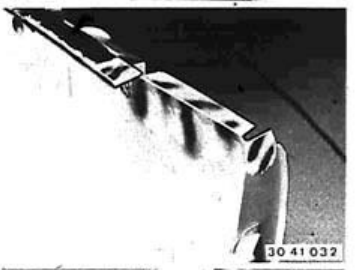
Cut off front wall on engine carrier.



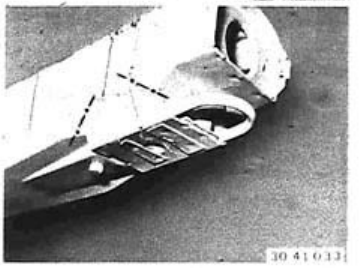
Cut off front wall on engine carrier.



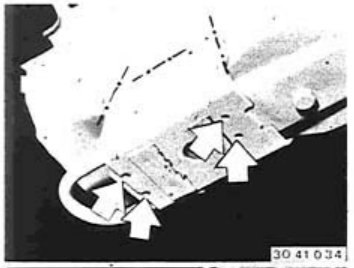
Grind off welded seams.
Take off front wall.



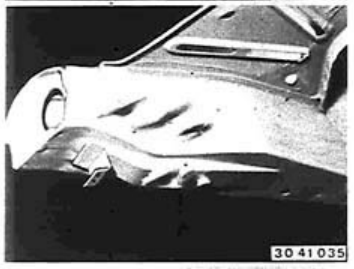
Remove scrap metal.
Straighten and grind mating surfaces.
Coat with zinc dust paint.



Grind off welded seams on eyelet.



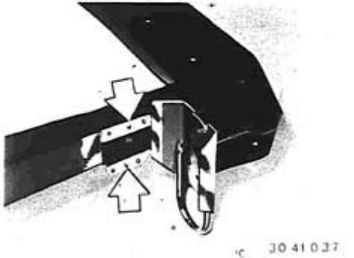
Grind off welding seams on towline eye.
Drill off welding spots.
Remove towline eye.



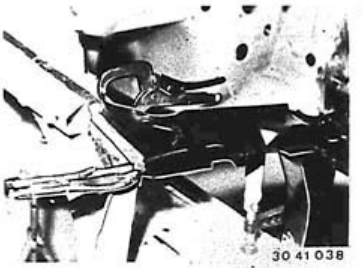
Remove scrap metal.
Straighten and grind mating surfaces.



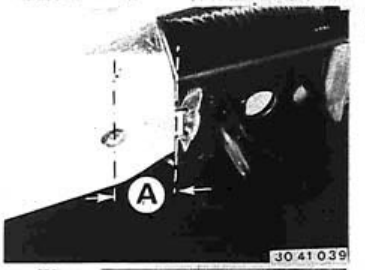
Grind mating surfaces on left and right sides of new front wall and coat with zinc dust paint.



Grind mating surfaces on left and right sides of new front panel wall.
Drill holes for inert gas plug welding.



Fit in and clamp front wall.



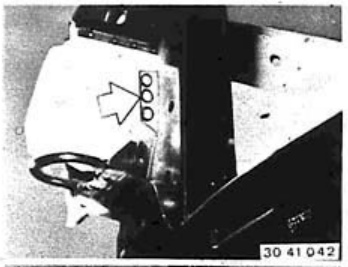
Note:
Distance A = 33.5 mm (1.319").



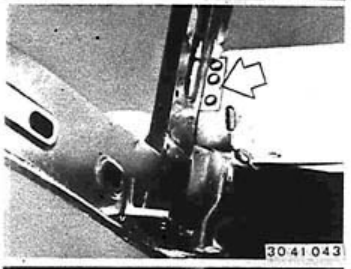
Spot weld front wall on wheel house.



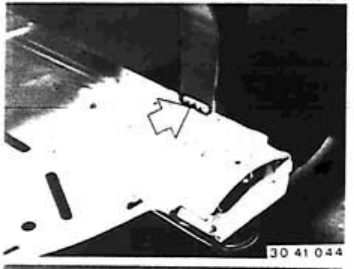
Inert gas weld towline eye on engine carrier inside and outside.
Spot weld and/or inert gas weld bracket.



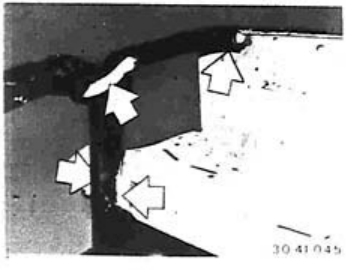
Inert gas plug weld front wall on engine carrier.



Inert gas plug weld front wall on engine carrier.



Inert gas weld front wall on end plate.

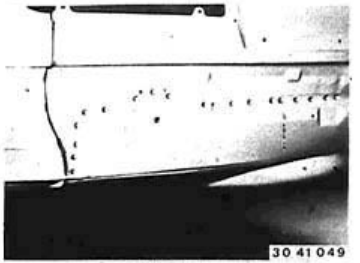


Coat all mating surfaces and joints with a body sealing compound*.

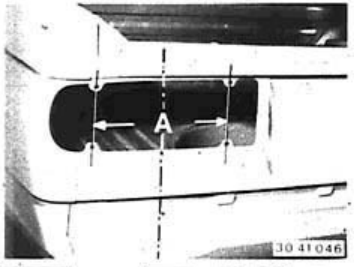
* Source: HWB

41 34 041 REPLACING TAIL PANEL

Refer to information on page 41 - 001.
Remove rear bumper.
Unscrew tail lights and license plate lights.
Disconnect wire harness partially.
Unscrew lock base with lock cylinder and license plate.
Unscrew final muffler holder.
Take off trunk lid seal partially.
Remove trunk mat and spare wheel.

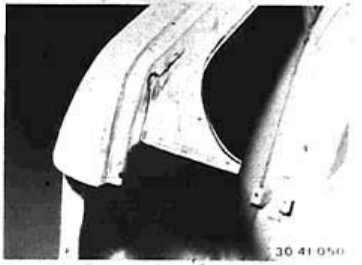


Drill off welding spots.
Take off tail panel.

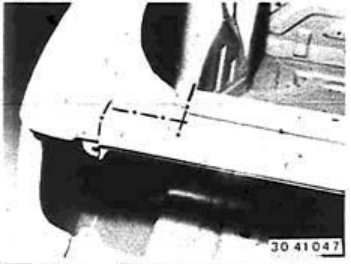


Note:
In order to limit paint spraying work to the tail panel, the cutting line can also be located in the tail light opening.

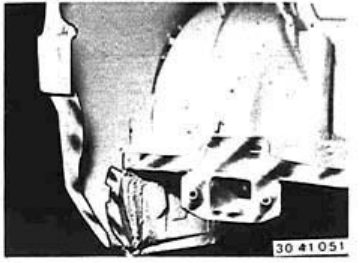
Distance A = 265 mm (10.433").



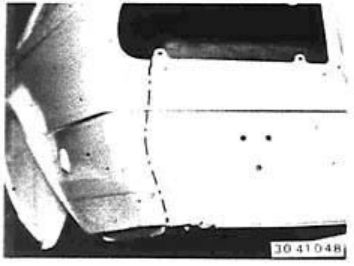
Remove scrap metal.



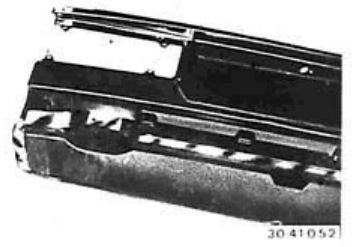
Cut off tail panel along lines on left and right sides.



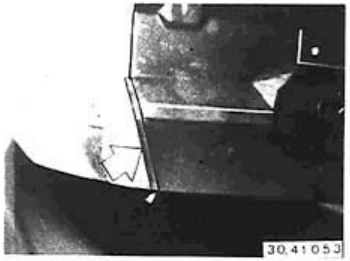
Remove scrap metal.
Coat surfaces required for spot welding with a zinc dust paint.



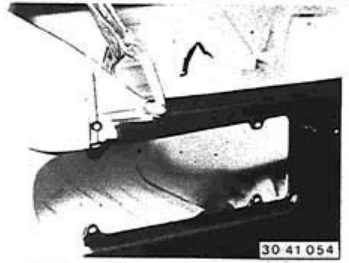
Cut off tail panel along lines on left and right sides.



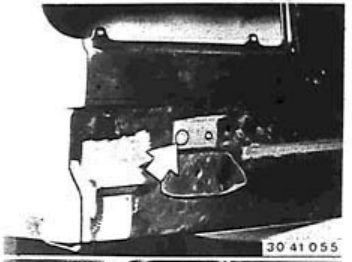
Grind down mating surfaces on new tail panel.
Coat surfaces required for spot welding with a zinc dust paint.



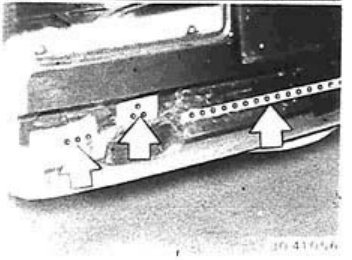
Cut off shouldered metal edge on one side far enough that tail panel can be pushed behind the side panel.



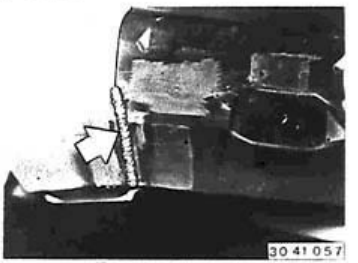
Fit in and tack weld tail panel.



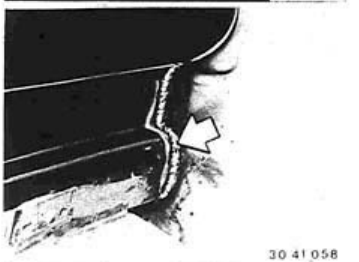
Mount tail panel on bumper bracket with a bolt.



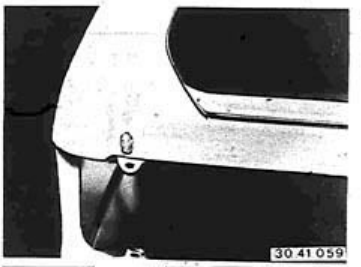
Spot weld tail panel on trunk floor plate and bumper bracket.



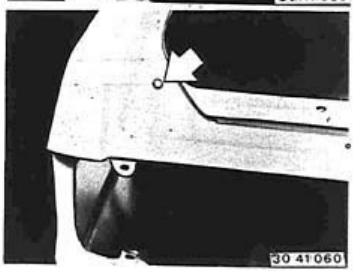
Weld bottom of tail panel on left and right side panels with an inert gas welder.



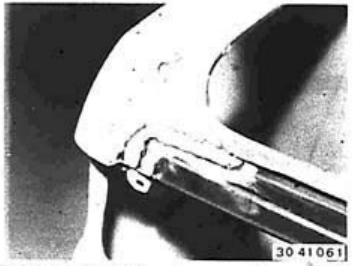
Weld web of tail panel and left and right side panels in area of trunk with an autogen welder.



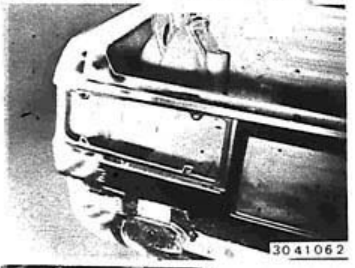
Weld tail panel on side panel.



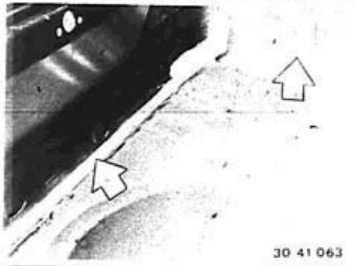
Spot weld tail panel on side panel.



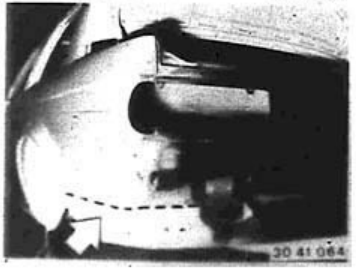
Braze reinforcement corner on tail panel.



Grind down all welded joints.



Coat all welded joints with body sealing compound* and spray with anti-drumming compound*.

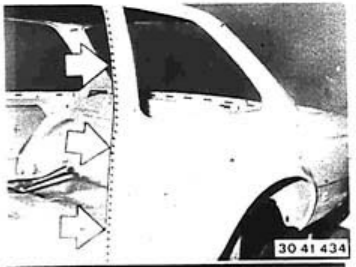


Spray an anti-drumming compound* on the side panel/tail panel joint underneath the bumper.

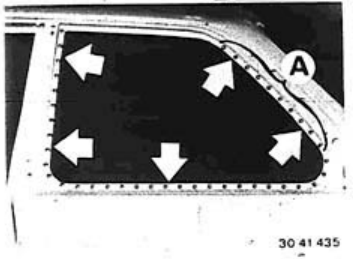
* Source: HWB

41 35 101 REPLACING LEFT REAR SIDE PANEL (Up To Roof Connection) – Two Door Models –

Refer to Information on page 41 - 001. Remove or disconnect following parts. Battery ground lead, rear bumper, left tail lights, trunk mat, wall trim panel, left wheel house trim panel, tail panel trim panel, trunk lid seal, rear window complete with frame, side window, rear seat cushion and backrest, side trim panel, hatrack, entrance cover strip, carpet partially, roof liner partially, door pillar trim, seat belt, front door seal, door striker, C pillar air extraction slot plate, rear side panel rubbing strip, left wheel house cover, fuel tank complete, strut on floor assembly and wire harness in trunk partially.

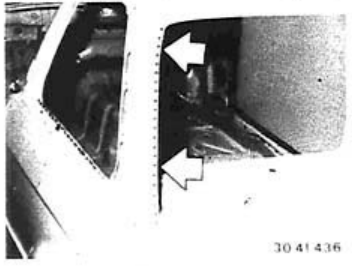


Uncover and drill off welding spots.

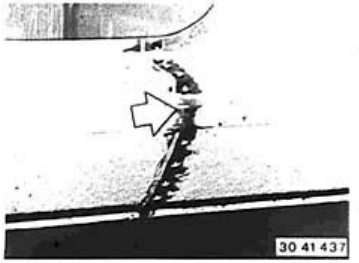


Uncover and drill off welding spots.

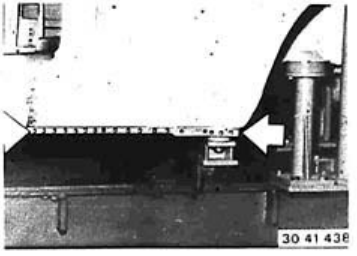
Note:
Drill through two panels in area (A) of the version with air extraction via the C- pillar.



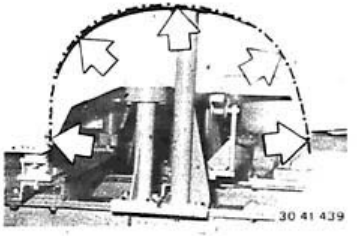
Uncover and drill off welding spots.



Uncover and drill off welding spots. Remove brazing solder.



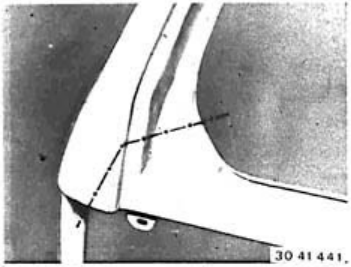
Uncover and drill off welding spots.



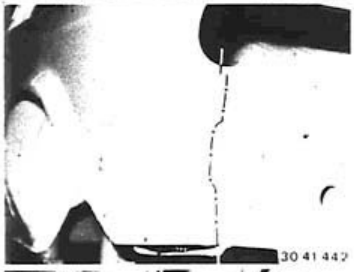
Grind off edge.



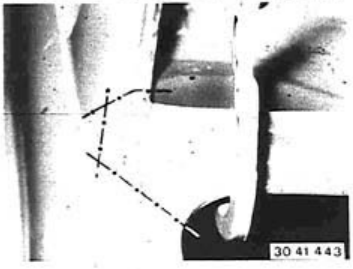
Uncover and drill off welding spots.



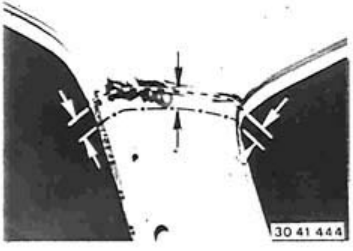
Cut off side panel along line.



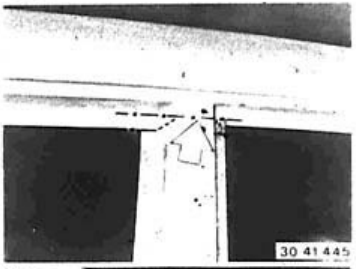
Cut off side panel along line.



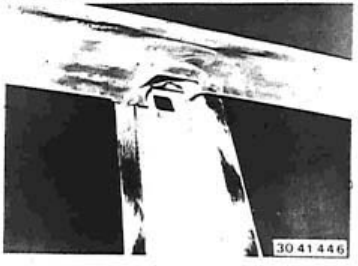
Cut off side panel along line.



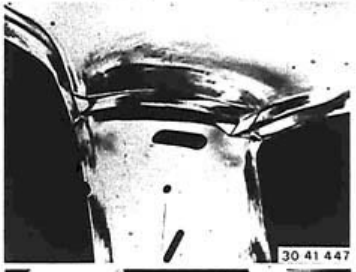
Uncover brazed roof joint.
Cut through side panel about 10 mm (0.394") below joint.



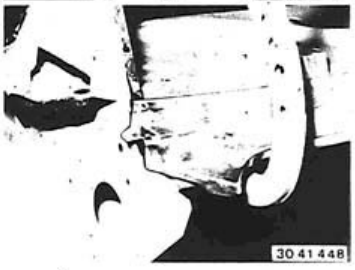
Cut through side panel in area of B pillar at top
Caution!
Don't cut end plate.
Lift off side panel.



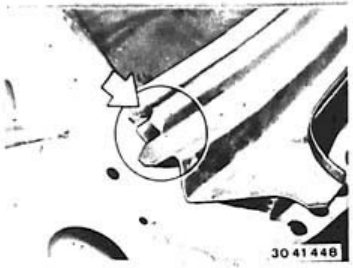
Remove scrap metal (brazing solder).
Straighten and grind mating surfaces.



Remove scrap metal (brazing solder).
Straighten and grind mating surfaces.

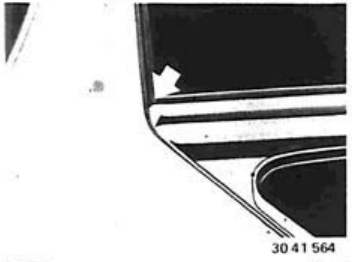


Remove scrap metal (brazing solder).
Straighten and grind mating surfaces.

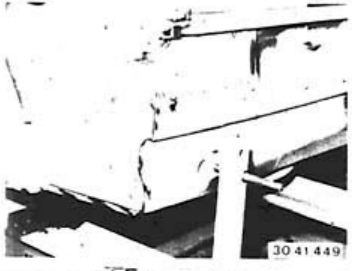


Note:
Side panel and window frame have been changed at bottom.

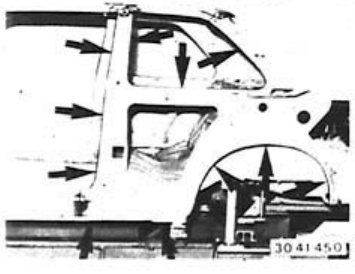
Correct bottom of window frame accordingly.



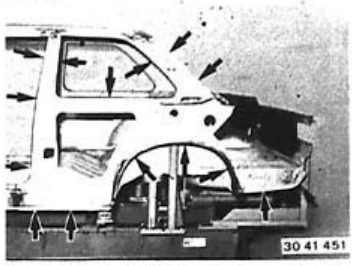
There must be a flat channel with the side panel installed.



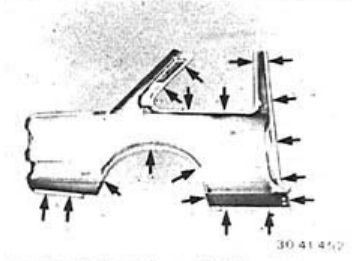
Remove scrap metal.
Straighten and grind mating surfaces.



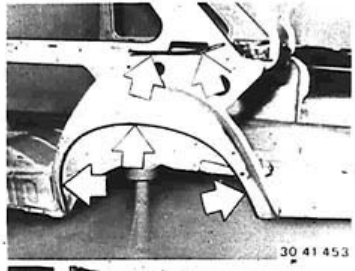
Remove scrap metal.
Straighten and grind mating surfaces.



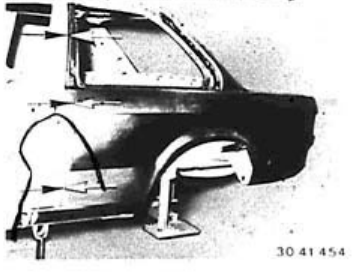
Coat mating surfaces needed for spot welding with zinc dust paint.



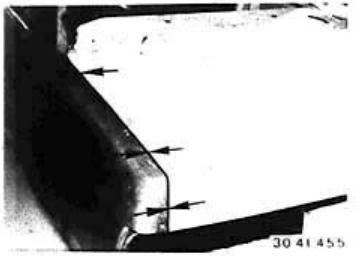
Grind mating surfaces on new side panel.
Drill holes for plug spot welding at the entrance joint.
Coat mating surfaces needed for spot welding with zinc dust paint.



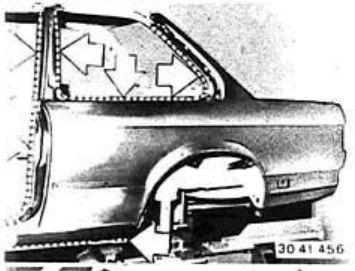
Use Terostat tape on wheel house joint and side frame reinforcement.



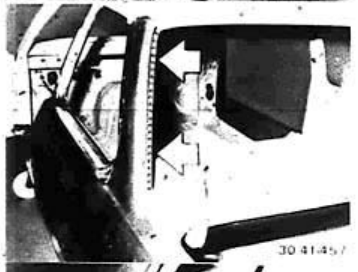
Install and clamp side panel, tack welding if necessary.
Check door gap.



Install trunk lid and check gap.



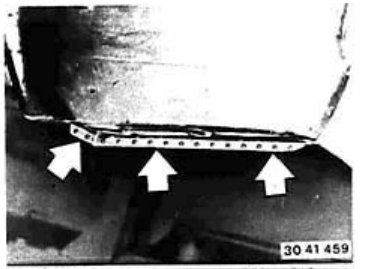
Spot weld side panel.



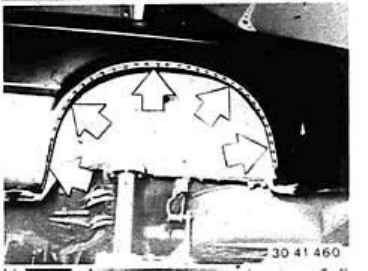
Spot weld side panel.



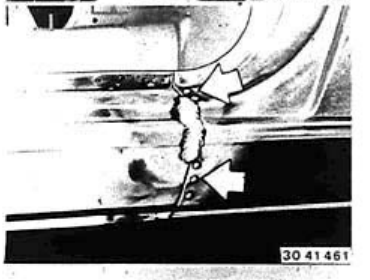
Spot weld side panel in area of trunk.



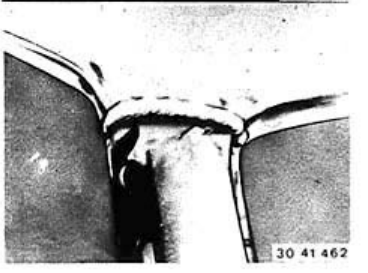
Spot weld side panel.



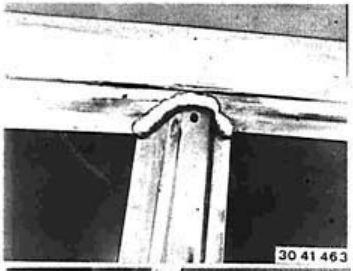
Spot weld side panel in wheel opening.



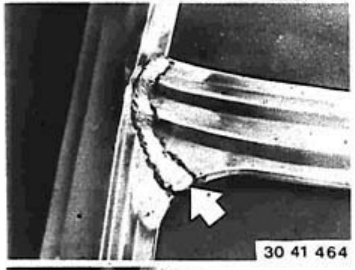
Plug spot weld side panel on entrance cover strip.
Braze on outside edge.



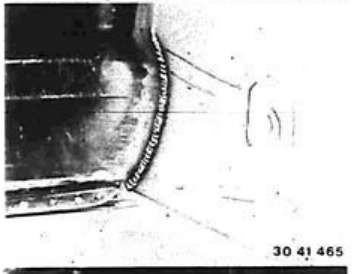
Braze roof joint.



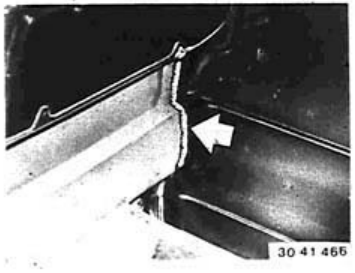
Braze B pillar joint.



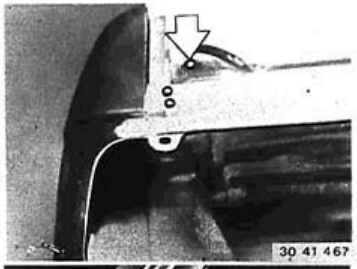
Braze side panel in area of rear window frame and trunk.



Inert gas weld side panel on tail panel.
Grind down welding bead.



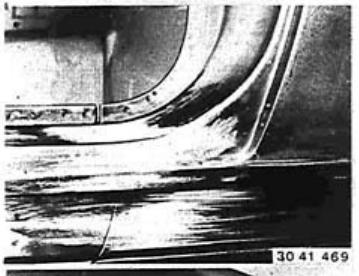
Weld connector between tail panel and side panel from inside with an autogen welder.



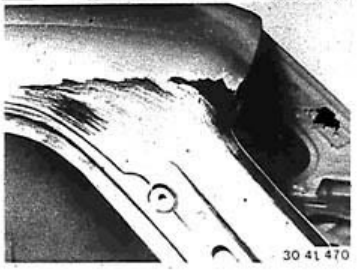
Spot weld tail panel on side panel.



Braze and grind down side panel/tail panel joint.



Grind joint, tinning if necessary.

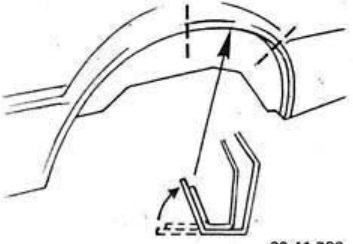


Grind joint, tinning if necessary.

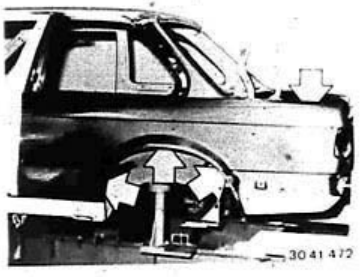


Grind joint, tinning if necessary.





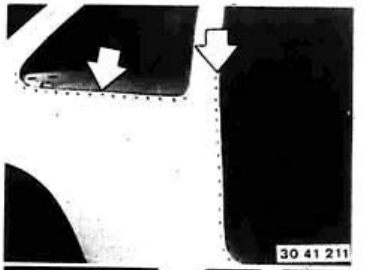
Important!
The spot welded flange in the rear area of the wheel opening must be cringed on cars beginning with 1988 models or when using wider tires.
Compare with opposite side if necessary.



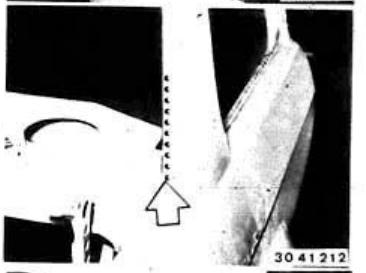
Seal all joints with a joint sealing compound. Replace damaged anti-drumming coat in wheel house, on bottom of side panel or in trunk.

41 35 291 REPLACING RIGHT REAR SIDE PANEL (PARTIAL REPLACEMENT UP TO WINDOW LINE) – Two Door Model –

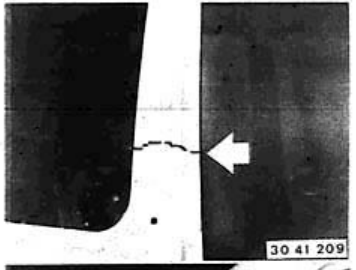
Refer to information on page 41 - 001.
Remove or disconnect following parts: rear bumper, right tail lights, trunk mat, wall trim panel, right wheel house trim panel, tail panel trim panel, trunk lid seal, rear window complete with frame, side window, rear seat cushion and backrest, side trim panel, hatrack, entrance cover strip, carpet partially, roof liner partially, door pillar trim, seat belt, front door seal, door striker, C pillar air extraction plate, rear side panel rubbing strip, right wheel house cover, fuel filler neck, expansion tank, fuel tank assy., floor brace, wire harness in trunk partially.



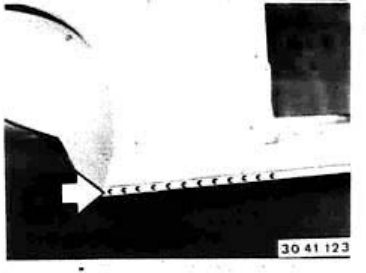
Uncover and drill out spot welds.



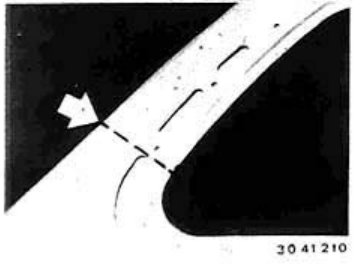
Uncover and drill out spot welds.



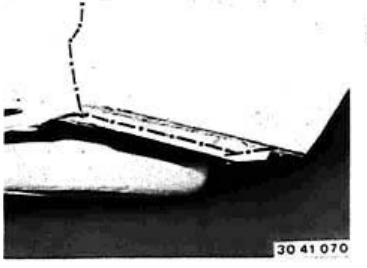
Make cutting line for partial replacement.



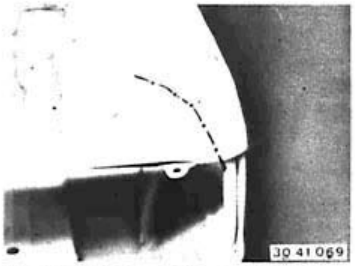
Uncover and drill out spot welds.



Make cutting line for partial replacement.



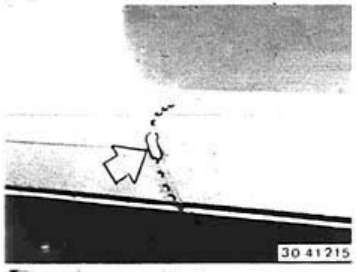
Cut off side panel on tail panel and trunk side section panel.



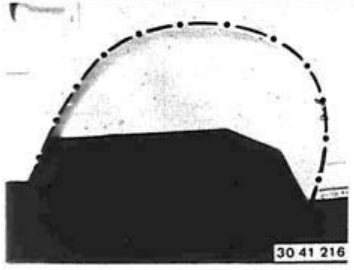
Cut off side panel on tail panel.



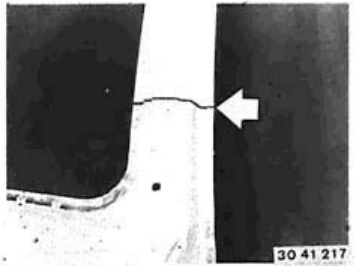
Cut off side panel along line.



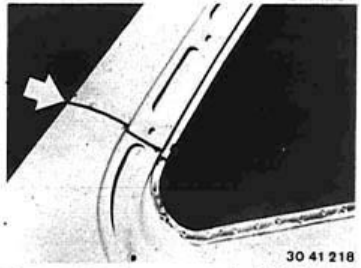
Clear joint and drill off welded spots.
Remove brazing solder.



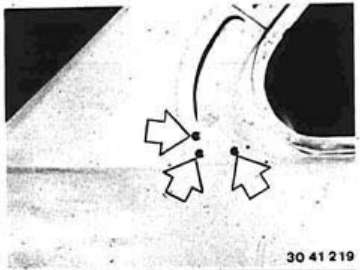
Grind off edge.



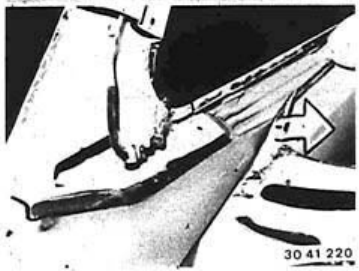
Cut through B pillar to end plate along marked cutting line.



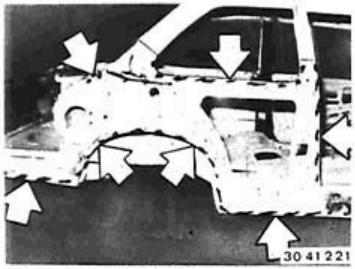
Cut off side panel along line.
Caution!
Don't cut through guide plate for forced air extraction.



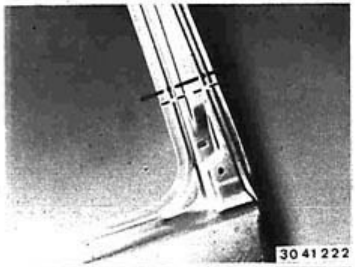
Drill off welded spots.



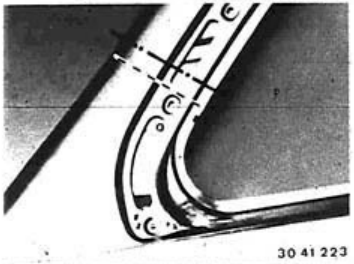
Cut off side panel on guide plate.
Remove side panel.



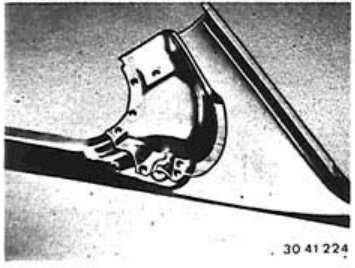
Remove scrap metal.
Straighten and grind mating surfaces.
Coat mating surfaces required for spot welding with zinc dust paint.



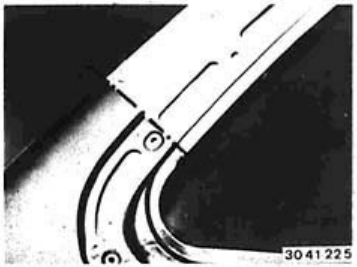
Cut off B pillar on new side panel to overlap planned mating surface upward by approx. 10 mm (3/8").



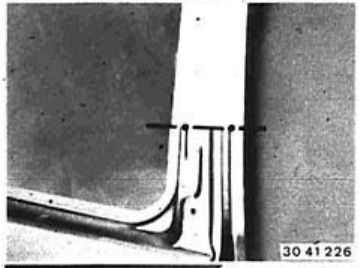
Cut through C pillar on new side panel above planned mating surface by approx. 10 mm (3/8").



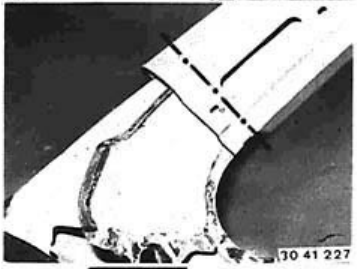
Drill off rest of guide plate.
Clean mating surfaces.



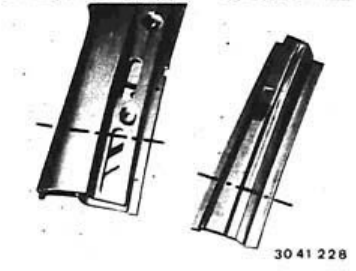
Install side panel and mark cutting line.



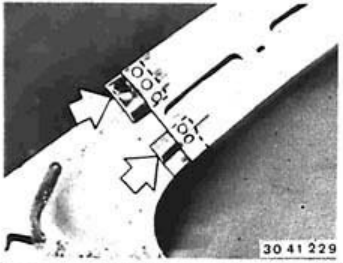
Mark cutting line.



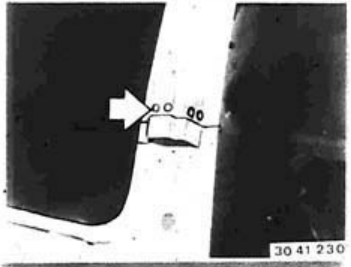
Remove scrap metal on B and C pillars.
Caution!
Don't damage the air-guide plate.



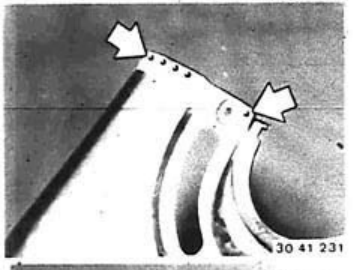
Produce an approx. 50 mm (2") wide brace from the pillar sections cut off of the new side panel.



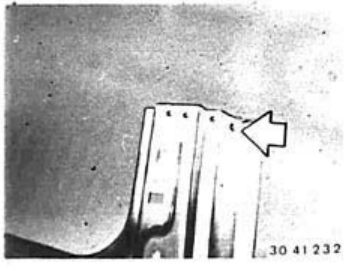
Cut brace to size, sliding half of it into C pillar and spot welding.



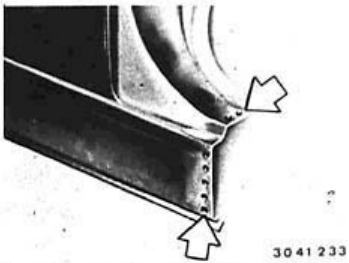
Cut brace to size, sliding half of it into B pillar and spot welding.



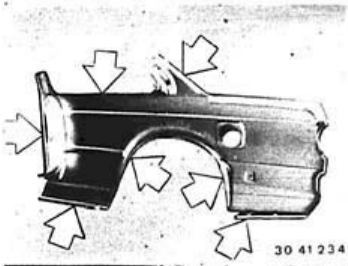
Drill holes for plug spot welding in C pillar joint.



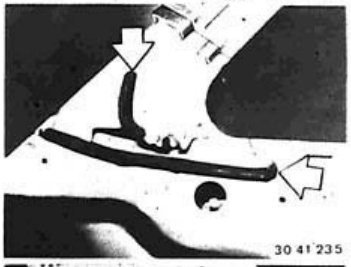
Drill holes for plug spot welding in B pillar joint.



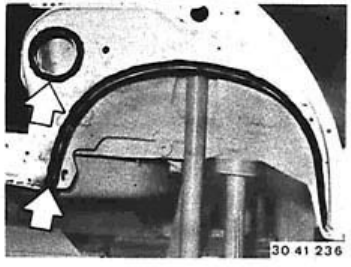
Drill holes for plug spot welding in entrance joint.



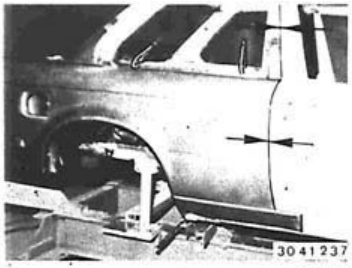
Grind mating surfaces on new side panel.
Coat mating surfaces intended for spot welding with zinc dust paint.



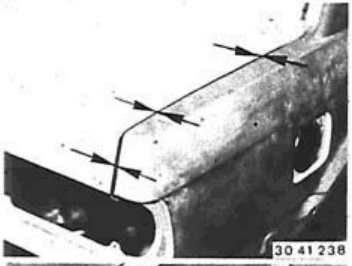
Use body sealing compound on bearing surfaces of air guide plates.



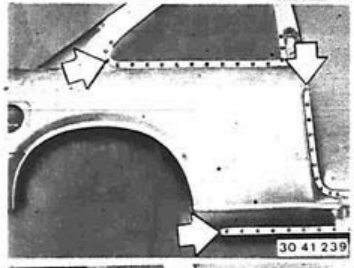
Apply coat of body sealing compound on bearing surface for fuel filler neck and on edge of wheel opening.



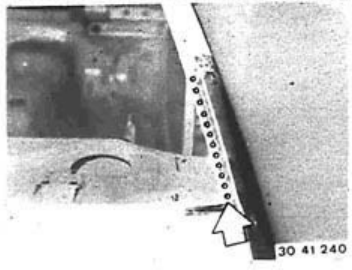
Mount and clamp side panel, tack welding if necessary.
Check door gap.



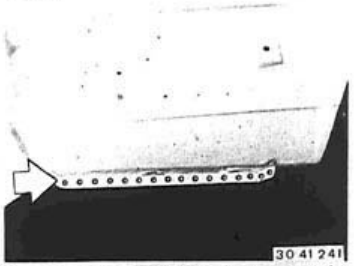
Check trunk lid gap.



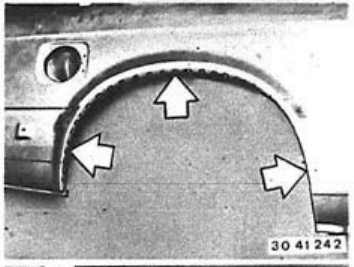
Spot weld side panel.



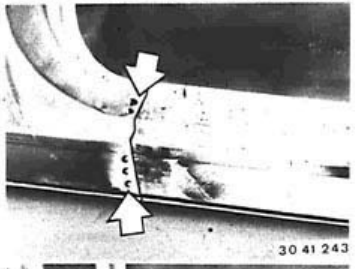
Spot weld side panel on rear window frame.



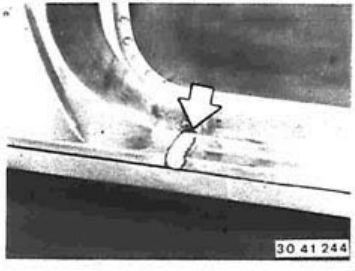
Spot weld side panel on trunk floor plate.



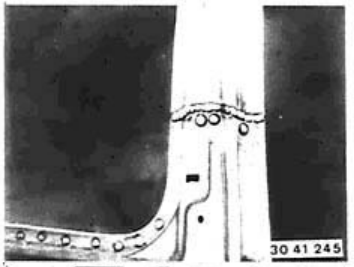
Spot weld side panel in wheel opening.



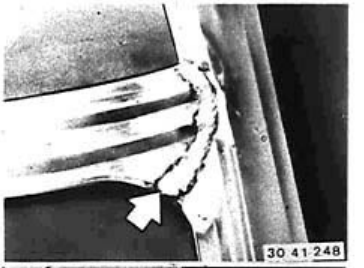
Inert gas plug weld joint on entrance.



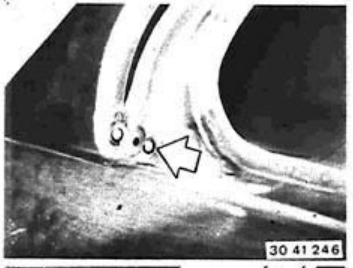
Braze entrance along outside edge.



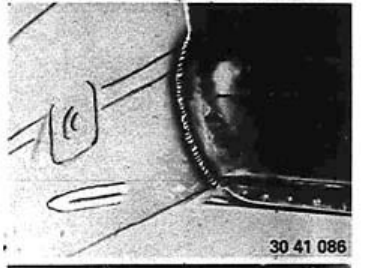
Plug spot weld joint on B pillar.
Inert gas weld joint.



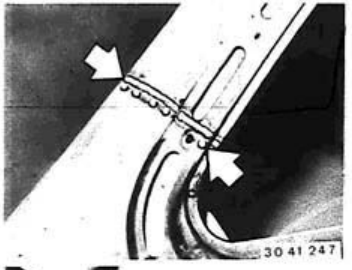
Braze joint.



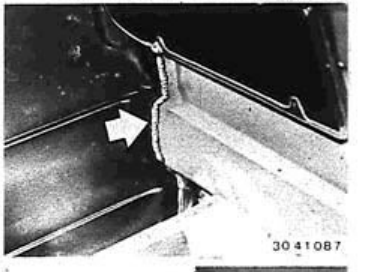
Inert gas plug weld cowl panel.



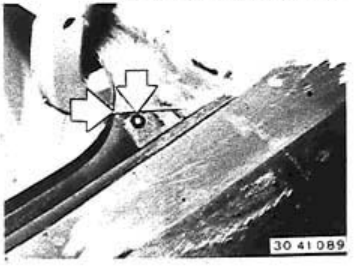
Inert gas weld side panel on tail panel.



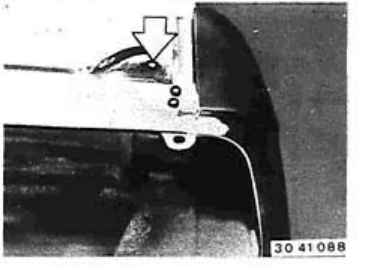
Plug spot weld joint on C pillar.
Inert gas weld joint.



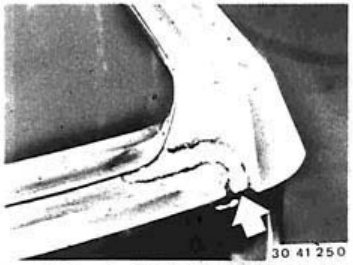
Autogen weld connecting panel on tail panel and side panel.



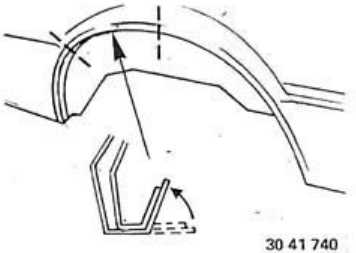
Spot weld side panel on trunk opening edge.



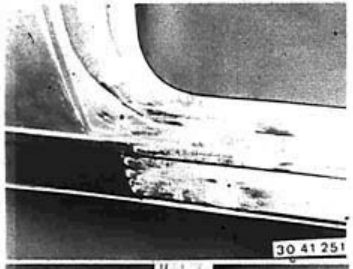
Spot weld tail panel on side panel.



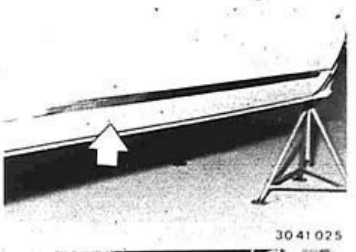
Braze and grind down connecting plate between side panel and tail panel.



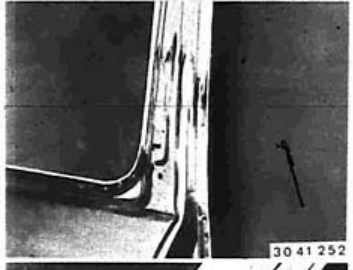
Important!
The spot welded flange in the rear area of the wheel opening has to be cringed in cars beginning with 1988 models or when using wider tires.
Compare with opposite side if necessary.



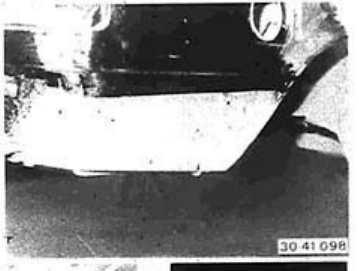
Grind dwon entrance joint and, if necessary, tin out.



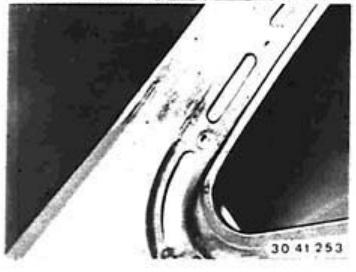
Spray an anti-drumming compound* on side panel and entrance from below.



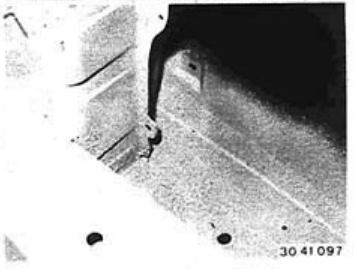
Grind down B pillar joint and, if necessary, tin out.



Spray an anti-drumming compound* on side panel and tail panel below bumper.



Grind down C pillar joint and, if necessary, tin out.



Seal inside of all joints with a body sealing compound* and spray on an anti-drumming compound*.

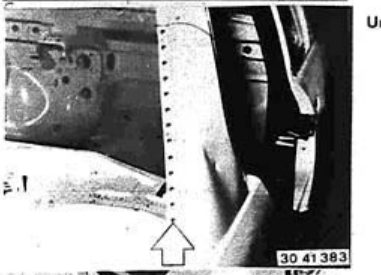
* Source of Supply: HWB

41 35 291 REPLACING RIGHT REAR SIDE PANEL (PARTIAL REPLACEMENT UP TO WINDOW LINE)
— Four Door Model —

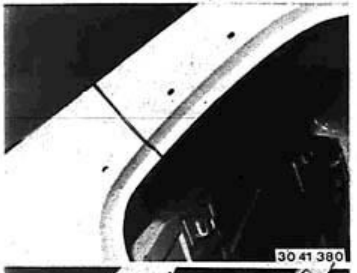
Refer to information on page 41 - 001.
Remove or disconnect following parts: complete trunk trim panels, trunk lid seal, rear bumper, right tail lights, upper tail panel plate, spare wheel, rear seat cushion and backrest, hatrack, rear window with rubber frame, entrance cover strip with cover plate, roof liner partially, carpet partially, rear seat belt, rear door edge guard, door striker, C pillar plate, rear wheel, wheel house cover, expansion tank, fuel tank, brace mounting parts.



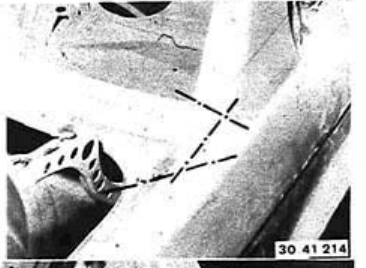
Remove brazing solder.
Drill out spot welds.



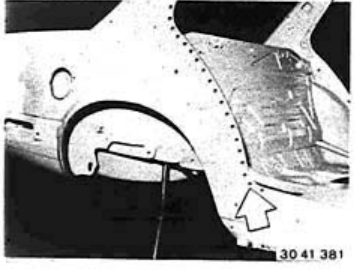
Uncover and drill out spot welds.



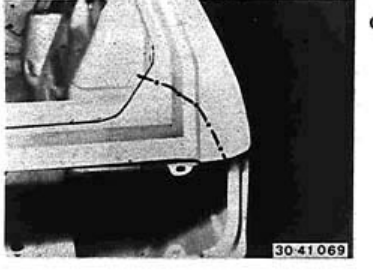
Make cutting line for partial replacement.
Cut through side panel along cutting line up to the end plate.
Caution!
Don't damage or bend the end plate.
Note:
Make cutting line in such a manner that roof joint paint finish can be touched up.



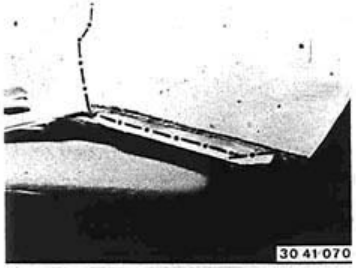
Cut out side panel along line.



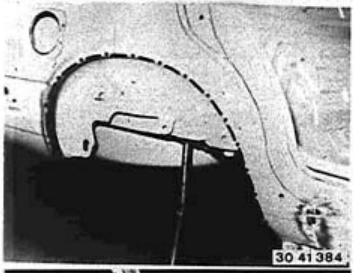
Uncover and drill out spot welds.



Cut side panel off of tail panel along line.



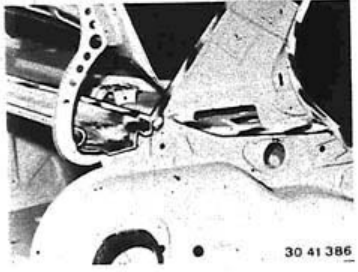
Cut off side panel on tail panel and trunk side section panel.



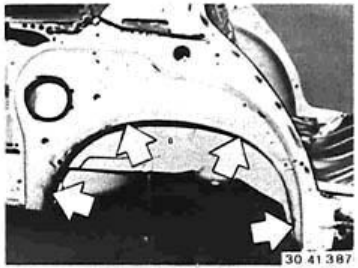
Grind down edge on wheel house.



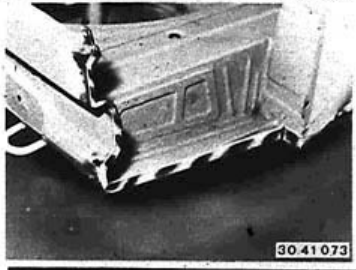
Lift off side panel.
Important!
Heat or cut off sealing material on C pillar and tank filler neck.



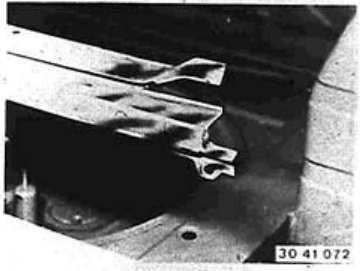
Remove scrap metal.
Straighten and grind mating surfaces.
Coat mating surfaces required for spot welding with zinc dust paint.



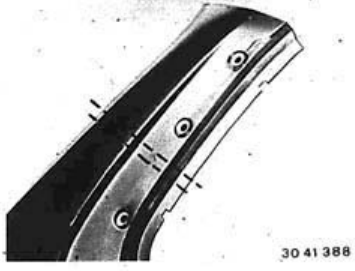
Remove scrap metal.
Straighten and grind mating surfaces.
Coat mating surfaces required for spot welding with zinc dust paint.

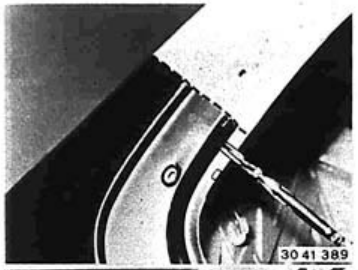


Remove scrap metal.
Straighten and grind mating surfaces.

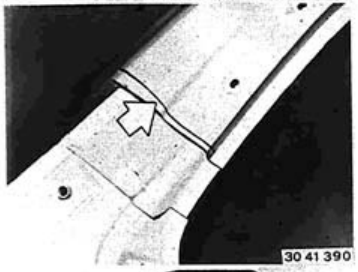


Cut off C pillar on new side panel approx. 10 mm (3/8") above planned mating point.

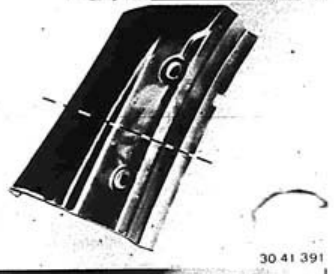




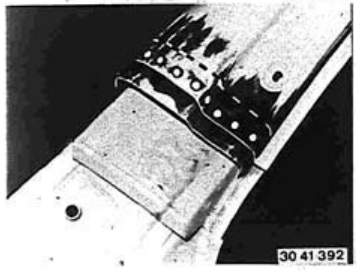
Install side panel and make cutting line.



Remove scrap metal on C pillar.
Caution!
Be careful not to damage end plate on inside.



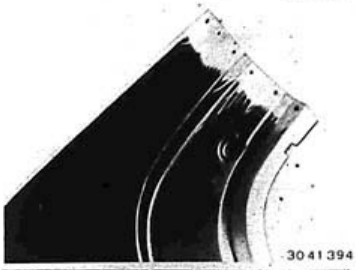
Produce an approx. 50 mm (2") wide brace from section cut off of new side panel.



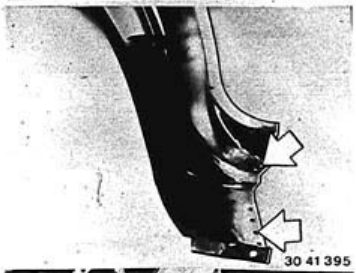
Slide brace into C pillar halfway and spot weld.



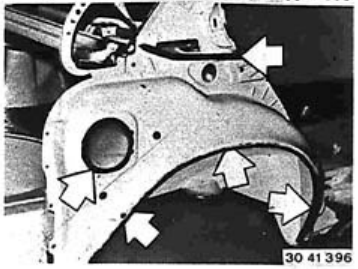
Grind mating surfaces on new side panel. Coat mating surfaces required for spot welding with zinc dust paint.



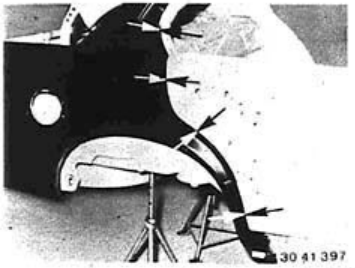
Drill holes for plug spot welding in C pillar mating surface.



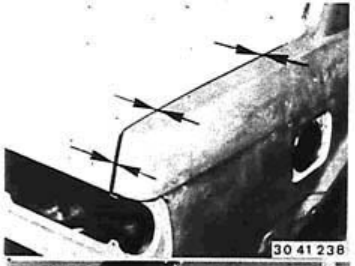
Drill holes for plug spot welding in entrance mating surface.



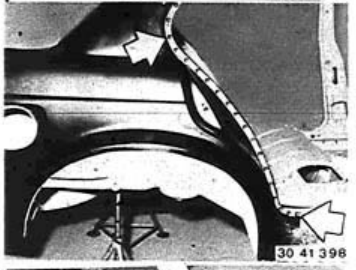
Coat bearing surfaces on guide plate, tank filler neck and in wheel opening with a body sealing compound.



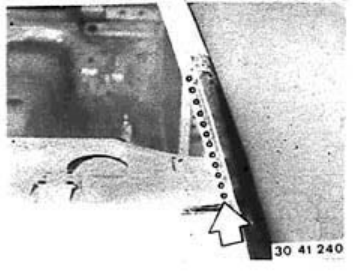
Install and clamp down side panel, tack welding if necessary.
Check door gaps.



Check trunk lid gaps.

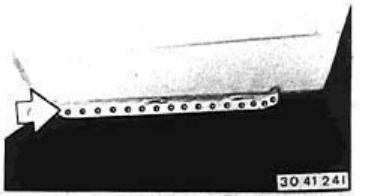


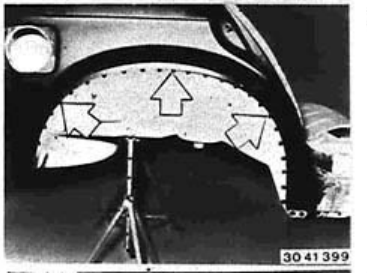
Spot weld side panel in door opening.



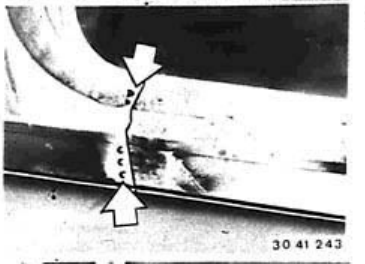
Spot weld side panel on rear window frame.

Spot weld side panel on trunk floor plate.

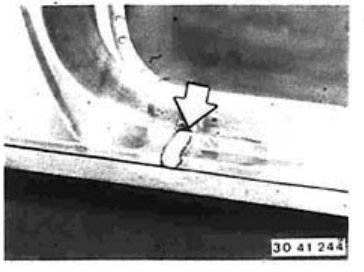




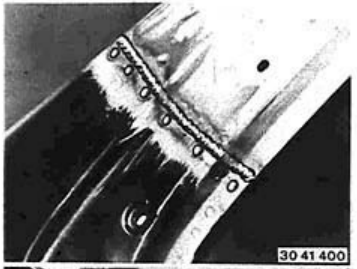
Spot weld side panel in wheel opening.



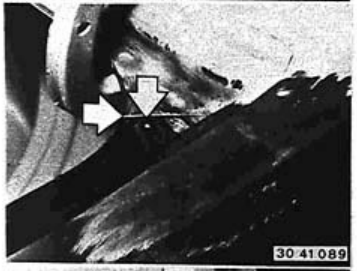
Inert gas plug weld entrance connection.



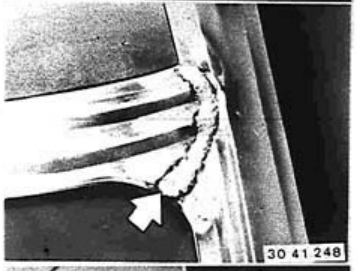
Braze entrance on outside edge.



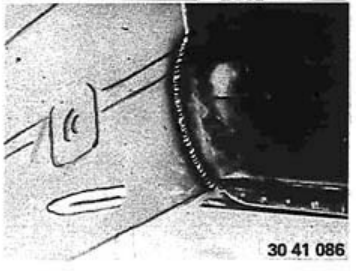
Plug spot weld mating surface on C pillar.
Inert gas weld joint.



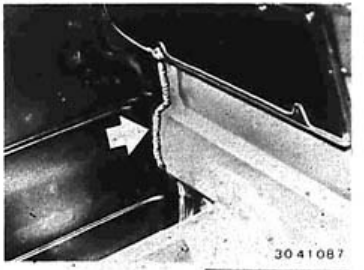
Spot weld side panel in trunk lid opening.



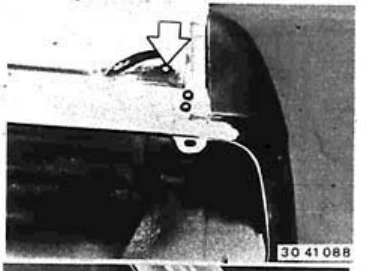
Braze joint.



Inert gas weld side panel on tail panel.
Grind down welding seam.



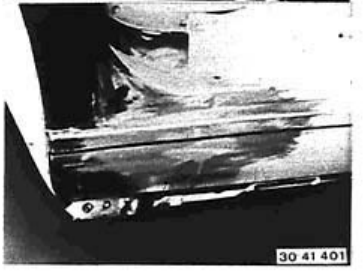
Autogen weld connector on tail panel and side panel from inside.



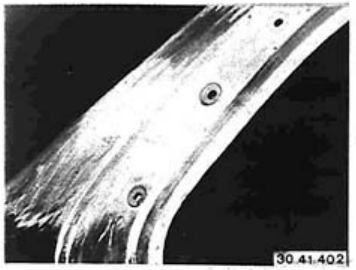
Spot weld tail panel on side panel.



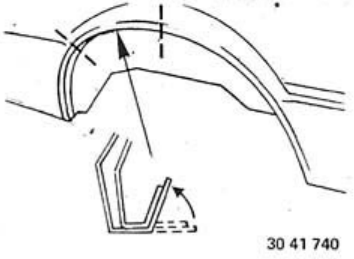
Braze and grind down joint between side panel and tail panel.



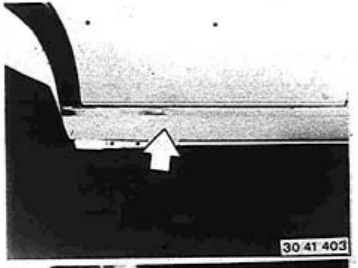
Grind down joints on entrance, tinning out if necessary.



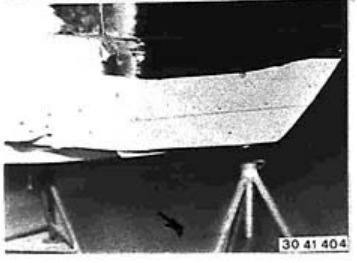
Grind down C pillar joint, tinning if necessary.



Important!
The spot welded flange in rear area of the wheel opening must be cringed on cars beginning with 1988 models or when using wider tires.
Compare with opposite side if necessary.

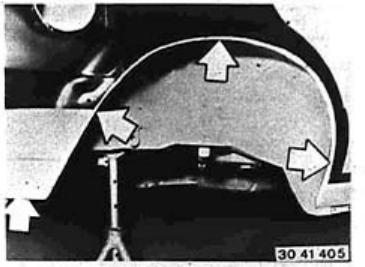


Spray coat of anti-drumming material* on bottom of side panel and entrance.

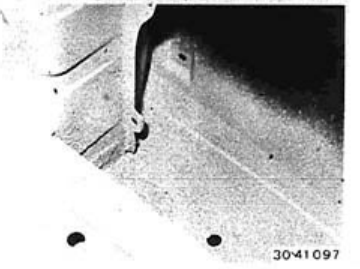


Spray coat of anti-drumming material* on side panel and tail panel below the bumper.

* Source of Supply: HWB



Repair spot welded flange and damaged anti-drumming coat in wheel house and on trunk floor plate.

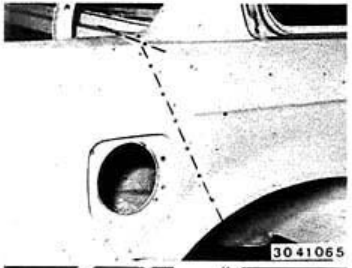


Seal inside of all joints with a body sealing compound* and spray on a coat of anti-drumming material.

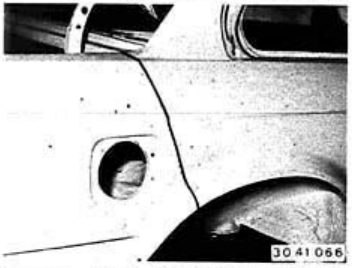
* Source of Supply: HWB

41 35 338 REPLACING RIGHT REAR SIDE PANEL (PARTIAL REPLACEMENT UP TO WHEEL HOUSE)

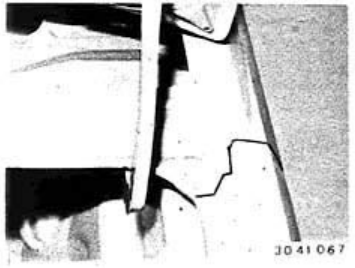
Refer to information on page 41 - 001.
Remove bumper assembly, tail lights, trunk mat, rear trim panel, right wheel house trim panel, tail panel trim panel, tail panel plate, trunk lid seal, fuel tank assembly, right wheel house cover, fuel filler neck and right expansion tank.



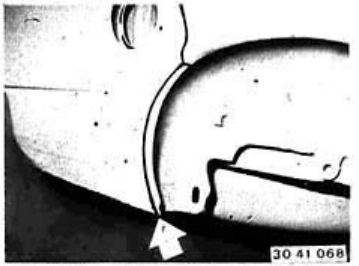
Draw cutting line for partail replacement.



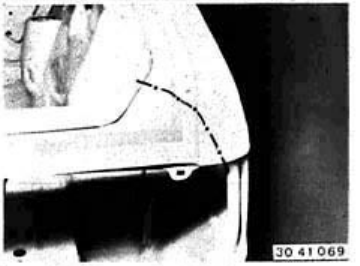
Cut off side panel along the line.



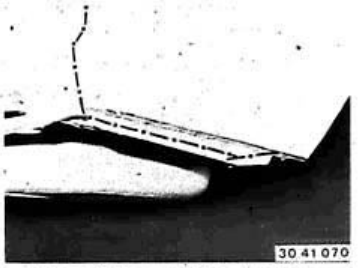
Cut off side panel along the line.



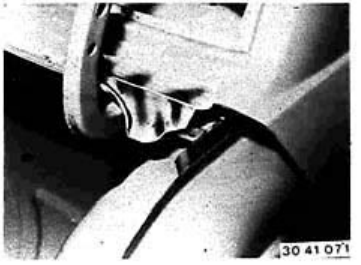
Cut off side panel around the wheel opening.



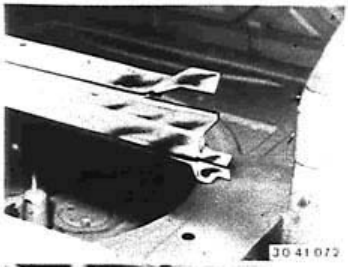
Cut off side panel on the tail panel.



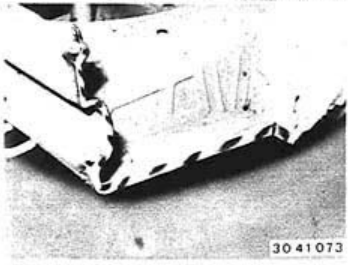
Cut off side panel on tail panel and trunk side section.
Take off side panel section.



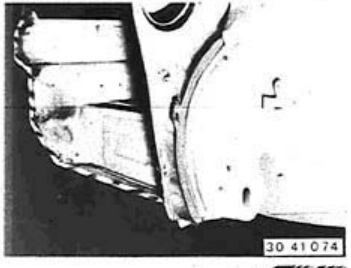
Remove scrap metal.



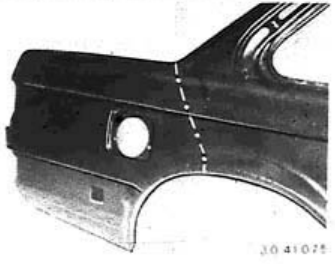
Remove scrap metal.



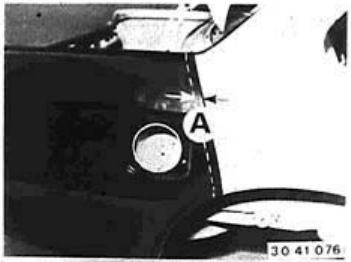
Remove scrap metal.



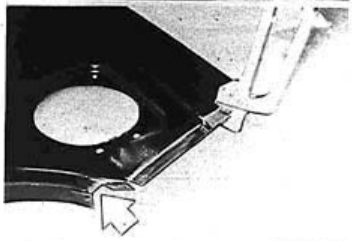
Remove scrap metal.



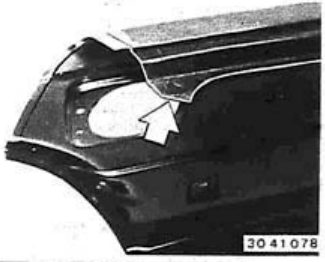
Cut off new side panel to overlap on mating surfaces.



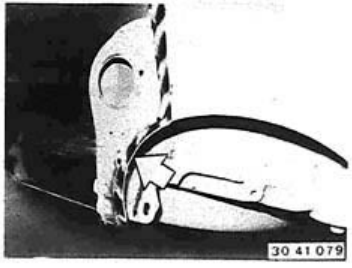
Cut mating surface to size that mating surface overlaps by distance A = 10 mm (0.394").



Make cuts in edges of partial replacement section and shoulder with a shouldering pliers.
Disengage wheel house on connection.



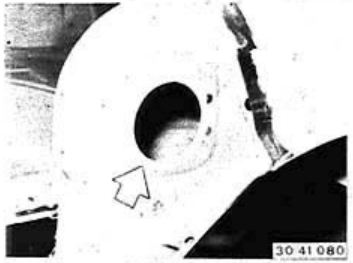
Notch in area of trunk for butt welding.



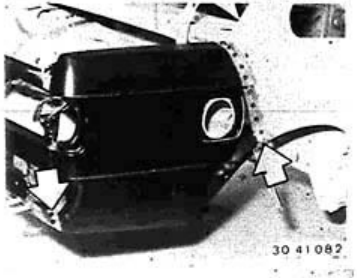
Grind mating surfaces.
Apply coat of spot welding paint on wheel house opening.



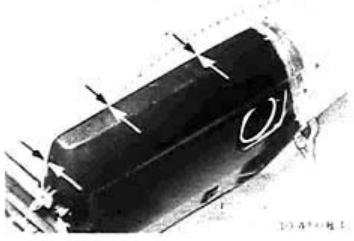
Grind mating surfaces on partial replacement section.
Apply coat of spot welding paint on wheel house opening and end plate/trunk floor plate.



Apply body sealing compound* in area of fuel tank filler neck.

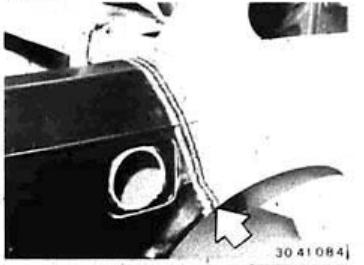


Clamp on and tack weld partial replacement section.

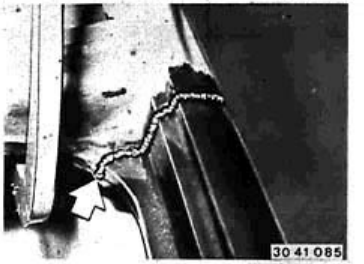


Check gap between trunk lid and side panel.

* Source: HWB



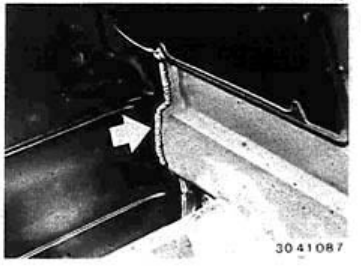
Inert gas weld mating surface joint.



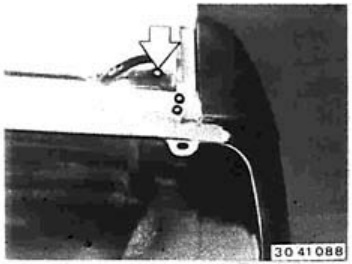
Inert gas weld mating surface joint.



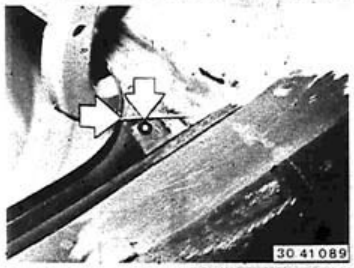
Inert gas weld side panel on tail panel.



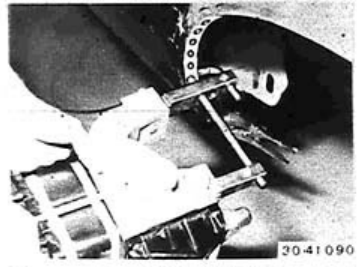
Autogen weld web of tail panel and side panel.



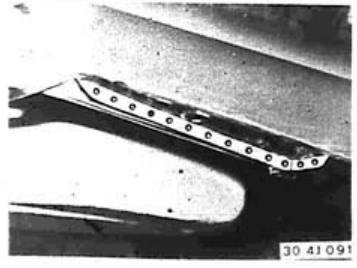
Reinforcement.
Spot weld tail panel on side panel.



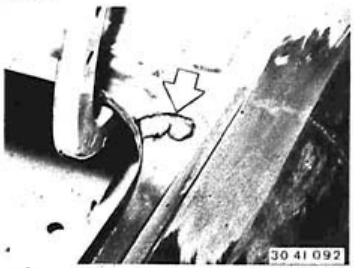
Spot weld side panel in trunk lid opening.



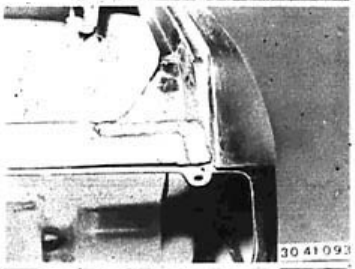
Spot weld side panel in wheel house opening.



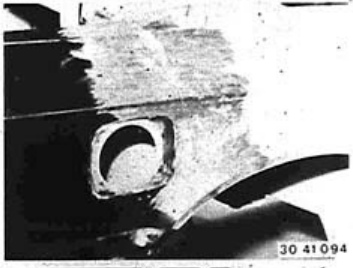
Spot weld side panel on joint of trunk floor and wheel house.



Braze mating surface joint.



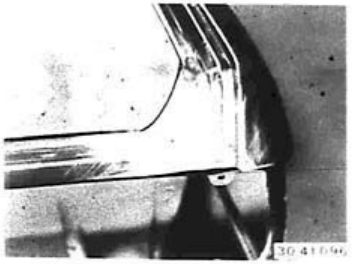
Braze side panel/tail panel reinforcement plate.



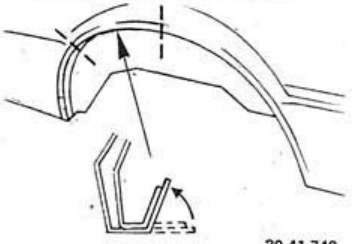
Grind down all welding seams.



Tin mating surface joints of side panel partial replacement section.

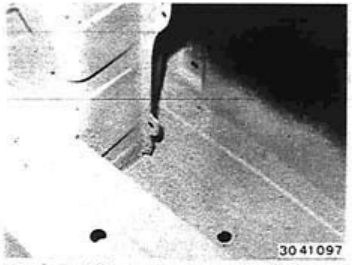


If applicable, tin upper tail panel-connecting joint.



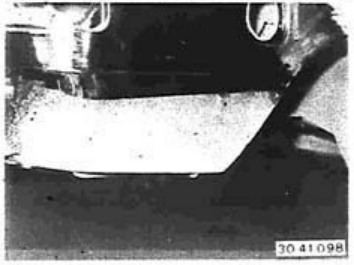
30 41 740

Important!
The spot welding flange in the rear area of the wheel housing opening must be cringed on cars beginning with 1988 models or when using wider tires.
Compare with opposite side if necessary.



30 41 097

Seal all joints with body sealing compound*.
Spray with anti-drumming compound*.



30 41 098

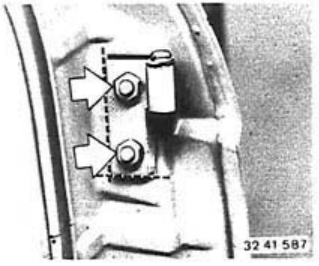
Spray an anti-drumming compound* on side panel/tail panel joint underneath the bumper.

* Sourec of Supply: HWB

41 51 ... REPLACING BEARING SLEEVES FOR DOOR HINGES

Remove front or rear doors – see 41 51 080 or 41 52 080.

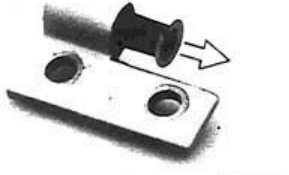
Note:
The bearing sleeve fitted with a hinge is on the door in reference to the top hinge or on the body in case of the bottom one.
The hinge must be unscrewed on the door to replace the upper bearing sleeve.


32 41 587

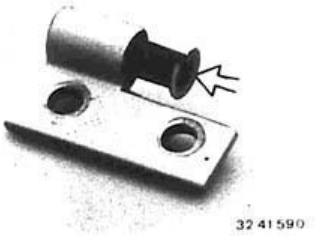
Mark position of door hinge.
Touch up damaged paint finish.


32 41 588

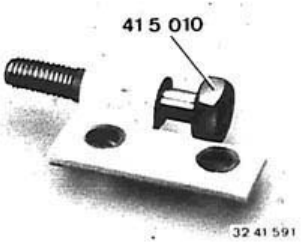
Lift off retainer and washer.
Pull out bolt.


32 41 589

Remove old bearing sleeve.

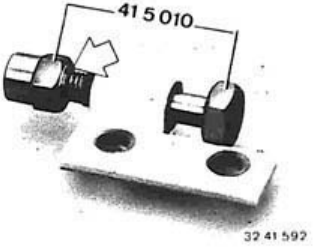

32 41 590

Insert new bearing sleeve.



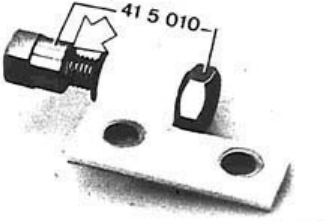
32 41 591

Push in bolt on Special Tool 41 5 010.



32 41 592

Screw nut on Special Tool 41 5 010 with conical side as shown.
Cringe the sleeve.
Unscrew nut.

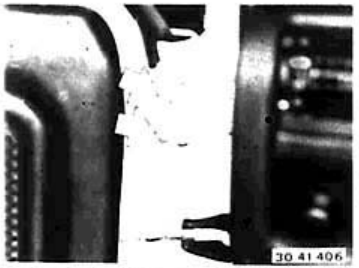


32 41 593

Screw nut on Special Tool 41 5 010 with flat side as shown.
Press the cringe flat.

Installation:
Lubricate bearing surface with grease*.

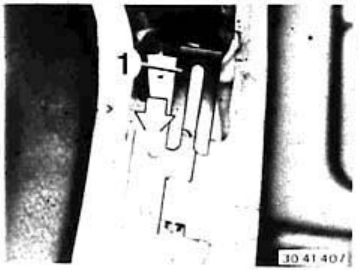
* Sourec of Supply: HWB



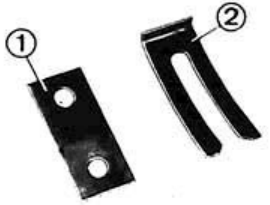
41 51 004 ADJUSTING LEFT OR RIGHT FRONT DOOR

Adjusting Front Door On Hinges:

Note:
Engine hood, trunk lid and doors are fitted and bolted in an unfinished body shell. Unpainted surfaces will be visible after making adjustments.
Paint such surfaces with pertinent body color
Loosen bolts at top and bottom.

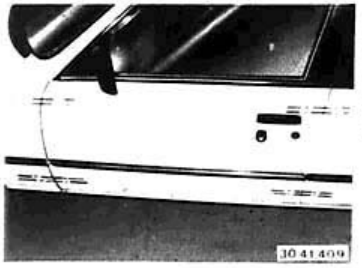


Adjust door outer panel surface to same plane of front side panel with shims (1).

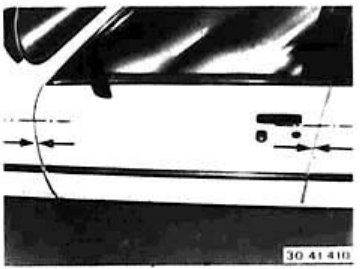


30 41 408

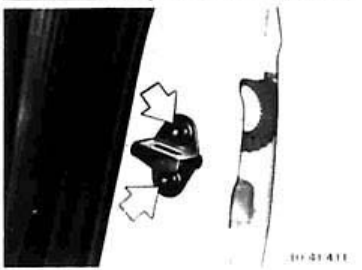
Note:
Basic adjustment should be made with 1 mm (0.039") thick shims (1).
Fine adjustments are made with shims (2) in thicknesses of optionally 0.5 mm (0.020") or 1.0 mm (0.039").



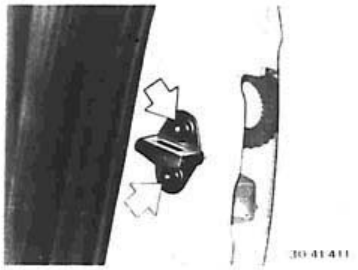
Note:
The door outer panel surface can be adjusted "deeper" than the front side panel by up to max. 1 mm (0.039"), in order to prevent wind noise and stone damage as well as to compensate optical irregularities (tolerances in the curvature).



Align door to have uniform gaps at front and rear
Align door at top with the embossed edges



Note:
Loosen striker on door lock, if necessary

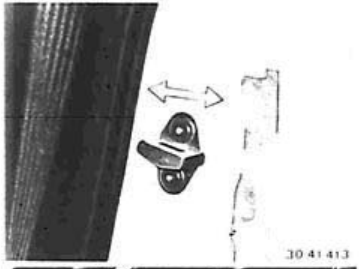


Adjusting Door Lock:

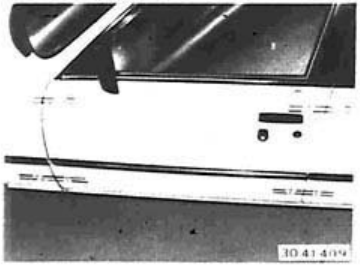
Loosen bolts (Torx).



Adjust striker vertically until guide engages in door without tension.

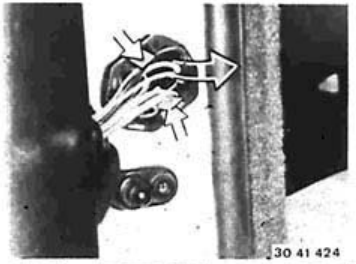


Adjust striker horizontally until outer panel surface of closed door (2nd catch) is in same plane with rear side panel or rear door.



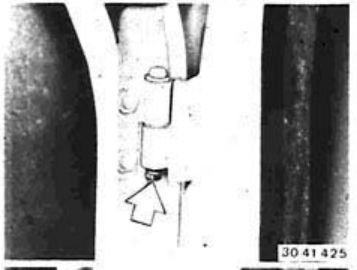
Note:

The adjacent rear side panel or rear door can be adjusted "deeper" by up to max. 1 mm (0.039"), in order to prevent wind noise and stone damage as well as for compensation of optical irregularities.

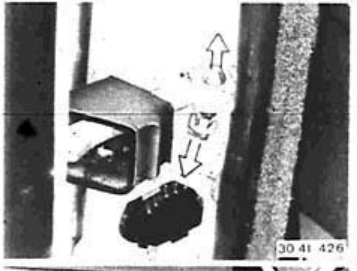


41 51 080 REMOVING AND INSTALLING LEFT OR RIGHT FRONT DOOR
– Detachable Front Door Type –

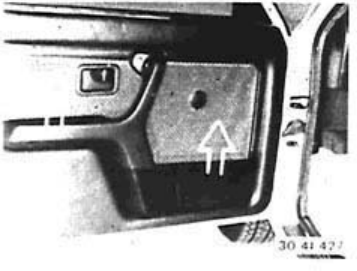
Disconnect plug on A pillar.



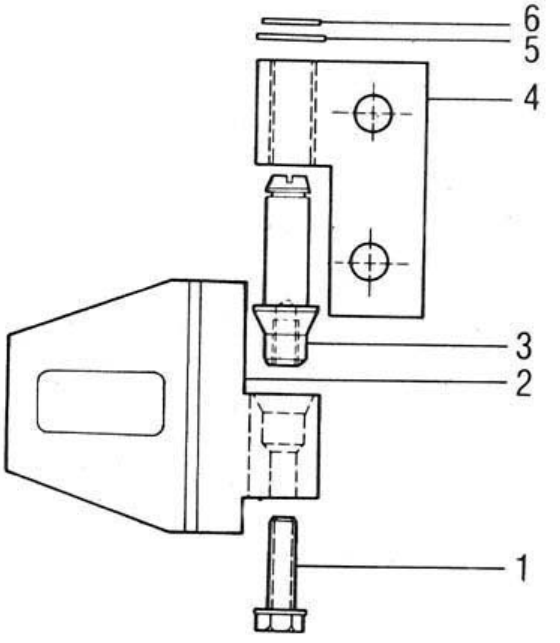
Unscrew bolts at top and bottom.



Lift off rubber cap.
Pull off retainer.
Press out pin.
Caution!
Be careful not to damage the side panel and door outside panel surface when opening the door.



Detach front door from above.



30 41 432

1 Bolt
2 Hinge (body end)*
3 Hinge pin
4 Hinge (door end) with bearing sleeve*
5 Washer
6 Lockwasher

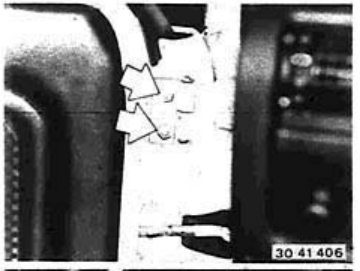
* Sketch shows the top hinge.
Mounting parts are located in inversed order on the bottom hinge.

41 51 101 REPLACING LEFT OR RIGHT FRONT DOOR

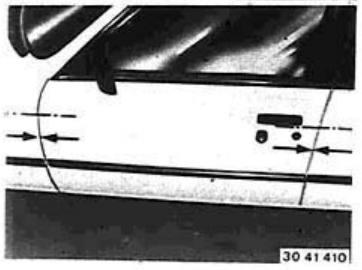
The following jobs must be performed in the given sequence.
Installation is in reverse sequence.
Seal cavities of a new door.

Remove front door trim panel – see	51 41 001
Remove door window – see	51 32 170
Remove window regulator – see	51 32 020
Remove power window, if applicable – see	51 33 000
Remove mirror – see	51 16 000
Remove complete ornamental frame on window frame – see	51 32 410
Remove door lock – see	51 21 090
Remove door lock cylinder – see	51 21 140
Remove outside handle and locking mechanism – see	51 21 300
Remove rubbing strip on front door – see	51 15 330
Remove door retarder – see	51 21 280

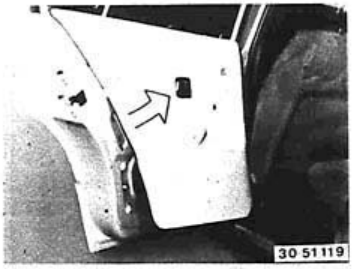
Pull wire harness out of door.
Transfer door weatherstrip from old to new door.
Transfer or replace all clamps and clips.



Unscrew hinges at top and bottom.
Lift off door.



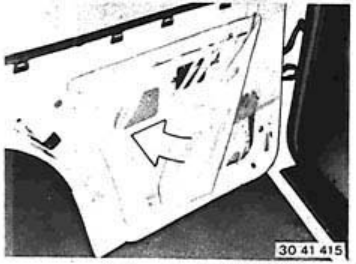
Installation:
Adjust front door, see 41 51 004



41 52 004 ADJUSTING LEFT OR RIGHT REAR DOOR

Adjusting Rear Door On Hinges:

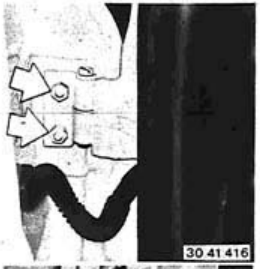
Remove door trim panel, see 51 42 001.



Pull off plastic sheet partially.

Installation:

Replace damaged plastic sheet.



Loosen bolts at top.

Note:

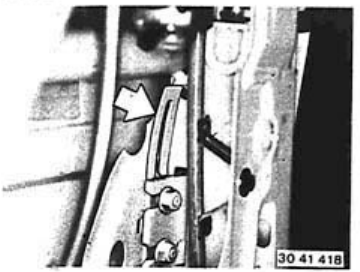
Engine hood, trunk lid and doors are fitted and bolted in an unfinished body shell.

Unpainted surfaces will be visible after making adjustments.

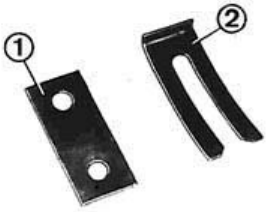
Paint these surfaces with pertinent body color paint.



Loosen bolts at bottom.



Adjust door outer panel surface to same plane of front door with shims.



30 41 408

Note:

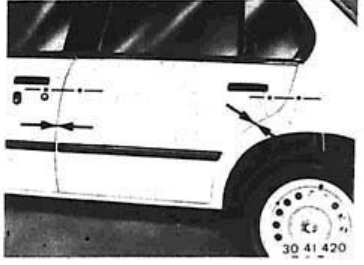
Basic adjustment should be made with 1 mm (0.039") thick shims (1).

Fine adjustment is made with shims (2) in thicknesses of optionally 0.5 mm (0.020") and 1.0 mm (0.039").



Note:

The rear door outer panel surface may be adjusted "deeper" than the front door by up to max. 1 mm (0.039"), in order to prevent wind noise and stone damage as well as for compensation of optical irregularities (tolerances in the curvature).

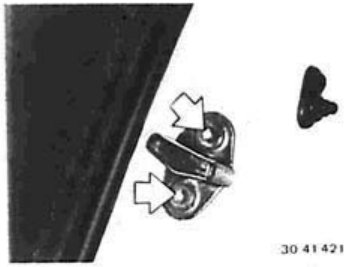


Adjust door to have uniform gaps at front and rear.

Adjust door at top with embossed edges.

Note:

Loosen striker on door lock, if necessary.



30 41 421

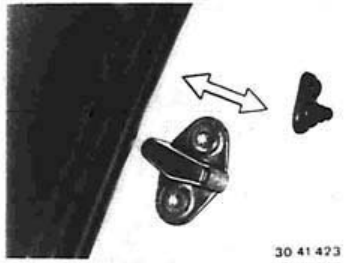
Adjusting Door Lock:

Loosen bolts (Torx).



30 41 422

Adjust striker vertically until guide engages in door without tension.



30 41 423

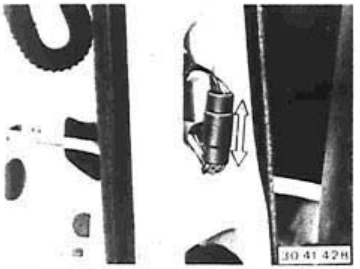
Adjust striker horizontally until outer panel surface of closed door (2nd catch) is in same plane with rear side panel.



30 41 419

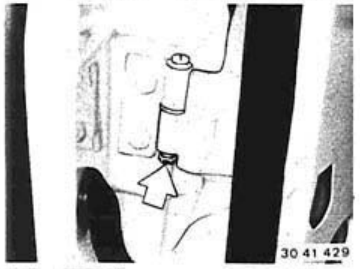
Note:

Rear side panel may be adjusted "deeper" by up to max. 1 mm (0.039"), in order to prevent wind noise and stone damage as well as for compensation of optical irregularities.

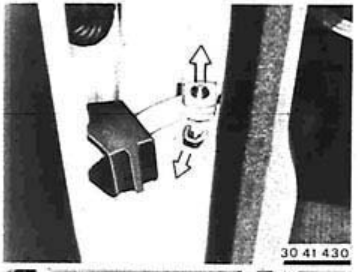


41 52 080 REMOVING AND INSTALLING LEFT OR RIGHT REAR DOOR
– Detachable Door Version –

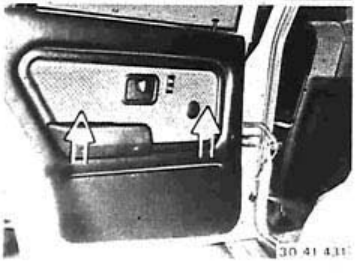
Note:
Disconnect plug in B pillar of cars with power windows or central locks.
Remove B pillar plate, see 51 43 150.
Pull door wire harness out of B pillar.



Unscrew bolts at top and bottom.



Lift off rubber cap.
Pull off retainer.
Press out pin.
Caution!
Open front door.
Be careful not to damage door outer panel surface and B pillar while opening rear door.



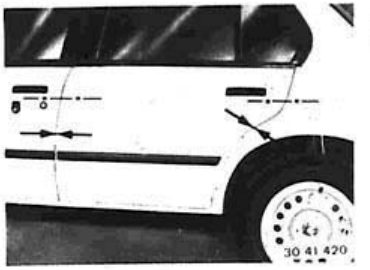
Detach rear door from above.

41 52 101 REPLACING LEFT OR RIGHT REAR DOOR

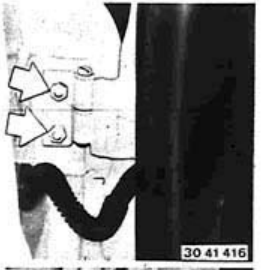
The following jobs must be performed in the given sequence.
Installation is in reverse sequence.
Seal cavities of a new door.

Remove rear door trim panel – see	51 42 001
Remove door window – see	51 34 170
Remove window regulator – see	51 34 020
Remove power window regulator – see	51 37 000
Remove window fixed in rear door window frame – see	51 34 190
Remove complete ornamental frame – see	51 34 380
Remove door lock – see	51 22 090
Remove outside handle and locking mechanism – see	51 22 220
Remove rubbing strip on rear door – see	51 15 360
Remove door retarder – see	51 22 280

If applicable, pull wire harness out of door.
Transfer door weatherstrip.
Transfer or replace all clamps and clips.



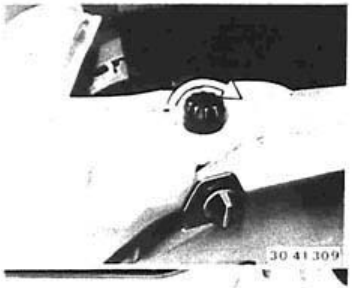
Installation:
Adjust rear door, see 41 52 004.



Unscrew hinge at top.



Unscrew hinge at bottom.
Lift off door.



41 61 014 ALIGNING ENGINE HOOD

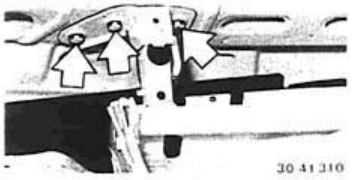
Note:
Engine hood, trunk lid and doors are fitted and bolted in an unfinished body shell.
Unpainted surfaces will be visible through subsequental adjustment.
These surfaces must be touched up with the pertinent body color paint.

Fitting Engine Hood in Body Opening:

Screw in left and right stop pads completely.

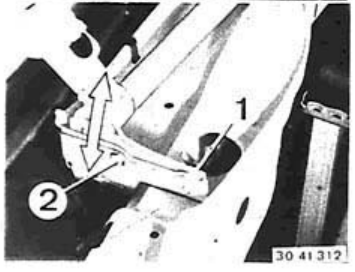
Installation:
Affer finishing adjustments loosen stop pads enough that engine hood has light tension and is in same plane with side panels.

Loosen left and right screws.



Align engine hood to the side panels at front and sides.





Front Engine Hood Height Adjustment:

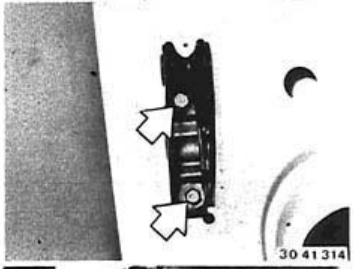
Loosen screws (1 and 2) on left and right sides.
Adjust console at screw (2) down or up.

Adjust engine hood in height that engine hood is approx. 1 mm (0.039") deeper than the side panels.

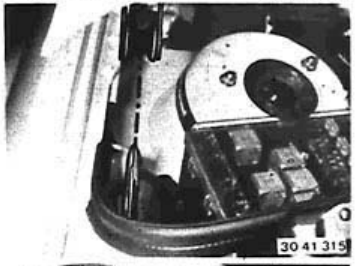


Adjusting Rear Guide Roller:

Loosen screws.

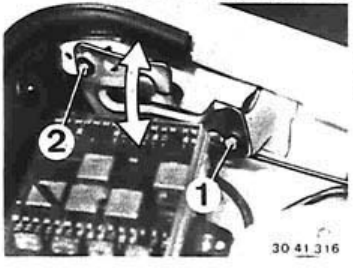


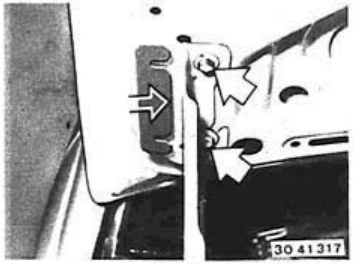
Adjust holder laterally until guide roller slides into catch correctly.
Check gap between left and right side panels and engine hood.

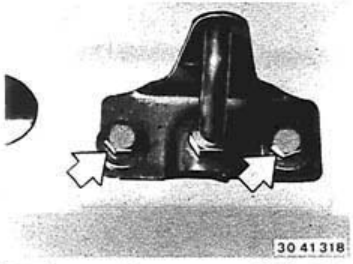


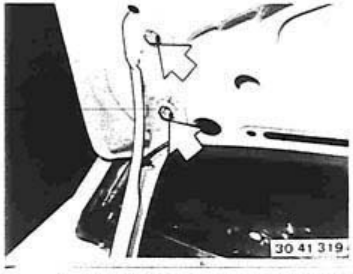
Rear Engine Hood Height Adjustment:

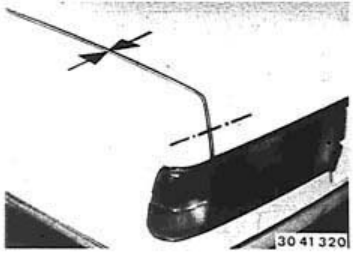
Loosen screws (1 and 2).
Adjust catch at screw (2) that closed engine hood is in same plane with side panels.











41 62 014 ALIGNING TRUNK LID

Note:
Engine hood, trunk lid and doors are fitted and bolted in an unfinished body shell. Subsequential adjustments could uncover unpainted surfaces. These surfaces must be painted with paint of same color as the body paint.

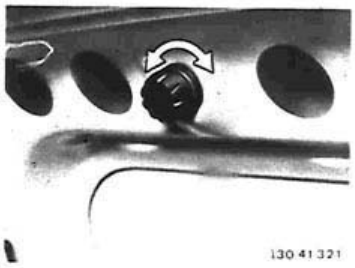
Trunk Lid Height at Front End:
Loosen bolts and install spacers as required.

Aligning Trunk Lid in Body Opening:
Loosen locking bar, unscrewing if necessary.

Installation:
Align locking bar according to the lock base.

Loosen bolts.

Align trunk lid.





Trunk Lid Height at Rear End:
Screw in left and right stop pads completely.

Installation:
Unscrew stop pads after finishing adjustments until the trunk lid rests on them with light tension and is in same plane with the side panels.

Adjust length of locking bar by turning the nut, until the surface of a closed trunk lid at rear is approx. 1 mm (0.039") deeper than the side panels.

Important Special Features of 1991 Model E 30 Convertible Body in Comparison with Sedan Body

- Two-piece engine carrier
- Front panel same as 1988 model sedan
- Side members stronger at front side
- Side member shoulder designed as second member
- Rear wheel housings modified on inside and outside
- Center pillars modified
- Carrier for dashboard same as sedan with airbag (SRS)
- Support for steering column with supporting pipe
- Left/right front cowl panels with inserted, two-piece reinforcement pipes extending into A-pillars
- Rear side panels as 1988 model sedan
- Tail panel as 1988 model sedan
- Front doors reinforced as US version and with fixed triangle windows

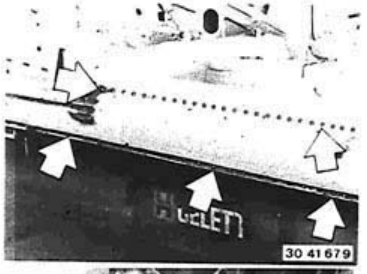
Note:
Left or right front cowl panel can only be replaced complete with reinforcement pipe and corresponding work on A-pillar.

When working on body special attention must be given to features of convertible bodies and repair procedures adapted to changed conditions accordingly.

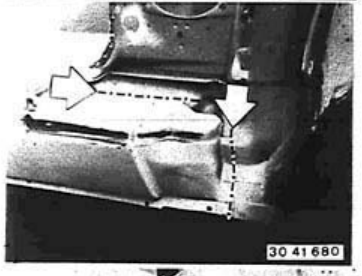
41 11 520 REPLACING COVER FOR LEFT OR RIGHT SIDE MEMBER
(Rear Side Panel and Door Pillar Removed)
– Convertible –

Refer to information on page 41 - 001.
Remove or cover up all car parts, which are located in the repair area or subjected to heat, sparks and dust.
Remove front side panel.
Remove rear side panel, see 41 35 111.
Remove door pillar with reinforcement, see 41 21 501.

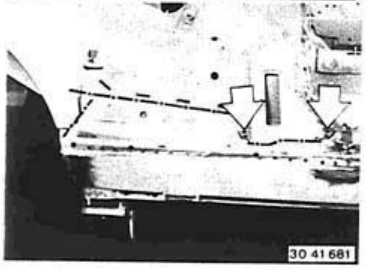
Drill out spot welds.



Grind off welding bead.

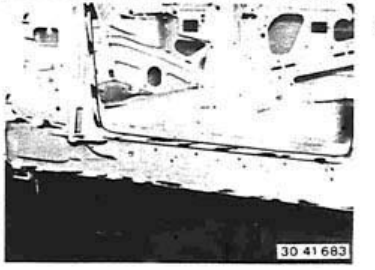


Drill out spot welds.
Grind off welding beads.

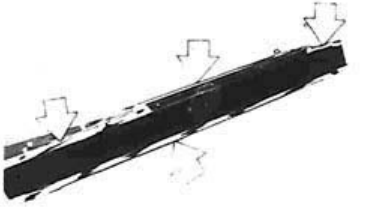




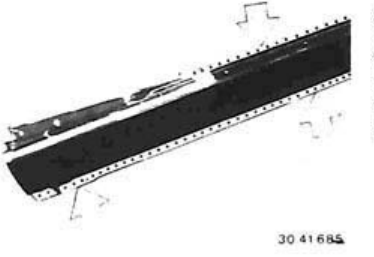
Grind off edge.
Lift off cover
Important!
Don't damage the end plate.



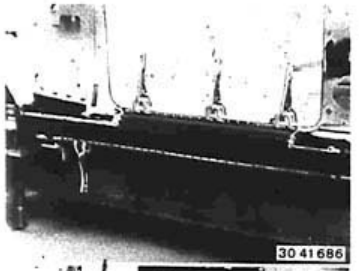
Straighten and grind all mating surfaces.



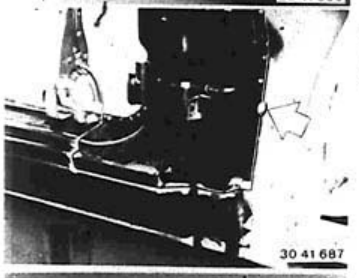
Grind mating surfaces on new cover.



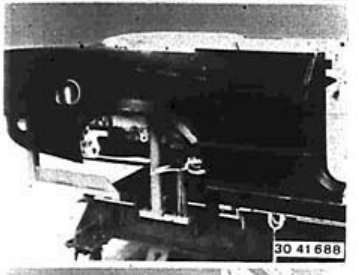
Sheet metal panels are too thick for perfect resistance spot welding with workshop equipment.
Drill holes in all mating surfaces required for plug spot welding.
Take spacing between holes from removed part.



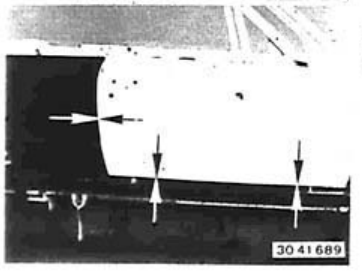
Clamp down and tack weld cover.



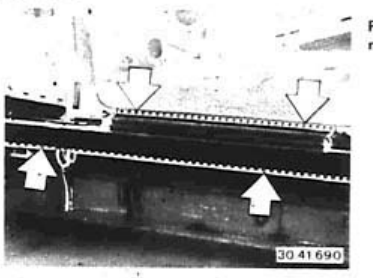
Set up and tack weld new door pillar lightly.
Note:
Door pillar must be removed again after fitting in.



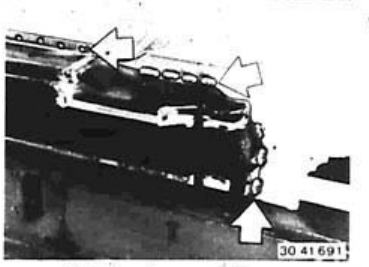
Set up and clamp down rear side panel.



Install door.
Check gap to entrance and rear side panel.
Lift off door, door pillar and rear side panel.



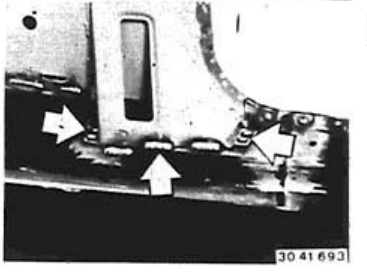
Plug spot weld cover on entrance and underneath.



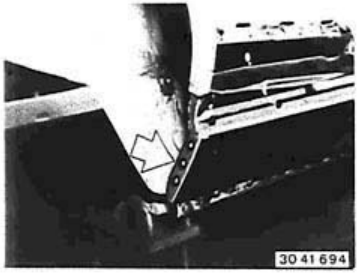
Weld cover on A pillar.



Inert gas weld connection on wheel house and end plate.



Plug spot weld support through the provided holes and lock with inert gas welding seams.

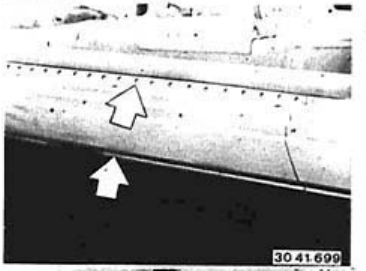


Plug spot weld connection on wheel house at rear.

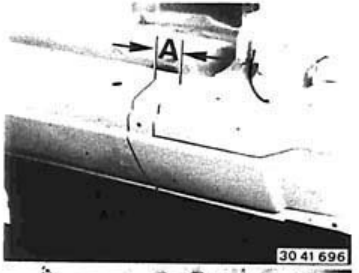
After Installation of Door Pillar With Reinforcement and Rear Side Panel:
Seal off connections with body sealing compound.
Spray on anti-drumming compound on the wheel house, trunk floor plate and entrance from underneath.

41 11 530 **REPLACING COVER FOR SIDE MEMBER LEFT OR RIGHT (Partial Replacement From Door Pillar / Rear Side Panel Removed) – Convertible –**

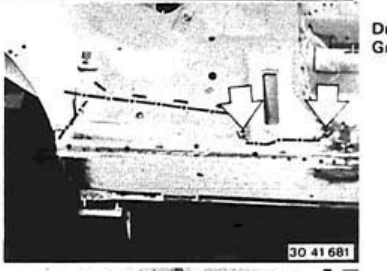
Refer to information on page 41 - 001.
Remove or cover up all car parts, which are located in the repair area or subjected to heat, sparks and dust.
Remove rear side panel – see 41 35 111.



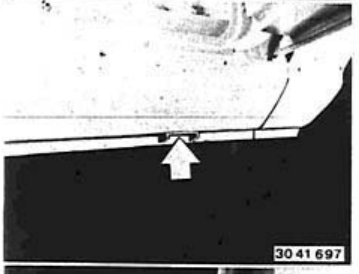
Drill out spot welds.



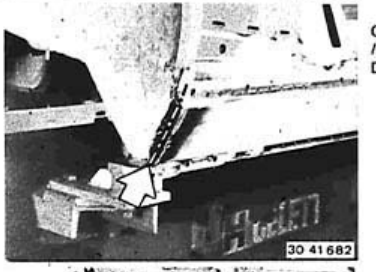
Mark cutting line.
Cutting line (A) must be at least 40 mm (1.575") away from door pillar connection.



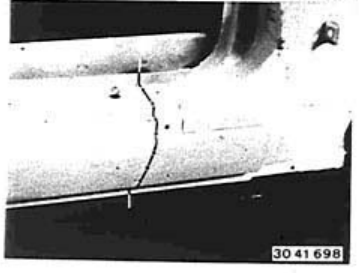
Drill out spot welds.
Grind off welding beads.



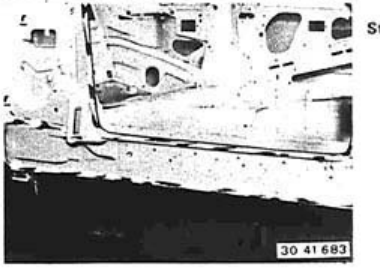
Note:
Make the cutting line in such a manner whenever possible, that the jack holder will not be cut.



Grind off edge and lift off cover.
Important!
Don't damage the end plate.



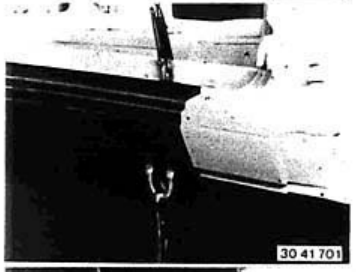
Cut off cover along marked cutting line.



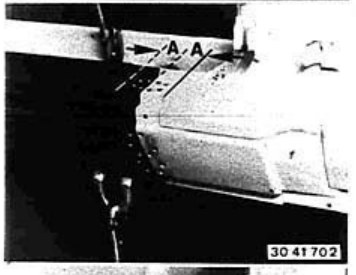
Straighten and grind all mating surfaces.



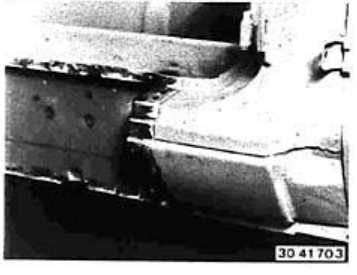
Make cutting line on new cover and cut off.



Fit in cover, cutting to size if necessary.



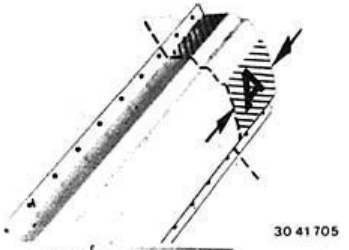
Mark location of and drill plug spot welding holes required for reinforcement strips.
Distance A = 30 mm (1.181").
Four holes each at top.
Six holes each at bottom.



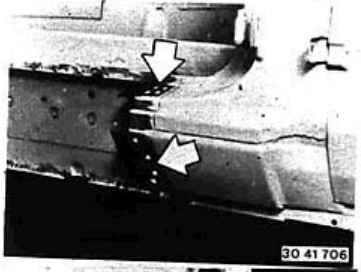
Lift off section panel.
Grind mating surfaces.
Deburr holes.



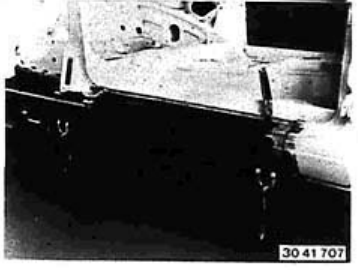
The sheet metal panels are too thick for perfect resistance spot welding with workshop equipment.
Drill holes for plug spot welding in all mating surfaces required for spot welding.
Take spacing between holes from removed part.
Grind mating surfaces.
Deburr holes.



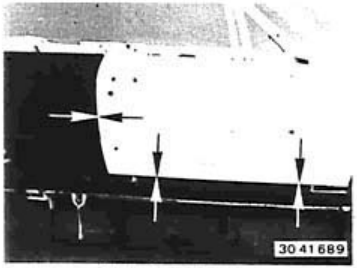
Prepare strips from the cut off cover for reinforcements.
A = 60 mm (2.362")



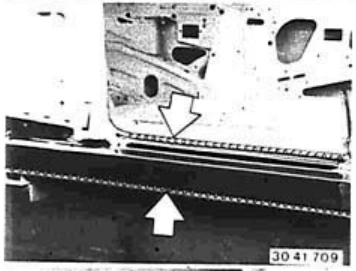
Slide in reinforcement strips half way, align and plug spot weld.



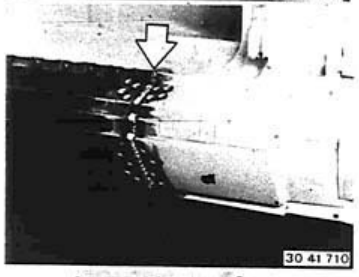
Clamp down and tack weld cover.



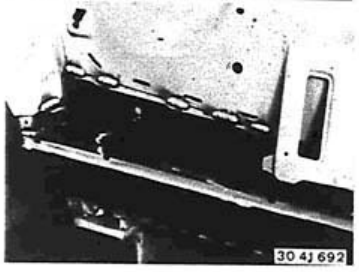
Fit in the rear side panel.
Install door.
Check gaps.



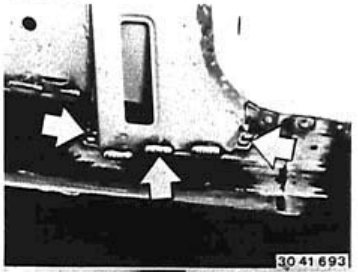
Remove door and rear side panel.
Plug spot weld cover on entrance and from underneath.



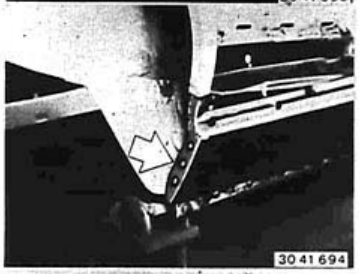
Plug spot weld panel section connection.
Weld mating surface point.



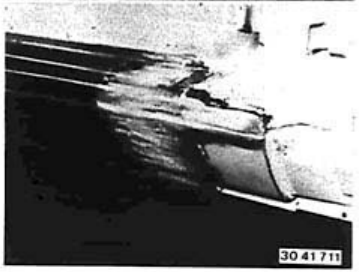
Inert gas weld connection on wheel house and end plate.



Plug spot weld the support through the provided holes and lock with inert gas welded seams.



Plug spot weld connection on wheel house at rear.

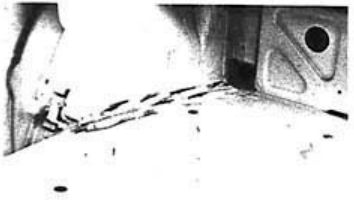


Grind panel section connection, tinning if necessary.

After Installation of Rear Side Panel:
Seal off connections with a body sealing compound.
Spray an anti-drumming compound on the wheel house, trunk floor plate and entrance from underneath.

41 12 570 REPLACING TRUNK FLOOR PLATE (Partial Replacement In Front of Cross Member) (Tail Panel Removed) – Convertible –

Refer to information on page 41 - 001.
Remove or cover up all car parts, which are located in the repair area or subjected to heat, sparks and dust.



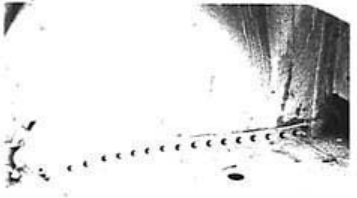
30 41 607

Make left and right connections accessible.



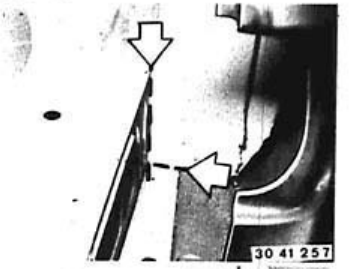
30 41 608

Mark cutting lines at height of transition on left and right sides.



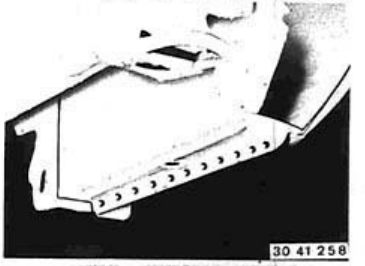
30 41 609

Drill out spot welds on left and right sides.



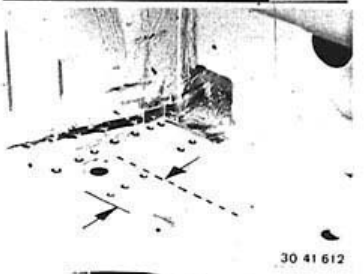
30 41 257

Cut off trunk floor plate from wheel house on left and right sides.



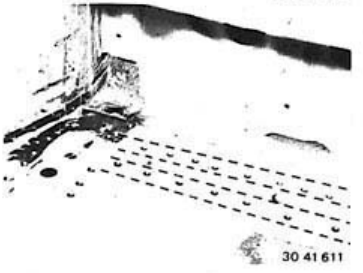
30 41 258

Make left and right spot welding accessible and drill out spot welds.



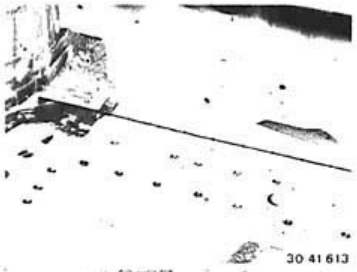
30 41 612

Drill out spot welds on side members forward up to cutting line and approx. 80 mm (3.150") toward rear.

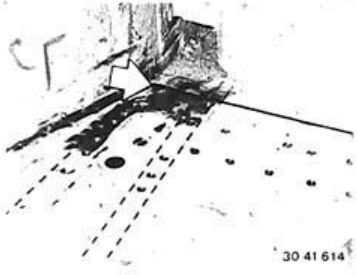


30 41 611

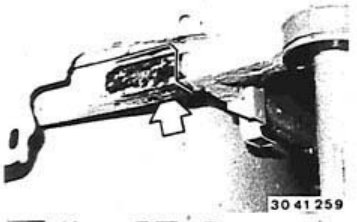
Make connections accessible.
Drill out spot welds.



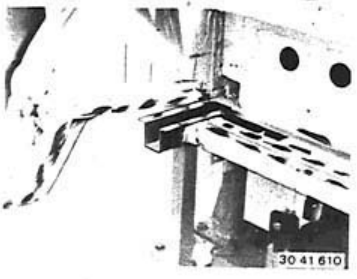
Cut off trunk floor plate along marked line.



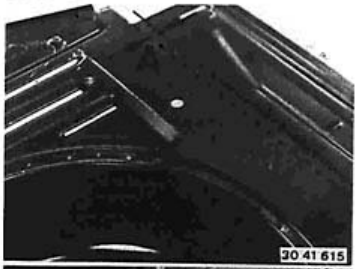
Important!
Don't damge the side members.



Uncover connections of left and right side members.
Drill out spot welds.
Lift off trunk floor plate complete with side members.



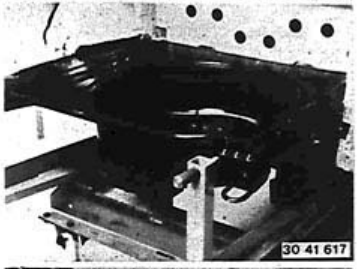
Remove scrap metal.
Straighten and grind mating surfaces.



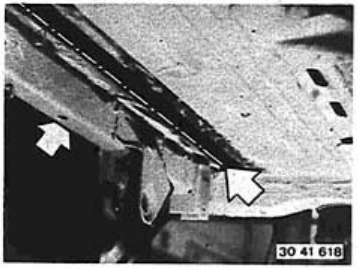
Prepare new trunk floor plate for partial replacement.
Mark line on transition.
Mark overlapping distance A = 20 mm (0.787") toward front.



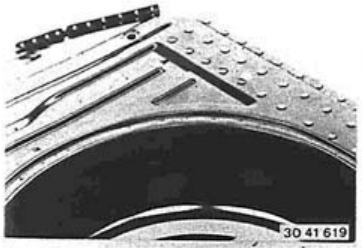
Cut off sheet metal.
Shoulder overlap upwards with a shouldering pliers.



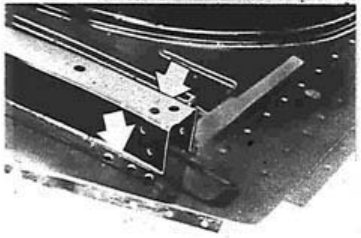
Set up car on straightening bench.
Fit in trunk floor plate.



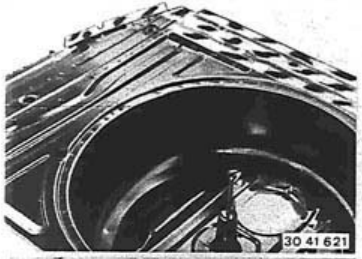
Mark location of cross member on the trunk floor plate.



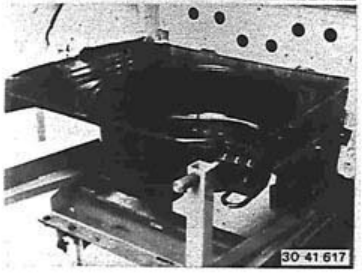
Lift off trunk floor plate.
Drill plug spot welding holes in mating surfaces which are not accessible for spot welding (cross member, partial replacement panel, wheel house).
Spacing between holes = 40 mm (1.575").



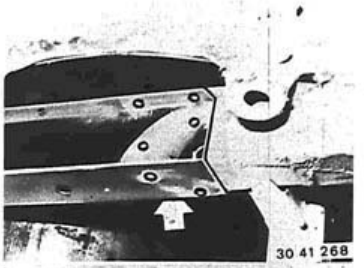
Drill plug spot welding holes in mating surfaces for side members.
Note:
Drill the holes in the flanges of side members through the trunk floor plate.



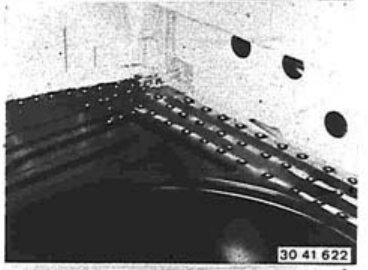
Grind all mating surfaces.
Coat mating surfaces required for spot welding with zinc dust paint.



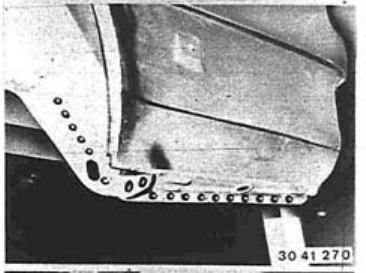
Insert trunk floor plate and align on straightening bench.



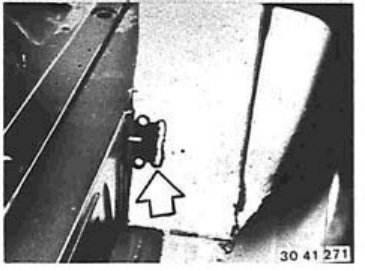
Plug spot weld both side members.



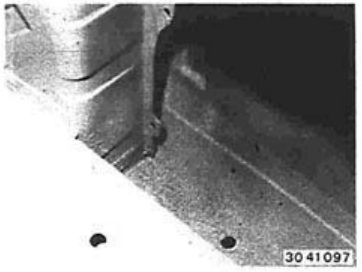
Plug spot weld front end of trunk floor plate on cross member, side members and wheel houses.



Spot weld connector on wheel house and side panel at left and right sides.



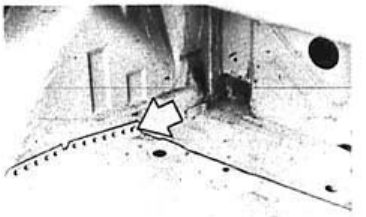
Weld on reinforcement brackets if necessary.



Install tail panel.
Seal off all mating surfaces from top and bottom with a body sealing compound.
Spray an anti-drumming compound on bottom of car, wheel houses and tail panel from underneath.

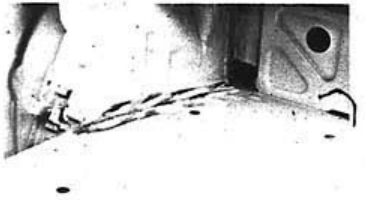
41 12 585 **REPLACING TRUNK FLOOR PLATE (Partial Replacement Behind Cross Member) (Tail Panel Removed) – Convertible –**

Refer to information on page 41 - 001.
Remove or cover up all car parts, which are located in the repair area or subjected to heat, sparks and dust.



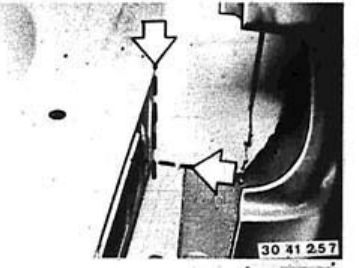
30 41 625

Drill out spot welds on left and right sides.



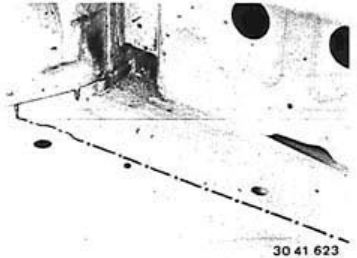
30 41 607

Uncover connections on left and right sides.



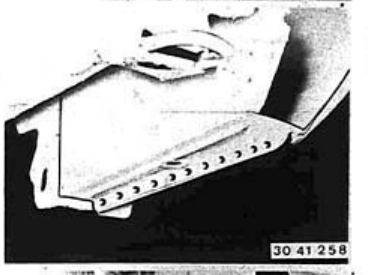
30 41 257

Cut off trunk floor plate at wheel house on left and right sides.



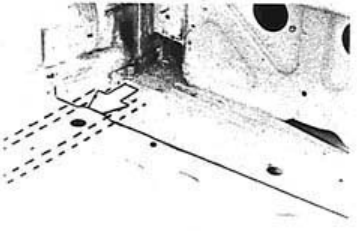
30 41 623

Mark cutting line behind flange of the cross member.
(Cutting line is approximately along edge of bead.)



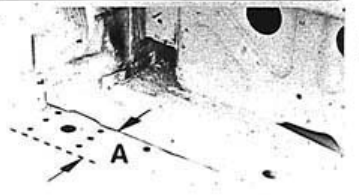
30 41 258

Uncover and drill out spot welds on left and right sides.



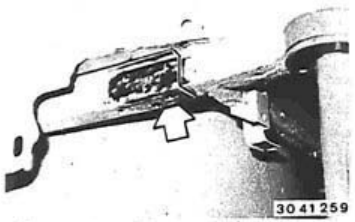
30 41 624

Cut off trunk floor plate along line.
Important!
Don't damage the side members.

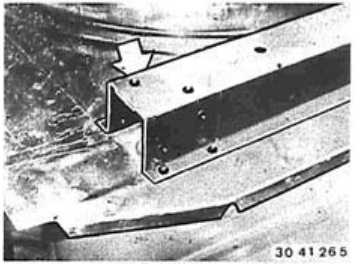


30 41 626

Drill out spot welds along side members approx. 80 mm (3.150") toward rear.

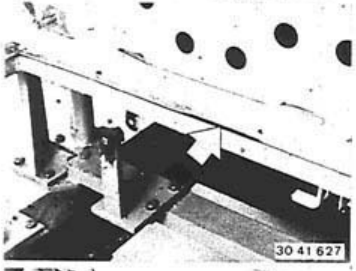


Uncover connections of left and right side members.
Drill out spot welds.
Lift off trunk floor plate complete with side members.



Drill plug spot welding holes in mating surfaces for side members.

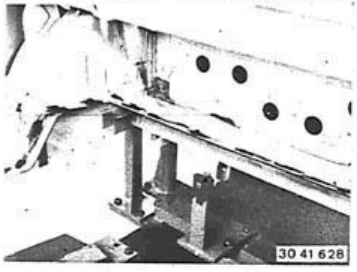
Note:
Also drill holes in flanges of side members through the trunk floor plate.
Drill off welding spots when applicable.



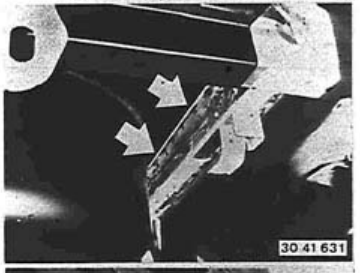
Grind off cut flush with flange of the cross member.
Check opening in area of the spare wheel well.



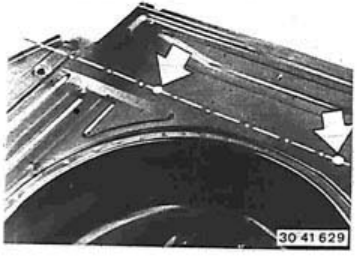
Set up car on a straightening bench.
Insert trunk floor plate.



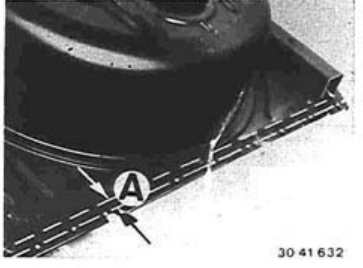
Remove scrap metal.
Straighten and grind mating surface.
Coat mating surfaces required for spot welding with zinc dust paint.



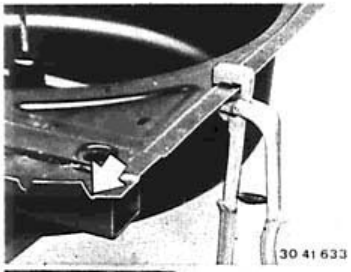
Mark location of cross member connections on new part from underneath.
Lift off trunk floor plate.



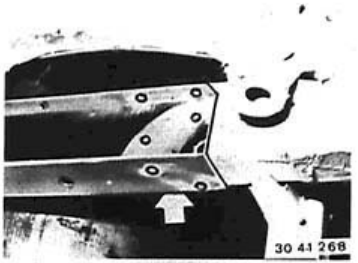
Cut off new trunk floor plate in area of holes.



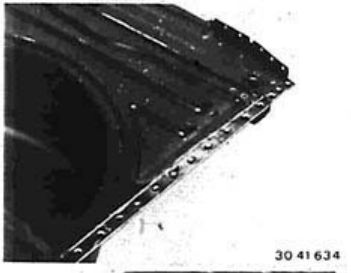
Mark distance A = 20 mm (0.787") forward from the marked line for overlapping.
Cut off excessive metal.



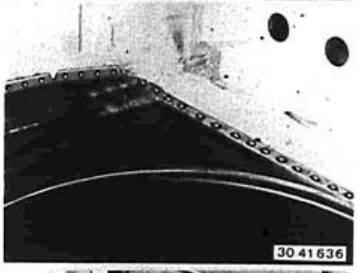
Shoulder overlap upwards.
Notch wheel house spot welding flange on left and right sides.



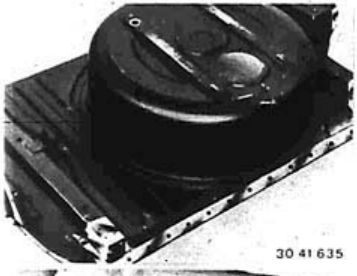
Plug spot weld both side members.



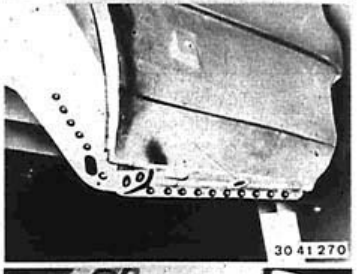
Drill plug spot welding holes in mating surfaces which are not accessible for spot welding.
Spacing between holes = 40 mm (1.575").



Plug spot weld trunk floor plate on the cross member, side members and wheel houses.



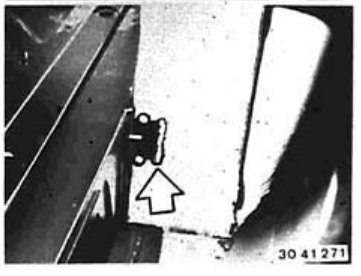
Grind all mating surfaces.
Coating mating surfaces required for spot welding with zinc dust paint.



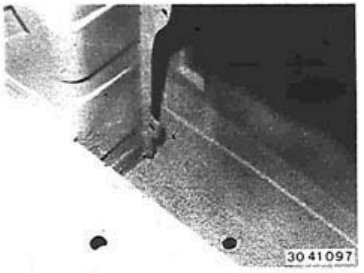
Spot weld connector on wheel house and side panel at left and right sides.



-Insert trunk floor plate and align on straightening bench.



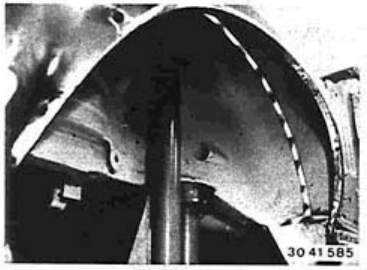
Weld on reinforcement brackets, if necessary.



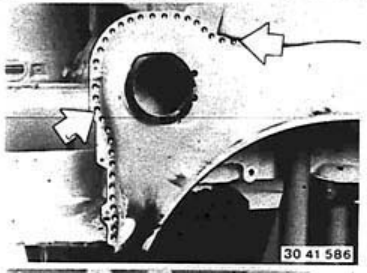
Install tail panel.
Seal off mating surfaces from top and bottom with a body sealing compound. Spray an anti-drumming compound on underside of car, wheel housings and tail panel from underneath.

41 14 161 REPLACING RIGHT WHEEL HOUSE OUTER SECTION AND REAR SIDE PANEL
– Convertible –

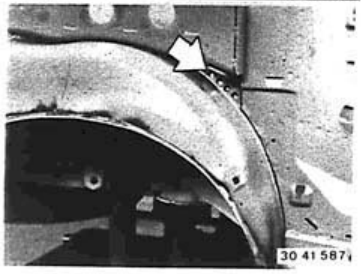
Refer to information on page 41 - 001.
Remove right rear side panel – see 41 35 110.



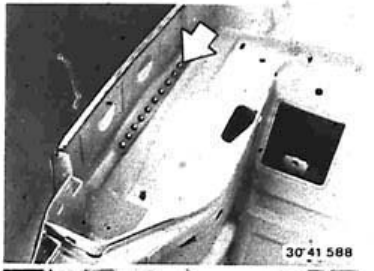
Remove anti-drumming coat on cutting surfaces.



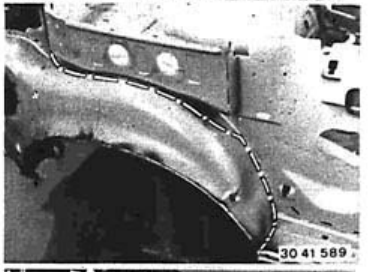
Drill out spot welds.



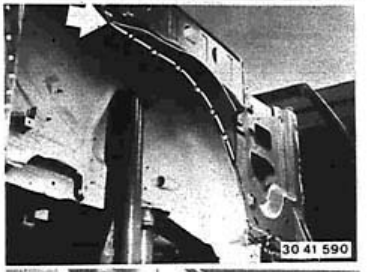
Drill out spot welds.



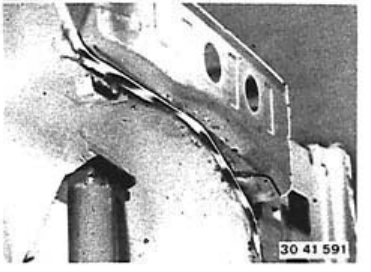
Drill out spot welds.



Cut off wheel house outer section along line.
Lift off wheel house outer section.



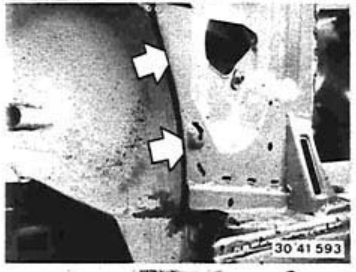
Grind off scrap metal in area of top box on edge.
Important!
Don't damage the inner wheel house panel.



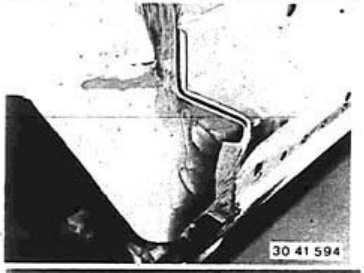
Remove scrap metal.
Straighten mating surface.



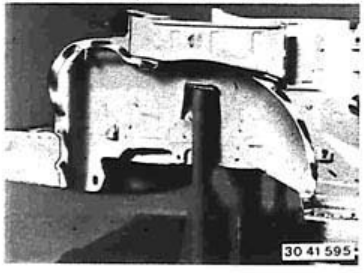
Grind off welding beads.



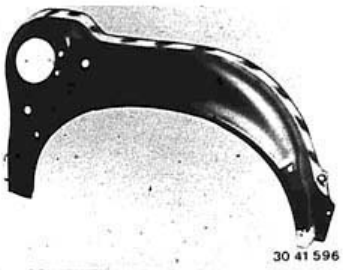
Lift end plate slightly.
Remove scrap metal.



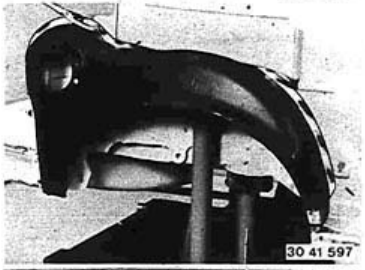
Remove scrap metal.



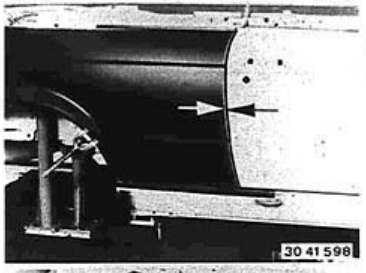
Straighten and grind all mating surfaces.
Coat mating surfaces required for spot welding with zinc dust paint.



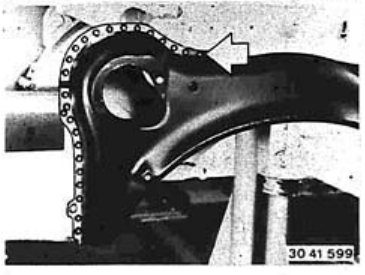
Grind mating surfaces on new wheel house outer section.
Coat mating surfaces required for spot welding with zinc dust paint.



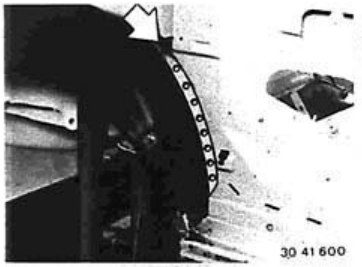
Insert and clamp down new wheel house outer section, tack welding if necessary.



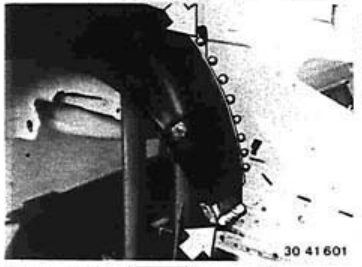
Mount side panel.
Check door gap and transition to the tail panel, correcting with wheel house if necessary.



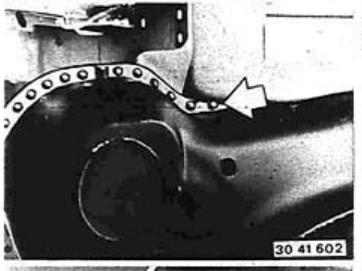
Spot weld wheel house.
Prepare areas for plug spot welding, when they are not accessible for spot welding tongs.



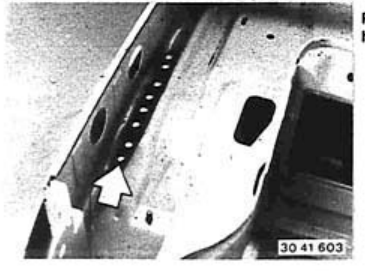
Drill plug spot welding holes through the reinforcement and wheel house outer section in area of the front reinforcement.



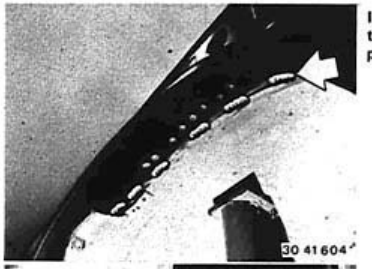
Plug spot weld reinforcement and wheel house outer section on the wheel house inner section.
Tack weld wheel house on the entrance cover strip.



Plug spot weld areas which are accessible for plug spot welding.



Plug spot weld the top box through provided holes.



Inert gas weld wheel house outer section with the inner section in area of the top box by producing beads.

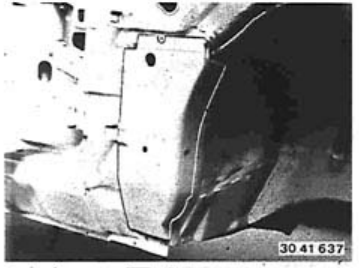


Weld bottom of wheel house on the end plate.

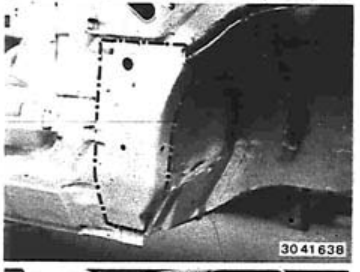
After Installation of Side Panel:
Seal off joints with a body sealing compound.
Spray an anti-drumming compound on the wheel house.

41 21 501 REPLACING LEFT OR RIGHT FRONT DOOR PILLAR
(Front Side Panel Removed)
– Convertible –

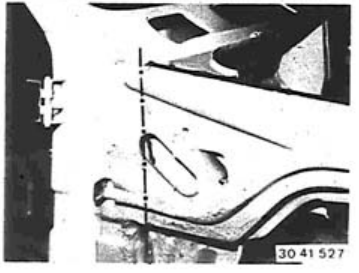
Refer to information on page 41 - 001.
Remove or cover up all car parts, which are located in the repair area or subjected to heat, sparks and dust.



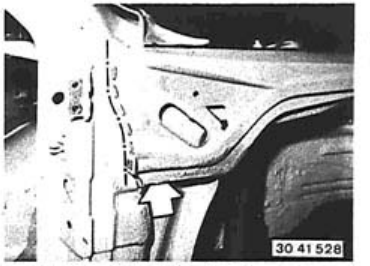
Uncover connections.



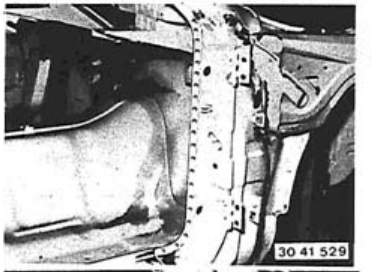
Grind off welding beads.
Lift off reinforcement.



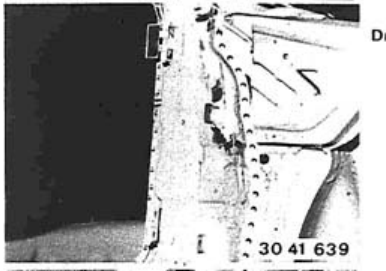
Cut through end plate along line.



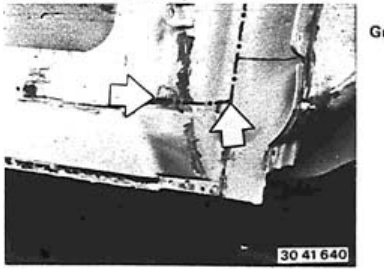
Grind off welding seams.
Drill out spot welds from underneath.
Take off end plate.



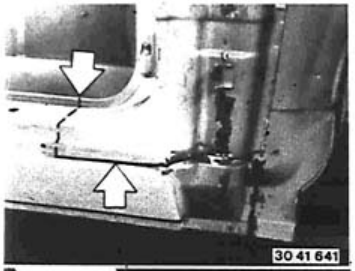
Uncover connections.
Drill off spot welding seam.



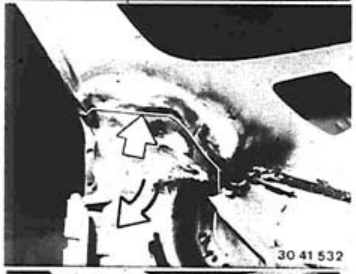
Drill out spot welds.



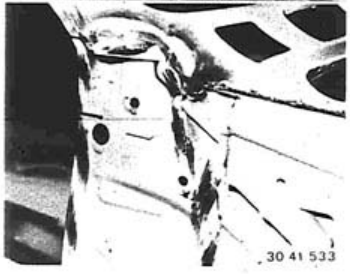
Grind off welding beads.



Remove brazing solder.
Loosen pillar.



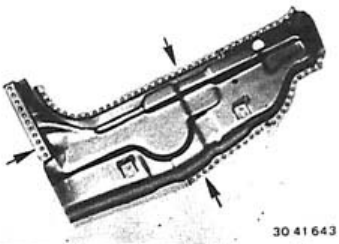
Remove brazing solder.
Lift off the door pillar.



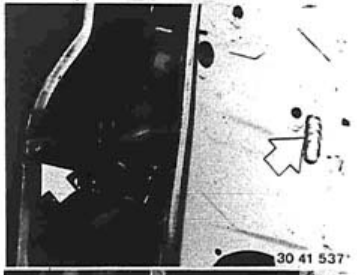
Remove scrap metal.
Straighten and grind mating surfaces.



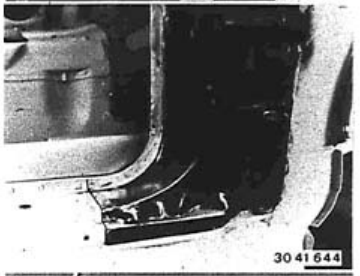
Grind mating surfaces on new door pillar.



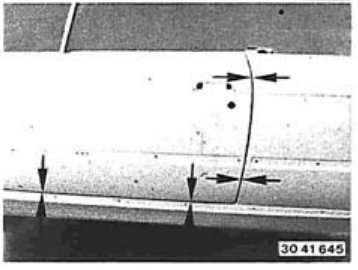
The sheet metal panels are too thick for perfect resistance spot welding with workshop equipment.
Drill plug spot welding holes in all mating surfaces required for plug spot welding.
Take spacing between holes from removed part.



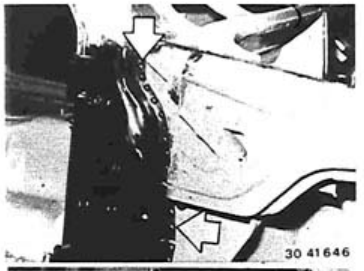
Use sealing tape* on bearing surface of the reinforcement.



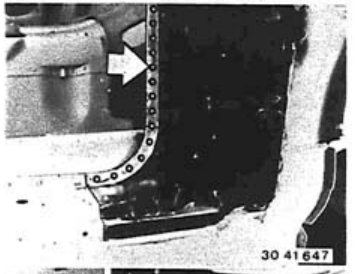
Mount and tack weld new door pillar.



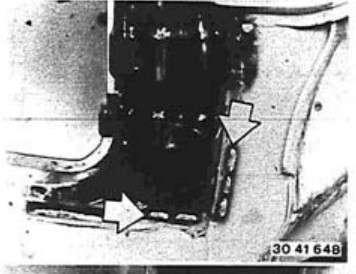
Install door.
Check gaps of entrance and rear side panel.
Remove door.



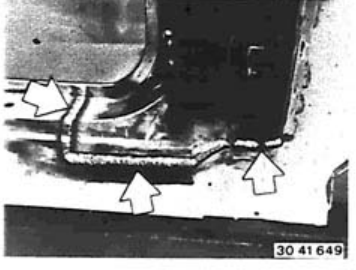
Plug spot weld the door pillar.



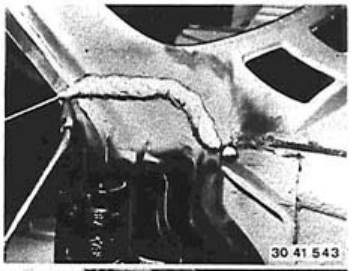
Plug spot weld the door pillar.



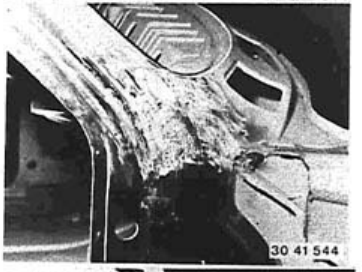
Inert gas weld bottom of door pillar.



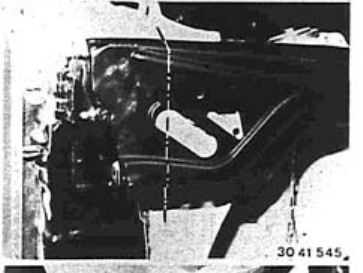
Braze the side member cover joint.



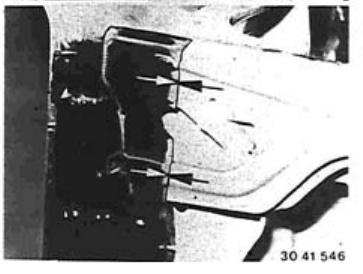
Braze the cowl panel joint.



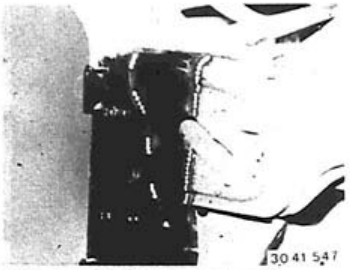
Grind mating surface.



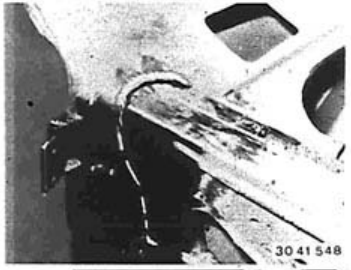
Install new end plate.
Mark cutting lines for partial replacement section.



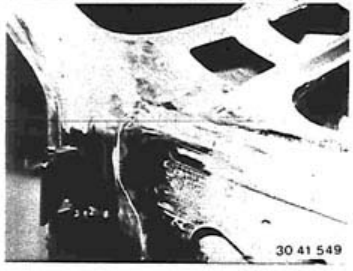
Grind mating surfaces on partial replacement section and fit in section.



Inert gas weld the partial replacement section.



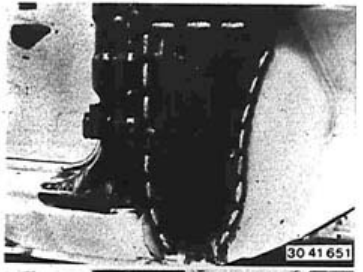
Braze in area of the cowl panel.



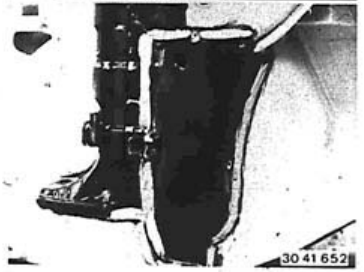
Grind down joints, tinning if necessary.



Grind mating surfaces on new reinforcement for door pillar.



Mount and weld the reinforcement.

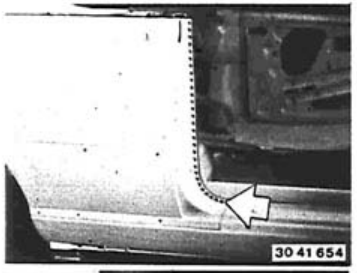


Seal off all mating surfaces with a joint sealing compound.

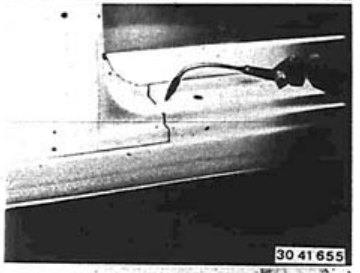
Replace anti-drumming compound on entrance and in wheel house.

41 35 110 REPLACING RIGHT REAR SIDE PANEL
– Convertible –

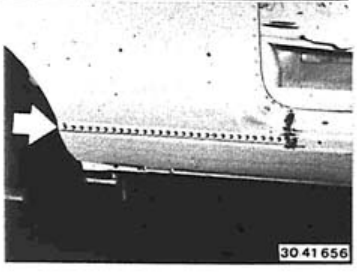
Refer to information on page 41 - 001.
Remove or cover up all car parts, which are located in the repair area or subjected to heat, sparks and dust.



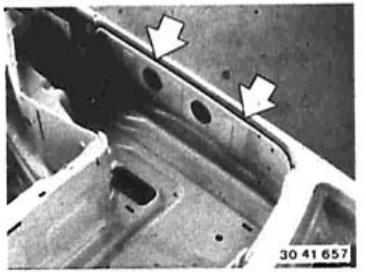
Uncover and drill out spot welds.



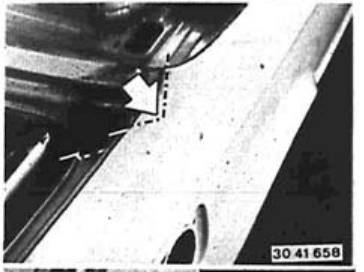
Remove brazing solder.
Uncover spot welding.



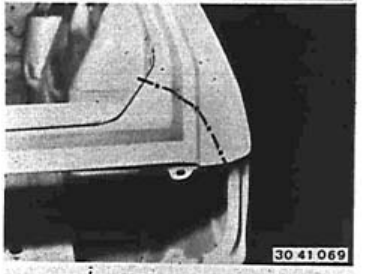
Uncover and drill out spot welds.



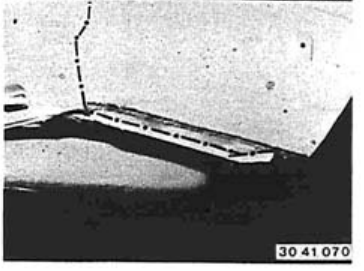
Uncover and drill out spot welds.



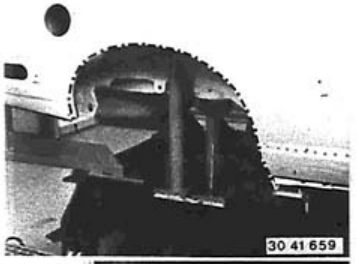
Uncover joint – cut off side panel along line.



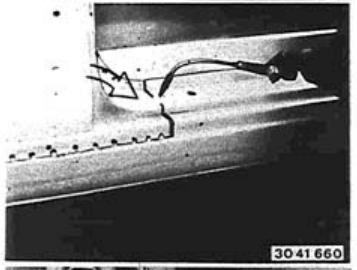
Cut off side panel from tail panel along line.



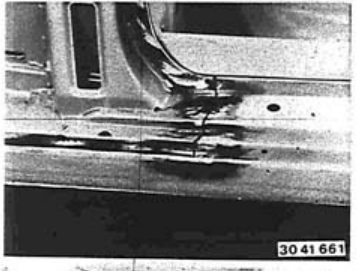
Cut off side panel from tail panel and trunk side section.



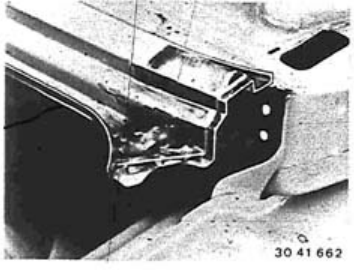
Grind off edge on wheel house.



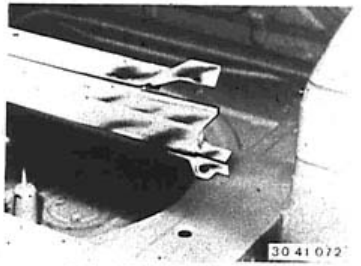
Heat brazing solder.
Lift off side panel.



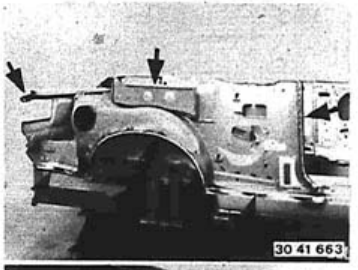
Remove scrap metal.
Straighten mating surfaces.



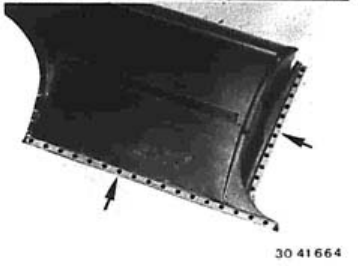
Remove scrap metal.
Straighten mating surfaces.



Remove scrap metal.
Straighten mating surfaces.



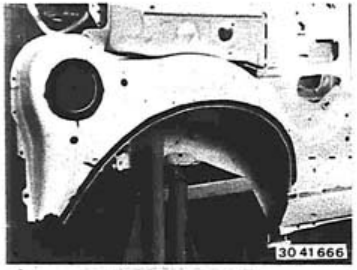
Remove scrap metal.
Straighten mating surfaces.
Coat mating surfaces required for spot welding with zinc dust paint.



The sheet metal panels are too thick for perfect resistance spot welding with workshop equipment.
Drill plug spot welding holes in mating surfaces of the "B pillar" and side member cover.
Take spacing between holes from the removed part.



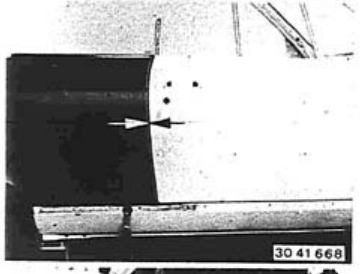
Grind all mating surfaces.
Coat mating surfaces required for spot welding with zinc dust paint.



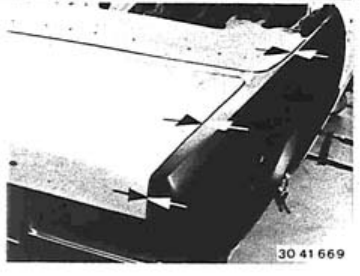
Apply a coat of body sealing compound on the wheel opening surface and fuel tank filler neck.



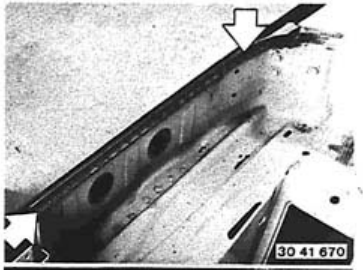
Mount and clamp down side panel, tack welding if necessary.



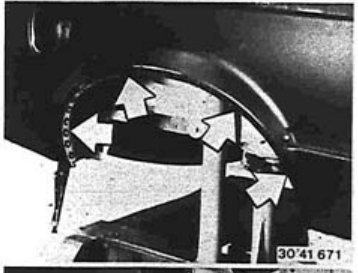
Check door gaps.



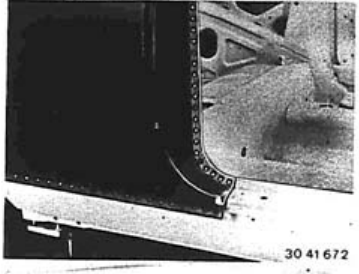
Install trunk lid and top lid. Check gaps.



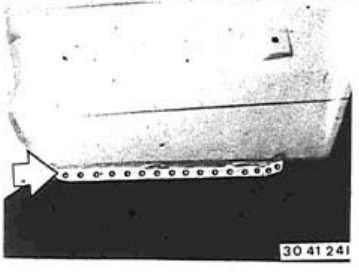
Spot weld side panel on the top box.



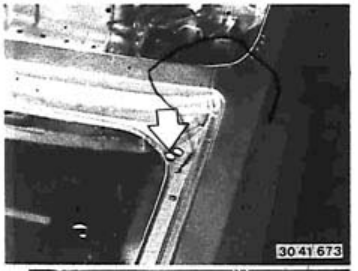
Spot weld side panel on wheel opening surface.



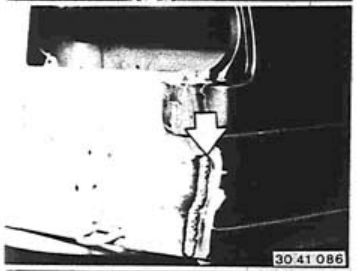
Plug spot weld side panel on side member cover and B pillar.



Spot weld side panel on trunk floor plate.



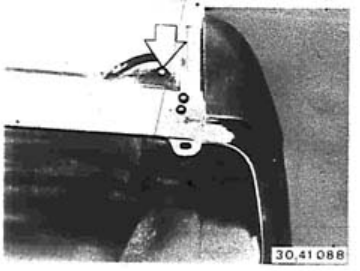
Spot weld side panel on trunk lid opening surface.



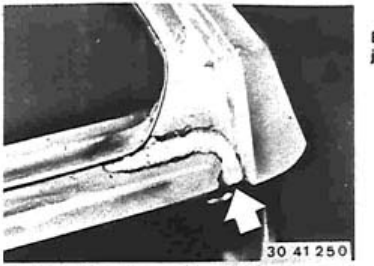
Inert gas weld side panel on tail panel. Grind down the welding bead.



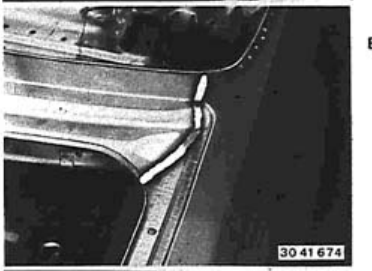
Autogen weld connector on tail panel and side panel from inside.



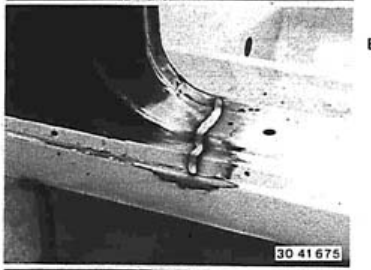
Spot weld tail panel on side panel.



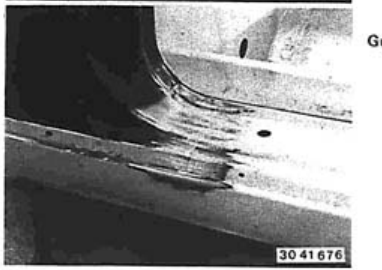
Braze and grind down side panel/tail panel joint.



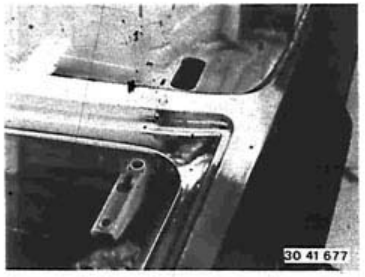
Braze transition.



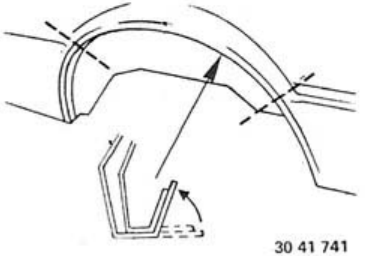
Braze entrance.



Grind down joint, tinning if necessary.



Grind down joint, tinning if necessary.



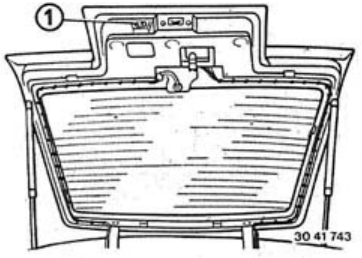
30 41 741

Important!
Cringe the spot welded flange on the wheel opening edge in the shown area.
Compare with opposite side if necessary.

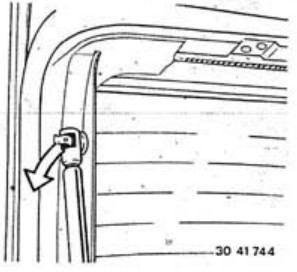
Seal off all joints with a body sealing compound.
Replace damaged anti-drumming compound in trunk and on outside.

41 62 000 REMOVING AND INSTALLING TAILGATE

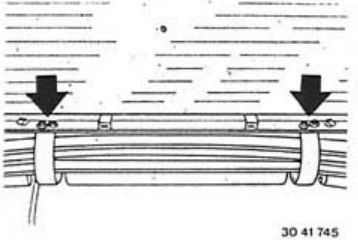
Remove hinge cover, hinge bar trim panel, tailgate frame cover and tailgate trim panel at bottom - see Group 51.



Remove inside light switch (1).
Unclip wire harness and washing fluid hose.
Pull off rear window defogger plug.
Remove wiper motor - see Group 61.
Unscrew ground connection.
Pull off plugs on license plate lights.
Pull wire harness out of the tailgate.



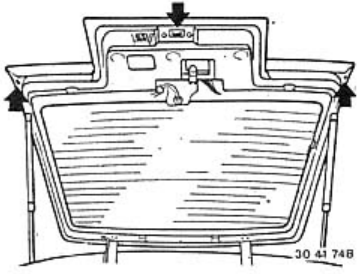
Lift out retainer and disconnect left and right gas pressure props,



If applicable, mark installed position of tailgate.
Unscrew bolts and take off tailgate.
Installation:
Align tailgate if necessary - see 41 62 014.

41 62 014 ALIGNING TAILGATE

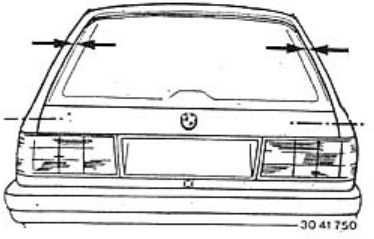
Installation:
Engine hood, tailgate and doors are fitted and bolted in a rough bodyshell. Unpainted surfaces could become visible when adjusting these parts later. If applicable, touch up such surfaces with paint of pertinent body color.


30 41 748

Remove hinge cover, tailgate frame trim panel and hinge bar cover - see Group 51.
Unscrew rubber stops on left and right sides.
Loosen or unscrew the lock baseplate.


30 41 749

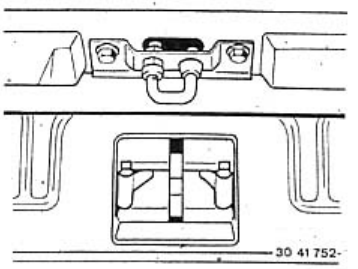
Pull roof liner out of clips at bottom.
Loosen hinge screws on roof hoopstick.


30 41 750

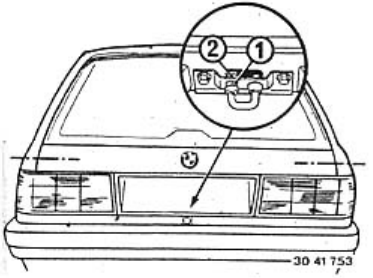
Align tailgate with side panels at top to have equal gaps on left and right sides. Bottom of tailgate must be flush with the left and right side panels in depth.


30 41 751

Unscrew hinge screws on tailgate. Adjust height of tailgate that the outer roof panel surface and rear spoiler are aligned.

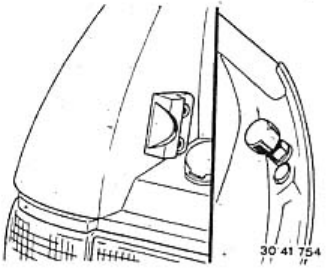

30 41 752

Align the lock baseplate with the lock.



30 41 753

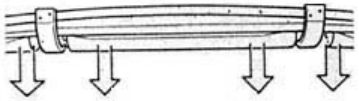
Unscrew nut (1) and turn nut (2) to move the lock baseplate in or out. The tailgate should be flush with the side panels when closed.


30 41 754

Screw in rubber stops on sides completely and align the catching wedges with the rubber stops. Unscrew rubber stops again far enough that there is contact with the catching wedges only after applying light pressure on the tailgate corners.

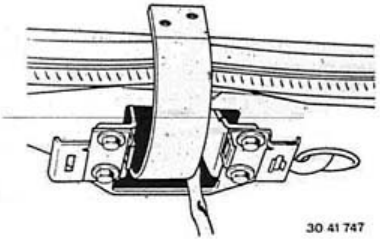
41 62 050 REMOVING AND INSTALLING OR REPLACING LEFT OR RIGHT HINGE FOR TAILGATE

Remove tailgate - see 41 62 000.



30 41 746

Pull roof liner down out of clips.



30 41 747

Mark installed position of tailgate hinge on the roof hoopstick, loosening the hose clamps if necessary.
Unscrew screws and take off hinge.

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51 Body Equipment

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51 Body Equipment

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51 00 ... INFORMATION FOR REPAIRING PLASTIC PARTS

The plastic part repairing conditions mentioned below conform with legislation in the Federal Republic of Germany. Always conform with pertinent legislation in a different country.

These repairing instructions are provided for qualified workers and assumes their skill, conscientiousness and sense of responsibility. The instructions are limited to factory approved repairing methods as well as associated tips and measures to make the work easier. Only general working procedures are described in these instructions. The scope of work and order of procedures will always have to be adapted to the pertinent damage condition. Repairs are an economical solution, so that optical deficiency cannot be excluded. Repairs should therefore only be carried out with explicit customer approval.

The following E 30 parts are made of plastic and can be repaired with 3 M Repair Material 5900.

- M-Technique body attachments
- Standard, M 3 and Touring rear spoilers
- Four wheel drive and M 3 entrance and side panels
- Bumpers beginning with 1988 models

Important!
Only such damage, which does not have influence on the strength and rigidness of the bumper, may be repaired. The following types of damage may not be repaired in the interest of safety.

- Damage on body mounting points.
- Damage in immediate vicinity of body mounting points.
- Peel-offs.
- Ruptures.
- Cracks, extending from corners and edges.
- Continuous cracks with a length of more than 100 mm (4").
- Holes from a size of 100 mm^2 (1.5 $in.^2$) on.

Parts with these types of damage must be replaced!

Refer to the BMW Painting Manual for information on painting plastic parts.

Required Materials:

- Aluminous abrasive fiber discs, grain size P 36 and P 80
- Sandpaper, grain size P 180
- 3M Cement Remover 8984
- 3M Aluminum Adhesive Tape Scotch 424
- 3M Glass Grid Fabric 9030
- 3M Plastic Repair Material 5900
- Mask
- Gloves

Source of Supply: HWB

Safety Precautions:

- Extracting of grinding abrasion.
- Wearing mask and gloves while grinding.
- Working only in well ventilated rooms.
- Washing hands frequently.
- Storing food separately.
- Not eating, drinking or smoking while working.
- Not inhaling vapors.

First Aid:

Take off dirty clothes immediately. If dust has gotten in eyes, rinse out with water thoroughly and go to a physician.
If great amount of vapors are inhaled, go outdoors in fresh air and, if necessary, visit a physician.

Information on Toxicology:

Irritates eyes, skin and the respiratory track. No damaging effects are known as long as handling is correct.

Measures in Case of Fire:

Fire extinguishing agents: powders, foam, CO_2, halon, water mist.

Scrapping:

Never let it get into drink water systems.
Single components of the repair material must be scrapped as special refuse. After mixing the single components and hardening, it can be brought to the normal refuse station.

Procedures:

1. Clean the area to be repaired with a cement remover.

   Note:
   Let cleaned surface dry at room temperature about 10 minutes before application of the repair material.

2. Grind down repair surface (grain size P 80).
   Grind damaged surface in V-shape (grain size P 36).
   If damage continues through the plastic, clean the back side of the repair surface with a cement remover and grind (grain size P 36).

3. Remove grinding abrasion.

4. Paste aluminum adhesive tape above the damaged surface on the front.

5. Cut glass grid fabric to size for the reapir surface.

6. Mix repair material to the instructions supplied with it.

7. Apply a coat of repair material on the back of the repair surface. Apply the glass grid fabric, cover it with repair material and let it harden at room temperature about 20 minutes.

8. Pull off aluminum adhesive tape and, if necessary, grind down and clean the repaired surface again.

9. Apply coat of repair material on the front and let it harden.

10. Grind down the repaired surface (grain size P 80) and smooth with grain size P 180.

    Important!
    It is absolutely necessary to use the specified grain size grinding materials in order to guarantee perfect results (thermal development).

Procedures for Repairing Minor Bruises and Scratches:

1. Grind down damaged zone generously (down into the subtrate) with dry sanding paper (grain size: 400 - 500).

2. Clean ground zone with a plastic cleaner.

3. Apply coat of plastic adhesion solution.
   Apply several coats of BMW Rapid Filler + 20 % BMW Softface Additive on the cleaned surface until the shape of the part can be restored after grinding.

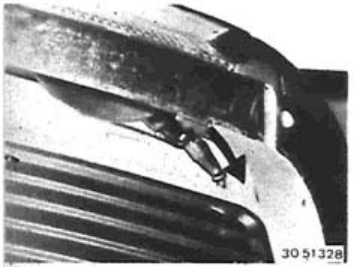
4. Grind down filled surface with wet sanding paper (grain size: 800 - 1000).
   Continue as described in point 3, if ground through spots or damaged spots are still visible.

5. Grind down entire part if applicable (depending on extent of damage).

6. Apply final coat of paint with two-component BMW acrylic paint + 20 % BMW softface additive; for double-layer metallic paint finishes 20 % softface additive is mixed with the BMW acrylic clear lacquer.

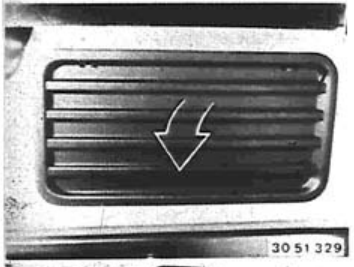
   Refer to the BMW Paint Spraying Manual for spraying instructions, materials and so on.

Caution!
Use mask and make sure of sufficient ventilation.
Conform with accident prevention stipulations for working with paints.
Conform with local and national legislation concerning safety at work and accident prevention as well as working material ordinances.
Refer to instructions supplied by the manufacturers!

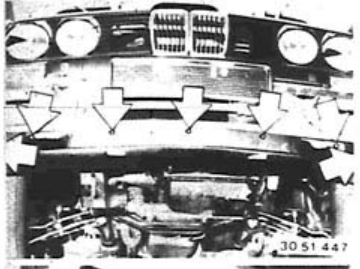


51 11 001 REPLACING FRONT BUMPER

Disconnect plugs on left and right turn signals.
Installation:
Make sure rubber grommets fit correctly.



Before 1986 Models:
Lift out left and right covers.

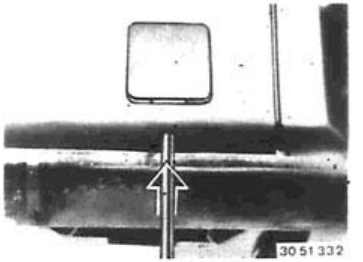


Cars with Front Fog Lamps:
Remove front spoiler 51 71 404.

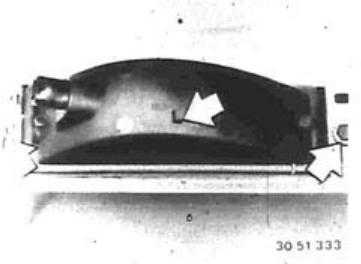


Since 1986 Models:
Remove front spoiler 51 71 404.
Unscrew left and right bolts.
Installation:
Tightening torque*.

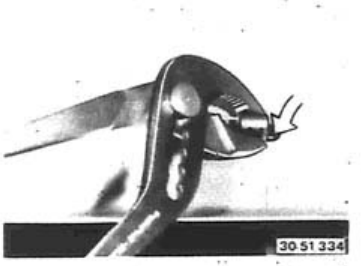
* See Specifications



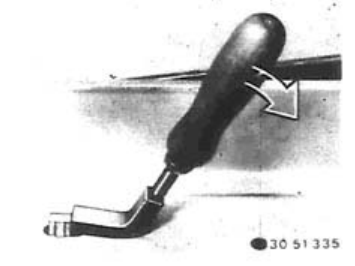
Pry off cover on left and right sides with a screwdriver.
Unscrew left and right nuts.
Installation:
Tightening torque*.
Arrows on back of covers face up.



Remove left and right turn signals.
Installation:
Turn signals are marked.
L = left
R = right

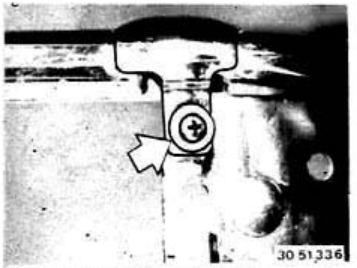


Compress locks and press out all strip clamps.
Take off rubbing strips.

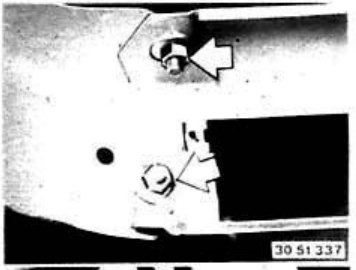


Installation:
Replace and pull in new strip clamps with Special Tool 5 13 160.

* See Specifications



Unscrew left and right bolts and take off plate.



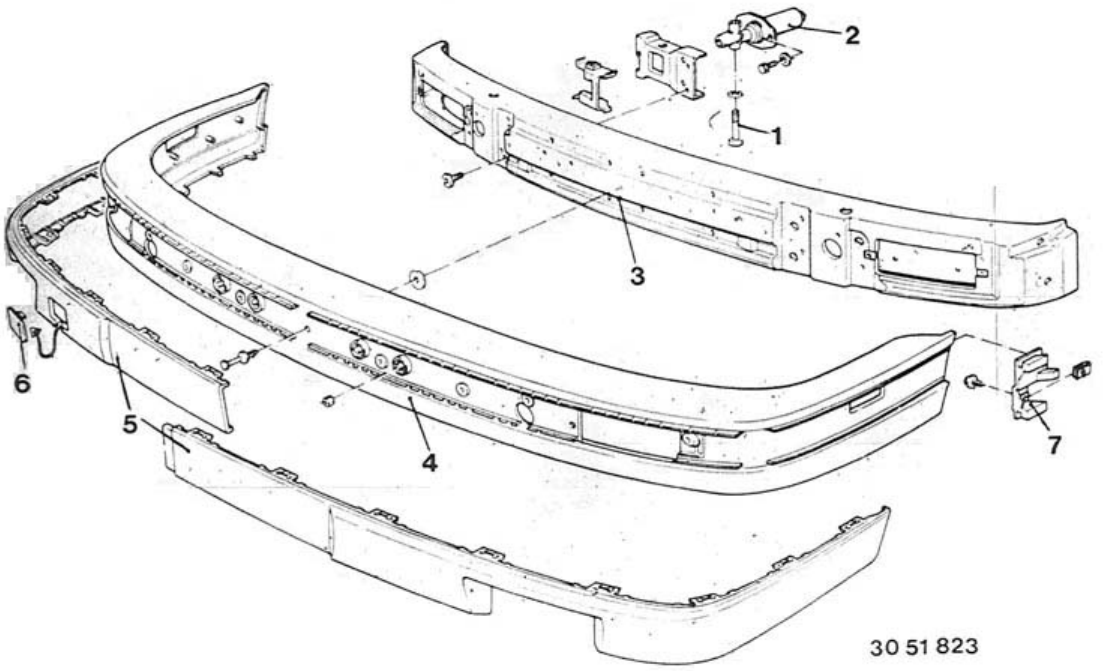
Unscrew left and right bolts.



Installation
Replace self-tapping nuts.

51–112

FRONT BUMPER ASSEMBLY DRAWING – Since 1988 Models



1 Bolt, left / right

2 Impact absorber

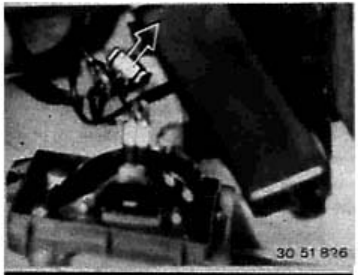
3 Bumper carrier

4 Bumper trim panel

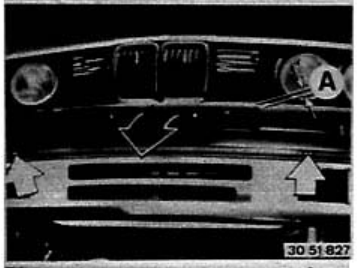
5 Rubber guard

6 Cover for towing eye

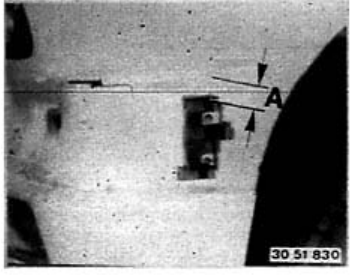
7 Bracket on side panel



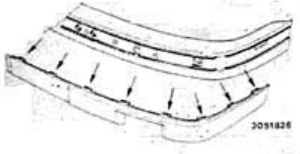
Since 1988 Models:
Pull off turn signal wires.



Unscrew bolts.
Take off bumper.
Installation:
Check gap between bumper and body.
A = 6 – 1 mm (0.236 – 0.039").
Tightening torque*.



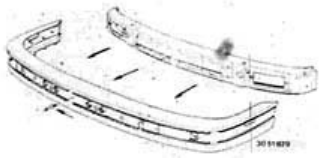
Installation:
Adjust basic distance A = 39 ± 1 mm (1.535 ± 0.039") after replacement of side panel or bracket.

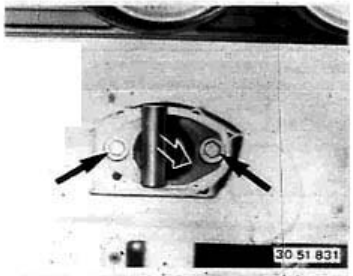


Lift out clips.
Take off rubber guard.

* See Specifications

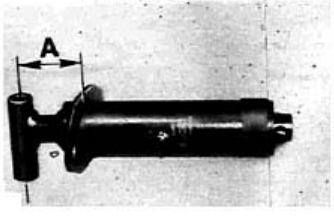
Press out plastic rivets.
Take off trim panel.





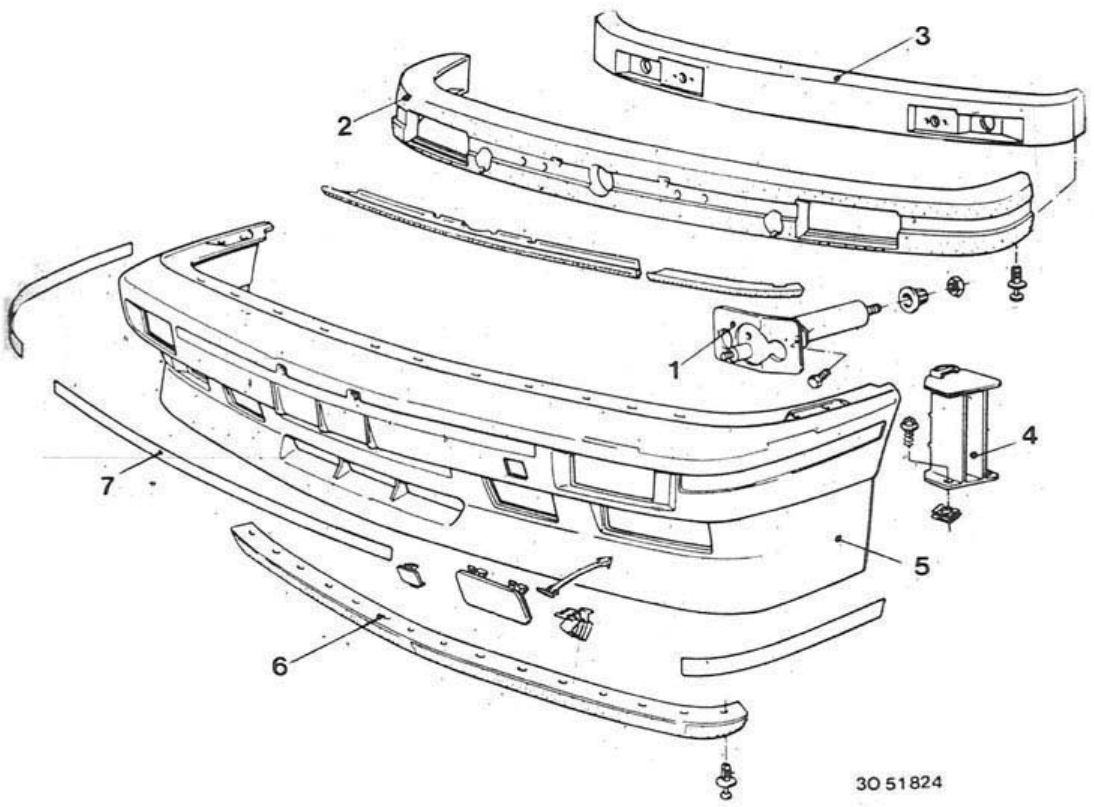
51 11 . . . REMOVING AND CHECKING IMPACT ABSORBERS

Remove bumper – see 51 11 001.
Unscrew bolts.
Lift out impact absorber.
Installation:
Align impact absorber, holding bumper in position if necessary and checking gap.

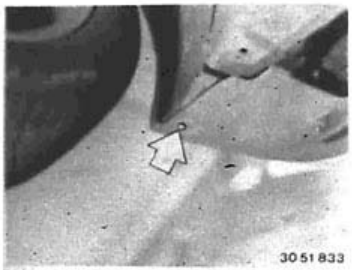


Note:
Distance A must not be less than 52 ± 1 mm (2.047 ± 0.039") after damaging car in an accident.

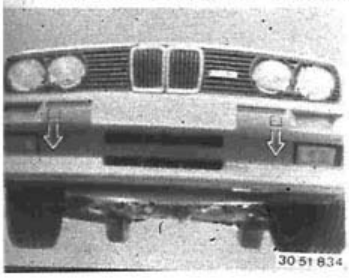
FRONT BUMPER ASSEMBLY DRAWING – M 3



1 Bracket with mounting parts
2 Foam rubber inlet
3 Bumper carrier
4 Bracket on side panel
5 Bumper trim panel
6 Spoiler
7 Ornamental strip



BMW M 3:
Unscrew bolts on engine splash guard.

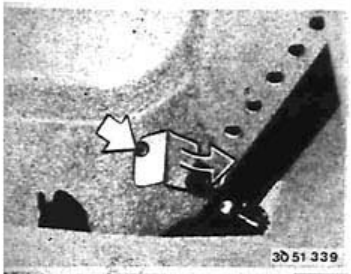


Lift out covers.
Unscrew bolts.
Installation:
Tightening torque*.

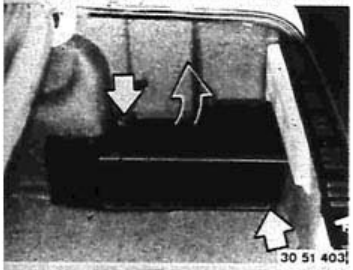
Pull off electric wires on turn signals, front fog lamps and temperature sensor.
Lift off bumper.

* See Specifications

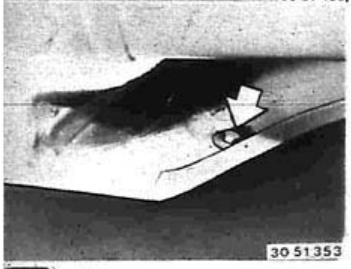
51 12 001 REPLACING REAR BUMPER



Break out opening in side panel and unscrew bolt on left and right sides.
Installation:
Tightening torque*.



If applicable, remove battery cover.

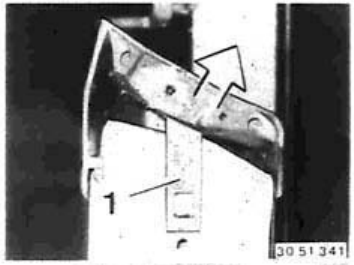


Unscrew bolts on left and right sides.
Installation:
Coat bolts with body sealing compound**.

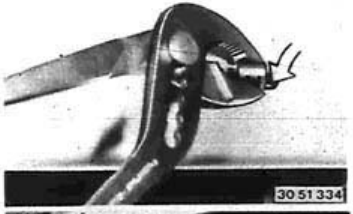


Unscrew bolts on left and right sides.
Take off bumper.
Installation:
Tightening torque*.

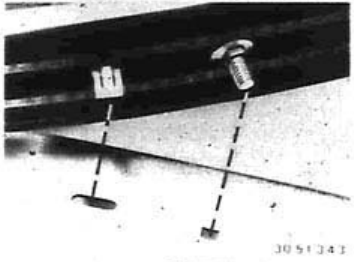
* See Specifications
** Source: HWB



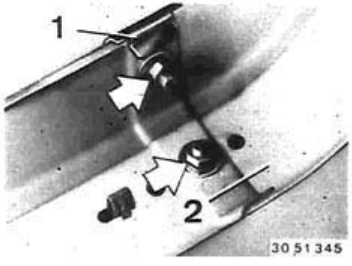
Lift tongue (1) and take off end piece.



Compress rubbing strip clips and push out.
Take off rubbing strip.

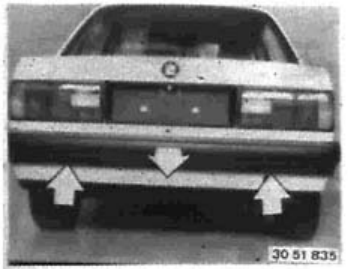


Installation:
Align mounting bolts and clips in rubbing strip with holes in bumper.
If applicable, use body sealing compound**.
Pull in clips with Special Tool 51 3 160.



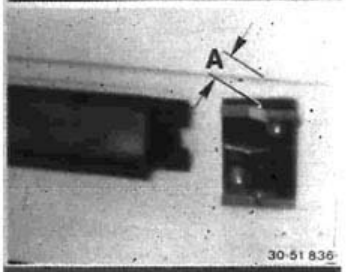
Unscrew bolts.
Take off plate (1) and side section (2).

** Source: HWB

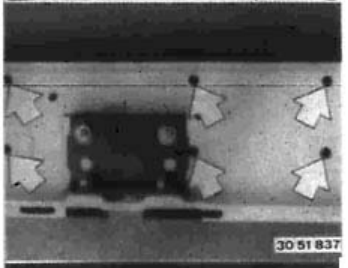


Since 1988 Models:

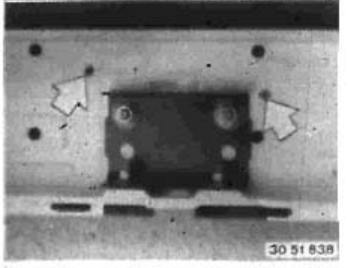
Unscrew bolts.
Take off bumper.
Installation:
Tightening torque*.



Installation:
Adjust distance A to 36 ± 1 mm (1.417 ± 0.040") after replacing the side panel or bracket.

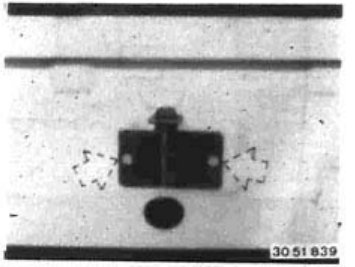


Lift out clips through holes.
Take off rubber guard.



Press out plastic rivets.
Take off trim panel.

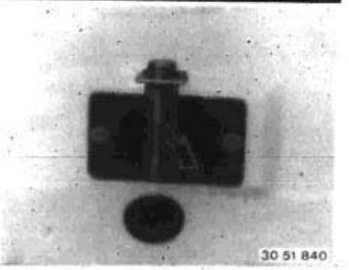
* See Specifications



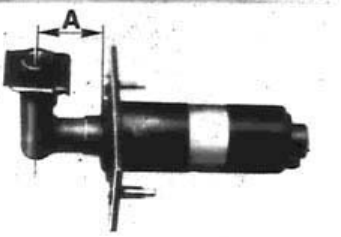
51 12 ... REMOVING AND CHECKING IMPACT ABSORBERS

Remove bumper - see 51 12 001.
Unscrew bolts.

Note:
Right end is bolted in the trunk.



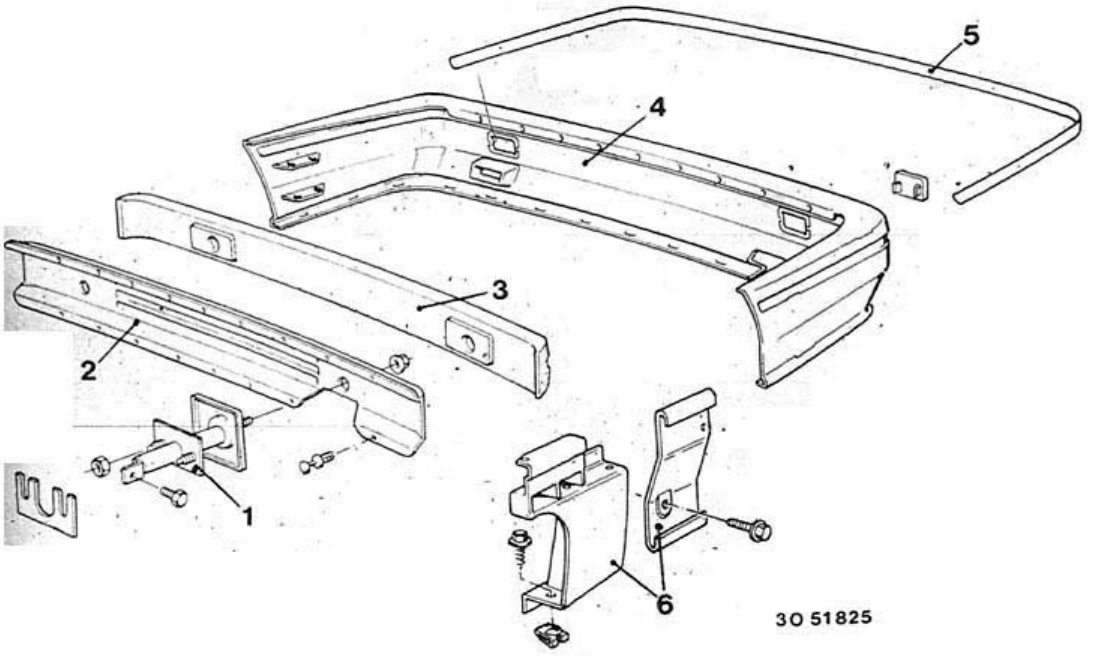
Lift out impact absorber.



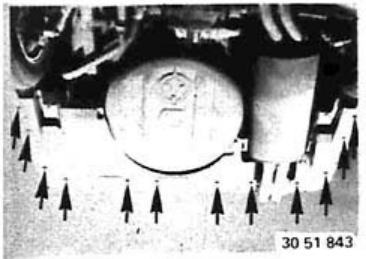
Note:
Distance A must not be less than 39 mm (1.535") after damage from an accident.

51–122

REAR BUMPER ASSEMBLY DRAWING – M 3



1 Bracket with mounting parts
2 Bumper carrier
3 Foam rubber inlet
4 Bumper trim panel
5 Ornamental strip
6 Bracket on side panel



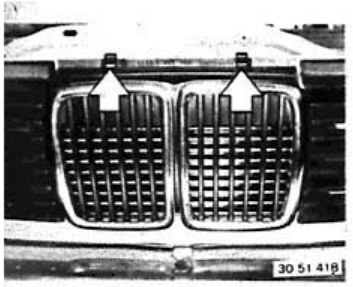
BMW M 3:
Unscrew bolts.



Lift off covers.
Unscrew bolts.
Installation:
Tightening torque*.

Lift off bumper.

* See Specifications



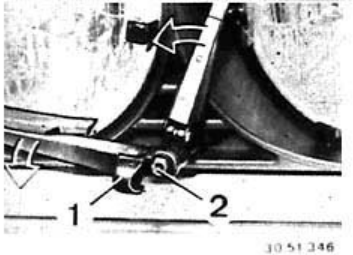
51 13 000 REMOVING AND INSTALLING RADIATOR GRILL CENTER SECTION

Open engine hood.
Lift off clamps.
Remove grill.

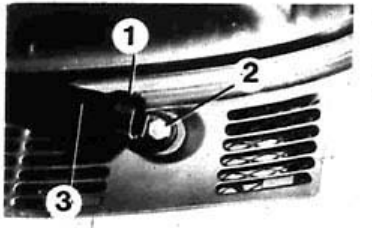


51 13 040 REMOVING AND INSTALLING RADIATOR GRILL SIDE SECTION

Lift off clamps.
Unscrew screws.
Remove grill.

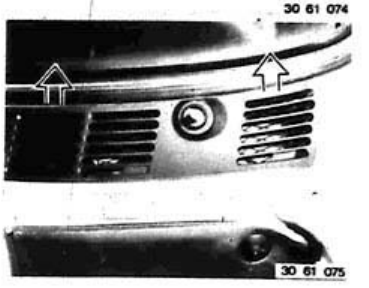


Cars with Headlight Cleaners:
Take off cap (1).
Unscrew nut (2).
Tilt wiper arms away from headlights and take them off.

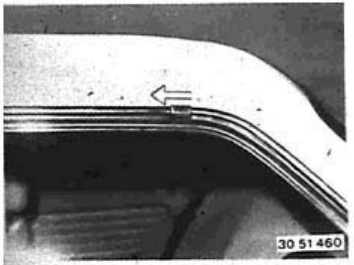


51 13 076 REMOVING HEATER AIR INLET GRILL

Lift out cover (1).
Unscrew nut (2).
Take off windshield wiper arm (3).

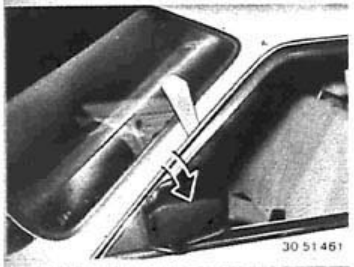


Lift out grill.

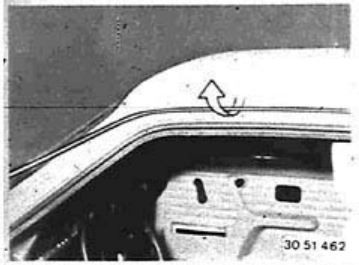


51 13 311 REPLACING ORNAMENTAL STRIP ON LEFT OR RIGHT RAIN MOLDING

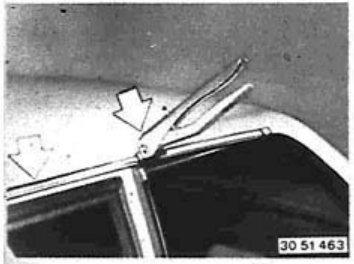
Slide clamp.



Lift out ornamental strip beginning at front end.



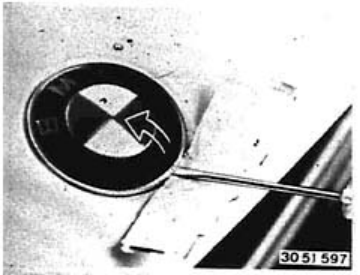
Turn and lift out ornamental strip from above.



Installation:
Replace clips located in front area if necessary.
Press on ornamental strip lightly with Special Tool 51 1 060.



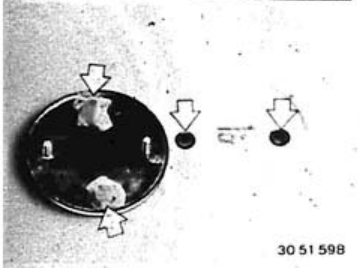
Convertibles:
Lift out ornamental strip.
Installation:
Replace clips if necessary.



51 14 000 REMOVING AND INSTALLING FRONT BMW EMBLEM

Lift out emblem carefully.

Installation:
Replace plastic clip, if necessary.
Use Terostat tape.

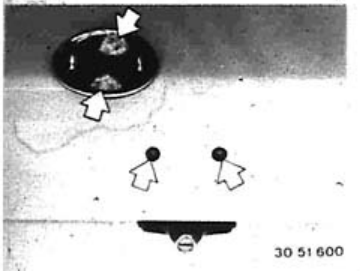




51 14 010 REMOVING AND INSTALLING REAR BMW EMBLEM

Lift out emblem carefully.

Installation:
Replace plastic clip, if necessary.
Use Terostat tape.



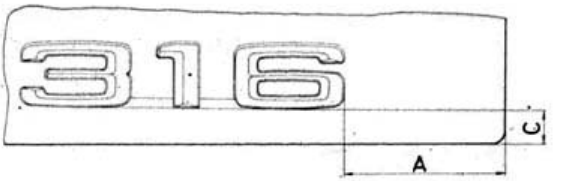
51 14 110 REPLACING REAR MODEL SIGN

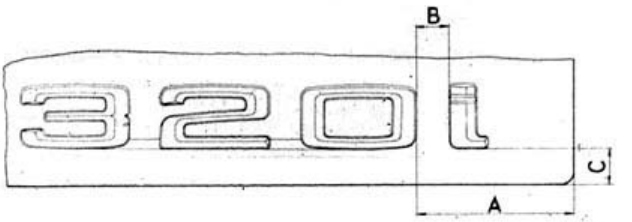
The model sign is cemented and cannot be reused.
Coat a nylon string or garn with Tenside (e.g. dish washing detergent) and "saw through" coat of cement between trunk lid and model sign.
Remove residual cement with gasoline.
Install new model sign at room temperature.
Locate tape up to upper edge "C" and mark distances according to table.
Heat model sign to approx. 40 ... 50° C (105 to 120° F) and press on firmly 5 to 10 seconds.

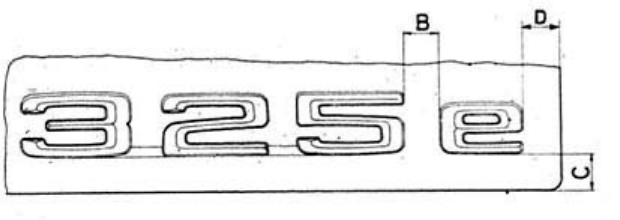
Distances for Model Signs:

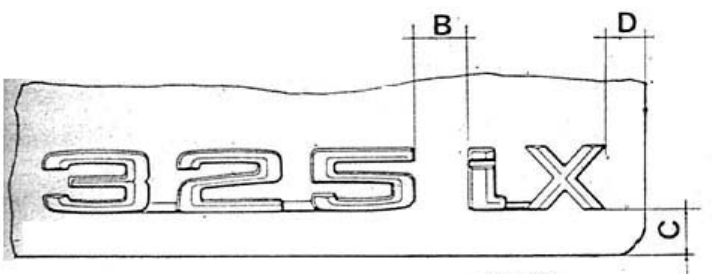
Distance in mm (inches)	A	B	C	D
BMW 316 - 325 i	62 (2.441)	16 (0.630)	19 (0.748)	
BMW 325 e / 324 d		18 (0.709)	19 (0.748)	22 (0.866)
BMW 324 td / 325 iX		18 (0.709)	19 (0.748)	22 (0.866)
BMW M 3		9 (0.354)	19 (0.748)	75 (2.953)

Note:
Model sign must be removed when baking paint at temperatures above 80° C (175° F).

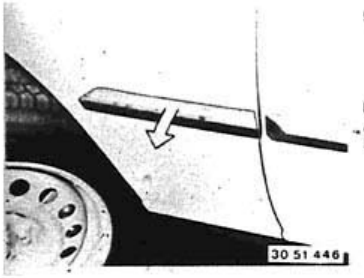






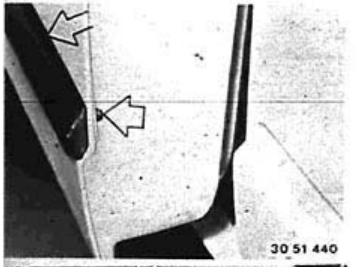


30 51 844



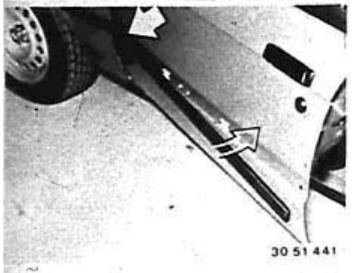
51 15 300 REMOVING AND INSTALLING OR REPLACING RUBBING STRIP ON LEFT OR RIGHT FRONT SIDE PANEL

Pull off rubbing strip.
Installation:
Replace clips, if necessary.

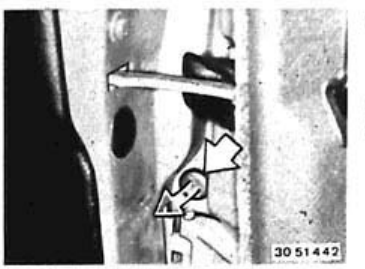


51 15 330 REMOVING AND INSTALLING OR REPLACING RUBBING STRIP ON LEFT OR RIGHT FRONT DOOR

Unscrew screw.
Pull off rubbing strip.

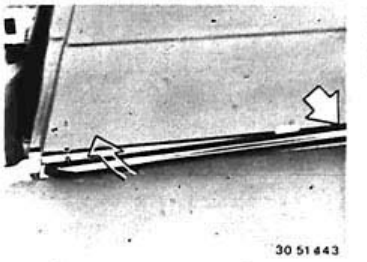


Installation:
Replace clips, if necessary.
First engage rubbing strip in angled clip.

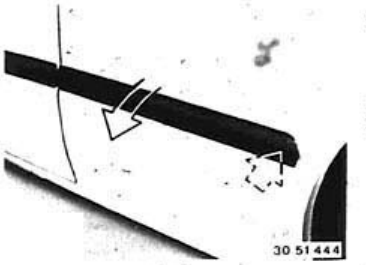


51 15 360 REMOVING AND INSTALLING OR REPLACING RUBBING STRIP ON LEFT OR RIGHT REAR DOOR

Lift off plug.
Unscrew screw.

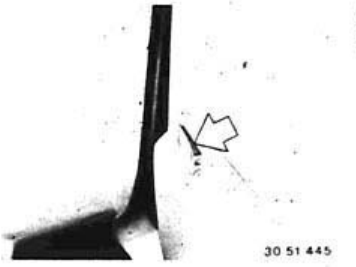


Pull off rubbing strip.
Installation:
Replace clips, if necessary.
First engage rubbing strip in angled clip.



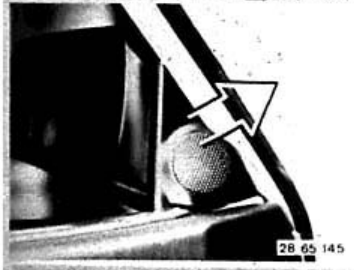
51 15 390 REMOVING AND INSTALLING OR REPLACING RUBBING STRIP ON LEFT OR RIGHT REAR SIDE PANEL

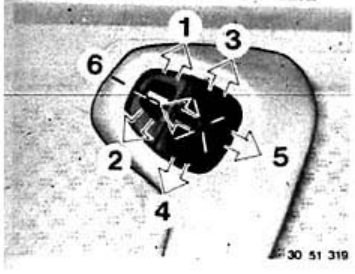
Unscrew screw.
Pull off rubbing strip.



Installation:
Replace clips, if necessary.
First engage rubbing strip in angled clip.







51 16 000 REMOVING AND INSTALLING OR REPLACING MIRROR ON LEFT OR RIGHT FRONT DOOR

Disconnect battery ground lead.
Pull off cover toward the rear.
Unscrew mirror mounting screws and disconnect the plug.

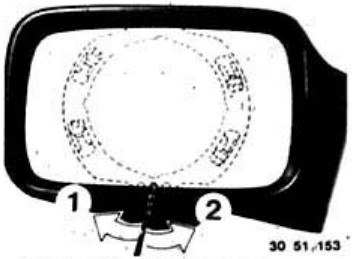
Note:
A blue dot indicates a heated outside mirror.

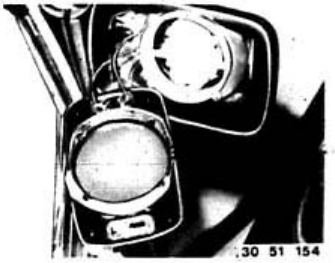
Cars with Sound System:
Pull off mirror triangle toward rear.
Pull off wires - also refer to Group 65.

Turn on ignition and check operation.
Switch Positions:
1 = Left outside mirror
2 = Right outside mirror
Adjusting Mirror:
3/4 Vertical plane
5/6 Horizontal plane

DESCRIPTION

The outside mirror can be adjusted and heated after turning on the ignition.
Heated is controlled automatically.
Heating is switched on by an integrated temperature switch when the mirror glass temperature is below + 15 ± 5° C (59 ± 9° F).
Heating is switched off automatically when a temperature of 60 ± 10° C (140 ± 18° F) is reached.
Heating switches in again when the temperature would drop below + 15 ± 5° C (59 ± 9° F).
The melting speed at - 10° C (+ 14° F) for a frozen mirror is about 5 minutes with a power consumption of approx. 1.5 A.



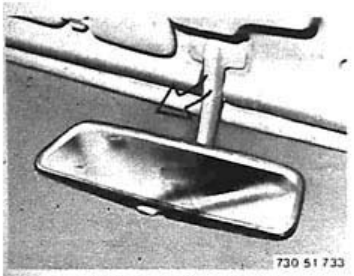


51 16 026 REPLACING MIRROR GLASS

Insert screwdriver in housing opening (bottom) a turn the retaining ring.
1 = Unlocking
2 = Locking

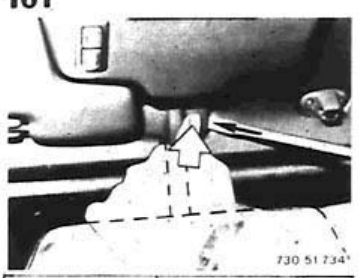
Installation:
Check for correct seating of the retaining ring (catching noticed).

Heated Mirror:
Pull off flat male plug and connect on new mirror glass.
Check operation - see 51 16 000.

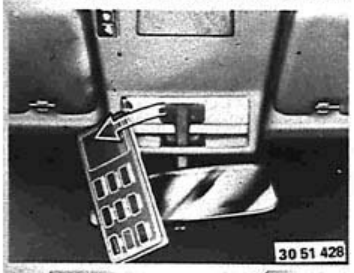


51 16 060 REMOVING AND INSTALLING INSIDE MIRROR

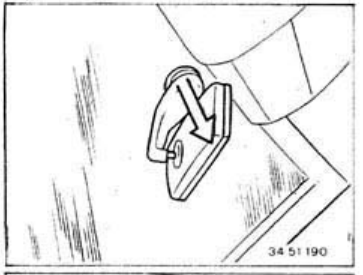
Lift off mirror.



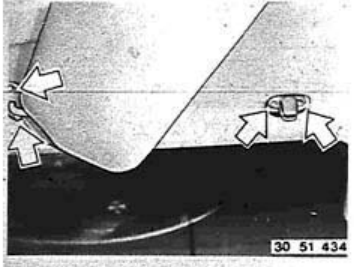
Installation:
Insert mirror diagonally and, if necessary, press in with the handle of a hammer.



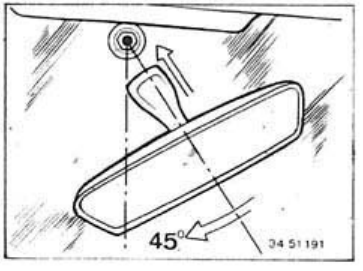
Installation:
If applicable, lift out display panel of cars with check control.



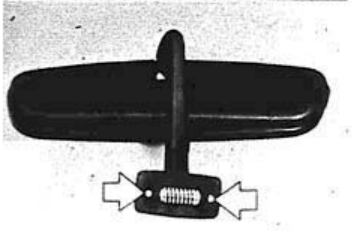
BMW Convertibles:
Pull mirror back off of the base.



Installation:
If applicable, remove front roof liner plate (see 51 44 150) of cars with a front roof liner plate not having check control.



Installation:
1. Mount mirror foot turned about 45° on the mirror base.
2. Turn the mirror foot until it engages in the mirror base.



Installation:
Spring has to be compressed.

51 16 . . . CEMENTING MIRROR BASE

Materials Required:

Mirror Base Cementing Repair Kit*
Primer XW 775*

1. Preparations

1.1 Cement at room temperature and make sure that on cold days the window glass and base are brought to room temperature in the workshop long enough, in order to prevent condensation on the surface.

1.2 Mark position of mirror base on outside of window glass. Scratch off old cement on glass and base with a sharp tool.

1.3 Clean cementing surface on glass and base with a clean shear wool cloth and alcohol/cetone and let surface dry!
Don't use paint thinners!

2. Primer Coat

Apply colorless, watery primer on the surface of the windshield intended for cementing with help of cotton tips (Q-Tips or similar).

Air drying time: min. 1 minute, max. 1 hour.

3. Cement Coat

3.1 Mixing Cement

Cut off sealing tips on containers of cement and hardener with a knife. Make sure that the openings are equal in size. Otherwise there could be mistakes in mixing.

The cap for subsequent plugging of these openings is located between both pistons of the tips. Break off cap.

Light pressure on the pistons will remove the required amount of cement and hardener. The mixing ratio for cement and hardener is 1 to 1 in weight and volume. It is important that the same volumes of cement and hardener are removed (increase size of openings when necessary).
Both components react chemically with each other. Thorough, homogenous and intensive mixing is a requirement for this reaction and for the quality of cementing.
Consequently both components must be mixed in such a manner, that there is an uniform, free-from-reams mixture color.

3.2 Application

The mixture is capable of being applied for about 5 to 10 minutes (potlife) with an ambient temperature of 20 to 25° C (70 to 75° F). Apply a thin (approx. 0.5 mm / 0.020" thick) and uniform coat of cement on the base with a spatula and press the base on the glass in such a manner, that the cement has good contact with the glass over the entire surface.

Note:
The temperature for the hardening process should not be lower than + 18° C (65° F).

3.3 Fixing Bonded Parts

Epoxide resin cements do not have an initial strength property. Consequently this makes it necessary to fix the bonded parts (with adhesive tape or something similar).
The joining and fixing of bonded parts must be accomplished within the potlife. Check that the arresting button is positioned correctly, so that the mirror mounted later will be straight (long side of mirror base hexagon parallel to upper edge of window).

3.4 Hardening of Cement

Hardening speed depends on the ambient temperature. Consequently the mirror base must be fixed with adhesive tape or something similar for at least 3 to 4 hours.
Button on the mirror after 12 hours at the earliest.

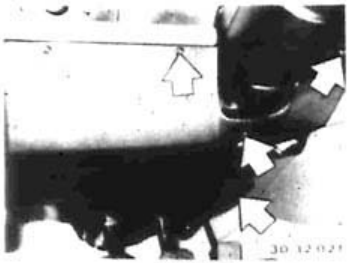
4. Working Hygiene

Caution!
Cement could impair the health if vapors are inhaled or cement has contact with the skin.
As is the case for all epoxide resins, sensitive persons might be confronted with an alergy through contact with the skin.

Make sure of good ventilation and that gloves are worn during application.

Wash off concerned spots of skin with soap and water immediately.
If cement gets in the eye, rinse the concerned eye with water thoroughly and visit a physician.

* Source of Supply: HWB

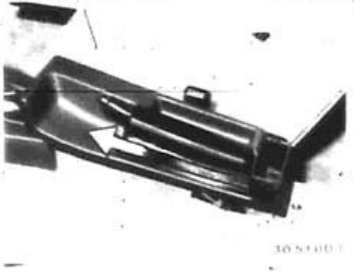


51 16 200 REMOVING AND INSTALLING CENTER CONSOLE

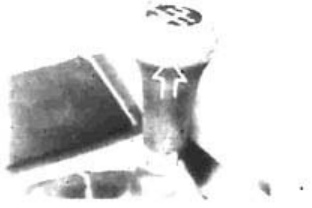
Disconnect battery ground lead.
Unscrew trim panel at bottom left.



Lift out ashtray.
Unscrew nut.

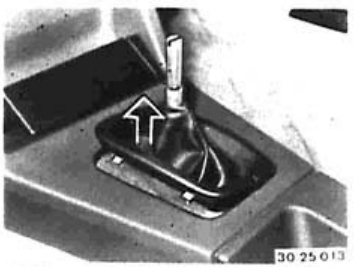


Disconnect console at front end by pulling back and pull it off of the parking brake lever.
Cars with EH Transmission:
Pull off plug.



Cars with Manual Transmission:
Pull off shift lever knob.

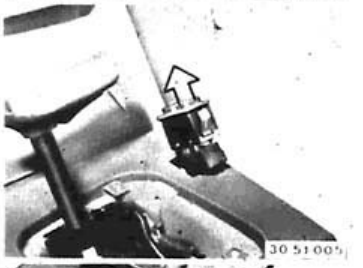
Installation
Engage shift lever knob in the turning prevention lock.



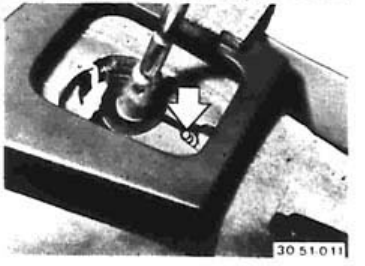
Lift off dust cover.



Cars with Automatic Transmission:
Lift out plate.
Unscrew screws.
Take off trim panel.

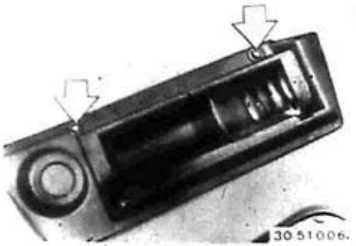


If applicable, lift out switches for power windows.
Pull off plugs.

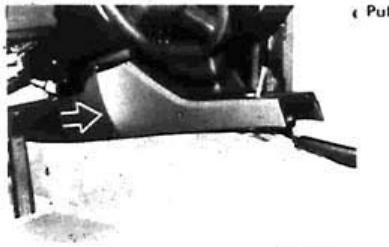


Remove insulation sheet.
Unscrew nut.

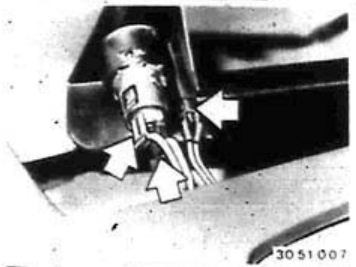
Installation:
Replace plastic nut and check tightness.
Tightening torque: 5 Nm (3.5 ft. lbs.).



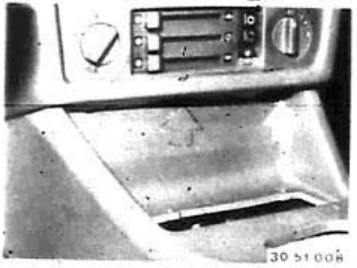
Unscrew bolts
Lift out ashtray console



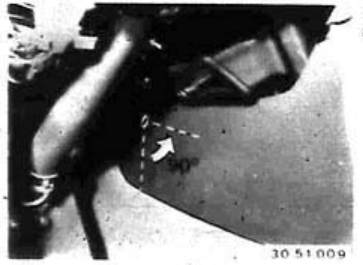
Pull out tray toward rear.



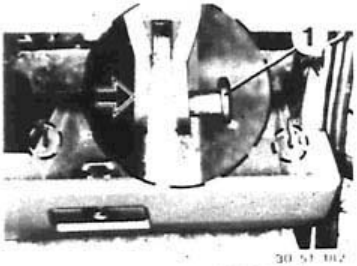
Pull off ashtray light and wires for cigar lighter



Unscrew bolt.

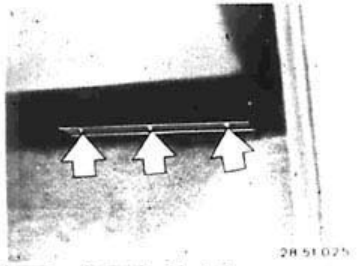


Remove retainers by turning clockwise and anticlockwise 90°.

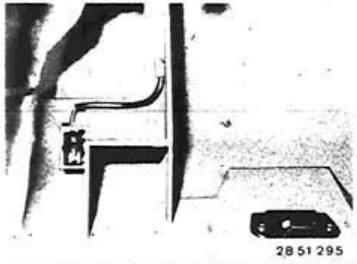


51 16 360 REMOVING AND INSTALLING RIGHT GLOVE BOX

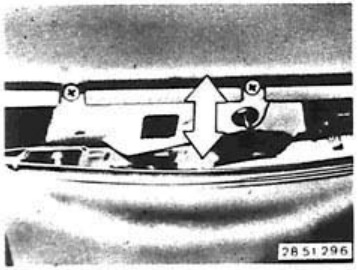
Push out pin.
Disconnect left and right retaining straps.
Remove trim panel.



Unscrew screws.

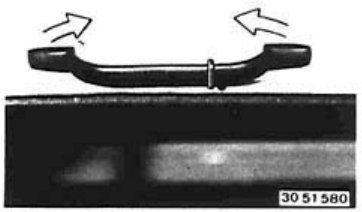


Lift out plug.

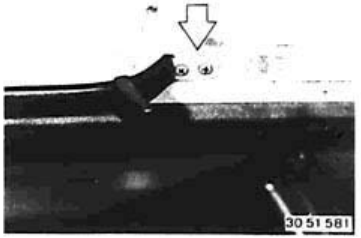


Installation:
If applicable, adjust striker for lock.

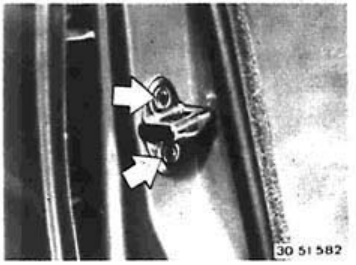
51 16 450/480 REMOVING AND INSTALLING GRAB HANDLE



Lift off plate.



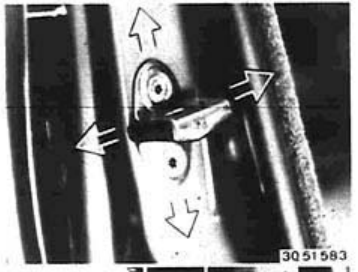
Unscrew bolt.



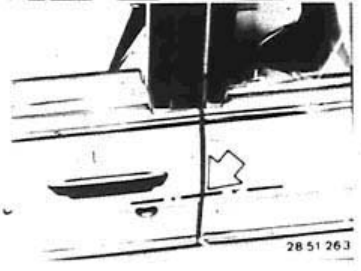
51 21 003 REPLACING LEFT OR RIGHT FRONT DOOR STRIKER

If applicable, mark installed position.
Unscrew bolts.

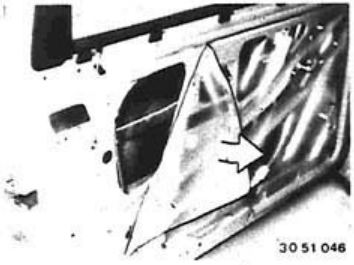
Four Door Model:
If applicable, remove B pillar trim – see 51 43 150.
Two Door Model:
If applicable, remove side panel trim – see 51 43 000.



Installation:
Tighten striker bolts lightly in middle position.
Close door with opened door handle.
This aligns the striker.

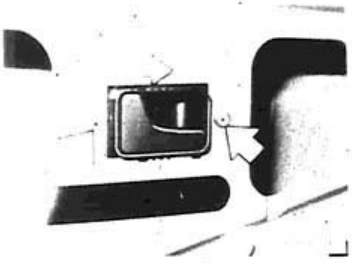


Tighten striker bolts.
Close door.
Check, correcting if necessary.
Edge of front door must be in same plane with rear door or side panel.

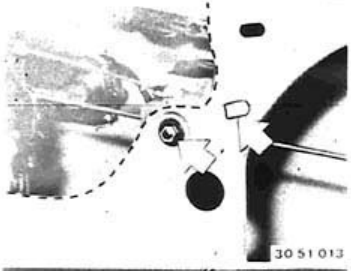


51 21 090 REMOVING AND INSTALLING OR REPLACING LEFT OR RIGHT FRONT DOOR LOCK

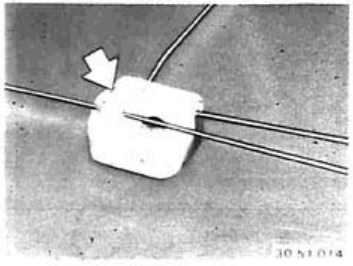
Note:
Some pictures show the sheet metal parts cut off for better understanding.
Remove door trim panel – 51 41 001.
Pull off plastic sheet.
Installation:
Replace damaged plastic sheet.



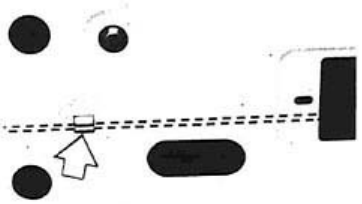
Unscrew door remote control.
Installation:
Preload door remote control lightly.



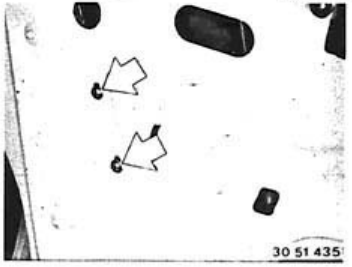
Two Door Cars:
Unscrew reversing lever.
Installation:
Insert twisting lock in opening.



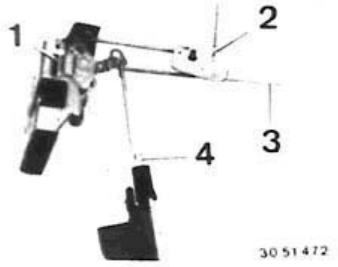
Two Door Cars:
Installation:
Engage remote control linkage in holder on protective cap of the reversing lever.



Four Door Cars:
Unclip remote control holder.

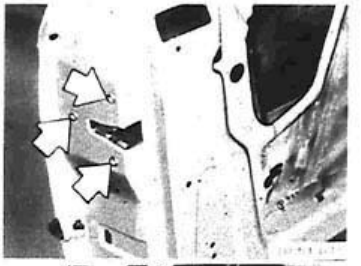


Cars with Central Locks:
Unscrew bolts.
Pull off plug.
Disengage drive.
Installation:
Adjust drive – see 51 26 000.
Troubleshoot central locks – see page 51 - 800.

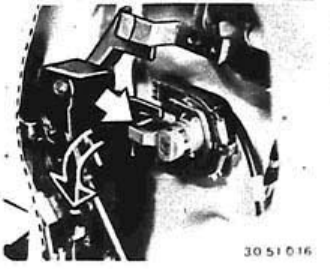


30 51 472

Two Door Arrangement:
1 = Lock
2 = Locking linkage
3 = Door remote control linkage
4 = Drive/connecting link



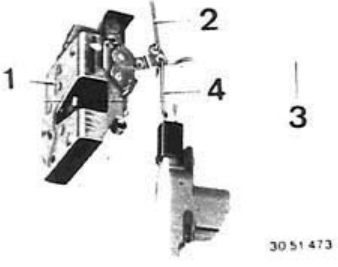
Unscrew bolts.



30 51 016

Disengage lock in lever on the lock cylinder.
Remove lock complete with remote control.

Convertibles:
Remove lock cylinder – see 51 21 140.

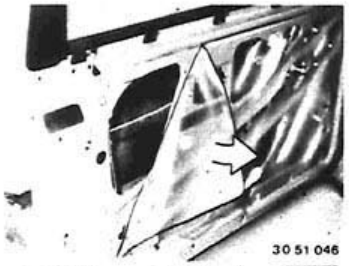


30 51 473

Four Door Arrangement:
1 = Lock
2 = Locking linkage
3 = Door remote control linkage
4 = Drive/connecting link

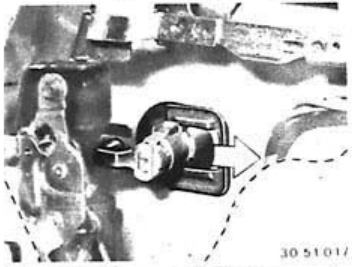
Installation:
Lubricate lock with grease*.

* Source: HWB

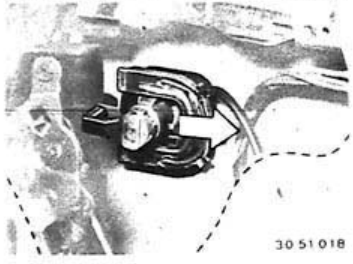

30 51 046

51 21 140 REMOVING AND INSTALLING OR REPLACING LEFT OR RIGHT FRONT DOOR LOCK CYLINDER ASSEMBLY

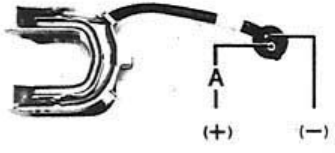
Note:
Some pictures show the sheet metal cut off for better understanding.
Remove door trim panel – see 51 41 001.
Pull off plastic sheet partially.
Installation:
Replace damaged plastic sheet.


30 51 017

Pull off retainer.

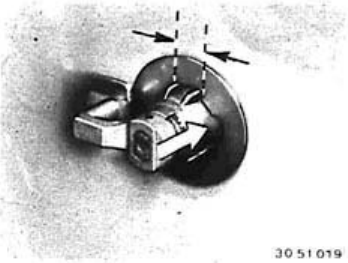

30 51 018

Version with Lock Heating:
Pull off retainer complete with heating ring.

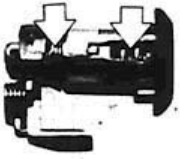


28 51 622

View of Door Lock Heating:
See Specifications of Group 61 for testing the power consumption.


30 51 019

Push out lock and remove washer.
Installation:
Wide opening of washer faces up.


30 51 704

Installation:
Lubricate lock cylinder with grease*.



30 51 705

Note:
The lock cylinder can be ordered from Parts by quoting the code number.

The old tumblers must be used as samples when using a lock cylinder repair set.
Note the number die-stamped on the tumbler. Insert the tumbler of the repair kit having the same number in the pertinent chamber of the new lock cylinder together with a new spring, lubricated with the supplied grease.

* Source of Supply: HWB



30 51 570

Driver's Door:
Installation:
Check for correct fit of spring in cars with central locks and unlocking arrest.



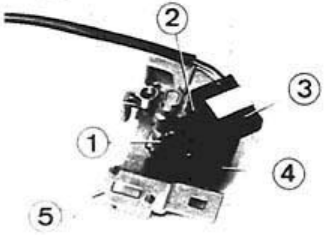
30 51 474

Installation:
Place drive for microswitch on holder.



30 51 475

Installation:
Plug in microswitch and secure it with a clamp.



30 51 476

Driver's Door Lock Cylinder Layout:
1 = Lock cylinder
2 = Drive for microswitch
3 = Microswitch
4 = Clamp
5 = Holder
Checking Microswitch:
Switch pressed = ≈ 0 Ω
Switch opened = ≈ ∞ Ω
Troubleshoot central locks – see page 51 - 800.



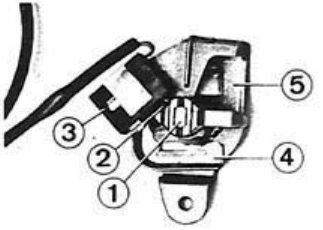
30 51 070

Front Passenger's Door:
Installation:
Place drive for microswitch on holder in cars with central locks.



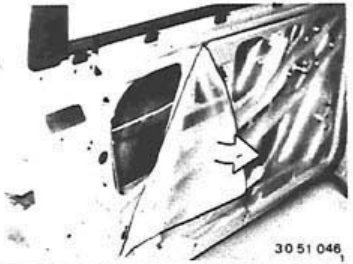
30 51 071

Plug in microswitch and secure it with a clamp.



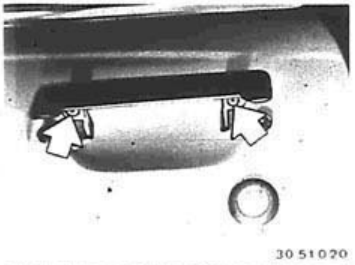
30 51 493

Front Passenger's Door Lock Cylinder Layout:
1 = Lock cylinder
2 = Drive for microswitch
3 = Microswitch
4 = Clamp
5 = Holder
Checking Microswitch:
Switch pressed = ≈ 0 Ω
Switch opened = ≈ ∞ Ω
Troubleshoot central locks – see page 51-800.

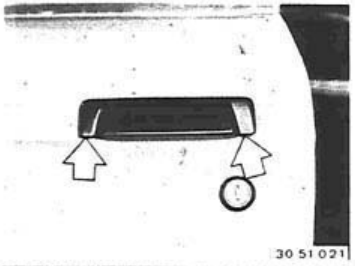


51 21 200 REMOVING AND INSTALLING OR REPLACING OUTSIDE HANDLE AND LOCKING MECHANISM OF LEFT OR RIGHT FRONT DOOR

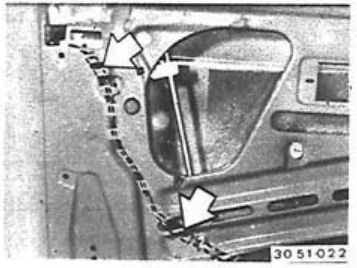
Note:
Some pictures show the sheet metal parts cut off for better understanding.
Remove door trim panel – see 51 41 001.
Pull off plastic sheet partially.



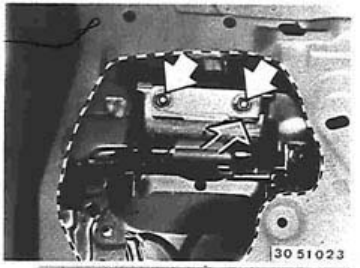
Installation:
Replace damaged plastic sheet.



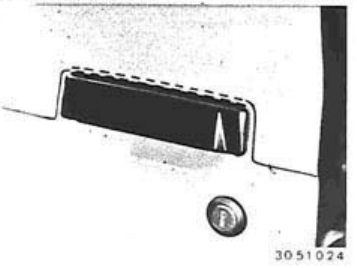
Unscrew outside handle.



Installation:
Align outside handle that it rests on the rubber pads.

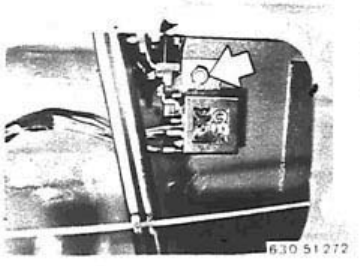


If applicable, disconnect plug

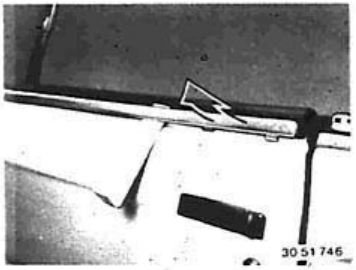


Unscrew nuts.
Remove locking mechanism.
Caution!
Be careful not to damage paint at openings.

Installation:
Align locking mechanism with bead in the door panel after screwing on the outside handle.



Installation:
If applicable, the lifted outside handle must operate the heating control unit for the door lock or the contact transmitter for inside light delayed action.
If applicable, adjust or bend the contact tongue.



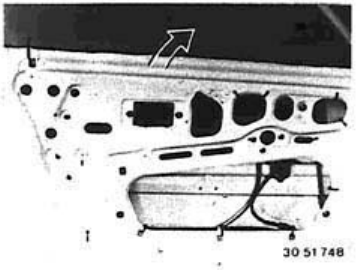
51 21 300 REMOVING AND INSTALLING OR REPLACING OUTSIDE WINDOW RECESS COVER STRIP

If applicable, remove outside mirror – see 51 16 000.
Lift out cover strip from above carefully.

Installation:
Replace damaged clips.



30 51 747



51 21 330 REMOVING AND INSTALLING OR REPLACING INSIDE WINDOW RECESS COVER STRIP

Remove door trim panel – see 51 41 001.
Lift out cover strip.

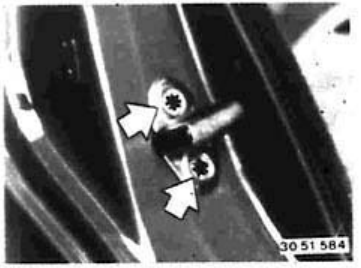
Installation:
Check for correct fit of cover strip in clips.



30 51 749

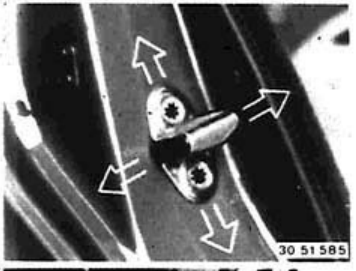


Convertibles:
Lift out cover strip.
Installation:
Check for correct fit of cover strip in clips.

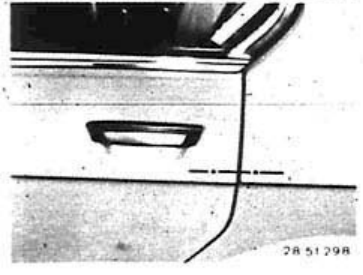


51 22 001 REPLACING LEFT OR RIGHT REAR DOOR STRIKER

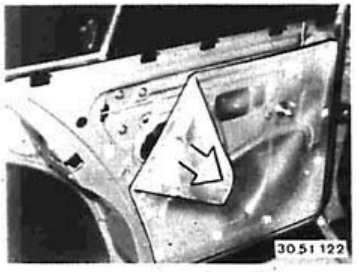
If applicable, mark installed position.
Unscrew bolts.



Installation:
Tighten striker bolts lightly in middle position.
Close door with opened door handle.
This aligns the striker.

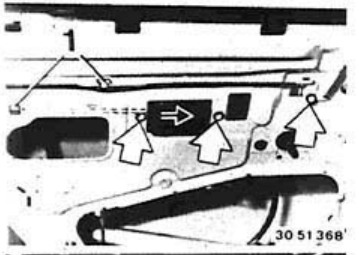


Tighten striker bolts.
Close door.
Check, correcting if necessary.
Edge of rear door must be in same plane with side panel.

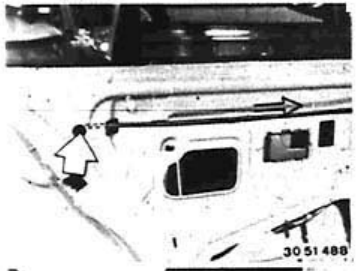


51 22 090 REMOVING AND INSTALLING LEFT OR RIGHT REAR DOOR LOCK

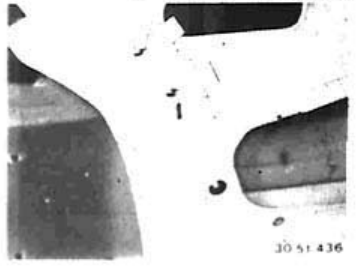
Raise window completely.
Remove door trim panel – see 51 42 001.
Pull off plastic sheet.
Installation:
Replace damaged plastic sheet.



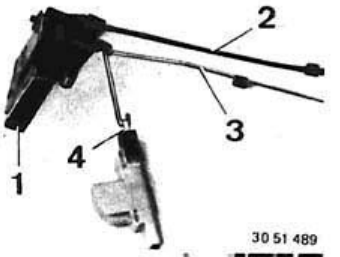
Unscrew bolts and unclip both holders (1).
Disengage door remote control.
Installation:
Preload remote control lightly.



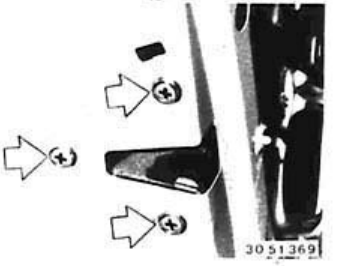
Disengage locking linkage.
Installation:
Pull linkage forward and press it into clip at same time.



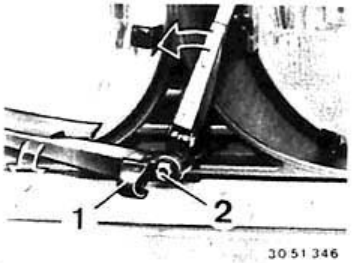
Cars with Central Locks:
Unscrew bolts.
Pull off plug.
Disengage drive.
Installation:
Adjust drive – see 51 26 010.
Troubleshoot central locks – see page 51 - 800.



Rear Door Lock Arrangement:
1 = Lock
2 = Locking linkage
3 = Door remote control
4 = Drive/connecting link

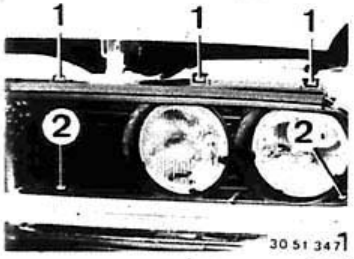


Unscrew bolts and take out door lock.

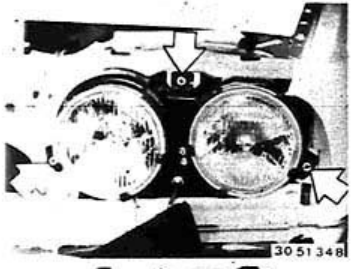


51 23 110 REMOVING AND INSTALLING OR REPLACING ENGINE HOOD LOCK

Raise engine hood.
Cars with Headlight Cleaners:
Take off cap (1).
Unscrew nut (2).
Pull wiper arms away from headlights and take off wiper linkage.



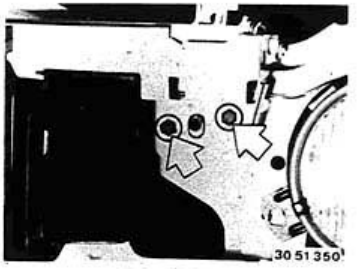
Lift clips (1) off of radiator grill on left-hand side.
Unscrew screws (2).



Unscrew left headlight.
Installation:
Aim headlights if necessary – see 63 10 004.



Unscrew and remove trim panel.



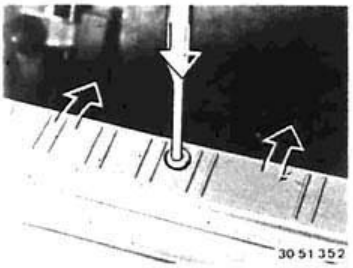
Unscrew screws.
Installation:
Align the striker through a hole provided in the body from the inside, before bolting down the striker.



Lift off cap.
Disconnect cable in holder.
Installation:
Lubricate lock with grease.
Make sure cable is seated correctly and engage in opened lock.

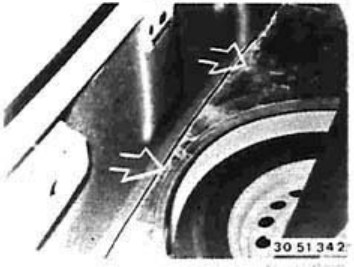
Installation:
The engine hood release must be installed prior to installation of the lock.

Installation:
Adjust engine hood if necessary – see 41 61 . . ..

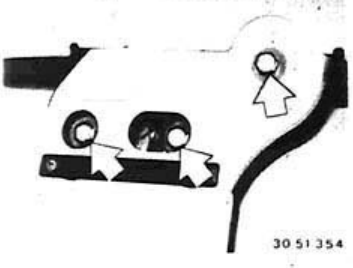

30 51 352

51 24 100 REMOVING AND INSTALLING OR REPLACING TRUNK LID LOCK

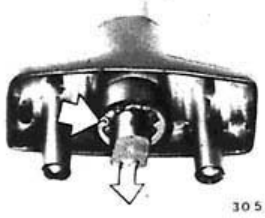
Cars with Ornamental Trunk Plate:
Press down on pins of clips and remove the ornamental plate.


30 51 342

Fold back the trunk mat.
Lift rear wall trim panel slightly at bottom and pull it out.

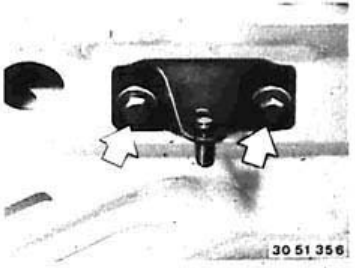

30 51 354

Unscrew screws.
Remove trunk lid lock.
Installation:
Take out lock from the side.
Prevent the lock cylinder from falling out.


30 51 355

Installation:
Service the lock cylinder if necessary.
Lift out circlip.
Pull out lock cylinder toward the rear.
Installation:
Check for correct fit of circlip in the groove.
Lubricate lock cylinder with grease*.

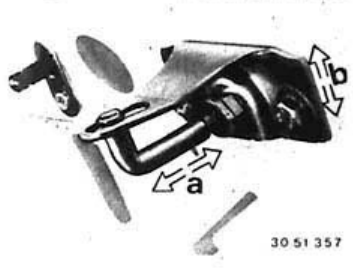
* Source: HWB


30 51 356

51 24 130 REMOVING AND INSTALLING OR REPLACING TRUNK LID LOCK BASE

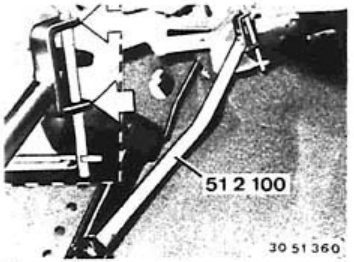
Unscrew screws.

Installation:
The lock base can be adjusted in height (a) and plane (b).



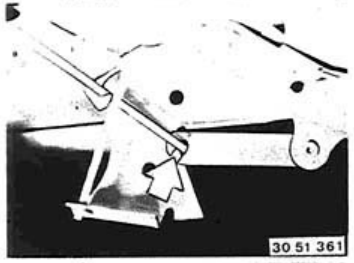
30 51 357

Installation:
Turn stop pads on left and right sides until the trunk lid has light preload.



51 24 341 REPLACING TORSION BARS FOR TRUNK LID

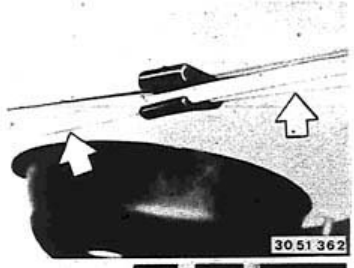
Disengage torsion bars with Special Tool 51 2 100.



Disengage torsion bars on trunk lid.

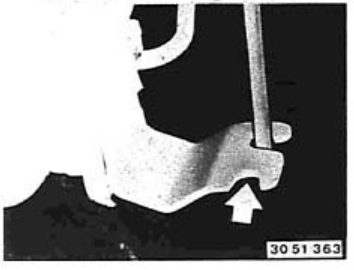
Installation:

Prevent trunk lid from falling down.
Torsion bars only have limited preload.



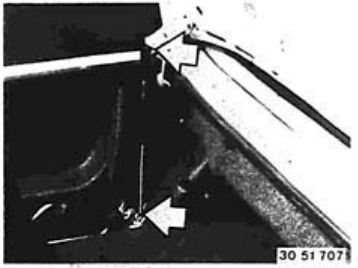
Installation:

Check torsion bars for rubbing spots in case of a grinding noise.
If necessary, lubricate joints with grease and align rubber mounts.



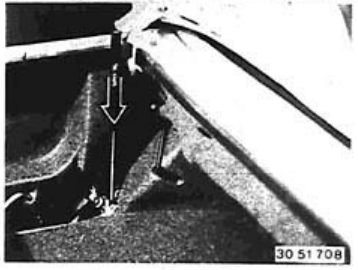
Installation:

The preload of torsion bars can be increased by inserting them in the second catch.
This could be necessary, for example, for the large toolbox.



51 24 . . . REMOVING AND INSTALLING OR REPLACING GAS PRESSURE PROPS

Lift out clips.
Remove gas pressure props.



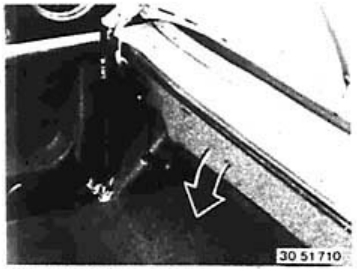
Installation:

Prevent trunk lid from falling down.
Compress gas pressure props slightly while installing.



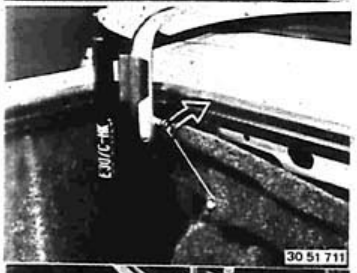
Installation:

Install piston rod facing down.
Protect piston rod against dirt, paint and damage.

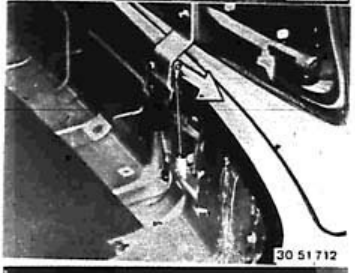


51 25 . . . REMOVING AND INSTALLING OR REPLACING LOCKING ELEMENT

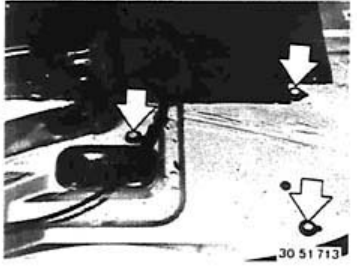
Lift out trim panel.



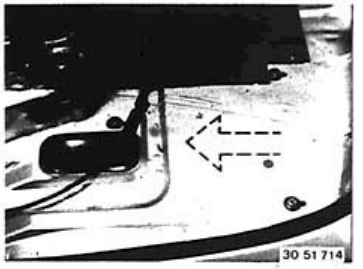
Lift out circlip.
Disconnect cable.
Note:
Only open one lid after disconnecting a cable (danger of damage).



Shut the trunk lid.
Open the top lid.
Lift out circlip.
Disconnect cable.

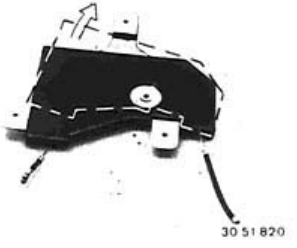


Unscrew bolts.
Lift out locking element.

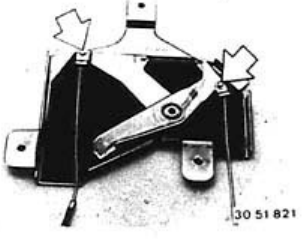


Adjusting Lock:
Tighten lock only finger tight.
Connect cables.
Shut the trunk lid.
Open the top lid.
Adjust lock in slots in forward direction until the cables are tight.
Screw on lock tight.

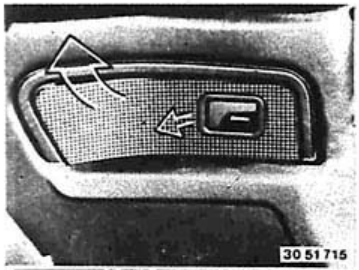
Checking Function:
Trunk lid and top lid must not interfere with each other when opened.



Note:
The plastic cover must be turned carefully to replace the cables.



The lock is shown in the picture without a plastic cover for better understanding.
If applicable, lift out retainer and remove the cable.



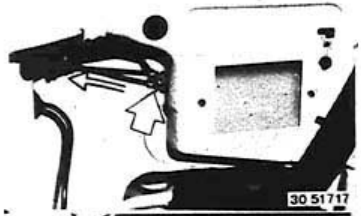
51 25 . . . REMOVING AND INSTALLING OR REPLACING CABLES FOR TOP LID LOCKS

Lift out plate.
Remove trim panel.



If applicable, lift out trim panel – see 51 43 000.
Remove remote control.

Disengage clips.

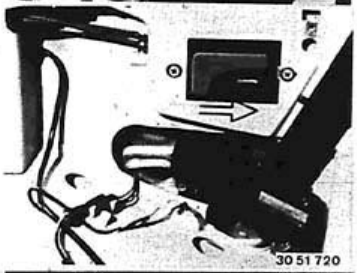




Disconnect left and right cables.

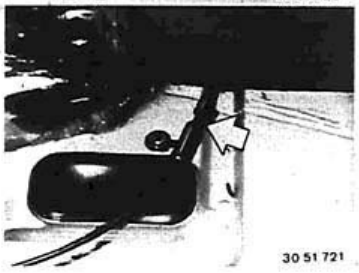


Pull out remote control.
Lift out caps.
Disconnect cables.

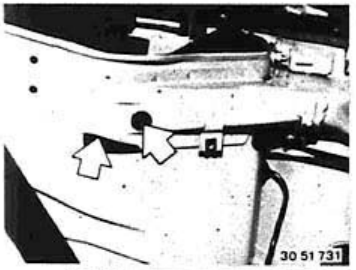


Installation:

1. Preload the short cable lightly by adjusting the remote control.

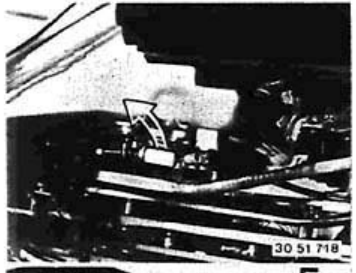


2. Preload the long cable lightly by adjusting.



51 25 . . . REMOVING AND INSTALLING OR REPLACING TOP LID LOCK

Remove trim panel – see 51 43 000.
Unscrew screws.

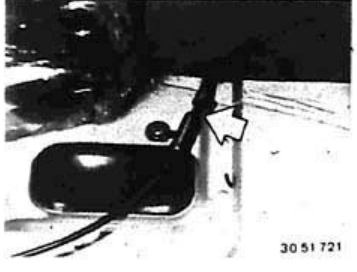


Disconnect cable.

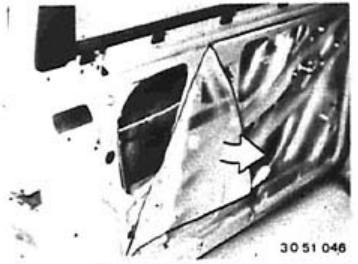


Installation:

1. Preload the short cable lightly by adjusting the remote control.

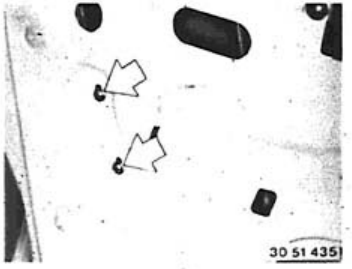


2. Preload the long cable lightly by adjusting.

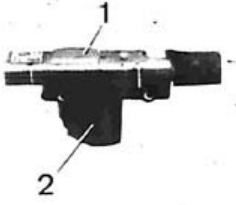


51 26 000 REPLACING SWITCH FOR LEFT OR RIGHT FRONT DOOR LOCK (DRIVE)

Remove door trim panel – see 51 41 001.
Pull off plastic sheet.
Installation:
Replace damaged plastic sheet.

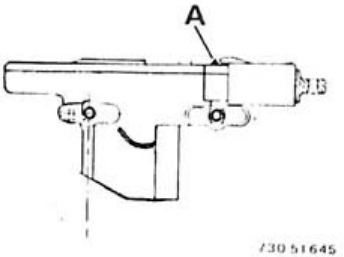


Unscrew screws.
Pull off plug.
Disengage drive.

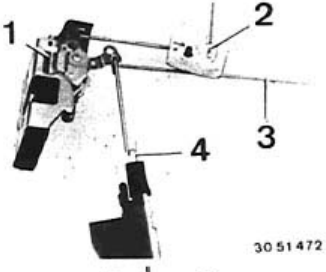


Installation:
Check identification.

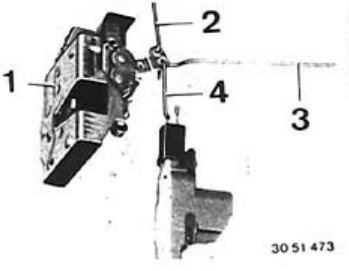
	Upper Section (1)	Lower Section (2)
Driver's door	white	red
Passenger's door	red	red
Rear doors	red	white
Trunk lid	white	red



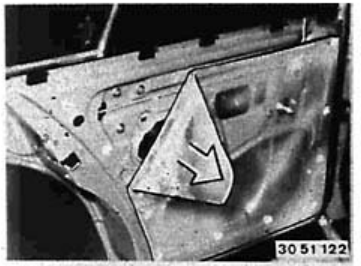
Troubleshooting central locks – see page 51 - 800.
Installation:
1. Lock in LOCKED position.
2. Locking linkage in LOCKED position.
3. Engage drive in connecting link and hold in installed position with a screw (screw is not tightened).
4. Screw in second screw.
Compress drive (position A), pull down slightly (linkage play) and then tighten screw with 2 Ncm (1.7 in. lbs.).
5. Tighten the screw installed first.
Upper section (1) faces
forward in 2-door cars
or
toward rear in 4-door cars.



Two Door Car Arrangement:
1 = Lock
2 = Locking linkage/reverse
3 = Door remote control linkage
4 = Drive/connecting link



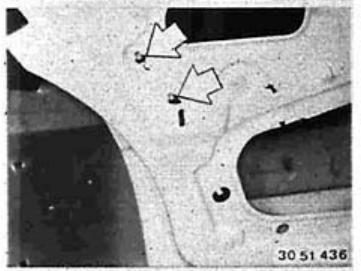
Four Door Car Arrangement:
1 = Lock
2 = Locking linkage
3 = Door remote control linkage
4 = Drive/connecting link



51 26 010 REPLACING SWITCH FOR LEFT OR RIGHT REAR DOOR LOCK (DRIVE)

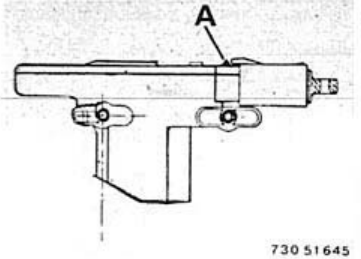
Remove door trim panel – see 51 42 001.
Pull off plastic sheet.

Installation:
Replace damaged plastic sheet.



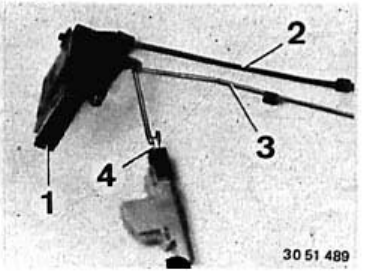
Unscrew screws.
Pull off plug.
Disengage drive.

Installation:
Check drive identification – see 51 26 000.

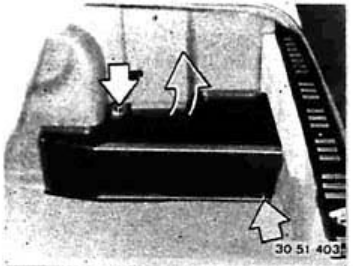


Troubleshoot central locks – see 51 - 800.

Installation:
1. Lock in LOCKED position.
2. Locking linkage in LOCKED position.
3. Engage drive in connecting link and hold in installed position with a screw (screw is not tightened).
4. Screw in second screw. Compress drive (position A), pull down lightly (linkage play) and then tighten screw to 2 Nm (1.4 ft. lbs.).
5. Tighten the screw installed first.

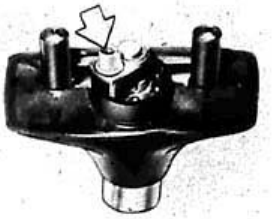


Rear Door Lock Arrangement:
1 = Lock
2 = Locking linkage
3 = Door remote control linkage
4 = Drive/connecting link

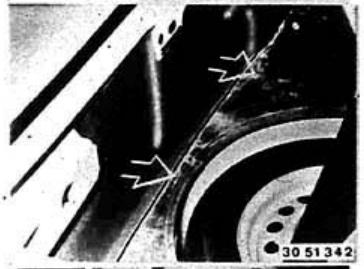


51 26 020 REPLACING SWITCH FOR TRUNK LID LOCK (DRIVE)

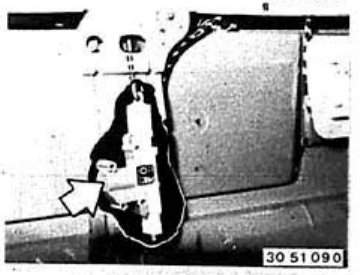
If applicable, remove battery cover.



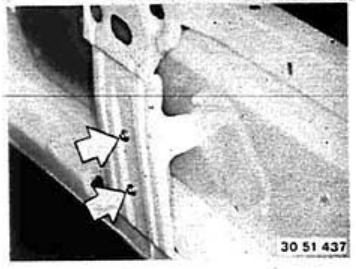
Installation:
Check for correct fit of linkage in lock.



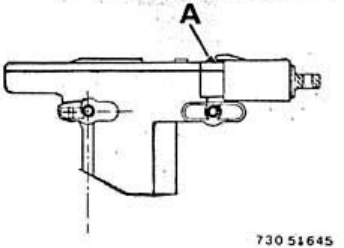
If applicable, disengage left and right tail light carriers.
If applicable, remove trim panel.



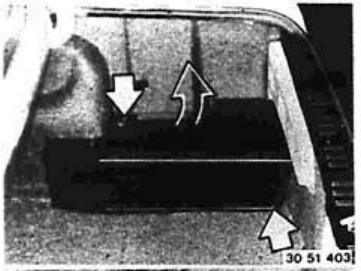
Installation:
Check drive identification — see 51 26 000.



Unscrew screws.
Disengage drive.
Pull off plug.
Installation:
Engage linkage in drive.
Slide in drive and engage in lock.

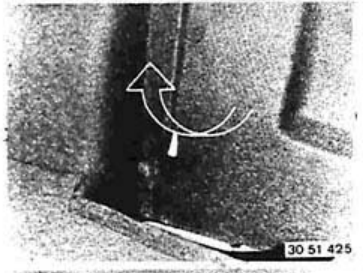


Installation:
1. Turn lock to UNLOCKED position (left).
2. Engage drive in connecting link and hold with a screw (screw is not tightened).
3. Screw in second screw.
   Compress drive (position A), pull down slightly (linkage play) and then tighten screw to 2 Nm (1.4 ft. lbs.).
4. Tighten the screw installed first.

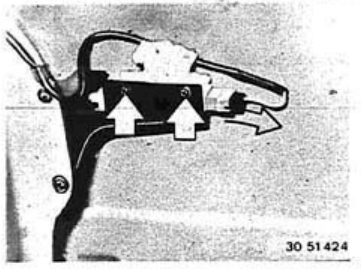


51 26 025 REPLACING SWITCH FOR FUEL TANK FLAP LOCK (DRIVE)

If applicable, remove battery cover.



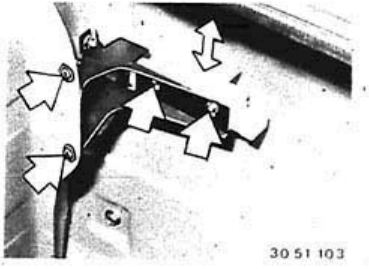
Lift out trim panel.



Unscrew screws.
Pull off plug.
Remove drive.

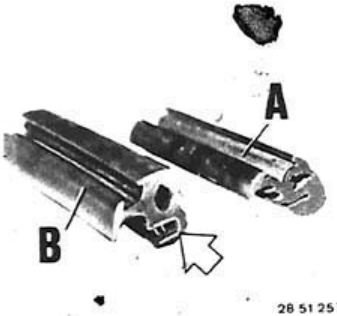


Installation:
Flat side faces down.



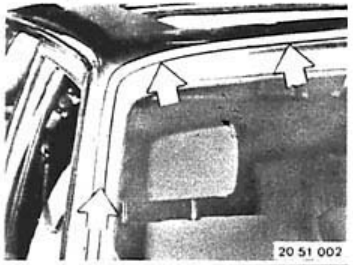
Align drive to tank flap and tighten screws.

51 31 011 REPLACING WINDSHIELD

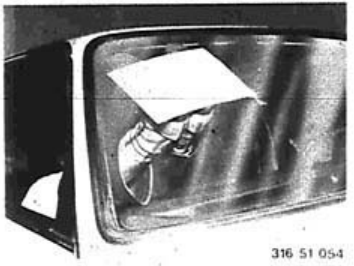


28 51 257

Note:
The rubber frame has sheet metal reinforcement in contradiction to older versions.
This changes the installation procedures.


20 51 002

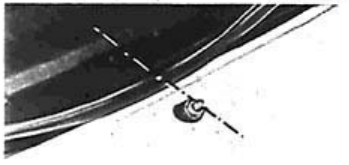
Pull out filler strip.
Pull rubber frame off of body and window glass carefully with Special Tool 51 3 057.


316 51 054

Loosen and press out windshield with foot pressure carefully, beginning at an upper corner.

Important!
The rubber frame remains in the body opening.

Installation:
Check rubber frame and filler strip, replacing if necessary.


316 51 357

Place rubber frame in body opening.
Begin with the seam at bottom center.


316 51 358

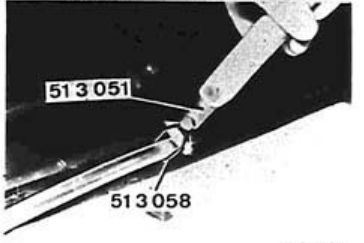
Press rubber frame firmly into body opening.


316 51 359

Rub in fold for window glass and filler strip with a lubricant*.
Slide windshield into window opening holder, starting from the middle, and center.


316 51 360

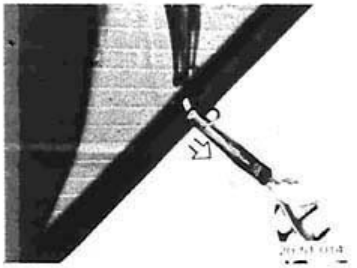
Pull rubber frame over window glass all around with a flat wood or plastic scraper.



30 51 612

Pull filler strip into rubber frame with Special Tools 51 3 051 and 51 3 058, beginning at bottom center.

* Source of Supply: HWB



51 31 200 REPLACING REAR WINDOW

Pull off connections for rear window defogger.
Installation:
Check operation.

Remaining procedures are identical with those described in 51 31 011.
If rear window glass had been broken, remove rear seat cushion and clean seat belt reels to remove glass splitters.

51 31 . . . WINDOW INSTALLING INSTRUCTIONS

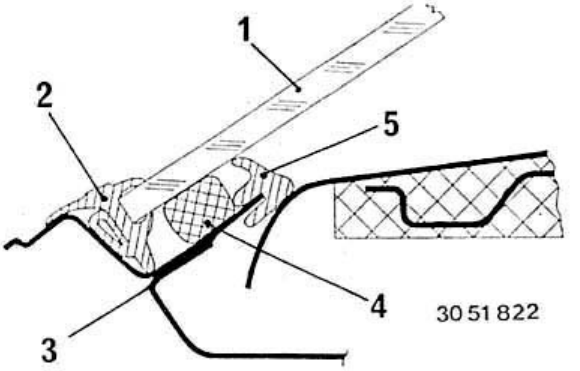
Windshield and rear window are cemented with the body for a positive connection. This improves the torsional strength of the car. Conformance with the following procedures is necessary to guarantee correctly cemented windows. Two different types of repairing are described.

1. When replacing windshield basic cement bead is already produced. For rear window clips for the ornamental frame are already installed on glass.
2. When installing windshield complete cement bead (basic and second beads) must be produced by hand. For rear window clips for the ornamental frame must be fitted.

Window glass is removed with an electric cutter* having an oscillating knife* without damaging the paint finish in the body opening as well as possible. Safety goggles and gloves must be worn for cutting out windows. Damaged body paint finish in the opening must be touched up with a BMW EP primer. The in-side of the glass has a coat of glass ceramic, which is ultra violet penetration proof, in the edge area for protection of the cement bead. The glass ceramic surface is brushed in thin with primer (repair kit*). Primer must dry at least 10 minutes. Edges of the body opening are also given a light coat of primer. The single component polyurethane (1 K-PUR) approved by BMW must be used as cement (repair kit*). The cement is applied on the window with a cartridge. Installation must be completed within 10 minutes, since otherwise the cement bead will have a skin and no longer provide sufficient adhesion.

Important!
Always remove contamination from cement remainders with benzin before the cement has hardened. Do not remove the window again for this purpose.

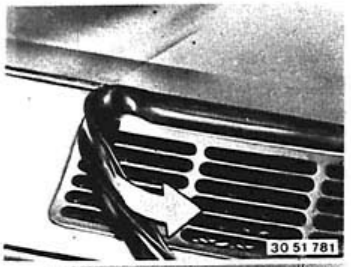
The cement hardens through reaction with air moisture at room temperature. Minimum hardening time is 4 hours at 22° C (72° F) and 38 % relative humidity. The car must not be subjected to onesided loads (e.g. one wheel on curbstone, lifting platform, etc.) during the minimum hardening time.
One side window should be opened, to avoid excessive pressure inside of the car when closing the doors.
The car can be towed or driven without a windshield or rear window.



M 3 Windshield at Bottom

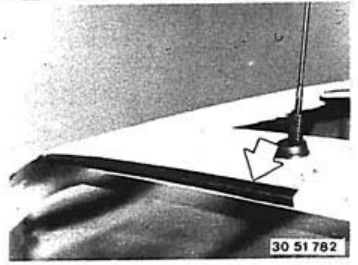
1 Windshield glass
2 Rubber frame
3 Body
4 Cement bead
5 Inside rubber seal

* Source of Supply: HWB



51 31 000 REMOVING AND INSTALLING WINDSHIELD – M 3 –

Lift out front roof liner plate and A pillar trim.
Remove windshield wipers – see Group 61.
Pull out rubber seal.



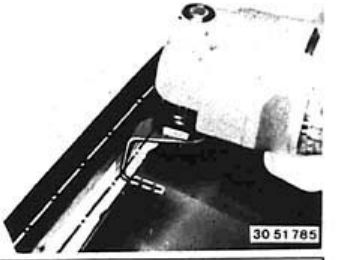
Remove cement on body.



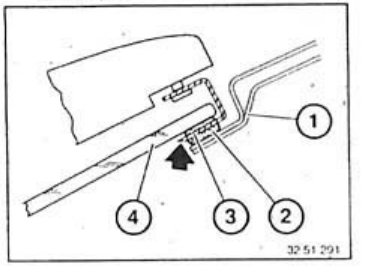
Mount knife* on electric tool*.
The knife must be parallel to the axis of the tool.

Guide in the knife* between the body and window carefully.

* Source of Supply: HWB

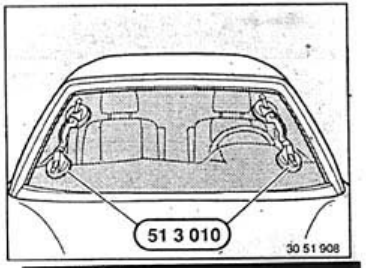


Guide traverse of knife* parallel to the window.



Cut through cement bead all around and as close as possible to the window.

1 Body opening
2 Cement bead
3 Knife
4 Window glass

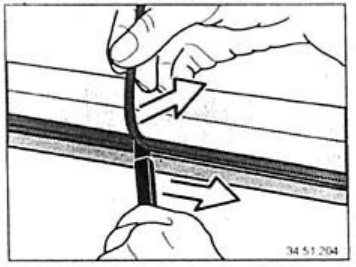


Lift out window with Special Tool 51 3 010.



If applicable, resharpen the knife* with the electric tool* running.

* Source of Supply: HWB



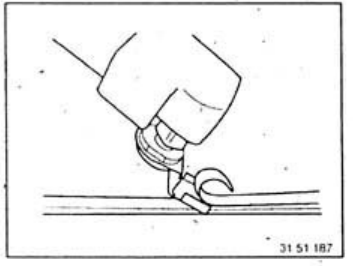
Remove residual cement on body opening but for a thickness of about 0.5 mm (0,020").

Cut off residual cement with universal knife (sharp as a razor blade) carefully to avoid damaging paint finish on body opening.

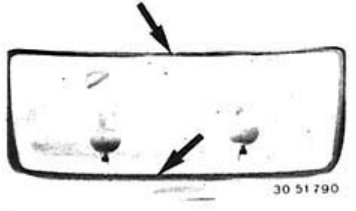
Important!
Always repair damaged paint finish to guarantee longterm corrosion inhibition!
Use BMW EP filler (2K) for this purpose.

Remove residual cement, sand out and touch up scratches in non-visible surfaces with BMW EP filler.

Large-surface damage must be sanded down to blank metal and coated with BMW EP filler (30 ... 40 µm thick coat). If complete paint buildup is necessary on visible surface, prime coated cement flange must be removed prior to application of final paint coat.



Reduce thickness of resdiual cement to about 0.5 mm (0.020") with knife*, if window can be used again.

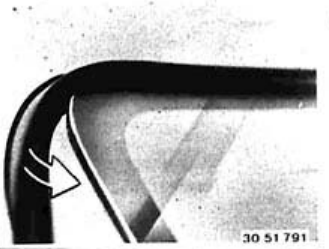


Coat window in area of cement surface with primer (repair kit*).

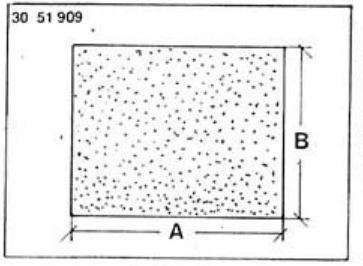
Important!
Only apply primer in area of cement surface, since otherwise glass would be impaired permanently.

Note:
Min. air drying time: 10 minutes.

* Source of Supply: HWB

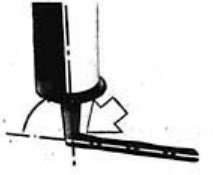


Mount rubber frame on window.



Produce new cement bead in two steps when reusing a window.
Produce first (basic) cement bead in rectangular shape (if necessary, correct the cement bead shape with a spatula).
a 12 mm (0.472")
b 10 mm (0.394")
Allow time for basic bead to harden.

Note:
Basic bead is produced in the factory for replacement windows.



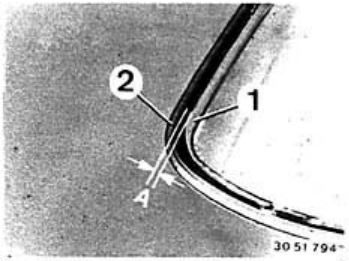
If necessary, make a sample bead before cementing.
Cartridge (repair kit*) must be perpendicular to window surface.
Make sure of uniform feed and pulling speed while producing a cement bead.

Note:
Use a cartridge gun* (pneumatic or electric) to produce uniform beads of cement.

30 51 793

Check the cement's date of expiry!

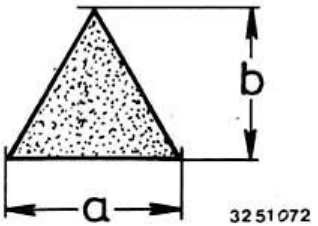
* Source of Supply: HWB



Produce first (basic) cement bead (1) on window glass next to rubber frame (2) at distance A all around.

Let first cement bead harden at least 12 hours before producing second cement bead.

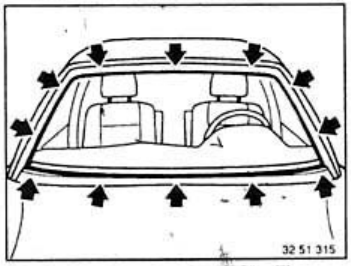
Distance A = 5 mm (0.197").



Shape of Second Cement Bead:

a 10 mm (0.394")
b 12 mm (0.472")

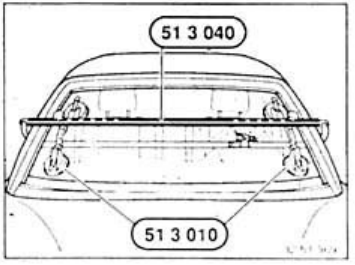
Produce second bead on the basic bead all around.



Important!
Repaired paint finish spots must be hardened!

Coat body in area of cement surface and basic bead with primer (repair kit*).

Note:
Min. air drying time: 10 minutes.



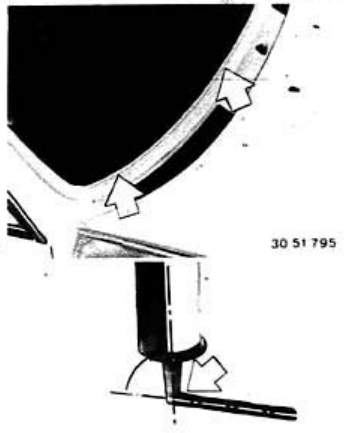
Fit in and press on window glass carefully with Special Tool 51 3 040 (used together with Special Tool 51 3 010).

Check for uniform spacing between the body and rubber frame all around.

Preload window lightly with the strap.

Important!
Always remove dirt from residual cement with cleaning benzol before the cement hardens. Don't press out the window glass again for this purpose.

Note:
Leaks can be detected by spraying water underneath the sealing lip or with an ultrasonic leak detector. Leaks can be sealed with a corresponding nozzle (repair kit*).



Place rubber in bottom area of the body opening.

If necessary, make a sample bead before cementing.
Cartridge (repair kit*) must be perpendicular to window surface.
Make sure of uniform feed and pulling speed while producing the cement bead.

Note:
Use a cartridge gun* (pneumatic or electric) to produce uniform beads of cement.

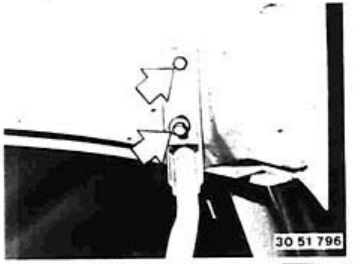
Check the cement's date of expiry!

* Source of Supply: HWB

* Source of Supply: HWB

51 31 200 REPLACING REAR WINDOW – M 3 –

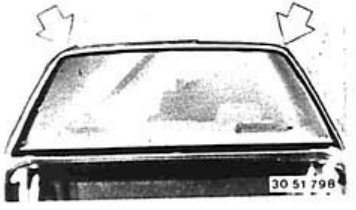
The same conditions are applicable to the rear window as to the windshield – also refer to the M 3 window installing instructions (51 31 . . .).



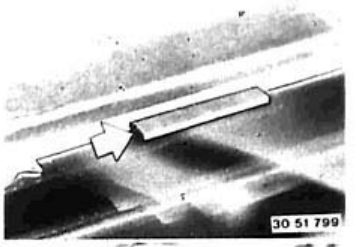
Unscrew bolts.
Remove trunk lid.
Disconnect torsión bars – see 51 24 341.



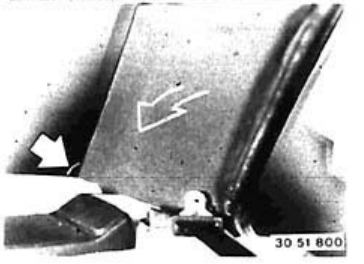
Push the cover aside.
Lift out the ornamental frame.



Remove cement on the body.



Lift out clips.

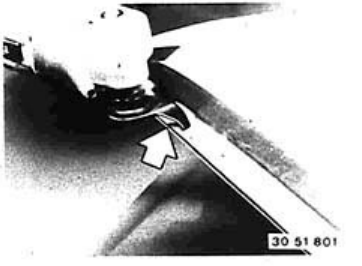


Lift out C pillar trim and pull off plug for the rear window defogger.
Remove side window in cars without a vent window – see 51 36 050.

Installation:
Cement the C pillar trim on the body opening edge for the window.

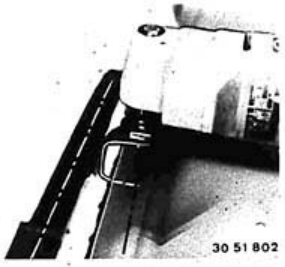


Mount the knife* on the electric tool*. The knife must be parallel to the axis of the tool.

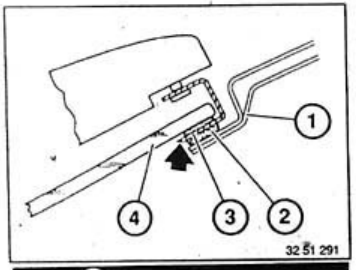


Guide in the knife between the body and window carefully.

* Source of Supply: HWB

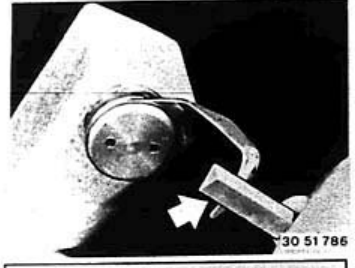


Guide traverse of knife parallel to window.

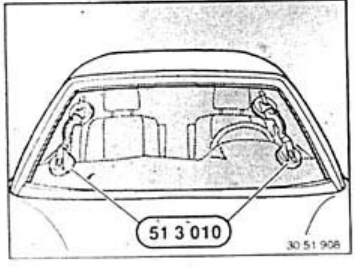


Cut through cement bead as close as possible to window glass.

1 Body opening
2 Cement bead
3 Knife
4 Window glass

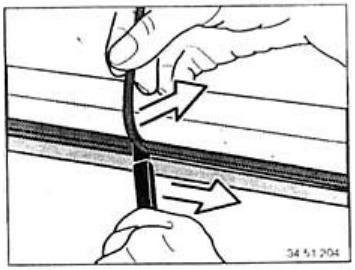


If applicable, resharpen the knife* while electric tool is running.



Lift out window with Special Tool 51 3 010.

* Source of Supply: HWB

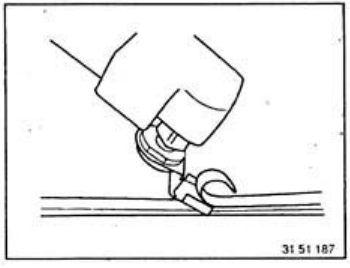


Reduce thickness of residual cement on body opening surface to about 0.5 mm (0.020").

Cut off residual cement with universal knife (sharp as a razor blade) carefully, to avoid damaging the paint finish on body opening surface.

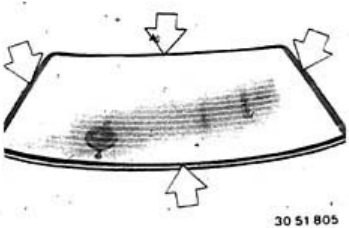
Important!
Always repair damaged paint finish to guarantee longterm corrosion inhibition!
Use BMW EP filler (2K) for this purpose.
Remove residual cement, sand out and touch up scratches in non-visible surfaces with BMW EP filler.

Large-surface damage must be sanded down to blank metal and coated with BMW EP filler (30 ... 40 µm thick coat). If complete paint buildup is necessary on visible surface, prime coated cement flange must be removed prior to application of final paint coat.



Reduce the residual cement to about 0.5 mm (0.020") when reusing the window.

Brush in window and body in area of cement surface with a primer (repair kit*).



Important!
Repaired paint finish spots must be hardened. Only apply primer in area of cement surface, since otherwise window glass will be impaired permanently.

Note:
Air drying time: at least 10 minutes.

* Source of Supply: HWB

The clips must be installed by hand when re-using the window.
Pull off cover on back of adhesive strips.



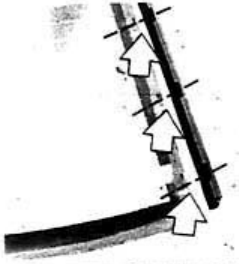
30 51 806

Moisten the adhesive strip covers with water to make installation easier.



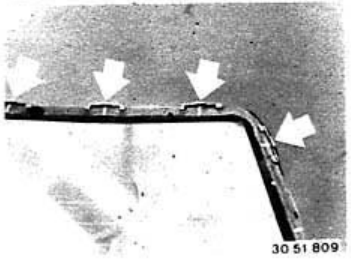
30 51 807

Mark window to match openings in the ornamental strips.
Center of ornamental strip opening = center of clip.

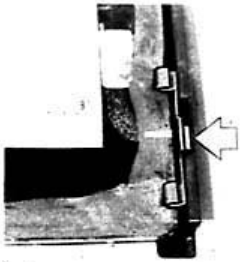


30 51 808

Mount clips to match the marks.

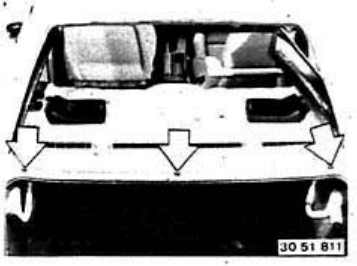


30 51 809



30 51 810

Clip in ornamental strips.



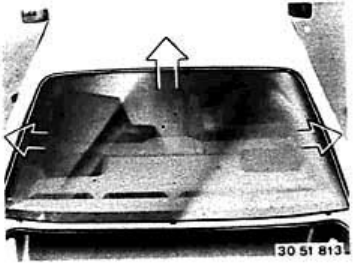
30 51 811

Place adjusting pads in openings of the window opening in the body.



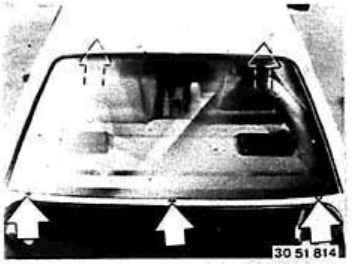
30 51 812

Note:
Three different heights, in steps of 1.5 mm (0.059") can be selected by turning the adjusting pads.

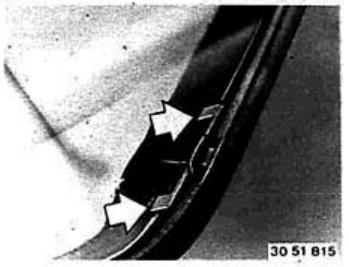


30 51 813

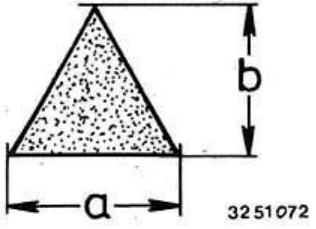
Install and fit window in the body opening with Special Tool 51 3 010. Ornamental strips and clips can be moved slightly (until moisture has evaporated) and therefore aligned with the body opening.



Adjust window by turning adjusting pads until window bears uniformly in body opening.

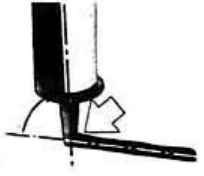


Lift out window with Special Tool 51 3 010 and cut off tabs on clips all around.



Shape of Cement Bead:

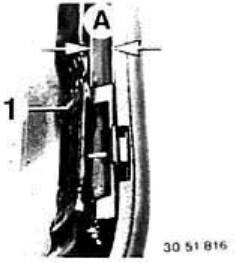
a 10 mm (0.394")
b 12 mm (0.472")



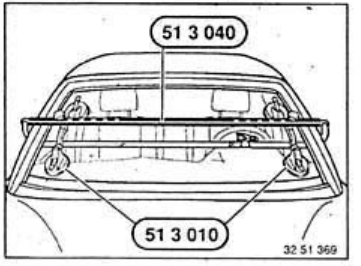
If necessary, make a sample bead before cementing. Catridge must be perpendicular to window surface. Check for uniform feed and pulling speed during application of cement.

Note:
Use a cartridge gun* (pneumatic or electric) to produce uniform beads of cement.
Check the cement's date of expiry!

* Source of Supply: HWB



Produce cement bead (1) on window all around.
Distance A to edge of window = approx. 5 mm (0.197").



Fit in and press on window carefully with Special Tool 51 3 040 (used in conjunction with Special Tool 51 3 010).

Check for uniform spacing between body and ornamental strip all around.

Preload window lightly with a strap.

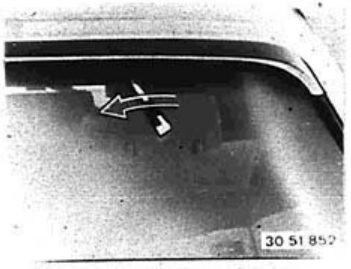
Important!
Always remove dirt from residual cement with cleaning benzol before the cement has hardened. Don't press out window again for this purpose.

Note:
Leaks can be detected by spraying water underneath sealing lip or with an ultrasonic leak detector.
Leaks can be repaired with a corresponding nozzle (repair kit*).

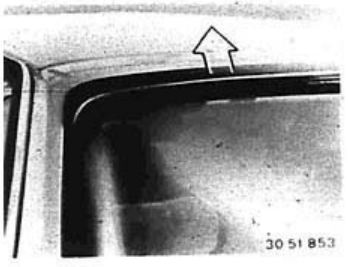
* Source of Supply: HWB

51 31 200 REMOVING AND INSTALLING REAR WINDOW – Touring –

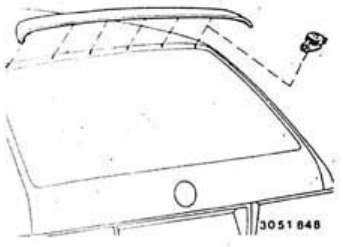
The same conditions are applicable to the rear window as to the windshield – also refer to M 3 window installing instructions (51 31 . . .).



Cut through the cement bead on the rear spoiler, as applicable, with a sharp flat knife or an electric tool* and knife*.

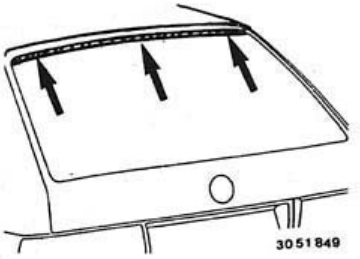


Lift off rear spoiler.



Installation:
Replace clips when reusing the spoiler. If applicable, remove the adhesive sheet uniformly.

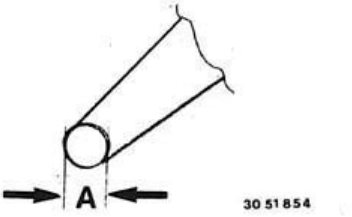
* **Source of Supply: HWB**



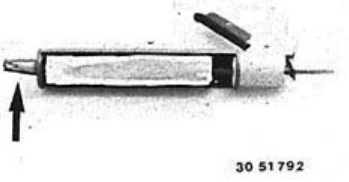
Brush in window in area of the cement surface with a primer*.

Note:
Air drying time: at least 10 minutes.

Important!
Apply the primer only in the area of the cement surface, since otherwise the window glass would be impaired permanently.

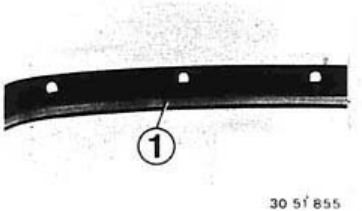


Cut off the closed nozzle tip in such a manner to have a cross section opening A of 5 mm (0.197").



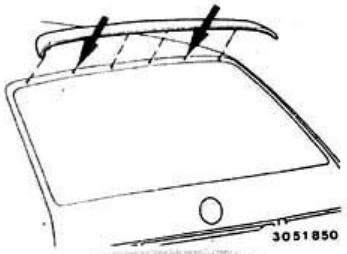
Produce sample beads before cementing.
Check for uniform feed and pulling speed during application of the cement.

Note:
Check the cement's date of expiry!



Produce cement bead (1) in area of the adhesive sheet.

* **Source of Supply: HWB**



Fit and press on the spoiler carefully.



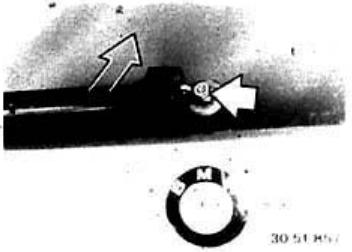
Hold spoiler on car with adhesive tape.

<u>Installing New Spoiler:</u>

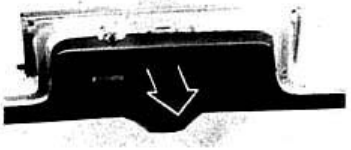
The spoiler must be heated to 40 ... 50° C (115 ... 130° F) for maximum 30 minutes prior to installation, in order to have greater initial adhesive force from the adhesive tape. The orange-red liner must be pulled off of the adhesive tape prior to installation.

The spoiler is pressed firmly on the window glass by hand after clipping in and positioning the spoiler. This requires a minimum pressing-on force of 10 N (2 lbs.) / cm^2; in other words it must be pressed on thoroughly and firmly.

Installation of the spoiler has then been completed and it is not necessary to hold it in position additionally.



Lift off cap.
Unscrew screw and take off window wiper.

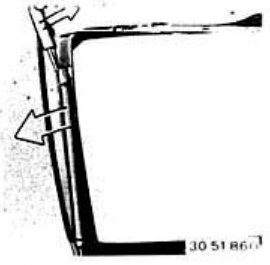


Unclip trim panel.

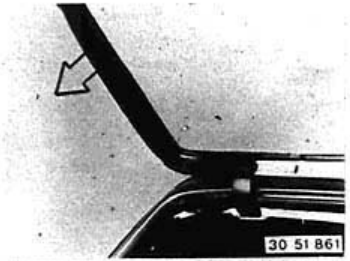
Installation:
Replace damaged clips.



Unscrew screws and take off window wiper motor.

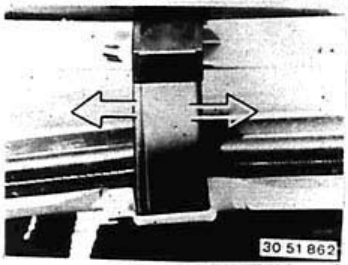


Prevent the tailgate from falling down.
Disconnect retainers on left and right sides.
Pull off gas pressure props on left and right sides.

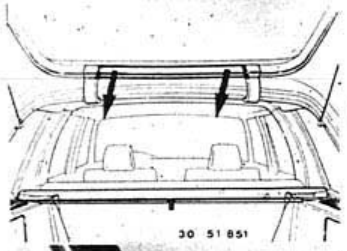


Unclip trim panel on left and right sides.
If applicable, reconnect gas pressure props.

Installation:
Replace damaged clips.

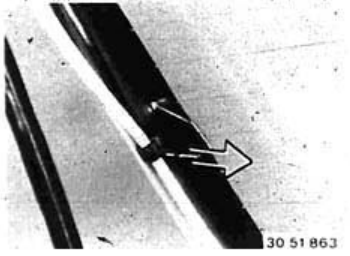


Remove hinge trim panel.



Unclip trim panel.

Installation:
Replace damaged clips.



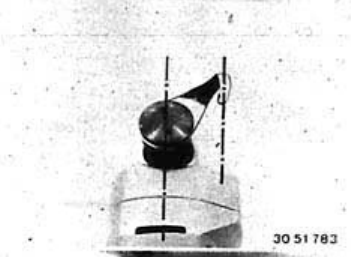
Pull off and hold plug on the window glass with adhesive tape.



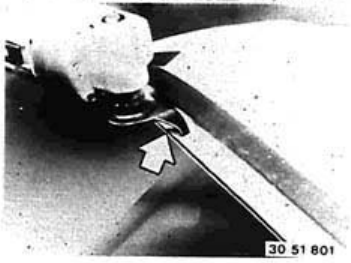
Lift off ornamental strips on left and right sides.



Pull out rubber seal.

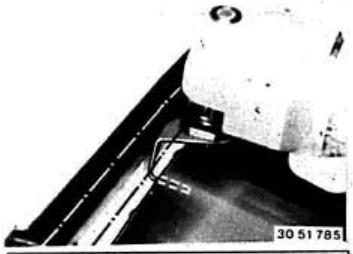


Mount knife* on electric tool*.
The knife must be parallel to the axis of the tool.

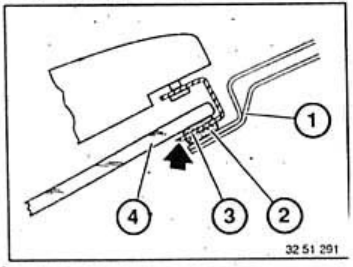


Guide in knife* carefully between the body and window glass.

* Source of Supply: HWB



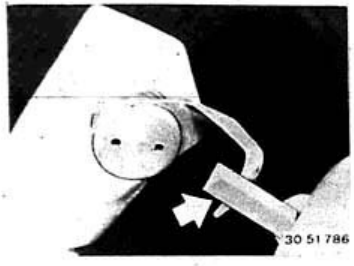
Guide traverse of knife* parallel to window glass.



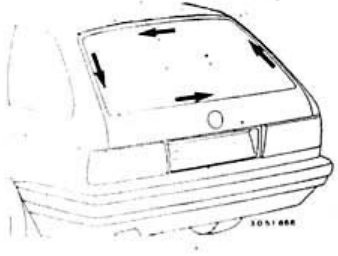
Cut through cement bead as close as possible to window.

1 Body opening
2 Cement bead
3 Knife
4 Window

If applicable, resharpen knife* while operating the electric tool*.



Cut through cement bead from outside all around.

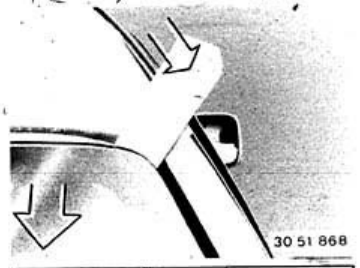


Cut through cement bead in corners, in bottom zone from inside, with a straight knife*.

* Source of Supply: HWB



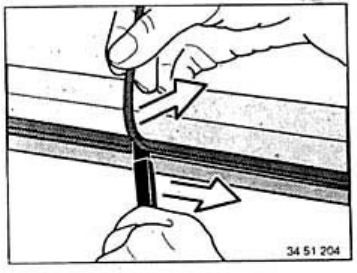
If applicable, lift window glass slightly with a wood wedge and lift out carefully with Special Tool 51 3 010.



Reduce residual cement on body opening surface to a thickness of approx. 0.5 mm (0.020").

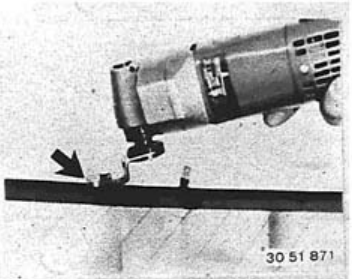
Cut off residual cement with an universal knife (sharp as a razor blade) carefully to avoid damaging paint finish on body opening surface.

Important!
Always repair damaged paint finish to guarantee longterm corrosion inhibition!
Use BMW EP filler (2K) for this purpose.



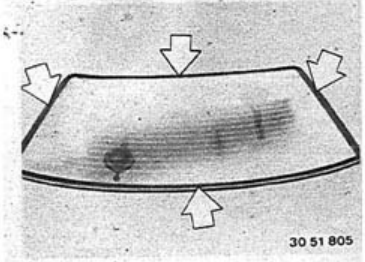
Remove residual cement, sand out and touch up scratches in non-visible surfaces with BMW EP filler.

Large-surface damage must be sanded down to blank metal and coated with BMW EP filler (30 ... 40 µm thick coat). If complete paint buildup is necessary on visible surface, prime coated cement flange must be removed prior to application of final paint coat.



Reduce residual cement on window glass to a thickness of approx. 0.5 mm (0.020") with knife* and clean cement surface to remove dust, dirt and grease when reusing window.

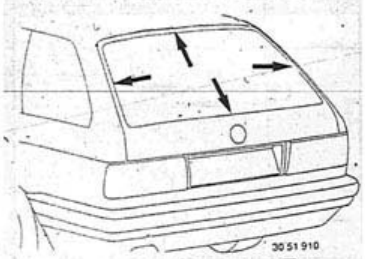
Important!
Don't damage glass ceramic layer.



Brush in window with a primer (repair kit*) in area of cement surface.

Important!
Apply primer only in the area of cement surface, since otherwise window glass would be impaired permanently.

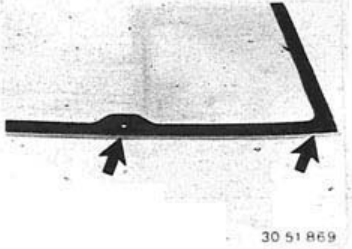
Note:
Air drying time: at least 10 minutes.



Brush in body with a primer (repair kit*) in area of cement surface.

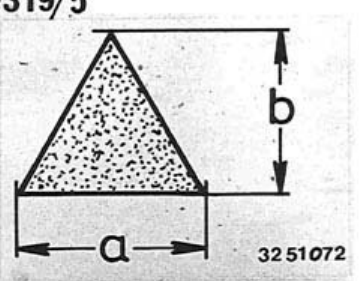
Important!
Repaired paint finish spots must be hardened.

Note:
Air drying time: at least 10 minutes.



Installation:
Install rubber seal on window glass.

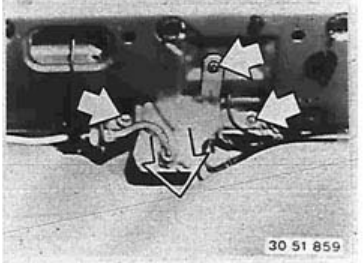
* Source of Supply: HWB



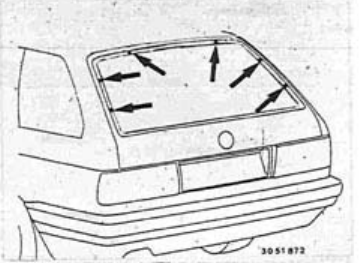
Shape of Cement Bead:

a 6 to 8 mm (0.236 to 0.315")
b 8 to 10 mm (0.315 to 0.394")

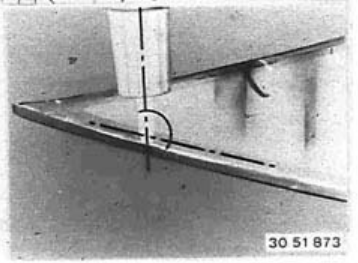
Shorten nozzle from repair kit* accordingly.



Mount window wiper motor (used to center window glass).

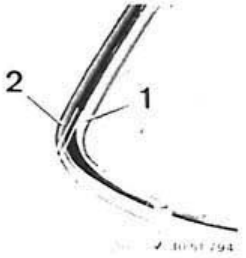


Insert spacers (repair kit*).



If necessary, produce a sample bead before cementing. Cartridge must be perpendicular to window surface. Make sure of uniform feed and pulling speed while producing cement bead.
Note:
Usa a cartridge gun* (pneumatic or electric) to produce uniform beads of cement.
Check the cement's date of expiry!

* Source of Supply: HWB



Produce cement bead (1) all around at distance (A) to window glass edge (2). Distance A =5 mm (0.197").

Fit in and press on window glass carefully with Special Tool 51 3 040 (used in conjunction with Special Tool 51 3 010).

Check for uniform spacing between the window glass and body all around.

Preload the window glass lightly with a strap.

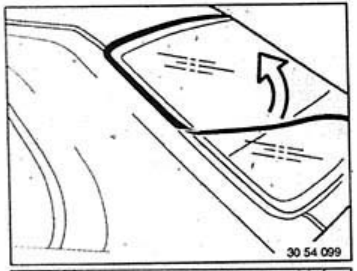
Important!
Always remove dirt from residual cement with a cleaning benzol before the cement has hardened. Don't press out the window glass again for this purpose.

Note:
Leaks can be detected by spraying water underneath the sealing lip or with an ultrasonic detector.
Leaks can be repaired with a corresponding nozzle (repair kit*).

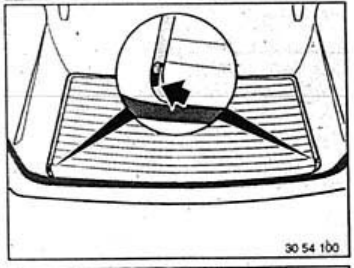
* Source of Supply: HWB

51 31 ... REMOVING AND INSTALLING REAR WINDOW
– Hardtop –

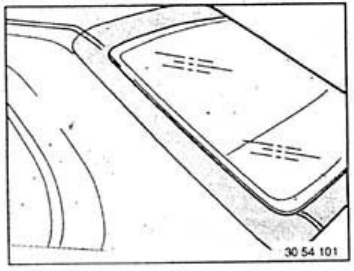
Same conditions apply to rear window installation as for windshield installation.
Also refer to M 3 window installing instructions – see 51 31 ....



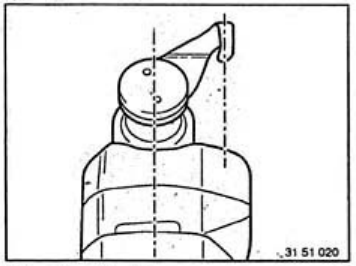
Pull out rubber inlet.



Pull off plugs for rear window defogger on left and right sides from inside.

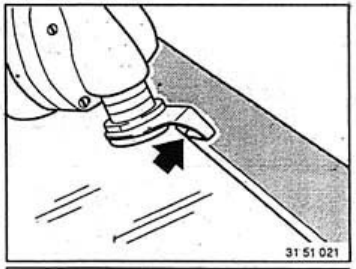


Cover hardtop in area of body opening generously.

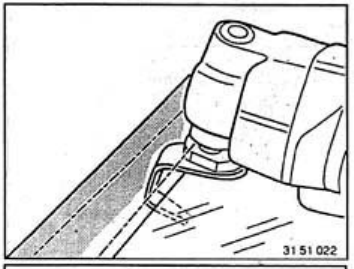


Install short knife* on electric cutter*.

Note:
Knife* must be parallel to tool axis.

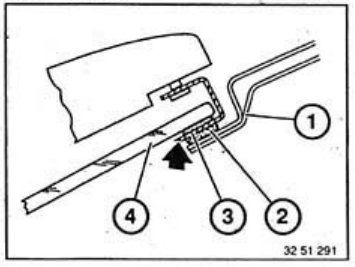


Guide in knife carefully between body and window.



Guide traverse of knife parallel to window.

Caution!
Don't damage hardtop skin.



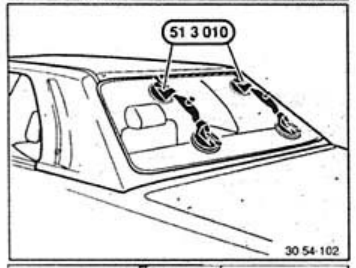
Cut through cement bead as close as possible to window.

1 Body opening (hardtop)
2 Cement bead
3 Knife
4 Window

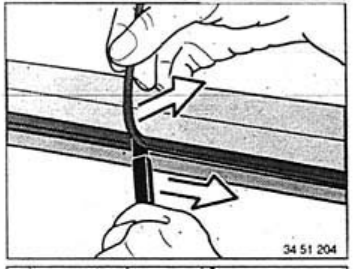
*** Source of Supply: HWB**



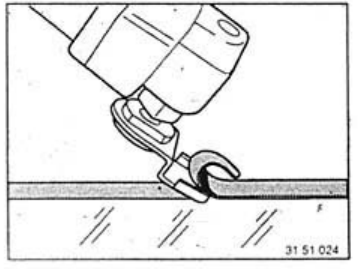
If necessary, resharpen knife* with electric tool* running.



Lift out window with Special Tool 51 3 010.

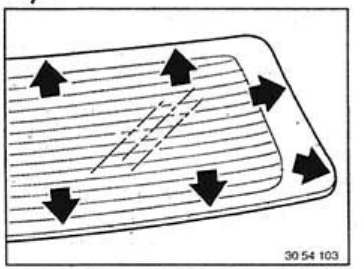


Reduce thickness of residual cement in body opening to about 0.5 mm (0.197"). Cut off residual cement with universal knife (sharp as razor blade) to avoid damaging hardtop skin.



If reusing window, reduce thickness of residual cement on glass with knife* to about 0.5 mm (0.020") and clean cement surface to remove dust. dirt and grease.

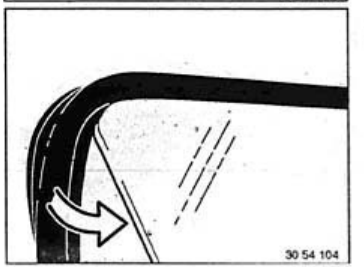
* Source of Supply: HWB



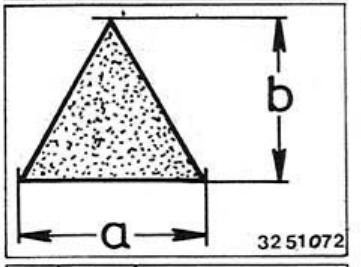
Brush in window and body opening in area of cement surface with primer (repair kit*).

Important!
Only apply primer in area of cement surface as otherwise non-removable dull spots will be produced on window.

Note:
Air drying time: at least 10 minutes.

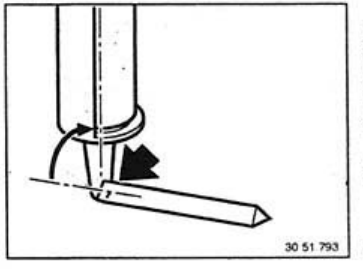


Install rubber inlet on window.



Shape of cement bead:

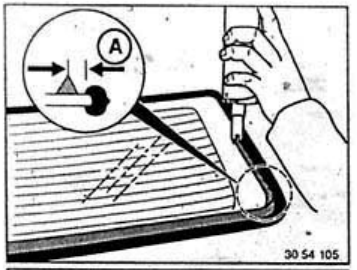
a = 10 mm (0.394")
b = 12 mm (0.472")



If necessary, make sample bead prior to cementing.
Cartridge must be perpendicular to window.
Make sure of uniform feed and pulling speed while producing cement bead.

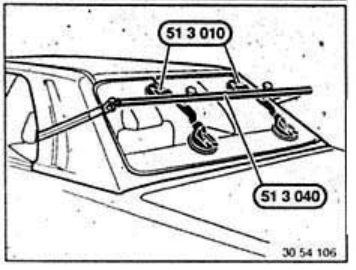
Note:
Check the cement's date of expiry!

* Source of Supply: HWB



Produce cement bead (1) on window glass all around next to rubber inlet (2) at distance (A).
A = 5 mm (0.197").

Important!
Cement spots on hardtop skin cannot be removed completely.



Fit in and press on window carefully with Special Tool 51 3 040 (used in conjunction with Special Tool 51 3 010).

Check for uniform spacing between body and rubber inlet all around.

Preload window lightly with a strap.

Note:
Leaks can be detected by spraying water underneath sealing lip or with ultrasonic leak detector.
Leaks can be repaired with corresponding nozzle (repair kit*).

* Source of Supply: HWB

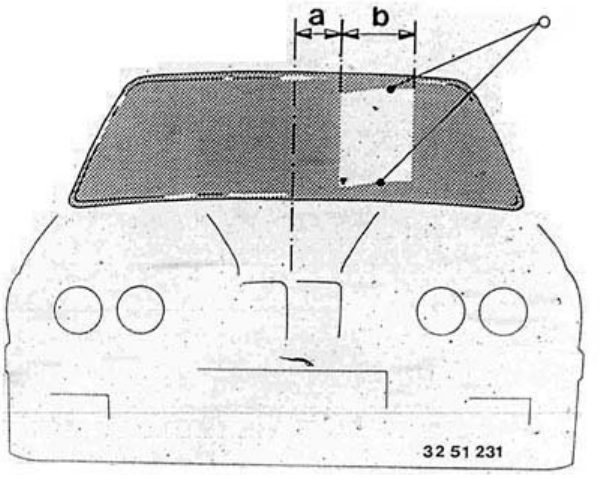
51 31 ... REPAIRING LAMINATED SAFETY GLASS WINDSHIELDS (CLEAR AND TINTED) DAMAGED BY FLYING STONES

These instructions are meant for specialists and assume their skill, conscientiousness and sense of responsibility. The instructions are also limited to factory approved repairing materials*, repairing methods and tips to make the work easier. Only general procedures are described in the instructions. Scope of work must be adapted to the actual damage situation. Repairing procedures are an economical solution, so that optical deficiencies cannot be excluded. Consequently the repair should only be carried out when explicitly ordered by the customer.

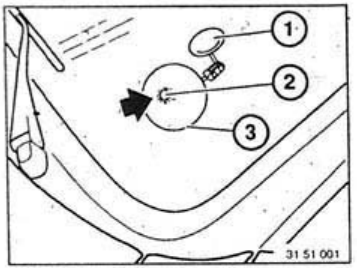
The conditions listed below for repairing laminated safety glass windshields conform with legislation in Germany. Always conform with the pertinent legislation in other countries!

Important!

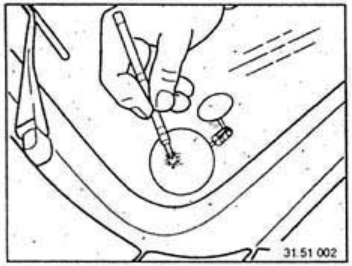
1. Only damage on the outside surface of the windshield may be repaired. Inside window surface and the plastic sheet between inside window and outside window must not be damaged at all.
2. Repairing should take place as soon as possible after the window had been damaged. Moisture and dirt or similar must not have been allowed to penetrate into the damaged spot.
3. The crater produced where the stone had hit the window must not exceed a diameter of 5 mm (0.197").
4. Cracks extending radially from the point where the stone had hit must not be longer than 50 mm (1.969"). They must not end in the rubber frame or ornamental frame of the windshield.
5. Repairs may be carried out only outside of the driver's field of view (see sketch). View through the repaired point must be clear, transparent and without distortion whenever possible.
6. Always conform with instructions supplied by the manufacturers.



a = 210 mm (8.268") (distance from view field to center of car)
b = 290 mm (11.417") (view field width)
o = Wiped field limit

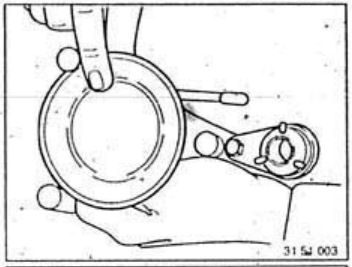


Apply a thin coat of gel on suction cup (1) of the concave mirror and position suction cup on inside of the windshield in such a manner that the impact spot (2) can be seen from the outside in concave mirror (3).

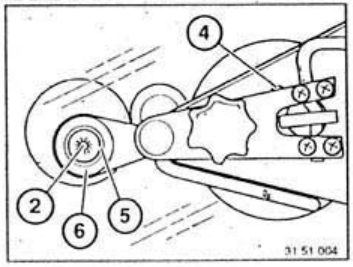


Remove all glass splitters from the impact spot from the outside with a scribe so that a rough surface is produced.

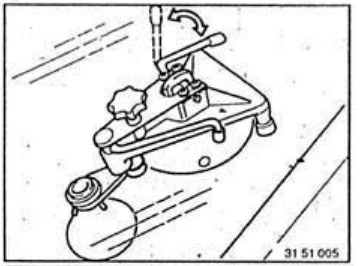
Important!
Don't increase the size of the impact spot hole.



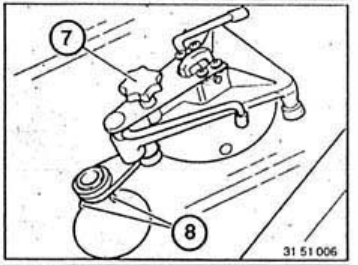
Apply a thin coat of gel on the suction cup of the tool holder.



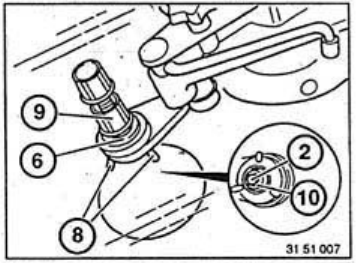
Position tool holder (4) on outside of the window in such a manner that opening (5) of head (6) is precisely over the impact spot (2).



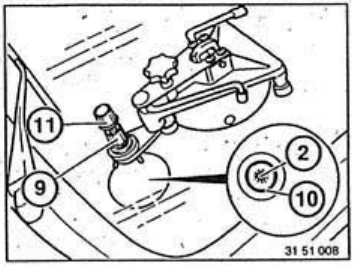
Move locking lever forward and back.



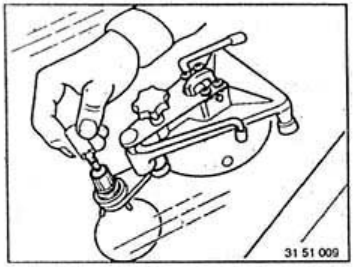
Screw in knurled head screw (7) far enough that base (8) bears firmly on the windshield.



Screw in cylinder (9) in head (6) far enough that rubber seal (10) surrounds impact spot (2) on the window firmly and base (8) just barely lifts off again.

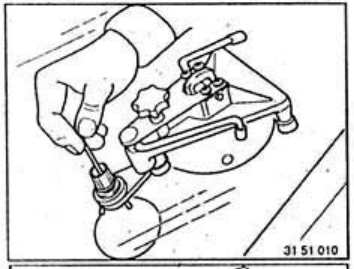


Screw injector (11) out of cylinder (9). Look into cylinder (9) from above and check whether rubber seal (10) is positioned centrally over impact spot (2). Reposition, if necessary.

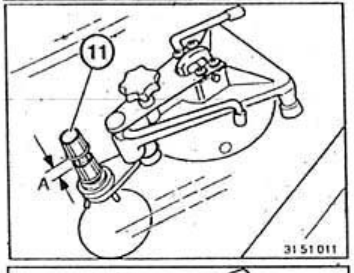


Open bottle of resin and pour about 1/3rd of its contents into the cylinder.

Important!
Always close the resin bottle immediately after use and protect it against ultraviolet light.

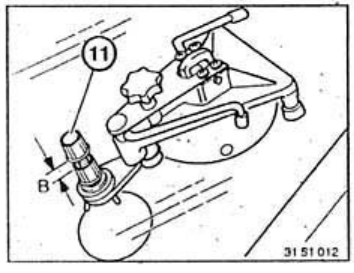


Stirr resin poured into the cylinder with a wooden rod to remove air bubbles.



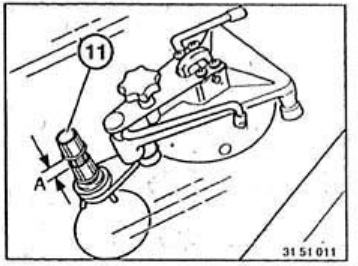
Screw injector (11) into cylinder up to distance A (slight resistance noticed) and let everything rest about 5 minutes.
Distance A = 5 mm (0.197").

Note:
Pressure will be about 16 bar (225 psi) in this position. When observing the impact spot,it will be recognized that air in the impact spot disappears slowly (recognized as black shade).



Unscrew injector (11) quickly to distabce B.
Distance B = 12 mm (0.472").

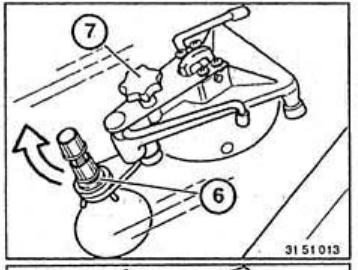
Note:
In this position there will now be vacuum which "pulls" the remaining air out of the impact spot.



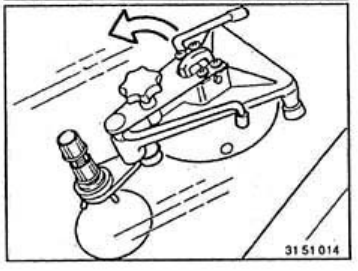
Screw injector (11) into cylinder to distance A again (slight resistance noticed) and let everything rest several minutes again.
Distance A = 5 mm (0.197").

Repeat this step several times, alternating between pressure and vacuum, and then let injector (11) rest for a time in an intermediate position between distance A and distance B.

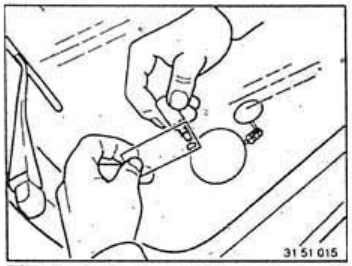
Note:
If this has still not removed all of the air, heat the inside of the window with a lighter several seconds. The flame should be held as close as possible to the window, but not touch it.



Loosen knurled head screw (7), swing head (6) aside and observe the repaired spot from above and in the concave mirror from various angles.
Air inclusions should no longer be visible.
Should air inclusions still be seen, swing head (6) back over the impact spot and screw in knurled head screw (7) as far as before.
Repeat the steps as from the pressure/vacuum step.

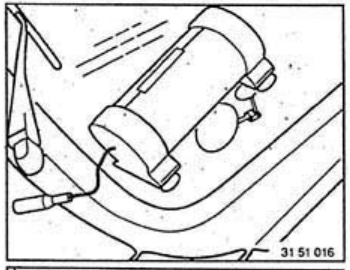


Swing locking lever forward and remove tool holder from the windshield.

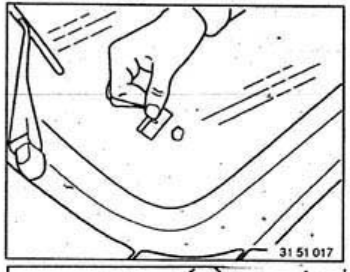


Let one drop of resin drip on the impact spot and cover with clear plastic sheet.

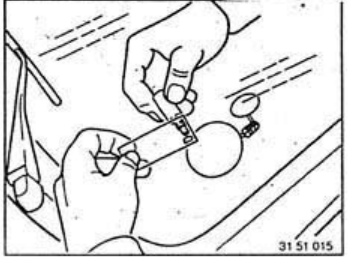
Note:
Only place clear plastic sheet over the impact spot — don't press it on!



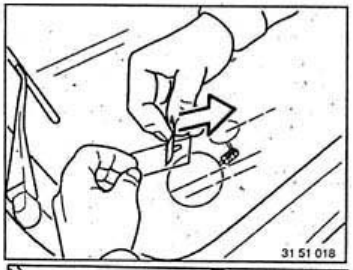
Apply ultraviolet lamp over the repaired spot and press on firmly (suction cups).
Connect ultraviolet lamp and let resin harden about 10 minutes.



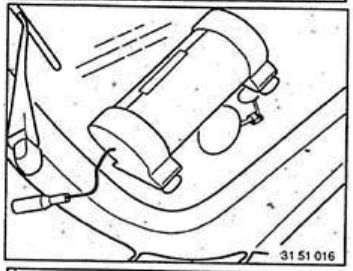
Remove ultraviolet lamp, pull off clear plastic sheet and scrape off excessive resin with a razor blade.



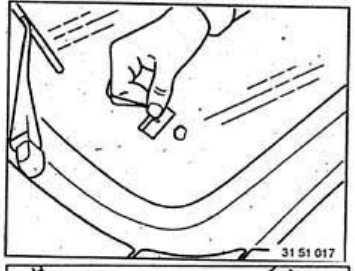
Let another drop of resin drip on the impact spot and cover with a new piece of clear plastic sheet.



Move the razor blade over the clear plastic sheet carefully to have excessive resin run out on the sides.

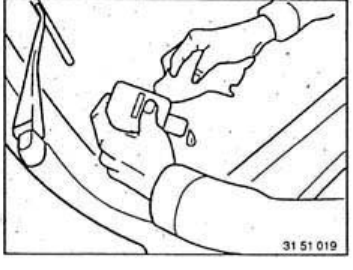


Set up ultraviolet lamp over the repaired spot again and press on firmly (suction cups).
Connect ultraviolet lamp and let resin harden about 10 minutes.

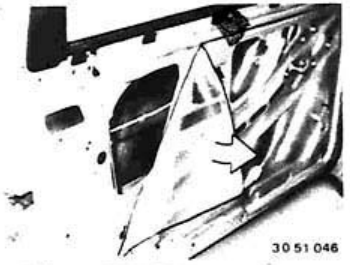


Remove ultraviolet lamp, pull off clear plastic sheet and scrape off excessive resin all around the impact spot with a razor blade.

Important!
Don't scrape on impact spot (2)!

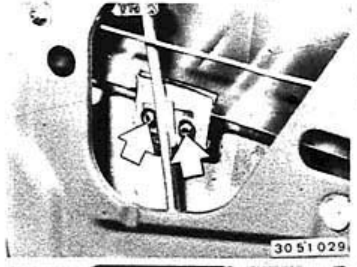


Polish the repaired spot with a cloth not losing lint and a polish until the surface is clean and smooth.

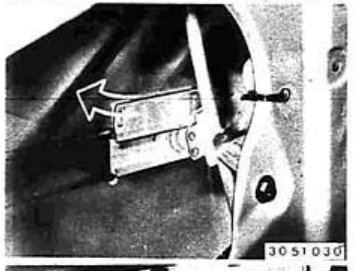


51 32 020 REMOVING AND INSTALLING OR REPLACING WINDOW REGULATOR IN LEFT OR RIGHT FRONT DOOR

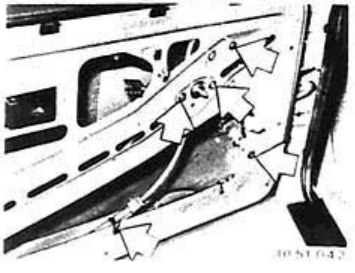
Remove door trim panel 51 41 001.
Pull off plastic sheet.
Installation:
Replace damaged plastic sheet.



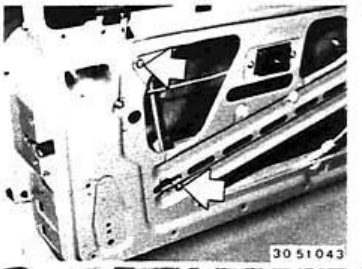
Position door window glass that mounting screws can be unscrewed.
Note:
Hold door window glass.
Installation:
Adjust door window 51 32 154.



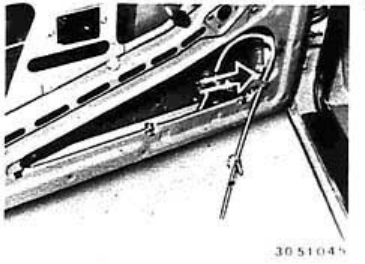
Swing front end of glass out of guide roller.
Lower door window glass.



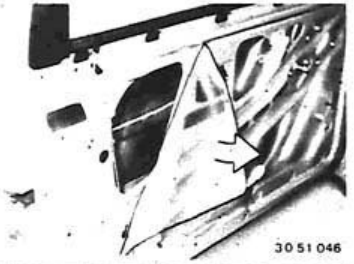
Unscrew screws.
Cut off electrician's tape.



Unscrew screws.

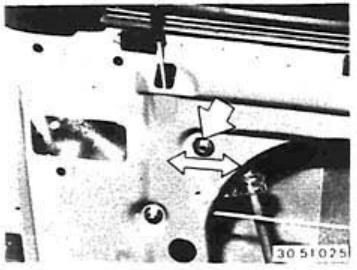


Remove window regulator.

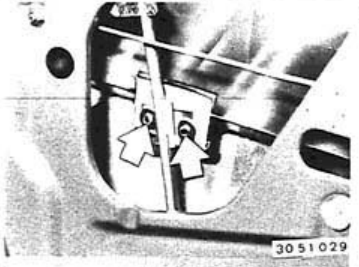


51 32 154 ADJUSTING LEFT OR RIGHT FRONT DOOR WINDOW

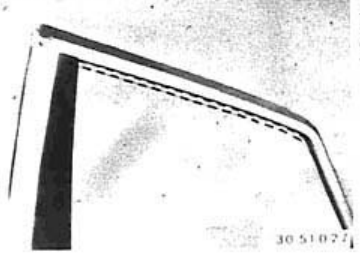
Remove door trim panel – see 51 41 001.
Pull off plastic sheet partially.
Installation:
Replace damaged plastic sheet.



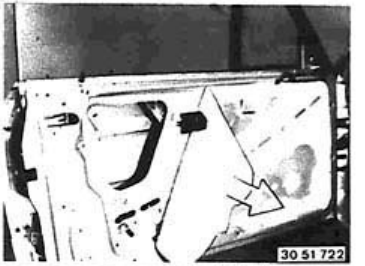
Raise window completely.
Loosen screw.
Bolt down window guide again without tension.



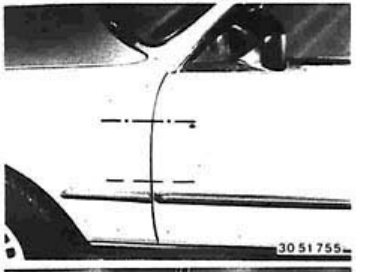
Loosen screws.



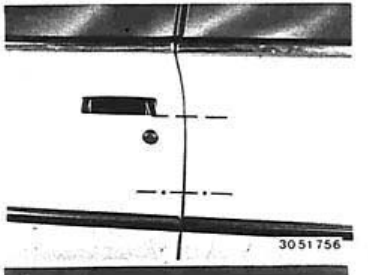
Adjust window in slots until there is an uniform gap between the window glass and window frame at top.
Tighten screws.



Convertibles:
Remove door trim panel – see 51 41 001.
Pull off plastic sheet.
Installation:
Replace damaged plastic sheet.



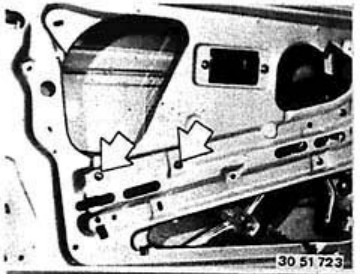
Requirements for Side Window Adjustment:
1. Correct Adjustment of Door:
   a) If necessary, correct door outside panel in area of front side panel with shims – see Group 41.



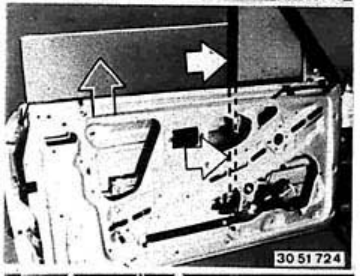
   b) If necessary, correct door outside panel in area of rear side panel by adjusting the door striker – also see 51 21 003.



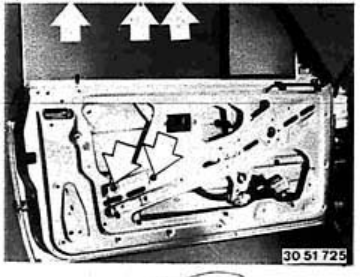
   c) Triangular window in area of cowl panel.
2. Correct Adjustment of Top:
   See Group 54.



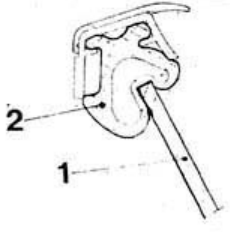
Operate window to half-open position.
Loosen screws.



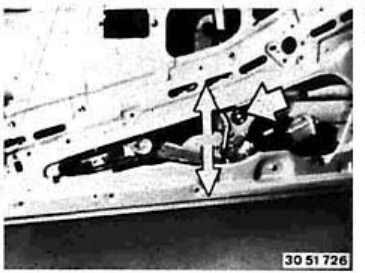
Shut window, while pressing against the front guide rail.
Window glass must be parallel in the guide rail.



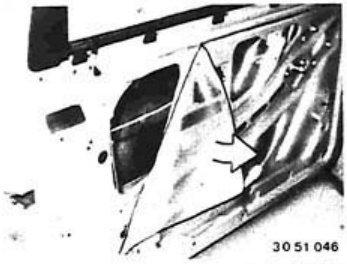
Tighten screws.
Check that there is easy movement as well as the system on the top, correcting if necessary.



Installation:
The window glass (1) must bear on rubber seal (2) as shown.

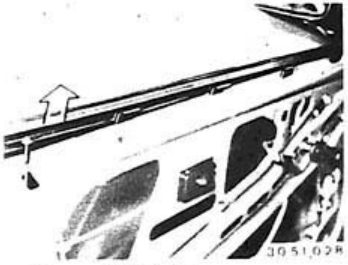


Limitation of window movement is adjusted with the stop.

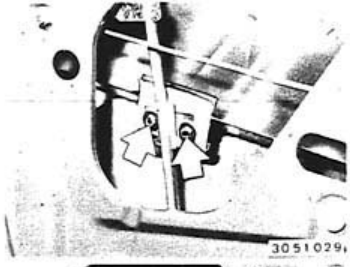


51 32 170 REMOVING AND INSTALLING OR REPLACING LEFT OR RIGHT FRONT DOOR WINDOW GLASS

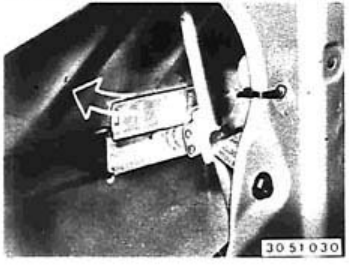
Remove door trim panel 51 41 001.
Pull off plastic sheet.
Installation:
Replace damaged plastic sheet.



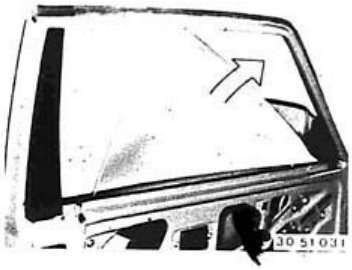
Pull off inside window recess cover.



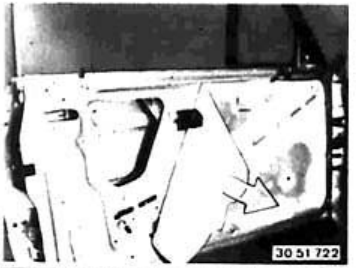
Unscrew screws.
Note:
Hold window glass.
Installation:
Adjust window, see 51 32 154.



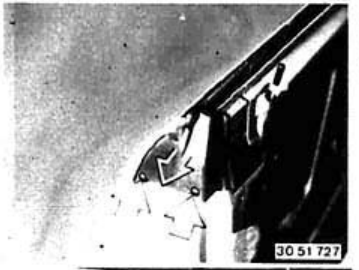
Swing front end of glass pane out of guide roller.



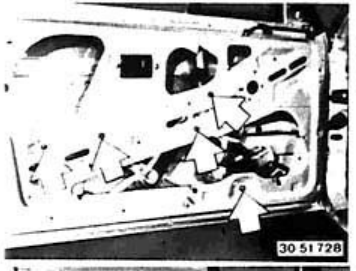
Remove door window glass.



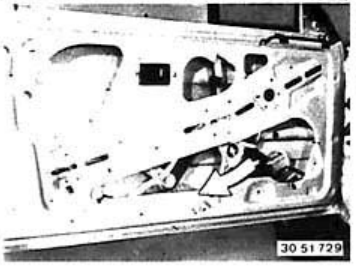
Convertibles:
Remove door trim panel – see 51 41 001.
Pull off plastic sheet.
Installation:
Replace damaged plastic sheet.



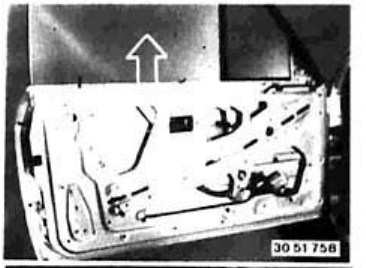
Lift out spreader rivets.
Remove trim panel.
Installation:
Use new spreader rivets, if necessary.



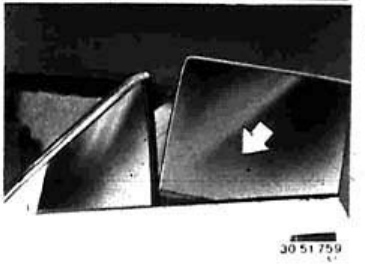
Remove outside window recess cover – see 51 21 300.
Run down the window – unscrew screws.
Installation:
Adjust window – see 51 32 154.



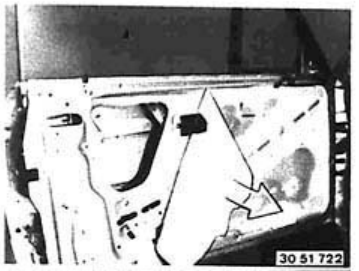
Pull off plug and slide window regulator forward out of the guides.
Installation:
Guide guiding rollers of window regulator into rails of window glass.
Align mounting holes of window regulator.



Pull out window glass from above

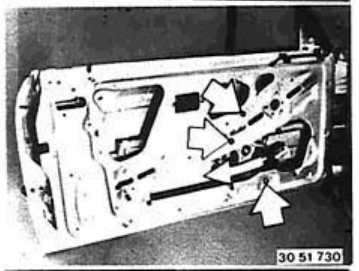


Installation:
Insert window glass at inclination – turn slightly – and slide down parallel.

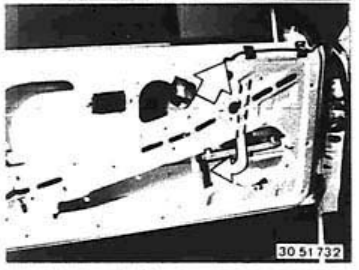


51 32 ... REMOVING AND INSTALLING OR REPLACING (FIXED) FRONT DOOR WINDOW

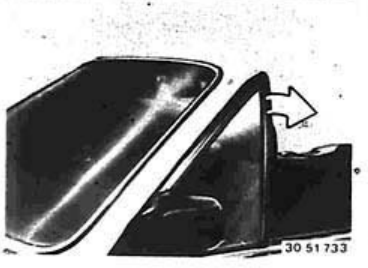
Remove door trim panel – see 51 41 001.
Pull off plastic sheet.
Installation:
Replace damaged plastic sheet.



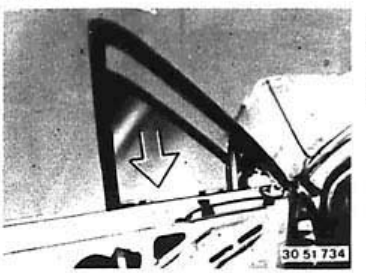
Unscrew screws.
Push the window regulator back.



Unscrew screw.
Lift out holder.
Installation:
Insert holder in provided openings.

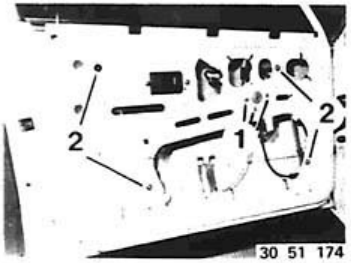


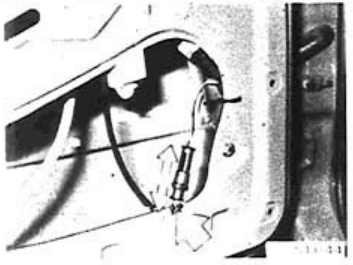
If applicable, lift off trim on door frame.



Slide out window glass and rubber frame downward.
Installation:
Rub in rubber frame with a lubricant*.
Slide in window glass parallel to the stop.

* Source: HWB



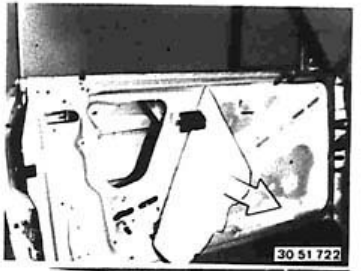


51 33 000 REMOVING AND INSTALLING POWER WINDOW REGULATOR IN LEFT OR RIGHT FRONT DOOR

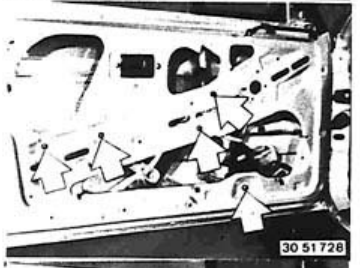
Procedures are identical with those described in 51 32 020.

Plus:
Mounting (1) with 3 nuts.

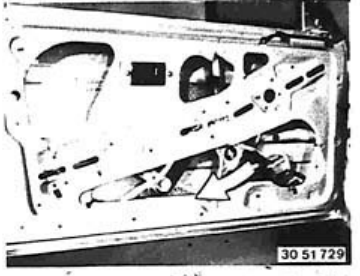
Disconnect plug.
Installation:
If applicable, secure wires with wire strap.



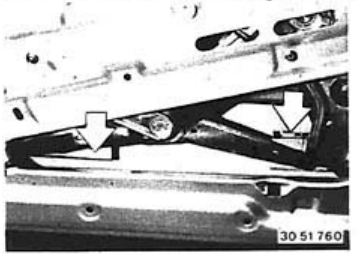
Convertibles:
Remove door trim panel – see 51 41 001
Pull off plastic sheet.
Installation:
Replace damaged plastic sheet.



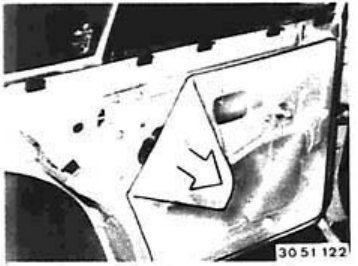
Run the window down.
Unscrew screws.
Installation:
Adjust window – see 51 32 154.



Pull off plug and slide window regulator forward out of the guides.
Lift out complete window regulator.

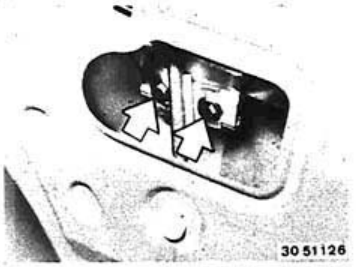


Installation:
Guide guding rollers of window regulator into rails of window glass.
Align mounting holes of window regulator.

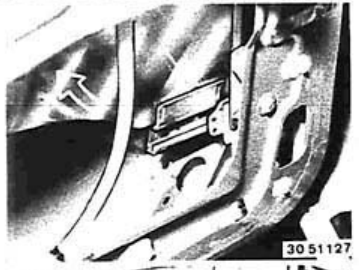


51 34 020 REMOVING AND INSTALLING OR REPLACING WINDOW REGULATOR IN LEFT OR RIGHT REAR DOOR

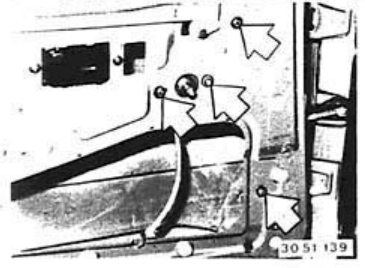
Remove door trim panel 51 42 001.
Pull off plastic sheet.
Installation:
Replace damaged plastic sheet.



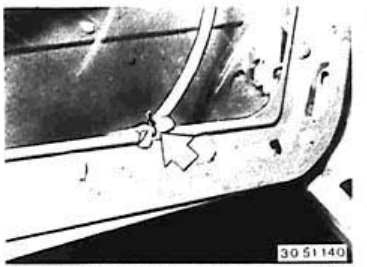
Unscrew screws.
Note:
Hold window glass.
Installation:
Adjust window, see 51 32 154.



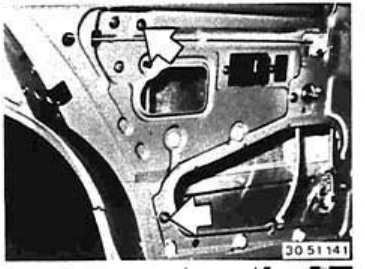
Wind down window glass and swing it out of guide roller.
Let window glass rest on bottom.



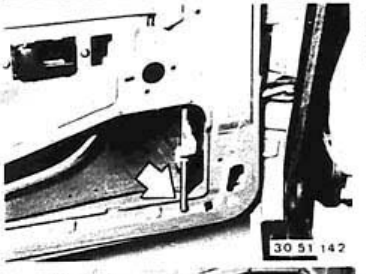
Unscrew screws.



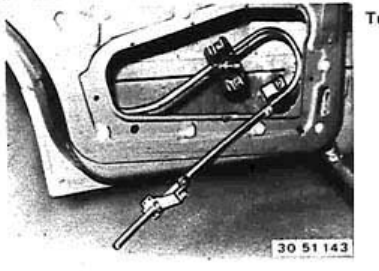
Remove wire strap.



Unscrew screws.

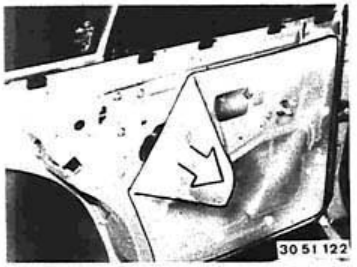


Push up window regulator far enough that front end can be taken out of the inside door panel.

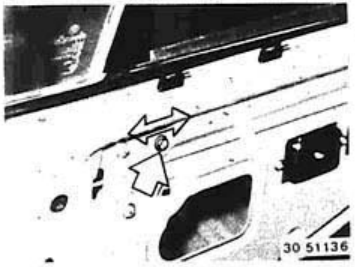


Turn and take out window regulator.

51 34 154 ADJUSTING LEFT OR RIGHT REAR DOOR WINDOW



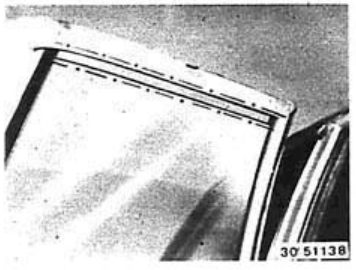
Remove door trim panel 51 42 001.
Pull off plastic sheet partially.
Installation:
Replace damaged plastic sheet.



Close window.
Loosen screw.
Tighten window regulator again without tension.

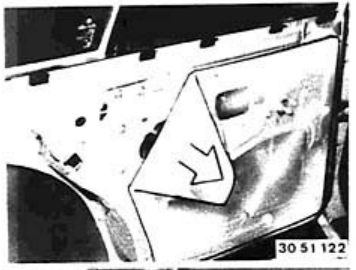


Loosen screws.

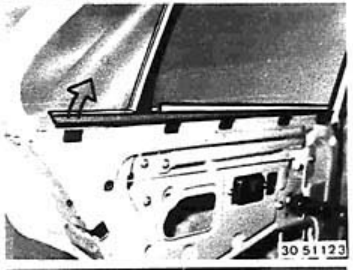


Adjust window in slots until there is an uniform gap between the window glass and window frame at top.
Tighten screws.

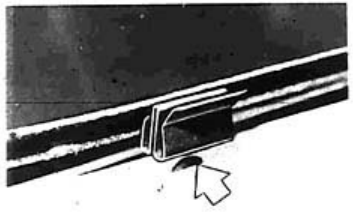
51 34 171 REPLACING LEFT OR RIGHT REAR DOOR WINDOW GLASS



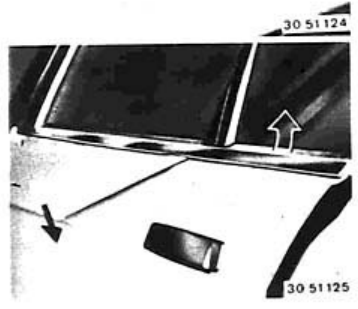
Remove door trim panel 51 42 001.
Pull off plastic sheet.
Installation:
Replace damaged plastic sheet.



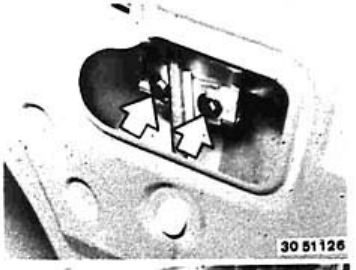
Pull off inside window recess cover.



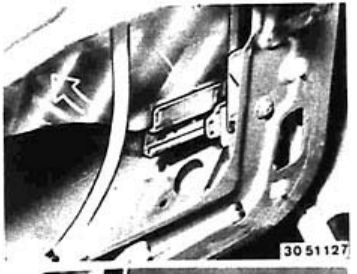
Lift clamps out of retaining tabs.



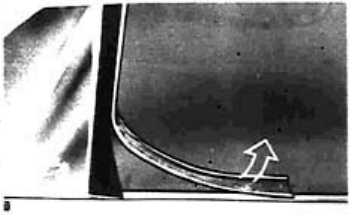
Loosen cover strip and window recess cover on outside by pressing up out of retaining clamps with a wooden wedge or similar tool (be careful not to damage the paint finish!).



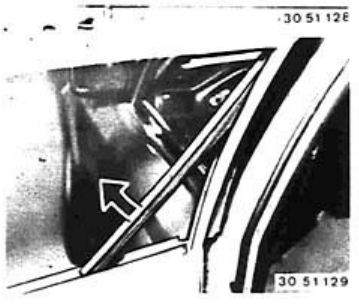
Unscrew screws.
Note:
Hold window glass.
Installation:
Adjust window, see 51 32 154.



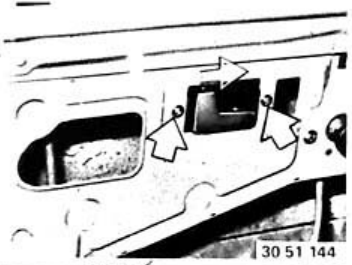
Wind down window glass and swing it out of guide roller.
Let glass rest on bottom.



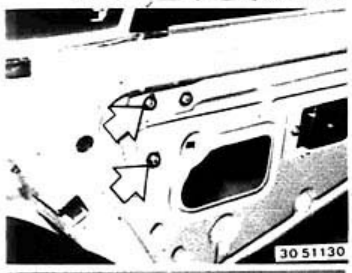
Pull out rear rubber window guide.



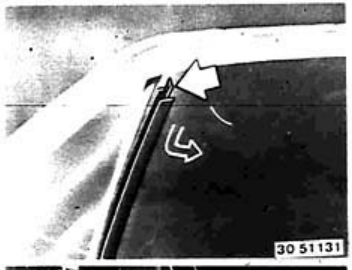
Pull out front rubber window guide.



Unscrew door remote control.
Open clip and let remote control hang down.
Installation:
Pre-load door remote control slightly.



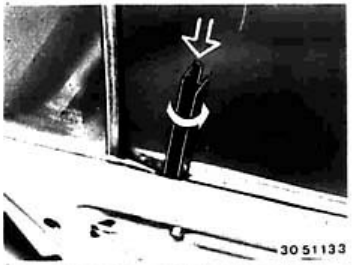
Unscrew bolts.



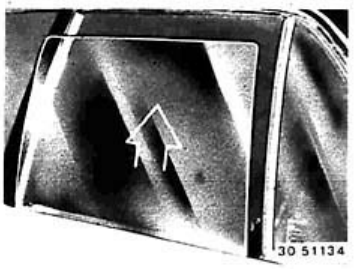
Loosen guide rail on rubber frame of fixed window and disconnect at top retainer.
Installation:
Coat rubber frame with relaxed water for easier installation.



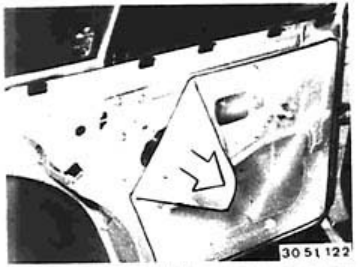
Installation:
Beads on rubber frame grab in holes of window guide.



Turn and push down guide rail.

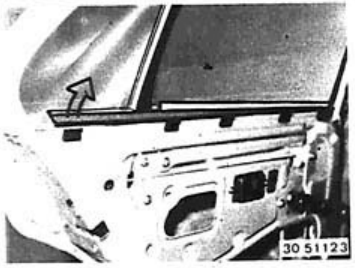


Pull out window glass from above.

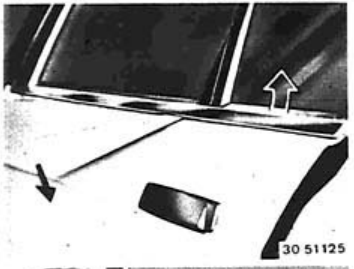


51 34 191 REPLACING WINDOW FIXED IN LEFT OR RIGHT REAR DOOR WINDOW FRAME

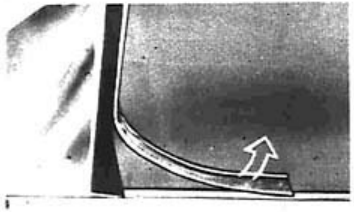
Remove door trim panel 51 42 001.
Pull off plastic sheet.
Installation:
Replace damaged plastic sheet.



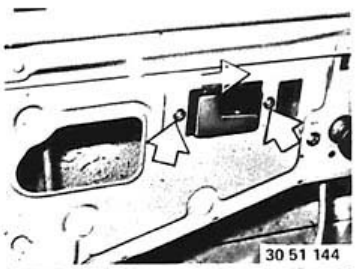
Pull off inside window recess cover.



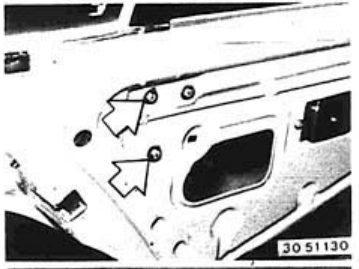
Loosen cover strip and window recess cover on outside by pressing up out of retaining clamps with a wooden wedge or similar tool (be careful not to damage the paint finish!).



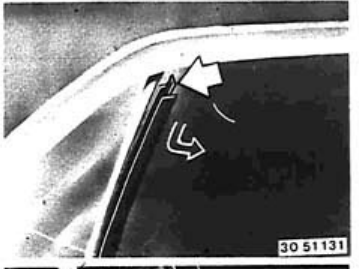
Wind down window glass.
Pull out rear rubber window guide.



Unscrew door remote control.
Loosen clips and let remote control hang down.
Installation:
Preload door remote control slightly.



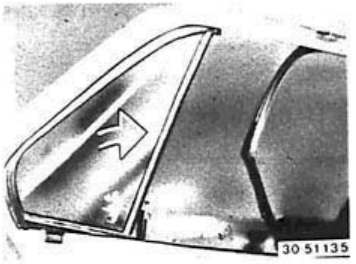
Unscrew screws.



Loosen guide rail in rubber frame of fixed window and disconnect in retaining tabs at top.
Installation:
Coat rubber frame with relaxed water to make installation easier.



Installation:
Beads on rubber frame engage in holes in window guide.

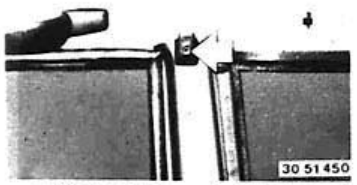


Tilt window glass with rubber frame out of window frame.

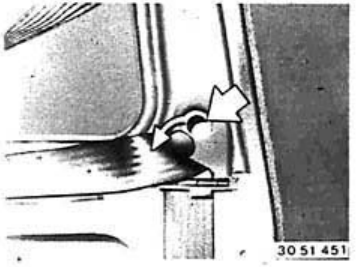
Installation:

Coat rubber frame with relaxed water for easier installation.

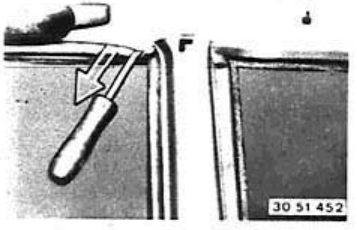
51 36 050 REMOVING AND INSTALLING LEFT OR RIGHT REAR SIDE WINDOW



Remove rear side trim panel, see 51 43 000.
Lift off C pillar plate.
Loosen screw.
Remove clotheshook.
Loosen screw.



Lift off cover.
Loosen screw.

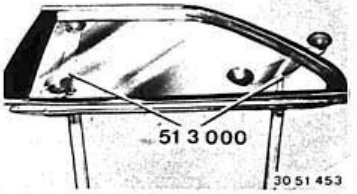


Lift out rubber frame, beginning at a corner, and press out window glass.
Caution!
Prevent window glass from falling down.

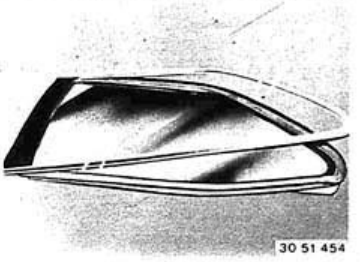
Installation:
Coat rubber frame with a lubricating solution*.
Press on window glass and pull in rubber frame all around with Special Tool 51 3 057 and a plastic spatula.

* See Specifications

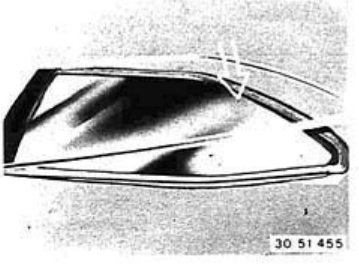
51 36 071 REPLACING LEFT OR RIGHT REAR SIDE WINDOW



Remove window, see 51 36 050.
Apply Special Tool 51 3 000 in toolbox.
Mount window glass.



Lift out ornamental strips.
Pull off rubber frame.

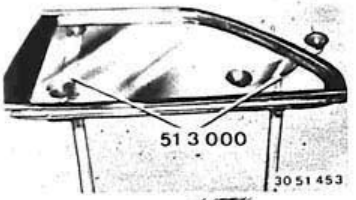


Installation:
Check rubber frame, replacing if necessary.
Insert ornamental strips, beginning at upper edge of window.
If necessary, coat rubber frame with a lubricating solution*.

Note:
If window had been broken, clean seat belt reel to remove glass splitters.

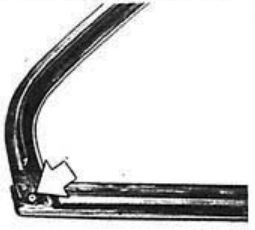
* See Specifications

51 36 545 REPLACING ALL ORNAMENTAL STRIPS ON REAR SIDE WINDOW
– Side Window Removed –

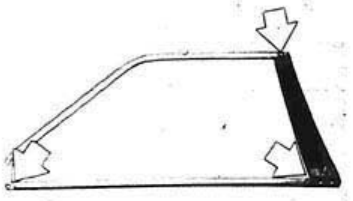


30 51 453

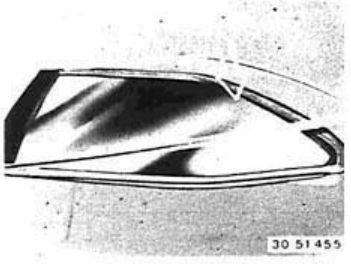
Apply window holder in toolbox.
Mount window glass.


30 51 457

Lift off ornamental frame.
If applicable, drill out rivet and insert new ornamental strip.


30 51 458

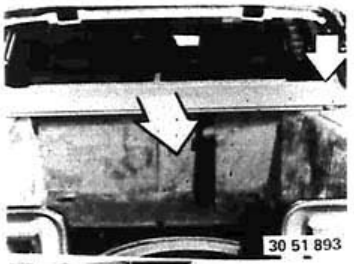
Rivet ornamental strips together.


30 51 455

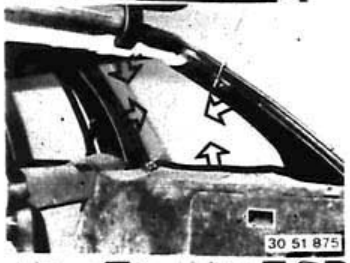
Installation:
Check rubber frame, replacing if necessary.
Insert ornamental strips, beginning at upper edge of window.
If necessary, coat rubber frame with a lubricating solution*

* See Specifications

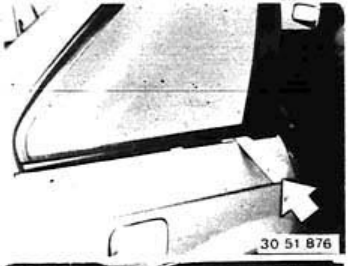
51 36 050 REMOVING AND INSTALLING LEFT OR RIGHT REAR SIDE WINDOW – Touring –



Press down, twist and lift out the shade holder.

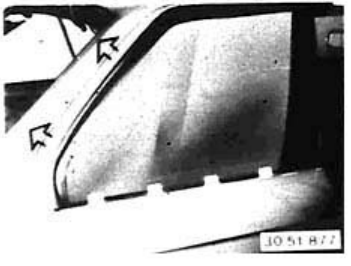


Lift and pull off seal carefully.



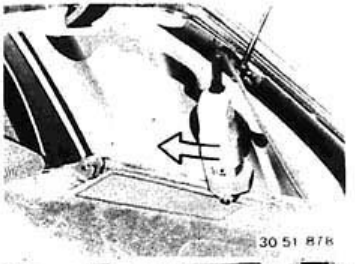
Unclip ornamental strip carefully.

Installation:
Replace damaged clips.



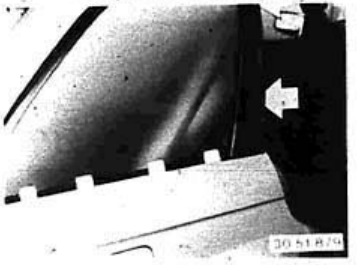
Unclip plate carefully.

Installation:
Replace damaged grommets.



Note:
Uncover radio speakers.

Cut through the cement bead from the inside all around with an electric tool* and knife*.

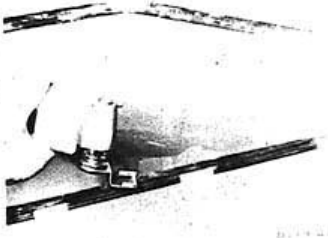


Cut through the cement bead underneath the plate.

Installation:
Replace a damaged plate.

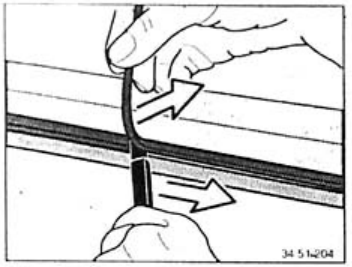


Press out the side window with a wood wedge or similar item, beginning at the rear.



Reduce the residual cement to a thickness of about 0.5 mm (0.020") with an electric tool* and knife* when reusing the window.

* Source of Supply: HWB



Reduce residual cement on body opening surface to thickness of approx. 0.5 mm (0.020").

Cut off residual cement carefully with universal knife (sharp as a razor blade) to avoid damaging paint finish in body opening.

Important!
Always touch up damaged paint finish to guarantee longterm corrosion inhibition!
Use BMW EP filler (2K) for this purpose.

Remove residual cement, sand out and touch up scratches in non-visible surfaces with BMW EP filler.

Large-surface damage must be sanded down to blank metal and coated with BMW EP filler (30 ... 40 µm thick coat). If complete paint buildup is necessary on visible surface, prime coated cement flange must be removed prior to application of final paint coat.



Important!
Repaired paint finish spots must be hardened.

Brush in body in area of cement surface with primer (repair kit*).

Note:
Air drying time: at least 10 minutes.



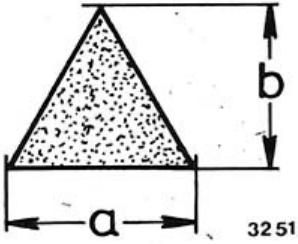
Brush in window glass in area of cement surface with primer (repair kit*).

Important!
Apply primer only in area of the cement surface, since otherwise window glass would be impaired permanently.

* Source of Supply: HWB



Mount plate (D pillar).

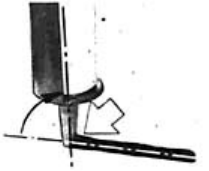


Shape of Cement Bead:

a 8 to 10 mm (0.315 to 0.394")
b 12 to 14 mm (0.472 to 0.551")

Shorten nozzle from the reapir kit* accordingly.

Note:
Use a cartridge gun* (pneumatic or electric) to produce uniform beads of cement.
Check the cement's date of expiry!

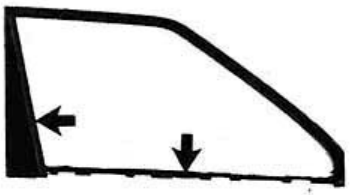


If necessary, produce a sample bead before cementing.
Cartridge must be perpendicular to window surface.
Make sure of uniform feed and pulling speed during application.

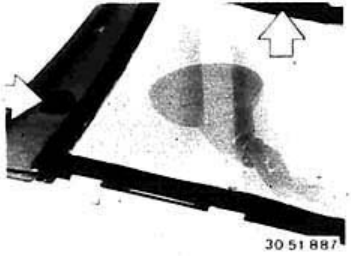
Important!
Always remove dirt from residual cement with cleaning benzol before cement has hardened.

30 51 793

* Source of Supply: HWB



Produce a cement bead all around.
Spacing to edge of window glass in front and bottom areas is about 3 mm (0.118").

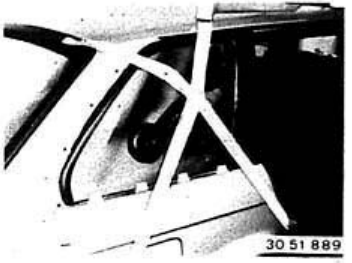


The ornamental strip is cemented at the same time in the upper and inclined rear areas.
Spacing to edge of ornamental strip is about 5 mm (0.197").

Fit in and press on side window carefully with Special Tool 51 3 010.



Check for uniform spacing between the window glass and body.
Check door gap and seating of the door's rubber seal after closing the door.



Preload the window glass with adhesive tape and foam rubber rolls or Special Tool 51 3 010.
Holding time is about 4 hours at room temperature - also refer to information on the installation of M 3 windows.

Note:
Leaks can be located by spraying on water or with an ultrasonic tester and sealed off from the inside of the window with a suitable size nozzle from the repair kit*.
This nozzle must be shortened to an appropriately small cross section size opening for this purpose.

* Source of Supply: HWB

51 36 ... INSTALLING SIDE WINDOW ORNAMENTAL STRIPS AND PLATES
- Touring -

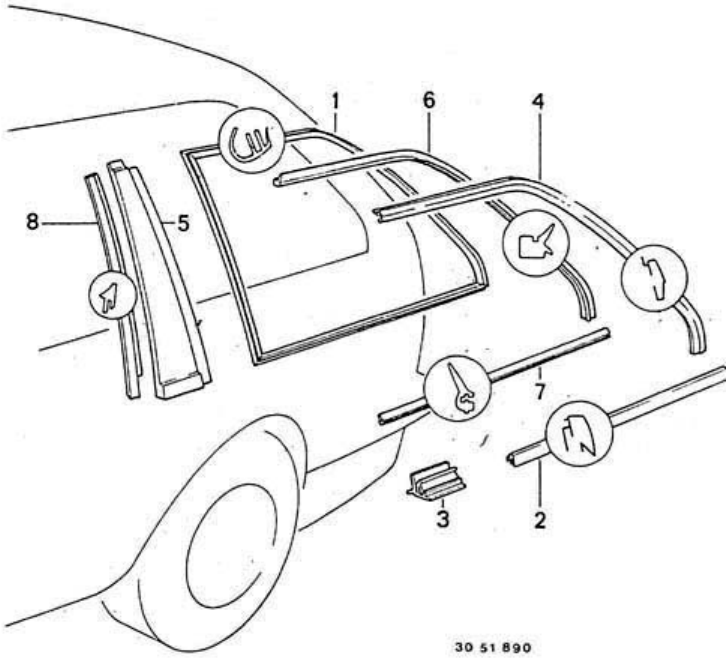
Lift off D-pillar plate.

Cut ornamental strip (4) and plate (5) off of the window with a flat knife* and special tool*, and lift them off.
If necessary, cut through the cement bead underneath plate (5) in the upper and middle areas with a flat spatula.

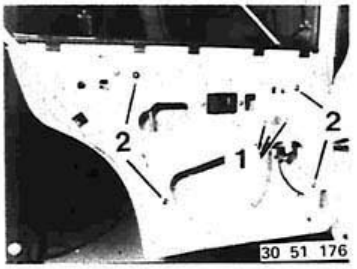
Installing:

1. If necessary, install / cement a new seal (8) on plate (5).
   Produce a thin cement bead (repair kit*) on the plate in the area of the window glass (close to the seam).
   Install, press on and, if necessary, hold plate with adhesive tape.

2. If necessary, install a new seal (6) on ornamental strip (4).
   Produce a thin cement bead (repair kit*) on the center web of ornamental strip (4).
   Install D-pillar plate.
   Fit in, press on and, if necessary, hold ornamental strip (4) with adhesive tape.



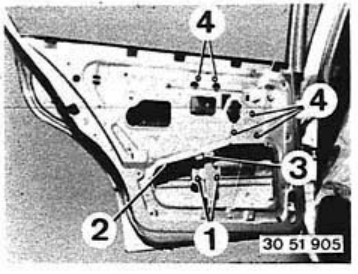
* Source of Supply: HWB



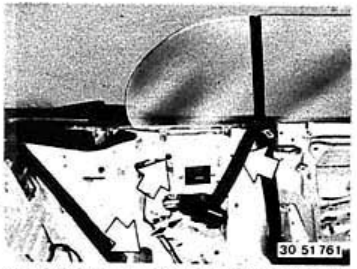
51 37 000 REMOVING AND INSTALLING LEFT OR RIGHT REAR POWER WINDOW REGULATOR

Procedures are identical with those for removing and installing window regulator in left or right rear door – see 51 34 020.

Additional:
Disconnect plug.
Installation (1) with three nuts.

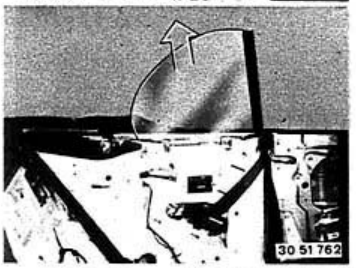


With Cable Regulator:
Lower window half the full distance and unscrew screws (1).
Push up and prevent window glass from falling down.
Loosen clamp (2) and disconnect plug (3).
Unscrew screws (4).
Twist and lift out the window regulator.

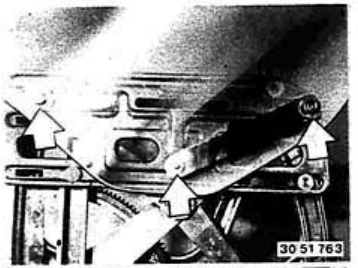


51 37 000 REMOVING AND INSTALLING OR REPLACING WINDOW REGULATOR

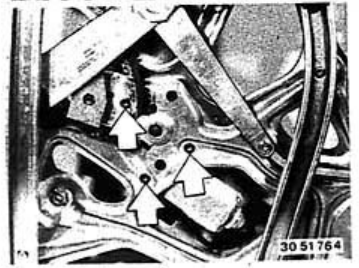
Remove trim panel – see 51 43 000.
Window closed.
Disconnect plug.
Unscrew screws.



Remove complete window regulator from above.
Installation:
Adjust rear window regulator – see 51 37 . . ..



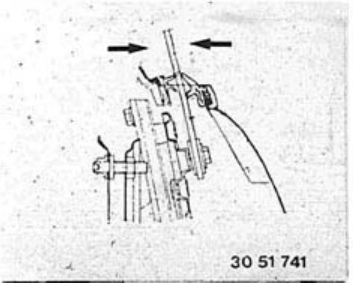
Unscrew screws.
Remove window glass.



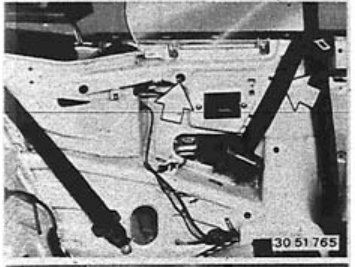
Unscrew screws.
Remove power window motor.

51 37 154 ADJUSTING LEFT OR RIGHT REAR SIDE WINDOW

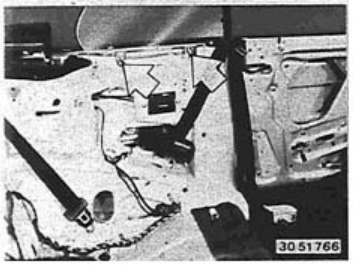
Remove rear side trim panel – see 51 43 000.
Requirement:
Front window adjusted correctly – see 51 32 154.



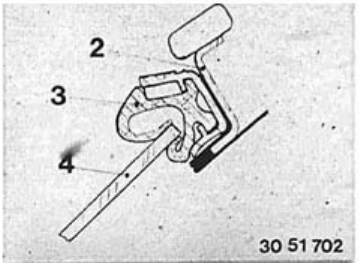
1. Adjust center position.



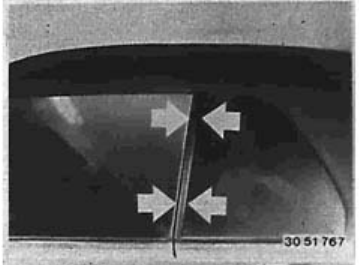
Align window uniformly at left and right.



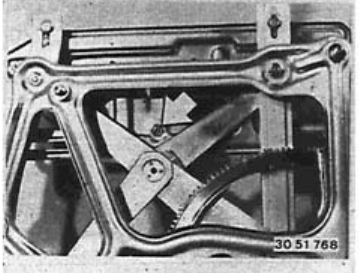
2. Adjust top stop.



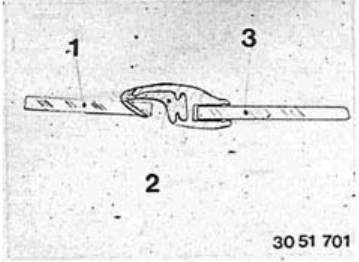
Window glass (4) must submerge uniformly in rubber seal (3) and roof frame (2).



Adjust gap between side window to be uniform at front and rear.

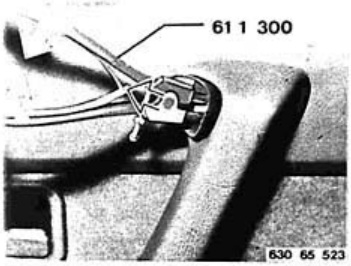


3. Adjust tension of side window.

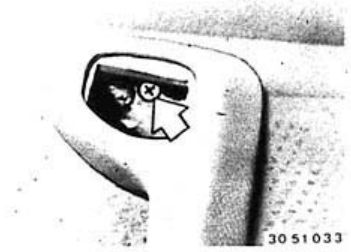


Rear side window (3) must bear together with seal (2) on front side window (1) uniformly with light tension.

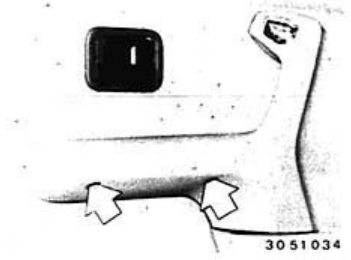
51 41 001 REPLACING LEFT OR RIGHT FRONT DOOR TRIM PANEL



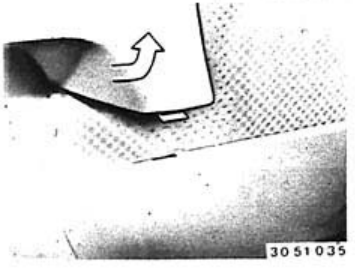
Pull off outside mirror adjusting button.
Lift out mirror switch with Special Tool 61 1 300.
Pull off plug.



Unscrew screw.



Unscrew screws.



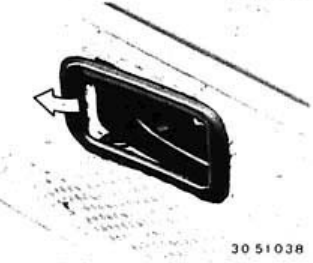
Pull armrest forward and disengage.



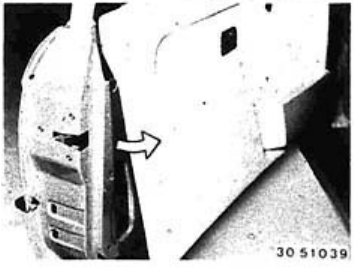
Lift off cover.
Pull off lock or unscrew screw.



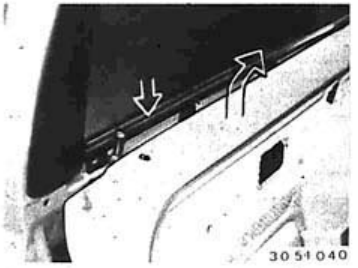
Pull off window winder and washer.
Installation:
Window winder faces forward with window raised fully.



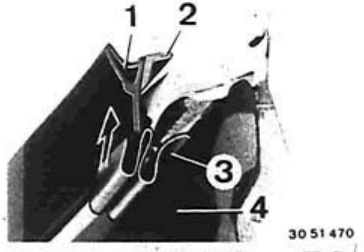
Pull off mask toward rear.



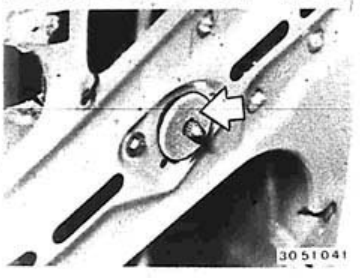
Door window lowered.
Lift door trim panel out of clips.
Installation:
Check clips, replacing if necessary.



Lift door trim panel out of clamps.
Note:
The window recess seal will also be lifted out.

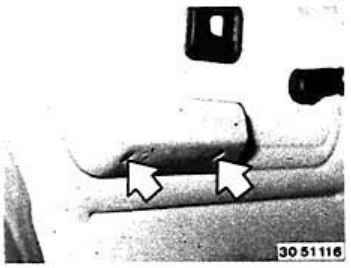


Installation:
Check for correct fit of clips.
1 Window recess seal
2 Ornamental strip
3 Clip
4 Door trim panel
Install door trim panel complete with window recess seal after lowering the door window.



Installation:
Check foam rubber washer on window regulator.

51 42 000 REMOVING AND INSTALLING LEFT OR RIGHT REAR DOOR TRIM PANEL

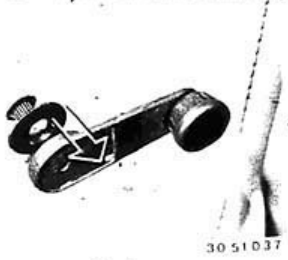


Unscrew screws.

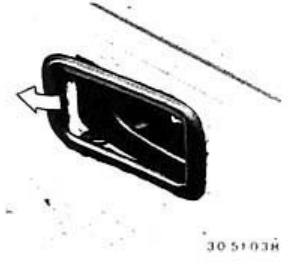
Important!
An additional screw holds the armrest on the trim panel from behind.



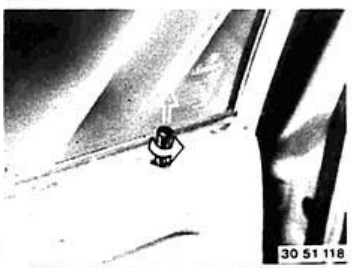
Lift off cover.
Remove circlip or unscrew screw.



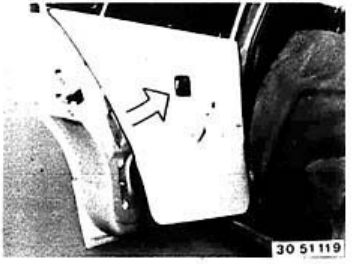
Pull off winder and washer.



Pull off mask toward rear.

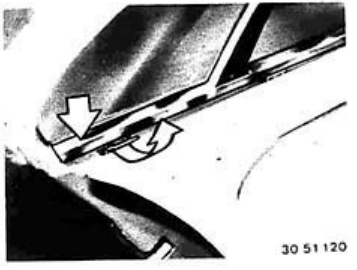


Unscrew catch button.



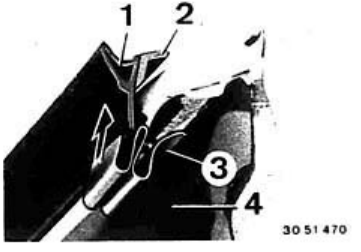
Door window lowered.
Lift off door trim panel with armrest.

Installation:
Check clips, replacing if necessary.



Lift door trim panel out of clamps.

Note:
The window recess seal will also be pulled off.

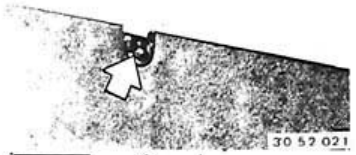


Installation:
Check for correct fit of clamps.
1 Window recess seal
2 Ornamental strip
3 Clamp
4 Door trim panel
Install door trim panel complete with window recess seal after lowering the door window.

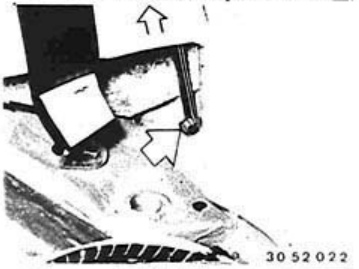


51 43 000 REMOVING AND INSTALLING OR REPLACING LEFT OR RIGHT REAR SIDE TRIM PANEL

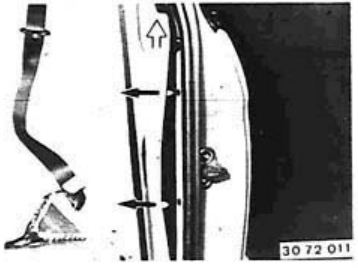
Lift out seat cushion.
Cars with Bolted Version:
Pull off covers and unscrew bolts on left and right sides.

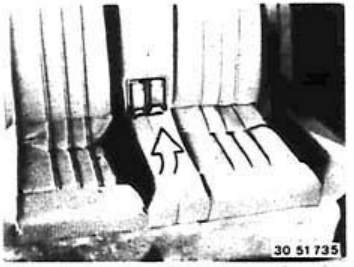


Unscrew left and right bolts.
Pull up and remove seat backrest.
Installation:
Engage backrest in upper holder.

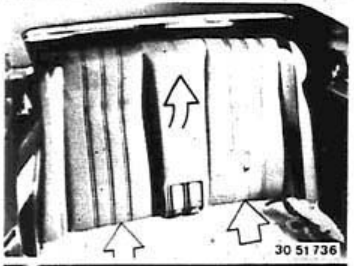


Disconnect side trim panel in three clips and pull up out of clamps.

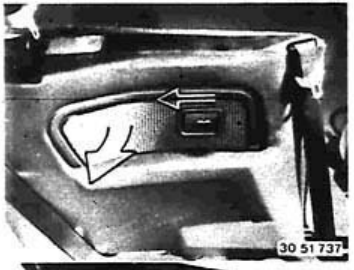




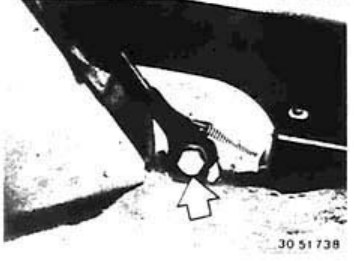
Convertibles:
Lift out the rear seat cushion.
Installation:
Seat cushion must engage in the openings.



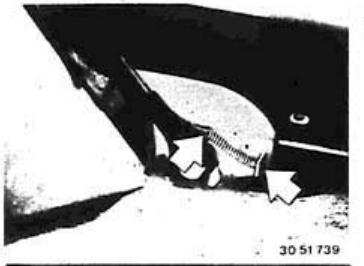
Unscrew bolts.
Pull out seat backrest from above.
Installation:
Engage backrest in holder (top).



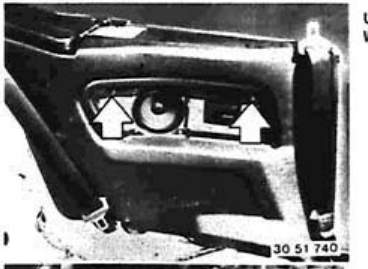
If applicable, lift out plate.
Pull off trim.



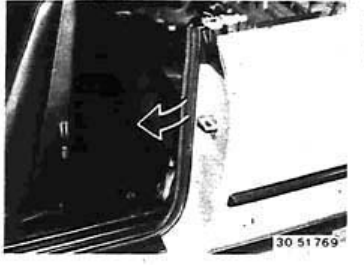
Unscrew bolt.
Lift out seat belt.



Installation:
Check for correct fit of spring.

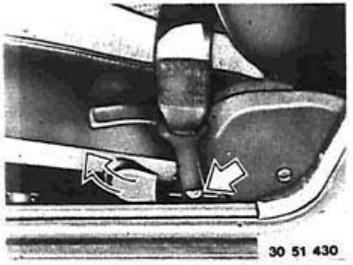


Unscrew screws.
Window open.

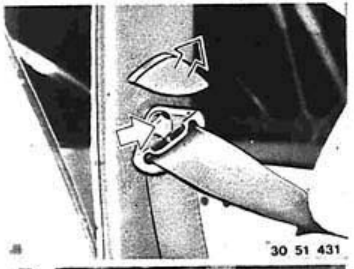


Pull off door weatherstrip.
Lift out trim.
If applicable, pull off speaker wires.

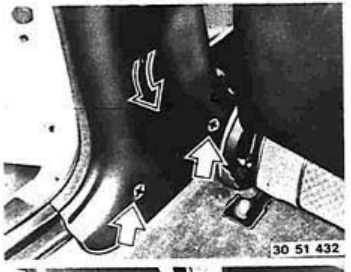
51 43 150 REMOVING AND INSTALLING TRIM FOR LEFT OR RIGHT DOOR PILLAR



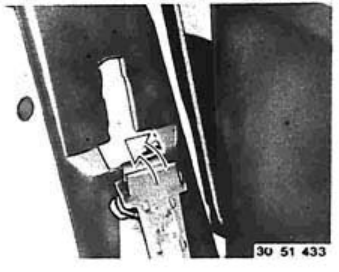
Pull off cap.
Unscrew screw.
Installation:
Tightening torque*.



Pull off cap.
Unscrew screw.
Installation:
Tightening torque*



Lift out clamps.
If applicable, unscrew screws.
Pull trim out of upper holder.

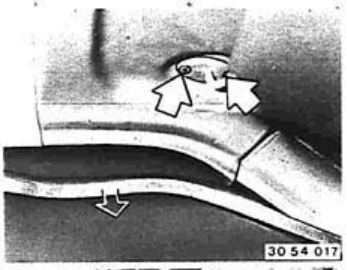


Press out cover and insert belt through trim of B pillar.
Remove trim.

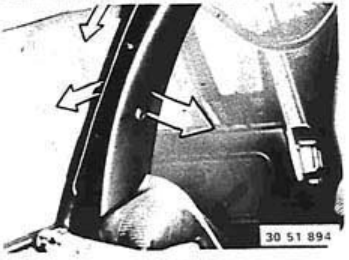
* See Specifications

51 44 011 REPLACING ROOF LINER – Touring –

Remove complete sun roof – see Group 54.
Remove check control – see Group 62.
Remove inside mirror – see 51 16 060.
Remove all grab handles – see 51 16 450/480.
Remove trim panels for left and right door pillars – see 51 43 150.
Remove all entrance strips – see 51 47 000/030.
Remove ceiling lights – see Group 63.



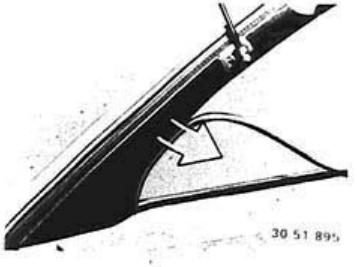
Unscrew sun visors with holders.
Pull off edge guard partially on all doors.



Unscrew seat belt and lift off C pillar trim.
Pull off rubber seals on both side windows in area of the roof liner.

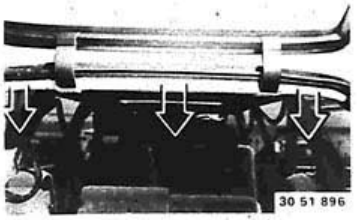
Installation:
Tightening torque*.

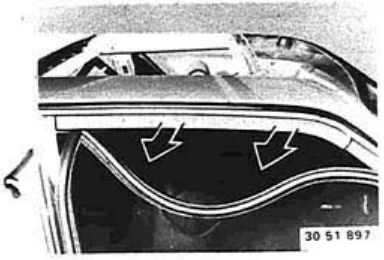
* See Specifications of Gr. 72



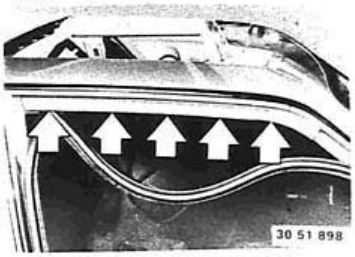
Lift off D pillar trim.

Remove tailgate hinge trim.
Pull roof liner down out of the clips.



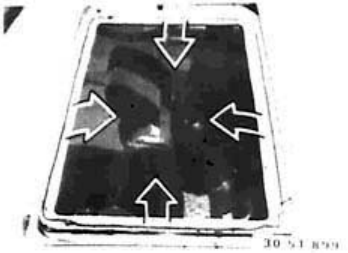


Pull off cemented roof liner.
Use a plastic or wood spatula to loosen a sticking roof liner.
Remove residual cement with a cement cleaner**.

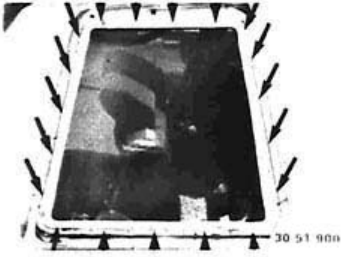


Installation:
Cement roof liner on sheet metal fold.
Cut off protruding material.
No protrusion should be visible after installation of edge guards.

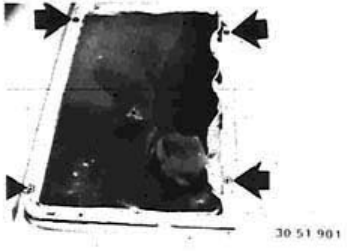
** Source of Supply: HWB



Pull off cemented roof liner.
Use a plastic or wood spatula to loosen a sticking roof liner.
Remove residual cement with a cement cleaner**



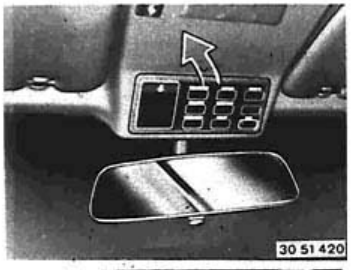
Installation:
Cement roof liner on the roof opening surface.
Cut off protruding material.
No protrusion should be visible after installation of the sun roof strips.



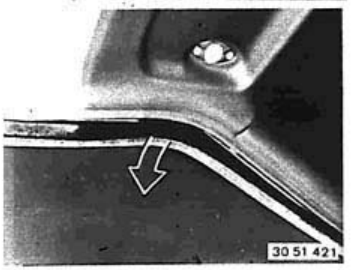
Unscrew screws.
Pull back and lift out the roof liner.

* Source of Supply: HWB

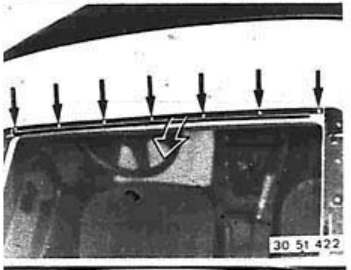
51 44 150 REMOVING AND INSTALLING FRONT ROOF LINER PLATE



If applicable, remove check control, see 62 14 070.
If applicable, remove sun roof winder, see 54 12 020.



Pull off left and right door weatherstrips partially.
Unscrew screws.
Remove sun visor and holder.

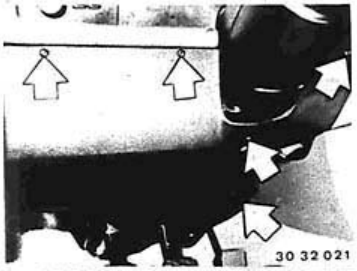


Cars with Sun Roof:
Open sun roof.
Unscrew screws.
Take off strip.
Installation:
Use Terostat tape* in strip.

Pull off plate cover.
Unscrew screws.
Take off plate.



* Source: HWB

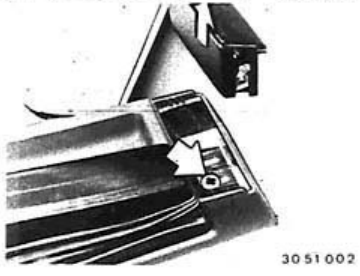

30 32 021

51 45 030 REMOVING AND INSTALLING INSTRUMENT PANEL TRIM

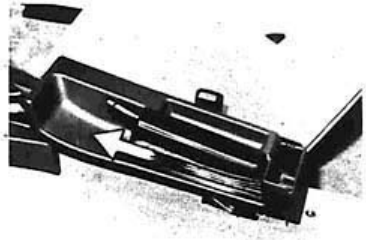
Disconnect battery ground lead.
Unscrew bolts.
Remove trim.
Remove steering wheel, see 32 33 000.


30 32 082

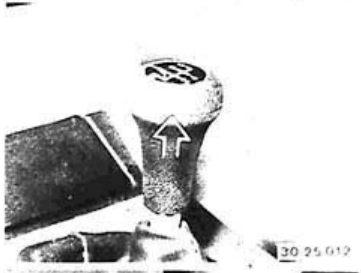
Detach steering column casing lower section.


30 51 002

Lift out ashtray.
Unscrew nut.


30 51 003

Disconnect console at front by pulling back and pull off on parking brake lever.


30 25 012

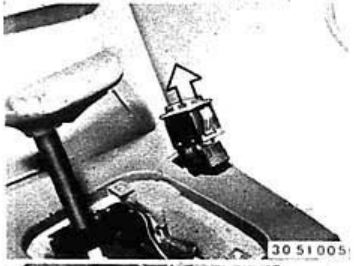
Manual Transmission:
Pull off shift lever knob.
Installation:
Shift lever knob must engage in twist lock.


30 25 013

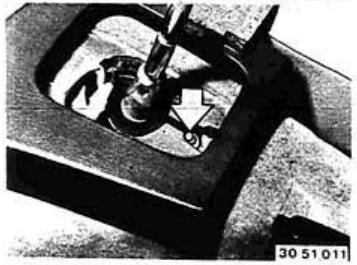
Lift off dust cover.



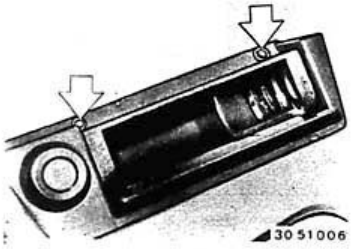
Automatic Transmission:
Lift out plate.
Unscrew bolts.
Remove trim.



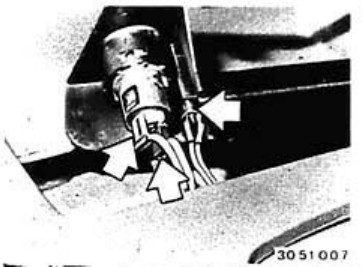
Cars with Electric Windows:
Lift out switch (1).
Pull off plug (2) on switch (1).



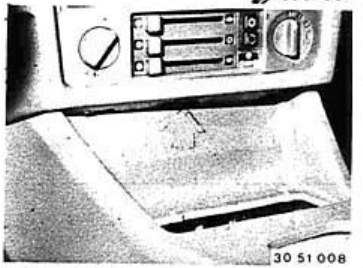
Remove insulation sheet.
Unscrew nut.



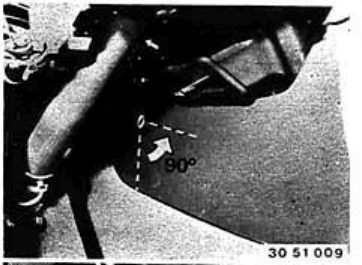
Unscrew bolts.
Lift out ashtray console.



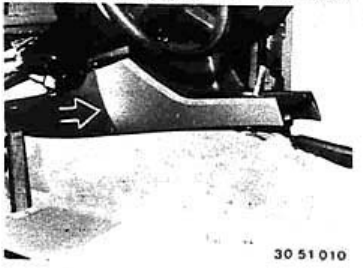
Pull off ashtray light and wires for cigar lighter.



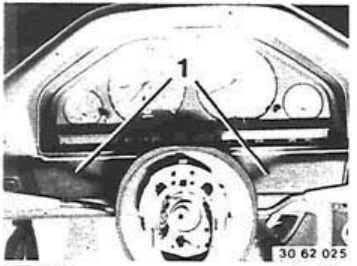
Unscrew bolt.



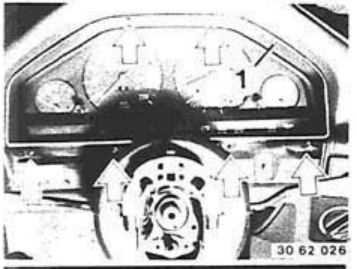
Remove retainer by turning anticlockwise and clockwise 90°.



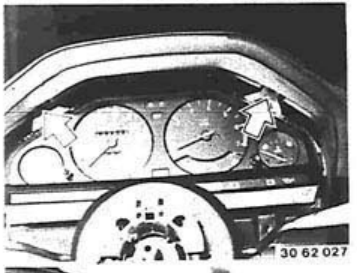
Pull out tray toward rear.



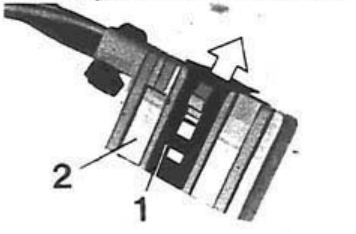
Unscrew nuts (1) and remove trim.



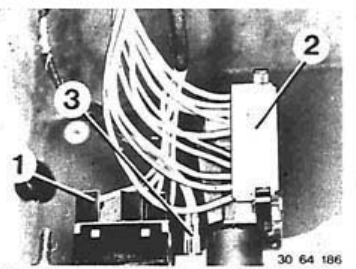
Unscrew bolts (1) and remove trim.



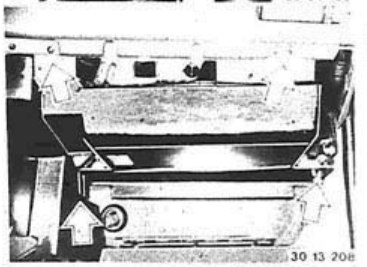
Unscrew bolts.



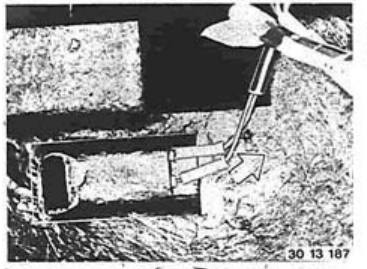
Lift instrument carrier out of instrument panel.
Pull off all plugs.
Note:
First pull back slider (1) on combination plug (2) to pull off combination plug on instrument carrier.



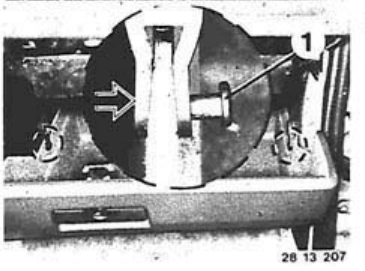
Pull off plugs (1 ... 3) on light switch.



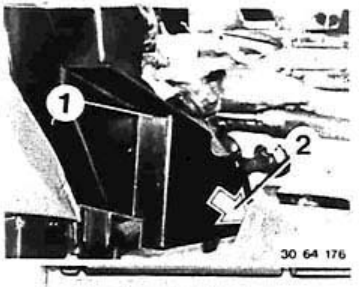
Open glove box.
Unscrew bolts.



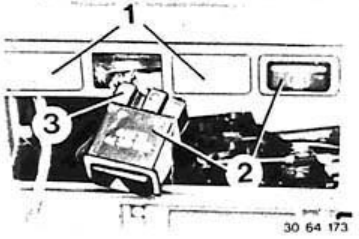
Pull off plug on glove box light.
Take off trim.



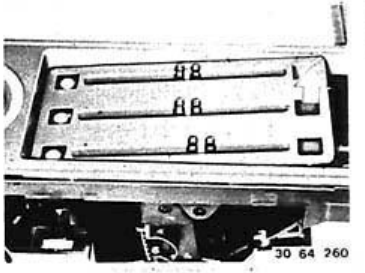
Disconnect pins of both retaining straps.



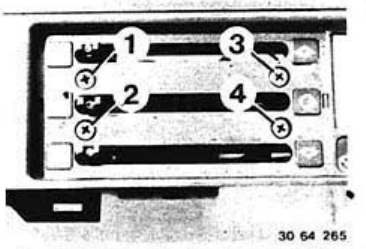
Unscrew screw (2).
Remove trim (1).



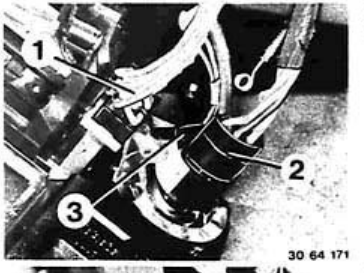
Remove radio mask or remove radio.
Pull masks (1) or switch (2) out of control panel.
Pull off plugs (3) on switches (2).



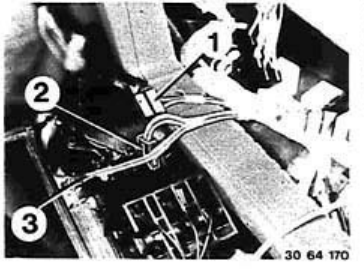
Pull off heating and ventilating controls.
Lift out sliding control.
Pull off plate.



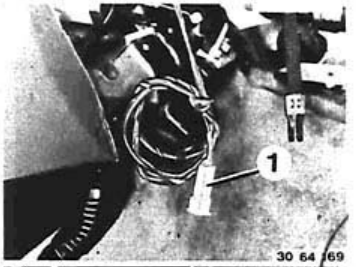
Unscrew screws (1 ... 4).



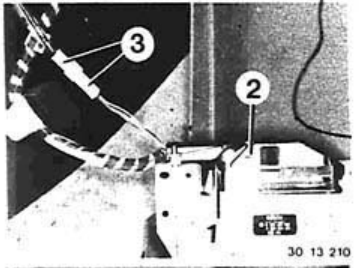
Pull off plug (1) on air conditioner switch.
Pull off plug (2) on blower switch.



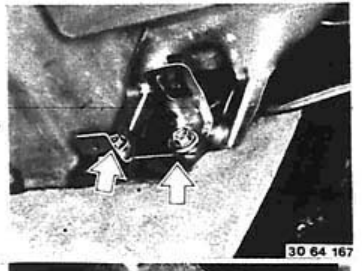
Pull off plug (1) on temperature selection housing.
Pull off plug (2) on sliding control.
Pull off bulb holder (3).
Pull off plug on clock.
Lay control unit aside.



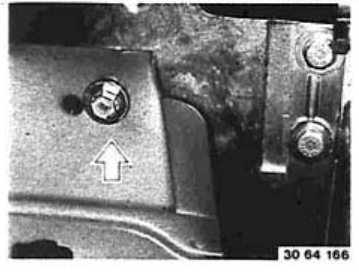
Only Cars with Additional Turn Signals:
Pull off plug (1) on right additional turn signal.



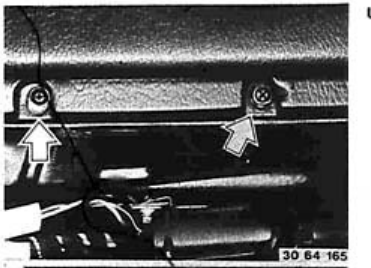
Push back retainer (1).
Pull off multiple pin plug (2) on control unit.
Disconnect plug (3).



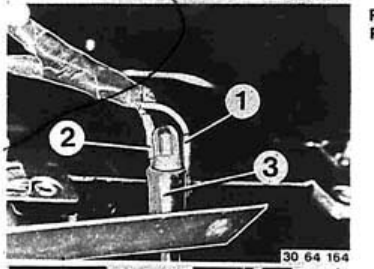
Unscrew bolts.



Unscrew bolt.



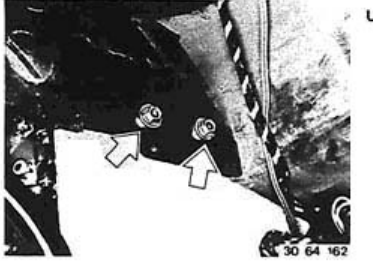
Unscrew bolt.



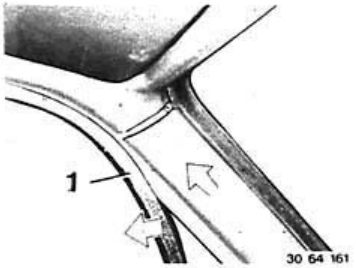
Pull off plugs (1 and 2) on switch (3).
Remove control unit with holders.



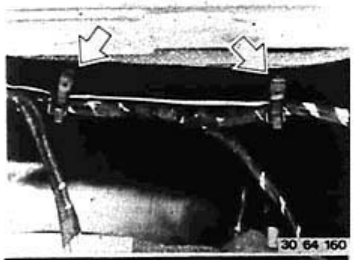
Unscrew bolt.



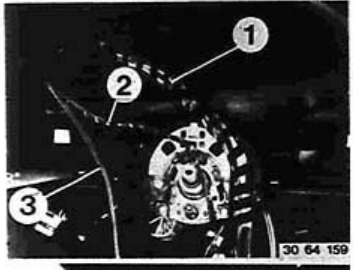
Unscrew both bolts.



Pull off edge guard (1) on body in area of left and right A pillars.
Pull away both column casings from A pillars and remove from above.



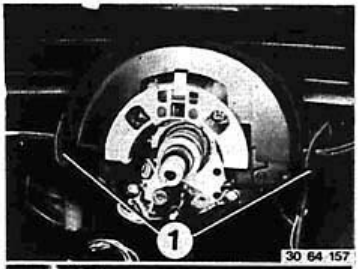
Open both wire straps.



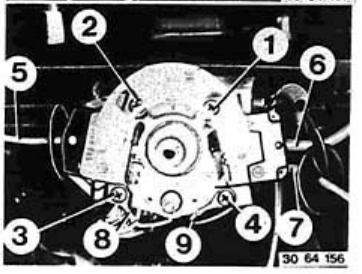
Disconnect wire harnesses (1 ... 3) underneath the instrument panel and pull back into footwell.
1 = Instrument panel wire harness
2 = Radio wire harness
3 = Radio speaker wire



Remove shim (1).

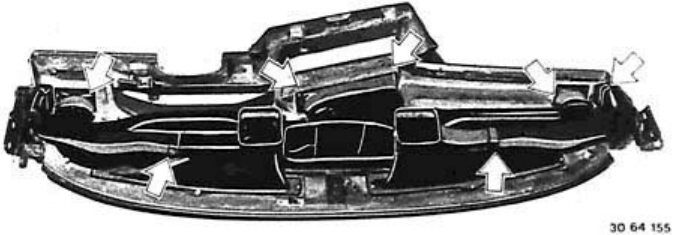


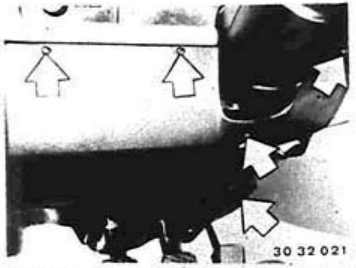
Remove upper steering column casing.
Installation:
Use rubber washers (1) behind casing.



Unscrew bolts (1 ... 4) and remove control levers (5 ... 7).
5 = Turn signal lever
6 = Wiper lever
7 = Cruise control lever
Installation:
Also secure ground wires (8 and 9).
Both tabs of cruise control lever must engage in bores.

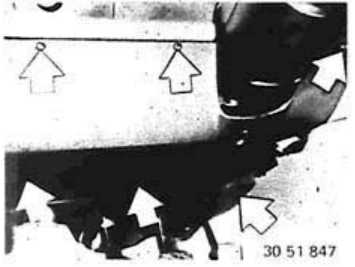
Remove instrument panel.
Installation:
Make sure air ducts fit properly.



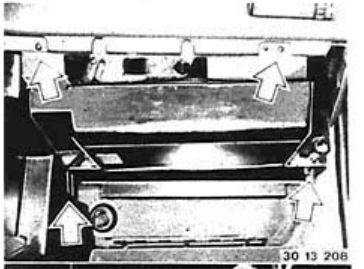


51 45 180 REMOVING DASHBOARD TRIM PANEL AT BOTTOM LEFT

Unscrew screws.
Take out trim panel.

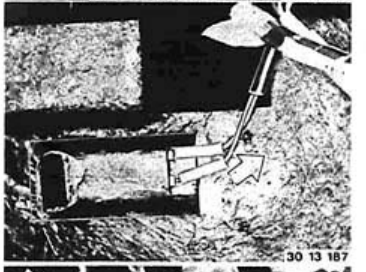


Cars with Airbag:
Unscrew screws and lift off trim panel.

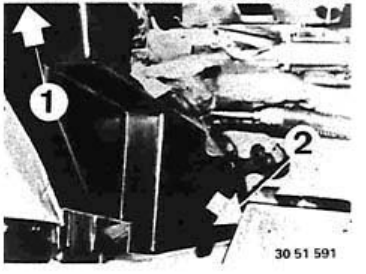


51 45 200 REMOVING DASHBOARD TRIM PANEL AT BOTTOM CENTER RIGHT

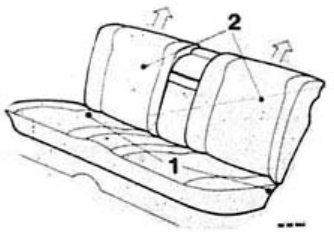
Open glove box.
Unscrew screws.



Pull off glove box light plug.
Lift out trim panel.

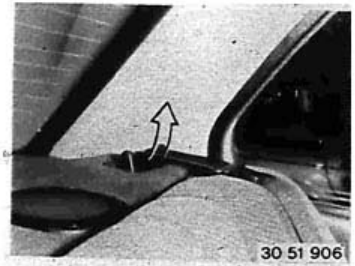


Unscrew screws (1 and 2).
Lift out trim panel.



51 46 000 REMOVING AND INSTALLING HATRACK TRIM PANEL

Pull out rear seat cushion from above.
Unscrew bolts (1) and disconnect backrest in holders (2).

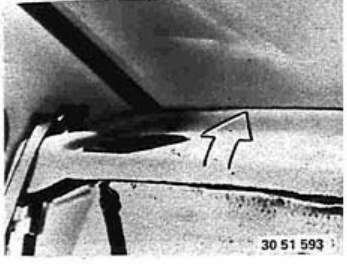


Lift out front end of and pull out cover.



Unscrew left and right screws.

Installation:
Tightening torque*.

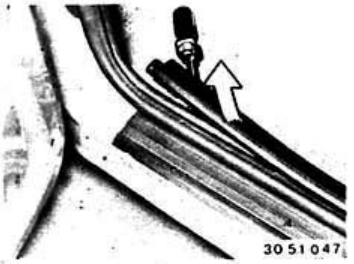


Unclip trim panel in middle and lift out panel.
If applicable, pull off radio speaker wires.

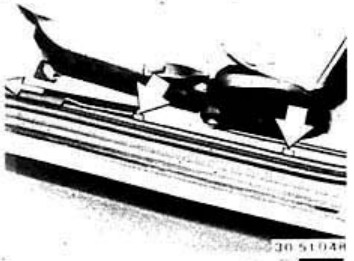
Installation:
Openings are marked for service installation of radio speakers.

* See Specifications of Gr. 72

51 47 000 REMOVING AND INSTALLING OR REPLACING LEFT OR RIGHT FRONT ENTRANCE COVER STRIP



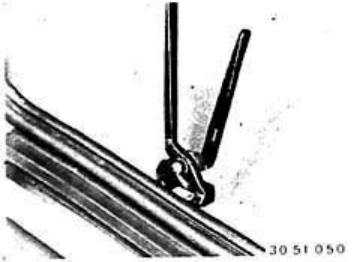
Pull cover strip off of first clip.
Note:
Pulling off will be difficult, pry off carefully with a screwdriver if necessary.



Slide cover strip forward as far as possible until rear clips are accessible.



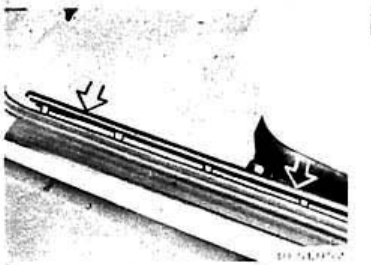
Pull off cover strip toward rear.



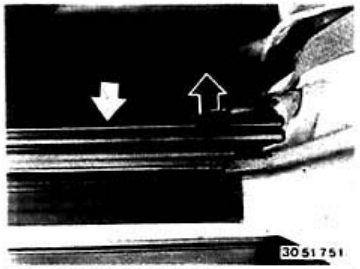
Compress clips with a pliers as shown and lift out.



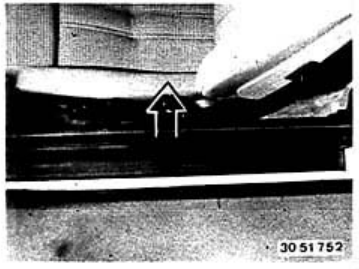
Slide clips on to cover strip.



Align clips with holes in entrance.
Press on cover strip.

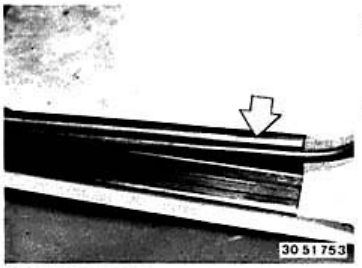


Convertibles:
Lift off cover on seat belt.
Lift out clips.

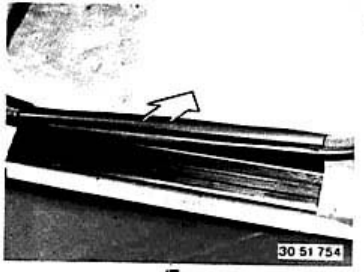


Remove cover.

51 47 030 REMOVING AND INSTALLING OR REPLACING LEFT OR RIGHT REAR ENTRANCE COVER STRIP



Pull out expander rivet.



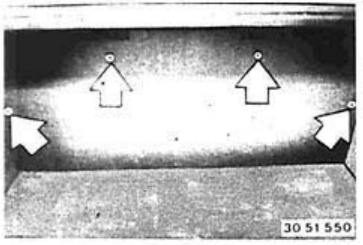
Lift out cover.



Compress and lift out clips with a pliers.

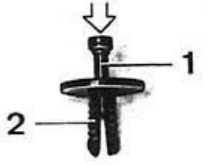


Installation:
If applicable, slide on and align new clips.



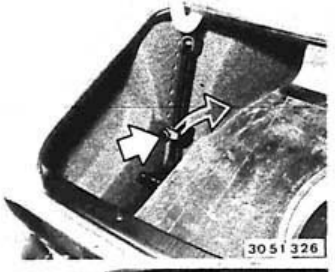
51 47 140 REMOVING AND INSTALLING TRIM PANEL FOR REAR TRUNK WALL

Pull out expander rivet.
Lift out plugs.
Remove trim panel.



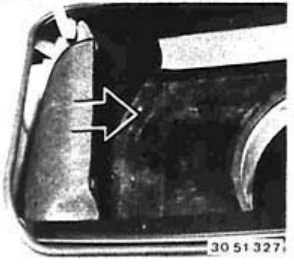
30 51 325

1 = Expander rivet
2 = Plug
Installation:
First insert the plug and then press in the expander rivet.

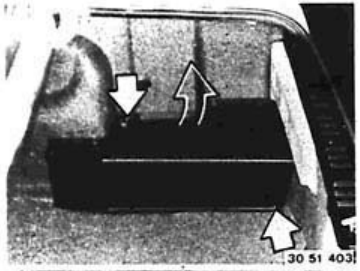


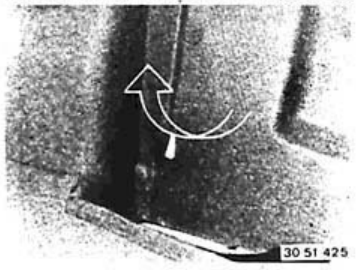
51 47 210 REMOVING AND INSTALLING TRUNK TRIM PANEL ON LEFT SIDE WALL

Remove trim panel for rear trunk wall – see 51 47 140.
Remove floor mat.
Unscrew screw, turn up lock and take out the car jack.



If applicable, lift out tail light bulb holder.
Pull out trim panel at top first and then remove it.

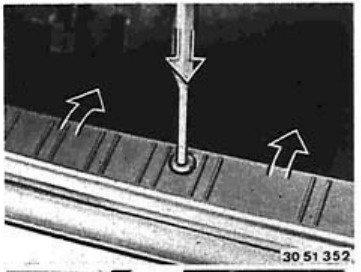


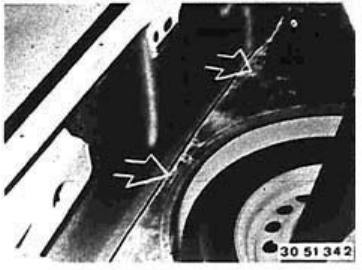


51 47 220 REMOVING AND INSTALLING TRUNK TRIM PANEL ON RIGHT SIDE WALL

If applicable, remove battery cover.
Remove trim panel for trunk rear wall – see 51 47 140.
Remove floor mat.

If applicable, lift out tail light bulb carrier.
Lift out trim panel.





51 47 240 REMOVING AND INSTALLING TRUNK TRIM PANEL ON TAIL PANEL WALL

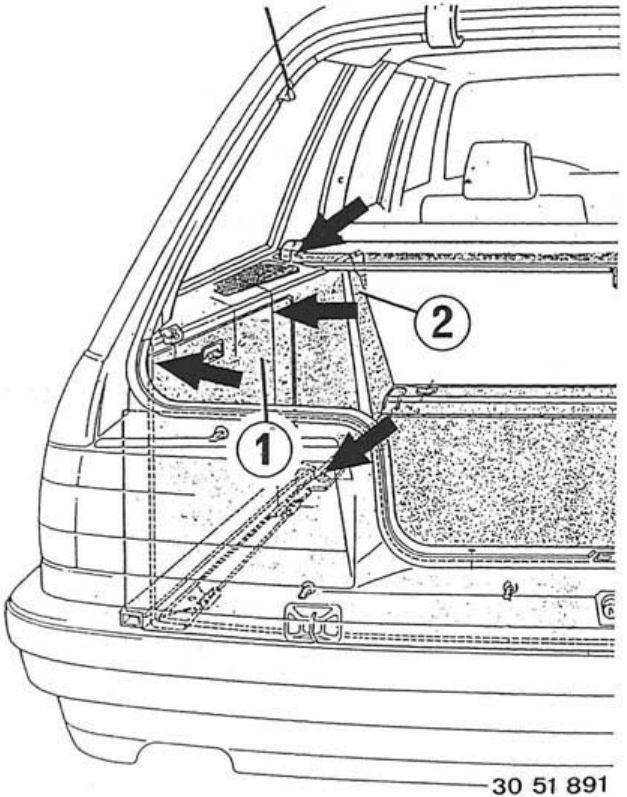
Press out pins of clips downward.
Take off plate.

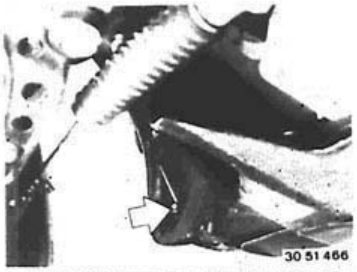
If applicable, lift out tail light bulb carrier.
Lift out trim panel.

51 47 . . . REMOVING AND INSTALLING LEFT OR RIGHT TRUNK TRIM PANEL

Open flap (1).
Unscrew screws.
Pull off radio speaker wires, if applicable.
Lift out trim panel.

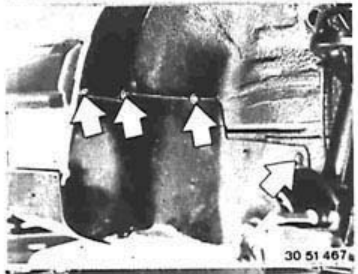
Installation:
Attach trim panel first on locking pin (2) of the seat cushion.



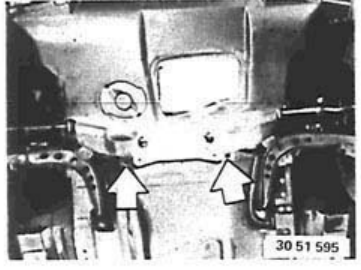


51 47 490 REMOVING AND INSTALLING OR REPLACING SPLASH GUARD FOR FRONT PANEL

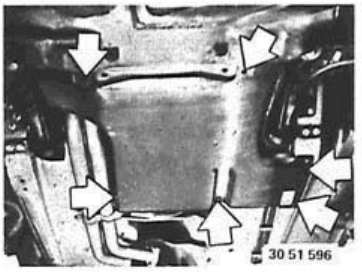
Unscrew screws on left and right sides.



Unscrew screws on left and right sides.
Remove engine compartment splash guard.

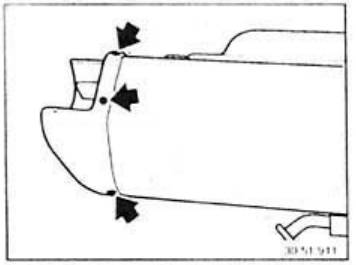


Additional for Diesels:
Unscrew screws.



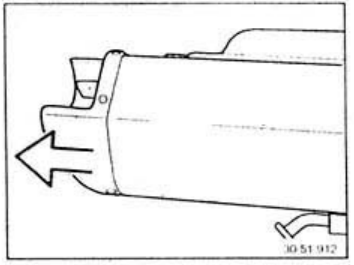
51 47 491 REMOVING AND INSTALLING REAR SPLASH GUARD FOR ENGINE COMPARTMENT

Unscrew screws.
Take off splash guard.

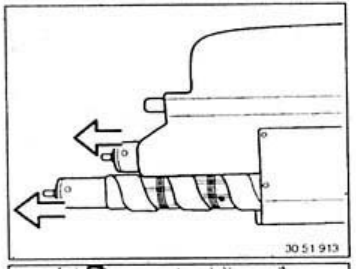


51 47 ... DISASSEMBLING AND ASSEMBLING COMBINATION SUN SHADE

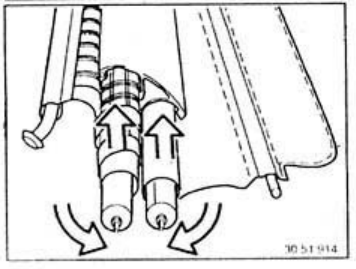
Disassembling:
Drill out rivets at left and right.



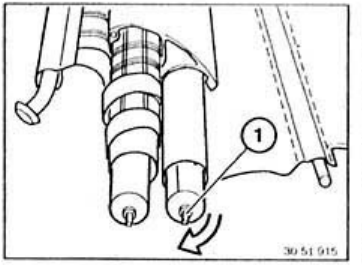
Pull off covers at left and right.



Pull out sun shade and partition net.



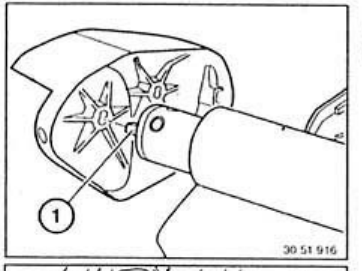
Assembling:
Wind up sun shade and partition net and slide into housing.



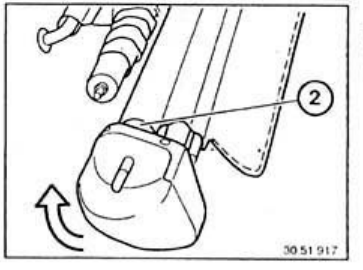
Important!
Check direction of rotation. Only tension spring in sun shade in clockwise direction. Turning in wrong direction would break spring.

Turn shaft end (1) of sun shade clockwise by hand until resistance is noticed.

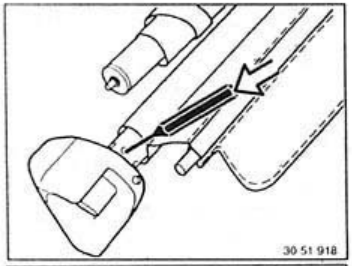
Note:
When released, shaft end must turn back slightly on its own.



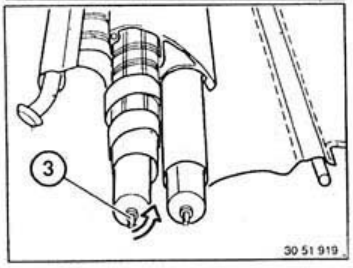
Place cover on shaft end (1) of sun shade.



Hold spring housing (2) firmly and tension spring by turning cover clockwise 6 times.



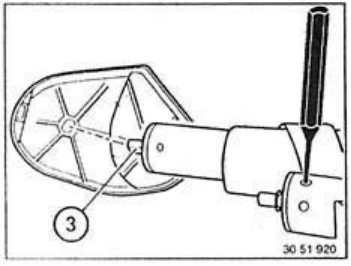
Insert mandrel (2 to 2.5 mm/0.079 to 0.098" dia.) in locking bore.
If necessary preload spring slightly until bore is accessible.
Take off cover.



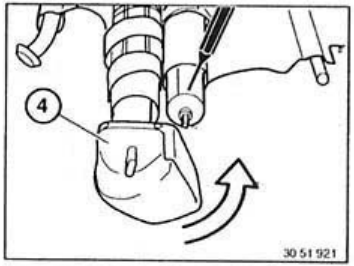
Important!
Check direction of rotation. Tension spring in partition net only counterclockwise. Turning in wrong direction would break spring.

Turn shaft end (3) on partition net counterclockwise by hand until resistance is noticed.

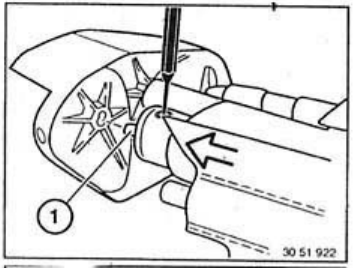
Note:
When released, shaft end must turn back slightly on its own.



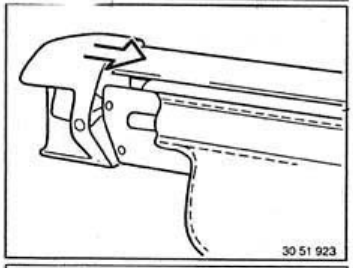
Place cover on shaft end (3) of partition net.



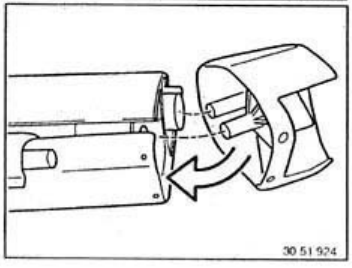
Hold spring housing (4) firmly and tension spring by turning cover counterclockwise 16 times.
Hold cover firmly.



Insert shaft end (1) of sun shade in cover.
Pull mandrel out of locking bore.



Slide sun shade and partition net into housing of combination sun shade completely until cover fits tight on housing.



Install cover for other end of combination sun shade on shaft ends and housing.

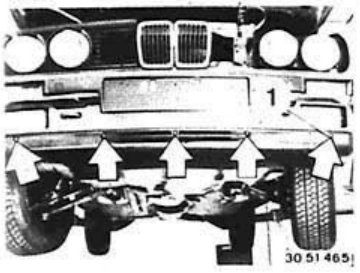
Check function!

Rivet both covers with blind rivets (3.2 mm dia. x 5.6 mm).



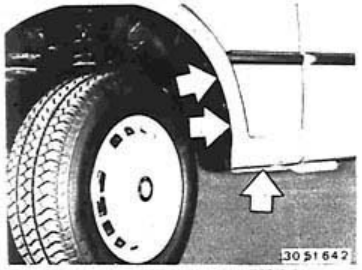
51 71 404 REMOVING AND INSTALLING FRONT SPOILER

Unscrew bolts on left and right sides.



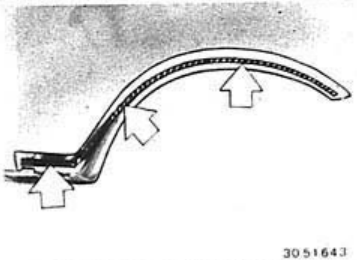
Unscrew bolts.
Take off spoiler.
If applicable, pull off temperature sensor (1).

Installation:
Tighten plastic nut on holding screw about two turns.
Slide in spoiler left and right.

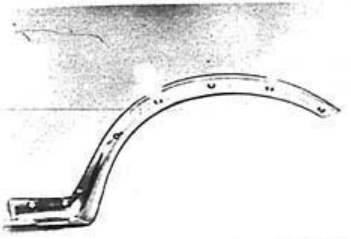


51 71 434 REPLACING ORNAMENT ON FRONT SIDE PANEL

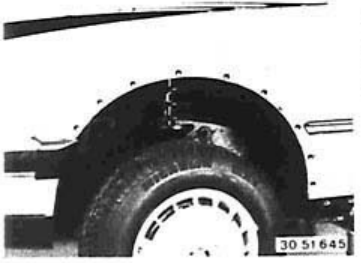
Unscrew screws.
Pull off ornament.
Installation:
Use new screws and self-tapping nuts.



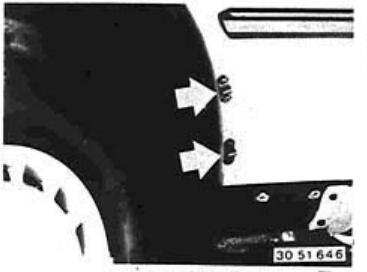
Pull off sealing tape.
Installation:
Pull new sealing tape into the trim panel.



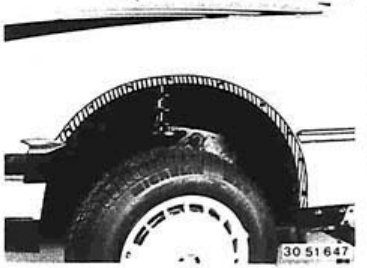
Lift out plugs.
Installation:
Insert new plugs in trim panel.
(round = side member area)
(square = wheel house)



Lift out grommets.
Installation:
Insert new grommets.
Grommets must be softened in water for a certain time prior to installation.

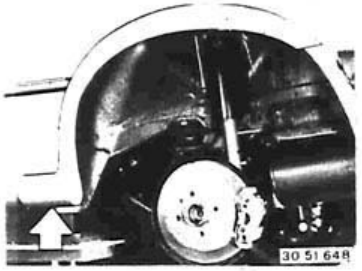


Lift out holder.
Installation:
Insert new holder.
Press in expander rivets.

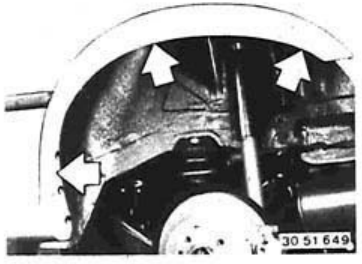


Installation:
When replacing the front side panel the mounting holes must be produced prior to painting.
Apply drilling template on edge and paste down along the wheel house contour.
Punch mark centers of holes, drill 9 mm (0.354") dia. holes, deburr and coat edges of holes with zinc dust paint.
Pull off drilling template.

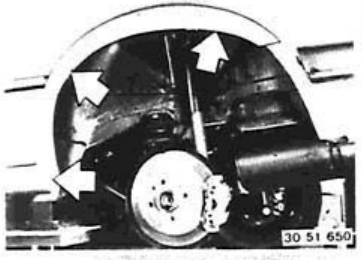
51 71 440 REPLACING ORNAMENT ON REAR SIDE PANEL



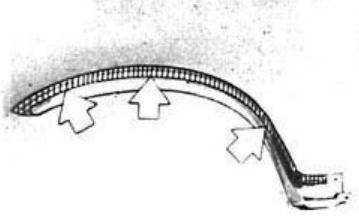
Unscrew screw.
Installation:
Use new screw and self-tapping nut.



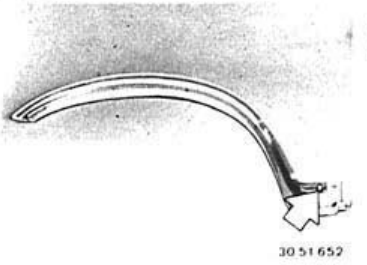
Lift out plastic rivets in wheel house.
Installation:
Install plastic rivets with Special Tool



Pull off ornament.
Installation:
Clip in and align the ornament.



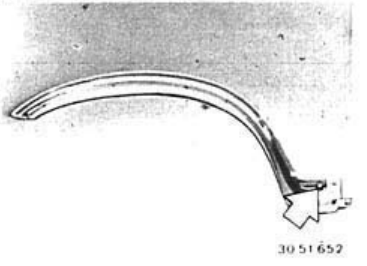
Pull off sealing tape.
Installation:
Pull new sealing tape into the ornament.



Lift out plugs.
Installation:
Insert new plugs in side panel.

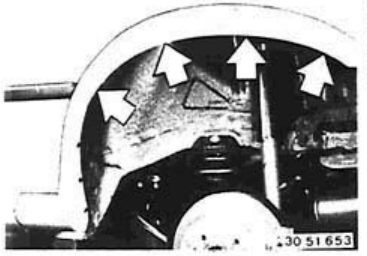


Lift out grommet.
Installation:
Insert new grommet.
Grommets must be softened in water several minutes prior to installation.

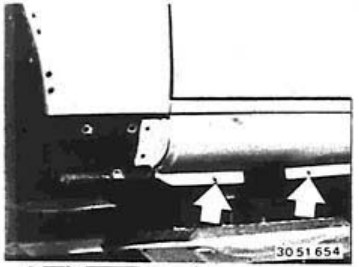


Installation:
Mounting holes must be produced when replacing the side panel.
Insert plug in ornament.

Insert grommet in side member.
Installation:
Grommets must be softened in water several minutes prior to installation.

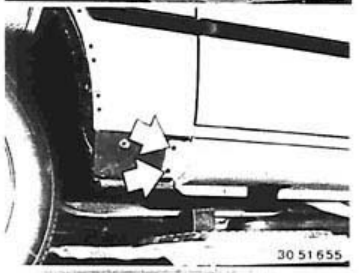


Clip in and align side trim panel.
Mark centers of holes.
Punch centers, drill 6.2 mm (0.244") dia. holes, deburr and coat edges of holes with zinc dust paint.

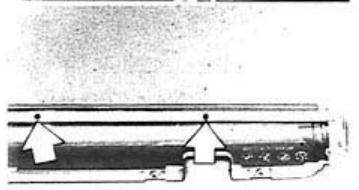


51 71 446 REPLACING TRIM PANEL FOR COVER ON SIDE MEMBER

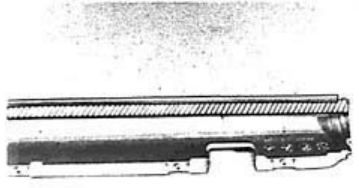
Remove ornament on front side panel – see 51 71 434.
Remove ornament on rear side panel – see 51 71 440.
Unscrew clamps.



Lift out expander rivets at front and rear.
Pull off trim panel.
Installation:
Pull off protective sheet on sealing tape.



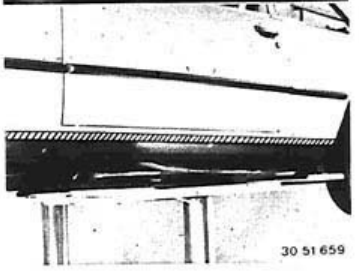
Lift out plugs.
Installation:
Insert new plugs in trim panel.



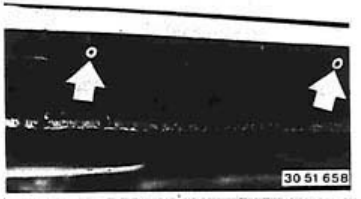
Pull off sealing tape.
Installation:
Pull new sealing tape into trim panel (two layers).



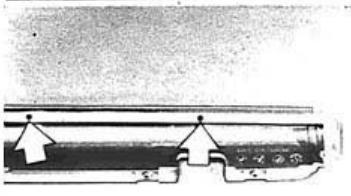
Lift out grommets.
Installation:
Insert new grommets.
Grommets must be softened in water several minutes prior to installation.



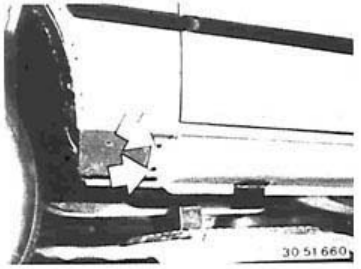
Installation:
Mounting holes must be produced prior to painting when replacing the side member.
Center drilling template at front and rear to same distance and paste down along edge.
Punch centers, drill 9 mm (0.354") dia. holes, deburr and coat edges of holes with zinc dust paint.
Pull off drilling template.



Insert grommets in side member.
Installation:
Grommets must be softened in water several minutes prior to installation.

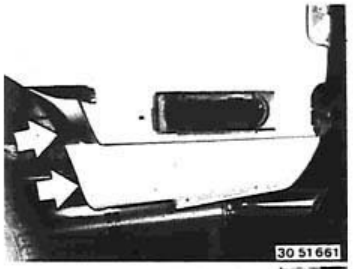


Insert plugs in trim panel.

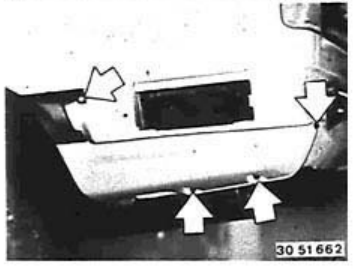


Clip in and align trim panel.
Mark centers of holes at front and rear.
Take off trim panel.
Punch centers, drill 6.5 mm (0.256") dia. holes, deburr and coat edges of holes with zinc dust paint.

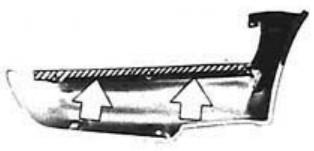
51 71 456 REPLACING REAR STONE PROTECTION TRIM PANEL



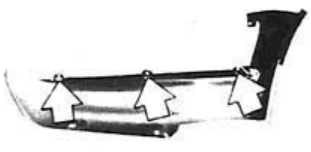
Remove rear bumper – see 51 12 000.
Lift out plastic rivets in wheel house.
Installation:
Install plastic rivets with Special Tool



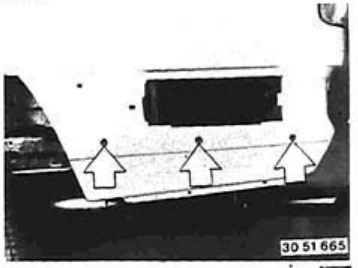
Lift out expander rivets.
Pull off trim panel.
Lift out grommets for expander rivets.
Installation:
Use new grommets and expander rivets.



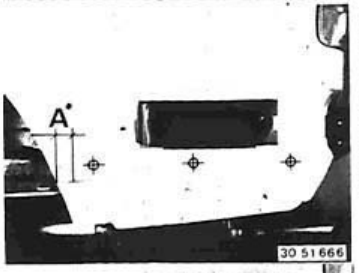
Pull off sealing tape.
Installation:
Pull new sealing tape into trim panel.



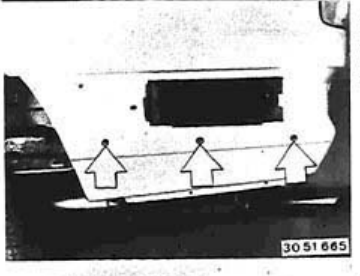
Lift out plugs.
Installation:
Insert new plugs in trim panel.
Insert seal.



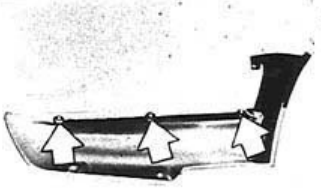
Lift out grommets.
Installation:
Insert new grommets.
Grommets must be softened in water several minutes prior to installation.



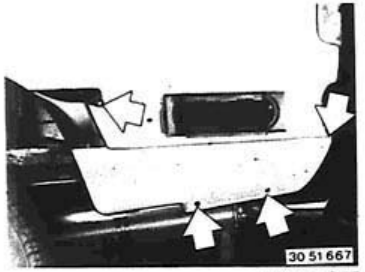
Installation:
Mounting holes must be produced prior to painting when replacing the rear side panel.
Tape down the drilling template along the edge.
Distance A = 29.5 mm (1.161").
Punch centers, drill 9 mm (0.354") dia. holes, deburr and coat edges of holes with zinc dust paint.
Pull off the drilling template.



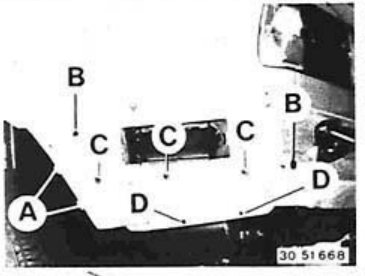
Insert grommets in side panel.
Installation:
Grommets must be softened in water several minutes prior to installation.



Insert plugs in stone protection trim panel.



Fit in stone protection trim panel and mark location of holes.



Punch centers and drill holes:
A = 6.2 mm (0.244") dia.
B = 8.5 mm (0.335") dia.
C = 9.0 mm (0.354") dia.
D = 6.5 mm (0.256") dia.
Deburr and coat edges of holes with zinc dust paint.



If applicable, install plug with a seal.

51 71 394 INSTALLING FRONT SPOILER (M-SYSTEM)

Painting:
The front spoiler is supplied with a prime coat and substructure paint, so that only the final coat of paint has to be sprayed on.

Procedures: BMW plastic part painting (see BMW Paint Brochure).

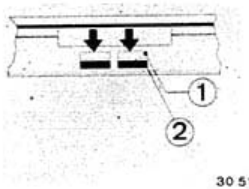
BMW acrylic paint + 20 % BMW softface additive.

Caution!
Maximum enamel baking temperature: 50° C (122° F).

Pertinent cooling air openings must be cut out prior to painting the front spoiler.
Cars Until 09/85.

1 = Open

2 = Closed



30 51 845

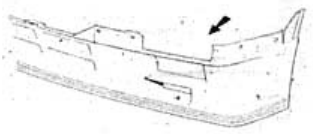
316 – 324 d Since 09/85:

Terminal	= Air Conditioner
1	= 316
2	= 318 i
3	= 325 e / 320 i*
4	= 325 i
5	= 325 iX
6	= 324 d



30 51 846

Opening in front spoiler must be made for the installation of front fog lamps.
Openings are marked with ribs on the back of a spoiler and can be cut out with a compass saw.
Edges must be filed smooth afterwards.
Important!
The prime coat must be touched up around the openings to guarantee adhesion of the final paint coat.
Paint front spoiler (refer to "Painting").

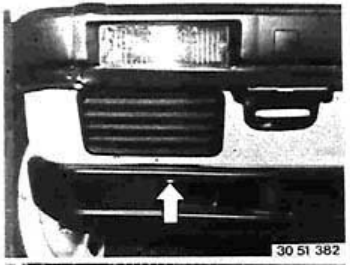


30 51 501

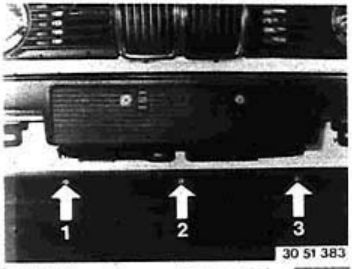
Disassemble front plastic panel (cars before 09/85).
Unscrew self-tapping screw (1) with an 8 mm wrench on the side panel.



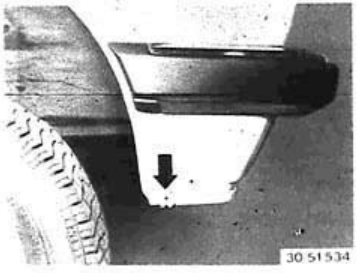
30 51 533



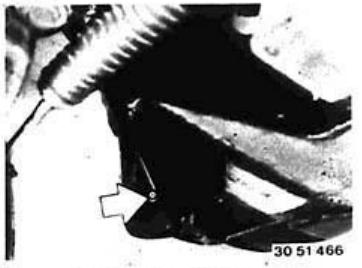
Remove phillips screws on left and right sides.



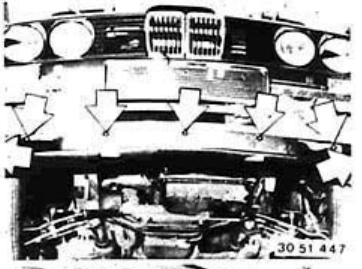
Unscrew self-tapping screws (1 ... 3).
Take off trim panel.



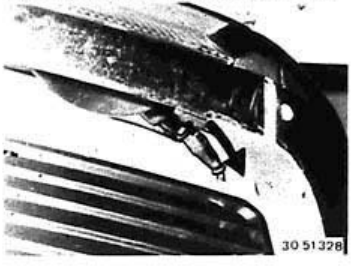
Pull self-tapping nuts off of plastic trim panel and mount on body.
Mount wheel house shells on sides.



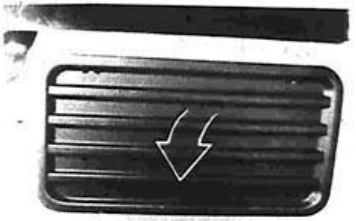
Cars Since 09/85:
Unscrew screws on left and right sides.



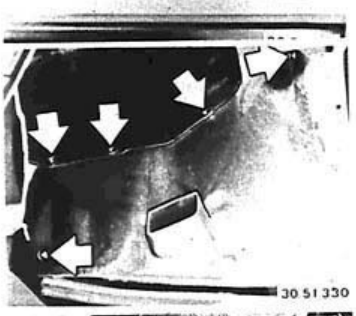
Unscrew front screws.
Take off trim panel.



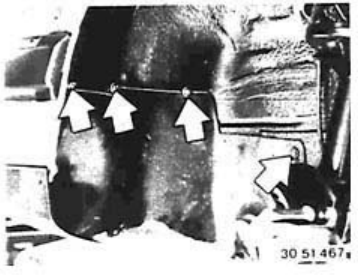
Unscrew front bumper.
Disconnect plugs on left and right turn signals.
Installation:
Check for correct fit of rubber grommets.



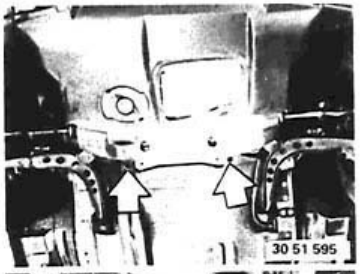
Cars Without Front Fog Lamps:
Lift out left and right covers.



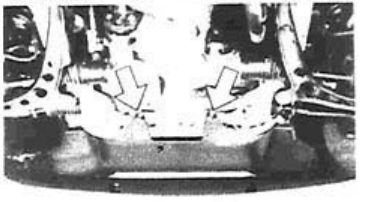
Cars With Front Fog Lamps Before 09/85:
Remove left and right wheel house panels.



Removing Splash Guard (316, 318 i, 320 i, 325 e, 325 i Since 09/85):
Unscrew left and right bolts.
Remove splash guard for engine.

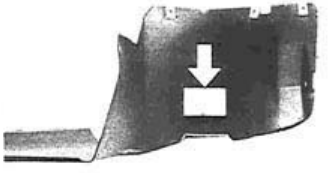


Additional for BMW 324 d:
Unscrew bolts.



Additional for BMW 325 iX:
Unscrew bolts.

30 51 602



Only Cars Since 09/85:
Make openings for air ducts along the lines provided in the splash guard for the engine.

30 51 605

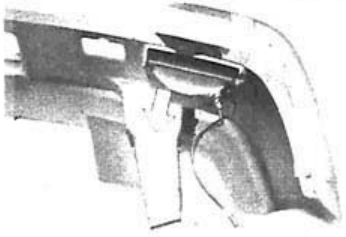


30 51 606

Produce 7 mm (0.275") dia. holes in the ventilation necks.

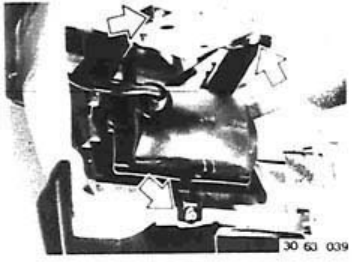
A = 57 mm (2.244")
a = 15 mm (0.590")

Note:
Check part numbers.
51 71 1 942 967 = left
51 71 1 942 968 = right
Part numbers must face down!



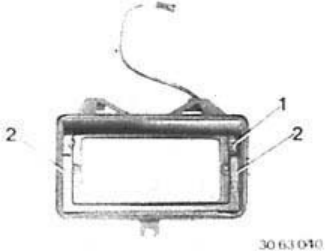
30 51 607

Mount ventilation necks on front spoiler, drill through holes and secure necks with expansion rivets.



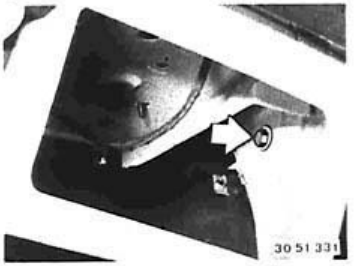
30 63 039

Removing Front Fog Lamps:
Pull off plugs on front fog lamps.
Unscrew screws and take off front fog lamps with housings.



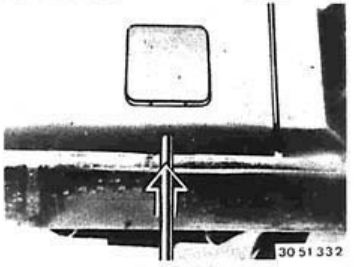
30 63 040

Taking Front Fog Lamps Out Of Holders:
Unscrew adjusting screw (1).
Remove covers (2).
Unclip front fog lamps in holders.



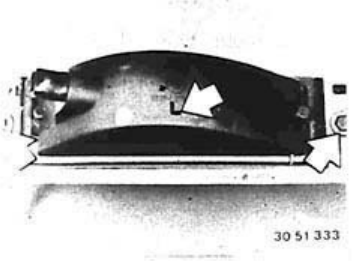
30 51 331

Removing Bumper:
Unscrew left and right bolts.
Installation:
Tightening torque: 6 to 9 Nm (4.5 to 6.5 ft. lbs.



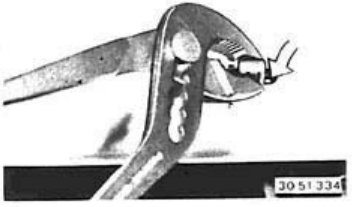
30 51 332

Lift out left and right covers with a screwdriver.
Unscrew left and right nuts.
Take off bumper.
Installation:
Tightening torque: 22 to 25 Nm (16 to 18 ft. lbs.).
Arrows on back of covers face up.



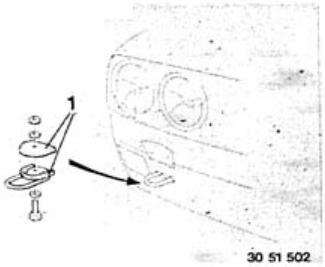
30 51 333

Unscrew and remove left and right turn signals.
Installation:
Turn signals are marked with
L for left or
R for right.



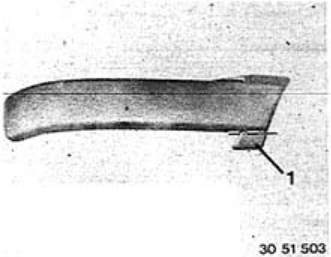
30 51 334

Removing Rubber Guard:
Compress and push out locking hooks of all rubber guard clips.



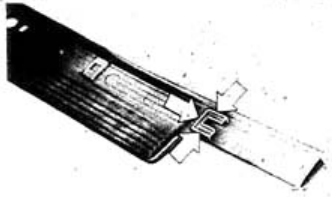
30 51 502

Extend the right towing eye with supplied adapter (1).
The left towing eye of cars since 09/85 must be cut off and the cut edges coated with zinc dust paint to prevent corrosion.
Installation:
Align towing eye in middle of opening when mounting the front spoiler.
Paint adapter to match color of car.



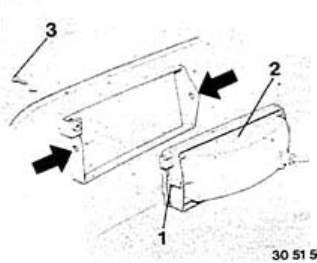
30 51 503

Cut side rubber guard sections to size as shown.



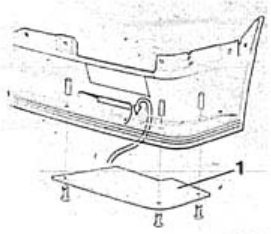
30 51 504

Grind off webs on license plate carrier.



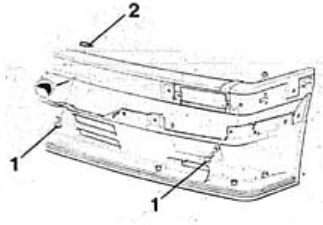
30 51 505

Mounting Front Fog Lamps on Front Spoiler:
Engage pins (1) of housing (2) in tabs of the trim panel provided for this purpose.
Screw in adjusting screw (3).



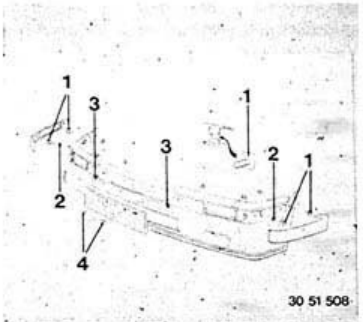
30 51 506

Rivet air guide plates (1) on front spoiler from the inside each with 3 expansion rivets.

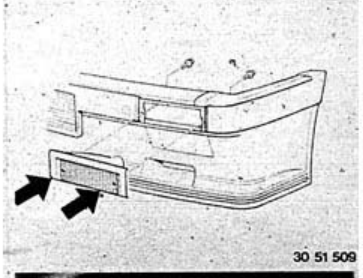


30 51 507

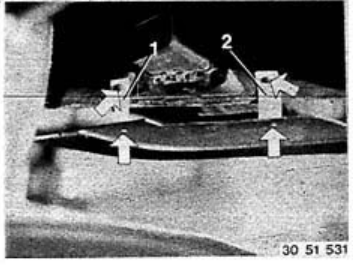
Mount front spoiler on bumper with 3 screws (1).
This requires drilling a 7 mm (0.275") dia. hole in the middle of the bumper (use spoiler as a template). Afterwards coat edges of hole with zinc dust paint to prevent corrosion.
Insert self-tapping nut (2) and tighten screws.



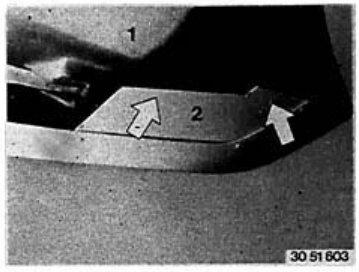
Screw on side rubber guard sections with screws (1) and spacers (2).
Mount license plate carrier with screws (3) and clips (4).



Screw on left and right turn signals.
Mount bumper complate with spoiler on body.
Important!
Check aiming if front fog lamps are mounted!
Installation:
Check for clearance between front spoiler and body (rubbing spots!).



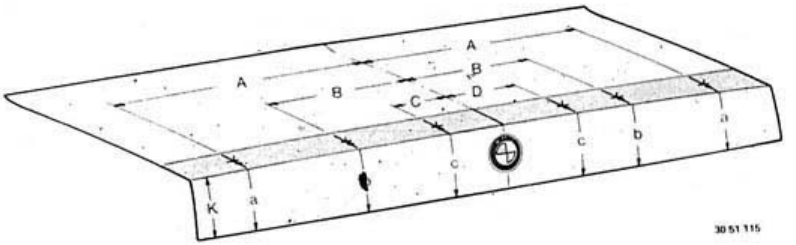
Only Cars Before 09/85:
Mount brackets on covers with expansion rivets.
Drill holes in wheel house shells and mount brackets (1 and 2) with expansion rivets.
Important!
Bracket (2) is bent stronger and must be mounted on the inside!



Only Cars Since 09/85:
Mount engine splash guard (1) and install left and right front spoiler covers (2) each with 2 expansion rivets.

51 71 412 INSTALLING REAR SPOILER

Install adhesive tape (approx. 30 mm (1.181") wide) at distance K to the trunk lid edge over the entire width. Mark center point of bore from the middle of the trunk lid and trunk lid edge (measuring tape), punch and drill (7.5 mm (0.295") diameter).



A	= 565 mm (22.244")	a	= 125 mm (4.921")
B	= 346 mm (13.622")	b	= 127 mm (5.000")
C	= 118 mm (4.646")	c	= 129 mm (5.079")
D	= 130 mm (5.118")		

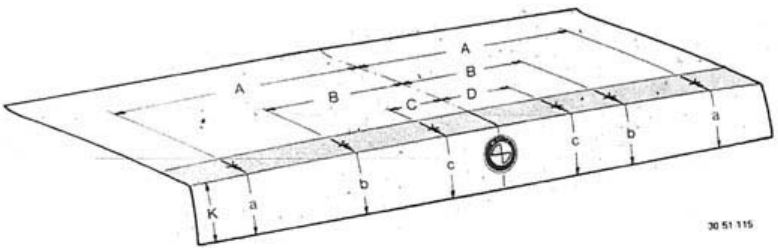
Pull off adhesive tape carefully. Deburr edges of holes and coat with zinc dust paint.
Screw on rear spoiler with the supplied cap nuts.

Painting Information:
Procedures for painting BMW plastic parts.

51 71 414 INSTALLING REAR SPOILER (M-SYSTEM)

Painting:
The panel of a rear spoiler is supplied with a prime coat and substructure paint coat, so that only the final paint coat has to be sprayed on.
Procedures: BMW Plastic Part Painting.
BMW Acrylic paint + 20 % BMW softface additive.
Important!
Maximum enamel baking temperature: 50° C (122° F) – higher temperature could lead to deformation.

Taping:
- Soak a clean cloth in washing gasoline or cold cleaner and wipe off surfaces to be taped.
- Position and press on the double-sided adhesive tape (heated hand warm prior to application!).
- Pull off protective backing and press on part at least 5 to 10 seconds. Initial adhesion can be improved by heating the body.

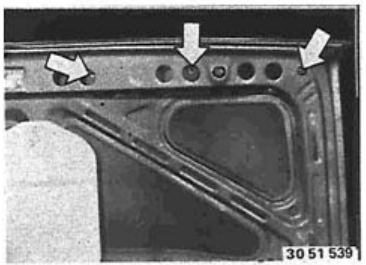


Drill holes in trunk lid of cars not having a standard rear spoiler. Install approximately 30 mm (1.181") wide adhesive tape across entire width of lid at distance K to lower edge of the trunk lid. Draw centerlines of holes from middle and lower edge of trunk lid (use measuring tape), punch and drill 7.5 mm (0.295") dia. holes.

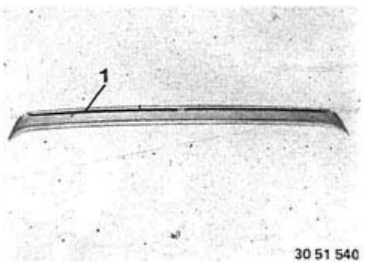
K = 110 mm (4.331")
A = 565 mm (22.244")
B = 346 mm (13.622")
C = 118 mm (4.646")
D = 130 mm (5.118")
a = 125 mm (4.921")
b = 127 mm (5.000")
c = 129 mm (5.079")

Pull off adhesive tape carefully. Deburr and coat edges of holes with zinc dust paint.

Cars With Standard Rear Spoiler:
Remove plastic nuts on inside of trunk lid and take off standard spoiler.



Paint the panel (refer to "Painting").
Install adhesive tape (1) (refer to "Taping").

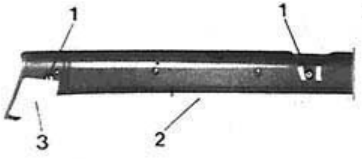


Remove protective backing on adhesive tape and mount panel on rear spoiler.



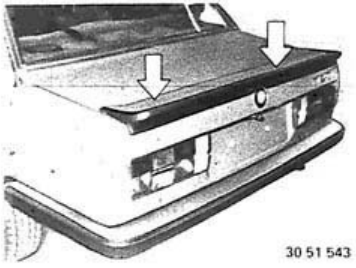
30 51 541

Screw on panel with three screws (1). Install adhesive strips (2) and adhesive molded parts (3).



30 51 542

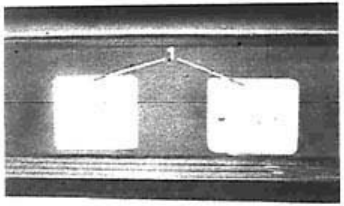
Pull off protective backing on adhesive tape, insert M-System rear spoiler in holes and screw on with plastic nuts and insulators.



30 51 543

51 71 423 INSTALLING TAIL PANEL (M-SYSTEM)

Painting:
The tail panel is supplied with a prime coat and substructure paint coats, so that only the final paint coat has to be sprayed on.
Procedures: BMW Plastic Part Painting.
BMW acrylic paint + 20 % BMW softface additive.
Caution!
Maximum enamel baking temperature: 50° C (122° F) – higher temperatures could lead to deformation.

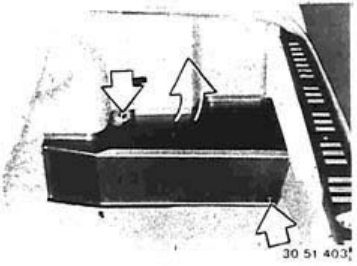


30 51 519

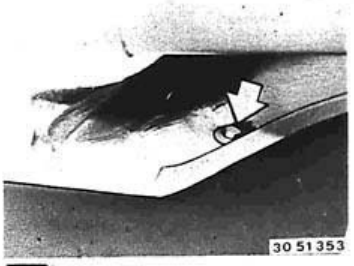
Cut out openings (1) in tail panel with a compass saw to take a trailer hitch as special equipment.
BMW 316, 318 i and 320 i:
Cut out tailpipe opening (2).
Afterwards smooth edges of openings with a file.
Openings are marked with ribs on back of panel (ribs remain!).
Important!
The prime coat must be touched up around openings to guarantee adhesion of the final paint coat.
Paint tail panel (see "Painting").


30 51 339

Removing Rear Bumper:
Uncover openings in side panels and unscrew left and right bolts.
Installation:
Tightening torque: 22 to 25 Nm (16 to 18 ft. lbs.).


30 51 403

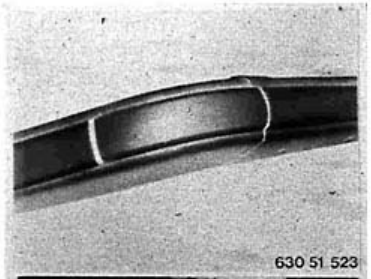
If applicable, remove battery cover.


30 51 353

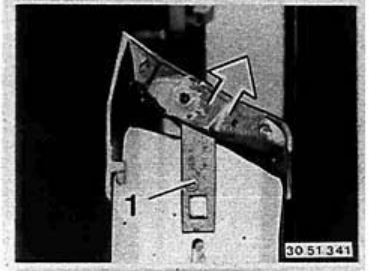
Unscrew left and right bolts.
Installation:
Coat bolts with body sealing compound.


30 51 340

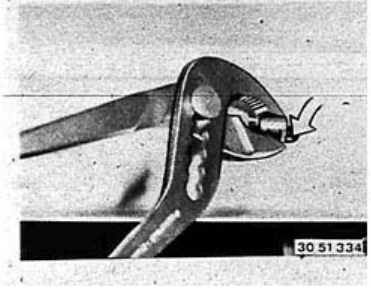
Unscrew left and right bolts.
Take off bumper.
Installation:
Tightening torque: 6 to 9 Nm (4.5 to 6.5 ft. lbs.).



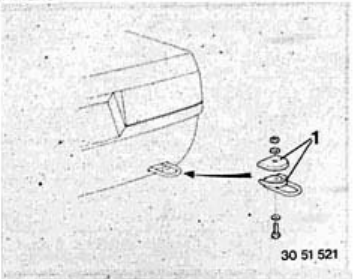
Mark radius inlet and outlet on rubber guard.



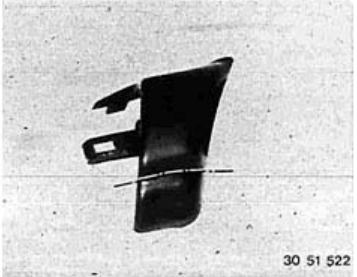
Lift tongue (1) and take off end piece.



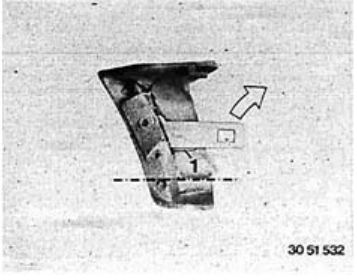
Compress and push through rubber guard clips.
Take off rubber guard.



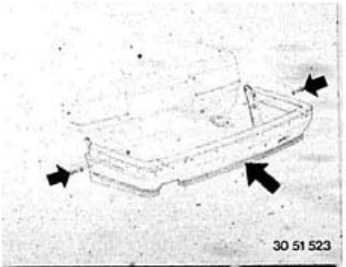
Extend the towing eye with supplied adapter (1).



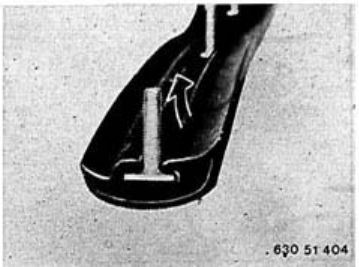
Cut off shoulders of rubber guard end pieces with an iron saw or grinder.



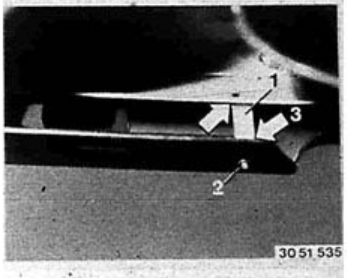
Cut rubber guard end pieces to size on inside as shown.
Leave outer tongue (1).
Coat metal insert with zinc dust paint to prevent corrosion.



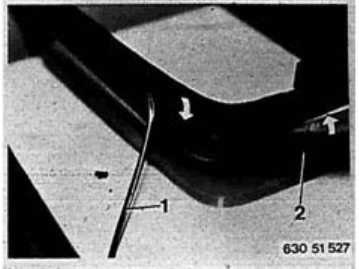
Mount bumper on body temporarily.
Mount, align and screw tail panel on bumper with two hexagon head screws provided for this purpose.



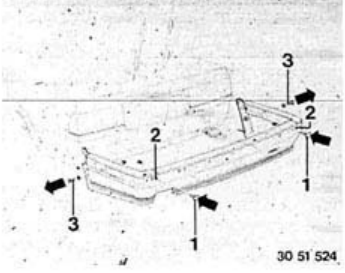
Slide screws into rubber guard and align with holes in bumper.



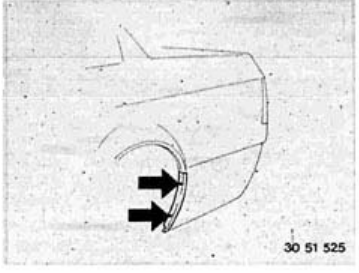
Screw bracket (1) on tail panel with self-tapping screws (2) and self-tapping nuts (3).
Mark location of 6 mm (0.236") dia. holes on tail panel and 5 mm (0.197") dia. holes on wheel house.



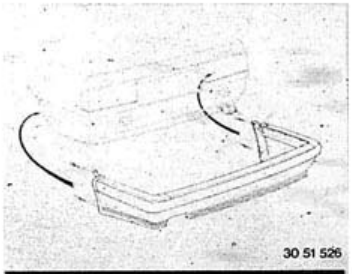
Install seal.
Screw on tail panel with rubber guard.
Note:
Knock on rubber guard, beginning at one side, with a rubber hammer lightly to guarantee good seating of the rubber guard and seal.
Cut off protruding seal, if necessary.



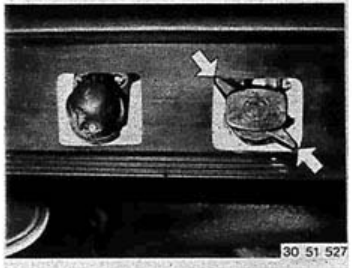
Remove bumper again.
Punch, drill and deburr edges of marked holes.
Coat edges of holes with zinc dust paint to prevent corrosion.
Insert screws (1) in holes (2) and tighten with hexagon nuts.
Remove hexagon head screws (3).



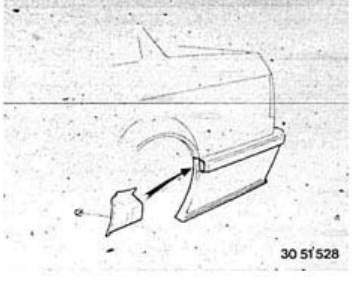
Paste plastic sheet on wheel housing opening and puncture holes.



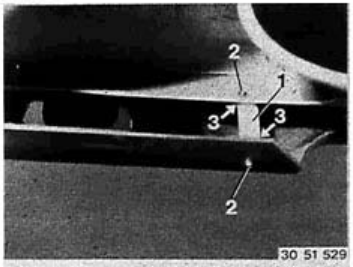
Mount bumper with tail panel on body.
Install blind rivets on wheel house opening.
Loosen wheel house shells.
Note:
It might be necessary to correct the height of the towing eye to avoid interference with the tail panel.



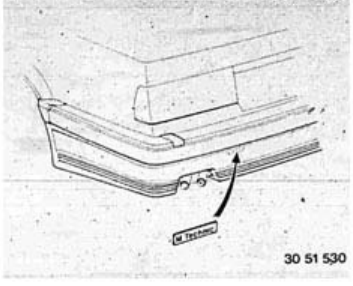
The locking bolt of a mounted trailer hitch, if applicable, must be diagonal to the opening in the tail panel, so that the bumper and tail panel can be installed.



Screw on rubber guard end pieces.



Screw bracket (1) on body with self-tapping screws (2) and self-tapping nuts (3).
Important!
Use a rubber washer between the mounting bracket and body!

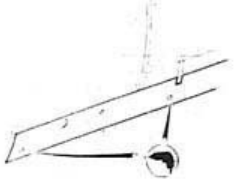


Install M-Technic label.

51 71 452 INSTALLING BOTH SIDE MEMBER COVER PANELS (M–SYSTEM)

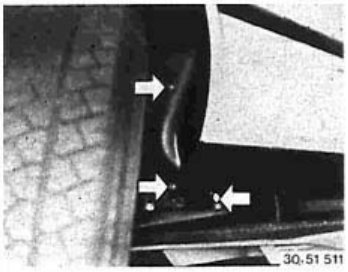
Painting:
The side member panels are supplied with a prime coat and substructure paint coats, so that only the final paint coat has to be sprayed on.
Procedures: BMW Plastic Part Painting.
BMW acrylic paint + 20 % BMW softface additive.
Caution!
Maximum enamel baking temperature: 50° C (122° F) – higher temperatures could lead to deformation.

Taping:
- Soak a clean cloth in washing gasoline or cold cleaner and wipe off the surface for adhesive tape.
- Position and press double-sided adhesive tape on side members (heat hand warm prior to application!).
- Pull off protective backing and mount the part, pressing on at least 5 to 10 seconds. The initial adhesion can be improved by warming the body.



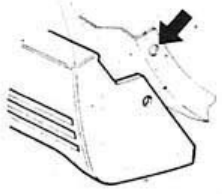
30 51 510

Paint side member panels (see "Painting").
Paste template on side members as shown and mark location of holes.
Punch centers and drill 9 mm (0.354") dia. holes with a spiral drill.
Deburr and coat edges of holes with zinc dust paint.
Treat side member cavities with a body cavity sealing compound to isolate any burrs from drilling which might have fallen in the side members.



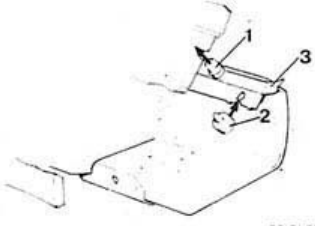
30 51 511

Remove screws on bottom of side panel.
Loosen wheel house shells.



30 51 512

Mount side member panel temporarily.
Mark location of holes on rear wheel house opening, punch centers and drill 5 mm (0.197") dia. holes.
Take off side member panel again.
Deburr and coat edges of holes with zinc dust paint.



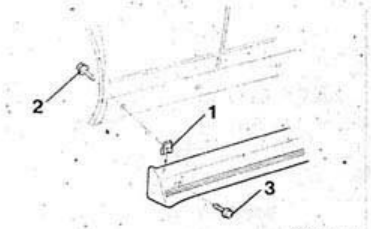
30 51 513

Install grommets (1) in side member.
Insert clips (2) in side member panel.
Install sealing tape (3).
Note:
Coat of PVC must be removed in area of holes for installation of grommets.

Paste plastic sheet on front and rear wheel house openings and puncture through holes.
Note:
Wrap and paste sheet around notched points.

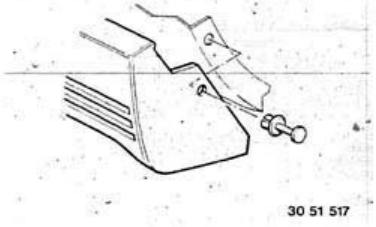


30 51 514



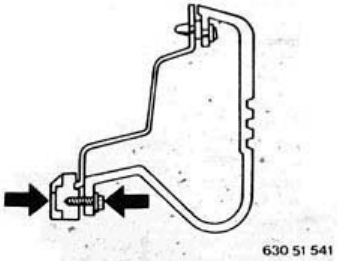
30 51 515

Install self-tapping nut (1).
Pull protective backing off of adhesive tape and mount side member panel again (refer to "Taping").
Screw in screws (2 and 3).



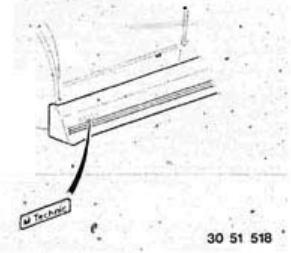
30 51 517

Install expansion rivets on rear wheel house opening.



630 51 541

Mount side member panel at bottom with clamps.
Note:
Remove PVC undercoat carefully in area of clamps.



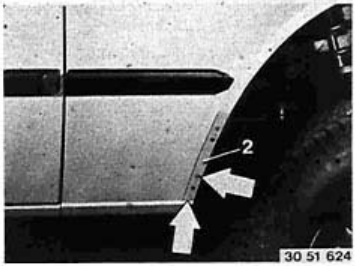
30 51 518

Install "M-Technic" label.

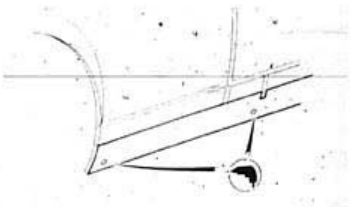
51 71 452 INSTALLING BOTH SIDE MEMBER COVER PANELS (M-SYSTEM VERSION II)

Painting:
Side member panels are supplied with a prime coat and substructure paint coats, so that only the final paint coat has to be sprayed on.
Procedures: BMW Plastic Part Painting (see BMW Paint Brochure).
BMW acrylic paint + 20 % BMW softface additive.
Caution!
Maximum enamel baking temperature: 50° C (122° F).

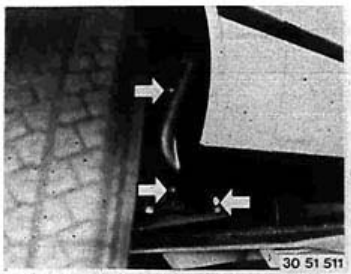
Taping:
- Clean surfaces for taping to remove grease.
- Install adhesive tape at room temperature. Heat parts being pasted to 40 ... 50° C (104 to 122° F) for sufficient adhesion and press on at least 5 to 10 seconds.



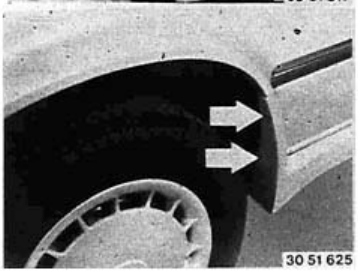
Paste template (2) along wheel housing opening (reference edges, see arrows), mark location of holes, punch centers and drill 5 mm (0.197") dia. holes with a spiral drill.
Open up holes to 9 mm (0.354") diameter with a 12 mm (0.472") dia. slicing drill.
Deburr and coat edges of holes with zinc dust paint.
Treat side member cavities with a body cavity sealing compound to neutralize any burrs from drilling which might have fallen in.



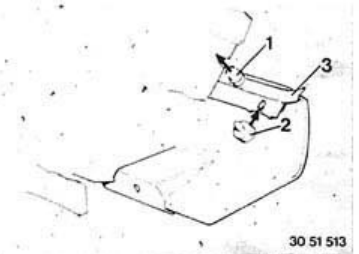
Paint side member panels (refer to "Painting").
Paste side member template (1) on side member as shown and mark location of holes.



Remove screws at bottom of side panels.

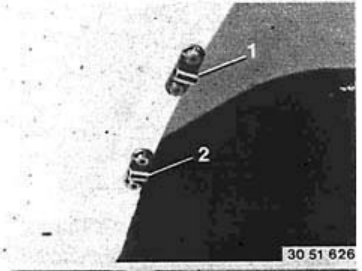


Mount side member panel temporarily.
Mark location of holes on rear wheel house opening, punch centers and drill 5 mm (0.197") dia. holes.
Take off side member panel again.
Deburr and coat edges of holes with zinc dust paint.
Important!
Press side member panel against wheel house opening firmly when marking location of holes.



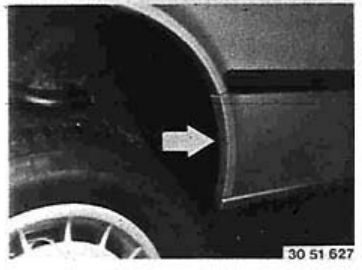
30 51 513

Install grommets (1) in side member.
Insert clips (2) in side member panel.
Install sealing tape (3).
Note:
Remove coat of PVC in area of holes for installation of grommets.

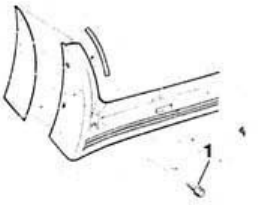


30 51 626

Install nuts (1 and 2) in front side panel.

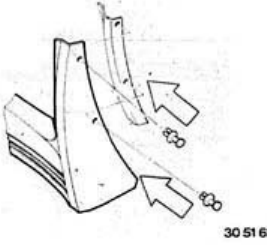

30 51 627

Paste plastic sheet on front and rear wheel house openings and puncture through holes.
Note:
Check part numbers:
1 952 343 = front left
1 952 344 = front right
1 952 341 = rear left
1 952 342 = rear right

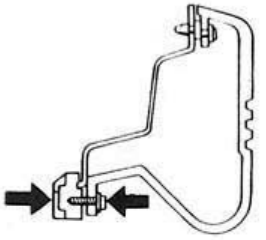


30 51 628

Pull protective backing off of adhesive tape and clip in the side member panel (refer to "Taping" instructions).
Screw in self-tapping screw (1).


30 51 629

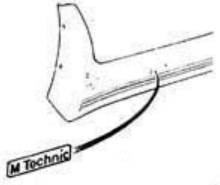
Install expansion rivets on rear wheel house opening.
Screw on front side member panel with self-tapping screws.



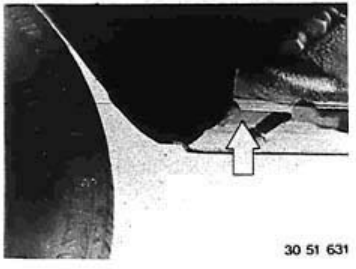
630 51 541

Mount bottom of side member panel with clamps.
Note:
Remove PVC undercoat carefully in area of clamps.

Install "M-Technic" label in recessed field.



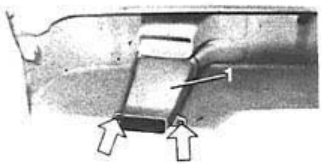
30 51 630



30 51 631

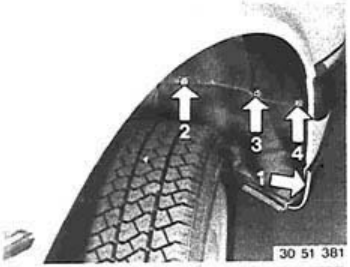
Important!
E 30 cars with mounted side member panels may only be lifted with 2-pillar lifting platforms at the front end on the suspension take-up points, and NOT on the car jack take-up points.

51 71 ... INSTALLING FRONT SPOILER (Until 1986 Models)



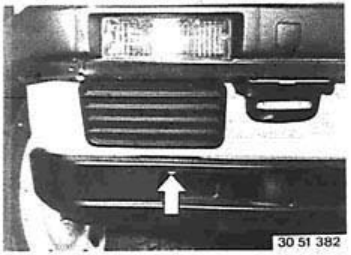
30 51 380

Rivet lower ventilation necks (1) on front spoiler.
Paint front spoiler.
Caution!
Maximum enamel baking temperature: 50° C (122° F) – higher temperature could lead to deformation.



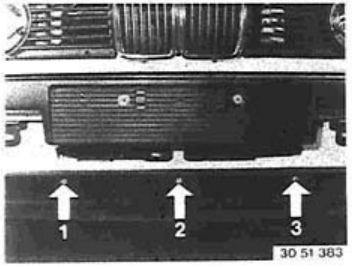
30 51 381

Removing Front Plastic Panel:
Unscrew self-tapping screws (1) on fenders with a 8 mm wrench and screws (2 ... 4) of plastic plates in wheel house on left and right sides.
Pull wheel house shells away to prevent damaging them when drilling holes.



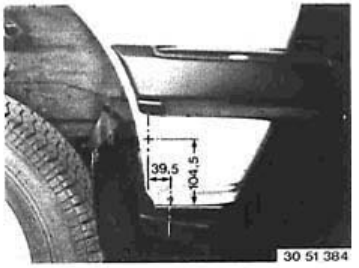
30 51 382

Remove phillips screws on left and right sides.



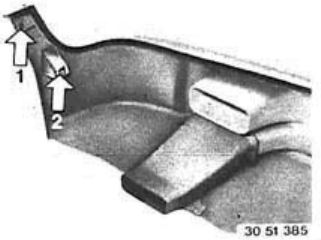
30 51 383

Unscrew self-tapping screws (1 ... 3) of front plastic panel.
Take off panel.



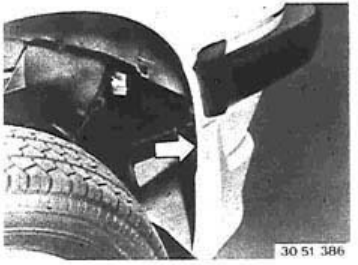
30 51 384

Install crepe tape on left and right fenders in area of holes.
Mark location of holes, punch centers and drill 9 mm (0.354") dia. holes.
Deburr and coat edges of holes with zinc dust paint.



30 51 385

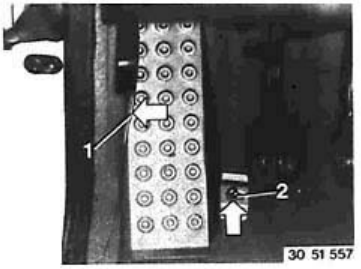
Install butyl tape on spoiler edge to seal.
Install self-tapping nuts (1 and 2) on left and right sides.



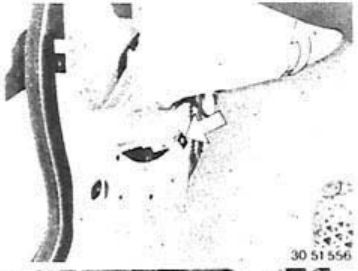
30 51 386

Mount spoiler, aligning slightly if necessary.
Note:
Both remaining screws must be screwed on the fenders before installation of the wheel house shells.

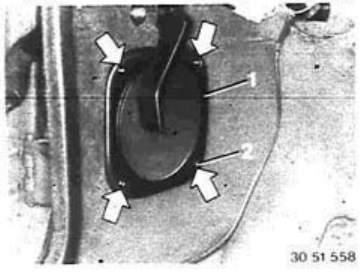
51 71 ... INSTALLING FOOTPROP (M-SYSTEM)



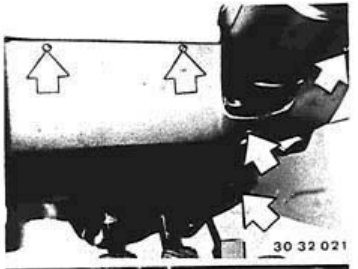
Push top of M-Technic footprop underneath the instrument panel trim.
Fit in footprop and mark location of mounting parts for rotating lock.
Puncture through carpet at this location with a punch and screw in the rotary lock.
Mount footprop with side screw (1) and rotary lock (2).
Place side carpet section over mounting bar of footprop.
Important!
It might be necessary to bend the bar slightly.



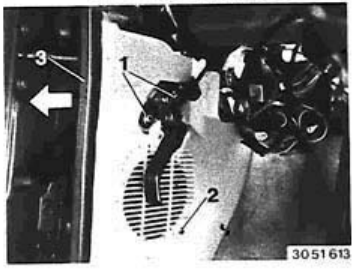
Cars Before 09/85 with Carpet and Without Front Radio Speakers:
Pull away side carpet section.
Install self-tapping nut.



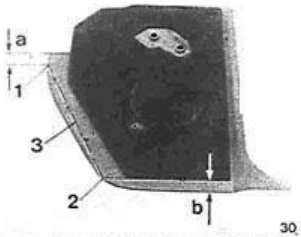
Cars Before 09/85 with Carpet and Front Radio Speakers:
Unscrew mask (1) and take out speaker.
Pull away side carpet section.
Slide holder of footprop underneath carpet and mount with screw (2).



Cars Since 09/85 with Plastic Side Panel:
Remove instrument panel trim – unscrew screws.

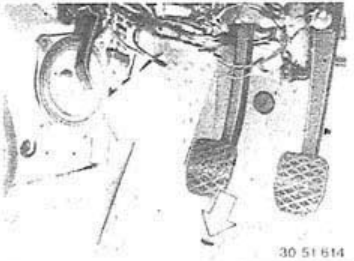


Removing Side Trim Panel:
Unscrew hexagon head screws (1) and self-tapping screw (2).
Pull off seal (3).
Take off engine hood release handle and side trim panel.

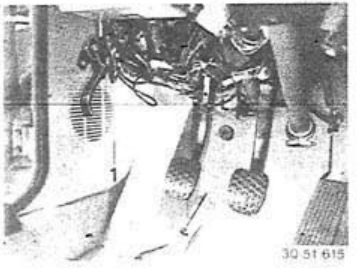


30 51 616

Cut out side trim panel as shown.
a = 30 mm (1.181")
b = 20 mm (0.787")
Mark points (1 and 2).
Draw cutting line (3), if not already available in form of a web, and cut side trim panel with a compass saw.
Smooth edges with a file, if necessary.


30 51 614

Cars with Front Radio Speakers:
Remove spacing clips.
Slide holder of footprop underneath speaker mount.
Mark location of puncturing point on carpet and puncture through carpet with a punch.

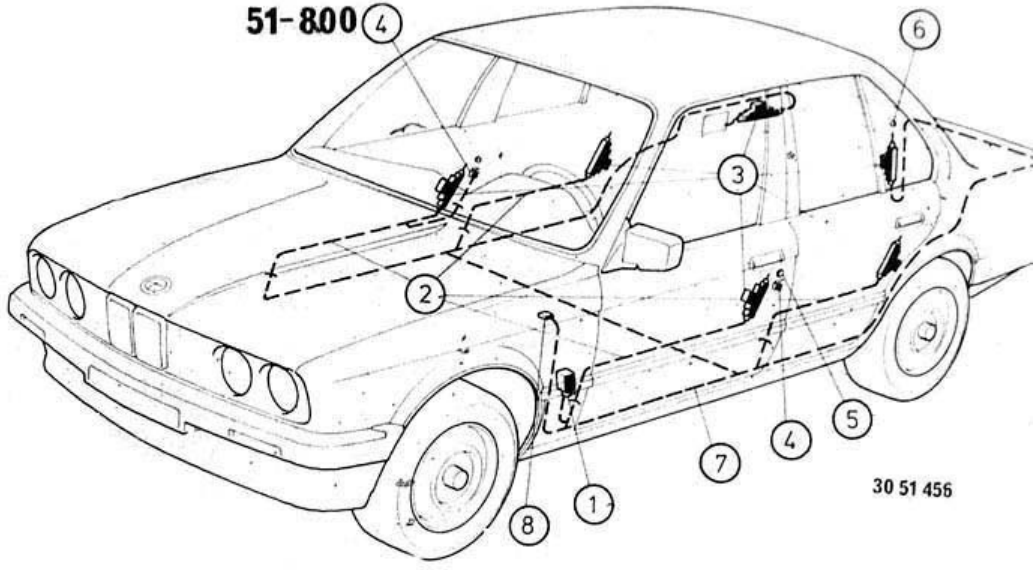


30 51 615

Install side trim panel and bolt down footprop with self-tapping screw (1).
Screw in rotary lock (2).
Install instrument panel trim.
It is recommended to cover the rotary lock with a BMW mat.

CENTRAL LOCKS WITH UNLOCKING ARREST – DESCRIPTION AND TROUBLESHOOTING –

1 Control unit / impact switch
2 Door wire harness
3 Drive for doors, trunk lid and tank flap
4 Microswitch - driver's/passenger's door
5 Lock cylinder - driver's door
6 Trunk lid lock
7 Main wire harness
8 Connection on special equipment plug

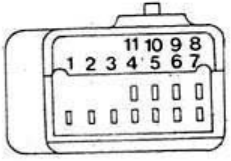


30 51 456

The locks of all doors, trunk lid and tank flap can be operated

a) with the driver's door lock (key turned 45°),
b) with the passenger's door lock,
c) with the trunk lid lock or
d) with the catch button on inside of the driver's door.

The unlocking arrest can only be operated via the driver's door lock (horizontal lock position). The locks cannot be unlocked with the unlocking buttons on the doors when the unlocking arrest is operated.
The trunk lid can still be unlocked and locked by turning the key clockwise even with the unlocking arrest operated.
The impact switch will unlock all locks automatically in case of a collision.
Note:
The tank flap can be unlocked manually by moving the locking rod (accessible from the trunk) in case of central locking system failure.
The central locking system is equipped with a multiple identifier (overload protector) since 9/85 models. Frequent operation of the locks within a brief period of time will activate the integrated overload protector, which switches off the system for a short time.



730 51 823

Control Unit/Impact Switch Connections:

Pin	Description		Wire Colors
1	Outlet LOCKED		blue
2	Outlet UNLOCKED		white
3	Battery +		red/black
4	Battery –		brown
5	Sensor +		green
6	Inlet I UNLOCKED	driver's and	green/blue
7	Inlet I LOCKED	passenger's door	yellow/blue
8	Inlet II LOCKED	trunk lid	green/black
9	Inlet II UNLOCKED	trunk lid	yellow/black
10	Inlet III LOCKED	unlocking arrest	red/brown
11	Outlet	unlocking arrest	black

TROUBLESHOOTING CENTRAL LOCKS

Test Requirements: Battery charged, at least 11 V, fuse no. 27 okay? — no → Check other connected electrical equipment: → On-board computer, burglar alarm, door lock heating.

yes

Locks and lock cylinders in perfect mechanical condition.
All tests made against vehicle ground.
Tests on plug connections should be made on both sides of plug.
Tests made with BMW service tester or digital tester II.
Check installed position (see print) of control unit/impact switch.

1. Failure of Entire System: Locking is not possible from the driver's door, passenger's door or trunk lid with the central locking system unlocked.

Does pin 3 of control unit have voltage (red/black)? With connected plug U > 11 V. — no → Is there voltage in socket no. 15 (red/black) of driver's door/body plug? U > 11 V. — yes → Repair wire harness.

yes

no

yes

no

Is there voltage in socket no. 3 (red/black) of driver's door/body plug?
U > 11 V.

yes → Repair wire harness of driver's door. Also refer to driver's door/body plug connection (corrosion, no connection).

no

Check wire harness up to fuse box for breaks.

Does pin 4 (brown) of control unit have ground?
Ω ≈ 0.

no → Check socket no. 4 wire (brown) on control unit plug for breaks – repairing if necessary. Also refer to ground supply on central ground point behind the instrument panel at bottom left.

yes

Replace control unit.

2. No Function When Operating Driver's Door Lock (Unlocking – Locking)
– See Test Requirements –

Linkage connected – drive adjusted correctly and mounted – plug connected on drive? — no → Connect linkage, adjust/mount drive, connect plug. See 51 26 000.

yes

Pull off plug on drive. Supply car ground to socket no. 4 wire (green/blue) or socket no. 3 wire (yellow/blue). Does system unlock or lock? — no → Make connection between pin no. 6 (green/blue) or pin bo. 7 (yellow/blue) on control unit with connected plug and ground. Does system unlock or lock? — no → Break in wire (blue or white) to drive – repair.

yes

yes

Break in (green/blue) or (yellow/blue) wire – repair. Also refer to driver's door/body plug socket no. 12 and 11 (corrosion/no connection).

Check socket no 5 (brown) on plug for driver's door drive against car ground. Resistance ≈ 0 Ω ? — no → Break in drive ground supply – repair. Also refer to driver's door/body plug socket no. 2 (brown) (corrosion/no connection).

yes

Does drive switch through ground? — no → Replace drive.

1. Betw. pin 5 (brown) and pin 4 (green/blue).
   Eye pulled out Ω ≈ 0
   Pushed into drive Ω ≈ ∞
2. Betw. pin 5 (brown) and pin 3 (yellow/blue)
   Eye pulled out Ω ≈ ∞
   Pushed into drive Ω ≈ 0

3. No Function When Operating Passenger's Door Lock
   – See Test Requirements

   A. Unlocking Not Possible

Linkage connected/moves – drive adjusted correctly and mounted – plug connected on drive correctly?
- no → Connect/repair linkage –adjust/mount drive – connect plug/check contact. See 51 26 000.
- yes ↓

Pull off plug on drive. Supply vehicle ground to socket no. 4 wire (green/blue). Does system unlock?
- no → Make connection between pin 6 (green/blue) on control unit with connected plug and vehicle ground. Does system unlock?
  - no → Break in (blue) or (white) wire to drive – repair.
  - yes ↓ Break in (green/blue) wire – repair. Also refer to passenger's door/body plug socket no. 12 (corrosion/no connection).
- yes ↓

Check socket no. 5 (brown) on plug for passenger's door drive against car ground. Resistance ≈ 0 Ω ?
- no → Break in ground supply to drive – repair. Also refer to passenger's door/body plug socket no. 4 (brown) (corrosion/no connection).
- yes ↓

Does drive switch through ground? Between pin 5 (brown) and pin 4 (green/blue).
System unlocked Ω ≈ 0
System locked Ω ≈ ∞
- no → Replace drive.

B. Locking Not Possible

Is microswitch activated – is microswitch plug connection okay?
- no → Assembly view: Microswitch – see 51 26 000.
- yes ↓

Pull off plug on microswitch and supply vehicle ground to wire end socket no. 2 (yellow/blue). Does system lock?
- no → Make connection between pin 7 (yellow/blue) on control unit with connected plug and vehicle ground. Does system lock?
  - no → Break in (blue) or (white) wire to drive – repair.
  - yes ↓ Break in (yellow/blue) wire – repair. Also refer to passenger's door/body plug socket no. 11 (corrosion/no connection).
- yes ↓

Check socket no. 1 (brown) on microswitch plug against ground. Resistance ≈ 0 Ω ?
- no → Break in ground to microswitch – repair. Also refer to passenger's door/body plug socket no. 4 (brown) (corrosion/no connection).
- yes ↓

Does microswitch switch through ground? Between pin 1 (brown) and pin 2 (yellow/blue).
Switch pressed Ω ≈ 0 ?
Switch open Ω ≈ ∞ ?
- no → Replace microswitch.

4. No Function When Operating Trunk Lid Lock (Unlocking – Locking)
– See Test Requirements –

Linkage connected – drive adjusted correctly and mounted – plug connected on drive correctly?
— no → Connect linkage – adjust/mount drive – connect plug. See 51 26 020.

yes

Pull off plug on drive. Supply vehicle ground to socket no. 4 wire (green/black) or socket no. 3 wire (yellow/black). Does system unlock or lock?
— no → Make connection between pin 8 (green/black) or pin 9 (yellow/black) on control unit with connected plug and ground. Does system unlock or lock?
— no → Replace control unit. If applicable, check (blue) or (white) wire for breaks.

yes

Break in (green/black) or (yellow/black) wire – repair.

yes

Check socket no. 5 (brown) on plug for trunk lid drive against vehicle ground. Resistance ≈ 0 Ω ?
— no → Break in ground to drive – repair. Also refer to connection on central ground point behind instrument panel at bottom left.

yes

Does drive switch through ground?
— no → Replace drive.

1. Between pin 5 (brown) and pin 4 (green/black).
   Eye pulled out Ω ≈ 0
   Eye pushed into drive Ω ≈ ∞
2. Between pin 5 (brown) and pin 3 (yellow/black).
   Eye pulled out Ω ≈ ∞
   Eye pushed into drive Ω ≈ 0

5. No Function of One or Both Rear Doors (Unlocking – Locking – Arresting)
– See Test Requirements –

Linkage connected – drive adjusted correctly and mounted – plug connected on drive correctly?

no → Connect linkage – adjust/mount drive – connect plug. See 51 26 010.

yes ↓

Pull off plug on drive. Measure voltage:
Wire (blue) while locking briefly > 9 V.
Wire (white) while unlocking briefly > 9 V.
Wire (black) while arresting briefly ≈ 1 V.
Voltage values correct?

no → Pull off plug on control unit and check wires (blue/white and black) for breaks. Ω ≈ 0 ?

no → Repair wires.

yes ↓

Replace drive.

6. No Function When Operating the Unlocking Arrest
– See Test Requirements –

Is microswitch of driver's door operated? —— no ——→ Repair – also refer to 51 21 140.

yes

1. Unlocking – locking function: —— no ——→ Replace control unit, if applicable.
Voltage measured on control unit pin 10 (red/brown) > 9 V ?
2. Unlocking Arrest Operated:
Voltage measured on control unit pin 10 (red/brown) ≈ 0 V ?

yes

Pull off plug on microswitch and measure switch end. —— no ——→ Replace microswitch.
Switch opened betw. 1 and 2 ≈ ∞ Ω ?
Switch pressed betw. 1 and 2 ≈ 0 Ω ?

yes

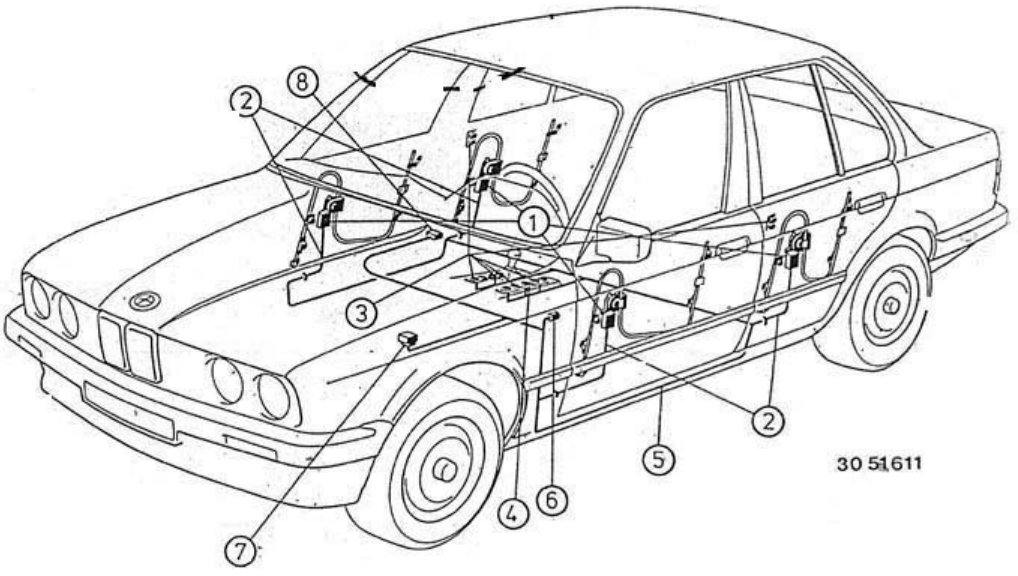
Check power flow in wires between socket no. 2 on microswitch plug wire end and socket no. 10 on control unit plug (red/brown wire). —— no ——→ Repair wires, if necessary. Also refer to driver's door/body plug socket no. 17 (corrosion/no connection).
Ω ≈ ∞ ?

yes

Check power flow in plug on microswitch wire end in socket no. 1 (white). —— no ——→ Break in ground supply wires – repair. Also refer to driver's door/body plug socket no. 10 (corrosion/no connection).
Ω ≈ 0 ?

POWER WINDOWS – DESCRIPTION AND TROUBLESHOOTING

1 Window motor
2 Door wire harness
3 Control switch
4 Child safety lock
5 Main wire harness
6 Connection on special equipment plug
7 Relay K 5 in fuse box or behind instrument panel at bottom left in case of service installation of holder on special equipment plug.
8 Safety switch



Power windows can be operated with the

a) push buttons in the center console or

b) push buttons in the trim panels of rear doors.

Operation with the push buttons in the trim panels of rear doors can be stopped by pressing the "child safety lock" push button in the center console.

The system is protected against excessive loads by a safety switch in the instrument panel.

TROUBLESHOOTING POWER WINDOWS

Test Requirements:
Battery charged with at least 11.5 V, fuse no. 17 okay? — no → Check other connected electric equipment. Sun roof – relay K 5.

yes

Only if function is not possible with driver's door open (comfort circuit). Fuse no. 28 okay? — no → Check other connected electric equipment (cigar lighter, automatic antenna, parked car heater).

yes

Power windows in perfect mechanical condition.
All tests made against car ground.
Plug connection tests made on both sides of plug.
Tests made with BMW service tester or BMW digital tester II.

1. Failure of Entire System
– See Test Requirements –

Does automatic cutout have voltage? > 11.5 V — no → Check (green/gray) wire to special equipment plug, power flow test if necessary.

yes

Does pin 3 (green/gray) of push buttons have voltage? > 11.5 V — no → Check wire harness for breaks, repairing if necessary.

yes

yes

Do pins 4 and 5 (brown) of push buttons have ground?
Ω ≈ 0 — no → Break in ground supply.
Power flow test:
Also check ground connection on central ground point behind instrument panel at bottom left.

2. No Function When Operating Power Window Push Button for Driver's Door
– See Test Requirements –

Does pin 3 (green/gray) of driver's door window push button have voltage?
> 11.5 V — no → Check wire harness for breaks, repairing if necessary.
Check plug connection on push button, repairing if necessary.
Check push button, replacing if necessary.

yes

Do pins 4 and 5 (brown) of driver's door window push button have ground?
Ω ≈ 0 — no → Check wire harness for breaks, repairing if necessary.
Also check central ground connection behind instrument panel at bottom left.

yes

Do pin 1 (black/white) and pin 8 (violet) have voltage or does pin 1 (black/white) have ground on the driver's door window push button while opening and closing the window? — no → Push button not switching voltage or ground through.
Check push button, replacing if necessary.

yes

yes

Is there voltage or ground in sockets 13 and 14 of the plug connection between the door wire harness and body when operating the driver's door push button? — no → Check wire harness for breaks, repairing if necessary.

yes

Is there voltage or ground in sockets 2 and 1 of plug connection between door wire harness and window motor when operating the driver's door push button? — no → Check door wire harness for breaks, repairing if necessary.

yes

Check window motor, replacing if necessary.

3. No Function When Operating Left Rear Door Window Push Button
– See Test Requirements –

Does pin 3 (green/gray) of left rear door window push button have voltage?
> 11.5 V — no → Check wire harness for breaks, repairing if necessary.
Check plug connection on push button, repairing if necessary.
Check push button, replacing if necessary.

yes

yes

Do pins 4 and 5 (brown) of left rear door window push button have ground?
Ω 0

no → Check wire harness for breaks, repairing if necessary. Also check central ground connection behind instrument panel at bottom left.

yes

Is there voltage on pin 1 (blue/green) and pin 8 (black/yellow) or ground on pin 1 (blue/yellow) of left rear door window push button while opening and closing?

no → Push button not switching voltage or ground through. Check push button, replacing if necessary.

yes

Is there voltage or ground in sockets 1 or 5 of plug connection between power window and body in the left B pillar while operating the left rear door window push button?

no → Check wire harness for breaks, repairing if necessary.

yes

Is there power flow between pins 4 and 1 or pins 5 and 8 of the left rear door window push button (not pressed)?

no → Check push button, replacing if necessary.

yes

yes

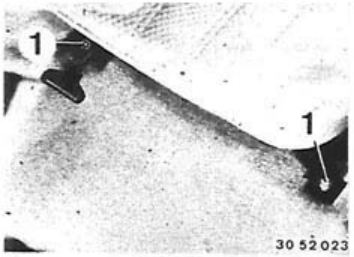
Is there voltage or ground in sockets 2 or 3 of the plug connection between left rear door wire harness and power window motor while operating the push button? — no → Check door wire harness for breaks, repairing if necessary.

yes

Check power window motor, replacing if necessary.

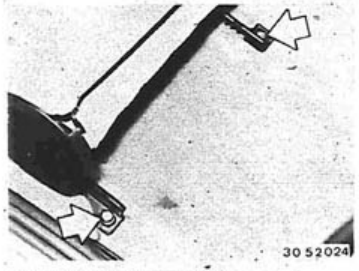
52 Seats

52 10 000	Front seat – remove and install	52- 1
100	Rail (outer or inner) on front seat – remove and install or replace	52- 1
210	Reclining mechanism on left or right front seat – remove and install or replace	52- 2
450	Backrest wall for left or right front seat – remove and install	52- 2a
52 20 000	Rear seat cushion and backrest – remove and install	52- 3
254	Lock for rear seat backrest, left or right – replace	52- 3

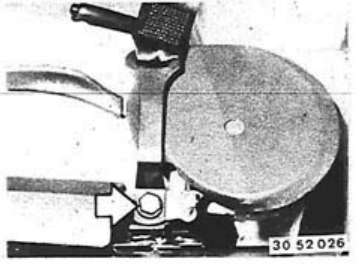


52 10 000 REMOVING AND INSTALLING FRONT SEAT

Push back seat.
Pull off caps.
Unscrew nuts (1).

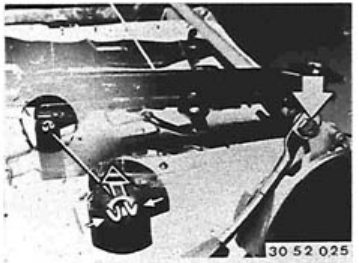


Push seat forward..
Pull off caps.
Unscrew nut and bolt.



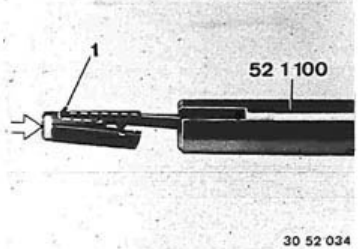
4 Doors:
Pull off cap.
Unscrew seat belt.
Installation:
Tightening torque*.

* See Specifications

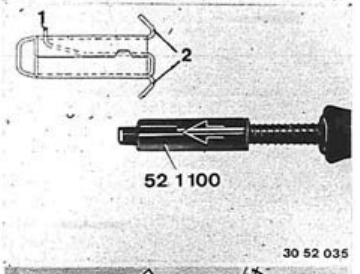


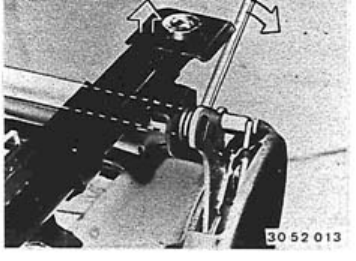
52 10 100 REMOVING AND INSTALLING OR REPLACING SEAT RAIL (OUTER OR INNER) ON LEFT OR RIGHT FRONT SEAT

Remove front seat – see 52 10 000.
Unscrew bolt.
Compress springs and pull out pin.
Installation:
Tightening torque*.
Always replace pin.



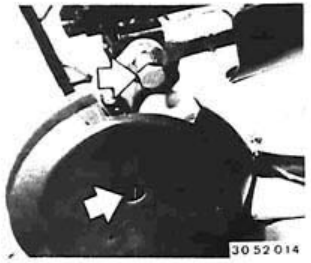
Saxionia Pin Shown Removed:
Guide in tongue of Special Tool 52 1 100 – arrest (1) is deactivated – add drive out pin.
Installation:
Always replace pin.
Drive in pin against stop with the special tool mandrel.
Check whether arrest (1) has engaged and stops (2) are not damaged.





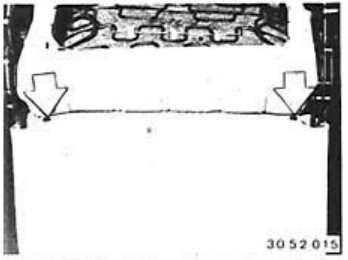
Disconnect linkage rod.
Lift connecting tube out of square hole in control lever with a screwdriver.

* See Specifications

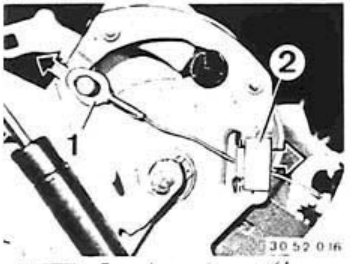


52 10 210 REMOVING AND INSTALLING OR REPLACING RECLINING MECHANISM ON LEFT OR RIGHT FRONT SEAT

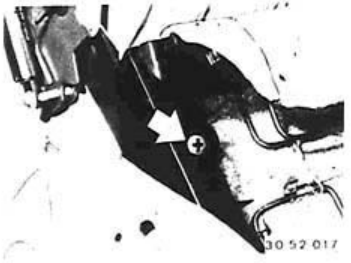
Remove front seat – see 52 10 000.
Remove seat rails – see 52 10 100.
Unscrew covers.



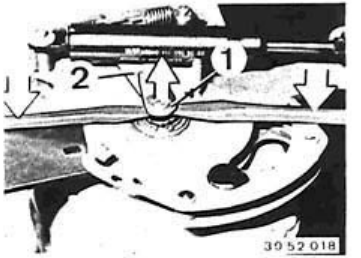
Unscrew screws and take off backrest trim panel.



Disconnect left and right cables (1) for backrest lock.
Press cable guides (2) out of holders.

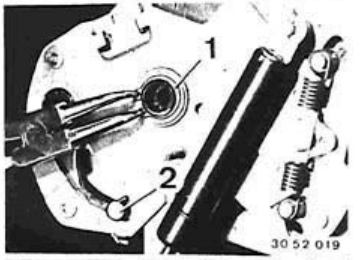


Disconnect seat cover partially.
Unscrew left and right bolts.
Take off backrest.

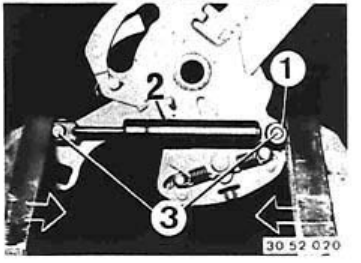


Lift out lever (1) with a screwdriver.

Installation:
Tab of lever (1) engages in lever (2).

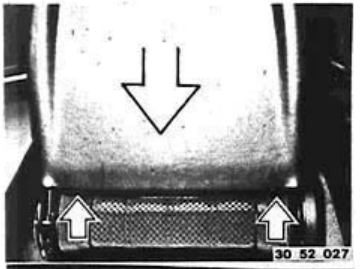


Remove circlip (1).
Unlock backrest with lever (2) and remove the reclining mechanism.



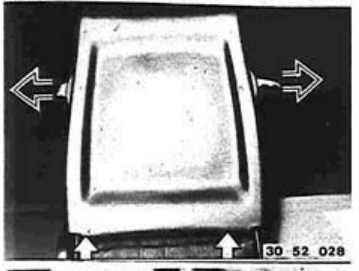
Pull off retainer (1).

Installation:
Connect gas pressure spring (2) with Special Tool 00 5 600 and secure with new retainers.

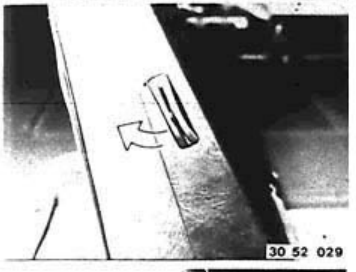


52 10 450 REMOVING AND INSTALLING PANEL ON BACK OF LEFT OR RIGHT FRONT SEAT BACK-REST

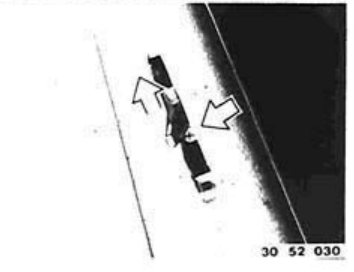
Unscrew screws and pull panel down.



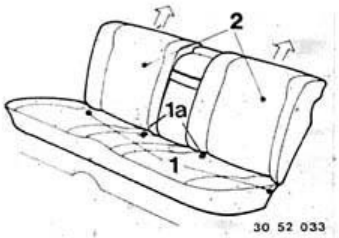
BMW Sport Seats:
Unscrew screws.
Pull off handles.



Lift out masks from underneath.



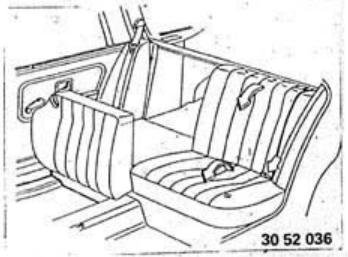
Inside Handle on Passenger's Side:
Unscrew screw and lift out holder upwards.
Push up panel and take it off over outside handle.



30 52 033

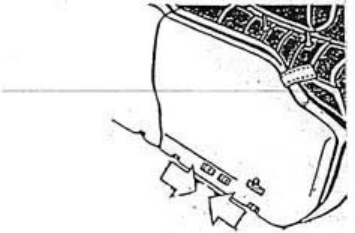
52 20 000 REMOVING AND INSTALLING REAR SEAT CUSHION AND BACKREST

Lift out seat cushion.
Unscrew bolts (1), or (1a) for convertibles, and pull up backrest out of holders (2).


30 52 036

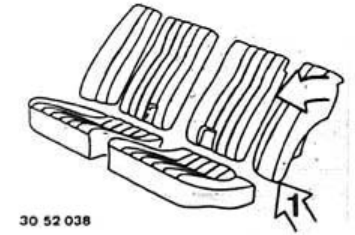
BMW Touring:

Split Rear Seat Cushion and Backrest:
Lift rear end of seat cushion on strap and tilt the cushion forward.


30 52 037

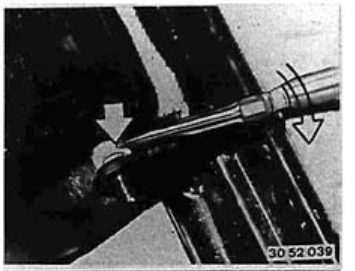
Push in both retainers and lift out both seat cushions separately.

Note:
Replacing Seat Cushion Covers:
Mount zipper with Special Tool 00 5 020.
Align the marks on the zipper to be opposite each other prior to installations.

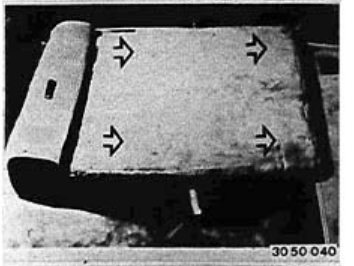


30 52 038

Removing Backrest:
Tilt the side backrest section forward for this purpose.
Unscrew bolt (1).
Lift out side backrest section.


30 52 039

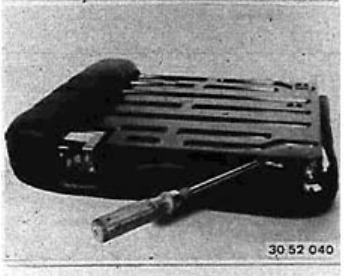
Tilt backrest forward.
Push in retainers with a screwdriver.
Lift out backrest from the side.


30 50 040

52 20 254 REPLACING LOCK FOR LEFT OR RIGHT REAR SEAT BACKREST

Slide off cover toward the rear.

Installation:
Install the backrest first and then the cover.


30 52 040

Pry off the backrest plate.


30 52 041

Unscrew lock bolts.
Disconnect linkage.
Remove backrest lock.

54 Hood, Sun Roof

54 12 004	Sun roof – adjust	54- 1
020	Sun roof winder – remove and install	54- 2
050	Sun roof winder recess plate – remove and install	54- 2
100	Sun roof lid – remove and install	54- 3
120	Sun roof lid seal – replace	54- 3
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240	Sun roof drive cables (manual) – replace	54- 5
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61 31 190	Microswitch (cow panel) – replace	54- 60
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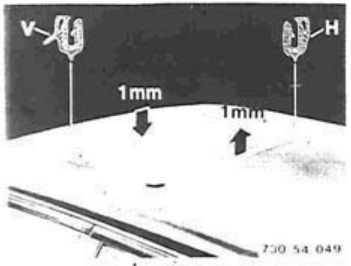
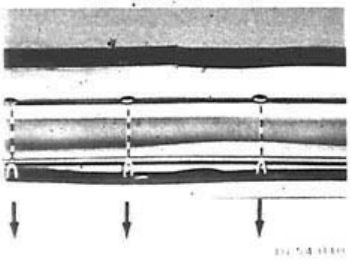
54 12 004 ADJUSTING SUN ROOF

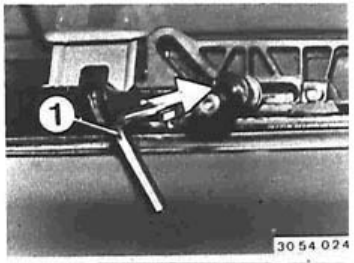
Description:
This sun roof can be operated as a
A) sliding roof and
B) lifting roof.
Switching to lift is only possible with the lid closed.
For electric sun roofs by way of a microswitch with the control switch in "close" position.
For manual sun roofs after overcoming a pressure point.



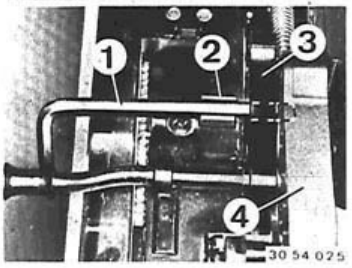
Ideal Sun Roof Lid Settings:
Heights:
Front = 1 mm (0.040") deeper than roof panel.
Rear = 1 mm (0.040") higher than roof panel.
Axial Setting:
Equal distance at front and rear between lid and roof – approx. 0.2 mm (0.008"), check with plastic gauge.
Check Velvet Strips:
V = Front with sealing lip
H = Rear without sealing lip



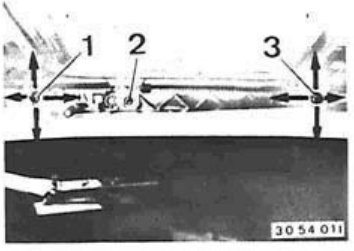
Open sun roof lid about 5 cm (2").
Press off front roof liner frame.
Close sun roof lid and slide back roof liner frame completely.
Installation:
Close sun roof lid.
Pull roof liner frame forward uniformly.
Open sun roof lid slightly, while holding roof liner frame by hand.
Press in holding clamps for front roof liner frame.



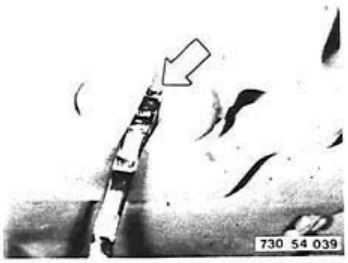
Sun roof closed = position 0.
Lock sun roof in position 0 on left and right sides with a 4 mm key (1).



Note:
Place key (1) in holder of guide pin (2) and insert in hole of operating lever (3) and gate (4).

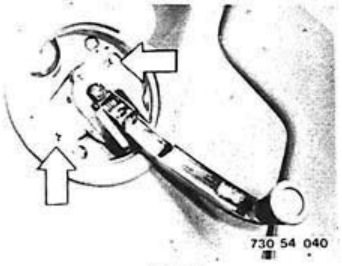


Loosen screws (1 ... 3) on left and right sides with Special Tools 00 2 102/103.
Slide and adjust sun roof in slots.
Note:
Replace self-locking screws.
Tightening torque: 3.5 Nm (2.5 ft. lbs.)

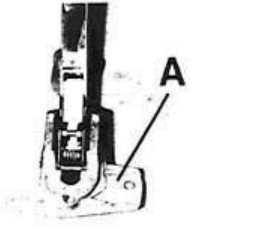


54 12 020 REMOVING AND INSTALLING SUN ROOF WINDER

Close sun roof lid to pressure point (do not lift lid).
Unscrew screw and take off escutcheon.

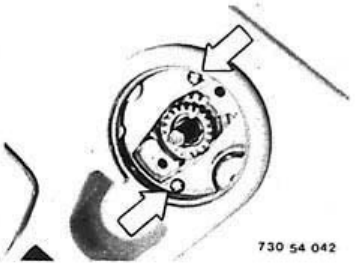


Unscrew screws and take off winder.



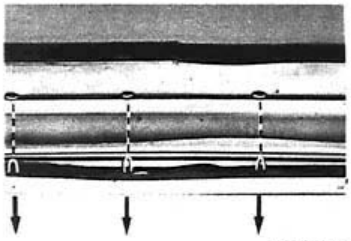
730 54 041

Installation:
Large opening (A) faces rear.



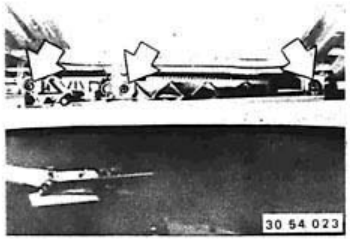
54 12 050 REMOVING AND INSTALLING SUN ROOF WINDER RECESS PLATE

Remove and install sun roof winder 54 12 020.
Unscrew screws and remove recess plate.

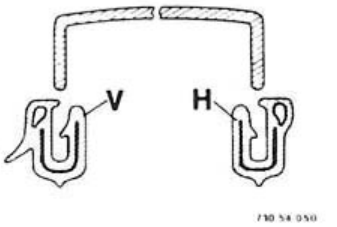


54 12 100 REMOVING AND INSTALLING SUN ROOF LID

Close sun roof lid but for about 5 cm (2").
Press off front roof liner frame.
Close sun roof lid and slide back roof liner frame completely.
Installation:
Close sun roof lid.
Pull roof liner frame forward uniformly.
Open sun roof lid slightly, while holding roof liner frame by hand.
Press in holding clamps for front roof liner frame.



Unscrew bolts on left and right sides with Special Tool 00 2 130.
Lift off sun roof lid.
Installation:
Adjust sun roof - see 54 12 004.
Replace self-locking bolts.

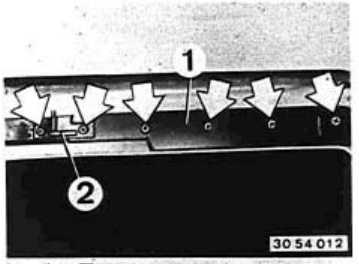


54 12 120 REPLACING SEAL FOR SUN ROOF LID

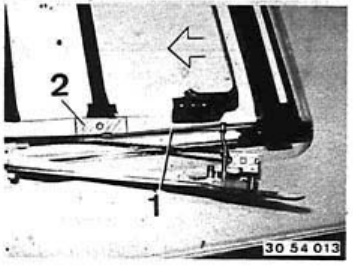
Remove sun roof lid - see 54 12 100.
Pull seal off of lid.
Installation:
Install seals with cement*.
V =Short front velvet strip (sealing lip faces forward)
H =Long rear velvet strip

54 12 130 REMOVING AND INSTALLING OR REPLACING ROOF LINER FRAME FOR SUN ROOF LID

Remove sun roof lid - see 54 12 100.



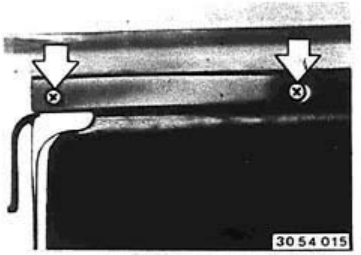
Unscrew screws on left and right sides.
Remove cover rails (1) and guide pins (2).
Guide pins (2) are marked with "L" for left or "R" for right.



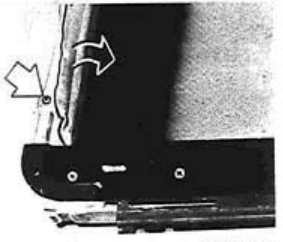
Pull cables out of guides.
Pull roof liner frame forward and remove.
If applicable, unrivet and rivet connecting rods (1).
Use a piece of tape on both sides in area of rivets (to avoid rattling noise).

* Source of Supply: HWB

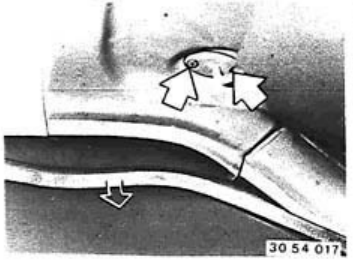
54 12 230 REMOVING AND INSTALLING OR REPLACING GEARBOX FOR MANUAL SUN ROOF



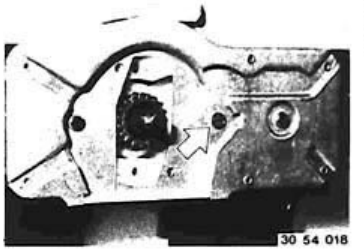
Unscrew clamping strip.



Pull off trim carefully.
Unscrew screws on left and right sides.
Installation:
Paste trim.



Close sun roof.
Remove and install winder recess plate 54 12 050.
Remove sun visors with holders.
Pull off edge guard partially.
Installation:
Insert rubber cover for inside mirror in plate.

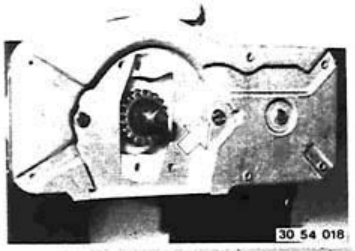


Unscrew bolt.
Remove gearbox.
Installation:
Set gearbox to position 0 (pressure point).

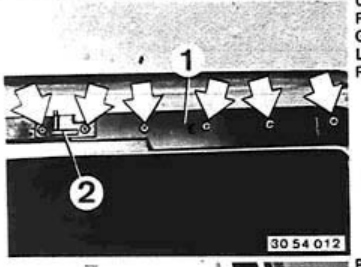
54 12 240 REPLACING BOTH DRIVE CABLES FOR MANUAL SUN ROOF LID

Remove and install sun roof lid 54 12 100.
Remove and install winder recess plate 54 12 050.

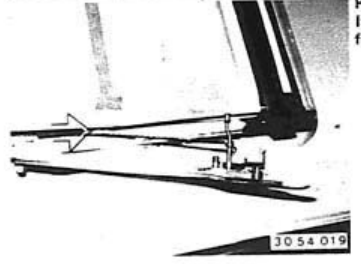
Loosen screw.

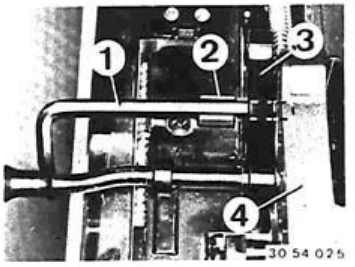


Unscrew screws on left and right sides.
Remove cover rails (1) and guidepins (2).
Guidepins (2) are marked with
L for left or
R for right.

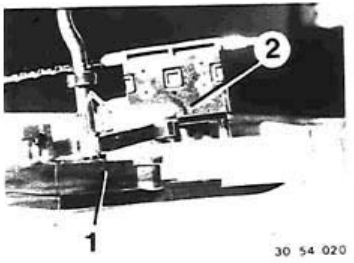


Pull drive cables out of guide tubes.
If necessary, loosen gearbox mounting screw further so that drive cables have free movement.





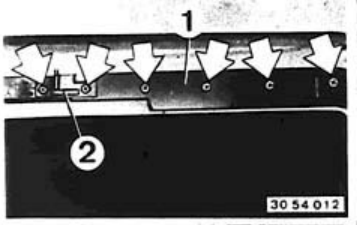
Installation:
Place 4 mm key (1) in holder of guidepin (2) on left and right sides and insert in holes of operating lever (3) and gate (4).
Set gearbox to position 0 (pressure point) and tighten screw.



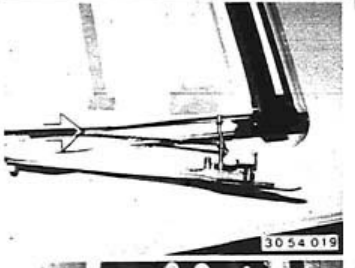
Press gate (1) off of drive cable (2).
Drive cables (2) are marked with
L for left or
R for right.

54 12 241 REPLACING BOTH DRIVE CABLES FOR ELECTRIC SUN ROOF LID

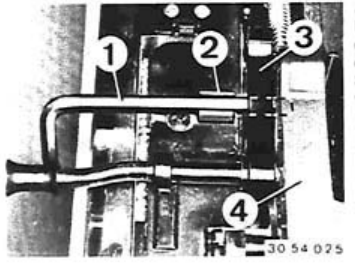
Remove and install sun roof lid 54 12 100.
Remove and install motor/gearbox unit for sun roof 54 13 010.



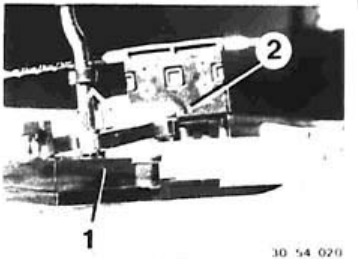
Unscrew screws on left and right sides.
Take off cover rails (1) and guidepins (2).
Guidepins (2) are marked with
L for left or
R for right.



Pull drive cables out of guide tubes.

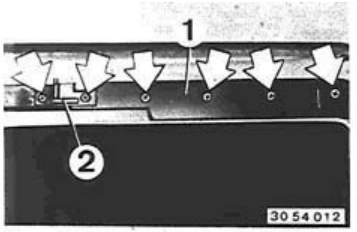


Installation:
Place 4 mm key (1) in holder of guidepin (2) on left and right sides and insert in holes of operating lever (3) and gate (4).
Set motor/gearbox unit to position 0 and tighten screw.

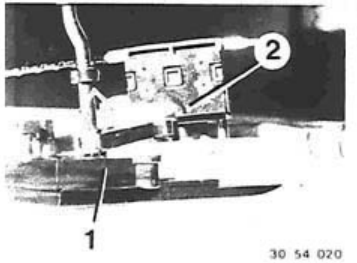


Press off gate (1) on drive cables (2).

54 12 250 REPLACING LEFT OR RIGHT GATE FOR SUN ROOF



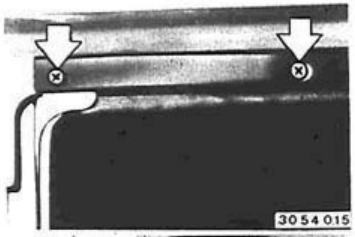
Remove sun roof lid – see 54 12 100.
Unscrew screws on left and right sides.
Take off cover rails (1) and guide pin (2).
Guide pin (2) is marked with
L for left or
R for right.



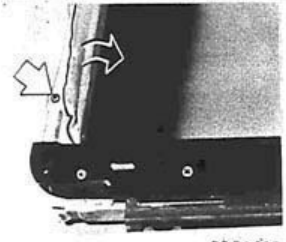
Pull cable out of guide.
Press gate (1) off of drive cable (2).
Transfer and lubricate slide with grease*.

* Source of Supply: HWB

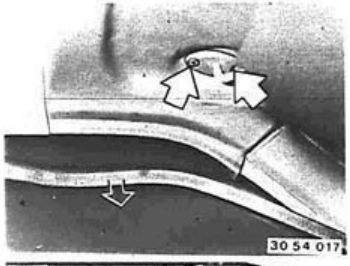
54 13 010 REMOVING AND INSTALLING OR REPLACING MOTOR/GEAR UNIT FOR SUN ROOF



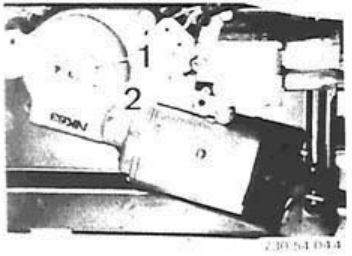
Detach clamping strip.



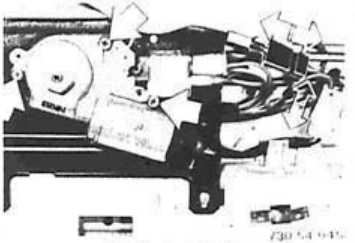
Pull off trim carefully.
Unscrew left and right bolts.
Installation:
Paste trim.



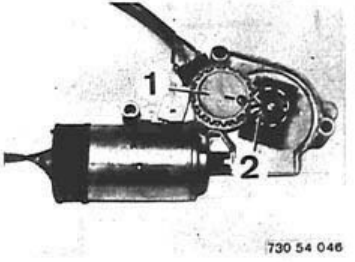
Remove control switch.
Remove sun visors with holders.
Pull off edge guard partially.



Close sun roof.
Manual Operation:
Unscrew nut (1) and turn drive shaft (2) with a socket wrench.
Close roof.



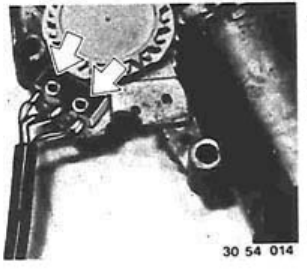
Disconnect plugs.
Unscrew bolts and remove motor/gear unit.



Installation:
Mark of switching gear (1) must be aligned with mark of control gear (2).
Lubricate teeth of pinion, control gear and switching gear with grease*.



Adjusting Motor/Gear Unit:
Unscrew nut (1) and adjust with socket wrench as described above.
Tighten nut to 450 ± 35 Nm (39 ± 3 in. lbs.).
Check function.



54 13 012 REPLACING MICROSWITCH FOR SUN ROOF MOTOR

Remove and install motor/gear unit 54 13 010
Drill out hollow rivets and rivet on new microswitch.

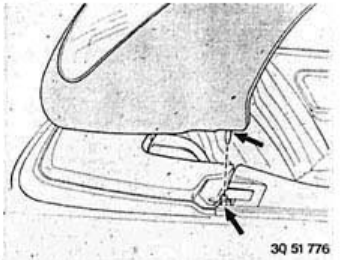
* Source of Supply: HWB

TROUBLESHOOTING SUN ROOF

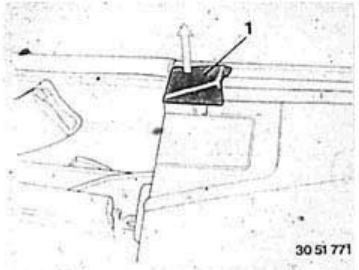
Condition	Cause	Correction
Rattling noise	a) Maladjusted	a) Adjust sun roof
	b) Guide tubes knocking against each other	b) Wrap tape around guide tubes
	c) Roof liner frame knocking against sun roof lid when open	c) Paste foam rubber on corners of sun roof frame
	d) Connector for water drain knocking on guide rail	d) Paste tape on rivets and guide linkage
	e) Excessive play of slides in guide rails as well as upper guide pins in gates	e) See Service Information 54 01 84 (298)
Sun roof can be lifted, but does not slide	a) Pins on gate holders bent	a) Replace gate holders
Sun roof lifts onesidedly	a) Drive cables maladjusted in position 0	a) Adjust drive cables in position 0
	b) Rear guide turns on drive cable	b) Lock drive cable in front of and behind guide with punch marks or by squeezing
Grinding noise when opening and closing	a) Sliding rails and plastic parts lubricated	a) Remove grease and/or replace slides
Grinding noise when lifting	a) Front seal dry	a) Lubricate seal with vaseline
	b) Contact force on front seal excessive	b) Adjust lid
Water leaking through roof liner area	a) Sun roof maladjusted in position 0	a) Adjust sun roof in position 0
	b) Seals loose/damaged	b) Paste/replace seals
	c) Wrong seal installed (front/rear seals different in shape)	c) Install original spare parts
	d) Drain hoses plugged	d) Clean drain hoses
	e) Guide rails and cover plates seal insufficiently on roof frame	e) Seal guide rails and cover plates
	f) Corners in rear roof opening leak	f) Seal corners
	g) Hose outlets plugged with sealing compound foam	g) Clean hoses

Condition	Cause	Correction
Exhaust odor in passenger compartment	a) Check flaps do not close	a) Service flaps
Whistling noise with sun roof closed	a) Excessive gap between roof and sun roof front or rear	a) Replace rubber seals or adjust sun roof lid
ELECTRIC SUN ROOF		
Drive motor does not run	a) Fuse blown b) Control switch defective c) Wire harness has a break d) Drive motor defective	a) Replace fuse b) Replace control switch c) Check or replace wire harness d) Replace drive motor
Drive motor runs, but sun roof lid does not move	a) Insufficient contact force of slip clutch	a) Adjust slip clutch
Sun roof does not lift	a) Relay defective b) Maladjusted	a) Replace relay b) Adjust position 0 of sun roof
Sun roof goes immediately to lift position when closed	a) Microswitch defective	a) Replace microswitch on drive motor

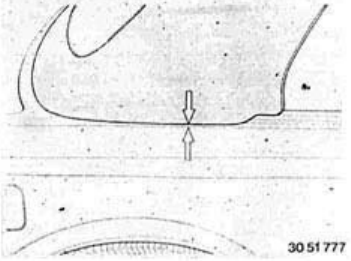
54 21 ... INSTALLING HARDTOP



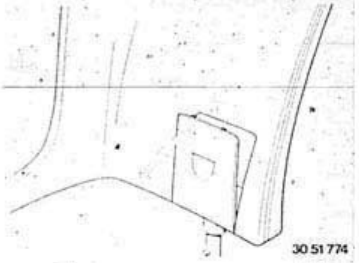
Mount hardtop with pins in the holders.



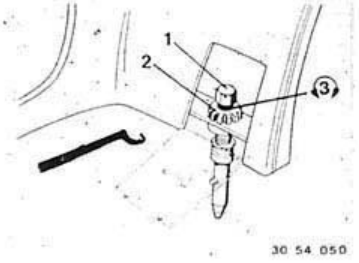
Wind down side windows completely.
Fold in the top.
Close the top lid.
Pull out plug (1).



Adjust spacing between hardtop and body to 5 ... 6 mm (0.197 to 0.236").
Turn locking screw with an open-end ring wrench until the lock is noticed to engage.
Engage the front locks.



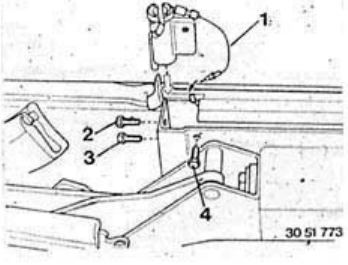
Fold down covers of rear fasteners on the hardtop.



1 Locking screw

2 Knurled nut for locking with special tool

3 Adjusting screw



Note for Hardtop Holders:
Connect rear window defogger lead (1).
Screw on left and right hardtop holders, each with three screws (2 ... 4).
Note:
Lock screws with Loctite.
Lubricate slip contacts with a light coat of contact grease.

INFORMATION FOR REPAIRING HARDTOPS

The conditions mentioned below for hardtop repairs conform with legislation in the Federal Republic of Germany. Always conform with the pertinent legislation of other countries.

This repair manual is provided for qualified workers and assumes their skill, conscientiousness and sense of responsibility. The instructions are limited to factory approved repairing methods as well as associated tips and measures to make the work easier. Only general working procedures are described in these instructions. The scope of work and order of procedures will always have to be adapted to the pertinent damage condition. Repairs are an economical solution so that optical deficiencies cannot be excluded. Consequently repairs should be carried out only with explicit approval of the customer.

Important!
Only such damage, which does not have influence on the strength and rigidness of the hardtop, may be repaired. The following types of damage may not be repaired on the honeycomb structure of the hardtop in the interest of safety.

- Damage on body mounting points.
- Damage in immediate vicinity of body mounting points.
- Ruptures.
- Cracks extending through the honeycomb structure with a length of more than 100 mm (4").
- Cracks in the surface of the honeycomb structure, which extend from corners and edges.
- Holes larger than 2500 mm^2 in size.
- Moisture must not have penetrated into the honeycomb structure.

A hardtop with this type of damage or similar must be replaced.

Required Materials and Equipment:

- Ultraviolet lamp*
- Ultraviolet light hardening fiber filler*
- Ultraviolet light hardening final filler*
- Sandpaper, grain size P 100 and P 220*
- Saddler's knife (standard tool)
- Rubber roller - approx. 25 mm dia., approx. 100 mm wide (standard tool)
- Gloves*
- Goggles*
- Mask*
- Repair patches* (match color of hardtop skin)
- Cement TIVO 3433/26*
- Hardener TIVOCUR bc 80 11*
- Plastisol*, colorless
- Glass rod*
- Satin-finished clear lacquer*

* Source of Supply: HWB

SAFETY PRECAUTIONS!!

Protective Measures:

- Wear workclothes to cover bare skin.
- Extract grinding abrasion.
- Wear goggles and mask while grinding.
- Work only in well ventilated rooms.
- Wash hands frequently.
- Keep food stored separately.
- Do not eat, drink or smoke while working.
- Do not inhale vapors.

First Aid:

Take off dirty clothes immediately. If dust has gotten in eyes, rinse out with plenty of water and go to a physician. Tab coated skin and wash with plenty of water. If great amounts of vapors are inhaled, go outdoors in the fresh air and, if necessary, visit a physician.

Information on Toxicology:

Systems containing styrene will irritate eyes, skin and the respiratory trck. No injurious effects are known,as long as handling is correct.

Measures in Case of Fire:

Fire extinguishing agents: water mist (no water stream), powders, foam, CO_2 and halon.

Scrapping:

Never let it get into drink water systems.
It can be brought to the normal refuse station after hardening.

Procedures:

1. Place repair patches on the damaged surface and hold them in position with adhesive tape. Cut out patches and roof skin together with a saddler's knife (at right angles to the surface being repaired).

2. Remove old cement and clean the repair surface.

3. Repair damaged point in the honeycomb structure with a fiber filler and harden with an ultraviolet light. In case of deeper damage apply the filler in layers and then harden with an ultraviolet light. Then apply a coat of final filler and harden with an ultraviolet light.

4. Grind and clean repair surface.

5. Mix cement and hardener in ratio of 15 to 1.

6. Apply a thin coat of the mixed cement on the repair surface and back of patches.

7. Allow about 15 minutes drying time for the cement.

8. Apply patches (edges butted) and press on firmly with a rubber roller.

   Important!
   If applicable, remove any cement squeezed out on the sides (don't smear it!).

9. Dip a glass rod in Plastisol and coat the butt edges thoroughly.

10. Allow about 15 minutes drying time for the butt edges.

11. Clean part of or the entire hardtop with an alcoholic solution (2 %) or watery solution on soap basis.

12. Paint part of or the entire hardtop with clear lacquer.

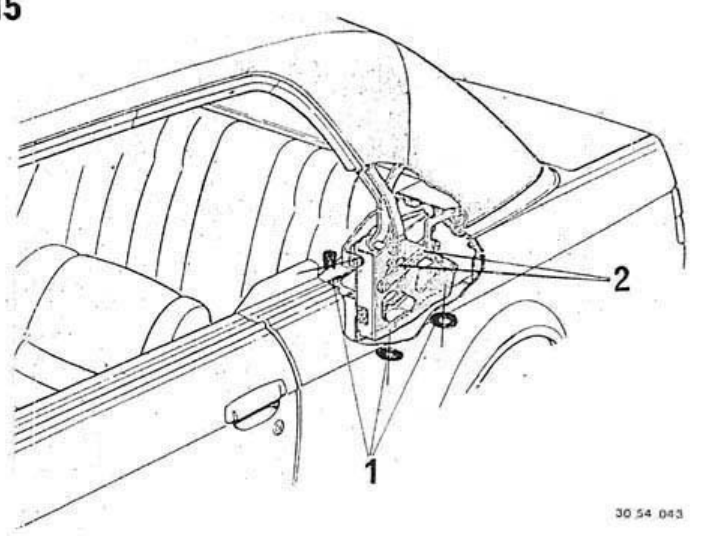
CONVERTIBLE TOP – GENERAL INFORMATION

Rear Window
- It is integrated in the top and cannot be replaced.
- Light scratching and smearing can sometimes be eliminated by heating the rear window to max. 90° C (195° F) with a hot air blower or heater.

Top
- Can only be replace complete.
- Use a convertible top cleaner for cleaning.

Frame
- Can only be replaced complete. Straightening is not approved.
- Replace gas pressure props when customer complains that top is too difficult to close (lift out of the top box).
- The joints of frame do not require servicing.
- Lubricate guides (2) with grease*.

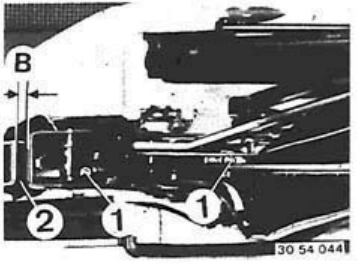
Seals
- Rubber seals must be coated with a lubricant*, if necessary.



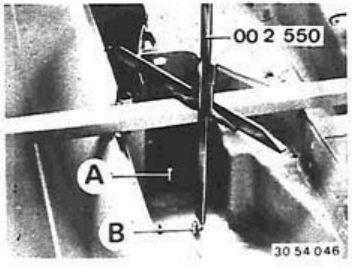
1 = Shims for top adjustment
2 = Lubricating points

* Source of Supply: HWB

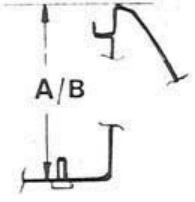
Adjusting Top:
Place rails on left and right side panels.
Rails must bear on metal – pull off the rubber partially.



Hold top with nuts (1) – it must still be possible to move the top.
Close the top and adjust distance (B) on the front mounting points with shims (2), which are available in thicknesses of 1 mm (0.039").
Tighten top nuts.



Measure distance from side panel (lower edge of rail) to bearing surface of top console at both threaded pins with Special Tool 00 2 550.



Adjust distance
A = 181 mm (7.126") - front threaded pin
B = 159 mm (6.260") - rear threaded pin
with shims which are available 1 mm (0.039") thick.

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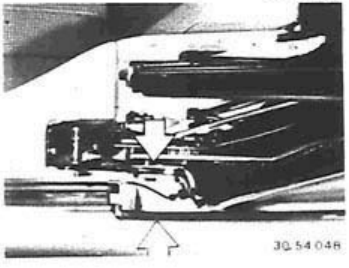
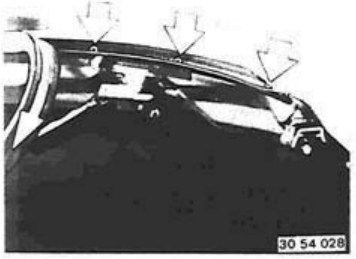
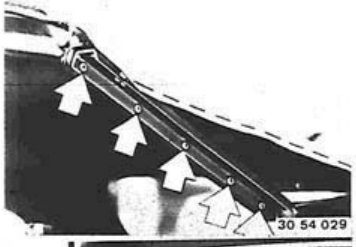


Center top to the side panels.

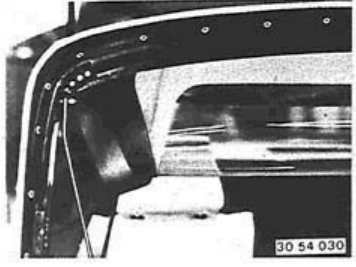
54 31 020 REPLACING TOP (CANVAS)



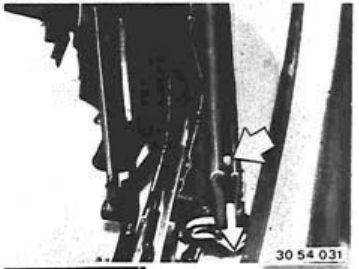
Pull off rubber seal.
Unscrew rail.



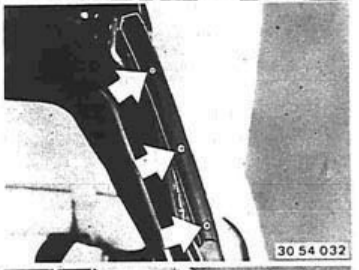
Unscrew rail – remains on cable.
Installation:
Replace screws.



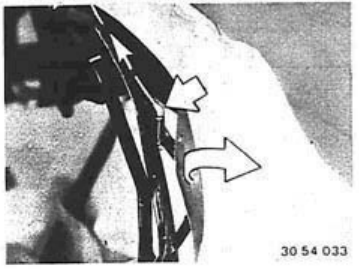
Pull off rubber seal.
Unscrew rail.



Drill out rivets and pull off window guide.



Remove rail.
Installation:
Replace screws.

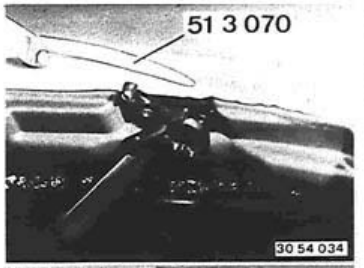


Pull top off of frame.
Disconnect cable and pull it out together with the rail forward.

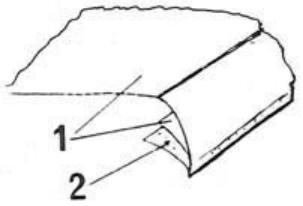
Pull top off of frame and hoopsticks.
Clean frame and hoopsticks with a solvent* to remove residual adhesive.

* Source of Supply: HWB

Note:
Secure window protection on inside and outside with masking tape.
Refer to instructions for application of cement*.



Press on top without folds with Special Tool 51 3 070.
Apply sealing compound* along the rail and on corners.
Mount rail and pull on rubber part.



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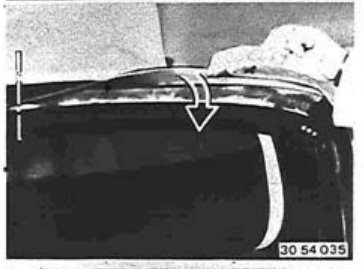
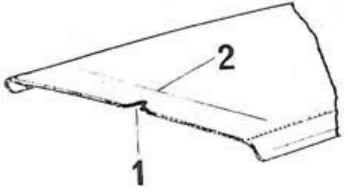
The control banners (2) permit alignment of top edges and must only be cemented after top (1) has been cemented on the frame.



Cement top on frame at rear.
Check center mark and proceed from the center.



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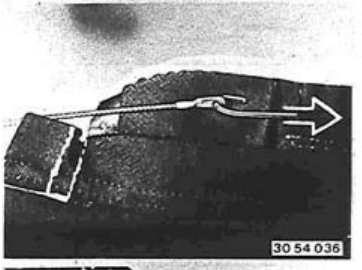
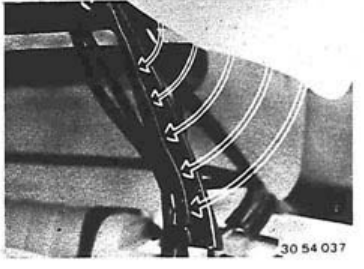
Cement the top, beginning at center (1).
Mark (2) must run precisely along the front frame edge.



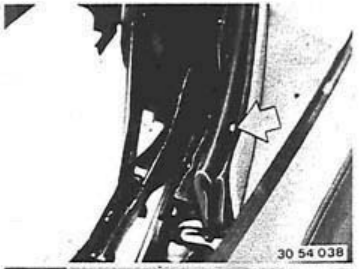
Pull in cable with a piece of welding wire and connect it on the spring.



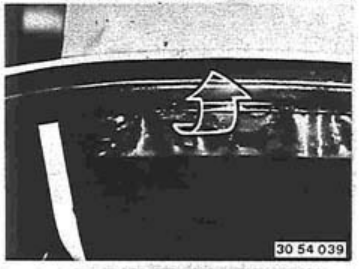
Cement the t

* Source of Supply: HWB

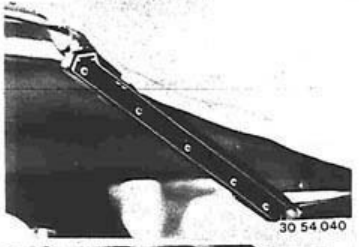
* Source of Supply: HWB



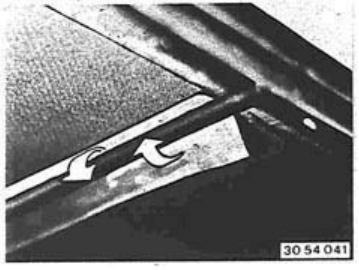
Mount rail.
Slide window guide into rail, using a special lubricant*.
Secure with a rivet and cement side on frame.



Cement the banner.
Mount rail and pull in rubber seal.



Mount rail and pull in rubber seal (use special lubricant*).



Close top.
Cement top on hoopsticks – beginning with short banner.

* Source of Supply: HWB

ELECTRIC / HYDRAULIC CONVERTIBLE TOP

Description:

It is only possible to operate the top in a stopped car and with the ignition on, and operation lasts only as long as the operating switch in the dashboard is pressed.
The switch is illuminated when lights are switched on.
All windows must be wound down and the trunk lid closed.
If the car is moved off with an unlocked top, the top will be run back into the top box (not when the top lid is already locked).

A Opening Top

1) Unlock and lift top past the TDC point	(manual)
2) Operate top switch in "open" direction (until opening movement is completed)	
3) Fold up tensioning bar	(automatic)
4) Unlock top lid	(automatic)
5) Open top lid	(automatic)
6) Lower tensioning bar	(automatic)
7) Run in top	(automatic)
8) Close top lid	(automatic)
9) Lock top lid	(automatic)

B Closing Top

1) Operate top switch in "close" direction (until closing movement is completed)	
2) Unlock top lid	(automatic)
3) Open top lid	(automatic)
4) Run out top	(automatic)
5) Fold up tensioning bar	(automatic)
6) Close top lid	(automatic)
7) Lock top lid	(automatic)
8) Lower tensioning bar	(automatic)
9) Pull top past the TDC point and lock	(automatic)

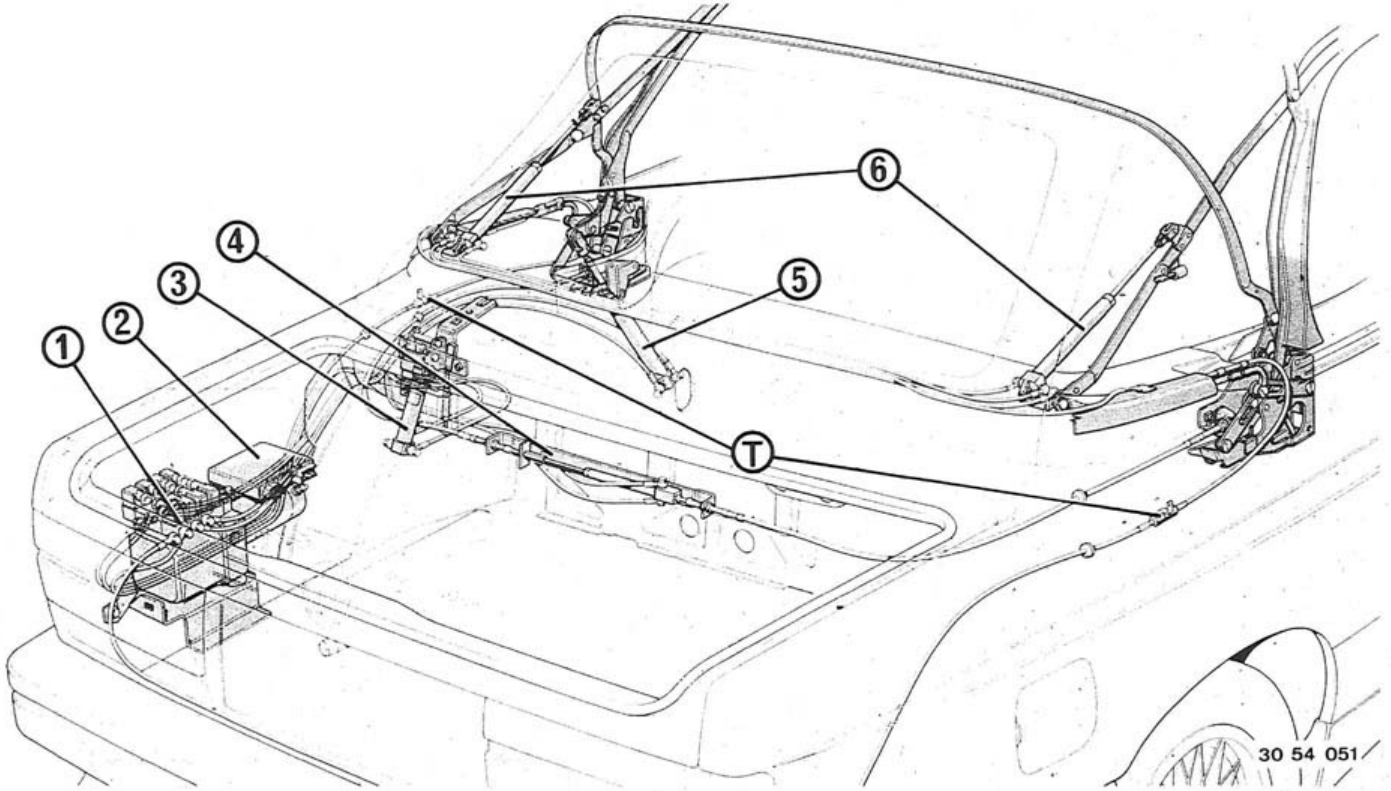
Pump and valves are operated by the electronic control unit in accordance with operation and position of the top. Pressure is built up in the operating cylinders, piston rods are run out or in and move the top or top lid via cinematics.

An indicator lamp in the instrument clouster sends information to the driver with the ignition turned on.

1) On Continuously:	During top operation ((switch pressed - top moving)
2) Continuous Flashing:	Don't move off! The final locked position of the top has not been reached (locking lever on cowl panel and/or top lid not closed).
3) Off:	One of the top's final locked positions has been reached (locked or top lid closed).

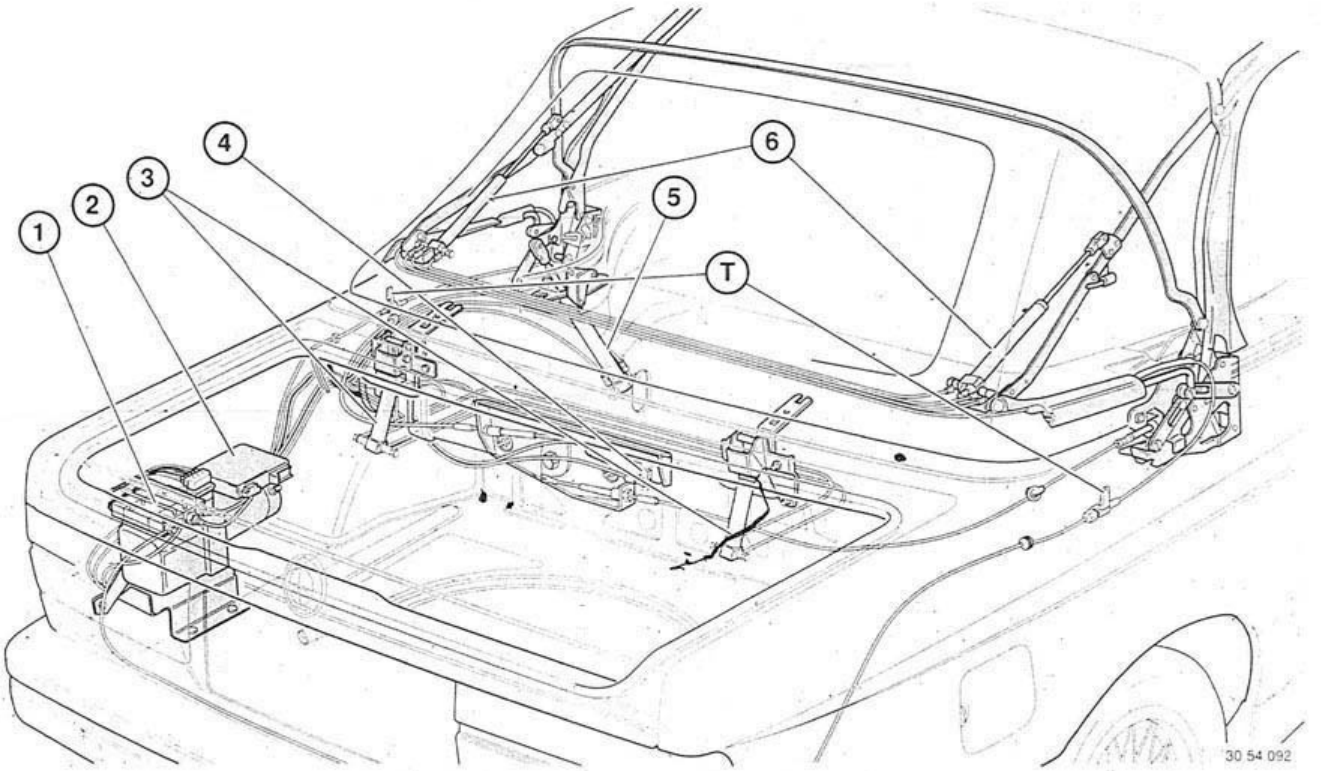
ELECTRIC/HYDRAULIC CONVERTIBLE TOP COMPONENTS – 1988 MODEL

1 Hydraulic control unit
2 Electronic control unit
3 Hydr. cylinder for top box lid
4 Hydr. cylinder for top box lid lock
5 Hydr. cylinder for top
6 Hydr. cylinders for tensioners
T Connection points of pipes for hydr. cylinders of tensioners



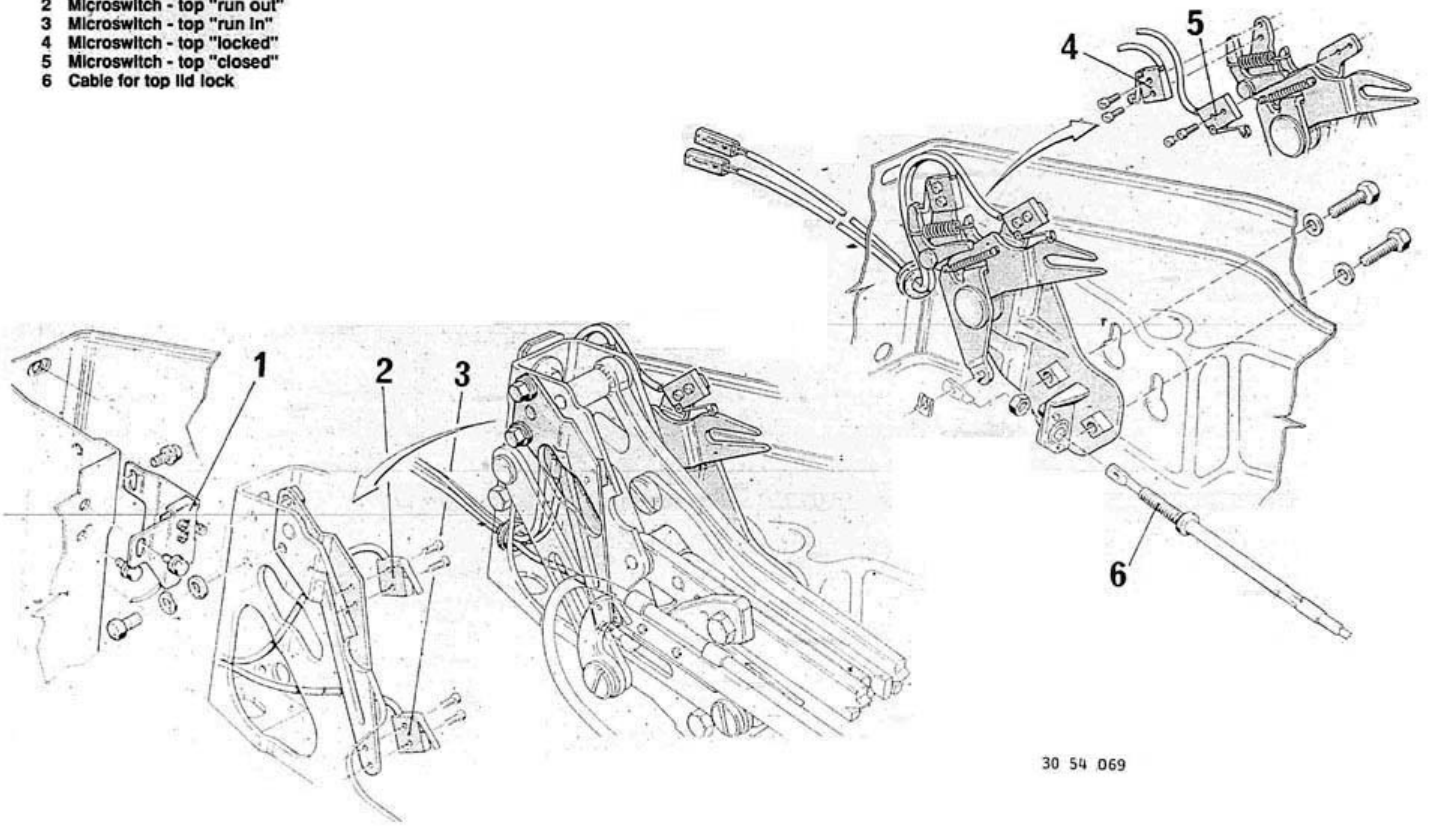
ELECTRIC/HYDRAULIC CONVERTIBLE TOP COMPONENTS – 1989 MODELS ON

1 Hydraulic control unit
2 Electronic control unit
3 Hydr. cylinder for top box lid
4 Hydr. cylinder for top box lid lock
5 Hydr. cylinder for top
6 Hydr. cylinders for tensioners
T Connection points of pipes for hydr. cylinders of tensioners



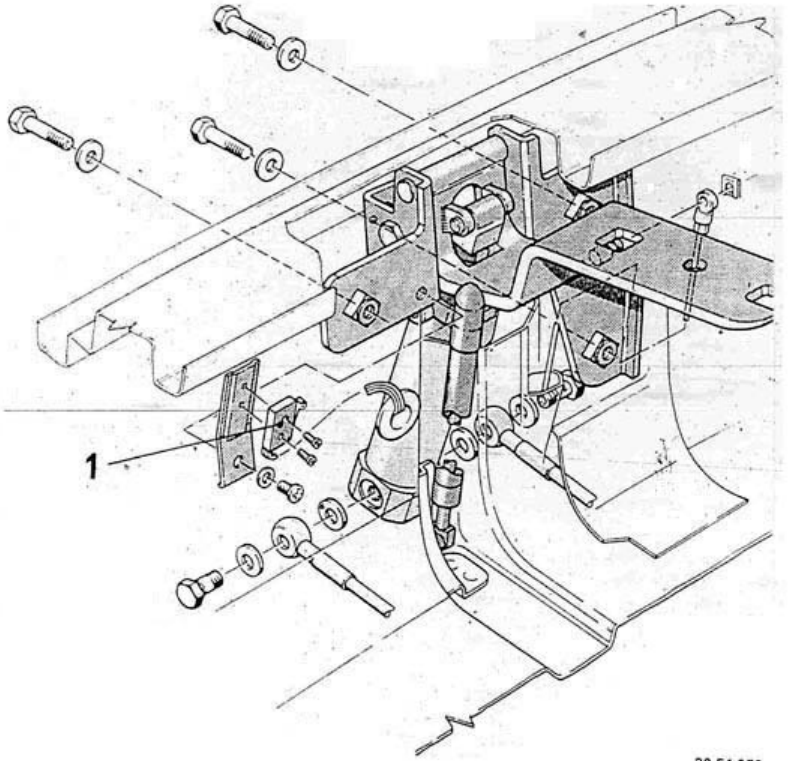
LEFT MAIN MOUNT ASSEMBLY

1 Microswitch - tensioning bar "up"
2 Microswitch - top "run out"
3 Microswitch - top "run in"
4 Microswitch - top "locked"
5 Microswitch - top "closed"
6 Cable for top lid lock



TOP LID ASSEMBLY

1 Microswitch - top lid "opened"



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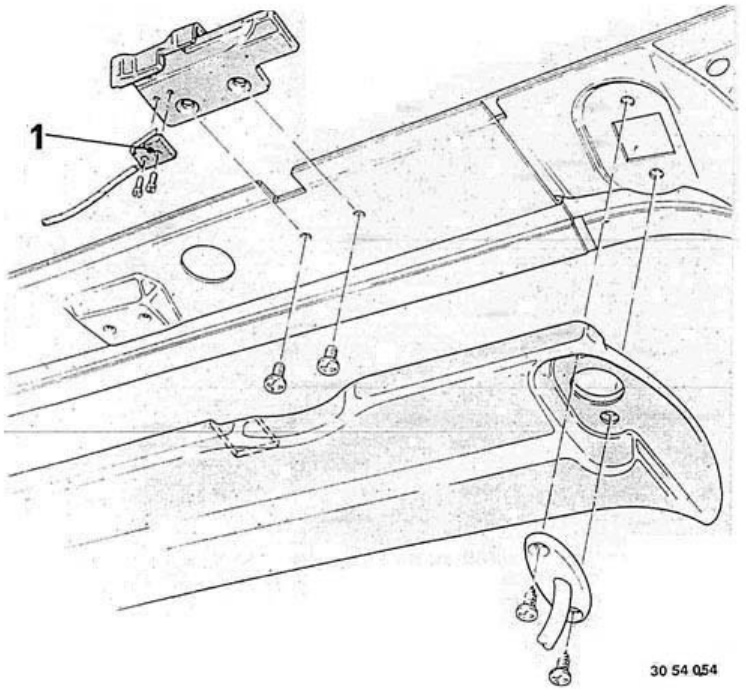
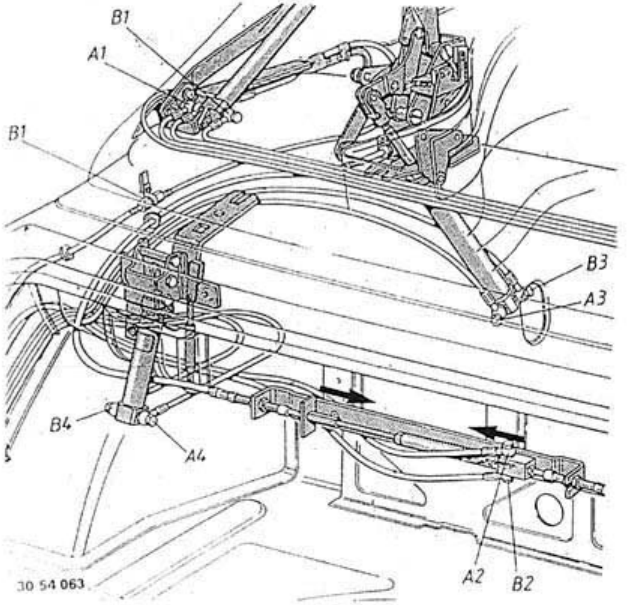
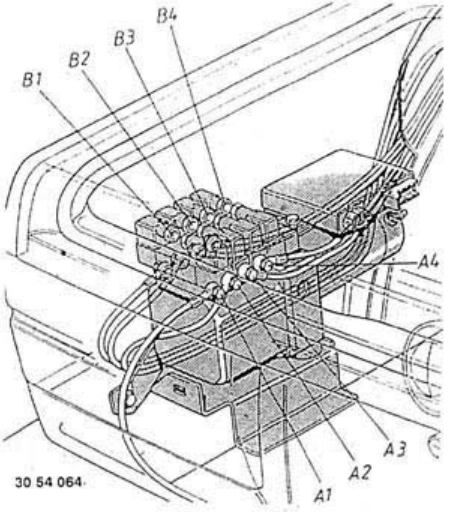
COWL PANEL LOCKING SWITCH

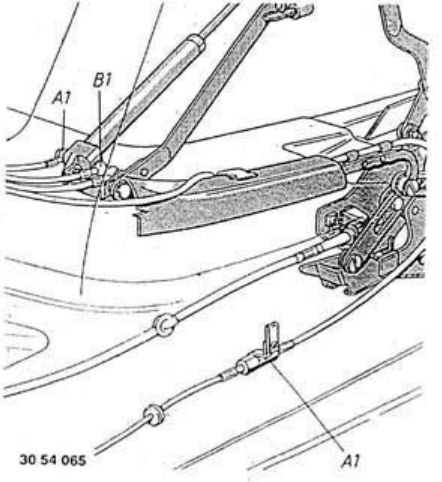
1 Microswitch

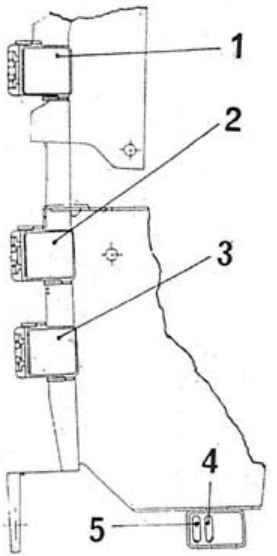


Hydraulic pipes/hoses and connections for hydraulic elements are marked. Conformance with the layout is mandatory.
Always replace seals. Tightening torque for coupling bolts = 7 to 9 Nm (5.0 to 6.5 ft. lbs.).
The top lid can be unlocked manually by pushing the piston back into the hydraulic element A2, B2.









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Installation of Fuses and Relays on Carrier of Hydraulic Control Unit:

1 Relay (yellow) for terminal 15

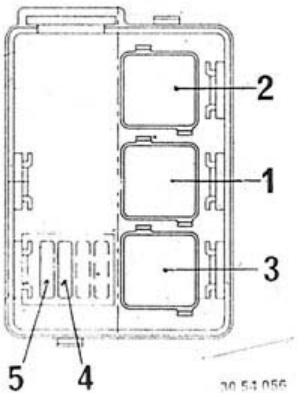
2 Relay (yellow) for additional fuse of top box lid

3 Relay (yellow) for pump motor

4 Fuse 25 A for pump motor

5 Fuse 10 A for electronics and valves

M 3:
Relay box in engine compartment – see explanation for numbers above.



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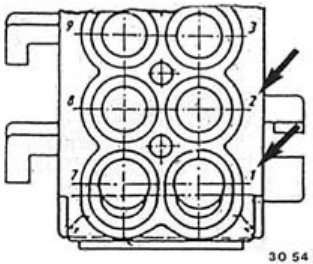

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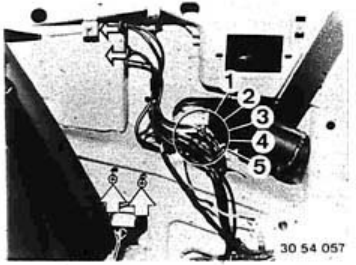
Pin Connections of Plug for Valves / Wire Harness (pin number is located on the pin receptacle):

Lead (Colors)	From Valve	In Pin No.
green/black	1	8
	2	11
	3	2
	4	5
brown/white	1	7
	2	10
	3	3
	4	6
brown/yellow	1	9
	2	12
	3	1
	4	4

Valve No.	For Hydraulic Cylinder
1	Tensioners
2	Top box lid lock
3	Top
4	Top box lid

54 34 . . . REMOVING COMPLETE CONVERTIBLE TOP

Remove both rear side trim panels – see 51 43 000.
Open the top.

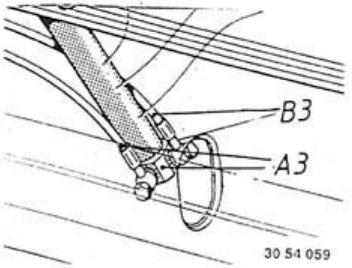


30 54 057

Disconnect plugs of microswitches and insert them through the rubber grommets.
Unscrew the light bulb tester for Check Control.

Installation:
Only connect plugs with the same numbers.

1 Top box lid closed (left)
2 Top box lid locked
3 Top run in
4 Top run out
5 Tensioner up
6 Top box lid closed (right)

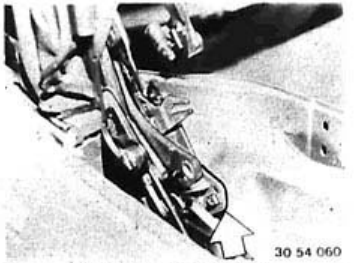


30 54 059

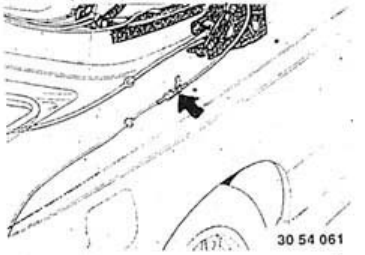
Unscrew hydraulic pipes.

Installation:
Replace gaskets.
Pipes and connections on the hydraulic element are marked.
Tightening torque*.

* See Specifications

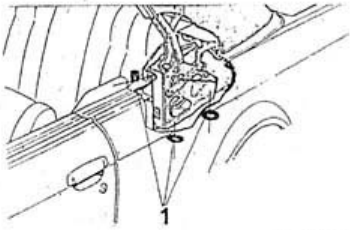

30 54 060

Mark location of top box lid locks on the body.
Unscrew locks.


30 54 061

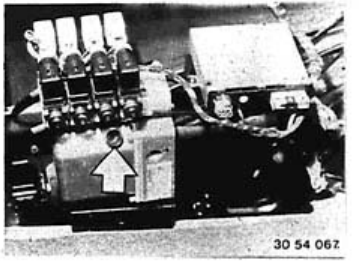
Disconnect left and right hydraulic pipes.

Installation:
Tightening torque*.



30 54 062

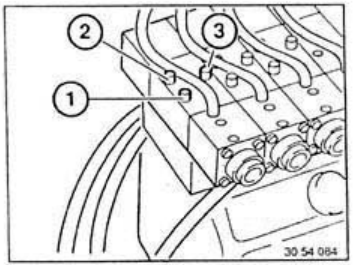
Unscrew bolts and take off top.
The top is aligned with the body – don't mix up washers (1).


30 54 067

Close the top, supporting top motion by hand, after finishing installation.
Correct the oil level.
Oil grade: CHF 7.1 (Pentosin).

Open and close the top several times to bleed the hydraulic system.

* See Specifications

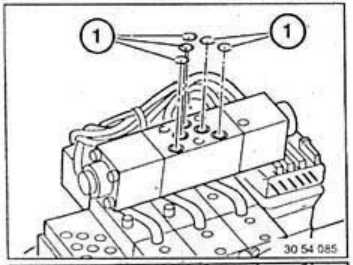


54 34 ... REMOVING AND INSTALLING CHECK VALVE

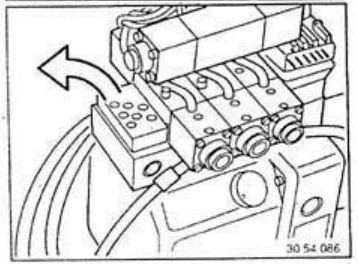
Absolute cleanliness is necessary for work on the hydraulic control unit.
Unscrew screws (1 ... 3).

Installation:
Tightening torque*.

Lift off valve from above.

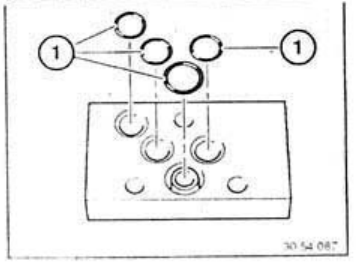


Installation:
Always replace seals (1).
Check for correct seating of seals.



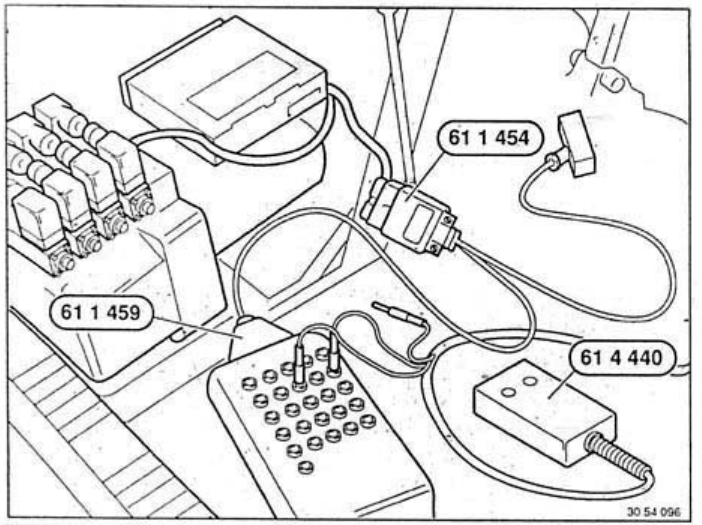
Lift off plate (check valve).

Installation:
Check the installed direction (gasket surface faces down).



Installation:
Always replace seals (1).
Check for correct seating of seals.

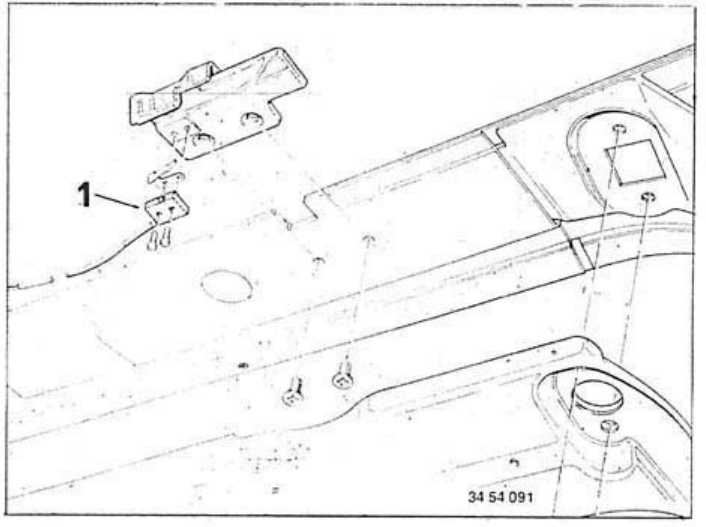
See Specifications



ADJUSTING ELECTRIC/HYDRAULIC CONVERTIBLE TOP

Pull off 26-pin plug on control unit and connect on Special Tool 61 1 459 (testbox) with Special Tool 61 1 454 (adapter).
Connect red/black terminals of Special Tool 61 4 440 (microswitch tester) on the car's battery. Connect blue, yellow and green plugs on the testbox.

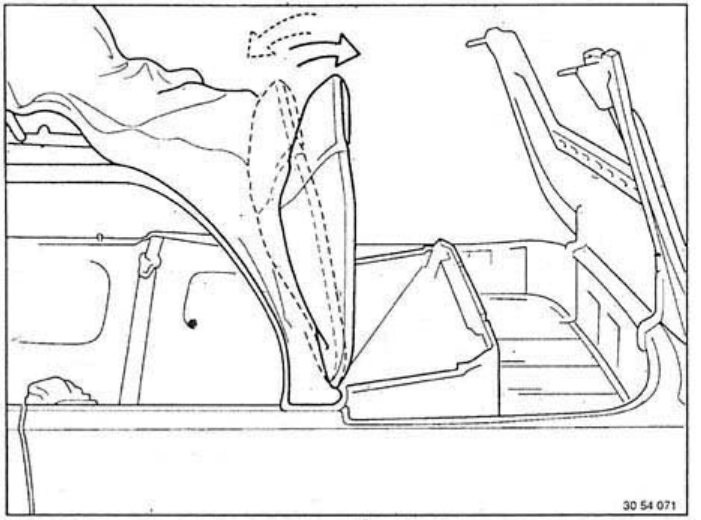
Blue	**pin 12 (requirement: control lamp in instrument cluster is okay)**
Blue	**car ground (when control lamp in instrument cluster is not okay)**
Yellow	**pin 8**
Green	**not connected presently**

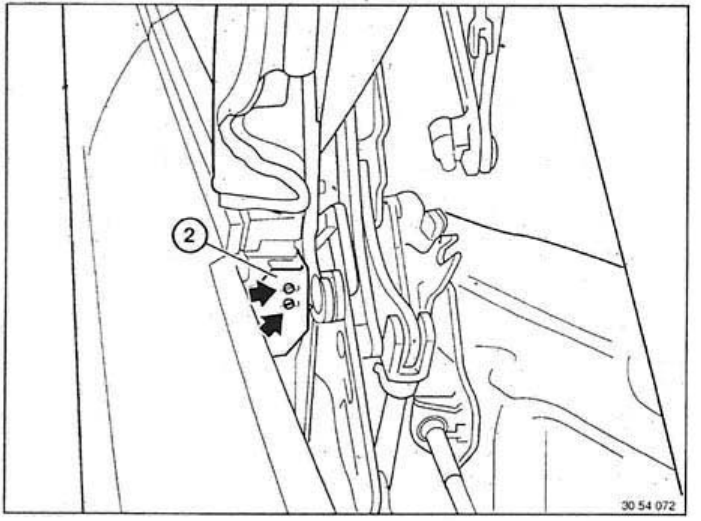


1. Microswitch - Cowl Panel "Up"

Connect yellow plug on pin 8.
Close and lock the top.
Adjust microswitch (1) on the plate from underneath until the yellow LED lights up.

Important!
Don't bend the tongue of the microswitch!





2. Microswitch - Tensioner "Up"

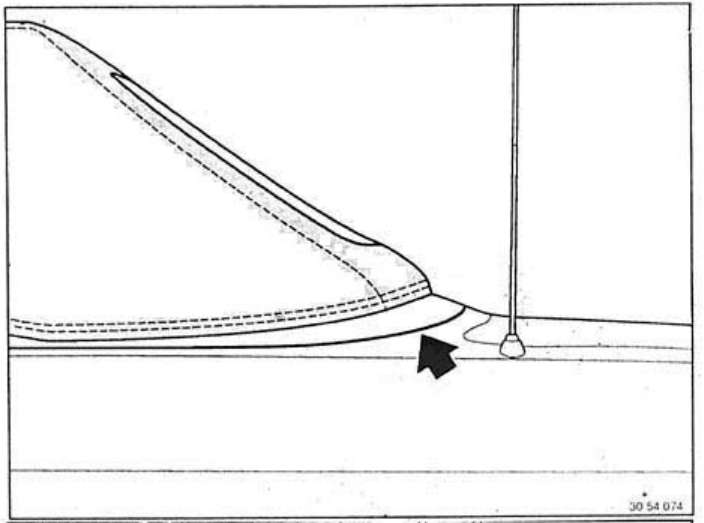
Connect yellow plug on pin 5.

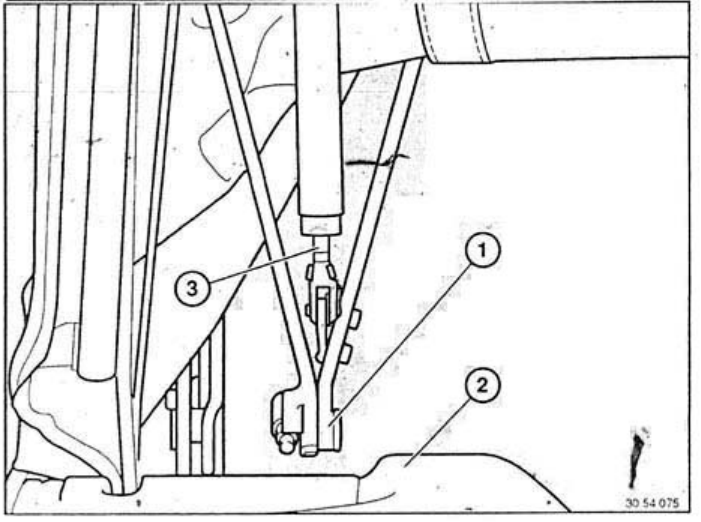
1988 Models (Check Valve Not Installed):
Pull up tensioner by hand up to the stop and then release it. Tensioner will then spring back slightly. Unlock and open the top box lid by hand. Adjust microswitch (2) in such a manner that the yellow LED still lights up after the tensioner springs back.

1989 Models (Check Valve Installed):
Pull up tensioner by hand up to the stop. Unlock the convertible top box lid by turning the unlocking hexagon with max. 50 Nm (36 ft. lbs.) (torque wrench) and open the lid by hand. Press the tensioner against the stop and adjust microswitch (2) in such a manner that the yellow LED lights up.

Important!
Set back microswitch (2) only enough, that the convertible top box lid does not scrape on the tensioner when opened.

Note:
The convertible top storage box lid will only open when microswitch (2) has been adjusted correctly.



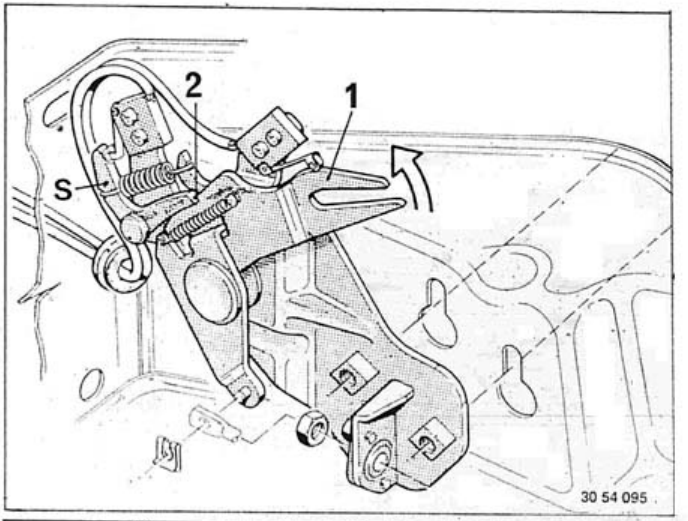


Corrective Measures When Top Box Lid Scrapes on Tensioner:

a. Inspect check valve in the hydraulic control unit for dirt / replace (1989 models) or convert (1988 models) – see 54 34 . . ..

b. Check / make sure that the convertible storage box lid is installed as far back as possible, without that the rubber seal on the top box is "clamped" when closing the top box lid. (This is necessary only after removal/replacement of the convertible top storage box lid. Otherwsie keep to the factory adjustment.)

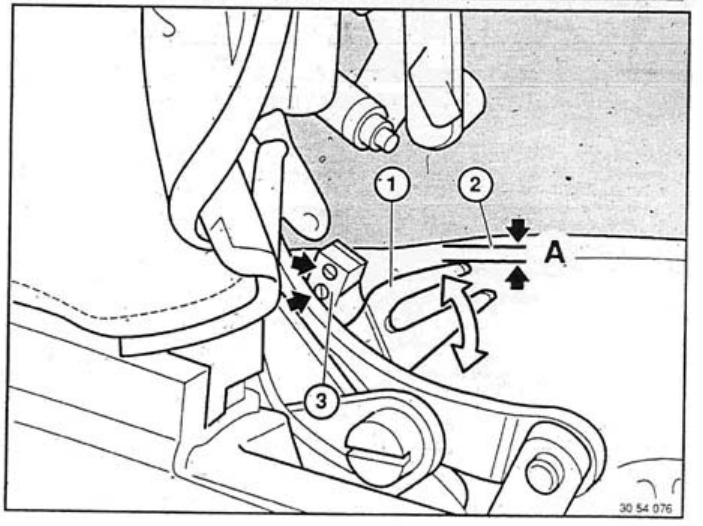
c. Check / make sure that the cylinder on the tensioner does not "pull excessively". Cylinder "pulls excessively" when tensioning rod hinge (1) scrapes on top box lid (2). If applicable, disconnect piston rod (2) and install a low height = approx. 3 mm (0.118") hexagon nut. Lock threads with Loctite.



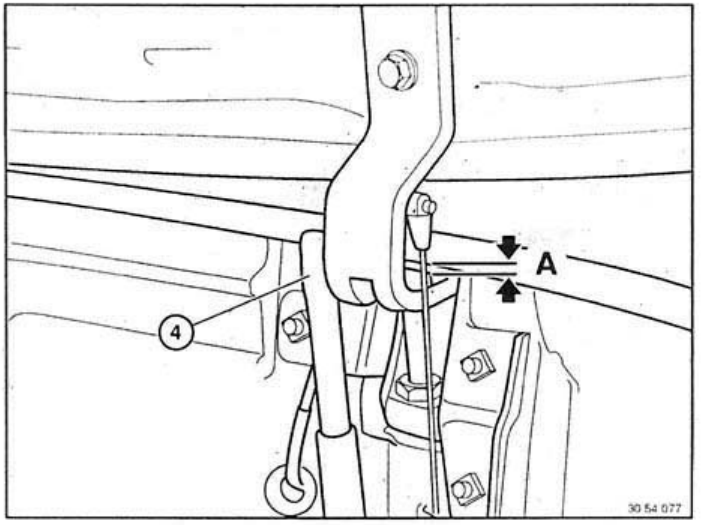
3. Microswitch - Convertible Top Box Lid "Closed"

Connect yellow plug on pin 4.
Pull up rotary catch (1) up to stop (2) of locking pawl (S) on left and right sides of the car.

Note:
If stop (2) of locking pawl (S) is not reached, check/correct the adjustment of the cables for the convertible top box lid locks (point 9).

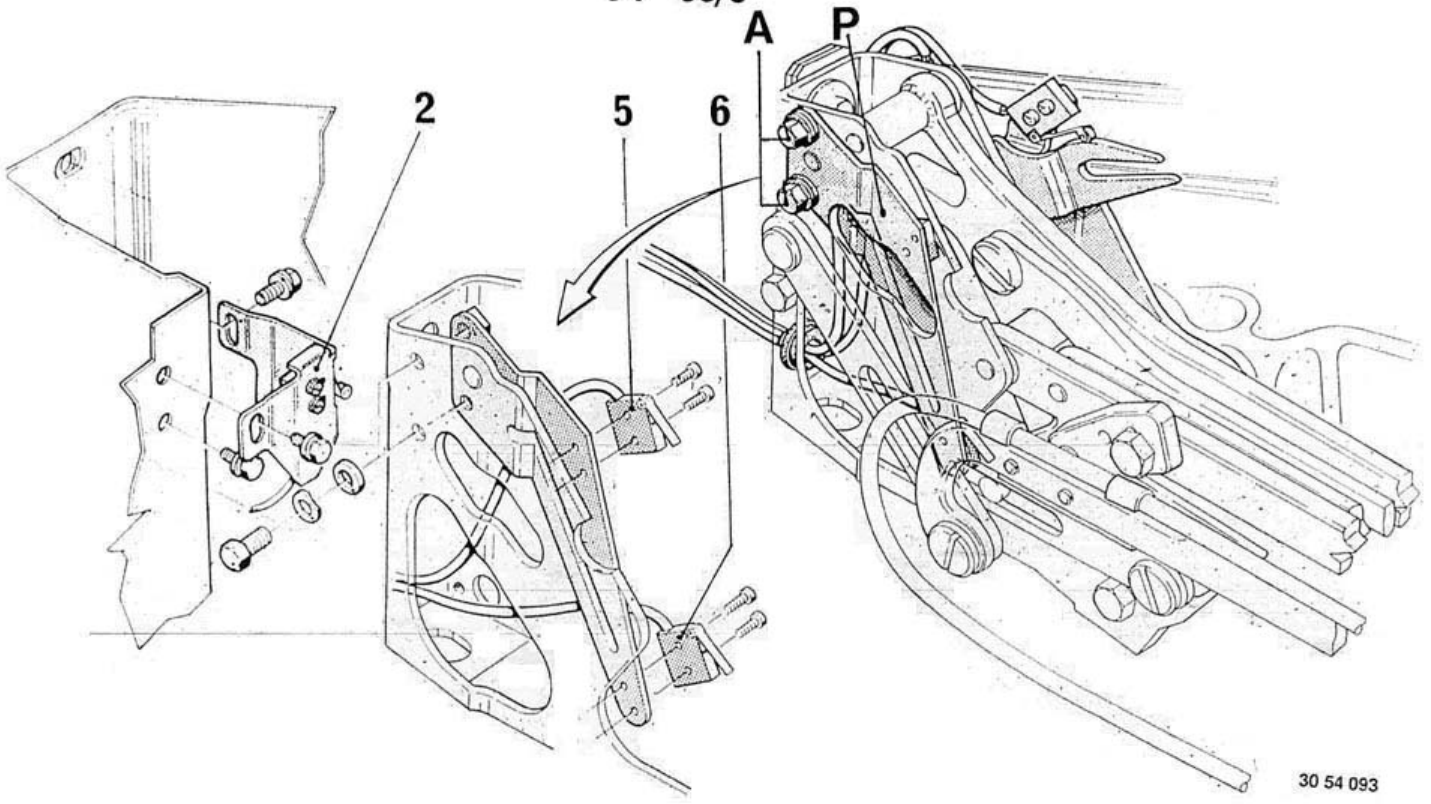


Press down rotary catch (1) on left and right sides of the car until distance A = 2 mm (0.079").
Adjust microswitch (3) by bending the tongue in such a manner that the yellow LED lights up (switching point).



4. Microswitch - Convertible Top Box Lid "Opened"

Connect yellow plug on pin 3.
Open convertible top box lid by hand up to the stop. Close top box lid again until a distance A of 5 mm (0.197") is reached.
Adjust the microswitch in such a manner that the yellow LED lights up.

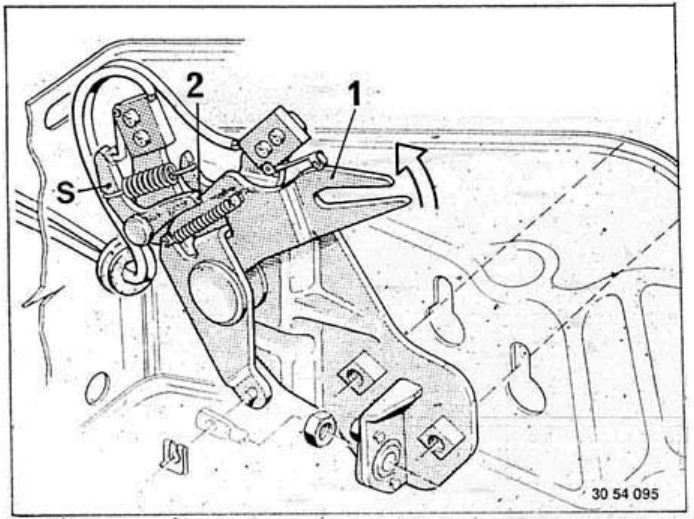


5. Microswitch - Convertible Top "Run Out"
(Only 1988 Models)

Connect yellow plug on pin 5 and green plug on pin 7 (both LEDs light up). Lift front end of top on the cowl panel hoopstick and fold it back into the storage box slowly. Microswitch (2) for tensioner "up" must switch prior to microswitch (5) for convertible top "run out" when folding in the convertible top, the microswitches are adjusted correctly if the yellow LED goes out first and then the green LED. If applicable, adjust microswitch (5) by bending up the tongue.
Pull plug out of the testbox.

6. Microswitch - Convertible Top "Run In"

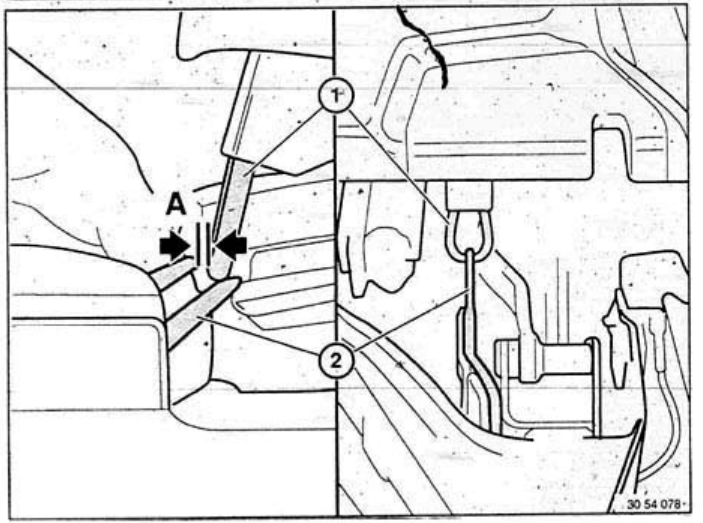
Connect yellow plug on pin 6.
Fold back the convertible top completely into the storage box.
Adjust microswitch (6) in such a manner that the yellow LED lights up, but the tongue of microswitch (6) does not bear on the housing. Remove the rear side trim panel (see Group 51) to adjust microswitch (6). Loosen screws (A) and adjust plate (P). Always check / correct the adjustment of microswitch (5) after adjustment of microswitch (6).



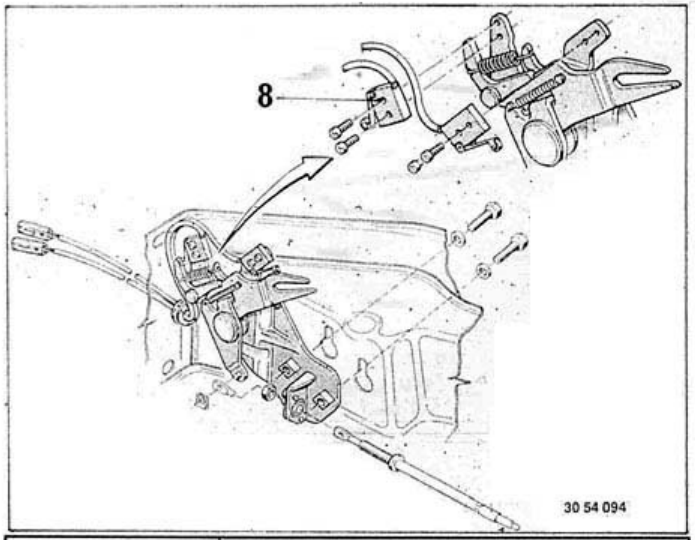
7. Adjusting Lock Shackle:

Pull up rotary catch (1) up to stop (2) of locking pawl (S) on left and right sides of the car.

Note:
If stop (2) of locking pawl (S) is not reached, check / correct the adjustment of cables for the convertible top box lid locks (point 9).



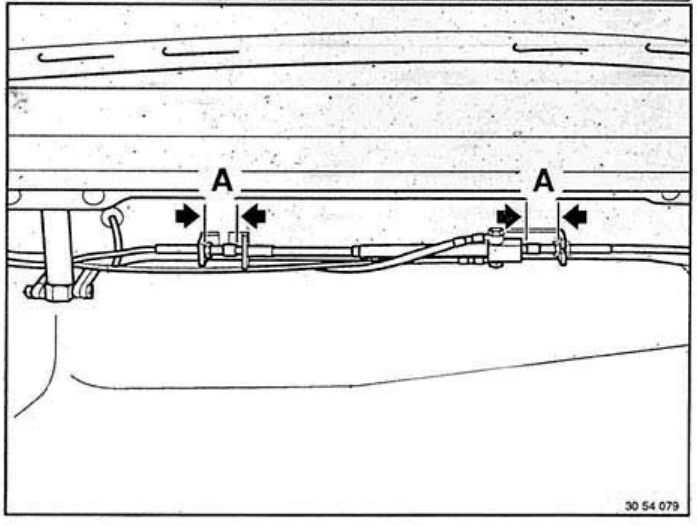
Close the top box lid only so far that lock shackle (1) is immediately before rotary catches (2). Adjust lock shackle (1) in such a manner that there is distance A = approx. 1.5 mm (0.059") on the left and right sides and that rotary catches (2) engage in the middle of lock shackle (1).



8. Microswitch - Convertible Top Box Lid "Locked"

Connect yellow plug on pin 9.
Press down rotary catch on left side of the car until the lock engages.
Adjust microswitch (8) by bending the tongue until the yellow LED lights up.

Note:
Leads must not be routed between the microswitch and locking pawl.

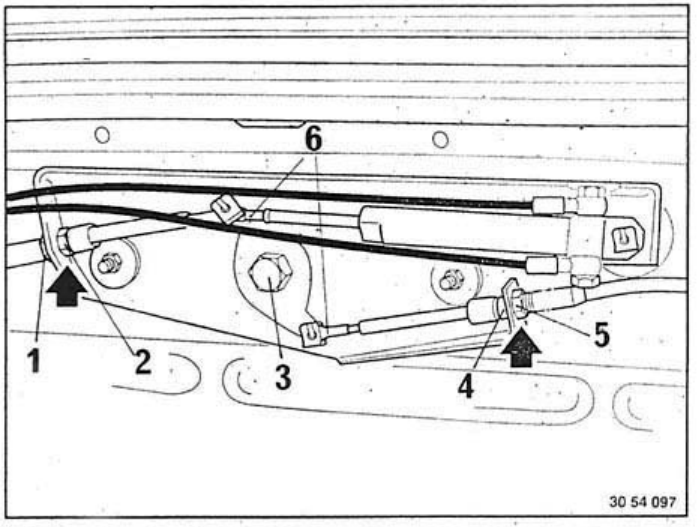


9. Adjusting Cables for Convertible Top Box Lid Lock

Open the top box lid and press down on the left and right rotary catches until both (left/right) locks are locked.

Version with "Flying" Cylinder:

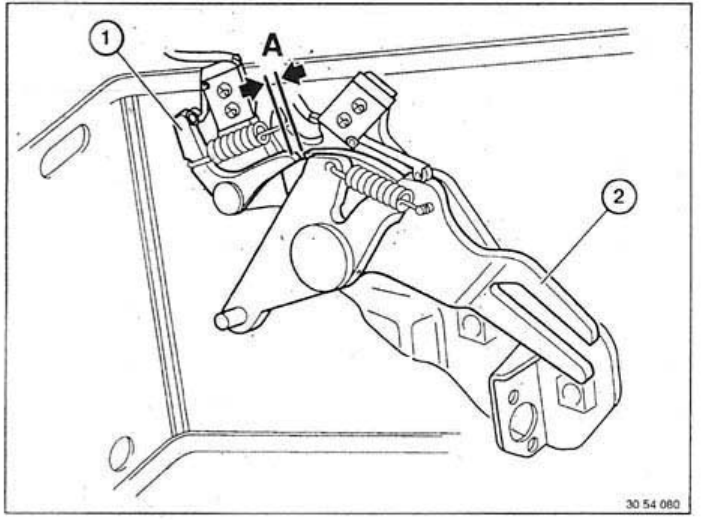
Adjust distance A = 40 mm (1.575") on both cables.



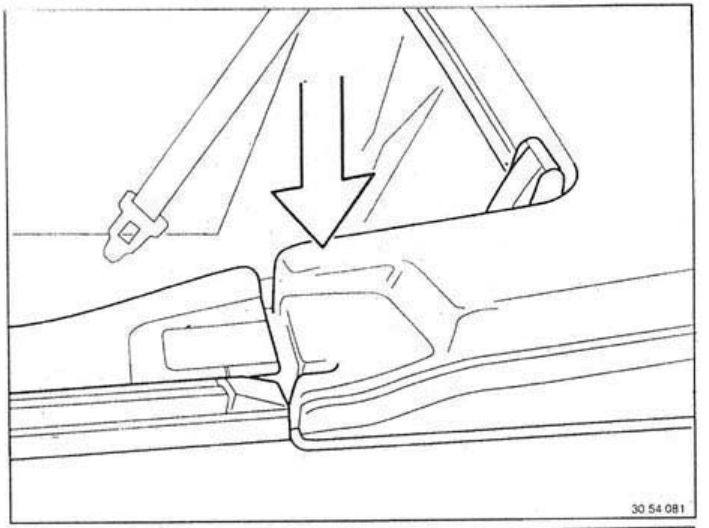
Version With Stationary Cylinder:

Important!
Max. torque on locking hexagon (3) = 50 Nm (36 ft. lbs.).
Don't install the cables twisted.
All tongues (6) on cables and hydraulic cylinder must be screwed in against the stop and may not be changed.
When replacing cables, install the cables without tension and only with locked locks.

Open the top box lid. Loosen nuts (1 and 5). Press down on the left and right rotary catches until both (left/right) locks are locked.
Screw on nut (2) up to the stop and lock by tightening nut (1).

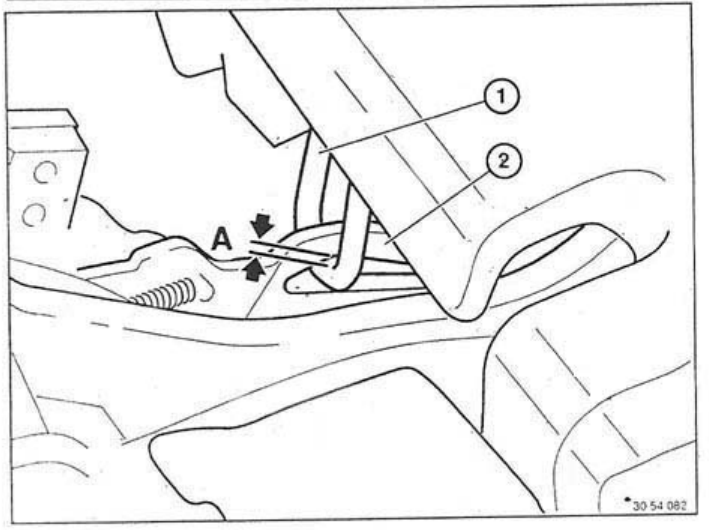


Turn locking hexagon (3) counterclockwise up to the stop – max. 50 Nm (36 ft. lbs.). Adjust the cables with nut (4) in such a manner that there is play A = 0.5 to 1 mm (0.020 to 0.039") on the left and right locks between locking pawls (1) and rotary catches (2), and that the right lock locks first when locking the top box lid.

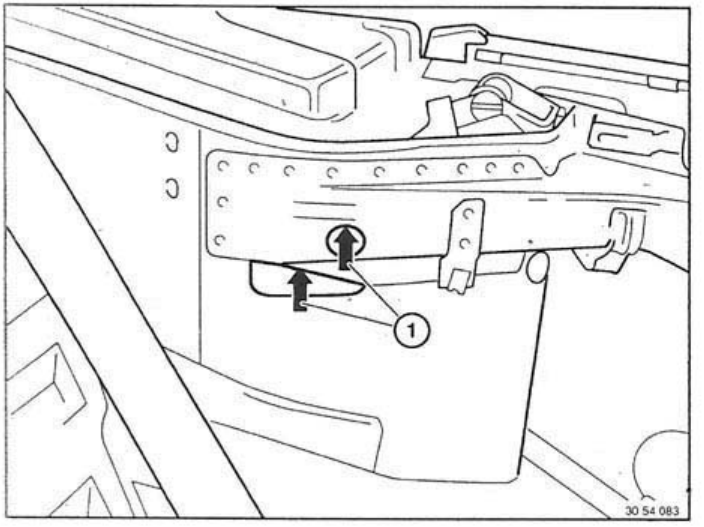


10. Adjusting Convertible Top Box Lid / Locks

Close and lock the convertible top storage box lid.
Press down on the top box lid lightly (don't damage the rubber seal).



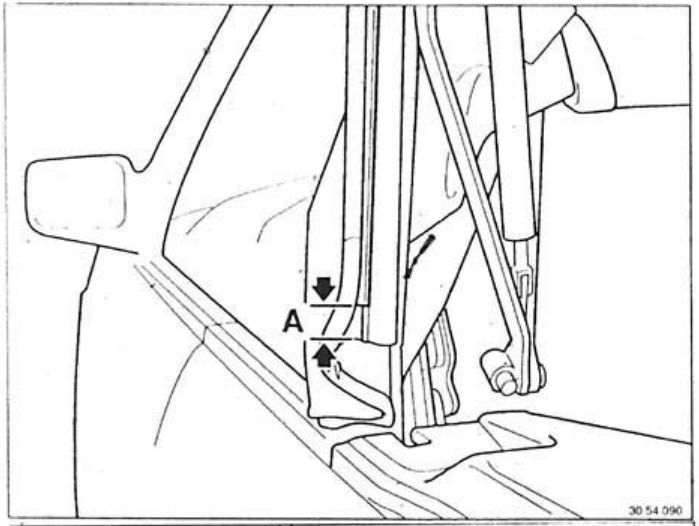
There must be distance A = 1 to 2 mm (0.039 to 0.079") between lock shackle (1) and the highest point of rotary catch (2).

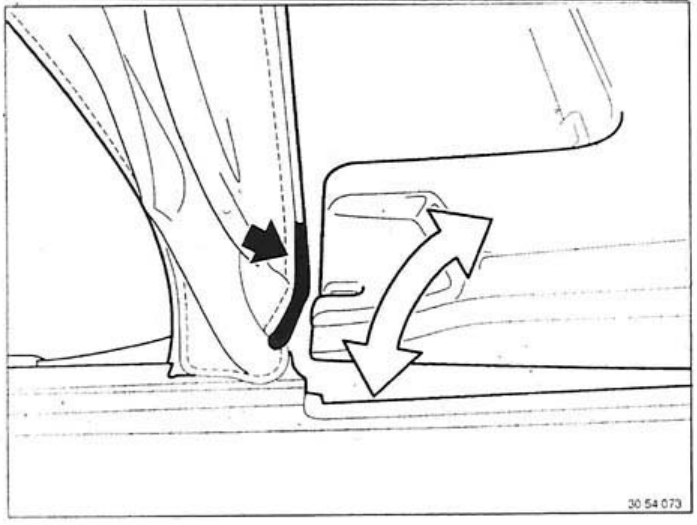


If applicable, remove the inside side trim panel – see Group 51. Loosen screws (1) and correct the lock adjustment.

Note:
Incorrectly adjusted top box lids / locks will rattle when driving the car on rough roads with the convertible top lowered.

Remove the testbox and reconnect the control unit.
Reinstall all removed parts.
Perform a trial run.





TROUBLESHOOTING ELECTRIC/HYDRAULIC CONVERTIBLE TOP

Fault: wind noise in area of top box / rear side window.

Cause / Correction:
Protrusion A = 20 to 30 mm (0.787 to 1.181") of seal not sufficient / pull out seal carefully (protrusion distance A) and cement with Loctite No. 309.

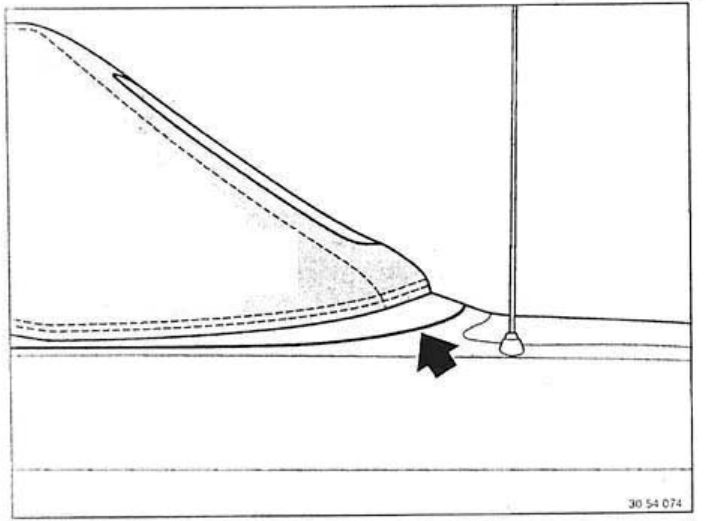
Fault: convertible top opens / closes too slow.

Cause / Correction:
Power supply not sufficient / correct; correct oil level in hydraulic control unit; hydraulic control unit faulty or restrictors and valves dirty (pressure test) / repair or replace as necessary; hydraulic pipes bent or dirty etc. / repair or replace; hydraulic cylinder faulty (pressure test) / replace if necessary.

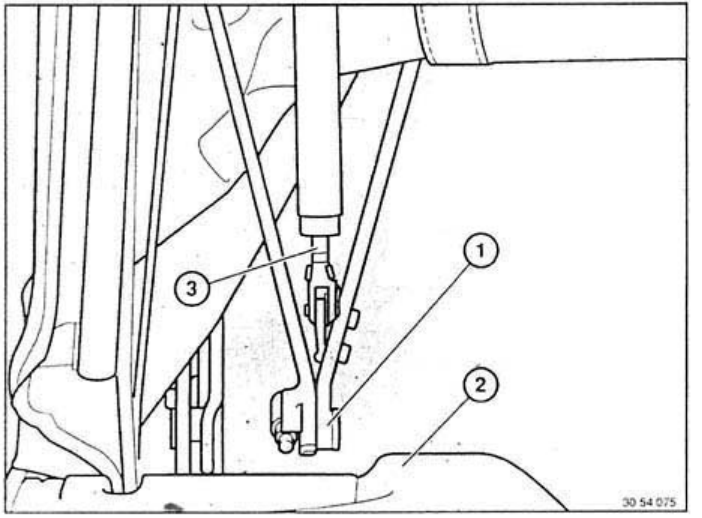
Fault: top box lid scrapes on tensioner.

Cause / Correction:
Check valve in hydraulic control unit dirty / inspect and replace (1989 models) or convert (1988 models) – see 54 34 . . ..

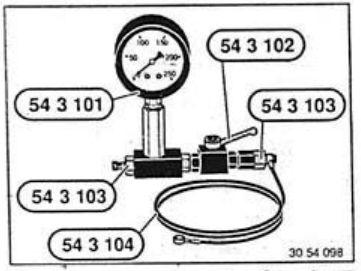
Adjustment of "tensioner up" microswitch incorrect / correct.



Cause / Correction:
Adjustment of top box lid incorrect / check and make sure that top box lid is installed as far back as possible without that the rubber seal on the top box is "clamped" when closing the top box lid (this is necessary only after removal / replacement of the top box lid; otherwise keep to the factory adjustment).



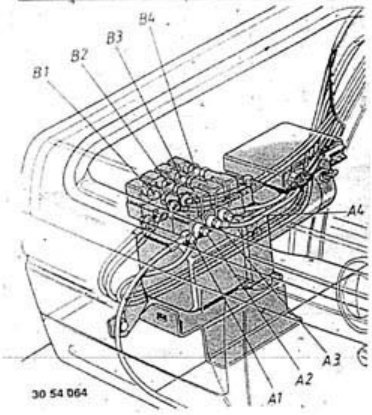
Cause / Correction:
Tensioner cylinder "pulls excessively". The cylinder "pulls excessively", if tensioning rod hinge (1) scrapes on top box lid (2). If applicable, loosen piston rod (3) and install a lower height = approx. 3 mm (0.118") hexagon nut. Coat the threads with Loctite.



54 34 ... PRESSURE TEST

Prepare the tester.
Connect adapters and pressure hose.

Fold back convertible top into the storage box completely.



Connect tester on the hydraulic control unit, on hose A 3.
Tightening torque*.
Open the top box lid.

Checking Hydraulic Control Unit:
Close shutoff valve on tester.
The hydraulic control unit is okay, if the pressure rises to about 160 bar (2275 psi).
Open shutoff valve on tester.

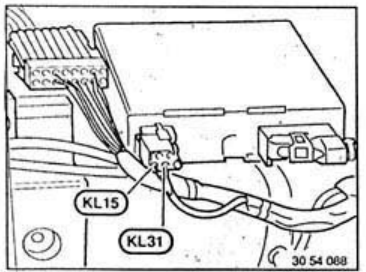
Checking Hydraulic Cylinder (Top):
Hold the convertible top tight and operate it.
The hydraulic cylinder is okay, if the pressure again rises to about 160 bar (2275 psi).

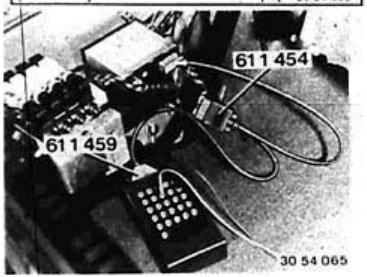
Remove the tester and reconnect the hose.
Tightening torque*.

* See Specifications

TROUBLESHOOTING ELECTRIC/HYDRAULIC CONVERTIBLE TOP

Requirements:
Battery voltage at least 11.5 V.
Fuse for pump motor and valves/electronics okay.
Hydraulic fluid tank filled.
Convertible top in perfect mechanical condition.
Tests performed with a BMW Service.Tester or Mutlimeter.





Turn on ignition.

Do terminals 15 and 31 on control unit have voltage or ground? — **no** — **Repair ground/power supply wiring diagram.**

yes

Connect adapter lead 61 1 454 with test box 61 1 459.
Is there flow to vehicle ground
on pin 1 = "open" and
on pin 2 = "close" of the test box with the operating switch pressed? — **no** — **Check/repair operating switch and wires.**

yes

Measure voltage on pin 23 - is there battery voltage? — **no** — **Check power supply lead and relay.**

yes

Press operating switch - does the voltage drop to < 1.5 V? — **no** — **Replace control unit.**

yes

Check function of microswitches. Operate convertible top manually.
Measure flow to vehicle ground on pins of test box.

- = ∞ ohms
x = flow

Pin 1 with cowl panel	unlocked	-
	locked	x
Pin 5 with tensioning bar	down	-
	up	x
Pin 6 with convertible top	run out	-
	run in	x
Pin 7 with convertible top	run in	-
	run out	x
Pin 9 with top lid	unlocked	-
	locked	x
Pin 4 with top lid	opened	-
	closed	x
Pin 3 with top lid	closed	-
	opened	x

Do microswitches operate correctly? — no — Adjust or replace pertinent switch, repair wire if applicable.

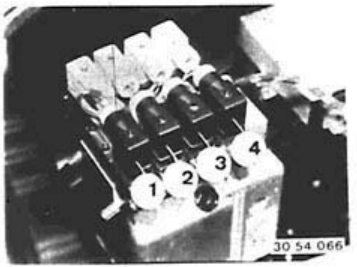
yes

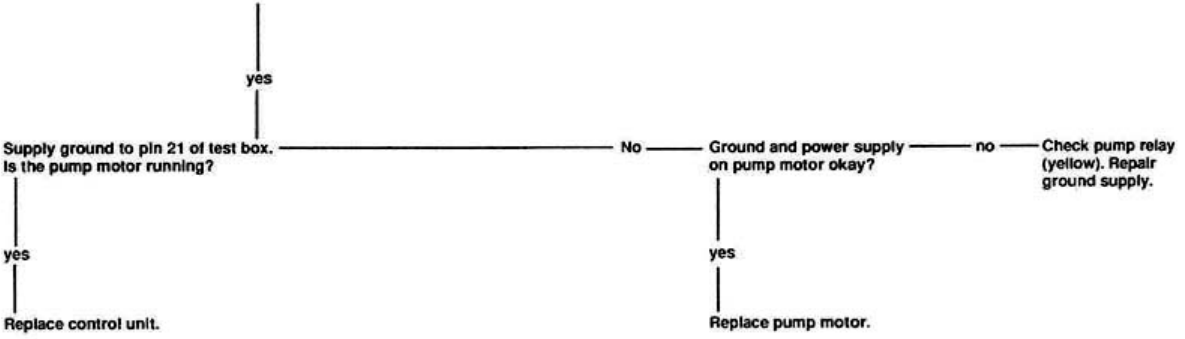
Check valves. Pull plug off of control unit. Supply ground to pins of test box - valves should operate. Place finger on pertinent valve. "Clicking" is felt when valve switches.

Pin 13 = valve 2	Pin 17 = valve 1
Pin 14 = valve 2	Pin 18 = valve 1
Pin 15 = valve 3	Pin 19 = valve 4
Pin 16 = valve 3	Pin 20 = valve 4

Are valves operating correctly? — no — Replace pertinent valve(s).

yes




yes
Supply ground to pin 21 of test box.
Is the pump motor running?
No
Ground and power supply
on pump motor okay?
no
Check pump relay
(yellow). Repair
ground supply.
yes
Replace control unit.
yes
Replace pump motor.

ELECTROMECHANICAL TOP

General Information

Removal of complete top is identical with procedures for removal of mechanical top, whereby additionally top push rod and push rod for top tensioning bow must be detached on top drive.

Top drive must be adjusted, refer to 54 34 023, after removal and installation of complete top or alteration of top adjustment.

If top cannot be lifted out of top box by hand in spite of correctly disengaged top drive, check top adjustment – refer to 54 34 023.

Lubricate surface between drive lever and trailing lever on top drive lightly with Polylub GLY 801* when necessary.

Lock joint head bolting of top push rod to top with Loctite No. 638; tightening torque = 25 Nm (18 ft. lbs.).

If power supply to control unit is interrupted (disconnection of battery/control unit) at an intermediate position between top opened and closed, restoring operation requires disengaging drives and moving top to a "defined" position. Refer to page 54-44 for information about restoring operation.

Description of Operation

Opening Top

Turn ignition key to "R" position.
Unlock top on cowl panel and lift above dead center.
Cowl panel switch switches ground lead of top operating switch to continuity. Operate top operating switch in open direction and keep it pressed in during entire opening action. Top motor receives power, top tensioning bow is run up and top motor is switched off when top tensioning bow reaches top dead center. Top storage box lid motor receives power, top storage box lid locks are unlocked and top storage box lid is opened. Top motor now moves top tensioning bow down and stores top in storage box. Top storage box lid motor closes storage box lid.

Closing Top

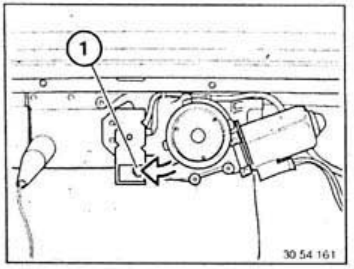
Turn ignition key to "R" position.
Operate top operating switch in close direction and keep it pressed in during entire closing action. Top storage box lid motor receives power and moves top out of storage box. Top tensioning bow is run up. Top storage box lid motor receives power to close and lock storage box lid. Top motor receives power and runs top tensioning bow down. Top must be pulled down manually over dead center to cowl panel and locked on cowl panel.

Note:
Entire top operation is controlled by microswitches mounted on gearboxes of top storage box lid motor and top motor. Two microswitches are mounted on each gearbox. Microswitches report instantaneous top position to control unit.

Top operation is not possible, if
- battery voltage is < 10.5 V (engine should be running to prevent battery voltage from dropping below 10.5 V during top operation),
- vehicle rolls (speedometer A signal received),
- ignition key is in "0" position or
- top is not unlocked.

Top operation is locked for 15 minutes if there is seizure or blocking three times during top opening or closing action. Lock can be eliminated by switching ignition on and off.

* Source of Supply: HWB



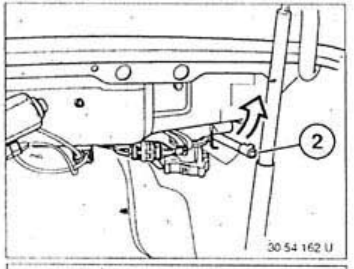
ELECTROMECHANICAL TOP

Emergency Operation (Closing Top) If Electric Operation Fails:

Note:
Figures drawn with trunk trim panels removed.

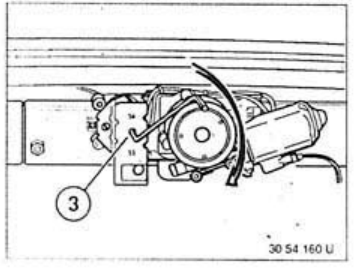
Raise trunk lid.
Insert centering pin (toolbox) in bore (1), press to left and unlock top storage box lid drive.

Insert centering pin in bore (2), press up and unlock top drive.

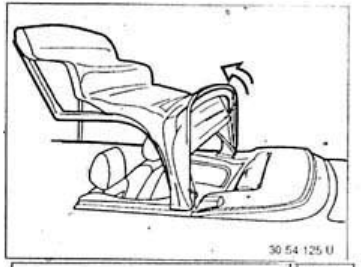


Insert hexagon key through bore (3) in hexagon socket, turn clockwise and unlock top storage box.

Open top storage box lid.
Lift top out of storage box.
Position top tensioning bow upright.
Close top storage box lid.
Lower top tensioning bow.
Pull down top at front and lock on cowl panel.



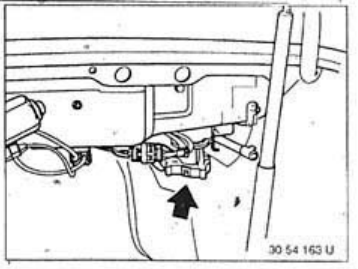
Note:
If top cannot be lifted out of top storage box in spite of correctly disengaged top drive, adjust top drive – refer to 54 34 023.



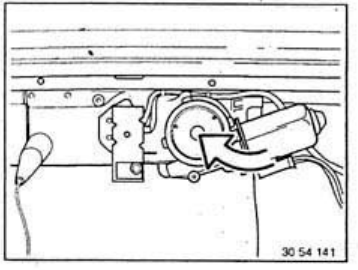
Restoring Operation After Fault Elimination:

Requirement:
Trunk trim panels removed.

Position top tensioning bow upright.
Close top storage box lid.
Raise trunk lid.

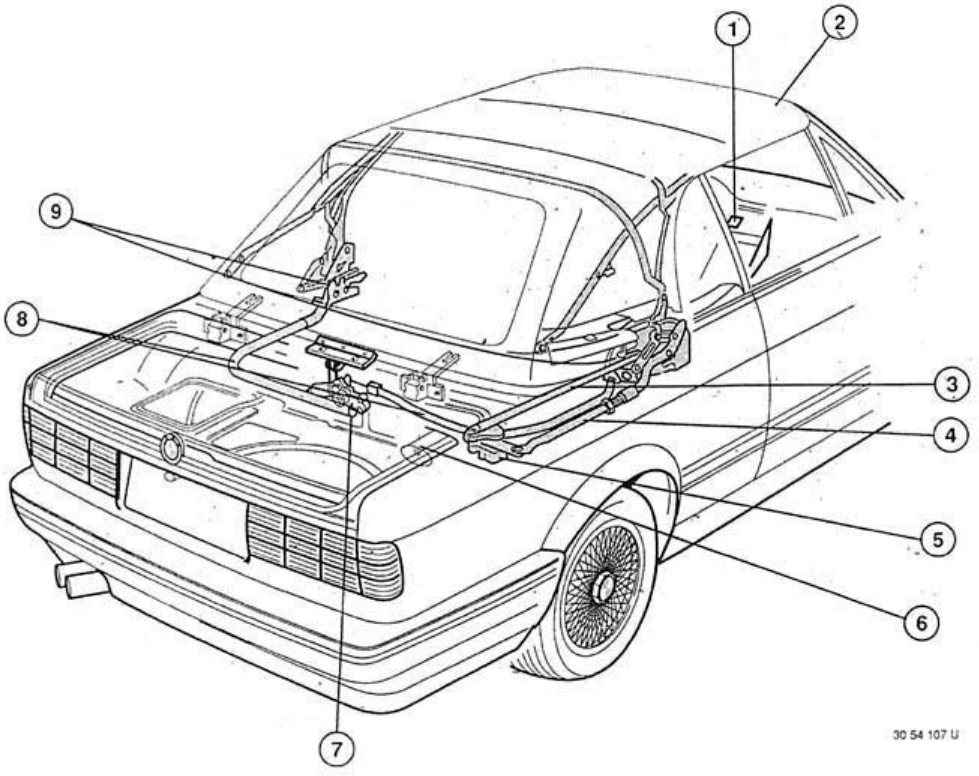


Move top tensioning bow back and forth slightly and press up top drive motor until it engages.



Move top storage box lid up and down slightly and press top storage box lid drive motor forward until it engages.

Install trunk trim panels.



ELECTROMECHANICAL TOP

Components

1 Operating switch
2 Cowl panel microswitch
3 Top push rod
4 Top tensioning bow push rod
5 Top drive
6 Control unit
7 Top storage box lid drive
8 Cables for top storage box lid locks
9 Top storage box lid locks

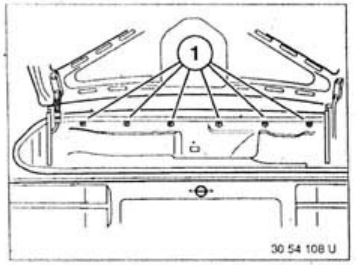
ELECTROMECHANICAL TOP

Control Unit Pin Connections

Pin	Description	Designation
1	Top storage box lid motor	K1
2	Top storage box lid motor	K2
3	Terminal 30, B+	30P
4	Top storage box lid microswitch (locked open)	S4
5	Top tensioning bow microswitch, up	S1
6	Top tensioning bow microswitch, down	S2
7	Top switch - open	auf
8	Top switch - close	zu
9	Top motor	K1
10	Top motor	K2
11	Electronic terminal 30, B+	30E
12	Electronic terminal 31, ground	31E
13	Top storage box lid microswitch (closed and locked)	S3
14	—	—
15	—	—
16	—	—
17	—	—
18	Speedometer A signal	A
19	Terminal R	R
20	Ground (load)	31P

Fuses

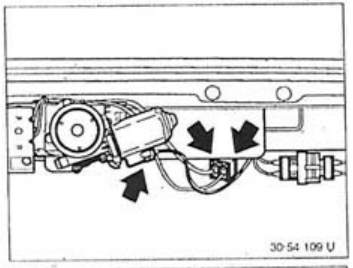
No. 4	Terminal R
No. 21	B+ supply for control unit
No. 25	B+ supply for load circuit



54 25 000 REMOVING AND INSTALLING OR REPLACING ELECTRIC TOP STORAGE BOX LID DRIVE

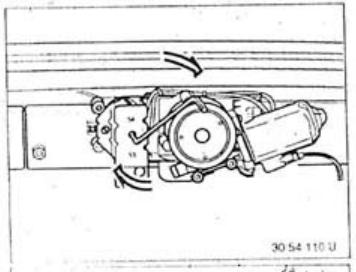
Turn ignition key to "0" position.
Raise trunk lid.
Loosen clips (1) and lower trunk trim panel.

Installation:
Adjust top storage box lid drive – see 54 25 001.

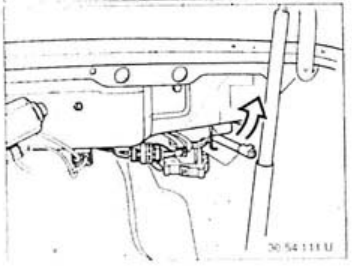


Disconnect plugs.

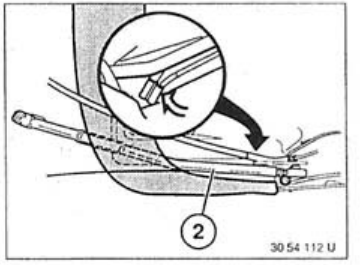
Gray plug – microswitch S3
Yellow plug – microswitch S4
White plug – power supply



Disengage top storage box lid drive and unlock top storage box lid.



Disengage top drive.

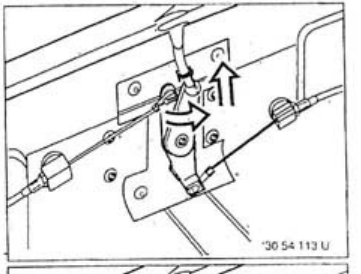


Shut trunk lid.

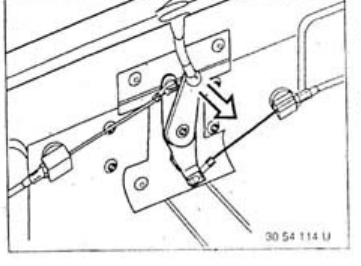
Top Closed:
Unlock top on cowl panel and lift at front end.
Position top tensioning bow upright and open top storage box lid.

Top Opened:
Open top storage box lid and lift top out of top storage box.
Position top tensioning bow upright.

Note:
If top cannot be lifted out of top storage box, engage top drive and run top out of storage box electrically.
If electric operation is not possible, press top into storage box completely and press out top push rod (2) firmly.
Check top adjustment – see 54 34 023.

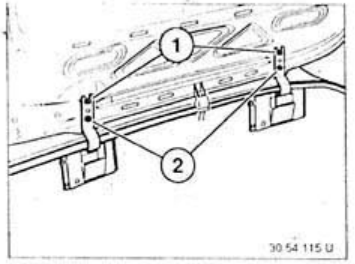


Disengage and pull out retainer from above.

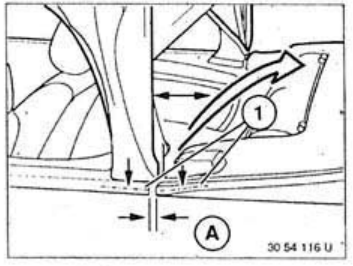


Pull linkage off ball head.

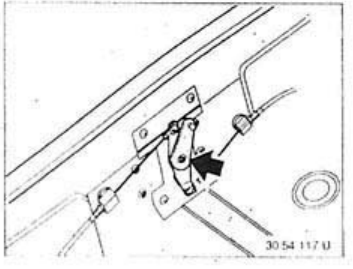
Installation:
Adjust length of linkage – see 54 25 001.



Loosen screws (1).
Unscrew screws (2).
Take off top storage box lid.



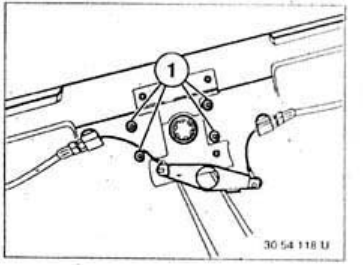
Installation:
Align top storage box lid in such a manner that when closed ornamental strips (1) are lined up, gap (A) between ornamental strips and lid is uniform on left and right sides and there is sufficient clearance to tensioning bow during movement of top storage box lid.



Unscrew screw and pull out drive lever forward.

Installation:
Drive lever can be inserted only in one position (splined shaft is asymmetric). Keep trying in different position until drive lever can be inserted easily.
Lock screw with Loctite No. 270*.
Tightening torque = 5 Nm (3.5 ft. lbs.).

* Source of Supply: HWB



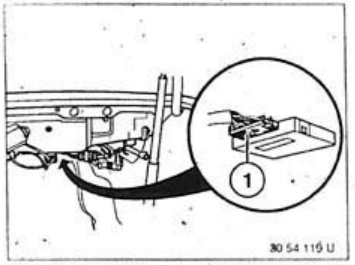
Raise trunk lid.
Hold drive tight in trunk and unscrew screws (1).

Installation:
Lock screws with Loctite No. 270*.
Tightening torque = 10 Nm (7 ft. lbs.).

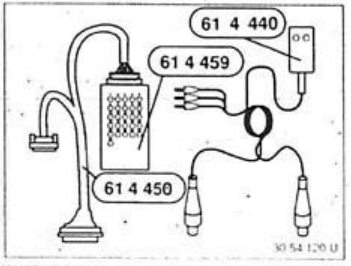
* Source of Supply: HWB

54 25 001 ADJUSTING ELECTRIC TOP STORAGE BOX LID DRIVE

Turn ignition key to "0" position.
Raise trunk lid.
Loosen clips (1) and lower trunk trim panel.



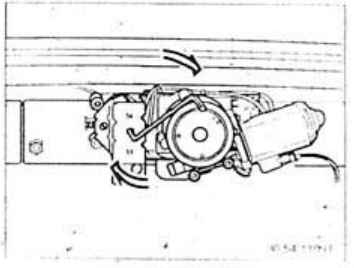
Disconnect plug (1).



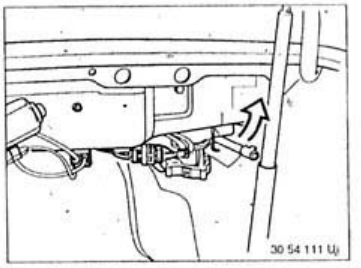
Connect plug (1) on test box 61 1 459 with help of adapter 61 4 450.
Don't connect control unit!
Connect microswitch test box 61 4 440 on test box.

Red plug	– B+ or pin 19
Black plug	– ground
Blue plug	– pin 20
Yellow plug	– pin 4 (microswitch S4)
Green plug	– pin 13 (microswitch S3)

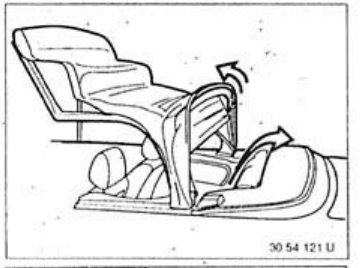
Turn ignition key to "R" position.



Disengage top storage box lid drive and unlock top storage box lid.



Disengage top drive.

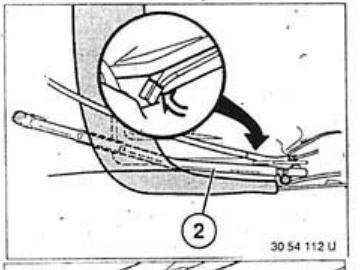


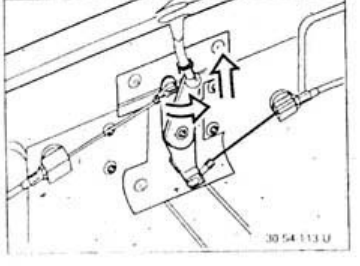
Take microswitch test box out of trunk and shut trunk lid.

Top Closed:
Unlock top on cowl panel and lift at front end.
Position top tensioning bow upright and open top storage box lid.

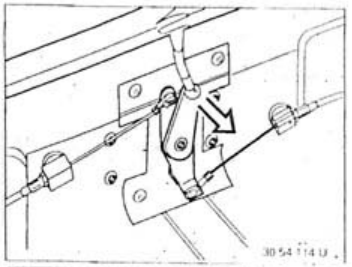
Top Opened:
Open top storage box lid and lift top out of storage box.
Position top tensioning bow upright.

Note:
If top cannot be lifted out of top storage box, engage top drive and run top out of storage box electrically.
If electric operation is not possible, press top in storage box completely and press out push rod (2) firmly.
Check top adjustment – see 54 34 023.

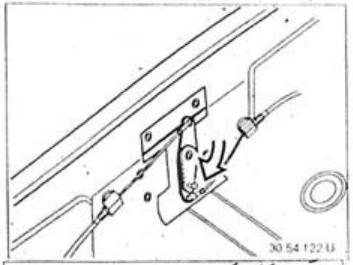




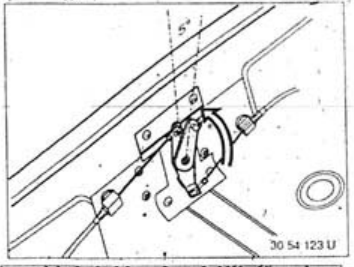
Disengage and pull out retainer from above.



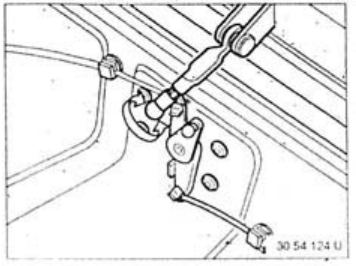
Pull linkage off ball head.



Turn drive lever clockwise until top storage box lid locks are locked.
Yellow LED must go out; if necessary, adjust cables longer uniformly until LED goes out (switch point S4).

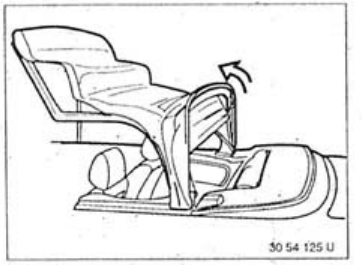


Turn drive lever counterclockwise until green LED just goes out (switch point S3).
Position = 5° after TDC (in clockwise direction).

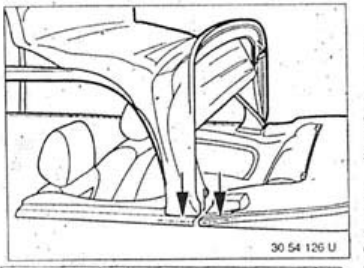


Adjust length of lid linkage by turning ball socket until linkage can be connected on ball head without tension.
Lock ball socket on lid linkage with Loctite No. 270*.
Mount ball head and insert retainer.

* Source of Supply: HWB



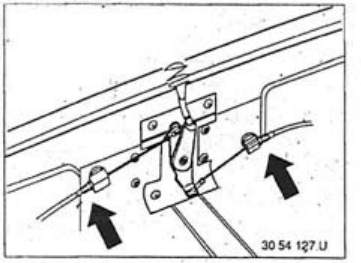
Shut top storage box lid.
Raise trunk lid.
Connect control unit.
Position top tensioning bow upright.

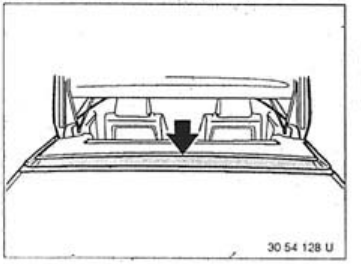


Engage top and top storage box lid drives.
Make trial operation.
Check whether top storage box lid closes correctly and locks.
If necessary, correct adjustment of top storage box lid locks – see 54 25 005.

Note:
If top tensioning bow does not fold down while closing top, switch point of microswitch S4 will not be reached (does not switch).

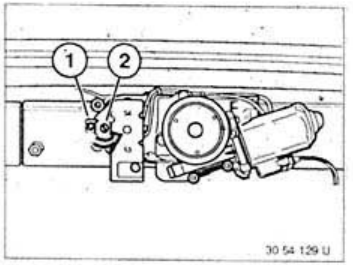
Remedy:
Adjust cables longer until switch point of microswitch "S4" is reached.
Recheck whether top storage box lid closes correctly and locks.
If necessary, correct adjustment of top storage box locks – see 54 25 005.





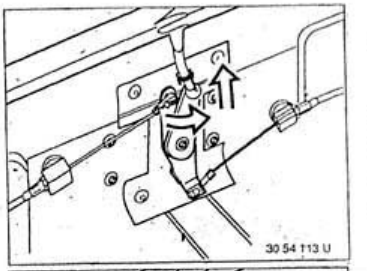
Open top and lock top storage box lid.
Check whether top storage box lid bulges up in area of top storage box drive.

Important!
Adjustment of microswitches "S3 / S4" may only be changed when there is evident bulging up of top storage box lid.



Loosen lockscrew (1).
Turn adjusting screw (2) counterclockwise slightly.
Tighten lockscrew (1).
Change length of top storage box lid linkage to new switch point "S3" with top storage box lid opened.
Position = < 5° after TDC (in clockwise direction).

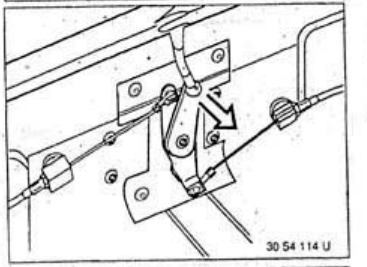
Repeat these procedures until top storage box lid no longer bulges up, whereby switch point "S3" may not be in TDC.
Afterwards check top storage box lid locking, correcting length of cables for top storage box lid locks if necessary.



54 25 002 ADJUSTING LINKAGE FOR TOP STORAGE BOX LID DRIVE

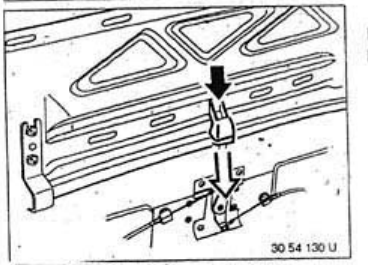
Run top out of top storage box until top tensioning bow is positioned upright.

Loosen and pull out retainer from above.

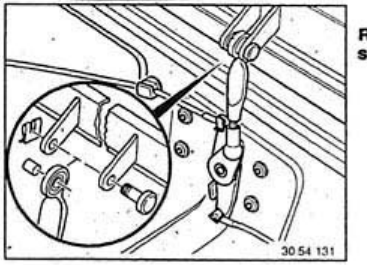


Hold top storage box lid tight and pull linkage off ball head.

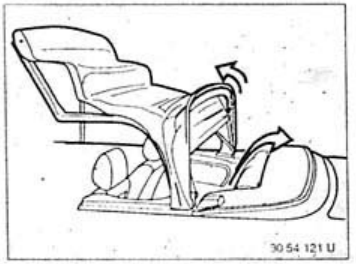
Installation:
Adjust top drive – see 54 25 001.



Disconnect catch strap and pull down protective sleeve.



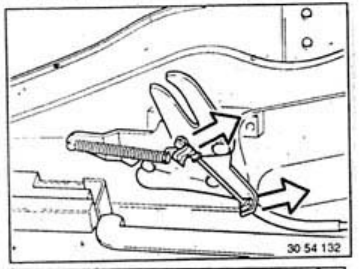
Remove retainer and pull out pin from side.



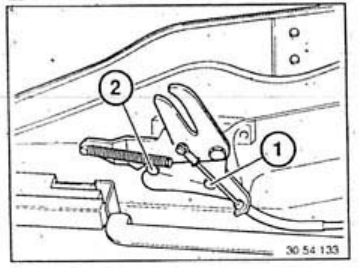
54 25 003 REMOVING AND INSTALLING OR REPLACING LEFT OR RIGHT TOP STORAGE BOX LID LOCK

Remove rear side trim panel – see 51 43 000.

Run top out of storage box until top tensioning bow is positioned upright and top storage box lid is opened.



Remove retainers and disconnect cable.



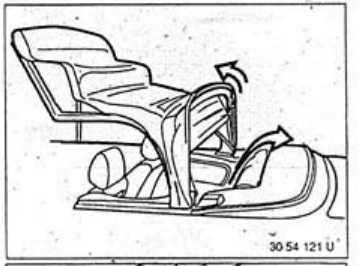
Caution!
Threaded plate can fall into cavity.

Hold threaded plate tight from behind. Unscrew screw (1) and loosen screw (2).
Take off top storage box lid lock.

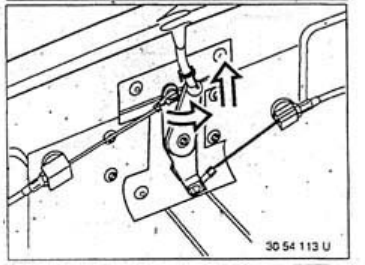
Installation:
Adjust top storage box lid lock – see 54 25 005.

54 25 005 ADJUSTING BOTH TOP STORAGE BOX LID LOCKS

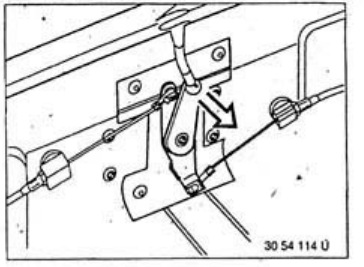
Requirement:
Top storage box lid adjusted correctly – see 54 25 000.



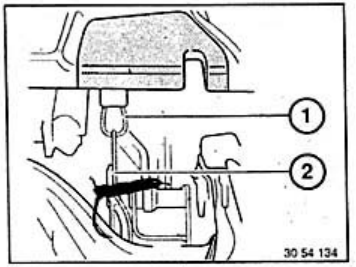
Run top out of storage box until top tensioning bow is positioned upright and top storage box lid is opened.



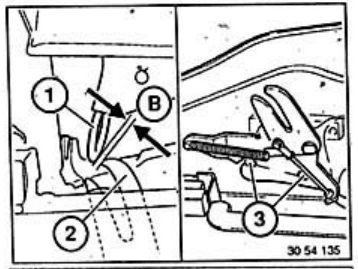
Loosen and pull out retainer from above.



Hold top storage box lid tight and pull linkage off ball head.

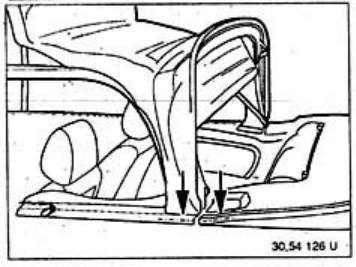


Lower top storage box lid on locks and adjust left/right locking bar (1) that left/right striker (2) engages in middle of locking bar (1).

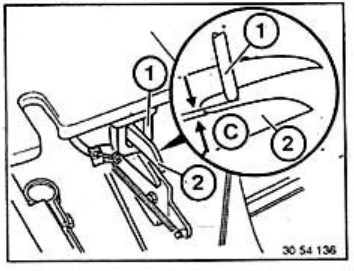


Loosen screws (3) and move top storage box lid locks forward or back so far that locking bars (1) emerge in strikers (2) by distance (B).

Distance B = approx. 3 mm (0.118").

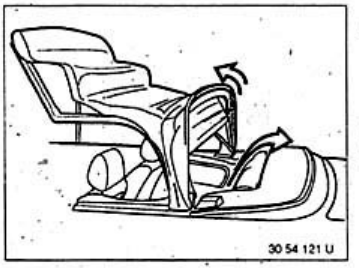


Shut top storage box lid and press down so far until ornamental strips are aligned.



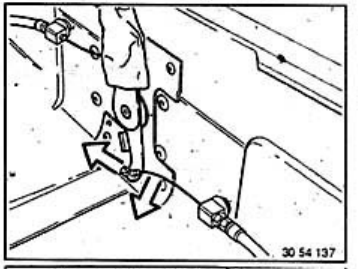
Press top storage box lid locks down so far that there is distance (C) between locking bars (1) and strikers (2) at bottom.
Tighten screws.

Distance C = approx. 3 mm (0.118").



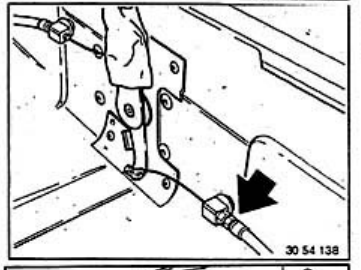
54 25 006 REMOVING AND INSTALLING OR REPLACING CABLE FOR LEFT OR RIGHT TOP STORAGE BOX LID LOCK

Open top storage box lid.
Run top out of storage box until top tensioning bow is positioned upright.

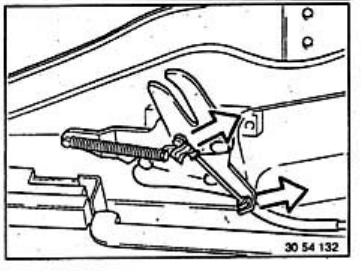


Remove retainer and disconnect cable.

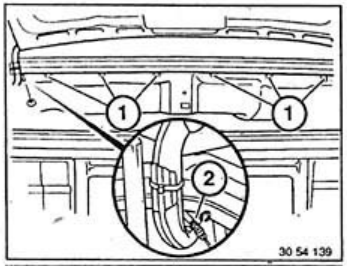
Installation:
Adjust top storage box lid drive – see 54 25 001.



Unscrew locknut and loosen adjusting screw completely.

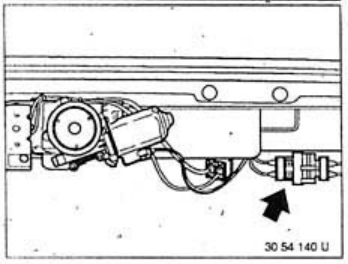


Remove retainers and disconnect cable.
Guide cable through holder on floor of top storage box and remove.



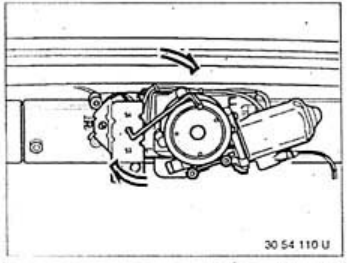
54 34 020 REMOVING AND INSTALLING OR REPLACING ELECTRIC TOP DRIVE

Remove trun lid – see Group 41.
Turn ignition key to "0" position.
Disengage clips (1) and retainer (2).
Disconnect cable and remove trunk trim panel.
Remove control unit – see 61 35 160.

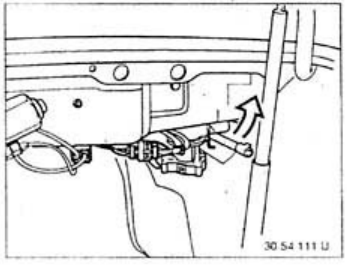


Disconnect plugs.

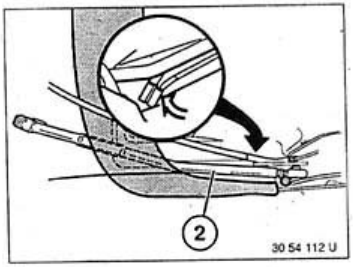
Black plug – microswitch S1
White plug – microswitch S2
Black plug – power supply



Disengage top storage box lid drive and unlock top storage box lid.



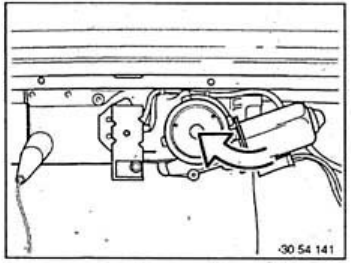
Disengage top drive.



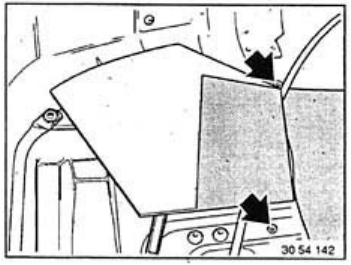
Top Closed:
Unlock top on cowl panel and lift at front end.
Position top tensioning bow upright and open top storage box lid.

Top Opened:
Open top storage box lid and lift top out of top storage box.
Position top tensioning bow upright.

Note:
If top cannot be lifted out of top storage box, engage top drive and run top out of storage box electrically.
If electric operation is not possible, press top in storage box completely and press out push rod (2) firmly.
Check top adjustment – see 54 34 023.



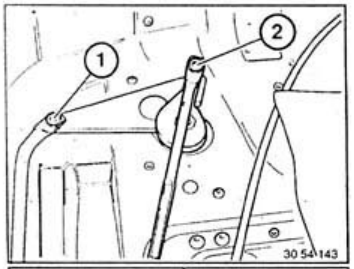
Open top storage box lid and re-engage top storage box lid motor.



Unscrew screws and take off cover.

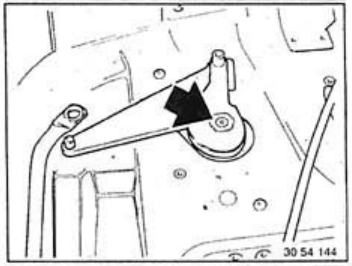
Installation:
Lock screws with Loctite No. 270*.
Tightening torque = 10 Nm (7 ft. lbs.).

* Source of Supply: HWB



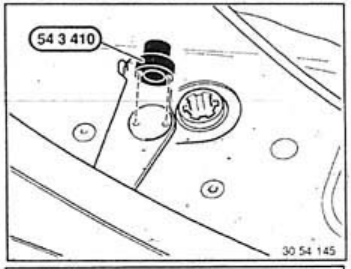
Unscrew screws (1 and 2).
Remove linkage from above.

Installation:
Lock screws with Loctite No. 270*.
Connect plugs for microswitches S1 and S2.
Adjust top drive – see 54 34 023.



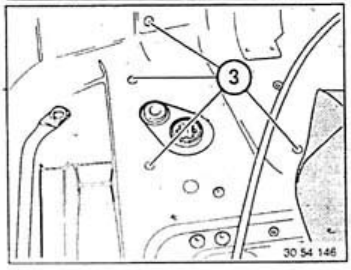
Unscrew screw and lift out drive lever from above.

Installation:
Drive lever can be inserted only in one position (splined shaft asymmetric).
Keep trying in different positions until drive lever can be inserted easily.
Lock screw with Loctite No. 270*.
Tightening torque = 5 Nm (3.5 ft. lbs.).



Unscrew screw with Special Tool 54 3 410 and take off trailing lever.

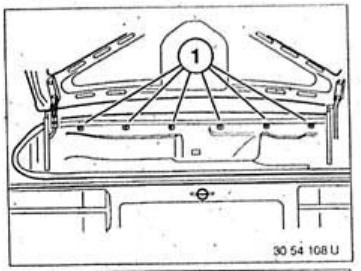
Installation:
Lock screw with Loctite No. 270*.
Tightening torque = 5 Nm (3.5 ft. lbs.).
Lubricate surface between drive lever and trailing lever lightly with Polylub GLY 801*.



Hold drive tight in trunk and unscrew screws (3).

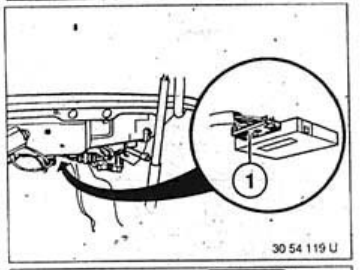
Installation:
Lock screws with Loctite No. 270*.
Tightening torque = 5 Nm (3.5 ft. lbs.).

* Source of Supply: HWB

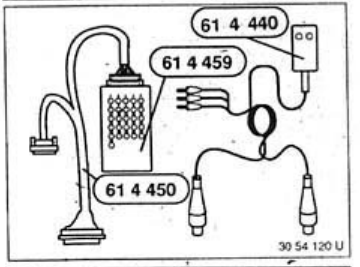


54 34 023 ADJUSTING ELECTRIC TOP DRIVE

Turn ignition key to "0" position.
Raise trunk lid.
Unclip clips (1) and lower trunk trim panel.



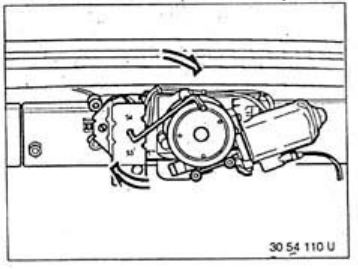
Disconnect plug (1).



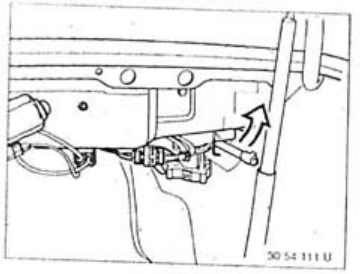
Connect plug (1) on test box 61 1 459 with help of adapter 61 4 450.
Don't connect control unit!
Connect microswitch test box 61 4 440 on test box.

Red plug	– B+ or pin 19
Black plug	– ground
Blue plug	– pin 20
Yellow plug	– pin 5 (microswitch S1)
Green plug	– pin 6 (microswitch S2)

Turn ignition key to "R" position.



Disengage top storage box lid drive and unlock top storage box lid.

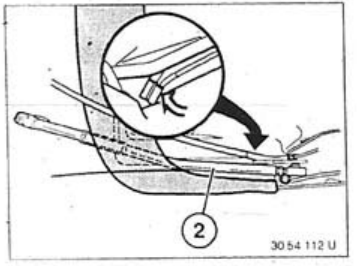


Disengage top drive.

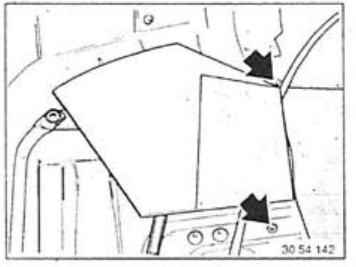
Take microswitch test box out of trunk and shut trunk lid.

Top Closed:
Unlock top on cowl panel and lift at front end.
Position top tensioning bow upright and open top storage box lid.

Top Opened:
Open top storage box lid and lift top out of top storage box.
Position top tensioning bow upright.



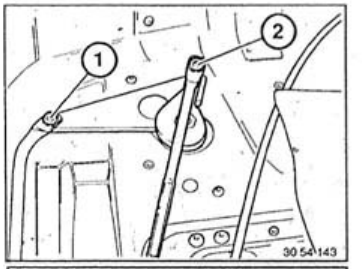
Note:
If top cannot be lifted out of top storage box, reconnect control unit, engage top drive and run top out of storage box electrically.
If electric operation is not possible, press top in top storage box completely and press out top push rod (2) firmly.



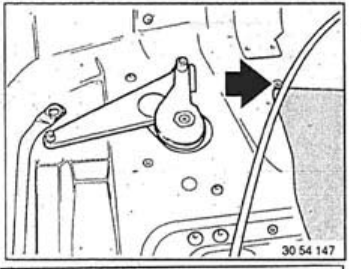
Unscrew screws and take off cover.

Installation:
Lock screws with Loctite No. 270*.
Tightening torque = 10 Nm (7 ft. lbs.).

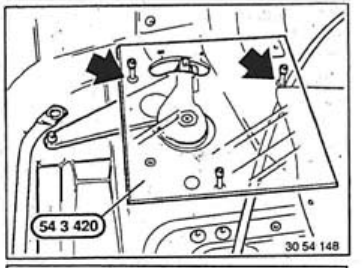
* Source of Supply: HWB



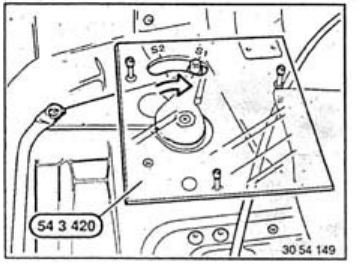
Unscrew screws (1 and 2).
Remove linkage from above.



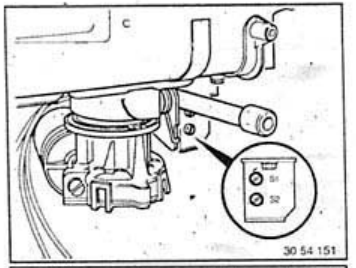
Screw in screw.



Apply Special Tool 54 3 420 on screws.

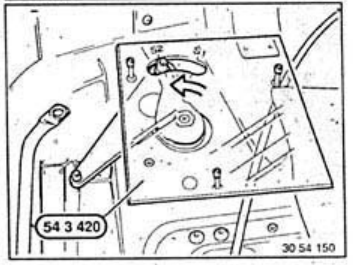


Turn drive lever (1) clockwise to "S1" position.
Center of bore (2) and notch (3) must be aligned.

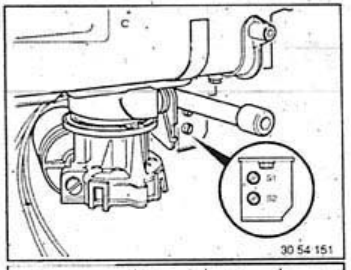


Adjust microswitch S1 with a long screwdriver (30 cm long, 5 mm tip width) until yellow LED just lights up.

Note:
Turning clockwise = LED begins to light up.
Turning counterclockwise = LED goes out.

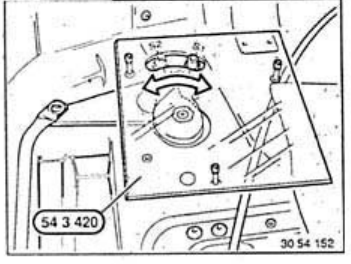


Turn drive lever (1) counterclockwise to "S2" position.

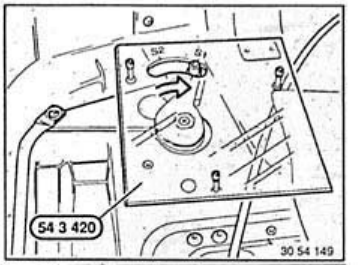


Adjust microswitch S2 until green LED just goes out.

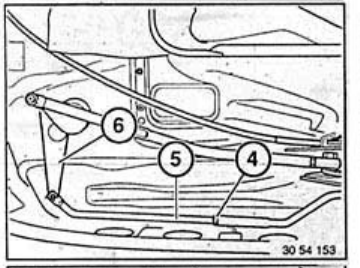
Note:
Turning clockwise = LED goes out.
Turning counterclockwise = LED begins to light up.



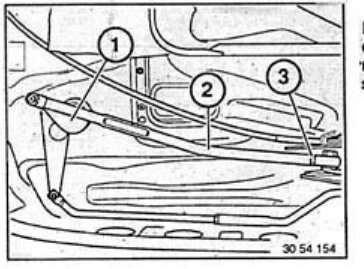
Turn drive lever (1) to positions "S1" and "S2", and check adjustment of microswitches.



Turn drive lever (1) to "S1" position. Remove Special Tool 51 3 420.



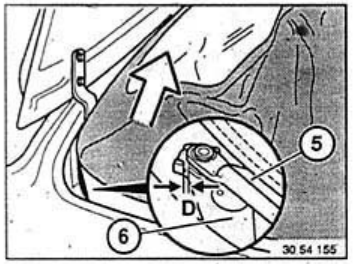
Position top tensioning bow upright. Loosen locknut (4) and adjust length of push rod for top tensioning bow (5) that it can be connected on trailing lever (6) without tension.
Tighten locknut (4).
Screw in and lock lockscrew for push rod (5) with Loctite No. 270*.



Loosen locknut (3) and adjust length of top push rod (2) that it can be connected on drive lever (1) without tension.

Take off top push rod (2) and then shorten by one complete turn.
Turn drive lever (1) counterclockwise until top push rod (2) can be connected. Screw in and lock lockscrew for top push rod (2) with Loctite No. 270*.

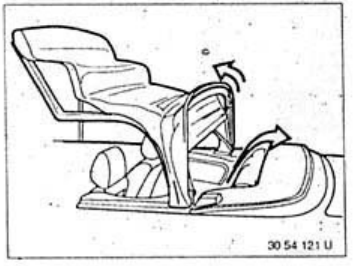
* Source of Supply: HWB



Place top in storage box by hand.
Lift out top again slowly and check distance (D) between drive lever (1) and trailing lever (6).

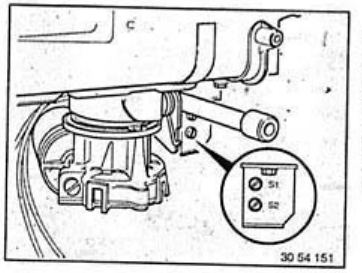
Distance D = at least 3 mm (0.118").

If necessary, shorten push rod for top tensioning bow slightly.



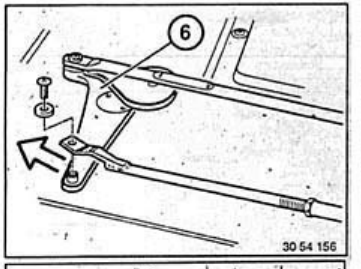
Close top until top tensioning bow is upright.
Engage top drive and top storage box lid drive.
Connect control unit.
Check function.
Run top into storage box completely.
Disengage top storage box lid drive and top drive.
Open top storage box lid and check whether top can be lifted out of storage box by hand.

Important!
Deviating adjustment of microswitch "S1" is permitted only when top cannot be lifted out of storage box by hand in spite of correctly disengaged drive.



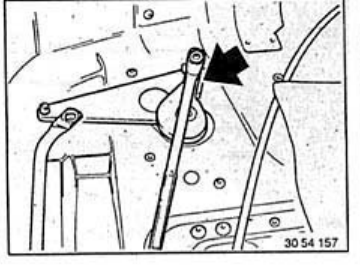
Turn adjusting screw for microswitch "S1" counterclockwise one half turn.
Engage top drive and run top out of and back in storage box electrically.
Disengage top drive and check whether top can be lifted out of storage box by hand.
Repeat these procedures until top can be lifted out of storage box by hand.

Close top electrically until top storage box lid begins to close.
Detach push rod to top tensioning bow in this position.



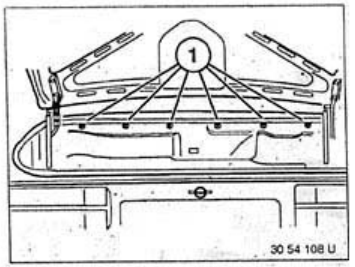
Check whether trailing arm (6) can still be turned clockwise (i.e. no self restriction between drive lever and trailing lever).
If trailing lever can no longer be moved (self restriction), exchange drive lever, trailing lever and, if applicable, top drive.

Installation:
Lubricate surface between drive lever and trailing lever lightly with Polylub GLY 801*.



Install cover and lock screws with Loctite No. 270*.
Position top tensioning bow upright.
Engage top and top storage box lid drives.
Install trunk trim panel.

* Source of Supply: HWB

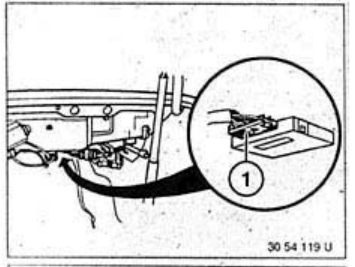


61 35 160 REPLACING CONTROL UNIT (EM TOP)

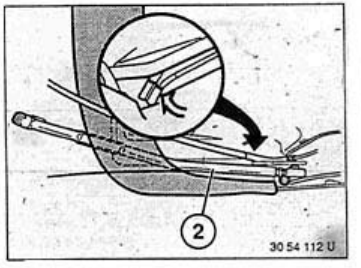
Turn ignition key to "0" position.
Raise trunk lid.
Unclip clips (1) and lower trunk trim panel.

Top Closed:
Unlock top on cowl panel and lift at front end.
Position top tensioning bow upright and open top storage box lid.

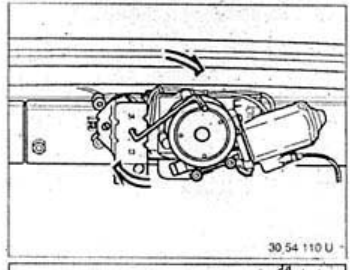
Top Opened:
Open top storage box lid and lift top out of top storage box.
Position top tensioning bow upright.



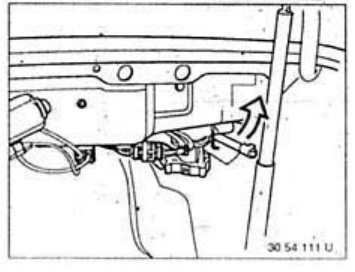
Disconnect plug (1).



Note:
If top cannot be lifted out of top storage box, engage top drive and run top out of storage box electrically.
If electric operation is not possible, press top in storage box completely and press out push rod (2) firmly.
Check top adjustment – see 54 34 023.

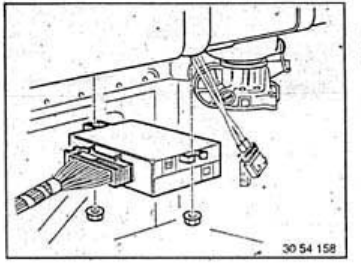


Disengage top storage box lid drive and unlock top storage box lid.

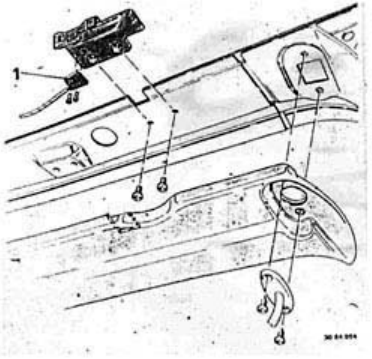


Disengage top drive.

Installation:
Position top tensioning bow upright.
Engage top drive and top storage box lid drive.



Unscrew screws and take out control unit.



61 31 190 REPLACING MICROSWITCH (Cowl Panel)

Pull edge off A-pillar partially.
Remove sun visors with holders.
If applicable, remove check control.
Take off cowl panel plate.
Unscrew screws and disconnect plug.

TROUBLESHOOTING TABLE FOR EM TOP MICROSWITCHES

Opening Top

	S 1	S 2	S 3	S 4	Top Switch on Cowl Panel
Top closed and locked	opened (no continuity)	opened (no continuity)	closed (continuity)	opened (no continuity)	opened (no continuity)
Top unlocked and lifted above dead center	opened (no continuity)	opened (no continuity)	closed (continuity)	opened (no continuity)	closed (continuity)
Positioning top tension bow upright	opened (no continuity)	closed (continuity)	closed (continuity)	opened (no continuity)	closed (continuity)
Top tensioning bow up	closed (continuity)	closed (continuity)	closed (continuity)	opened (no continuity)	closed (continuity)
Top storage box lid unlocked	closed (continuity)	closed (continuity)	closed (continuity)	closed (continuity)	closed (continuity)
Top storage box lid open	closed (continuity)	closed (continuity)	opened (no continuity)	closed (continuity)	closed (continuity)
Lowering top tensioning bow	opened (no continuity)	closed (continuity)	opened (no continuity)	closed (continuity)	closed (continuity
Folding top in top storage box	opened (no continuity)	opened (no continuity)	opened (no continuity)	closed (continuity)	closed (continuity)
Closing top storage box lid	opened (no continuity)	opened (no continuity)	closed (continuity)	closed (continuity)	closed (continuity)
Locking top storage box lid	opened (no continuity)	opened (no continuity)	closed (continuity)	opened (no continuity)	closed (continuity)

Closing Top

	S 1	S 2	S 3	S 4	Top Switch on Cowl Panel
Top storage box lid unlocked	opened (no continuity)	opened (no continuity)	closed (continuity)	closed (continuity)	closed (continuity)
Top storage box lid open	opened (no continuity)	opened (no continuity)	opened (no continuity)	closed (continuity)	closed (continuity)
Running out top	opened (no continuity)	closed (continuity)	opened (no continuity)	closed (continuity)	closed (continuity)
Top tensioning bow up	closed (continuity)	closed (continuity)	opened (no continuity)	closed (continuity)	closed (continuity)
Closing top storage box lid	closed (continuity)	closed (continuity)	closed (continuity)	closed (continuity)	closed (continuity)
Locking top storage box lid	closed (continuity)	closed (continuity)	closed (continuity)	opened (no continuity)	closed (continuity)
Lowering top tensioning bow	opened (no continuity)	closed (continuity)	closed (continuity)	opened (no continuity)	closed (continuity)
Top tensioning bow down	opened (no continuity)	opened (no continuity)	closed (continuity)	opened (no continuity)	closed (continuity)
Pulling top above dead center and locking	opened (no continuity)	opened (no continuity)	closed (continuity)	opened (no continuity)	opened (no continuity)

TROUBLESHOOTING EM TOP

Condition	Cause	Correction
Top does not open or close	a) Battery voltage < 10.5 V	a) Charge battery, let engine run
	b) Terminal R not switched on	b) Switch on terminal R, check terminal R fuse
	c) Top not unlocked and lifted above dead center	c) Open top as specified
	d) Vehicle rolling	d) Stop vehicle
	e) Microswitch in cowl panel faulty	e) Refer to page 54-61
	f) Microswitch maladjusted	f) Refer to page 54-61
	g) Fuses faulty	g) Refer to fuse connection plan
	h) Breaks in electric wires	h) Refer to page 54-64
	i) Breaks in plug connections	i) Repair plug connections
	k) Control unit faulty	k) Refer to page 54-64

61 90 ... TROUBLESHOOTING CONTROL UNIT FOR ELECTRIC CONVERTIBLE TOP

Test Requirements:
Wiring diagram – refer to General Car Electrical System for 3 Series E 30.
Adapter 61 4 450 connected on 26-pin test box.
Microswitch test box 61 4 440.
Multimeter.
Battery charged (control switches off drives when battery voltage drops below 10.5 V).
Fuses OK.
Terminal R switched on continuously.
Microswitches of drives adjusted as specified.

Testing:
Front trunk trim panel removed.
Terminal R switched on continuously.
Adapter 61 4 450 connected on 26-pin test box 61 1 459.
Control unit plug disconnected.
26-pin test box connected on wire harness.
Control unit remains disconnected.
Multimeter used.

Test Step 1:

Terminal R Signal Test

Measure voltage on test box betw. pin 19 and vehicle ground.
Specification: approx. battery voltage.

no → Repair electric wire from ignition lock to control unit.

yes ↓

Continue with Test Step 2.

Test Step 2:

Electronic Power Supply Test

Measure voltage between pin 11 and vehicle ground.
Specification:
approx. battery voltage.

no → Repair positive electric wire to control unit.

yes ↓

Measure voltage between pin 11 and pin 12.
Specification:
approx. battery voltage.

no → Repair negative electric wire of control unit.

yes ↓

Continue with Test Step 3.

Test Step 3:

Load Circuit Power Supply Test

Measure voltage between pin 20 and vehicle ground.
Specification:
approx. battery voltage.

no → Repair positive electric wire to control unit.

yes ↓

Measure voltage between pin 20 and pin 3.
Specification:
approx. battery voltage.

no → Repair negative electric wire of control unit.

yes ↓

Continue with Test Step 4.

Test Step 4:

Test of Switch Signals on Wire Harness End to Control Unit.

Unlock and lift top above dead center.
Connect microswitch test box 61 4 440 on 26-pin test box 61 1 459.
Black terminal on vehicle ground.
Red terminal on test box pin 19.
Blue plug on test box pin 20.
Yellow plug on test box pin 7 (open signal from switch).
Green plug on test box pin 8 (close signal from switch).

Operate switch in dashboard in open direction.
Does green LED on test box light up?

no → Continue with Test Step 5.

yes ↓

Operate switch in dashboard in close direction.
Does yellow LED on test box light up?

no → Continue with Test Step 5.

yes ↓

Switch in dashboard and cowl panel switch are OK.

Test Step 5:

Cowl Panel Switch Test

Cowl panel switch interrupts ground electric lead of top switch when top is closed.
Top must be taken out of cowl panel.
Remove check control or cowl panel plate.
Disconnect plug of microswitch in cowl panel (above mirror).

Bridge plug in wire harness direction of brown/white wire and brown wire .
Operate top switch in open direction.
Does green LED light up?

no → Continue with Test Step 6.

yes ↓

Bridge plug in wire harness direction of brown/white wire and brown wire.
Operate top switch in open direction.
Does yellow LED light up?

no → Continue with Test Step 6.

yes ↓

Cowl panel switch is faulty.

Test Step 6:

Top Switch Test

Remove radio.
Remove top switch.
Disconnect plug from top switch.

Operate switch in open direction.
Measure resistance between pin 5 and pin 1.
Specification:
approx. 0.2 ... 1 ohm.

no → Top switch is faulty.

yes ↓

Operate switch in close direction.
Measure resistance between pin 5 and pin 4.
Specification:
approx. 0.2 ... 1 ohm.

no → Top switch is faulty.

yes ↓

Continue with Test Step 7.

Test Step 7

Drive Motor Test

Same testing sequence for top storage box lid motor and top motor.
Disconnect 2-pin motor plugs.
Disengage motors.

Supply approx. 12 V power on plug in direction of motor.
Does motor run?

no → Motor is faulty.

yes

Continue with Test Step 8.

Test Step 8:

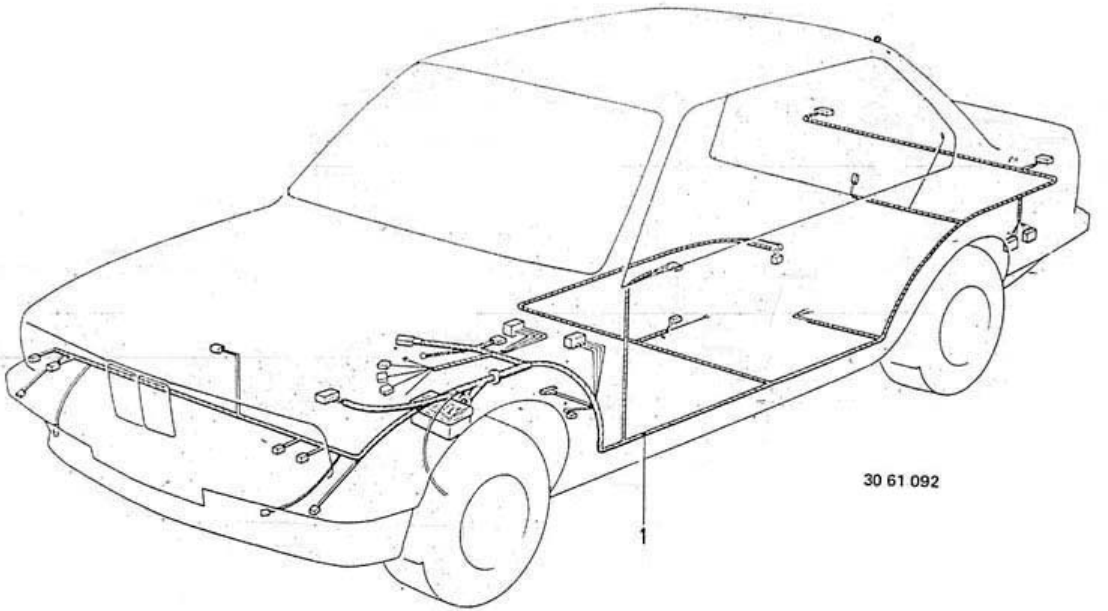
Control Unit Test

Replace control unit, if all of the above mentioned test steps have been carried out and top does not work in spite of correctly adjusted microswitches.

61 Electrical System

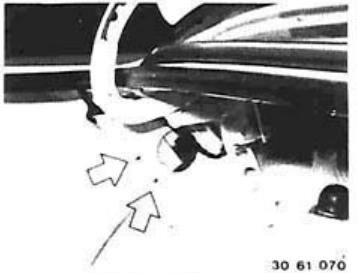
61 10 . . .	Main wire harness – layout	61- 0/1
100	Main wire harness - replace	61- 0/2
61 13 . . .	Plug connectors – remove and install	61- 0/4
. . .	12 pin plug receptacle	61- 0/4
. . .	20-pin round male plug	61- 0/5
. . .	8-pin round male plug	61- 0/5
. . .	35 and 55-pin coupling	61- 0/6
021	Fuse box for power distributor – replace	61- 1
61	Relay survey	61- 1b
61 21 010	Battery – remove and install	61- 2
015	Degassing tank – remove and install or replace	61- 2
61 31 016	Turn signal / headlight dimmer switch – replace	61- 3
018	Cruise control selector switch – replace	61- 3
020	Steering lock / ignition switch – remove and install	61- 3
028	Light switch – remove and install	61- 4
040	Windshield wiper switch – remove and install	61- 4
045	Intensive cleaning control unit – replace	61- 5
051	Heater (blower) switch – remove and install	61- 5
060	Rear window defogger switch – remove and install	61- 5
070	Front and rear fog light switch – remove and install	61- 5
080	Hazard light switch – remove and install	61- 5
085	Air conditioner switch – remove and install	61- 5
095	Door lock heating control unit – remove and install or replace	61- 6
105	Power window automatic cut-out – replace	61- 6
115	Power window switch – replace	61- 6
205	Central lock impact switch – replace	61- 6
210	Door contact switch, left or right – remove and install	61- 6
250	Trunk light contact switch – remove and install	61- 7
255	Outside power mirror switch – replace	61- 7
260	Transmission switch – replace	61- 7
265	Program switch for automatic transmission control (EH) – replace	61- 7
270	Backup light switch – replace	61- 8
280	Oil pressure switch – remove and install	61- 8
282	Engine oil level switch – replace	61- 9
310	Stop light switch – replace	61- 9
313	Brake pad wear sensor – replace	61- 10
315	Brake fluid level switch – replace	61- 10
320	Parking brake control lamp switch – replace	61- 10
330	Glove box light switch – remove and install	61- 11
360	Flasher (relay) for turn signals / hazard lights – remove and install	61- 11
370	Wipe / wash control unit – replace	61- 11
382	Coolant level switch – replace	61- 11
390	Bulb tester (tall and stop lights) for check control – replace	61- 12
475	Switchover relay for power sun roof – replace	61- 12
492	Windshield washing fluid level switch – replace	61- 12
. . .	Relays in power distributor – replace	61- 12
61 33 040	Two-tone horn, left or right – remove and install	61- 13
61 61 270	Windshield wiper console – remove and install	61- 14
61	Rear window wiper – replace (touring)	61- 15
61 71 504	Windshield spray nozzles – aim	61- 15

MAIN WIRE HARNESS LAYOUT DRAWING

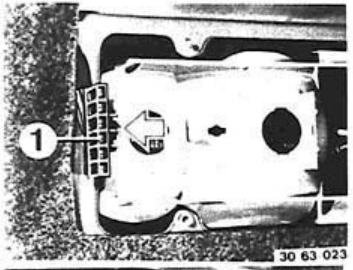


61 10 100 REPLACING MAIN WIRE HARNESS

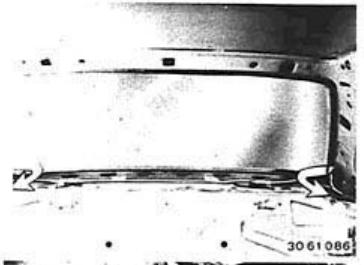
Remove windshield, front roof liner plate, center console, instrument carrier, front seats, rear seat cushion and backrest, rear side trim panels as applicable, all radiator grill sections and both entrance cover strips. Loosen and attach carpets and insulation sheets.



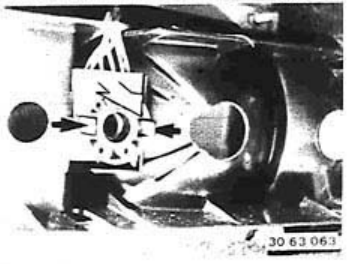
If applicable, pull off plug on bulb tester.



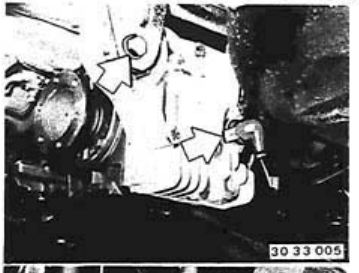
Lift off tail light covers on left and right side and pull off plugs.



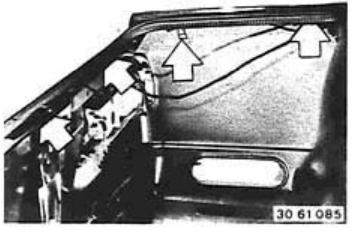
Pull off rear window defogger wires on left and right sides and lead back to the main wire harness.



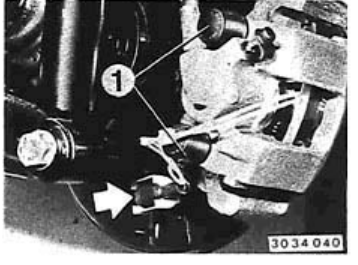
1988 Models On:
Unscrew covers on left and right sides. Compress clips and pull out plugs.



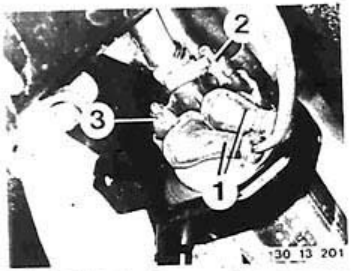
Pull off wires on pulse sender for the speedometer, loosen clips and guide wires into the passenger compartment.



Lift out plugs on license plate lights. Bend open all metal holders and pull wire harness into the passenger compartment.



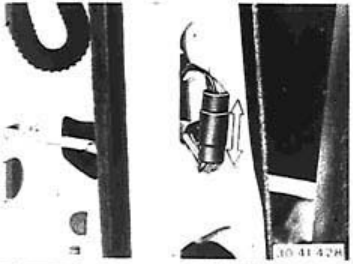
If applicable, disconnect brake pad wear indicator plug on the right-hand side and pull in wires.



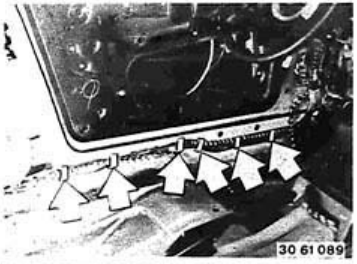
Disconnect wires on electric fuel pump and run in.

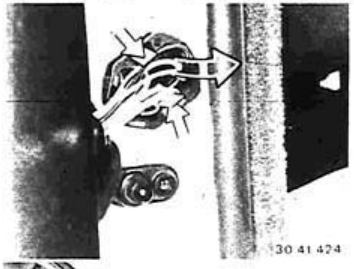


Loosen all clips and lift wire harness out of side member.

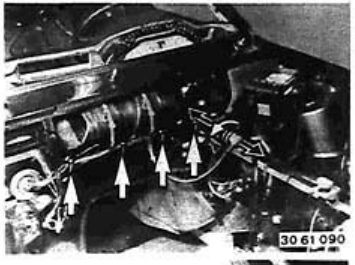


Four Door Cars:
If applicable, disconnect wires for power windows or central locks in the B pillar and lift wires out of left and right B pillars.

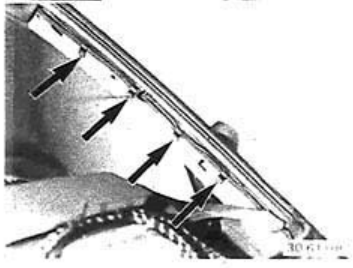




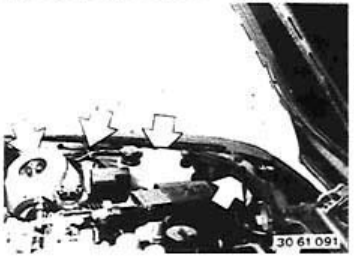
Disconnect plugs in left and right A pillars and lift wires out of A pillars.



Loosen straps.
Disconnect engine wire harness on main wire harness.
Loosen positive lead up to the power distributor.

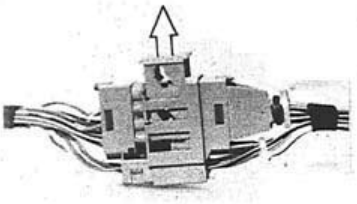


If applicable, loosen clips and run wires for check control into the left footwell.



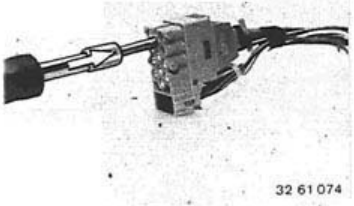
Disconnect wires on turn signals, headlights, coolant level switch and brake fluid level switch.
Loosen straps and lead wire harness to the power distributor.

61 13 . . . REMOVING AND INSTALLING PLUG CONNECTORS



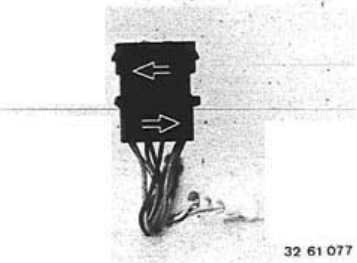
32 61 073

Pull locking lever and disconnect plug.



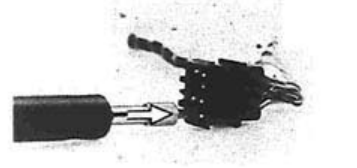
32 61 074

Push back lockpins with special tool and press out contact sleeve or pin.



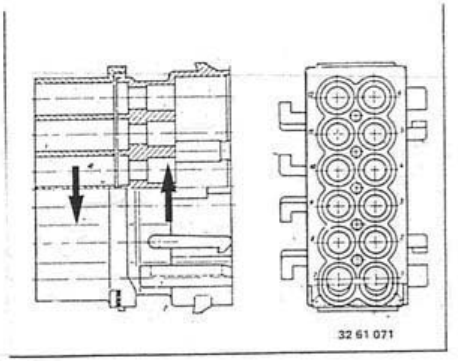
32 61 077

Push plug upper and lower sections against each other and press out contact pin or sleeve with special tool.



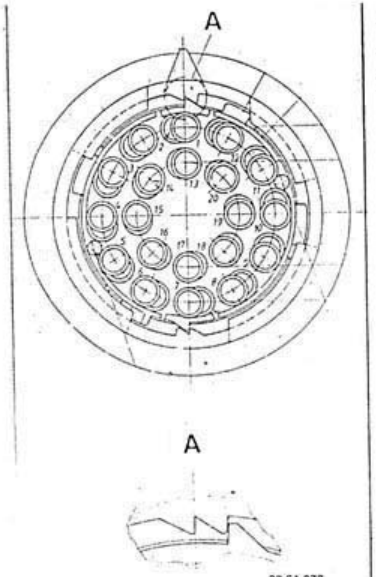
32 61 078

61 13 . . . 12 PIN PLUG RECEPTACLE



32 61 071

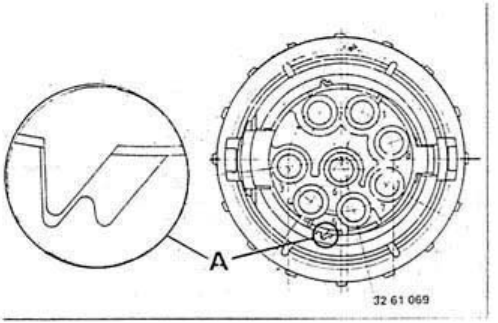
Push plug upper and lower sections against each other and press out contact pin or sleeve with special tool.



61 13 . . . 20 PIN ROUND MALE PLUG

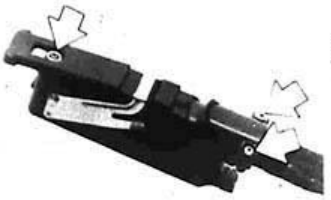
Turn plug to final catch position A and press out contact pin or sleeve with special tool.

61 13 . . . 8 PIN ROUND MALE PLUG



Turn plug to final catch position A and press out contact pin or sleeve with special tool.

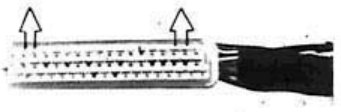
61 13 . . . 35 AND 55 PIN PLUG COUPLING



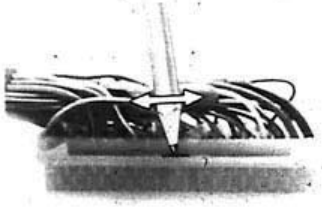
32 61 079

Unscrew screws and lift out contact carrier with seal forward.

Push locking plate to the side and unlock.

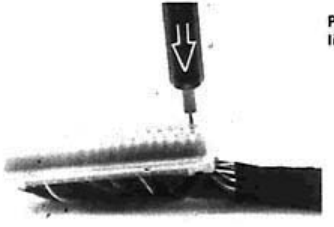


32 61 080



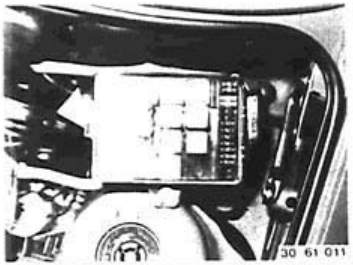
32 61 081

Connection numbers are on the edge of the contact carrier and can be made vissible by rubbing over them with a pencil.



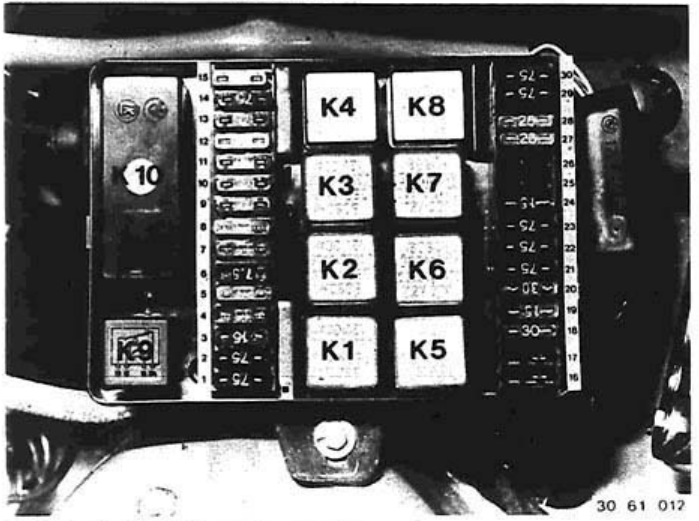
32 61 082

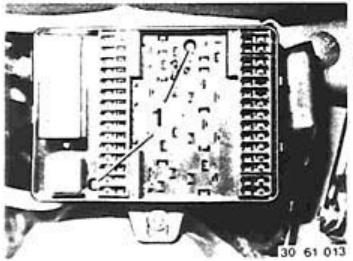
Push back contact lock with special tool and lift out wires.



61 13 021 REPLACING FUSE / RELAY PLATE

Disconnect battery ground lead.
Take off cover.
Pull out all relays and fuses.





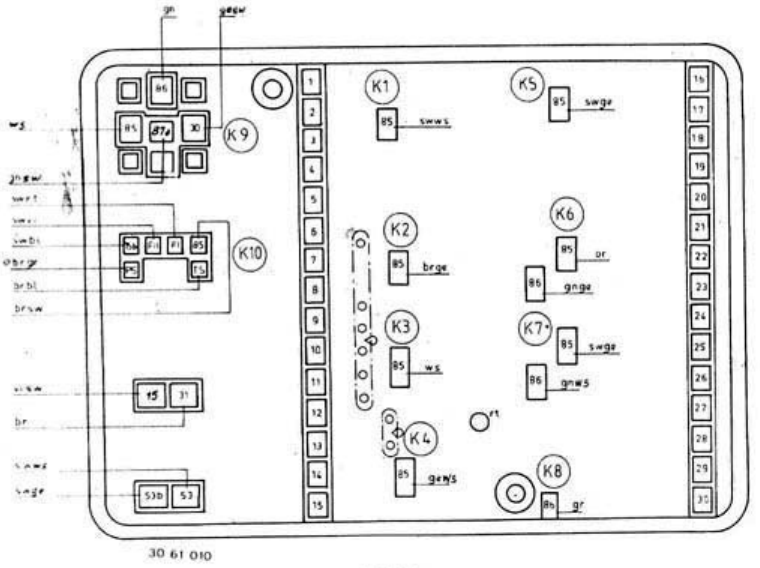
Unscrew bolts (1).
Lift fuse/relay plate.
Disconnect all wires.
Installation:
See wiring diagram for connections.

Fuse No.	Current (A)	Description
1	7.5	High beam left
2	7.5	High beam right
3	15	Extra fan 91° C (air conditioner)
4	15	Turn signal indicator
5	30	Wipe/wash, headlight cleaning and intensive cleaning systems
6	7.5	Brake lights, electronic cruise control
7	15	Two-tone horns
8	20	Rear window defogger
9	15	Engine electrics, backup lights before 9/84, range ind. for autom. transm.
10	7.5	Instruments, on-board computer, backup lights since 9/84
11	15	Fuel transfer pump
12	7.5	Radio, check control and instruments
13	7.5	Low beam left
14	7.5	Low beam right
15	7.5	Rear fog light
16	15	Seat heating
17	30	Sun roof, power windows
18	30	Extra fan 99° C (air conditioner)
19	7.5	Mirror operating and heating
20	30	Heater blower, air conditioner
21	7.5	Inside light, glove box light, trunk light, handlamp, clock, radio memory, on-board computer
22	7.5	Overnight, tail and parking lights left
23	7.5	Overnight, tail and parking lights right, license plate and instrument lights
24	15	Hazard lights
25	–	–
26	–	–
27	30	Central locks, door lock heating, burglar alarm, on-board computer horn
28	30	Cigar lighter, automatic antenna
29	7.5	Front fog lamp left
30	7.5	Front fog lamp right

Relay*	Description	Spare Fuse (In Cover):
K 1	Extra fan speed I	1 x 7.5 A
K 2	Two-tone horns	1 x 15 A
K 3	High beams	2 x 30 A
K 4	Low beams, rear fog light	
K 5	Seat heating, sun roof, power windows	
K 6	Extra fan speed II	
K 7	Heater blower, rear window defogger, power mirrors	
K 8	Front fog lamps	
K 9	Rear fog light (F, CH)	
K 10	Intensive cleaning control unit	

* Stamped in cover

FUSE / RELAY CONNECTIONS



30 61 010

Relays:

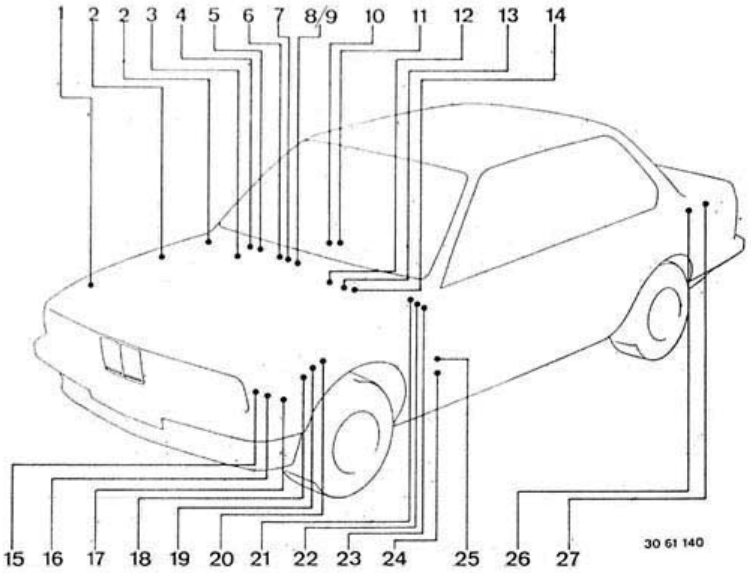
K 1	Extra fan speed I
K 2	Two-tone horns
K 3	High beams
K 4	Low beams, rear fog light
K 5	Seat heating, sun roof, power windows
K 6	Extra fan speed II
K 7	Heater blower, rear window defogger, power mirrors
K 8	Front fog lamps
K 9	Rear fog light (F, CH)
K 10	Intensive cleaning control unit

Fuse No.	Wire Colors
1	wsvi
2	wsbl
3	swgn
4	vigr
5	visw
6	vign
7	vige
8	gnbl
9	gnge
10	gnws
11	gnvi
12	viws
13	gews
14	gebl
15	gesw
16	wsbr
17	wssw
18	swbl
19	gnsw
20	gnbr
21	rtgn
22	grsw
23	grgn
24	rtws
25	—
26	—
27	rtsw
28	rtge
29	gebr
30	gevi

Color Codes:

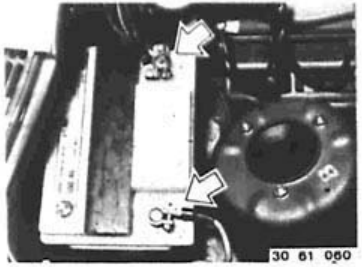
bl	blue
br	brown
ge	yellow
gn	green
gr	gray
rt	red
sw	black
vi	violet
ws	white
tr	transparent

SURVEY OF RELAYS AND CONTROL UNITS OUTSIDE OF POWER DISTRIBUTOR



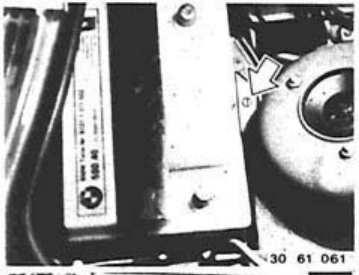
1 Relay for headlight cleaners (in engine compartment right)
2 Relay for intensive cleaning (on washing fluid tank or depending on version)
3 Control unit DME/LE-Jetronic (in glove box top)
4 Control unit for cruise control (above glove box)
5 Control unit for idle speed control (in glove box top)
6 Solenoid for ignition advance control (on firewall)
7 Ignition control unit (on firewall)
8 Electric fuel pump relay (on firewall) for M 40
9 Oxygen sensor heating relay (on firewall) since 1988 models
10 AC relay for blower (behind center console)
11 AC relay (behind center console)
12 Flashing relay (above steering column left)
13 ABS overvoltage relay (underneath instrument carrier)
14 ABS control unit (underneath instrument carrier)
15 Hydraulic control unit (in engine compartment left)
16 Valve relay (in engine compartment left)
17 Motor relay (in engine compartment left)
18 Ignition advance control relay for 318 i Cat. (on inside of left wheel house) omitted since 1988 models
19 Idle stabilization or EIIP relay for DME (on inside of left wheel house) for M 10 and M 20
20 L-Jetronic master relay or 2 BE carburetor relay or oxygen sensor heating relay (on left wheel house) until 1987 models
21 DWA control unit/relay box (underneath instrument carrier left)
22 Power window relay (underneath instrument carrier left)
23 Starter interlocking relay (underneath instrument carrier left)
24 ZV control unit (A pillar behind radio speaker left)
25 Inside light delayer (A pillar behind radio speaker left)
26 Bulb tester for check control (in trunk top left)
27 AEGS control unit (in trunk top left)

ABS	Antiblock system
AC	Air conditioner (automatic climate)
AEGS	Independent electronic transmission control
BC	On-board computer
DME	Digital motor electronics
DWA	Burglar alarm system
SA	Special equipment
Stgt	Control unit
ZV	Central locks

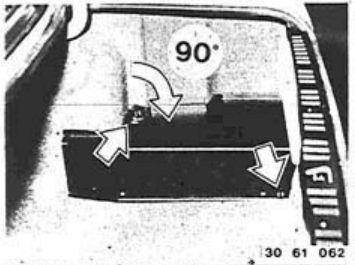


61 21 010 REMOVING AND INSTALLING BATTERY

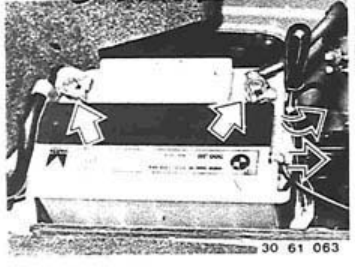
a) Located in Engine Compartment:
Disconnect ground lead.
Remove cap on positive pole.
Disconnect positive lead.



Unscrew bolt.
Remove holder and lift out battery.



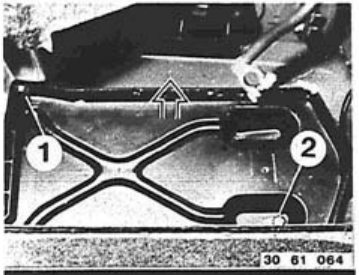
b) Located in Trunk:
Turn fasteners 90° and lift out trim panel.



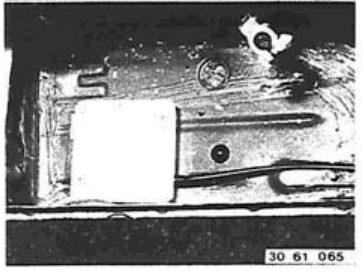
Disconnect negative and positive leads.
Unscrew holder.
Pull off vent hose.
Lift out battery.

61 21 015 REMOVING AND INSTALLING OR REPLACING DEGASING TANK

Remove battery – see b) in 61 21 010.



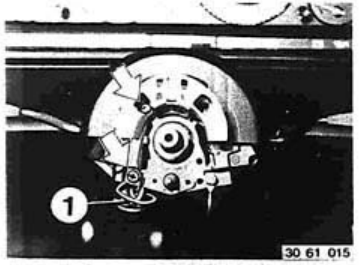
Unscrew bolt (1) and remove with nut and washer.
Unscrew nut (2) and remove with washer.
Lift out connecting plate.



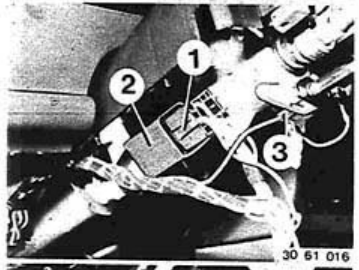
Lift out degasing tank.
Caution!
Degasing tank contains battery acid.

61 31 016 REPLACING TURN SIGNAL/ HEADLIGHT DIMMER SWITCH

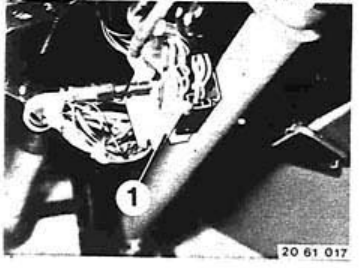
Disconnect battery ground lead.
Remove steering wheel 32 33 000.
Remove instrument panel trim at bottom left 51 45 180.
Remove steering column casing lower section 32 31 020.



Unscrew screws.
Remove turn signal/headlight dimmer switch.
Note:
Check ground wire (1).



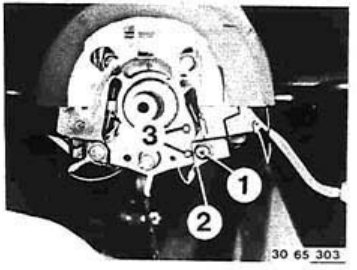
Lift out plug (1) with flasher relay (2).
Pull relay off of plug.
Pull off plug on wire (3) for two-tone horns.



Disconnect wire straps.
Disconnect plug (1).

61 31 018 REPLACING CRUISE CONTROL SELECTOR SWITCH

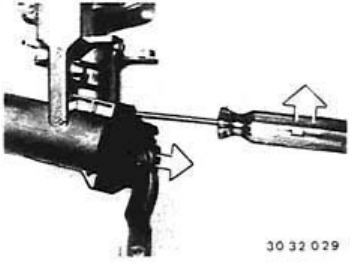
Disconnect battery ground lead.
Remove steering wheel 32 33 000.
Remove instrument panel trim at bottom left 51 45 180.
Remove steering column casing lower section 32 31 020.



Unscrew screw (1) and lift out selector switch.
Cut open wire strap and disconnect plug.
Installation:
Also mount ground wire (2).
Both retainers must engage in bores (3).

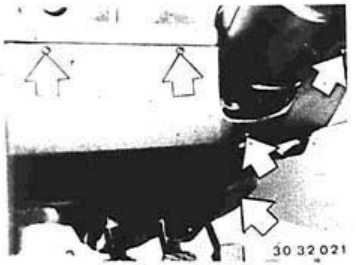
61 31 020 REMOVING AND INSTALLING STEERING LOCK / IGNITION SWITCH

Disconnect battery ground lead.
Remove steering wheel 32 33 000.
Remove instrument panel trim at bottom left 51 45 180.
Remove steering column casing lower section 32 31 020.



Press in locks on both sides toward ignition switch and pull out ignition switch.
Installation:
Check position of ignition switch – steering wheel lock!

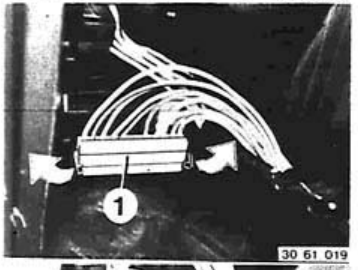
61 31 028 REMOVING AND INSTALLING LIGHT SWITCH



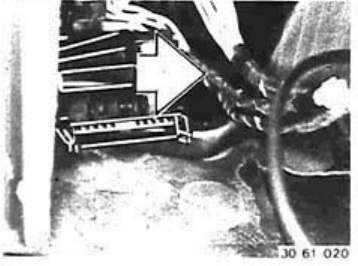
Disconnect battery ground lead.
Remove trim panel.



Unscrew control knob

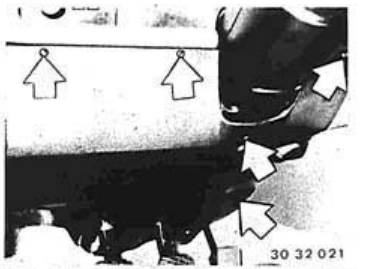


Pull off plug (1).

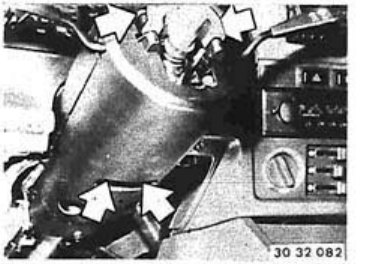


Pull out light switch.

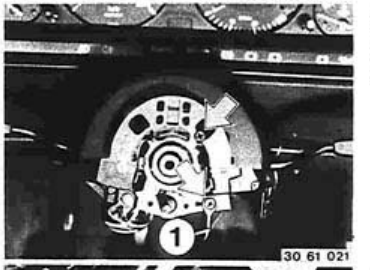
61 31 040 REMOVING AND INSTALLING WIPER SWITCH



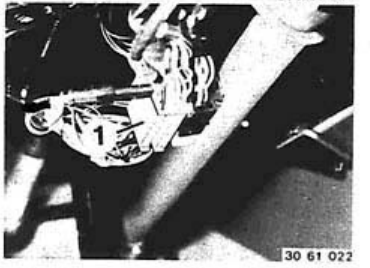
Disconnect battery ground lead.
Remove and install steering wheel 32 33 000.
Remove trim panel.



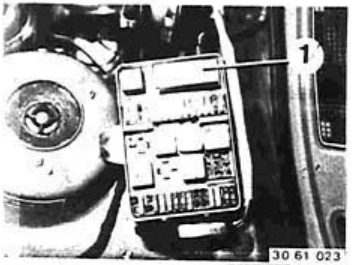
Remove trim.



Unscrew screws.
Remove wiper switch.
Installation:
Also mount ground wire (1).



Open wire straps.
Disconnect plug (1).



61 31 045 REPLACING INTENSIVE CLEANER CONTROL UNIT

Lift off cover on fuse/relay plate.
Pull out control unit (1).

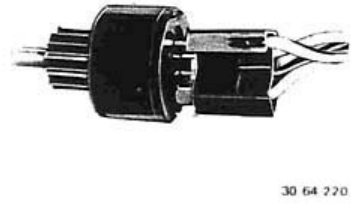


61 31 051 REMOVING AND INSTALLING HEATER (BLOWER) SWITCH

Lift off radio opening mask or remove radio.
Pull off control knob.



Unscrew nut.



Remove transmission switch.
Pull off plug.



61 31 060 REMOVING AND INSTALLING REAR WINDOW DEFOGGER SWITCH

Lift out switch with a small screwdriver.
Pull off plug.



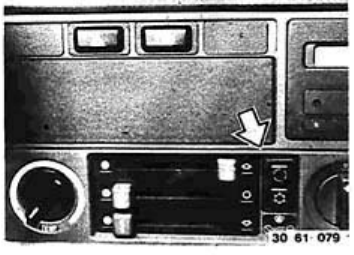
61 31 070 REMOVING AND INSTALLING FRONT AND REAR FOG LIGHT SWITCH

Lift out switch with a small screwdriver.
Pull off plug.



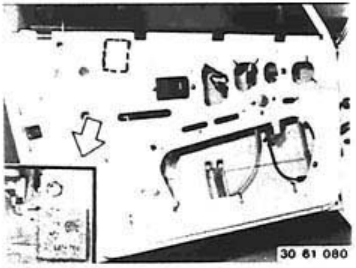
61 31 080 REMOVING AND INSTALLING HAZARD LIGHT SWITCH

Lift out switch with a small screwdriver.
Pull off plug.



61 31 085 REPLACING AIR CONDITIONER SWITCH

Lift out switch with a small screwdriver.
Pull off plug.



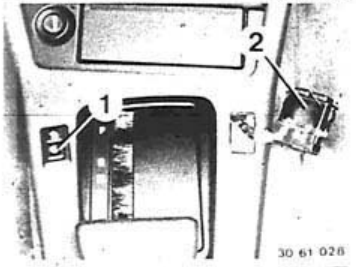
61 31 095 REMOVING AND INSTALLING OR REPLACING CONTROL UNIT FOR DOOR LOCK HEATING

Remove left front door trim panel 51 41 001.
Control unit is located in door at height of door handle.
Unscrew nut.
Disconnect plug.



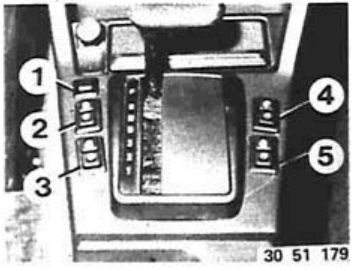
61 31 105 REPLACING ELECTRIC WINDOW AUTOMATIC CUTOUT

Lift switch with a small screwdriver.
Pull off plug.

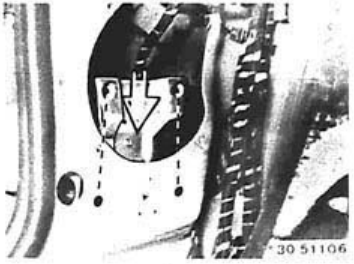


61 31 115 REPLACING ELECTRIC WINDOW SWITCH

Lift out switch with a small screwdriver.
Pull off plugs.
Two Door:
1 = Driver's door
2 = Passenger's door

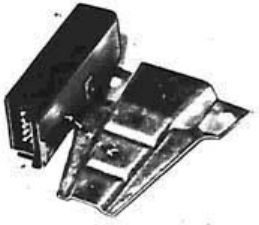


Four Door:
1 = Child safety lock
2 = Driver's door
3 = Rear door left
4 = Passenger's door
5 = Rear door right

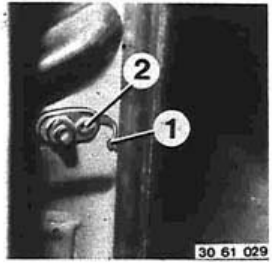


61 31 205 REPLACING IMPACT SWITCH FOR CENTRAL LOCKS

Testing procedures – see Group 51.
Take radio speaker out of left A pillar.
Pull off carpet.
Unscrew screws and remove impact switch with holder from radio speaker installation location.
Disconnect plug.

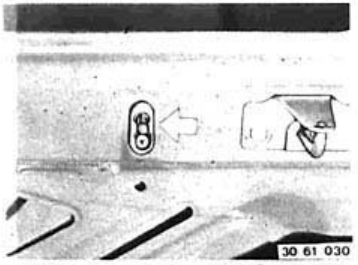


Unscrew screws.
Take impact switch off of holder.
Installation:
Retainer must protrude into bore of holder.



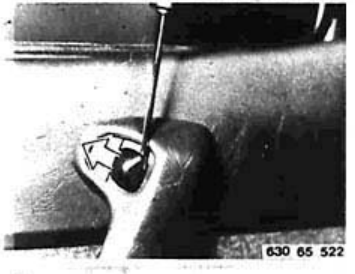
61 31 210 REMOVING AND INSTALLING LEFT OR RIGHT DOOR CONTACT SWITCH

Lift out cover (1).
Unscrew bolt (2).
Remove switch.
Pull off plug.



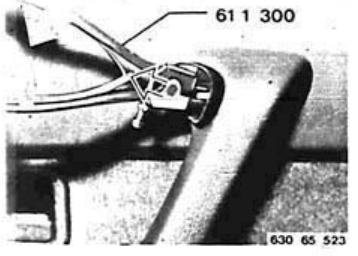
61 31 250 REMOVING AND INSTALLING TRUNK LIGHT CONTACT SWITCH

Unscrew screw.
Remove switch.
Pull off plug.



61 31 255 REPLACING OUTSIDE POWER MIRROR SWITCH

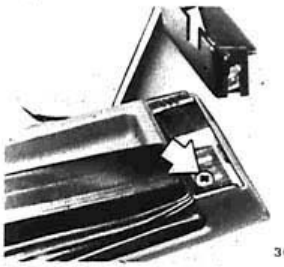
Pull off mirror adjusting button.



Lift out mirror switch with Special Tool 61 1 300.
Pull off plug.

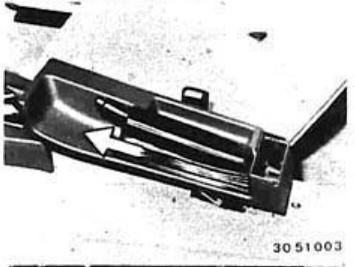
61 31 260 REPLACING TRANSMISSION SWITCH

See "Removing and Installing Selector Lever" – 25 16 080.

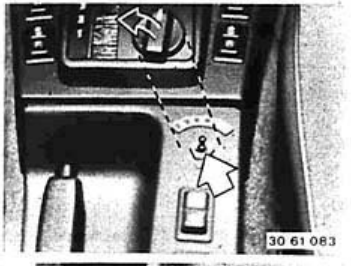


61 31 265 REPLACING PROGRAM SWITCH FOR AUTOMATIC TRANSMISSION CONTROL (EH)

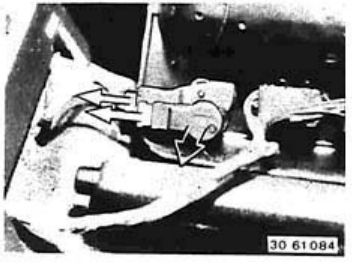
Pull out ashtray for rear seats.
Unscrew nut.



Lift off cover forward.
Pull off plug on program switch.
Pull out ashtray light.

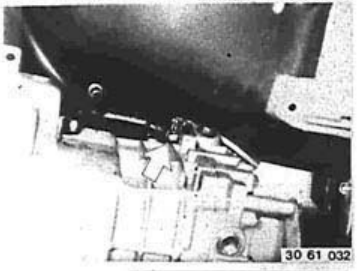


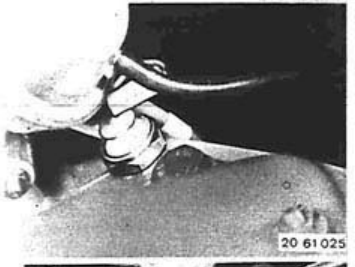
Pull off program switch knob from above.
Unscrew nut.

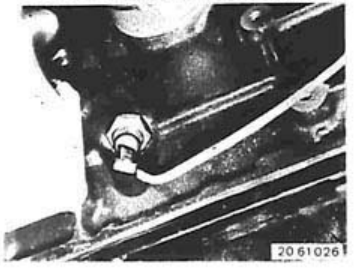


Pull off plug and lift out switch downward.









61 31 270 REPLACING BACKUP LIGHT SWITCH

Four Speed Manual Transmission:

Pull off plug.
Unscrew switch.

Five Speed Manual Transmission:

Pull off plug.
Unscrew switch.

Automatic Transmission:

Backup light switch is integrated in transmission switch.

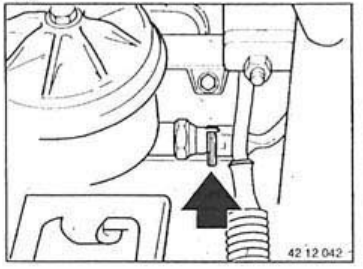
61 31 280 REMOVING AND INSTALLING OIL PRESSURE SWITCH

M 10 Engine:

Pull off plug.
Unscrew switch.

M 20 Engine:

Pull off plug.
Unscrew switch.

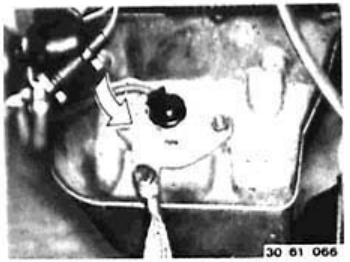


M 40 / M 42 Engine:

Oil pressure switch is located on base of oil filter.
Loosen oil filter cover to have oil in oil filter run back into oil pan.
Pull off plug.

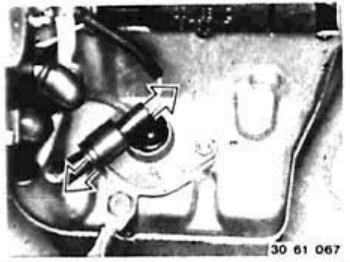
Unscrew switch.

Installation:
Tighten oil filter cover.
Install switch.
Add engine oil if necessary.

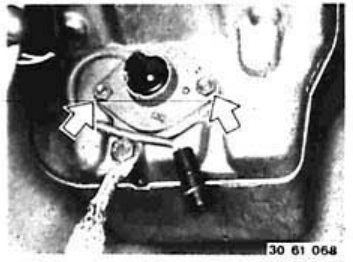


61 31 282 REPLACING ENGINE OIL LEVEL SWITCH

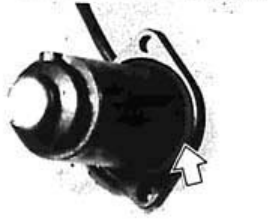
Air cleaner was removed for better presentation.
Pull plug out of holder.



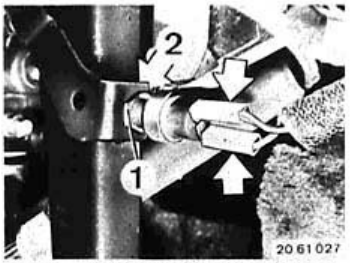
Disconnect plug.



Unscrew nuts.
Lift level switch and let oil flow out of switch back into the oil pan.

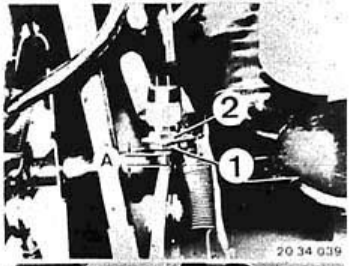


Check seal, replacing if necessary.

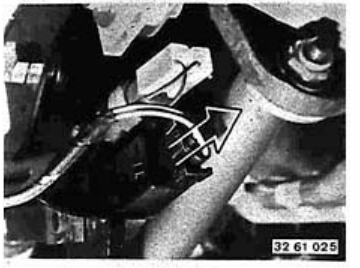


61 31 310 REPLACING STOP LIGHT SWITCH

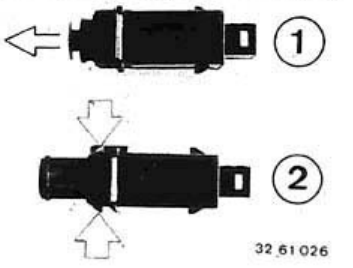
a)
Pull off plug.
Loosen lock nut (1).
Unscrew nut (2).



Adjusting:
Adjust stop light switch with nut (1) and lock nut (2) that distance A = 5 to 6 mm (0.197 to 0.236") of the contact button is visible when the brake pedal is released.



b)
Remove dashboard trim panel at left bottom – see 51 45 180.
Pull off electric lead plug.



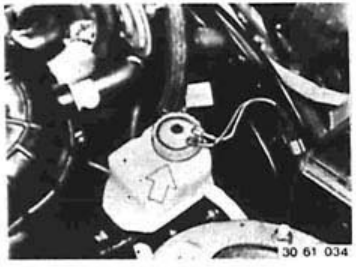
Floor the brake pedal.
1 =Pull plunger and sleeve forward the complete distance.
2 =Squeeze the retainers and pull switch back.

Installation:
Insert switch as shown in (2).
Adjustment is automatic.
Release pedal to neutral position slowly.

Important!
Adjustment of the switch could be changed when the brake pedal bounces back. Check function.

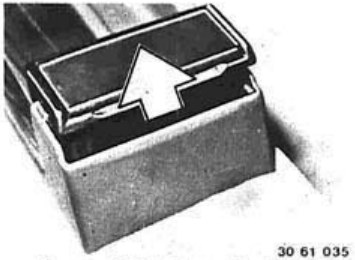
61 31 313 REPLACING ONE BRAKE PAD WEAR SENSOR

Refer to "Replacing Brake Pads" in 34 11 000.


30 61 034

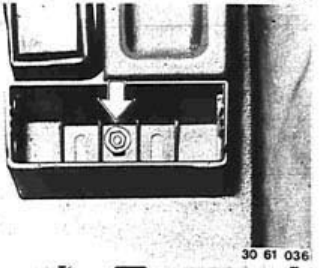
61 31 315 REPLACING BRAKE FLUID LEVEL SWITCH

Pull off plug.
Unscrew cap with integrated switch.

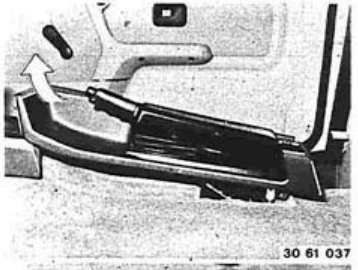

30 61 035

61 31 320 REPLACING PARKING BRAKE CONTROL LAMP SWITCH

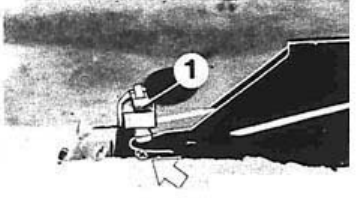
Lift out ashtray.


30 61 036

Unscrew nut.
Disconnect plug on ashtray light.

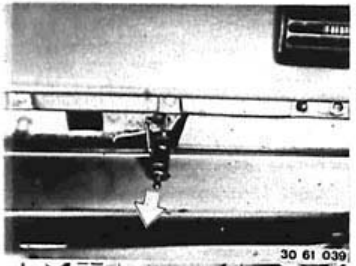

30 61 037

Pull up parking brake lever.
Lift console and push forward.



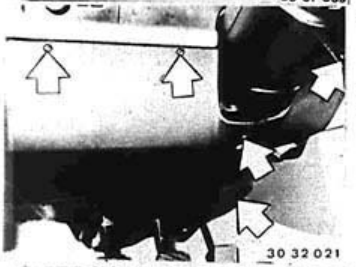
30 61 038

Push down spring (1) and pull out lead.
Unscrew screw.
Remove switch.



61 31 330 REMOVING AND INSTALLING GLOVE BOX LIGHT SWITCH

Open glove box.
Pull out switch.
Pull off plug.

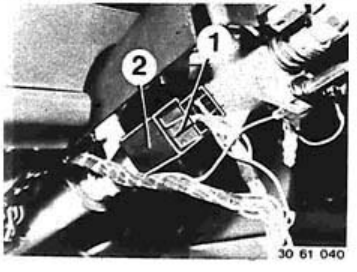


61 31 360 REMOVING AND INSTALLING TURN SIGNAL/HAZARD LIGHT FLASHER (RELAY)

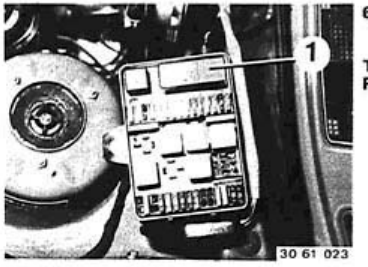
Remove and install steering wheel 32 33 000.
Remove trim panel.



Remove trim

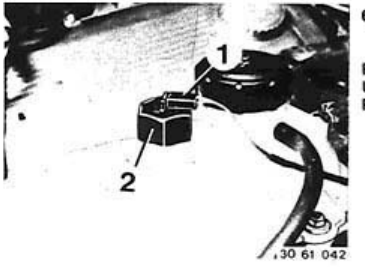


Pull off plug (1) with relay (2) on steering column.
Pull off relay on plug.



61 31 370 REPLACING WIPE/WASH ACTION RELAY

Take cover off of fuse/relay plate.
Pull out wipe/wash relay (1).

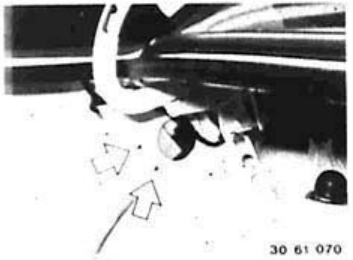


61 31 382 REPLACING COOLANT FLUID LEVEL SWITCH

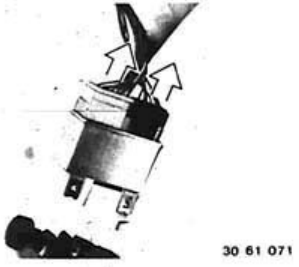
Pull off plug (1).
Unscrew coupling nut (2).
Pull out switch.

61 31 390 REPLACING TAIL AND BRAKE LIGHT BULB TESTER FOR CHECK CONTROL

Remove trunk trim panel on left side wall 51 47 210.

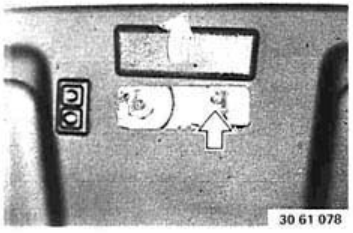


Unscrew screws.

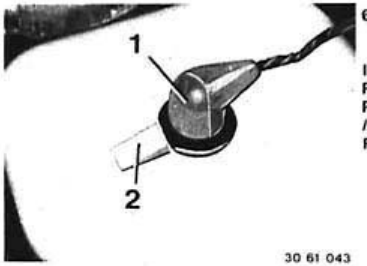


Pull off plugs on bulb tester and remove bulb tester.

61 31 475 REPLACING SUN ROOF RELAY

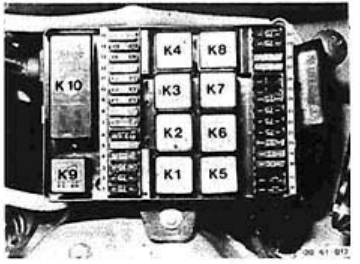


Lift off cover.
Unscrew screw and pull out relay.
Installation:
Connect wires that colors match.



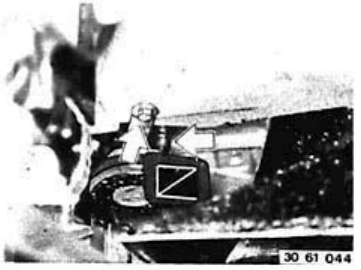
61 31 492 REPLACING WASHING FLUID LEVEL SWITCH

If full, remove washing fluid tank.
Pull off plug with protective cap (1).
Pull out level switch.
Installation:
Flat side faces tab (2).



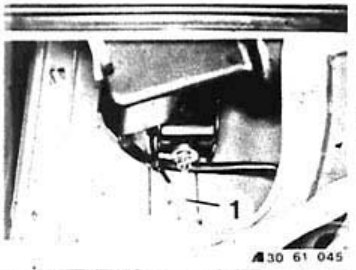
61 31 ... REPLACING RELAYS IN POWER DISTRIBUTOR

Relay As Stamped in Cover	Description
K 1	Extra fan speed I
K 2	Two-tone horns
K 3	High beams
K 4	Low beams, rear fog light
K 5	Seat heating, sun roof, power windows
K 6	Extra fan speed II
K 7	Heater blower, rear window defogger, power mirrors
K 8	Front fog lamps
K 9	Rear fog light (F, CH)
K 10	Intensive cleaning control unit



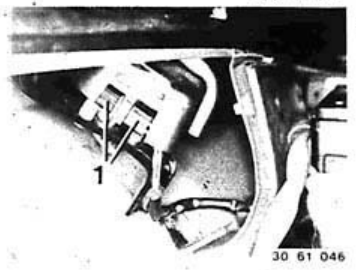
61 33 040 REMOVING AND INSTALLING LEFT AND RIGHT TWO-TONE HORNS

Remove front splash guard – see 51 47 490.
Pull off plug with protective cap.
Unscrew bolt.

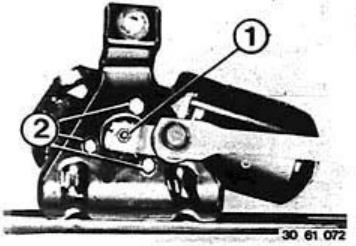


61 61 270 REMOVING AND INSTALLING CONSOLE FOR WINDSHIELD WIPERS COMPLETE WITH WIPER MOTOR

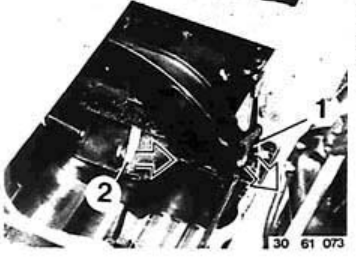
Remove heater motor 64 11 210.
Remove bracket (1).



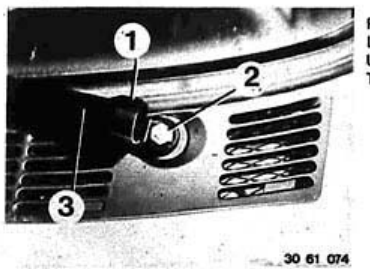
Disconnect plug (1).



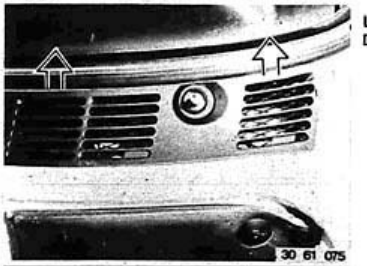
Installed in Car:
Unscrew nut (1) and pull off linkage.
Unscrew bolts (2) and lift out motor.



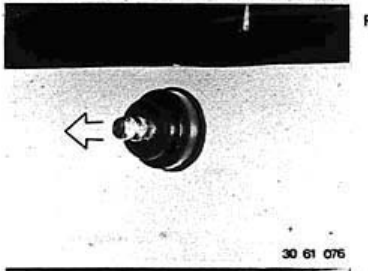
Open clamps (1) on front and rear, left and right sides of blower plate.
Disengage left and right air circulating flaps (2).
Lift out blower plate.



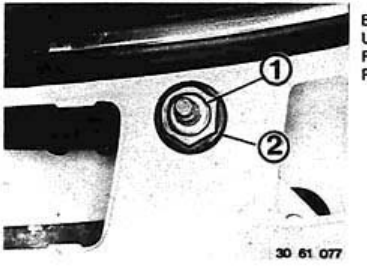
Removing Both Wiper Arms:
Lift off cover (1).
Unscrew nut (2).
Take off wiper arm (3).



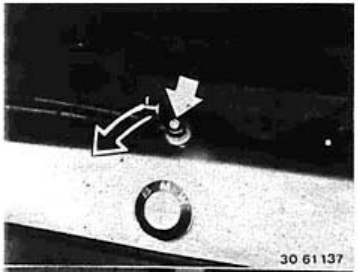
Lift out grill.
Disengage both links on left pivot mount.



Remove cover (1).



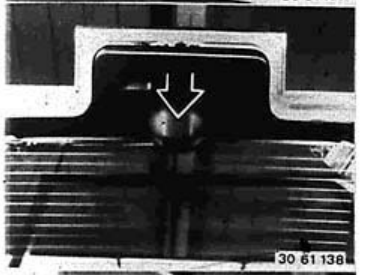
Both Pivot Mounts:
Unscrew nut (1).
Remove washer (2).
Remove console.



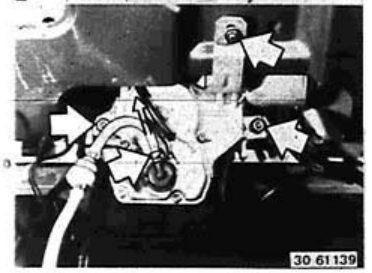
61 . . . . . REPLACING REAR WINDOW WIPER

Pull off cap on wiper arm.

Note:
Run the wiper motor into final position before mounting the wiper arm.



Pry off trunk lid trim panel.



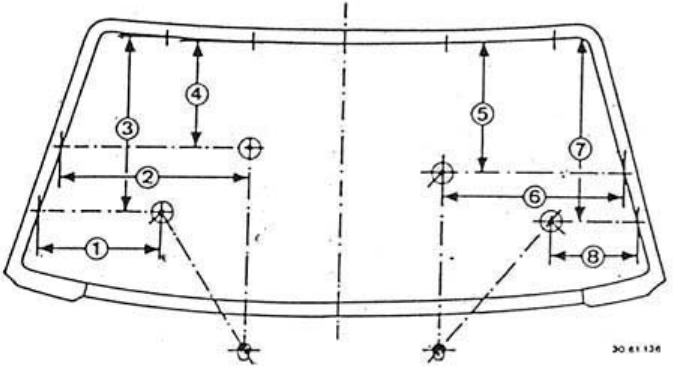
Pinch off the hose clamp.
Pull off plug.
Unscrew nuts.
Lift out wiper motor.

61 71 504 ADJUSTING WINDSHIELD WASHING SPRAY JETS

The picture below shows the pertinent spraying range of both spray jets. First transfer distances 1 ... 8 to the windshield when aiming the spray jets. Mark the spraying ranges with a 30 mm (1.181") dia. dot and aim the sprayed water to the pertinent dot with a needle inserted in the spray jet.

Distance:

1 = 258 mm (10.157")
2 = 460 mm (18.110")
3 = 405 mm (15.945")
4 = 265 mm (10.433")
5 = 310 mm (12.205")
6 = 473 mm (18.622")
7 = 490 mm (19.291")
8 = 285 mm (11.220")

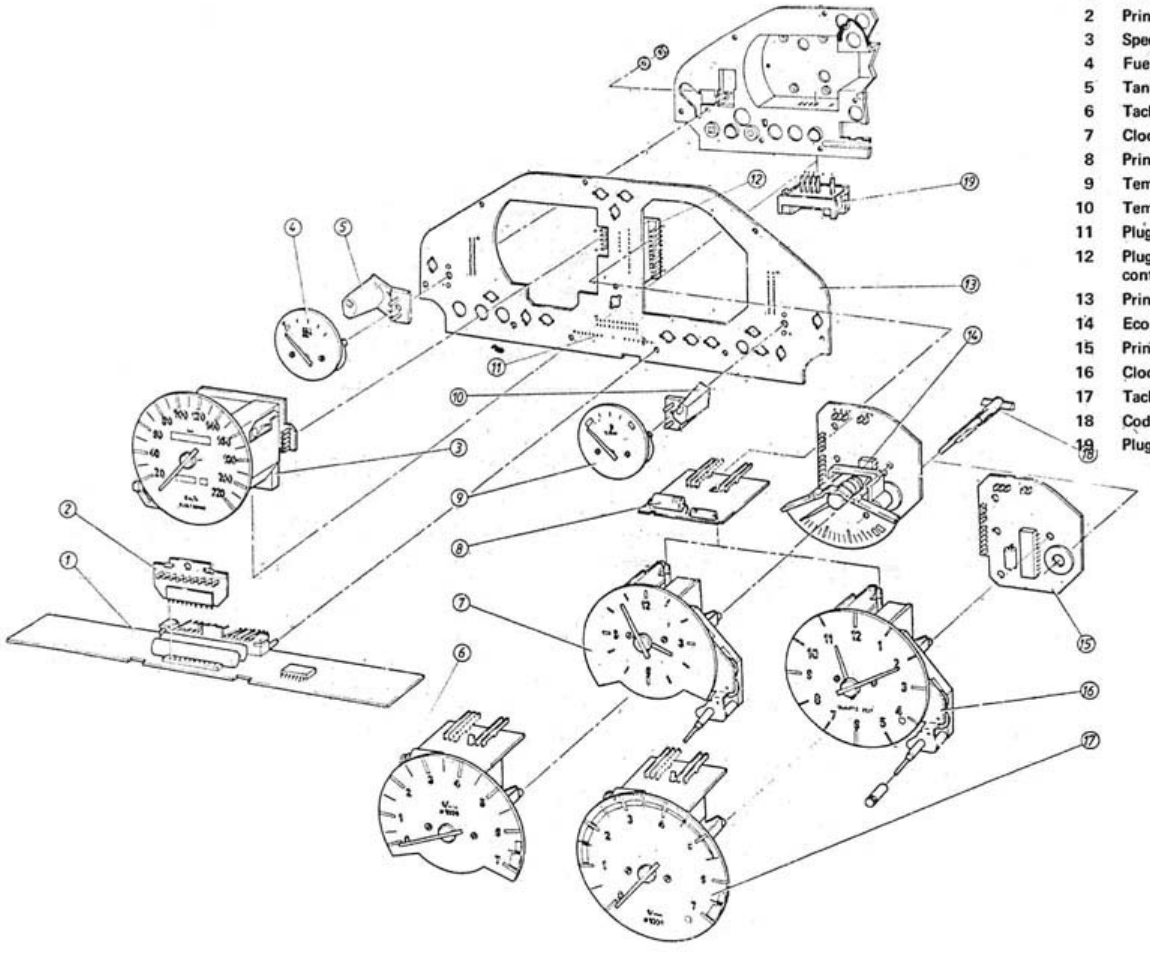


62 Instruments

	Instrument cluster survey	62- 1a
	Instrument cluster plug connections	62- 1b
62 11 030	Printed circuit board for service interval indicator – replace	62- 1c
090	Temperature gauge – remove and install or replace	62- 2
130	Fuel gauge – remove and install or replace	62- 3
62 12 000	Speedometer – remove and install	62- 4
62 13 000	Tachometer – remove and install	62- 5
050	Clock – remove and install	62- 6
62 14 070	Check control – remove and install or replace	62- 7
62 16 071	Speed sender for speedometer display – replace	62- 7
62 21 000	Instrument carrier assembly – remove and install	62- 8
62 99 . . .	Light bulbs in instrument carrier – replace	62- 8
	Service interval indicator – troubleshoot	62- 51
	Economy control – troubleshoot	62- 61
	Check control – troubleshoot	62- 71

62-1a

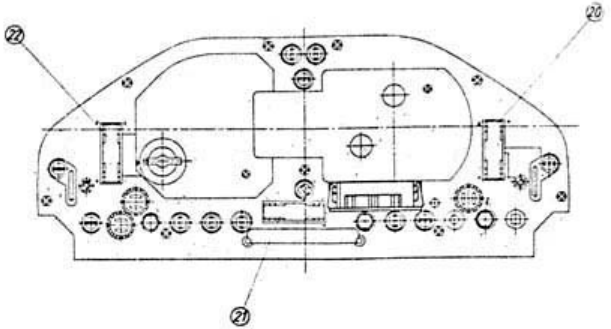
NSTRUMENT CLUSTER – E 30



Pos.	Description
1	Printed circuit board for service indicator
2	Printed circuit board for SI diodes
3	Speedometer
4	Fuel gauge
5	Tank gauge light port
6	Tachometer
7	Clock
8	Printed circuit board for speed signals
9	Temperature gauge
10	Temperature gauge light port
11	Plug plate V (SI connection)
12	Plug plate IV (conn. tachometer, economy control, clock, speedometer)
13	Printed circuit board for instr. cluster
14	Economy control
15	Printed circ. for clock, tach. with SI
16	Clock without EC
17	Tachometer without EC
18	Coding plug
19	Plug receptacle

PLUG CONNECTIONS ON INSTRUMENT CLUSTER – E 30

Pos.	Description
20	Pin board white (II)
21	Pin board yellow (III)
22	Pin board blue (I)



Pin Board Blue (I)

Plug No.	Description	Signal	Outlet	Inlet
1	Term. 50	+12V		x
2	Term. 30	+12V		x
3	Term. 61	+12V	–	–
4	Centr. warning lamp	(frequency)		x
5	Free		–	–
6	Term. 15	+12V	–	–
7	Term. 1	+12V		x
8	Free		–	–
9	Free		–	–
10	Term. 15	+12V	–	–
11	Term. 11 (injec. line)	+12V (freq.)	–	x
12	Term. 56a (high beam)	+12V	–	x
13	Turn signals right	+12V	–	x
14	Term. 15 (charge contr.)	+12V	–	x
15	Free		–	–
16	Term. 61 (charge contr.)	+12V	–	x
17	Brakes	ground	–	x
18	Oil pressure	ground	–	x
19	Term. 15	+12V	–	–
20	Term. 31	ground	–	x
21	Brake pads	ground	–	x
22	SI reset (diagn. socket)	+ 5 V	–	x
23	Term. 15	12V	–	x
24	Free		–	–
25	Temp. warning lamp	ground	–	–
26	Temp. transm.	R(Ω)	–	x

Pin Board White (II)

Plug No.	Description	Signal	Outlet	Inlet
1	Parking brake	ground	–	x
2	Free		–	–
3	Term. 31	ground	–	–
4	Fuel level transm.	R(Ω)=3 72(Ω)	–	x
5	Tank warning lamp	R(Ω)=	–	x
6	Term. 15	+12V	–	x
7	Turn signals left	+12V	–	x
8	Term. 31	ground	–	–
9	Free		–	–
10	Free		–	–
11	Free		–	–
12	Term. 31b	(frequency)	–	x
13	Term. R	+12V	–	x
14	Rear fog light	+12V	–	x
15	Free		–	–
16	Term. 31	ground	–	x
17	Free		–	–
18	Free		–	–
19	Free		–	–
20	Free		–	–
21	Term. 31	ground	–	–
22	Front fog lamps	+12V	–	x
23	Term. 58 k	+12V	–	x
24	Term. 31 g	regulated	–	x
25	5 V outlet	5 V	x	–
26	Brake pads	ground	–	x

Pin Board Yellow (III)

Plug No.	Description	Signal	Outlet	Inlet
1	Term. 31	ground	x	–
2	Term. 15	+12V	x	–
3	Free		–	–
4	Tank warning lamp	R(Ω)=	x	–
5	Fuel level transm.	R(Ω)=3 72( )	x	–
6	Parking brake	ground	–	–
7	Term. 58 f	+12V	x	–
8	Term. 31 g	regulated	x	–
9	Term. 50	+12V	x	–
10	Term. 30	+12V	x	–
11	Term. 1	+12V	x	–
12	Free		–	–
13	R	+12V	x	–
14	Term. 15	+ 12V	x	–
15	Term. 15	+12V	x	–
16	Free		–	–
17	Free		–	–
18	Free		–	–
19	Parking brake	ground	–	–
20	Term. 58 k	+12V	x	–
21	Term. 31 g	regulated	x	–
22	Term. 50	+12V	x	–
23	Term. 30	+12V	x	–
24	Term. 1	+12V	x	–
25	Term. 11	+12V(freq.)	x	–
26	Analog speed. outlet	frequency	x	–

Pin Board (IV) (tach./EC/clock/speed.)

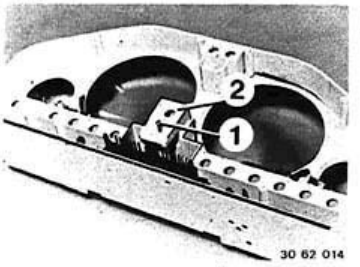
Plug No.	Description
1	Term. 15
2	Term. 11
3	Term. 31
4	Analog speed.
5	R
6	4/6 cyl.
7	Speed pulse
8	Distance pulse
9	5 V
10	Term. 30
11	Term. 1
12	Term. 61
13	Term. 31
14	Term. 31b
15	Analog speed.
16	R

Pin Board (V) Service Indicator

Plug No.	Description
1	Term. 31
2	Brake pad wear ind.
3	Temp. gauge
4	Brake pads
5	SI reset
6	Temp. transm.
7	Term. 15
8	–
9	–
10	–
11	–
12	Term. 50
13	Term. 30
14	5 V
15	Distance pulse
16	Speed pulse
17	4/6 cylinders
18	Free
19	Brake pads

62 11 030 REPLACING PRINTED CIRCUIT BOARD FOR SERVICE INDICATOR

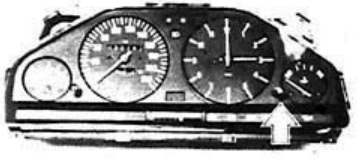
Remove instrument carrier assembly 62 21 000.

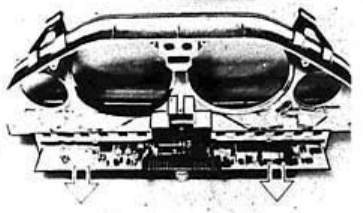


30 62 014

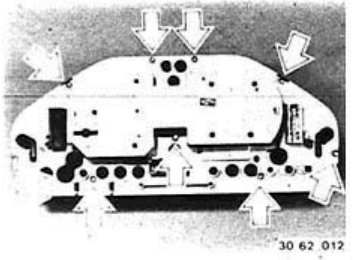
Unscrew screw (1).
Remove light duct (2).

Cars with Analog Clock:
Pull off reset button.

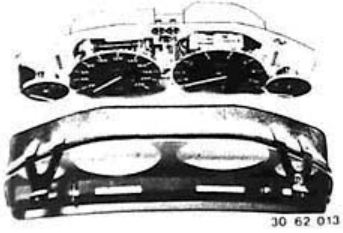

30 62 010


30 62 015

Pull printed circuit board out of housing.


30 62 012

Unscrew screws.

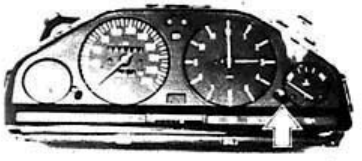

30 62 013

Take instruments and carrier plate out of housing.

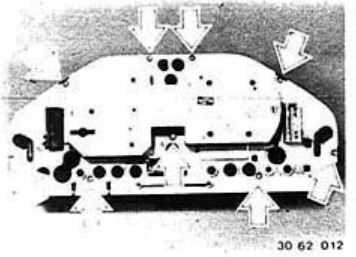
62 11 090 REMOVING AND INSTALLING/ REPLACING TEMPERATURE GAGE

Remove instrument carrier assembly – see 62 21 000.

Cars with Analog Clock:
Pull off reset button.



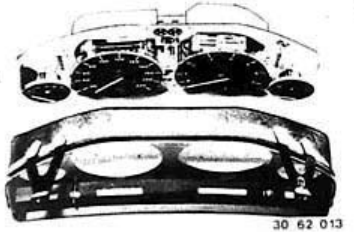
30 62 010



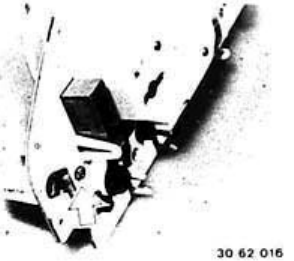
30 62 012

Unscrew screws.

Take instruments and carrier plate out of housing.



30 62 013

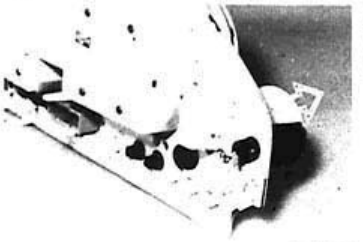


30 62 016

Unscrew nut.
Take out temperature gage.
Installation:
Insert temperature gage in lock.

62 11 130 REMOVING AND INSTALLING/ REPLACING FUEL GAGE

Remove instrument carrier assembly – see 62 21 000.



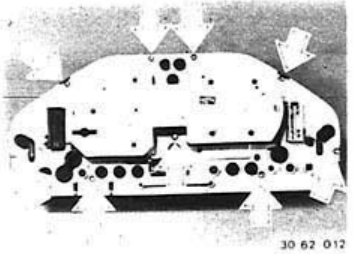
30 62 017

Unscrew nut.
Take out fuel gage.
Installation:
Insert fuel gage in lock.

Cars with Analog Clock:
Pull off reset button.



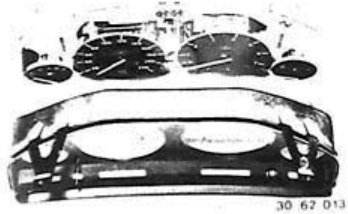
30 62 010



30 62 012

Unscrew screws.

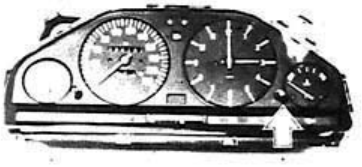
Take instruments and carrier plate out of housing.



30 62 013

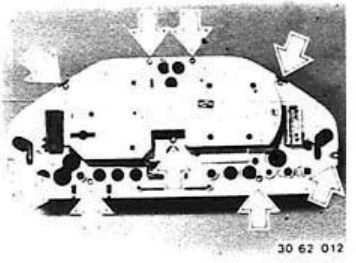
62 12 000 REMOVING AND INSTALLING SPEEDOMETER

Remove instrument carrier assembly – see 62 21 000.



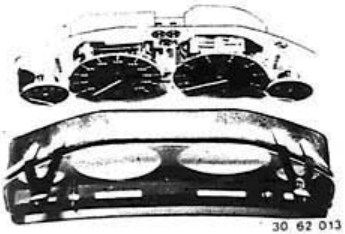
30 62 010

Cars with Analog Clock:
Pull off reset button.



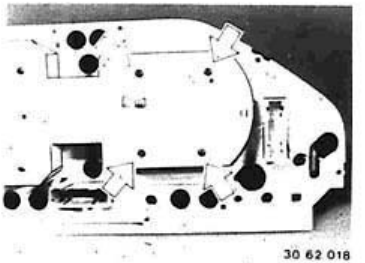
30 62 012

Unscrew screws.



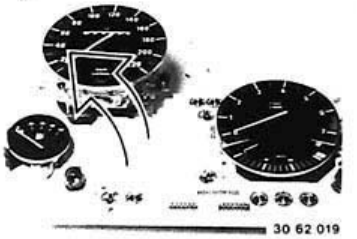
30 62 013

Take instruments and carrier plate out of housing.



30 62 018

Unscrew screw.

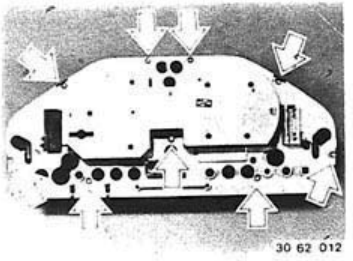


30 62 019

Take out speedometer.

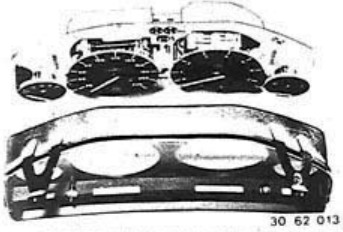
62 13 000 REMOVING AND INSTALLING TACHOMETER

Remove instrument carrier assembly – see 62 21 000.



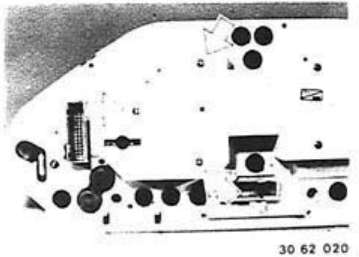
30 62 012

Unscrew screws.



30 62 013

Take instruments and carrier plate out of housing.



30 62 020

Unscrew screws.



30 62 021

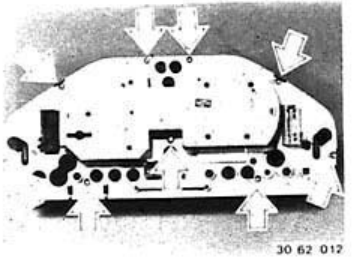
Take out tachometer.

62 13 050 REMOVING AND INSTALLING CLOCK



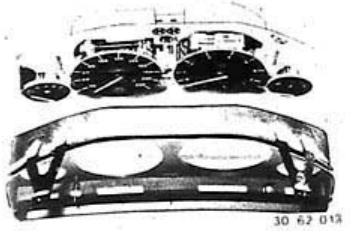
30 62 010

a) Clock in Instrument Carrier:
Remove instrument carrier assembly – see 61 21 000.
Pull off reset button.



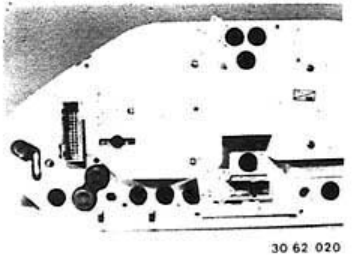
30 62 012

Unscrew screws.



30 62 013

Take instruments and carrier plate out of housing.



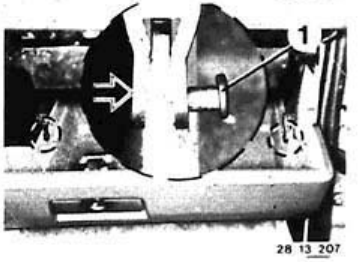
30 62 020

Unscrew screws.



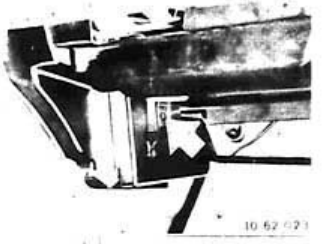
30 62 022

Take out clock.



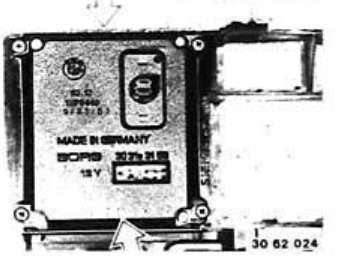
28 13 207

b) Clock Next to Radio Opening:
Open glove box.
Disconnect retaining straps.



10 62 021

Remove trim panel.



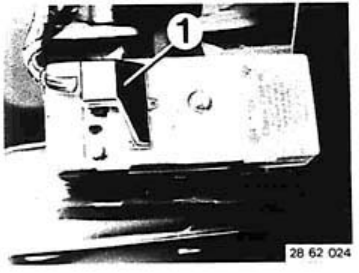
30 62 024

Pull off plug on clock.
Push in retainers at top and bottom.
Press out clock.

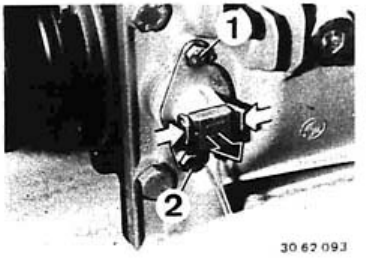


62 14 070 REMOVING AND INSTALLING OR REPLACING CHECK CONTROL

Lift check control out of plate.

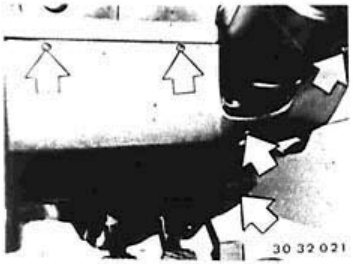


Pull off plug (1).



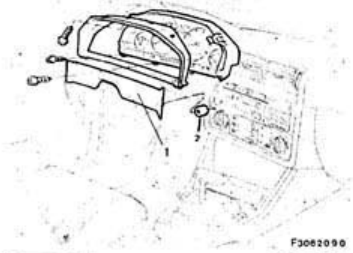
62 16 071 REPLACING SENDER FOR SPEEDOMETER

Pull off plug.
Unscrew screws (1 and 2).
Lift out sender.

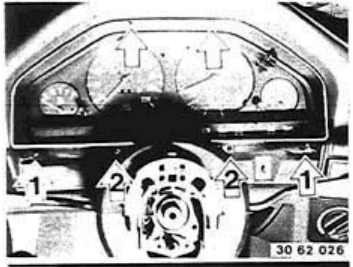


62 21 000 REMOVING AND INSTALLING INSTRUMENT CARRIER ASSY.

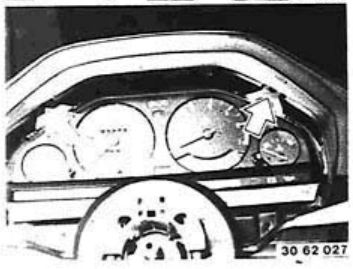
Turn screws 90°.
Take off trim panel.



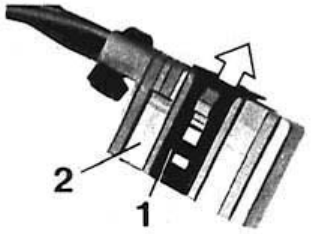
Unscrew mounting nuts for trim panel (1) from behind.
Lift out trim panel (1).



Unscrew screws.
Lift out trim panel.
Important!
The two inside screws (2) must not be mixed up with outside screws (1).
Max. length of screws (2) = 9.5 mm.

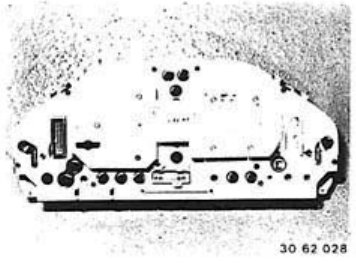


Unscrew screws.



733 62 019

Lift instrument carrier out of instrument panel.
Pull off all plugs.
Note:
First pull out slider (1) on combination plug (2) when pulling the combination plug off of the instrument carrier.



62 99 . . . REPLACING LIGHT BULBS IN INSTRUMENT CARRIER

Remove instrument carrier assembly – see 62 21 000.
Unscrew light bulbs (bayonet).

TROUBLESHOOTING SERVICE INTERVAL INDICATOR

CONDITION	CAUSE	CORRECTION
One or more LEDs do not light up, i.e. break in diode light assembly (ignition turned ON)	- LED faulty	- Replace diode light assembly of service indicator - see 62 11 040.
Green LEDs light up while engine is running or do not go out within two seconds after starting the engine	- Term. 15 interrupted briefly - Signal from term. 50 (starter) interrupted or too short - Engine push started (without starter)	- Check term. 15 or term. 50. - Check (blue) plug on instrument cluster. - Check plug connection inside of instrument cluster. - Repeat engine starting > 0.5 second. - Replace SI printed circuit board - see 62 11 030.
Undefined lighting up (flashing) of LEDs	- SI printed circuit board faults - Loose contact in instrument cluster or on plug connections	- Replace SI printed circuit board - see 62 11 030. - Check plug connections on inside and outside of instrument cluster.
1 yellow LED, 3 red LEDs, OIL SERVICE and INSPECTION signs light up suddenly	- SI printed circuit board faulty - Ground connections - Wrong relays installed - Z-diode in heater wire harness faulty (only E 30)	- Replace SI printed circuit board - see 62 11 030. - Exchange SI printed circuit board for clock/tachometer or economy control. - Check/clean central ground point on body (battery negative connection). - Check/clean central ground point underneath instrument carrier. - Horn relay, heater blower relay and dimmer relay must be diode relays. - Check Z-diode (in heater wire harness close to the water valve).

TROUBLESHOOTING SERVICE INTERVAL INDICATOR (Continued)

CONDITION	CAUSE	CORRECTION
Yellow LED, three red LEDs and OIL SERVICE sign light up	- Buffer batteries discharged excessively	- Check charging cycle: Replace SI printed circuit board - see 62 11 030 - If INSPECTION sign does not appear after one minute. If necessary, exchange SI printed circuit board for clock/tachometer or economy control.
Only INSPECTION sign on continuously	- Both buffer batteries were discharged - SI printed circuit board faulty	- Check charging cycle and reset SI - Replace SI printed circuit board - see 62 11 030. - Replace SI printed circuit board for clock/ tachometer or economy control.

Condition	Cause	Correction
Only 3 green LEDs and yellow LED come on	– SI printed circuit board defective	– Replace SI printed circuit board (62 11 030) – Replace SI printed circuit board for clock/tachometer or economy control
Inspection interval 24,000 km > 11 months	– Distance pulse process for tachometer – Coding plug wrong or missing – Time quartz on SI printed circuit board defective – Reset made erroneously too early	– Replace tachometer – Check coding plug* – Replace SI printed circuit board (62 11 030) – Refer to wrong reset
Oil service interval too short < 6,000 km	– Printed circuit board damaged	– Replace SI printed circuit board (62 11 030) – Replace SI printed circuit board for clock/tachometer or economy control
Inspection interval too short < 12,000 km	– Coding plug wrong or missing	– Check coding plug*
Resetting not possible	– SI resetter defective – Break in reset wire (engine plug, diagnosis plug, instrument cluster plug) – Tachometer defective	– Check connection 7 on diagnosis plug blue/white wire up to central electric board (5 volts, only check with multimeter) – Check connection 14 blue plug on instrument cluster – Replace tachometer

* See Specifications

Information On Service Interval Resetting:

a) Gasoline Engine:
After an oil service it is only possible to reset the previously put in wear signals, but not the previously put in time signals.

Examples:

1) If an oil service reset is made 10 months after the last inspection reset (no green LEDs or OIL SERVICE on), only 1 green LED will come on. After expiration of the 12th month this lamp goes out and it is time for the annual check.

2) If an oil service reset is made earlier (1 green LED still on) and the last inspection reset was 10 months ago, no additional green LED will come on. After expiration of the 12th month the lamp will go out and it is time for the annual check.

A modified instrument cluster is standard gradually since January, 1986. Its new Service Indicator has a clock symbol and now only one red LED. The load and time memories are activated separately.

Oil reset after an oil service causes cancellation of the Oil Service sign, yellow and red LEDs as well as activation of all five green LEDs.

Inspection reset after an inspection causes cancellation of the Inspection sign, yellow and red LEDs after a load-dependent display as well as activation of all five green LEDs. The lighted clock symbol will also be cancelled after a time-dependent display.

If load and time-dependent inspections happen to fall together, the inspection reset must be repeated after at least 10 seconds, in order to cancel the clock symbol and Inspection sign.

b) Diesel Engine:
Uncoupling the Time Factor

The time factor is uncoupled from the green LEDs. In other words the annual check is due, when the inspection sign comes on and the green LEDs have not yet gone out.

Oil Service

There are basically two oil services between the wear-dependent inspections and this is indicated by all five green LEDs going out and the Oil Service sign lighting up.

Oil reset after the 1st and 2nd oil service will cancel the oil service sign and activate all five green LEDs at the same time.

Inspection:

A. Wear factors have activated the inspection sign.
B. Time factor has activated the inspection sign.

A. Wear Dependent Inspection:

All five green LEDs off – inspection sign on.

Inspection reset will cancel the inspection sign and activate all five green LEDs.

B. Time Dependent Inspection:

One or more green LEDs still on – inspection sign on.

Inspection reset will cancel the inspection sign, but the green LEDs are not influenced and are subordinated to wear.

Special Case: wear and time factors simultaneously.

All five green LEDs off – inspection sign on.

2 x inspection reset!

The 1st inspection reset will cancel the inspection which was first in activating the "inspection" sign. This could have been either the wear dependent or time dependent inspection.

TROUBLESHOOTING ECONOMY CONTROL

– In neutral (car stopped – engine running) EC will always show the highest fuel consumption.

– In the coasting phase there will be no fuel injection and consequently EC shows zero consumption.

Condition	Cause	Correction
Unrealistic display (e.g. only 6 liters for wide open throttle in 4th gear)	– Coding plug wrong – Coding plug broken	– Check or replace coding plug*
EC display too high	– Temperature error on quartz – Coding plug wrong	– Tachometer with economy control – See coding plug table*
No display	– Injection signal missing – Loose plug connection – Measuring mechanism failure (mech. defect)	– Check injection signal on instrument cluster plug (blue) pin 2 – Check plug connection – Replace tachometer with economy control
Needle wanders in neutral	– Disturbances through term. 1	– Disconnect black wire of term. 1 on instrument cluster plug, pull wire out of wire harness and wrap it around the wire harness.
Needle wanders when using light switch or headlight flasher	– Disturbances through low beam relay	– Replace low beam relay (only install a diode relay, Part No. 61 31 1 373 154)

* See Specifications

TROUBLESHOOTING CHECK CONTROL

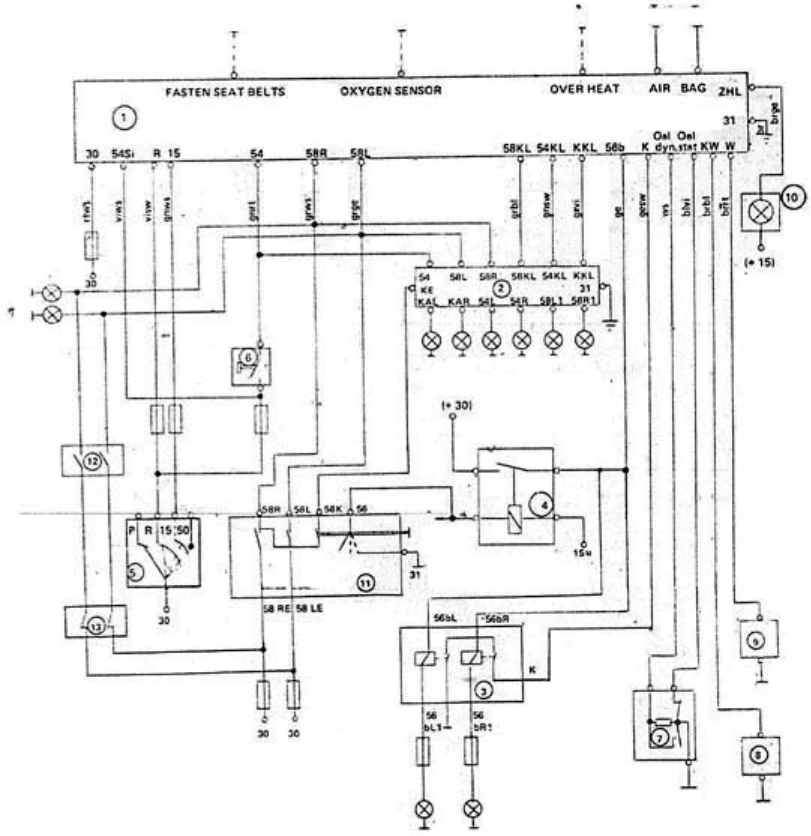
Checking Input Signals on Disconnected Plug of Check Control

Pin No.	Wire Colors	Function on Car	Input Signals Test Results with Multimeter Pin	Tester	Pin	Test Value
1 'R' Terminal 'R'	violet/gray	Ignition key in 'R'	1 (+)	voltmeter	9 (-)	= Battery voltage
2 'ZHL' Central warning lamp	brown/yellow	Ignition turned on	2 connected with 9 (-) = central warning lamp on continuously			
3 Not used						
4 '15' Terminal '15'	green/white	Ignition turned on	4 (+)	voltmeter	9 (-)	= Battery voltage
5 'OX' (USA) Oxygen sensor	blue/white	Ignition turned on	5 (-)	voltmeter	4 (+)	= Battery voltage
6 'AB' (USA) Airbag (+)			6 (+)	voltmeter	9 (-)	= Battery voltage
7 'AB' (USA) Airbag (-)			7 (-)	voltmeter	4 (+)	= Battery voltage
8 'FS (USA) Fasten Seat Belts	brown/violet	Ignition turned in	8 (-)	voltmeter	4 (+)	= Battery voltage
9 '31' Terminal 31	brown	Ground	9 (-)	voltmeter	15 (+)	= Battery voltage

Pin No. Designation	Wire Colors	Function on Car	Input Signals Test Results with Multimeter Pin Tester Pin Test Value
10 Not used	–	–	–
11 '58R' Tail lights right	gray/white	Tail lights on	11 (+) –voltmeter– 9 (–) = U_B
12 '58L' Tail lights left	gray/yellow	Tail lights on	12 (+) –voltmeter– 9 (–) = U_B
13 '58KL'	gray/blue	Tail lights on, bulb tester okay	13 –ohmmeter– 9 (–) = 4.7 ohms
14 Not used	–	–	
15 '30' Terminal '30'	red/white	Positive from term. 30 via fuse no.	15 (+) –voltmeter– 9 (–) = U_B
16 'Öl stat.' Oil level static	blue/violet	Max. oil level and transmitter okay	16 –ohmmeter– 9 (–) = approx. 0 ohm
17 'W' Washing fluid	brown/red	Washing fluid level and transmitter okay	17 –ohmmeter– 9 (–) = approx. 0 ohm
18 'KW' Coolant	brown/blue	Coolant level and transmitter okay	18 –ohmmeter– 9 (–) = approx. 0 ohm
19 Not used	–	–	–

Pin No. Designation	Wire Colors	Function on Car	Input Signals Test Results with Multimeter Pin Tester Pin Test Value
20 'Öl dyn. Oil level dynamic	white	Oil level + transm. okay Min. oil level and transmitter okay	20 –ohmmeter– 9 (–) = 1 k-ohm 20 –ohmmeter– 9 (–) = 0 ohm
21 '56b' Low beams	yellow	Low beams on	21 (+) –voltmeter– 9 (–) = U_B
22 'K' Low beam ind.	yellow/black	Low beams and bulb tester okay	22 –ohmmeter– 9 (–) = 0 ohm
23 '54Si' Fuse monitor	violet/white	Ignition key in 'R'	23 (+) –voltmeter– 9 (–) = U_B
24 '54KL' Stop light ind.	green/black	Stop lights and bulb tester okay	24 –ohmmeter– 9 (–) = 4.7 ohms
25 '54' Stop lights	green/red	Brakes applied, stop lights okay	25 (+) –voltmeter– 9 (–) = U_B
26 'KKL' License plate light indicator	gray/violet	License plate lights and bulb tester okay	26 –ohmmeter– 9 (–) = 4.7 ohms

CHECK CONTROL WIRING DIAGRAM – E 30



1 = Check control
2 = Bulb tester (stop, tail and license plate lights)
3 = Bulb tester (low beams)
4 = Low beam relay
5 = Ignition lock
6 = Stop light switch
7 = Oil level
8 = Coolant level
9 = Washing fluid level
10 = Central warning lamp in instrument cluster
11 = Light switch
12 = Parking light switch
13 = Ignition switch (parking lights)
KAL = License plate light outlet left
KAR = License plate light outlet right
KKL = Indicator lamp outlet, license pl. lights
K = Indicator lamp outlet, low beams

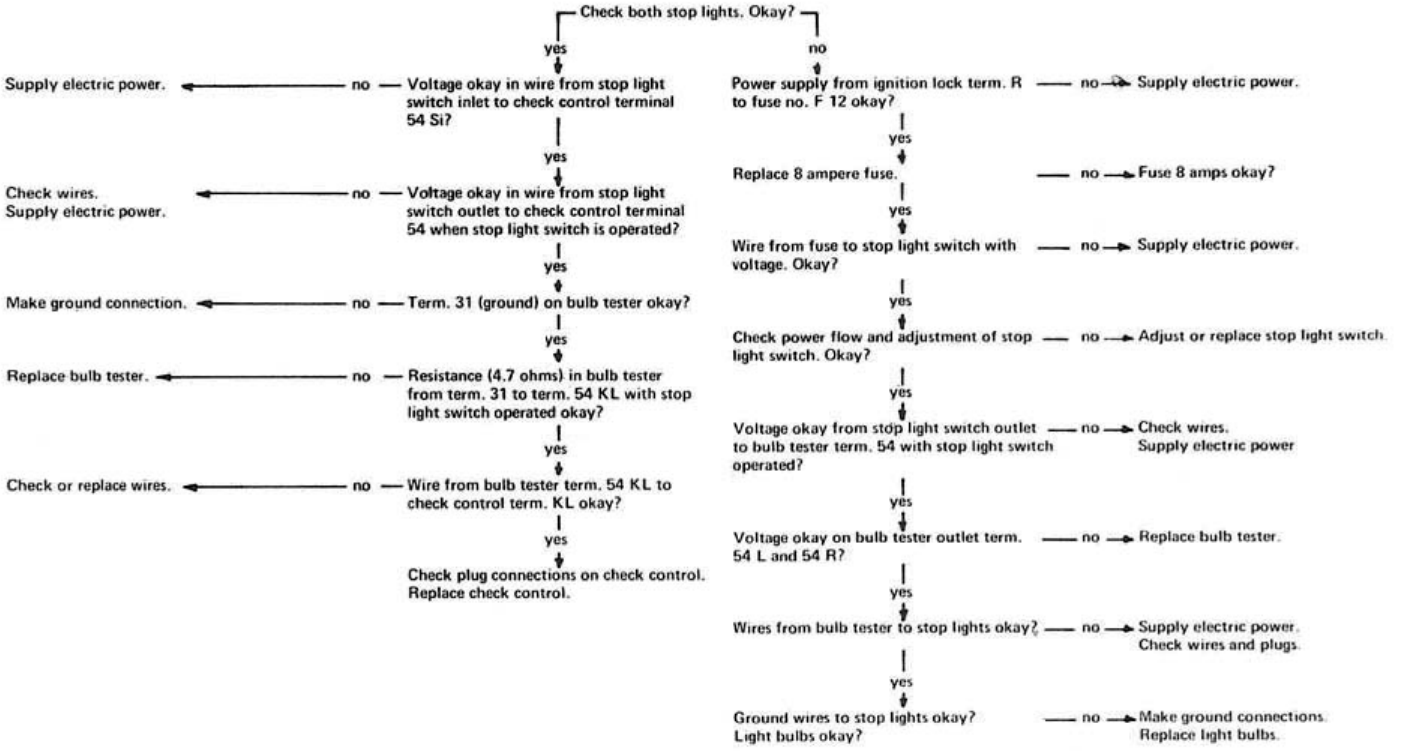
TEST: ENGINE OIL

Check engine oil level – okay? — no → Add oil.
↓ yes
Check transmitter in oil pan – static 0 ohm – dyn. 1 k-ohm – okay? — no → – Apply extra ground wire. – Replace transmitter
↓ yes
Transmitter wire plug connection okay? — no → Repair or replace transmitter.
↓ yes
Check power flow in wires from transmitter to check control static oil term. and dyn. oil terminal. Okay? — no → Repair or replace wires.
↓ yes
Check plug connections of check control. Replace check control.

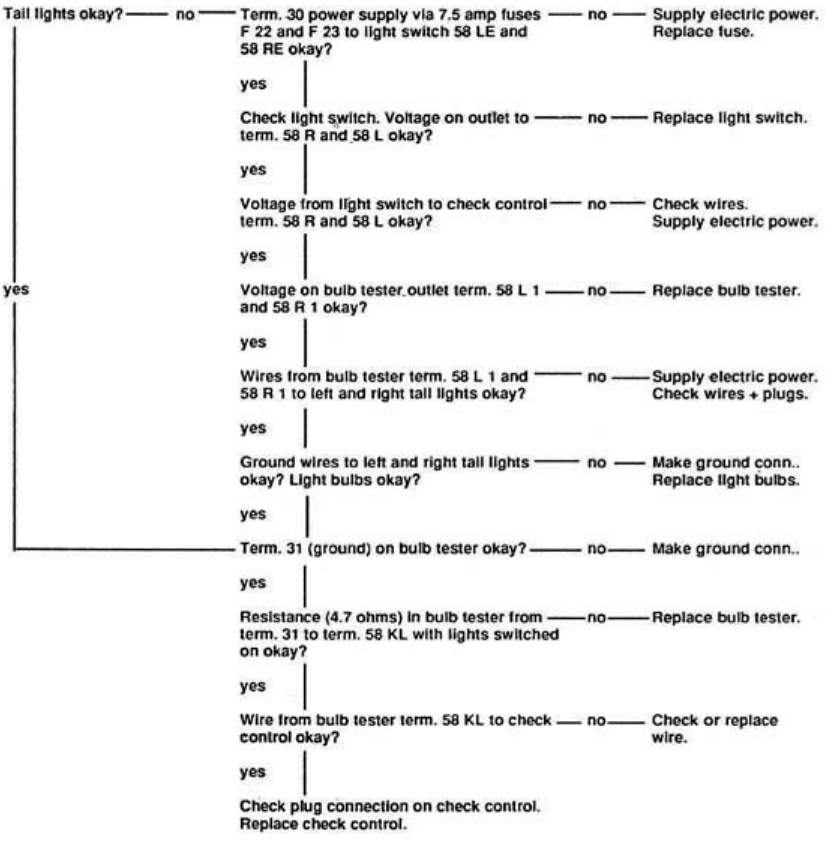
TEST: COOLANT AND WASHING FLUID

Coolant and washing fluid level okay? — no → Add coolant and/or washing fluid with pertinent antifreeze concentration.
↓ yes
Check coolant/washing fluid level transmitters with ohmmeter – 0 ohm. Okay? — no → Repair ground wire. Replace transmitters.
↓ yes
Plug connections on transmitters okay? — no → Repair or replace transmitters.
↓ yes
Wires from transmitters to check control term. KW and WW with power flow. Okay? — no → Repair or replace wires.
↓ yes
Check plug connections on check control. Replace check control.

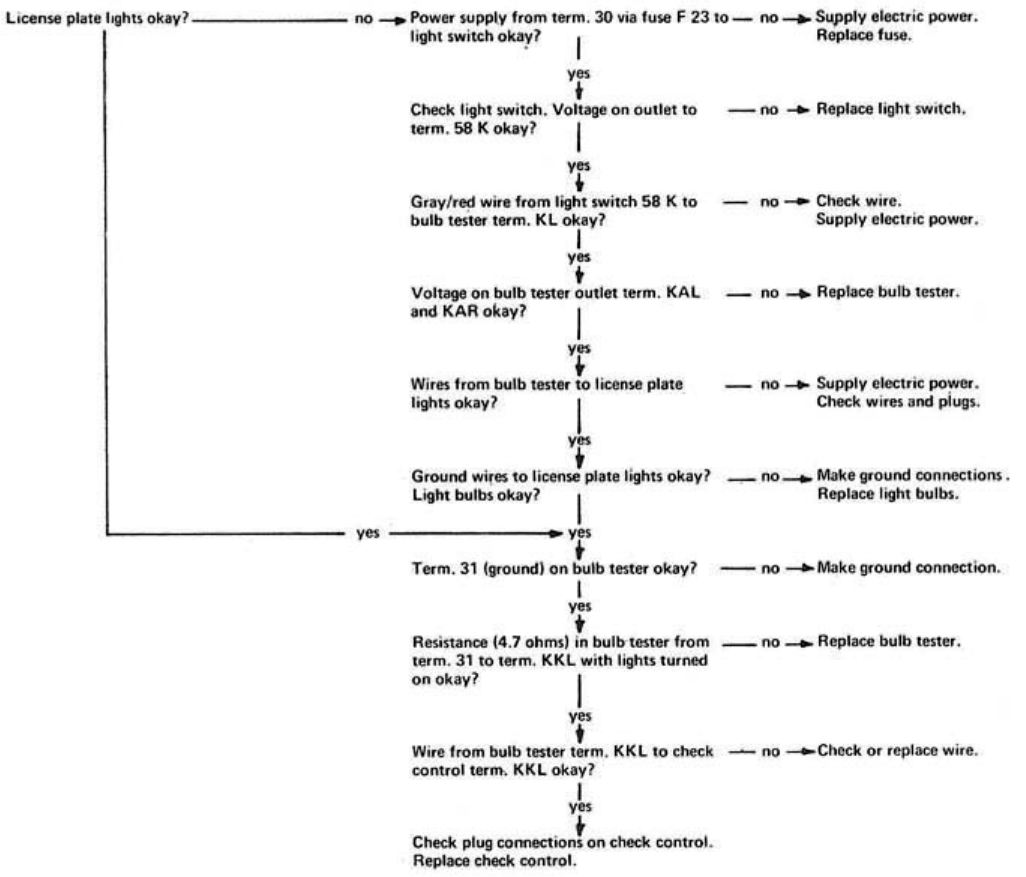
TEST: STOP LIGHTS



TEST: TAIL LIGHTS



TEST: LICENSE PLATE LIGHTS



TEST: LOW BEAM HEADLIGHTS

Check both headlights. Okay? — no → Check ground connection on light switch. Okay? — no → Make ground connection

yes

Check light switch. Ground on outlet to term. 56 with light switch turned on? — no → Replace light switch.

yes

Ground from light switch term. 56 to low beam relay term. 85 in yellow wire? — no → Make ground connection.

yes

Check low beam relay:
- Positive term. 30
- Positive term. 15
- Ground term. 85
- Positive term. 87

Okay? — no → Make positive or ground connections as required. Replace relay.

yes

Voltage of yellow wire 56 b to check control conn. 21 and to test point no. 3 (see figure)? — no → Check wire, supply power or replace central electric board.

yes

Voltage on fuse inlets for left and right low beams? — no → Check central elec. board.

yes

Left and right low beam fuse okay? Voltage on fuse outlet? — no → Replace fuse.

yes

Voltage from fuse outlet for left and right low beams to left and right low beam headlight wires "yellow/white" and "yellow/blue"? — no → Check wires. Supply electric power.

yes

Headlight ground connections and light bulbs okay? — no → Make ground connections. Replace light bulbs.

yes

Ground in term. 31 on bulb tester in centr. elec. board test point no. 1 (see figure) okay? — no → Check central electric board.

yes

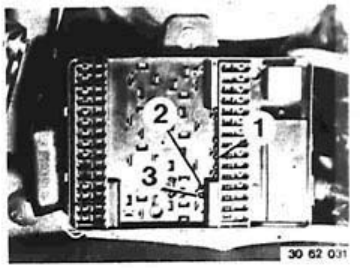
Connect conn. "K" on bulb tester in centr. elec. board test points no. 1 and 2 (see figure). 0 ohm. Okay? If necessary, install special low beam relay with BMW Part No. 61 31 1 366 058. — no → Replace central electric board.

yes

Check yellow/black wire from bulb tester in centr. elec. board conn. "K" to plug conn. check control conn. 22. 0 ohm. Okay? — no → Replace wire.

yes

Check contact of plug connection. Replace check control.



TEST: POWER SUPPLY AND OUTLET WIRES ON CHECK CONTROL

Term. 30 s electric power supply okay? — no → Check wire to fuse no. F 5.
Check fuse no. F 5, replacing with 8 amp fuse if necessary.
Check power rail in central electric board for fuse no. 5.

yes

Term. 15 electric power supply with ignition turned on okay? — no → Check wire to fuse no. F 6.
Check fuse no. F 6, replacing with 8 amp fuse if necessary.
Check wire from fuse no. F 6 to ignition lock term. 15.

yes

Term. R electric power supply with ignition key in "R" okay? — no → Check wire to fuse no. F 8.
Check fuse no. F 8, replacing with 8 amp fuse if necessary.
Check bridge between fuse no. F 8 and fuse no. F 11.
Check wire from fuse no. F 11 to ignition lock term. R.

yes

Term. 31 ground connection okay? — no → Check ground wire, replacing if necessary.

yes

Central warning lamp in instrument cluster okay? — no →
- Check wire from check control term. ZH to pin 9 of blue instrument cluster plug.
- With turn signal on a ground signal of 1 Hz can be measured on pin 9 of blue instrument cluster plug.

63 Lights

63 10 004	Headlights – aim	63- 1
63 12 100	Double headlight assembly, left or right – remove and install	63- 1.1
250	High beam lamp, left or right – remove and install	63- 2
280	Low beam lamp, left or right – remove and install (up to 1987 models)	63- 3
280	Low beam lamp, left or right – remove and install (since 1988 models)	63- 3.1
430	Headlight vertical aim control – replace	63- 3.2
63 13 150	Turn signal assembly, left or right – remove and install	63- 4
63 21 180	Tail light assembly, left or right – remove and install	63- 4
63 99 001	Halogen light bulb for high beam headlight, left or right – replace	63- 5
071	Halogen light bulb for low beam headlight, left or right – replace	63- 5
131	Light bulb of front parking light, left or right – replace	63- 6
201	Halogen light bulb for front fog lamp, left or right – replace	63- 6
271	Light bulb for turn signal, left or right – replace	63- 7
. . .	Light bulb for tail light, left or right – replace	63- 7
63 17 150	Front fog lamps – service install	63- 101

63 10 004 AIMING HEADLIGHTS

Testing Requirements:
Check/correct tire inflation pressure. Load down driver's seat with one person (about 75 kg/165 lbs.). Car's fuel tank full and additional weights in trunk. Car parked on level floor. Aimer aligned with car's longitudinal axis and parallel to contact surface. Marking line adjusted to distance e (presently 12 cm (4.724")/10 mtr. (32 feet)).

Adjusting Procedures:
The light/dark border of the low beam headlights must be aligned with the horizontal marking line of the aimer for the vertical adjustment. The inclined line must begin below the central mark on the horizontal marking line for the lateral adjustment.

Explanations:
e H - h = 12 cm (4.724")

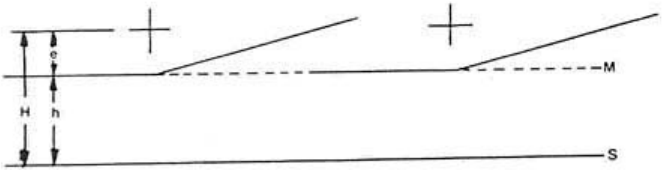
H Height of headlight center above wheel contact surface

h Height of marking line above wheel contact surface

\+ Central mark = middle of headlight

M Marking line

S Wheel contact surface

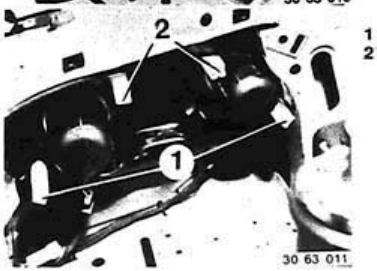


30 63 067



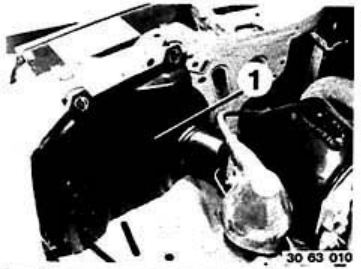
30 63 010

Correcting:
Remove headlight cover (1).



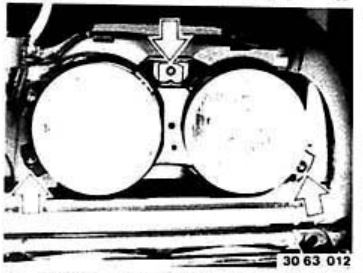
30 63 011

1 = Lateral adjustment
2 = Vertical adjustment

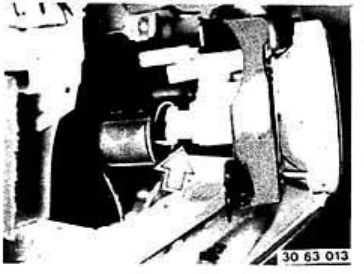


63 12 100 REMOVING AND INSTALLING LEFT OR RIGHT DOUBLE HEADLIGHT ASSEMBLY

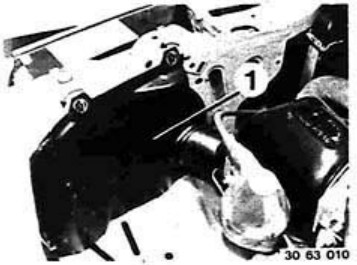
Remove side radiator grill section - see 51 13 040.
Remove headlight cover (1).



Unscrew screws.

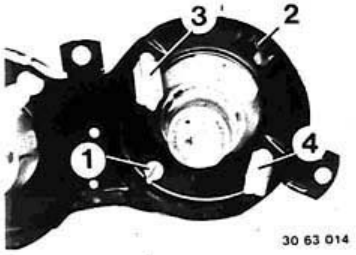


Remove caps and pull plugs off of headlight.

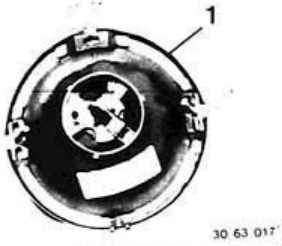


63 12 250 REMOVING AND INSTALLING LEFT OR RIGHT HIGH BEAM HEADLIGHT LAMP

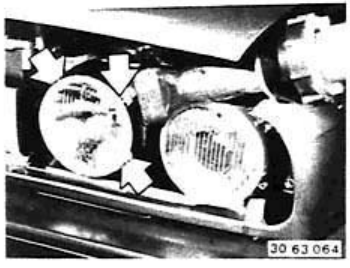
Remove side radiator grill section - see 51 13 040.
Lift off headlight cover (1).



Until 1987 Models:
Turn joint (1) 1/4th of a turn.
Disconnect spring (2).
Unscrew vertical control (3).
Unscrew lateral control (4).
Take headlight off of headlight carrier.

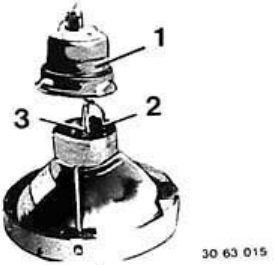


Lift off ornamental ring (1).

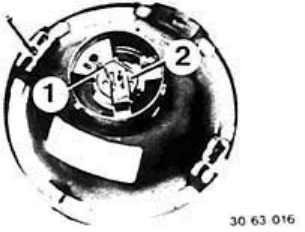


Since 1988 Models:
Heat clips with a hot air blower and lift out.

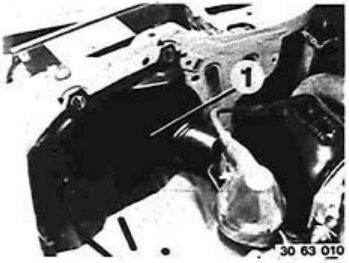
Installation:
First place clips on the ball-ended pins.
Press headlight lamp into clips.



Remove cap (1).
Pull off plugs (2 and 3).

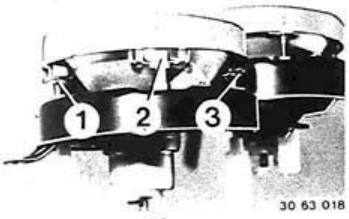


Lift out retainer (1).
Remove light bulb (2).

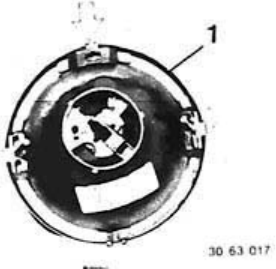


63 12 280 **REMOVING AND INSTALLING LEFT OR RIGHT LOW BEAM LAMP (Until 1987 Models)**

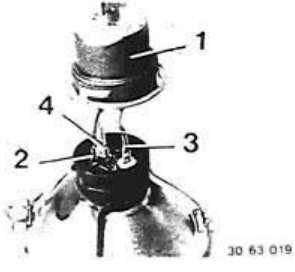
Remove side radiator grill section – see Group 51.
Lift out headlight cover (1).



Disconnect joints (1 ... 3).
Take headlight off headlight carrier.

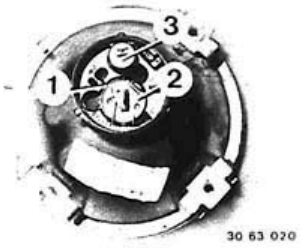


Lift out ornamental ring (1).

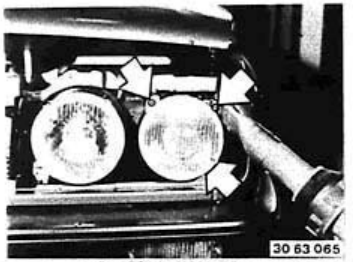


Unscrew cap (1).
Pull off plugs (2 ... 4).

2 = Brown wire, ground
3 = Gray wire, parking light bulb
4 = Yellow wire, low beam light bulb



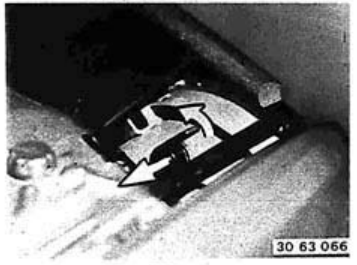
Lift out retainer (1).
Remove light bulb (2) for low beam.
Pull out light bulb (3) for parking light.



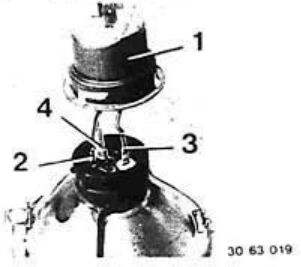
63 12 280 REMOVING AND INSTALLING LEFT OR RIGHT LOW BEAM LAMP (Since 1988 Models)

Destroy or heat with hot air blower and lift out clips.

Installation:
First place clips on ball-end pins and then press headlight lamp into clips.



Turn lever about 90° and pull out light bulb holder for parking light.

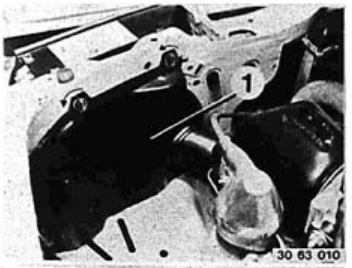


Unscrew cap (1).
Pull off plugs (2 ... 4).

2 = Brown wire, ground
3 = Gray wire, parking light bulb
4 = Yellow wire, low beam light bulb

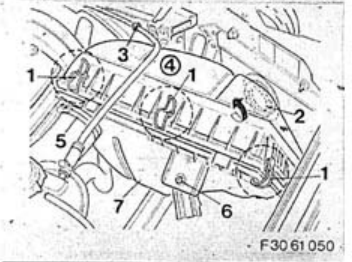


Lift out retainer (1).
Remove light bulb (2) for low beam.

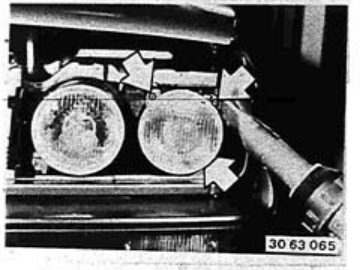


63 12 430 REPLACING VERTICAL HEADLIGHT AIM CONTROL

Remove all radiator grill sections – see Group 51.
Lift out headlight cover (1).

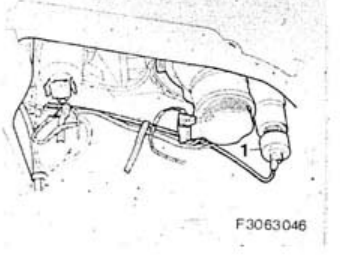


324 d, 324 td:
Remove air cleaner – see Group 13.

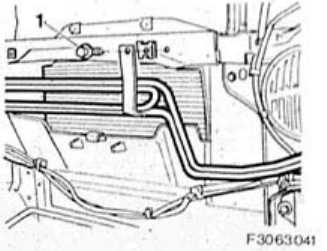


Destroy or heat with hot air blower and lift out clips.

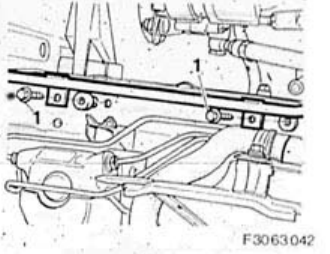
Installation:
First place clips on ball-end pins and press headlight lamp into clips.



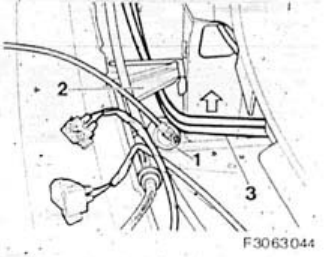
Turn vertical headlight aim control (1) to the right and left, and lift out.
Cut off wire strap.



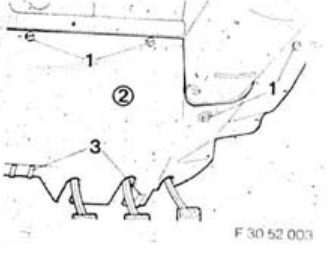
Cars with Cooling Pipe:
Unscrew screws (1).



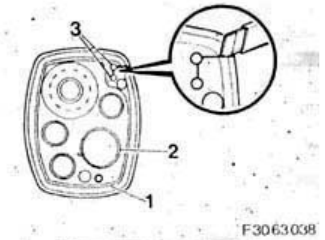
Unscrew screws (1).



Press cooling pipe (3) in direction of arrow and pull out vertical headlight aim control underneath metal strips (2).

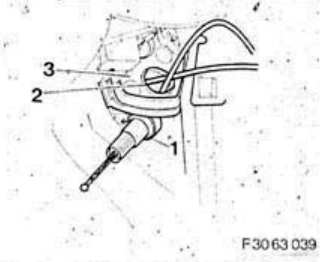


Turn screws (1) 90° and remove dashboard trim panel at bottom left.



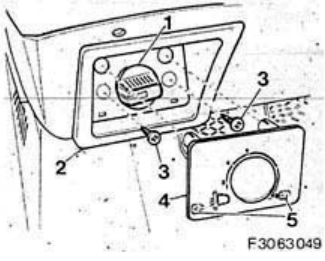
F3063038

Pull rubber grommet (1) on pedal console out of firewall.



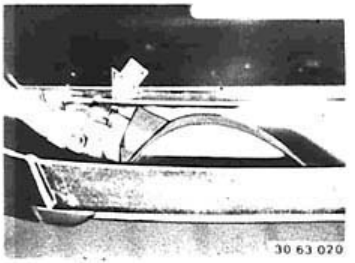
F3063039

Pull vertical headlight aim control through opening into inside of car.



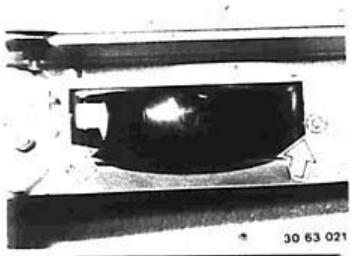
F3063049

Pry out mask (4) carefully.
Unscrew screws (3) and pull out control element.

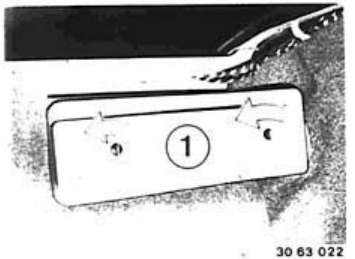


63 13 150 REMOVING AND INSTALLING LEFT OR RIGHT FRONT TURN SIGNAL ASSEMBLY

Pull off cap and plug.

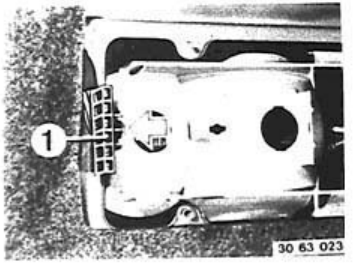


Unscrew screws.
Remove turn signal from bumper.
Beginning with 1988 Models:
First remove bumper – see Group 51.

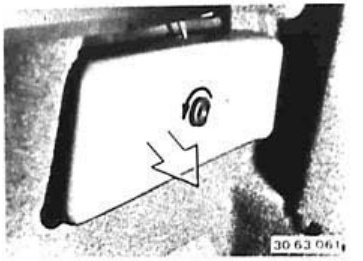


63 21 180 REMOVING AND INSTALLING LEFT OR RIGHT TAIL LIGHT ASSEMBLY

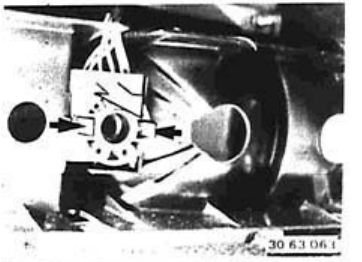
Until 1987 Models:
Remove cover (1).



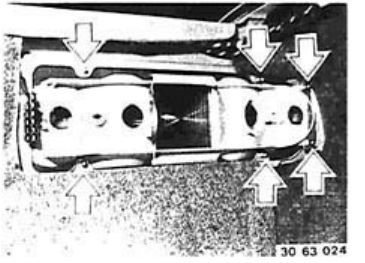
Lift off plug (1).



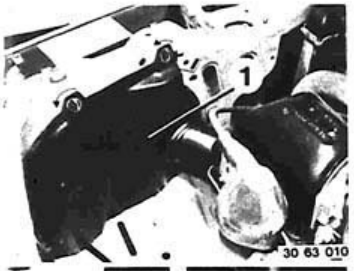
Since 1988 Models:
Loosen rotary lock and lift off cover.



Squeeze clips and lift out plug.

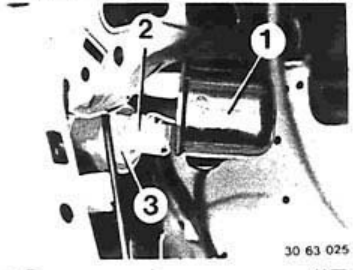


All Models:
Unscrew screws.
Take tail light assembly out of tail panel.

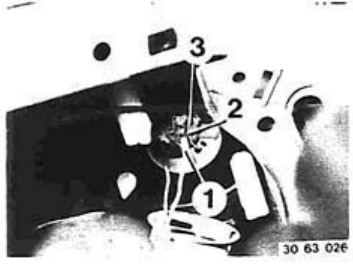


63 99 001 REPLACING HALOGEN LIGHT BULB FOR LEFT OR RIGHT HIGH BEAM HEADLIGHT

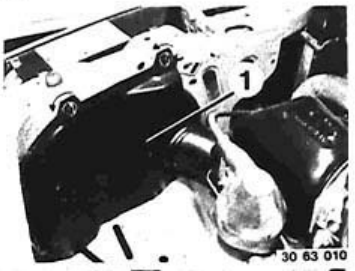
Lift out headlight cover (1).



Pull off cap (1) and plug (2).
Unscrew cap (3).

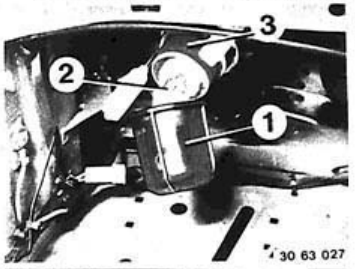


Pull off plug (1).
Lift out clamp (2).
Remove light bulb (3).

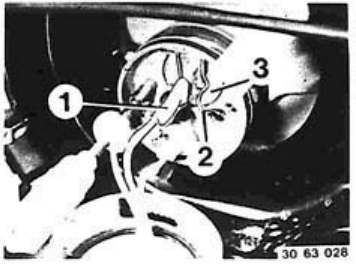


63 99 071 REPLACING HALOGEN LIGHT BULB FOR LEFT OR RIGHT LOW BEAM HEADLIGHT

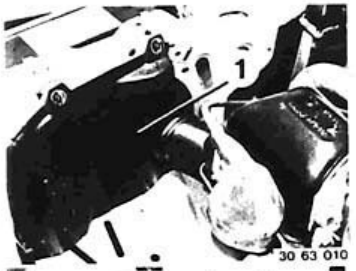
Remove headlight cover (1).



Pull off cap (1) and plug (2).
Unscrew cap (3).

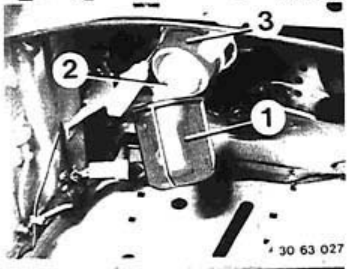


Pull off plug (1).
Lift out clamp (2).
Remove light bulb (3).
Note:
Never touch glass of light bulb with bare fingers.



63 99 131 REPLACING LIGHT BULB FOR LEFT OR RIGHT FRONT PARKING LIGHT

Until 1987 Models:
Remove headlight cover (1).



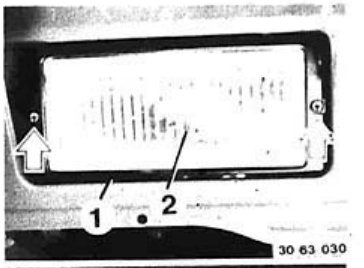
Pull off cap (1) and plug (2).
Unscrew cap (3).



Pull out bulb holder (1).
Twist light bulb to remove from holder.

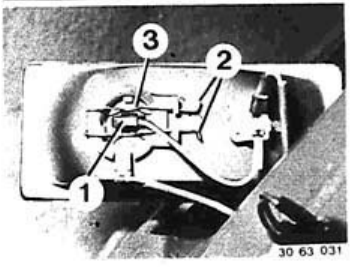


Since 1988 Models:
Turn bulb holder about 90° and lift out.
Twist light bulb to remove from holder.



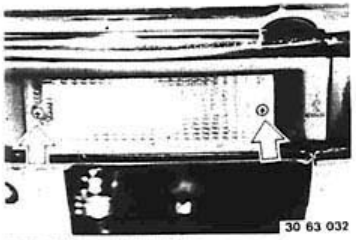
63 99 201 REPLACING HALOGEN LIGHT BULB FOR LEFT OR RIGHT FRONT FOG LAMP

Unscrew screws.
Remove holding frame (1) and headlight lamp (2).



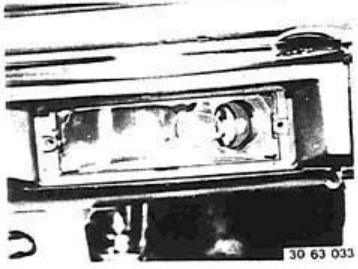
Pull out plug (1).
Lift out retainer (2).
Remove light bulb (3).

Note:
Never touch glass of light bulb with bare fingers.

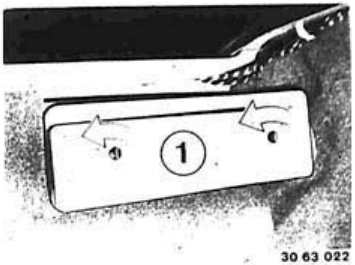


63 99 271 REPLACING LIGHT BULB FOR LEFT OR RIGHT FRONT TURN SIGNAL

Unscrew screw.
Take off lens.

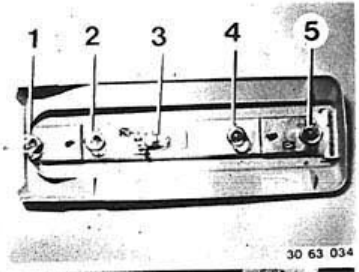


Unscrew light bulb in bulb holder.

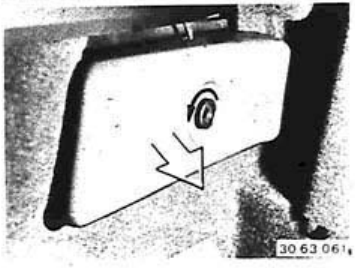


63 99 . . . REPLACING LIGHT BULB IN LEFT OR RIGHT TAIL LIGHTS

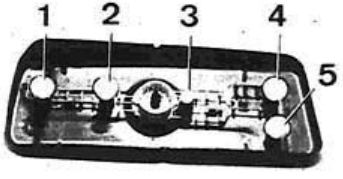
Remove cover (1).



Unscrew light bulb in bulb holder.
1 Turn signal
2 Rear fog light
3 Tail light
4 Stop light
5 Backup light

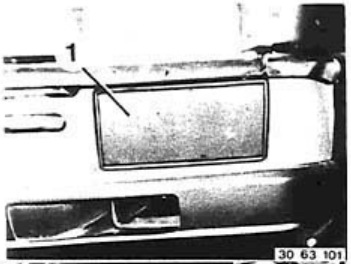


1988 Models On:
Open fastener and lift out cover.



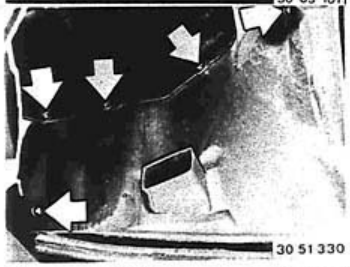
Unscrew light bulb in bulb holder
1 Turn signal
2 Stop light
3 Tail light
4 Backup light
5 Rear fog light

30 63 062

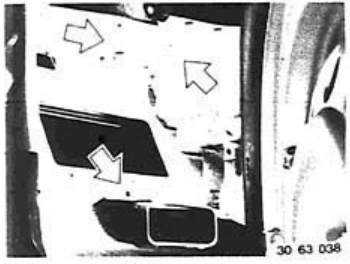


63 17 150 SERVICE INSTALLING FRONT FOG LAMPS

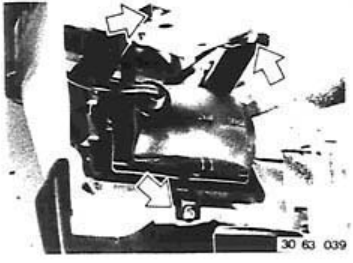
Left and Right Sides:
Before 9/85:
Lift out black cover (1).
Since 9/85:
Press in cover (painted in body color).



Before 9/85:
Unscrew bolts.
Remove splash guard.
Since 9/85:
Remove front spoiler 51 71 404.



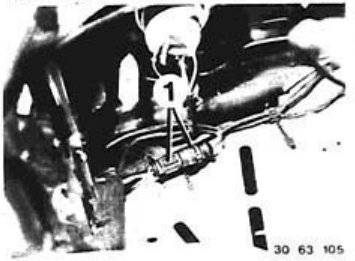
Insert spreader nuts.



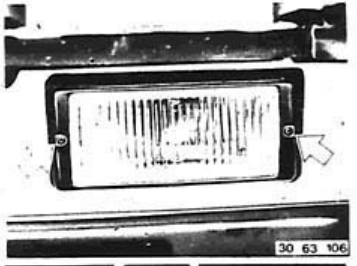
Mount fog lamp with three 4.8 x 13 mm self-tapping screws.
Note:
Left fog lamp is marked "links" (=left) and right fog lamp with "rechts" (= right).
Route wire from fog lamp to place of low and high beam headlight installation.



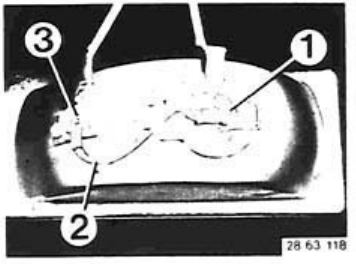
Remove headlight cover (1).



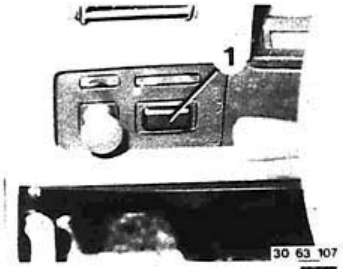
Connect plug from fog lamp with tied back plug receptacle (1).
Reinstall headlight cover.



Unscrew screws.
Lift out headlight lamp.



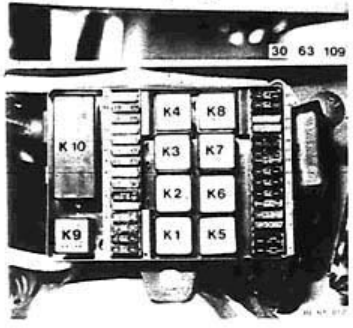
Install light bulb (1) from installation kit.
Insert wire (2) in wire connector (3).
Important!
Never touch glass of light bulb with bare fingers.
Note:
Only use YC 12 V 55 W light bulbs.



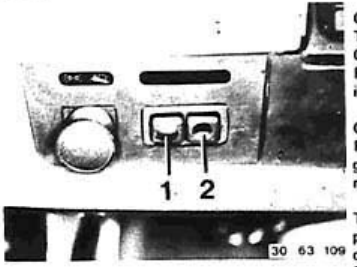
Lift out rear fog light switch (1) with a small screwdriver.
Pull off plug.



Connect switch from installation kit on plug and install.
Installed Position:
Fog light switch (1) with curvature must be on left side.
Rear fog light switch (2) with recess must be on right side.



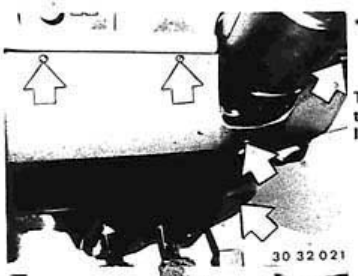
Take cover off of fuse box.
Install supplied 7.5 A fuses in fuse sockets 29 and 30.
Plug supplied relay in relay socket K 8.
Note:
Also install relay in relay socket K 9 of cars for Switzerland and France.



Checking Operation:
Turn on ignition and parked car lights.
Operate fog lamp switch (1).
Front fog lamps and green indicator lamp in instrument cluster should now be on.

Operate rear fog light switch (2).
Front fog lamps and rear fog light as well as green and yellow* indicator lamps in instrument cluster should now be on.

The rear fog light is only on with switched on parked car lights, if the fog lamps are switched on.
Front fog lamps and rear fog light may be switched on together with parked car lights, low beam and high beam headlights.
Note:
Check local legislation!



* If the yellow indicator lamp does not come on, it must be connected subsequentally as follows.

Turn screws 90° and remove instrument panel trim at bottom left.
Install supplied bulb holder (bayonet type).



Aiming Front Fog Lamps:
Check and correct tire inflation pressure.
Load down car to normal position**.
Check aiming of fog lamps with an optical aimer to instructions supplied with aimer.
Correcting:
Aim fog lamp with screw (1).

** See Specifications of Gr. 32

64 Heating and Air Conditioning

	Description	64- 0/1
	Components	64- 1
	Air flow layout	64- 2
64 11 071	Cable for footwell ventilation – replace	64- 3
081	Cable for window ventilation – replace	64- 4
161	Cable for temperature mixing flap – replace	64- 5
191	Cable for fresh air flap – replace	64- 6
205	Heater – remove and install	64- 7
210	Heater motor – remove and install	64- 9
220	Resistor plate for blower motor – remove and install	64- 11
271	Water valve for heater – replace	64- 12
365	Temperature switch (freezing prevention switch) – replace	64- 13a
311	Fresh air grill – remove and install	64- 13a
531	Heater core – remove and install	64- 14
. . .	Drive motor for fresh air / bypass air flap – remove and install or replace	64- 15
64 23 000	Rear window fan (convertible) – remove and install	64- 17
64 31 500	Microfilter for passenger compartment ventilator – replace	64- 18
	Refrigerant circuit	64- 50
	Discharging and charging station	64- 51
64 50 009	Air conditioner – discharge and charge	64- 52
	Air conditioner – check	64- 56
64 52 . . .	Valve core – remove and install	64- 56a
020	Compressor – remove and install	64- 57
64 51 050	Expansion valve – remove and install	64- 58
590	Evaporator – replace	64- 61
64 53 010	Drier – remove and install	64- 63
050	Condenser – remove and install	64- 64

Description of Integrated Heating and Air Conditioning System

The heating system is an air side controlled unit, i.e. the temperature is regulated by the mixing ratio of cold and warm air with help of the temperature mixing flap.
All outlets can be heated. Flaps are operated via cables. The water flow rate through the heater is regulated by an electromagnetic water valve in the water return circuit. It is switched on and off by the temperature control via a track circuit with loop contact. The valve will be closed when the temperature control is set to < 20° C (68° F). The valve is open without electric power.

With air conditioning the refrigerant is injected via an expansion valve, which is located in the housing on the right side.

A mechanical thermostat switch, located on left side of the unit, is applied for protection against freezing.

With air conditioning the fresh air/circulated air can be operated for extremely fast cooling of the passenger compartment or elimination of disturbing odors.

The flaps are located in front of both blowers and are operated by two positioning motors.

Air conditioning equipment includes an additional two-speed electric fan.

This fan always runs at least in first speed when the air conditioner is switched on.

Regardless of air conditioner operation 1st speed of extra fan is switched on as from a coolant temperature of 89 ... 93° C (192 ... 199° F) and switched off with a coolant temperature of 86 ... 82° C (187 ... 180° F).
Regardless of air conditioner operation 2nd speed of extra fan is switched on as from a coolant temperature of 97 ... 101° C (207 ... 214° F) and switched off with a coolant temperature of 94 ... 90° C (201 ... 194° F).

The drier has one high pressure and one low pressure safety switch.

The high pressure switch stops the compressor when reaching a coolant pressure of 25.5 ... 17.7 bar (363 ... 252 psi) and switches the compressor on again when coolant pressure drops to 22.5 ... 20 bar (320 ... 284 psi).

The low pressure switch stops the compressor when coolant pressure drops to 2.22 ... 1.72 bar (32 ... 24 psi) and switches the compressor on again when coolant pressure rises to 2.0 ... 2.4 bar (28 ... 34 psi).

These safety switches prevent damage in or on the air conditioning system.

Heating and Air Conditioning Controls

Consisting of:

Temperature Control

The temperature control regulates the temperature regulating flap via a cable and opens the water valve at an angle of > 20°.

Air Volume Control Switch

It switches the blower in 3 speeds via fixed resistors, which are located in the heater.

Air Up Control Lever

It operates via a cable the flap in the heater/air conditioner for air distribution to the windshield (defrost).

Air Center Control Lever

It operates via a cable the flap in the heater/air conditioner for air distribution out of the instrument panel nozzles (ventilation).

With air conditioning the control lever will also have a circuit breaking switch (track circuit) for the compressor. The compressor will be switched off with a flap opening of < 20 %, to avoid liquid knocks in the air conditioner which could destroy the compressor.

Air Down Control Lever

It operates via a cable the flap in the heater/air conditioner for air distribution down to the footwells.

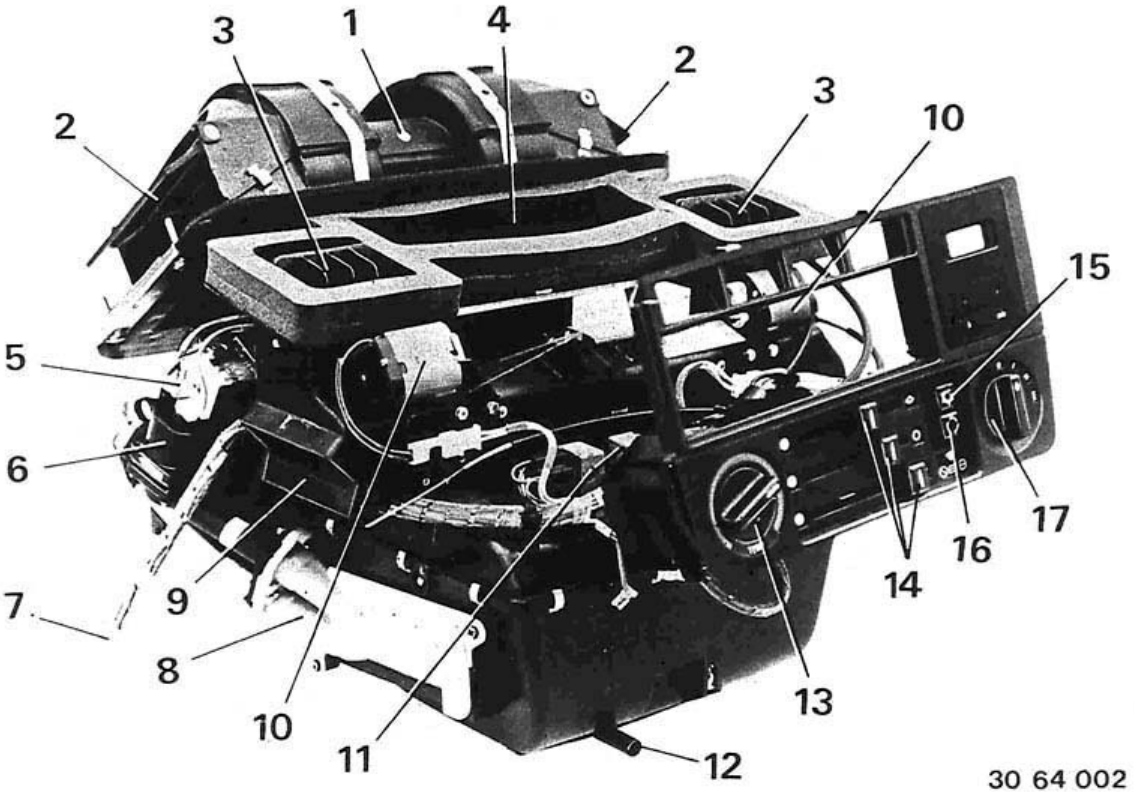
With air conditioning the control lever will have the same compressor circuit breaking switch as for the air center control lever.

A/C Compressor Push Button Switch

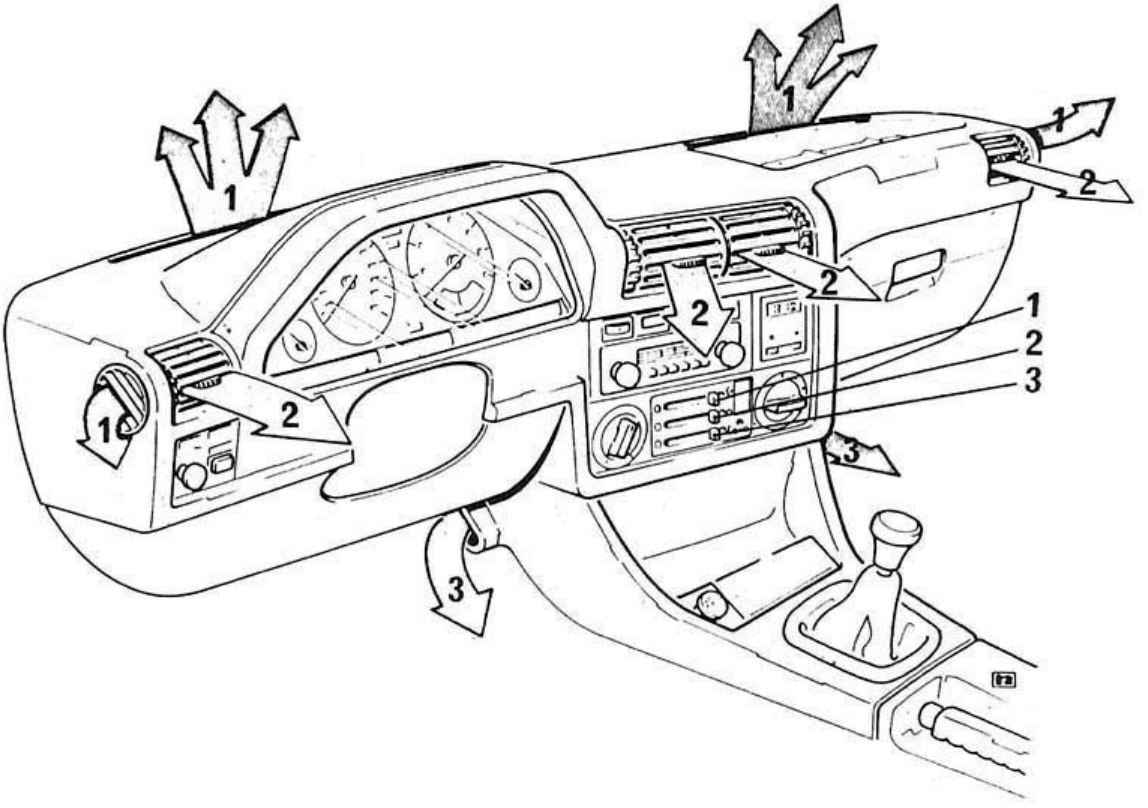
Air conditioner is switched on and off with this push button switch.
When air conditioning is switched on, the heater blower motor will always run in at least 1st speed.
When air conditioning is switched on, the additional fan will always run in at least 1st speed.

Fresh Air/Circulated Air Push Button Switch

When air conditioner is operated, it is used to switch fresh air or circulated air as desired.
In the circulated air switch position the heater blower motor will always run in at least 1st speed.



1 = Blower motor
2 = Bypass air flaps
3 = Fresh air flaps
4 = Window defrost flaps
5 = Freeze-protection switch
6 = Water valve
7 = Wire plug
8 = Heater core
9 = Footwell flaps
10 = Bypass flap motor
11 = Motor relay
12 = Condensation water drain
13 = Temperature control wheel
14 = Control lever
15 = Air conditioner switch
16 = Bypass air switch
17 = Blower switch



30 64 276

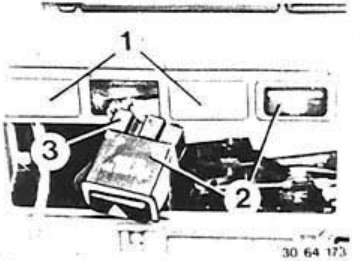
1 = Sliding control lever for air directed to windshield and front side windows

2 = Sliding control lever for air flowing out of center air grills (air slightly colder with heater on than in case of 1 and 3)

3 = Sliding control lever for air directed to footwells

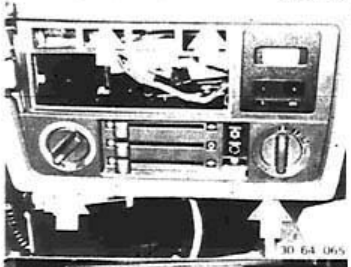
64 11 071 REPLACING CABLE FOR FOOTWELL VENTILATION

Disconnect battery ground lead.
Remove and install instrument panel trim on left side 51 45 180.
Remove and install tray 51 16 200.

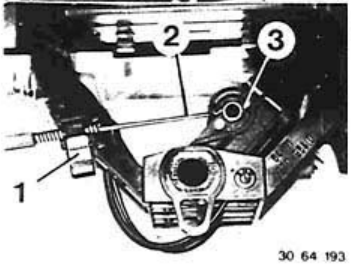


30 64 173

Remove radio opening mask or radio.
Pull opening covers (1) or switches (2) out of control panel.
Pull off plugs (3) on switches (2).

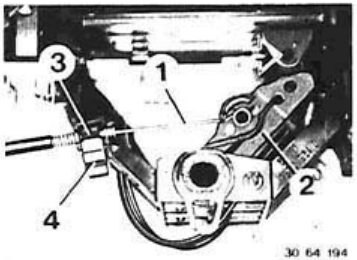

30 64 065

Unscrew screws.
Pull out control panel slightly.



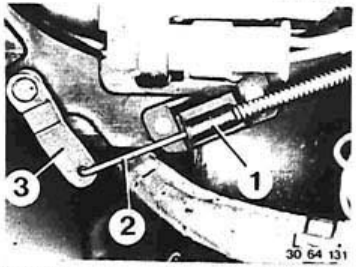
30 64 193

Lift out clamp (1).
Disconnect cable (2) on lever (3).



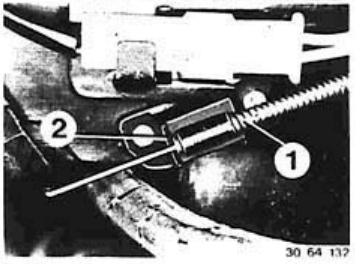
30 64 194

Installation:
Connect cable (1) in sliding control (2).
Push sliding control and air flap against stop.
Turn sleeve (3) enough until it can be placed in opening.
Secure cable with clamp (4).



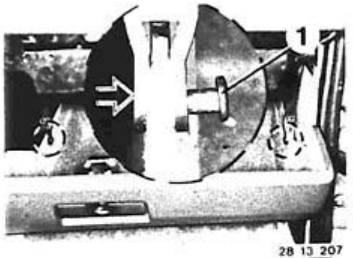
30 64 131

Pull out clamp (1).
Disconnect cable (2) on lever (3) and remove.



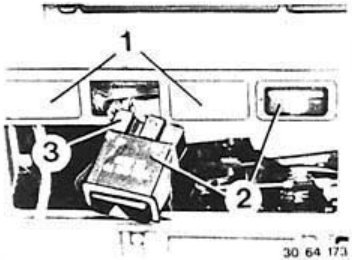
30 64 132

Installation:
Cable sleeve (1) must be flush with stop (2).

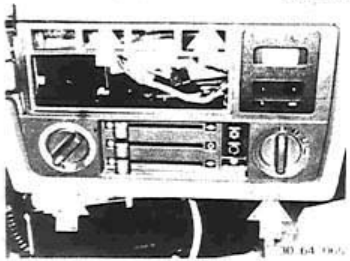


64 11 081 REPLACING CABLE FOR WINDOW VENTILATION

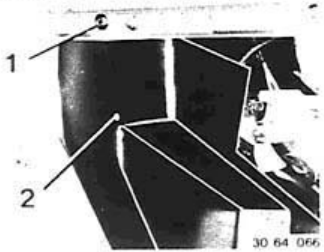
Disconnect battery ground lead.
Remove and install instrument panel trim on left side 51 45 180.
Remove and install tray 51 16 200.
Open glove box.
Disconnect pins (1) of both retaining straps.



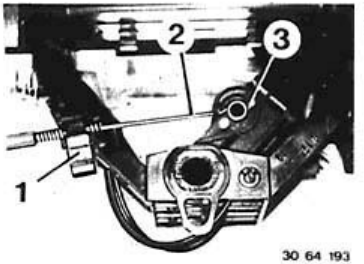
Remove radio opening mask or radio.
Pull opening covers (1) or switches (2) out of control panel.
Pull off plugs (3) on switches (2).



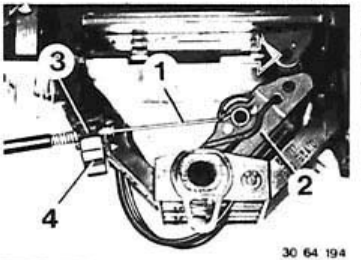
Unscrew screws.
Pull out control panel slightly.



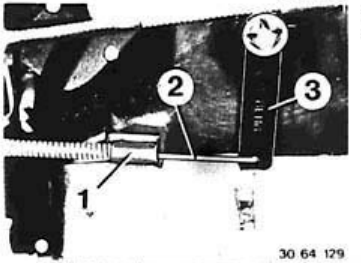
Unscrew screw (1).
Take off trim panel (2).



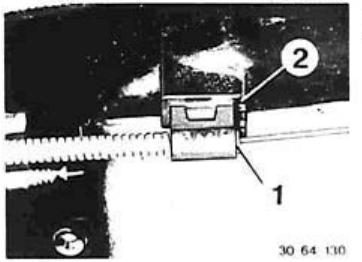
Lift out clamp (1).
Disconnect cable (2) on lever (3) and remove.



Installation:
Connect cable (1) in sliding control (2).
Push sliding control and air flap against stop.
Turn sleeve (3) enough until it can be placed in opening.
Secure cable with clamp (4).

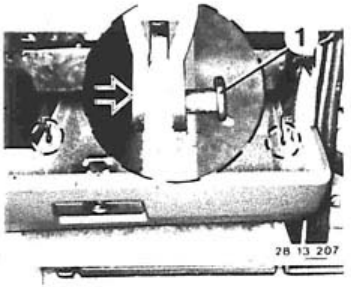


Pull out clamp (1).
Disconnect cable (2) on lever (3) and remove.

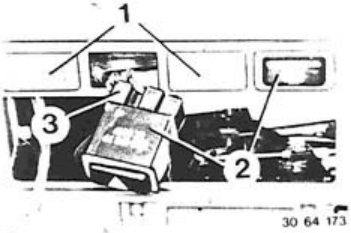


Installation:
Cable sleeve (1) must be flush with stop (2).

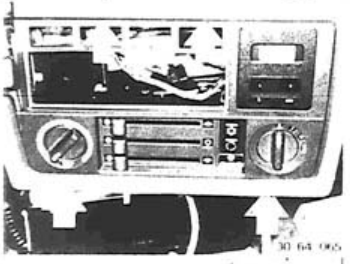
64 11 161 REPLACING CABLE FOR TEMPERATURE MIXING FLAP



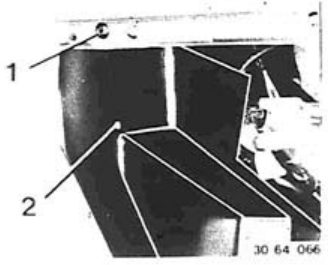
Disconnect battery ground lead.
Remove and install instrument panel trim on left side 51 45 180.
Remove and install tray 51 16 200.
Open glove box.
Disconnect pins (1) of both retaining straps.



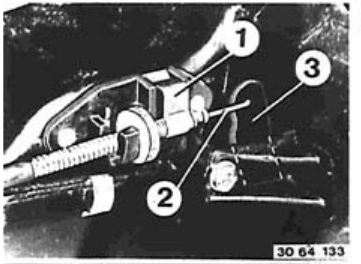
Remove radio opening mask or radio.
Pull opening covers (1) or switches (2) out of control panel.
Pull off plugs (3) on switches (2).



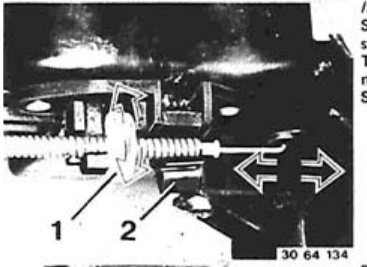
Unscrew screws.
Pull out control panel slightly.



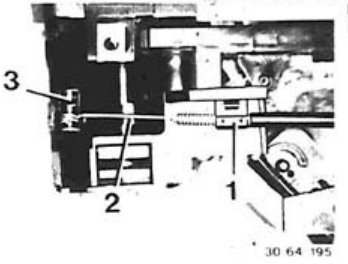
Unscrew screw (1).
Take off trim panel (2).



Lift out clamp (1).
Disconnect cable (2) on lever (3).

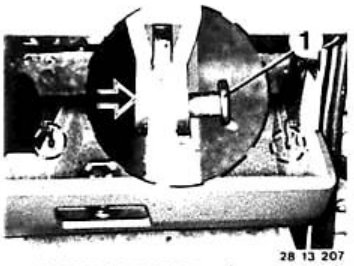


Installation:
Set temperature selection wheel to (cold or warm) stop.
Turn knurled nut (1) to also move temperature mixing flap to (cold or warm) stop.
Secure cable with clamp (2).

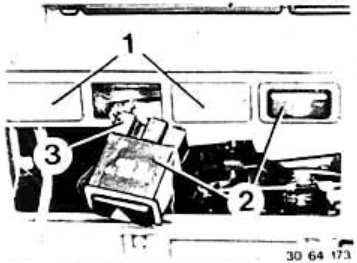


Pull out clamp (1).
Disconnect cable (2) on lever (3) and remove.

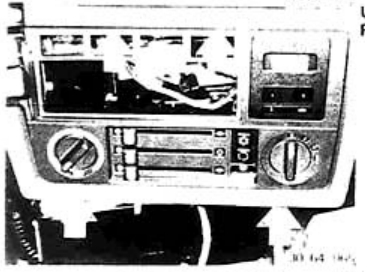
64 11 191 REPLACING CABLE FOR FRESH AIR FLAP



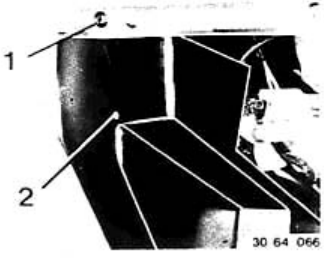
Disconnect battery ground lead.
Remove and install instrument panel trim on left side 51 45 180.
Remove and install tray 51 16 200.
Open glove box.
Disconnect pins (1) of both retaining straps.



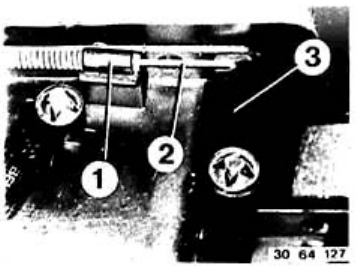
Remove radio opening mask or radio.
Pull opening covers (1) or switches (2) out of control panel.
Pull off plugs (3) on switches (2).



Unscrew screws.
Pull out control panel slightly.

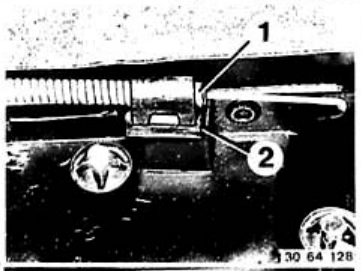


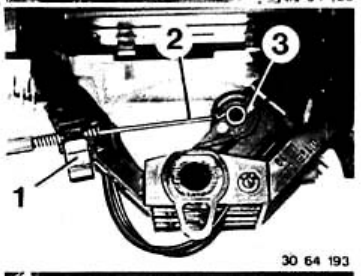
Unscrew screw (1).
Take off trim panel (2).



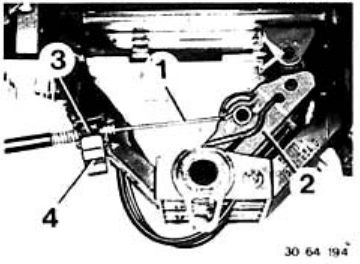
Pull out clamp (1).
Disconnect cable (2) on lever (3) and remove.

Installation:
Cable sleeve (1) must be flush with stop (2)

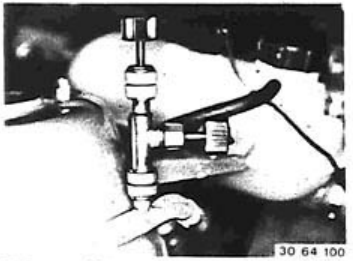




Lift out clamp (1).
Disconnect cable (2) on lever (3) and remove.



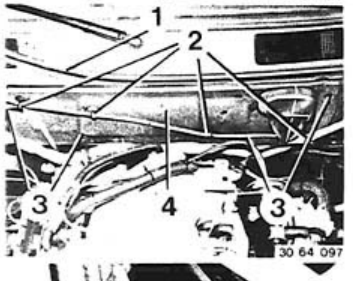
Installation:
Connect cable (1) in sliding control (2).
Push sliding control and air flap against stop.
Turn sleeve (3) enough until it can be placed in opening.
Secure cable with clamp (4).



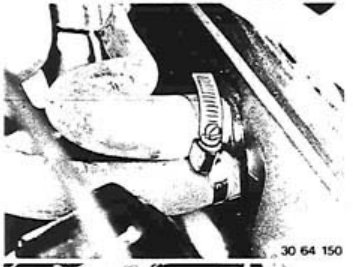
64 11 205 REMOVING AND INSTALLING HEATER

Remove dashboard trim panel – see 51 45 030.
Don't discharge refrigerant outdoors, but instead draw it out of system – refer to operating instructions supplied with equipment.

Installation:
Discharge, charge and check air conditioner for leaks after installation.



Disconnect battery ground lead.
Pull off rubber strip (1).
Cut off wire straps (2).
Unscrew bolts (3).
Place cover (4) aside.

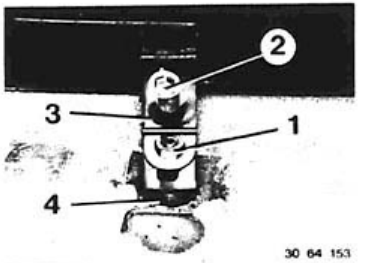


Drain coolant.
Disconnect both water hoses.

Installation:
Bleed cooling system.
Check coolant.

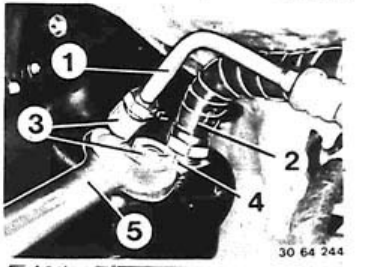


Disconnect plugs (1) connecting heater wire harness and car wire harness.



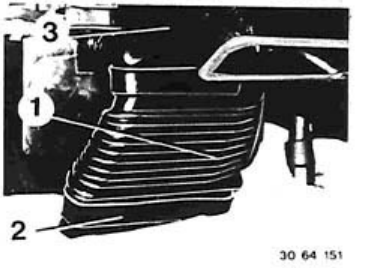
Unscrew nut (1) and bolt (2).
Take off bracket (3).

Installation:
Check rubber mount (4), replacing if necessary.



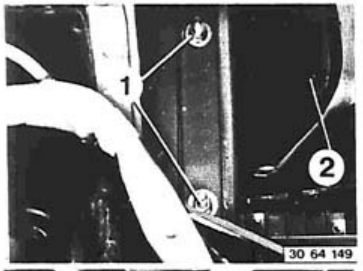
Only for Cars with Air Conditioner:
Unscrew pipes (1 and 2).
Insert plugs (3) in open connections immediately.
Counterhold on block valve (4) with wrench (5).

Installation:
Tightening torque*.
Replace seals.

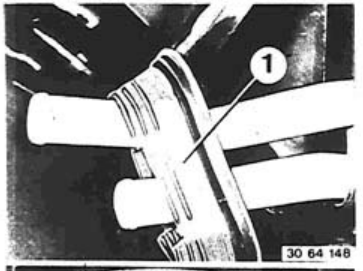


Remove connector (1) between heater (3) and rear area heater duct (2) on left and right sides.

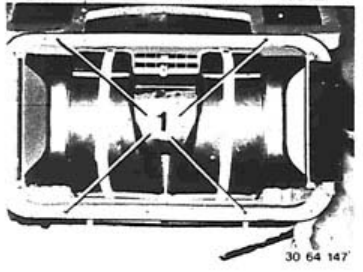
* See Specifications



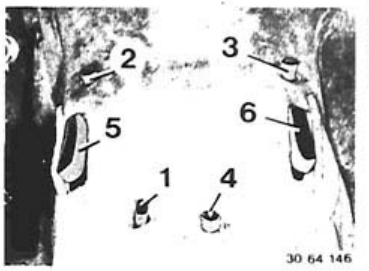
Unscrew nuts (1) on left and right sides.
Remove heater.
Note:
Close bypass air flaps (2) – heater can only be removed in this state.



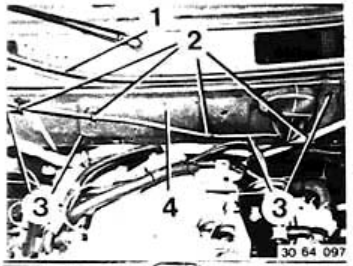
Installation:
Check for perfect fit of sleeve (1) in body wall.



Installation:
Check sealing frame (1), replacing if necessary.

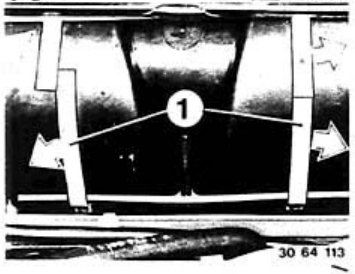


Installation
Condensation water drains (1 ... 3) must be connected with heater.
Check rubber mount (4), replacing if necessary
(5) and (6) are heater ducts for rear area of car



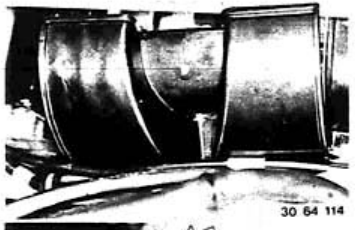
64 11 210 REMOVING AND INSTALLING HEATER MOTOR

Disconnect battery ground lead.
Pull off rubber strip (1).
Cut off wire strap (2).
Unscrew bolt (3).
Lay cover (4) aside.



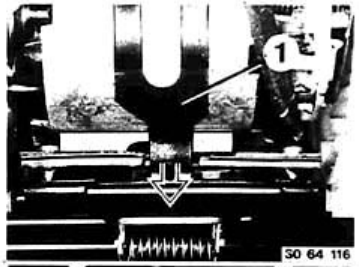
Open retaining straps (1) and swing aside..

Remove cover.

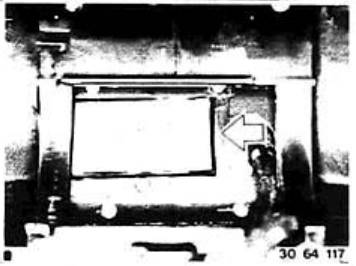




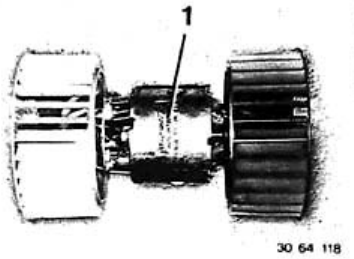
Pull off both wire plugs.



Disengage clamp (1).
Lift out fan motor with fan.

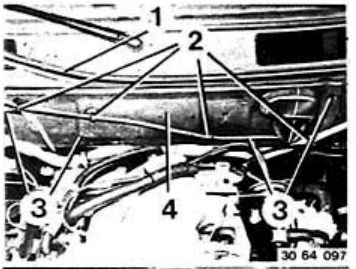


Important!
Be careful not to damage the air flap.



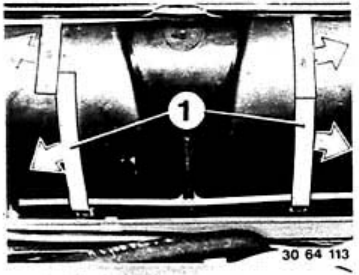
Installation:
Check code number (1)*.
Important!
Do not remove or turn fan wheels on motor shaft since motor and fan wheels were balanced in assembled state.

* See Specifications and Spare Part Microfilm



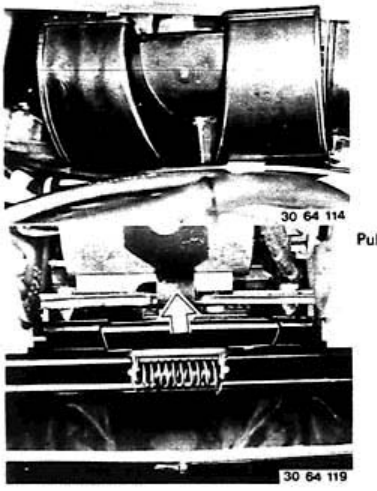
64 11 220 REMOVING AND INSTALLING RESISTOR PLATE FOR BLOWER MOTOR

Disconnect battery ground lead.
Pull off rubber strip (1).
Cut off wire strap (2).
Unscrew bolts (3).
Lay cover (4) aside.



Open retaining straps (1) and swing aside.

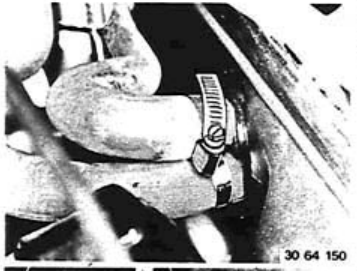
Remove cover.



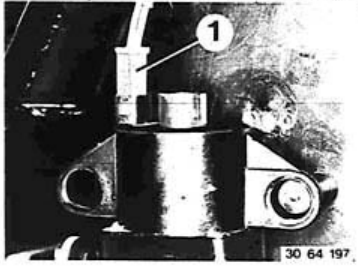
Pull off resistor plate.

64 11 271 REPLACING WATER VALVE FOR HEATER

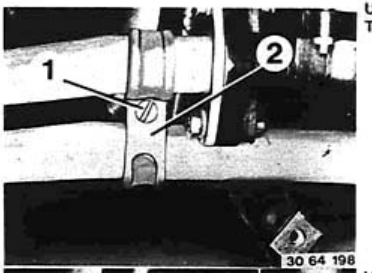
Disconnect battery ground lead.
Remove and install instrument panel trim on left side 51 45 180.
Remove and install tray 51 16 200.



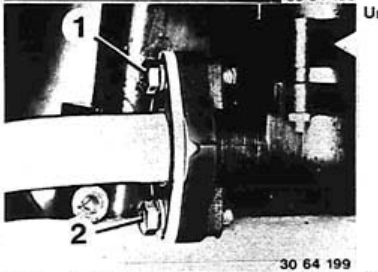
Drain coolant.
Disconnect both water hoses.
Installation:
Bleed cooling system.
Check coolant.



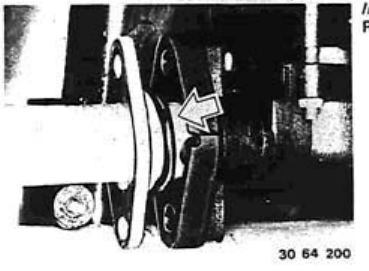
Pull off plug (1).



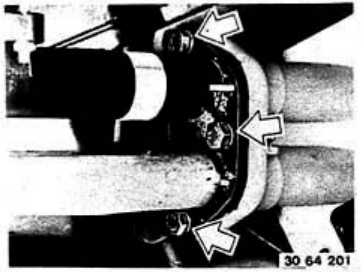
Unscrew bolt (1).
Take off clamp (2).



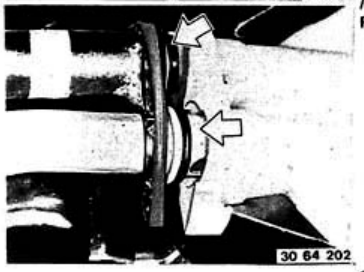
Unscrew bolts (1 and 2).



Installation:
Replace seal.



Unscrew bolts.
Take out water valve with pipes.

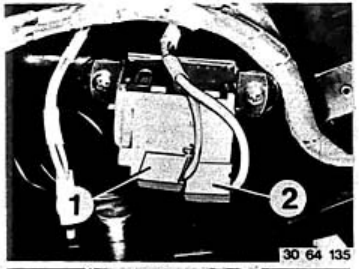


Installation:
Replace seals.

Checking Water Valve:
Water valve will be open when without electric power.
Water valve should be closed when applying battery voltage.

64 11 365 REPLACING ICING PREVENTION SWITCH

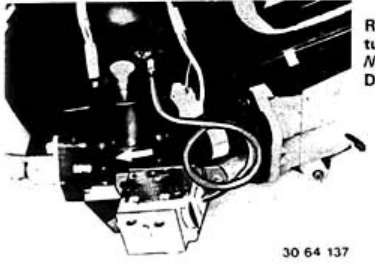
Disconnect battery ground lead.
Remove and install console 51 16 200.
Remove and install instrument panel trim at left 51 45 180.



Pull off plugs (1 and 2).



Unscrew screws.



Remove temperature switch and pull temperature sensor out of housing at same time.
Note:
Don't bend the temperature sensor.

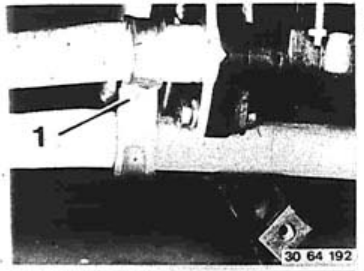


64 11 311 REMOVING AND INSTALLING FRESH AIR GRILL

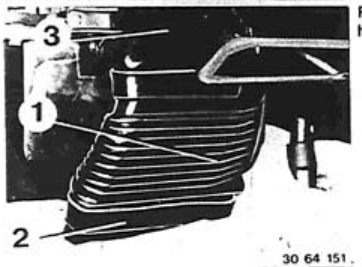
Fresh air grills are merely plugged in (lift out toward front).

64 11 531 REPLACING HEATER CORE

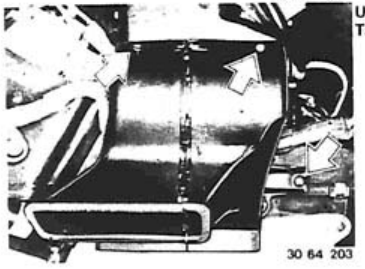
Disconnect battery ground lead.
Remove and install tray 51 16 200.
Remove and install instrument panel trim on left side 51 45 180.



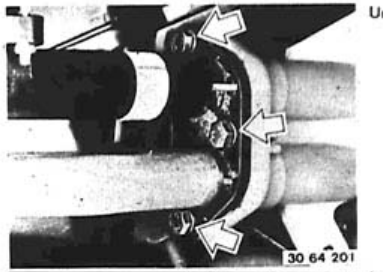
Drain coolant.
Loosen screw (1).



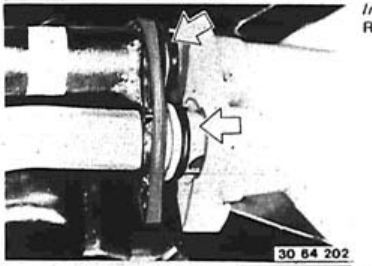
Remove connector (1) on left side between heater (3) and rear area heater duct (2).



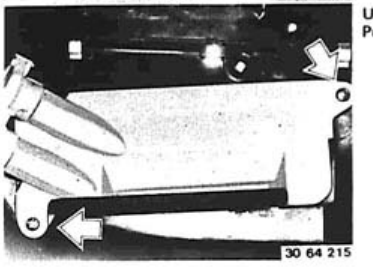
Unscrew screws.
Take off molded part.



Unscrew bolts.



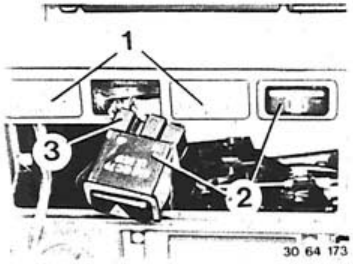
Installation:
Replace seals.



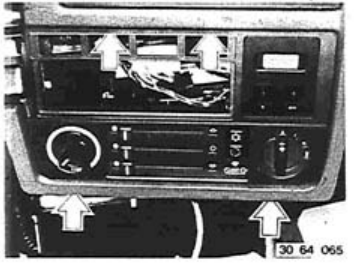
Unscrew bolts.
Pull heater core out of housing.

64 11 . . . REPLACING ONE OPERATING MOTOR FOR FRESH AIR / BYPASS AIR FLAP

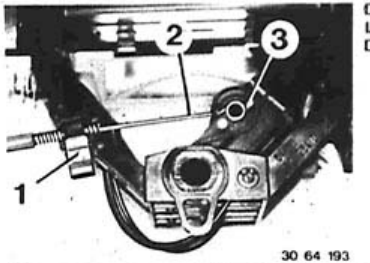
Disconnect battery ground lead.
Remove and install tray 51 16 200.
Remove and install instrument panel trim on left side 51 45 180.



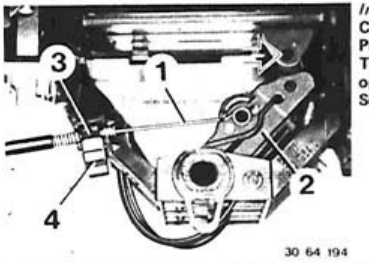
Remove radio opening mask or radio.
Pull opening covers (1) or switches (2) out of control panel.
Pull off plugs (3) on switches (2).



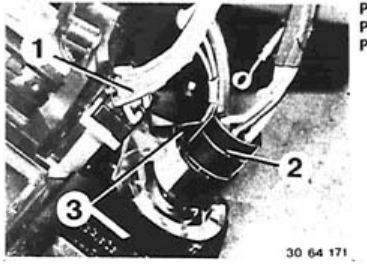
Unscrew screws.
Pull out control panel slightly.



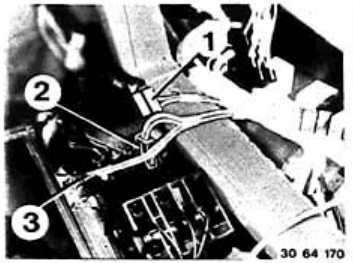
Disconnect all cables as described earlier.
Lift out clamp (1).
Disconnect cable (2) on lever (3).



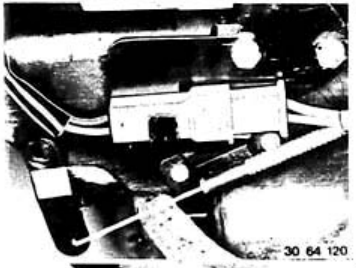
Installation:
Connect cable (1) in sliding control (2).
Push sliding control and air flap against stop.
Turn sleeve (3) enough until it can be placed in opening.
Secure cable with clamp (4).



Pull off plug (1) on air conditioner switch.
Pull off plug (2) on blower switch.
Pull off wire (3) with bulb holder.



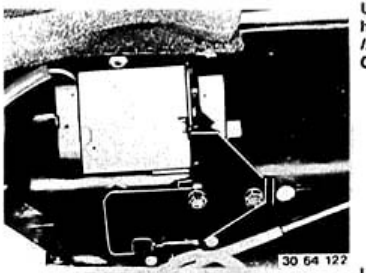
Pull off plug (1) on temperature control housing.
Pull off plug (2) on sliding control.
Pull off wire (3) with bulb holder.
Pull off plug on clock.
Place control unit aside.



Disconnect plugs.



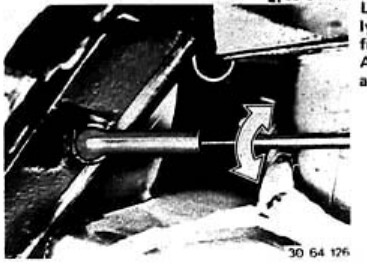
Disconnect operating rod.



Unscrew bolts and take off operating motor with holder.
Installation:
Connect holder in housing bar.



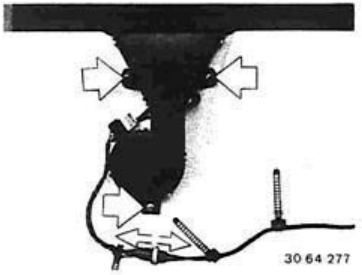
Unscrew bolts.
Take operating motor off of holder.



Length of operating rod must be adjusted correctly so that operating motor can open and close fresh air/bypass air flaps fully.
Adjust by disconnecting operating rod on motor and turning operating rod in ball socket joint.

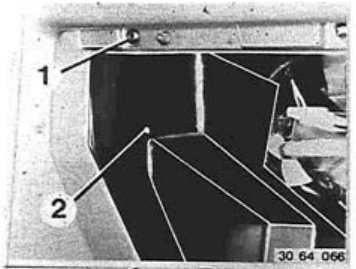
64 23 000 **REMOVING AND INSTALLING OR REPLACING REAR WINDOW VENTILATOR (Convertible)**

Remove rear seat cushion and backrest – see 52 20 000.



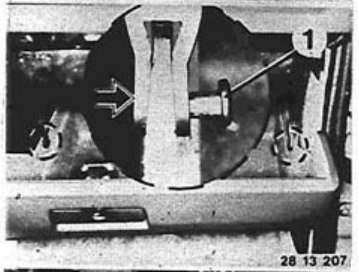
Disconnect plug.
Pull off relay.
Unscrew screws and take off fan.

Note:
Fan will only work with top closed (microswitch in top storage box on left side).

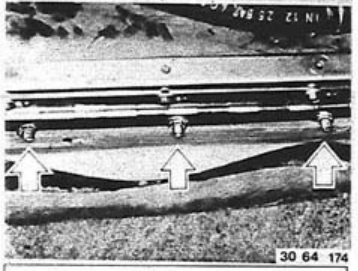


64 31 500 REPLACING MICROFILTER FOR INSIDE VENTILATOR

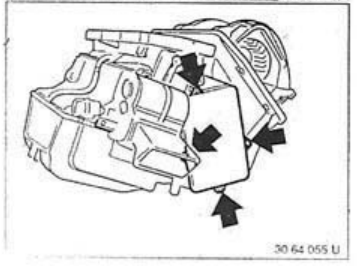
Open glove box.
Unscrew screw (1).
Take off trim (2).



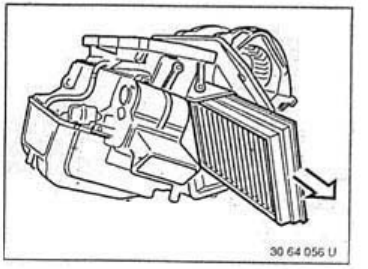
Disengage pins (1) of both retaining straps.



Loosen nuts and take out glove box.



Unscrew screws and take off cover.



Remove filter.

DESCRIPTION OF AIR CONDITIONING SYSTEM

Switching on the air conditioner activates electromagnetic coupling (1) of compressor (2). The compressor (2) is now driven by the running engine.

Compressor (2) increases the pressure of gaseous refrigerant (Frigen), which automatically causes the refrigerant temperature to also rise.

The refrigerant puts off heat in condenser (3), through which it is condensed (turns into a liquid).

Drier (4) removes residual water from the refrigerant and absorbs it.

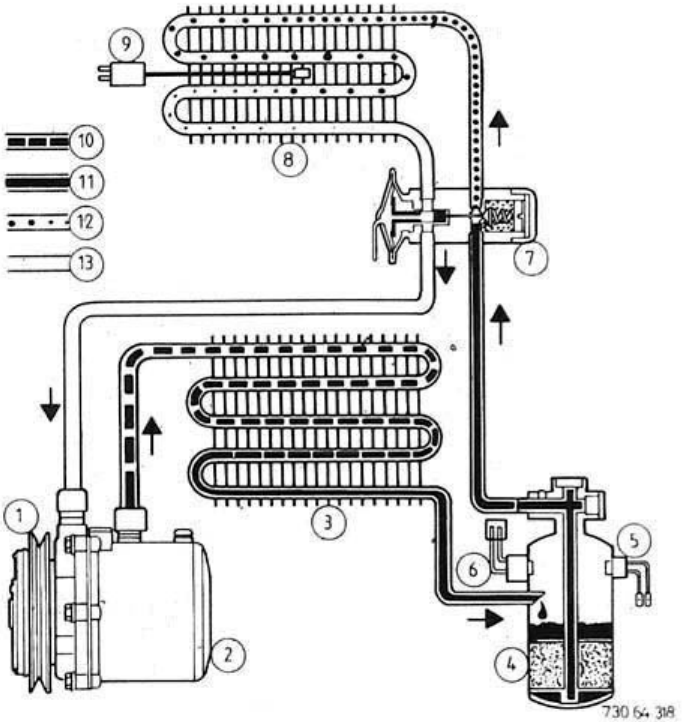
Safety switches (5 and 6) stop the compressor when pressure is too high or too low*. In this manner damage is prevented in the air conditioning system.

Expansion valve (7) meters the amount of refrigerant which is injected into evaporator (8). The amount of refrigerant will depend on the temperature and pressure of refrigerant at outlet of the evaporator.

The liquid refrigerant expands in evaporator (8) and is turned into gas. This change in state produces strong cooling off of the refrigerant and evaporator. The fresh air (or bypass circulation air) is cooled as it passes the evaporator.

Freezing prevention switch (9) switches the compressor to prevent the formation of ice on the evaporator. Ice formation would reduce the cross section opening size and impair cooling efficiency.

Moisture in the fresh air (or bypass circulation air) condenses on the evaporator and is discharged outside of car via lines on the transmission tunnel. This water is normal and not a sign of leakage.



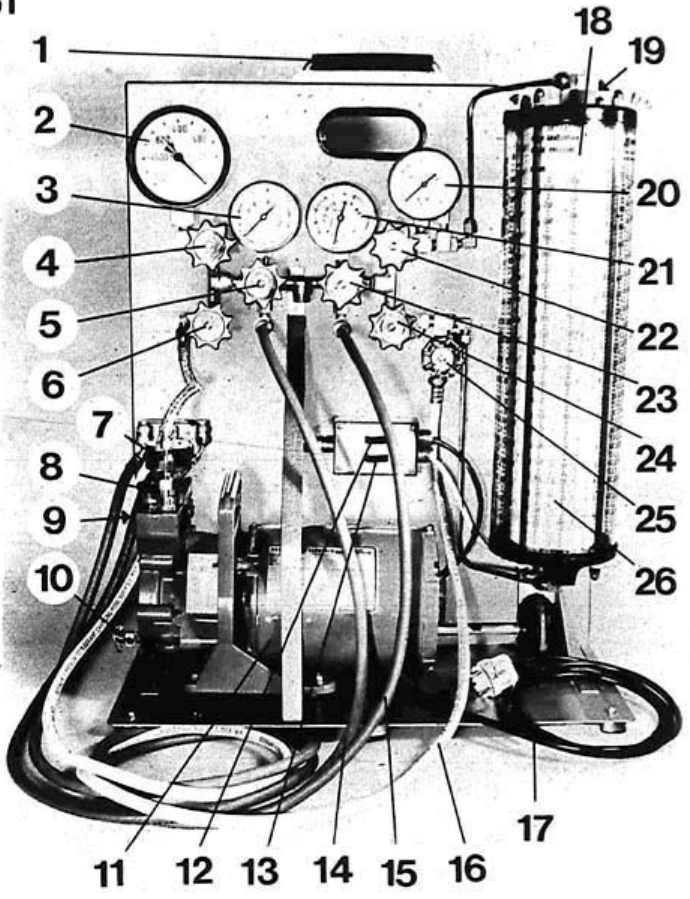
Main Components of Air Conditioner

1 = Pulley with electromagnetic coupling
2 = Compressor
3 = Condenser
4 = Drier
5 = Safety switch (low pressure pressostat)
6 = Safety switch (high pressure pressostat)
7 = Expansion valve
8 = Evaporator
9 = Freezing prevention switch
10 = High pressure – gas
11 = High pressure – liquid
12 = Low pressure – liquid
13 = Low pressure – gas

* See Specifications

DISCHARGING AND CHARGING STATION

1 = Pull-out carrying handle
2 = Pressure gage
3 = Low pressure gage
4 = Vacuum valve
5 = Charging valve "low pressure"
6 = Shut-off valve
7 = Filter
8 = Gas ballast valve
9 = Oil level sight glass
10 = Shut-off valve – compressor oil
11 = Vacuum pump
12 = Switch
13 = Switch
14 = Charging hose (blue) "low pressure"
15 = Charging hose (red) "high pressure"
16 = Charging hose (white)
17 = Power cord
18 = Volume scale
19 = Schrader valve
20 = Pressure gage "charging pressure"
21 = Pressure gage "high pressure"
22 = Charging valve "gas"
23 = Charging valve "high pressure"
24 = Charging valve "liquid"
25 = Charging valve "refrigerant"
26 = Charging cylinder



730 64 342

64 50 009 DISCHARGING AND CHARGING AIR CONDITIONER

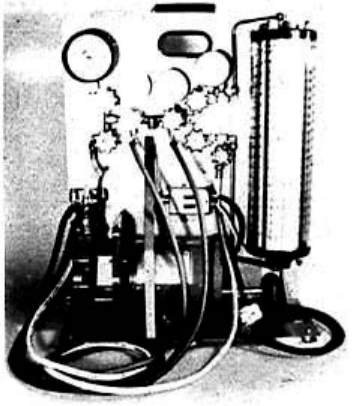
Safety Precautions for Handling Refrigerants:

The air conditioning system must be filled with a safety refrigerant (Frigen 12).
Although this refrigerant is non-toxic, non-flammable and non-explosive in any mixture ratio with air at normal temperatures, it can still be dangerous when appropriate safety precautions were not observed.

Avoid any contact with liquid or gaseous refrigerants. When working on the refrigerant circuit of an air conditioner protect hands with gloves and eyes with goggles.

Refrigerant on the skin will cause frostbite. Wash off pertinent parts of body with cold water thoroughly. If refrigerant gets in the eyes, also rinse out with water and then contact a physician immediately.

Refrigerants are heavier than air and therefore should not be discharged in closed rooms. Especially in working pits there would be an acute danger of asphyxiation, which would not be noticeable since the gas has no color or odor.
Turn on available air extraction systems.
Never perform welding work on a discharged air conditioner or in the vicinity. The pressure which would occur could lead to an explosion.
In addition, refrigerants decompose at high temperatures or when exposed to an open flame. The decomposed products are injurious to health.
Store full refrigerant cylinders that they are not subjected to direct sunshine or other sources of heat (max. temperature 45° C / 113° F).

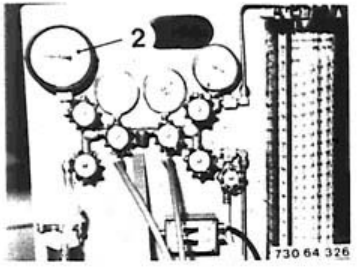


730 64 315

Discharging and Charging Air Conditioner:

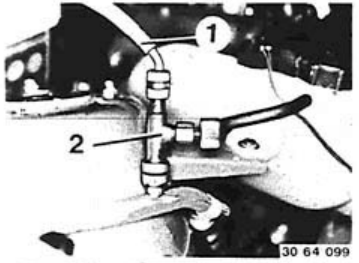
Conform with operating instructions supplied with pertinent charging equipment.
Major Procedures:
1) Connecting charging equipment.
2) Discharging (time depends on condition of air conditioner).
3) Flushing with refrigerant.
4) Discharging.
5) Charging with refrigerant – "volume"*.
   Caution!
   Never operate air conditioner while charging.
6) Checking function of air conditioner.

* See Specifications

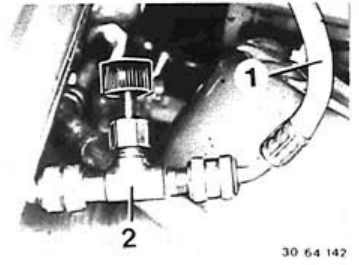


Check operating condition of discharging and charging equipment before using.
Check oil level and oil grade in compressor.
Also refer to operating instructions for charging equipment.
Caution!
Do not subject pressure gage (2) to excessive pressure during procedures – danger of destruction.

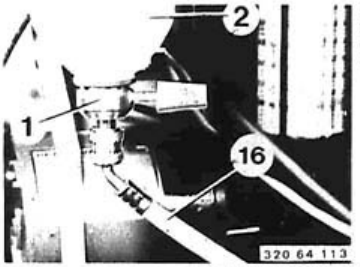
Note:
An air conditioner could also be discharged and charged with only one charging hose (high or low pressure side).
Discharging and charging procedures, however, are faster when carried out with a core valve remover and two charging hoses..
Absolute cleanliness is required for work on air conditioners.
Wear protective clothes.
Close all valves on equipment before starting work.
Following jobs are only applicable to the illustrated charging station.



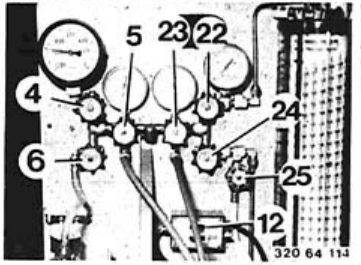
Remove cap.
Connect blue charging hose (1) on low pressure side (thick pipe) of air conditioner.



Remove cap.
Connect red charging hose (1) on high pressure side (thin pipe or drier) of air conditioner.

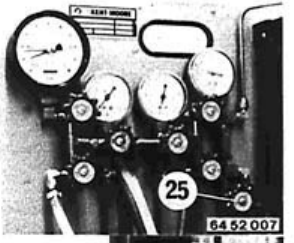


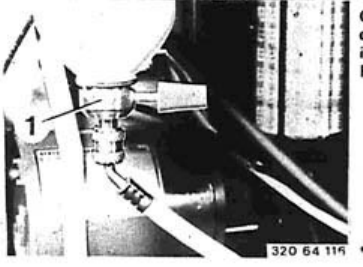
Connect refrigerant bottle (2) and charging hose (16) with charging valve (1).
Charging valve (1) remains closed until filling the charging cylinder.



Open valves (4, 6 and 22).
Turn on pump with switch (12) and discharge air conditioner.
Close valve (22) and open valves (5 and 23).
Discharge air conditioner.

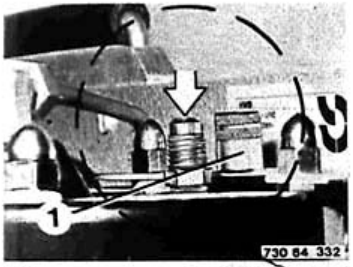
Open valve (25).



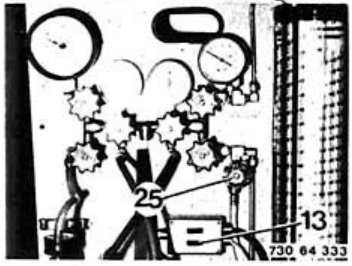


Open charging valve (1) and fill charging cylinder with refrigerant while air conditioner is being further discharged.
Refrigerant and volume*.

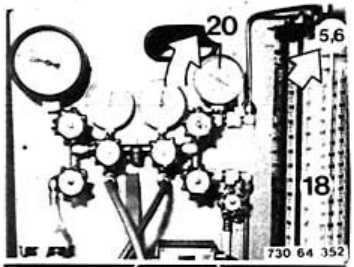
* See label in engine compartment.



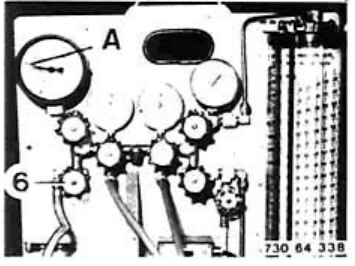
To fill charging cylinder, unscrew the cap (1) and let pressure escape from charging cylinder by pressing down on the valve core.
This is necessary to have refrigerant flow into the charging cylinder.



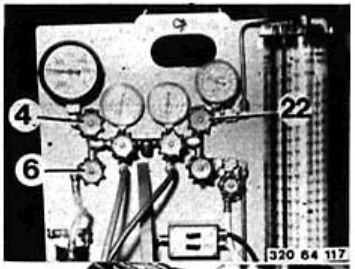
Close charging valve (25) after finishing charging procedures and operate heater with switch (13).



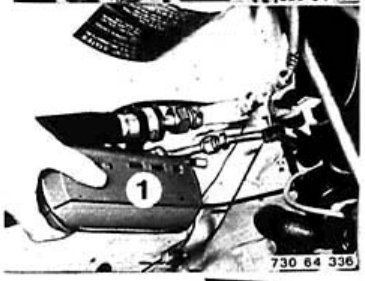
Read rising pressure in charging cylinder on pressure gage (20) and set same pressure (e.g. 5.6 bar / 80 psi) on volume scale (18).
Only the amount of refrigerant in the charging cylinder can be read on the volume scale.
Switch off heater after reaching charging pressure of 4.9 to 9.1 bar (70 to 129 psi).



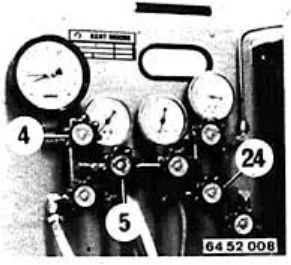
After completion of discharging:
Close shut-off valve (6).
Mark red needle (A) with displayed value.
If pressure does not rise, air conditioner does not have moisture or leaks.
Switch off vacuum pump.



Leak Test:
Close shut-off valve (6).
Close vacuum valve (4).
Switch off vacuum pump.
Open charging valve (22) about 1 second and then close again.



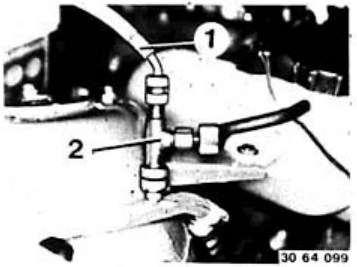
Calibrate leak detector (1) according to supplied operating instructions.
Check air conditioner for leaks with the leak detector (1).
Eliminate leaks.
Note:
Always look for leaks below an assumed leak point, since refrigerant is heavier than air.



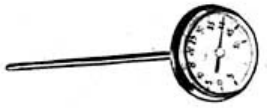
Charging System:
Close vacuum valves (4 and 5).
Open valve (24) and let correct amount* of refrigerant flow into system.

After the correct amount* of refrigerant is in the system, close valve (24).
Disconnect hoses and screw on caps.

* See Label in Engine Compartment

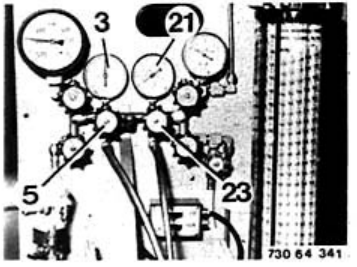


Checking Air Conditioner:
Unscrew cap.
Connect blue charging hose (1) with valve core remover (2) on low pressure side of air conditioner.
Connect high pressure hose as low pressure hose was connected.

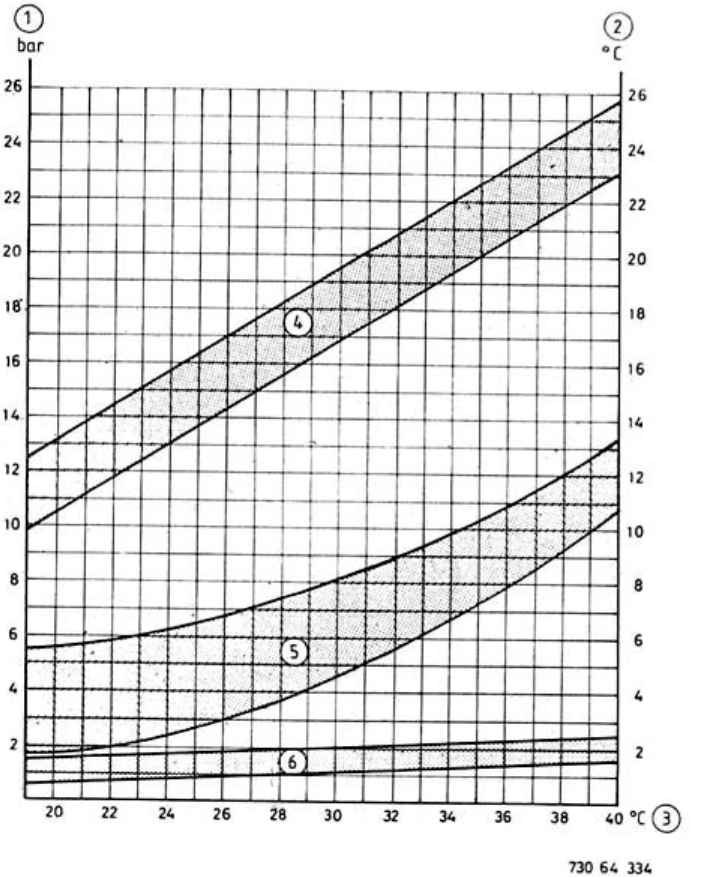


Insert a thermometer in the air outlet grill.
Test Conditions:
1. Car parked in shade (inside of building).
2. Air conditioner discharged, charged. Compressor oil volume and grade okay.
3. Engine speed 2000 rpm and air conditioner switched on.
4. Doors closed.

730 64 350

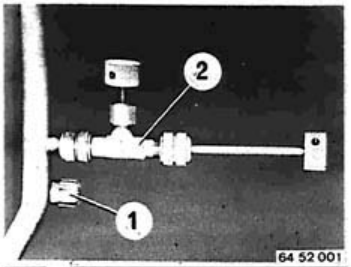


Close all valves of discharging and charging station.
Only open charging valves (5 and 23).
Read pressure from low and high pressure gages (3 and 21) and compare with nominal value graph 730 64 334.
Always only check one pressure range.



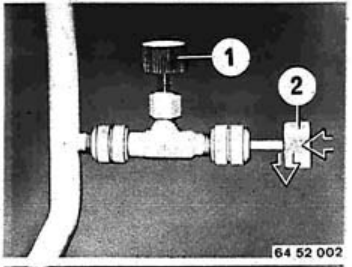
730 64 334

(1) = Pressure scale in bar
(2) = Temperature scale in °C
(3) = Ambient temperature scale in °C
(4) = High pressure range tolerances
(5) = Center nozzle air outlet tolerances
(6) = Low pressure range tolerances

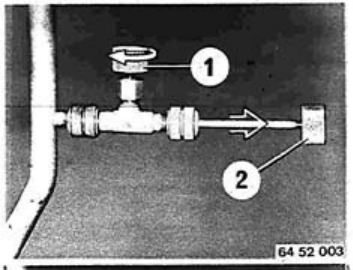


64 52 . . . REMOVING AND INSTALLING VALVE CORE

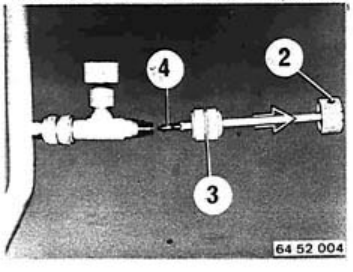
Unscrew cap (1).
Screw on valve core remover (2).



Open valve (1).
Unscrew valve core with valve turner (2).



Pull back valve turner (2) with valve core.
Close valve (1).



Unscrew coupling nut (3) and take off valve turner (2) with valve core (4).



730 64 304

Installation:
Refrigerant-proof valve cores can be recognized on transparent seal (1).



64 52 020 REMOVING AND INSTALLING COMPRESSOR

316 ... 318 I / M 10 Engine:
Important!
Don't discharge refrigerant outdoors, but instead draw it out of system – see operating instructions supplied with equipment

Installation:
Discharge, charge and check air conditioner for leaks after installation.

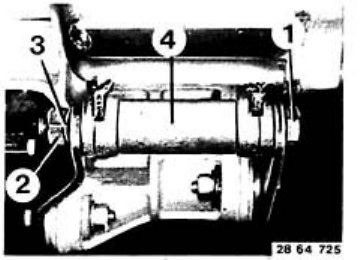
Disconnect plug (1) for solenoid of pulley.



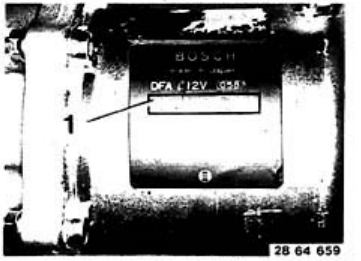


Unscrew bolts (1 an 2).
Disconnect pipes (3 and 4).
Insert plugs in open connections immediately.

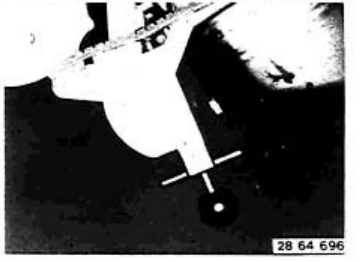
Installation:
Replace seals.
Tightening torque*.



Unscrew nut (2).
Remove bolt (1), washer (3) and spacer (4).
Take off compressor.



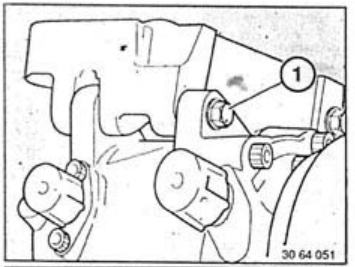
Installation:
Check code number (1)*.
Tightening torque*.



Installation:
Check drive belt tightness with a tester, correcting if necessary.
Pulling hook must always rest on tip of tooth.

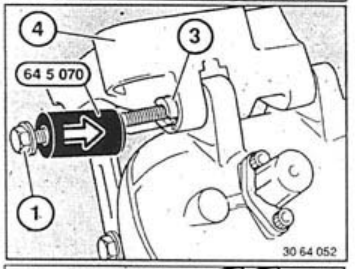
* See Specifications

* See Specifications and Parts Microfiche



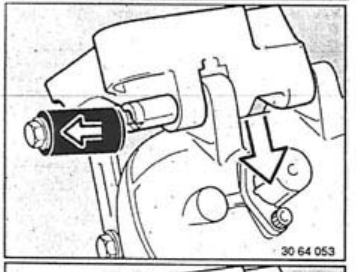
316 ... 318 I / M 40 Engine:
Unscrew bolt (1).

Note:
Shown on removed compressor with bracket for better presentation.

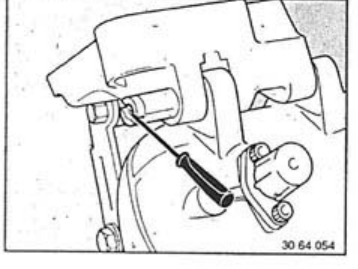


Pull dowel sleeve (3) out of bracket (4) from behind with bolt (1) and Special Tool 64 5 070 so far, until the compressor is loose.

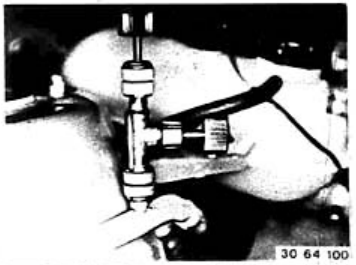
Important!
Use the original bolt so that the compressor is still held while pulling the dowel sleeve out of the compressor bracket and does not fall on the ground.



Unscrew bolt in the dowel sleeve with help of the special tool and remove the compressor.



Installation:
The groove on the dowel sleeve must face out while pulling in so that the dowel sleeve could be held tight should it be turning. The dowel sleeve must be pulled in against the stop.

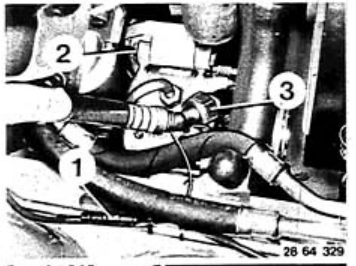


64 52 020 REMOVING AND INSTALLING COMPRESSOR

320 i ... 323 i:

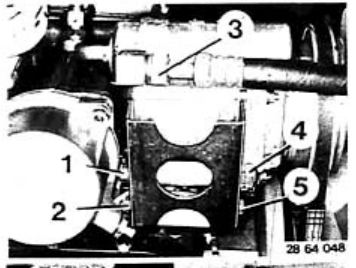
Important!
Don't discharge refrigerant outdoors, but instead draw it out of system – see operating instructions supplied with equipment.

Installation:
Discharge, charge and check air conditioner for leaks after installation.



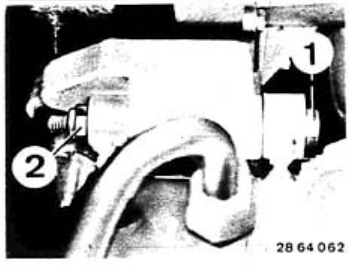
Remove air cleaner.
Disconnect plug (1).
Unscrew nut (2).
Disconnect hose (3).
Insert plugs in open connections immediately.

Installation:
Tightening torque*.
Replace seal.



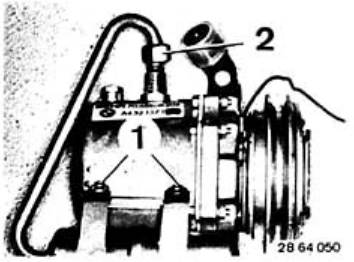
Unscrew nuts (1 and 2).
Disconnect hose (3).
Insert plugs in open connections immediately.
Remove bolts (4 and 5).

Installation:
Tightening torque*.
Replace seal.



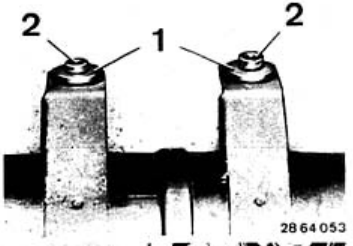
Remove bolt (1).
Remove compressor.

* See Specifications

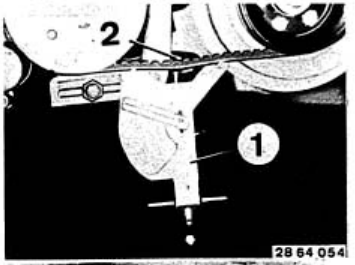


Unscrew bolts (1).
Unscrew nut (2) and take off stabilizer.

Installation:
Tightening torque*.
Replace seal.



Installation:
Check rubber mounts (1), replacing if necessary.
Don't forget the spacers (2).



Installation:
Check drive belt tightness with tester (1).

Note:
Pulling hook (2) must always be on tip of a tooth.

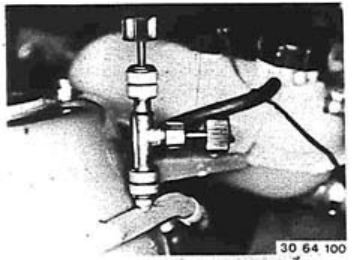


Note:
Replace compressor oil.
Unscrew bolt (1).
Let oil run out of the compressor.
Pour in oil.
Oil volume*.
Oil grade*.

* See Specifications

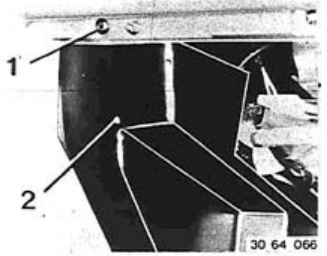
64 51 050 REMOVING AND INSTALLING EXPANSION VALVE

Disconnect battery ground lead.
Remove center console – see 51 16 200.
Remove dashboard trim panel at left – see 51 45 180.

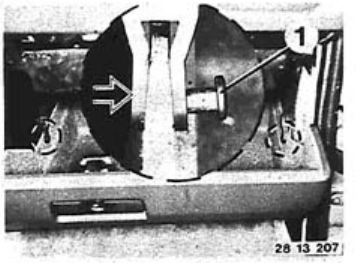


Important!
Don't discharge refrigerant outdoors, but instead draw it out of system – see operating instructions supplied with equipment.

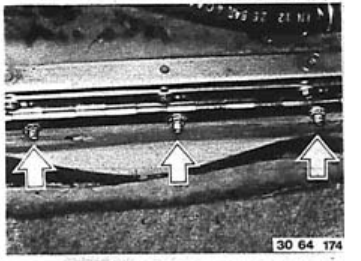
Installation:
Discharge, charge and check air conditioner for leaks after installation.



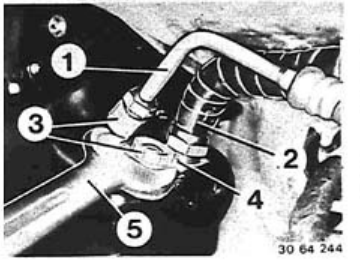
Open glove box.
Unscrew screw (1).
Take off trim (2).



Disengage pins (1) of both retaining straps.



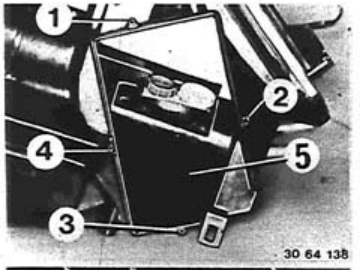
Loosen nuts and remove glove box.



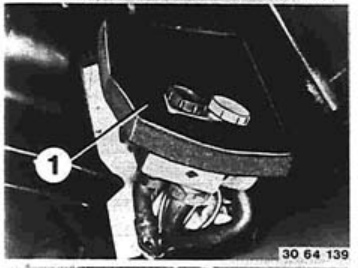
Unscrew pipes (1 and 2).
Insert plugs (3) in open connections immediately.
Counterhold on expansion valve (4) with wrench (5).

Installation:
Tightening torque*.
Replace seals.

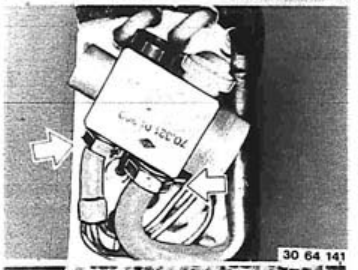
* See Specifications



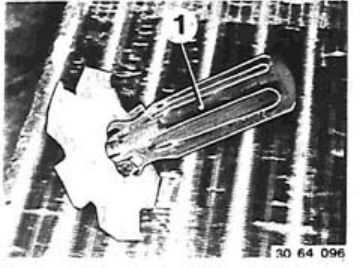
Unscrew bolts (1 ... 4).
Take off cover (5).



Take off foam rubber cover (1).
Pull evaporator out of housing.



Disconnect both pipes.
Insert plugs in open connections immediately.
Counterhold on expansion valve with a wrench.
Installation:
Replace seals.
Tightening torque*.

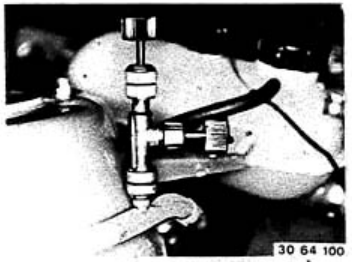


Note.
Straighten up bent plates on evaporator with help of fin comb (1).

* See Specifications

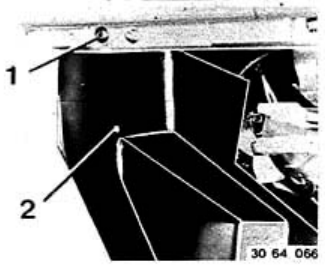
64 51 590 REPLACING EVAPORATOR

Disconnect battery ground lead.
Remove center console – see 51 16 200.
Remove dashboard trim panel at left – see 51 45 180.

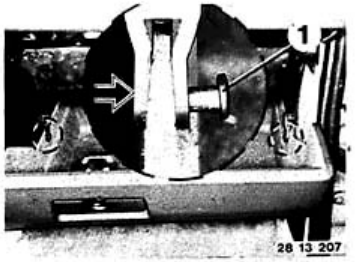


Important!
Don't discharge refrigerant outdoors, but instead draw it out of system – see operating instructions supplied with equipment.

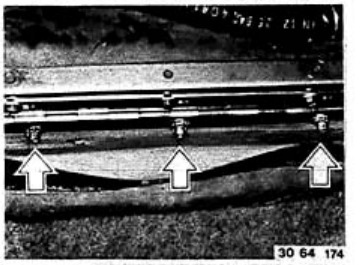
Installation:
Discharge, charge and check air conditioner for leaks after installation.



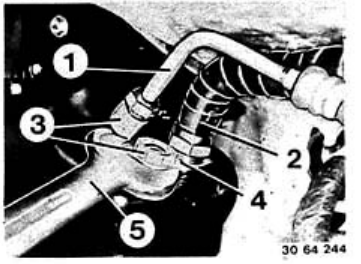
Open glove box.
Unscrew screw (1).
Take off trim (2).



Disengage pins (1) of both retaining straps.



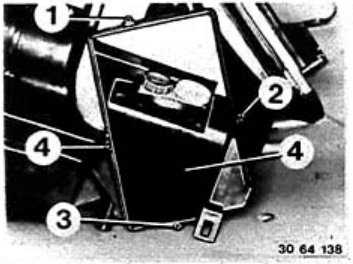
Loosen nuts and remove glove box.



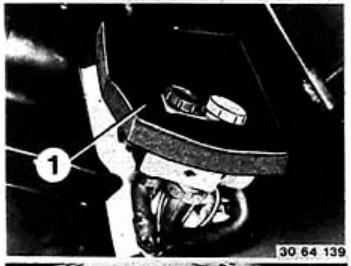
Unscrew pipes (1 and 2).
Insert plugs (3) in open connections immediately.
Counterhold on expansion valve (4) with wrench (5).

Installation:
Tightening torque*.
Replace seals.

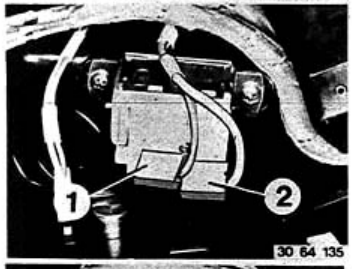
* See Specifications



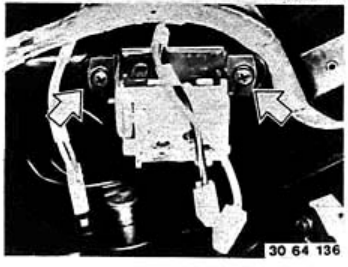
Unscrew screws (1 ... 4).
Remove trim panel (5).



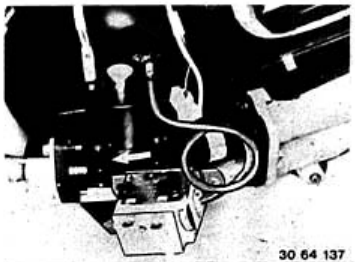
Remove foam rubber cover (1).



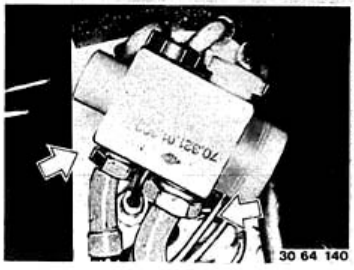
Pull off plugs (1 and 2).



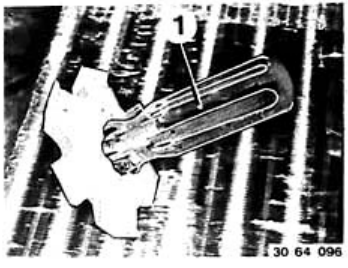
Unscrew bolts.



Remove temperature switch, pulling temperature sensor out of housing at same time.
Note:
Don't bend temperature sensor.

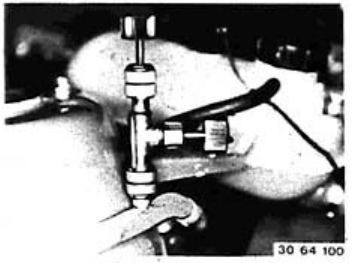


Pull evaporator out of housing.
Disconnect both pipes.
Insert plugs in open connections immediately.
Counterhold on expansion valve with a wrench.
Installation:
Install freezing prevention switch only after installation of evaporator.
Replace seals.
Tightening torque*.



Note:
Straighten bent cooling fins on condenser with help of fin comb (1).

* See Specifications

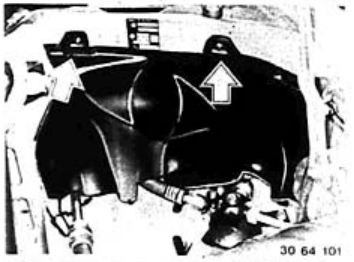

30 64 100

64 53 010 REMOVING AND INSTALLING A/C DRIER

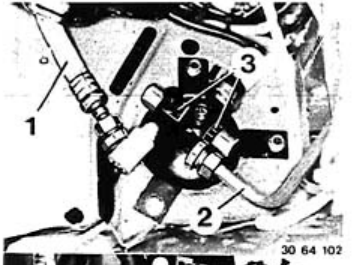
Important!
Don't discharge refrigerant outdoors, but instead draw it out of system – see operating instructions supplied with equipment.

Installation:
Dischrage, charge and check air conditioner for leaks after installation.

Remove washing fluid tank.


30 64 101

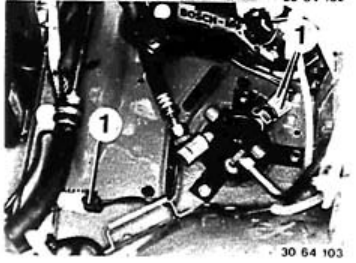
Unscrew screws.
Take off trim.



30 64 102

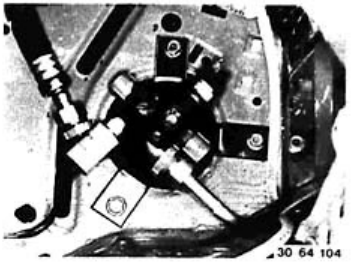
Unscrew pipes (1 and 2), while counterholding on hexagon (3).
Insert plugs in open connections immediately.

Installation:
Tightening torque*.
Check seals, replacing if necessary.

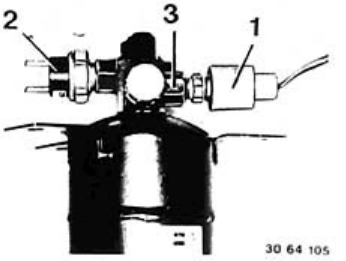


30 64 103

Disconnect plugs (1) on both safety switches.


30 64 104

Unscrew bolts.
Remove drier.



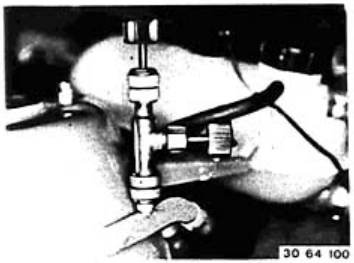
30 64 105

Unscrew safety switch (1 = high pressure and 2 = low pressure pressostat), while counterholding on hexagon (3).
Insert plugs in open connections immediately.

Installation:
Install both safety switches with bolt cement, HWB No. 81 22 9 407 144.
Tightening torque*.

* See Specifications

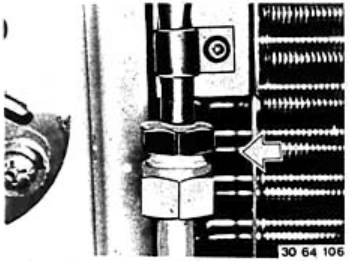
* See Specifications



64 53 050 REMOVING AND INSTALLING CONDENSER

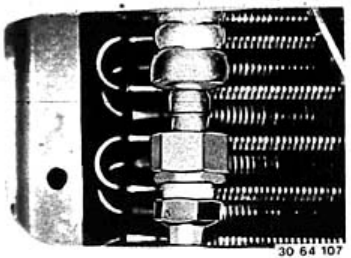
Remove radiator.
Don't discharge refrigerant outdoors, but instead draw it out of system – see operating instructions supplied with equipment.

Installation:
Discharge, charge and check air conditioner for leaks after installation.



Remove right radiator grill section.
Unscrew pipe connection.
Insert plugs in open connections immediately.

Installation:
Tightening torque*.
Replace gasket.



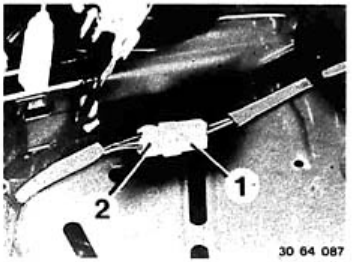
Unscrew pipe connection.
Insert plugs in open connections immediately.

Installation:
Tightening torque*.
Replace gasket.

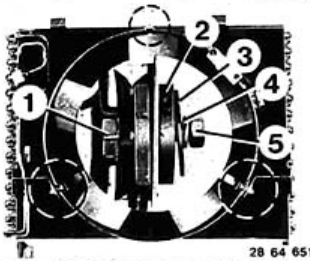


Unscrew bolts.
Remove condenser from above.

* See Specifications

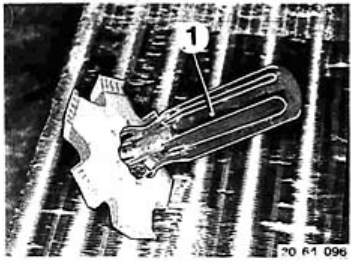


Disconnect multiple-pin plug (1) from additional fan.



Unscrew bolts.
Take additional fan off condenser.

1 = Bolt
2 = Rubber mount
3 = Washer
4 = Lock washer
5 = Nut



Note:
Straighten bent cooling fins with help of special cooling fin comb.

65 Radio and Special Equipment

65 11 030	Radio – remove and install or replace	65- 110
	Bavaria S / Bavaria	65- 110
	Bavaria Cassette III / Europe / CR Digital / Europe Digital	65- 111
	Bavaria C II or Reverse II	65- 111a
	Bavaria Electronic	65- 112
	Becker Mexico Electronic	65- 113
	Business	65- 113a
	Testing instructions for "Bavaria" radios	65- 114
	Troubleshooting	65- 118
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020	Loudspeakers, rear – remove and install or replace	65- 120
65 13 . . .	Sound system layout	65- 130
000	Treble loudspeakers – remove and install or replace	65- 131
020	Rear sound system loudspeakers – remove and install or replace	65- 131
65 14 000	Cassette box – remove and install or replace	65- 140
65 21 101	Retractable antenna (rear) – remove and install or replace	65- 210
65 22 005	Automatic antenna (rear) – remove and install or replace	65- 220
040	Automatic antenna telescope – replace	65- 221
65 71 010	Control unit for cruise control – remove and install or replace	65- 710
020	Drive for cruise control – remove and install or replace	65- 710
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	Test procedures for cruise control	65- 714
65 75 . . .	Burglar alarm survey	65- 750
	Burglar alarm control unit – remove and install or replace	65- 751
	Burglar alarm coding lock – remove and install or replace	65- 751
	Burglar alarm switching unit for driver's door – remove and install or replace	65- 752
	Burglar alarm switching unit for trunk lid – remove and install or replace	65- 752
	Burglar alarm horn – remove and install or replace	65- 753
	Burglar alarm – troubleshoot	65- 754
65 81 020	Control panel for on-board computer – remove and install or replace	65- 810
045	Relay for on-board computer II – remove and install or replace	65- 811
050	Gong for on-board computer – remove and install or replace	65- 811
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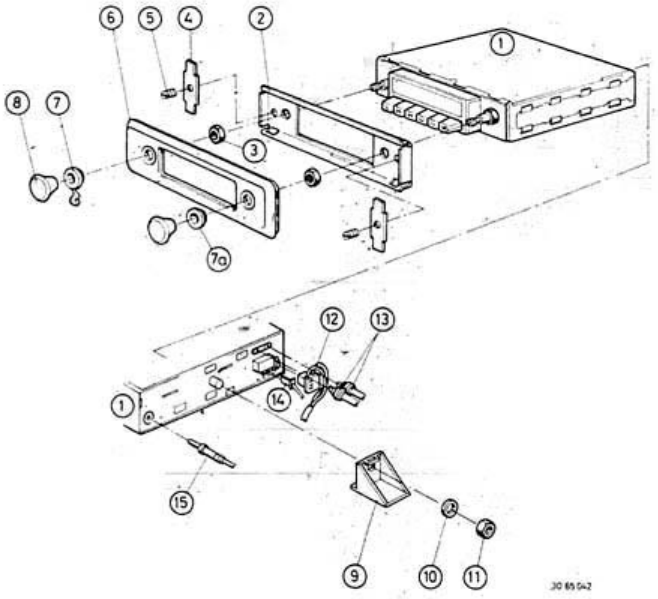
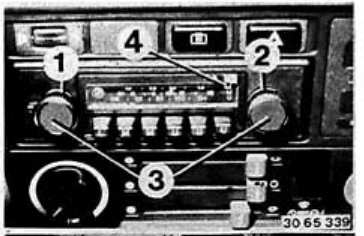
	Test instructions for on-board computer II	65- 813

65 11 030 REMOVING AND INSTALLING OR REPLACING RADIO

1.1 Bavaria S / Bavaria

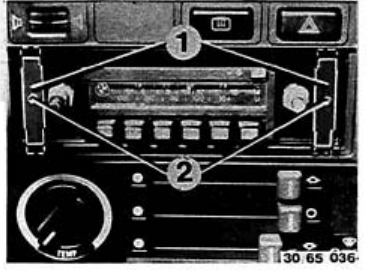




Pull off knobs (3).
Pull off tone regulator (1) and ornament (2).
Installation:
Mounting the left knob activates the no-sound circuit (see operating instructions).
4 = Opening for antenna trimmer



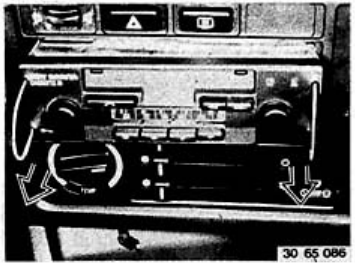
Push back spring retainers (2) upwards to remove the radio face plate (1).
Installation:
Install face plate that spring retainers face up.



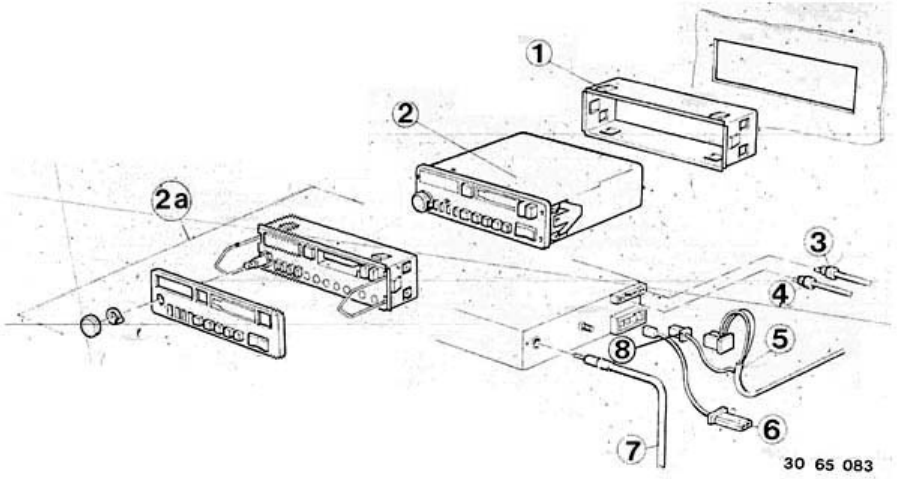
Remove screws (2) and holders (1).
Take out radio.
Installation:
Do not screw in screws too tight.

1	Radio	8	Knob
2	Radio console	9	Support
3	Nut	10	Washer
4	Holder	11	Nut
5	Screw	12	Plug for B + and ground
6	Face plate	13	Plug for speaker
7	Tone regulator (ornament for Bavaria)	14	Plug for automatic antenna
7a	Ornament	15	Plug for antenna

1.2 **Bavaria Cassette III / Bavaria Europe**
Bavaria CR Digital / Bavaria Europe Digital
Bavaria C
Bavaria C Reverse

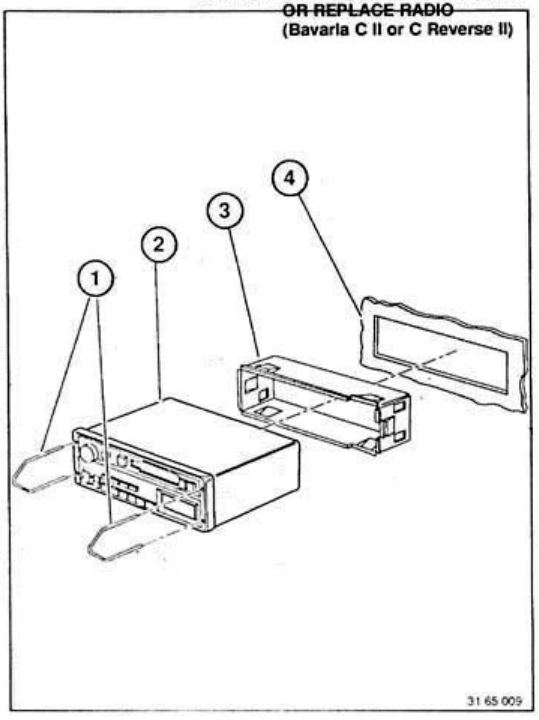


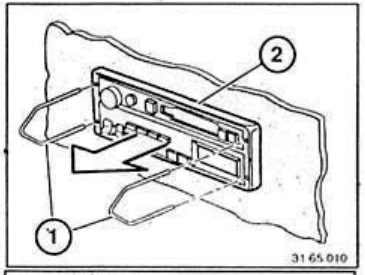
Insert hook and pull out radio with it.
Radios Without Holes in Face Plate:
Pull off knobs and face plate.
Insert unlocking hook and pull out radio.



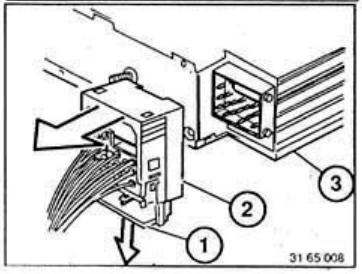
1 Radio console
2 Radio (with holes for removal)
2a Radio (without holes for removal)
3 Plug for speaker, left
4 Plug for speaker, right
5 Plug for B + and ground
6 Plug for power supply (term. 30) (only digital models)
7 Plug for antenna
8 Plug for automatic antenna control

65 11 030 REMOVING AND INSTALLING OR REPLACE RADIO (Bavaria C II or C Reverse II)





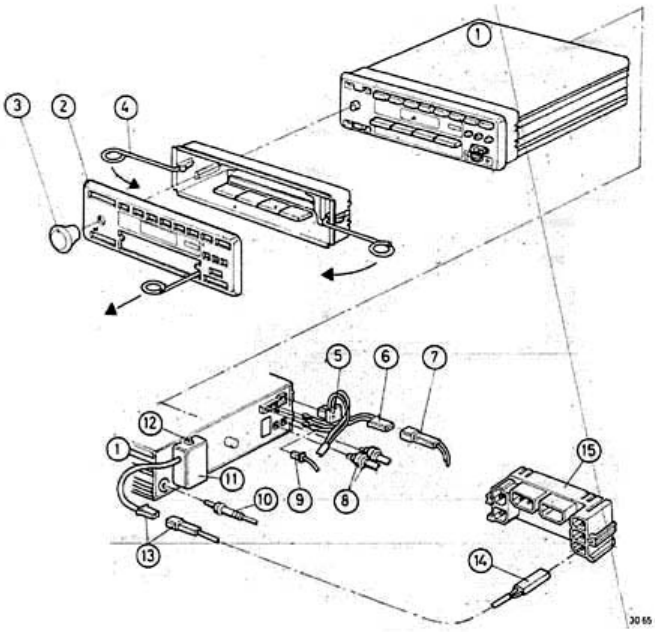
Press left and right unlocking hooks (1) into radio.
Pull out radio with hooks carefully.

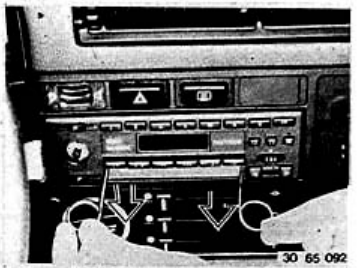


Pull out retainer (1) and disconnect plug (2) on radio (3).

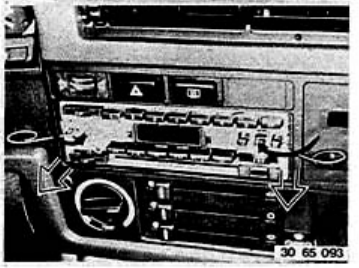
1 = Unlocking hook
2 = Radio
3 = Radio carrier
4 = Radio opening

1.3 Bavaria Electronic





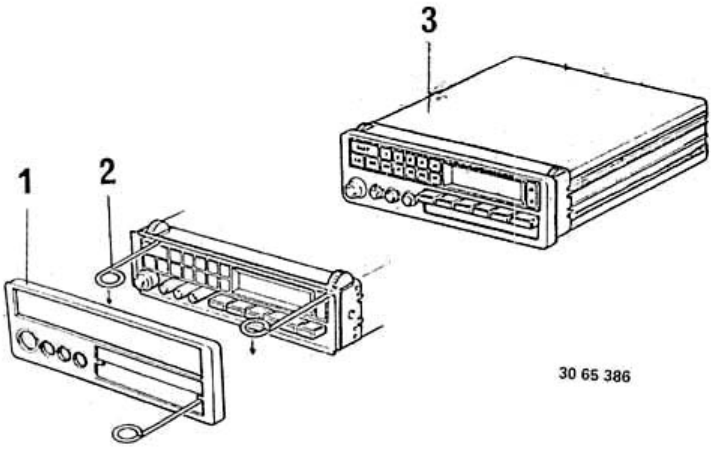
Pull off Knob.
Take off face plate carefully with the unlocking hook.
Note:
Only attach hook on the face plate.



Push back clamps on left and right sides with the unlocking hooks and pull out the radio.

1 Radio
2 Face plate
3 Knob
4 Unlocking hook for radio removal
5 Plug for B + and ground
6 Adapter
7 Plug for power supply to electronics and light
8 Plug for speakers
9 Plug for automatic antenna
10 Plug for antenna
11 Adapter for noise-dependent loudness control
12 Switch for 11
13 Plug for 11
14 Plug for 11
15 Plug receptacle on instrument carrier

1.3.1 Bavaria C "Exclusive"
Bavaria C "Electronic"



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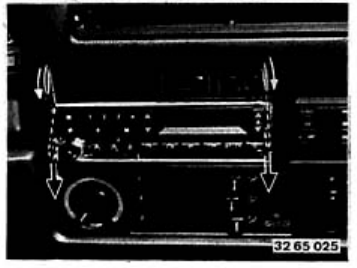
Take off mask carefully with the unlocking hooks.
Note:
Only grab hold of mask with hooks.



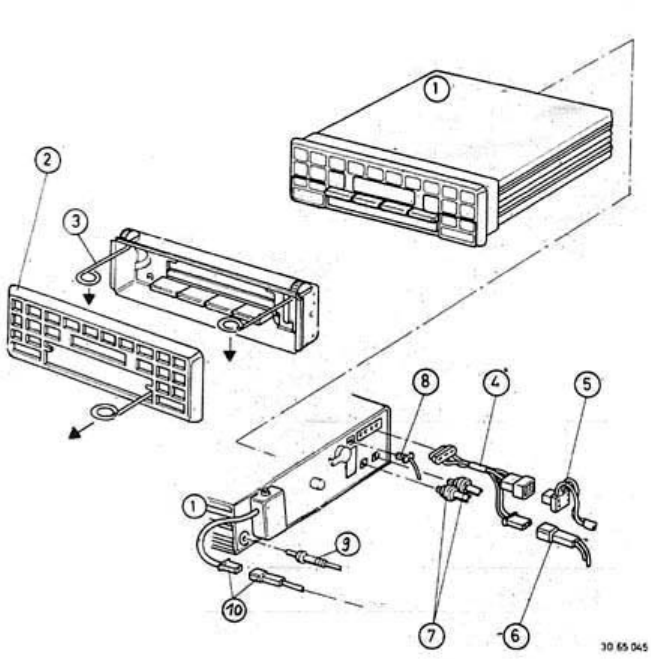
Press down clamps on left and right sides with the unlocking hooks and pull out radio.

1 Mask

2 Unlocking hook for radio removal

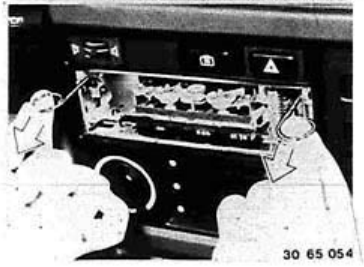
3 Radio

1.4 Becker Mexico Electronic





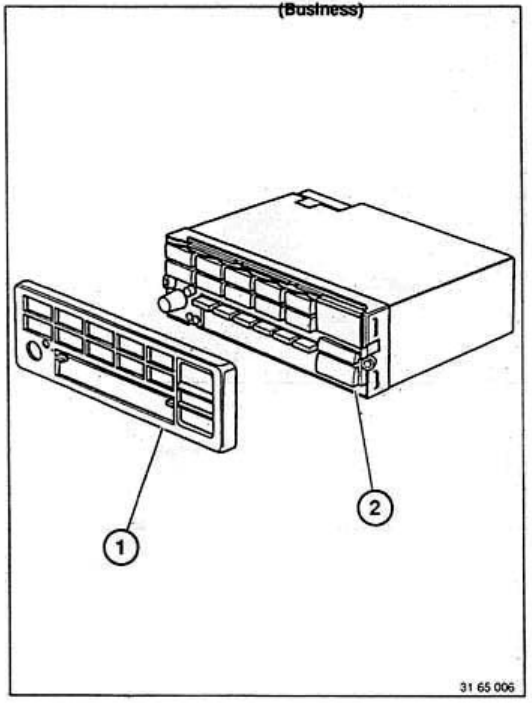
Take off the control panel with unlocking hooks (1).
Note:
The control panel fits very tight.



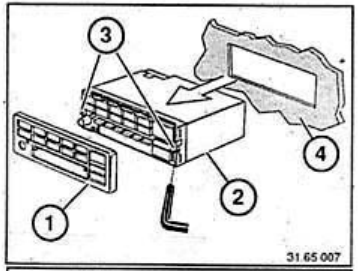
Push back clamps on left and right sides with the unlocking hooks and pull out the radio.

1 Radio
2 Control panel
3 Unlocking hook for radio removal
4 Adapter
5 Plug for B + and ground
6 Plug for power supply to electronics and light
7 Plug for speakers
8 Plug for automatic antenna
9 Plug for antenna

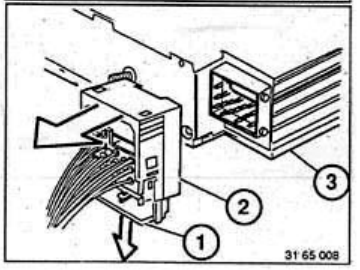
65 11 030 REMOVING AND INSTALLING OR REPLACING RADIO (Business)



1 = Front panel
2 = Radio



Pull off front panel (1).
Unscrew left and right screws (3).
Pull radio (2) out of radio opening.



Pull out retainer (1) and disconnect plug (2) on radio (3).

TESTING INSTRUCTIONS FOR "BAVARIA" RADIO

GENERAL INFORMATION

A car radio has especially great requirements to fullfill in regards to reception, reproduction quality and operational safety.

The "BAVARIA" radio, as all other car radios, differs in several points to a stationary home radio. Direct comparsion with a home radio unit is not possible due to the relatively unfavorable acoustic conditions, to which the very changing reception conditions and the electrical system in the car belong.

These testing instructions will provide a brief explanation of the most important relations between the broadcasting station and radio, and also point out possible sources of defect and appropriate corrective measures.

NOTE

- Not every radio complaint necessarily menas a defective radio.
- Determine a test driving route for radio complaints and always tune in the same stations during test drives.
- Note the places where shade-off background noise etc. is heard.
- Compare the reception of radio being reprimanded with a radio of same type, a thorough inspection is only justified when deviations are extreme.
- Prior to test driving the operating instructions of the pertinent radio should be read for reference and perhaps explain to the customer how the radio should be operated and some of the general reception problems of the different wave ranges.

TRIMMING RADIO

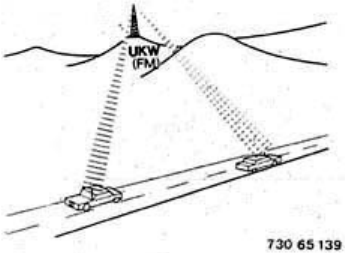
1. Pull out antenna to length of about 0.9 ... 1.0 meters (35 to 39"), making sure that bottom telescope section is pulled out fully.
2. Set medium wave range (AM) of radio to a weak reception station at 1100 kHZ. Now turn the antenna trimmer until the maximum loudness is reached.
   Should there not be station at 1100 kHZ, it would be sufficient to trim the background noise to maximum loudness.
   To check whether trimming is correct, turn the antenna trimmer around its axis once. Now the maximum loudness should be found at two different positions of the trimmer.
   At these points there is the greatest input voltage and the greatest resonance. The trimmer must be set to one of both positions.

NOTE:

Make sure that the antenna is "grounded" correctly; remove paint, Teroson or rust and coat cleaned surfaces with graphite grease for protection against corrosion.

INFLUENCES ON RADIO RECEPTION. WHILE DRIVING

In spite of an accurately trimmed antenna, good ground contact and perfect car shielding, there could be many different disturbing noises while driving, which are described below and cannot be corrected.



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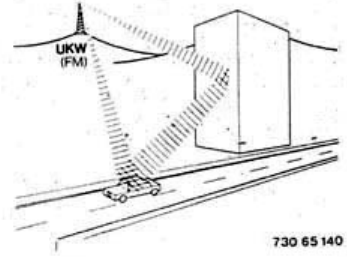
FLUTTER

This noise will usually occur because of shade off. The direct station/radio connection will be interrupted by a natural or artificial obstacle. When driving down an avenue this is known as the "lattice effect".



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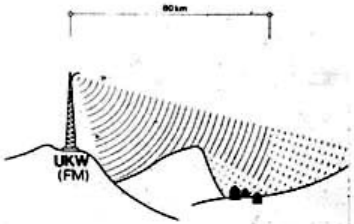
HISS, CRACKLE AND SPLASH

These noises will usually be caused by reflection. Reflections occur, when the same station signals are received in the car radio two or many times within a fraction of a second.
The quickly changing loudness is very disturbing. An optical comparision would be the "ghost" on the TV screen, which is also produced by reflections.



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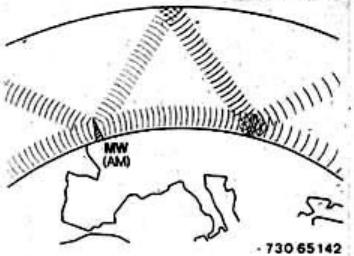

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CONSTANT BACKGROUND NOISE

This disturbing noise will usually take place after leaving the reception area of a station or is indication of a wide-spread shade-off area.
The only remedy would be to tune in a stronger station.

FADING

This happens especially in the medium wave range (AM) and is usually accompanied by reception distortion.
The cause of this is a superimposition of ground and space waves at site of reception.

Weather factors, such as fog, rain or snow, could also have a negative effect on radio reception.

DIFFICULT RECEPTION CONDITIONS FOR STEREO RADIO SETS

Good quality reception with a stereo radio is only possible in areas with high field strength.
When the stereo indicator lamp comes on, this does not necessarily mean that a stereo station is being received, rather only that the station does broadcast stereo programs.
If the distance from the station is too great, the radio will switch to mono even though the stereo indicator lamp is still on. If there is fast switching between mono and stereo, the reception will be disturbed by background noise.
In this case the switch must be set to "mono".

CASSETTES

The cassette should conform with the special conditions in a car. Consequently only use cassettes C 60 = 2 x 30 minutes or C 90 = 2 x 45 minutes playback time.
The tape in cassettes C 120 = 2 x 60 minutes is naturally thinner, which could lead to problems.
When driving on rough roads the shaking could cause the tape to run up, which could delay and finally stop the tape movement.

NOTE

The use of SM cassettes will only prevent the tape from tangling (tape salad).
Store cassettes underneath the instrument panel as cool as possible. If temperatures are constantly + 40° C (105° F) or higher, the cassette housings could be distorted.
This would result in difficult winding of the tape and therefore constant ejection of the cassette.
A pushed in cassette must be ejected after turning off the radio, when operating the ejection button at end of a tape or when tape movement is disturbed.

NOTE

Mexico full stereo reverse cassettes should only be ejected when turning off the radio and when operating the ejection button.
Also when tape movement is disturbed.

TROUBELSHOOTING

Troubleshooting should always begin with an inspections of the antenna.

ROD ANTENNA / Antenna Length

The ideal antenna length for AM/FM reception is about 0.9 to 1.0 meters (35 to 39").
IMPORTANT:
The bottom telescope section must always be pulled out fully.

CHECKING ANTENNA

CONNECTION:
Tune in a medium wave station.
The connection of the antenna is okay, if when contacting the antenna rod the reception turns considerably quieter (at least difference in loudness).
GROUND CONNECTION:
The resistance measured between the antenna plug, ground terminal and body should be zero. If this value is not reached, the ground connection on the antenna base and/or upper holder is not correct.

CURRENT FLOW

The current flow resistance measured between the antenna plug peak and antenna rod should be zero ohms, and never above 3 ohms. To check for breaks, the antenna wire must be moved continuously while measuring the resistance.

IMPORTANT!
Not applicable to extension wire due to shortening capacitor.

INSULATION RESISTANCE
If the insulation resistance between the antenna plug peak and plug ground terminal is less than 1 M-ohm, the antenna or antenna wire has ground out and must be replaced.

SERVICING
Clean a pulled out antenna rod often with a dry cloth and then coat with an antenna grease*. This is especially important after long trips in rain.

* Source HWB

TROUBLESHOOTING

Condition	Possible Cause
Crackle and sizzle	Tune in a weak station just next to the station concerned. Accelerate engine to about 5,000 rpm, turn off ignition. Radio should still be receiving. If reception noise disappears when turning off ignition, ignition disturbance is concerned. CHECK: – Shielding of distributor cap. – Shielding ground wire connection. – Shielding capacitor 2.2 µF at ignition coil term. (15). IMPORTANT! Not for thyristor ignition. – Shielded filter in wire (1). – Perfect connection and resistance of ignition wires - plug caps/distributor cap/ignition coil. – Distributor rotor resistance*. – Hairline cracks in distributor cap/distributor rotor/plug caps/spark plugs/ignition coil neck. – Ground wire of engine/firewall) – Ground wire of engine hood/body) perfect contact – Ground connection of radio) – Engine hood closed correctly.
Crackle and knock	Accelerate engine until interference noise is considerably louder. Now turn on headlights and rear window defogger. If noise disappears or changes, regulator is defective.
Howl and/or whistle, depending on engine speed	Detach drive belts and run engine briefly. If this eliminates the interference, check capacitor at term. (+) on the alternator. If an electronic antenna is installed, install a 2.2 µF bypassing capacitor in the positive wire to the electronic antenna (at antenna height) as close as possible to the wire inlet of the antenna amplifier.
Sizzle and knock	This interference is only heard while driving and disappears when operating the brake pedal. Cause – electrostatic charge. Remedy – install wheel hub contacts on front axle.
Knock and crash	These noises are similar to those for ignition disturbances and are caused by a break in the antenna wire (usually occurs while driving).
Howl and crackle	This interference will disappear when switching off extra equipment, for example: Windshield wiper motor) Washer pump) remedy: install shielded filter 2 x 0.47 µF Extra fan)
Scale light not on, no reception	– Fuse oxidation – Fuse defective - type* – Power wire loose/not connected – Ground connection – Radio defective
Scale light on, no background noise with loudness control turned up fully; automatic station tuner malfunctions	– Speaker wire plug loose on radio – Break in speaker wires – Plugs on speaker balance control loose – Speakers defective – Dummy plug on tape socket loose or defective – Radio defective

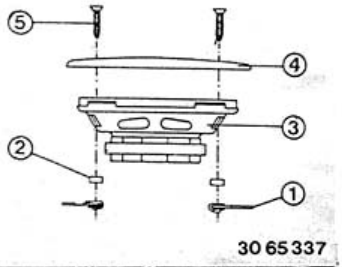
* See Specifications

TROUBLESHOOTING

Condition	Possible Cause
Background noise with loudness control turned up fully, but no reception	– Antenna plug not connected on radio – Break in antenna wire – Antenna not pulled out (failure of automatic antenna drive) – Antenna short circuit – Radio defective
Loud background noise while driving	– Antenna not pulled out fully – Antenna plug not connected on radio correctly – Check current flow in antenna wire – Antenna trimmer not adjusted – Regional reception area was changed – Station button or station set wrong – Radio defective – Switch stereo reception to "mono" – Station too weak, tune in stronger station – Radio set for reception of traffic reports only – Interference caused by electronic antenna – Check speaker connection
Reception cuts out while driving	– Break in power supply wire to radio – Fuse oxidized – Ground connection on radio not correct – Break in antenna wire – Loose antenna wire – Speaker wires loose – Break in speaker wires – Dummy plug in tape socket loose
USW reception, but no MW reception	– Break in antenna wire – Antenna trimmer not adjusted
Insufficient stations heard in MW range	– Antenna not pulled out far enough – Failure of automatic antenna drive – Antenna trimmer not adjusted – Antenna defective
USW reception cuts out while driving	– Station too weak (insufficient field strength) – Regional reception area was changed – Lower telescope section of rod antenna not pulled out fully – Wrong antenna length; ideal length: 0.9 to 1.0 meters (35 to 39") – Antenna defective
Stereo reception has background noise, cuts out sometimes, indicator lamp out	– Station tuned in is received too weak (insufficient field strength) – Weak reception area, in which stereo reception is not possible
No stereo reception	– Set mono/stereo switch to "stereo" – Mono/stereo switch defective
Reception of only several or no stations	– Wave range switch set for reception of traffic reports only

TROUBELSHOOTING

Condition	Possible Cause
Traffic report indicator cuts out or flickers	– Tuned in traffic report station reception too weak (insufficient field strength) – Weak reception area; reception not possible – Regional reception area was changed
Radio with automatic station tuner receives no or only several stations, but has normal reception from manual lever	– Sensitivity switch for automatic station tuner set to unsensitive – Antenna not pulled out completely – Lower telescope section of rod antenna not pulled out fully
Automatic station tuner runs through all wave ranges without stopping	– Start button for automatic station tuner stuck or maladjusted
Whistle spots throughout LW, MW and SW ranges	– Caused by electronic antenna
Stations from LW, MW and SW ranges heard in USW range	– This happens only close to broadcasting station and is caused by electronic antenna. – Range of other stations extended by weather conditions
Sound quality not satisfactory	– Foreign particles in speaker diaphragms – Speakers installed with tension. – When using more than one speaker per channel all speakers must be connected equally – Speaker balance control set to center position for stereo radio – Install other speakers for comparison – Only for cassette reception: Use Q-tips soaked in alcohol or a cleaning tape to clean the sound head, sound and pressure shafts
Cassette ejected while playing	– Cassette without SM – Tape of cassette winds too slowly – Cassette housing distorted – C-90 or C-120 cassette – tape is too thin due to long playing time



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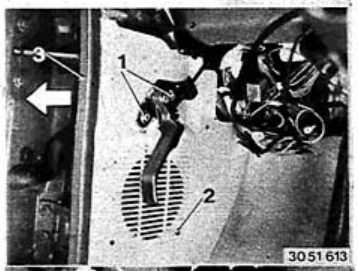
65.12 000 REMOVING AND INSTALLING OR REPLACING FRONT RADIO SPEAKERS

Unscrew screws.
Remove face plate and speaker.
Pull off plug.
Arrangement:
1 Door beam panel
2 Spacer
3 Speaker
4 Face plate
5 Screw



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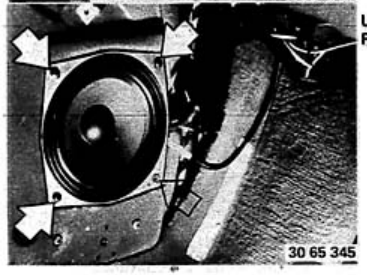
Models Since 9/85:
Unscrew screws (1) and take off lever.
Pull off edge guard (3) partially.
Unscrew screw (2) and remove trim panel.
Note:
Cement trim panel on carpet partially.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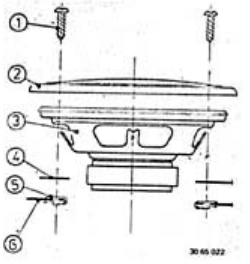
Unscrew screws.
Remove speaker and pull off plug.



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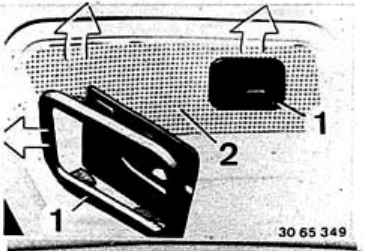
65 12 020 REMOVING AND INSTALLING OR REPLACING REAR RADIO SPEAKERS

Unscrew screws.
Remove face plate and speaker.
Pull off plug.
Arrangement:
1 Self-tapping screw
2 Face plate for speaker
3 Speaker
4 Washer
5 Self-tapping nut
6 Hatrack



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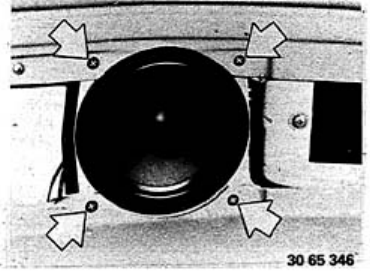
Convertibles:
Pull out grip plate (1) toward rear.
Pull off speaker trim (2) from above and remove.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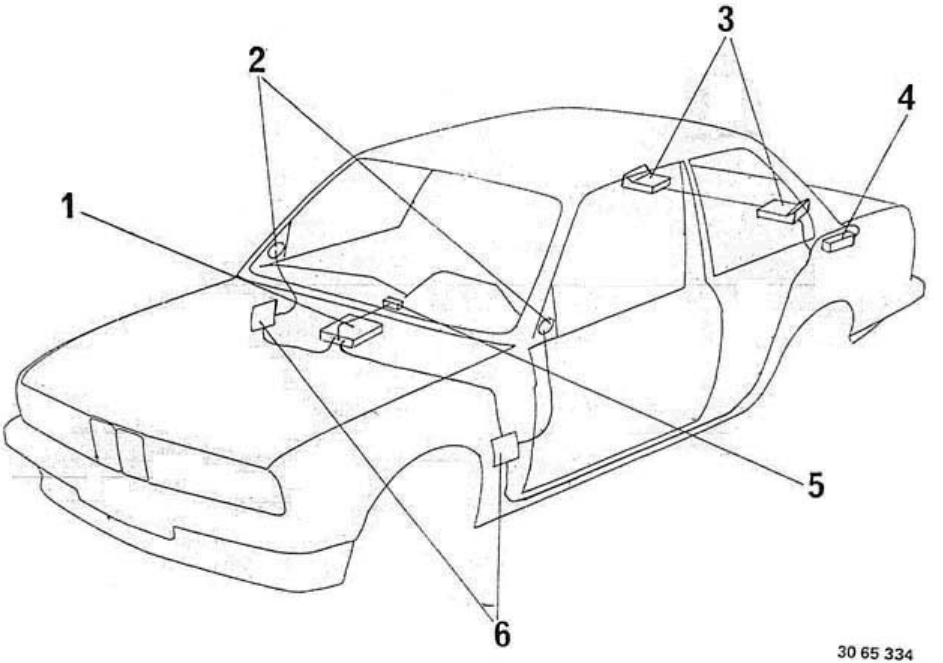
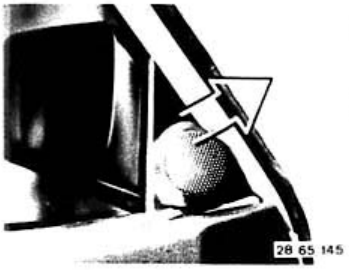
Unscrew screws and remove speaker.
Pull off plug.

SOUND SYSTEM SURVEY

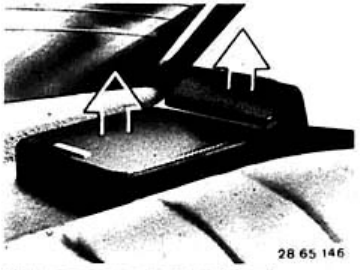


1 Radio
2 High tuner
3 Speakers – rear
4 Amplifier
5 Speaker balance control
6 Speakers – front



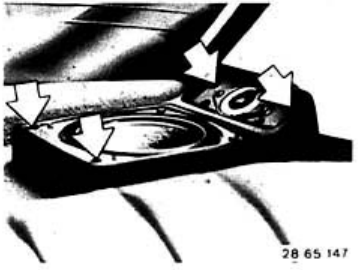
65 13 000 REMOVING AND INSTALLING OR REPLACING HIGH TONE RADIO SPEAKERS

Lift out trim panel with high tone speaker.
Disconnect plug.



65 13 020 REMOVING AND INSTALLING OR REPLACING REAR RADIO SPEAKERS (SOUND SYSTEM)

Lift out speaker face plate.



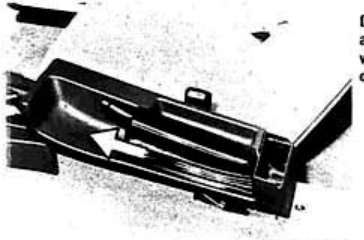
Unscrew screws and lift speaker.
Disconnect plug.

65 14 000 REMOVING AND INSTALLING OR REPLACING CASSETTE BOX



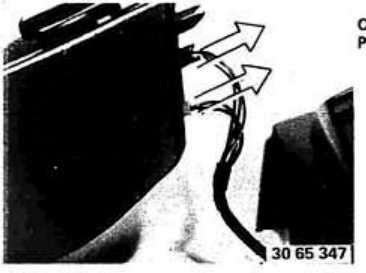
30 51 002

Lift out ashtray.
Unscrew nut.



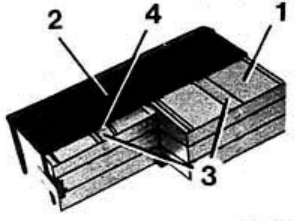
30 51 003

Disengage console at front by pulling back and pull it off of the parking brake lever, while pulling the ashtray light off of the console.



30 65 347

Cars with EH Transmission:
Pull off wire plug.



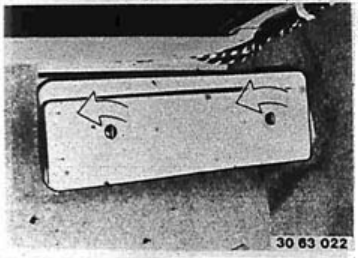
30 65 066

Pull cassette boxes (1) downward out of holding frame (2).
Installation:
Web (3) of cassette box must slide in opening (4) of holder.

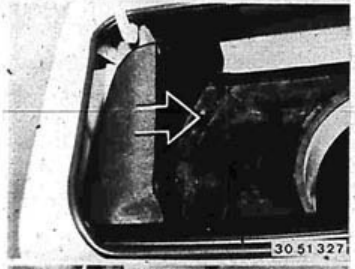


65 21 101 REMOVING AND INSTALLING OR REPLACING (REAR) RETRACTABLE ANTENNA

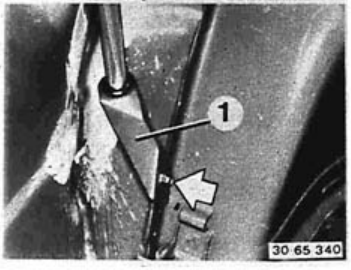
Remove car jack.



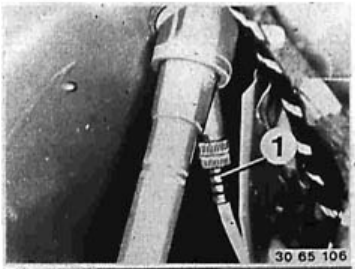
Turn holding screws of tail light cover 90° and take off cover.



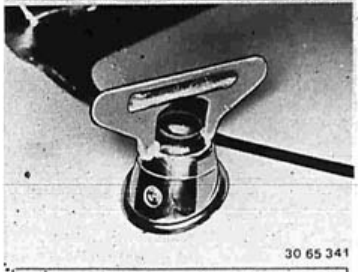
Pull out trim panel at top first and then remove it.



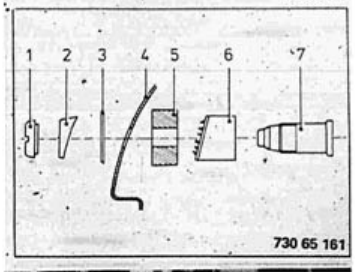
Unscrew screw on antenna holder (1).



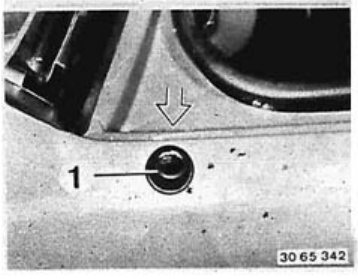
Disconnect antenna lead (1).



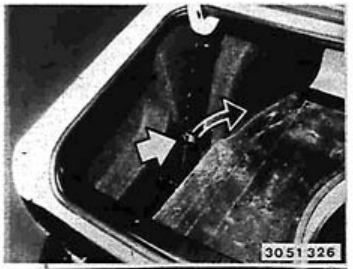
Bolted Antenna:
Unscrew nut with an antenna wrench and remove antenna from below.



Installation:
1 = Nut
2 = Adapter
3 = Seal
4 = Car's side panel
5 = Seal
6 = Brass ring
7 = Antenna

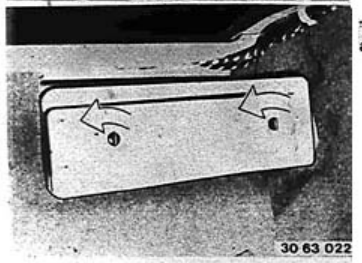


Plugged In Antenna:
Disconnect ground lead.
Pull out antenna from below.
Installation:
If guide (1) had been removed, use a lubricant for installation when necessary.

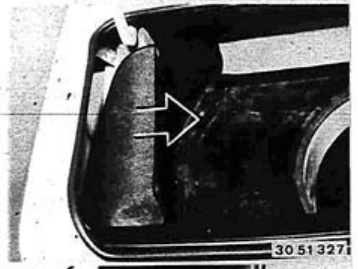


65 22 005 REMOVING AND INSTALLING OR REPLACING (REAR) AUTOMATIC ANTENNA

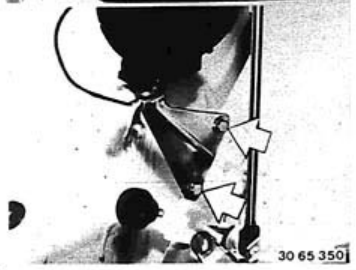
Remove car jack.



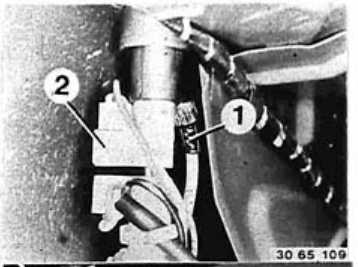
Turn holding screws of tail light cover 90° and take off cover.



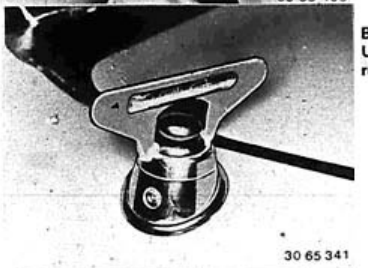
Pull out trim panel at top first and then remove it.



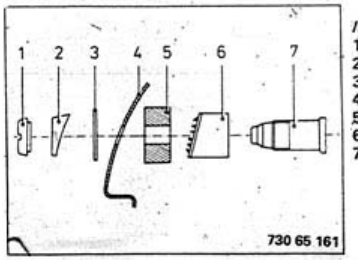
Unscrew screws on antenna holder.



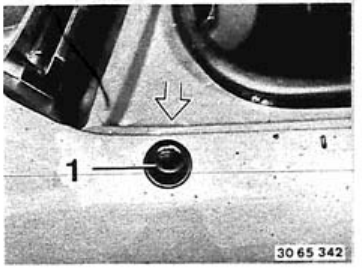
Disconnect antenna lead (1) and plug (2).
Disconnect antenna ground lead.



Bolted Antenna:
Unscrew nut with an antenna wrench and remove antenna from below.



Installation:
1 = Nut
2 = Adapter
3 = Seal
4 = Car's side panel
5 = Seal
6 = Brass ring
7 = Antenna



Plugged In Antenna:
Pull out antenna from below.
Installation:
If guide (1) had been removed, use a lubricant for installation when necessary.

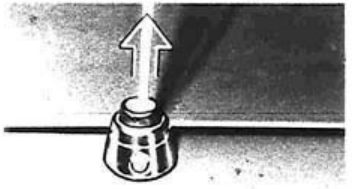
65 22 040 REPLACING TELESCOPE FOR AUTOMATIC ANTENNA

The automatic antenna remains in the car when replacing telescope.
Telescope is replaced together with the plastic cable.



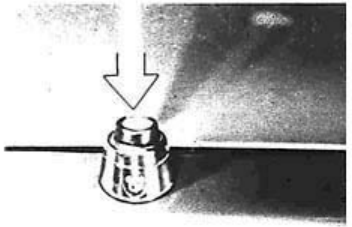
28 65 026

Turn on radio to run out telescope as far as possible.
Unscrew threaded sleeve.



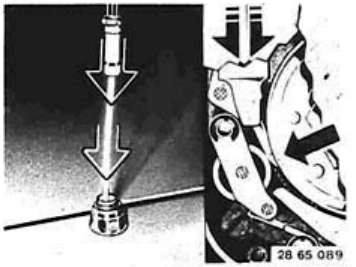
28 65 027

Remove telescope and plastic cable.
This requires firm pulling, especially if, for example, a bent telescope cannot be run out fully.



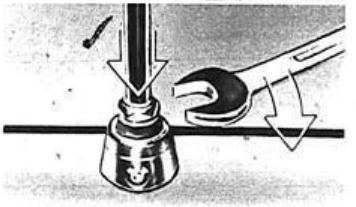
28 65 028

Slide straightened, pointed plastic end of new telescope into antenna adapter until resistance is felt on the contact roller.



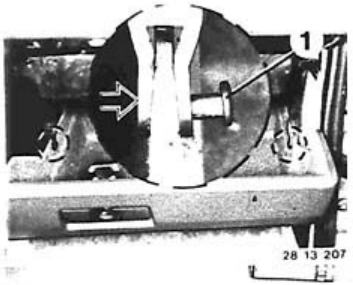
28 65 089

Turn off radio to run in the antenna.
Push in cable slightly until it is pulled in automatically by the drive.
Guide in plastic cable and telescope by hand at same time.



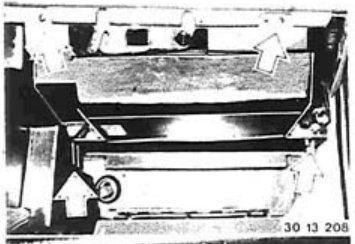
28 65 030

Screw in threaded sleeve tight and run telescope out and in several times.

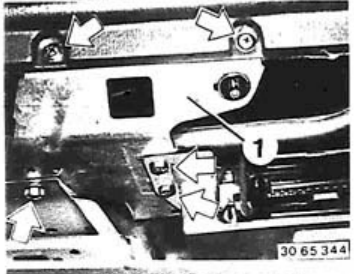


65 71 010 REMOVING AND INSTALLING OR REPLACING CONTROL UNIT FOR CRUISE CONTROL

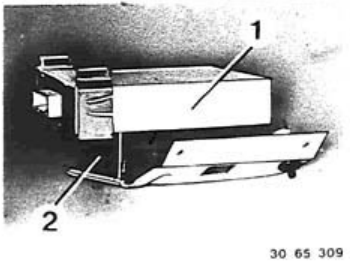
Open glove box and disconnect both straps by pulling out pins (1).



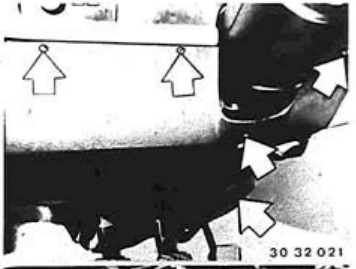
Unscrew screws and remove the cover.



Unscrew screws and remove holder (1).

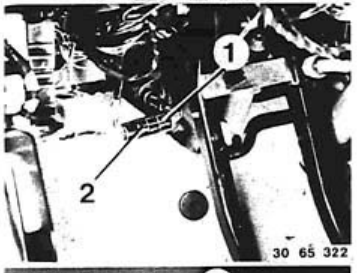


Pull off plug and pull control unit (1) out of holder (2).

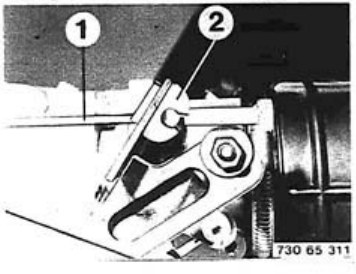


65 71 020 REMOVING AND INSTALLING OR REPLACING DRIVE FOR CRUISE CONTROL

Turn holding screws of instrument panel trim at bottom left 90° and remove the trim panel.

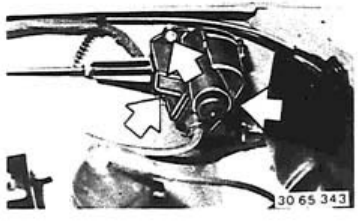


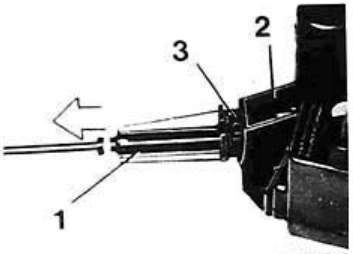
Pull off drive motor wire plug (1) from auxiliary wire harness (2) and pull out wire toward front.



Disconnect cable (1) with holder (2) on the throttle valve lever.

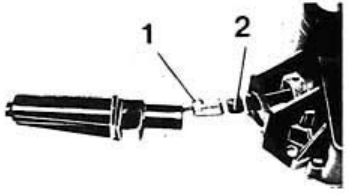
Unscrew screws and take off drive motor.





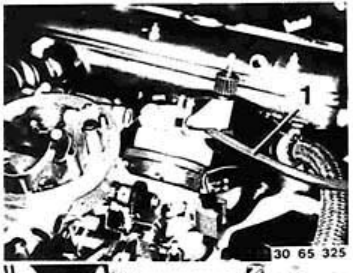
30 65 348

Press down spring retainer (3) and pull cable sleeve (1) out of drive motor (2).



Disconnect cable (1) in cable holder (2).

28 65 312



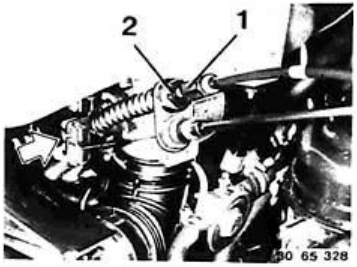
30 65 325

Installation – BMW 316:
Start engine.
Disconnect hose (1).
Stop engine.
Important!
The throttle valve lever must bear on the stop (throttle valve closed).



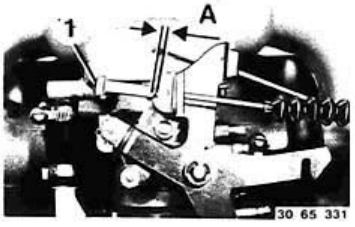
65 326

Check gap = 1.0 to 1.5 mm (0.039 to 0.059") between the nipple and nipple holder.
Adjust with screw (1) and nut (2) if necessary.



30 65 328

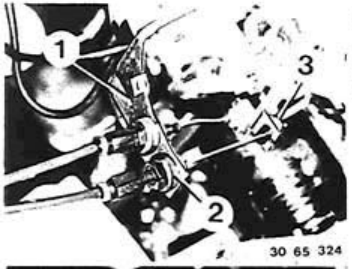
Installation – BMW 318 i:
Check gap = 1.0 to 1.5 mm (0.039 to 0.059") between the nipple and nipple holder with the throttle valve closed and the drive motor deactivated (motor in neutral).
Adjust with screw (1) and nut (2) if necessary.



30 65 331

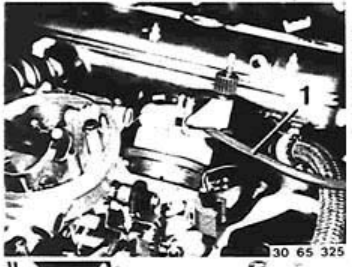
Installation – BMW 320 i ... 325 i and 324 d:
Check gap A = 1.0 to 1.5 mm (0.039 to 0.059") with the throttle valve closed and deactivated drive motor (motor in neutral).
Adjust with knurled nut (1) if necessary.

65 71 040 REMOVING AND INSTALLING OR REPLACING CABLE FOR CRUISE CONTROL

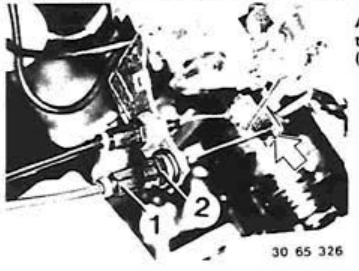


BMW 316:

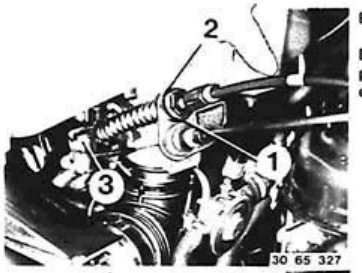
Disconnect cable with black nipple holder (3) and pull out of holder (1) together with the rubber grommet (2).



Installation:
Start engine.
Disconnect hose (1).
Stop engine.
Important!
The throttle valve lever must bear on the stop (throttle valve closed).

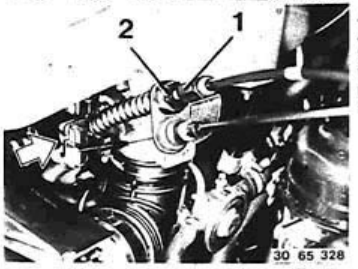


Adjust gap between nipple and nipple holder to 1.0 ... 1.5 mm (0.039 to 0.059") on screw (1) and nut (2).

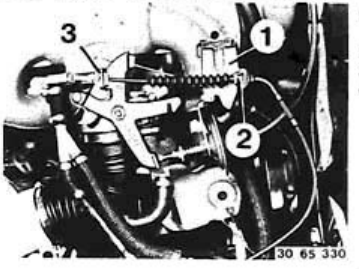


BMW 318 i:

Disconnect cable with nipple holder (3) and pull together with rubber grommet (2) out of holder (1).

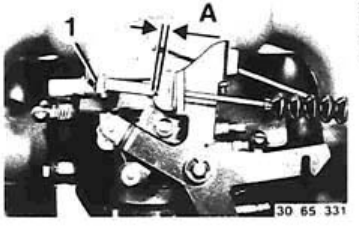


Installation:
Adjust gap between nipple and nipple holder to 1.0 ... 1.5 mm (0.039 to 0.059") with the throttle valve closed and deactivated drive motor (motor in neutral) on screw (1) and nut (2).

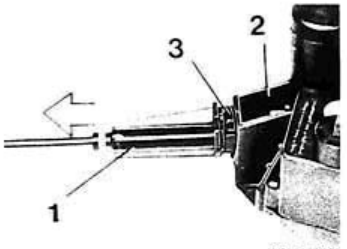


BMW 320 i ... 325 i and 324 d:

Disconnect cable with white nipple holder (3) and pull out of holder (1) together with clamp (2).

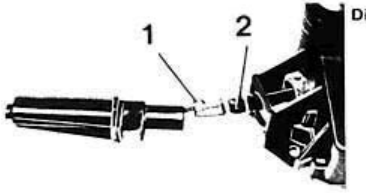


Installation:
Adjust gap A to 1.0 ... 1.5 mm (0.039 to 0.059") on knurled nut (1) with the throttle valve closed and deactivated drive motor (motor in neutral).



30 65 348

Press down spring retainer (3) and pull cable sleeve (1) out of drive motor (2).



28 65 312

Disconnect cable end (1) on cable holder (2).

TESTING PROCEDURES FOR ELECTRONIC CRUISE CONTROL

Test Requirement:
Battery charged – battery voltage okay. (U ≥ 11,5 V).
Specified multimeter functions (e.g. M 01) are in reference to the BMW SERVICE TEST. The following multimeter functions are required: 01/06/14. The following test procedures do not include sources of defect, which are outside of the electronic cruise control system.

Check fuse no. 6 and contact of fuse. Fuse and contact okay? — no → Replace fuse. Clean and bend fuse holder.

yes ↓

Check bulbs of stop lights and their contact. Bulbs and contact okay? — no → Replace light bulbs. Clean and bend contacts.

yes ↓

Check cable adjustment. Cable adjustment okay? — no → Adjust cable. Replace cable, see 65 71 040 in Repair Manual.

yes ↓

Check cable and strap of operating motor for damage and easy movement. Cable and strap okay? — no → Replace cable or operating motor.

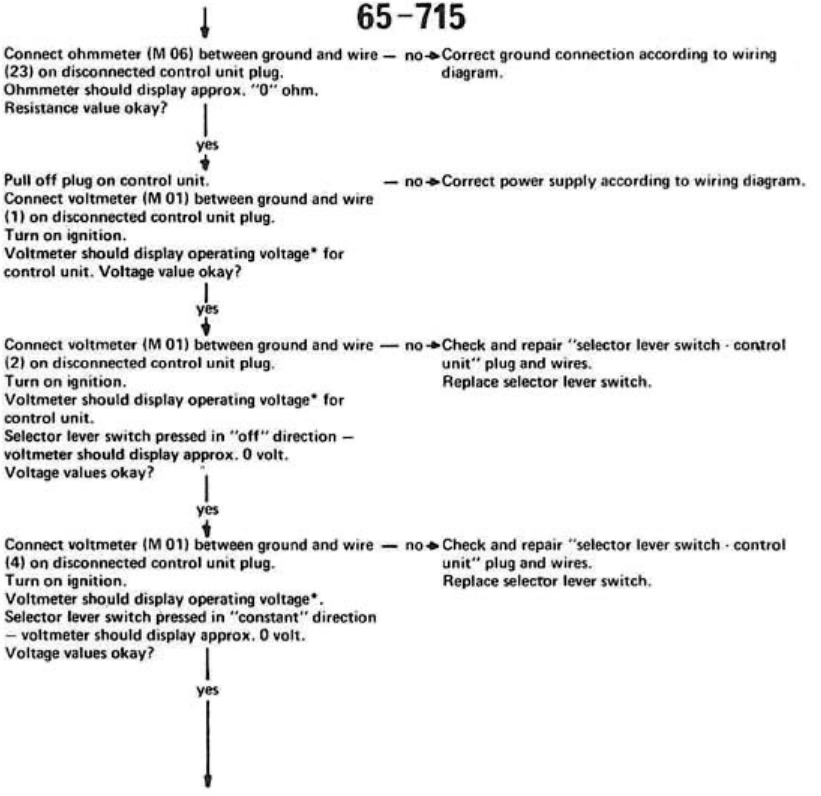
yes ↓

Check adjustment of brake and clutch pedal switch. Adjustment okay? — no → Adjust brake and clutch pedal switch. See group 35 of repair manual.

yes ↓

Check all plugs (see wiring diagram) and wires for tight fit and damage. Plugs and wires okay? — no → Repair or replace plugs and wires.

yes ↓



* See Specifications

Connect voltmeter (M 01) between ground and wire (5) on disconnected control unit plug.
Turn on ignition.
Voltmeter should display about 0 volt.
Press selector lever switch in "call" direction ⏚ voltmeter should display operating voltage*.
Voltage values okay?

— no → Check and repair "selector lever switch - control unit" plug and wires.
Replace selector lever switch.

yes ↓

Connect voltmeter (M 01) between ground and wire (9) on disconnected control unit plug.
Turn on ignition.
Voltmeter should display approx. 0 volt.
Voltage value okay?

— no → Replace brake pedal switch, see Group 35 in Repair Manual.

yes ↓

Connect voltmeter (M 01) between ground and wire (9) on disconnected control unit plug.
Turn on ignition.
Operate brake pedal.
Voltmeter should display operating voltage*.
Voltage value okay?

— no → Check stop light switch:
Pull off both plugs on stop light switch.
Connect ohmmeter (M 06) on stop light switch.
Operate brake pedal.
Ohmmeter should display approx. 0 ohm.

— no → Replace stop light switch.

yes ↓

Check clutch switch:
Pull off both plugs on clutch switch.
Connect ohmmeter (M 06) on clutch switch.
Ohmmeter should display approx. 0 ohm.
Operate clutch pedal.
Ohmmeter should display 0 ohm.
Values okay?

— no → Replace clutch switch.

yes ↓

Check wires, repairing if necessary.

* See Specifications

Connect frequency meter (M 14) on wires 23 and 6 on disconnected control unit plug. Lift car. Support driven axle close to wheels to avoid damaging drive shaft joints. Start engine. Accelerate briefly to about 60 km/h. Frequency meter should display frequency*. Value okay?

no → Check sender for speedometer, see Group 62 in Repair manual.

no → Check electric wires, repairing if necessary.

yes

Reconnect control unit plug. Following tests are carried out on 7-pin plug for "control unit – drive motor".
Connect voltmeter (M 01) on connection (4) and connection (3).
Switch on ignition.
Voltmeter should display voltage.
Voltage value okay?

no → Replace control unit.

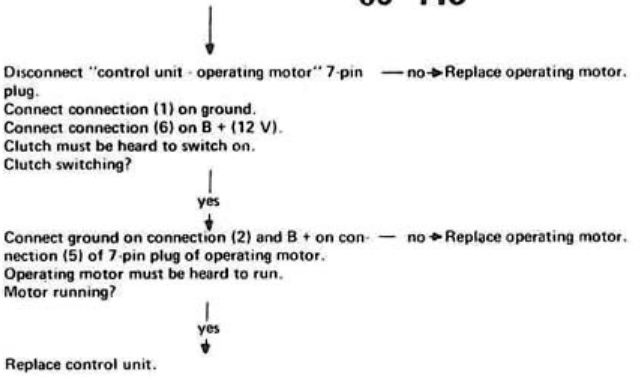
yes

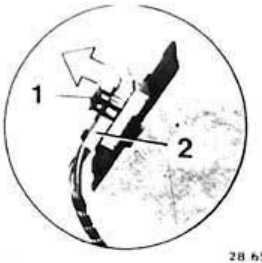
Connect voltmeter (M 01) on connection (3) and connection (7).
Switch on ignition.
Voltmeter should display voltage.
Voltage value okay?

no → Replace drive motor.

yes

* See Specifications of Group 62.


Disconnect "control unit - operating motor" 7-pin plug.
no → Replace operating motor.
Connect connection (1) on ground.
Connect connection (6) on B + (12 V).
Clutch must be heard to switch on.
Clutch switching?
yes
Connect ground on connection (2) and B + on connection (5) of 7-pin plug of operating motor.
no → Replace operating motor.
Operating motor must be heard to run.
Motor running?
yes
Replace control unit.



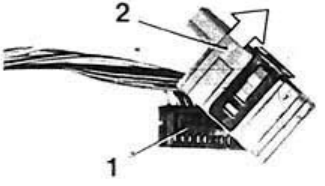
28 65 181

Important Information for 26 Pin Central Plug:
Pull back holding clip (1).
Pull off central plug (2).



28 65 182

Cut off wire strap (1).



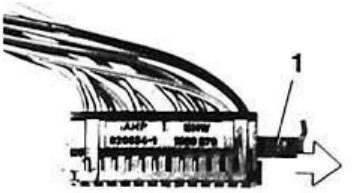
28 65 183

Pull plug cartridge (1) out of housing (2).



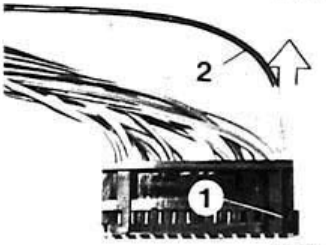
28 65 184

Testing on a disconnected central plug, e.g. for troubleshooting, can be performed with test clips on windows (1).



28 65 185

Pull out slide control (1)

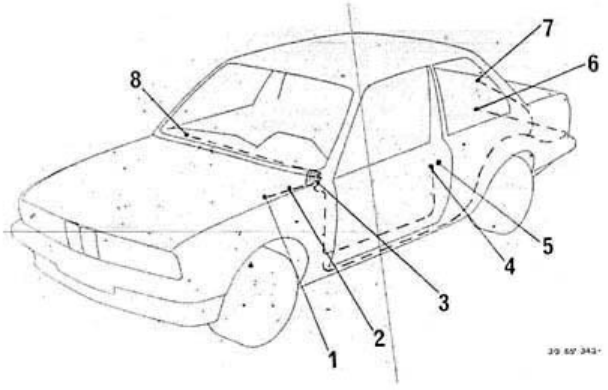


28 65 186

Push on pertinent wire window with a screw driver and pull wire (2) out of plug receptacle.

BURGLAR ALARM SURVEY

A. Burglar Alarm Layout



1 = Alarm horn
2 = Engine compartment contact
3 = Control unit
4 = Burglar alarm lock with light
5 = Switching unit - driver's door
6 = Indicator lamp
7 = Switching unit - trunk lid
8 = Connection on engine wire harness

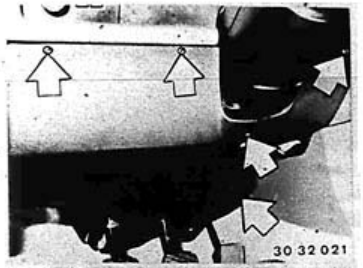
B. Components Monitored By Burglar Alarm

a) All doors
b) Engine hood
c) Trunk lid
d) Rear window defogger circuit
e) Ignition lock

C. Description

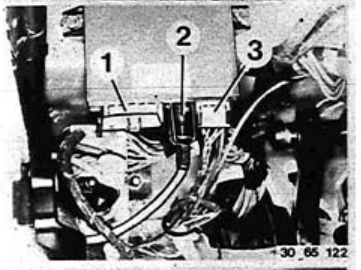
Operation / Burglar Alarm Initial State	Insert Coding Key	Unlock Door or Trunk Lid Lock	Unlocking, Locking or Operating Components Described in B
SYSTEM OFF	a) Light on approx. 15 seconds*, burglar alarm on. b) Light flashes approx. 15 seconds, burglar alarm on, but car not locked correctly: – Turn burglar alarm off and lock car.		
SYSTEM ON	Light on approx. 1.5 seconds, burglar alarm off.	Light flashes approx. 15 seconds – turn off burglar alarm before opening door or trunk lid.	Burglar alarm activates alarm – horn blown 30 seconds. Ignition is interrupted.

* Applicable for domestic version (FRG), otherwise light on 24 hours.

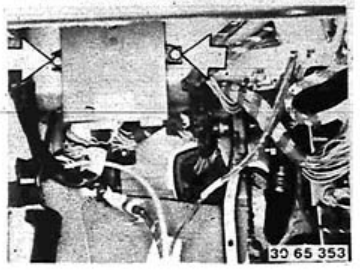


65 75 ... REMOVING AND INSTALLING OR REPLACING CONTROL UNIT FOR BURGLAR ALARM

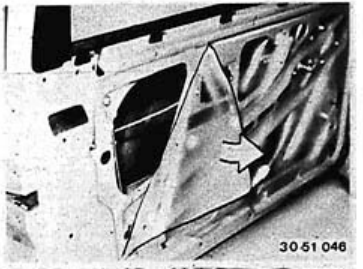
Turn holding screws of instrument panel trim at bottom left 90° and remove trim panel.



Disconnect plugs (1 ... 3).
Note:
First unlock plugs (1 and 2).

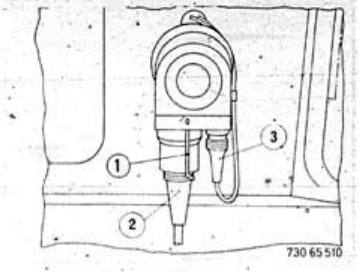


Unscrew screws and remove control unit.

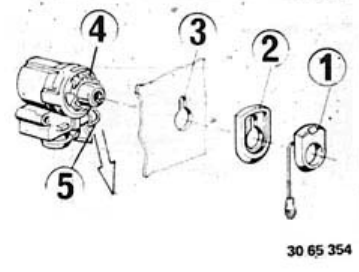


65 75 ... REMOVING AND INSTALLING OR REPLACING CODING LOCK FOR BURGLAR ALARM

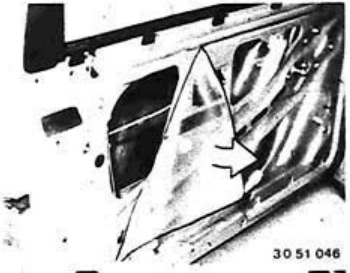
Remove door trim panel – see 51 41 001.
Pull off plastic sheet partially.
Installation:
Replace damaged plastic sheet.



Push back clamp (1).
Pull off plugs (2 and 3).

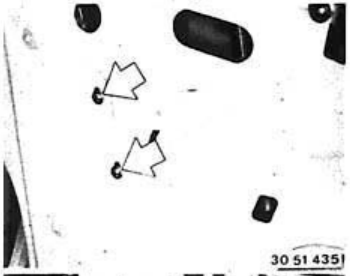


Pull off spring retainer (5) and remove coding lock (4).
Installation:
1. Place spring retainer in groove below the diaphragm spring on the coding lock and align that tab faces plug connection of the door wire harness.
2. Assemble plate (1) and liner (2), and insert in door panel (3).
3. Press coding lock against the plate until the spring retainer engages.

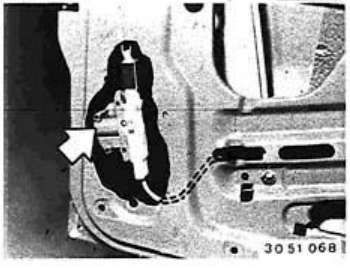


65 75 ... REMOVING AND INSTALLING OR REPLACING SWITCHING UNIT FOR DRIVER'S DOOR (BURGLAR ALARM)

Remove door trim panel – see 51 41 001.
Pull off plastic sheet partially.
Installation:
Replace damaged plastic sheet.



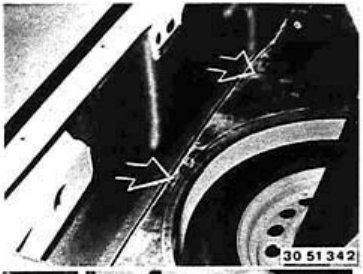
Unscrew screws.
Pull off plug.
Disengage switching unit.



Installation:
Check for correct installed position.

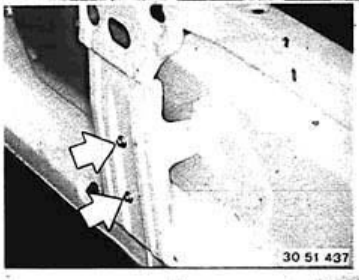
Two Door Cars:
Housing faces rear (see picture).

Four Door Cars:
Housing faces forward.

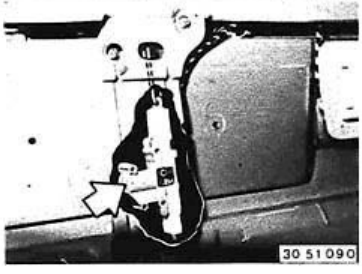


65 75 ... REMOVING AND INSTALLING OR REPLACING SWITCHING UNIT FOR TRUNK LID (BURGLAR ALARM)

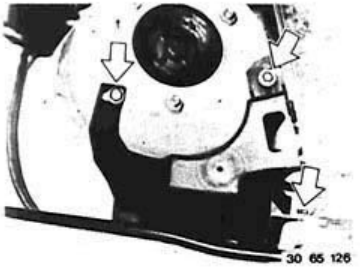
Fold back trunk mat.
Remove tail light carrier.
Lift rear wall trim panel at bottom slightly and pull out.



Unscrew screws.



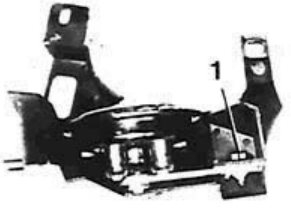
Pull off plug.
Disengage and remove switching unit.
Note:
Check installed direction.



30 65 126

65 75 . . . REMOVING AND INSTALLING OR REPLACING ALARM HORN FOR BURGLAR ALARM

Unscrew screws.
Take off holder and pull off plug.



30 65 124

Unscrew screw (1) and take out alarm horn.

TROUBLESHOOTING BURGLAR ALARM

Test Requirements:
Fuse no. 27 in power distributor okay.
Battery charged (voltage at least 11.5 V).
Tests made with BMW service tester or BMW digital tester II and universal adapter with 26-pin connecting lead.
If applicable to car, central locks and/or on-board computer okay.

Pull off all plugs on burglar alarm control unit and connect the universal adapter on leads.

Fault Description	Test No.
A. Burglar alarm not working at all Cars with central locks/unlocking arrest — continue with Cars without central locks — continue with	I I a I b
B. Burglar alarm can be turned "on", but lamp flashes	II
C. Burglar alarm can be turned "on" and "off", but no alarm	III
D. Burglar alarm can be turned "on" and "off", but no ignition alarm	IV
E. Indicator lamp not on, but burglar alarm not working	V

Note for Tests III and IV:

Plug A (4-pin flat male plug, 2 bevelled edges) is located right rear on the burglar alarm control unit.

I Is there resistance between pin 10 and car ground? — no → Check ground connection of burglar alarm control unit, repairing if necessary.

yes ↓

Check voltage between pin 6 and car ground. Battery voltage? — no → Check connection of term. 30 on burglar alarm control unit, repairing if necessary.

yes ↓

a) Central locks unlocked/unlocking arrest (if applicable) unlocked. Check voltage between pin 20 / 21 and car ground. 0 to 2 volts? — no → Check and repair central locks – see Group 51 in Repair Manual.

yes ↓

Central locks locked / unlocking arrest (if applicable) operated. Check voltage between pin 20 / 21 and car ground. 4 to 12 volts? — no → Check and repair central locks – see Group 51 in Repair Manual.

yes ↓

Burglar alarm control unit or burglar alarm lock defective.

b) Driver's door and trunk lid unlocked.
Resistance between pin 21 and car ground? — yes → Replace switching units for driver's door and trunk lid.

no

Pull off plug on trunk lid switching unit.
Resistance between pins 3 and 5 on trunk lid switching unit? — yes → Replace trunk lid switching unit.

no

Resistance between pin 21 and car ground with trunk lid plug pulled off? — yes → Replace switching unit for driver's door.

no

Burglar alarm control unit or burglar alarm lock defective.

11 Resistance between pin 12 and car ground (with engine hood closed)? — no → Engine hood switch defective.

yes ↓

Resistance between pin 13 and car ground (with trunk lid closed)? — no → Trunk lid switch defective.

yes ↓

Resistance between pin 26 and car ground (with all doors closed)? — no → Remove and check door contacts separately.

yes ↓

Resistance between pin 19 and car ground (with rear window defogger switched off) < 10 ohms? — no → Check rear window defogger circuit – see Group 61 in Repair Manual.

yes ↓

Burglar alarm control unit or burglar alarm lock defective.

III Connect connection A 1 with connection A 2 on plug A. Alarm horn sounding? — no → Alarm horn defective.

yes ↓

Burglar alarm control unit defective.

IV Ignition turned on. Voltage (battery voltage) between connection A 3 and car ground? — no → Check wires.

yes ↓

Burglar alarm control unit defective.

V To check the indicator lamp (rear) connect pin 25 with car ground and pin 23 via ballast resistor (500 - 1000 ohms) with battery + (term. 30).

To check the indicator lamp (driver's door) pull off plug on coding lock; connect left side (II) of plug on car ground and right side (I) via ballast resistor (500 - 1000 ohms) on battery + (term. 30).

II I

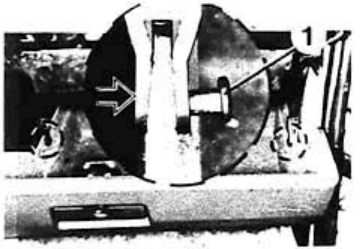
(term. 31) – + (term. 30 via ballast resistor)

Wire	Wire
brown	brown/red

Note for Replacement of Burglar Alarm Control Unit or Burglar Alarm Lock:
Both parts should be available for repairs, since it is not always possible to determine whether the burglar alarm control unit or burglar alarm lock is defective.
Always replace the burglar alarm lock first to avoid destruction of a new burglar alarm control unit with a defective burglar alarm lock.

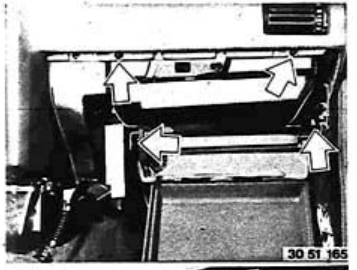
65 81 020 REMOVING AND INSTALLING OR REPLACING CONTROL PANEL FOR ON-BOARD COMPUTER

Important!
The coding has to be checked when replacing the control panel (see testing instructions).

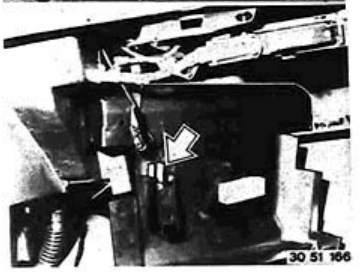


30 51 182

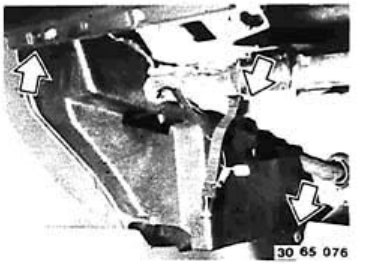
Open glove box.
Pull out pin (1) of both retaining straps.


30 51 165

Unscrew screws and pull down cover.


30 51 166

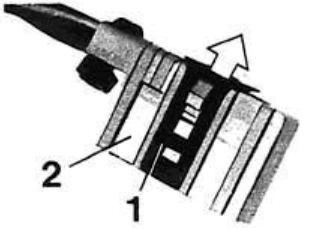
Pull off wire plug and remove cover.


30 65 076

Unscrew screws and take off cover.

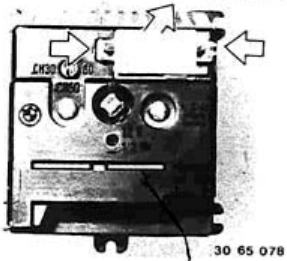

30 65 077

Unscrew screws and remove on-board computer.



733 62 019

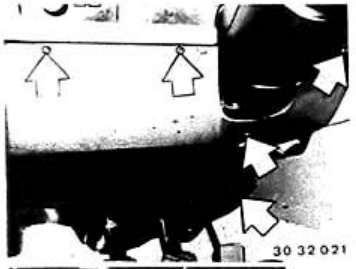
Pull out slide (1) and pull off plug (2).



30 65 078

Replacing Coding Plug*:
Compress retainers and pull out coding plug.

* See Specifications

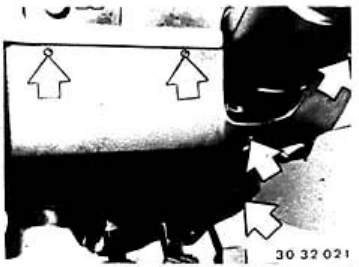


65 81 045 REMOVING AND INSTALLING OR REPLACING RELAY FOR ON-BOARD COMPUTER II

Turn holding screws of instrument panel trim at bottom left 90° and remove trim panel.



Pull off plug.
Unscrew screws.

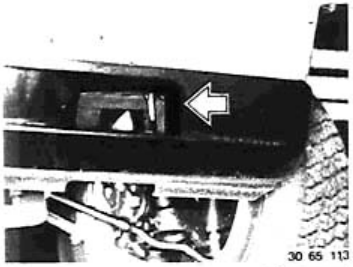


65 81 050 REMOVING AND INSTALLING OR REPLACING GONG FOR ON-BOARD COMPUTER

Turn holding screws of instrument panel trim at bottom left 90° and remove trim panel.

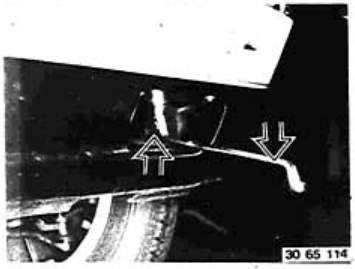


Disconnect plug.
Pull gong out of clamp.

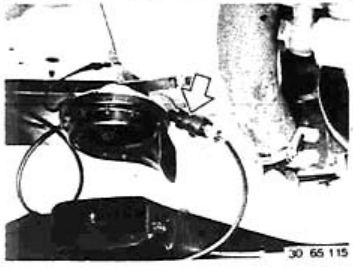


65 81 060 REMOVING AND INSTALLING AIR TEMPERATURE SENSOR

a) Before 9/85:
The air temperature sensor is located in the air inlet opening of the front spoiler.

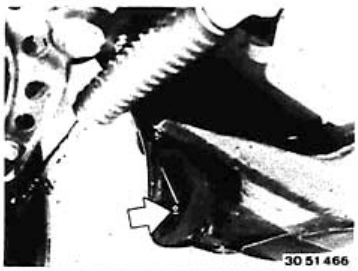


Press out temperature sensor with a bent 8 mm ring wrench.

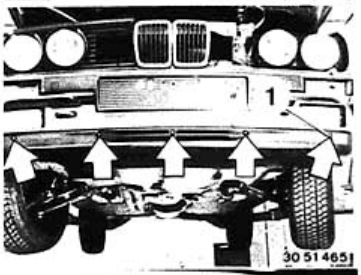


Pull plug out of holder and disconnect it.
(The lower trim panel has been removed for better illustration, but this is not necessary to remove the temperature sensor.)

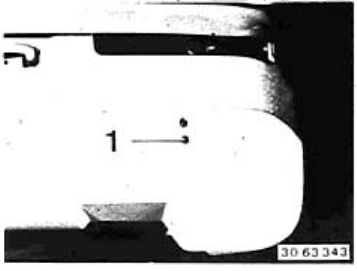
Checking:
Check temperature sensor by measuring the resistance*



b) Since 9/85:
Unscrew screws of front spoiler in front wheel house on left and right sides.



Unscrew screws.
Take off spoiler.
Disconnect plug on temperature sensor (1).
Pull out temperature sensor.



Note:
Temperature sensor (1) is located approx. 2 cm (3/4") below the left mounting screw.

* See Specifications

65-813

TESTING INSTRUCTIONS FOR SECOND GENERATION ON-BOARD COMPUTER – SERIES '3'

These testing instructions are given in logical order, but separate test steps may also be used. The specified pins (numbers) are mandatory – danger of short circuit!

- Testing requirements: On-board computer II calling and storing according to chapter 2 in Owner's Manual.
- Testing equipment required: Universal adapter* with connecting lead as well as BMW service test unit (multimeter tests).
- Data stored in on-board computer II (BC II) is cancelled by connecting the test adapter between BC II wire harness plug and BC II.
- Functions in ignition lock positions: 0 No indicator panel background lighting; no operation of buttons possible.
  R Indicator panel illuminated; operation possible; code function ready
  15 Same as R, however also distance/time/consumption functions; coding function blocked
  50 Same as 15, but only here and 6 seconds after taking away term. 50 signal may the starting interlock function

* Universal adapter, HWB No. 81 12 9 425 091
Conn. lead wire harness 26-pin 096
Conn. lead control unit 26-pin 097

Note: The type of coding plug* can be called in ignition lock position 15 by pressing buttons 1 and 100 at same time. If calling is not possible, check power supply between pin 10 (= B –) and pin 7 (= term. 15).

Malfunction When Operating	Possible Defect	Test / Nominal Values	Not Conforming with Nominal Values Sources of Defect / Instructions
1. PPPP appears in indicator panel	– In rear coding plug*	Coding test	– Replace coding plug, disconnect power supply, reconnect, perform coding test.
	– On its plug contacts		
	– Or on BC II		– Replace BC II. Check coding and compare reserve quantity after replacing BC II. If tank volume does not correspond with reserve range, pull fuel level transmitter out of tank far enough that float is on bottom stop. Remove anti-tamper lock on BC II (to the left of button 1000). Ignition lock in 15. Adjust displayed liter value* with a screwdriver then while pressing buttons 1 and 1000 at same time. Reinstall anti-tamper lock.
Note: The driving range display could be changed after calling the tank volume.			
2. AAAA appears in indicator panel	Internal BC II defect		Replace BC II, also refer to point 1.
3. No display	Power supply missing	Between pin 10 (= B –) and pin 6 (= B +) Nominal value: U ≧ 10 V	Wires to/from instrument cluster, plug connections
4. Weak clock display, but no other operations possible in ignition lock pos. R	– Voltage missing on term. R	Between pin 10 (= B –) and pin 5 (= term. R) Nominal value: U ≧ 10 V	– Wires to/from instrument cluster, plug connections
	– BC II defective (e.g. buttons)		– Replace BC II (see point 1).

* See Specifications

Malfunction When Operating	Possible Defect	Test / Nominal Values	Not Conforming with Nominal Values Sources of Defect / Instructions
5. Ignition lock from pos. R Indicator panel background/ button lighting (with light on) without function	– Term. 31g, term. R, term. 58 power supply missing – Bulbs in BC II defective	– Between pin 10 (= term. 31) and pin 5 (= term. R) Nominal value: ≙ 10 V (button panel lighting only works with lights switched on) – Between pin 9 (= term. 31g) and pin 8 (= term. 58k): Nominal value: U ≙ U battery, depending on switch position	– Wiring – Replace light bulbs; depending on type of defect either pull out light slide with a small pliers (check stamped voltage value for external testing) or lamp for button lighting (12 V, 1.2 W)
6. None or wrong SPEED display	– Wrong coding plug* in BC II Speedometer signal missing – Defect on input signal – BC II defective	– see point 1 – Simulate speedometer signal on wire plug connection with BMW service test unit – Turn ignition on (don't run engine) with simulation of 256 Hz; press SPEED and SET-RES buttons on BC II; see display value in coding plug table*	– Trace signal up to BC II – Replace BC II (also refer to point 1)
7. None or wrong CONSUMPTION display	– Wrong coding plug* in BC II Defect on input signal – BC II defective	– see point 1 – With engine running there must be a consumption signal on pin 17 and pin 10 (= B –)	– Check signal from L-Jetronic control unit pin 16 or wire 11 of 2BE control unit with BMW service test unit. Scope test or BMW digital tester 2: ⎍ ms test, possibly compare with signal of cyl. 1 or 2 – Replace BC II (also refer to point 1)

* See Specifications

Malfunction When Operating	Possible Defect	Test / Nominal Values	Not Conforming with Nominal Values Sources of Defect / Instructions
8. TEMPERATURE display Considerable display difference between R and 15 – displays – 30° C	– Fuel level transmitter or its line		– Fuel level transmitter/connections – Wire short circuit – Wire break
	– Temperature sensor or its wires	– Measure resistance* between pin 16 and pin 10 (= B –) (BCII not connected) and compare with actual temp..	– Wires – Temperature sensor
Wrong TEMP function	– Temp. sensor not as specified	– See Specifications* for values	– Replace temperature sensor
	– BC II defective		– Replace BC II (see point 1)
9. No GONG	– Defect on gong signal transmitter/ wires	Turn ignition switch to R or 15, connect pin 10 and pin 2; there should be gong	No gonging: – Defect in wires to gong – Defect in gong (check gong externally) Gonging:
	– BC II defective		– Replace BC II (see point 1)
10. No activation of parked car heating *Note:* Parked car heating will soon be available for E 30.	– Parked car heating relay defective/ wires	Connect pin 14 with pin 6 (= B +): relay should switch	Nominal value not reached. Measure resistance between pin 14 and pin 10 (BC II not connected) (ignition switch at 0), nominal value between 80 and 120 (see wiring diagram of enclosure 3) – Relay defective – Wires defective
	– BC II defective		– Replace BC II (see point 1)
11. No activation of horn relay	– Relay box for horn activation defective/wires	Connect pin 1 and pin 10 (= B –) Horn relay must switch and horn must be operated.	Defect in relay box, wires, horn – its function is okay.
	– BC II defective		– Replace BC II (see point 1)

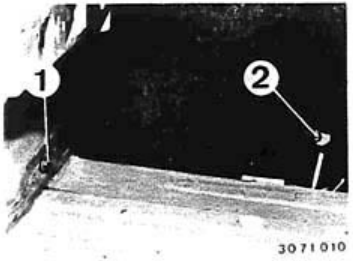
* See Specifications

Malfunction When Operating	Possible Defect	Test / Nominal Values	Not Conforming with Nominal Values Sources of Defect / Instructions
12. No activation of starter interlock activation	– Defect in relay box, starter interlock activation – Wires	Connect pin 11 with pin 10 (= B –) and turn ignition switch to R or 15: relay in relay box must switch	See defect notes of point 10, but between pin 6 and pin 11.
	– BC II defective		Replace BC II (see point 1)
13. No function of remote control	– Steering column switch defective – Wires	Ignition switch turned to R or 15 Connect pin 10 (= B –) with pin 4 several times briefly: displayed information must change each time	Nominal values not reached: – Defect in steering column switch (check without BC II) – Wires
	– BC II defective		– Replace BC II (see point 1)
14. Driving range malfunctions	– Coding plug – Reserve quantity – Speedometer signal – Consumption signal – Fuel level transmitter/reserve contact	– see point 1 – see point 6 – see point 7 – Fuel display in instrument cluster correct	 – Connection between instrument cluster and BC II – Supply wire to instrument cluster

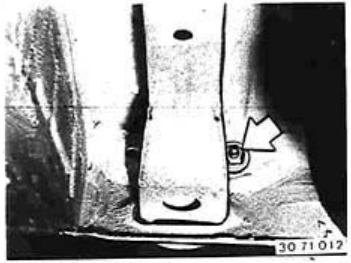
71 Equipment and Accessories for Engine and Chassis

71 60 010 Trailer hitch complete with electrical system – install 71- 1

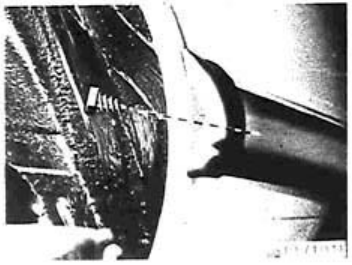
71 60 010 INSTALLING TRAILER HITCH COMPLETE WITH ELECTRICAL CONNECTIONS



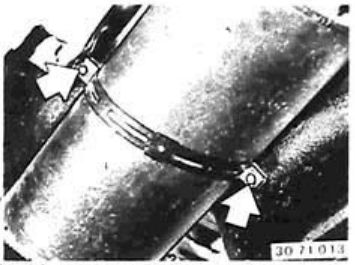
Remove trunk mat and, if applicable, trim on tail panel.
Unscrew nut (1) and bolt (2) on left and right sides.



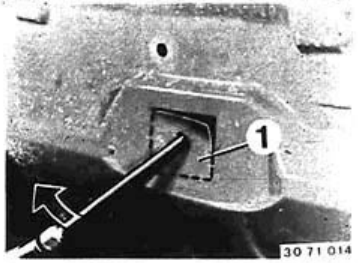
Unscrew nuts on left and right sides.



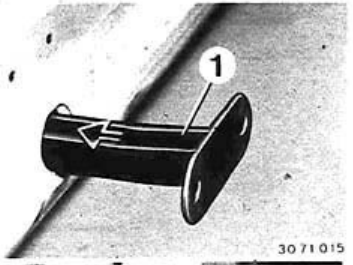
Unscrew bolts on left and right sides.
Remove bumper.
Remove left and right bumper brackets.
(Brackets are omitted – bumper is mounted on trailer hitch.)



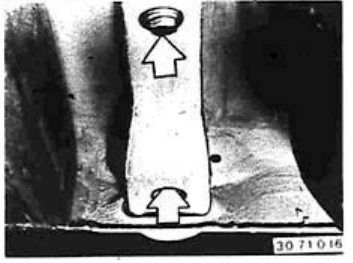
Unscrew nuts.
Lower final muffler approx. 10 cm (4") and suspend it from body with a piece of wire.



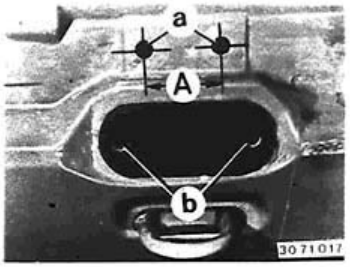
Knock out pre-punched openings (1) on left and right sides.
Coat opening edges with zinc dust paint.



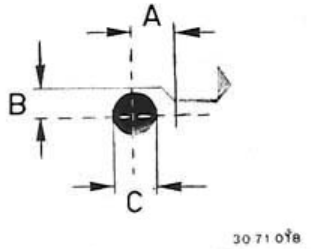
Push supports (1) into side members on left and right sides.
Note:
If necessary, recut M 10 tapped bores.



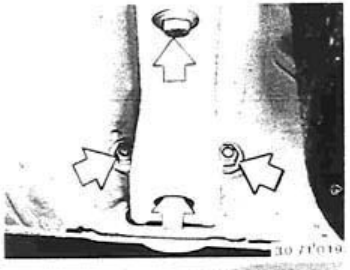
Bolt supports (1) on body hand tight.
Four each M 10 x 20 hexagon head bolts
Four each 10.5 x 30 x 3 washers
Important!
Remove undercoating on bearing surfaces for washers and coat blank metal surfaces with zinc dust paint.



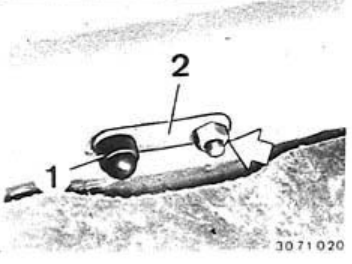
Open up holes (a).
Drill 5 mm (0.197") diameter holes (b).
Dia. = 10.5 mm (0.413").
A = 52 mm (2.047").
Deburr and coat edges of holes with zinc dust paint.



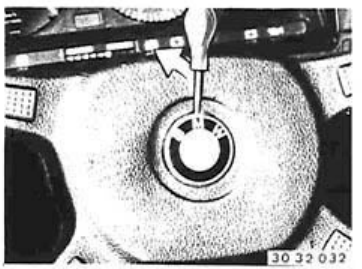
Mark location of hole for electric wires, center punch and drill hole (initial and final drilling).
A = 24 mm (0.945")
B = 20 mm (0.787")
C = 36 mm (1.417") dia.
Deburr and coat edges of hole with zinc dust paint.
Remove burrs from trunk.



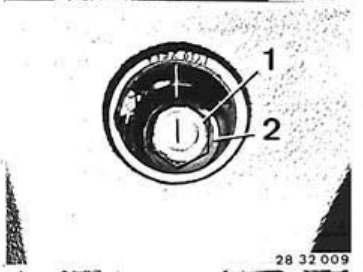
Mount trailer hitch.
Four each M 10 hexagon nuts.
Four each 10.5 x 30 x 3 washers
Tighten nuts and bolts to torque of 43 to 48 Nm (31 to 35 ft. lbs.).
Bolt final muffler.



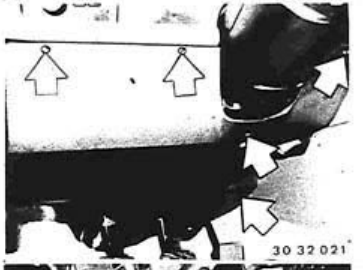
Install reinforcement plate (2).
Tighten nuts to torque of 43 to 48 Nm (31 to 35 ft. lbs.) and install caps (1).
Four each M 10 nuts
2 reinforcement plates
4 caps
Note:
Seal hole (a).



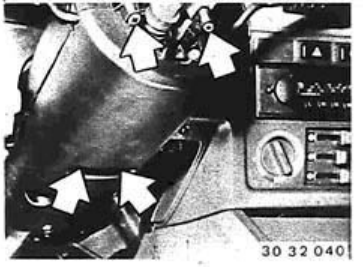
Disconnect battery ground lead.
Remove BMW emblem.



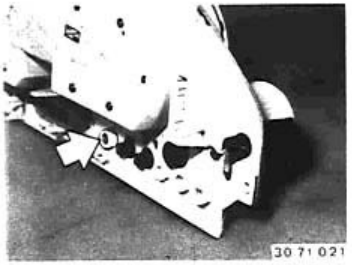
Mark position of steering wheel to steering spindle.
Unscrew nut (1) and remove with washer (2).
Important!
Steering wheel can only be pulled off after unlocking the steering lock.
Installation:
Replace self-locking nut.
Nut tightening torque: 73 to 85 Nm (53 to 61 ft. lbs.).



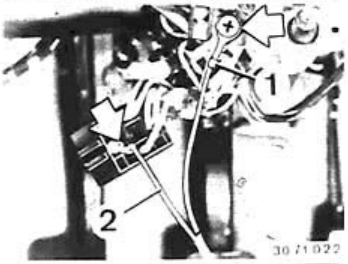
Remove instrument panel trim.



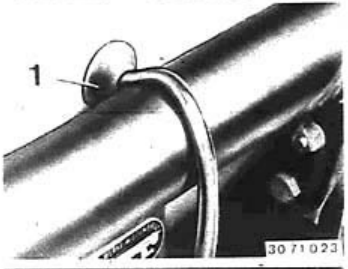
Remove steering column casing lower section.



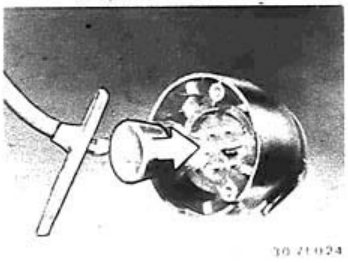
Insert light bulb in socket of extra wire.
Insert socket in turn signal indicator lamp holder on instrument carrier.
(Instrument carrier was removed for better photography.)
Route extra wire to steering column.



Bolt on ground wire (1) (brown).
Pull off plug receptacle on flasher relay and plug wire (2) in jack no. 4 of plug receptacle.
Replace flasher relay – connect plugs.

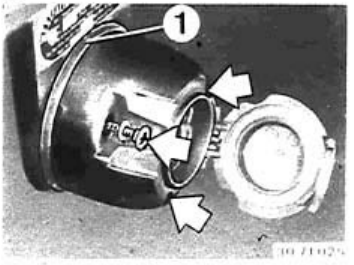


Run extra wire through hole and insert rubber grommet (1).

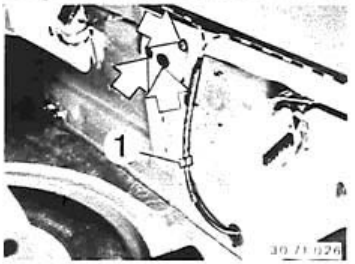


Connect central electric plug.
Plug Connections:

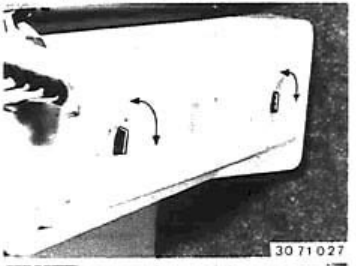
	Wire Color	Terminal No.
Turn signal, left	blue/red	1/L
Tail fog light	gray/violet	2/54G
Ground	brown	3/31
Turn signal, right	blue/black	4/R
Tail light, right and license plate light	gray/white	5/58R
Stop light	green/red	6/54
Tail light, left	gray/yellow	7/58L



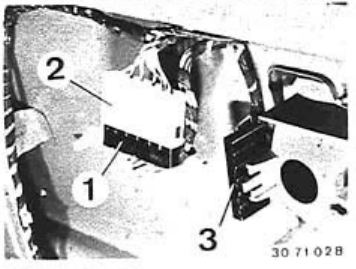
Install rubber seal (1) on socket.
Bolt socket on holder.
If necessary, recut tapped bores.



Remove trunk lid lock.
Install clamp (1) and route extra wire along standard wire harness to tail lights.
Install trunk lid lock.



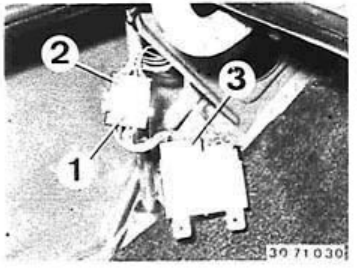
Remove bulb holders on left and right sides.



Press female plug (1) out of holder and connect with multiple-pin plug (2) of extra wire.
Insert female plug (3) of extra wire in holder of tail light housing.
Install bulb holder.



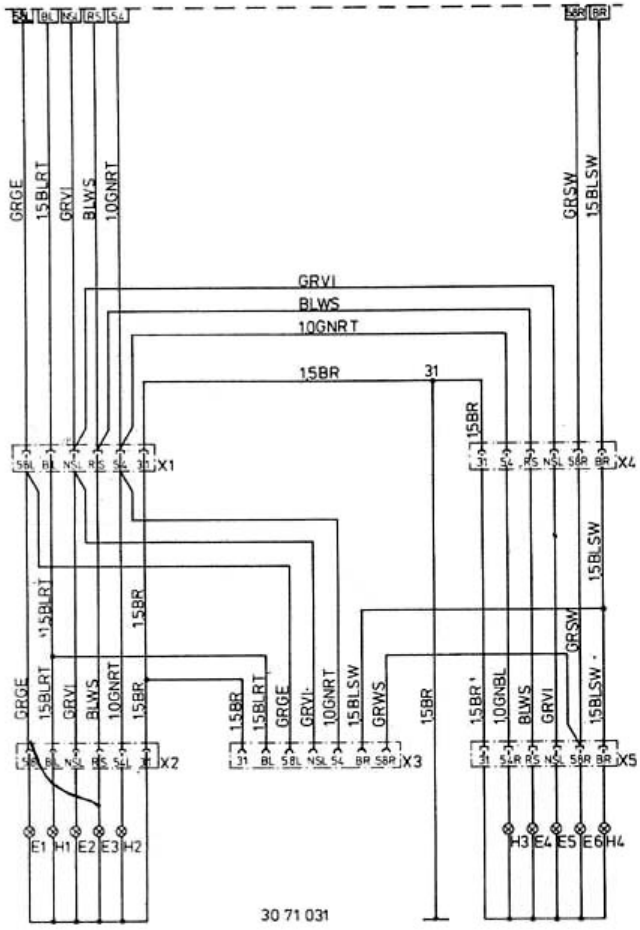
Extra for Cars with Check Control:
Pull off left wheel house trim partially.
Route extra wires along standard wire harness.
Remove control unit.

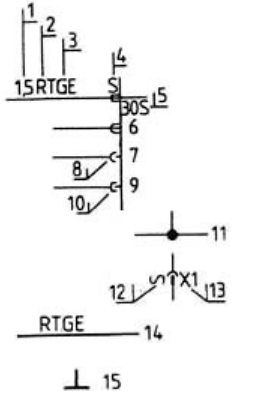


Pull off multiple-pin plug (1) on control unit and connect with female plug (2) of extra wire.
Connect multiple-pin plug (3) of extra wire on control unit.
Install control unit.

Checking Operation:
Connect battery ground lead.
Make sure connections of corresponding plug match connections of socket.
Check function of trailer lights and turn signals when hitching a trailer.
Extra indicator lamp flashes only when trailer is hitched.
Install all removed parts.
Install drawbar load label.
Important!
Install a 15 ampere fuse in place of 7.5 amp fuse in fuse position no. 6, if car has extra stop lights.

CURRENT FLOW DIAGRAM WITHOUT CHECK CONTROL





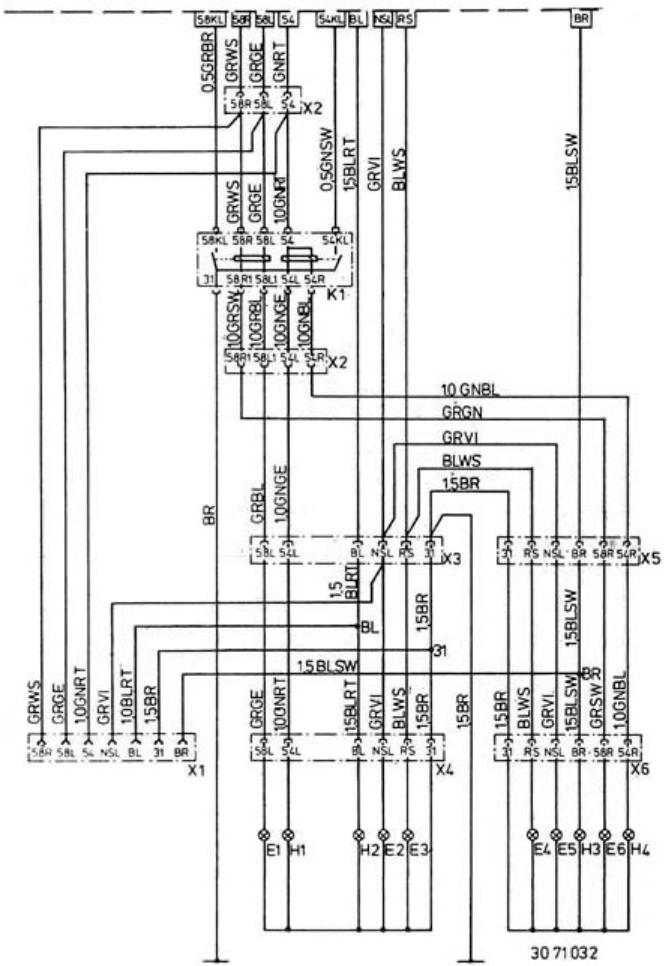
Explanation of Current Flow Diagram Codes:

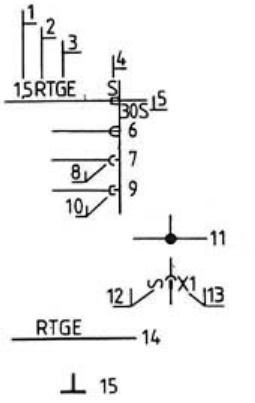
1	Wire cross section size in mm²
2	Wire basic color
3	Wire spiral color
4	Chamber number
5	Terminal designation
6	Wire connector
7	Round male plug
8	Round female plug
9	Flat male plug
10	Flat female plug
11	Soldered point or connector
12	Chamber number
13	Plug connection designation
14	Wires without size data always 0.75 mm²
15	Ground
E1	Tail light left
E2	Tail fog light left
E3	Backup light left
E4	Backup light right
E5	Tail fog light right
E6	Tail light right
H1	Turn signal left rear
H2	Stop light left
H3	Stop light right
H4	Turn signal right rear
X1	Plug, main wire harness left – trailer hitch wire
X2	Connection for left tail lights
X3	Trailer socket
X4	Plug, main wire harness right – trailer hitch wire
X5	Connection for right tail lights
54	Current flow continuation (see car current flow diagram)

Wire Color Codes:

BL	blue
BR	brown
GE	yellow
GN	green
GR	gray
RT	red
SW	black
VI	violet
WS	white
TR	transparent

CURRENT FLOW DIAGRAM WITH CHECK CONTROL





Explanation of Current Flow Diagram Codes:

1	Wire cross section size in mm²
2	Wire basic color
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4	Chamber number
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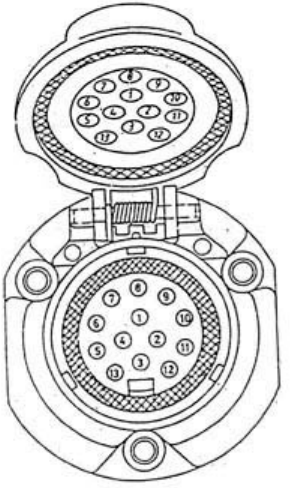
6	Wire connector
7	Round male plug
8	Round female plug
9	Flat male plug
10	Flat female plug
11	Soldered point or connector
12	Chamber number
13	Plug connection designation
14	Wires without size data always 0.75 mm²
15	Ground
E1	Tail light left
E2	Tail fog light left
E3	Backup light left
E4	Backup light right
E5	Tail fog light right
E6	Tail light right
H1	Stop light left
H2	Turn signal left
H3	Turn signal right
H4	Stop light right
X1	Trailer socket
X2	Plug, main wire harness (bulb tester) – trailer hitch wire (8-pin)
X3	Plug, main wire harness (left tail light) – trailer hitch wire
X4	Left tail light connection
X5	Plug, main wire harness (right tail light) – trailer hitch wire
X6	Right tail light connection
54	Current flow continuation (see car current flow diagram)

Wire Color Codes:

BL	blue
BR	brown
GE	yellow
GN	green
GR	gray
RT	red
SW	black
VI	violet
WS	white
TR	transparent

CONNECTIONS OF 13-PIN PLUG

13 Pin Plug	Description	7 Pin Plug
Pin 1	Turn signal indicator, left	Pin 1/L
Pin 2	Rear fog lights	Pin 2/54g
Pin 3*	Ground for circuit contacts 1 through 8	Pin 3/31
Pin 4	Turn signal indicator, right	Pin 4/R
Pin 5	Right tail lights, outline light, side marker and license plate lights	Pin 5/58 R
Pin 6	Stop lights	Pin 6/54
Pin 7	Left tail lights, outline light, side marker and license plate lights	Pin 7/58 L
Pin 8	Backup lights and/or backup device for running-up brake	
Pin 9	Power supply (permanent positive)	
Pin 10	Positive charging lead for battery in trailer	
Pin 11	Not used	
Pin 12	Not used	
Pin 13*	Ground for circuits contacts 9 through 12	



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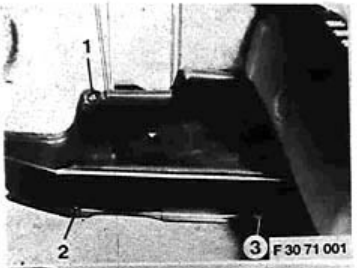
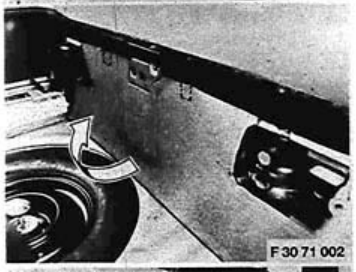
* Both ground leads must not be connected with electric conductance on the trailer end.



Since 1988 Models:
Disconnect battery ground lead.
Remove trun floor mat.
BMW 324 d, 324 td and 325 i;
Remove battery cover in trunk after turning screws (1 ... 3).

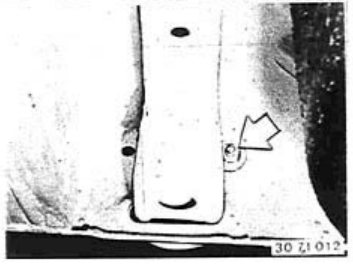


Remove trim panel on tail panel.

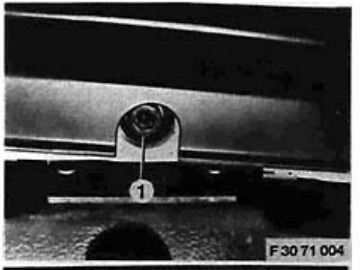


Unscrew nut (1).

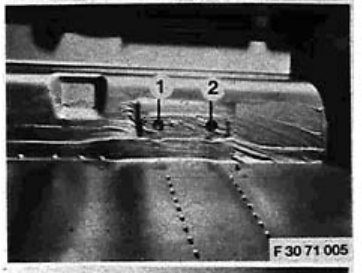
Note:
Remove battery when necessary.



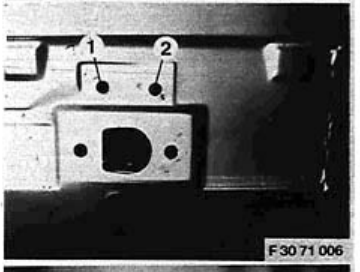
Unscrew nuts on left and right sides.



Unscrew bolt (1) on left and right sides.
Take off bumper carefully.
Unscrew bumper brackets on left and right sides.
Brackets and therefore impact absorbers are omitted.
The bumper is mounted on the trailer hitch.

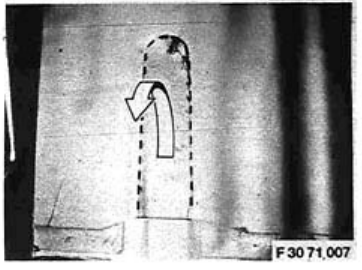


Mark location of holes (1 and 2).
Punch centers of holes with a punch from the inside.

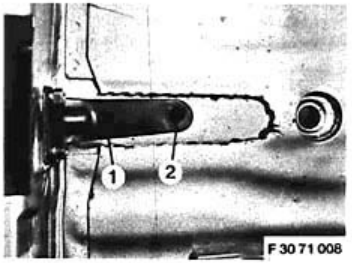


Pre-drill holes (1 and 2) to a diameter of 5 mm (0.197") from the outside.
Open them up afterwards to 10.5 mm (0.413") diameter.

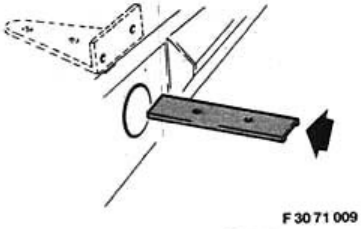
Caution!
Protect the unremoved battery to avoid damage.



Remove insulation sheet as shown.



Insert reinforcement bracket.
Mark centers of holes (1 and 2).
Pre-drill to 5 mm (0.197") diameter.
Open up to 8.5 mm (0.335") diameter.
Remove burrs in trunk with a vacuum cleaner.
Deburr and coat edges of all holes with zinc dust paint.

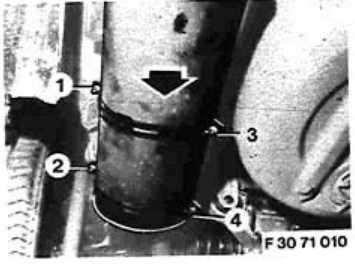


Insert plates in left and right side members and bolt reinforcement brackets on body finger tight.
Four (4) socket head screws.

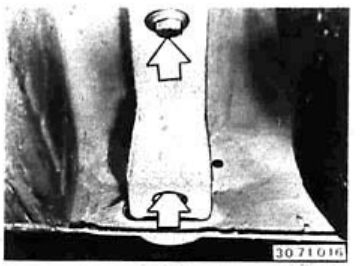


Slide supports (1) into left and right side members.

Note:
If necessary, tap M 10 threaded holes.

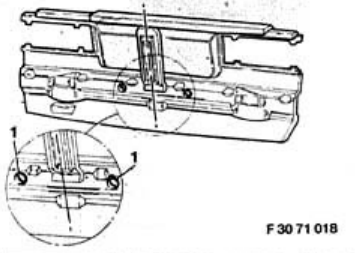


Unscrew nuts (1 ... 4).
Lower final muffler and mount on the body.

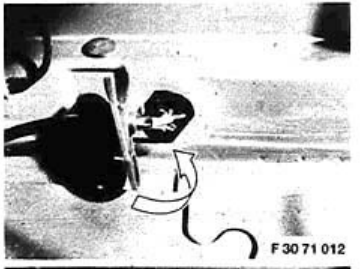


Bolt supports (1) on the body finger tight.
Four M 10 x 20 hexagon head bolts
Four 10.5 x 30 x 3 washers

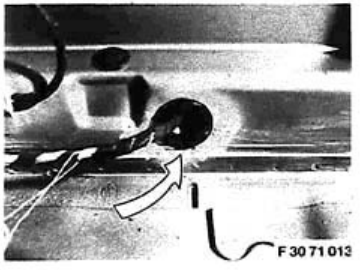
Important!
Remove undercoating on bearing surfaces for washers.
Coat blank metal surfaces with zinc dust paint.



Mark locations, punch centers and drill (initial and final drilling) holes for electric leads.
Final size: 35 mm (1.378") diameter.
Deburr and coat edges of holes with zinc dust paint.
Remove burrs in trunk with a vacuum cleaner.

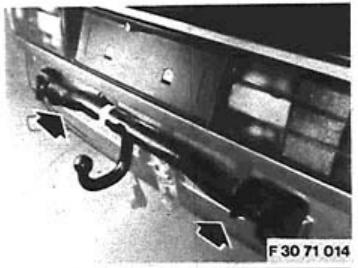


Guide additional wire harness plugs through the holes.

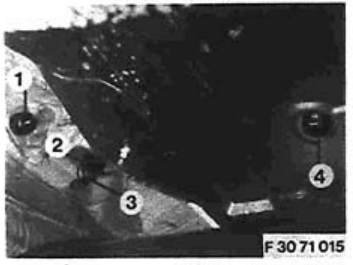


Insert rubber grommets.

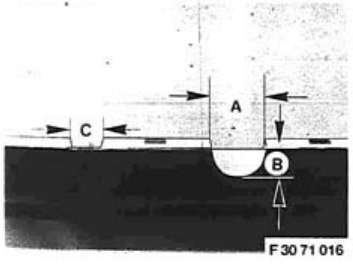
Note:
Check for correct seating of rubber grommets.



Install trailer hitch.



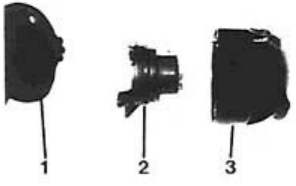
Tighten nuts (1 ... 4) finger tight.
Four M 10 hexagon nuts
Four 10.5 x 30 x 3 washers
Tighten all nuts and bolts to torque of 43 to 48 Nm (31 to 35 ft. lbs.).
Bolt down final muffler.



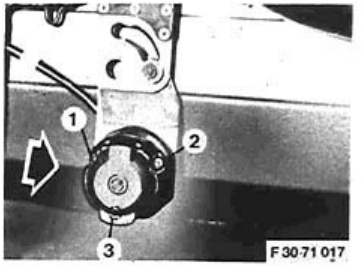
Mark location of and produce openings in middle of bumper.

A = 50 mm (1.968")
B = 40 mm (1.575")
C = 20 mm (0.787")

Mount bumper.



Connect central plug (1), adapter (2) and socket (3).



Insert assembly in trailer hitch holder.

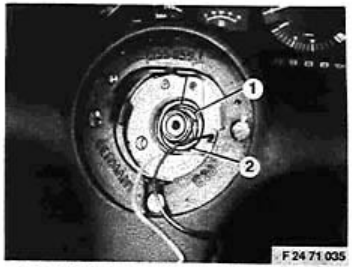
Note:
If necessary, secure the additional wire harness on the trailer hitch with wire straps.

Bolt socket assembly on the holder.
Three bolts
Three washers
Three nuts

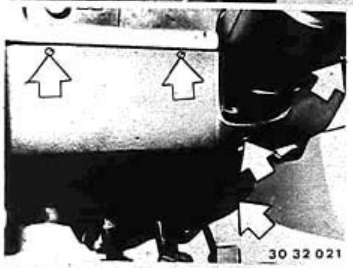
Note:
Check for correct seating of rubber seal.



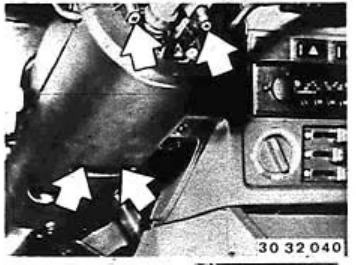
Pry off BMW emblem carefully with a screwdriver.



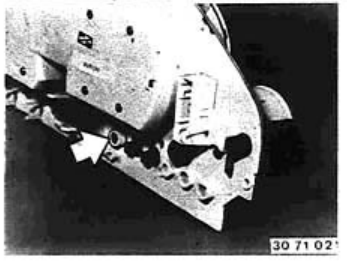
Unscrew nut (1) and remove with washer (2).
Mark position of steering wheel to steering spindle.
Important!
The steering wheel can only be pulled off after unlocking the steering.
Take off steering wheel.
Installation:
Replace self-locking nut.
Tightening torque: 70 to 85 Nm (51 to 61 ft. lbs.)
Be careful not to damage the turn signal self-cancelling cams.



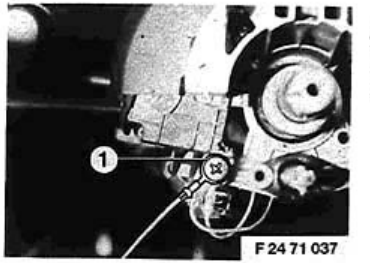
Remove dashboard trim panel at bottom.



Unscrew screws (1 ... 4).
Remove lower steering column casing section.

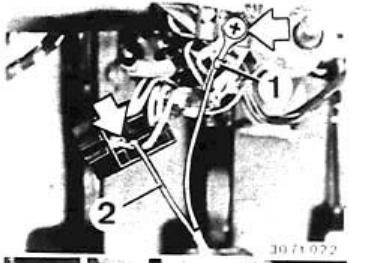


Insert light bulb in socket of additional electric lead.
Insert socket in holder for additional turn signal indicator on the instrument carrier (instrument carrier was removed for better understanding).
Route additional electric lead to the steering column.

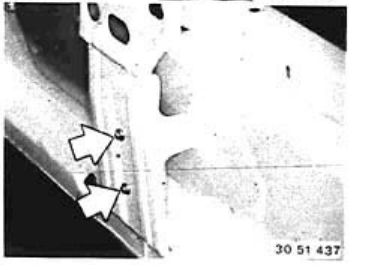


Route additional electric lead to the steering column.
Unscrew screw (1).
Mount the ground connection (brown) of the additional wire harness.

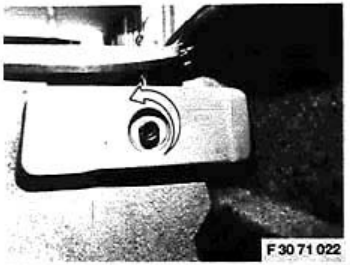
Exchange the flashing relay.



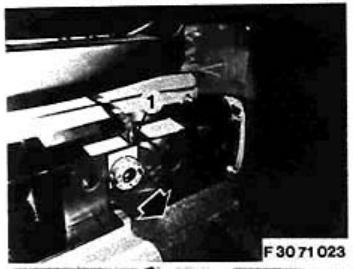
Insert additional electric lead (2) in plug receptacle no. 4.



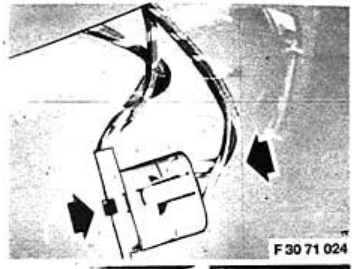
Unscrew screws of central locking mechanism and route the additional wire harness along the standard wire harness to the tail lights.



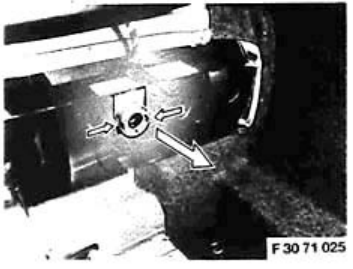
Remove left and right light bulb holders.



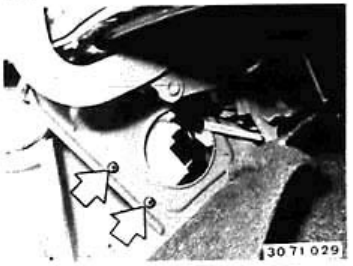
Unclip plug (1) by pressing in both tabs.



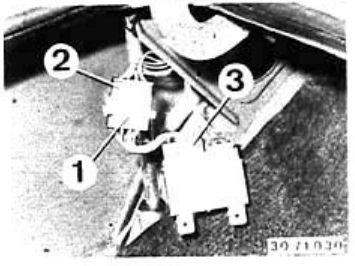
Connect connection with the additional wire harness.



Clip additional wire harness plug in the tail lights.
Place plug behind the side trim panel; secure with straps.
Install light bulb holder.



Additionally in Cars with Check Control:
Pull off left wheel house trim panel partially.
Route additional electric leads along the standard wire harness.
Unscrew control unit.



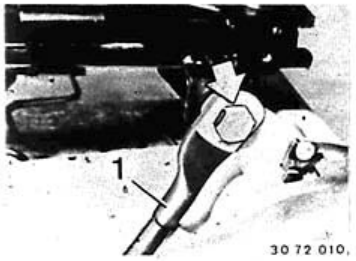
Pull multiple-pin plug (1) off of the control unit and connect it with female plug (2) of the additional electric lead.
Connect multiple-pin plug (3) of the additional electric lead on the control unit.
Screw on control unit.

Function Test:
Connect battery ground lead.
Always make sure that connections of pertinent plug match the connections of the socket.
Check operation of trailer lights and turn signals after hitching a trailer.
The additional indicator lamp flashes only when a trailer is hauled.
Install all removed parts.
Install drawbar load label.

Important!
Fuse No. 6 (7.5 amps) in cars with additional stop lights must be exchanged against a 15 ampere fuse.

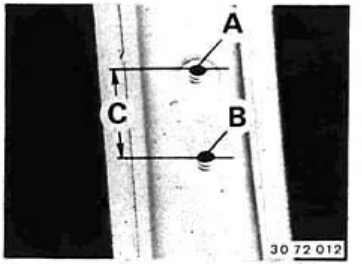
72 Equipment and Accessories for Body

72 11 030	Seat belt, front – remove and install or replace	72- 110
102	Seat belt, rear – remove and install or replace	72- 113
	Seats belts – inspect	72- 115
	Check list for automatic reel seat belts	72- 117
54 12 490	Wind deflector for sun roof – install	72- 120

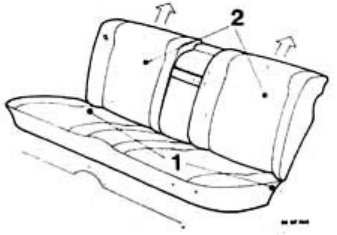


72 11 030 REMOVING AND INSTALLING OR REPLACING FRONT SEAT BELT (COMPLETE)

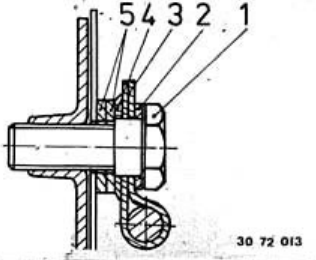
Remove and install front seat 52 10 000.
Pull off cap.
Detach bottom belt strap (1).
Installation:
Tightening torque*



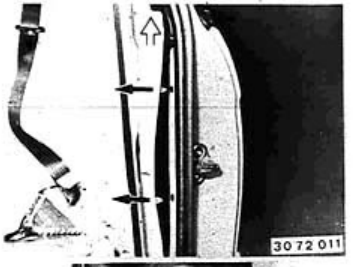
Belt holder can be mounted in bore A or B depending on size of person.
Cut out B pillar trim for bore B.
C = approx. 50 mm (2").



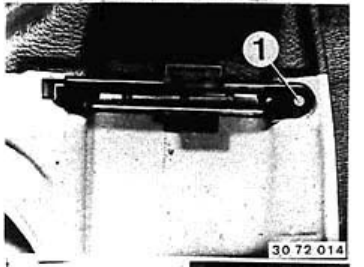
Two Door:
Lift out rear seat cushion from above.
Unscrew bolts (1) and disconnect backrest in holders (2) from above.



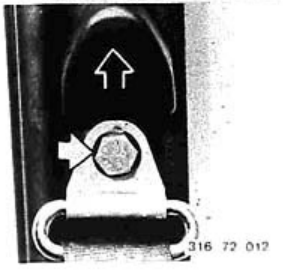
Installed Order:
1) Bolt
2) Plastic washer
3) Top belt
4) Plastic washer
5) Washer (2x)
Tightening torque*
Since 1985 Models:
Washers 2 and 4 omitted.



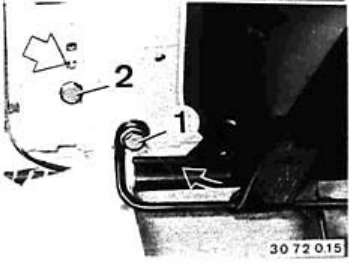
Disconnect side trim panel (3 clips) and pull up out of clamps.



Insert pin (1) and remove slide.



Pull off cap and unscrew bolt.



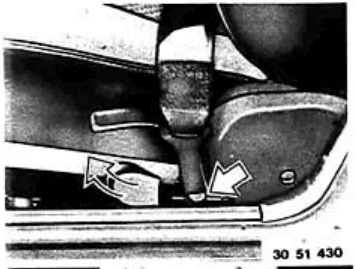
Unscrew bolt (1) and disconnect belt strap.
Unscrew bolt (2) and remove automatic reel.
Installation:
Centering pin engages in bore.
Tightening torque*.

* See Specifications

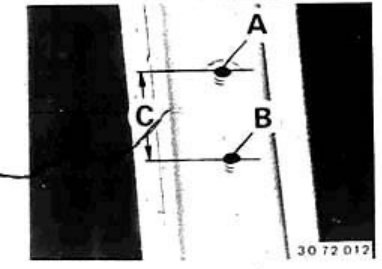
* See Specifications



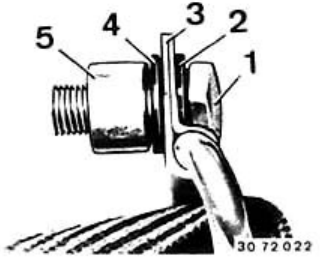
Four Door:
Pull off cap and unscrew bolt.



Pull off cap.
Unscrew bolt.
Installation:
Tightening torque*

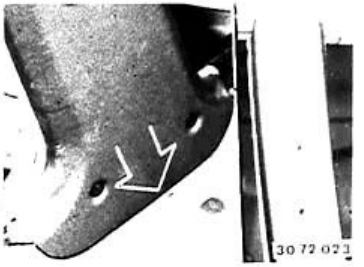


Belt holder can be mounted in bore A or B depending on size of person.
Cut out B pillar trim for bore B.
C = approx. 50 mm (2").

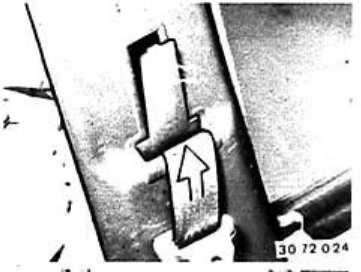


Installed Order:
1 = Bolt
2 = Plastic washer
3 = Top belt
4 = Plastic washer
5 = Spacer
Since 1985 Models:
Washers 2 and 4 omitted.

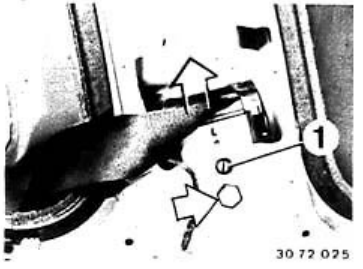
* See Specifications



Unclip or, if applicable, unscrew B pillar trim and pull out of upper holder.

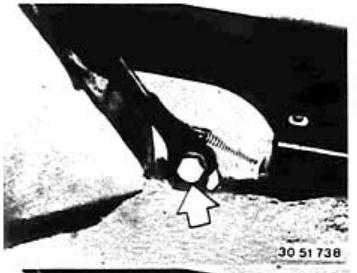


Press out cover and insert belt through B pillar trim.

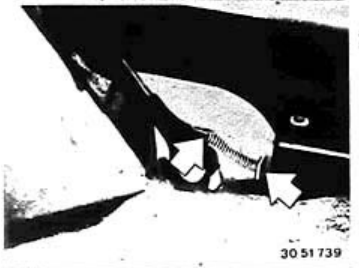


Unscrew bolt and remove automatic reel.
Installation:
Centering pin (1) engages in bore.
Tightening torque*.

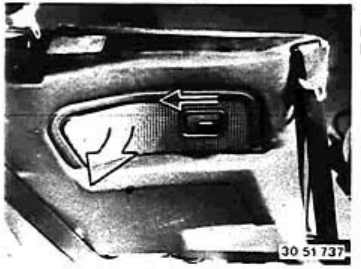
* See Specifications



Convertibles:
Lift out plate.
Unscrew screw.
Lift out seat belt.
Installation:
Tightening torque*.



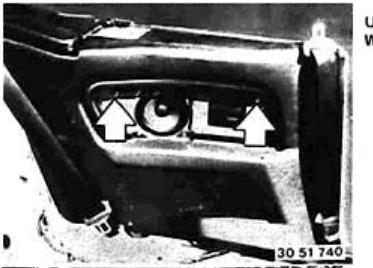
Installation:
Check for correct fit of spring.



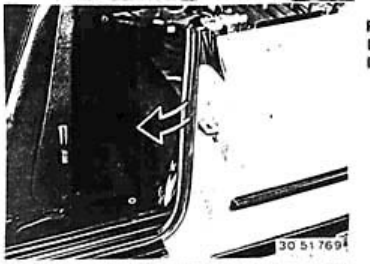
Remove complete rear seat – see 52 20 000.
If applicable, lift out plate.

Pull off trim.

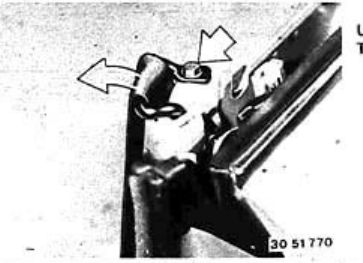
* See Specifications



Unscrew screws.
Window opened.



Pull off rubber seal on door.
Lift out trim.
If applicable, pull off speaker wires.



Unscrew screw.
Take off stirrup.



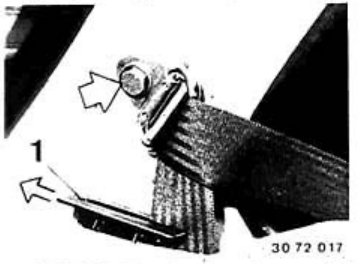
Unscrew bolt.
Remove automatic reel.
Installation:
Tightening torque*.

* See Specifications

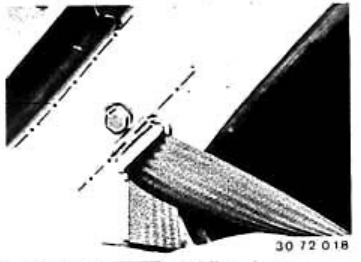


72 11 102 REMOVING AND INSTALLING OR REPLACING REAR SEAT BELT

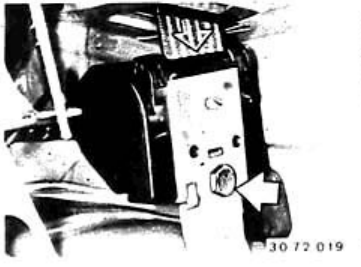
Remove and install rear seat cushion/backrest 52 20 000.
Unscrew bolt.
Installation:
Tightening torque*.



Pull off cap and unscrew bolt.
Lift off cover (1) and pull off of belt strap.

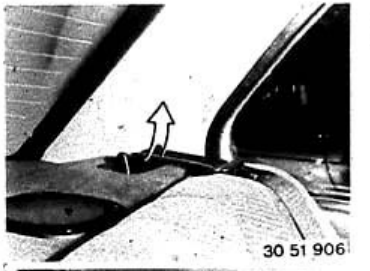


Installation:
Adjust belt holder to be parallel to C pillar.
Tightening torque*.

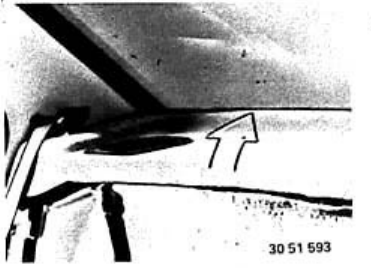


Unscrew bolt in trunk.
Pull belt strap through hatrack and remove automatic reel.
Installation:
Tightening torque*.

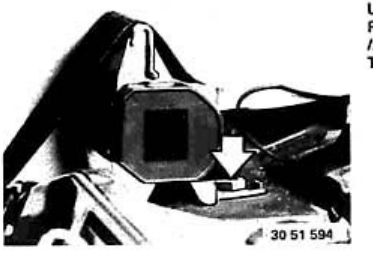
* See Specifications



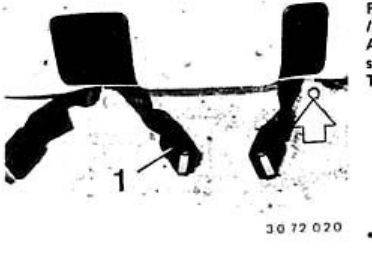
Since 1986 Models:
Lift out cover.



Lift out hatrack.

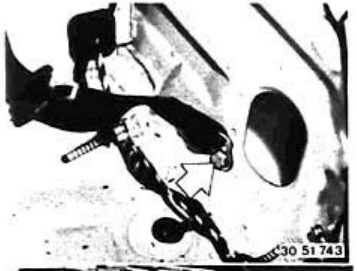


Unscrew bolt.
Remove automatic reel.
Installation:
Tightening torque*.



Remove lower belt strap.
Installation:
Attach belt lock for center seat belt on right side.
Tightening torque*.

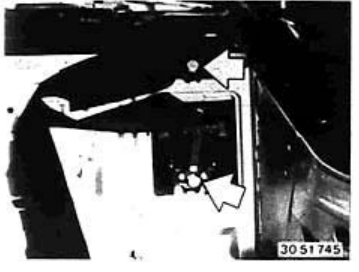
* See Specifications



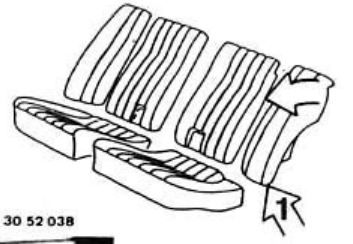
Convertibles:
Remove rear seat cushion and backrest - see 52 20 000.
Unscrew bolt.
Installation:
Tightening torque*.



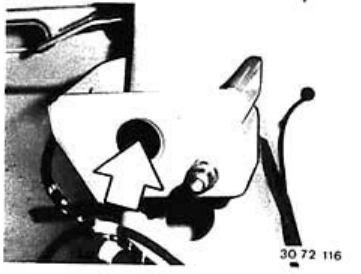
Lift out trim panel.



Unscrew bolts.
Remove automatic reel and reverser.
Installation:
Tightening torque*.

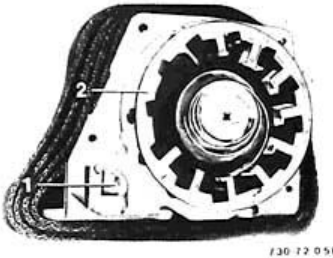


Touring:
Tilt the backrest forward.
Unscrew bolt (1).
Lift out side backrest.
Remove side trim panel - see 51 47 . . ..



Unscrew bolt.
Remove automatic reel.

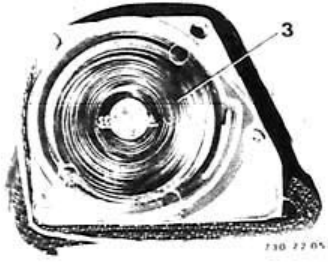
* See Specifications



730 72 058

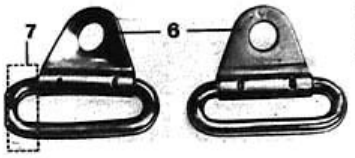
Checking Automatic Seat Belts:

The automatic reel has two independent activating systems for the locking effect.
The first activating system should lock the reel when driving fast in curves, driving in tight curves, when car rolls over, during sharp braking or by impact.
This activation is accomplished with a ball (1).
To check, seat must be set upright and both hands placed on steering wheel in supporting position.
Then apply brakes fully while driving at a road speed equal to twice walking speed (road must be dry).
The seat belt should lock.
The second activating system is for additional safety and is controlled by inertia mass (2).
If reel locks when pulling out belt suddenly, this system is also okay.



730 72 057

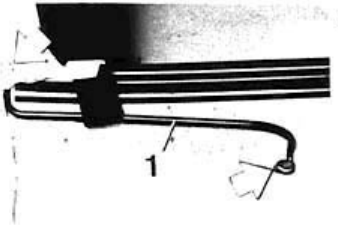
The belt should retract automatically as far as possible when released.
It could happen that the last section of the belt will have to be guided to the door beam by hand.
If this last section is not wound, there could be a weak or broken return spring (3) and/or excessive friction in the belt guides.
An unusuable seat belt or a seat belt worn in a serious accident should be destroyed immediately after removal to guarantee that it cannot be used again.
The automatic reel does not require servicing and must not be opened.



730 72 053

The automatic seat belt has to be replaced when the mounting bar (6) is bent or the stirrup is distorted in area (7).
The stirrup must still pivot after mounting bolt has been tightened; only applicable to front seat belts.

To fasten a belt the tongue should insert easily and engage in the lock with a loud click.
When pushing in the "PRESS" button the belt tongue will be ejected from the lock by spring force.
Replace seat belt when lock trim is missing or damaged.
When replacing a seat belt also replace the lower strap.
In the case of belts integrated in seats an impact could defform the lower strap stop on the seat rail.
Never attempt to straighten the seat or seat rails.



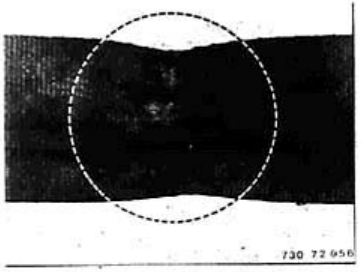
30 72 021

Deformed stirrups (1) must be replaced.



730 72 054

If the plastic cover in the opening for the belt above the anchorage bar (16) has traces of wear, the seat belt must be replaced.



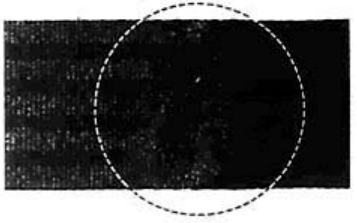
730 72 056

Belt Straps:

Only clean belt straps in a luke-warm soap solution or a commercial fine laundry detergent. Never clean belts chemically or dye belts.

An automatic seat belt must be replaced when there is

- creasing (see picture),
- unraveling,
- pinches,

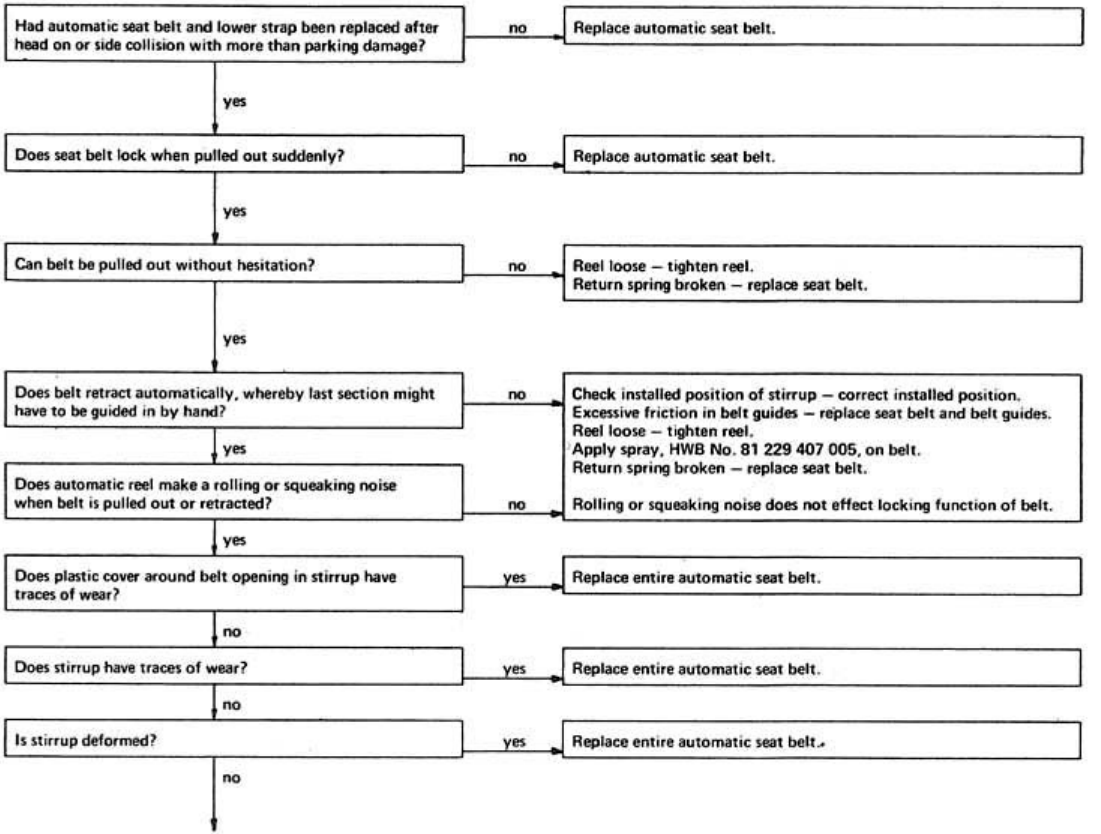


730 72 055

- tears and/or cuts,
- melting (see picture) or
- damaged seams on end of belt in area of holding or pivoting part.

To improve belt retraction the belt can be sprayed with universal belt spray, HWB No. 8 122 947 005.
This will reduce friction, especially on the stirrup.

CHECK LIST FOR AUTOMATIC REEL SEAT BELTS



Is mounting tab on belt reversing holder free of distortion? — no → Replace complete automatic reel seat belt.

yes

Is the fully pulled out belt strap free of pinches, melt spots, cuts, creases, tears and fringing? — no → Replace complete automatic reel seat belt.

yes

Is seam on end of belt strap free of damage? — no → Replace complete automatic reel seat belt.

yes

Does spring pressure eject the belt tongue out of the the lock when operating the "PRESS" button while seat belt is fastened? — no → Replace complete auromatic reel seat belt.

yes

Is a fastened seat belt locked when stopping a car from a speed twice as fast as walking with brakes applied fully? — no → Replace complete automatic reel seat belt.

yes

Is a fully pulled out belt strap free of serious dirt and spots? — no → Seat belt must be replaced, if dirt and spots cannot be removed with a commercial fine laundry detergent.

yes

Is the front tongue of the reclining mechanism or seat rails free of deformation in the case of seat-integrated seat belts? — no → Replace damaged parts and the complete automatic reel seat belt.

yes

Automatic reel seat belt is okay!

ADDITIONAL FOR BELT WARNING UNIT:

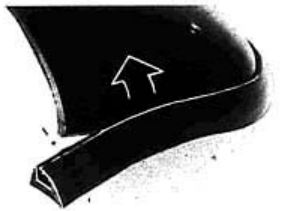
Is there a warning signal with the driver's door closed, ignition turned on and belt lock locked? — no → Automatic reel seat belt is okay.

yes

Check switch in the seat belt lock.
Measure resistance on switch of lock.
Lock locked = ∞ ohms
Lock unlocked = 0 ohm

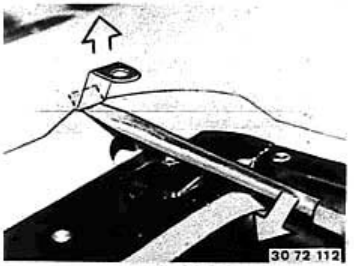
54 12 490 INSTALLING WIND DEFLECTOR FOR SUN ROOF

Parts:
1 Wind deflector
1 Rubber seal
2 Flat head screws
2 Knurled nuts
2 Holders



30 72 111

Mount rubber seal on wind deflector and, if applicable, cut off protruding ends.



30 72 112

Open sun roof.
Press in holders between beaded edge and panel on left and right sides with a screwdriver.



30 72 113

Align wind deflector parallel to roof opening and tighten left and right screws uniformly.
Note:
Tighten screws uniformly after driving car approx. 100 km (60 miles).

97 Body Cavity Sealing and Undercoating

97 00 010 Body cavity sealing for entire car 97- 1

97-1

BODY CAVITY SEALING – '3' SERIES – E 30

Sealing Preparations

- Underside of car must be clean and dry.
- If applicable, damaged PVC on underside including wheel housings and side panels must be repaired and treated with Tectyl.

  The thickness of undercoating should not exceed 250 μm (0.25 mm / 0.010").
- Check car for paint finish damage and damage from flying stones and, if applicable, repair after consulting the customer.
  - Sealing compounds and the car itself should have room temperature (approx. 20° C / 68° F).
  - Check spray pattern of guns and nozzles.
  - When drilling holes, dip the stepped drill bit in sealing compound to trap burrs.
  - Remove dripping sealing compound.
  - Insert plugs dipped in Tectyl in all drilled holes after finishing sealing.
  - Spray engine sealing compound on engine and engine compartment to cover completely.
  - When repairing body parts damaged in an accident or replacing the car body, body cavity sealing must be carried out immediately after painting and before installation of attachments, equipment, trim, etc.. If repair welding seams and joints are only accessible from one side, the side which produces a cavity has to be treated with wax. The same is applicable for the rear side panels, above the wheel housings up to the roof joint, as well as doors especially in the upper corner areas.

Body cavity sealing performed after body repairs must be confirmed on the annual inspection sheets (Owner's Manual) !

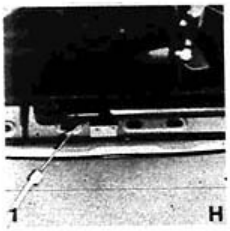
Sealing Procedures on Lifting Platform (wheels protected with covers available from HWB)

1.	Front cross member, through openings on sides	H or F
2.	Side panels and wheel housings - front	N or RS
3.	Engine carrier over entire length	N or RS
4.	Front side panels in rear area from behind through provided hole	N or RS
5.	All reinforcement of floor assembly in front seat area through provided openings	N or RS
6.	Door member at center from underneath	N or RS
7.	Doors twice each through provided holes as well as front door window frame at rear (plates removed)	T+N or F+RS
8.	Left and right rear spring mounts through provided openings	N or RS
9.	Side and cross members underneath trunk through provided openings	N or RS

Sealing Procedures without Lifting Platform

10.	Braces of engine hood and all member sections of front panel through provided openings	H of F
11.	Spring strut peak reinforcement	H or F
12.	Wheel house braces / cowl panel from underneath	H+N or F+RS
13.	A pillar (door contact switches removed; cars with radio: speakers removed)	N or RS
14.	Rear side panels and wheel housing through rubber rubbing strip openings (2-door cars) or door member/rear side panel joints (4-door cars)	N or RS
15.	Rear side panels and wheel housings from trunk	N or RS
16.	Braces of trunk lid through provided openings	H or F

H = Hook-type probe
N = Nylon probe
T = Door probe
RS = Round spray pattern slotted nozzle
F = Flat spray pattern nozzle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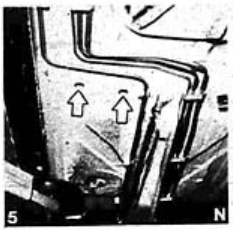
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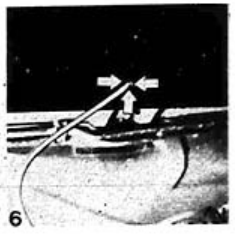
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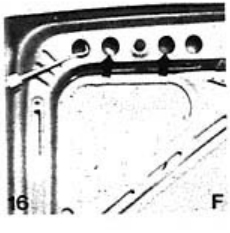
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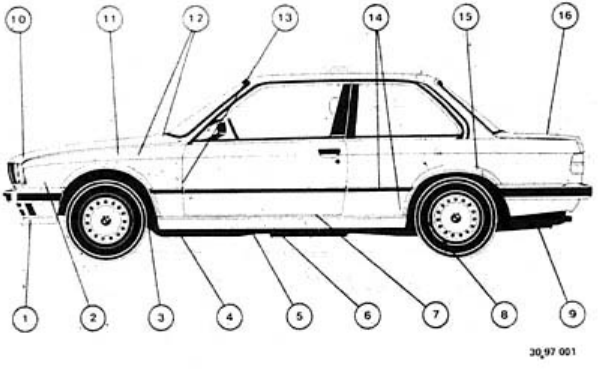
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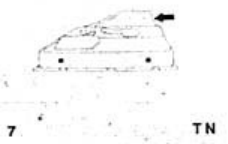
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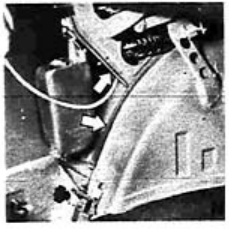

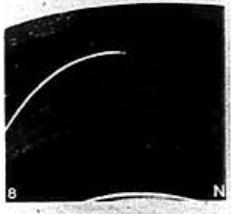
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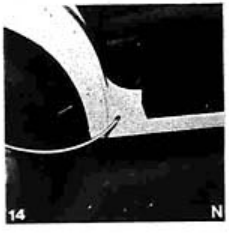
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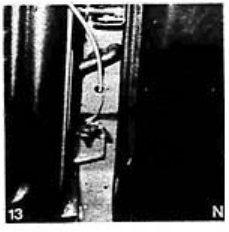
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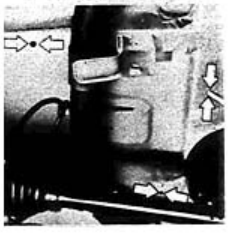
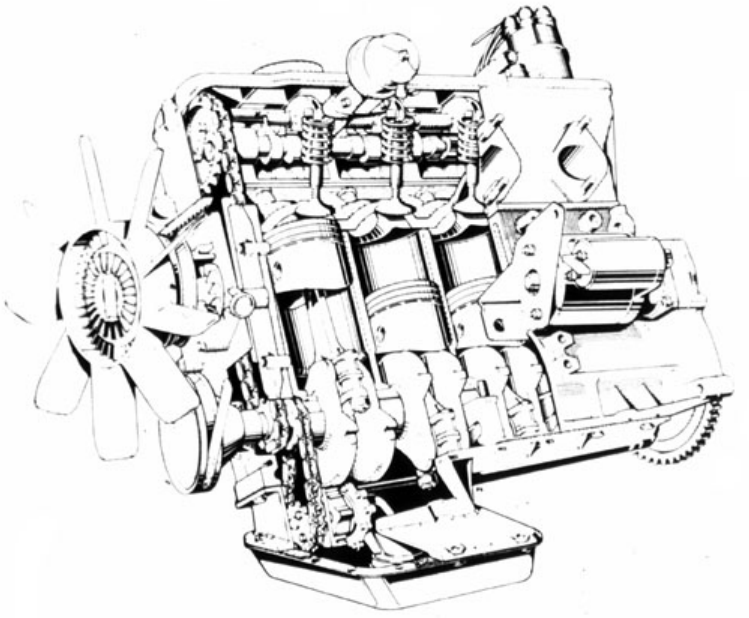
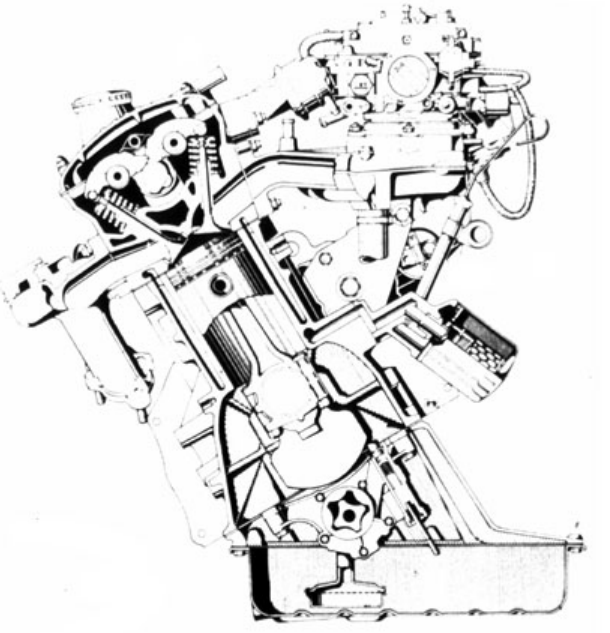


Construction group 11 Engine M10

	Engine view	11-	0
11 12 000	Cylinder head cover – remove and install	11-	1
101	Cylinder head gasket – replace	11-	1
500	Cylinder head – remove and install – engine removed	11-	2
595	Valve guide – inspect for wear	11-	3
591	Valve guide – replace – valves removed	11-	3
607	Valve seats and valves – machine – cylinder head disassembled	11-	3
719	Cylinder head sealing surface – grind – cylinder head disassembled	11-	4
729	Cylinder head – check for cracks in water test – cylinder head disassembled	11-	4
11 14 100	Timing case cover, upper – remove and install / seal	11-	5
120	Timing case cover, lower – remove and install / seal	11-	5
141	Radial oil seal in timing case cover – replace	11-	7
605	Radial oil seal in clutch end cover – replace – transmission removed	11-	7
11 21 000	Crankshaft – remove and install	11-	8
120	Pulley on crankshaft – remove and install	11-	9
501	Crankshaft – replace – crankshaft removed	11-	10
531	Crankshaft main bearing shells – replace – engine disassembled	11-	10b
571	Pilot bearing in crankshaft – replace	11-	11
11 22 000	Flywheel – remove and install	11-	12
051	Drive plate for torque converter – replace	11-	12
541	Starter gear ring – replace	11-	12
11 24 521	Connecting rods – replace – pistons removed	11-	13
571	Conrod bearing shells – replace – disassemble engine	11-	13
11 25 000	Piston – remove and install	11-	14
651	Piston rings of one piston – replace – piston removed	11-	15
11 31 000	Camshaft – remove and install	11-	16
051	Timing chain – replace	11-	17
061	Timing chain sprocket set – replace	11-	18
090	Timing chain tensioner piston – remove and install	11-	19
601	Tensioning rail / guide rail – replace – timing chain removed	11-	19
11 33 020	rocker arm shafts – remove and install	11-	20
031	Rocker arms – replace	11-	21
11 34 004	Valve clearance – adjust	11-	21
509	Valves – check for leaks – camshaft removed	11-	21
550	Valves – remove and install – rocker arm shafts removed	11-	22
	Engine oil circuit	11-	23
11 40 000	Engine oil pressure – check	11-	24
11 41 000	Oil pump – remove and install	11-	24
151	Oil pump drive chain – replace	11-	25
11 42 020	Full flow oil filter – remove and install/seal	11-	26
021	Full flow oil filter – replace	11-	26
11 51 000	Water pump – remove and install	11-	26
502	Water pump – overhaul	11-	27
11 52 000	Fan – remove and install	11-	28
020	Fan coupling – replace	11-	28
11 53 000	Coolant thermostat – remove and install	11-	28

M 10 = 4 cylinders
B = Gasoline
18 = Displacement (x 100)
V = Carburetor
L = L-Jetronic
A/C/S/U = Australia/Switzerland/Sweden/USA





M 10 B 18 V = BMW 316/518
M 10 B 18 L = BMW 318 i/518
M 10 B 18 L U = BMW 318 i (Catalytic Converter)
M 10 B 18 L A/C/S = BMW 518 i (Emission Control)



11 12 000 REMOVING AND INSTALLING CYLINDER HEAD COVER

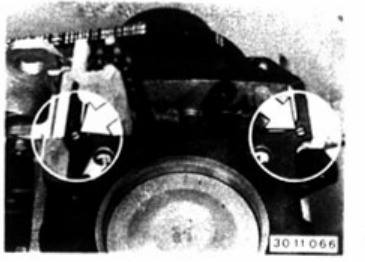
Disconnect hose (8).
Unscrew cylinder head cover.
Installation:
Tighten nuts and bolts in order of 1 ... 7.
Tightening torque*.
Also screw on holder for ignition lead.
Check gasket, replacing if necessary.



11 12 101 REPLACING CYLINDER HEAD GASKET

Remove cylinder head – 11 12 100.
Clean sealing surfaces on cylinder head and crankcase – use gasket remover** and a hard wood scraper.
Check levelness with a standard steel ruler, grinding cylinder head sealing surface (see 11 12 719) if necessary.
Installation:
Only use original cylinder head gaskets to guarantee precise matching of holes and openings for coolant.

A gasket with standard thickness may be installed on a reground cylinder head, or a gasket which is 0.3 mm (0.012") thicker in order to avoid reduction in combustion chamber size.
Identification:
Stamped codes
1.8 / 1.8 E / 2.0 / 2.0 E.



Important!
Fill bores with a brush on type universal sealing compound / Three Bond Silicone 1207** prior to installation of timing case cover.

* See Specifications

** Source: HWB



11 12 500 REMOVING AND INSTALLING CYLINDER HEAD

– Engine Removed –

Disconnect hose (8).
Remove cylinder head cover.
Installation:
Tighten nuts and bolts in order of 1 ... 7.
Also screw on holder for ignition lead.
Tightening torque*
Check gasket, replacing if necessary.



Remove upper timing case cover – see 11 14 100.
Remove distributor – see 12 11 060.
Turn crankshaft until cylinder no. 1 is at TDC – cast boss aligned with notch in pulley.

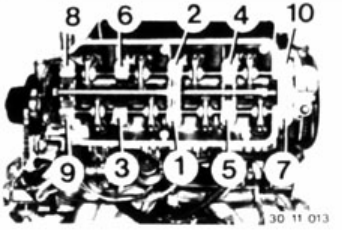


Remove piston for chain tensioner – see 11 31 090.
Unscrew sprocket.
Caution!
Never turn engine after removing the timing chain.
Installation:
Position timing chain that the bore for the dowel pin faces down.
Tightening torque*.



Installation:
Turn in the camshaft before mounting the cylinder head, so that notch in camshaft flange is aligned with cast boss on cylinder head.
Cylinder no. 1 is at TDC.
Also install the timing chain in this position.

* See Specifications

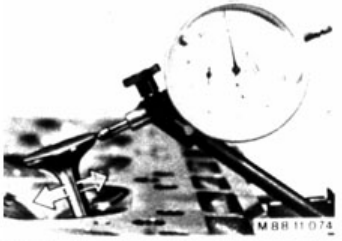


Unscrew cylinder head bolts in order of 10 ... 1 and lift off the cylinder head.
Installation:
Keep oil out of cavities since otherwise bolts tightened with the specified torque might not exert sufficient pressure on the cylinder head. In addition, the crankcase might be cracked.
Clean cylinder head bolts.
Lubricate threads and bearing surfaces of bolt heads with a light coat of oil.
Replace cylinder head gasket – see 11 12 101.



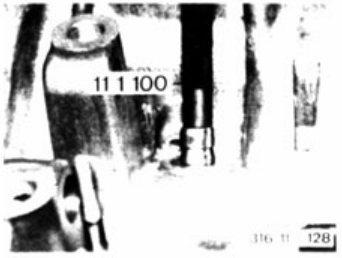
Tighten bolts in order of 1 ... 10 in 3 steps*.
Adjust valve clearance – see 11 34 004.
Adjust ignition timing – see 12 11 004.
Adjust engine idle speed and CO level – see 13 00 054.
Tighten cylinder head bolts to specified torque angle with Special Tool 11 2 110 regardless of the engine temperature in the 3rd step (cover of cylinder head removed again after running engine warm).
Note:
Cylinder head is not tightened again after 1,000 km (600 miles).

* See Specifications



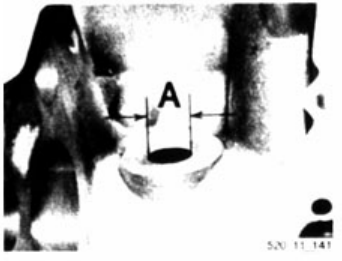
11 12 595 CHECKING VALVE GUIDE FOR WEAR
– Valve Removed –

To measure wear, insert a new valve that the end of the valve stem is flush with the valve guide.
Set up dial gage and measure tilt clearance.
Max. permissible tilt clearance*.

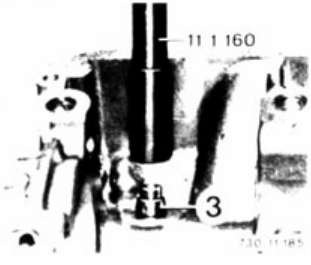


11 12 591 REPLACING VALVE GUIDE
– Valves Removed –

Drive out valve guide cold into the combustion chamber with Special Tool 11 1 100.

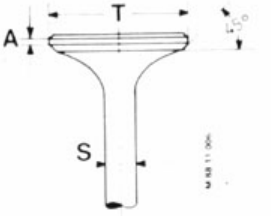


Check bore (A) in cylinder head.
If permissible diameter* is exceeded, bore must be reamed out and an oversize* valve guide installed.



Heat* cylinder head.
Drive in valve guide (3) from the camshaft end with Special Tool 11 1 160.
Bore in the special tool determines the amount of protrusion.*
Ream out valve guide to specified inside diameter.
Machine valve seats – see 11 12 607.

* See Specifications

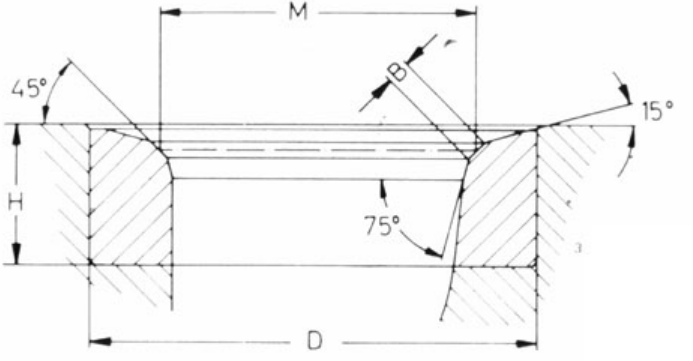


11 12 607 MACHINING VALVE SEATS AND VALVES
– Valves Removed –

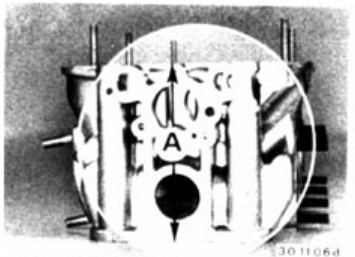
Valve must be replaced, if edge thickness A* is less than specified.

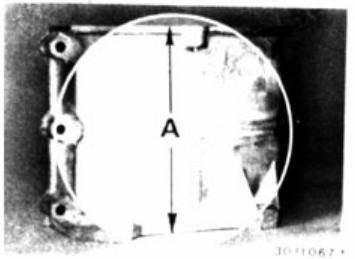


Machine correction angles* to produce valve seat diameter M* and valve seat width B*, after machining the valve seat angle*.
Grind in valves with grinding paste and check valves for leaks – see 11 34 509.



* See Specifications

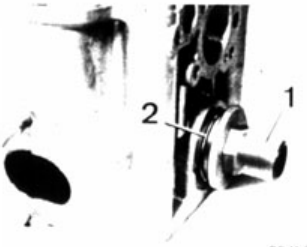




11 14 100 REMOVING AND INSTALLING/ SEALING UPPER TIMING CASE COVER

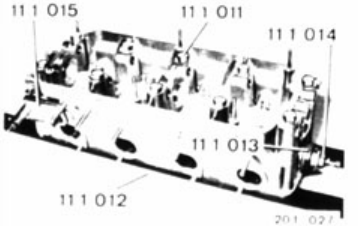
Remove cylinder head cover 11 12 000.
Unscrew bracket (1).
Unscrew timing case.
Installation:
Tighten bolts (2 and 3) finger tight.
Then tighten bolts (4 ... 9) one after the other and finally bolts (2 and 3).
Replace gasket and hold new gasket in position with grease.

Important!
Coat bores with a brush-on type universal sealing compound / Three Bond Silicon 1207** before installing the timing case cover.
If damaged, replace cylinder head gasket.



11 14 120 REMOVING AND INSTALLING/ SEALING LOWER TIMING CASE COVER

Disconnect battery ground lead.
Remove upper timing case cover 11 14 100.
Disconnect wires on alternator.
Unscrew bolt on crankcase.



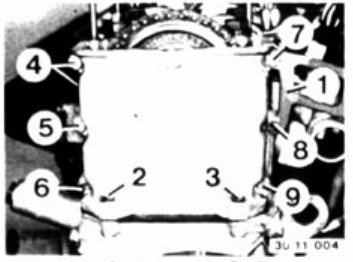
Unscrew alternator with console and tensioning bar.



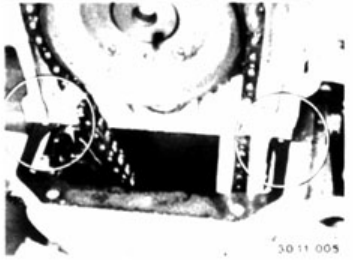
All Cars with Power Steering:
Loosen drive belt.
Unscrew bracket (1).
Pressure hoses remain connected.
Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.

Remove water pump 11 51 000.
Remove crankshaft pulley 11 21 120.
Remove chain tensioner piston 11 31 090.
Unscrew remaining timing case cover bolts.

** Source: HWB



Two-Piece Oil Pan:
Unscrew reinforcement plate.
Remove oil pan lower section 11 13 020.



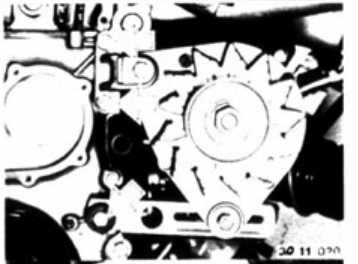
Unscrew bolts (1 ... 3).
Loosen remaining oil pan bolts.

Lift oil pan gasket off of timing case cover carefully with a knife.
If oil pan gasket is damaged, remove oil pan 11 13 000.

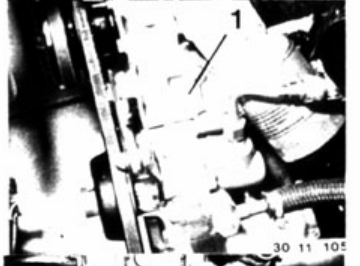
Take off timing case cover.
Installation
Coat mating surfaces between oil pan and crankcase with a brush-on type universal sealing compound / Three Bond Silicon 1207**.
Important!
Take-up web for tensioning piston must extend into oil pocket.

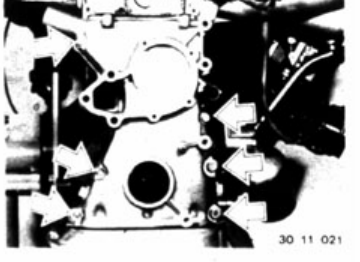


One Piece Oil Pan:
Unscrew reinforcement plate.



Unscrew oil pan bolts at front end.
Loosen all other oil pan bolts.





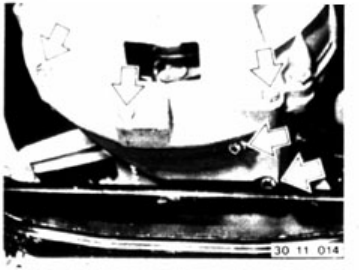
** Source: HWB



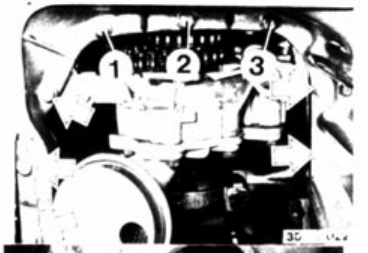
One Piece Oil Pan:
Unscrew reinforcement plate.



Unscrew front oil pan bolts.
Loosen all other oil pan bolts.



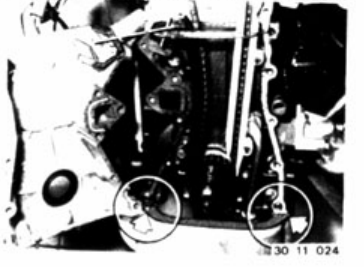
Two Piece Oil Pan:
Unscrew reinforcement plate.
Unscrew lower oil pan section – 11 13 020.



Unscrew bolts (1 ... 3).
Loosen all other oil pan bolts.
Installation:
Install bolts (1 ... 3) with Loctite No. 270**.

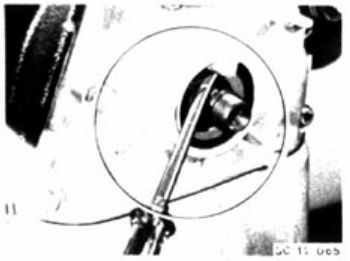


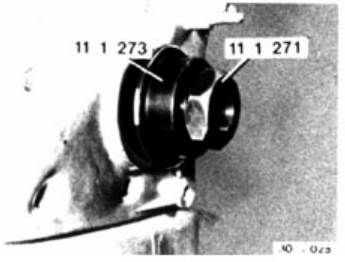
All Models:
Pry oil pan gasket off of timing case cover carefully with a knife.
Remove oil pan – see 11 13 000 – if oil pan gasket is damaged.



Remove timing case cover.
Installation:
Coat mating surfaces between oil pan and crankcase with a brush-on universal sealing compound (Three Bond Silicone 1207**).
Important!
Take-up for tensioning piston must be located in the oil pocket.

** Source: HWB



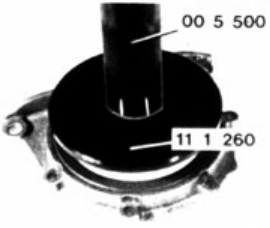


11 14 141 REPLACING RADIAL OIL SEAL IN TIMING CASE COVER

Remove crankshaft pulley – 11 21 120.
Lift out radial oil seal with a screwdriver.

Lubricate sealing lip of radial oil seal with oil.
Press in radial oil seal flush with Special Tools 11 1 273 and 11 1 271.





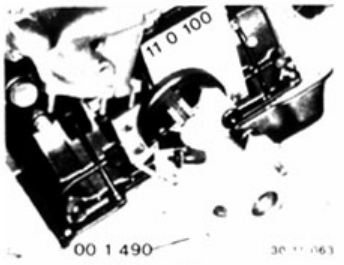
11 14 605 REPLACING RADIAL OIL SEAL IN CLUTCH END COVER – Transmission Removed

Remove flywheel – 11 22 000.
Drain engine oil.
Loosen oil pan bolts.
Pry off gasket carefully with a knife in area of end cover/oil pan joint.
Unscrew end cover.
Press radial oil seal out of end cover.
Installation:
Replace gasket.
If oil pan gasket was damaged, remove oil pan – 11 13 000.

Apply a coat of brush-on universal sealing compound / Three Bond Silicone 1207** on end cover/oil pan joint.
Use Special Tool 11 2 213 to avoid damaging the radial oil seal.

Press in radial oil seal with Special Tools 11 1 260 and 00 5 500.
In contradiction to the standard seal which had been installed flush, install the new radial oil seal with approx. 1 to 2 mm (0.039 to 0.079") offset toward the inside.
Lubricate sealing lip with oil.

** Source: HWB



11 21 000 REMOVING AND INSTALLING CRANKSHAFT

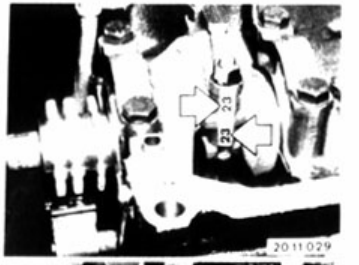
Remove engine 11 00 050.
Unscrew engine mounts.
Mount crankcase in assembly stand 00 1 490 with Special Tool 11 0 100.



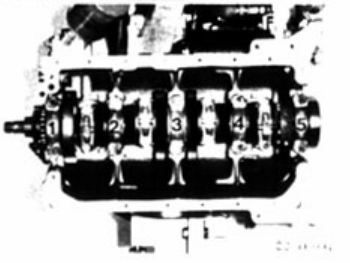
Remove clutch 21 21 000.
Remove cylinder head 11 12 100.
Remove timing chain 11 31 051.
Remove oil pump 11 41 000.
Check axial play* before removing the crankshaft.
Max. Permissible Play Exceeded:
Check or replace thrust bearing.



Remove flywheel 11 22 000.
Unscrew end cover.
Installation:
Replace gasket.
Use Special Tool 11 2 213 to avoid damage on the radial oil seal.
Cut off gasket on oil pan sealing surface.



Unscrew conrod bearing caps.
Installation:
Replace conrod bearing shells and check conrod bearing play, see 11 24 571.
Pair numbers (0 ... 99) must be the same on connecting rods and caps.
Tightening torque*.

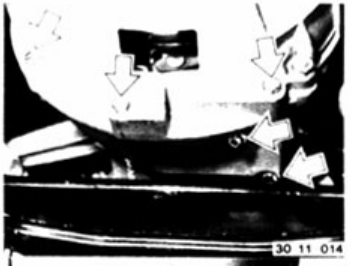


Unscrew crankshaft bearing caps and lift out crankshaft.
Installation:
Bearing cap no. 1 is on sprocket end.
Install bearing shells and check bearing play, see 11 21 531.
Installation:
Measure axial play after installing crankshaft loosen thrust bearing no. 3 again.
Center thrust bearing by applying knocks from a plastic hammer on front and rear ends of the crankshaft.
Tighten thrust bearing to specifications.
Check axial play*.

If crankcase is replaced, clean oil and water bores again thoroughly to remove casting sand.

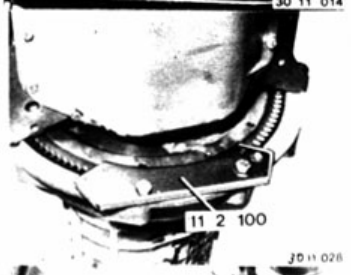
* See Specifications

* See Specifications



11 21 120 REMOVING AND INSTALLING PULLEY ON CRANKSHAFT

Detach reinforcement plate.



Hold flywheel with Special Tool 11 2 100.



Unscrew nut on pulley.
Pull off pulley.
Installation:
Tightening torque*.

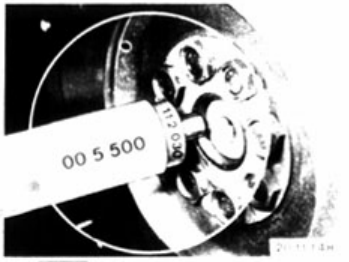


Installation:
Check that woodruff key (1) is positioned correctly.

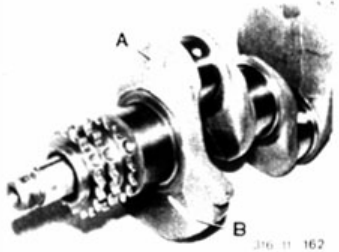
* See Specifications

11 21 501 REPLACING CRANKSHAFT
– Crankshaft Removed –

Note:
A replacement crankshaft is supplied complete with corresponding bearing shells for main and conrod bearings.



Fill bore in crankshaft with approx. 1 gram (0.035 oz.) of lubricating grease. Drive in pilot bearing with Special Tools 11 2 030 and 00 5 500.

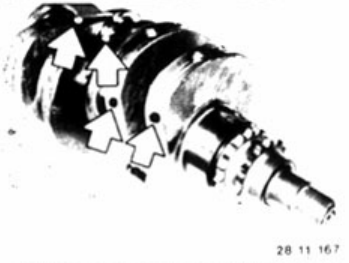


Crankshaft is surface treated and may only be reground in the factory.

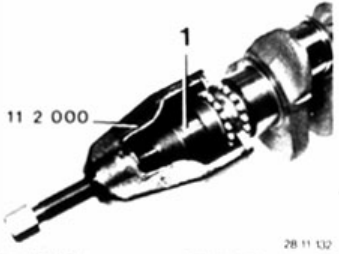
Reground crankshafts are marked with stripes of paint.

Conrod Bearing Journal (A)
1 paint stripe Size 1 *
2 paint stripes Size 2 *

Main Bearing Journal (B)
1 paint stripe Size 1 *
2 paint stripes Size 2 *

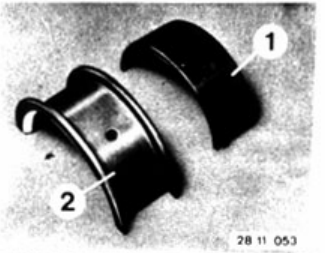


Replacement crankshafts are only supplied with bearing shells of double classification.
A crankshaft is marked with red or blue paint because of the main bearing journal tolerances.



Transferring Sprocket:
Lift out woodruff key (1).
Pull off sprocket with Special Tool 11 2 000.

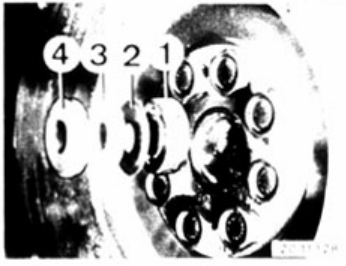
Installation:
Heat sprocket to max. 200° C (390° F) for installation.



1 = Bearing shell 1–2–4–5
2 = Bearing shell 3 (pilot bearing)

The color code is located on the side of a bearing shell.

Check the ground size of main bearing journals.



Cars with Manual Transmission:
Install pilot bearing for the transmission main shaft.

Installed Order:
Ball bearing (1), cover (2), felt ring (3) and capsule (4).

Insert cover (2) with embossment facing out.



Installing Instructions:
Only place bearing shells with "red" marks in the crankcase (regardless of the old color code mark on the crankcase).
Install bearing shells in bearing caps depending on the color code of the crankshaft main bearing journals – "red" or "blue".

* See Specifications

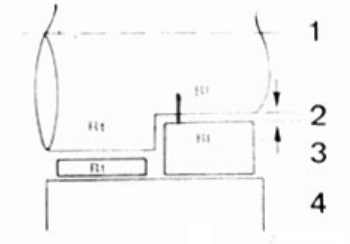


Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps with the correct torque*.
Do not turn the crankshaft.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt



Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with different color code marks.



Survey of Color Code Shaft Diameter/ Bearing Shell Thickness*

Double Classification Color Codes:
Rt = red
Bl = blue

1 Crankshaft diameter
2 Bearing play
3 Bearing shell thickness
4 Console diameter

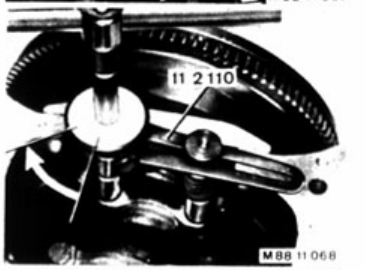


Replacing Conrod Bearing Shells:
Red or blue conrod bearing shells are installed standard depending on the color code mark on the connecting rod for a pertinent crankshaft ground size.

Only install the red bearing shells of a pertinent ground size supplied with a replacement crankshaft.

* See Specifications







Place Type PG 1 Plastigage on a crankshaft wiped clean of oil in BDC position.
Connecting rods and caps are marked with the same pair number (0 ... 99).
All pair numbers are located on one side in an engine.
Mount conrod caps.
Tightening torque:
Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

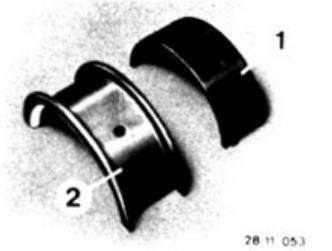
Important!
Do not turn connecting rods or the crankshaft.
Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with different color code marks.
Replace conrod bolts for final installation and tighten the conrod bearing caps.
Tightening torque*.

* See Specifications



11 21 531 REPLACING CRANKSHAFT MAIN BEARING SHELLS
– Engine Disassembled –

A crankshaft is marked with red or blue paint depending on main bearing journal tolerances.



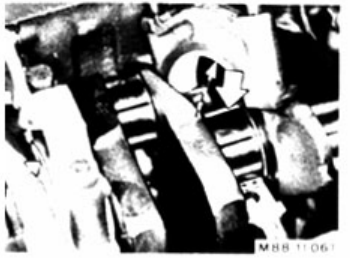
1 = Bearing shell 1–2–4–5
2 = Bearing shell 3 (pilot bearing)

Color code mark is located on the side of a bearing shell.

Check ground size of main bearing journals.



Install bearing shells in crankcase with same color code as the dot of paint on the console.
Install both bearing shells according to the crankshaft color code, if the color code mark on the crankcase is washed off.
Install bearing shells in bearing caps with the same color code as for the crankshaft.



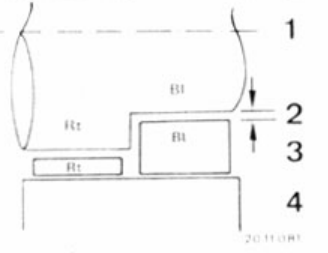
Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps with correct torque*.
Do not turn the crankshaft.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

* See Specifications



Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct bearing play by installing new bearing shells, bearing shells of different machined size or with different color code.



Survey of Color Code Shaft Diameter Bearing Shell Thickness*

Double Classification Color Codes:
Rt = red
Bl = blue

1 Crankshaft diameter
2 Bearing play
3 Bearing shell thickness
4 Console diameter

* See Specifications



11 21 571 REPLACING PILOT BEARING IN CRANKSHAFT

Remove clutch 21 21 000.
Pull out ball bearing with Special Tool 11 2 010



Installed Order:
1 Ball bearing
2 Cover
3 Felt ring
4 Capsule
Install cover (2) with stamp facing out.



Pack bore in crankshaft with approx. 1 gram of lubricating grease.
Drive in pilot bearing with Special Tools 11 2 030 and 00 5 500.



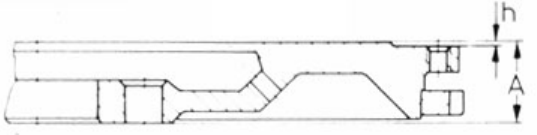


11 22 000 REMOVING AND INSTALLING FLYWHEEL

Remove clutch 21 21 000.
Hold flywheel with Special Tool 11 2 160.
Unscrew bolts and take off flywheel.
Installation
Clean tapped bores.
Install washer (1).
Replace and install expansion bolts with Loctite No. 270**.
Important!
Only coat threads of bolts.
Tightening torque*.

Check axial runout* of flywheel.

Friction surface may be machined to minimum thickness A*.
If machining the friction surface reduces distance "h" to zero, flange surface (distance "h") must be machined.



* See Specifications
** Source: HWB



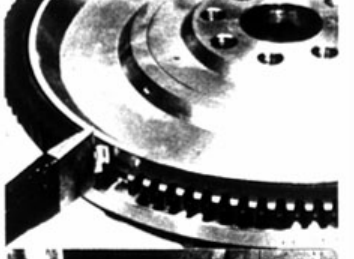
11 22 051 REPLACING DRIVE PLATE FOR TORQUE CONVERTER

Remove transmission 24 00 020.
Hold flywheel with Special Tool 11 2 160.
Unscrew expansion bolts.
Replace drive plate (1).
Installation
Clean tapped bores.
Replace expansion bolts and install with Loctite No. 270**.
Important!
Only coat threads of bolts.
Tightening torque*.



11 22 541 REPLACING STARTER GEAR RING

Drill a 6 mm (0.236") dia. hole approx. 8 mm (0.315") deep below a tooth gap to make breaking the gear ring easier.



Break gear ring at drilled point with a chisel.



Installation
Heat new starter gear ring to 200 ... 230° C (395 to 445° F), checking temperature with a thermocolor pencil.
Tooth bevel faces engine.
Install starter gear ring to fit tight with a brass mandrel.

* See Specifications
** Source: HWB



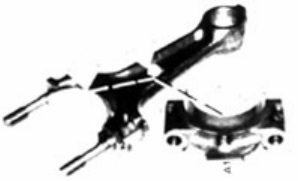
28 11 275

11 24 521 REPLACING CONNECTING RODS – PISTONS REMOVED –

Important!
Only install connecting rods of same weight class in one engine.
Weight class is stamped in machined conrod cap surface or indicated by a color code.
Connecting rods may not be machined.



Piston pin must slide through conrod bushing under light pressure.
Install conrod bearing shells 11 24 571.



11 24 571 REPLACING CONNECTING ROD BEARING SHELLS – ENGINE DISASSEMBLED –

Install conrod bearing shells in connecting rods and conrod bearing caps.
Shells with Double Classification:
Install red or blue conrod bearing shells according to color code on connecting rod.
Important!
Check machined size (conrod bearing diameter).

28 11 305



28 11 306

In BDC position place Plastigage Type PG 1 on a crankshaft wiped clean of oil.
Connecting rods and conrod bearing caps are marked with identical pair codes (0 ... 99).
Pair codes must always be on one side in an engine.
Mount conrod bearing caps.
Tightening torque*.
Source for Plastigage:
Cartool
Alfred Brehm Str. 5
D-8070 Ingolstadt



28 11 061

Important!
Don't turn connecting rods or crankshaft.
Take off bearing caps.
Read bearing play* on supplied scale by measuring width of flattened Plastigage.
Correct bearing play by installing new bearing shells, bearing shells of different machined size or with different color code.
For final installation, replace conrod bearing cap bolts and tighten bearing caps.
Tightening torque*.

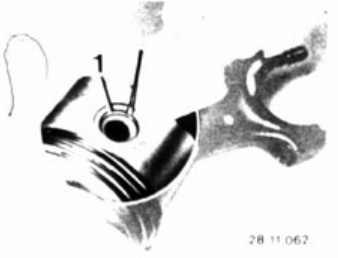
* See Specifications



20.11.029

11 25 000 REMOVING AND INSTALLING PISTON

Remove engine.
Take off cylinder head, oil pan and oil pump.
Unscrew control bearing cap and press out piston with connecting rod upwards.
Important!
Mark installed position of connecting rod to crankshaft, if conrod bearing shells do not have to be replaced.



28.11.062

Remove circlip (1).
Press out piston pin.
Installation:
Piston pins and pistons are matched and must not be mixed up.
Important!
In case of excessive play between piston pin and conrod bush (which sounds like acceleration knock), check conrod bush diameter and, if necessary, replace connecting rod or bush.
Install connecting rod, see 11 24 521.


30.11.052

Only install a piston of same make and same weight class.
Weight class is die stamped with "+" or "-" in piston crown.
Important!
Check machined size (piston diameter)*.

Identification:

Type	E*	Piston Bowl Height (mm)	Dia. (mm)
M 10 B 18 V	9.5	4.5	89
M 10 B 18 L M 10 B 18 L.A/C/S	9.5	4.8	89
M 10 B 18 L.U	9.0	3.6	89
since 4/85	8.2	1.5	89

Check piston installed clearance*.

Engine	Make	Measuring Point A = mm
M 10 B 18	Mahle	14.00
(light alloy piston)	KS	30.85
	Alcan	15.50



28.11.064

* See Specifications


28.11.063

Set internal calipers to zero on micrometer with the measured piston diameter.

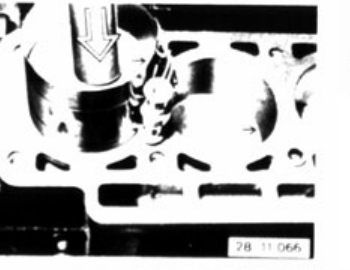


Measure cylinder bore with internal calipers at bottom, center and top in forward and rotational directions.
Check piston installed clearance*.



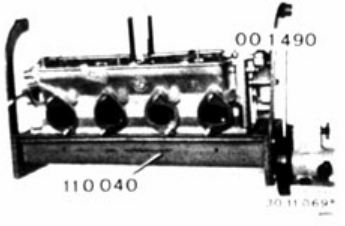
28.11.065

Lubricate piston and piston rings with oil.
Offset piston ring end gaps by 120°.
Compress piston rings with Special Tool 11 2 260.


28.11.066

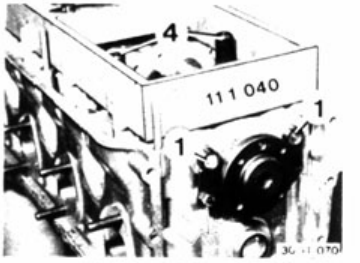
Install piston that arrow faces timing chain.

* See Specifications

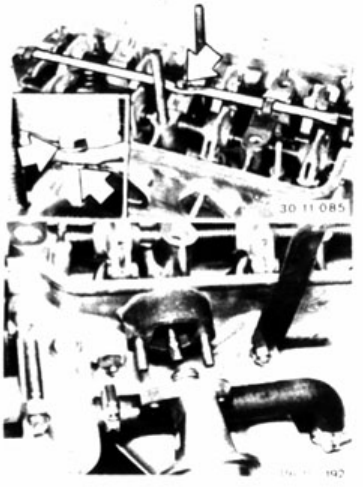


11 31 000 REMOVING AND INSTALLING CAMSHAFT

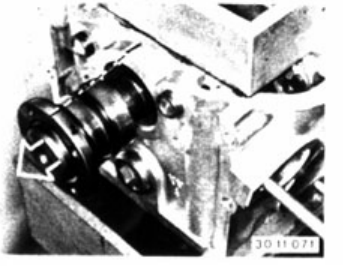
Remove cylinder head 11 12 100.
Mount cylinder head in Special Tool 11 1 040.



Insert dowel pins (4) and unscrew guide plate.
Installation:
Replace loose plugs (1) and install with Loctite No. 270**.
Camshaft must still turn easily after installing the guide plate.

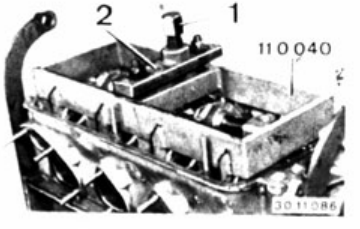


Unscrew oil line.
Installation:
Check installed position of seals.
Tightening torque*.



Pull out camshaft carefully.
Installation:
Turn camshaft in such a manner that notch on camshaft flange is aligned with cast boss on cylinder head, before removing the special tool.
Camshaft Identification:
2 = 264° = standard version.

M 10 B 18 V:
Unscrew fuel pump.
Installation:
Check gaskets and insulating flange, replacing if necessary.
Pull out plunger partially.



Adjust clearance of all valves to maximum value.
Mount Special Tool 11 1 040 and apply pressure on rocker arms.
Caution!
Pressure bolt (1) is off-center.
Apply tensioning bar (2) with short end facing the exhaust manifold, to avoid contact between valve heads.
Installation:
Adjust valve clearance 11 34 004.

* See Specifications

** Source: HWB


30 11 002

11 31 051 REPLACING TIMING CHAIN

Remove upper timing case cover 11 14 100
Remove lower timing case cover 11 14 120
Set cylinder no. 1 to TDC
Unscrew sprocket
Important!
Never crank engine after removing chain.


30 11 003

Installation
Install timing chain that notch in camshaft flange is aligned with cast boss on cylinder head.
Cylinder no. 1 is at TDC.
Tightening torque*.



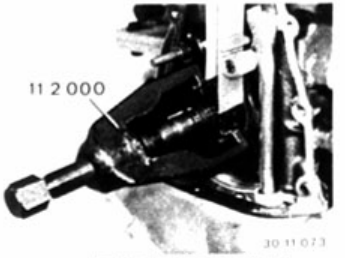
Take timing chain off of lower sprocket and guide carefully out of guide rail.
Note:
Timing chain is stretched.

* See Specifications



11 31 061 REPLACING SET OF TIMING CHAIN SPROCKETS

Remove timing chain 11 31 051
Single Piece Oil Pan:
Remove oil pan 11 13 000
Unscrew sprocket on oil pump
Remove woodruff key (1)
Take off chain



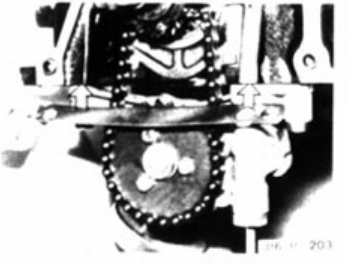
All Models:
Pull off sprocket with Special Tool 11 2 000
Installation
Heat sprocket to approx. 80° C (175° F)



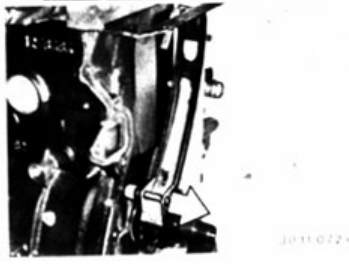
Installation
Chain must be tightened to give under light thumb pressure applied midway between two pulleys



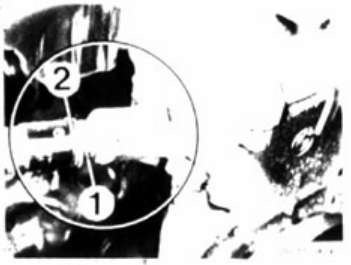
Double Piece Oil Pan:
Remove oil pan lower section 11 13 020
Unscrew sprocket (1) on oil pump
Take off chain



Adjust chain tightness with a shim
Important!
Check position of oil bore in shim

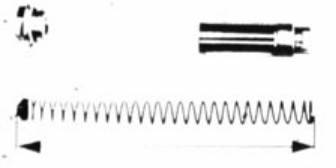


Remove lockwasher, swing tensioning rail toward inside and remove.

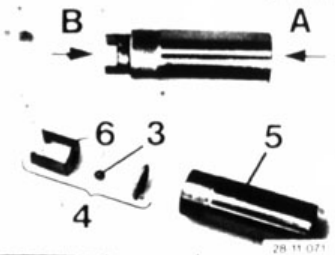


11 31 090 REMOVING AND INSTALLING CHAIN TENSIONER PISTON

Unscrew plug (1)
Caution!
Strong spring force
Remove spring and piston
Installation
Replace seal (2)



Installation
Check spring length*
Tapered end of coil spring faces plug

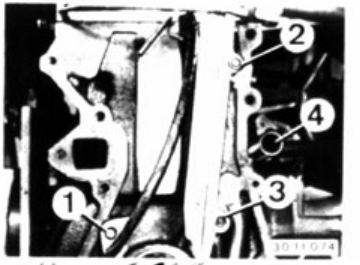


Checking Piston
Check free movement of ball (3) by shaking
Check function of valve by blowing air
in direction A = closed and
in direction B = opened
If applicable, drive valve (4) out of sleeve (5) and clean
Make sure vent slots (6) are not clogged



To bleed piston, remove cylinder head cover 11 12 000
Loosen plug (1) and remove tensioning rail (6) back and forth until oil runs out at plug (1) and resistance can be felt
Points Causing Unusual Chain Noise
a) Piston bled insufficiently
b) Piston seized
c) Vent slots clogged
d) Ball valve in piston malfunctions
e) Spring force excessive or insufficient

* See Specifications



11 31 601 REPLACING TENSIONING RAIL GUIDE RAIL - TIMING CHAIN REMOVED

Remove circlips (1 ... 3)
Disconnect water pipe (4) on holder



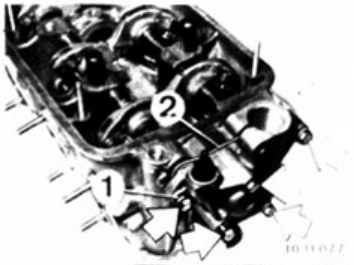
Swing in and remove tensioning rail



Pull off guide rail on bottom bearing pin

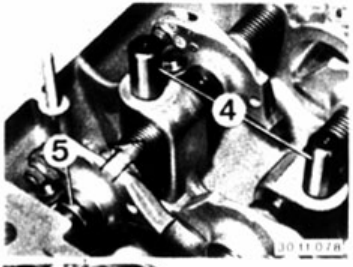


Swing guide rail aside and remove

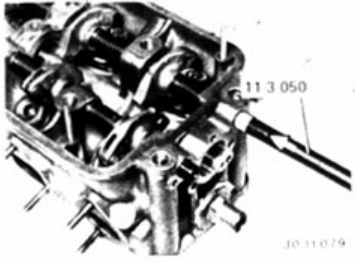


11 33 020 REMOVING AND INSTALLING ROCKER ARM SHAFTS

Remove camshaft 11 31 000
Unscrew distributor flange
Installation
Replace seal (1) and gasket (2)



Push back rocker arms and thrust rings
Remove snap rings (5)
Remove dowel pin (4)



Drive out rocker arm shafts with Special Tool 11 3 050.
Installation
Replace worn shafts.



Important!
Rear end of rocker arm shaft for intake side is open.
Rocker arm shaft on exhaust side must be closed.
Replace missing and install new or loose old plugs with Loctite No. 270**



Installed Order
Spring (9), washer (8), rocker arm (7), thrust ring (6) and snap ring (5)
A = Exhaust side
E = Intake side
Align rocker arm shafts that cylinder head bolts fit in openings.
Install dowel pins (4)
Important!
The new, short springs (9) may be installed together (mixed) with the conventional, long springs (9).

** Source: HWB



28 11 102

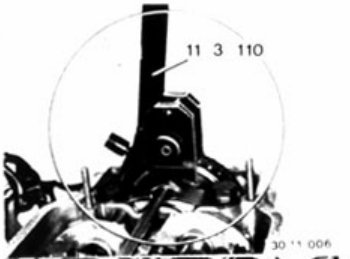
11 33 031 REPLACING ROCKER ARMS

Remove rocker arms 11 33 020
Replace worn rocker arms or rocker arms with loose slides.
Loose slides will be noticed as excessively loud valve noise.



28 11 566

Transfer setscrew (1), eccentric (2), washer (3) and nut (4) to new rocker arm.
Replace a worn eccentric.
Important!
Setscrew and nut have M 6 x 0.75 fine threads.
Bore faces out and thick side down.
Bevelled side of setscrew faces tab on rocker arm.



30 11 006

11 34 004 ADJUSTING VALVE CLEARANCE

Remove cylinder head cover 11 12 000
Crank engine with Special Tool 11 3 110



28 11 120

Adjusting order is same as firing order (1 3 4 2) in compression top dead center (TDC).
Adjust valve clearance* between valve and eccentric after loosening nut (1).



28 11 121

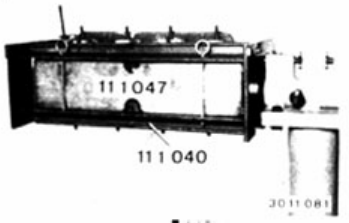
Tighten nut (1) with Special Tools 11 1 150 and 00 2 050.
Tightening torque*.



11 34 509 CHECKING ALL VALVES FOR LEAKS – CAMSHAFT REMOVED –

Spark plugs remain installed.
Fill combustion chamber with gasoline outdoors or indoors while conforming with fire prevention measures.
If gasoline runs past the valves, inspect valves and valve seats.
Remove and install valves 11 34 550.
Machine valve seats 11 12 607.

* See Specifications



11 34 550 REMOVING AND INSTALLING VALVES
– Rocker Arm Shafts Removed –

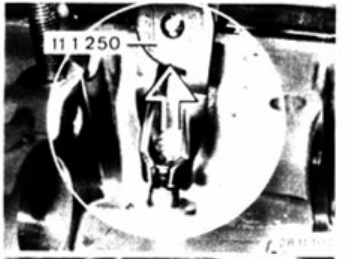
Place Special Tool 11 0 047 (tray) in Special Tool 11 1 040.



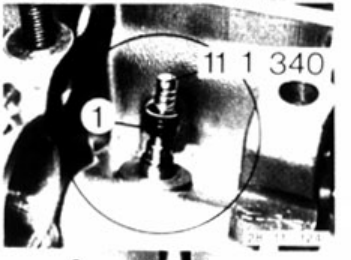
Press down on valve springs with Special Tool 11 1 040 and remove collets.



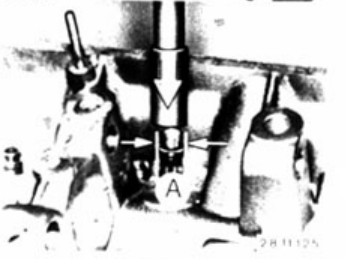
Remove upper spring retainer, valve springs and lower spring retainer.
Take tray out of special tool fixture and pull out valve.
Installation:
Only install valve springs with same color code, wire gauge size and length.
Lubricate valve guide and valve stem with oil.



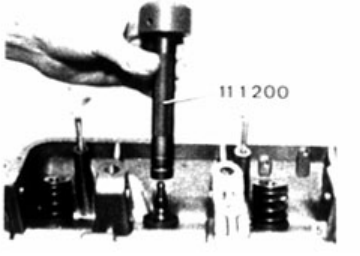
Pull off valve stem seal with Special Tool 11 1 250.



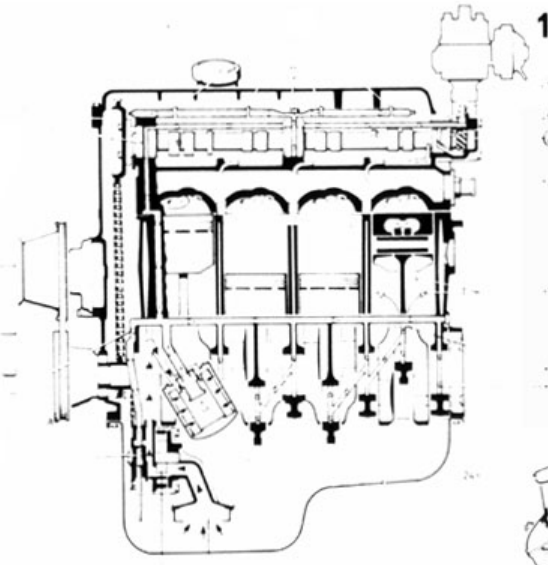
Install valve.
Use Special Tool 11 1 340 to avoid damaging valve stem seal.
Lubricate valve stem seal (1) with oil and install.
Special Tool Source:
Cartool
Alfred Brehm Str. 5
D–8070 Ingolstadt

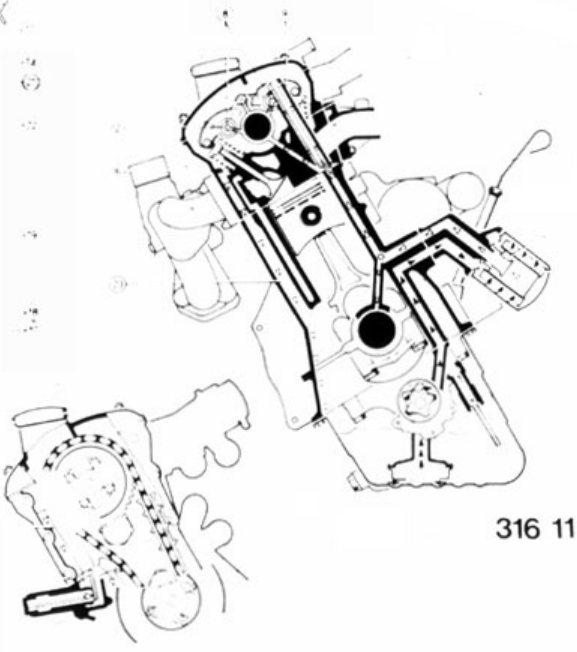


Press on valve stem seal against stop with Special Tool 11 1 090 when diameter A = 14.0 ± 0.2 mm (0.551 ± 0.008")
or
Special Tool 11 1 070 when diameter A = 14.3 ± 0.2 mm (0.563 ± 0.008").



New, improved valve stem seals with grooves on the inside are pressed on by hand with Special Tool 11 1 200.
Special Tool 11 1 200 has two diameters – for 7 mm (0.276") and 8 mm (0.315") valve stem seals.



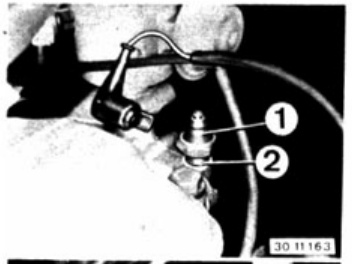


316 11 362

ENGINE OIL CIRCUIT

Unfiltered oil
Filtered oil

1 Oil pan
2 Intake with filter screen
3 Oil pump
3a Pressure relief valve
4 Oil filter
4a Safety valve
5 Main distribution bore
6 Oil bore in cyl. head
7 Camshaft bearing
8 Rocker arm shaft
9 Rocker arm bearing (intake valves)
10 Oil pressure transmitter
11 Camshaft bearing
12 Rocker arm bearings (exh. valves)
13 Camshaft bearing
14 Oil spray tube
15 Valve guide
16 Overflow from cylinder head
17 Crankshaft bearing
18 Conrod bearing
19 Spray oil
20 Pocket/chain lubrication
21 Oil sump/distributor drive
22 Overflow bore
23 Oil drain bore
24 Oil filler neck
25 Oil dipstick
26 Oil drain plug



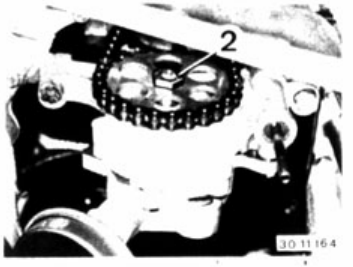
11 40 000 CHECKING ENGINE OIL PRESSURE

Pull off wires on oil pressure switch.
Unscrew oil pressure switch (1).
Installation:
Check seal (2), replacing if necessary.



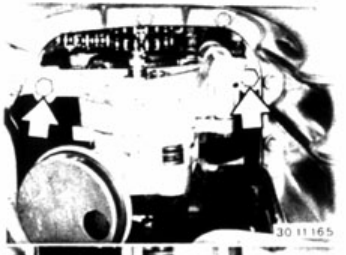
Screw in Special Tool 11 4 060.
Connect 10 bar (142 psi) pressure tester of BMW service test unit.
Check oil pressure*.

* See Specifications

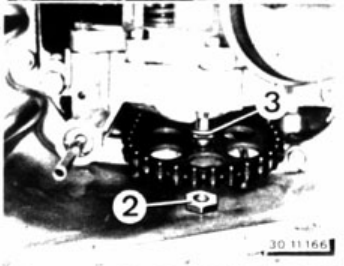


11 41 000 REMOVING AND INSTALLING OIL PUMP

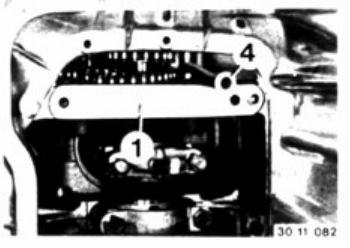
Remove oil pan lower section 11 13 020.
Unscrew nut (2) and take off sprocket.



Unscrew oil pump.

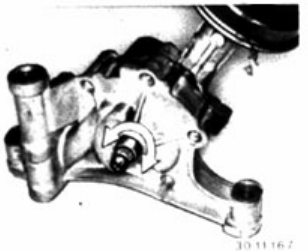


Installation:
Install shim (3).
Tightening torque* for nut (2).



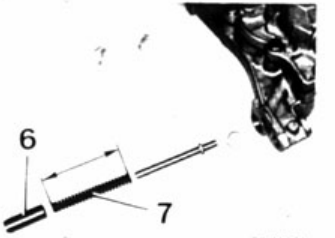
Installation:
Check installed position of O-ring (4) between housing and pressure line.
Important!
Adjust chain tightness with shim (1) that chain gives under slight thumb pressure.
Check position of oil bore in shim.

* See Specifications

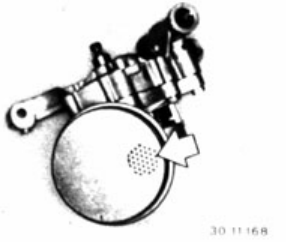


Checking and Servicing:

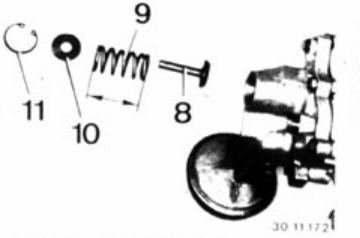
Turn drive shaft to check whether oil pump moves easily.



Pressure relief valve is located in main bore and regulates the engine oil pressure*, see 11 40 000.
Check whether piston (6) moves easily.
Check length of spring (7) = 68 mm (2.677").



Clean oil filter screen.



The 8 bar (114 psi) safety valve regulates the oil pressure in front of the oil filter and prevents oil filter leakage.
Check seating of piston (8).
Check length of spring (9) = 44 ± 0.4 mm (1.732 ± 0.016").



Disassemble oil pump.



Installation:
Press in spring (9) and washer (10) with a wrench socket and install circlip (11).



Check oil pump for wear.
– Scoring in body
– Wear on rotors

11 41 151 REPLACING OIL PUMP DRIVE CHAIN

Detach oil pan lower section 11 13 020.
Remove timing chain 11 31 051.
Unscrew nut (2) and take off sprocket.
Installation:
Check sprockets for wear.
Adjust chain tightness, see 11 41 000.
Chains with green color code are longer than those with red color code.
Tightening torque*.

* See Specifications





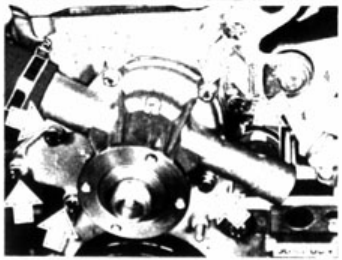
11 42 020 REMOVING AND INSTALLING/ SEALING COMPLETE FULL FLOW OIL FILTER

Unscrew full flow oil filter on crankcase.
Installation:
Replace gasket (1).

11 42 021 REPLACING FULL FLOW OIL FILTER

Unscrew filter with Special Tools 11 4 000/ 11 4 020.
Installation:
Give gasket a light coat of oil.
Screw on oil filter by hand until gasket touches and then tighten filter by hand with one half turn.
Add oil, start engine and check oil level as well as for leaks.
If oil pressure is not built up in engines after replacing the oil filter cartridge, stop engine, loosen filter about 90° and tighten again only after starting engine and waiting until a small amount of oil runs out at filter (bleeding procedures).





11 51 000 REMOVING AND INSTALLING WATER PUMP

Remove fan 11 52 000.
Loosen alternator.
Remove pulley and drive belt.
Installation:
Tighten drive belt 12 31 299.

Loosen hose clamps.
Unscrew water pump.
Installation:
Replace gasket.

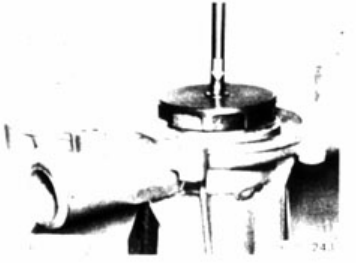


11 51 502 OVERHAULING WATER PUMP

Pull off hub with Special Tool 00 8 500 from Kukko.

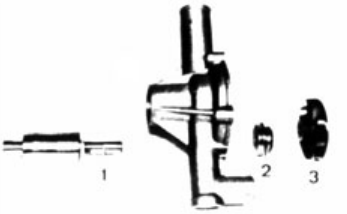


Installation
Distance (A)*.

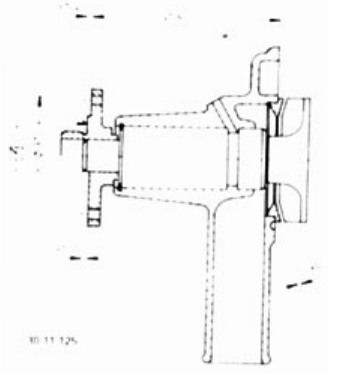


Remove circlip.

Press impeller off of shaft and water pump bearing out of housing.



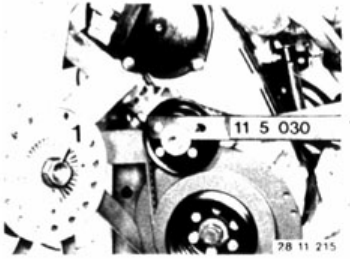
Replace bearing (1) and seal (2).
Check impeller (3), replacing if necessary.



Installation
Press on impeller with Loctite No. 270**.
Distance (B)* must always be held.

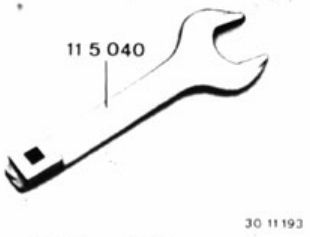
* See Specifications

* See Specifications
** Source: HWB

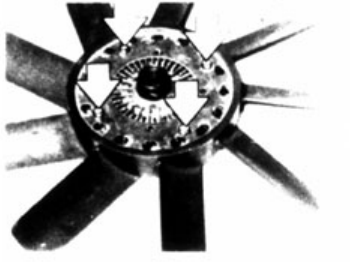


11 52 000 REMOVING AND INSTALLING FAN

Hold pulley with Special Tool 11 5 030 and unscrew coupling nut (1).
Important!
Left hand threads – turn nut clockwise to unscrew.
Tightening torque*.



Installation
Tighten fan with Special Tool 11 5 040.
40 Nm (29 ft. lbs.) tightening torque is equal to a 30 Nm (22 ft. lbs.) setting on torque wrench.



11 52 020 REPLACING FAN CLUTCH

Remove fan – see 11 52 000.
Replace fan clutch when
a) hub has seized (fan of stopped engine cannot be turned or is hard to turn),
b) fan coupling has axial/radial play or is losing oil.
Check switching points* with a Vibrocard***.
Unscrew fan mounting bolts and take off fan clutch.



11 53 000 REMOVING AND INSTALLING COOLANT THERMOSTAT

Drain coolant.
Loosen hose clamps.
Remove thermostat.
Installation
Bleed cooling system – see 17 11 000.



Checking Thermostat:
Place thermostat in a container filled with water and heat water.
Check opening temperature* and opening travel with a steel ruler.
Opening travel: 8 ± 1 mm (0.315 ± 0.039").

* See Specifications
*** See Workshop Equipment Catalog

* See Specifications

Construction group 11Engine M20

	Engine view	11-	100
11 12 000	Cylinder head cover – remove and install	11-	101
101	Cylinder head gasket – replace	11-	101
240	Radial oil seal in end cover – replace	11-	102
500	Cylinder head – remove and install – engine removed	11-	103
561	Valve guide – replace – valve removed	11-	104
595	Valve guide – check for wear	11-	104
600	Valve guide – ream	11-	104
607	Valve seats and valves – machine – cylinder head disassembled	11-	105
719	Cylinder head sealing surface – grind – cylinder head disassembled	11-	105
729	Cylinder head – check for cracks in water test – cylinder head disassembled	11-	105
11 14 175	Front end cover – remove and install	11-	106
180	Radial oil seal in front end cover – replace	11-	107
605	Radial oil seal in clutch end cover – replace – transmission removed	11-	107
11 21 000	Crankshaft – remove and install	11-	108
501	Crankshaft – replace – crankshaft removed	11-	109
531	Crankshaft main bearing shells – replace – engine disassembled	11-	109b
571	Pilot bearing in crankshaft – replace	11-	110
11 22 000	Flywheel – remove and install	11-	111
051	Drive plate for torque converter – replace	11-	111
541	Starter gear ring – replace	11-	111
11 23 010	Vibration damper – replace	11-	112
031	Vibration damper hub – replace	11-	112
11 24 521	Connecting rods – replace – pistons removed	11-	113
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651	Piston rings of one piston – replace – piston removed	11-	115
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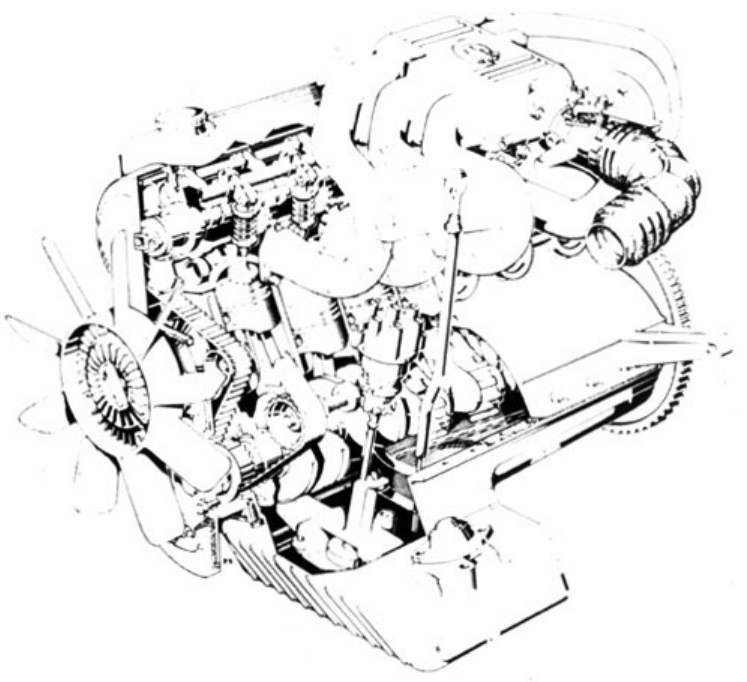
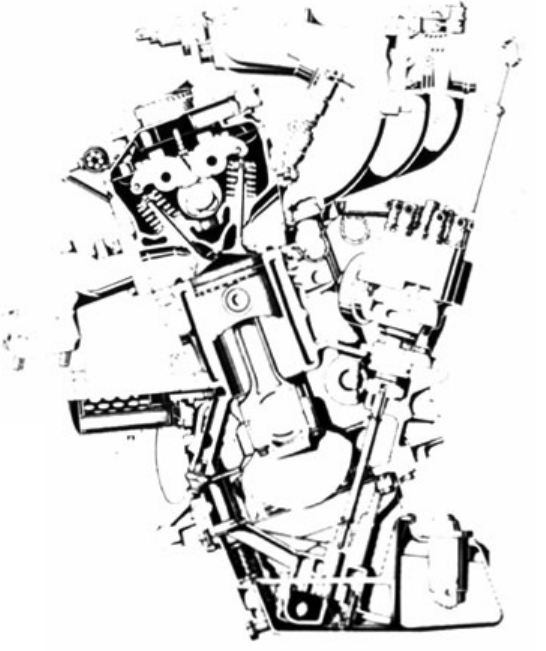
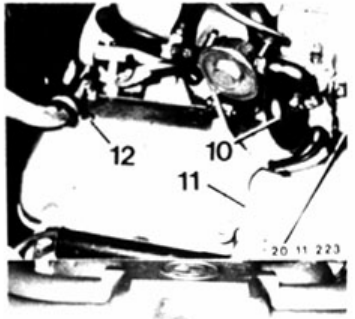
020	Fan clutch – replace	11-	129
11 53 000	Coolant thermostat – remove and install	11-	129
080	Temperature transmitter – replace	11-	129



M 20 = Small 6 cylinder
B = Gasoline
20 = Displacement (x 100)
L = L Jetronic
M = Motronic
A/C/S/U = Australia/Switzerland/Sweden/USA
Z = Catalytic converter (worldwide)



M 20 B 20 L	= BMW 320 i / 520 i
M 20 B 20 L.C/S	= BMW 320 i / 520 i (low emission)
M 20 B 20 M.Z	= BMW 320 i / 520 i (catalytic converter)
M 20 B 23 L	= BMW 323 i
M 20 B 23 L.A/C/S	= BMW 323 i (low emission)
M 20 B 25 M	= BMW 325 i
M 20 B 25 M.Z	= BMW 325 i (catalytic converter)
M 20 B 27 M	= BMW 525 e
M 20 B 27 M.U	= BMW 325 e / 525 e (catalytic converter)
M 20 B 27 M.Z	= BMW 325 e / 525 e (catalytic converter)

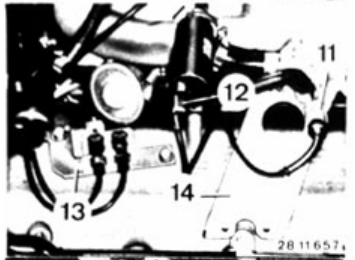


11 12 000 REMOVING AND INSTALLING CYLINDER HEAD COVER

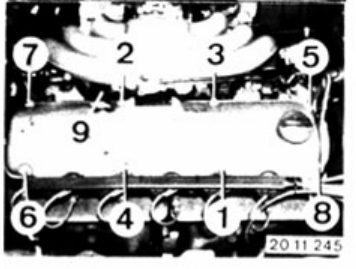
M 20 B 20 / B 23:
Pull off hose (10).
Unscrew support (11).
Unscrew clamp (12).



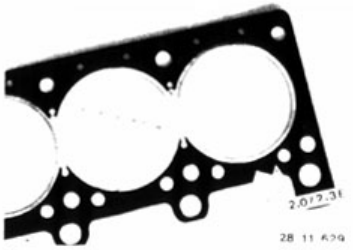
M 20 B 25:
Unscrew support (1).



M 20 B 27:
Pull off plugs (11 and 12) and unscrew holder (13).
Unscrew support (14).



All Models:
Disconnect hose (9).
Unscrew nuts (1 ... 8) and take off cover.
Installation:
Check gasket, replacing if necessary.
Screw on ground strap with nut (6).
Tighten nuts in order of 1 ... 8.
Tightening torque*.



11 12 101 REPLACING CYLINDER HEAD GASKET

Remove cylinder head 11 12 100.
Clean sealing surfaces on cylinder head and crankcase, using gasket remover** and a hard wood scraper.
Check levelness with a standard steel ruler, grinding cylinder head sealing surface (see 11 12 719) if necessary.
Installation:
Only use original cylinder head gaskets to guarantee matching of holes and openings for coolant.

Engine	Stamped Identification
M 20 B 20	2.0 / 2.3 E
M 20 B 23	2.0 / 2.3 E
M 20 B 25	2.5
M 20 B 27	2.7

Important!
A 0.3 mm (0.012") thicker gasket can be installed on a reground cylinder head to avoid reduction in size of the combustion chamber. This gasket can also be used to avoid engine knock when proper grade fuel is not available.

* See Specifications

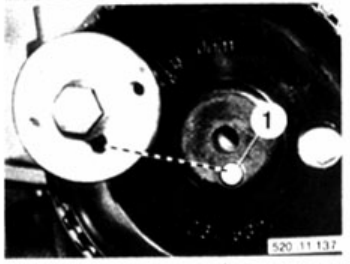
** Source: HWB



11 12 240 REPLACING RADIAL OIL SEAL IN END COVER

Remove toothed drive belt - see 11 31 110.

M 20 B 20 / B 23:
Unscrew adapter.



Unscrew toothed belt sprocket on camshaft.

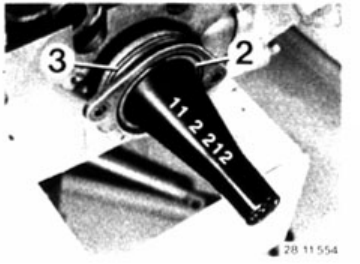
Installation:
Cylindrical pin must be in bore of camshaft.



M 20 B 27 / B 25:
Take off toothed belt sprocket.



All M 20:
Unscrew cover.



Replace radial oil seal (2) and round cord seal (3).

Installation
Use Special Tool for installation of the cover.

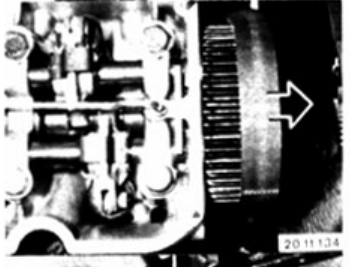


11 12 500 REMOVING AND INSTALLING CYLINDER HEAD (Engine Removed)

Remove cylinder head cover – see 11 12 000.
Turn crankshaft to have cylinder no. 1 in TDC – valves of cylinder no. 6 overlap.



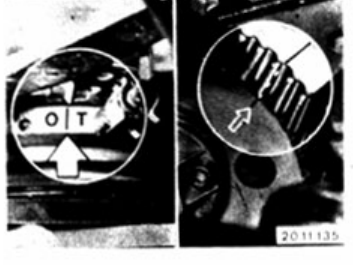
Remove drive belt cover.
Loosen bolts (7 and 8).
Push in tensioning roller and tighten bolt (8).



Take drive belt off of the camshaft sprocket.

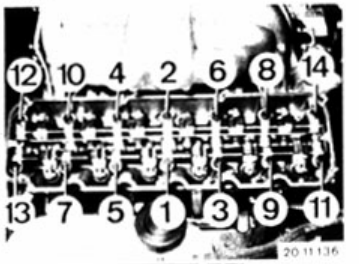
Caution!
Never crank engine after removing the drive belt.

Installation:
An used drive belt must always be replaced with a new belt each time the tensioning roller is loosened, regardless of the mileage***.
Replace drive belt – see 11 31 110.



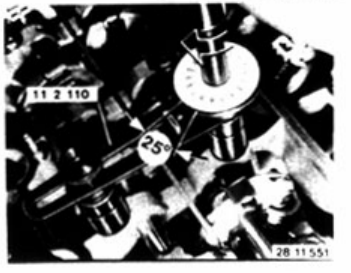
Installation:
Turn camshaft that mark on camshaft sprocket points to mark on cylinder head prior to mounting the cylinder head.
Cylinder no. 1 is set to TDC.
Also mount the drive belt in this position.

*** See Service Information of Gr. 11



Unscrew bolts in order of 14 to 1 and take off the cylinder head.

Installation:
Replace cylinder head gasket – see 11 12 101.
There must not be oil in cavities (danger of cracking, wrong tightening torque).
Clean and lubricate cylinder head bolts lightly with oil.
Tighten bolts in order of 1 to 14 in three steps.



Hexagon Head Bolts (Version A):

Step 1	40 Nm (29 ft. lbs.) torque 15 minute settling time
Step 2	60 Nm (43 ft. lbs.) torque 25 minute warm running
Step 3	25° torque angle

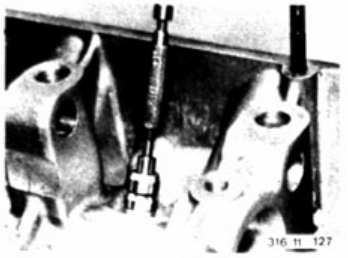
Torx Bolts (Version B):

Use new bolts!

Step 1	30 Nm (22 ft. lbs.) torque
Step 2	90° torque angle
Step 3	90° torque angle

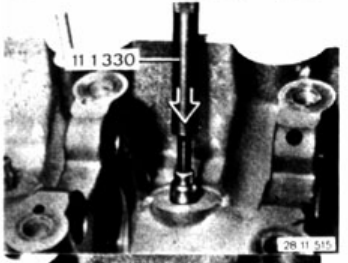
(no settling or warm running time)

Version A can be converted to Version B.

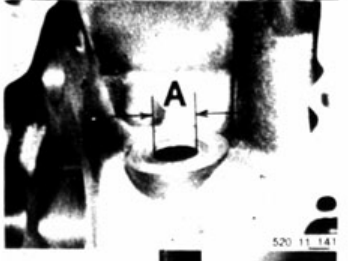


11 12 561 REPLACING VALVE GUIDE – Valve Removed

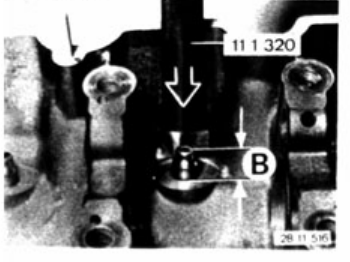
Check valve guide wear* with Special Tool 00 4 300.



Drive out valve guide (cold) into combustion chamber with Special Tool 11 1 330.



Check bore in cylinder head with Special Tool 00 4 530.
If permissible diameter has been exceeded, ream out bore A with a standard reamer and install an oversize* valve guide.



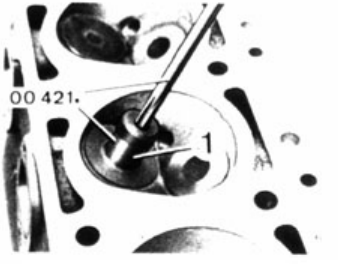
Heat* cylinder head.
Drive valve guide into combustion chamber from the camshaft side with Special Tool 11 1 320.
Stepped end of valve guide faces camshaft.
Important!
Bore in mandrel determines installed depth.
B = 14.5 ±0.5 mm (0.571 ±0.020").
Ream out valve guide to diameter of 7 H 7 mm (0.2756") with Special Tool 00 4 200.
Machine valve seat – 11 12 607.

* See Specifications



11 12 595 CHECKING VALVE GUIDE FOR WEAR – Valve Removed

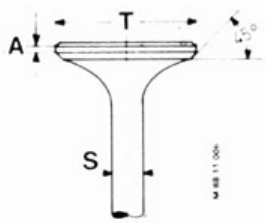
To measure amount of wear, install a new valve that end of valve stem is flush with valve guide.
Set up dial gage and measure tilt clearance.
Max. permissible tilt clearance*.



11 12 600 REAMING OUT VALVE GUIDE – Valve Removed

If there is excessive clearance between the valve guide and valve stem (see 11 12 595), ream out valve guide and install a repair valve with an oversized stem diameter "S"*.
This also requires machining the valve seat, see 11 12 607.
Press guide pad (1) on to valve seat and ream out valve guide starting from the combustion chamber side – turn down reamer once.

* See Specifications

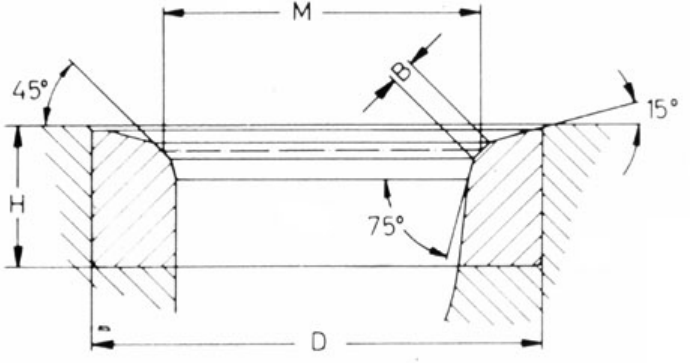


11 12 607 MACHINING VALVE SEATS AND VALVES
– Valves Removed –

If edge thickness A* is less than specified, the valve must be replaced.



Machine correction angles* to produce valve seat diameter M* and valve seat width B* after machining the valve seat angle*.
Grind in valves with grinding paste and check valves for leaks – 11 34 509.

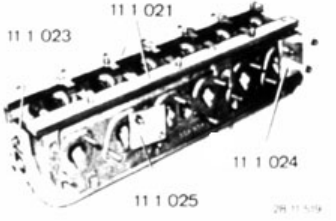


* See Specifications



11 12 719 GRINDING CYLINDER HEAD SEALING SURFACE
– Cylinder Head Disassembled

The total thickness (A) = 125.1 ± 0.1 mm (4.925 ± 0.004") of an original cylinder head must not be reduced by more than 0.3 mm (0.012").
Use a 0.3 mm (0.012") thicker gasket on a reground cylinder head (also refer to 11 12 101).



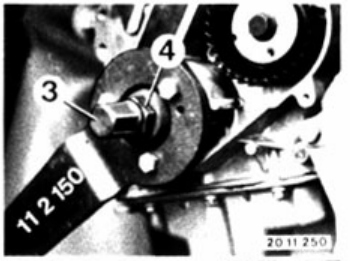
11 12 729 CHECKING CYLINDER HEAD FOR CRACKS IN WATER TEST
– Cylinder Head Disassembled

Mount Special Tools 11 1 021 on cylinder head (using cylinder head mounting bolts).
Close off water circuit on cylinder head with Special Tools 11 1 023, 11 1 024 and 11 1 025.



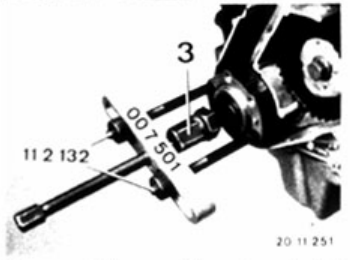
Apply compressed air on cylinder head.
Testing pressure: 4.5 bar (64 psi).
Place cylinder head in water bath and check for cracks.
Note
If necessary, relax water bath with a detergent.

* See Specifications



11 14 175 REMOVING AND INSTALLING FRONT END COVER

Remove radiator - see Group 17.
Remove toothed drive belt - see 11 31 110.
Single Piece Hub / Sprocket:
Hold sprocket with Special Tool 11 2 150.
Unscrew bolt (3).
Take off collar (4).
Installation:
Tightening torque*.



Screw in bolt (3) about three turns.
Pull hub / sprocket off of the crankshaft with help of Special Tools 00 7 501 and 11 2 132.

Important!
Woodruff key.



Double Piece Hub / Sprocket:
Screw in bolt (3) again.
Pull sprocket off of the crankshaft with help of Special Tools 00 7 501 and 11 2 131.

Important!
Woodruff key.

Installation:
Mount sprocket that the lettering faces forward.



Removing Sprocket on Intermediate Shaft:

Version with Two Tapped Bores in Flange of Intermediate Shaft:
Hold sprocket with Special Tool 11 2 190.
Unscrew bolt (6).
Take off washer (7) and toothed drive belt sprocket.



Version with One Tapped Bore:
Use Special Tool 11 2 280.



Unscrew bolts (8 ... 10).
Only loosen remaining oil pan bolts.
Loosen oil pan gasket on end cover carefully with a knife.
Unscrew cover.
Installation:
Remove oil pan and replace gasket (see 11 13 000), if oil pan gasket is damaged.
Coat holes of oil pan gasket with Three Bond Silicon 1207** brush-on universal sealing compound.
Replace gasket.



Check radial oil seal, replacing if necessary.

Important!
Always use Special Tools 11 2 211 (crankshaft) and 11 2 212 (intermediate shaft) for installation of the end cover.

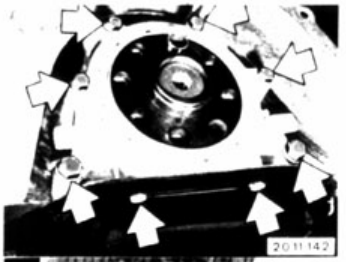
* See Specifications

** Source of Supply: HWB



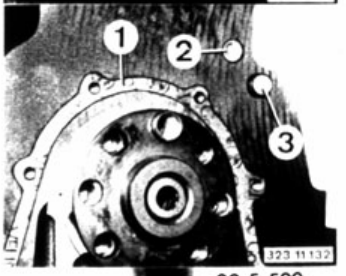
11 14 180 REPLACING RADIAL OIL SEAL IN FRONT END COVER

Remove front end cover - see 11 14 175.
Press radial oil seal out of cover.
Press in new radial oil seal with Special Tools 24 1 050 / 24 1 040.
Install new radial oil seals about 1 to 2 mm (0.039 to 0.079") deep in contradiction to the old seals, which were installed flush in standard production.
Lubricate sealing lips with oil.



11 14 605 REPLACING RADIAL OIL SEAL IN CLUTCH END COVER - Transmission Removed -

Remove flywheel - see 11 22 000.
Unscrew oil pan / end cover bolts.
Only loosen remaining oil pan bolts.
Loosen oil pan gasket on end cover carefully with a knife.
If the oil pan gasket is damaged, remove oil pan - see 11 13 000.
Unscrew end cover.
Replace gasket (1).



Important!
Check plug (2) of main oil bore for leaks, replacing with new plugs (3) front and rear if necessary.
Install plugs with Loctite No. 270**.



Use Special Tools 11 1 260 and 00 5 500 to press in the radial oil seal.
Install new radial oil seal about 1 to 2 mm (0.039 to 0.079") deep in contradiction to the old seal, which was installed flush in standard production.
Lubricate sealing lip with oil.



Coat joint between end cover and oil pan with Three Bond Silicon 1207** brush-on universal sealing compound.
Use Special Tool 11 2 213 to avoid damaging the radial oil seal.

** Source of Supply: HWB



11 21 000 REMOVING AND INSTALLING CRANKSHAFT

Remove engine 11 00 050.
Mount crankcase in assembly stand 00 1 490 with Special Tool 11 0 120.



Remove clutch 21 21 000.
Remove cylinder head 11 12 100.
Remove front end cover 11 14 175.
Remove oil pump 11 41 000.
Check axial play* before removing the crankshaft.
Max. Permissible Play Exceeded:
Check or replace thrust bearing.

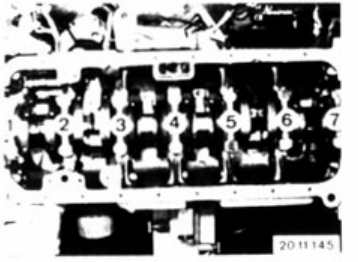


Remove flywheel 11 22 000.
Unscrew end cover.
Installation:
Replace gasket.
Use Special Tool 11 2 213 to avoid damaging radial oil seal.
Cut off gasket on oil pan sealing surface.



Unscrew conrod bearing caps.
Installation:
Replace conrod bearing shells and measure conrod bearing play, see 11 24 571.
Pair numbers (0 ... 99) must be the same on connecting rods and caps.

* See Specifications



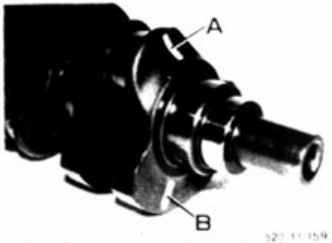
Unscrew crankshaft bearing caps and lift out crankshaft.
Installation:
Don't mix up bearing caps.
Bearing cap no. 1 is on drive belt end.
Bearing no. 6 is the thrust bearing.
Install bearing shells and check bearing play, see 11 21 531.

Installation:
Measure axial play after installing crankshaft loosen thrust bearing no. 6 again.
Center thrust bearing by applying knocks from a plastic hammer on front and rear ends of crankshaft.
Tighten thrust bearing to specifications.
Check axial play*.
If crankcase is replaced, clean oil and water bores again thoroughly to remove casting sand.

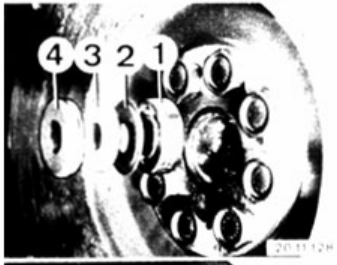
* See Specifications



28 11 307



521 11 159



20 11 12H



20 11 14H

11 21 501 REPLACING CRANKSHAFT
– Crankshaft Removed –

Note:
A replacement crankshaft is supplied complete with corresponding bearing shells for main and conrod bearings.
Crankshaft Identification:

Engine	Stroke	Grooves	Code
M 20 B 20	66.0 mm	1	U
M 20 B 23	76.8 mm	–	V
M 20 B 25	75.0 mm	3	X
M 20 B 27	81.0 mm	2	W

Crankshaft is surface treated and may only be reground in the factory.

Reground crankshafts are marked with stripes of paint.

Conrod Bearing Journal (A)
1 paint stripe — Size 1 *
2 paint stripes — Size 2 *

Main Bearing Journal (B)
1 paint stripe — Size 1 *
2 paint stripes — Size 2 *

Cars with Manual Transmission:
Install pilot bearing for the transmission main shaft.

Installed Order:
Ball bearing (1), cover (2), felt ring (3) and capsule (4).

Insert cover (2) with embossment facing out.

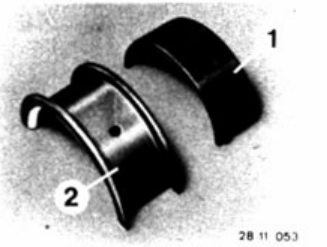
Fill bore in crankshaft with approx. 1 gram (0.035 oz.) of lubricating grease. Drive in pilot bearing with Special Tools 11 2 030 and 00 5 500.

* See Specifications


28 11 308

Crankshaft bearing shells were installed standard with the following color codes for a pertinent ground size.
- Double classification: red blue (old color codes)
- Triple classification: yellow green white (new color codes)

Replacement crankshafts are only supplied with bearing shells of triple classification.



28 11 053

1 = Bearing shell 1–2–3–4–5–7
2 = Bearing shell 6 (pilot bearing)

The color code is located on the side of the bearing shell.


M88 11 060

Installing Instructions:
Only place bearing shells with "yellow" marks in the crankcase (regardless of the old color code mark on the crankcase).
Install bearing shells in bearing caps depending on the color code of the carnkshaft bearing journals – "yellow-green-white".


M88 11 061

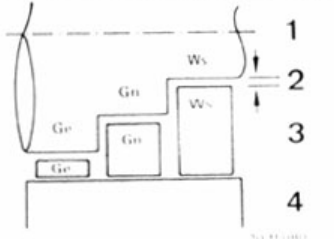
Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps with the correct torque*. Do not turn the crankshaft.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

* See Specifications



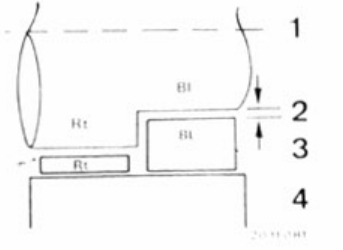
Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with different color code marks.



Survey of Color Code Shaft Diameter/ Bearing Shell Thickness*

Triple Classification Color Codes:
Ge = yellow
Gn = green
Ws = white
Double Classification Color Codes:
Rt = red
Bl = blue

1 Crankshaft diameter
2 Bearing play
3 Bearin shell thickness
4 Console dimeter





Replacing Conrod Bearing Shells:
Red or blue conrod bearing shells are installed standard depending on the color code mark on the connecting rod or crankshaft for a pertinent ground size.

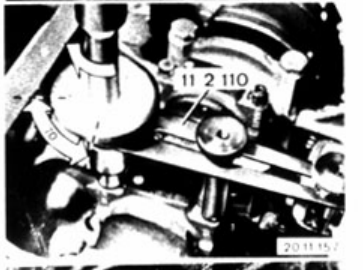
Only install the red bearing shells of a pertinent ground size for a replacement crankshaft.

* See Specifications



Place Type PG-1 Plastigage on crankshaft wiped clean of oil in BDC position and mount the bearing caps that all grooves are on one side.
The pair number (0 ... 99) must be the same on connecting rods and caps.

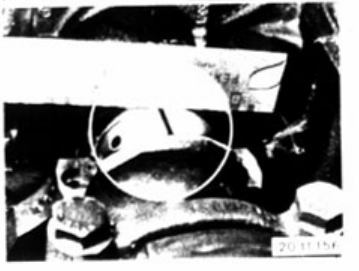
Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt



Tighten bolts in two steps (use old conrod bolts).
Step 1 20 Nm (14.5 ft. lbs.)
Step 2 70° torque angle

Important!
Do not turn the connecting rods or crankshaft.

Remove bearing caps.



Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with different color code marks.
Replace conrod bolts for final installation and tighten the conrod caps in two steps (see above).

* See Specifications

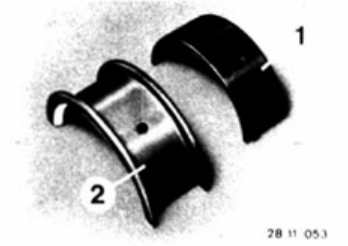


28 11 308

11 21 531 REPLACING CRANKSHAFT MAIN BEARING SHELLS – Engine Disassembled –

Crankshaft bearing shells with the following color codes for a pertinent ground size had been installed standard.

- Double classification: red blue (old color code)
- Triple classification: yellow green white (new color code)



28 11 053

1 = Bearing shell 1–2–3–4–5–7
2 = Bearing shell 6 (pilot bearing)

Color code mark is located on the side of a bearing shell.



M88 11 060

Install bearing shells in crankcase with same color code as the dot of paint on the console.
Install both bearing shells according to the crankshaft color code, if the color code mark on the crankcase is washed off.
Install bearing shells in bearing caps with the same color code as for the crankshaft.

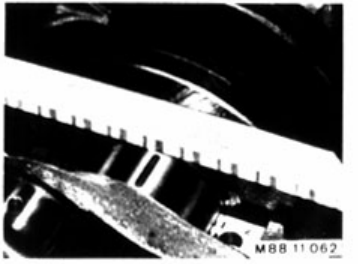


M88 11 061

Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps with the correct torque*.
Do not turn the crankshaft.

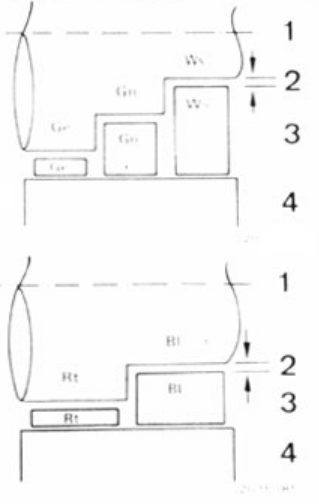
Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

* See Specifications



M88 11 062

Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with a different color code.



Survey of Color Code Shaft Diameter Bearing Shell Thickness*

Triple Classification Color Codes:
Ge = yellow
Gn = green
Ws = white
Double Classification Color Codes:
Rt = red
Bl = blue

1 Crankshaft diameter
2 Bearing play
3 Bearing shell thickness
4 Console diameter

* See Specifications

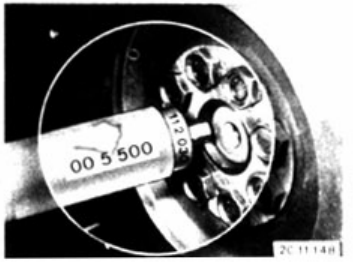


11 21 571 REPLACING PILOT BEARING IN CRANKSHAFT

Remove clutch 21 21 000.
Pull out ball bearing with Special Tool 11 2 010.

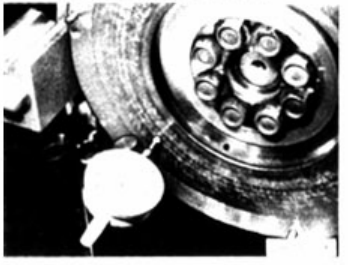


Installed Order:
1 Ball bearing
2 Cover
3 Felt ring
4 Capsule
Insert cover (2) with embossment facing out.



Pack bore in crankshaft with approx. 1 gram of lubricating grease.
Drive in pilot bearing with Special Tools 11 2 030 and 00 5 500.





11 22 000 REMOVING AND INSTALLING FLYWHEEL

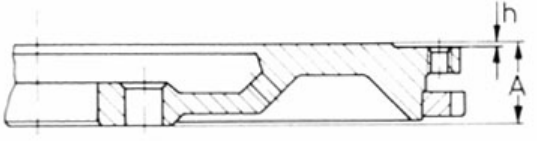
Remove clutch – see 21 21 000.
Hold flywheel with Special Tool 11 2 170.
Unscrew bolts and take off flywheel.

Installation:
Clean tapped bores.
Insert ring (1).
Install new bolts coated with microencapsulated cement.
Tightening torque*.

If necessary, check flywheel for axial runout*.

The friction surface may be machined to minimum distance A*.
If machining the friction surface reduces distance "h" to zero, the flange surface (distance "h") must be machined.
Machining is not possible on a double-mass flywheel.

M 88 11 072



* See Specifications
** Source of Supply: BMW Parts









11 22 051 REPLACING DRIVE PLATE FOR TORQUE CONVERTER

Remove transmission - see Group 24.
Hold flywheel with Special Tool 11 2 170.
Unscrew bolts and take off flywheel.

Installation:
Clean tapped bores.
Install new bolts coated with microencapsulated cement.
Tightening torque*.

11 22 541 REPLACING STARTER GEAR RING

Drill a hole about 8 mm deep below a tooth gap with a 6 mm dia. drill to make breaking the gear ring easier.

Break gear ring at drilled point with a chisel.

Installation:
Heat new starter gear ring to 200 ... 230° C.
Check temperature with a thermo-color pencil.
Tooth bevel faces engine.
Mount starter gear ring to fit firmly with help of a brass mandrel.

* See Specifications



11 23 010 REPLACING VIBRATION DAMPER

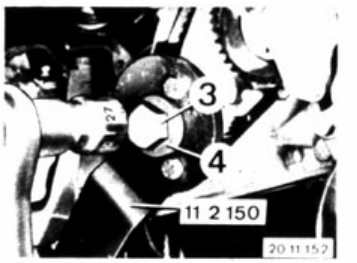
M 20 B 20 / B 27:
Take drive belts off of alternator, power steering pump and, if applicable, compressor for air conditioner.
Installation:
Tighten drive belts and check tightness with Special Tool 11 5 020.



M 20 B 23 / B 25:
Remove fan – see 11 52 000.
Take drive belt off of alternator, power steering pump and, if applicable, air conditioner.
Unscrew pulley on water pump.
Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.

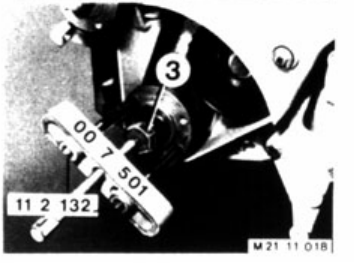


All:
Take pulley and vibration damper off of hub.
Installation:
Centering pin must be in bore of vibration damper.



11 23 031 REPLACING HUB FOR VIBRATION DAMPER

Two Piece Hub/Pulley:
Remove radiator – 17 11 000.
Remove vibration damper – 11 23 010.
Hold hub with Special Tool 11 2 150.
Unscrew bolt (3).
Take off collar (4).
Installation:
Tightening torque*.



Screw in bolt (3) about three turns.
Pull hub off of crankshaft with Special Tools 00 7 501 and 11 2 132.
Unscrew bolt (3).

* See Specifications



M 21 11 156

11 24 521 REPLACING CONNECTING RODS
– Pistons Removed –

Important!
Only install connecting rods of same weight class in one engine.
Weight class is stamped in machined surface of conrod bearing cap.
Connecting rods cannot be machined.
Check connecting rod length!



Piston pin must slide through conrod bushing under light pressure.



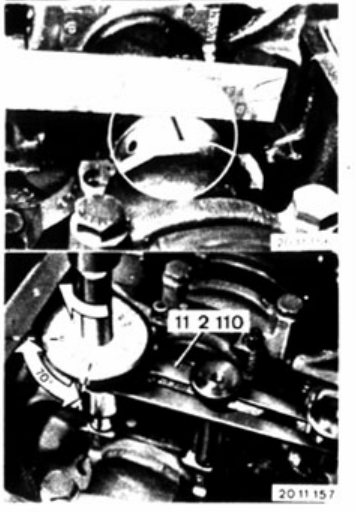
M 21 11 154

11 24 571 REPLACING CONROD BEARING SHELLS
– Engine Disassembled –

Place conrod bearing shells in connecting rods and conrod caps.
Double Classification:
Use red or blue conrod bearing shells according to color code on connecting rod.
Important!
Check machined size (conrod bearing diameter).



In BDC position place Plastigage Type PG * on crankshaft wiped clean of oil and install conrod bearing caps that all grooves are on one side.
Pairing code (0 ... 99) must be the same on cap and connecting rod.
Source for Plastigage
Cartool
Alfred Brehm Str. 5
D 8070 Ingolstadt



20 11 157

Tighten bolts in two steps (using old conrod bolts).
Step 1 = 20 Nm (14 ft. lbs.)
Step 2 = 70° torque angle
Important!
Do not turn connecting rods or crankshaft.
Remove bearing caps.
Read bearing play* from supplied scale used to measure width of flattened Plastigage.
Correct bearing play by installing new bearing shells, bearing shells of different machined size or with different color code.
Use new conrod bearing cap bolts for final installation and tighten bolts in two steps (see above).

* See Specifications



11 25 000 REMOVING AND INSTALLING PISTON

Remove engine.
Take off cylinder head, oil pan and oil pump.
Unscrew conrod bearing cap and push out piston with connecting rod upwards.

Important!
Mark installed position of connecting rod to crankshaft, if conrod bearings are not being replaced.

Remove circlip (1).
Push out piston pin.



20.11.159

Installation
Piston pins and pistons are matched and must not be mixed up.

Important!
In case of excessive play between piston pin and conrod bush (sounds like acceleration knock), check conrod bush diameter, replacing connecting rod or bush if necessary.

Only install a piston of same make and same weight class.
Weight class is stamped with "+" or "–" in piston crown.



20.11.160

Important!
Check machined size (piston diameter)*.

Engine	E*	Piston Bowl Height (mm)	Dia (mm)
M 20 B 20 L	9.8	3.3	80
M 20 B 20 L A/C/S	9.4	2.3	80
M 20 B 20 M Z	8.8	0.8	80
M 20 B 23 L	9.8	0.7	80
M 20 B 23 L A/C/S	9.4	–	80
M 20 B 25 M	9.7	–	84
M 20 B 25 M Z	8.8	4.4	84
M 20 B 27 M	11	0.65	84
M 20 B 27 since 9/85	10.2	0.9 (piston	84
M 20 B 27 M U	9	3.5 well)	84
M 20 B 27 M Z	8.5	3.6	84

* See Specifications



20.11.161



M88.11.052



20.11.162



20.11.163

Check piston installed clearance*.

Engine	Make	Measuring Point A = mm
M 20 B 20	Mahle	9.00
	KS	25.95
	Alcan	20.50
	Borgo	15.00
M 20 B 23	Mahle	12.00
	KS	18.05
	Alcan	22.70
M 20 B 25 M	Mahle	9.00
	KS	11.65
M 20 B 27	Mahle	23.00
	KS	23.00
M 20 B 27 M Z	Mahle	14.00

Set internal calipers to zero on the micrometer with the measured piston diameter.
Measure cylinder bore at bottom, middle and top with the internal calipers in forward and turning directions.
Compare measured piston installed clearance with specified piston installed clearance / max permissible total wear clearance.

Lubricate piston and piston rings with oil.
Offset piston ring end gaps by 120°.
Compress piston rings with Special Tool 11 2 260.

Install piston that arrow faces toothed belt.
Install connecting rod see 11 24 521.

* See Specifications



20.11.164

11 25 651 REPLACING PISTON RINGS OF ONE PISTON
– Piston Removed –

Measure side clearance* of piston rings.



Remove piston rings and measure end clearance*.



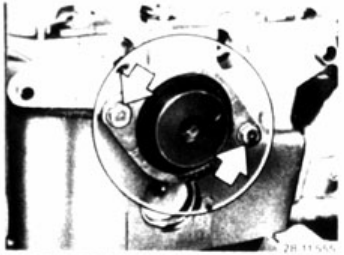
20.11.165

Installation
Install piston rings with the word "TOP" facing the piston crown.

1 Plain compression ring
2 Tapered face compression ring
3 Slotted oil scraper ring

Note
It might not be possible to find the identification on used piston rings.
Lay piston rings aside in correct sequence and installed position.

* See Specifications



11 31 000 REMOVING AND INSTALLING CAMSHAFT

Remove rocker arm shafts 11 33 020.
Unscrew end cover.



Check radial oil seal (1) and round cord seal (2), replacing if necessary.
Installation:
Use Special Tool 11 2 212 for installation of end cover.
Check axial play*.



Pull out camshaft.
Camshaft Codes:

Type	Degrees	Color Ring	Code
M 20 B 20 L	252	yellow	D
M 20 B 20 M.Z	260	–	L
M 20 B 23 L	252	white	C
M 20 B 25 M	260	green	F
M 20 B 25 M.Z	260	–	K
M 20 B 27 M	236	–	B
M 20 B 27 M since 9/85	236	blue	G
M 20 B 27 M.U	236	–	B
M 20 B 27 M.Z	236	–	B

* See Specifications

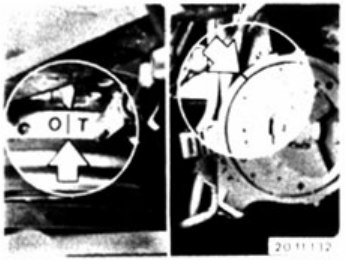
11 31 100 TIGHTENING TOOTHED DRIVE BELT

Do not retighten an used toothed drive belt replace a loose toothed drive belt.
Tighten toothed drive belt at coolant temperature of 15 to 35° C (60 to 95° F).
Remove rubber guard (1).
Unscrew nut (2).
Installation:
Tightening torque*.

Unscrew bolts (3).

Crank engine on crankshaft in running direction of engine.
This tightens the toothed belt.
Now tighten bolts (3).
Tightening torque*.

* See Specifications



11 31 110 REPLACING TOOTHED BELT

Important:
Always replace an used toothed belt each time the tensioning rooler is loosened, regardless of the mileage ***

Distributor Engine
Set valves in cylinder no. 1 to TDC (speed governor aligned with notch in distributor housing).



Loosen clamp (1).
Remove bolt (2) and take off suspension eye (3).



Unscrew nut (4).
Lift out TDC sender lead (5).
Remove protective cover (6).
Remove vibration damper - see 11 23 010.



Two Piece Hub/Toothed Belt Sprocket
Remove hub for vibration damper - see 11 23 031.
Swing away clamp (7).
Lift out TDC sender (8).
Unscrew screw (9) and take off protective cover.

*** See Service Information of Gr. 11



DME Engine
Unscrew distributor cap (1).
Unscrew distributor rotor (2).
Old version
Unscrew adapter (8).
Remove cover (3).
Unscrew screws (4).
Installation
Check seal (9), replacing if necessary.
Tightening torque*



Take off rubber guard (5).
Unscrew nut (6).
Remove protective cover (7).
Reinstall adapter (8).

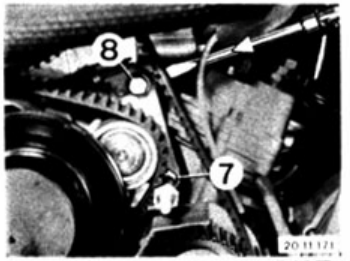


Turn crankshaft to move valves in cylinder no. 1 to TDC (arrow on camshaft sprocket faces mark on cylinder head).
Remove vibration damper - see 11 23 010.



Two Piece Hub/Toothed Belt Sprocket
Remove hub for vibration damper - see 11 23 031.
Swing away clamp (7).
Lift out TDC sender (8).
Unscrew screw (9) and take off protective cover.

* See Specifications





All:
Loosen bolts (7 and 8).
Push in tensioning roller.
Tighten bolt (8).
Take off drive belt.

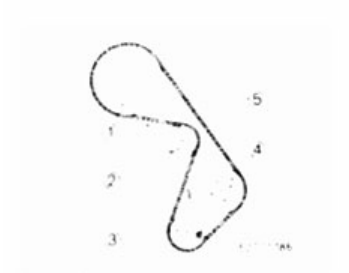
Installation
There are different toothed drive belt versions.

1. Sprockets with Square Profile:
   A. Square profile with 111 teeth
   B. Square profile with 110 teeth ("Z 127") with modified tensioning spring and tensioning roller marked "Z 127".

2. Sprockets with Semi-round Profile:
   A. Semi-round profile with 128 teeth
   B. Semi-round profile with 127 teeth ("Z 127") and tensioning roller marked "Z 127".

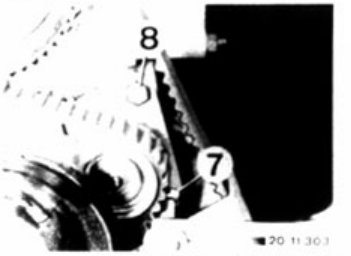
Versions A must be converted to B***.
Install toothed drive belt starting from the crankshaft sprocket and working opposite the engine's direction of rotation.

Important!
Check position of the distributor.



Toothed Drive Belt Assembly:
1 Camshaft sprocket
2 Tensioning roller
3 Crankshaft sprocket
4 Intermediate shaft sprocket
5 Toothed drive belt

*** See Service Information of Gr. 11





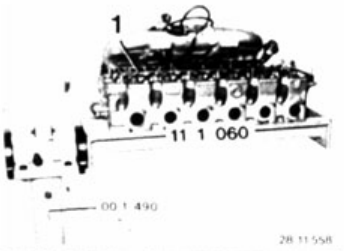
Tightening Toothed Drive Belt:

Loosen bolt (8) (spring force should be capable of moving the tensioning roller).

Crank engine once on the crankshaft in direction of rotation up to the TDC mark (drive belt is tightened).

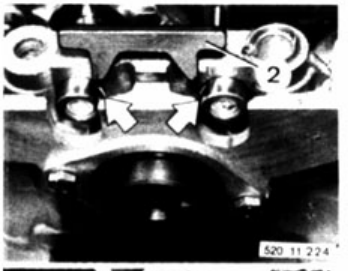
Check timing (mark on camshaft sprocket must be aligned precisely with mark on cylinder head with the crankshaft at TDC mark).

Paste a label containing the date and mileage on the cylinder head cover after finishing the work.



11 33 020 REMOVING AND INSTALLING ROCKER ARM SHAFTS

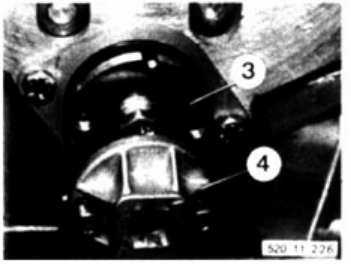
Engine with Distributor:
Remove cylinder head 11 12 100.
Mount cylinder head on Special Tool 11 1 060 and bolt down with one cylinder head bolt.
Unscrew oil line (1).



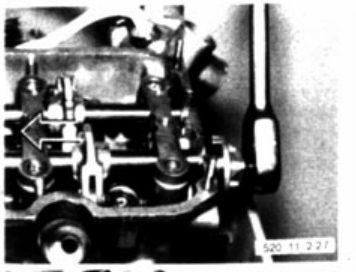
Unscrew toothed belt sprocket.
Adjust clearance of all valves to maximum value.
Remove plugs.
Remove guide plate (2).
Installation
Guide plate (2) must fit in grooves of rocker arm shafts.



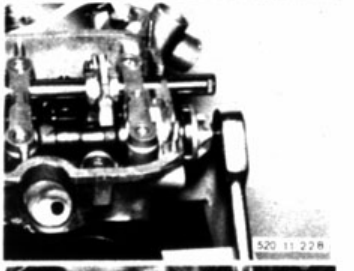
Lift out clamps.
Installation
Straight surface of clamp must fit in groove of rocker arm shafts.



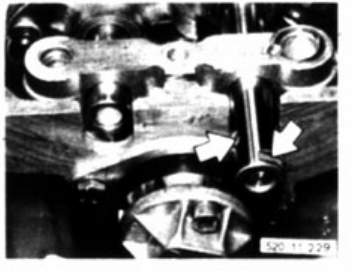
Mount disc (3) and adapter (4) on camshaft to turn the camshaft.



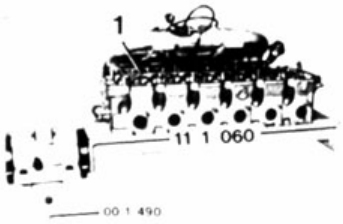
Removing Rocker Arm Shafts
a) Exhaust Side
Valves of cylinder no. 6 must overlap.
Push in rocker arm of first cylinder.
Turn camshaft on adapter toward intake side until pressure is taken off of all rocker arms.
Pull out rocker arm shaft or drive out with Special Tool 11 3 050.



b) Intake Side
Turn camshaft on adapter toward exhaust side until pressure is taken off of all rocker arms.
Pull out rocker arm shaft or drive out with Special Tool 11 3 050.



Replace worn rocker arm shafts and rocker arms.
Installation
Install rocker arm shafts that large oil bores face valve guides and grooves for guide plate face in.

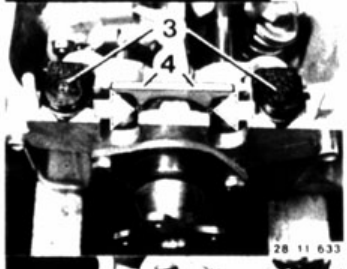


11 33 020 REMOVING AND INSTALLING ROCKER ARM SHAFTS

Engine with DME
Remove cylinder head 11 12 100
Mount Special Tool 11 1 060 on assembly stand 00 1 490 and mount cylinder head with one cylinder head bolt
Unscrew oil line (1)
Remove toothed belt sprocket



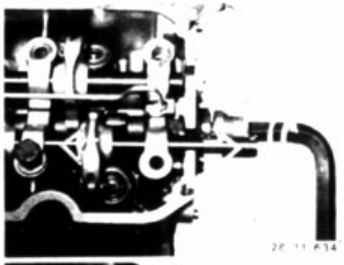
Mount adapter (2)
Adjust valve clearance of all valves to maximum value



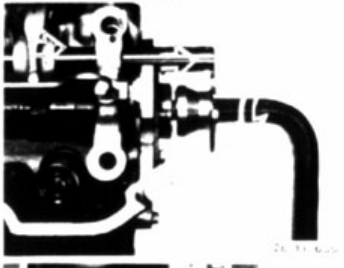
Lift out front and rear plugs (3)
Remove guide plate (4)
Installation
Guide plate (4) must fit in grooves of rocker arm shafts



Lift out clamps
Installation
Straight surface of clamps must fit in groove of rocker arm shafts



Removing Rocker Arm Shafts
a) Exhaust Side
Valves of cylinder no. 6 must overlap
Push in rocker arm of first cylinder and turn camshaft on adapter toward intake side until pressure is taken off of all rocker arms
Pull out rocker arm shaft or drive out with Special Tool 11 3 050



b) Intake Side
Turn camshaft on adapter toward exhaust side and move rocker arms until pressure is taken off of all rocker arms
Pull out rocker arm shaft or drive out with Special Tool 11 3 050



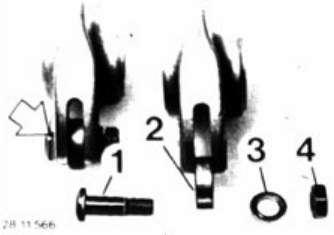
Replace worn rocker arm shafts and rocker arms
Installation
Install rocker arm shafts that oil bores (large face down toward valve guide and small oil bores and grooves for guide plate face in



28.11.565

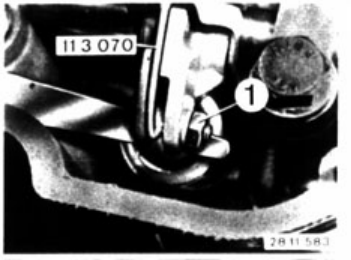
11 33 031 REPLACING ROCKER ARMS

Remove rocker arm shafts 11 33 020.
Replace worn rocker arms or rocker arms with loose slides.
Loose slides will be noticed as unusually loud valve noise.



28.11.566

Transfer adjusting screw (1), eccentric (2), washer (3) and nut (4) to new rocker arm.
Replace a worn eccentric.
Important!
Adjusting screw and nut have M 6 x 0.75 fine threads.
Bore faces out and thick side down.
Bevelled surface of adjusting screw faces boss on rocker arm.



28.11.583

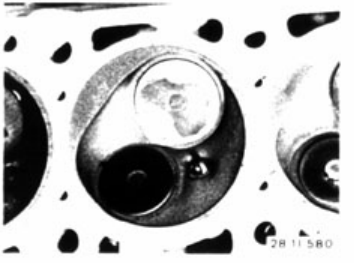
11 34 004 ADJUSTING VALVE CLEARANCE

Remove cylinder head cover 11 12 000.
Crank engine on crankshaft.
Make adjustments in firing order 1 5 3 6 2 4 in compression TDC.
Adjust valve clearance* between valve and eccentric after loosening nut (1).



28.11.582

Tighten nut (1) with Special Tools 11 1 150 and 00 2 050.
Tightening torque*.



28.11.580

11 34 509 CHECKING ALL VALVES FOR LEAKS
– Camshaft Removed

Spark plugs remain installed.
Fill combustion chamber with gasoline outdoors or indoors in conformance with fire prevention regulations.
Valves and valve seats must be inspected, if gasoline escapes around the valve heads.
Remove and install valves 11 34 550.
Machine valve seats 11 12 607.

* See Specifications



11 34 550 REMOVING AND INSTALLING VALVES

Remove rocker arm shafts 11 33 020.
Place Special Tool 11 1 066 (tray) in Special Tool 11 1 060.
Unscrew intake manifold.
Installation:
Replacing gaskets.



Press down valve springs with Special Tool 11 1 060 and remove valve collets.



Take off upper spring retainer, valve springs and lower spring retainer.
Take tray out of assembly fixture and pull out valves.
Installation:
Only install valve springs with same color code, wire gage size and length.
Lubricate valve guides and valve stems with oil.



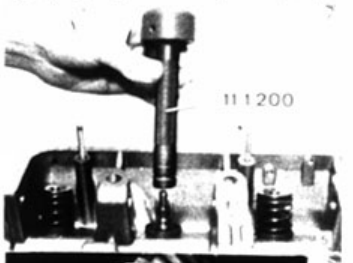
Pull off valve seal with Special Tool 11 1 250.



Install valve.
Always use Special Tool 11 1 350 to avoid damaging valve seals.
Lubricate valve seal (1) with oil and install.
Source for Special Tool Sleeves:
Cartool
Alfred Brehm Str.
D-8070 Ingolstadt



With "Gotze" Seals:
Press on valve seal to fit tight with Special Tool 11 1 140.
Dia. A = 12.8 mm (0.504").
With "Elring" Seals:
Press on valve seal to fit tight with Special Tool 11 1 080.
Dia. A = 13.5 mm (0.531").

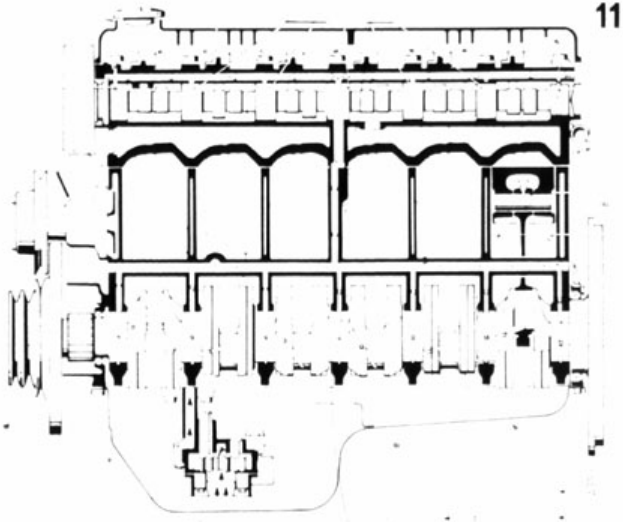


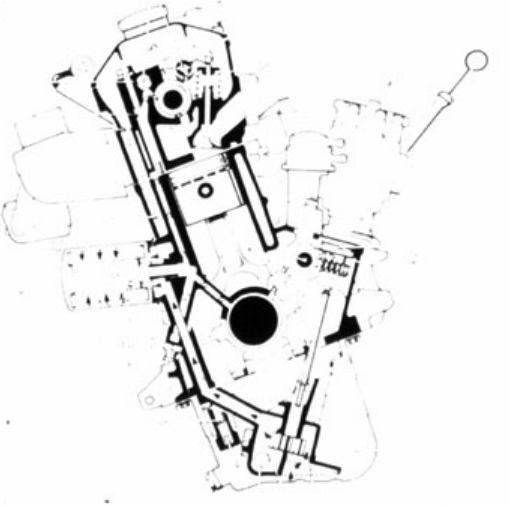
New, improved valve stem seals with grooves on the inside are pressed on by hand with Special Tool 11 1 200.
Special Tool 11 1 200 has two diameters – for 7 mm (0.276") and 8 mm (0.315") valve stem seals.



11 35 020 REMOVING AND INSTALLING DISTRIBUTOR INTERMEDIATE SHAFT

Remove fuel pump – see 13 31 030.
Remove distributor – see 12 11 060.
Remove front end cover – see 11 14 175.
Unscrew guide (1) and pull out intermediate shaft (2).
Installation
Check sprocket, replacing interm. shaft if necessary. Install sprocket with mark "B"***
Bearings in crankcase cannot be replaced
*** See Service Information of Gr. 11



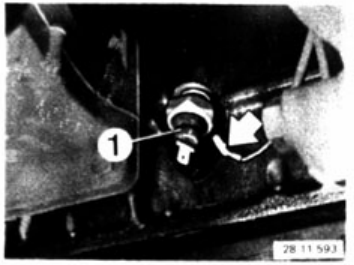


520 11 253

Unfiltered oil
Filtered oil

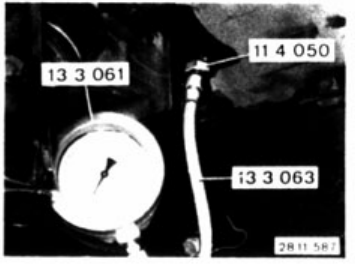
ENGINE OIL CIRCUIT

1 Oil pan
2 Intake with filter screen
3 Oil pump
3a Safety valve
4 Oil filter
4a Safety valve (oil filter)
4b Check valve, unfiltered side) prevent draining of filter
4c Check valve, filtered side) on stopped engine
4d Pressure relief valve
5 Main distribution bore
6 Oil pressure lamp sensor
7 Crankshaft bearing
8 Oil bore in cylinder head
9 Hollow rocker arm shaft
10 Front camshaft bearing
11 Camshaft bearing
12 Rear camshaft bearing
13 Rocker arm bearings (intake)
14 Rocker arm bearings (exhaust)
15 Intermediate shaft bearings
15a Spray oil for distributor gear
16 Oil line for cams
17 Valve guide
18 Conrod bearing
19 Spray oil
20 Piston pin/cylinder wall
21 Spill from cylinder head
22 Oil drain
23 Oil filler neck
24 Oil dipstick
25 Oil drain plug



11 40 000 CHECKING ENGINE OIL PRESSURE

Pull off wires on oil pressure switch.
Unscrew oil pressure switch (1).
Installation
Check gasket, replacing if necessary.



Screw in Special Tool 11 4 050 (connector).
Connect Special Tool 13 3 063 (hose) in conjunction with Special Tool 13 3 061 (pressure tester).
Check oil pressure*.

* See Specifications

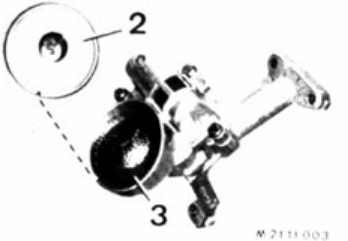


11 41 000 REMOVING AND INSTALLING OIL PUMP

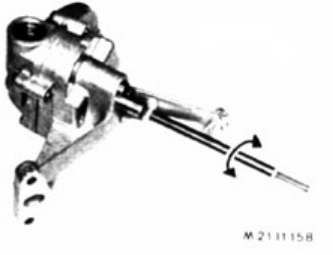
Remove oil pan 11 13 000.
Unscrew oil pump.



Installation:
Guide in drive shaft (1).
Replace bearing – see 11 11 160.
325 iX:
Fill master oil bore (pressure end) of oil pump with engine oil***.



Testing and Servicing:
Unscrew cover (2) and clean oil filter screen (3).

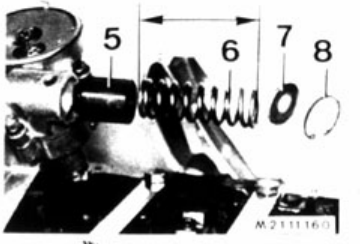


Check whether gears turn easily by turning the drive shaft.

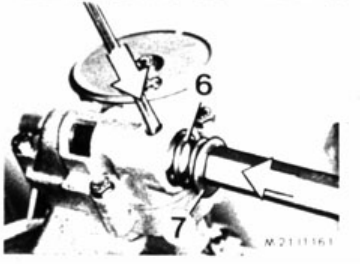
*** See Service Information of Gr. 11



Unscrew oil pump cover and check oil pump for wear.
- Scoring in body / cover
- Wear on gears



The pressure relief valve regulates oil pressure in front of the oil filter and prevents oil filter leakage.
Check that piston (5) moves easily.
Check length of spring (6) = 44 ± 0.2 mm (1.732 ± 0.008").



Installation:
Press in and hold spring (6) and washer (7) with a screwdriver.
Install circlip (8).





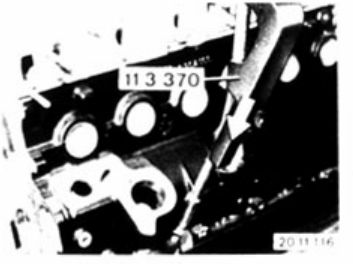
11 41 110 REMOVING AND INSTALLING PRESSURE RELIEF VALVE

The pressure relief valve is located in the main bore and regulates the engine oil pressure* after the oil filter.
Remove oil pan 11 13 000.
Unscrew pressure relief valve.
Remove sleeve (1).

11 42 020 REPLACING FULL FLOW OIL FILTER

Unscrew filter with Special Tool 11 4 020.
Installation:
Give gasket a light coat of oil.
Screw on oil filter by hand until gasket makes contact and then tighten by hand with one half turn.
Add oil, start engine, check oil level and check for leaks.
If oil pressure is not built up in engines after replacing the oil filter cartridge, stop engine, turn (loosen) filter about 90°, start engine again and tighten filter after oil runs out at filter briefly (bleeding procedures).





11 43 101 REPLACING GUIDE TUBE FOR OIL DIPSTICK

Install guide tube with Loctite No. 270** and drive in against stop.

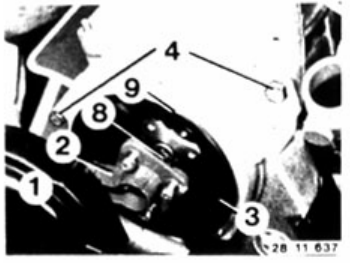
* See Specifications

** Source: HWB



11 51 000 REMOVING AND INSTALLING WATER PUMP

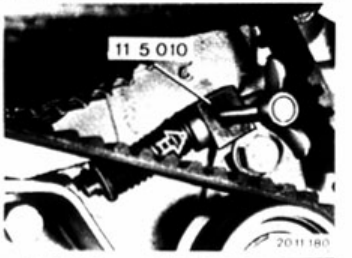
Engine with Distributor:
Drain coolant.
Loosen clamp (1).
Remove bolts (2) and take off suspension eye (3).
Remove fan 11 52 000.
Installation:
Fill and bleed cooling system 17 00 039.



Engine with DME:
Drain coolant.
Remove distributor cap (1).
Remove distributor rotor (2).
Unscrew adapter (8).
Remove cover (3).
Unscrew bolts (4).
Remove fan 11 52 000.
Installation:
Fill and bleed cooling system 17 00 039.
Check seal (9), replacing if necessary.



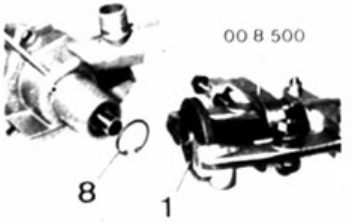
Unscrew pulley.
Unscrew bolt (4) and take off drive belt.
Remove rubber part (5) and pull out cover (6).
Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.



Compress spring clip and hold pin with Special Tool 11 5 010.
Installation:
Check installed position of pin to water pump.



Disconnect water hoses (7 and 8).
Unscrew water pump.
Installation:
Replace gasket.



11 51 502 OVERHAULING WATER PUMP
– WATER PUMP REMOVED –

Pull off hub (1) with Special Tool 00 8 500
Remove circlip (8)

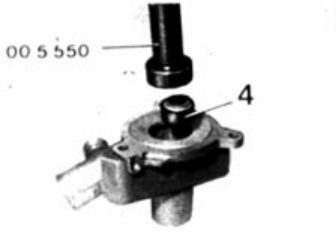


Replace bearing (3) and seal (4)
Check impeller (6), replacing if necessary
1 = Hub
2 = Water pump body
Installation
Press in bearing (3) against stop
Press on impeller (6)



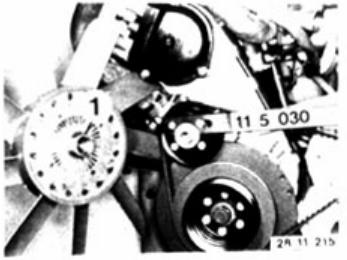
Press out water pump bearing

Check assembled distances



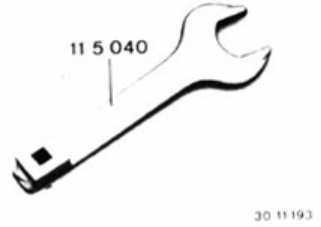
Drive out seal (4)
Installation
Press in seal (4) with Special Tool 00 5 550



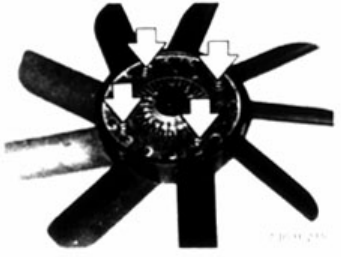


11 52 000 REMOVING AND INSTALLING FAN

Temperature Dependent Viscous Fan Clutch:
Hold pulley with Special Tool 11 5 030 and unscrew coupling nut (1).
Important!
Left-hand threads – loosen nut by turning clockwise.
Tightening torque*



Installation:
Tighten fan with Special Tool 11 5 040 40 Nm (29 ft. lbs.) tightening torque is equal to 30 Nm (22 ft. lbs.) setting on torque wrench.



11 52 020 REPLACING FAN CLUTCH

Remove fan – see 11 52 000.
Fan clutch must be replaced when
a) hub has seized – fan of stopped engine cannot be turned or is hard to turn,
b) fan clutch has axial and/or radial play or is losing oil.
Check switching points* with a Vibrocard***
Unscrew fan mounting bolts and take off fan clutch.

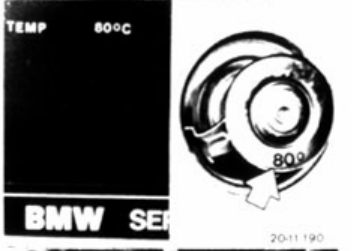


11 53 000 REMOVING AND INSTALLING COOLANT THERMOSTAT

Drain coolant partially.
Take off cover (1).
Installation:
Bleed cooling system – see 17 00 039.



Remove thermostat.
Installation:
Clamp on thermostat faces out.
Replace rubber ring (2).
New Thermostat Housing Since 1986 Models:
Install thermostat with number 1 715 040 (small valve seat).



Checking Thermostat:
Does thermostat begin to open at temperature given in the Specifications?
Check opening temperature by placing thermostat in hot water and compare test value with specified value.



11 53 080 REPLACING TEMPERATURE TRANSMITTER

Pull off wire (1).
Unscrew transmitter.
Installation:
Replace seal (2).
Bleed cooling system – see 17 00 039.

* See Specifications
*** See Workshop Equipment Catalog

Constrution group 11 Engine M21

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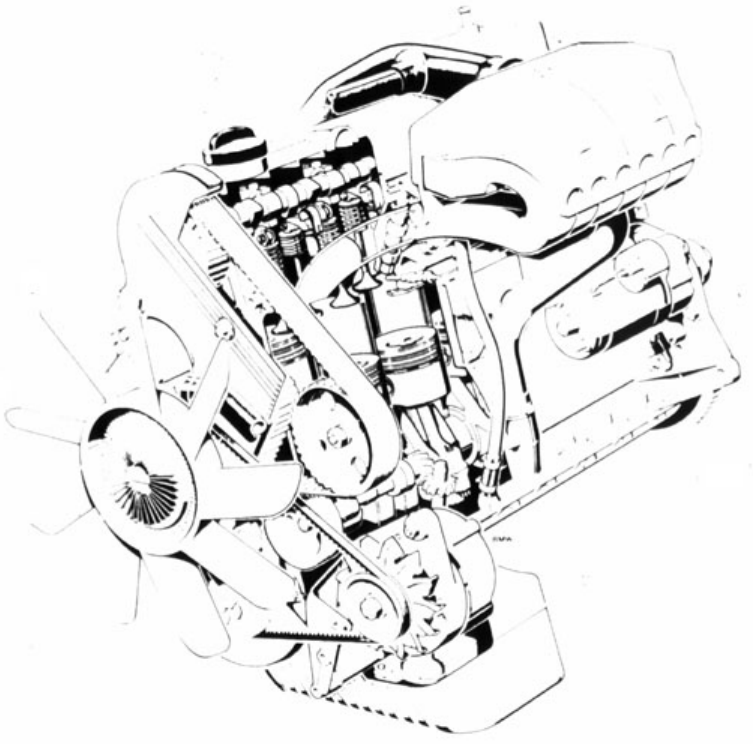
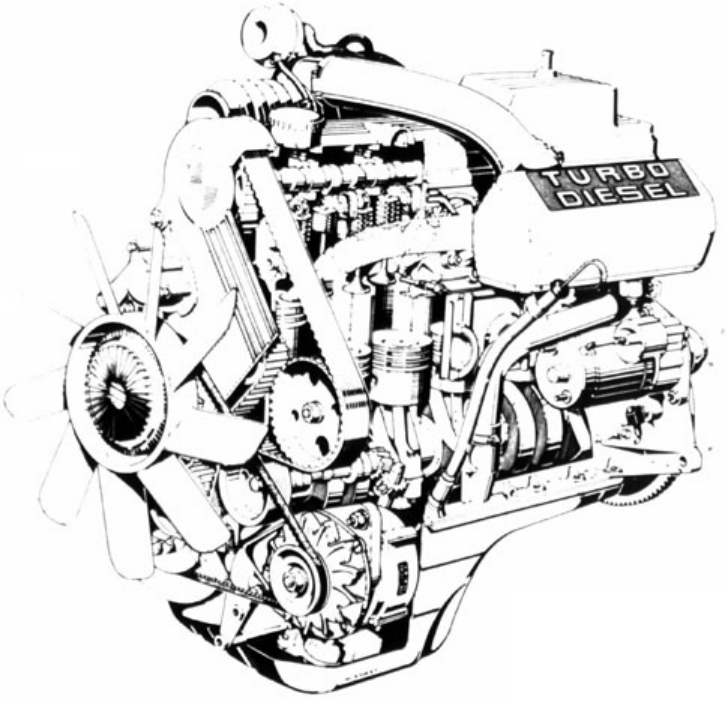
M 21 = Small 6 cylinder
D = Diesel
24 = Displacement (x 100)
W = Swirl chamber

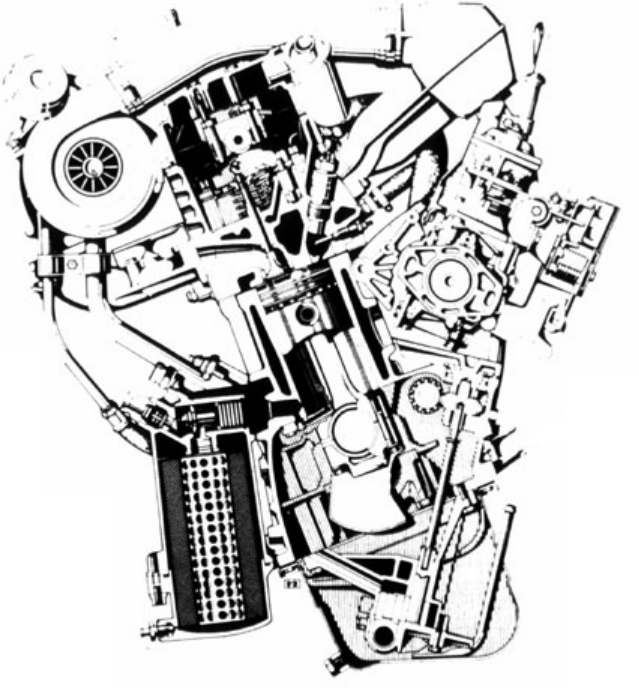




M 21 D 24 W – BMW 324 d / 524 d

M 21 = Small 6 cylinder
D = Diesel
24 = Displacement (x 100)
W = Swirl chamber
A = Turbocharged





M 21 D 24 W A – BMW 524 td

WORKING INSTRUCTIONS

concerning cleanliness on fuel system

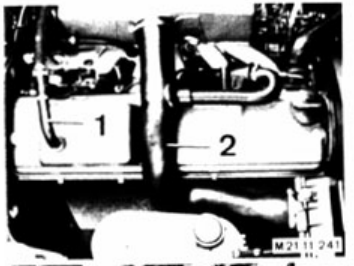
- Clean area around repair point thoroughly – e.g. prior to unscrewing lines, switches, etc.

  Always place removed parts on a clean surface and cover with plastic sheet – never use rags losing lint!

- Close off or insert plugs in open lines and components immediately.

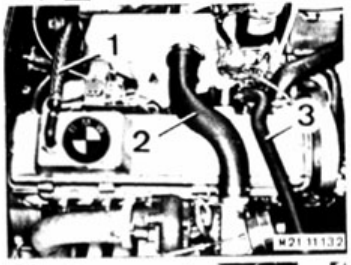
- Only install cleaned parts.
  Take new spare parts out of their packaging only immediately before installation.

- Never let diesel fuel spill on to coolant hoses – if applicable, wash off immediately with water.



11 12 000 REMOVING AND INSTALLING CYLINDER HEAD COVER

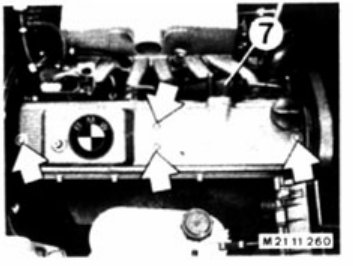
M 21 D 24 W:
Disconnect hoses (1 ... 2).



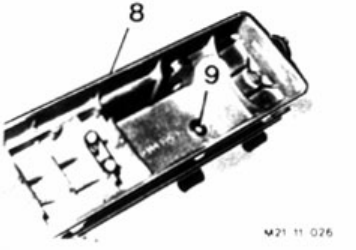
M 21 D 24 WA:
Disconnect hoses (1 ... 3).



Loosen screws of cover.
Installation:
First tighten the cylinder head cover and then the protective cover.



Remove oil trap (7).
Unscrew threaded sleeves and take off cylinder head cover.
Installation:
Install threaded sleeves with seals.
Check seal on oil trap, replacing if necessary.



Installation:
Check cylinder head cover gasket (8) and rubber ring (9), replacing if necessary.
Insert rubber ring (9) in cover and lubricate with oil.
Tightening torque*

* See Specifications





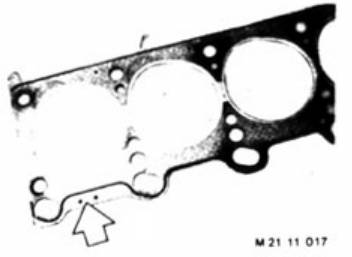


11 12 101 REPLACING CYLINDER HEAD GASKET

Remove cylinder head 11 12 100.
Clean sealing surfaces on cylinder head and crankcase carefully with gasket remover** and a hard wood scraper (even slight scratching would cause engine td leak because of high compression).
Check levelness with standard steel ruler.
Never machine cylinder heads!
Install a cylinder head gasket conforming with highest piston protrusion of all six pistons.

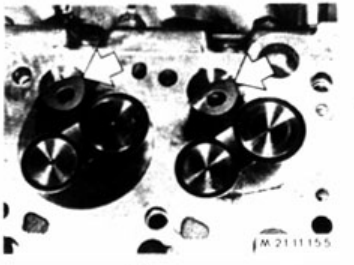
Measuring Piston Protrusion:
Place dial gauge in Special Tool 00 2 530 on cleaned cylinder head sealing surface and set to zero with pre load.

Apply dial gauge on measuring point "A" of cleaned piston and find highest point by turning crankshaft.
Note displayed value = piston protrusion "A".
Apply dial gauge on measuring point "B" and note piston protrusion "B".
Mean value of "A" + "B" is the "piston protrusion" of a piston.
Repeat measuring on all six pistons.

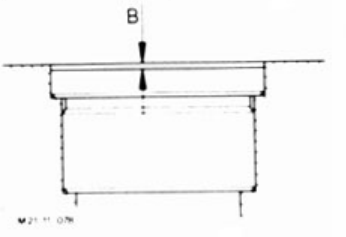


Piston with highest "piston protrusion" will determine thickness of cylinder head gasket.
Cylinder Head Gaskets:

Highest Piston Protrusion of All 6 Pistons (mm)	Code of Cylinder Head Gasket (no. of holes)
0.64 ... 0.78	1
0.79 ... 0.91	2
0.92 ... 1.08	3



Burners are installed with shrink fit in cylinder head.
Replace cylinder head, if burners are loose or damaged.



Burner retrusion = distance "B"*.

* See Specifications

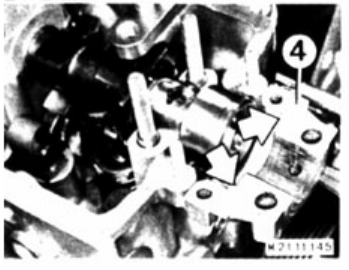


11 12 240 REPLACING RADIAL OIL SEAL IN END COVER

Remove toothed drive belt 11 31 110.
Unscrew pulley (1).
Installation
Slid- slot of pulley and bore of washer (2) over pin of camshaft.



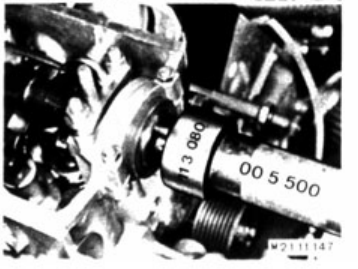
Unscrew oil line (3) and take off bearing cap (4).
Pull off radial oil seal.



Coat sealing surface with a brush on universal sealing compound / Three Bond Silicon 1207** and mount bearing cap (4).
Tightening torque*.



Push on radial oil seal over Special Tool 11 2 212.
Lubricate sealing lip with oil.



Press in radial oil seal with Special Tools 11 3 080 and 00 5 500.
Press in new radial oil seal against stop in contradiction to the standard seal, which was installed flush.

* See Specifications
** Source: HWB

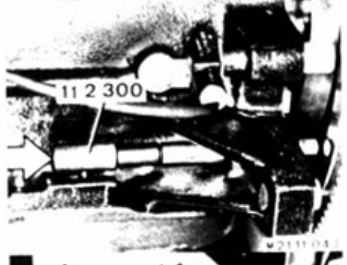


11 12 500 REMOVING AND INSTALLING CYLINDER HEAD
– Engine Removed –

Unscrew injection pipes on fuel injectors and injection pump with Special Tool 13 5 020.
Mount protective caps.
Remove cylinder head cover – see 11 12 000.
Installation:
Tightening torque: 20 to 25 Nm (15 to 18 ft. lbs.).



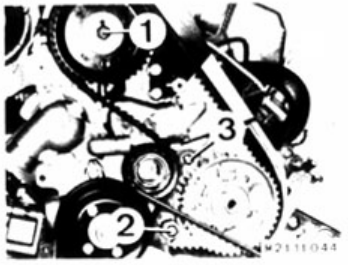
Turn cylinder no. 1 to TDC – cylinder no. 6 overlaps.



Hold crankshaft with Special Tool 11 2 300.



Remove hose (5) and protective cover.
Installation:
Tighten the cylinder head cover first and then the protective cover.



Loosen bolts (1 and 2) and nut (3).
Loosen and take toothed drive belt off of the camshaft sprocket.

Installation:
Turn in the camshaft before mounting the cylinder head, so that valves of cylinder no. 6 overlap – hold camshaft with Special Tool 11 3 090.
Install and tighten toothed drive belt – see 11 31 110.



Unscrew bolts in order of 14 ... 1 and take off the cylinder head.
Installation:
Keep oil out of cavities since otherwise bolts tightened with specified torque might not exert sufficient force on the cylinder head. In addition, the crankcase might be cracked.
Clean cylinder head bolts.
Lubricate threads and bearing surfaces of bolt heads with a light coat of oil.
Replace cylinder head gasket – measure piston protrusion – see 11 12 101.
Tighten bolts in order of 1 ... 14 in three steps*.
Adjust valve clearance – see 11 34 004.
Check static adjustment of the injection pump – see 13 51 005.
Tighten cylinder head bolts to specified torque angle with Special Tool 11 2 110 regardless of the engine temperature in the 3rd step (cover of cylinder head removed again after running engine warm).

* See Specifications



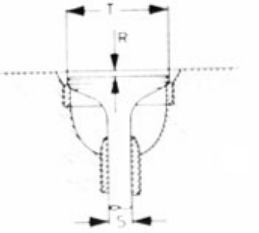
11 12 595 CHECKING VALVE GUIDE FOR WEAR
– Valve Removed –

To check install a new valve that the end of the valve stem is flush with the valve guide.
Apply dial gauge and measure tilt play.
Max. permissible tilt play*.

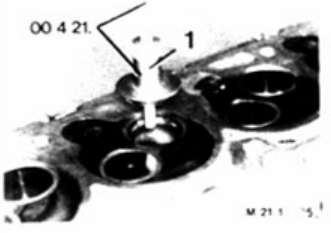


11 12 607 MACHINING VALVE SEAT
– Cylinder Head Disassembled

The valve seat machine from Hunger and a five sided cutting tool from New Way must be used to machine valve seat insert rings.
An oversize valve must be installed after machining a valve seat.
Machine valve seat insert rings until specified valve retrusion "R" is reached.

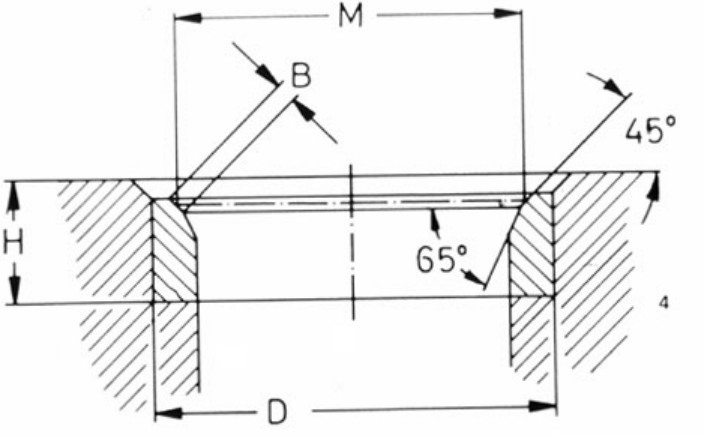


Valve retrusion R*.
Machine correction angles* to produce valve seat diameter M* and valve seat width B*, after machining the valve seat angle*.
Valves may not be ground in.
Check valves for leaks 11 34 509.



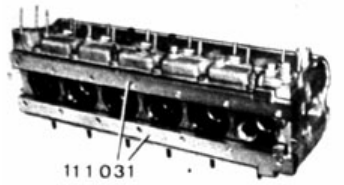
11 12 600 REAMING OUT VALVE GUIDE
– Valve Removed –

If there is excessive play between the valve guide and valve stem (see 11 12 595), ream out valve guide and install a repair valve with an oversized stem diameter "S"*.
This also requires machining the valve seat, see 11 12 607.
Press guide pad (1) on to valve seat and ream out valve guide starting from the combustion chamber end – turn down reamer once.



* See Specifications

* See Specifications

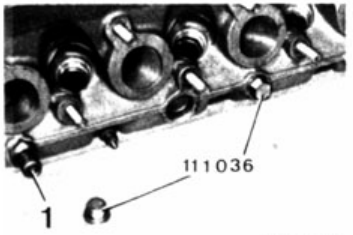


M 2111083

11 12 729 CHECKING CYLINDER HEAD FOR CRACKS IN WATER TEST

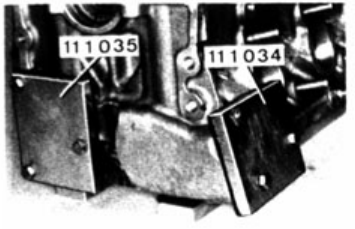
– Cylinder Head Disassembled –

Mount Special Tools 11 1 031 on cylinder head (using cylinder head bolts).



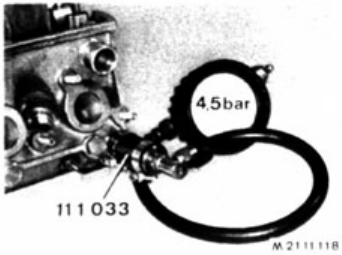
M 2111100

Unscrew adapter (1) and plug openings with Special Tools 11 1 036.
Insert seals.
Installation:
Install adapter with bolt cement**.



M 2111117

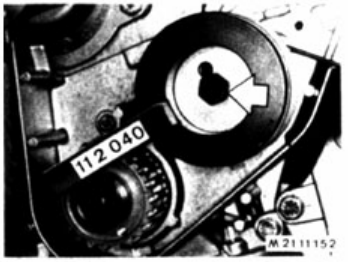
Apply Special Tools 11 1 034 and 11 1 035.



M 2111118

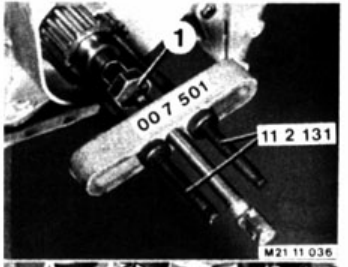
Attach Special Tool 11 1 033.
Apply compressed air on cylinder head.
Test pressure = 4.5 bar (64 psi).
Place cylinder head in water bath and check for leaks.
Note:
Relax water bath with a detergent if necessary.

** Source: HWB

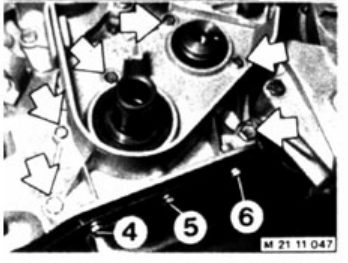


11 14 175 REMOVING AND INSTALLING FRONT END COVER

Remove vibration damper hub 11 23 031.
Remove toothed belt 11 31 110.
Hold intermediate shaft gear with Special Tool 11 2 040.
Unscrew bolt.
Remove washer and gear.
Installation:
Guide centering pin into bore.



Screw in bolt (1) again.
Pull gear off of crankshaft with Special Tools 00 7 501 and 11 2 131.
Important!
Woodruff key.
Installation:
Mount gear that shouldered end faces forward.



Unscrew bolts (4 ... 6).
Only loosen other oil pan bolts.
Separate oil pan gasket on end cover carefully with a knife.
Take off end cover.



Installation:
If oil pan gasket is damaged, remove oil pan and replace gasket 11 13 000.
Fill bores of oil pan gasket with a brush on universal sealing compound / Three Bond Silicon 1207**
Replace gasket (7).



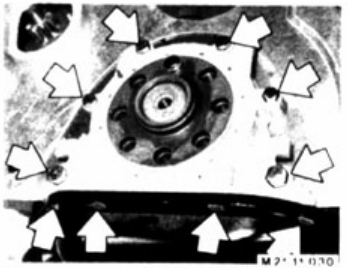
Check radial oil seals, replacing if necessary.
Use Special Tool 11 2 211 on crankshaft and Special Tool 11 2 212 on intermediate shaft when installing end cover.



11 14 180 REPLACING RADIAL OIL SEAL IN FRONT END COVER

Remove front end cover 11 14 175.
Press radial oil seals out of cover.
Press in radial oil seals with Special Tools 24 1 050 and 24 1 040.
Press in new radial oil seals to depth of approx 1 to 2 mm (0.039 to 0.079") in contradiction to standard seals which were installed flush.
Lubricate sealing lips with oil.

** Source: HWB



M21 11 030

11 14 605 REPLACING RADIAL OIL SEAL IN CLUTCH END COVER

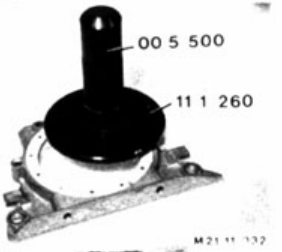
– Transmission Removed –

Remove flywheel 11 22 000.
Unscrew oil pan/end cover mounting bolts.
Only loosen other oil pan bolts.
Separate oil pan gasket on end cover carefully with a knife.
Take off end cover.
If oil pan gasket is damaged, remove oil pan and replace gasket 11 13 000.



M21 11 031

Installation:
Replace gasket (1).
Coat holes of oil pan gasket with a brush on universal sealing compound * Three Bond Silicon 1207**.



M21 11 032

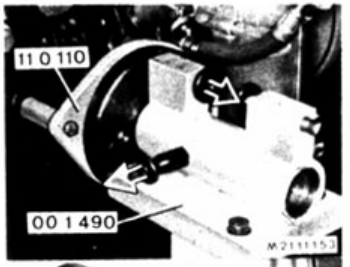
Press in radial oil seal with Special Tools 11 1 260 and 00 5 500.
Press in new radial oil seal to depth of approx. 1 to 2 mm (0.039 to 0.079") in contradiction to standard seal which was installed flush.
Lubricate sealing lip with oil.



M21 11 033

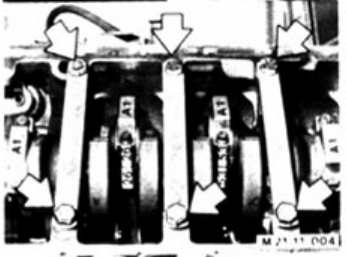
Installation:
Use Special Tool 11 2 213 to install end cover.

** Source: HWB



11 21 000 REMOVING AND INSTALLING CRANKSHAFT

Remove engine 11 00 050.
Mount crankcase on Special Tool 00 1 490 with Special Tool 11 0 110.



Remove clutch 21 21 000.
Remove cylinder head 11 12 100.
Remove front end cover 11 14 175.
Remove oil pump 11 41 000.
Unscrew braces.



Check axial play* before removing crankshaft.
If maximum permissible play is exceeded, check or replace thrust bearing.

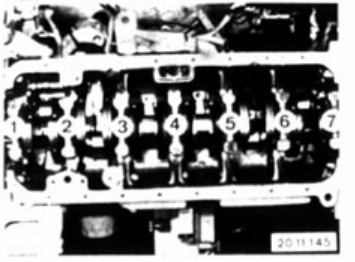


Remove flywheel 11 22 000.
Take off end cover.
Installation:
Replace gasket.
Use Special Tool 11 2 213 to avoid damaging radial oil seal.
Cut off gasket on oil pan sealing surface.

* See Specifications



Unscrew connecting rod bearing caps.
Installation
Replace conrod bearing shells and check conrod bearing play, see 11 24 571.
Pair code numbers (0 ... 99) must be same on connecting rods and bearing caps.



Remove crankshaft bearing caps and lift out crankshaft.
Installation
Do not mix up bearing caps.
Bearing cap no. 1 is on toothed belt end.
Bearing cap no. 6 is the thrust bearing.
Install bearing shells and check bearing play, see 11 21 531.

Installation
Check axial play after installing crankshaft – unscrew thrust bearing cap no. 6 again.
Center thrust bearing by applying knocks from a plastic hammer on rear and front ends of the crankshaft.
Tighten thrust bearing cap bolts again as specified.
Check axial play*.

If crankcase is replaced, clean oil and water ports again thoroughly to remove casting sand.

* See Specifications



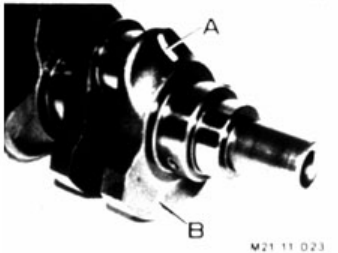
28 11 307

11 21 501 REPLACING CRANKSHAFT
– Crankshaft Removed –

Note:
A replacement crankshaft is supplied complete with corresponding bearing shells for main and conrod bearings.

Crankshaft Identification:

Engine	Stroke	Code
M 21 D	81.0 mm	C



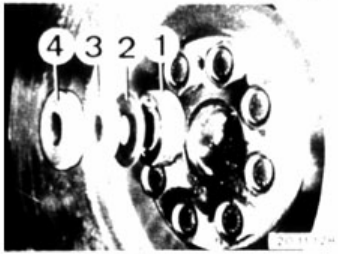
M21 11 023

Crankshaft is surface treated and may only be reground in the factory.

Reground crankshafts are marked with stripes of paint.

Conrod Bearing Journal (A)
1 paint stripe Size 1 *
2 paint stripes Size 2 *

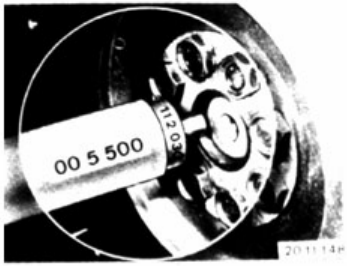
Main Bearing Journals (B)
1 paint stripe Size 1 *
2 paint stripes Size 2 *



Cars with Manual Transmission:
Install pilot bearing for transmission main shaft.

Installed Order:
Ball bearing (1), cover (2), felt ring (3) and capsule (4).

Insert cover (2) with the embossment facing out.



2011 14

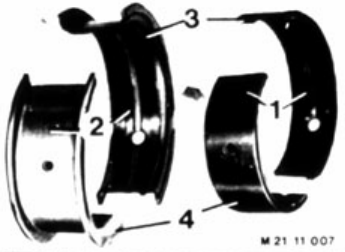
Fill bore in crankshaft with approx. 1 gram (0.035 oz.) of lubricating grease. Drive in pilot bearing with Special Tools 11 2 030 and 00 5 500.

* See Specifications



28 11 308

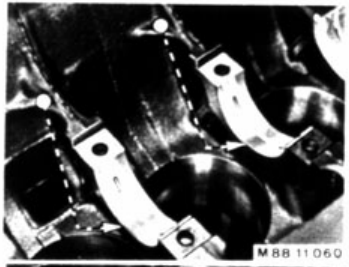
The crankshaft is marked with yellow, green or white paint depending on main bearing journal tolerances.



M 21 11 007

The bearing shells are marked with yellow, green or white paint.
1 Bearing shell 1-2-3-4-5-7
2 Bearing shell 6 (pilot bearing)
3 Bearing shell with lubricating groove installed in crankcase
4 Bearing shell without lubricating groove installed in bearing cap

Check ground size of the main bearing journals!



M88 11 060

Installing Instructions:
Install only bearing shells with "yellow" color code in the crankcase (regardless of old color code mark on the crankcase).
Install bearing shells with "yellow - green - white" color code in bearing caps depending on the crankshaft bearing journal color code.



M88 11 061

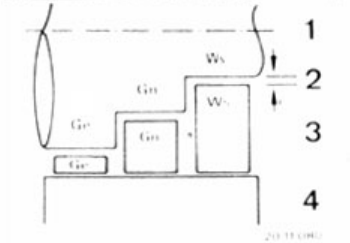
Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps with the correct torque*. Do not turn the crankshaft.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

* See Specifications



Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with a different color code.



Survey of Color Code Shaft Diameter/ Bearing Shell Thickness*

Triple Classification Color Codes:
Ge = yellow
Gn = green
Ws = white

1 Crankshaft diameter
2 Bearing play
3 Bearing shell thickness
4 Console diameter



Replacing Conrod Bearing Shells:
Red or blue conrod bearing shells in accordance with the color code mark on the connecting rod are installed standard for a pertinent ground size or crankshaft.

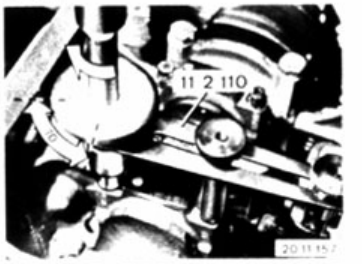
Install only red bearing shells of a pertinent ground size for a replacement crankshaft.



Place Type PG-1 Plastigage on crankshaft wiped clean of oil in the BDC position and mount conrod bearing caps that all grooves are on one side. Pair numbers (0 ... 99) must be the same on caps and connecting rods.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

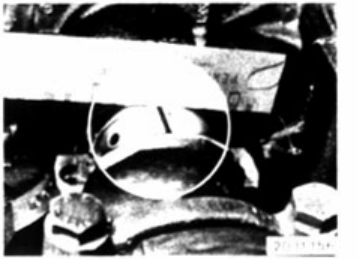
* See Specifications



Tighten bolts in two steps (use old conrod bolts).
Step 1 20 Nm (14.5 ft. lbs.)
Step 2 70° torque angle

Important!
Do not turn the connecting rods or crankshaft.

Remove bearing caps.



Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearings shells of a different machined size or with a different color code.
Replace conrod bolts for final installation and tighten the conrod bearing caps in two steps (see above).

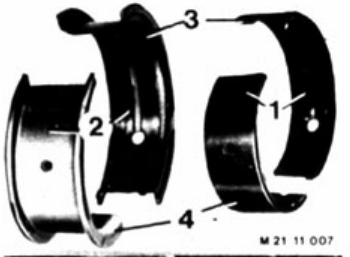
* See Specifications



28 11 308

11 21 531 REPLACING CRANKSHAFT MAIN BEARING SHELLS – Engine Disassembled –

The crankshaft is marked with yellow, green or white paint depending on main bearing journal tolerances.



M 21 11 007

The bearing shells are marked with yellow, green or white paint.

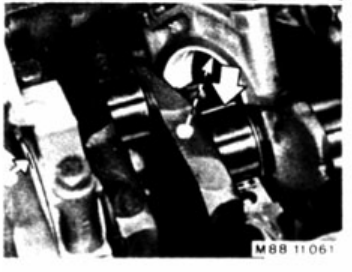
1 Bearing shell 1–2–3–4–5–7
2 Bearing shell 6 (pilot bearing)
3 Bearing shell with lubricating groove installed in crankcase*
4 Bearing shell without lubricating groove installed in bearing cap

Check ground size of the main bearing journals!



M88 11 060

Install bearing shells in the crankcase with the same color code as the dot of paint on the console.
Install both bearing shells according to the crankshaft color code mark, if the color code marked on the crankcase is washed off.
Install bearing shells in the bearing caps with the same color code as for the crankshaft.



M88 11 061

Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten the bearing caps with the correct torque*.
Do not turn the crankshaft.

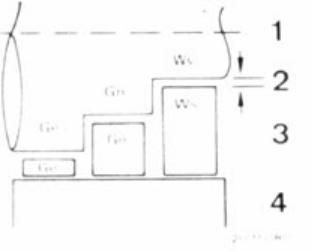
Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

* See Specifications



M88 11 062

Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with a different color code.



Survey of Color Code Shaft Diameter Bearing Shell Thickness*

Triple Classification Color Codes:
Ge = yellow
Gn = green
Ws = white

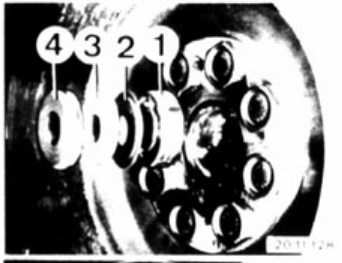
1 Crankshaft diameter
2 Bearing play
3 Bearing shell thickness
4 Console diameter

* See Specifications

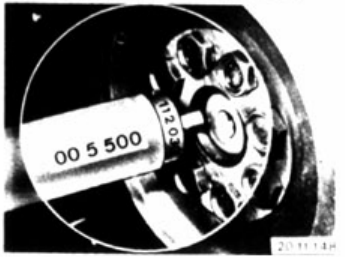


11 21 571 REPLACING PILOT BEARING IN CRANKSHAFT

Remove clutch – see 21 21 000
Pull out ball bearing with Special Tool 11 2 010



Installed Order:
Ball bearing (1), cover (2), felt ring (3) and capsule (4)
Insert cover (2) with embossment facing out

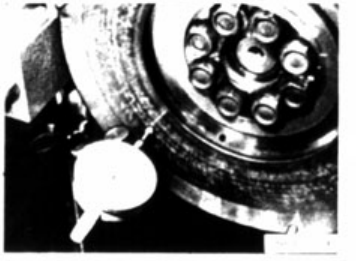


Pack bore in crankshaft with about 1 gram of lubricating grease
Drive in pilot bearing with Special Tools 11 2 030 and 00 5 500



11 22 000 REMOVING AND INSTALLING FLYWHEEL

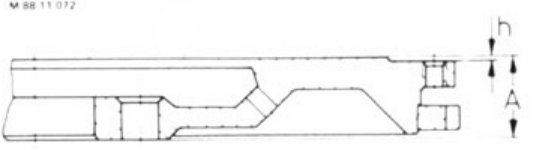
Remove clutch – see 21 21 000
Hold flywheel with Special Tool 11 2 170
Unscrew bolts and take off flywheel
Installation
Clean tapped bores
Insert ring (1)
Replace and install new expansion bolts with a bolt cement**
Tightening torque*



Check flywheel for axial runout*

Friction surfaces may be machined to minimum distance A*
If machining the friction surface reduces distance "h" to zero, the flange surface (distance "h") must be machined

Friction surfaces of double mass flywheels cannot be machined





11 22 051 REPLACING DRIVE PLATE FOR TORQUE CONVERTER

Remove transmission – see Group 24
Hold flywheel with Special Tool 11 2 170
Unscrew bolts and take off flywheel
Installation
Clean tapped bores
Replace and install new expansion bolts with a bolt cement**
Tightening torque*

* See Specifications
** Source: HWB



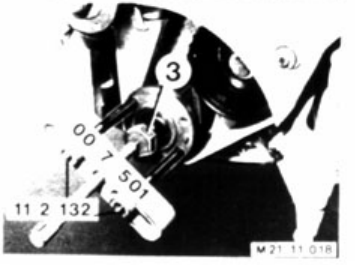


11 23 010 REPLACING VIBRATION DAMPER

Remove fan 11 52 000
Take off drive belt on alternator, power pump and, if applicable, compressor for air conditioner
Unscrew pulley
Installation
Tighten drive belt and check tightness with Special Tool 11 5 020

Unscrew pulley and vibration damper on hub
Installation
Centering pin must fit in bore in vibration damper





11 23 031 REPLACING VIBRATION DAMPER HUB

Remove radiator 17 11 000
Remove vibration damper 11 23 010
Hold hub with Special Tool 11 2 150
Unscrew bolt (3)
Take off collar washer (4)
Installation
Tightening torque*

Screw in bolt (3) about three turns
Pull hub off of crankshaft with Special Tools 00 7 501 and 11 2 132
Unscrew bolt (3)

* See Specifications



11 24 521 REPLACING CONNECTING RODS – PISTONS REMOVED –

Important!
Only install connecting rods of same weight class in one engine.
Weight class is die stamped in machined conrod bearing cap surface.
Connecting rods may not be reground.



Piston pin should slide through connecting rod bushing under light pressure.



11 24 571 REPLACING CONNECTING ROD BEARING SHELLS – ENGINE DISASSEMBLED –

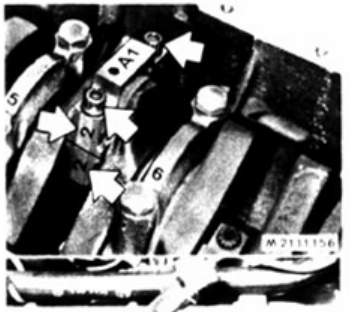
Install red or blue bearing shells in connecting rod depending on color code on crankshaft counterweight.
Important!
Check machined size (conrod diameter)*



Install red or blue bearing shells in connecting rod bearing cap depending on color code on conrod bearing caps.
In BDC position place Type PG 1 plastigage on crankshaft wiped clean of oil and install conrod bearing caps that lubricating grooves are on one side.
Paired code numbers (0 ... 99) must be same on caps and connecting rods.
Source for Plastigage:
Cartool
Alfred Brehm Str. 5
D-8070 Ingolstadt
West Germany

Tighten bolts in two steps (use old conrod bolts).
Step 1 = 20 Nm (15 ft. lbs.)
Step 2 = torque angle of 70°
Important!
Don't turn connecting rods or crankshaft.
Remove bearing caps.
Read bearing play* from width of flattened Plastigage with help of supplied scale.
Correct bearing play by installing new bearing shells, bearing shells of different machined size or with different color code.
Use new conrod bolts for final assembly and tighten connecting rod bearing cap bolts in two steps (see above).

* See Specifications



11 25 000 REMOVING AND INSTALLING PISTON

Remove engine.
Take off cylinder head, oil pan and oil pump.
Remove connecting rod bearing cap.
Important!
Mark installed position of connecting rod to crankshaft, if conrod bearing shells do not have to be replaced.



M 21 D 24 WA:
Important!
Engine oil is injected into annular bore (4) of piston via oil spray jet (3) for piston cooling. Even slight damage on oil spray jet (3) will impair guarantee of oil stream meeting bore (4), which would result in immediate engine failure.



Screw Special Tool 11 2 050 on connecting rod to avoid damage on oil spray jet (3).
Press out piston upwards.



Remove circlip (1).
Press out piston pin.
Installation:
Piston pins and pistons are matched and must not be mixed up.

M 21 11 008



M 21 11 009

Only install a piston of same make and same weight class.
Weight class is die stamped with * or ** in piston crown.
Important!
Check machined size (piston diameter)*.



Check piston installed clearance*.

Model	Make	Measuring Point A
M 21 D	Alcan	15.00 mm (0.591")
	KS	18.00 mm (0.709")
	Mahle	12.00 mm (0.472")
	Konig	



Set internal calipers to zero on micrometer with the measured piston diameter.

Measure cylinder bore with internal calipers at bottom, center and top in forward and rotational directions.
Check piston installed clearance*.

* See Specifications



Lubricate piston and piston rings with oil.
Offset piston ring end gaps by 120° to each other.
Compress piston rings with Special Tool 11 2 260.



11 25 651 REPLACING PISTON RINGS OF ONE PISTON
- Piston Removed -

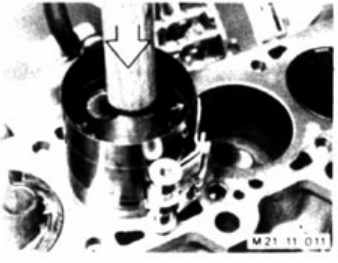
Measure side clearance* of piston rings (only possible on rings 2 and 3).



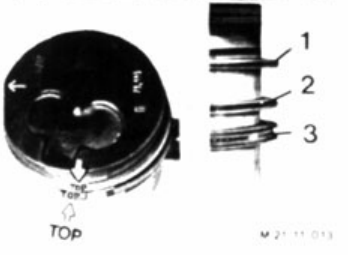
Screw Special Tool 11 2 050 on to connecting rod to avoid damaging oil spray jet (3).



Remove piston rings and measure end clearance*.



Insert piston that arrow points to the toothed drive belt.
Install connecting rod - see 11 24 521.



Installation
Install piston rings with the word "TOP" facing the piston crown.

1 Double wedge compression ring
2 Bevelled face compression ring
3 Oil scraper ring with rubber lined spring

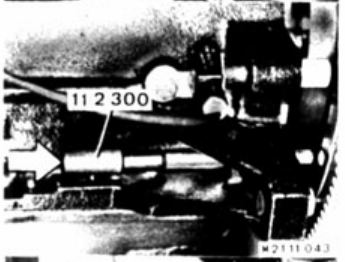
Note
It might not be possible to find the identification on used piston rings.
Lay piston rings aside in correct sequence and installed position.

* See Specifications



11 31 000 REMOVING AND INSTALLING CAMSHAFT

Remove air cleaner – see Group 13.
Remove fan – 11 52 000.
Turn crankshaft to have TDC in cylinder no. 1 and overlapping in cylinder no. 6.



Hold crankshaft with Special Tool 11 2 300.



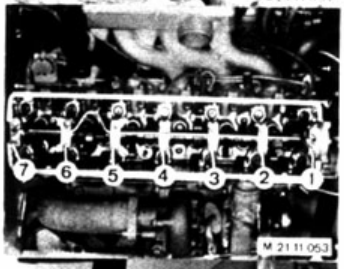
Unscrew hose (5) and cover.
Remove vacuum pump – 11 66 000.
Remove rocker arm for exhaust in 2nd cylinder and for intake in 3rd cylinder to take tension off of camshaft. See 11 33 031.



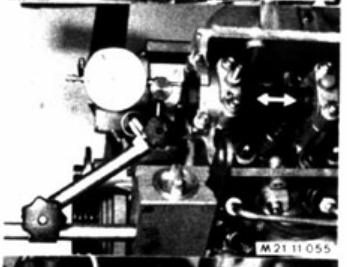
Loosen bolts (1 ... 2) and nut (3).
Loosen toothed belt and take it off of camshaft sprocket.
Unscrew bolt (1) and remove camshaft sprocket.
Installation:
Tightening torque*.



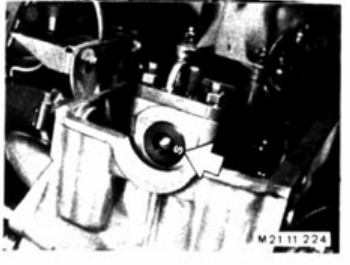
Installation
Slide slot of pulley and bore of washer (2) over pin of camshaft



Unscrew camshaft.
Installation:
Replace rocker arms when replacing a camshaft because of worn cams!
Slide steel ring over cam for vacuum pump.
Bearings are marked.
Bearing no. 1 is at front end.
See 11 12 240 for installation of bearing no. 1 with insertion of radial oil seal.
Mount oil line.



Check camshaft axial play*.
Install and tighten toothed belt, see 11 31 110.



Codes of Camshafts:

Engine	Code
M 21 D 24 W	S
M 21 D 24 WA	E / T

* See Specifications

* See Specifications

11 31 100 TIGHTENING TOOTHED DRIVE BELT

Remove air cleaner – see Group 13.
Remove fan – 11 52 000.

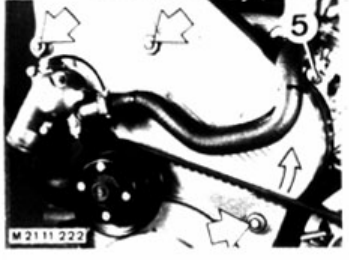




Turn cylinder no. 1 to TDC; valves of cylinder no. 6 overlap.



Hold crankshaft with Special Tool 11 2 300.



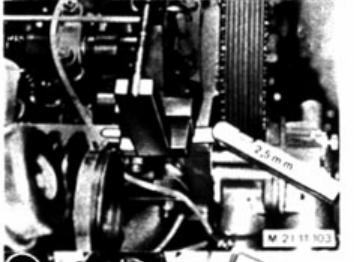
Disconnect hose (5) and unscrew cover.
Remove cylinder head cover 11 12 000.



Loosen bolts (1 and 2) and nut (3).



Hold camshaft in position with Special Tool 11 3 090 with cylinder no. 1 at TDC and valves of cylinder no. 6 overlapping.



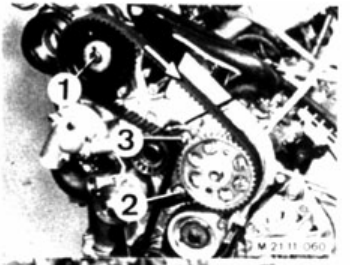
Important!
Tighten toothed drive belt with coolant temperature between 15 and 35° C (60 and 95° F).
Use a 2.5 mm (0.098") feeler gage blade on the exhaust side for a new toothed drive belt or a belt used less than 15,000 km (10,000 miles).



Press out tensioning roller with a torque wrench (analog display).
Torque for toothed drive belt used
up to 15,000 km (10,000 miles) = 42 + 3 Nm (30 + 2 ft. lbs.) or
from 15,000 km (10,000 miles) on = 30 to 35 Nm (22 to 25 ft. lbs.).
Tighten nut (3) and then bolts (1 and 2).
Check tightening torque for bolt (1).
Crank engine once in rotating direction and recheck timing.
Make static injection pump adjustment – see 13 51 005.

11 31 110 REMOVING AND INSTALLING TOOTHED DRIVE BELT

Remove air cleaner – see Group 13
Remove fan – 11 52 000



Loosen bolts (1 and 2) and nut (3)
Mark running direction of toothed drive belt and take off belt



Turn crankshaft for TDC in cylinder no. 1 and overlapping in cylinder no. 6



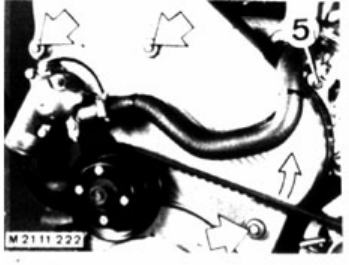
Installation
Hold camshaft with Special Tool 11 3 090 – TDC in cylinder no. 1 and overlapping in cylinder no. 6



Hold crankshaft with Special Tool 11 2 300



Hold injection pump gear wheel with Special Tool 13 5 340 for rough adjustment of the injection pump
Install toothed drive belt in opposite direction of engine rotation – turn loose camshaft sprocket against toothed drive belt completely
Remove Special Tool 13 5 340
Tighten toothed drive belt – see 11 31 100



Disconnect hose (5) and remove cover
Remove vibration damper – 11 23 010
Remove cylinder head cover – 11 12 000

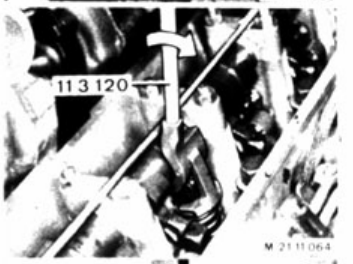


Toothed Drive Belt Layout
Adjust injection pump statically – see 13 51 005

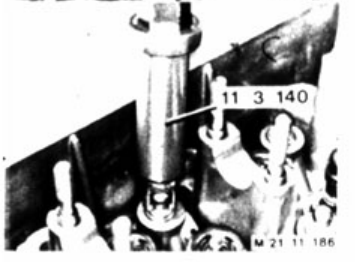


11 33 050 REPLACING ROCKER ARM

Remove vacuum pump 11 66 000
Pull off spring clip (1)
Pertinent cams of camshaft must be turned up for removal of rocker arms



Press down valve springs with Special Tool 11 3 120 and remove rocker arm – watching out for valve collets
Important!
Install rocker arm with same ball headed bolt
When replacing rocker arms, it is always necessary to also replace the ball headed bolts

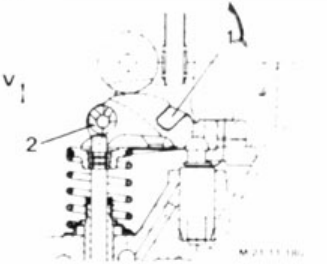


Pull out ball headed bolt with Special Tool 11 3 140
Installation
Install ball headed bolt with a bolt cement** and press in against stop



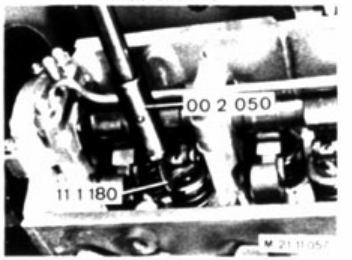
Installation
Press spring clip into groove of ball headed bolt
Adjust valve clearance 11 34 004

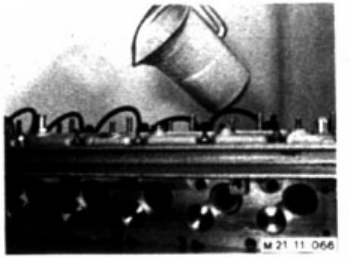
** Source: HWB



11 34 004 ADJUSTING VALVE CLEARANCE

Remove cylinder head cover 11 12 000
Turn engine to TDC with a wrench socket used on crankshaft (vibration damper)
Apply a 12 mm open end wrench on nut (1) for counterholding and unscrew nut on adjusting eccentric (2)
Adjust valve clearance "V" – eccentric always turned toward outside
Make adjustments in firing order (1 5 3 6 2 4) and in compression TDC
Tighten nut with Special Tools 11 1 180 and 00 2 050
Tightening torque*

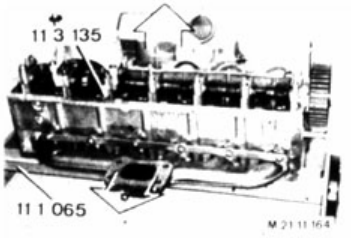




11 34 509 CHECKING VALVES FOR LEAKS – Camshaft Removed

Fill intake and exhaust ports with gasoline outdoors or indoors with strict conformance of fire prevention regulations
Valves and valve seats must be inspected if the gasoline runs past the valve heads
Remove and install valves 11 34 550
Machine valve seats 11 12 607

* See Specifications



11 34 550 REMOVING AND INSTALLING VALVES

Remove cylinder head – 11 12 000.
Remove thermostat housing and mount cylinder head on Special Tool 11 1 065 with Special Tool 11 3 135.
Unscrew intake manifold and exhaust manifold.
Installation:
Replace gaskets.



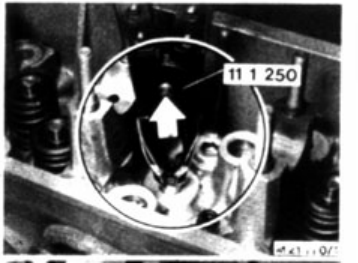
Remove camshaft – see 11 31 000.
Mount Special Tools 11 3 131 / 133 and place 11 3 132 (tray) in assembly fixture.
Remove rocker arm.



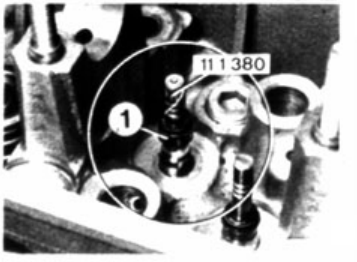
Press down valve springs and remove valve collets.



Take off upper spring retainers, valve springs and lower spring retainers.
Take tray out of assembly fixture and pull out valves.
Installation:
Only install valve springs with same color code, wire gage size and length.
Lubricate valve guides and valve stems with oil.
Measure valve retrusion R* – see 11 12 607.



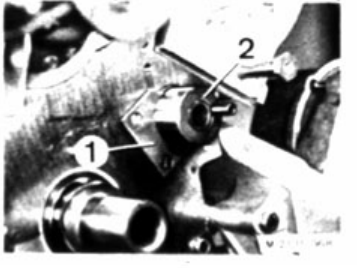
Pull off valve stem seal with Special Tool 11 1 250.



Install valve.
Always use sleeves to avoid damaging valve stem seals.
Lubricate valve stem seal (1) with oil and install.
Source for Sleeves:
Cartool
Alfred Brehm Str. 5
D 8070 Ingolstadt



Press on valve stem seal against stop with Special Tool 11 1 170.
New, improved valve stem seals with grooves on the inside are pressed on by hand with Special Tool 11 1 200.
Special Tool 11 1 200 has two diameters for 7 mm (0.276") and 8 mm (0.315") valve stem seals.



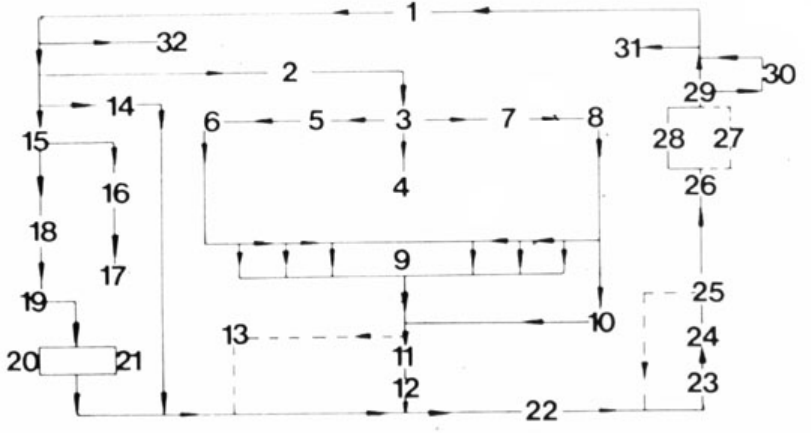
11 35 020 REMOVING AND INSTALLING INTERMEDIATE SHAFT

Remove front end cover – 11 14 175.
Unscrew guide plate (1).
Pull out intermediate shaft (2) – turning crankshaft if necessary.
Installation:
Check gear – replacing intermediate shaft if necessary.
Bearings in crankcase cannot be replaced.

* See Specifications

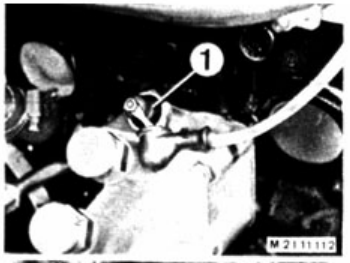


M21 11 086



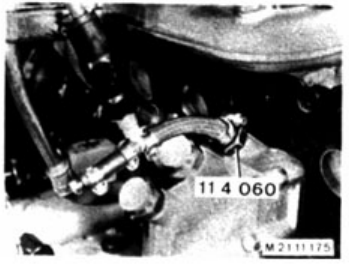
ENGINE OIL CIRCUIT

1 Main distribution bore in crankcase
2 Oil riser bore in cyl. head
3 Camshaft bearing, center
4 Distributing bore in cyl. head
5 Hollow camshaft
6 Camshaft bearing, front
7 Hollow camshaft
8 Camshaft bearing, rear
9 Oil supply line with open jets for cams on outside, valve guides and ball headed pins for rocker arms
10 Eccentric for vacuum pump
11 Spill from cylinder head
12 Drain to oil pan
13 Oil trap (crankcase vent)
14 Turbocharger
15 Crankshaft bearings
16 Intermediate shaft bearings and guide plate
17 Spray oil for gear wheels (oil pump drive)
18 Conrod bearings
19 Spray oil
20 Piston pins
21 Cylinder walls
22 Oil pan
23 Fuel intake with filter screen
24 Oil pump
25 Engine oil pressure regulating valve in oil pump (open with pressure of 5.5 to 6.5 bar = 78 to 92 psi)
26 Oil filter, volume: 1.2 ltr. (2.4 pts.)
27 Safety valve (open with pressure of 2.5 bar = 35 psi; oil supply guaranteed even with filter cartridge clogged.)
28 Filter cartridge
29 Thermostat
30 Oil cooler
31 Connection for oil pressure transmitter of indicator lamp
32 Oil spray jet (piston cooling) (open with pressure of 1.5 to 2 bar = 21 to 28 psi)



11 40 000 CHECKING ENGINE OIL PRESSURE

Disconnect wire on oil pressure switch.
Unscrew oil pressure switch (1).
Installation:
Check gasket, replacing if necessary.



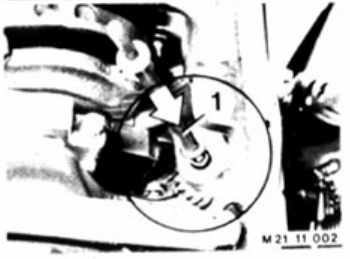
Screw in Special Tool 11 4 060.
Connect 10 bar (142 psi) pressure tester of BMW service test unit.
Check oil pressure*.

* See Specifications

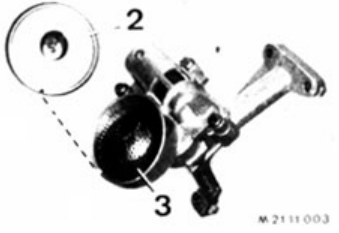


11 41 000 REMOVING AND INSTALLING OIL PUMP

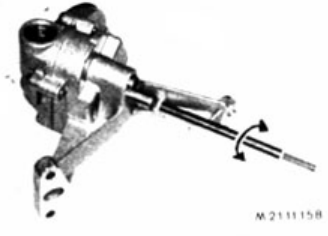
Remove oil pan 11 13 000.
Remove oil pump.



Installation:
Guide drive shaft (1) into bearing.
Replace bearing, see 11 11 160.



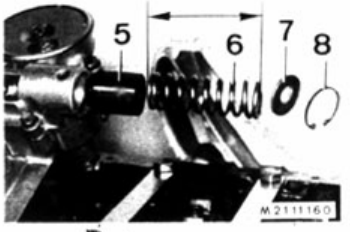
Testing and Servicing:
Unscrew cap (2) and clean oil filter screen (3).



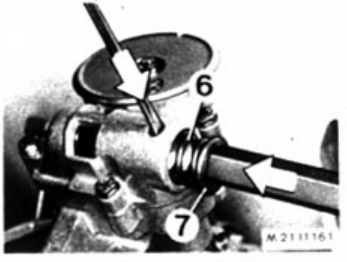
Check whether gears move easily by turning the drive shaft.



Unscrew oil pump cover and inspect oil pump for wear.
- Scoring in body / cover
- Wear on gears

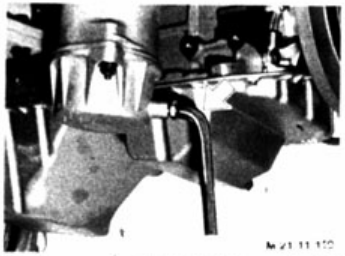


The engine oil pressure regulating valve regulates the engine oil pressure*.
Check that piston (5) moves easily.
Check length of spring (6) = 71.6 mm (2.819").



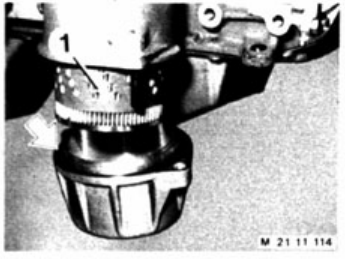
Installation:
Press in spring (6) and washer (7), and hold in with a screwdriver.
Install circlip (8).

* See Specifications



11 42 020 REPLACING OIL FILTER

Unscrew oil drain plug in oil filter and drain oil.
Installation:
Tightening torque*.



Unscrew cap and pull out oil filter (1).
Installation:
Replace seal.
Add oil* and ***.
Tightening torque*.

11 42 650 REMOVING AND INSTALLING/ REPLACING OIL SPRAY JET
– Crankshaft Removed –

Engien oil is injected into annular bore (4) of piston via oil spray jet (3) for piston cooling. A guarantee that oil stream meets bore (4) could not be given were oil spray jet (3) even slightly damaged.
Follow up damage would be immediate engine failure.

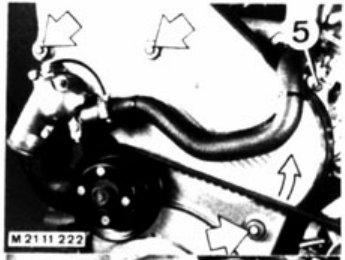


Unscrew screws and take out oil spray jet (3).

* See Specifications
*** See Service Information of Gr. 00

11 51 000 REMOVING AND INSTALLING WATER PUMP

Remove air cleaner – see Group 13.
Remove fan – 11 52 000.



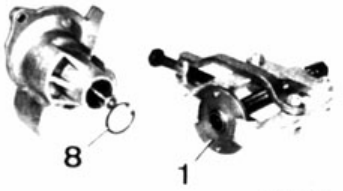
Take off drive belt and unscrew pulley.
Disconnect hose (5) and unscrew cover.
Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.



Detach water hose.
Unscrew water pump.
Note:
Only push toothed belt to one side.



Installation:
Replace gasket (1).



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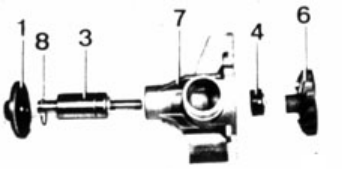
11 51 502 OVERHAULING WATER PUMP
– WATER PUMP REMOVED –

Pull off hub (1) with Special Tool 00 8 500.
Remove circlip (8).



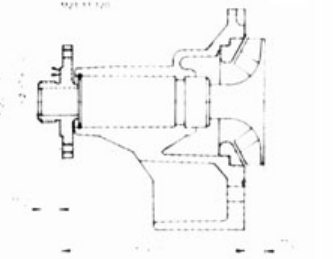
M 21.11.169

Replace bearing (3) and seal (4).
Check impeller (6), replacing if necessary.
1 = Hub
7 = Water pump body
Installation:
Press in bearing (3) against stop.
Press on impeller (6).



M 21.11.167

Press out water pump bearing.

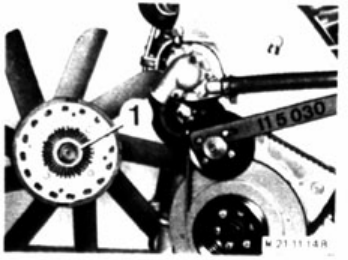


Check assembled distances.



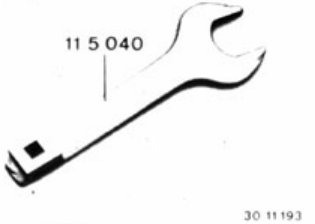
M 21.11.168

Drive out seal (4).
Installation:
Lubricate seal (4) with oil and press in with Special Tool 00 5 550.

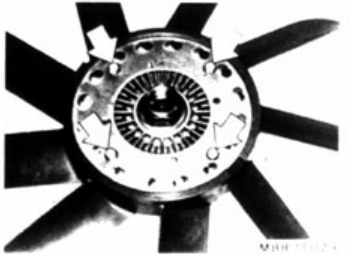


11 52 000 REMOVING AND INSTALLING FAN

Remove fan cowl.
Hold pulley with Special Tool 11 5 030 and unscrew coupling nut (1).
Important!
Left hand threads – turn nut clockwise to unscrew.
Tightening torque*



Installation:
Tighten fan with Special Tool 11 5 040.
40 Nm (29 ft. lbs.) tightening torque is equal to 30 Nm (22 ft. lbs.) setting on the torque wrench.



11 52 020 REPLACING FAN CLUTCH

Remove fan – see 11 52 000.
Replace fan clutch when
a) hub has seized (fan oilstopped engine cannot be turned or hard to turn),
b) fan clutch has axial/radial play or is losing oil.
Check switching points* with Vibrocard***.
Unscrew fan mounting bolts and take off fan clutch.



11 53 000 REMOVING AND INSTALLING COOLANT THERMOSTAT

Remove fan – see 11 52 000.
Drain coolant partially.
Remove caps (1).
Remove thermostat.



Installation:
Bar on thermostat faces out.
Replace rubber ring (2) and gasket.
Loosen bleeder screw (3) with engine at operating temperature, heater set to "warm" and engine running at fast idle speed.
Tighten bleeder screw again when escaping coolant is without air bubbles.



Testing Thermostat:
Does thermostat begin to open at specified temperature?
Check opening temperature by placing the thermostat in a hot water bath and comparing actual opening temperature against stamped value.



11 53 080 REPLACING TEMPERATURE TRANSMITTER

Pull off plug – unscrew transmitter.
Installation:
Replace seal.
Tightening torque*.
Testing – see Group 12.

* See Specifications
*** See Workshop Equipment Catalog

* See Specifications

Constrution group 11 Engine M40

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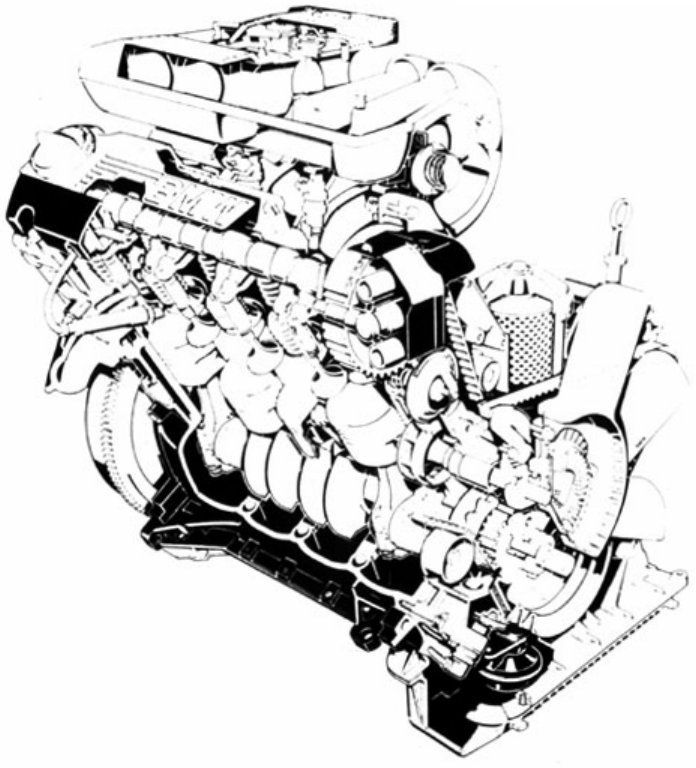
M 40 ENGINE VIEW (Section Drawing)



11 00 603 DISASSEMBLING AND ASSEMBLING ENGINE
– Engine Removed –

General Information:

An engine (cylinder head) with installed hydraulic valve clearance compensators must not be left upside down longer than 10 minutes.
Hydraulic valve clearance compensators must be transported only in vertical position.
Drained hydraulic valve clearance compensators may not be installed.
After finishing repairs the hydraulic valve clearance compensators or rocker arms must not rattle during the trial run of the engine or the engine must be operated at speeds up to max. 2,000 rpm for so long until the rattling stops.

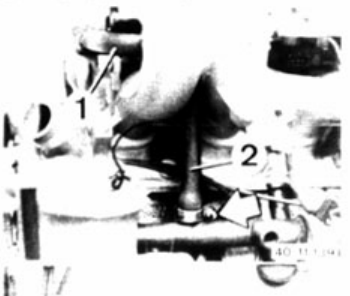
Disassembling and repairing the engine is described below in chronological sequence. The numbers provided in the list of contents will make it easier to continue after interrupting a repair job or find separate repair points. They only describe the actual removal or installation, but not the entire work scope.



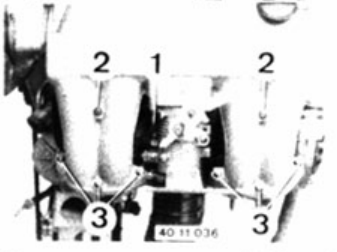
A. Removing, Disassembling and Repairing Cylinder Head

o Removing Air Cleaner:

Loosen clamp and pull hose off.

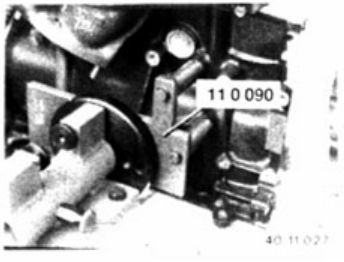


Pull hose (1) off of cylinder head cover.
Loosen clamp and pull hose (2) off of coolant pipe.



Pull vacuum hose (1) off.
Unscrew locating bolts (2) and nuts (3).
Remove upper manifold section.

Installation:
Replace gasket.
Graphite surface faces the cylinder head.
Tightening torque:
Bolts (2) 9 Nm
Nuts (3) 15 Nm



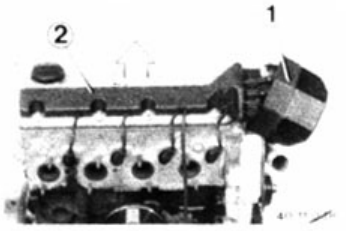
o Mounting Engine on Assembly Stand:

Mount engine on Special Tool 00 1 490 using Special Tool 00 1 490.



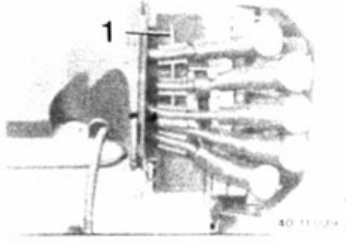
Unscrew nuts and remove lower manifold section.

Installation:
Replace gasket.
Tightening torque: 13 Nm

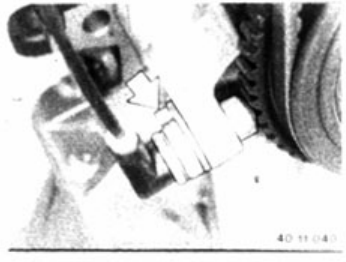


REMOVING IGNITION LEADS DISTRIBUTOR

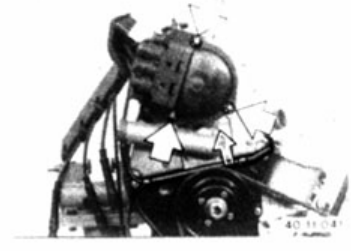
Pull [illegible] lead plugs.
Take [illegible] (1).
Lift o[illegible] electric lead duct (2) with a screwdriver.



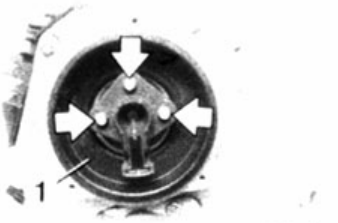
Installation:
Insert ignition leads in guides on insulator (1) in correct order.



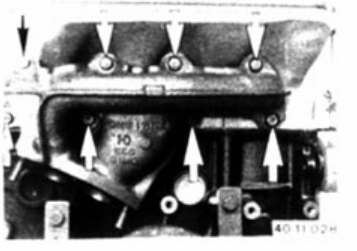
Unscrew reference mark sender.



Lift out electric lead duct on face end.
Unscrew screws on distributor cap and take off the ignition tackle.

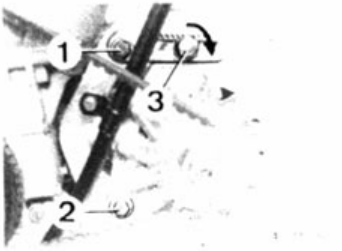


Unscrew screws and take off distributor finger.
Take off cover (1) afterwards.
Installation
Check O-ring on cover, replacing if necessary.



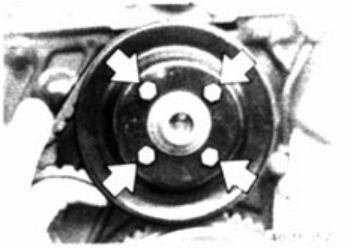
REMOVING EXHAUST MANIFOLD:

Unscrew nuts and take off exhaust manifold.
Installation
Replace self-locking nuts.
Tightening torque = 23 Nm (17 ft. lbs.).



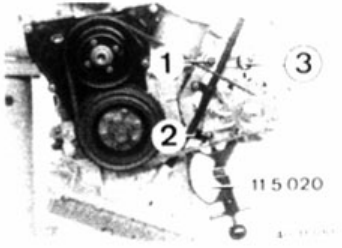
● REMOVING DRIVE BELT:

Loosen bolt (1).
Loosen nuts on bolts (2 and 3) and loosen drive belt by turning bolt (3) in direction of arrow.
Take off drive belt.

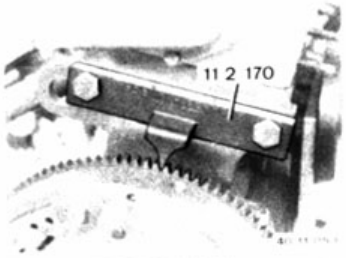


● REMOVING WATER PUMP PULLEY:

Counterhold pulley with drive belt and unscrew bolts

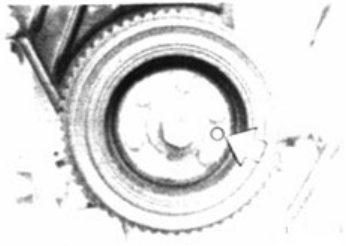


Installation:
Adjust tightness of drive belt with Special Tool 11 5 020 by turning bolt (3) in direction of arrow.
Tighten nuts on bolts (2 and 3) and bolt (1).



● REMOVING VIBRATION DAMPER:

Hold engine with Special Tool 11 2 170.



Unscrew bolts on vibration damper and take off vibration damper.

Installation:

Align dowel pin bore in vibration damper precisely with dowel pin.

Tightening torque: 23 Nm (17 ft. lbs.).



● REMOVING THERMOSTAT:

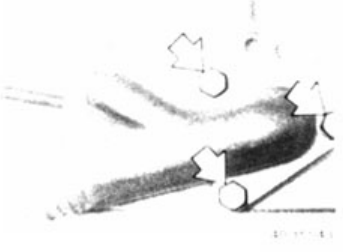
Unscrew bolts and take off thermostat housing and thermostat.



Installation:

Check O ring (1), replacing if necessary.

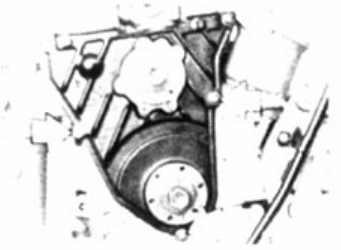
Install thermostat with O ring facing housing.



● REMOVING CONNECTORS FOR HEATER HOSES:

Installation:

Clean sealing surfaces and replace gasket.



o Removing Toothed Belt Cover:

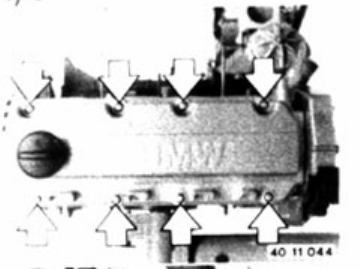
Unscrew screws and remove lower cover.

Installation:
Check gasket, replacing if necessary.



Unscrew screws and remove upper cover.

Installation:
Note dowel sleeves.



o Removing Rocker Arms:

Unscrew bolts and remove cylinder head cover.

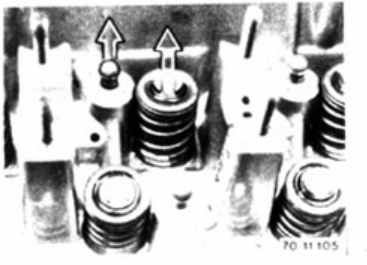
Installation:
Check gasket, replacing if necessary.
Tighten bolts diagonally from inside to outside.
Tightening torque: 9 Nm.

Important!
After tightening, retighten the four inner bolts diagonally one more time.



Press down on valve with Special Tool 11 31 80 and remove rocker arm.

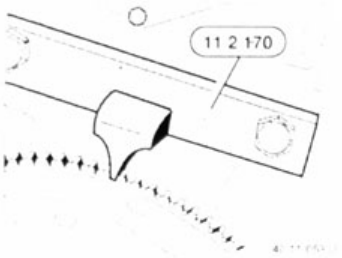
Note:
Have each cam facing up perpendicular to the cylinder head.
Special tool must not bear on the cam.
Lay rocker arms aside in order and install in the same positions.



Remove hydraulic valve clearance compensators and guides.

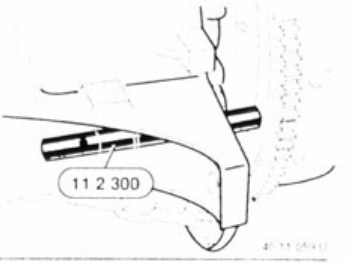
Important!
Keep removed hydraulic valve clearance compensators standing upright to prevent oil from running out.

Cover oil return bores to prevent guides from falling into the crankcase.



o Removing Toothed Belt:

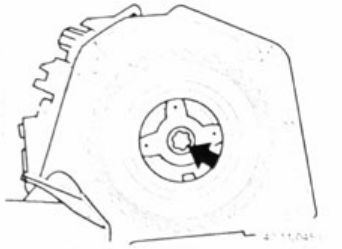
Turn crankshaft to TDC and hold flywheel with Special Tool 11 2 170.



o Installing Toothed Belt and Adjusting Timing:

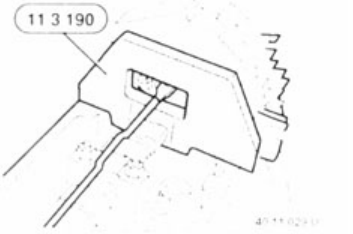
Hold crankshaft in TDC position with Special Tool 11 2 300.

Important!
Remove special tool before operating the engine.

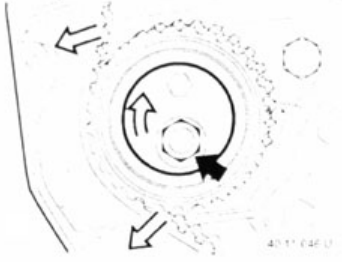


Loosen mounting bolt on camshaft sprocket.

Remove Special Tool 11 2 170.

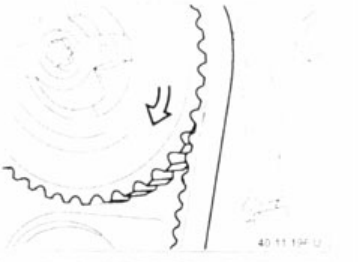


Hold camshaft in TDC position (valves of cylinder no. 4 overlap) with Special Tool 11 3 190.

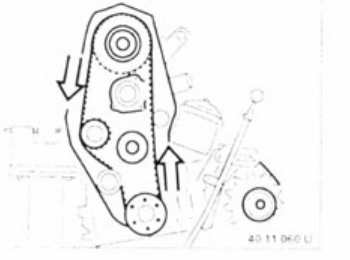


Loosen nut on tensioning roller and take off toothed belt.

Important!
Regardless of the hours of operation a toothed belt must always be replaced each time the tensioning roller is loosened.



Mount camshaft sprocket with an initial torque of 1 ... 3 Nm (turnable without play) and turn in engine's direction of rotation as far as stop (tab in groove).



Install new toothed belt beginning at the crankshaft sprocket and going via the camshaft sprocket under tension to the tensioning roller.

Important!
Position toothed belt on sprockets in the middle.

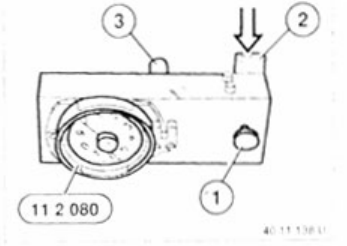


Mount tensioning roller with torque of about 1 Nm that it can be turned easily.



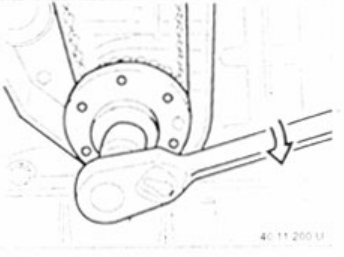
Adjust toothed belt tension to 45 + 5 scale units by turning the tensioning roller.

Tighten tensioning roller with 22 - 3 Nm and camshaft sprocket with 60 + 5 Nm torque.

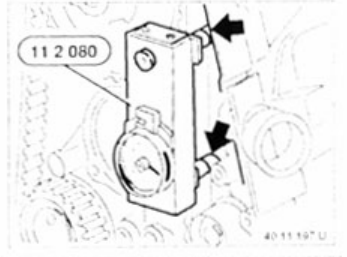


Prepare Special Tool 11 2 080 for the tension test (also refer to operating instructions for 11 2 080):

Pull lockpin (1) up and set bearing pins to maximum size with slide (2).
Set gage needle to "0" and align follow-up needle with gage needle.

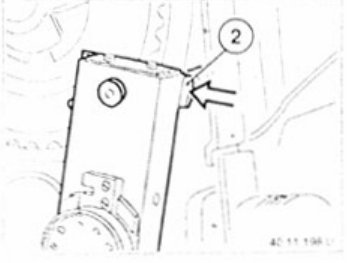


Crank engine on crankshaft at least two full turns in engine's direction of rotation.

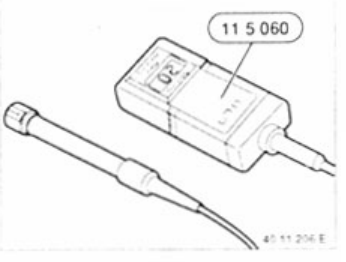


Apply tester between the camshaft and small intermediate roller in such a manner that both rollers of tester bear on the back of the teeth and the center pin is located in a tooth gap.

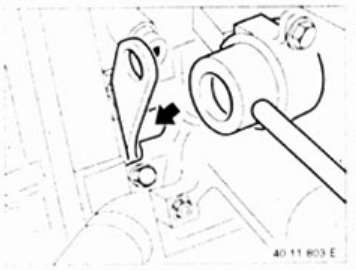
Hold crankshaft with Special Tool 11 2 300 and camshaft with Special Tool 11 3 190.
Loosen camshaft bolt to 1 Nm torque.
Apply Special Tool 11 2 080.
Loosen tensioning roller bolt and tension toothed belt briefly to 45 + 5 scale units.



Press slide (2) in until engagement of the lockpin is noticed.



Temperature expansion of engine components must be considered for precise belt tension.
To measure temperature:
Special Tool 11 5 060.



Place temperature sensor at machined cast boss on cylinder head above the coolant outlet and read the temperature.
Afterwards adjust the toothed belt tension precisely to the value given in the temperature / tension graph.

Tighten tensioning roller with 22 · 3 Nm and camshaft sprocket with 60 + 5 Nm torque.

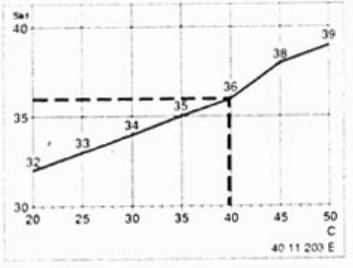
Remove holding tools and tester.

Adjusting Table for Readjustments:

Skt = Scale units on tester

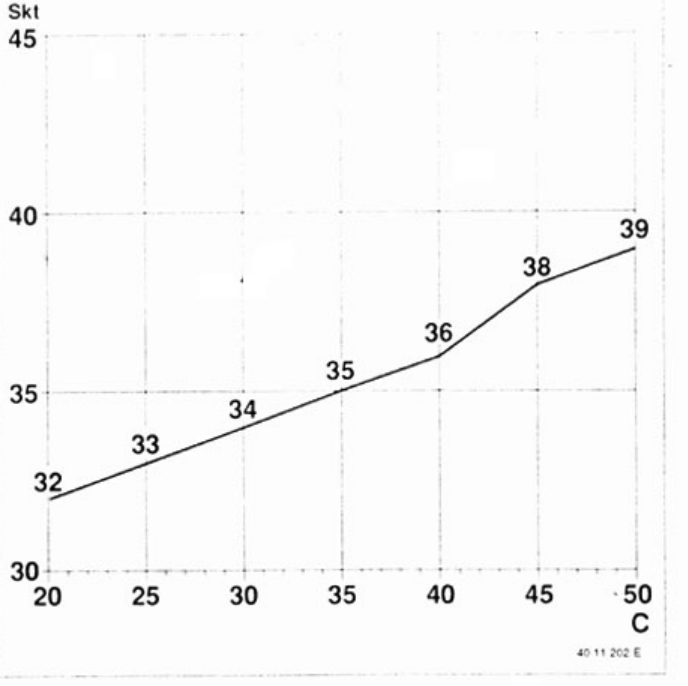
°C = Temperature measured at measuring point on cylinder head

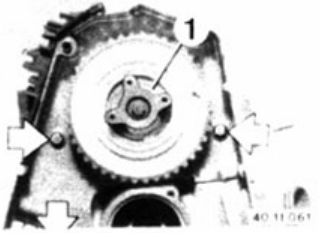
Permissible tolerance: + 2 scale units.



Example:
Engine temperature at measuring point: 40° C.
Adjust toothed belt tension to 36 scale units on the tester.
Round off values.

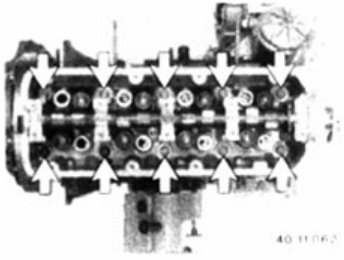
Important!
Toothed belt tension must not be adjusted if the component (cylinder head) temperature is less than 20° C.



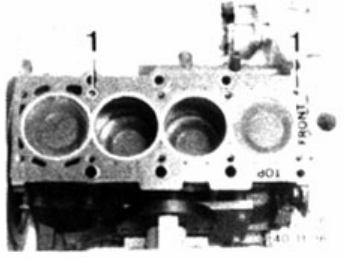


o Removing Cylinder Head:

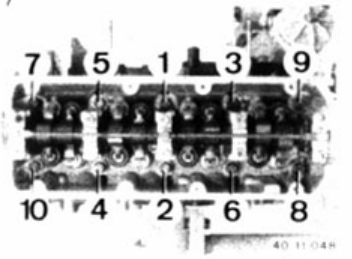
Unscrew camshaft sprocket (1).
Loosen bolts and take off housing.



Unscrew cylinder head bolts from outside to inside and take off cylinder head.



Installation:
Clean sealing surfaces on cylinder head and crankcase, if necessary removing remainders of gaskets with gasket remover** and a hard wood scraper; be careful that bits of gaskets do not fall into oil bores or cooling ports.
Install new cylinder head gasket with "TOP" facing up and "FRONT" facing the toothed belt end.
Check dowel sleeves (1) for damage and correct installed position.



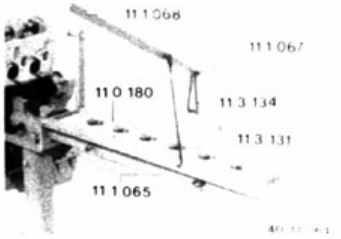
Mount cylinder head and tighten new bolts (lightly lubricated with oil) in three steps in the sequence of 1 through 10.

Step 1:	33 Nm torque
Step 2:	93° torque angle
Step 3:	93° torque angle

Important!
Cylinder head bolts may only be used once.
Keep oil out of holes in the engine block (danger of cracking the block, falsified tightening torque values).



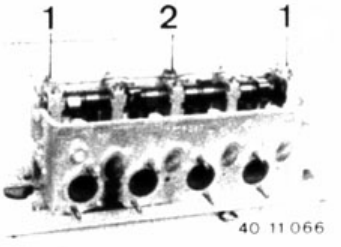
** Source of Supply: HWB



o Mounting Cylinder Head on Assembly Stand Fixture:

Mounting Special Tool 11 1 065 on Special Tool 00 1 490.

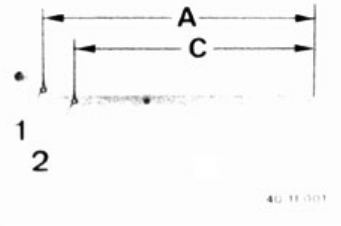
11 0 180 = Tray (opening on valve support faces forward)
11 1 067 = Guide rod
11 1 068 = Thrust lever
11 3 131 = Guide bar
11 3 134 = Thrust cage



o Removing Camshaft:

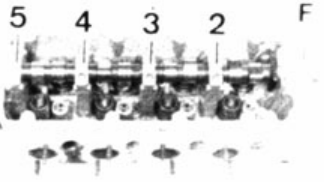
Loosen bolts (1 and 2) and take off oil pipe.

Installation:
Replace gasket between hollow connection bolt (2) and pipe.
Tightening torque:
Bolt (1) = 5.5 Nm
Bolt (2) = 11 Nm



Note:
If not already produced, drill 5.1 mm dia. holes (1 and 2) in Special Tool 11 1 068 at distances A = 496 mm and C = 437 mm.

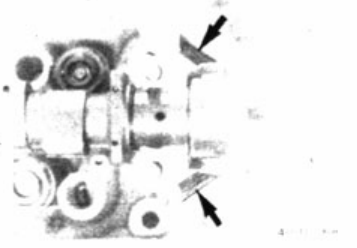
Hole 1 for removal of intake valve.
Hole 2 for removal of exhaust valve.



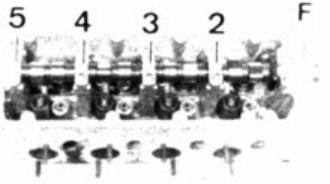
Unscrew and remove camshaft bearing caps (F, 2 ... 5) and take out camshaft.
Pull old radial oil seal off of camshaft.



Place cylinder head on assembly fixture that the exhaust end faces forward, align and secure with one cylinder head bolt (front center).

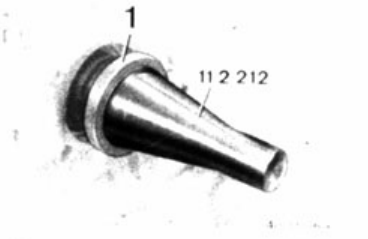


Installation:
Lubricate camshaft bearings with oil and install camshaft.
Apply a thin coat of non-hardening sealing compound** on the bearing surface of bearing cap (F).



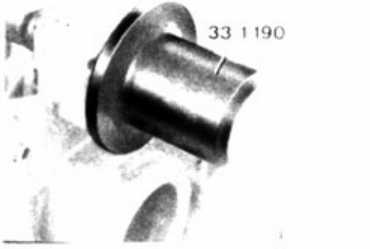
Mount bearing caps (F, 2 ... 5) in the same position and tighten the bolts.
Tightening torque: 11 Nm.

** Source of Supply: HWB

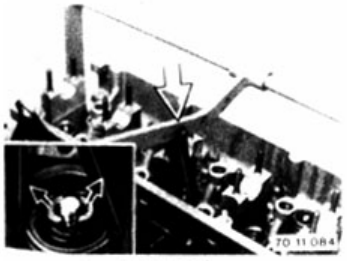


o Replacing Radial Oil Seal for Camshaft:

Lubricate sealing lip of new radial oil seal with oil.
Apply Special Tool 11 2 212 on camshaft and push on seal (1) as far as possible.

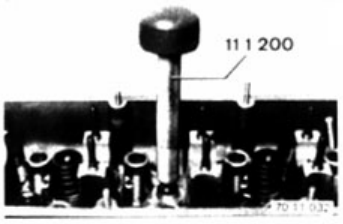


Drive in radial oil seal as far as stop with Special Tool 33 1 190.



REMOVING VALVES

Compress valve springs and remove valve collets.
Take off valve springs and spring retainers.
Take tray out of assembly fixture from underneath and remove valves.



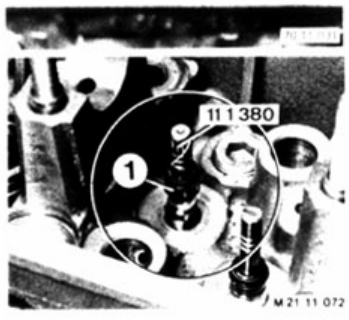
Press on valve stem seal by hand against the stop with help of Special Tool 11 1 200.



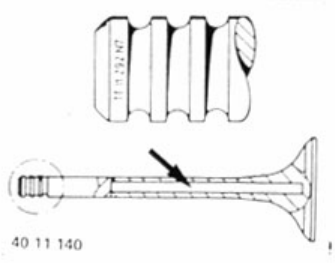
Pull off valve stem seal with Special Tool 11 1 250.



Installed Order:
1 = Valve
2 = Inner spring retainer
3 = Valve stem seal
4 = Outer spring retainer
5 = Inner spring
6 = Outer spring
7 = Upper spring retainer
8 = Valve collets



Installation:
Lubricate valve stem with oil and insert valve.
Use a new valve stem seal.
Always use Special Tool 11 1 380 to avoid damaging the seal.
Lubricate seal (1) with oil and mount.

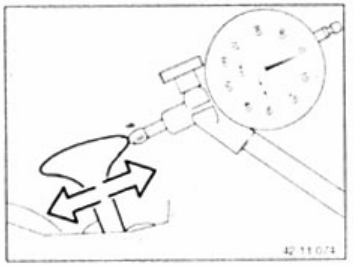


Important Scrapping Information!
Exhaust valves are filled with sodium to improve carrying off heat.

Sodium filled valves may not be scrapped as normal parts without special treatment.
The reason for this is that sodium could explode when melted.
It is also not approved to use them as "special tools" (for example: driving mandrels, etc.), which is common practice in some workshops!

Consequently sodium filled exhaust valves must be collected for scrapping and sent to the Landshut Factory, HT-L-2, for neutralization.

See Service Information of Group 11 for scrapping in countries, where it is absolutely impossible to return used valves or when they are not obligated to return parts.

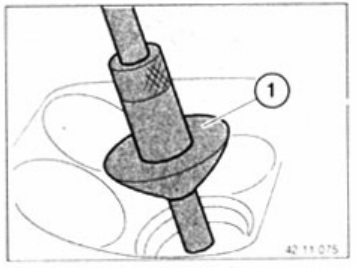


o Machining Valve Guide and Seat

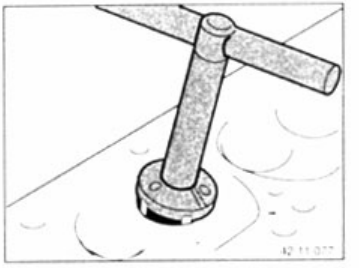
To measure, insert a new valve in such a manner that the valve stem end is flush with the valve guide.
Apply dial gage and measure tilt.
Max. permissible tilt*.

o Reaming Valve Guides

In case of excessive play between the valve stem and valve guide, the valve guide must be reamed out and a repair valve with oversized stem diameter* installed.



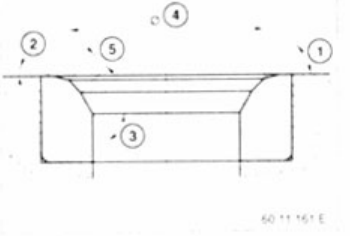
Assemble Special Tool 00 4 200 depending on the stem diameter.
Press mushroom guide (1) against the valve seat and ream out the valve guide dry from the combustion chamber end.
Turn down the reamer once.



o Machining Valve Seat

Machine the valve seat to instructions of the tool supplier using Special Tool 00 3 520 or 00 3 580.
Dimensions and angles*.

Correction cutter from Neway:



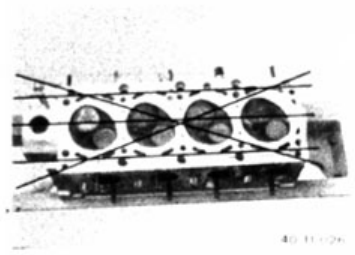
After Machining Valve Seat Surface:
Machine valve seat outside and inside diameters to specified size using a correction cutter* in such a manner that the specified valve seat width* is produced.

1 Valve seat angle
2 Outside dia. correction angle
3 Inside dia. correction angle
4 Valve seat outside diameter
5 Seat width

Valve seat dimensions*.

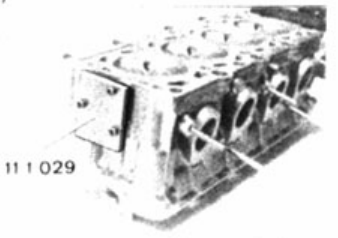
* Refer to Specifications

* Refer to Specifications



• CHECKING/MACHINING CYLINDER HEAD SEALING SURFACE:

Check levelness of cylinder head sealing surface with a standard steel ruler.
Max. deviation in levelness: 0.03 mm (0.0012").

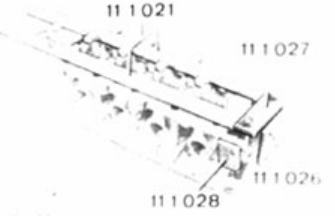


• CHECKING CYLINDER HEAD FOR CRACKS IN WATER TEST:
– Cylinder Head Disassembled –

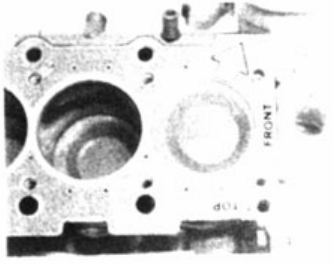
Mount Special Tool 11 1 029.
Note:
Leave the temperature sensor/sender installed.

Remove all attachments on cylinder head to machine the sealing surface.

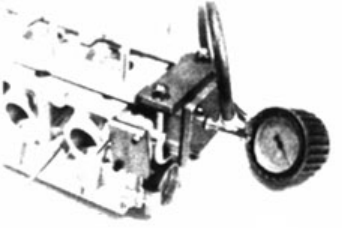
Max. machining:	0.3 ± 0.05 mm (0.012 ± 0.002")
New cyl. head height:	141.0 mm (5.551")
Machining limit:	140.55 mm (5.533")



Mount Special Tools 11 1 021 with cylinder head bolts.
Mount Special Tools 11 1 026 / 027 / 028.

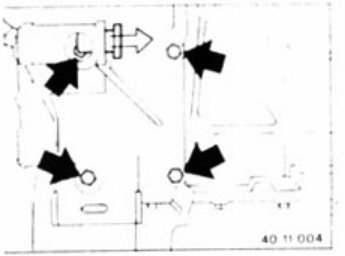


A 0.3 mm (0.012") thicker cylinder head gasket, which must be installed together with an appropriately thicker O-ring for the coolant duct, is available for 0.3 mm (0.012") machining.



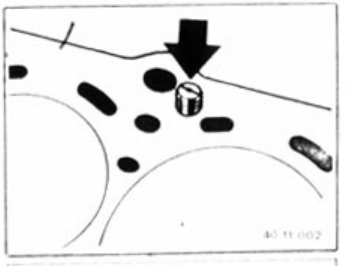
Fill cylinder head with compressed air (testing pressure: 4.5 bar = 64 psi).
If pressure drops, place cylinder head in water bath and check for cracks.
Note:
If necessary, relax water bath with a detergent.

B DISASSEMBLING AND REPAIRING ENGINE BLOCK CRANKSHAFT DRIVE



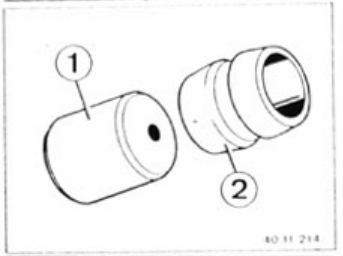
o Removing Alternator Console

Press out sleeve (1).
Unscrew bolts and remove console.

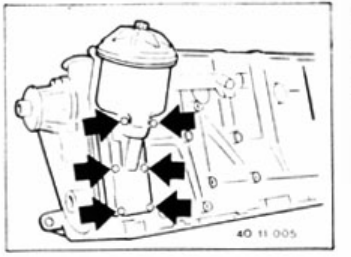


o Checking Orifice for Oil Supply to Hydr Valve Clearance Compensators

Screw orifice out of engine block and check that its bore is not clogged, cleaning the bore if necessary.



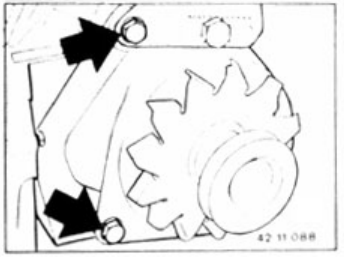
Important:
A reduction jet (1) with rubber-lined spacing sleeve (2) for oil supply to the cylinder head is installed in the engine block of M 40 engines since 9.92.



o Removing Oil Filter Housing

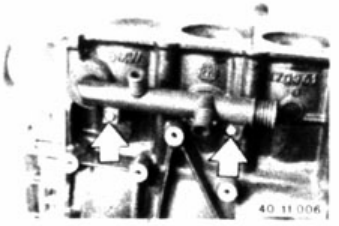
Unscrew bolts and remove oil filter housing.

Installation:
Check seals, replacing them if necessary.



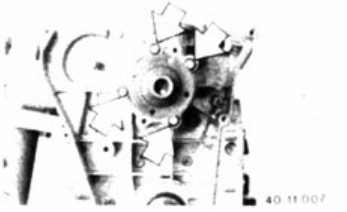
o Removing Alternator

Unscrew bolts and remove alternator.



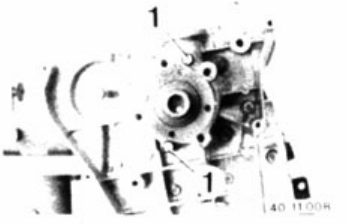
● REMOVING COOLANT PIPE:

Unscrew bolts and pull coolant pipe out of engine block.
Installation:
Replace and lubricate O-ring with a lubricant**.



● REMOVING WATER PUMP:

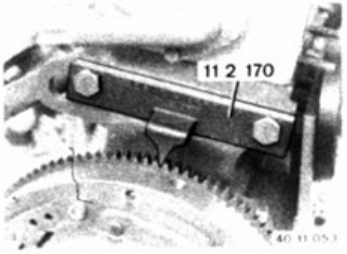
Unscrew bolts.



Screw two bolts in threads (1) and press off the water pump uniformly.
Installation:
Replace O-ring and coat with lubricant**.
Tightening torque: 9 Nm (6.5 ft. lbs.).

** Source: HWB

** Source: HWB



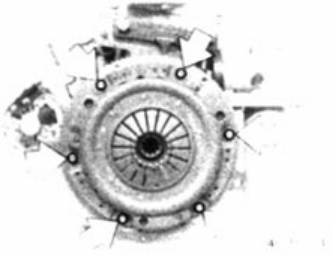
● REMOVING CLUTCH / FLYWHEEL:

Hold flywheel with Special Tool 11 2 170.

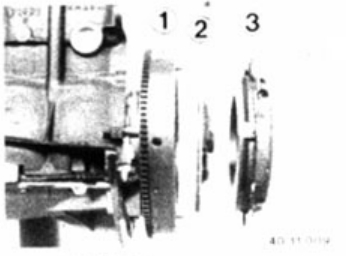


Unscrew bolts and take off flywheel.

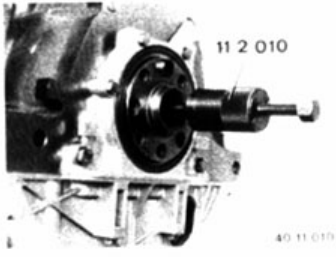
Installation:
Clean threads and install bolts with a bolt cement**.
Tightening torque: 105 Nm (76 ft. lbs.).



Unscrew bolts uniformly.
Take off pressure plate and drive plate.

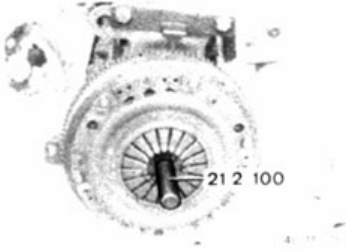


Installation:
1 = Flywheel
2 = Drive plate
3 = Pressure plate
Install drive plate (2) with flat end facing flywheel (1).

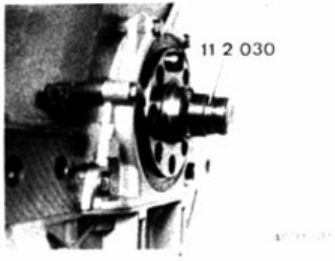


● REPLACING PILOT BEARING IN CRANKSHAFT:

Remove pilot bearing with Special Tool 11 2 010.

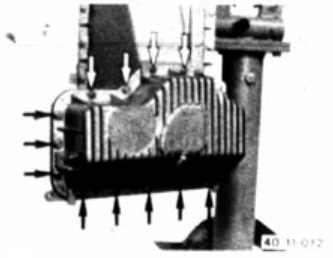


Center drive plate with Special Tool 21 2 100 and tighten bolts.
Tightening torque: 23 Nm (17 ft. lbs.).



Installation:
Insert pilot bearing and drive it in against the stop with Special Tool 11 2 030.

** Source: HWB



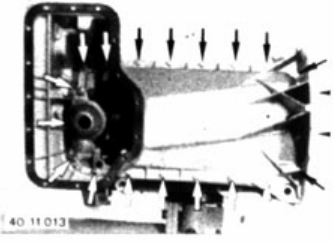
REMOVING OIL PAN:

Unscrew bolts and take off lower oil pan section.

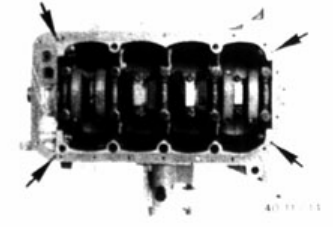
Installation

Replace gasket.

Tightening torque = 9 Nm (6.5 ft. lbs.).



Unscrew bolts and take off oil pan.



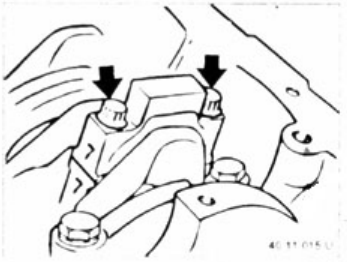
Installation

Replace gasket.

Fill out oil pan gasket on joints between front or rear end covers and crankcase with a non-hardening sealant**.

Tightening torque = 9 Nm (6.5 ft. lbs.).

** Source of Supply: HWB



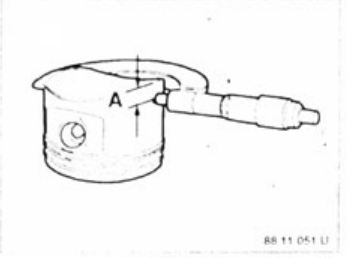
o Removing Piston

Unscrew conrod bearing cap.
Remove piston.

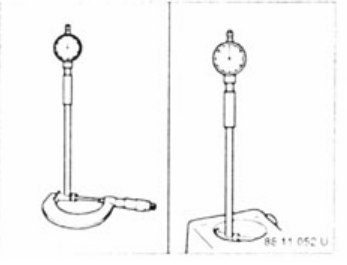
Important!
Mark position of connecting rod to crankshaft, if the bearing shells do not have to be replaced.
Connecting rods and caps are marked with the same pair numbers (1 ... 99) and must not be mixed up.



Mark piston and reinstall it at the same position, if the piston does not have to be replaced.



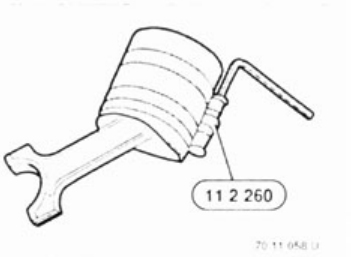
Installation:
Measure the piston installed clearance before installing.
Measure the piston diameter at distance A* from the bottom edge of the piston using a micrometer.



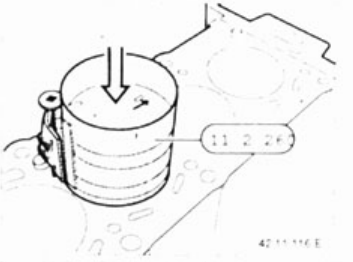
Set internal caliper to zero on micrometer with the measured piston diameter.
Measure cylinder bore at bottom, middle and top diagonally.

New piston installed clearance*.
Max. permissible total wear clearance*.

* Refer to Specifications



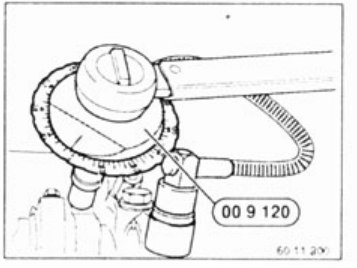
Installation:
Lubricate piston and piston rings lightly with oil.
Align gaps of piston rings (offset approx. 120°, but not above the piston pin eye).
Compress piston rings using Special Tool 11 2 260.
Apply Special Tool 11 2 470 on connecting rod.



Installation:
Insert piston that arrow points to camshaft drive.
Guide crankshaft journal and connecting rod together.
Compressing tool must bear flat on crankcase all around.
Press in piston with light knocks (e.g. from handle of a hammer).



Installation:
Lubricate conrod bearing shells with oil.
Mount bearing cap that pair numbers are aligned.
Use new conrod bolts.



Installation:
Tighten conrod bolts use Special Tool 00 9 120 or Special Tool 11 2 110.

Conrod bearing cap bolt tightening torque*.

* Refer to Specifications


70 11 063

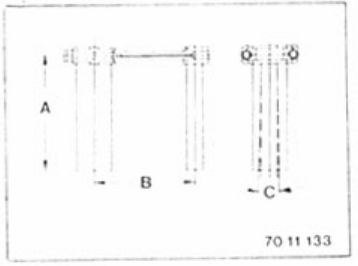
o Removing Connecting Rods:

Lift out circlip and press out piston pin.

Important!
Pistons and piston pins are matched and must not be mixed up.
Insert circlip that its opening is opposite the hole.


40 11 032

Note:
Install connecting rod that the pair number is opposite that piston's arrow for installed direction.



70 11 133

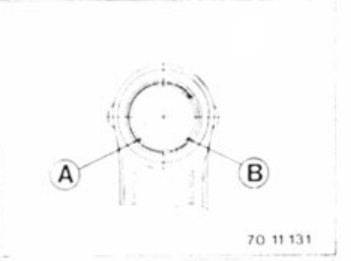
o Checking Connecting Rods:

Check connecting rod for deviation from parallel and distortion.

A Testing distance = 150 mm
B Max. permissible parallel deviation in testing distance = 0.04 mm
C Max. permissible distortion to either side = 0° 30'


70 11 068

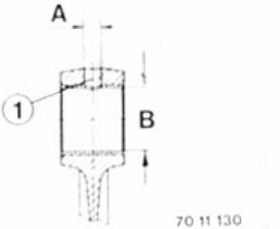
Checking Bush in Conrod:
Press-fit between the bush and piston pin is correct, if the piston pin can be pressed through the bush by hand with only slight force and there is no noticeable play.



70 11 131

o Replacing Bush in Conrod:

Press out old bush with a suitable mandrel.
Press in new bush.
Bush gap may be positioned optionally at point A or B.



70 11 130

Drill oil bore (1).
Distance A = 6 mm diameter.
Deburr edges of bore at sliding surface of bush.
Ream bush open to diameter B = 22.005 ... 22.010 mm.

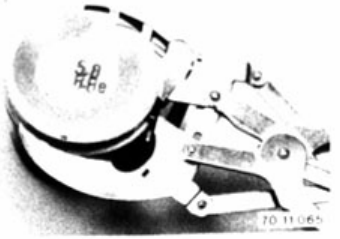


70 11 069

o Replacing Connecting Rods:

Only connecting rods of the same weight class (die-stamped on bearing caps) may be installed in one engine.

Note:
Therefore only sets of connecting rods are available from Parts.



o Replacing Piston Rings of One Piston:

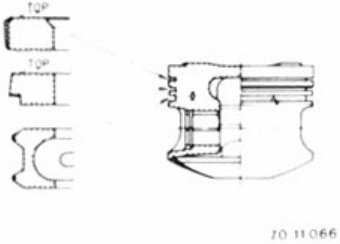
Remove piston rings with a piston ring compressing pliers.

Note:
It might not be possible to find the identification on used piston rings.
Lay piston rings aside in correct sequence and installed position.



Measure side clearance.

Groove 1: 0.020 ... 0.052 mm
Groove 2: 0.020 ... 0.052 mm
Groove 3: 0.020 ... 0.055 mm



Installation:
Install piston rings with the word "TOP" facing the piston crown.

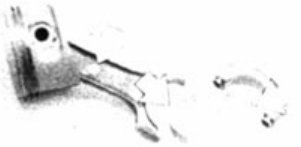
1 Plain compression ring
2 Bevelled face compression ring
3 Oil scraper ring with rubber lined spring

Offset piston ring end gaps by about 120° to each other, but not above piston pin bores.



Measure end clearance.

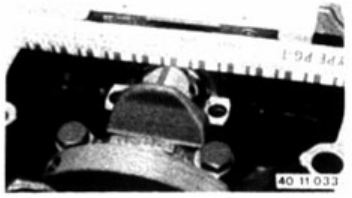
Specifications:
Ring 1: 0.20 ... 0.40 mm
Ring 2: 0.20 ... 0.40 mm
Ring 3: 0.20 ... 0.45 mm



40 11 083

● REPLACING CONNECTING ROD BEARING SHELLS:

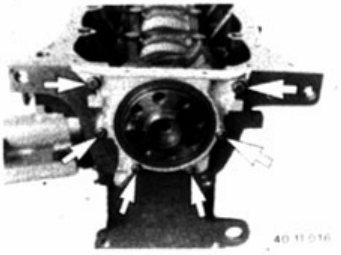
Select new bearing shells according to paint mark on connecting rod.
Important!
Check ground size of crankshaft also refer to Replacing Main Bearing Shells).



40 11 033

Installation:
Check conrod bearing play.
Place Plastigage Type PG 1 on crankshaft wiped clean of oil in BDC position.
Mount conrod bearing caps and tighten with the old conrod bolts to specified torque.

Important!
Do not turn the connecting rods or crankshaft.
Remove bearing caps and read bearing play (nominal: 0.020 to 0.055 mm = 0.0008 to 0.0022") by measuring width of flattened Plastigage with help of supplied scale.
Correct bearing play by installing new or bearing shells with a different paint mark.



40 11 016

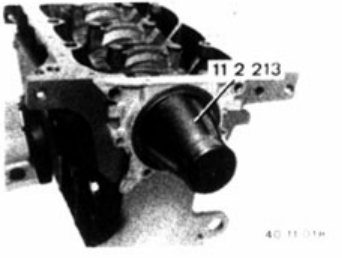
● REMOVING REAR END COVER:

Unscrew bolts and take off cover.



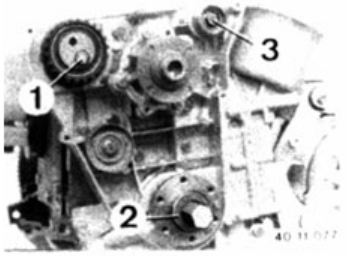
40 11 017

Installation:
Lift out radial oil seal and drive in new seal with Special Tool 11 1 260.



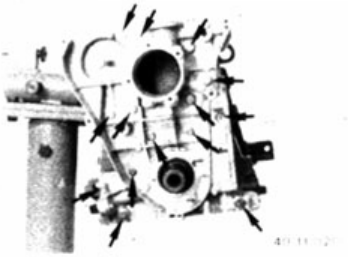
40 11 018

Apply Special Tool 11 2 213 on crankshaft.
– Replace gasket for cover.
– Lubricate sealing lip of radial oil seal with oil.
Slide on and tighten cover.
Tightening torque: M 6 – 9 Nm (6.5 ft. lbs.)
M 8 – 22 Nm (16 ft. lbs.)

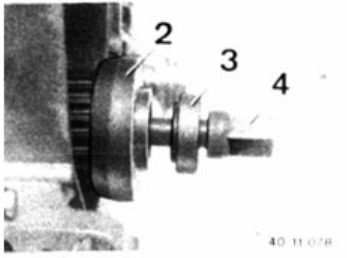


REMOVING FRONT END COVER:

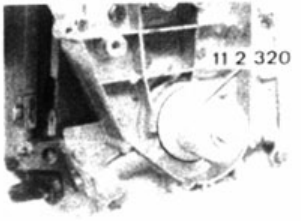
Unscrew tensioning roller (1), drive gear (2) and stabilizing roller (3).



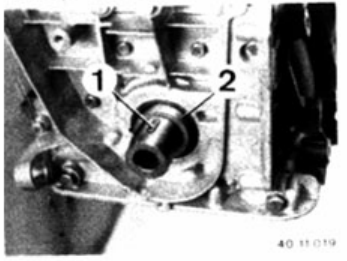
Unscrew all mounting bolts of end cover and take off cover.



Installation
Align drive gear (2) with groove facing the woodruff key and push on crankshaft.
Mount washer (3) with shoulder against the drive gear and tighten bolt (4).
Tightening torque = 310 Nm (224 ft. lbs.).
Screw on nut for tensioning roller only loosely.



Installation
Replace O-ring on crankshaft.
Replace cover gasket.
Mount end cover.
Tightening torque:
M 6 = 9 Nm (6.5 ft. lbs.)
M 8 = 22 Nm (16 ft. lbs.)
Drive in new radial oil seal against stop with Special Tool 11 2 320.
Lubricate sealing lip of radial oil seal with oil.

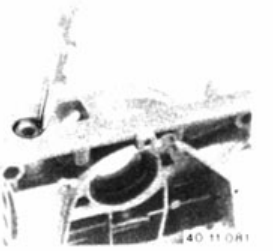


Lift out woodruff key (1) and pull off ring (2)

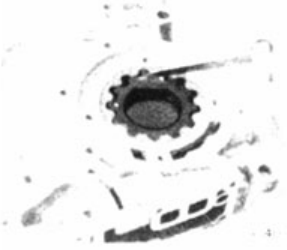


● REMOVING/CHECKING OIL PUMP:

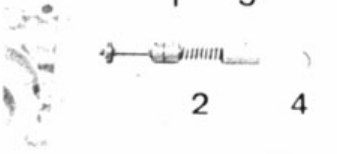
Unscrew bolts and take off cover.
Installation:
Tightening torque: 9 Nm (6.5 ft. lbs.).



Lift out circlip and remove pressure valve.



Measure play between pump body / outer rotor and outer rotor / inner rotor.
Nominal value = 0.12 to 0.20 mm (0.005 to 0.008").
Note
Reinstall rotors in the same position (inner rotor with guide facing the body).



Installation
1 = Piston
2 = Spring
3 = Sleeve
4 = Circlip

Measure length of unloaded spring (2).
Nominal value = 84.1 mm (3.311").



- REMOVING CRANKSHAFT
(Replace crankshaft - see 11 21 501)

Remove main bearing caps (1 ... 5) and lift out crankshaft.

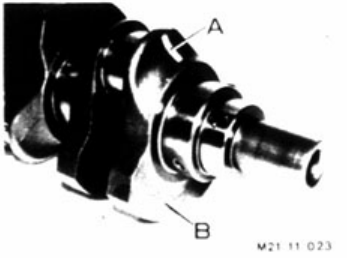


- REPLACING MAIN BEARING SHELLS:

The crankshaft is marked with yellow, green or white paint depending on main bearing journal tolerances.



Installation:
Bearing caps (1 ... 3) are marked with die-stamped numbers.
Bearing cap (4) has a shoulder on the side of the cap and bearing cap (5) is not marked.



M21 11 023

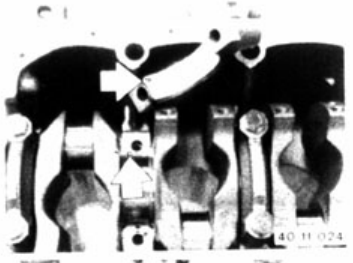
Important!
Check ground size* of the crankshaft.

Conrod Bearing Journal (A)

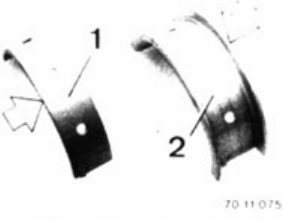
1 paint stripe	Size 1 (0.25 mm)
2 paint stripes	Size 2 (0.50 mm)

Main Bearing Journal (B)

1 paint stripe	Size 1 (0.25 mm)
2 paint stripes	Size 2 (0.50 mm)


40 11 024

Lubricate bearing shells with oil.
Install crankshaft.
Mount bearing caps (1 ... 5) with bearing cap no. 1 on the camshaft drive end in such a manner that all bearing shell grooves are on one side.
Align bearing caps precisely.



70 11 075

The bearing shells are marked with yellow, green or white paint.

1 Bearing shell 1–2–3–4 (only caps)–5
2 Bearing shell 4 (thrust bearing, only crankshaft)

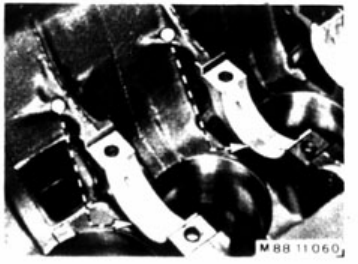
Check the ground size of main bearing journals!



40 11 042

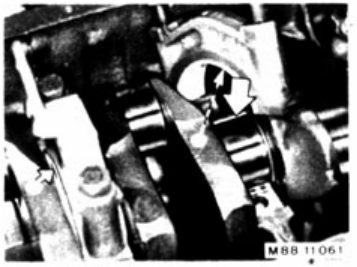
Tighten bolts (washed and lubricated with oil) in two steps.

Step 1	23 Nm (17 ft. lbs.)
Step 2	50° torque angle


M88 11 060

Install bearing shells in the crankcase with the same color code mark as the dot of paint on the console.
Install both bearing shells according to the crankshaft color code mark, if the color code mark of the crankcase has been washed off.
Install bearing shells in bearing caps with the same color code mark as for the crankshaft.

* See Specifications

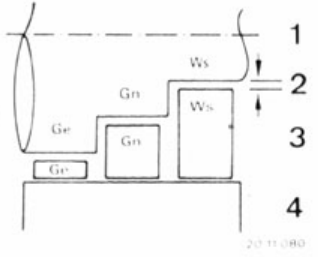


Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps to the specified torqueing procedure*.
Do not turn the crankshaft.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt



Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with a different color code.



Survey of Color Code Shaft Diameter/ Bearing Shell Thickness*

Triple Classification Color Codes:
Ge = yellow
Gn = green
Ws = white

1 Crankshaft diameter
2 Bearing play
3 Bearing shell thickness
4 Console diameter

* See Specifications



11 21 501 REPLACING CRANKSHAFT
– Crankshaft Removed –

Note:
A replacement crankshaft is supplied complete with corresponding bearing shells for main and conrod bearings.

Crankshaft Identification
(Cast on Crank):

Engine	Stroke (mm)
M 40 B 16	72 (2.835")
M 40 B 18	81 (3.189")

The crankshaft is surface treated and may only be reground in the factory.

Reground crankshafts are marked with stripes of paint.

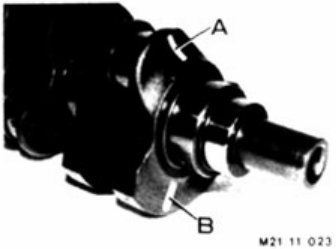
Conrod Bearing Journal (A)

1 paint stripe	Size 1 *
2 paint stripes	Size 2 *

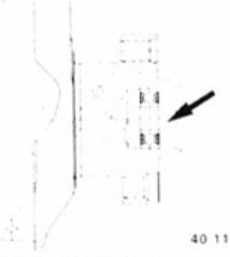
Main Bearing Journal (B)

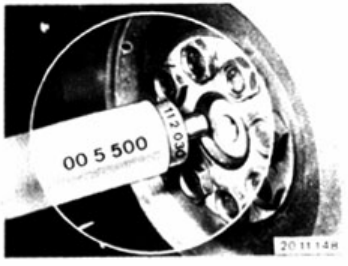
1 paint stripe	Size 1 *
2 paint stripes	Size 2 *

Cars with Manual Transmission:
Install pilot bearing for the transmission main shaft.



M21 11 023


40 11 142

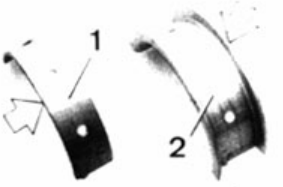


20 11 148

Drive in pilot bearing with Special Tools 11 2 030 and 00 5 500.



The crankshaft is marked with yellow, green or white paint depending on the main bearing journal tolerances.

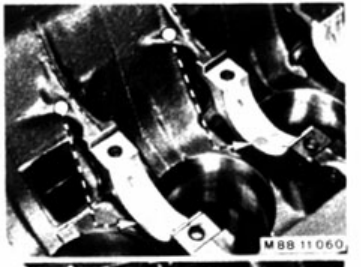


70 11 075

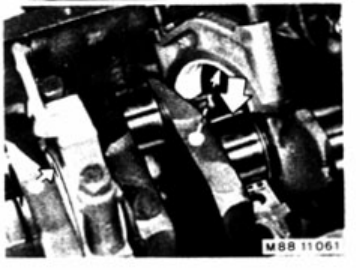
The bearing shells are marked with yellow, green or white paint.

1 Bearing shell 1–2–3–4 (only cap)–5
2 Bearing shell 4 (thrust bearing, only crankcase)

Check the ground size of main bearing journals!


M88 11 060

Installing Instructions:
Install only "yellow" bearing shells in the crankcase (regardless of the old color code mark on the crankcase).
Install "yellow or green or white" bearing shells in bearing caps depending on the crankshaft bearing journal color code mark.


M88 11 061

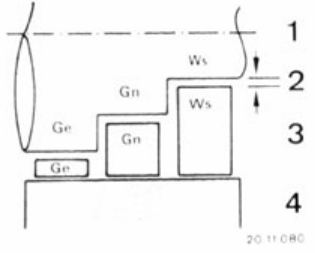
Install crankshaft.
Place Type PG-1 Plastigage on the crankshaft wiped clean of oil and tighten the bearing caps with correct torque*.
Do not turn the crankshaft.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

* See Specifications



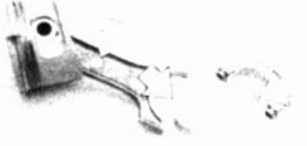
Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with a different color code.



Survey of Color Code/Shaft Diameter/ Bearing Shell Thickness*

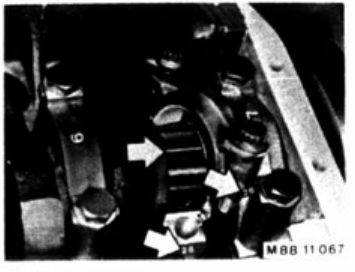
Triple Classification Color Codes:
Ge = yellow
Gn = green
Ws = white

1 Crankshaft diameter
2 Bearing play
3 Bearing shell thickness
4 Console diameter



Replacing Conrod Bearing Shells:
Red or blue conrod bearing shells are installed standard according to the color code mark on the connecting rod for a pertinent ground size or crankshaft.

Install only red bearing shells of the pertinent ground size for replacement crankshafts.



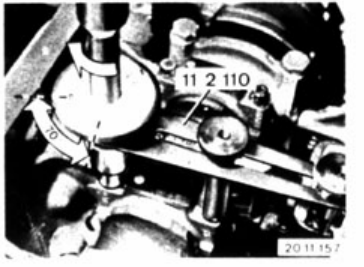
Installation:
Check conrod bearing play.
Place Type PG-1 Plastigage on the crankshaft wiped clean of oil in BDC position.
Mount conrod bearing caps and tighten the old conrod bolts with correct torque*.

* See Specifications



Important!
Do not turn the connecting rods or crankshaft.

Remove bearing caps and check bearing play = 0.020 to 0.055 mm (0.0008 to 0.0022") by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells or bearing shells with a different color code.



Tightening Conrod Bolts:
Lubricate conrod bearing shells with oil.
Mount bearing caps that pair numbers are on one side.
Use new conrod bolts and tighten them in two steps.

Step 1	20 Nm (14.5 ft. lbs.)
Step 2	70° torque angle

Constrution group 11 Engine M42

11 00 . . .	Engine – disassemble and assemble – engine removed	11- 42/1
	Engine – mount on assembly stand	11- 42/1
	A. Cylinder head – remove	11- 42/2
	• Cylinder head cover – remove	11- 42/2
	• Cylinder head – remove	11- 42/3
	B. Cylinder head – disassemble	11- 42/7
	• Cylinder head – mount on assembly fixture	11- 42/7
	• Intake manifold – remove	11- 42/8
	• Camshafts – remove	11- 42/9
	• Valves – remove	11- 42/11
	• Valve guide – check	11- 42/13
	• Valve guide – ream	11- 42/13
	• Valve seat – machine	11- 42/13
	• Cylinder head sealing surface – check, machine	11- 42/14
	C. Engine block – crankshaft – disassemble and repair	11- 42/15
	• Drive belt – remove	11- 42/15
	• Alternator – remove	11- 42/15
	• Alternator console – remove	11- 42/15
	• Oil filter housing – remove	11- 42/16
	• Coolant pipe – remove	11- 42/16
	• Water pump – remove	11- 42/16
	• Vibration damper – remove	11- 42/17
	• Vibration damper hub – remove	11- 42/17
	• Lower timing case cover – remove	11- 42/17
	• Timing chain and guides – remove	11- 42/18
	• Oil pan – remove	11- 42/19
	• Timing case with oil pump – remove	11- 42/19
	• Oil pump – remove, check	11- 42/20
	• Clutch – flywheel – remove	11- 42/20
	• Pilot bearing in crankshaft – replace	11- 42/21
	• Rear end cover – remove	11- 42/21
	• Connecting rod and piston – remove	11- 42/22
	• Connecting rod – remove, check	11- 42/22
	• Connecting rod bearing shells – replace	11- 42/23
	• Piston – replace, check	11- 42/24
	• Piston rings – replace, check	11- 42/24
	• Crankshaft – remove	11- 42/25
	• Main bearing shells – replace	11- 42/25
	• Spray jets in crankshaft bearing caps – replace	11- 42/26
11 21 501	Crankshaft – replace – crankshaft removed	11- 42/27

11 00 DISASSEMBLING AND ASSEMBLING ENGINE
Engine Removed

If work had been carried out on the cylinder head for which the camshaft was removed, there must be compliance with the following.
Hydraulic valve tappets expand without load from the camshaft and require a certain amount of time to be compressed again after installation. Consequently in case of fast installation even the "closed" valves could be opened and touch the pistons.

The following waiting times are necessary between installing of the camshaft and mounting the cylinder head.

Room temp. (20° C)	4 minutes
10 to 20° C	11 minutes
0 to 10° C	30 minutes

After installation of the camshaft and timing chain the engine may first be cranked after the following waiting times.

Room temp. (20° C)	after 10 minutes
10 to 20° C	after 30 minutes
0 to 10° C	after 75 minutes

Working on Valve Train with Installed Cylinder Head

Turn crankshaft in engine's direction of rotation 90 - 45° from TDC.
In this manner none of the pistons will be in TDC.
Install camshaft that peaks of cams for cylinder no. 1 point to each other.
Keep to the above mentioned waiting times.
Turn crankshaft back to TDC and install the timing chain.
Crank engine for first time 10 minutes after installation of the camshaft.

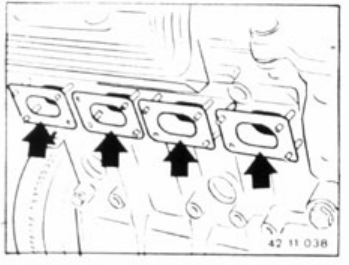
Disassembling and repairing the engine are described in chronological sequence on the following pages. The list of contents is provided to help take up work again after an interruption or to more easily find a certain point. They only describe direct removal and installation, and do not contain full details of procedures.



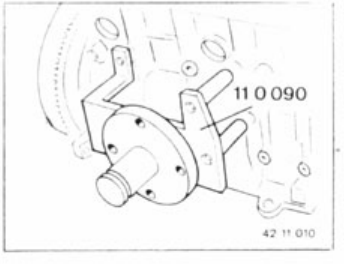
o Mounting Engine on Assembly Stand

Unscrew exhaust manifold.
Unscrew nuts.
Lift off exhaust manifold.

Installation:
Replace nuts.
Coat threads with copper paste**.
Tightening torque*.

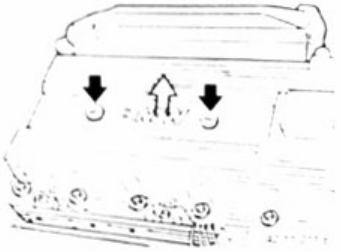


Installation:
Replace gaskets.
Beads of gaskets face the exhaust manifold.



Mount engine on Special Tool 00 1 490 using Special Tool 11 0 090.

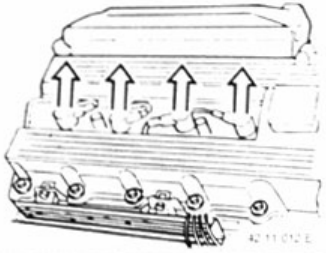
* Refer to Specifications
** Source of Supply: BMW Parts



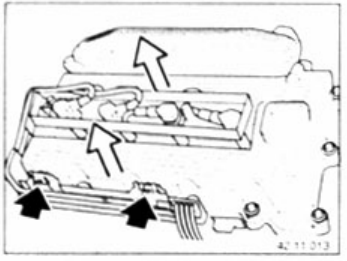
A. REMOVING CYLINDER HEAD

o Removing Cylinder Head Cover:

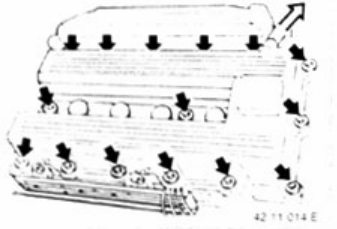
Unscrew cover for ignition coil.



Pull off spark plug connectors.



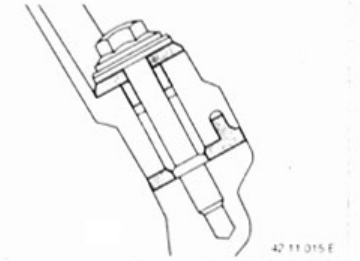
Loosen both nuts.
Lift out complete ignition tackle.



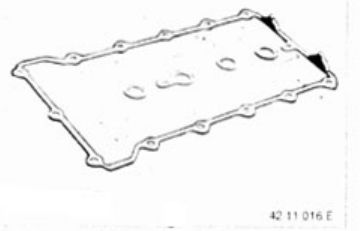
Pull off hose.
Unscrew cylinder head cover.

Installation:
Tightening torque*.

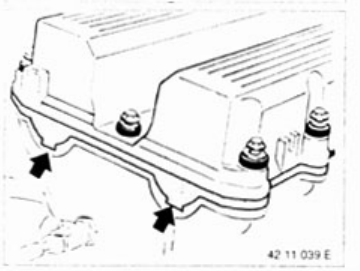
* See Specifications



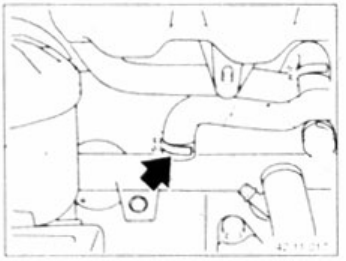
Note:
Rubber mounts and gaskets are used to separate the cylinder head cover and cylinder head in regards to oscillation.
Note arrangement of rubber mounts.



Installation:
Check gaskets, replacing if necessary.

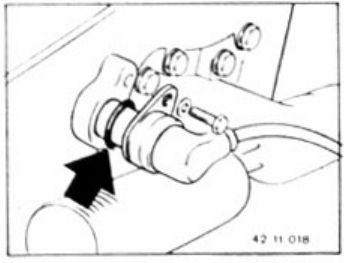


Installation:
Check for correct seating of gasket on back of the cylinder head when mounting the cylinder head cover.



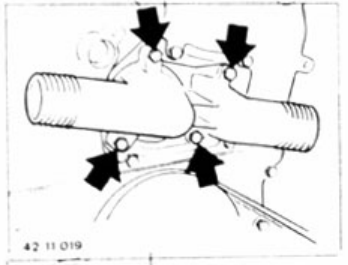
o Removing Cylinder Head

Disconnect coolant hose at coolant pipe.

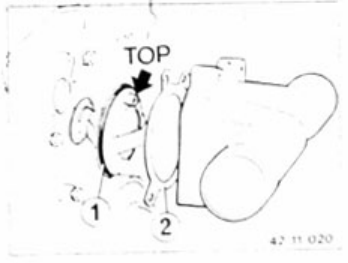


Remove sender.

Installation:
Check seal, replacing it if necessary.

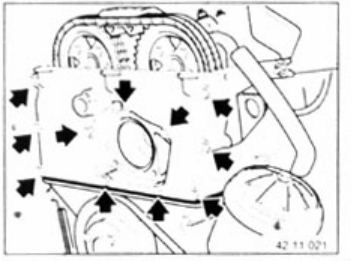


Remove thermostat housing and thermostat.

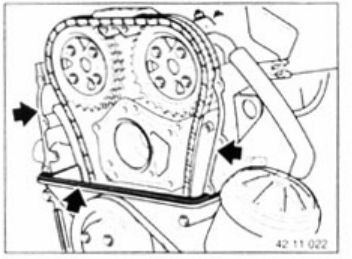


Installation:
Vent points up.
Replace O-ring.
Coat O-ring lightly with glycerine.

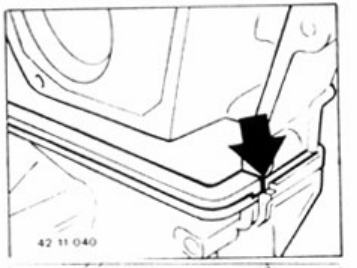
1 O-ring
2 Gasket



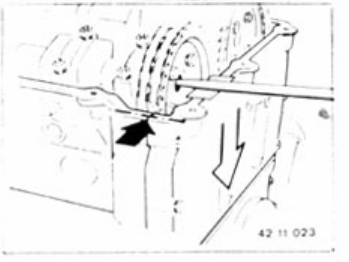
Unscrew upper timing case cover.



Installation:
Replace gaskets.

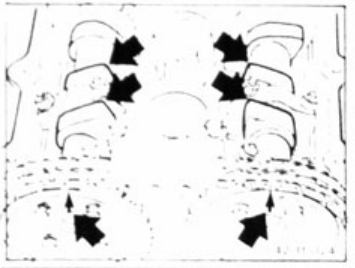


Installation:
Fill joints between gaskets with permanently elastic sealing compound 3 Bond 1209**.

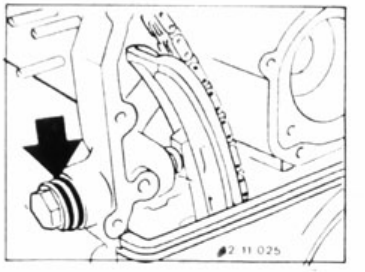


Installation:
Screw in 2 bolts.
Press down on timing case until upper edge of cover is in same plane as cylinder head.
Don't damage sealing surfaces.
Screw in and tighten all bolts.
Tightening torque*.

* Refer to Specifications
** Source of Supply: BMW Parts



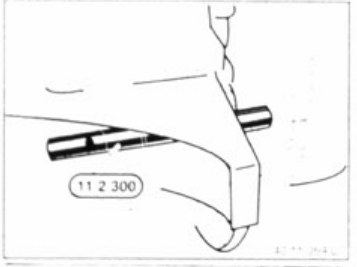
Crank over engine in direction of rotation until peaks of intake and exhaust cams in cylinder no. 1 face each other.
Arrows on timing chain sprockets face up.



Remove chain tensioner.

Installation:
Tightening torque*.

Important!
A new or disassembled chain tensioner is without an oil filling.
To guarantee correct function the engine must be operated the first time at 3500 rpm about 20 seconds.

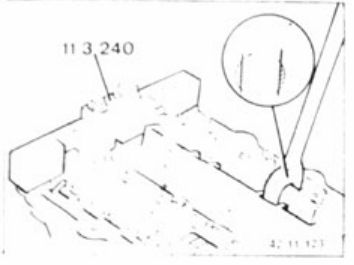


Installation:
Hold crankshaft in TDC position with Special Tool 11 2 300.

Caution!
Remove special tool before operating the engine.

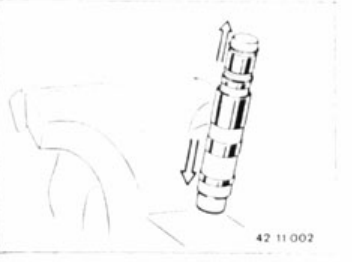


Installation – Important!
The hydraulic plunger of the chain tensioner must be brought into basic position (transporting position for new chain tensioners) *before* installing or after loosening the plug.
Reason: After running out the hydraulic plunger is locked and cannot be pressed back.
No spring action — chain or tensioner would break.



Installation:
Align camshaft and hold it with Special Tool 11 3 240.
Camshafts can be turned on the hexagon with a 27 mm wrench.

Caution!
Don't damage the bearing plate — machine sides of open-end wrench as shown if necessary.

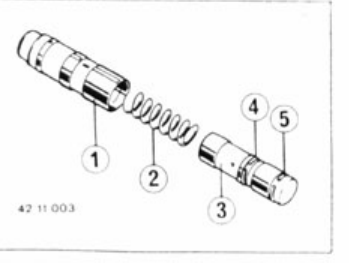


Installation:
Bring hydraulic plunger into installed basic position:

Knock outside sleeve of chain tensioner on a hard surface (clamp anvil).
This causes the piston to jump out of the lock.

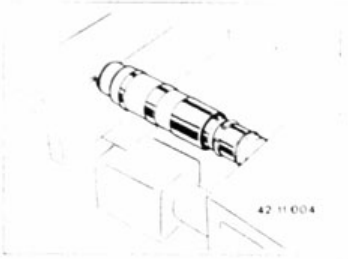


Important!
If the camshaft position has to be corrected enough that there is valve movement in cylinder no. 1 and 4, first turn the crankshaft approx. 90° away from TDC position in the engine's direction of rotation and return it only after turning the camshaft.
In this manner contact between valves and the piston will be avoided.
Install and unlock chain tensioner after assembling.
Press chain tensioner against the timing chain.
Recheck the camshaft adjustment.

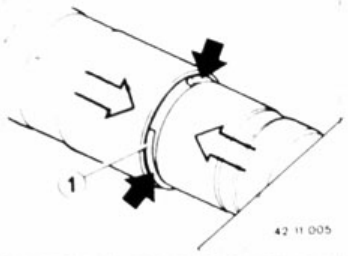


Installation:
Arrangement of Parts:

1 Sleeve
2 Spring
3 Hydr. piston
4 Circlip
5 Circlip

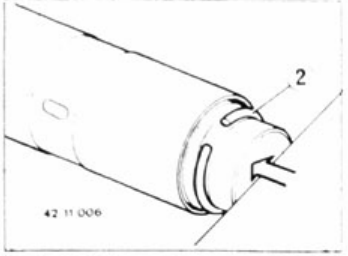


Installation
Assemble and clamp chain tensioner in a vise fitted with soft jaws.

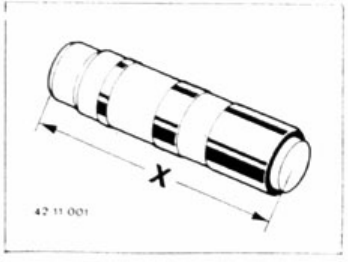


Installation
Push chain tensioner together.

Important!
Place circlip (1) in slip bevel of the sleeve.

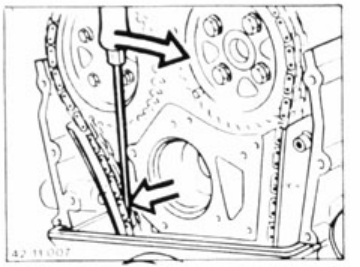


Installation
Push chain tensioner together even further until circlip (2) is heard to engage.
Loosen vise.
Chain tensioner must remain in the transporting position.

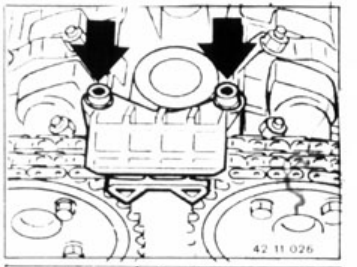


Installation
The hydraulic piston runs out again, if the "catch point" was overrun or not reached.
Chain tensioner must then be disassembled again and the procedures repeated.

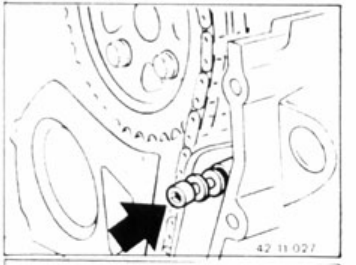
X = 68.5 mm (2.697").



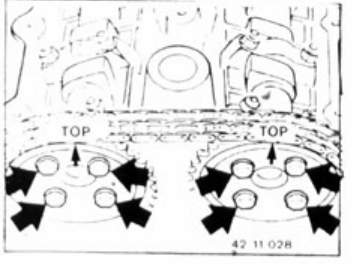
Installation
Install chain tensioner.
Push chain tensioning rail against the hydraulic piston briefly until the tensioning element is released.



Unscrew upper chain guide.



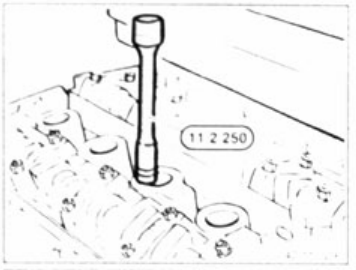
Unscrew upper chain guide bolt on right hand side.



Unscrew sprockets.

Installation:
Arrows on sprockets face up.
Tightening torque*.

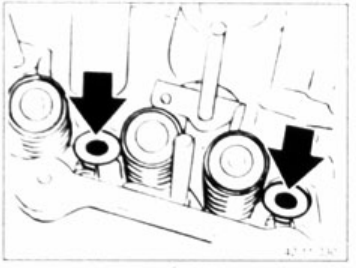
* See Specifications



Unscrew cylinder heads bolts from outside to inside in several steps using Special Tool 11 2 250.
Lift off cylinder head.



Note!
In contradiction to the M 40 engine, an orifice for supply of oil to the cylinder head is *not* installed in the M 42 engine block.



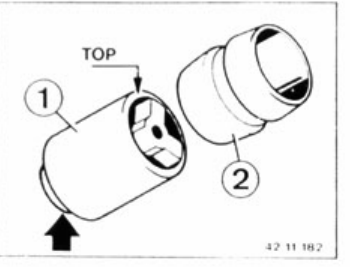
Note!
Standard production cylinder heads have punch-locked washers to avoid losing them.
When installing a new cylinder head, use new washers with punch-locking.



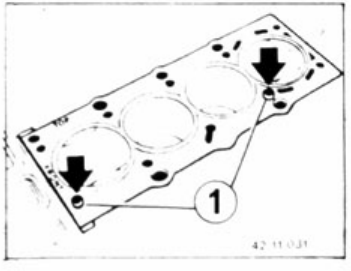
Important!
A check valve with rubber-lined spacing sleeve for supply of oil to the cylinder head is installed in the engine block of M 42 engines since 9.92.



Installation:
Keep to the waiting times for hydraulic valve tappets when installing the cylinder head.
Refer to "General Information".

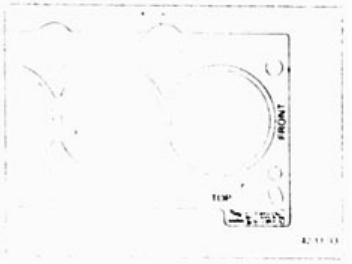


Installation:
Install check valve (1) with its collar facing the crankcase in the oil supply bore for the cylinder head.
Insert rubber-lined spacing sleeve (2).

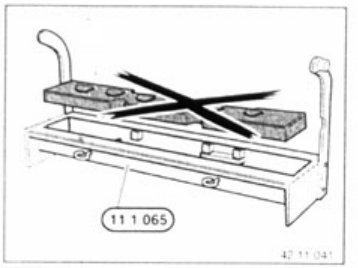


Installation:
Clean sealing surfaces on cylinder head and crankcase. If applicable, remove bits of gaskets using a hard wood scraper and ensure that bits of gaskets do not fall into oil and coolant bores.
Install new cylinder head gasket with "TOP" facing up and "FRONT" on the chain end.
Check dowel sleeves (1) for damage and correct installation.

Caution!
If check valve (1) were installed in the wrong direction, it would block the supply of oil to the cylinder head.



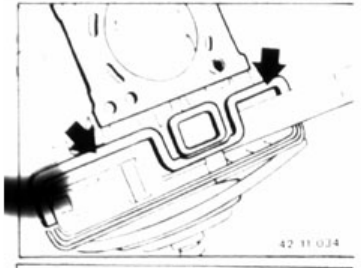
Installation:
A 0.3 mm thicker cylinder head gasket is available for machined (ground) cylinder heads.



B. DISASSEMBLING CYLINDER HEAD

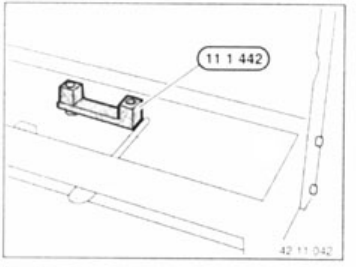
o Mounting Cylinder Head on Assembly Stand

Mount Special Tool 11 1 065 on Special Tool 00 1 490.
Do *not* insert Special Tool 11 0 180.

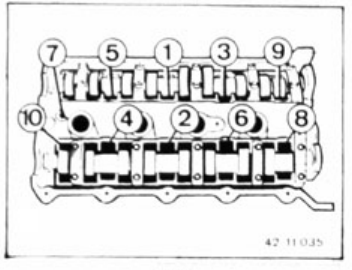


Installation:
Install timing case gasket.

Note:
The gasket can also be used together with the thicker cylinder head gasket.

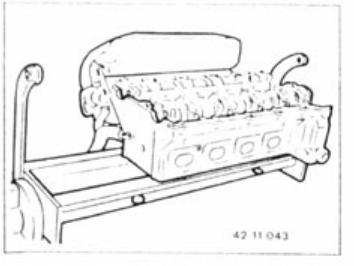


Note:
Screw Special Tool 11 1 442 on already delivered special tool assembly fixtures.

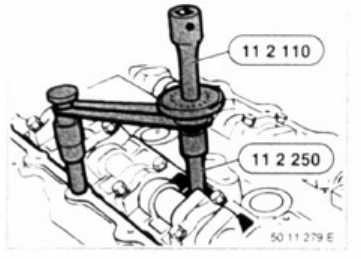


Installation:
Mount cylinder head and tighten the new (lightly oiled) bolts in sequence of 1 ... 10 in three steps.
Tightening torque*.

Important!
Cylinder head bolts may only be used once.
Keep oil out of tapped bores in the engine block (danger of cracking block, falsified torque values).

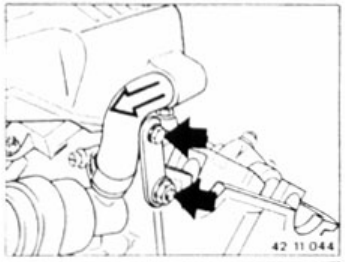


Mount cylinder head on assembly stand fixture using two cylinder head bolts.



Note:
Use Special Tools 11 2 250 and 11 2 110 or 00 9 120 to tighten bolts to torque angle*.

* Refer to Specifications

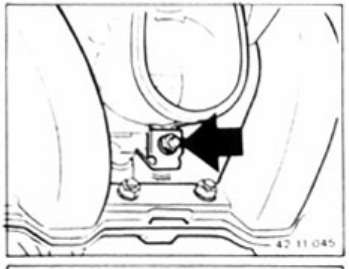


o Removing Intake Manifold:

Unscrew upper manifold section.
Unscrew rear brace.
Pull off hose.

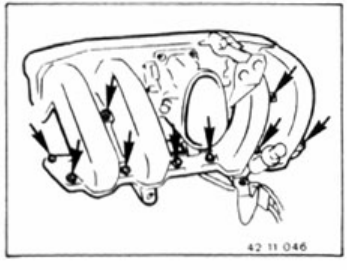


Loosen front brace.

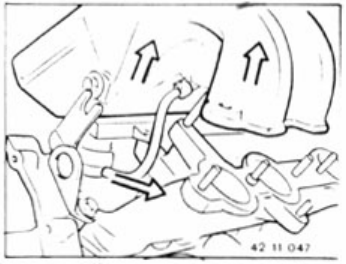


Unscrew holder for preheater.

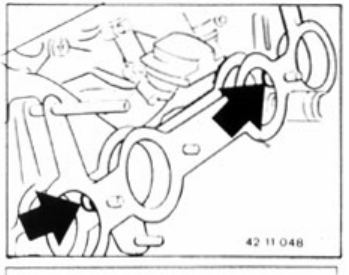
Installation:
If applicable, bend holder for preheater far enough that bearing surface of preheater bears firmly on the throttle valve assembly.



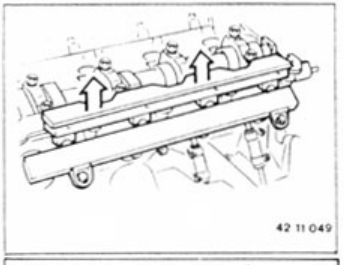
Unscrew bolts.



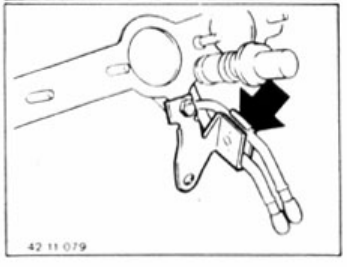
Lift off upper intake manifold section.
Pull hose off of fuel pressure regulator at the same time.



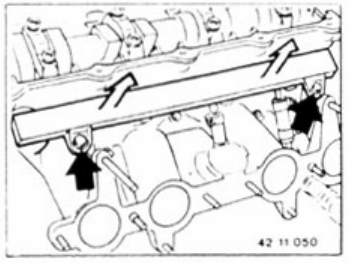
Installation:
Replace gasket.
Check dowel sleeves.



Pull plug plate off of fuel injectors.

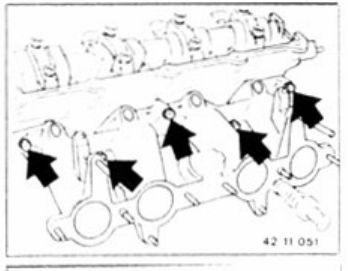


Unscrew clamp.

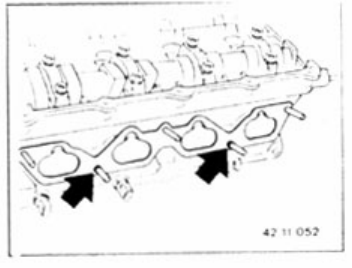


Unscrew bolts.
Pull off injection pipe complete with fuel injectors.

Installation:
Lubricate seals lightly with oil.



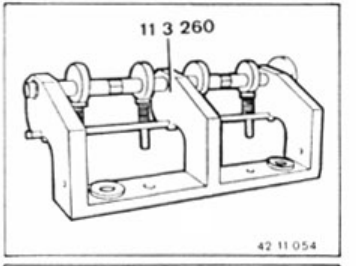
Unscrew lower manifold section.



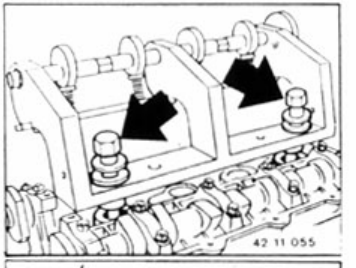
Installation:
Replace gasket.
Check dowel sleeves.

o Removing Camshafts:

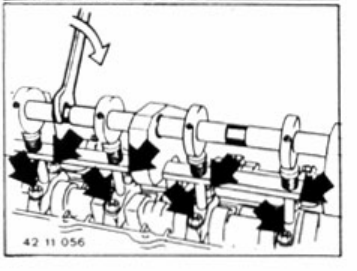
Important!
Camshafts could be pre-damaged or broken when removal/installation were performed incorrectly without a fixture. In addition, valves could be bent through contact with piston crowns when mounting the cylinder head on the crankcase.
Always conform with assembly instructions and sequence.



Prepare Special Tool 11 3 260 for a four cylinder engine.



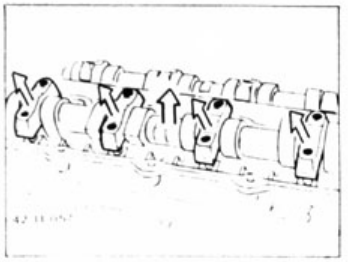
Unscrew spark plugs.
Mount and bolt special tool fixture in tapped bores for spark plugs.
Tightening torque = 23 Nm (17 ft. lbs.).



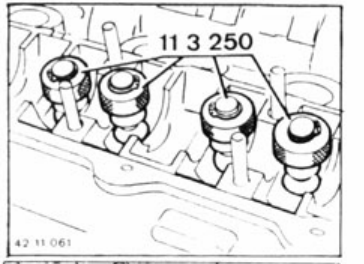
Apply load on bearing caps by turning the eccentric shaft.
Unscrew bolts for bearing caps.

Installation:
Tightening torque*.

* See Specifications

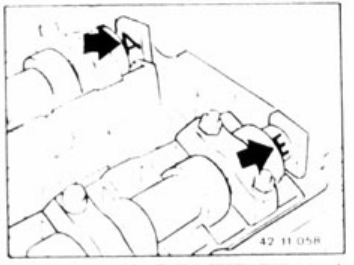


Release and remove special tool.
Lift out bearing caps and camshaft.

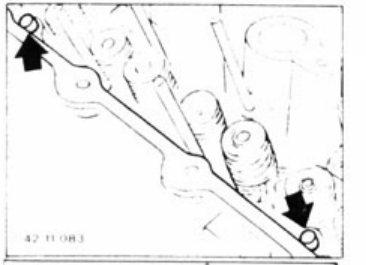


Hold valve clearance compensators tight with Special Tools 11 3 250.

Lift out bearing plate complete with valve tappets.



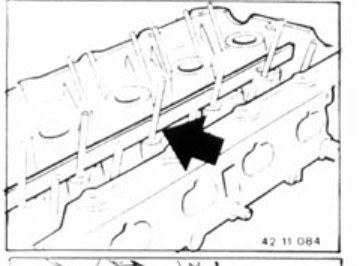
Installation:
Camshafts are marked with "A" for exhaust or "E" for intake.



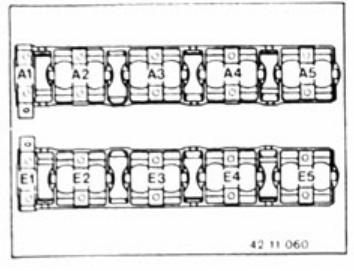
Installation:
Check centering sleeves on mounting bolts for bearings 2 and 5.



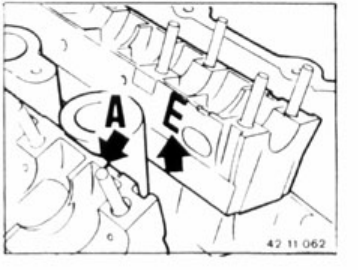
Installation:
Install camshafts that the peaks of intake and exhaust cams face each other in cylinder no. 1.



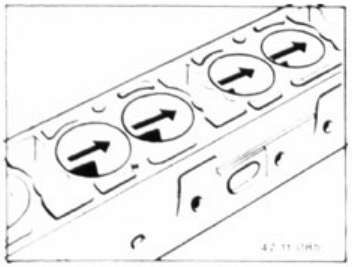
Note:
If the cylinder head has to be replaced because of mechanical damage (crack, distortion), the bearing surfaces of bearing plates must be checked for distortion with a steel straightedge on the old cylinder head.
Max. gap = 0.05 mm.
Also replace the bearing plates if this specification is exceeded.



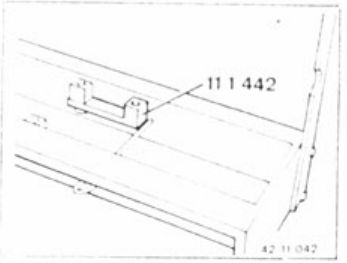
Installation:
Bearing caps are marked with
A1 ... A5 for the exhaust side and
E1 ... E5 for the intake side
and can be read from the intake side.



Installation
Bearing plates are marked with "A" for the exhaust side or "E" for the intake side.



Installation
Inspect bearing surfaces of valve clearance compensating elements for wear (scoring).



o Removing Valves:

Mount Special Tool 11 1 065 on Special Tool 00 1 490.

Note:
Bolt on Special Tool 11 1 442 in case of assembly fixtures supplied earlier.

Installation
Valve clearance compensating elements expand without load from the camshaft and require a certain amount of time after installation before they compress again. Consequently when installation is fast even the "closed" valves could still be open and bear on the pistons.

Always conform with the following waiting times between installation of the camshaft and mounting of the cylinder head.

Room temp. = 20° C (68° F)	4 minutes
10 to 20° C (50 to 68° F)	11 minutes
0 to 10° C (32 to 50° F)	30 minutes

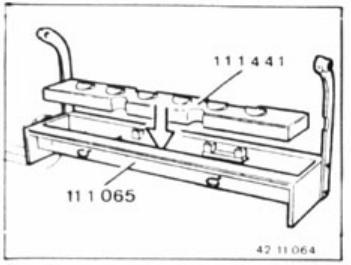
The engine may be cranked after installation of the camshaft and timing chain only after the following waiting times.

Room temp. = 20° C (68° F)	10 minutes
10 to 20° C (50 to 68° F)	30 minutes
0 to 10° C (32 to 50° F)	75 minutes

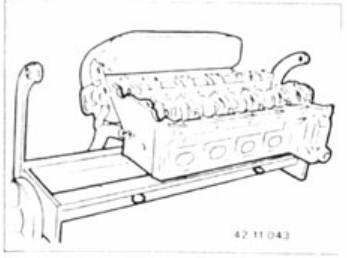
If applicable, proceed as described below.

Working on Valve Train with Mounted Cylinder Head:

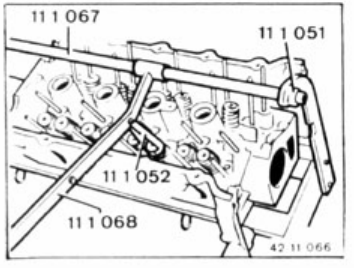
Turn crankshaft in engine's direction of rotation by 90° ± 45° from the TDC mark. This will mean that none of the pistons are at TDC.
Insert camshaft that cam peaks of the 1st cylinder face each other.
Wait the time mentioned above.
Turn crankshaft back to TDC position and install the timing chain.
Wait 10 minutes after installation of the camshaft before cranking the engine.



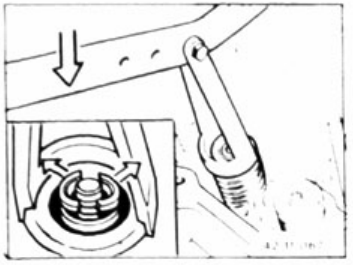
Place Special Tool 11 0 180 in the assembly fixture.



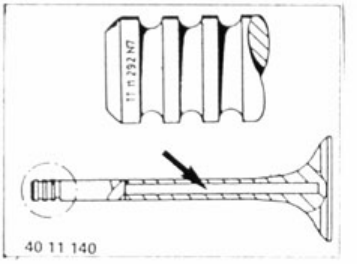
Mount cylinder head on the assembly fixture with two cylinder head bolts.



Bolt on Special Tool 11 1 051.
Mount Special Tools 11 1 068, 11 1 052 and 11 1 067.



Press down valve springs and take out valve collets.
Remove valve springs and spring retainers.
Take tray out of the assembly fixture from below and pull out valve.



Important Information On Scrapping!

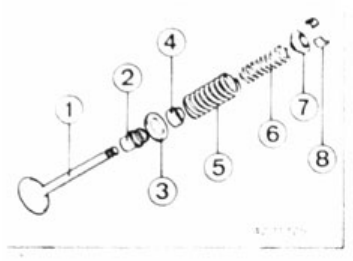
Exhaust valves are filled with sodium to improve carrying off heat.

Sodium filled valves may not be scrapped in the conventional manner without special treatment.
The reason for this is the danger of the sodium exploding when melted.
It is also not permitted to use them as "special tools" – such as, for example, impact mandrels – as is common in some workshops.

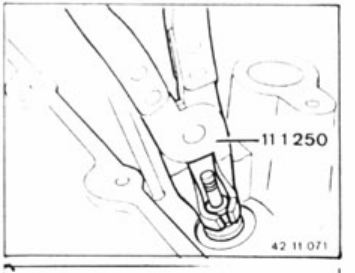
Consequently sodium filled valves to be scrapped must be collected and sent to HT-L-2 in the Landshut factory for neutralization.

Refer to Service Information of Gr. 11 for information on scrapping in those countries, where valves can not be returned regardless of circumstances or which are not obligated to return parts.

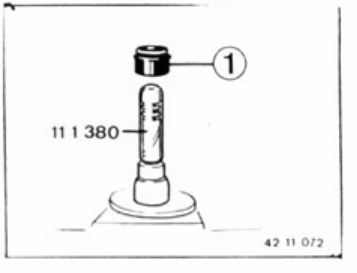
Installation
Both springs must be replaced, even if only one spring of a spring package (inner or outer spring) is damaged or broken.
Only use inner and outer springs from the same manufacturer and with the same color code.



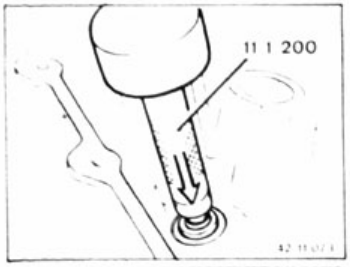
Installed Order:
1 Valve
2 Valve stem seal
3 Outer spring retainer
4 Inner spring retainer
5 Outer spring
6 Inner spring
7 Upper spring retainer
8 Valve collets



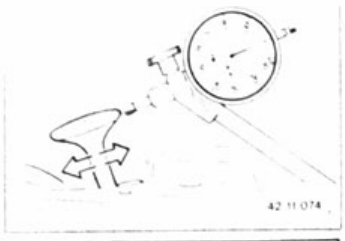
Pull off valve stem seal with Special Tool 11 1 250.



Installation:
Lubricate valve stem with oil and insert valve.
Apply Special Tool 11 1 380.
Lubricate new valve stem seal with oil and install.

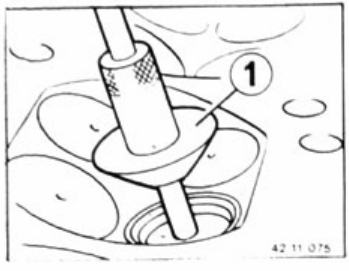


Installation
Press on valve stem seal against the stop by hand with Special Tool 11 1 200.



o Checking Valve Guide:

Insert a new valve in such a manner that the end of the valve stem is flush with the valve guide.
Mount dial gage and measure the tilt clearance.
Max. permissible tilt clearance = 0.5 mm (0.020").



o Reaming Valve Guide:

Ream valve guide and install a repair valve with an oversize stem diameter of + 0.1 or 0.2 mm (0.004 or 0.008") if there is excessive play between the valve stem and valve guide.
Press guide (1) on the valve seat and ream out the valve guide beginning at the combustion chamber end.
Turn down the reamer once.

Note:
Valve seat must be machined after reaming.

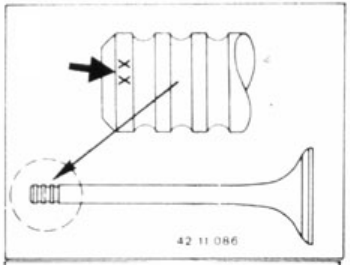
o Machining Valve Seat:

If more than 0.2 mm (0.008") is machined off of the valve seat, a valve with a thicker valve head must be installed (compression would be changed).
The following valve versions are available in addition to standard valves.

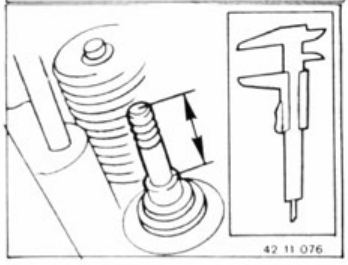
Stem oversize	0.0 mm	0.1 mm (0.004")	0.2 mm (0.008")
Valve head thickness oversize	0.2 mm (0.008")	0.2 mm (0.008")	0.4 mm (0.016")
For machining on seat insert ring in excess	0.2 mm (0.008")	0.2 mm (0.008")	0.4 mm (0.016")
Identification on stem (see picture)	0.0 mm	0.1 mm (0.004")	0.2 mm (0.008")

Information for 2nd Machining:
If size "00" is already installed and valve seat machining exceeds 0.2 mm (0.008"), install size "0.2".

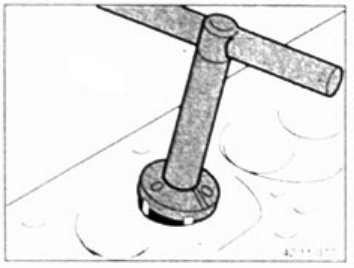
Important!
Valves with excessively thick valve heads cause engine damage (anti-knock limit is exceeded).



Valve Identification



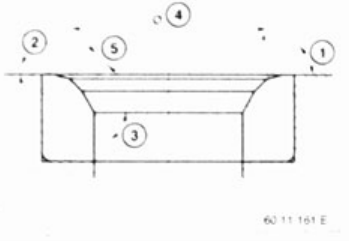
Determine to which extent the valve seat has to be machined by inserting the valve, measuring the protrusion from the valve stem to the valve guide and noting this distance.
Machine valve seat.
Insert the same valve again, measure protrusion from valve stem to valve guide and note this distance.
The difference between both distances is the amount of machining.



o Machining Valve Seat

Machine the valve seat to instructions of the tool supplier using Special Tool 00 3 520 or 00 3 580.
Dimensions and angles*.

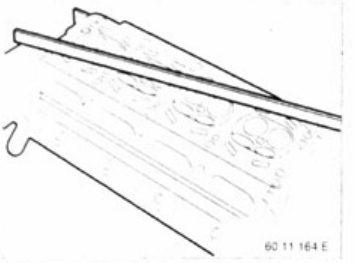
Correction cutter from Neway:



After Machining Valve Seat Surface:
Machine valve seat outside and inside diameters to specified size using a correction cutter* in such a manner that the specified valve seat width* is produced.

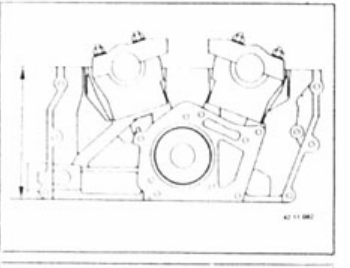
1 Valve seat angle
2 Outside dia. correction angle
3 Inside dia. correction angle
4 Valve seat outside diameter
5 Seat width

Valve seat dimensions*.



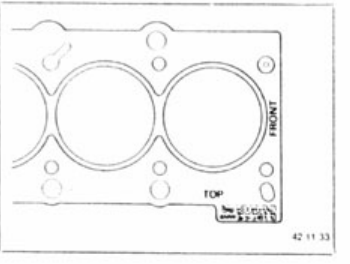
o **Inspecting Cylinder Head Sealing Surface**

Check levelness of the cylinder head sealing surface using a standard straightedge. Max. permissible deviation = 0.03 mm.



Remove all attachments from cylinder head to machine the sealing surfaces.

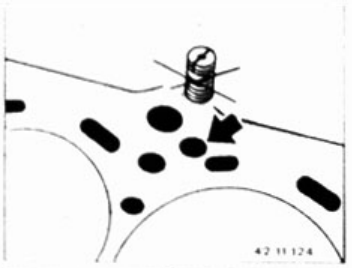
Machining limit*.



A 0.3 mm thicker cylinder head gasket is available for repairs when cylinder head thickness is reduced by 0.3 mm.

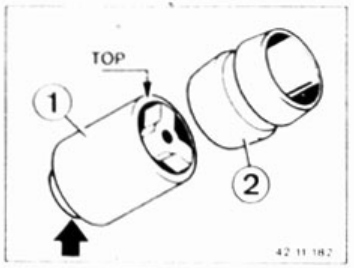
* Refer to Specifications

* Refer to Specifications



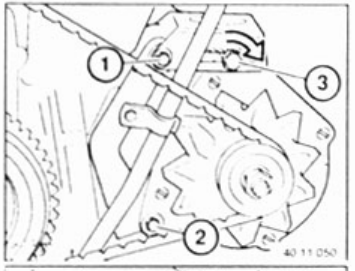
C DISASSEMBLING AND REPAIRING ENGINE BLOCK, CRANKSHAFT DRIVE

Note:
In contradiction to the M 40 engine, an orifice for supply of oil to the cylinder head is not installed in the M 42 engine block.



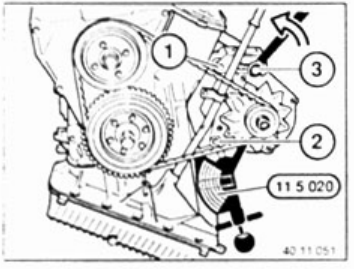
Important:
A check valve with rubber-lined spacing sleeve for supply of oil to the cylinder head is installed in the engine block of M 42 engines since 9.92.
Install check valve (1) with its collar facing the crankcase in the oil supply bore for the cylinder head.
Insert rubber-lined spacing sleeve (2).

Caution!
If check valve (1) were installed in the wrong direction, it would block the supply of oil to the cylinder head.

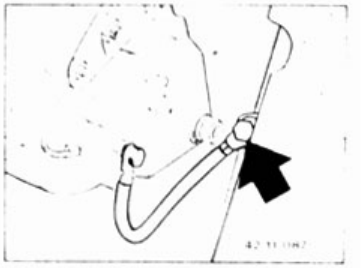


o Removing Drive Belt

Loosen bolt (1).
Loosen nuts on bolts (2 and 3) and turn bolt (3) in direction of arrow to slacken the drive belt.
Remove drive belt.

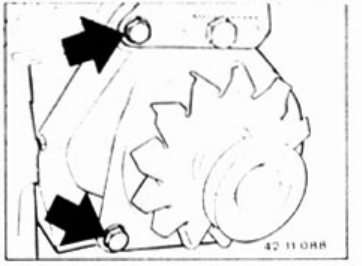


Installation:
Adjust drive belt tension by turning bolt (3) in direction of arrow using Special Tool 11 5 020.
Tighten nut on bolt (3).
Tighten bolts (1 and 2).

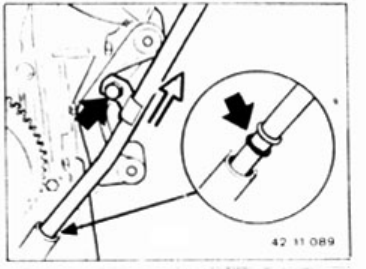


o Removing Alternator

Unscrew ground strap.



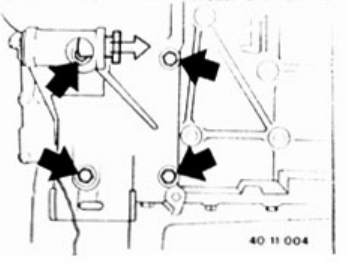
Unscrew bolts and remove alt[illegible]r.



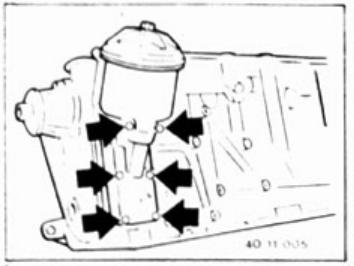
o Removing Alternator Conso[illegible]

Unscrew and pull out oil dipst[illegible]de tube.

Installation:
Replace seal.

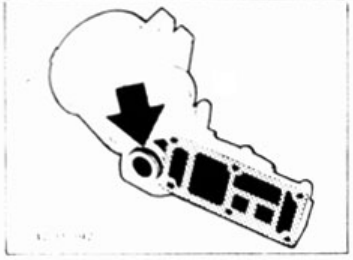


Press out sleeve.
Unscrew bolts and remove con[illegible]

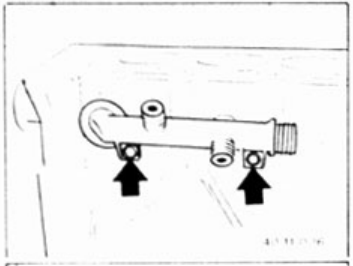


o Removing Oil Filter Housing:

Unscrew bolts and take off oil filter housing.



Installation
Replace O-ring and gasket.
Coat O-ring with a lubricant**.
Tightening torque = 9 Nm (6.5 ft. lbs.).



o Removing Coolant Pipe:

Unscrew bolts and pull coolant pipe out of the engine block.



Installation:
Replace O-ring and coat with a lubricant**.

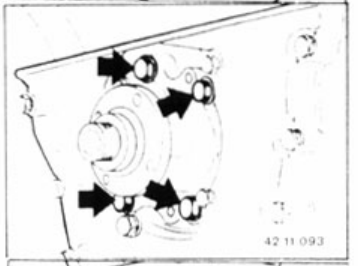
** Source of Supply: HWB



o Removing Water Pump:

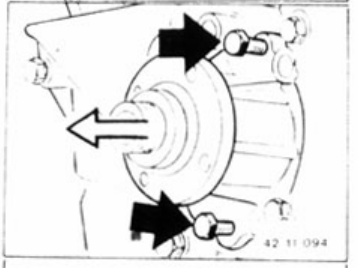
Hold pulley tight on the drive belt and unscrew bolts.

Installation
Tightening torque = 9 Nm (6 lbs.

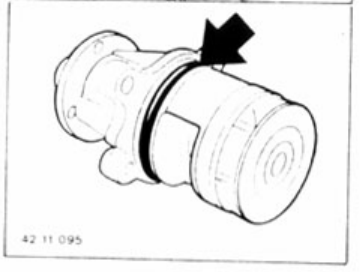


Unscrew bolts.

Installation
Tightening torque = 9 Nm (6.5 ft. lbs.

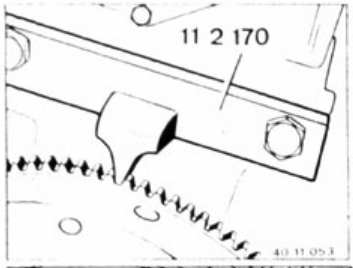


Screw two M 6 bolts in tapped bores (1) and press water pump out of the end cover uniformly.



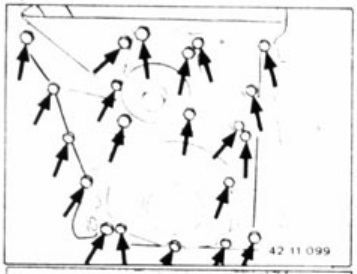
Installation:
Replace O-ring and coat with a lubricant**.
Tightening torque = 9 Nm (6.5 ft. lbs.

** Source of Supply: HWB



o Removing Vibration Damper:

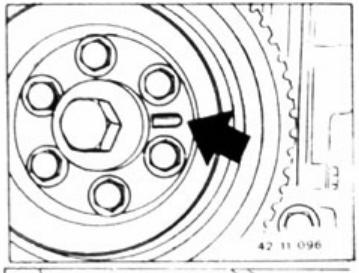
Prevent cranking of engine with Special Tool 11 2 170.



o Removing Lower Timing Case Cover

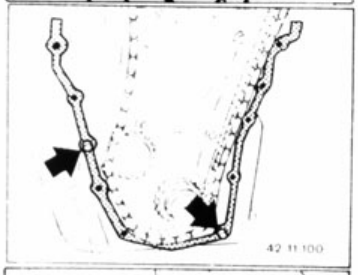
Unscrew bolts.
Lift off timing case cover.

Note:
Timing case cover could also be removed without removing the water pump.

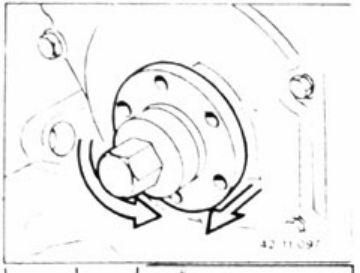


Unscrew bolts on vibration damper and take off vibration damper.

Installation:
Align dowel pin bore in vibration damper with dowel pin.
Tightening torque = 23 Nm (17 ft. lbs.).

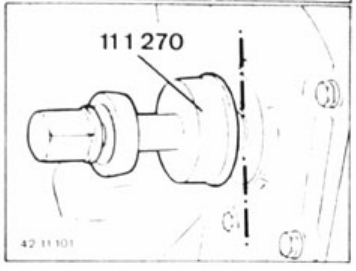


Installation:
Replace gaskets.
Check dowel sleeves.

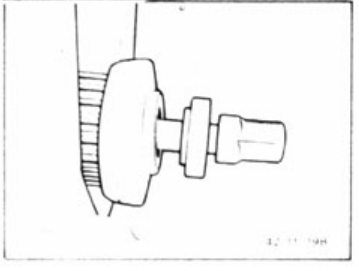


o Removing Vibration Damper Hub:

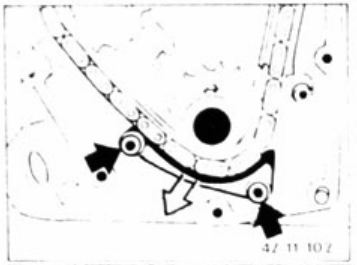
Hold flywheel with Special Tool 11 2 170.
Unscrew central bolt.
Take off washer and hub.



Installation:
Press in new radial oil seal flush with thrust ring of Special Tool 11 1 270 in conjunction with the central bolt and washer, with the timing case cover mounted.

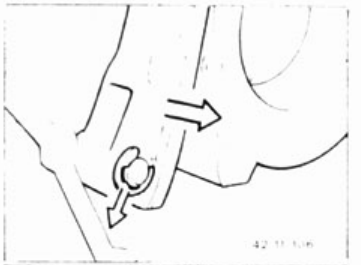


Installation:
Align groove of hub with woodruff key.
Collar of washer faces hub.
Tightening torque of central bolt = 310 Nm (224 ft. lbs.).

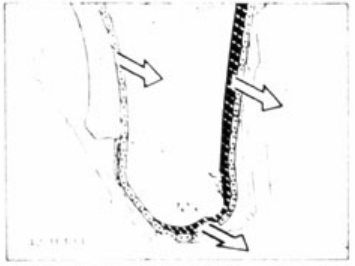


o Removing Timing Chain and Guides:

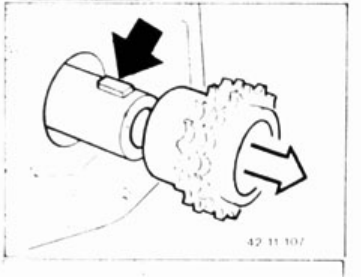
Unscrew lower guide.



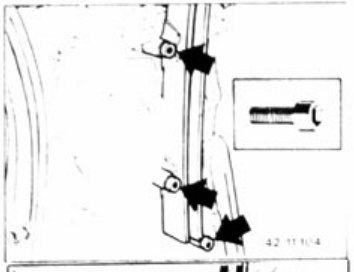
If applicable, remove tensioning rail



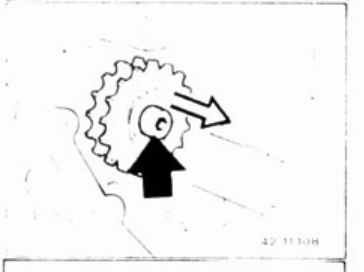
Lift out chain.



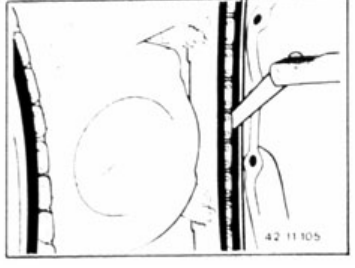
Pull sprocket off of the crankshaft.
Lift out woodruff key.



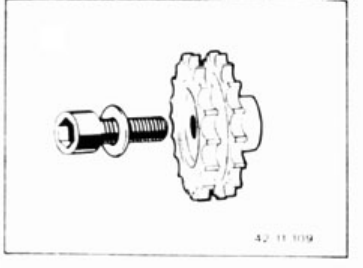
Remove chain guide.



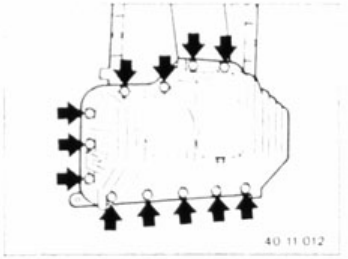
If applicable, remove reversing roller



Installation:
Align and bolt chain guide only after installation of the cylinder head and complete chain system.



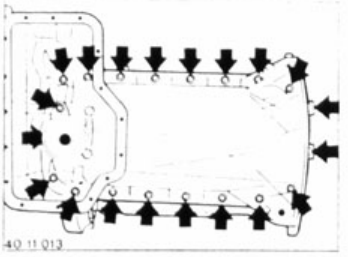
Note:
Reversing roller may be replaced only complete with the bearing.



o Removing Oil Pan:

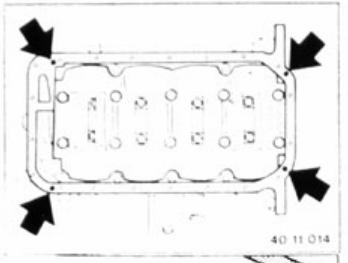
Unscrew bolts and take off lower oil pan section.

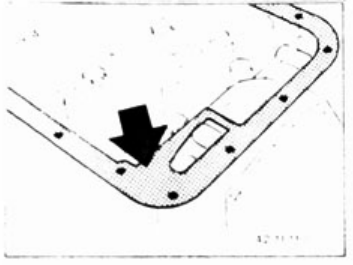
Installation:
Replace gasket.
Tightening torque = 9 Nm (6.5 ft. lbs.).



Unscrew bolts and take off oil pan.

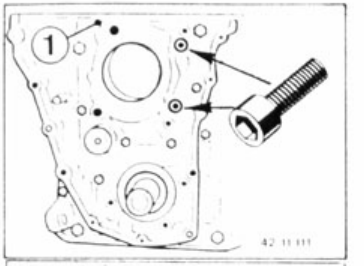
Installation
Replace gasket.
Fill in transitions to the timing case at front end and end cover at rear end with a permanently elastic sealing compound, 3 Bond 1207 B black**.
Tightening torque = 9 Nm (6.5 ft. lbs.).

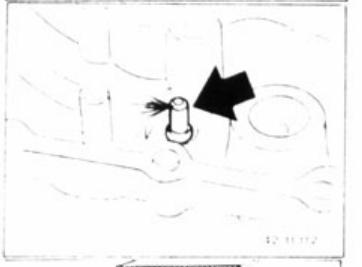


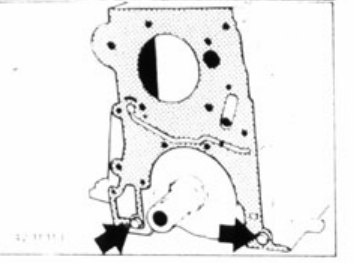


Installation:
Make sure gasket is positioned correctly (not inversed).

** Source of Supply: HWB







o Removing Timing Case and Oil Pump:

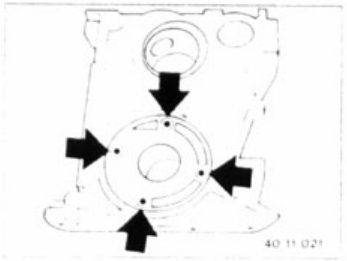
Unscrew all bolts.
Lift off timing case.

Installation:
Check location of socket head bolts.
Upper left bore (1) is not used.
Tighten all bolts uniformly.
Tightening torque*.

Installation
Chain lubrication spray jet faces bolt

Installation
Replace gasket.
Check dowel sleeves.

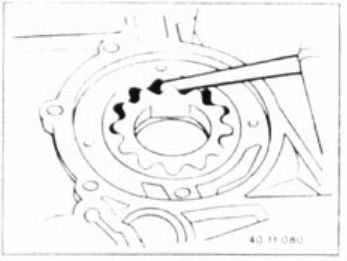
* See Specifications



o Removing - Checking Oil Pump

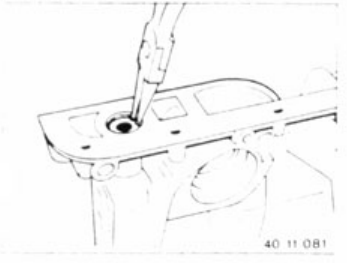
Unscrew bolts and remove cover.

Installation:
Bolt holes will only be aligned when cover is in correct installed position.
Tightening torque*.



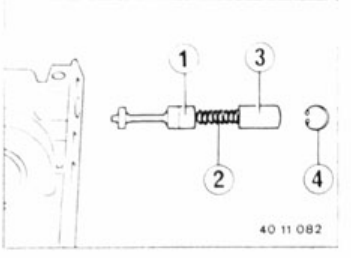
Measure play between pump body - outer rotor and outer rotor - inner rotor*.

Note:
Insert rotors in same position (inner rotor with guide facing the body).
Marks on inner and outer rotors face up.



Press down sleeve slightly using a suitable punch.
Lift out circlip and remove pressure valve.

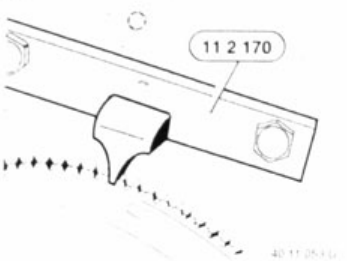
Caution!
Strong spring force.



Installation:
1 Piston
2 Spring
3 Sleeve
4 Circlip

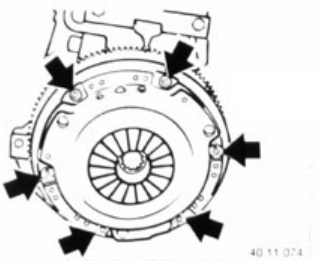
Measure length of unloaded spring (2).
Specification: 84.1 mm.

* Refer to Specifications



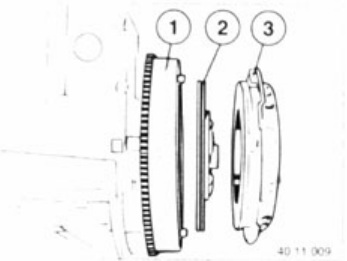
o Removing Clutch / Flywheel:

Hold flywheel using Special Tool 11 2 17



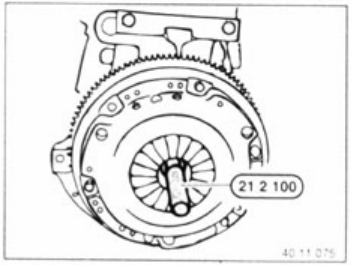
Unscrew bolts uniformly.
Remove pressure plate and drive plate.

Installation:
Check for dowel pins.



Installation:
1 Flywheel
2 Drive plate
3 Pressure plate

Flat side of drive plate (2) faces flywheel (



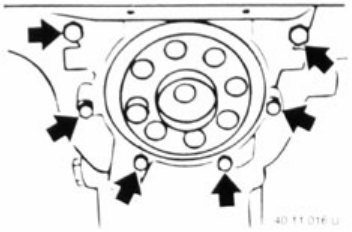
Center drive plate using Special Tool 21 2 100 and tighten bolts.
Tightening torque*.

* Refer to Specifications



Unscrew bolts and remove flywheel.

Installation:
Clean threads and install bolts using bolt cement**.
Tightening torque*.

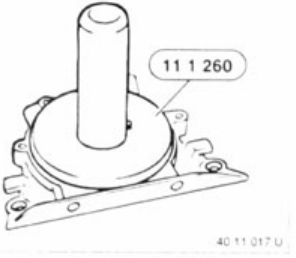


o Removing Rear End Cover

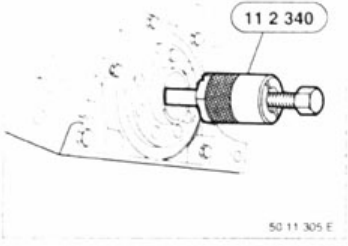
Unscrew bolts and remove cover.



Installation:
Check for dowel sleeve.

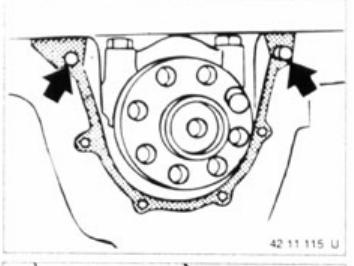


Installation:
Lift out radial oil seal and drive in new seal using Special Tool 11 1 260.

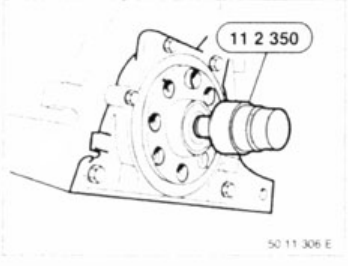


o Replacing Pilot Bearing in Crankshaft

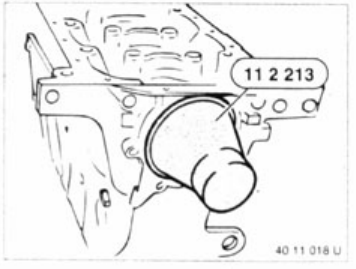
Remove pilot bearing using Special Tool 11 2 340 or 11 2 010.



Installation:
Replace gasket.
Check for dowel sleeves.

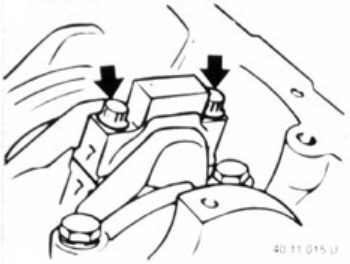


Installation:
Insert and drive in pilot bearing as far as stop using Special Tool 11 2 350 or 11 2 030.



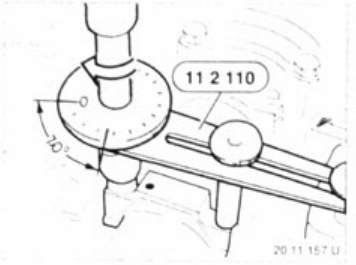
Installation:
Apply Special Tool 11 2 213 on crankshaft
Lubricate sealing lip of radial oil seal with oil.
Mount and bolt cover.

* Refer to Specifications
** Source of Supply: BMW Parts



o Removing Connecting Rod and Piston

Unscrew conrod bearing cap.
Pull out connecting rod and piston to the cylinder head end.



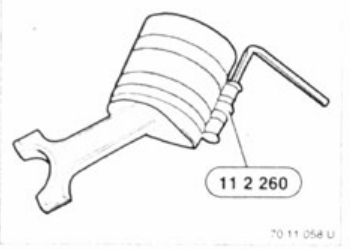
Installation:
Conrod bolt tightening procedures:
Lubricate conrod bearing shells with oil.
Mount bearing cap that pair numbers are aligned.

Install new conrod bolts.

Tighten conrod bolts in two steps using Special Tool 00 9 120 or 11 2 110.

Tightening torque*.

Important!
Reinstall piston, connecting rod and bearing shells in the same installed position.
Connecting rods and bearing caps are marked with the same pair number and must not be mixed up.



Installation:
Lubricate piston and piston rings lightly with oil.
Align gaps of piston rings (offset approx. 120°, but not above the piston pin eye).
Compress piston rings using Special Tool 11 2 260.

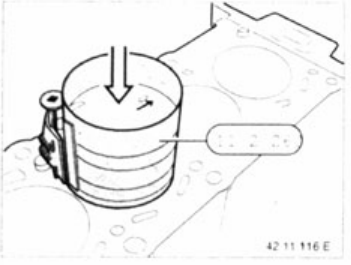


o Removing / Checking Connecting Rod

Lift out circlip and press out piston pin.

Important!
Pistons and piston pins are matched and must not be mixed up.

Installation:
Insert circlip in such a manner that its gap is opposite the opening.

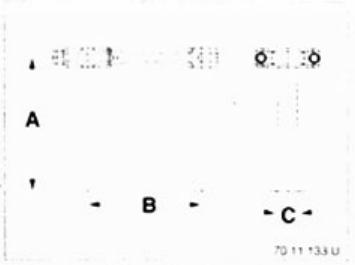


Installation:
Insert piston that arrow points to camshaft drive.
Compressing tool must bear flat on crankcase all around.
Press in piston with light knocks (e.g. from handle of a hammer).
Guide crankshaft journal and connecting rod together at same time.



Installation:
Install connecting rod in such a manner that when the pair number is visible the installed direction arrow on the piston points to the right.

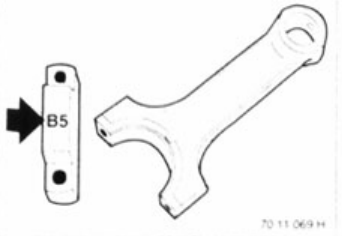
* Refer to Specifications



Checking Connecting Rod:

Check connecting rod for deviation in parallelism and distortion.

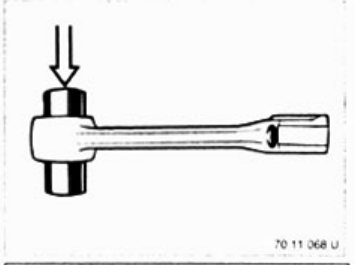
A Testing distance*
B Permissible parallel deviation at distance A*
C Max. permissible distortion to each side*



Replacing Connecting Rod:

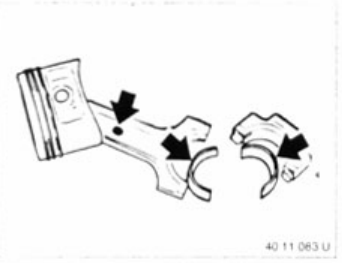
Only connecting rods of the same weight class (stamped on bearing cap) may be installed in one engine.

Consequently only complete sets are available from Parts.



Checking Piston Pin Bush:

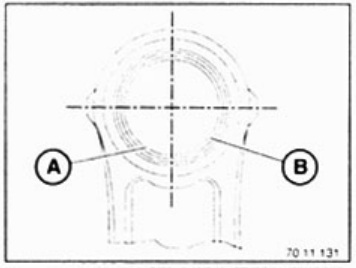
It should be possible to push the piston pin through the bush by hand with slight force and there must not be noticeable play.



o Replacing Conrod Bearing Shells

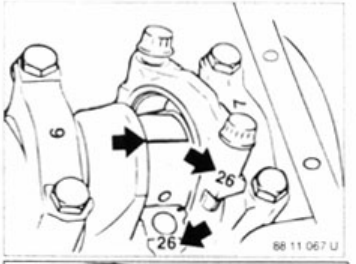
Select new bearing shells to conform with paint mark on connecting rod.

Important!
Check ground size of the crankshaft - also refer to "Replacing Main Bearing Shells".



Replacing Piston Pin Bush:

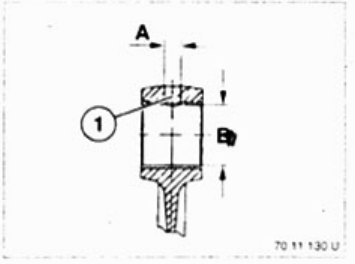
Press out old bush using a suitable punch.
Press in new bush with bush gap located optionally at A or B.



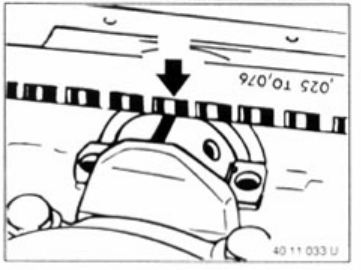
Installation:
Checking conrod bearing play.
Only carry out for control purposes.

With piston in BDC place Type PG1 Plastigage (Special Tool 00 2 590) on crankshaft wiped clean of oil.
Mount bearing cap and secure with old conrod bolts tightened to specifications.

Important!
Don't turn the connecting rod or crankshaft



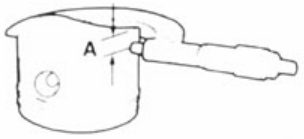
Drill oil bore (1).
Diameter A = 6 mm.
Remove burrs from both ends of bore.
Ream out bush to specified diameter* using a reamer.



Remove bearing cap and read bearing play by measuring width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by install new bearing shells or bearing shells with a different paint mark.

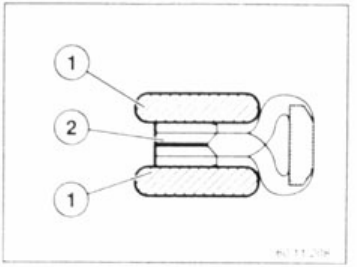
* Refer to Specifications

* Refer to Specifications

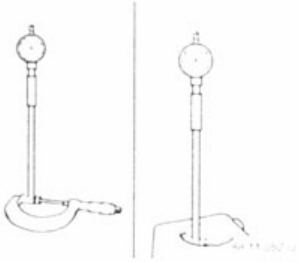


o Replacing Checking Piston

Installation:
Measure the piston installed clearance before installing.
Measure the piston diameter at distance A = 13 mm from the bottom edge of the piston using a micrometer.

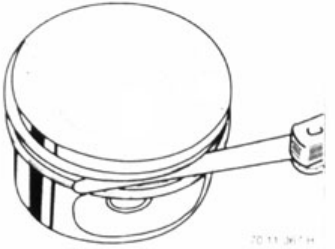


Installation:
The oil scraper ring consists of two steel band rings (1) and one spring ring (2).
Install all parts separately.
Offset gaps about 120°.



Set internal caliper to zero on micrometer with the measured piston diameter.
Measure cylinder bore at bottom, middle and top diagonally.

New piston installed clearance*.
Max. permissible total wear clearance*.



Measure side clearance.

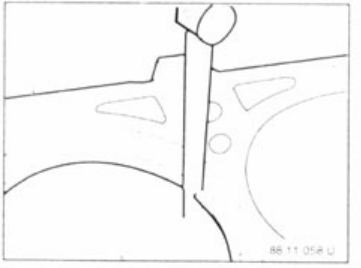
Specification*.



o Replacing Checking Piston Rings

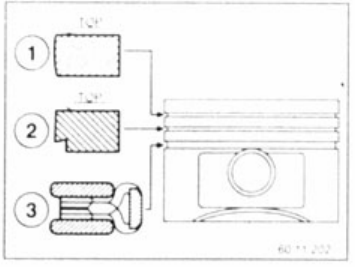
Remove piston rings using a piston ring compressing pliers.

Note:
Identification might not be visible on used piston rings.
Lay piston rings aside in correct sequence and position of installation.



Measure end clearance.

Specification*.



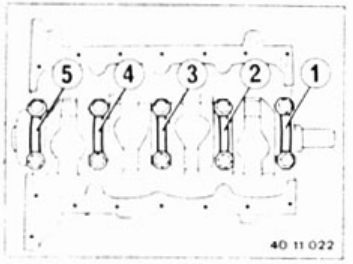
Installation:
Insert piston rings with "TOP" facing piston crown.

1 Plain compression ring
2 Stepped taper face ring
3 Steel band oil scraper ring

Offset piston ring gaps about 120° to each other, but not above the piston pin eye.

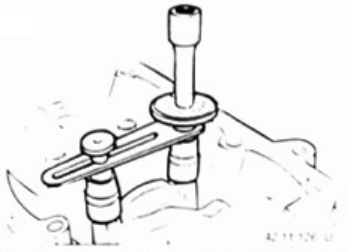
* Refer to Specifications

* Refer to Specifications



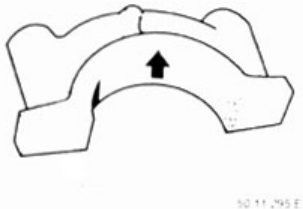
o Removing Crankshaft (Replacing Crankshaft - refer to 11 21 501)

Unscrew main bearing caps (1 .... 5) and lift out crankshaft.



Main Bearing Tightening Procedures:

Tighten bolts (washed and lubricated with oil) in two steps.
Tightening torque*.

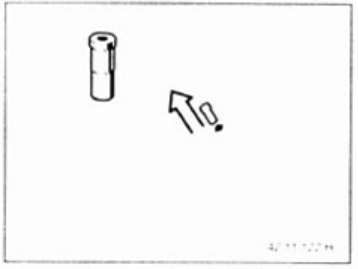


Installation
Bearing caps 1 ... 3 are marked with die-stamped numbers.
Bearing cap 4 has a shoulder on the cap side.
Bearing cap 5 is not marked.

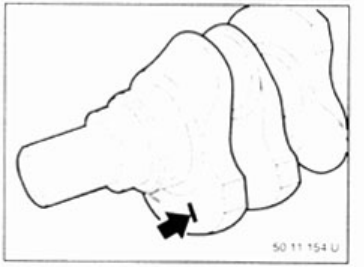


o Replacing Main Bearing Shells

The crankshaft is marked with yellow, green or white paint depending on main bearing journal tolerances.



Installation
Ensure that oil spray jets are used at bearings 2 .... 5.



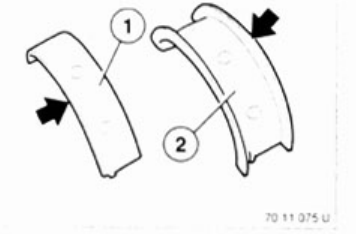
Important!
Check ground size* of the crankshaft.

1 paint stripe — Size 1*
2 paint stripes — Size 2*



Installation
Lubricate bearing shells with oil.
Install crankshaft.
Mount bearing caps 1 .... 5 (bearing no. 1 at camshaft drive end) in such a manner that grooves of the bearing shell guide are on one side.
Align bearing caps precisely.

Note:
The thrust bearing shell is installed only in the crankcase at bearing no. 4.

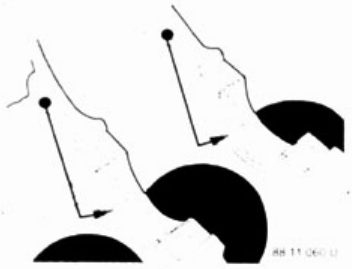


Bearing shells are marked with yellow, green or white paint.

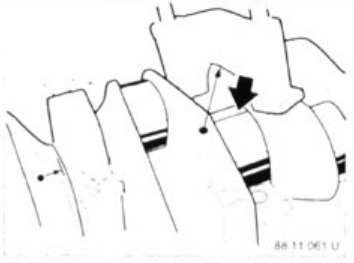
1 Bearing shell 1-2-3-4-5 (5 only cap)
2 Bearing shell 4 (thrust bearing only crankcase)

Check ground size of main bearing journal

* Refer to Specifications

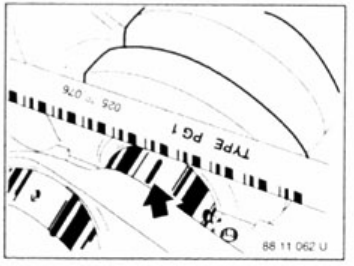


Place bearing shell in crankcase having same paint mark color as dot of paint on crankcase.
If paint mark has been washed off of crankcase, install both bearing shells according to the crankshaft paint mark color.
Install bearing shells in bearing caps having same paint mark color as that of the crankshaft.

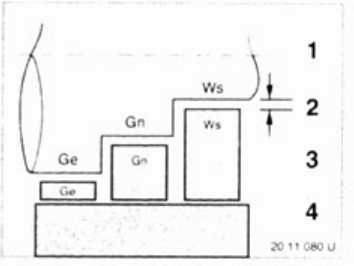


Check bearing clearance.
Only carry out this step for control purposes.

Install crankshaft.
Place Type PG 1 Plastigage (Special Tool 00 2 590) on crankshaft wiped clean of oil and tighten bearing cap bolts as specified.
Tightening torque*.
Don't turn the crankshaft.



Remove bearing cap and read bearing play* by measuring width of the flattened Plasti- gage with help of the supplied scale.
Correct the bearing play by installing new bearing shells or bearing shells with a different paint mark.

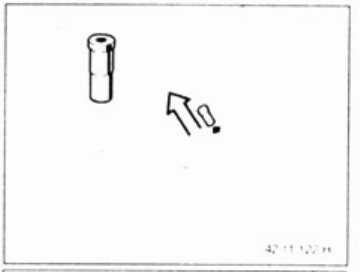


Color Code Shaft Diameter Bearing Shell Thickness* Survey

Triple Classification Color Codes:
Ge = Yellow
Gn = Green
Ws = White

1 = Crankshaft diameter
2 = Bearing play
3 = Bearing shell thickness
4 = Journal diameter

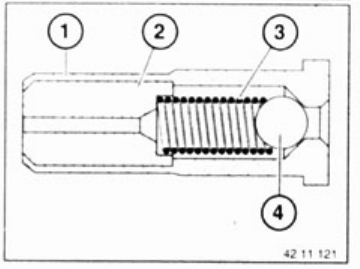
* Refer to Specifications



o Replacing Spray Jets in Crankcase

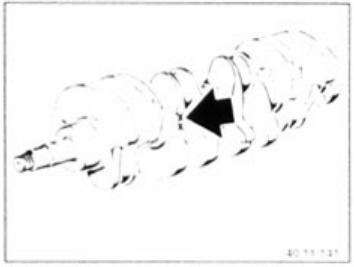
Note:
Spray jets are installed in bores of crankcase for bearings 2-3-4-5 and serve lubrication of piston pins and cooling of pistons

Pull spray jet out of crankcase.



Spray Jet Assembly:

1 Jet body
2 Jet
3 Spring
4 Ball



11 21 501 REPLACING CRANKSHAFT
– Crankshaft Removed –

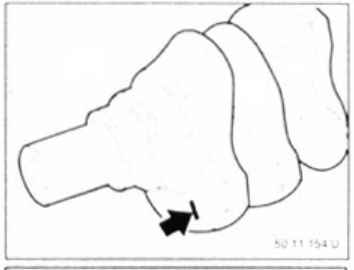
Note:
Replacement crankshafts are supplied complete with corresponding bearing shells for main and conrod bearings.

Crankshaft Identification (cast in crank web):

Engine	Stroke (mm)
M42 B18	81



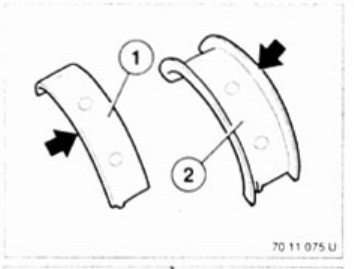
The crankshaft is marked with yellow, green or white paint depending on main bearing journal tolerances.



The crankshaft is surface treated and may only be reground in the factory.

Reground crankshafts are marked with stripes of paint.

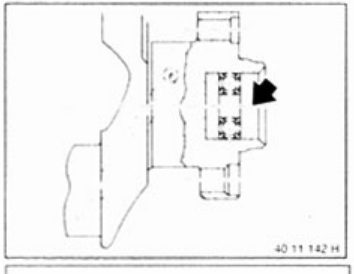
1 paint stripe	Size 1 *
2 paint stripes	Size 2 *



Bearing shells are marked with yellow, green or white paint.

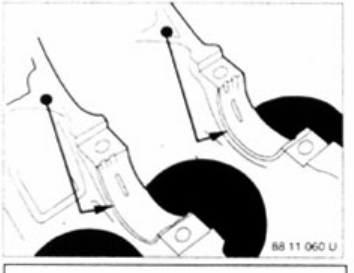
1 Bearing shell 1-2-3-4-5 (5 only cap)
2 Bearing shell 4 (thrust bearing only crankcase)

Check ground size of main bearing journal



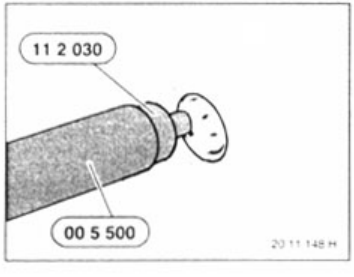
Models with Manual Transmission.

Install pilot bearing for transmission's main shaft.

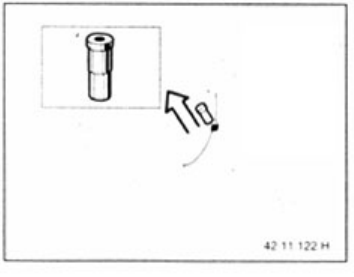


Installing Procedures:

Only place "yellow" color code bearing shells in crankcase (regardless of paint mark still visible on crankcase).
Install "yellow-green-white" color code bearing shells in bearing caps depending on the crankshaft bearing journal paint mark color

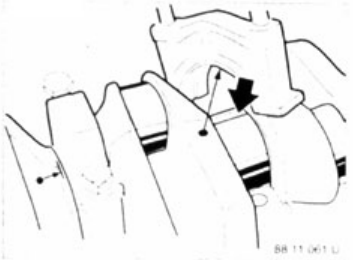


Knock in pilot bearing using Special Tool 11 2 350 or 11 2 030 and Special Tool 00 5 500.



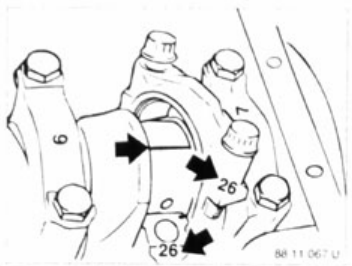
Installation:
Ensure that oil spray jets are used at bearings 2 ... 5.

* Refer to Specifications



Check bearing clearance.
Only carry out this step for control purposes.

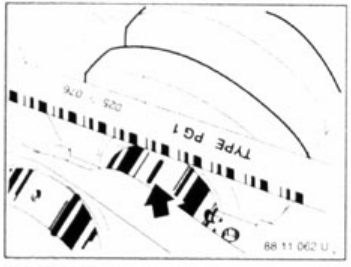
Install crankshaft.
Place Type PG 1 Plastigage (Special Tool 00 2 590) on crankshaft wiped clean of oil and tighten bearing cap bolts as specified.
Tightening torque*.
Don't turn the crankshaft.



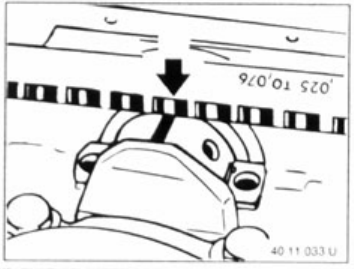
Installation
Check conrod bearing clearance.
Only carry out this step for control purposes.

With piston at BDC place Type PG 1 Plastigage (Special Tool 00 2 590) on crankshaft wiped clean of oil and tighten bearing cap bolts as specified.
Tightening torque*.

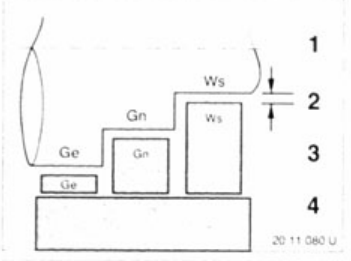
Important!
Don't turn the connecting rod or crankshaft



Remove bearing cap and read bearing play* by measuring width of the flattened Plasti- gage with help of the supplied scale.
Correct the bearing play by installing new bearing shells or bearing shells with a different paint mark.



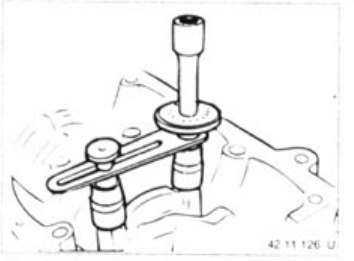
Remove bearing cap and read bearing play by measuring width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells or bearing shells with a different paint mark.



Color Code Shaft Diameter Bearing Shell Thickness* Survey

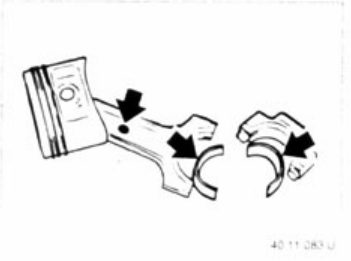
Triple Classification Color Codes:
Ge = Yellow
Gn = Green
Ws = White

1 = Crankshaft diameter
2 = Bearing play
3 = Bearing shell thickness
4 = Journal diameter



Main Bearing Bolt Tightening Procedures:

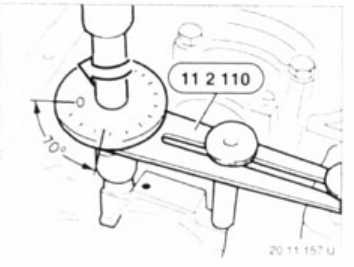
Tighten bolts (washed and lubricated with oil) in two steps.
Tightening torque*.



Replacing Conrod Bearing Shells:

Red or blue conrod bearing shells are installed standard depending on paint mark color on connecting rod for pertinent ground size or crankshaft.

Only install red bearing shells of pertinent ground size when replacing crankshaft.



Conrod Bolt Tightening Procedures:

Lubricate conrod bearing shells with oil.
Mount bearing cap that pair numbers are aligned.

Install new conrod bolts.

Tighten conrod bolts in two steps using Special Tool 00 9 120 or 11 2 110.
Tightening torque*.

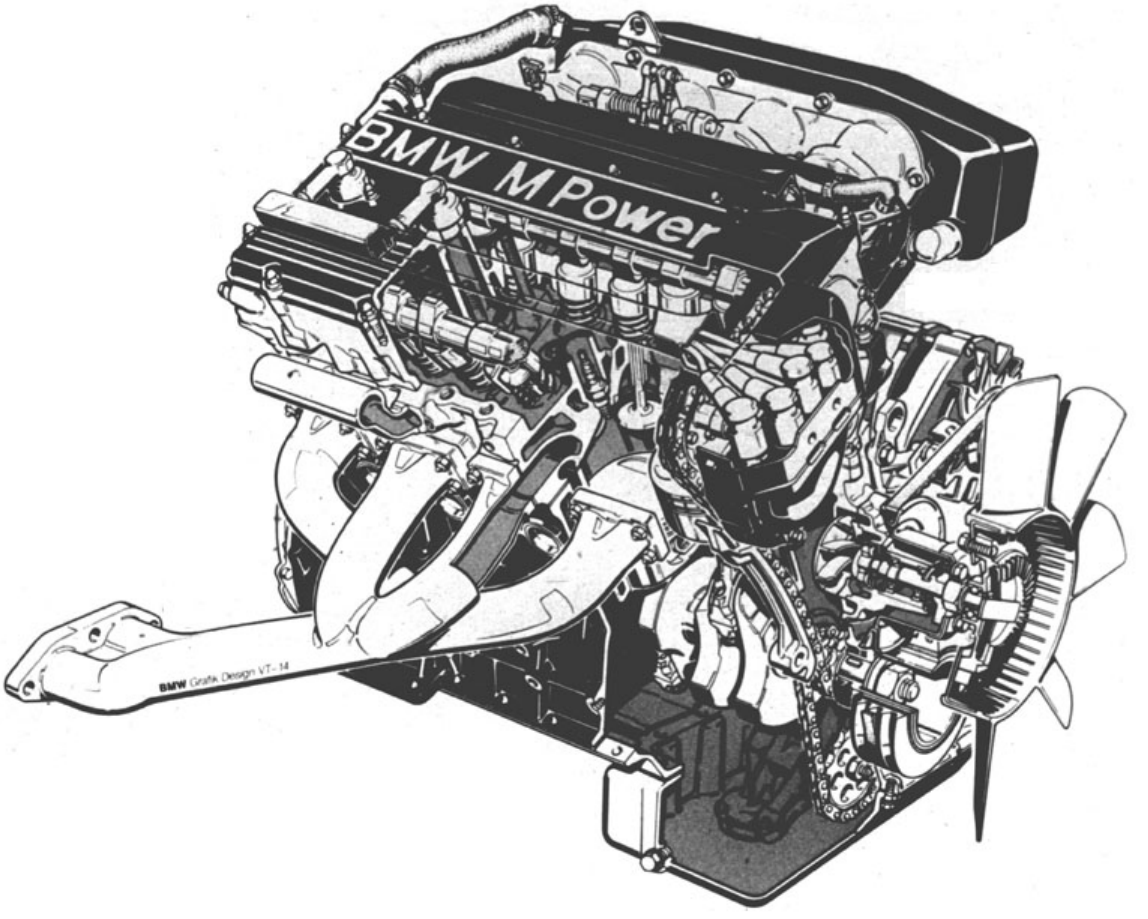
* Refer to Specifications

* Refer to Specifications

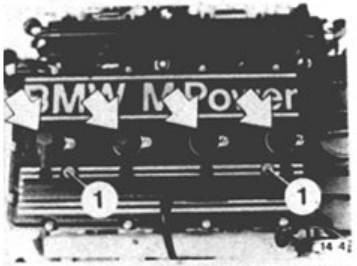
Constrution group 11 Engine S14

S14 = 4 Cylinder M-Power Engine

	Engine view	11-	50
11 12 000	Cylinder head cover – remove and install	11-	51
101	Cylinder head gasket – replace	11-	51
500	Cylinder head – remove and install – engine removed	11-	52
595	Valve guide – inspect for wear – valve removed	11-	54
600	Valve guide – ream – valve removed	11-	54
607	Valve seats and valves – machine – valves removed	11-	54
719	Cylinder head sealing surface – grind – cylinder head disassembled This job is not approved for S14 engines.	11-	55
729	Cylinder head – inspect for cracks in water test – cylinder head disassembled	11-	55
11 14 105	Radial oil seal in distributor housing – replace	11-	56
110	Lower timing case cover – remove and install / seal	11-	56
141	Radial oil seal in lower timing case cover – replace	11-	58
605	Radial oil seal in clutch end cover – replace	11-	58
11 21 000	Crankshaft – remove and install	11-	59
120	Crankshaft pulley – remove and install	11-	60
501	Crankshaft – replace – crankshaft removed	11-	61
531	Crankshaft main bearing shells – replace – engine disassembled	11-	61b
571	Pilot bearing in crankshaft – replace	11-	62
11 22 000	Flywheel – remove and install	11-	63
541	Starter gear ring – replace	11-	63
11 24 521	Connecting rods – replace – pistons removed	11-	64
571	Conrod bearing shells – replace – disassemble engine	11-	64
11 25 000	Pistons – remove and install – engine removed	11-	65
651	Piston rings of one piston – replace	11-	66
11 31 000	Camshaft – remove and install	11-	67
051	Timing chain – replace	11-	70
061	Timing chain sprocket set – replace – timing chain removed	11-	71
090	Timing chain tensioner piston – remove and install	11-	72
11 34 004	Valve clearance – adjust	11-	73
509	Valves – check for leaks – cylinder head removed	11-	73
550	Valves – remove and install – cylinder head removed	11-	74
11 40 000	Engine oil pressure – check	11-	75
11 41 000	Oil pump – remove and install	11-	75
151	Oil pump drive chain – replace	11-	76
11 42 021	Full flow oil filter – replace	11-	77
11 43 101	Oil dipstick guide tube	11-	78
11 51 000	Water pump – remove and install	11-	78
11 52 000	Fan – remove and install	11-	79
020	Fan clutch – replace	11-	79
11 53 000	Coolant thermostat – remove and install	11-	79

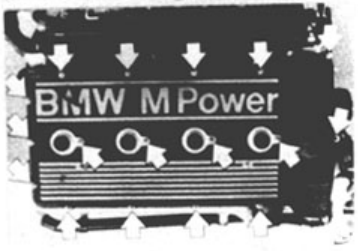


S 14 B 20 – BMW 320 is
S 14 B 23 – BMW M 3

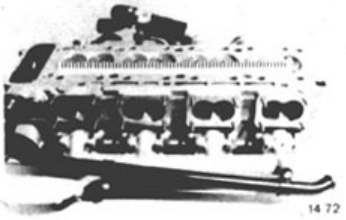


11 12 000 REMOVING CYLINDER HEAD COVER

Unscrew ignition lead tube (1) and pull out spark plug connectors.

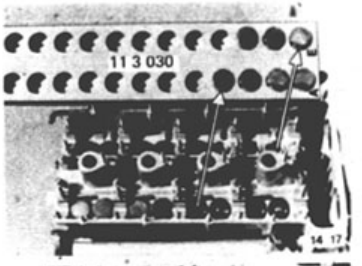


Unscrew cylinder head cover.
Installation:
Check gaskets, replacing if necessary.



11 12 101 REPLACING CYLINDER HEAD GASKET

Remove cylinder head – see 11 12 500.
Clean sealing surfaces on cylinder head and crankcase thoroughly – use a sealant remover** and hard wood scraper.
Check levelness with a standard steel ruler.

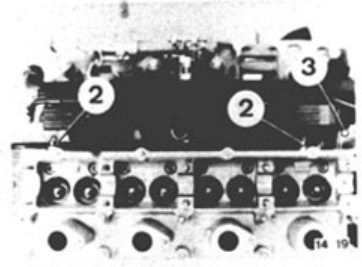


11 12 500 REMOVING AND INSTALLING CYLINDER HEAD
– Engine Removed –

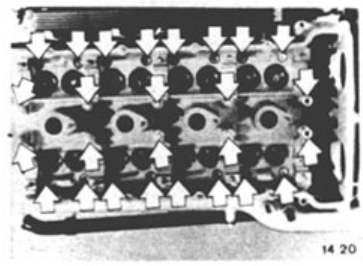
Remove camshaft – see 11 31 000.
Pull out tappets and place them on the tray, Special Tool 11 3 030.
Installation:
Insert tappets in the same position.



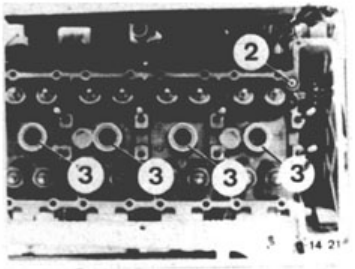
Unscrew bolts.
Installation:
Longer bolt (1) is used to lock the shaft for the upper tensioning rail.



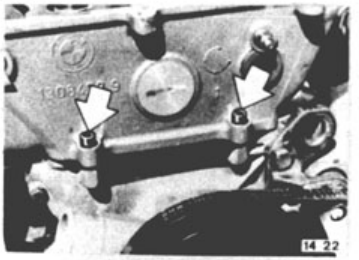
Unscrew pipe (2).
Unscrew bolt (3).



Unscrew timing case.



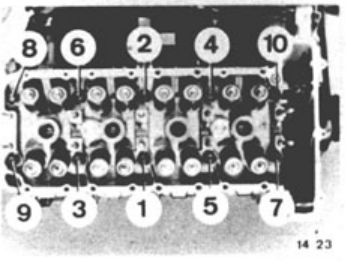
Installation:
Replace O-ring (2) in oil bore.
Check O-rings (3), replacing if necessary.
Coat sealing surfaces with Three Bond 1207**.
Tighten bolts uniformly.
Tightening torque:
M 7 = 15 +/- 2 Nm (11 +/- 1.5 ft. lbs.)
M 8 = 21 +/- 1 Nm (15 +/- 1 ft. lbs.)



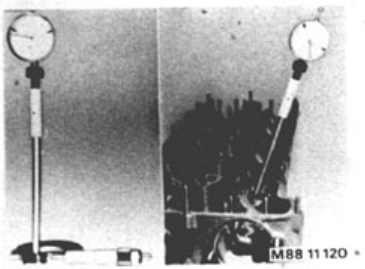
Unscrew bolts.



Measuring Tappet Clearance:
Measure tappet diameter with a micrometer.



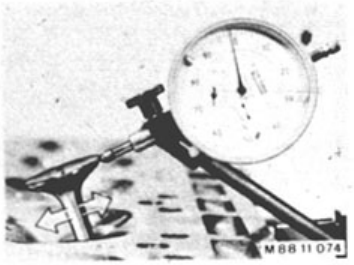
Unscrew cylinder head bolts in order of 10 through 1 and lift off cylinder head.
Installation:
Clean cavities in crankcase and cylinder head bolts.
Lubricate cylinder head bolts with oil.
Replace cylinder head gasket.



Set internal calipers to zero on the micrometer with the measured tappet diameter.
Measure tappet bore diameter.
Compare measured tappet clearance with the specified clearance.
Tappet Clearance/Installed Clearance:
0.025 to 0.066 mm (0.0010 to 0.0026").

Check tensioning rail arrangement while mounting the cylinder head.
Tighten bolts in order of 1 through 10 in three steps.
Step 1: 50 +/- 2 Nm (36 +/- 1.5 ft. lbs.)
Step 2: 80 +/- 2 Nm (58 +/- 1.5 ft. lbs.)
Wait 15 minutes.
Step 3: 100 +/- 2Nm (72 +/- 1.5 ft. lbs.)
Check and adjust engine idle speed - see 13 00 054.

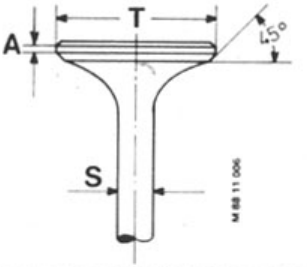
** Source of Supply: HWB



11 12 595 CHECKING VALVE GUIDE FOR WEAR
– Valve Removed –

To measure, insert a new valve that end of valve stem is flush with valve guide.
Mount the dial gage and measure tilt play.
Max. permissible tilt play:

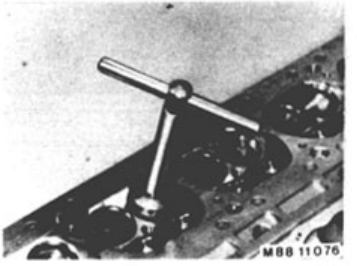
Intake valve	0.65 mm (0.025")
Exhaust valve	0.80 mm (0.031")



11 12 607 MACHINING VALVE SEATS AND VALVES
– Valves Removed –

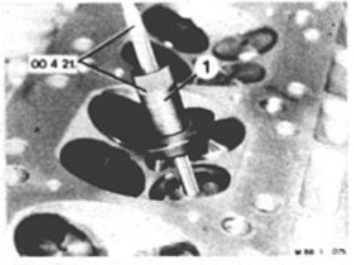
Valve must be replaced, if minimum edge thickness "A" is not held.

"A" Intake valve	0.50 mm (0.020")
"A" Exhaust valve	0.95 mm (0.037")
"T" Intake valve	37 – 0.1 mm (1.457 – 0.004")
"T" Exhaust valve	32 – 0.1 mm (1.260 0.004")



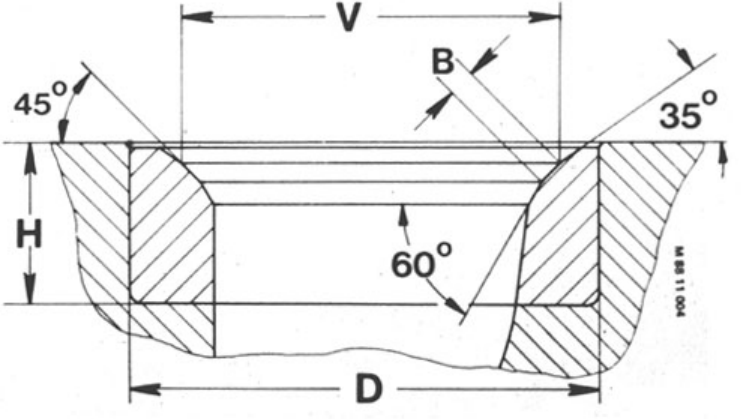
After machining the valve seat angle (45°), produce valve seat diameter V and valve seat width B by machining correction angles (35°/60°). Grind in valves with grinding paste and check for leaks – see 11 34 509.

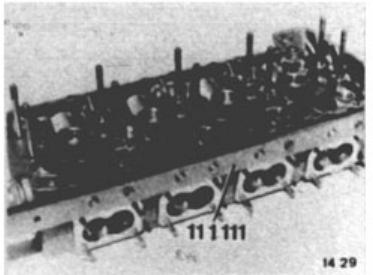
"V" Intake valve	36.6 + 0.1 mm (1.441 + 0.004")
"V" Exhaust valve	31.4 + 0.1 mm (1.236 + 0.004")
"B" Intake valve	1.2 + 0.1 mm (0.047 + 0.004")
"B" Exhaust valve	1.4 + 0.1 mm (0.055 + 0.004")



11 12 600 REAMING OUT VALVE GUIDE
– Valve Removed –

If there is excessive play between the valve guide and valve stem, see 11 12 595, ream out the valve guide and install an oversize valve with stem diameter "S" = 7.1 or 7.2 mm (0.279 or 0.283").
The valve seat must then also be machined – see 11 12 607.
Press guide (1) against the valve seat and ream out the valve guide from the combustion chamber end – turn down the reamer once.

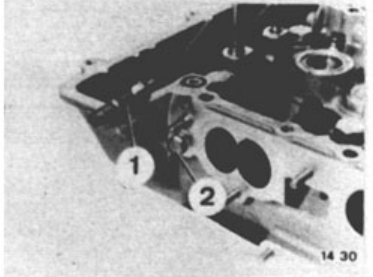




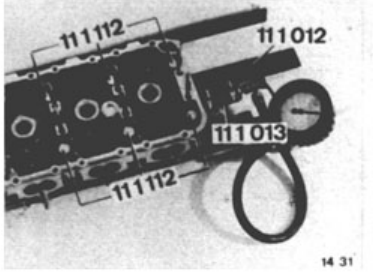
11 12 729 CHECKING CYLINDER HEAD FOR CRACKS IN A WATER TEST

- Cyl. Head Disassembled -

Bolt on Special Tool 11 1 111.

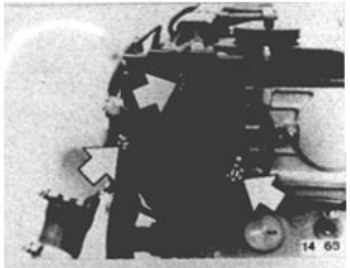


Unscrew connector (1).
Plug opening with bolt (2) - copper bolt from M 30 exhaust manifold.



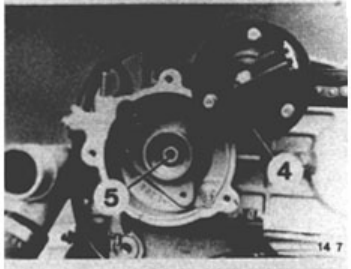
Bolt on Special Tools 11 1 012 with Special Tools 11 1 112.
Install Special Tool 11 1 113.
Fill cylinder head with air pressure - 2 bar (28 psi) testing pressure - and check for cracks (leaks) by placing it in a water bath.

Note:
Water bath can be relaxed with a detergent if necessary.



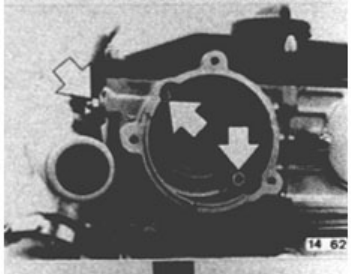
11 14 105 REPLACING RADIAL OIL SEAL IN DISTRIBUTOR HOUSING

Unscrew ignition lead tube.
Remove distributor cap.



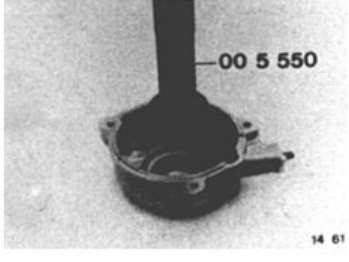
Unscrew distributor rotor (4).
Unscrew adapter (5).

Important!
Since 12.88 a high tension distributor cap with distributor rotor is installed, which has a fixed brass pin instead of a spring-loaded carbon pin.
The corresponding distributor rotor has a hole.
Mixed installation of both versions is not possible.

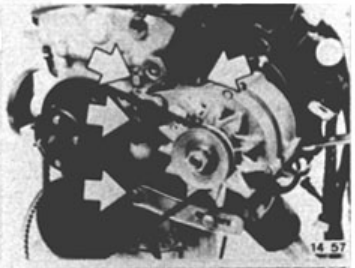


Unscrew distributor housing.

Installation:
Check O-ring, replacing if necessary.



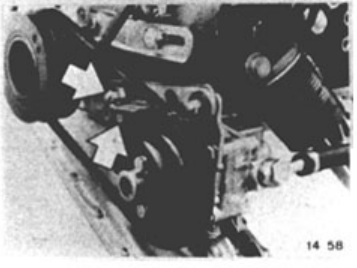
Lift out radial oil seal.
Drive in new radial oil seal with Special Tool 00 5 550.
Lubricate sealing lip with oil.



11 14 110 REMOVING AND INSTALLING / SEALING LOWER TIMING CASE COVER

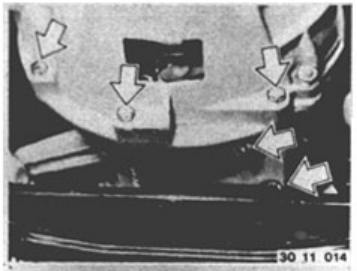
Unscrew alternator.

Installation:
Tension drive belt and check tightness with Special Tool 11 5 020.

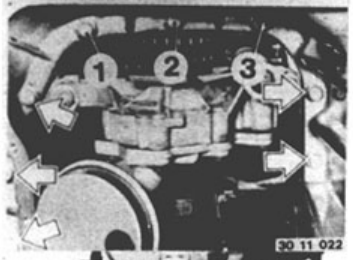


Unscrew hydraulic pump.
Hoses remain connected.

Installation:
Tension drive belt and check tightness with Special Tool 11 5 020.



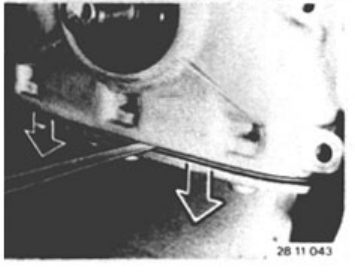
Unscrew reinforcement plate.
Remove lower oil pan section – see 11 13 020.



Unscrew and remove bolts (1 ... 3).
Loosen remaining oil pan bolts.
Installation:
Install bolts (1 ... 3) with Loctite No. 270**.

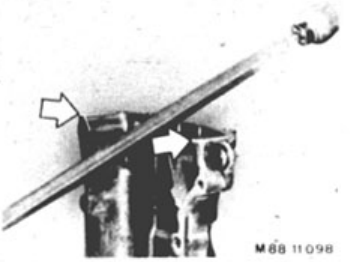


Remove water pump – see 11 51 000.
Remove pulley on crankshaft – see 11 21 120.
Remove piston for chain tensioner – see 11 31 090.
Unscrew bolts (4).
Unscrew remaining bolts on timing case cover.

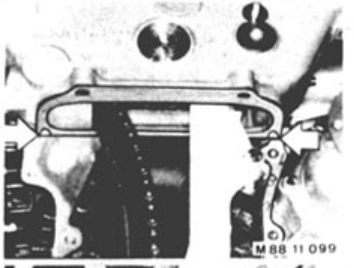


Loosen oil pan gasket on timing case cover carefully with a knife.
If oil pan gasket is damaged, remove oil pan and replace gasket – see 11 13 000.

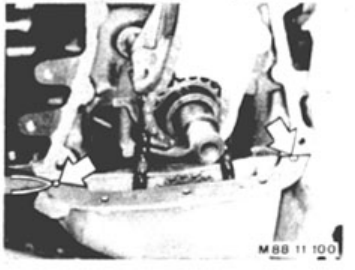
** Source: HWB



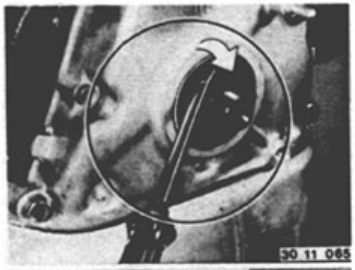
Take off timing case cover.
Installation:
Break upper edges with a file.
Coat sealing surfaces with Three Bond Silicone 1207**.



Installation:
Install new gaskets, coat with Three Bond Silicone 1207** and cut off ends.
Coat mating surfaces with Three Bond Silicone 1207**.
Guide in cover uniformly.



** Source: HWB



11 14 141 REPLACING RADIAL OIL SEAL IN TIMING CASE COVER

Remove pulley on crankshaft – see 11 21 120.
Lift out radial oil seal with a screwdriver.

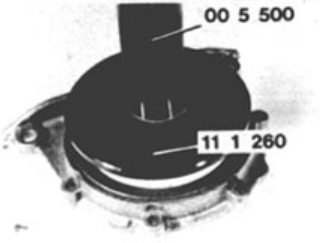


Lubricate sealing lip of radial oil seal with oil.
Press in radial oil seal flush with Special Tools 11 1 273 and 11 1 271.



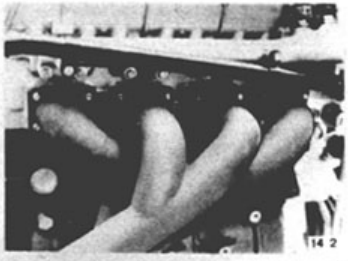
11 14 605 REPLACING RADIAL OIL SEAL IN CLUTCH END COVER – Transmission Removed –

Remove flywheel – see 11 22 000.
Drain engine oil.
Loosen oil pan.
Loosen gasket in area of end cover/oil pan joint carefully with a knife.
Remove end cover.
Press radial oil seal out of end cover.



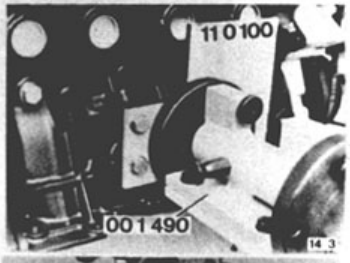
Installation:
Replace gasket.
Remove oil pan – see 11 13 000 if oil pan gasket was damaged.
Coat end cover/oil pan joint with Three Bond Silicone 1207**.
Use Special Tool 11 2 213 to avoid damaging the radial oil seal.
Add engine oil***.
Use Special Tools 11 1 260 and 00 5 500 to press in the radial oil seal.
Press in new radial oil seal with approx. 1 to 2 mm (0.039 to 0.079") offset toward the inside in contradiction to the standard seal, which was installed flush.
Lubricate sealing lip with oil.

** Source: HWB
*** See Service Information of Gr. 00

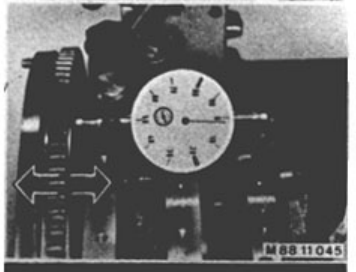


11 21 000 REMOVING AND INSTALLING CRANKSHAFT

Remove engine – see 11 00 050.
Remove exhaust manifold.
Installation:
Replace gaskets.
Tightening torque: 9 to 10 Nm (6.5 to 7.0 ft. lbs.).



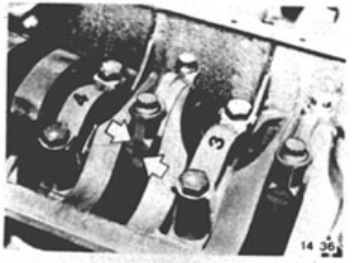
Unscrew engine mounts.
Mount crankcase on Special Tool 00 1 490 with help of Special Tool 11 0 100.



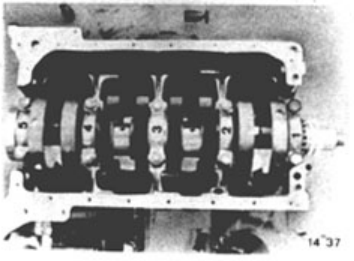
Remove clutch – see 21 21 000.
Remove cylinder head – see 11 12 100.
Remove timing chain – see 11 31 051.
Remove oil pump – 11 41 000.
Measure axial play before removing the crankshaft.
Nominal value: 0.085 to 0.174 mm (0.0033 to 0.0068").
Check/replace thrust bearing, if maximum permissible play is exceeded.



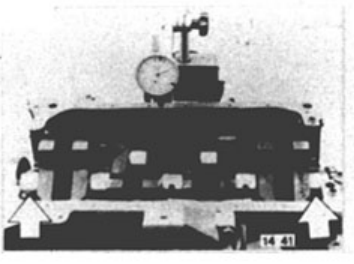
Remove flywheel – see 11 22 000.
Unscrew end cover.
Installation:
Replace gasket.
Use Special Tool 11 2 213 to avoid damaging the radial oil seal.
Cut off gasket along oil pan sealing surface.



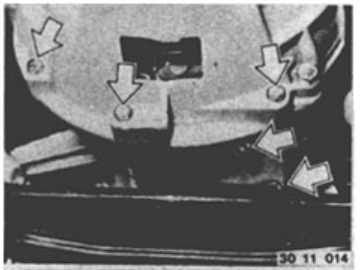
Unscrew conrod bearing caps.
Installation:
Replace conrod bearing shells and measure conrod bearing play – see 11 24 571.
Pair code (0 ... 99) must be the same on connecting rods and conrod bearing caps.



Unscrew crankshaft bearing caps and lift out the crankshaft.
Installation:
Bearing cap no. 1 is on the sprocket end.
Install bearing shells and check the bearing play – see 11 21 531.
Installation:
Measure axial play with installed crankshaft - loosen thrust bearing no. 3 again.
Center the thrust bearing by applying knocks on the front and rear ends of the crankshaft with a plastic hammer.
Tighten thrust bearing as specified.
Measure axial play.
Nominal value: 0.085 to 0.174 mm (0.0033 to 0.0068").
If the crankcase is replaced, clean oil and water bores again thoroughly to remove casting sand.

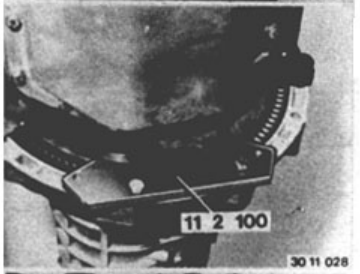


Checking Runout:
Install bearing shells 1 and 5.
Apply dial gage on center bearing and measure the runout while turning the crankshaft.
Nominal value: max. 0.1 mm (0.004").



11 21 120 REMOVING AND INSTALLING PULLEY ON CRANKSHAFT

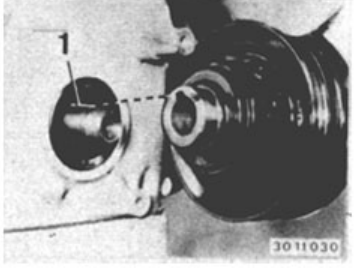
Unscrew reinforcement plate.



Hold flywheel with Special Tool 11 2 100.



Unscrew nut on pulley.
Pull off pulley.
Installation:
Tightening torque*.

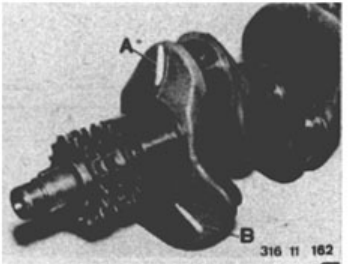


Installation:
Check for correct installed position of woodruff key (1).

* See Specifications

11 21 501 REPLACING CRANKSHAFT – Crankshaft Removed –

Note:
A replacement crankshaft is supplied complete with corresponding bearing shells for main and conrod bearings.

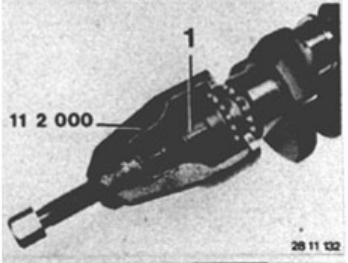


Crankshaft is surface treated and may only be reground in the factory.

Reground crankshafts are marked with stripes of paint.

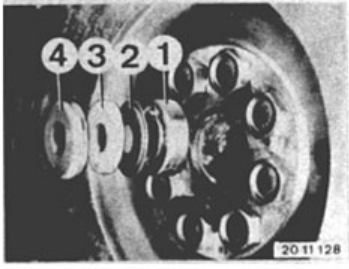
Conrod Bearing Journal (A)
1 paint stripe Size 1 *
2 paint stripes Size 2 *

Main Bearing Journal (B)
1 paint stripe Size 1 *
2 paint stripes Size 2 *



Transferring Sprocket:
Lift out woodruff key (1).
Pull off sprocket with Special Tool 11 2 000.

Installation:
Heat sprocket to max. 200° C (390° F) for installation.

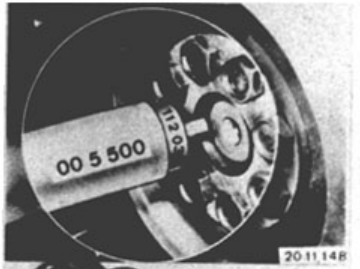


Cars with Manual Transmission:
Install pilot bearing for the transmission main shaft.

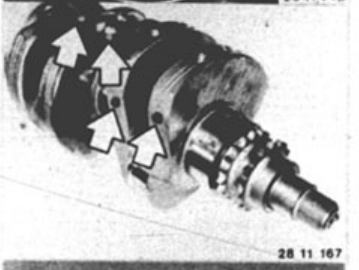
Installed Order:
Ball bearing (1), cover (2), felt ring (3) and capsule (4).

Insert cover (2) with embossment facing out.

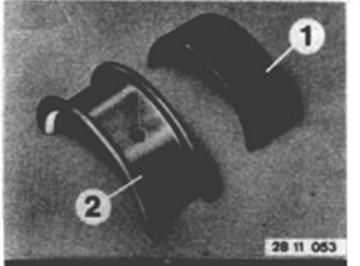
*** See Specifications**



Fill bore in crankshaft with approx. 1 gram (0.035 oz.) of lubricating grease. Drive in pilot bearing with Special Tools 11 2 030 and 00 5 500.



Replacement crankshafts are only supplied with bearing shells of double classification.
A crankshaft is marked with red or blue paint because of the main bearing journal tolerances.



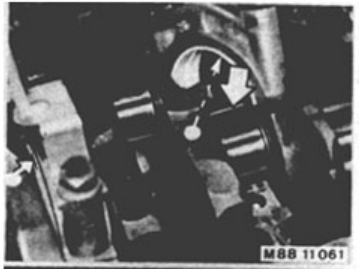
1 = Bearing shell 1–2–4–5
2 = Bearing shell 3 (pilot bearing)

The color code is located on the side of a bearing shell.

Check the ground size of main bearing journals.



Installing Instructions:
Only place bearing shells with "red" marks in the crankcase (regardless of the old color code mark on the crankcase).
Install bearing shells in bearing caps depending on the color code of the crankshaft main bearing journals – "red" or "blue".

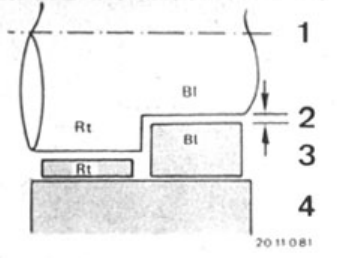


Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps with the correct torque*.
Do not turn the crankshaft.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt



Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with different color code marks.



Survey of Color Code/Shaft Diameter/ Bearing Shell Thickness*

Double Classification Color Codes:
Rt = red
Bl = blue

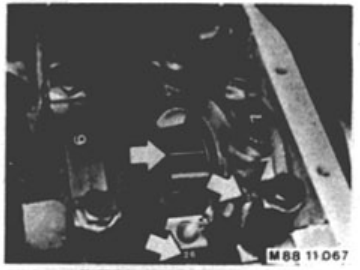
1 Crankshaft diameter
2 Bearing play
3 Bearing shell thickness
4 Console diameter



Replacing Conrod Bearing Shells:
Red or blue conrod bearing shells are installed standard depending on the color code mark on the connecting rod for a pertinent crankshaft ground size.

Only install the red bearing shells of a pertinent ground size supplied with a replacement crankshaft.

* See Specifications



Place Type PG-1 Plastigage on conrod bearing journals wiped clean of oil in BDC position.
Mount conrod caps – pair codes and grooves of bearing shells are on the outside.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt



Tighten bolts (use old conrod bolts).
Do not turn the crankshaft.
Remove conrod bearing caps.

Tightening Torque of Conrod Bolts:
Step 1 10 Nm (7 ft. lbs.)
Step 2 30 Nm (22 ft. lbs.)
Step 3 60° + 2° torque angle
Conrod bearing play: 0.024 to 0.064 mm (0.0009 to 0.0025").
Installation:
Use new conrod bolts for final installation.



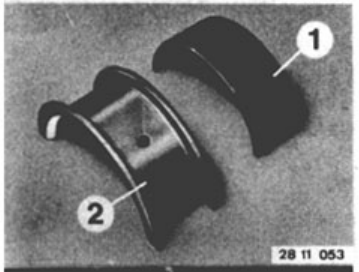
Check conrod bearing play by measuring width of the flattened Plastigage with help of the supplied scale.



28 11 167

11 21 531 REPLACING CRANKSHAFT MAIN BEARING SHELLS
– Engine Disassembled –

A crankshaft is marked with red or blue paint depending on main bearing journal tolerances.



28 11 053

1 = Bearing shell 1–2–4–5
2 = Bearing shell 3 (pilot bearing)

Color code mark is located on the side of a bearing shell.

Check the ground size of main bearing journals.



M88 11 060

Install bearing shells in crankcase with same color code as the dot of paint on the console.
Install both bearing shells according to the crankshaft color code, if the color code mark on the crankcase is washed off.
Install bearing shells in bearing caps with the same color code as for the crankshaft.



M88 11 061

Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps with correct torque*.
Do not turn the crankshaft.

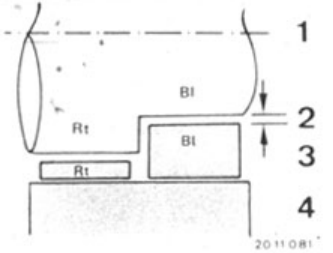
Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

* See Specifications



M88 11 062

Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct bearing play by installing new bearing shells, bearing shells of different machined size or with different color code.



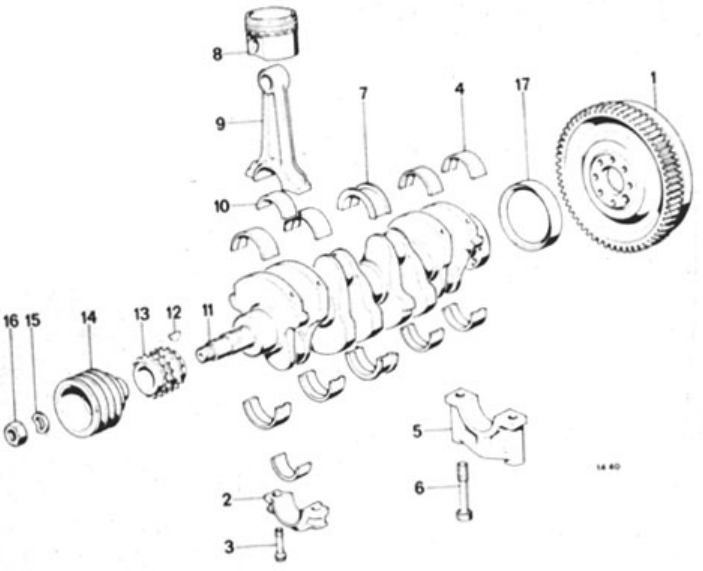
2011 081

Survey of Color Code/Shaft Diameter/Bearing Shell Thickness*

Double Classification Color Codes:
Rt = red
Bl = blue

1 Crankshaft diameter
2 Bearing play
3 Bearing shell thickness
4 Console diameter

* See Specifications



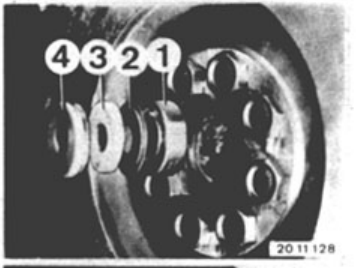
Crankshaft Survey

1 Flywheel
2 Conrod bearing cap
3 Conrod bolt
4 Main bearing shell
5 Main bearing cap
6 Main bearing cap bolt
7 Thrust bearing
8 Piston
9 Connecting rod
10 Conrod bearing shell
11 Crankshaft
12 Woodruff key
13 Sprocket set
14 Vibration damper
15 Washer
16 Nut
17 Radial oil seal



11 21 571 REPLACING PILOT BEARING IN CRANKSHAFT

Remove clutch – see 21 21 000.
Pull out ball bearing with Special Tool 11 2 010.



Installed Order:
Ball bearing (1)
Cover (2)
Felt ring (3)
Capsule (4)
Install cover (2) with embossment facing out.



Pack bore in crankshaft with approx. 1 gram of lubricating grease.
Drive in pilot bearing with Special Tools 11 2 030 and 00 5 500.



11 22 000 REMOVING AND INSTALLING FLYWHEEL

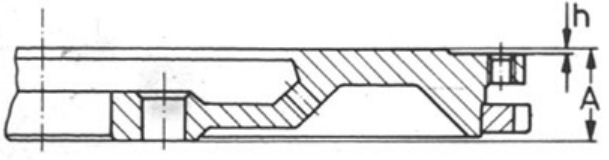
Remove clutch – see 21 21 000.
Hold flywheel with Special Tool 11 2 160.
Unscrew bolts and take off the flywheel.
Installation:
Clean tapped bores.
Install new expansion bolts with Loctite No. 270**.
Tightening torque: 105 ± 4 Nm (76 ± 3 ft. lbs,).



Check axial runout of flywheel.
Nominal value: max. 0.1 mm (0.004").

Friction surface may be machined to the minimum distance A = 29.1 – 0.1 mm (1.146 – 0.004").
If machining the friction surface reduces distance "h" to zero, the flange surface has to be machined.

M 88 11 072



** Source: HWB

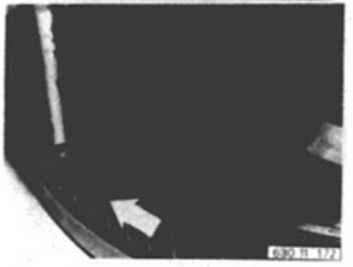


11 22 541 REPLACING STARTER GEAR RING

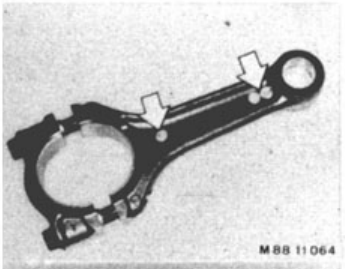
Drill a 6 mm (0.236") diameter hole approx. 8 mm (0.315") deep below a tooth gap to make breaking the ring gear easier.

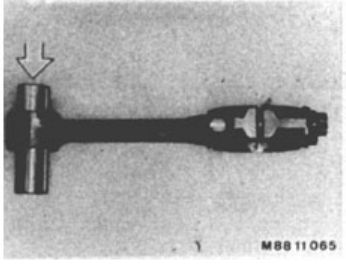


Break ring gear at drilled point with a chisel.



Installation:
Heat new starter gear ring to 200 ... 230° C (395 to 445° F).
Measure temperature with a thermo-color pencil.
Tooth bevel faces the engine.
Knock on starter gear ring to fit firmly all around with a brass mandrel.


M88 11 064

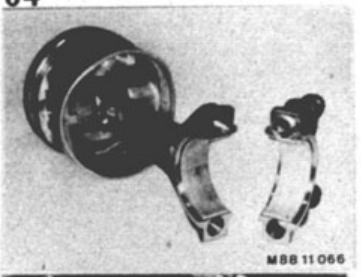

M88 11 065

11 24 521 REPLACING CONNECTING RODS
– Pistons Removed –

Note:
Only install connecting rods of same weight class (die-stamped on bearing caps) in one engine.

Consequently only sets of connecting rods are available from Parts.

Piston pin must slide through conrod bushing under light pressure.
Install conrod bearing shells – see 11 24 571.


M88 11 066


M88 11 067



M88 11 068



11 24 571 REPLACING CONROD BEARING SHELLS
– Engine Disassembled –

Install one each bearing shell in connecting rod and conrod bearing cap

or

one blue bearing shell in connecting rod and one red bearing shell in cap.
Check machined size (conrod bearing dia.).

Place Plastigage (Type PG - 1) on conrod bearing journals wiped clean of oil in BDC position.
Mount conrod bearing caps — pair code and grooves of bearing shells must be on the outside.

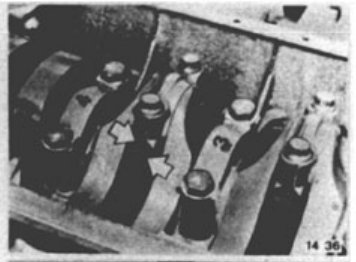
Source of Supply for Plastigage:
Cartool
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

Tighten bolts — use old conrod bolts.
Turn crankshaft slightly.
Remove conrod bearing caps.
Read conrod bearing play from supplied scale by measuring width of the flattened Plastigage.

Install new bearing shells, bearing shells of different machined size or different color code to correct the bearing play.
Replace conrod bolts for final installation.
Conrod bolt tightening torque:

Step 1:	**10 Nm**
Step 2:	**30 Nm**
Step 3:	**60 + 2° torque angle**

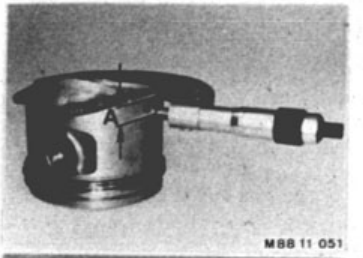
Conrod bearing play: 0.024 ... 0.064 mm.



11 25 000 REMOVING AND INSTALLING PISTONS

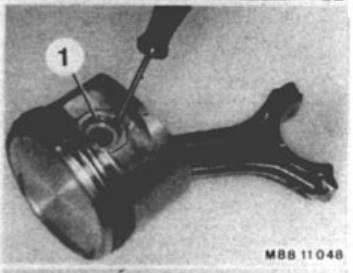
– Engine Removed –

Remove cylinder head – see 11 12 100.
Remove oil pump – see 11 41 000.
Remove conrod bearing cap and press out piston with connecting rod upwards.

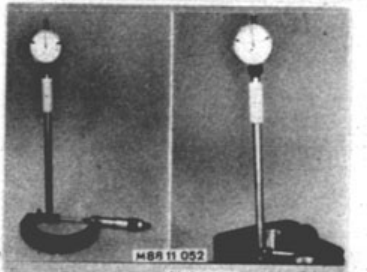


Measuring Piston Installed Clearance:
Measure piston diameter* at checkpoint "A" with a micrometer.

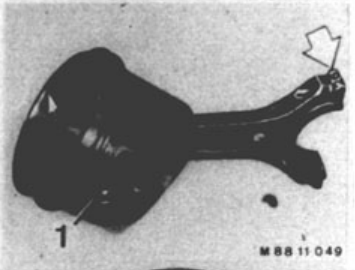
Engine	Make	Checkpoint "A"
S 14	Mahle	6 mm (0.236")



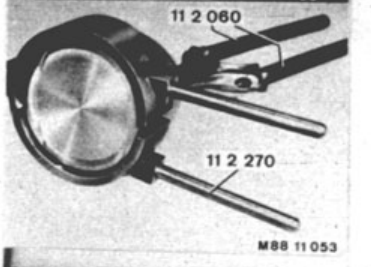
Remove circlip (1).
Press out piston pin.
Installation:
Piston pin is matched with piston and must not be mixed up.



Set internal calipers to zero on the micrometer with the measured piston diameter.
Measure cylinder bore diameter at bottom, center and top with the internal calipers in forward and turning directions.
Compare measured piston installed clearance with specified piston installed clearance/max. total wear play.
Installed clearance: 0.03 to 0.06 mm (0.0012 to 0.0024").
Max. permissible total wear play: 0.15 mm (0.006").



Installation:
Pairing code and grooves of bearing shells are on the exhaust side.
Install circlip (1) with gap facing down.



Bolt Special Tool 11 2 060 on connecting rod.
Lubricate piston and piston rings with oil.
Offset piston ring end gaps by 120° to each other.
Compress piston rings with Special Tool 11 2 270 ...



Only install pistons of same make and same weight class.
Weight class is specified on piston crown with "+" or "–".
Identification:

Engine	E	Diameter
S 14	10.5	93.4 mm (3.677")

Check the machined size* (piston diameter).



... install piston that arrow faces timing chain.
Turn pertinent conrod bearing journal to BDC for installation of piston.

* See Specifications

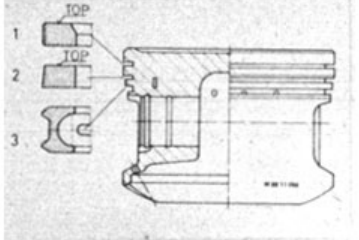
* See Specifications



11 25 651 REPLACING PISTON RINGS OF ONE PISTON
– Piston Removed –

Remove piston rings with a piston ring compressing pliers.

Note:
The identification of used piston rings might not be visible.
Lay piston rings aside in correct sequence and installed position.



Installation:
Install piston rings with the word "TOP" facing the piston crown.

1 Plain compression ring
2 Bevelled face compression ring
3 Oil scraper ring with rubber lined spring

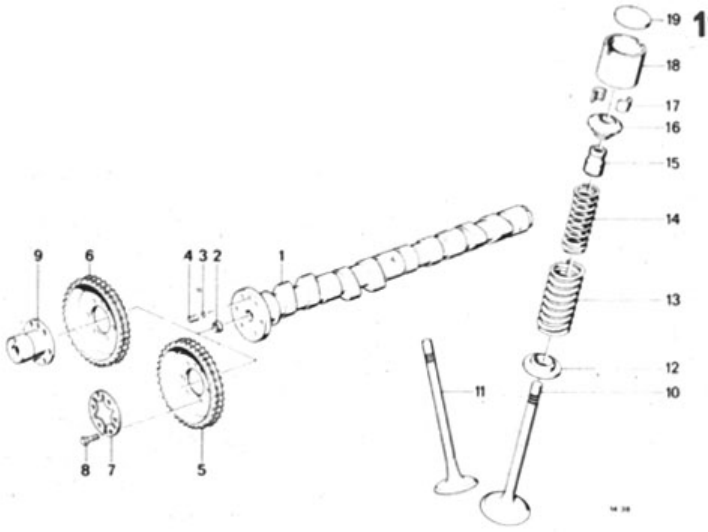


Measure side clearance*.



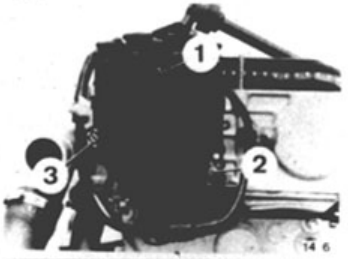
Measure end clearance*.

* See Specifications



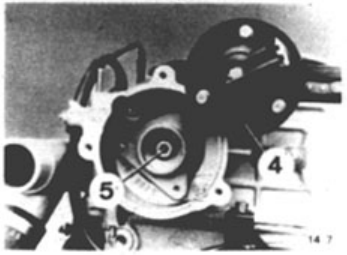
Valve Timing

1 Camshaft 248°
2 Plug for oil bore in camshaft
3 Lockwasher
4 Dowel pin
5 Sprocket - intake "E"
6 Sprocket - exhaust "A"
7 Lockplate
8 Hexagon head bolt M 6 x 16
9 Adapter for distributor rotor
10 Intake valve – 37 mm (1.457") dia.
Oversize valves with larger stem diameters are available
11 Exhaust valve – 32 mm (1.260") dia.
Oversize valves with larger stem diameters are available
12 Spring retainer, lower
13 Valve spring, outer – 41 mm (1.614") long
14 Valve spring, inner – 38.5 mm (1.516") long
15 Valve stem seal
16 Valve spring retainer, upper
17 Valve collet
18 Tappet
19 Shims from 3.00 to 4.25 mm (0.118 to 0.167")

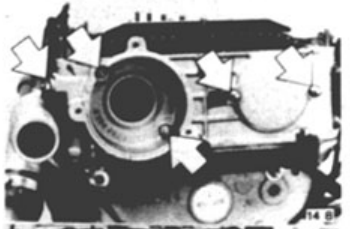


11 31 000 REMOVING AND INSTALLING CAMSHAFT

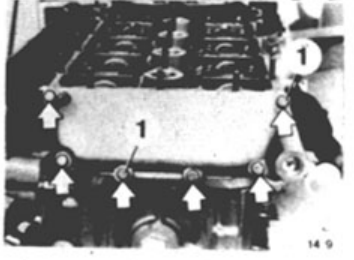
Remove cylinder head cover – see 11 12 000.
Unscrew bolts (1 ... 3) and take off distributor cap.



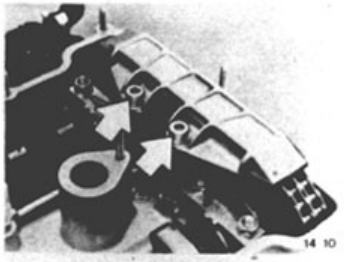
Unscrew distributor rotor (4).
Unscrew adapter (5).
Installation:
Tightening torque:
23 ± 1 Nm (16.5 ± 0.5 ft. lbs.).



Unscrew and remove distributor housing and plug.
Installation:
Check O-rings, replacing if necessary.



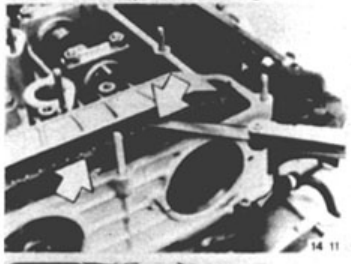
Remove end cover.
Installation:
Replace gasket.
Use longer bolts in bore with a dowel sleeve (1).



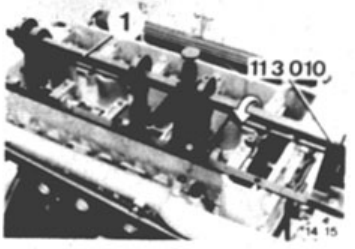
Unscrew guide rail.



Mount Special Tool 11 3 010 on timing case. Turn shaft (1) up to the arrest – camshaft is held down for removal of bearing caps. Unscrew camshaft bearing caps.



Installation:
Center guide rail with a feeler gage.



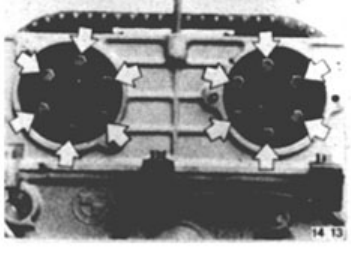
Loosen the arrest and relax the camshaft.
Remove Special Tool 11 3 010.
Mark camshafts "E" or "A" and remove.
Installation:
Camshafts are identical for exhaust and intake sides.
Install an used camshaft in the same position.



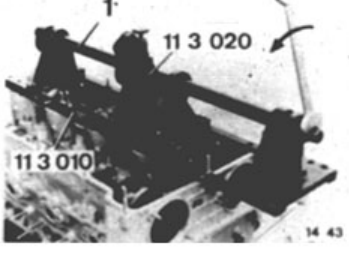
Turn crankshaft with Special Tool 11 3 020 to position cylinder no. 1 to TDC – cylinder no. 4 overlaps.
Caution!
Never crank the engine after removing the timing chain.



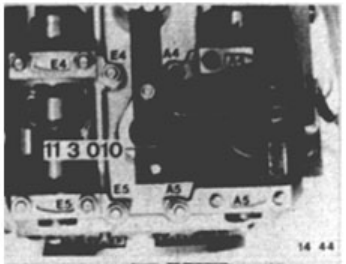
Installation:
Turn crankshaft to TDC.
Install camshaft that one each groove faces up and in – TDC position.



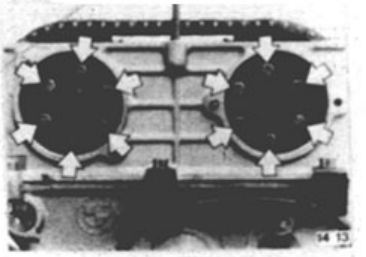
Remove chain tensioner – see 11 31 090.
Open lockplates and unscrew sprockets.
Installation:
Tightening torque: 9 + 1 Nm (6.5 + 0.5 ft. lbs.).



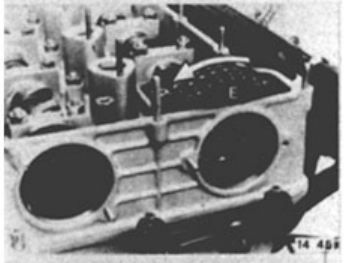
Mount Special Tool 11 3 010 on timing case. Hold camshaft in TDC position with Special Tool 11 3 020 and turn shaft (1) up to the arrest – camshaft is held down for installation of bearing caps.



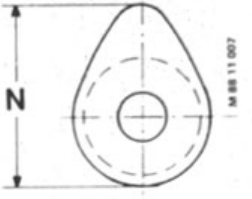
Install camshaft bearing caps on timing case according to lettering.
Tightening torque: 22 ± 2 Nm (16 ± 1.5 ft. lbs.).



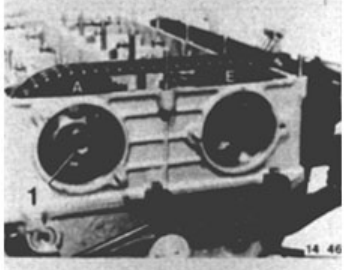
Lock sprocket mounting bolts with a lockplate.
Adjust valve clearance – see 11 34 004.



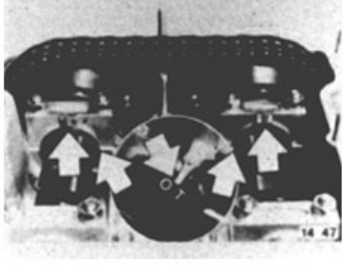
Tighten the timing chain in opposite direction of engine rotation and mount on the intake side sprocket "E" first.
Install lockplate and bolt down the sprocket.
Tightening torque: 9 + 1 Nm (6.5 + 0.5 ft. lbs.).



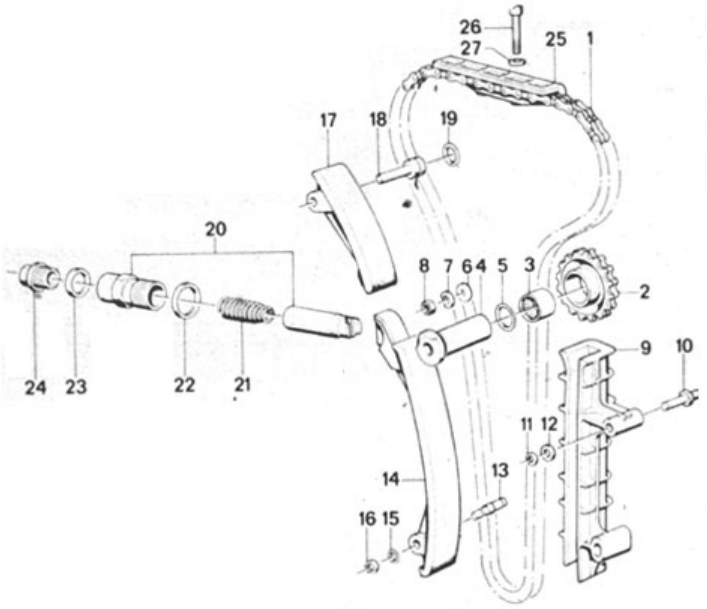
Cam distance "N"
Nominal value: 43.713 mm (1.721")



Installation:
Install exhaust side sprocket "A".
Install adapter (1).
Install lockplate and bolt down the sprocket.
Tightening torque: 9 + 1 Nm (6.5 + 0.5 ft. lbs.).



Install chain tensioner – see 11 31 090.
Turn engine once in direction of rotation and recheck the timing.
- Crankshaft at TDC
- One each camshaft groove faces in
- One each camshaft groove faces cast boss on bearing cap



Valve Timing

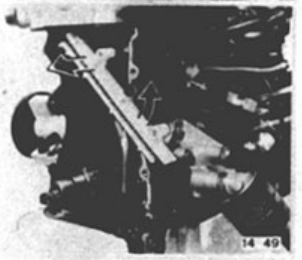
1 Double-row timing chain
2 Sprocket (guide wheel)
3 Needle sleeve
4 Shaft
5 O-ring
6 Washer
7 Spring washer
8 Hexagon nut
9 Guide rail
10 Shaft bolt
11 Lockwasher
12 Washer
13 Shaft bolt
14 Tensioning rail, lower (head removed)
15 Lockwasher
16 Circlip
17 Tensioning rail, upper (chain removed)
18 Shaft bolt
19 O-ring
20 Chain tensioner piston and cylinder (matched)
21 Spring
22 Seal
23 Seal
24 Plug
25 Guide rail
26 Bolt
27 Washer

11 31 051 REPLACING TIMING CHAIN

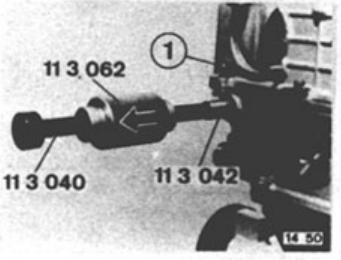
Remove lower timing case cover – see 11 14 110.
Remove sprockets on camshafts – see 11 31 000.



Remove lockwashers.

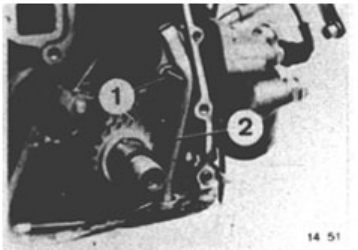


Pull guide rail forward and swing aside.
Remove timing chain.
Installation:
Timing chain is pre-stretched.



11 31 . . . REMOVING AND INSTALLING UPPER TENSIONING RAIL

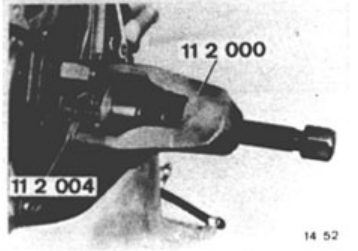
Remove timing chain – see 11 31 051.
Unscrew bolt (1) partially.
Screw on Special Tools 11 3 040, 11 3 042 and 11 3 062.
Knock out the shaft.
Installation:
Check O-ring, replacing if necessary.
Check tensioning rail arrangement!



14 51

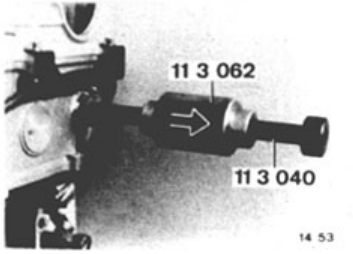
11 31 061 REPLACING SPROCKET SET
– Timing Chain Removed –

Remove oil pump drive chain – see 11 41 151.
Unscrew shaft bolt (1) and take off oil pipe (2).
Installation:
Check O-rings, replacing if necessary.



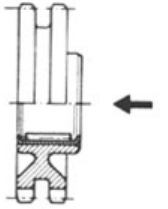
14 52

Pull off sprocket with Special Tools 11 2 000 and 11 2 004.
Installation:
Heat sprocket to max. 200° C (390° F) for installation.
Tighten oil pump drive chain – see 11 41 000.



14 53

Mount Special Tools 11 3 040 and 11 3 062 on shaft of guide sprocket.
Knock out the shaft.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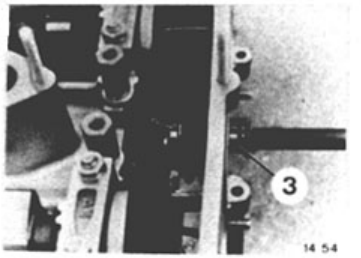
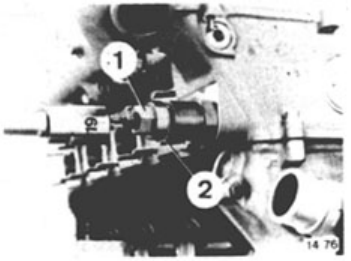
Installation:
Check needle sleeve in sprocket, replacing if necessary.
← Forward direction and pressing-in direction for needle sleeve.



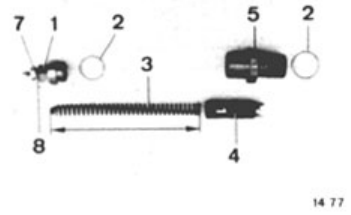
14 54

Installation:
Replace O-ring (3).
Drive in shaft partially with bore facing up.
Slide on the guide sprocket.
Drive in shaft against the stop.

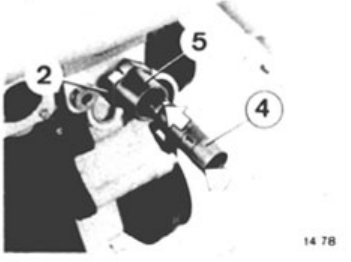


11 31 090 REMOVING AND INSTALLING PISTON FOR CHAIN TENSIONER

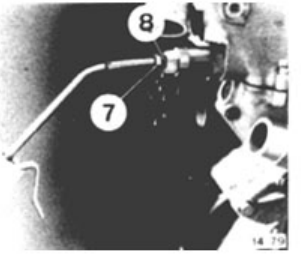
Unscrew plug (1).
Caution!
Strong spring pressure.
Remove spring (3) and piston (4).
Installation:
Replace seal (2).



Installation:
Check length of spring (3).
Nominal value: 159 ± 0.5 mm (6.260 ± 0.020").
Conically wound end of spring faces plug (1).
Tightening torque for:
– plug (1) 40 ± 2 Nm (29 ± 1.5 ft. lbs.)
– cylinder (5) 50 ± 2 Nm (36 ± 1.5 ft. lbs.)



Piston (4) and cylinder (5) are matched* – code 1 or 2.
Only install parts with same code.
Install cylinder with groove facing back (as seen looking forward in car) and piston with groove facing up.
Guide piston opening into tensioning rail.



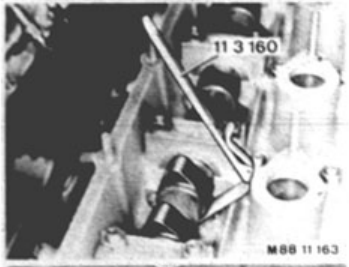
Unscrew nipple (7) – replace O-ring (8) if necessary.
Add engine oil, until oil runs out of nipple (7).
Tighten nipple (7).

* See Specifications

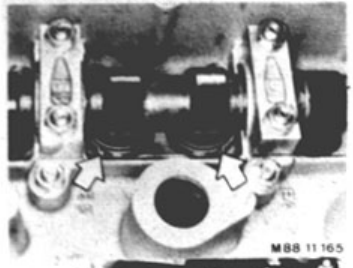


11 34 004 ADJUSTING VALVE CLEARANCE

Remove cylinder head cover – see 11 12 000.
Crank engine with Special Tool 11 3 020.



Measure valve clearance of cams facing up.
Compare measured valve clerance with specified valve clearance.
Nominal value:
0.26 to 0.35 mm (0.010 to 0.014") – cold*
0.31 to 0.40 mm (0.012 to 0.016") – warm*

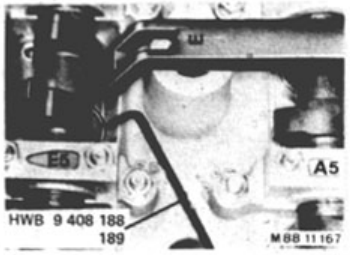


Turn openings of tappets as shown in picture in case measured valve clearance is not within specified tolerances.



Guide in Special Tool according to camshaft "A" or "E" and press tappet down.

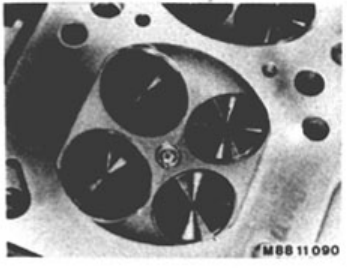
* See Specifications



Blow out valve shim with compressed air.

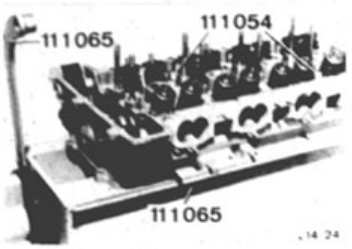


Measure thickness of removed valve shim.
Install shim of required thickness with lettering facing down.



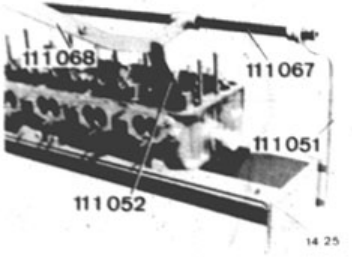
11 34 509 CHECKING VALVES FOR LEAKS – Cylinder Head Removed

Spark plugs remain screwed in.
Fill combustion chamber with gasoline outdoors or indoors with conformance of fire prevention regulations.
Valves and valve seats must be inspected, if gasoline runs past the valve heads.
Remove valves – see 11 34 550.
Machine valve seats – see 11 12 607.

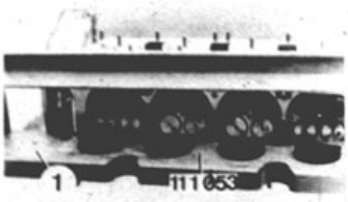


11 34 550 REMOVING AND INSTALLING VALVES
– Cylinder Head Removed –

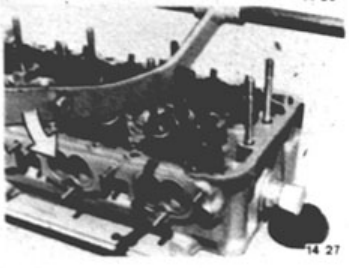
Unscrew spark plugs.
Mount cylinder head on Special Tool 11 1 065 with Special Tools 11 1 054.
Screw on Special Tool 11 1 065.
Installation:
Tightening torque for spark plugs: 20 ± 5 Nm (14.5 ± 3.5 ft. lbs.).



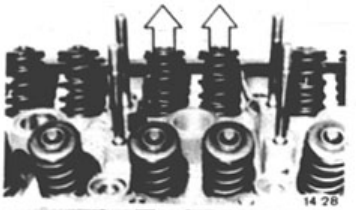
Screw on Special Tool 11 1 051.
Mount Special Tools 11 1 068, 11 1 052 and 11 1 067.



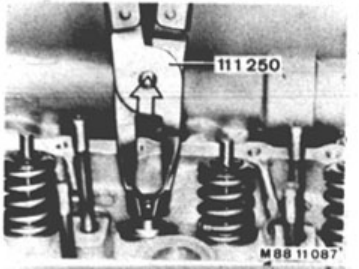
Place Special Tool 11 1 053 (tray) in assembly stand – pull out rubber part (1)!



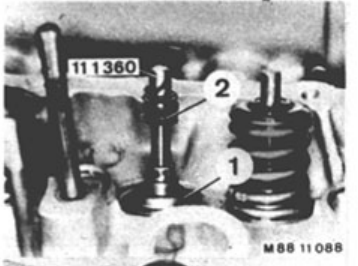
Compress valve springs and remove valve collets.



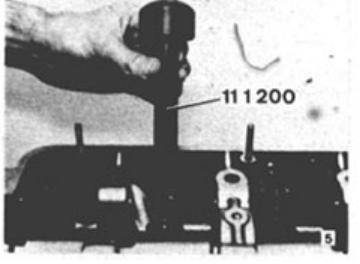
Remove upper spring retainer and double spring set.
Take tray out of assembly stand and pull out valve.
Installation:
Lubricate valve guide and valve stem with oil.



Pull off valve stem seal with Special Tool 11 1 250.
Check valve guide for wear – see 11 12 595.



Install valve and insert Special Tool 11 1 053 (tray).
Insert lower spring retainer (1).
Use Special Tool 11 1 360 to avoid damaging the valve stem seal.
Lubricate valve stem seal (2) with oil and install.
Source for Special Tool Sleeves:
CARTOOL
Alfred-Brehm-Str. 5
D–8070 Ingolstadt



Press on valve stem seal with Special Tool 11 1 200 by hand.
Special Tool 11 1 200 has two diameters for 7 and 8 mm (0.275 and 0.315") valve stem seals.

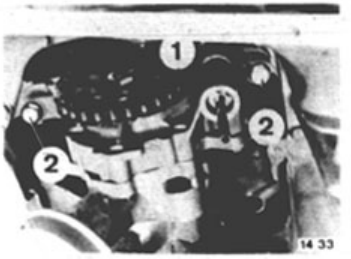


11 40 000 CHECKING ENGINE OIL PRESSURE

Remove air cleaner with air flow sensor.
Pull off plug on oil pressure switch.
Unscrew oil pressure switch (1).
Installation:
Check seal (2), replacing if necessary.

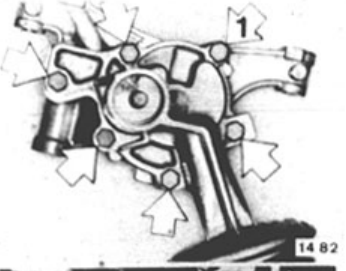


Screw in Special Tool 11 4 060.
Connect 10 bar (142 psi) pressure tester of BMW Service Tester.
Install air cleaner.
Measure oil pressure*.



11 41 000 REMOVING AND INSTALLING OIL PUMP

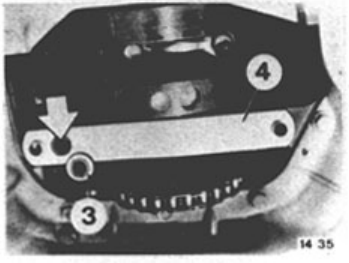
Remove lower oil pan section -- see 11 13 020.
Unscrew nut (1) and take off sprocket.
Unscrew bolts (2).



Note:
If bolt (1) has a shorter head than the others, convert from the old one to a new one when replacing the oil pump.

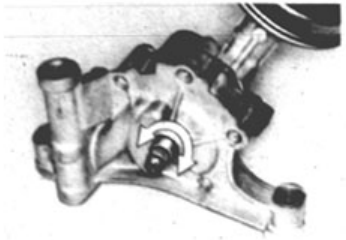


Installation:
Push on sprocket with mounted oil pump.
Tightening torque of nut:
25 to 30 Nm (18 to 22 ft. lbs.).

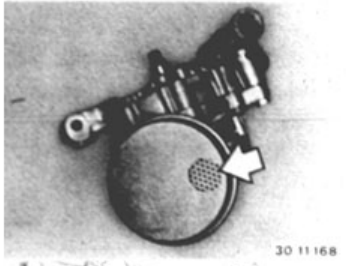


Installation / Chain Tightness:
Check installed position of O-ring (3) between housing and pressure pipe.
Adjust chain tightness with shim (4) in such a manner, that chain gives under light thumb pressure.
Check position of oil bore in shim.

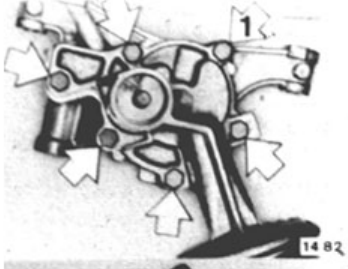
* See Specifications



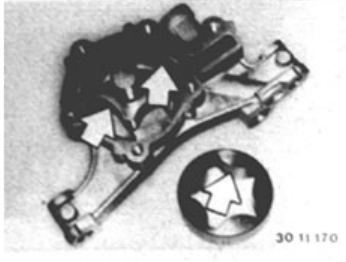
Testing and Servicing:
Check whether oil pump runs easily by turning the drive shaft.



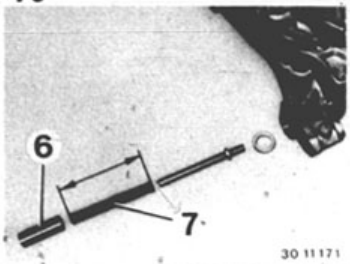
Clean oil filter screen.



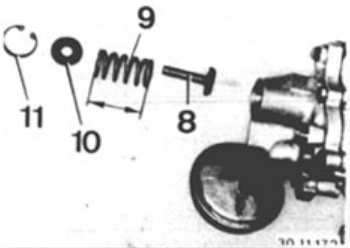
Diassemble oil pump.
Installation:
If bolt (1) has a shorter head than the others, it is absolutely essential to install it in the same location.



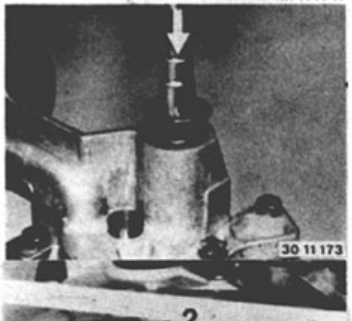
Check oil pump for wear.
– Scoring in body
– Wear on rotors



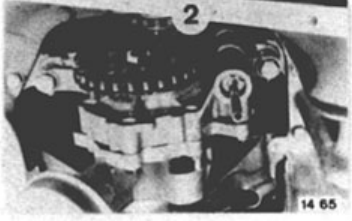
The pressure safety valve is located in the main bore and regulates the engine oil pressure* – see 11 40 000.
Check whether piston (6) moves easily.
Check length of spring (7) = 68 mm (2.677").



Pressure safety valve (8 bar = 114 psi) regulates the oil pressure in front of the oil filter and prevents oil filter leakage.
Check seat of piston (8).
Check length of spring (9) = 44 ± 0.4 mm (1.732 ± 0.016").



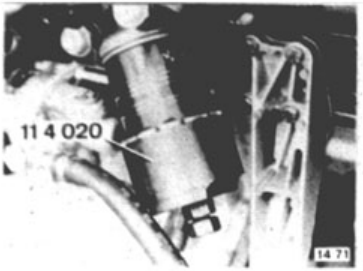
Installation:
Press in spring (9) and washer (10) with a wrench socket and install circlip (11).



11 41 151 REPLACING OIL PUMP DRIVE CHAIN

Remove lower oil pan section – see 11 13 020.
Remove timing chain – see 11 31 051.
Unscrew nut (2) and take off sprocket.
Installation:
Check sprockets for wear.
Adjust chain tightness – see 11 41 000.
Chains with green code are longer than chains with red code.
Tightening torque: 25 to 30 Nm (18 to 22 ft. lbs.).

* See Specifications



11 42 021 REPLACING FULL FLOW OIL FILTER

Unscrew filter with Special Tool 11 4 020.

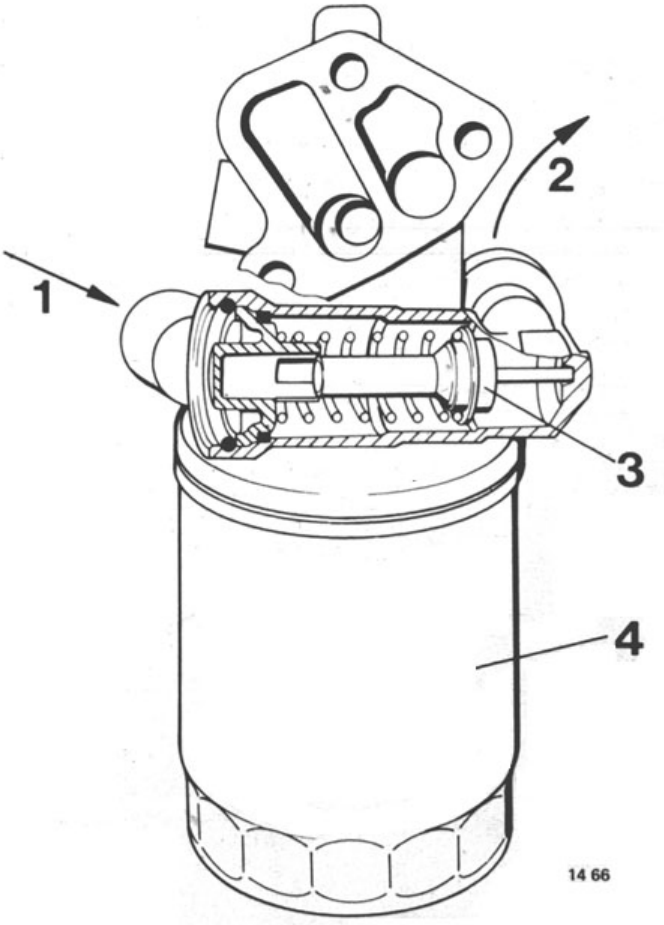
Installation:

Lubricate gasket with light coat of oil.

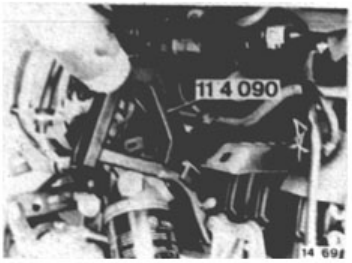
Tighten oil filter by hand until the gasket bears on surface – then tighten filter by hand one half turn more.

Add oil, start engine and check oil level as well as for leaks.

If engine no longer builds up oil pressure after replacement of the oil filter cartridge, stop the engine, turn the filter cartridge approx. 90° and tighten it again after starting the engine and waiting until a small amount of oil escapes from the filter (bleeding procedures).

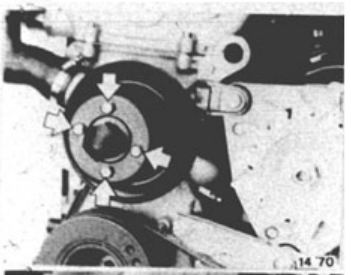


1 From oil cooler
2 To oil cooler
3 Temperature regulator – switches off oil cooler as of approx. 95° C (203° F)
4 Oil filter



11 43 101 REPLACING GUIDE TUBE FOR OIL DIPSTICK

Install guide tube with Loctite No. 270** and drive in against the stop.





11 51 000 REMOVING AND INSTALLING WATER PUMP

Drain coolant.
If applicable, remove fan cowl and fan – see 11 52 000.
Take off drive belt and remove pulley.
Installation:
Add coolant***.
Tighten drive belt – check tightness with Special Tool 11 5 020.

Loosen hose clamps.
Remove water pump.
Installation:
Replace gasket.

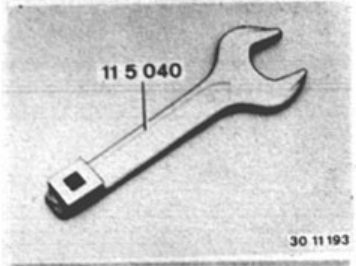
** Source: HWB

*** See Service Information of Gr. 00

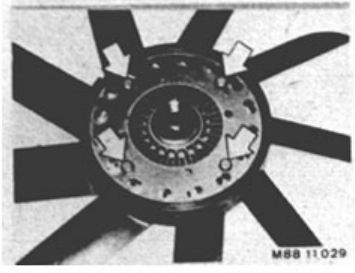


11 52 000 REMOVING AND INSTALLING FAN

Hold pulley with Special Tool 11 5 030 and unscrew coupling nut (1).
Important!
Left-hand threads – nut must be turned clockwise to unscrew.
Tightening torque:
40 + 10 Nm (29 + 7 ft. lbs.).



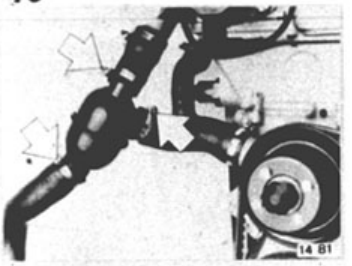
Installation:
Tighten fan with Special Tool 11 5 040.
40 Nm (29 ft. lbs.) tightening torque is equal to 30 Nm (22 ft. lbs.) setting on torque wrench.



11 52 020 REPLACING FAN CLUTCH

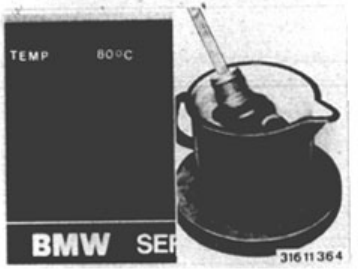
Remove fan – see 11 52 000.
Fan clutch must be replaced, if
a) hub has seized (fan of stopped engine cannot be turned or is hard to turn),
b) fan clutch has axial or radial play, or is losing oil.

Check switching points* with Vibrocard***.
Unscrew fan mounting bolts and take off fan clutch.



11 53 000 REMOVING AND INSTALLING COOLANT THERMOSTAT

Drain coolant.
Loosen hose clamps.
Remove thermostat.
Installation:
Bleed cooling system – see 17 11 000.



Checking Thermostat:
Place thermostat in water and heat the water.
Measure beginning of opening temperature and opening distance with a steel ruler.
Opening Temperature/Travel:
80 ± 2° C (176 ± 3° F) / 0.1 mm (0.004").
Testing Temperature/Travel:
95° C (203° F) / 8 mm (0.315").

* See Specifications
*** See Workshop Equipment Catalog

Construction group 12 Engine electrical system

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INSTRUCTIONS FOR WORKING ON ENGINE ELECTRIC AND IGNITION SYSTEMS

- Always disconnect battery or interrupt power supply to ignition control unit and ignition coil when working on the electrical system – dangerous high voltage in engine and electrical system components (e.g. on the tachometer)!

- Never start the engine after removing the distributor cap or disconnecting wires on ignition coil term. 4 – pull off plug on ignition control unit and also stop the delivery of fuel in cars with catalytic converter.

- Never disconnect battery or wires on alternator and starter while engine is running.

- Only use specified genuine BMW components.

- Never connect a shielded capacitor or test lamp on term. 1 of the ignition coil.

- Never connect wire of ignition coil term. 1 on ground or B +. Consequently the ignition coil term. 1 must not be used to prevent starting when service installing a burglar alarm system.

- Pull off plug on control unit for TCI or fuel injection master relay (relay 2) for DME and stop fuel delivery in cars with catalytic converter, when checking compression.

- The secondary side (high voltage side) of the ignition system must be shielded with at least 4 k-ohms, whereby the original distributor rotor with 1 k-ohm shielded resistor must be installed. Do not use 5 k-ohm distributor rotors for the shielding of radio and/or communication equipment!

TROUBLESHOOTING TRANSISTOR COIL IGNITION (TCI)

Testing Requirements:
- Battery charged (voltage > 12 V)
- Specified fuel in tank (octane rating)
- Ambient temperature approx. 20° C (68° F); considerable deviation would change the measured values

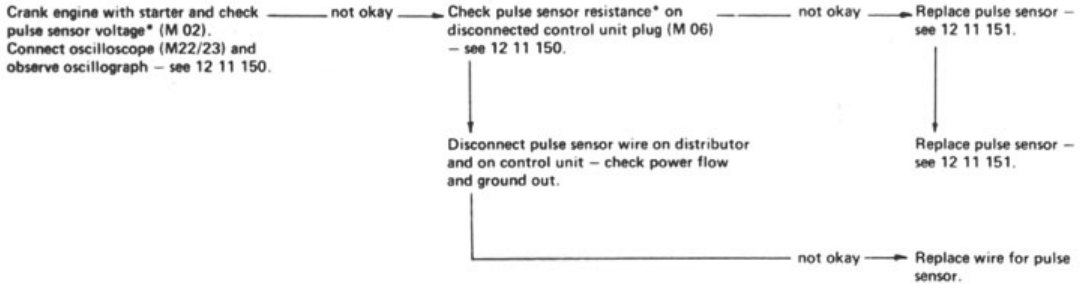
Testing instructions refer to the BMW SERVICE TEST, e.g. engine test / test step 05 (P 05) or multimeter 02 (M 02). Make connections according to operating instructions.

Important!

Refer to instructions for working on TCI and DME – see page 12 - 0.

Faults in TCI will be indicated by: a) Engine not running or running incorrectly
b) Misfiring in different operating conditions
c) Poor engine output

Test 1 – PULSE SENSOR in Distributor



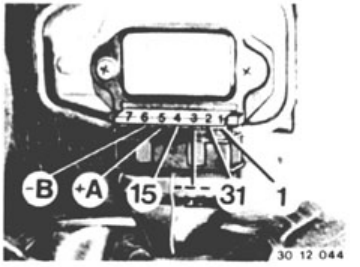
* See Specifications and Repair Manual/Group 12

Test 2 – Voltage Supply for TCI-i Control Unit and Ignition Coil

Pull off plug on control unit and turn on ignition.
Check voltage (approx. 12 V) on specified connections (term. 15 and 31 as shown in figures) of plug.

Not okay

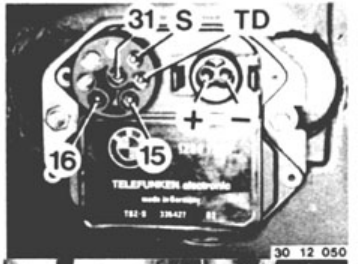
Routing of terminal u wire*:
Ignition lock – plug connection on wire harness of car electric system – connector (soldered point) in wire harness – engine wire harness plug connection –
for 4 cyl. engines: – connector (soldered point) engine wire harness
– ignition coil
– TCI control unit
for 6 cyl. engines: – ignition coil – TCI control unit
The ground wire is routed to ground point on intake manifold or to battery negative pole – see engine electrical equipment layout.

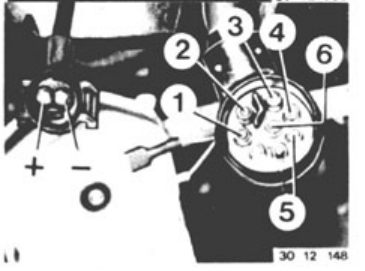


TCI-i Control Unit
(Bosch)

No.	Term.	Description
1	1	To ignition coil
2	31	Ground
3	– – –	Shielding
4	15	Power supply
5/6	A+/B–	Pulse sensor

For the 2.8 liter M 30 engine voltage supply* (term. 15) is provided via the TCI-R control unit (R = ignition return or retard control).
TCI will not function if this control unit fails.
Bridge terminals 15 E and 15 A on control unit plug for brief test.





TCI-i-S Control Unit
(S = ignition retard while starting)
(Siemens/Telefunken)

No.	Term.	Description
1	–	–
2	1/16	To ignition coil
3	15	Power supply
4	TD	– to fuel pump relay – to L-Jetr. control unit – to tachometer
5	S	To starter term. 50
6	31	Ground
	+/–	Pulse sensor

* See Wiring Diagram for Car and Engine Electrical Systems

Test 3 – Ignition Coil and Power Supply Lead

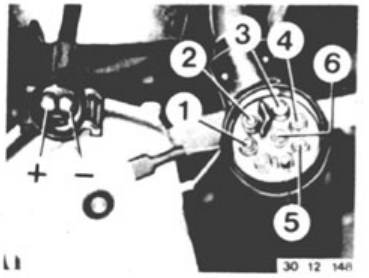
Turn on ignition.
Check voltage(> 10 V) on control unit pin 2 (M 01).
Also contained in engine test (P 01).

not okay → Check wire from ignition coil (terminal 1) to control unit for breaks and ground out (M 06).

↓

Check ignition coil – see 12 13 009.
Check resistance* of primary and secondary coils.

not okay → Replace ignition coil.
If casting compound has run out or the plug is missing, also replace TCI control unit.



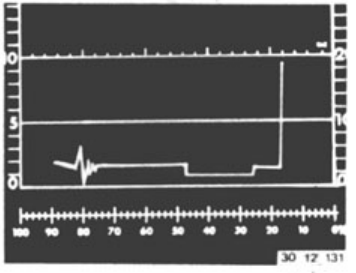
Test 4 – TCI Control Unit

Requirement: Tests 1 through 3 completed and no malfunction.

Connect car for engine test (P 05).
Crank engine with starter or start engine.
Primary display on oscilloscope should conform with that illustrated here – if necessary, replace control unit.

↓

Check primary current (M 03) – this is only necessary when the primary oscillograph deviates.
Connect ammeter in power supply lead (term. 15) on plug for engine wire harness.
Run engine at 1000 ± 50 rpm.
Value should be 1.2 to 1.7 A – if necessary, replace control unit.



* See Specifications

Test 5 – Distributor Cap / Rotor and Ignition Leads.

Bend ignition leads in a tight radius and check for cracks and traces of burning. Check connection and tightness of plugs and connections. — not okay → Replace ignition leads or repair connections.

↓

Check distributor cap and distributor rotor for cracks and traces of burning. Measure resistance* in distributor rotor. — not okay → Replace distributor cap and/or rotor – see 12 11 091/111.

Test 6 – Spark Plugs and Connectors

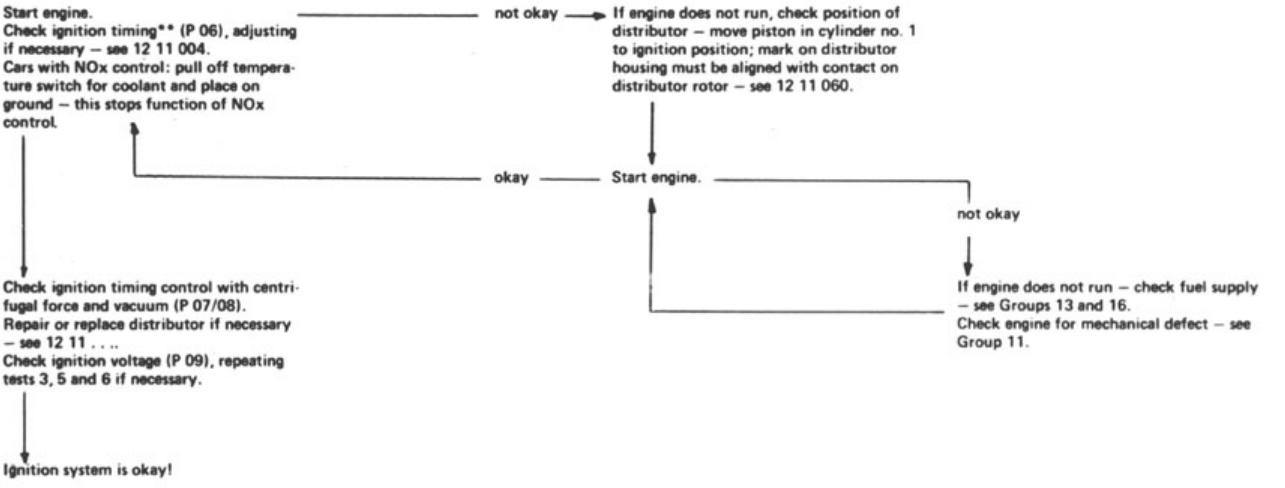
Measure resistance* of shielded and spark plug connectors. Check for cracks and traces of burning. — not okay → Replace shielded and/or spark plug connectors – see 12 12 072.

↓

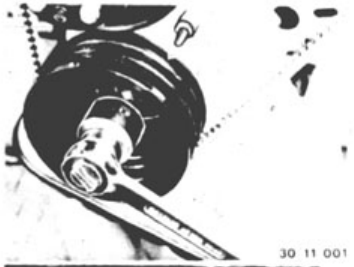
Check spark plugs for electrode erosion and electrode gap*. Check insulator for traces of burning. — not okay → Replace spark plugs – only install specified types.

* See Specifications

Test 7 – IGNITION TIMING / IGNITION TIMING CONTROL

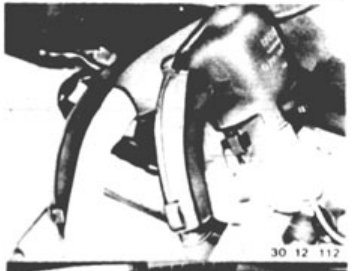


* See Specifications
** See Nominal Value Microfiche

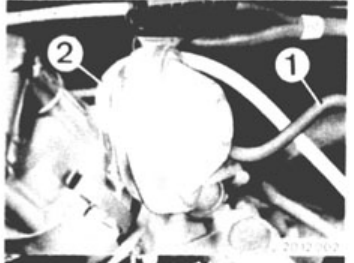


12 11 060 REMOVING AND INSTALLING DISTRIBUTOR

Four Cylinder M 10 Engines:
Turn engine to TDC mark (ignition for cylinder no. 1) with a 30 mm wrench socket.



Disconnect retaining strap.
Pull off ground wire.
Remove protective cap.
Pull off hose for vacuum box.



Vacuum Box with Two Connections:
1 = Hose for advance control (black)
2 = Hose for retard control (white or black/white)



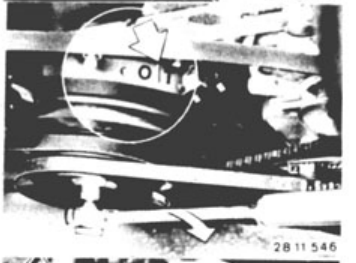
Take off distributor cap.
Check position of distributor rotor – it should point to notch in distributor; turn crankshaft if necessary.
Loosen and pull off plug for pulse sensor.
Unscrew mounting screw.



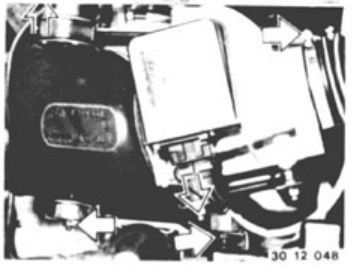
Pull out distributor while turning at same time.
Caution!
Retainers must not block the pulse sensor gear.
Hub can be turned in relation to the pulse sensor gear.



Installation:
Turn distributor rotor 30° opposite the running direction.
Install distributor – notch must be aligned with distributor rotor contact.
Repeat installation if necessary.
After finishing installation, adjust ignition timing – see 12 11 004.



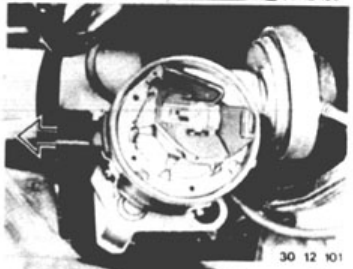
Six Cylinder M 20 Engines:
Unscrew spark plugs.
Turn crankshaft up to TDC mark



Remove air cleaner with air flow sensor.



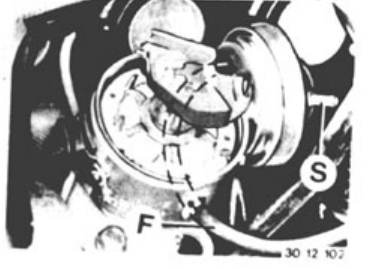
Loosen, press and turn both distributor cap retainers.
Pull off ground strap.
Take off distributor cap.



Loosen and pull off plug.
Pull off vacuum hoses.

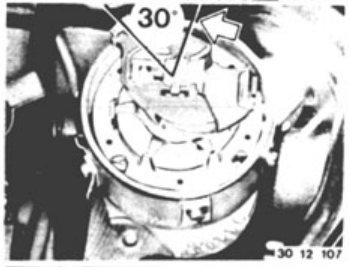


Installation:
F = Advance control (black)
S = Retard control (black/white)
Connection (S) is not used in cars with automatic transmission.
Important!
In case of vacuum control with connector diameter of 4 mm and 8 mm:
F = Advance control
(4 mm dia., black)
S = Retard control
(8 mm dia. black/red)

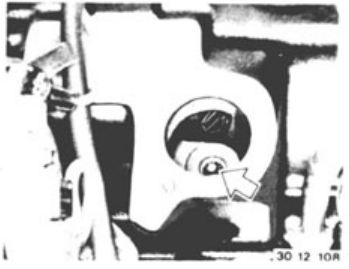




Unscrew bolt and take off holder.
Pull out distributor.
Installation:
Check seal on distributor shaft, replacing if necessary.



Installation:
Turn distributor rotor approx. 30° from mark opposite the normal running direction.



Turn distributor shaft slightly during installation so that the oil pump drive (arrow) engages.
Notch must be aligned with distributor rotor contact, repeat installation if necessary.
After finishing installation, check ignition timing – see 12 11 004 in repair manual for pertinent model series.

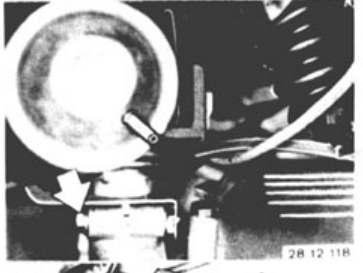
Distributors are supplied without the drive gear.
If the old drive gear is in good condition, it can be used again on the new distributor.
If the drive gear is defective, the complete gear set must be replaced – see 11 35 020.



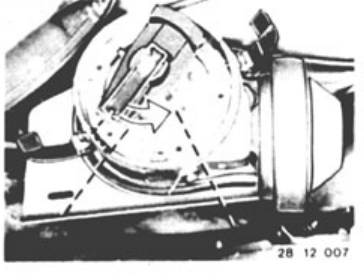
Six Cylinder M 30 Engines:
Take off cap.
Loosen retainers and remove distributor cap.



Pull off pulse sensor plug and hoses.
1 Black hose for advance control
2 Black/white hose for retard control



Set piston of cylinder no. 1 to TDC – mark on vibration damper.
Unscrew bolt and pull out distributor.

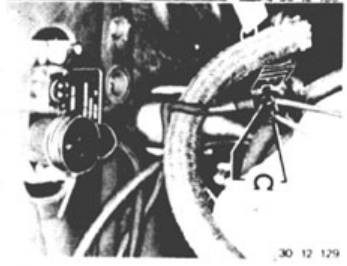


Installation:
Turn distributor shaft approx. 60° from mark in counterclockwise direction.
Insert distributor – mark must be aligned with distributor rotor contact.
Adjust ignition timing – see 12 11 004.

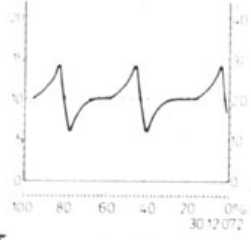


12 11 150 CHECKING PULSE SENSOR IN DISTRIBUTOR

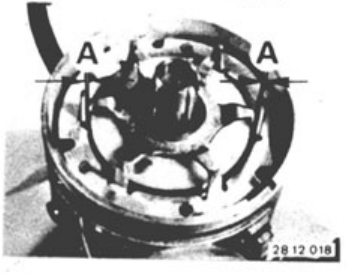
Cars with TCI-i Control Unit (Bosch):
Pull off plug.
Measure pulse sensor resistance* on pins (5 and 6) with BMW service test unit (M 06).



Cars with TCI-S Control Unit (Siemens / Telefunken):
Pull off pulse sensor plug and measure resistance*.

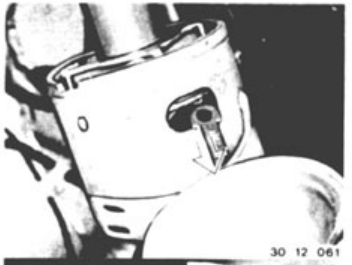


Afterwards connect oscilloscope (M 22/23) on same pins and crank engine with the starter – approx. 250 to 300 rpm.
Oscillograph should be as illustrated.
Pulse sensor voltage will then be 1.0 to 2.0 V (M 02).



Check pulse sensor distance*, correcting if necessary.
Press distributor shaft with finger in direction of pulse sensor tooth (stator) – there should be a gap of at least 0.2 mm (0.008"), loosen and center carrier plate if necessary.

* See Specifications

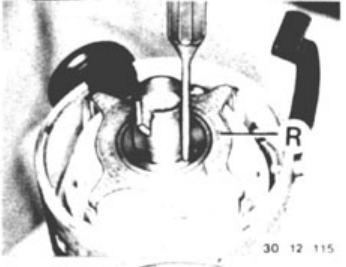


12 11 635 REPLACING PULSE SENSOR IN DISTRIBUTOR – Distributor Removed –

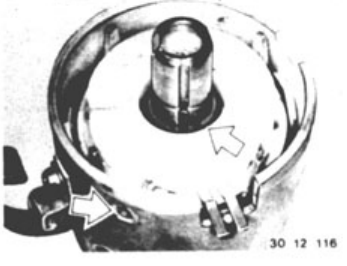
Four Cylinder M 10 Engines:
Unscrew vacuum control and let it hang down.
Installation:
Lubricate connecting rod in opening with grease.



Remove circlip.
Installation:
Check pulse sensor distance (A)*, correcting if necessary.

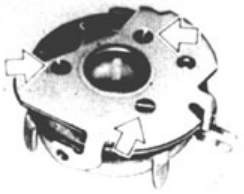


Knock down dowel pin with an impact manidrel and take off pulse sensor gear (rotor).



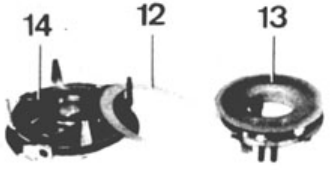
Remove circlip.
Remove plug receptacle and mounting screws.

* See Specifications



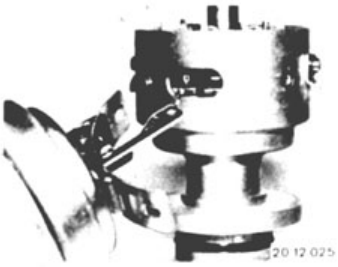
30 12 117

Unscrew pulse sensor on carrier plate.
Installation:
Check arrangement of connections on carrier plate (see figure).



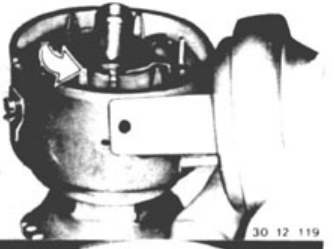
320 12 047

Arrangement:
12 Insulator
13 Pulse sensor
14 Carrier plate
After finishing installation, adjust ignition timing – see 12 11 004.



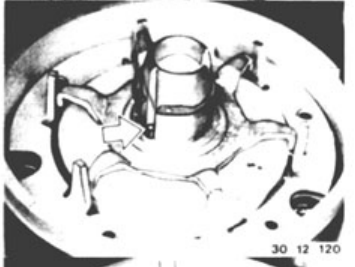
320 12 025

Six Cylinder M 20/M 30 Engines:
Remove distributor – see 12 11 060.
Unscrew vacuum control and let it hang down.



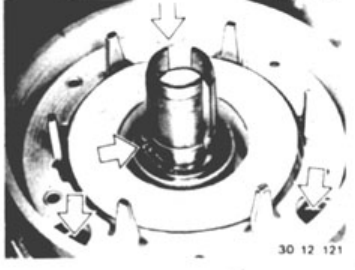
30 12 119

Installation:
Lubricate connecting rod in opening with grease. Turn carrier plate (stator) counterclockwise all the way and attach connecting rod from below at an angle.



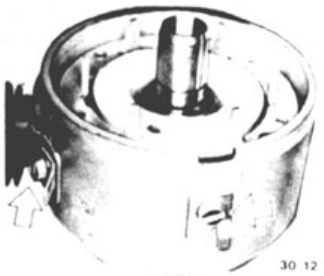
30 12 120

Remove circlip.
Knock down dowel pin with an impact mandrel and take off pulse sensor gear (rotor).



30 12 121

Unscrew carrier plate screws.
Remove circlip.



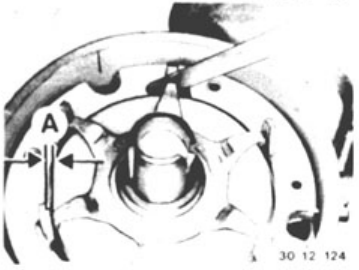
30 12 122

Disconnect plug receptacle and unscrew screws.
Remove carrier plate with pulse sensor.



30 12 123

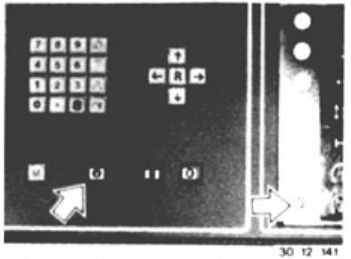
Unscrew pulse sensor on carrier plate.
Installation:
Check arrangement of connections on carrier plate (see figure).



30 12 124

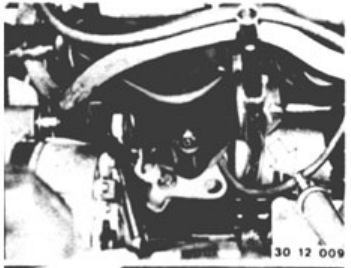
Installation:
After installation, adjust pulse sensor distance (A)*.
Press distributor shaft with finger in radial direction – gap between pulse sensor spider and stator should be at least 0.2 mm (0.008").
If necessary, loosen and center carrier plate.

* See Specifications

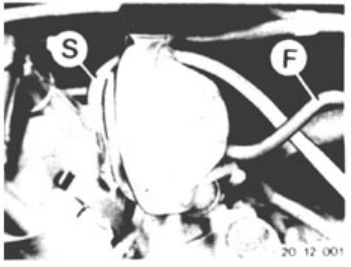

30 12 141

12 11 . . . CHECKING VACUUM CONTROL

Connect BMW service test unit or BMW digital tester and perform engine test (P 08)*.
Vacuum supply and restriction are by way of the vacuum pump and orifice valve.

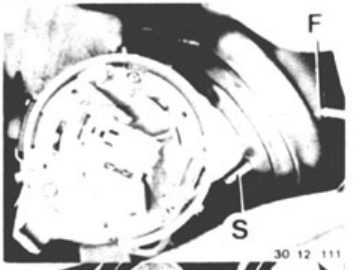

30 12 009

Models with Pressure Converter or Solenoid Valve in Front of Vacuum Control:
Connect vacuum supply hose direct on vacuum control.



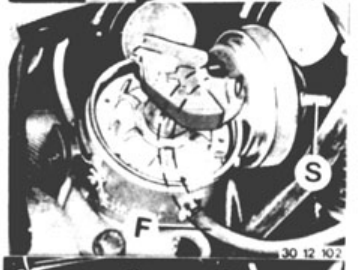
20 12 001

Four Cylinder M 10 Engines:
Pull off retard control hose (S) when checking "advance control" or vice versa when checking "retard control".
F = Advance control hose (black)
S = Retard control hose (black/white)
Accelerate engine to test speed* and compare test values* against nominal values* with specified vacuum*.



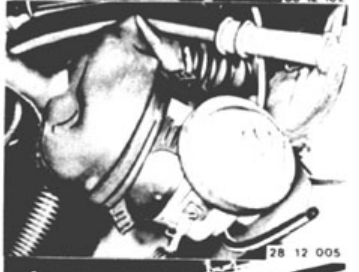
30 12 111

Six Cylinder M 20 Engines:
Pull off retard control hose (S) when checking "advance control" or vice versa when checking "retard control".
F = Hose for advance control (black)
S = Hose for retard control (black/white)
Connection (S) for retard control is not used in cars with automatic transmission.

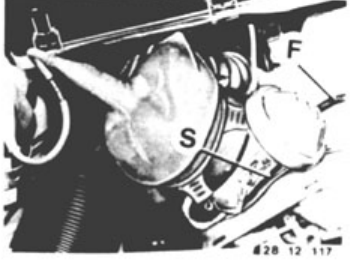


30 12 102

Important!
Vacuum control with connector diameter of 4 mm or 8 mm:
F = Advance control (4 mm dia.)
S = Retard control (8 mm dia.)


28 12 005

Six Cylinder M 30 Engines:
Connect BMW service test unit or BMW digital tester and perform engine test (P 08)*.
Accelerate engine to test speed* and compare test values* against nominal values* with specified vacuum*.



28 12 117

Pull off retard control hose (S) when checking "advance control" or vice versa when checking "retard control",
F = Hose for advance control (black)
S = Hose for retard control (black/white)

* See Nominal Value Microfiche

* See Nominal Value Microfiche



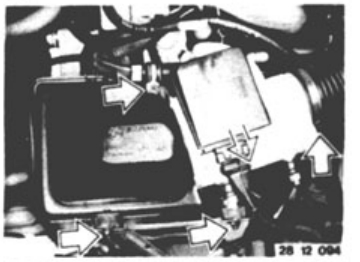


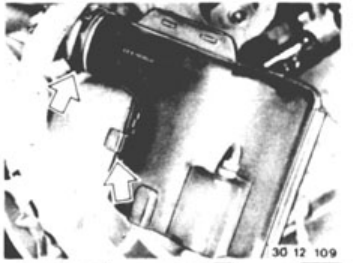
12 11 209 CHECKING DISTRIBUTOR CAP. IGNITION LEADS AND IGNITION LEAD PLUGS

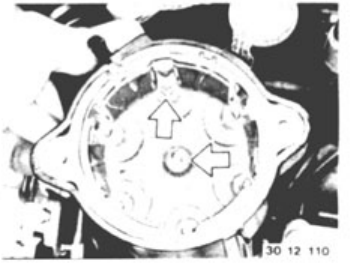
Four Cylinder M 10 Engines:
Disconnect retaining strap.
Pull off ground wire on distributor.
Take off protective cap.

Installation:
Engage clips correctly.
Connect retaining strap.

Take off distributor cap.
Check inside and outside of distributor cap for cracks and traces of burning.
Pull off shielded plugs on distributor cap and ignition coil and check contact (oxidation, dirt).
Check resistance* from distributor contact to spark plug connector or shielded connector of ignition coil.
Bend ignition lead in area of spark plug connector in a tight radius and check for cracks, replacing all leads if necessary.







Six Cylinder M 20 B 20 / B 23 Engines:
Remove air cleaner with air flow sensor.

Open both retainers for distributor cap.
Pull off ground wire and remove cap.
Check protective cap (installation, sealing sleeve).

Check inside and outside of distributor cap for cracks and traces of burning.
Pull off shielded plugs on distributor cap and ignition lead and check contact (oxidation, dirt).
Check resistance* from distributor contact to spark plug connector or shielded connector of ignition coil.
Bend ignition lead in area of spark plug connector in a tight radius and check for cracks, replacing all leads if necessary.

* See Specifications

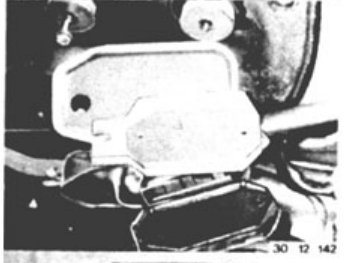
* See Specifications

12 14 010 REMOVING AND INSTALLING/ REPLACING CONTROL UNIT FOR TCIi

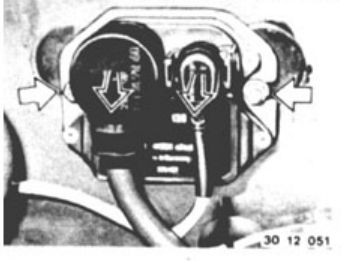
Important!
Instructions for working on ignition systems – see page 12 - 0.



TCIi Control Unit (Bosch):
Take off protective cap.
Unlock locking wire and pull off plug.
Unscrew bolts.

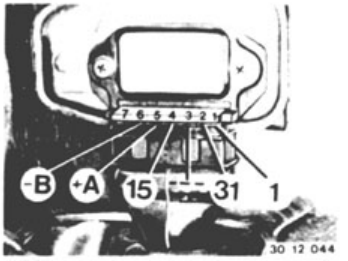


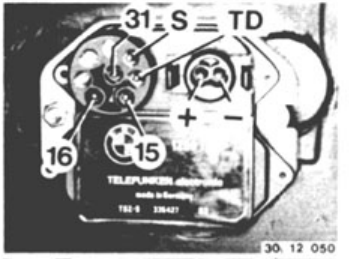
Installation:
Clean cooler, smoothing with sandpaper if necessary to guarantee good heat transition.
Also coat back with Curil K 2** before installing control unit.
Check and, if necessary, correct ignition timing* after installation.

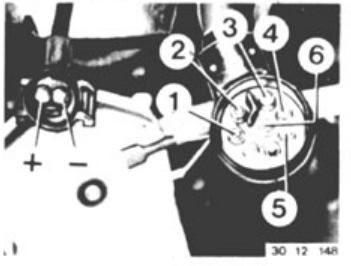


TCIi/S Control Unit (Siemens/Telefunken):
Pull off connecting plug.
Unscrew nuts.
Installation:
Check and, if necessary, correct ignition timing* after installation.

* See Nominal Value Microfiche
** Source: HWB







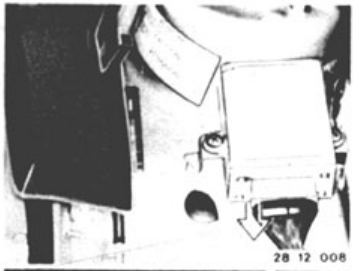
CONNECTING PLAN

TCIi Control Unit (Bosch):

No.	Terminal	Description
1	1	To ignition coil
2	31	Ground
3	–––	Shielding
4	15	Power supply
5/6	A+/B–	Pulse sensor

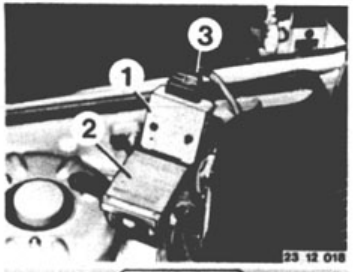
TCIi/S Control Unit (Siemens/Telefunken):

No.	Terminal	Description
1	–	
2	1/16	To ignition coil
3	15	Power supply
4	TD	– to fuel pump relay – to L-Jetr. control unit – to tachometer
5	S	To starter term. 50
6	31	Ground
	+/–	Pulse sensor

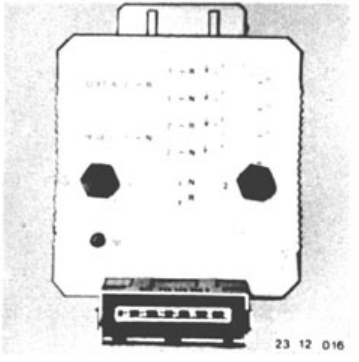


12 14 . . . **CHECKING CONTROL UNIT FOR IGNITION CONTROL (TCI-R)**

Take off cover and pull off plug (as for TCI control unit).



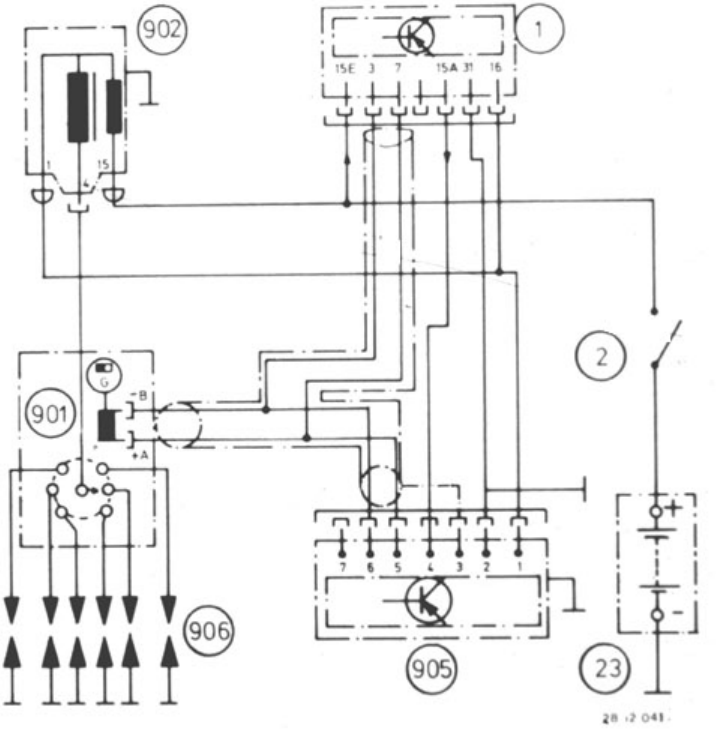
Connect ignition timing reset simulator 12 1 450 on control unit (TCI-R).
Connect BMW service tester or BMW digital tester.



Switch 1 positioned at N – otherwise no engine running.
Switch 2 positioned at R.
Start engine and run to operating temperature.
Increase engine speed slowly to 5,000 rpm.
Ignition timing is reduced* from about 3,500 rpm on.
A difference of approx. 3° on crankshaft will be displayed by turning switch 2 from R to N.

Connecting Plan for TCI System in M 30 B 28 Engines with Control Unit for Ignition Control (TCI-R)

1 Control unit for ignition control (TCI-R)
2 Ignition switch
23 Battery
901 Distributor
902 Ignition coil
905 Control unit for TCI
906 Spark plugs



* See Nominal Value Microfiche

INSTRUCTIONS FOR WORKING ON ENGINE ELECTRIC AND IGNITION SYSTEMS

- Always disconnect battery or interrupt power supply to ignition control unit and ignition coil when working on the electrical system – dangerous high voltage in engine and electrical system components (e.g. on the tachometer).

- Never start the engine after removing the distributor cap or disconnecting wires on ignition coil term. 4 – pull off plug on ignition control unit and also stop the delivery of fuel in cars with catalytic converter.

- Never disconnect battery or wires on alternator and starting motor while engine is running.

- Only use specified genuine BMW components.

- Never connect a shielded capacitor or test lamp on term. 1 of the ignition coil.

- Never connect wire of ignition coil term. 1 on ground or B +. Consequently the ignition coil term. 1 must not be used to prevent starting when service installing a burglar alarm system.

- Pull off plug on control unit for TCI or fuel injection master relay (relay 2) for DME and stop fuel delivery in cars with catalytic converter, when checking compression.

- The secondary side (high voltage side) of the ignition system must be shielded with at least 4 l-ohms, whereby the original distributor rotor with 1 k-ohm shielded resistor must be installed. Do not use 5 k-ohm distributor rotors for the shielding of radio and/or communication equipment!

- Only work on the electrical system with the ignition turned on when the heating time control unit is disconnected, to prevent destruction of heater plugs.

SURVEY FOR TROUBLESHOOTING ENGINE ELECTRIC SYSTEM WITH DIGITAL MOTOR ELECTRONICS (DME)

See next page for information on application.
Testing Requirements:
Engine in perfect condition (timing, compression, carbon deposits, etc.).
Starting system in perfect condition (battery voltage, starter, ignition lock, etc.).
Perfect gasoline in tank (octane rating, leaded/unleaded etc.).
Connections, plugs and ground points as on wiring diagram.
See "Troubleshooting Fuel Injection" in Group 13 for other test positions.

1) Cold engine cannot be started (oil temp. below 20° C/68° F)
2) Engine can be started, but stalls again
3) Cold engine hard to start (oil temp. below 20° C/68° F)
4) Warm engine cannot be started
5) Warm engine hard to start
6) Erratic idling during warm-up phase
7) Idle speed not correct
8) Splashing in intake tank
9) Shaking while accelerating
10) Hesitation while accelerating
11) Hesitation during coasting
12) Misfiring with constant misfiring
13) Poor acceleration/final output
14) Fuel Consumption
15) Exhaust values (CO/HC) not correct

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			
X			X								X									1	Speed sender / reference mark sender	
X		X	X	X			X				X									2	Ignition coil	
		X		X	X	X	X	X	X		X	X		X						3	Spark plugs	
		X		X	X		X	X			X									4	High tension distributor	
		X		X	X		X	X			X									5	Ignition plug connectors and leads	
X	X	X	X	X				X	X	X		X	X							6	DME control unit/ignition timing/ignition control	
																				7		
																				8		
																				9		
													X	X						10	Exhaust gas control or recirculation	Gr. 11
																				11		
																				12	Knock control	BMW Technik Gr. 11
	X			X				X				X								13	Tank venting	Gr. 16
												X								14	Charge pressure control*	BMW Technik Gr. 11
X		X			X	X														15	Fuel supply	Gr. 16
	X	X		X	X	X		X		X	X	X		X						16	Intake system	Gr. 13
						X		X				X	X	X						17	Turbocharger/charge air*	Gr. 11
														X						18	Exhaust system/cat, conv.	Gr. 18/11
		X		X	X	X						X		X						19	Crankcase breather	Gr. 11
					X	X														20	Cooling system	Gr. 17
																				21		
																				22		
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																				26		
																				27		
																				28		
																				29		
																				30	* + Model E 34 524 td	

TEST POSITIONS TO TROUBLESHOOT DIGITAL MOTOR ELECTRONICS

Application Information:

This survey can be applied for troubleshooting and consequently finding sources of defect more quickly.

The points have been compiled on the basis of greatest probability, so that under certain circumstances it could be possible that additional tests would be necessary.

Testing instructions refer to the BMW SERVICE TEST, e.g. engine test/test step 05 (P 05) or a multimeter function (M). See operating instructions for connections.

Test 1 – SPEED AND REFERENCE MARK SENSORS

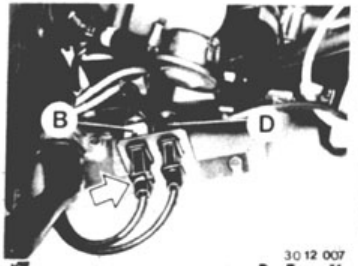
Check wires for tight fit and damage.
Check connections and arrangement of plug connections.
Reference mark sensor is marked with a ring – see 12 14 510/515.

↓

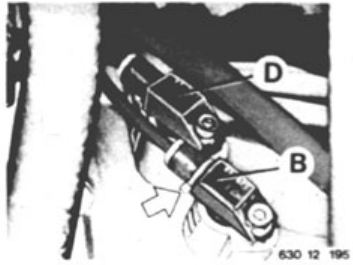
Turn engine with the starter. Check resistance (M 06) and oscillograph (M 22/23) on disconnected plug with BMW service test unit, see 12 14 510.

↓

Check wires leading to DME control unit:
See engine electrical wiring diagram for routing and terminal designations. Pull off plug on control unit and connect universal adapter** (35 pins).
Measure resistance and insulation (M 06) of wires on specified pins.



30 12 007



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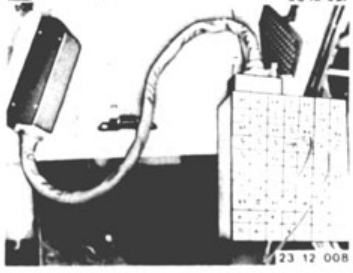
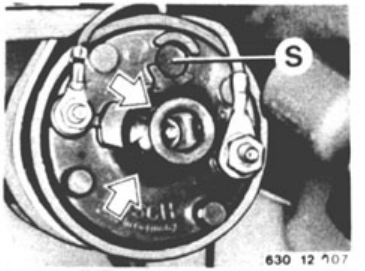


23 12 008

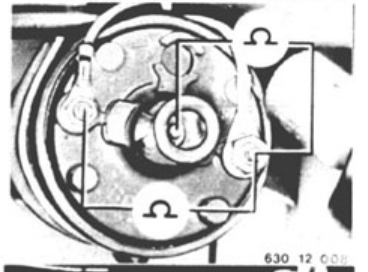
* See Specifications
** Source: HWB

Test 2 - IGNITION COIL

Check code number* of ignition coil.
Check ignition coil for damage, whether plug (S) is installed and contact of electric lead connections.



Check resistance* (M 06) and inductivity* (M 07) of primary and secondary coils - also refer to 12 13 009.



Test 3 - SPARK PLUGS

Check spark plugs for tight fit (leakage).
Check insulators for surface current leakage.
Check spark plug type* and electrode gap*.



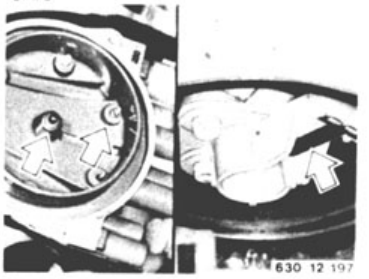
* See Specifications

Test 4 – HIGH VOLTAGE DISTRIBUTOR

Check distributor cap and rotor for correct fit, damage and hairline cracks. Check wire connections for good contact – see 12 11 091 / 111.

Check resistance* (M 06) from distributor peak to corresponding contact in distributor cap.
Resistance must be approximately 0 ohm.

Check resistance* (M 06) of distributor rotor.



Test 5 – IGNITION LEADS AND CONNECTORS

Check spark plug connectors and shielded connectors for damage, tightness and good contact.
Bend ignition leads in a tight radius and check for cracks.

Check resistance* (M 06) of spark plug connectors, ignition leads and connectors.

* See Specifications

Test 6: DME Control Unit and Power Supply, Ignition Timing and Control

Check code* and manufacturing date on DME control unit – see Group 13.

↓

Check power supply**:
Pull plug off of control unit and connect on universal adapter* (35 pins).
Turn on ignition and check voltage on pins**, e.g. on conn. 17 (–) and 35 (+).

→ Pull off relay 2 and bridge term. 87 and 30. This supplies power to control unit.
Check activation** for relay 2:
Turn on ignition.
Term. 85 (–) and 86 (+) should have power (approx. 12 V).

↓

Reconnect control unit and start engine.

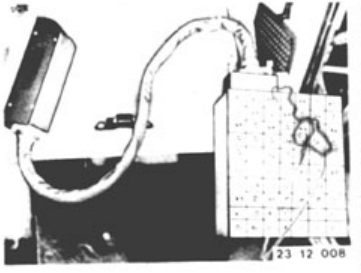
→ Pull off plug on DME control unit.
Connect universal adapter* (35 pins) and perform periphery test.
Control units before 12/86 may not be installed in cars after 1986.

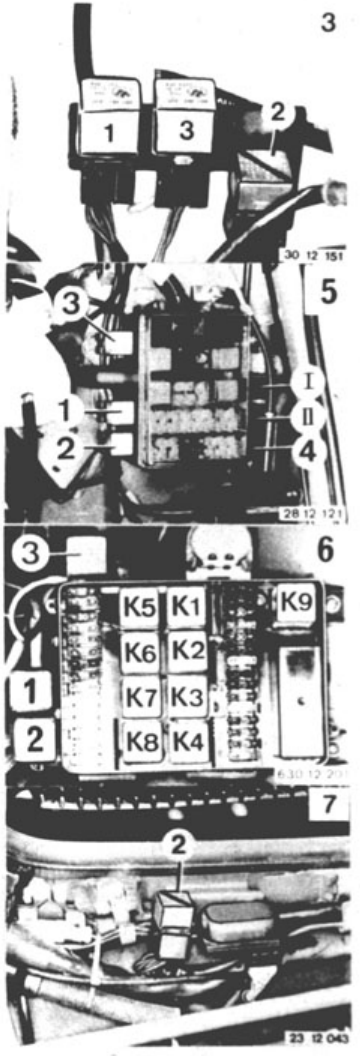
↓

Check ignition timing** and ignition control** (P 06/07).

↓

Not okay. → Replace DME control unit.





* Source of Supply: HWB
** See Nominal Value Microfiche
* See Specifications
** See Engine Electric Wiring Diagram

Test 12 – KNOCK CONTROL (Only BMW 745 i since 5.83)

a) Checking Power Supply**:

Pull off plug on control unit.
Connect 25-pin universal adapter*.
Turn on ignition.
Check voltage (approx. 12 V) on pins 12 (–) and 25 (+).
Connection 17 should have voltage (approx. 12 V) while starting (term. 50).

→ Pull off relay 2 and bridge terminals 87 and 30.
This will supply power to the control unit.
Check activation** for relay 2:
Turn on ignition.
Term. 85 (–) and 86 (+) should have voltage (approx. 12 V).

b) Checking Cylinder Identifying Pulse Sensor:

Pull off plug on control unit.
Connect 25-pin universal adapter*.
Measure resistance (0.8 to 1.1 ohms) between pins 18 and 19, replacing sensor if necessary.

→ Check wire** and plug connection for sensor.

c) Checking Knock Sensor:

Pull off plug on control unit.
Connect 25-pin universal adapter.
Measure resistance (280 to 310 k-ohms) each time between pins 9 and 10 (sensor 1) as well as 6 and 10 (sensor 2).

→ Check wires** and plug connections for sensors.

d) Throttle Potentiometer – See Group 13:

Troubleshooting Fuel Injection.

* Source: HWB
** See engine wiring diagram

Test 13 – TANK VENT

Refer to repair manual of pertinent model series for arrangement of wires.

Check flow in lines from fuel tank to expansion tank.
Check flow in vent line from expansion tank to outside discharging. → Repair connections; replace bent or crushed lines.

↓

Check rollover valve in expansion tank. → Replace expansion tank.

Test 14 – CHARGING PRESSURE CONTROL (Only BMW 745 i since 5.83)

a) Checking Electric Switching Valve for Charging Pressure Control

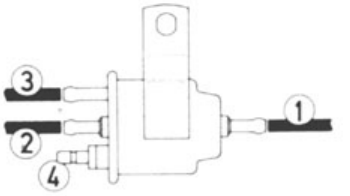
Pull off plug on switching valve (4) – there must be power flow between connections 2 and 3.
If battery voltage is supplied to the switching valve via a test lead, there must be power flow from connection 1 to 2 and no power flow between connections 2 and 3 – replace switching valve if necessary.

↓

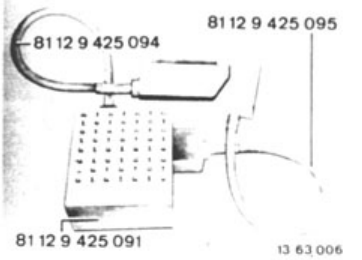
The switching valve is supplied with electric power by turning on the ignition (15 u and term. 10 engine plug).
Ground is only activated while operating car via the knock control unit (with activated knock control).

↓

Pull off plug on knock control unit.
Connect 25-pin universal adapter*.
Check wire** on pin 2 to switching valve.



2313 020



13 63 006

* Source: HWB
** See Engien Wiring Diagram

Test 15 – FUEL SUPPLY

Check fuel feed to electric fuel pump. → Check filter screen in fuel intake – also refer to Group 16.

↓

Check electric fuel pump, fuel lines, pressure regulator and fuel pressure – refer to "Troubleshooting Fuel Injection" in Gr. 13.

Test 16 – INTAKE SYSTEM

Check intake manifold pipes and air cleaner for tight connections and damage.
Check tightness of connections and bolts.
Check for leaks.
Replace a contaminated air filter cartridge.

Test 18 – EXHAUST SYSTEM

Check exhaust system for damage, tight fit and leaks.

Test 19 – CRANKCASE VENT

Check crankcase vent and oil dipstick for tight fit and leaks.

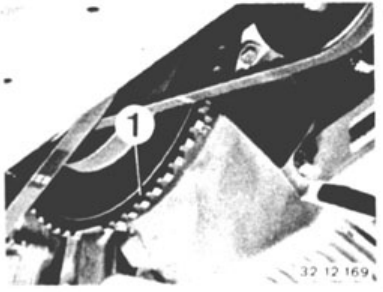
Test 20 – COOLING SYSTEM

Check level and grade** of coolant, filling and bleeding cooling system if necessary – also refer to Group 17.

** See Service Information of Gr. 00

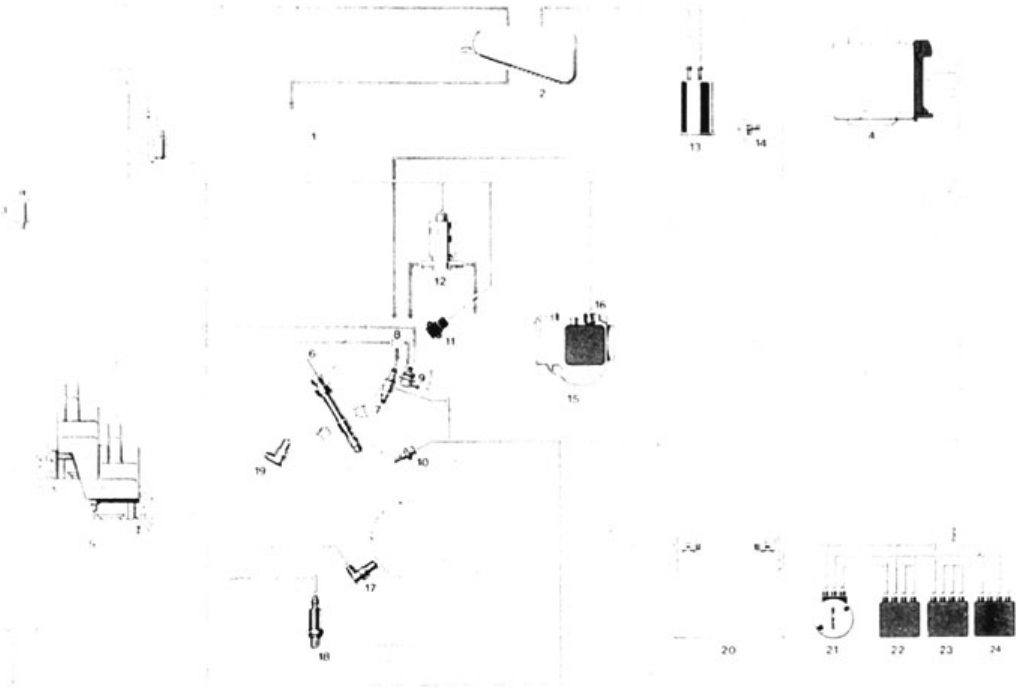
TROUBLESHOOTING ENGINE ELECTRIC SYSTEM AND DME

Accomplished with a BMW Diagnosis Tester since introduction of M 1.1.



Can be recognized on the increment wheel (1) for sender-type Motronic.

DME 1.7 Diagram for M 42



1 Fuel tank and pump
2 Fuel expansion tank
3 Fuel filter
4 DME M 1.7 control unit
5 Separate ignition coil package
6 Spark plug
7 Fuel injector
8 Fuel distribution pipe
9 Fuel pressure regulator
10 Coolant temperature sensor
11 Throttle valve potentiometer
12 Idle speed control
13 Carbon canister
14 Tank venting solenoid
15 Air flow sensor
16 Air temperature sensor
17 Speed and reference mark sender
18 Oxygen sensor
19 Cylinder identifying sender
20 Battery
21 Ignition lock
22 Master relay
23 Fuel pump relay
24 Oxygen sensor heating relay

42 12 051

Digital Motor Electronics (DME) M 1.7 / Four Cylinder M 42 Engines

New in Comparison with Old DME Control Units:

- 88-pin plug
- Stationary ignition distribution
- Camshaft sender
- Throttle valve potentiometer
- Air conditioner compressor shutoff

Description of DME 1.7 Operation:

DME permit precise control and regulation of fuel injection and ignition even under variable operating conditions. It works additionally in conjunction with other systems, namely

- burglar alarm,
- instrument cluster and
- on-board computer,

which can influence the entire engine timing depending on requirements.

DME performs the following operations, which will be described in detail later.

- Fuel injection timing
- Ignition timing
- Ignition distribution
- Cold start control
- Adaptive idle speed regulation
- Adaptive oxygen sensor regulation
- Adaptive tank venting
- Accelerating enrichment
- Dynamic coasting shutoff
- Catalytic converter protection
- Anti-knock
- Emergency running
- Family curve switchover with EH transmission
- Relay controls
- Self-diagnosis with fault memory

Components Delivering Input Signals to DME Control Unit:

- Pulse sender (speed/position)
- Pulse sender (cylinder identification) camshaft sender
- Air flow sender
- Oxygen sensor
- Idle speed CO potentiometer (without catalytic converter)
- Throttle valve potentiometer
- Temperature sensor (intake air)
- Temperature sensor (engine)
- Road speed sender
- Burglar alarm
- Air conditioner switch
- Air conditioner compressor
- Battery
- Terminal 15
- Programming voltage (version coding)

Outputs on DME Control Unit Wired via Final Stages to Deliver Signals to Following Components:

- Fuel injectors (cylinders 1 + 3)
- Fuel injectors (cylinders 2 + 4)
- Ignition coil 1
- Ignition coil 2
- Ignition coil 3
- Ignition coil 4
- Idle speed control
- Air flow sensor
- Throttle valve potentiometer
- Tank venting valve
- Master relay (control unit power supply)
- Fuel pump relay
- Oxygen sensor heating relay
- Fault lamp (only USA)
- Economy control (instrument cluster)
- Instrument cluster (TD and ti signals)

IDLE SPEED CONTROL, SPEED LIMIT, COLD START CONTROL

Refer to E 34 diagnosis test plan in chapter 1210 DME M 1.3.

TYPES OF INJECTION

Each group of fuel injectors (2 + 4 or 1 + 3) is activated by a final stage (current amplifier). It is therefore possible to divide the injection cycle into groups of cylinders. This guarantees limited engine operation even when one group fails.

Semi-sequential injection:

There is injection in one group of cylinders (2 + 4 or 1 + 3) only once every 720 crankshaft degrees as from an engine speed of 600 rpm. This timing can function only when the DME control unit receives a signal from the camshaft sender (on camshaft sprocket of exhaust valves). Timing remains in semi-sequential injection if the signal is received later.

Parallel injection:

Parallel injection means simultaneous activation of all fuel injectors for each crankshaft revolution and takes place only when the camshaft sender has not put out any signals since starting the engine.
If a signal is put out later, the system switches over to semi-sequential injection as soon as an engine speed of 2500 rpm is exceeded.

IGNITION

Stationary Ignition Distribution:

Each cylinder has its own ignition coil. In this manner the system of rotating ignition distribution is omitted. DME activates each ignition coil separately.

Double Ignition:

Double ignition means activation of the spark plugs for each crankshaft revolution and takes place only when the camshaft sender does not put out signals. Switching over from normal to double ignition, or vice versa, takes place immediately in contradiction to fuel injection.

ANTI-KNOCK FUNCTION

The ignition timing is retarded depending on intake air and engine temperature, in order to prevent self-ignition of the fuel/air mixture in the combustion chamber (knocking).

CATALYTIC CONVERTER PROTECTION

There is danger of overheating the catalytic converter when the catalytic converter protection is active over a long period of time. For this reason the fuel / air mixture is enriched to reduce the exhaust gas temperature.

THROTTLE VALVE POTENTIOMETER

A throttle valve potentiometer is installed instead of a throttle valve switch with idle and full load contacts. This potentiometer must no longer be adjusted, since DME learns the idle speed ignition timing (idle speed switching point) on its own. DME adds a determined value to the learned value. This value must go from the potentiometer to DME in order to be processed as a full load signal in DME.

AIR CONDITIONER COMPRESSOR SHUTOFF

In order to have the entire engine power for drive while moving off, the air conditioner compressor is switched off for up to 7 seconds at road speeds of < 8 km/h (5 mph) and simultaneous full load state.

TANK VENTING FOR MODELS WITH CATALYTIC CONVERTER

OXYGEN SENSOR CONTROL FOR MODELS WITH CATALYTIC CONVERTER

DRIVE AWAY PREVENTION

SELF-DIAGNOSIS

Refer to E 34 diagnosis test plan in chapter 1210 DME M 1.3 for information about the BMW diagnosing system.

ABBREVIATIONS

AG	Automatic transmission
DK	Throttle valve
DME	Digital motor electronics
DWA	Burglar alarm
EH	Electronic / hydraulic
EGS	Electronic transmission control
EKP	Electric fuel pump
EV	Fuel injector
HG	Manual transmission
KD	Kickdown
KW	Crankshaft
LL	Idle speed
LLS	Idle speed control
LMM	Air flow sensor
MF	Micrtofiche
MV	Solenoid
NW	Camshaft
RxD	Dagnosing sensing line
TD	Speed signal once each ignition
TE	Tank venting
ti	Injection time (duration)
TL	Partial load
tL	Load signal
TR	Speed signal once each revolution
TxD	Diagnosing data line
SG	Control unit
U-Batt	Battery voltage
U-Vers	Power supply
VL	Full load

PIN CONNECTIONS

Connections of 88 Pin Plug on DME Control Unit

Engine is running at idle speed, if there is no other testing instruction.

Pin	Type	Description / Function	Type of Signal	Testing Information
1	A	EKP relay and KW ref. TR	Ground+speed signal (superimposed)	
2	–	–		
3	A	Fuel injectors (1 + 3)	Square-wave signal	
4	–	–		
5	–	–		
6	M	Ground - fuel injectors	Ground	
7	–	–		
8	A	Fault lamp	Ground	(only US) if exhaust relevant fault is stored in memory
9	–	–		
10	–	–		
11	A	DK potentiometer	Pulse module signal for EGS	
12	E	DK potentiometer	5 V	depending on DK position
13	–	–		
14	M	Air flow sensor	Ground	
15	–	–		
16	E	Camshaft sender	Square-wave signal	
17	A	KVA signal (for instr. cluster)	Square-wave signal	
18	A	Air cond. compressor shutoff	Ground	8 km/h (5 mph) + full load
19	–	–		
20	–	–		
21	–	–		
22	–	–		
23	–	–		
24	A	Ignition cyl. 3	Primary signal	
25	A	Ignition cyl. 1	Primary signal	
26	E	Permanent positive	Battery voltage	
27	A	DME master relay	Ground	
28	M	Ground elec./shield sensors	Ground	
29	A	Idle speed control	Square-wave signal	
30	–	–		
31	–	–		
32	A	Fuel injectors (2 + 4)	Square-wave signal	
33	–	–		
34	M	Ground other final stages	Ground	
35	–	–		
36	A	Tank venting	Ground	if open
37	A	Oxygen sensor heating	Ground	if on
38	–	–		
39	–	–		
40	–	–		
41	E	Signal - air flow sensor	0 V	
42	–	–		
43	M	Ground sender (DK-poti, T-eng)	Ground	
44	M	Ground camshaft sender	Ground	
45	–	–		
46	–	–		
47	–	–		
48	A	Kickdown preventer	Ground	if not active
49	–	–		

Pin	Type	Description / Function	Type of Signal	Testing Information
50	–	–		
51	A	Ignition cyl. 4	Primary signal	
52	A	Ignition cyl. 2	Primary signal	
53	–	–		
54	E	Battery voltage	Battery voltage	
55	M	Ground - ignition	Ground	
56	E	Terminal 15	Battery voltage	
57	–	–		
58	–	–		
59	A	+ 5 volts (for LMM)	5 V	
60	E	Programming voltage input	Ground	diagnosis socket cover closed
61	E	Programming voltage test	Ground	diagnosis socket cover closed
62	–	–		
63	E	Switch - converter lockup	Ground	if WK closed
64	E	Switch - transmission tap	Ground	if tap active
65	E	Switch - range (P/N)	Ground	if P/N position
66	–	–		
67	E	Inductive pulse sender	Square-wave signal	
68	M	Inductive pulse sender	Ground	
69	–	–		
70	E	Signal - oxygen sensor	0.2 to 0.8 V	
71	M	Ground - oxygen sensor	Ground	
72	–	–		
73	E	Speedometer signal	Square-wave signal	
74	A	TD signal	Square-wave signal	
75	–	–		
76	E	LL-CO poti voltage	1 to 4 V	
77	E	Temp. sensor - intake air	0 V	
78	E	Temp. sensor - engine	0 V	
79	–	–		
80	–	–		
81	E	Switch - burglar alarm	Battery voltage	if burglar alarm activated
82	–	–		
83	–	–		
84	–	–		
85	E	Switch - A/C compressor	Battery voltage	if compressor on
86	E	Switch - air conditioner	Battery voltage	if switched on
87	E	RxD line	Battery voltage	diagnosis socket cover closed
88	E,A	TxD line	Ground	diagnosis socket cover closed

E = Input
A = Output
M = Ground

TROUBLESHOOTING

Note:
Always conform with safety and accident prevention regulations for all tests and work on the engine electric and electronic system.

Caution!
Dangerous high tension on primary and secondary circuits of ignition.

The battery should not be disconnected whenever possible, since otherwise this would cancel the faults stored in memories of all control units.

Disconnect control units on wire harness only with the ignition turned off.

Test electric leads only with disconnected control unit or component plugs.

Testing Aids:

Wiring diagrams are filed in the "General Electric System - 3 Series" binder.

Presentation of a memory-stored fault on screen.

Location of Fault:
The number of a fault refers to the pin connection on the control unit. A fault could be on a component, concerned electric leads or in the control unit.

Type of Fault:
Shorts, breaks, exceeding of ranges or implausible functions are displayed.

Frequency:
Information whether or not (brief fault) a fault exists at the moment of time. Also display of how often the fault was recognized. If the fault no longer exists, the number of times the engine had been started since the last recognition of the fault is displayed.

Recognition During:
Additional fault information about the operating conditions during recognition of a fault.

List of Faults:

Faults stored in memories can be displayed on the tester by selecting 900 (Fault Memory).

No faults stored in memories.

Function disturbed: engine operation not possible.

Troubleshooting:

Requirements:
- Starting system okay (battery charged, ignition switch and starter okay, etc.).
- Ground connections on battery, engine and body okay.
- Specified gasoline in tank.
- Engine in perfect operating condition (timing, compression, etc.).

a) Check power supply for DME control unit according to wiring diagram.

b) Measure input signals.
- Speed signal from inductive pulse sender 200 at starting speed.
- Air flow sensor signals 200.

c) Measure output signals.
- Activation of fuel pump relay according to wiring diagram.
- Ignition final stage with help of ENGINE TEST test step 09.
- Fuel injectors with 300.

d) Test fuel pressure.
Technical data – see component testing chapter.

FAULT 1

900 fault memory: 1 electric fuel pump relay

Explanation:
This fault is stored when a short occurs on relay 1 (electric fuel pump) or in control lead to DME control unit pin 1. This fault is recognized only when at least one additional final stage is faulty.

Troubleshooting: as displayed on screen.

FAULT 3

900 fault memory: 3 fuel injectors cyl. 1 + 3

Explanation:
This fault is stored when shorts or breaks occur on fuel injectors for cyl. 1 + 3 or their power supply leads.

Note: The entire fuel injector group is stopped with a short on one fuel injector or its power supply lead. Two cylinders remain in operation.

Troubleshooting: as displayed on screen.

FAULT 8

900 fault memory: 8 fault lamp

Explanation: Only applicable for US models.
This fault is stored when shorts occur on fault lamp or its power supply lead.

Troubleshooting: as displayed on screen.

FAULT 12

900 fault memory: 12 throttle valve potentiometer

Explanation: This fault is stored when shorts or breaks occur on potentiometer or its power supply leads.

Troubleshooting: as displayed on screen. Test values – see component testing.

FAULT 16

900 fault memory: 16 camshaft sender

Explanation: This fault is stored when faulty signals from camshaft sender occurr at speed of 2500 rpm.

Troubleshooting: as displayed on screen.

FAULT 29

900 fault memory: 29 idle speed control

Explanation: This fault is stored when a short occurs on lead to pin 29.

Troubleshooting: as displayed on screen.

FAULT 32

900 fault memory: 32 fuel injectors - cyl. 2 + 4

Explanation: see Fault 36.

FAULT 36

900 fault memory: 36 tank venting valve

Explanation: This fault is stored when a short or break occurs on tank venting valve or its power supply lead.

Troubleshooting: as displayed on screen. Test values – see component testing.

FAULT 37

900 fault memory: 37 oxygen sensor heating relay

Explanation: Fault is stored when a short or break on relay or power supply lead from DME control unit pin 37 is recognized.

Troubleshooting: as displayed on screen.

FAULT 41

900 fault memory: 41 air flow sensor

Explanation: This fault is stored when shorts or breaks occur on air flow sensor or its leads (power supply or signal lead).
Also recognition when Up/Uv value of LMM is no longer in the normal operating range of 0.02 to 0.95.
DME control unit then works with determined replacement values, load signal tL = 3.5 ms (partial load) and 6.0 ms (full load) and ignition timing = 20 crankshaft degrees before TDC.

Troubleshooting: as displayed on screen.
Test air flow sensor with status call 200. Up/Uv value shows the relation betw. potentiometer voltage (slider) and power supply voltage (5 V) in air flow sensor.
Specifications – see component testing.

FAULT 54

900 fault memory: 54 control unit power supply

Explanation: This fault is stored when power supply exceeds 16 V. A drop below 9 V is recognized 3 minutes after starting at the earliest.

Possible Fault Causes:
- Contact resistance on lead connections
- Incorrect drive belt tightness
- Voltage regulator or alternator faulty

Troubleshooting: as displayed on screen.

FAULT 70

900 fault memory: 70 oxygen sensor

Explanation: This fault is stored when a short or break occurs on oxygen sensor or its leads, or when no oxygen senor is installed (cars prepared for catalytic converter). It requires an engine temperature of 70° C (158° F) and a load signal of 4.5 ms for 5 seconds.

Troubleshooting: as displayed on screen.
Test values for oxygen sensor – see component testing.

FAULT 73

900 fault memory: 73 road speed signal

Explanation: This fault is stored by DME when following conditions are fulfilled simultaneously.

Engine speed	4500 rpm
Load signal	4.0 ms
Road speed signal	3 to 5 km/h (2 to 3 mph)

Troubleshooting: as displayed on screen.

FAULT 76

900 fault memory: 76 idle speed CO potentiometer

Explanation: Valid only for cars without catalytic converter. This fault is stored when shorts or breaks occur on potentiometer or its leads. Replacement value of 1.99 V is used.

Troubleshooting: as displayed on screen. Test values – see component testing.

FAULT 77

900 fault memory: 77 intake air temperature sensor

Explanation: This fault is stored when shorts or breaks occur on temperature sensor or its leads. Recognition of a break requires 3 minutes time after starting and idle speed for at least 30 seconds. Replacement value of 50° C (122° F) is used after recognition of fault.

Troubleshooting: as displayed on screen. Test values – see component testing.

FAULT 78

900 fault memory: 78 engine temperature sensor

Explanation: This fault is stored when shorts or breaks occur on temperature sensor or its leads.
Intake air temperature is used as a replacement value in case of fault, but only for the first 3 minutes after starting when air temperature is < 20° C (68° F). A replacement value of 80° C (176° F) is ready for use in other conditions.

Troubleshooting: as displayed on screen. Test values – see component testing.

FAULT 85

900 fault memory: 85 air conditioner compressor

Explanation: This fault is stored when control unit receives "compressor in operation" (battery voltage on pin 85) and "A/C switch not operated" (0 V on pin 86) signals simultaneously. In this case either pin 86 has a break or there is a short between battery voltage and pin 85.

Troubleshooting: as displayed on screen.

FAULT 100

900 fault memory: 100 final stage

Explanation: This fault is stored when a loose contact occurs on a final stage output. If another final stage fault (Fault Codes 1, 3, 18, 29, 32, 36 or 37) occurs additionally, it can be assumed that fault 100 is identical with one of these faults.

FAULT 200

900 fault memory: 200 DME control unit

Explanation: This fault is stored when the internal self-test finds a fault in the memory modules.

Possible causes: programming fault or disturbed program run-off in DME control unit.

Correction: Test drive car after cancelling the fault memory. DME control unit must be replaced if the fault occurs again.

FAULT 201

900 fault memory: 201 oxygen sensor control

Explanation: This fault is stored in case of excessive deviation in the fuel/air mixture (excessively rich or lean mixture for longer than 8 seconds). It requires an oxygen sensor ready for operation.

Possible Causes of Fault:
- Wrong fuel pressure
- Faulty or carbonized fuel injectors
- Faulty engine temperature sensor
- Wrong air in intake
- Faulty tank venting system

Troubleshooting: as displayed on screen. Test values – see component testing and technical data microfiche.

COMPONENT TESTING

Note:
Always conform with safety and accident prevention regulations for all tests and work on the engine electric and electronic system.

Caution!
Dangerous high tension on primary and secondary circuits of ignition.

Important!
The battery should not be disconnected whenever possible, since otherwise this would cancel the faults stored in memories of all control units.

Disconnect control units on wire harness only with the ignition turned off.

Test electric leads only with disconnected control unit or component plugs.

Testing Aids:

Wiring diagrams are filed in the "General Electric System - 3 Series" binder.

Only use specified test leads, terminals and test points.

Test values for component testing are listed in the appendix. Refer to technical data microfiche for other specifications.

Removal and installation are described in the repair manual.

SURVEY OF FAULT CODES AND COMPONENT TESTS

Component / Function	Brief Test Input	Fault Code in Memory
DME control unit	–	200
Ignition coils	–	–
Fuel pump relay (relay 1)	100	1
Throttle valve potentiometer	200	12
Tank venting valve	100, 300	36
Air flow sensor	200	41
Camshaft sender	100	16
Oxygen control	100	201
Fault lamp	–	8
Fuel injectors	300	3/32
Sensor heating relay	300	37
Oxygen sensor	100	70
Road speed signal	200	73
Kickdown prevention solenoid	–	48
Master relay (relay 2)	100	–
Power supply	200	54
A/C compressor	100	85
Intake air temperature sensor	200	77
Engine temperature sensor	200	78
Speed/position pulse sender	200	–
Ignition timing tap	100	64
Converter clutch	–	63

DME CONTROL UNIT

Function Test:
Different function blocks such as, for example, ignition, injection, oxygen control, etc. can only be tested when necessary input signals are receivede on the control unit first – see pin connections.

FUEL PUMP RELAY (DME Relay 1)

Function Test:
100 - electric fuel pump relay must switch on while starting or running engine (display: ON).

Possible Causes of Fault:
- **Lead to DME control unit pin 1 faulty**
- **Relay 1 or power supply faulty**
- **Power supply for DME control unit faulty**
- **No signals from speed/position pulse sender**
- **No ground potential put out on DME control unit pin 1 while starting and running engine, although above points are okay = control unit is faulty**

IDLE SPEED CONTROL (LLS)

Function Test:
300 - Idle speed control is activated with second cycle – plate on idle speed control must open and close fully.

Resistance Test:
Resistance of coil can be measured direct on the component.
See appendix for specifications.

TANK VENTING VALVE

Electric Function Test:
300 - Valve is activated with second cycle. Cycling can be felt with hand.

Leak Test:
Disconnect hoses on valve, connect vacuum supply from Service Tester on the 8 mm connection (note flow direction arrow). Regulate vacuum to 600 mbar and supply 12 V to valve.
Switch off vacuum pump – pressure drop must not exceed 50 mbar after 20 seconds.
In a state without electric current the valve is closed by a check valve to to intake pipe vacuum of 20 mbar.

Activating Phase Test:
100 - Valve is activated at idle speed (display: OFF) and therefore closed. Gradual opening can be observed as soon as oxygen control is active and the speed increased (display: OPEN).
The valve is still kept closed for 3 to 5 seconds after stopping the engine.

AIR FLOW SENSOR (LMM)

LMM Signal Test:
100 - Up/Uv value (Up = potentiometer voltage, Uv = power supply voltage 5 V) indicates the voltage relation resulting from the sensor plate position in LMM. At idle speed the value should be 0.2 to 0.3; at full load it rises to 0.9. A value of 0.02 is displayed when power supply or control lead has a break.

Power Supply Test:
5 V power is supplied to LMM from DME control unit pin 59 (+) and pin 14 (–) with the ignition ON. See wiring diagram for connections on LMM.

CAMSHAFT SENDER

Function Test:
100 - Full bank injection is switched over to semi-sequential injection and double ignition switched off as soon as the control unit receives camshaft sender signals. If the signal comes later, semi-sequential injection is maintained. Switching over from normal to double ignition, or vice versa, takes place immediately in contradiction to fuel injection.
Further testing with multimeter test 23/24. Connect oscilloscope on component plug and operate engine at idle speed. An alternating voltage curve with positive and negative half-waves should appear on the screen.

Resistance Test:
Resistance can be measured direct on the component plug. See appendix for specifications.

OXYGEN CONTROL

Function Test:
100 - Oxygen sensor at operating temperature is required for calling. Engine must be run 30 to 40 seconds before regulation cuts in.
Regulation can compensate wear-caused deviations in fuel/air mixing to a great extent and consequently hide other faults. If applicable, disconnect the oxygen sensor while troubleshooting the fuel/air mixture.

FAULT LAMP "CHECK ENGINE" (only USA)

Function Test:
Fault lamp receives 12 V power supply from control unit as soon as an exhaust relevant fault is detected. It lights up continuously after ignition is turned ON for controlling.

FUEL INJECTORS

Electric Function Test:
300 - Fuel injectors are activated with a frequency of 10 Hz. Pulse time is 1 ms to avoid the ejection of fuel. Activation can be felt with a hand. Pulses can be checked with a multimeter on the fuel injector plug.

Resistance Test:
Resistance of a fuel injector must be measured direct on the component. Only a complete fuel injector group (e.g. 2 injectors of four cyl. engine) can be measured on DME control unit plug. See appendix for specifications.

SENSOR HEATING RELAY

Function Test:
300 - This activation takes place in second cycles. Relay remains switched on in normal operation for so long, until high speeds or load occur.

Possible Causes of Fault:
- Lead to DME control unit pin 37 faulty
- Relay or power supply faulty

OXYGEN SENSOR

Function Test:
200 - Requirement for calling is oxygen sensor at operating temperature. The displayed voltage signal is tapped in steps and fluctuates between 0.02 and 0.85 V. A constant value of 0.45 V is displayed when the oxygen sensor is not working or lead to DME control unit has a break. This value is also displayed when no oxygen sensor is installed.

CONTROL MASTER RELAY (DME Relay 2)

Function Test:
100 - Master relay is activated on terminal 85 with ground potential after ignition is turned ON or engine runs (display: ON). Relay switches on and supplies rest of control unit with power.

Possible Causes of Fault:
- Lead to DME control unit pin 54 faulty
- Relay 2 or power supply faulty
- Power supply for DME control unit faulty
- Control unit faulty when ground potential is not put out on control unit pin 54, although above points are okay

CONTROL UNIT POWER SUPPLY

100 - Control unit has the voltage displayed at the moment. It should not be less than 10 V.

INTAKE AIR TEMPERATURE SENSOR (in LMM)

Function Test:
200 - Intake air temperature of engine at operating temperature is 50 to 70° C (122 to 158° F) – ambient air temperature 23 ± 5° C (73 ± 9° F).
A display below – 40° C (– 40° F) indicates a break in the temperature sensor or lead to the DME control unit.

Resistance Test:
Connect universal adapter. Measure resistance on connections 77 and 14. Or direct on air flow sensor pins 4 and 5. See appendix for specifications.

ENGINE TEMPERATURE SENSOR (Coolant)

Function Test:
200 - Displayed engine temperature should correspond with the coolant temperature. A value below – 40° C (– 40° F) indicates a break in the temperature sensor or lead to the DME control unit.

Resistance Test:
Connect universal adapter on engine wire harness. Measure resistance on connections 45 and 19. See appendix for specifications.

SPEED / POSITION PULSE SENDER

Function Test:
200 - Speed signals can be called at starting speed on from running engine. Further testing with multimeter test 23/24. Connect oscilloscope on component plug and crank the engine. An alternating voltage curve with positive and negative half-waves should appear on the screen.

Resistance Test:
Resistance can be measured direct on the component plug. See wiring diagram for connections. See appendix for specifications.

Possible Cause of Fault:
If lead, plug and resistance are okay, check distance of pulse sender to incremental wheel on the vibration damper – 0.15 to 1.5 mm (0.006 to 0.059"). Adjusted distance with adjustable holder: 1.0 ± 0.3 mm (0.039 ± 0.012").

THROTTLE VALVE POTENTIOMETER

Function Test:
200 - Operate throttle valve and observe the voltage value. Voltage values between 0.6 (idle speed) and 5.0 (full load) volts.

Resistance Test:
See appendix for specifications.

IGNITION COIL

See 12-212.

Status Call 100	Nominal State
101 Electric fuel pump relay	While starting or running engine = ON
116 Camshaft sender	After increasing speed once = ON
127 Master relay	While starting or running engine = ON
136 Tank venting valve	Idling = OFF or ON until timing begins
137 Oxygen sensor heating	With high speed and load = OFF
163 Converter clutch (only EGS)	Speed dependent in 3rd + 4th gear = ON
164 Ignition timing tap (only cars with manual transmission)	At idle speed = OFF, only for downshifts ON briefly
165 Range P/N (only automatics)	Selector lever in P or N = ON
171 Oxygen control	Engine running = ON, if oxygen sensor has operating temperature
181 Burglar alarm switch	Burglar alarm not activated = OFF
185 Compressor control	Compressor relay switched on = ON
186 Air conditioner switch	Switch operated and air volume control wheel not set to 0 = ON

Status Call 200	Nominal Values
212 Throttle valve potentiometer	0.6 V (idle) to 5.0 V (full load)
241 LMM Up/Uv relation [1]	0.2 to 0.3, break = 0.02
254 Control unit power supply	10 V
270 Oxygen sensor voltage (cat) [1]	0.02 to 0.85 V, with break or faulty oxygen sensor = 0.45 V
273 Road speed	Depending on road speed
276 CO potentiometer (no cat.)	Basic setting = 2.0 V
277 Intake air temperature	Depending on ambient temperature, approx. – 40° C (– 40° F) = break
278 Engine temperature	Depending on engine operation, approx. – 40° C (– 40° F) = break
225 Ign. timing in crankshaft degrees before TDC [1]	11 ± 3
274 Engine speed in rpm [1]	
Idle speed	850 ± 40
Shutoff speed	6500 ± 40
217 Inj. signal ti in ms [1] [2]	3.5 to 3.9
290 Load signal tL in ms [1]	1.3 to 1.6
CO volume % [1] [3]	0.7 to 0.5

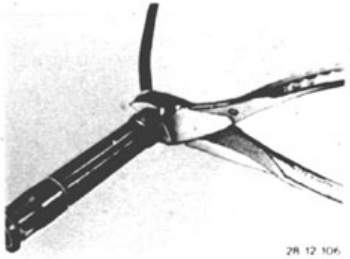
1) Oil temperature 60° C (140° F) or coolant temperature 80° C (176° F), no electric power consuming equipment switched on, at idle speed.

2) Valid with semi-sequential injection.

3) Measured ahead of the catalytic converter – engine test, test step 09.

M 42 TECHNICAL DATA
Resistance measured at 23 ± 5° C (73 ± 9° F)

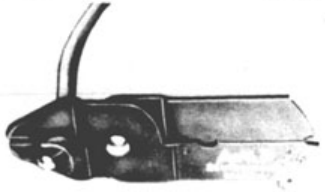
Idle speed control (one coil)	8 ± 2 ohms
Fuel injector	15 to 17 ohms
Fule injector group (2 injectors)	8 ± 0.5 ohms
Speed/position pulse sender	540 ± 60 ohms
Cylinder identifying pulse sender	1.15 to 1.41 k-ohms
Engine temperature sensor	
at 20 ± 3° C (68 ± 5° F) coolant temp.	2.3 to 2.7 k-ohms
at 80 ± 3° C (176 ± 5° F) coolant temp.	0.3 to 0.36 k-ohm
Intake air temperature sensor	
at 20 ± 3° C (68 ± 5° F) air temp.	2.2 to 2.7 k-ohms
at 50 ± 3° C (122 ± 5° F) air temp.	0.76 to 0.91 k-ohm
Tank venting valve	45 ± 20 ohms
Ignition coil	
primary coil	0.4 ± 0.1 ohm
secondary coil	not measurable
Throttle valve potentiometer	
idle speed position	4 ± 0.8 k-ohms
full load position	1 ± 0.2 k-ohm



28 12 106

12 12 072 REPLACING ONE SPARK PLUG CONNECTOR

Cut off ignition lead close to plug connector.



23 12 031

Strip ignition lead insulation by 6 mm (0.236") with a stripping pliers* (1.5 mm wire cross section size).



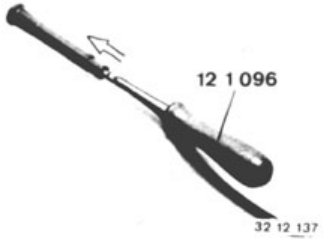
32 12 135

Install connection on ignition lead and squeeze tight on wire end first with pliers 12 1 080/081.



32 12 136

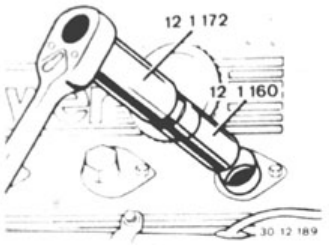
Position connection flush with pliers and squeeze on.



32 12 137

Place ignition lead in Special Tool 12 1 096 and slide into spark plug connector until connection is heard to engage.
If necessary, spray with lubricant 12 1 098.

* Source: HWB

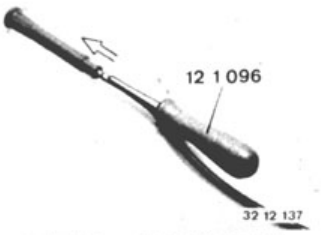


12 12 071 REPLACING ONE SPARK PLUG CONNECTOR (1987 Plant Shutdown On)

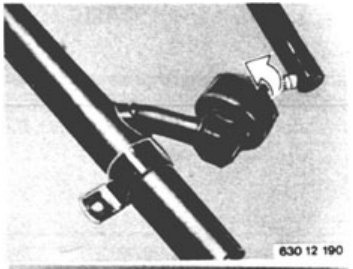
M 3 / M 5 / M 6 Models:
Unscrew ignition lead pipe.
Pull out spark plug connector.

Testing:
Measure shielded resistance*.

12 1 160 = special spark plug wrench.
12 1 172 = torque governor.

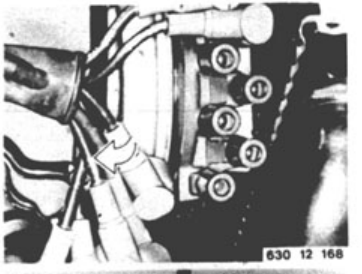


Place ignition lead in Special Tool 12 1 096 and push into spark plug connector until the connector is heard to engage.
Spray a lubricant** on Special Tool 12 1 096 if necessary.



Pull off rubber cap toward rear.
Unscrew spark plug connector.

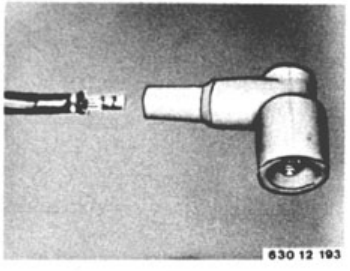
Installation:
Apply a thin coat of lubricant** to make installation of the rubber cap easier.



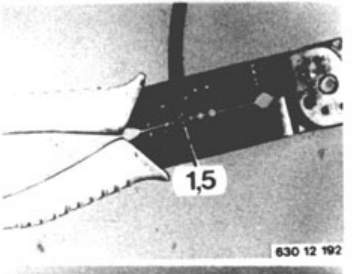
12 12 151 REPLACING SHIELDED PLUG AND IGNITION LEAD CONTACT (On Ignition Lead for Ignition Coil or Distributor)

M 3 / M 5 / M 6 Models:
Pull off shielded plug and unscrew on ignition lead.

Testing:
Measure shielded resistance*.



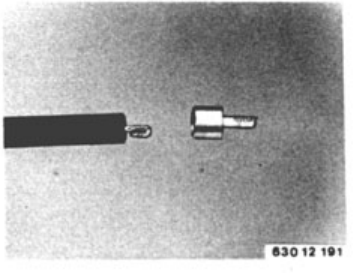
Replacing Connector (Screwed) for Ignition Lead:
Strip ignition lead about 12 mm (0.472") with a stripping pliers** after cutting off the connector.
Bend wires at length of 6 mm (0.236").



Strip ignition lead with a stripping pliers** after cutting off the old lead contact.



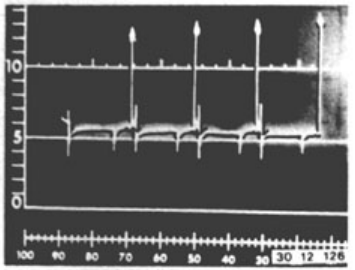
Position connector flush with the pliers and knock on.



Install new lead contact with ignition lead contact pliers**.
Perform tearing out test.
Apply a thin coat of lubricant** to make installation easier.
Screw shielded plug on the ignition lead.

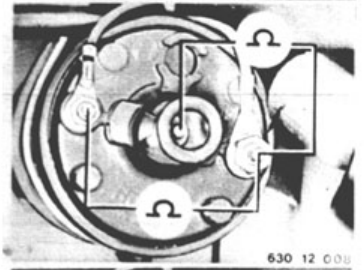
* See Specifications
** Source of Supply: HWB

* See Specifications
** Source of Supply: HWB

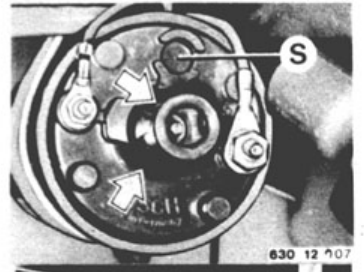


12 13 009 CHECKING IGNITION COIL

Connect BMW SERVICE TESTER.
Perform step 09 of engine test.
Observe oscilloscope - ignition voltage and ignition voltage deviation must conform with the nominal values.**
M 70:
Manual testing / not with test step 09 for cylinders 7 ... 12.



Multimeter Test (M 06):
Measure resistance* of primary coil (term. 1/15) and secondary coil (term. 15/4).



Check connection plate for hairline cracks and traces of burning.
Check whether plug (S) fits tight - if pressed out, replace ignition coil.

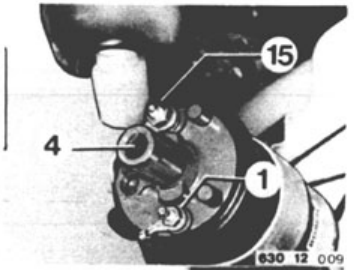


Multimeter Test
M 30 / 1988 Model
Same test as above.

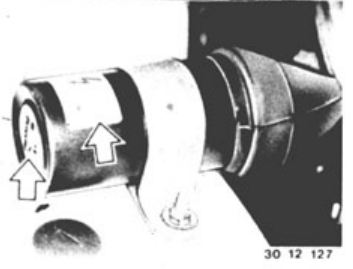
* See Specifications
** See Nominal Value Microfiche

12 13 011 REPLACING IGNITION COIL

Caution!
Always turn off the ignition before working on the ignition system - very dangerous high voltage.
Refer to instructions for working on ignition systems on page 12 - 0.

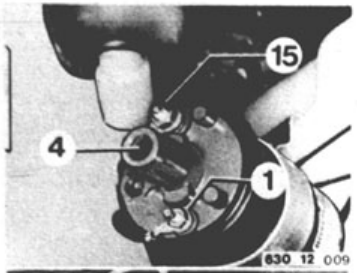


Pull off protective cap and ignition lead (term. 4).
Unscrew connections (terminals 1 and 15).
Unscrew holder and take off ignition coil.



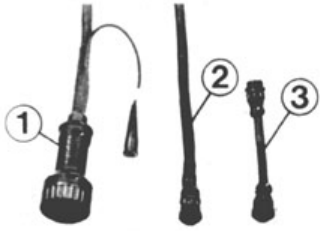
Installation:
Check new ignition coil for correct code number* and color code label*.

* See Specifications

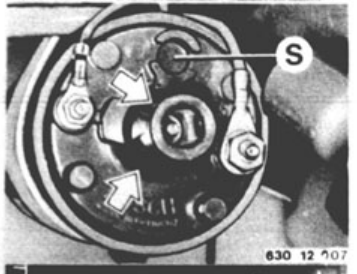


12 13 009 CHECKING IGNITION COIL

Multimeter Test (M 06):
Measure resistance of primary coil
- term. 1/15 = 0.5 ohm + 10 %
and of secondary coil
- term. 15/4 = 6 k-ohms + 10 %.

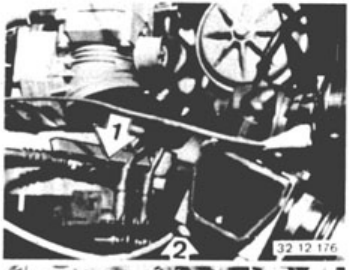


M 70:
Measure left cylinder bank 7 - 12 with adapter lead (3), HWB No. 81 12 9 428 906, and an universal diagnosing lead (2), HWB No. 81 12 9 408 013.
Note:
Take off left distributor protective cap.
Remove air flow sensor intake hose - only to connect the test leads.

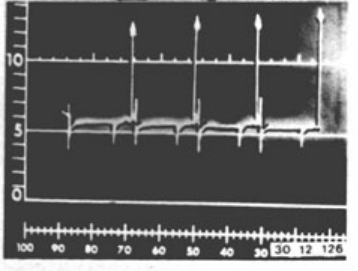


Check connection plate for hairlinf cracks and traces of burning.
Check plug (S) for tight fit - if pressed out, replace ignition coil.

T 109



Connections:
High tension clip (2) on ignition coil lead (4) close to the distributor wire plug.
Red trigger clip (1) on ignition lead (7) for cylinder no. 7.
The numbering of ignition leads for cylinder bank 7 - 12 corresponds with cylinder bank 1 - 6, i.e.
cylinder 7 = ignition lead 1,
cylinder 8 = ignition lead 2,
and so on.



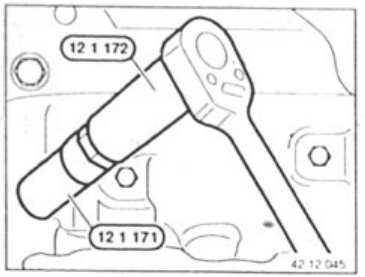
Connect BMW SERVICE TESTER on diagnosis plug.
Perform step 09 of engine test.
Observe oscilloscope - ignition voltage = 6 to 14 kV.
Check ignition voltage deviation - up to 3 kV.



Connections:
Ignition coil on left side
- black clip on terminal 1 and
- brown clip on car ground.

M 70:
Cylinder Bank t - 12
Perform test with adapter lead (14 - 16 pins), HWB No. 81 12 9 428 906, and an universal diagnosing connection lead.
Black connection on ignition coil term. 1.
Brown connection on car ground.

Note:
Cylinder identifying sender for left side on cylinder 12 ignition lead and
for right side on cylinder 6 ignition lead.
Firing Order:
M 70: 1-7-5-11-3-9-6-12-2-8-4-10
(If necessary, make up adapter lead for ignition coil lead 4 - high tension distributor locally in order to be able to perform the test faster.)

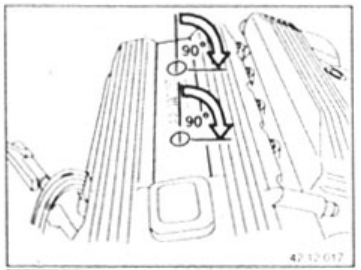


12 12 011 REPLACING SPARK PLUGS

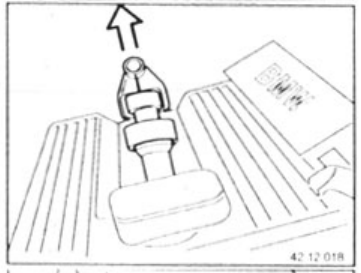
M 70:
Unscrew cyl. 7 ... 12 wire rail.
Lift off engine plug.
Remove cyl. 1 ... 6 washing fluid tank.
Tighten spark plugs with Special Tools 12 1 171 and 12 1 172.
Check tightening torque* when working without Special Tool 12 1 172.

* See Specifications

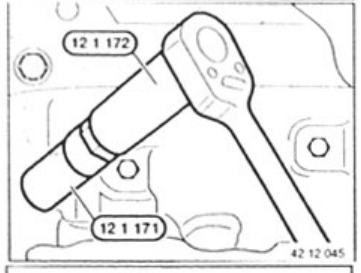
12 12 011 REPLACING SPARK PLUGS



M 42:
Unscrew wire duct cover.

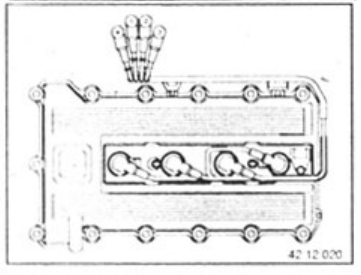


Pull off spark plug connectors.



Unscrew spark plugs.
Use Special Tool 12 1 171.

Installation:
Tighten spark plugs with Special Tools 12 1 172 and 12 1 171.



Routing of electric leads in cylinder head cover.

INSTRUCTIONS FOR WORKING ON STATIONARY IGNITION DISTRIBUTION (RZV) OF M 42 ENGINE

Caution!
Ignition must always be turned off before working on the ignition system. Dangerous high tension occurs when working with the ignition turned on.

Location of Dangerous Tension:
- **Ignition coil terminal 4**
- **Ignition lead**
- **Spark plug connector**
- **Spark plug**
- **Ignition coil term. 1 lead to DME control unit**

Ignition must always be turned off before connecting the service or digital tester, primary or secondary adapter and replacing parts of the ignition system.

Testing instructions:

The engine may not be started without a connected secondary circuit, i. e. after disconnection of spark plug connectors on spark plugs and ground connection 4a.

Master relay of DME must be pulled off for the compression test.

Shielded capacitors may not be connected on terminal 1 of the ignition coil.

Terminal 1 of the ignition coil may not be connected with ground or B + (danger of shorting the ignition final stages in the DME control unit).

Multimeter or test lamp may not be connected on terminal 1 while the engine is running.

Caution!
Approx. 350 V tension.

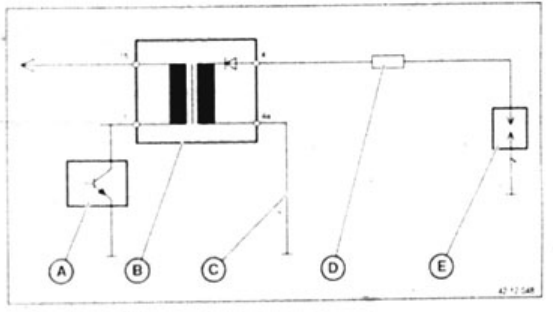
WIRING DIAGRAM FOR STATIONARY IGNITION DISTRIBUTOR OF M 42 ENGINE

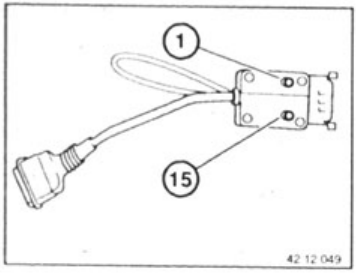
A = Control signal for ignition coil from DME

B = Ignition coil

C = Secondary coil ground connection

D = Ballast resistor for ignition lead, spark plug connector





CHECKING PRIMARY SIGNAL FOR STATIONARY IGNITION DISTRIBUTOR

Engine Test Step 05

Connect universal adapter lead on tester.
Connect brown clip on vehicle ground.

Connect primary lead adapter 12 7 020 on pertinent ignition coil being tested.

Connect black clip of universal adapter lead on pin 1 of adapter.

Produce stationary signal on oscilloscope by pressing button R on the tester.

CHECKING SECONDARY SIGNAL FOR STATIONARY IGNITION DISTRIBUTOR

Engine Test Step 10

Connect diagnosing lead on tester.

Connect capacitive clip (blue) on pertinent ignition lead being tested.

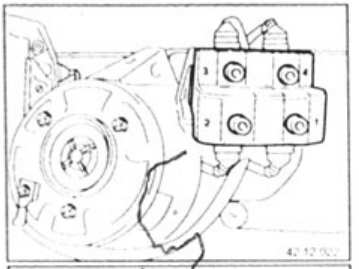
If pin 1 of the diagnosis socket is not used, connect primary adapter lead 12 7 020 on ignition coil 1.

Connect black clip on primary adapter lead pin 1.

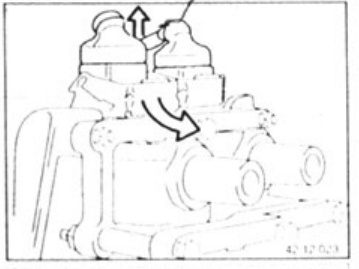
Produce stationary signal on oscilloscope by pressing button R on the tester.

Note:
Neighboring ignition leads could cause disturbance on the screen of the oscilloscope.

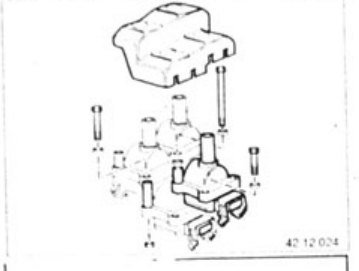
12 13 011 REPLACING ONE IGNITION COIL (Stationary Ignition Lead)

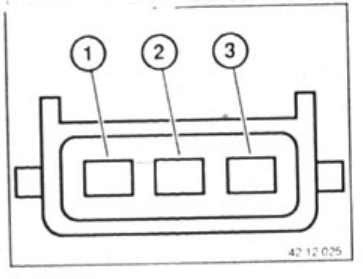


Arrangement of Ignition Coils



Pull off high tension lead.
Take off cap.
Unlock plug.
Pull off plug.





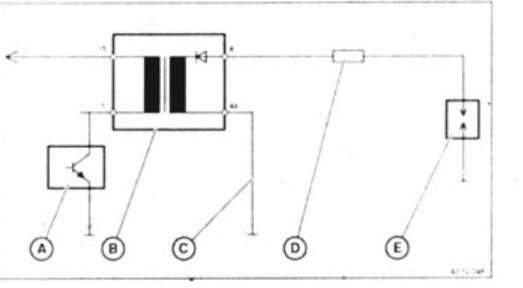
Ignition Coil Plug Pin Connections

1 = Terminal 15

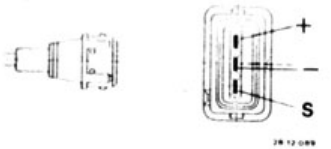
2 = Terminal 4a

3 = Terminal 1

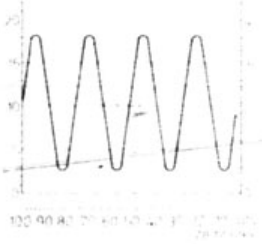
Wiring Diagram of Ignition Coil, Stationary Ignition Distributor



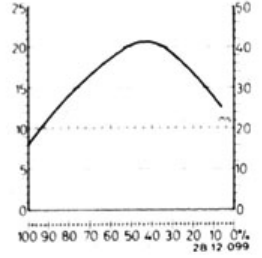
12 14 . . . CHECKING SPEED AND REFERENCE MARK SENDERS



Disconnect plug.
Connect BMW Service Tester to operating instructions (M 06 / 22 / 23).
Use universal test leads.
Measure resistance* of sender coil (M 06) on + and – of plug.
Check insulation* on + / S and – / S of plug.



Connect oscilloscope on + and – connections of speed sender (M 22 / 23).
Crank engine with the starting motor.
This signal should appear on the screen.



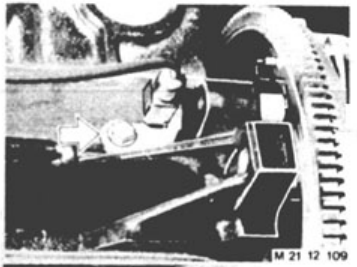
Repeat same test on the reference mark sender.
If oscillograph deviates, remove and check sender for dirt (grease, burrs, dust), cleaning if necessary.
Check the reference mark.

* See Specifications



12 14 160 REPLACING AND ADJUSTING SPEED SENDER (M 21)

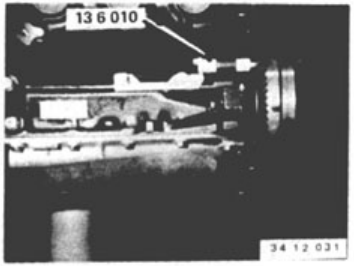
Disconnect plug.
Disconnect electric lead.



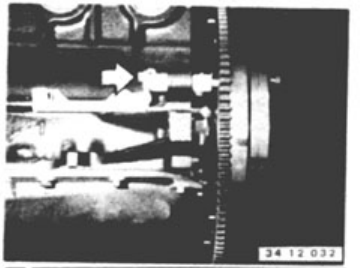
Unscrew holder.



Adjusting:
Turn crankshaft 40 mm (1.575") past the TDC mark.
Check whether the dowel pin of the flywheel can be seen through the take-up bore for the speed sender.



Mount Special Tool 13 6 010 on the holder.
Mount holder on the crankcase and push it forward against the stop.
Tighten holder.



Unscrew Special Tool 13 6 010 on the holder and pull it out.

Important!
The holder must no longer be loosened on the engine block – only unscrew and pull out the special tool.



Push speed sender into the holder.
Screw on speed sender.

TROUBLESHOOTING PREHEATING SYSTEM
(M 21)

Test Requirements:
- Charged battery.
- Correct wire connnections on control lamps, control unit and heater plugs.

Turn ignition key to "Drive" prior to each test.

Yellow and green control lamps do not light up.

Check fuse (80 A) on heating time control unit.

Check light bulb(s) in instrument carrier, replacing if necessary – refer to 62 99 . . ..

Disconnect small plug on heating time control unit.
Connect female plugs LA 1 (for yellow lamp) and LA 2 (for green lamp) with ground – the control lamps must light up. If not, check power supply for control lamps.

Yellow and green control lamps do not light up – coolant temperature < 60° C.

Check coolant temperature sensor, replacing if necessary – refer to 13 62 . . ..

Yellow control lamp does not light up.

Engine hard to start in cold state.

One or more faulty heater plugs.
Disconnect control unit plug (connections G1 ... G6). Connect BMW Service Tester (M 03), supply battery voltage to each connection G1 to G6 for 5 seconds (324 td max. 4 seconds) and measure current consumption*.
Replace faulty heater plugs – refer to 12 23 . . ..

Yellow control lamp flashes.

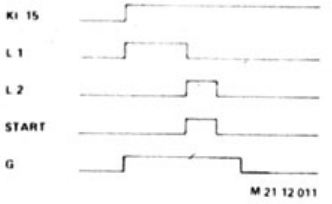
Disconnect heating time control unit plug (connections G1 ... G6).

Check heater plugs, replacing if necessary – refer to 12 23 . . ..
Replace control unit.

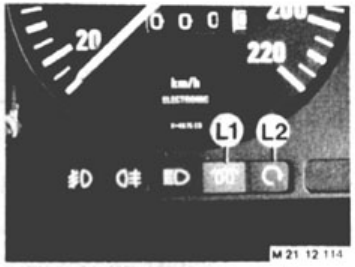
* Refer to Specifications

12 21 ... CHECKING PREHEATING SYSTEM (M 21)

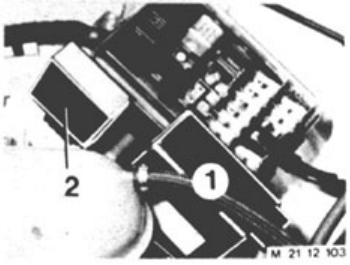
Normal Operation:
After turning the ignition key to "DRIVE" (term. 15) preheating (G) begins and yellow control lamp (L 1) in dash panel lights up. Green control lamp (L 2) lights up to indicate that engine may be started. Preheating continues during the starting phase and ends shortly afterwards. Green control lamp (L 2) lights up immediately when coolant temperature is > 60° C.



M 21 12 011



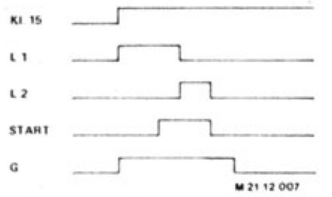
M 21 12 114



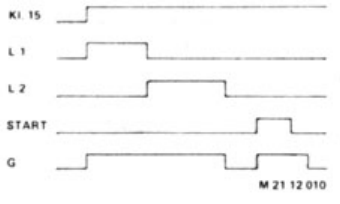
M 21 12 103

Preheating Without Start:
Preheating is switched off by a safety circuit in control unit (1) after 8 ... 11 seconds.

Preheating With Premature Start:
The time for starting the engine will be longer if it is not waited until lamp (L 2) lights up.

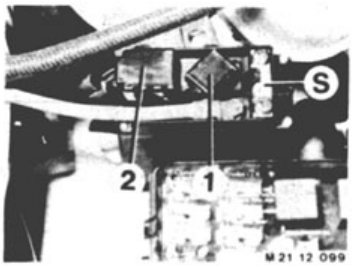


M 21 12 007



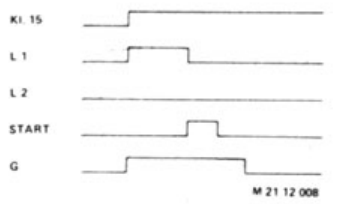
M 21 12 010

Preheating With Subsequent Start:
If engine is started after lamp (L 2) has gone out again, the safety circuit permits preheating during the starting phase and switches it off after a brief delay.



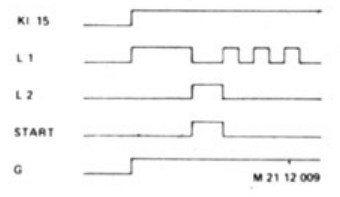
M 21 12 099

The yellow control lamp will not light up if the 80 ampere fuse (S) has blown or the control unit is faulty (coolant temperature below 60° C).



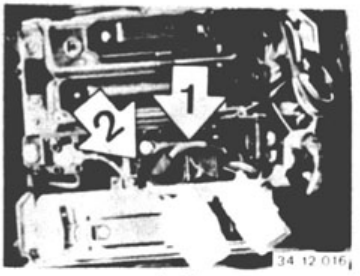
M 21 12 008

Green control lamp (L 2) will no longer light up in case of one or more faulty heater plugs.



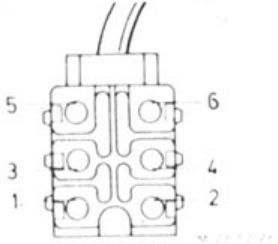
M 21 12 009

A flashing yellow control lamp (L 1) indicates continued perheating of the heater plugs – replace control unit and check heater plugs.



12 23 000 CHECKING HEATER PLUGS (M 21)
– Installed –

Take cover off of heating time control unit.
Disconnect plugs (1 and 2).



Note:
Plug No. 2 Pin Connections

Wire Color

G1 - black/green	for cyl. 1
G2 - black/violet	for cyl. 2
G3 - black/yellow	for cyl. 3
G4 - black/red	for cyl. 4
G5 - black/white	for cyl. 5
G6 - black/brown	for cyl. 6

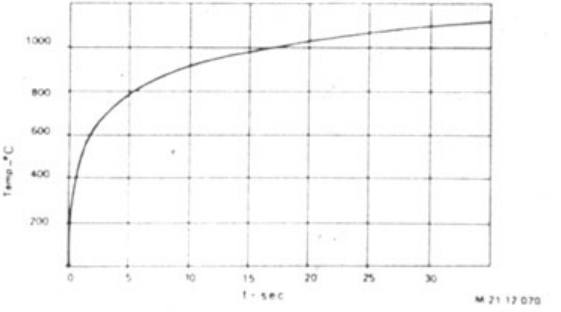
Important!
Up to the middle of 1986 G1 ... G6 do not have to be identical with cylinders 1 ... 6 (free plug pin use).



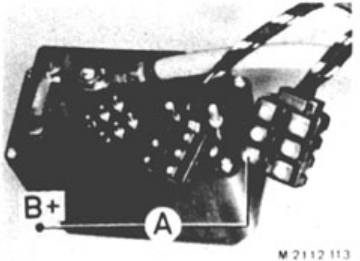
M 21 12 074

Caution!
Never operate removed heater plugs – danger of injury and fire!

Refer to diagram for temperature curve.



M 21 12 070

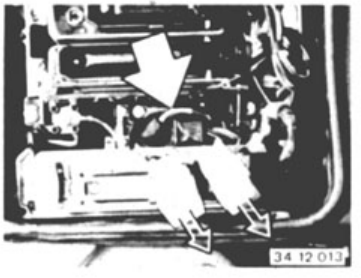


M 21 12 113

Current Test:
Connect test lead from battery positive to all female plugs G1 ... G6 each for 5 seconds.
Connect BMW Service Tester (M 03) or ammeter and measure current consumption*.

Note:
1988 model 324 td/524 td have different heating time (4 seconds). Max. testing time: 4 to 5 seconds. 324 td has modified heater plugs (design); current consumption and resistance are identical.

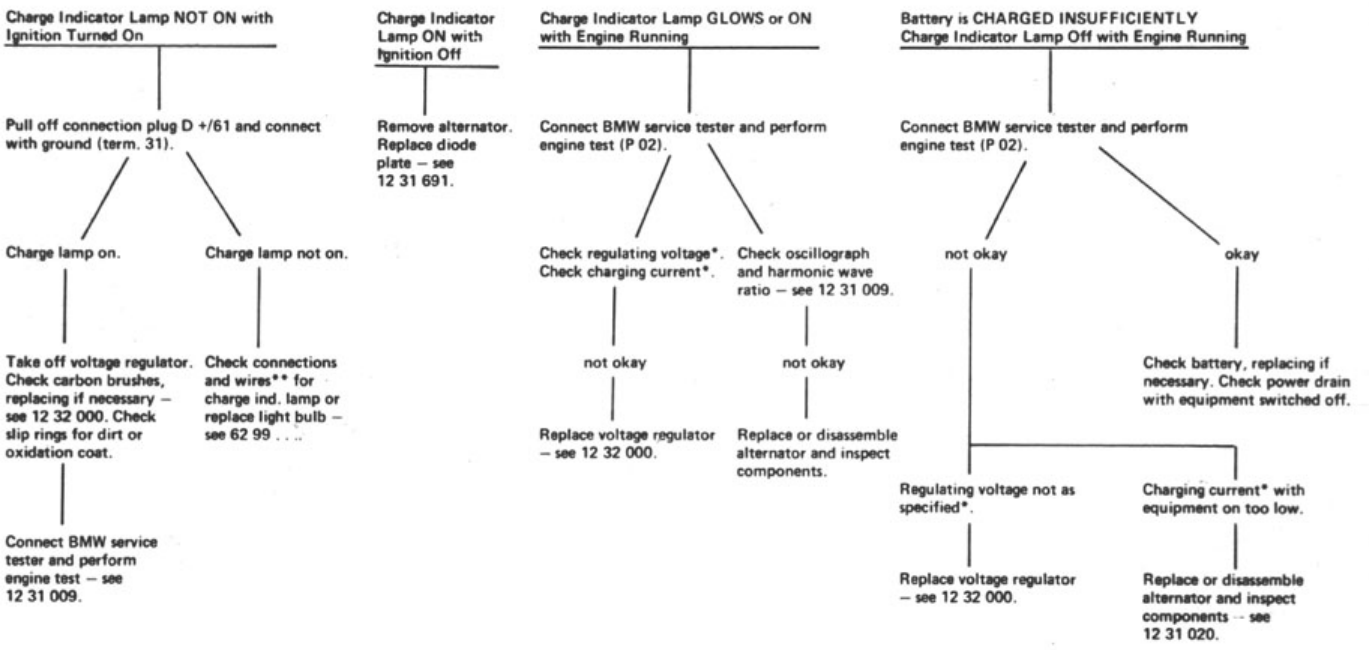
* **Refer to specifications**



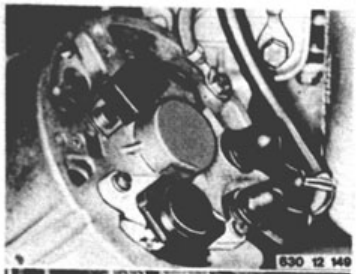
Heating time control unit 1988 model 524 td

TROUBLESHOOTING ALTERNATOR

Test Requirements: – Correct connections on battery, starter and alternator.
– Good ground connection between engine and body.
– Tight drive belt.

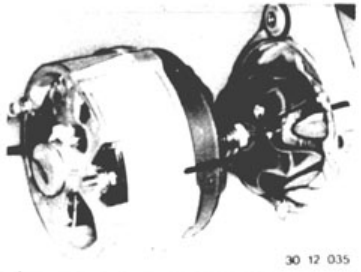


* See Nominal Value Microfiche or M 21 Technical Data
** See Wiring Diagram


630 12 149

12 31 009 CHECKING ALTERNATOR AND VOLTAGE REGULATOR

Test Requirements:
- Correct connections on charged battery.
- Correct connections on alternator and starting motor.
- Good ground connection between engine and body.
- Tight drive belt.

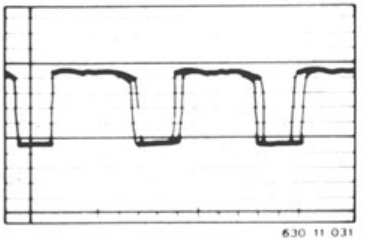

30 12 035

If specified charging current is not reached, remove and disassemble alternator and inspect components – see 12 31 020 / 513.

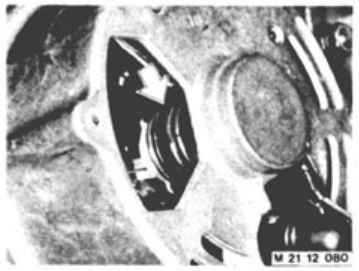


630 12 150

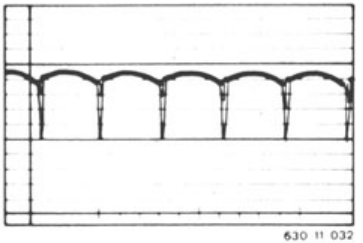
Charge Indicator Lamp on Continuously:
Remove voltage regulator and check carbon brushes, replacing if necessary – see 12 31 200.
Min. length "V" = 5 mm (0.197").


630 11 031

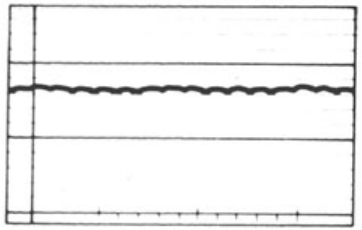
Oscillographs of Faulty Alternator:
Faulty power or exciter diode.


M 21 12 080

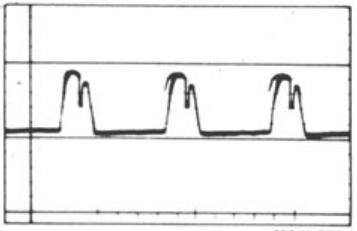
Installation:
Check slip rings for wear, fine grinding and polishing if necessary.
Connect BMW service tester.
Start engine and compare measured values with nominal values*.
M 21 Engine:
Measured values (regulating voltage – charging power).


630 11 032

Shorted turn in stator coil.


630 11 025

If battery charge indicator lamp goes out with engine running and the regulating voltage* is not reached (while harmonic wave ratio* and oscillograph are okay as shown), the voltage regulator must be replaced – see 12 32 000.


630 11 027

Break in exciter diode.

* See Nominal Value Microfiche
** See Specifications

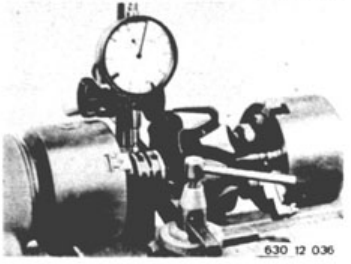

M 21 12 034

12 31 200 REPLACING CARBON BRUSHES – Bosch Alternator –

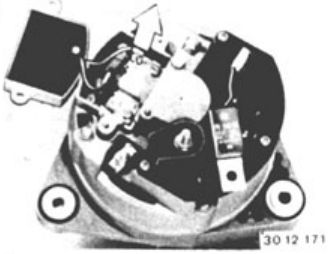
Remove voltage regulator – see 12 32 000 in repair manual of pertinent model series.
Unsolder leads on carbon brush holder.
Note:
Only use small amount of solder for soldering to avoid hardening of leads.


M 21 12 080

Installation:
Check slip rings for wear, disassembling alternator and fine grinding as well as polishing slip rings, if necessary.

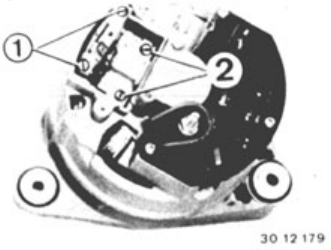

630 12 036

Check for out-of-true.
Max. out-of-true for slip rings is 0.03 mm (0.0012").


30 12 171

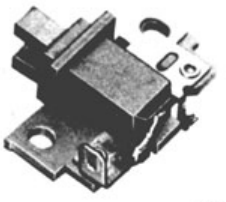
12 32 205 REPLACING CARBON BRUSHES – Motorola Alternator –

Remove alternator and voltage regulator see repair manual of pertinent model series.

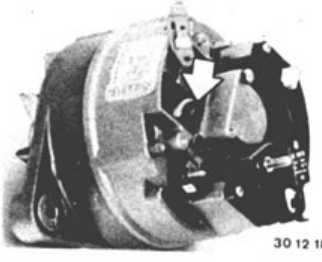


30 12 179

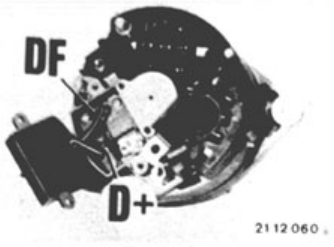
Unscrew screws (1 and 2) and take off carbon brush holder.


21 12 071

Carbon brush holder is replaced complete.


30 12 180

Installation:
Check slip rings for wear, disassembling alternator to fine grind and polish slip rings if necessary.
Max. out-of-true for slip rings is 0.03 mm (0.0012").



2112060

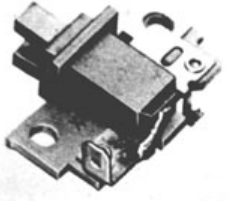
12 31 205 REPLACING CARBON BRUSHES – Motorola Alternator –

Remove alternator and voltage regulator – see repair manual of pertinent model series.

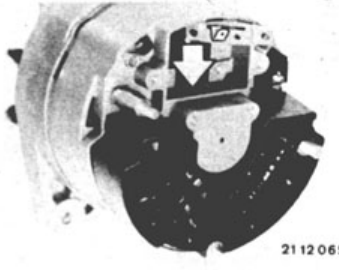


2112063

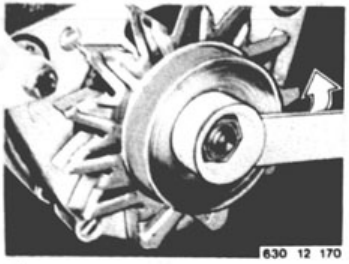
Unscrew screws (1 and 2) and take off carbon brush holder.


2112071

Carbon brush holder is replaced complete.


2112065

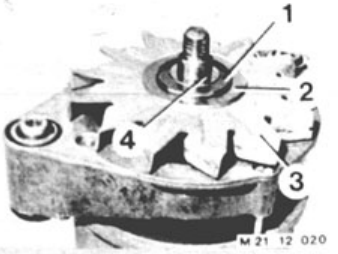
Installation:
Check slip rings for wear, disassembling alternator to fine grind and polish slip rings if necessary.
Max. out-of-true for slip rings is 0.03 mm (0.0012").



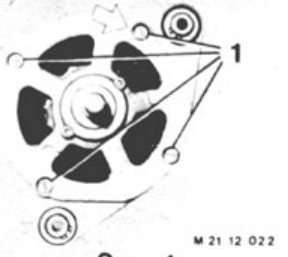
12 31 513 DISASSEMBLING/ASSEMBLING ALTERNATOR

– Alternator Removed –

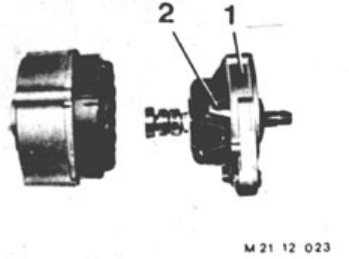
Alternator 65 A:
Remove voltage regulator – see 12 32 000.
Remove pulley and fan, using Special Tool 12 31 000.
Installation:
Tightening torque*.



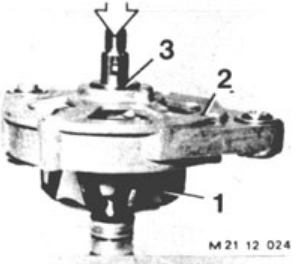
Remove washers (1 and 2), fan (3) and woodruff key (4).



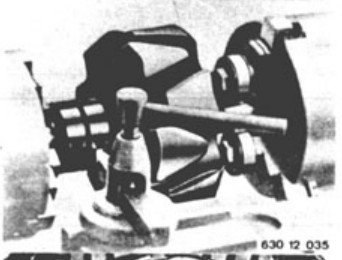
Unscrew screws (1).
Mark location of housing sections to each other.
Installation:
Install longer screw for ground wire in correct position.



Pull out bearing plate (1) with rotor (2).



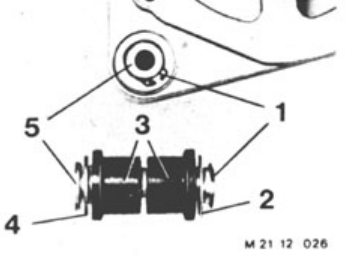
Press on rotor (1) and take off washer (3).
Check installed position of washer (3).



Check slip rings for wear, fine grinding and polishing if necessary – see 12 31 201.

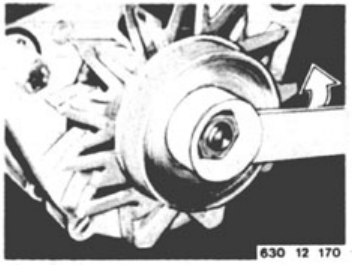


Unsolder stator coil on diode plate.
Caution!
Excessive heat from soldering iron would destroy the diodes.



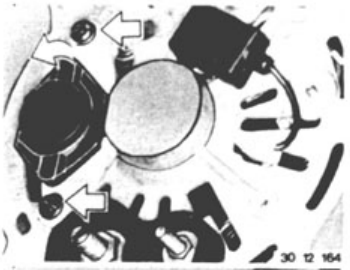
If necessary, press rubber mount out of housing.
Order:
1 Circlip
2 Washer
3 Rubber mount
4 Washer
5 Bushing

*** See Specifications**


630 12 170

12 31 513 DISASSEMBLING/ASSEMBLING ALTERNATOR

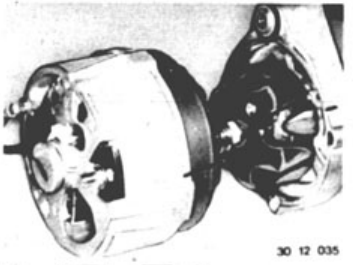
– Alternator Removed –


30 12 164

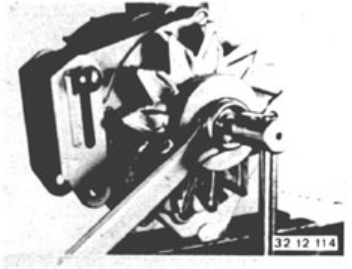
Unscrew voltage regulator.


630 12 181

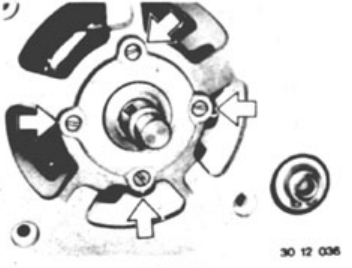
Arrangement of washers.


30 12 035

Mark position of housing sections to each other.
Unscrew bolts and pull housing sections apart.


32 12 114

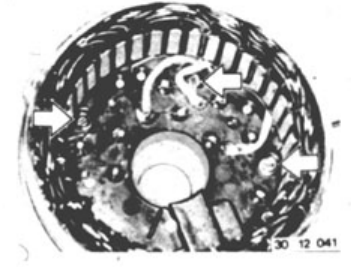
Bosch 80 A Alternator (with Fan Clutch):
Unscrew nuts, counterholding with a socket wrench.
Installation:
Tightening torque*.


30 12 036

Unscrew bolts for bearing cover and take off bearing bracket.


32 12 173

Take off pulley and fan.
Note correct order.


30 12 041

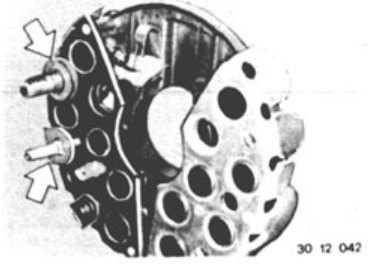
Unscrew screws for diode plate.

* See Specifications



30 12 040

Unscrew shielded capacitor.
Unscrew nuts on B + and D + pins.
Take off diode plate with stator coil.



30 12 042

Installation:
Check condition of insulating sleeves and insulators, replacing if necessary.

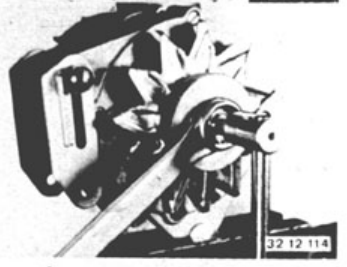


12 31 513 DISASSEMBLING AND ASSEMBLING ALTERNATOR – Alternator Removed –

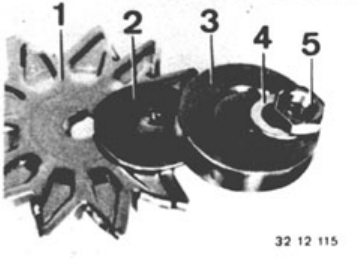
Bosch 90 A/115 A/140 A Alternator:
Unscrew cover.



Remove voltage regulator.

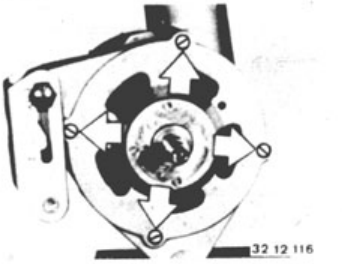


Mark position of housing parts to each other.
Unscrew nut while counterholding with a socket wrench.
Installation:
Tightening torque*.



Assembly:
1 Fan
2 Washer
3 Pulley
4 Washer
5 Nut

* See Specifications



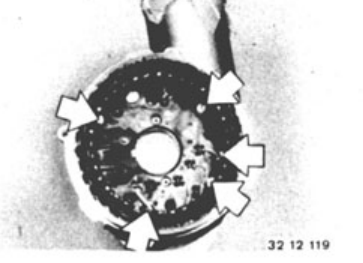
Unscrew bolts – pull housing sections apart.



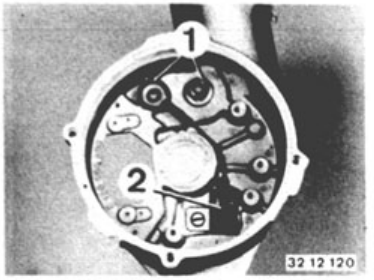
Unscrew bearing cover.
Remove wedge (1).



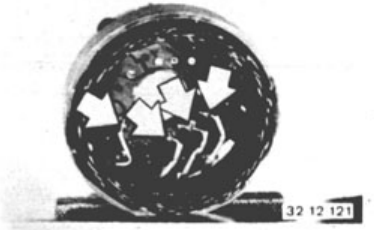
Unscrew nuts – take off plastic part.



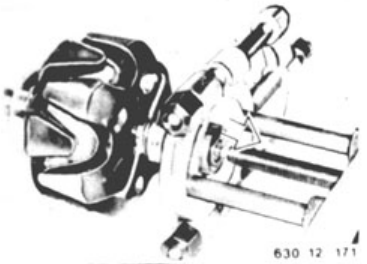
Unscrew screws.



Installation:
Mount insulators (1) and capacitor (2).
Measure capacity of capacitor – replace the capacitor when measured value deviates from the specified value by 50 %.



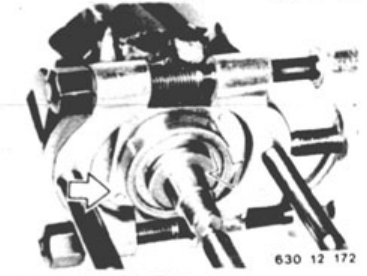
Mark and unsolder wires for diode plate.



630 12 171

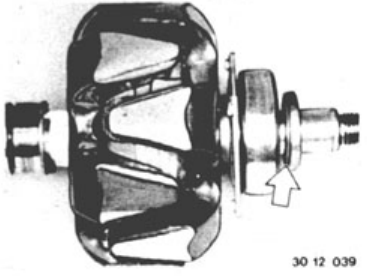
12 31 581 REPLACING BALL BEARING – Alternator Removed and Disassembled –

Bosch Alternator:
Pull off bearing with Special Tool 00 7 500.



630 12 172

Installation:
Replace cover for bearing, if it had been damaged through application of the special tool.



30 12 039

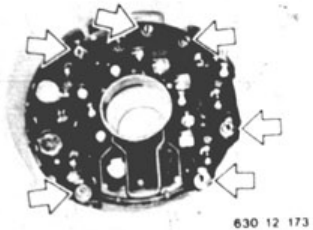
Installation:
Check installed position of washer – collar faces bearing.



630 12 178

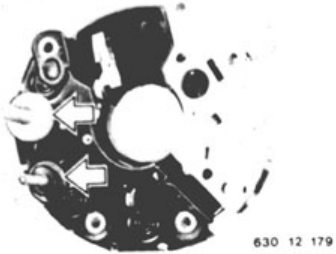
12 31 691 REPLACING DIODE PLATE – Alternator Removed and Disassembled –

Bosch Alternator:
Unsolder stator coil on diode plate.
Caution!
Excessive heat from soldering iron would destroy the diodes.



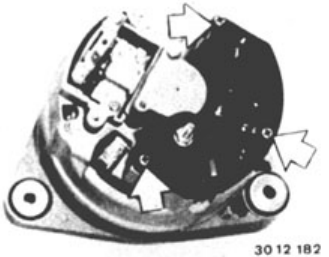
630 12 173

Unscrew bolts.
Remove diode plate.



630 12 179

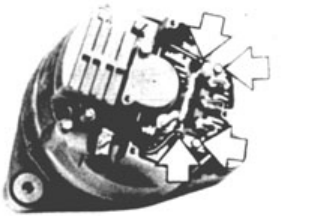
Installation:
Check condition of insulating sleeves and insulators.



30 12 182

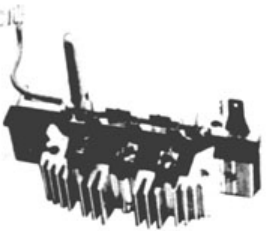
12 31 695 REPLACING DIODE PLATE – Alternator Removed –

Unscrew capacitor and cover.



30 12 195

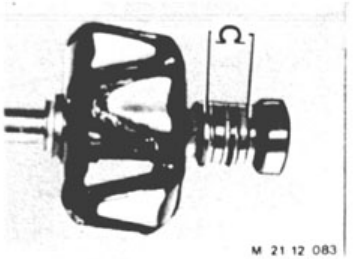
Motorola 65 A Alternator:
Unsolder stator coil on diode plate.
Caution!
Excessive heat from the soldering iron could destroy the diodes.



30 12 196

Unscrew bolts.
Remove diode plate.

Installation:
Install insulator again.

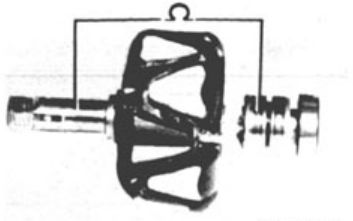


M 21 12 083

12 31 . . . ELECTRIC TEST ON BOSCH ALTERNATOR
– Alternator Disassembled –

Make tests with a BMW Service Tester.
Checking Stator Coil for Breaks and Shorted Turns:
Place test leads for resistance testing on slip rings.

Alternator	80 A – 2.80 ohms ± 10 %
	65 A – 3.40 ohms ± 10 %
	90 A – 2.90 ohms ± 10 %
	115 A – 2.65 ohms ± 10 %
	140 A – 2.65 ohms ± 10 %

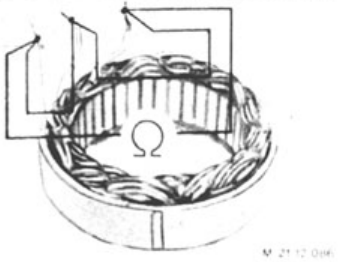


M 21 12 084

Checking Rotor Coil for Ground Contact:
Connect test leads for resistance test on slip ring and rotor shaft.
Nominal value: ∞ = 999 k-ohm display.


M 21 12 085

Checking Stator Coil for Ground Contact:
Connect test leads for resistance test on solder point and stator (coil carrier).
Nominal value: ∞ = 999 k-ohm display.



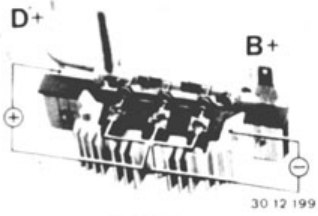
M 21 12 086

Checking Stator Coil for Breaks:
Compare resistance values of wires 1/2, 1/3 and 2/3 with an ohmmeter – they must be identical.
The shorted turn test can be performed with a standard tester.



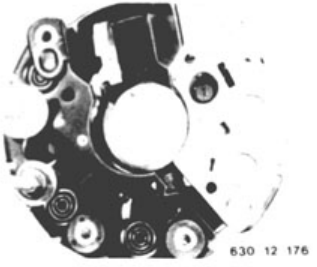
630 12 177

Checking Negative Diodes:
Connect test leads for diode test.
Negative lead on cooler and positive lead on one of the negative diode connections.
Display with perfect condition diodes: polarity "–".



30 12 199

Checking Positive Diodes:
Connect negative lead on B + connection pin and positive lead on one of the positive diode connections.
Display with perfect condition diodes: polarity "+".


630 12 176

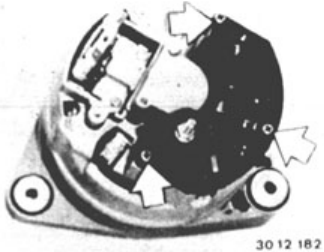
If a diode is faulty, replace the entire diode plate – see 12 31 691.

12 31 513 DISASSEMBLING AND ASSEMBLING ALTERNATOR – Alternator Removed –



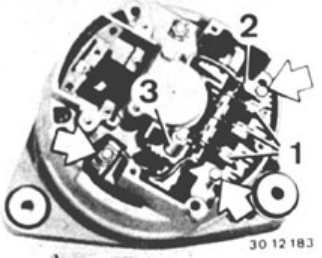
30 12 181

Motorola 65/80 A Alternator:
Remove pulley and fan.



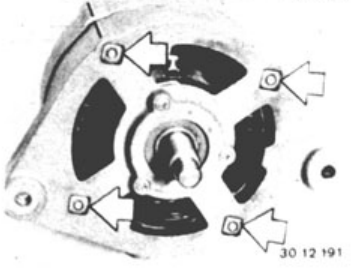
30 12 182

Remove voltage regulator and carbon brush holder – see 12 31 205.
Unscrew B + connection and cover.



30 12 183

Unsolder wires in connections (1 and 2).
Unscrew diode plate screws.
Installation:
Reinstall sleeve (3) and insulator (4).



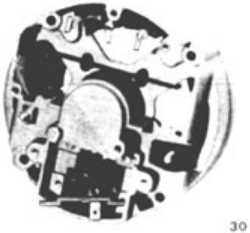
30 12 191

Mark housing sections, unscrew bolts and pull housing sections apart.



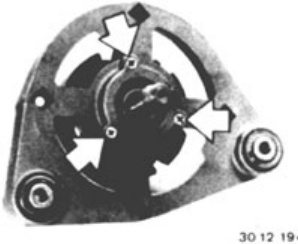
30 12 192

If hard moving from the face (through the regulator opening) drive out rotor toward rear with brief knocks from a piece of hard wood and plastic hammer.



30 12 193

Disconnect stator coil on housing.



30 12 194

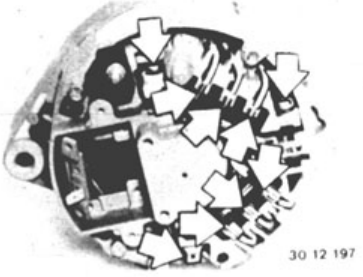
Unscrew bearing cover.



30 12 300

12 31 695 REPLACING DIODE PLATE
– Alternator Removed –

Motorola Alternator:
Unscrew capacitor and cover.



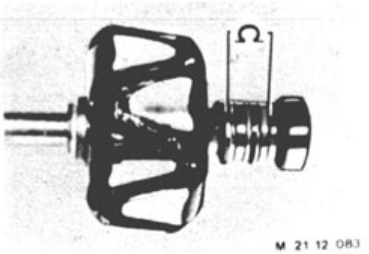
30 12 197

Unsolder stator wires on the diode plate.
Unscrew screws and take off diode plate.
Caution!
Excessive heat from the soldering iron could destroy the diodes.



30 12 198

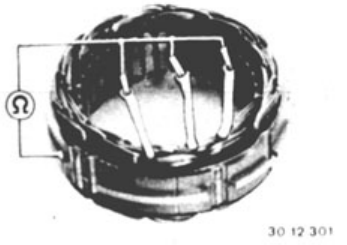
Installation:
Check condition of insulators.



M 21 12 083

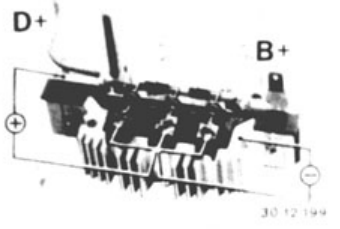
12 31 . . . ELECTRIC TEST ON 65/80 A MOTOROLA ALTERNATOR
– Alternator Disassembled –

Make tests with a BMW Service Tester.
Check rotor coil for breaks, ground contact and shorted turns.
Coil resistance = 4 ohms ± 10 %.



30 12 301

Check stator coil for ground contact and breaks.
Use a standard shorted turn tester.

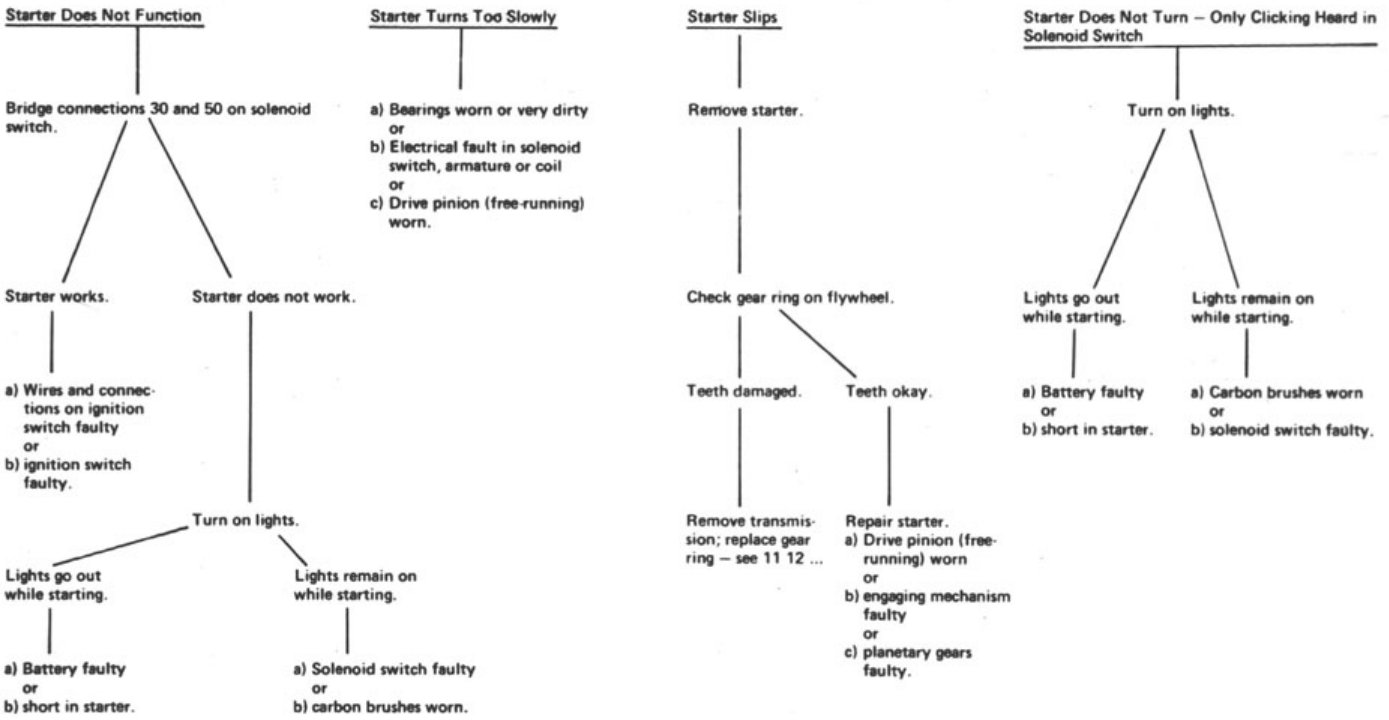


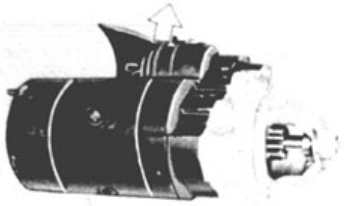
30 12 199

Check diodes – note the polarity.
Replace the entire diode plate in case of a faulty diode – see 12 31 695.

TROUBLESHOOTING STARTING MOTOR

Test Requirements: – Correct connections on battery and starting motor.
– Good ground connection between engine and body.
– Charged battery.

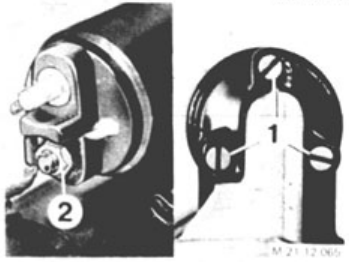




M 21 12 095

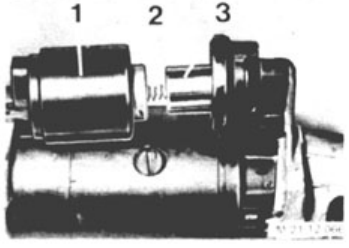
12 41 041 REPLACING SOLENOID SWITCH

Remove starting motor – 12 41 020.
Take off cover.



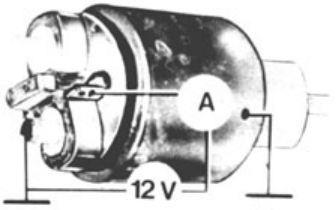
M 21 12 065

Unscrew solenoid switch (1 and 2).
Installation:
Do not turn wire connector while tightening – danger of short circuit.

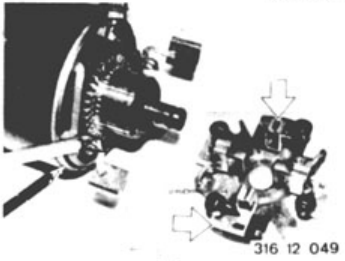


M 21 12 064

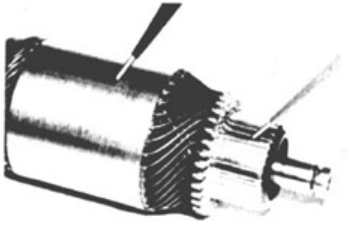
Remove solenoid switch (1) and spring (2).
Disconnect pin (3).
Installation:
Check pin (3) for wear and lubricate with grease.



630 12 186



316 12 049



316 12 053

12 41 . . . CHECKING COMPONENTS OF STARTING MOTOR (Electric Test)

Check power input* of engaging and holding coils in solenoid switch.

Check exciter coil, carbon brush holder and armature coil for ground contact.
Check armature for shorted turns.
Use a standard tester.
Checking the exciter coil is not necessary with permanent magnets.

* See Specifications



630 12 052

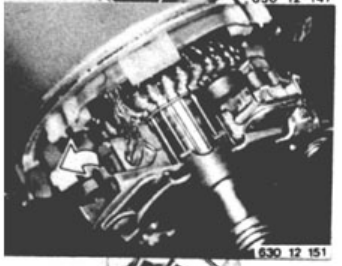
12 41 513 DISASSEMBLING AND ASSEMBLING STARTING MOTOR

– Starting Motor Removed –

Remove solenoid switch – see 12 41 041.
Unscrew dust cap (2).
Take off circlip (3), shims (4) and seal (5).
Installation:
Check axial play* of armature, correcting with shims if necessary.


630 12 147

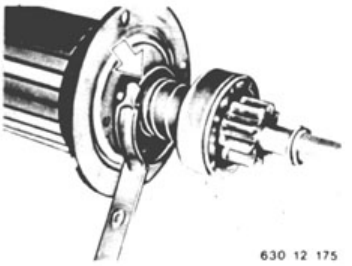
Unscrew housing bolts and take off cover.
Installation:
Align openings for housing bolts and insulator to each other.
Check bearing sleeve, lubricating with oil before installing.


630 12 151

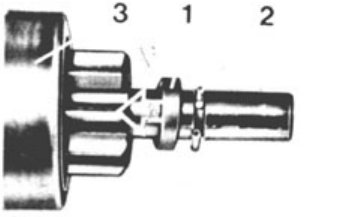
Lift springs and pull out carbon brushes.
Remove holder.
Installation:
Check carbon brushes and commutator for wear, repairing if necessary – see 12 41 551.


630 12 174

Remove pole housing.
Unscrew engaging lever bolt and remove rubber seal.


630 12 175

Lift out armature with drive pinion and engaging fork.
Installation:
Lubricate guide for engaging fork with grease.
Check bearing sleeve in drive bearing bracket, lubricating with oil before installing.

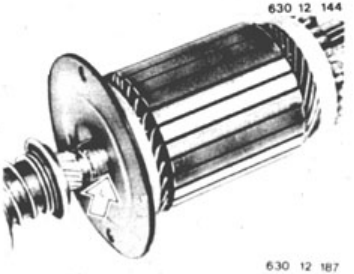


28 12 049

Push back bearing race (1) with a piece of suitable pipe.
Pry circlip (2) apart and pull it off of the shaft.
Remove burrs with a file.
Take off drive pinion (3).
Installation:
Use new circlip (2).
Lubricate bearing surface for drive pinion with grease*.



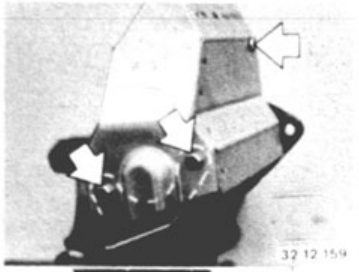
Installation:
Check pinion for wear (on teeth, bearings, one-way clutch), replacing if necessary.


630 12 187

Check sleeve in intermediate bearing, replacing if necessary.

* See Specifications

* Source: HWB

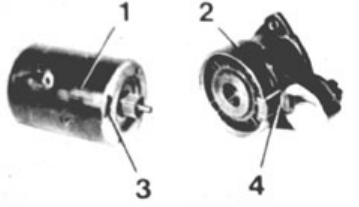

32 12 159

12 41 513 DISASSEMBLING AND ASSEMBLING STARTER INTERMEDIATE SHAFT
- Starter Removed -

Unscrew heat shield (if installed).
Unscrew bracket.
Check spacers.

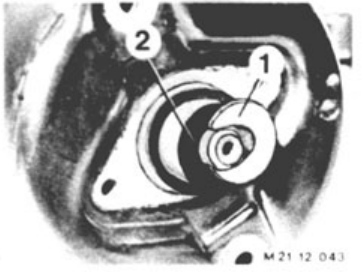

M 21 12 039

Remove solenoid - see 12 41 041.
Unscrew both studs.
Installation:
Clean all parts thoroughly before assembling.



M 21 12 040

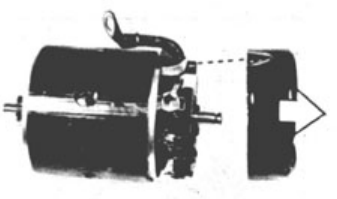
Separate motor (1) and gearbox (2).
Installation:
Groove (3) should be aligned with rubber part (4).



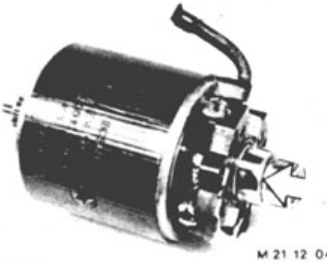
M 21 12 043

Take off protective cap.
Remove retainer (1) and shims (2).
Installation:
Check axial clearance*, correcting if necessary.

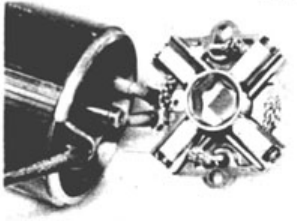
* **See Specifications**


M 21 12 044

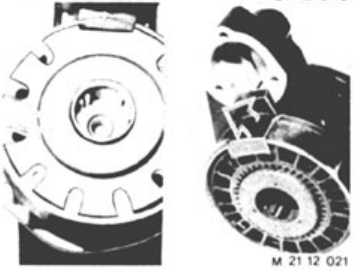
Check armature shaft, removing burrs if necessary.
Take off cover.


M 21 12 045

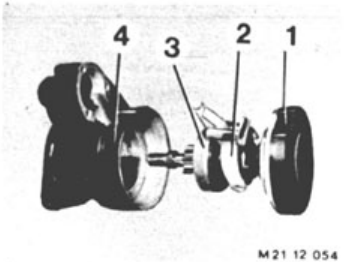
Insert a 22 mm wrench socket or piece of pipe with an outside diameter of approx. 30 mm (1.181"), in order to prevent the carbon brushes from springing out.


M 21 12 046

Installation:
Use wrench socket or pipe again to make installation easier.
Mount entire assembly on transmission case and then tighten the wire connector.

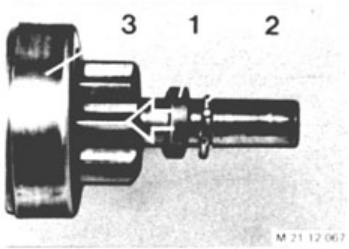

M 21 12 021

Take off cover and rubber block.



M 21 12 054

Pull out gearbox unit.
Take toothed ring off of planetary gearbox and release.
1 Planetary gearbox
2 Release
3 Pinion
4 Gearbox case

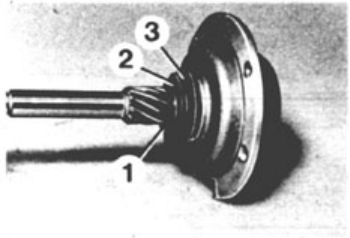


M 21 12 067

Knock back thrust ring (1).
Pull off retainer (2) forward.
If applicable, remove burrs and then take off drive pinion.
Installation:
Clean bearing surface of pinion thoroughly and lubricate with grease.

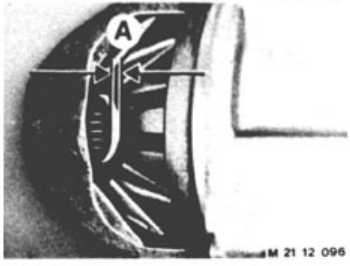

M 21 12 057

Installation:
Openings and bores must be aligned.



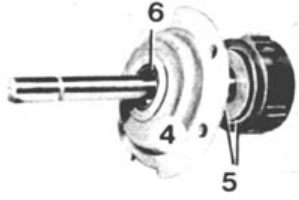
M 21 12 059

Pull off circlip (1) and take off washers.
2 Metal washer
3 Plastic washer



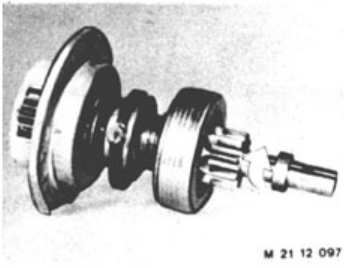
M 21 12 096

Check bearing and, if necessary, drive it out with a suitable mandrel.
Installation:
Lubricate new bearing with grease and press it in to distance A = approx. 1 mm (0.039").

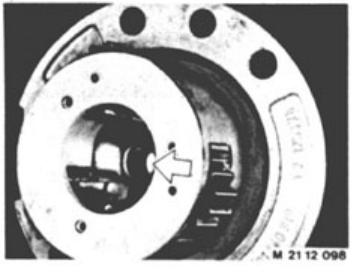


M 21 12 060

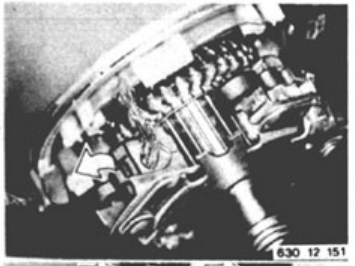
Take off bearing cover (4) and washers (5).
Check bearing sleeve (6), replacing if necessary.
Installation:
Lubricate sleeve with oil after pressing it in.


M 21 12 097

Turn drive pinion against stop.
Pinion will be very easy to turn, if the one-way clutch is worn.
Check bearing sleeve and teeth of pinion for wear.

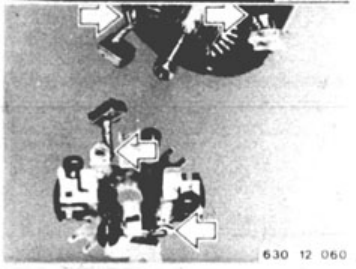

M 21 12 098

Check bearing sleeve and, if necessary, remove it with a suitable puller.
Check planet gears for wear.
Installation:
Lubricate sleeve with oil after pressing it in.

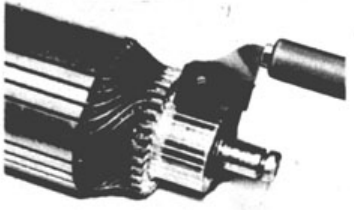

630 12 151

12 41 551 REPLACING CARBON BRUSHES
-- Starting Motor Removed and Disassembled --

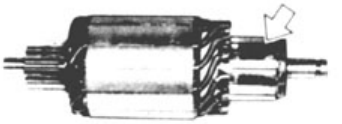
Lift springs and pull out carbon brushes.


630 12 060

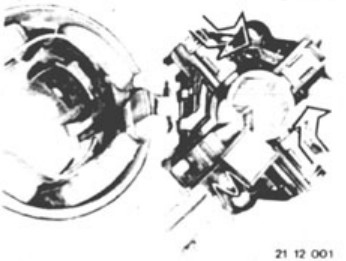
Remove holder and pole housing.
Unsolder or cut off all carbon brushes.
When soldering in new carbon brushes, make sure that copper leads are not hardened with flowing solder.


630 12 065

Check commutator for wear, fine grinding if necessary.
Diameter must be at least 33.5 mm (1.319").
Machine insulation between plates approx. 0.5 to 0.7 mm (0.020 to 0.028") deep.


21 12 008

Fine grind and polish commutator.
Machine or file insulation between plates of commutator 0.5 to 0.7 mm (0.020 to 0.027") deep.
Check for shorted turns after machining.


21 12 001

Slide carbon brush holder to center and lift off.

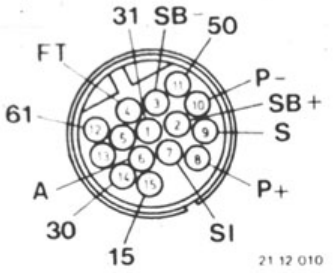

M 21 12 050

Installation:
Engage hooks of carbon brush holder completely.


21 12 002

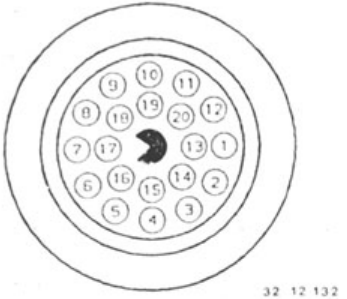
Two slip ring carbon brushes must be cut off on the leads.
Solder in new slip ring carbon brushes.

12 41 551 REPLACING CARBON BRUSHES
-- Starting Motor and Gearbox Disassembled --



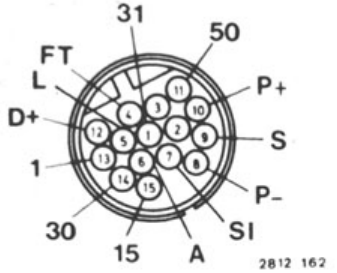
DIAGNOSIS PLUG CONNECTIONS
(Gasoline Engine)

No.	Term.	Description	
1	31	Ground	
2	SB +	Injection begin sensor	only USA
3	SB –	Injection begin sensor	
4	FT	Temperature gage	
5	–	–	
6	A	Diagnosis lead for airbag	
7	SI	Service Indicator	
8	P +	Position transmitter	
9	S	Shielding	
10	P –	Position transmitter	
11	50	Start pulse for starter	
12	61	Alternator charge indicator	
13	TD	Speed signal	
14	30	Battery +	
15	15	Power supply with ignition on	



PLUG CONNECTIONS FOR DIAGNOSIS SOCKET

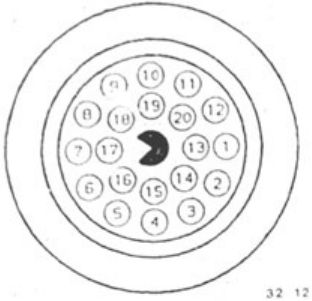
No.	Term.	Description	Wire Colors
1	TD	Speed signals	black
2	SD1	Injection begin sensor	black
3	SD0	Injection begin sensor	yellow
4	FT	Temperature gage	brown/violet
5	–	–	–
6		Diagnosis lead Airbag	white/black
7	SI	Service Indicator	white/blue
8	–	–	–
9	–	–	–
10	–	–	–
11	50	Start pulse for starter	
12	D +	Generator charge indicator	blue
13	–	–	–
14	B +	Battery	red
15	RD	Stimulating lead	black/white
16	15S	Voltage with ignition on	green/white
17	–	–	–
18	–	–	–
19	31	Ground	brown
20	DLA	Data lead	green/blue



2812 162

DIAGNOSIS PLUG CONNECTIONS
(Diesel Engine)

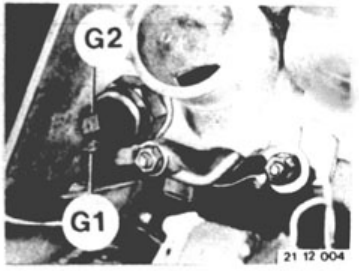
No.	Term.	Description
1	31	Ground
2	–	–
3	–	–
4	FT	Temperature gage
5	L	– Engine M 10 B 18: integrator output for CO level – Engine M 30 B 34: oxygen sensor signal
6	A	Diagnosis lead for airbag
7	SI	Service Indicator
8	P +	Position transmitter
9	S	Shielding
10	P –	Position transmitter
11	50	Start pulse for starter
12	61	Alternator charge indicator
13	1	Ignition signal
14	30	Battery +
15	15	Power supply for ignition



32 12 132

PLUG CONNECTIONS FOR DIAGNOSIS SOCKET

Pin No.	Description	Wire Colors
1	Terminal 1	black
7	Service Indicator Reset	white/green
11	Terminal 50	black/yellow
12	D + Alternator charge indicator	blue
14	Terminal 30	red
15	RXD stimulating lead	white/yellow
16	15 s power supply with ign. on	green/white
18	PGSP for DME programming control unit	green/blue
19	Terminal 31	brown
20	TXD data lead	white/violet



12 62 . . . **CHECKING / REPLACING COOLANT TEMPERATURE SENSOR (Glow Time/Temperature Gage)**

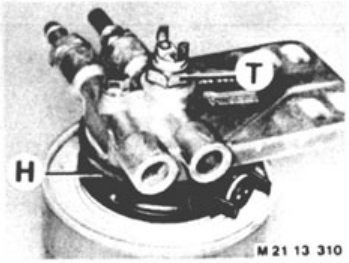
Connections:
G 1 = For coolant temperature display (temperature gage)
G 2 = For glow time control (to glow time control unit)

Dip removed temperature sensor in warm coolant up to hexagon.
Check resistance values* on G 1 / G 2 and ground at specified temperature*.



Installation:
Use a new seal.
Tightening torque*.

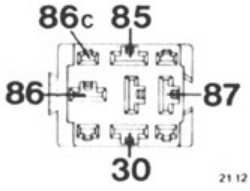
* See Specifications



M 21 13 310

12 64 . . . CHECKING FUEL FILTER HEATING

Fuel is heated at temperatures below + 5.5° C (+ 42° F) starting with "DRIVE" ignition key position.
Temperature switch (T) activates a relay, which delivers power to heating element (H) – see engine electric wiring diagram.



2112 040

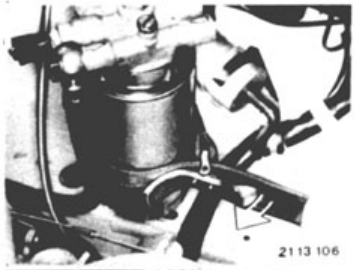
Pull off relay (see engine electric wiring diagram).
Measure power input* between terminals 30 and 87 – should drop as heating element temperature rises.



2113 134

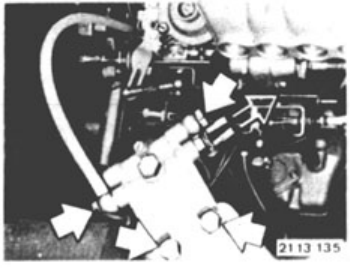
Measure resistance* of coil with ohmmeter, replacing heating element if necessary.

* See Specifications

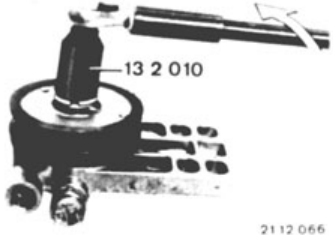

2113 106

12 64 005 REPLACING HEATING ELEMENT FOR FUEL FILTER HEATING

Unscrew filter cartridge.


2113 135

Unscrew fuel pipes.
Pull off plug for temperature switch.
Unscrew filter head.



2112 066

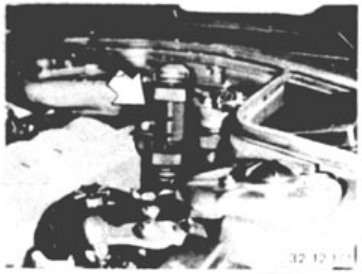
Unscrew heating element with Special Tool 13 2 010.



2112 067

Installation:
Install seal (1) correctly – check dowel pins.
Tightening torque* for nut (2).

* See Specifications



TOP



12 70 500 CHECKING EXTERNAL SAFETY PATH

Note:
Read EML fault memory before installation of a testing adapter.

Ignition turned off.
Disconnect EML plug and install testing adapter, Special Tool 12 7 010.

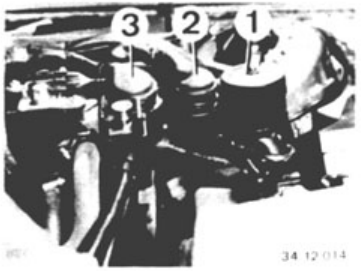
Check installed direction of testing adapter.
Knurled wheel in "–" position.
Start engine and regulate its speed to approx. 2,500 rpm with the knurled wheel.

EML Testing Adapter:
Special Tool 12 7 010.

Now operate the brake pedal, whereby the engine speed must be reduced "immediately" by the coasting shutoff function.
External path is okay.

Remove adapter.
Connect EML plug.

Note:
If applicable, cancel fault memories in diagnosing memories of EML and DME – see BMW Diagnosing Test by putting in 999.



EML Plug:
535 I (only special equipment

750 I (arrangement since 1987 plant shutdown)

1 = Diagnosing socket
2 = EML plug
3 = Engine plug

Note:
Read the EML fault memory first should it be necessary to replace the instrument cluster.
Make sure that the warning lamp functions correctly after installation.
Check safety path - see 12 70 500.

Caution!
Always turn off the ignition before disconnecting the multiple pin plug, in order to avoid damaging the DME, EML and ABS control units.

13 Fuel system

Diesel Engine: 324td, 524td, 324td, 524td – E24 .....

2 BE Carburettor – 316 Model .....

M40 Engine – Models: 318i Cat. Conv. / Cat. Conv. Provisions and 316i since 9/88 .....

1.8 lt.: 318i / 318i (Catalytic Converter/US) / 318i (Catalytic Converter/ECE) / 518i .....

2.0 lt. / 2.3 lt. / 2.5 lt. / 2.7 lt.: 320i / 323i / 325i / 325eECE /
325eUS / 520i /525eECE / 528eUS / 520i-E34 / 525i-E34 .....

S14 – Models M3 .....

Construction group 13 Fuel system

Valid for Diesel Engine – Models: 324d, 524td, 324td, 524td-E24

	Working instruction	13- 1
	Fuel and injection system – troubleshoot	13- 5
13 00 050	Idling speed – check / adjust	13- 10
550	Cold idling speed system – check / adjust	13- 11
13 31 028	Fuel delivery pressure – check	13- 12
13 51 002	Internal injection pump pressure – check	13- 15
007	Full load smoke – correct (324d, 524td, 524td E28)	13- 16
008	Acceleration smoke – correct (524td E28)	13- 16
300	Electric fuel shutoff – check	13- 19
310	Electric cold start valve – check	13- 20
340	Injection pump operating lever – check / adjust – automatic transmission	13- 21
800	Injection nozzle – check – combination fuel injector removed	13- 22
13 53 . . .	Injection nozzle – flush – installed	13- 23
	Injection nozzle – clean	13- 24
	Injection nozzle – disassemble	13- 25
	Injection nozzle – adjust	13- 25
	Seal of injection nozzle assembly – replace	13- 26
	DDE – troubleshoot	13- 30
13 00 050	Idling speed – check (324td, 524td – E34)	13- 31
13 51 300	Electric shutoff valve – check (324td, 524td – E34)	13- 31
13 31 028	Fuel delivery pressure – check (324td, 524td – E34)	13- 32
13 51 002	Internal injection pump pressure – check (324td, 524td – E34)	13- 33
13 61 000	Control units – remove and install	13- 35

INSTRUCTIONS

concerning cleanliness when working on fuel systems.

- Clean area around repair point thoroughly – for example before disconnecting lines, switches, etc..

- Always place removed parts on a clean surface and cover with plastic sheet – never use rags losing lint!

- Close off or insert plugs in open lines or components immediately.

- Only install cleaned parts.
  Take new spare parts out of their packaging only shortly before installation.

- Never let diesel fuel drip on coolant hoses – if applicable, wash off with water immediately.

TROUBLESHOOTING ENGINE ELECTRIC, FUEL AND INJECTION SYSTEM

1. Engine cannot be started
2. Engine hard to start (coolant 20° C / 68° F)
3. Engine surges in idle
4. Erratic idling on warm engine
5. Engine backfiring while driving
6. Performance unsatisfactory
7. Fuel consumption too high
8. Engine cannot be stopped
9. Engine runs hard, black smoke in full load range
10. Fogging exhaust gas
11. Unsatisfactory idling of cold engine
12. Engine does not race in cold state
13. Distributor injection pump too hot
14. Excessive black smoke in constant full load driving
15. Excessive black smoke in acceleration phase

Requirements:
- Starting system okay (battery voltage, starter, ignition lock, etc.)
- Engine in perfect running condition (timing, compression)
- Specified fuel in tank (without contamination, winterproof)
- Connections, plugs and ground points according to wiring diagram

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
X	X			X	X					X	X								
X	X		X	X	X					X	X								
X				X			X												
	X	X	X		X	X		X			X								
X	X		X		X			X	X										
					X	X		X	X										
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	TEST POSITION	REFERENCE
1	Fuel delivery pressure	13 31 028
2	Bleed system, leak test	13 51 320
3	Electric shutoff	13 51 301
4	Static injection point adjustment	13 51 005
5	Fuel injectors	13 53 800
6	Air cleaner	13 71 001
7	Preheating system	12 21 ... / 12 23 ...
8	Cold idle device	13 00 550
9	Linkage and cable adjustment	13 51 340
10	Idle speed adjustment	13 00 050
11	Fuel return	13 51 000
12	Cold start system	13 51 310
13	Valves on injection pump	13 51 290
14	Atmospheric pressure dependent control	13 51 . . .
15	Charge pressure dependent control	13 51 . . .
16	Injection pump	13 51 001
17	Injection pump correction	13 51 007
18	Injection pump correction	13 51 008
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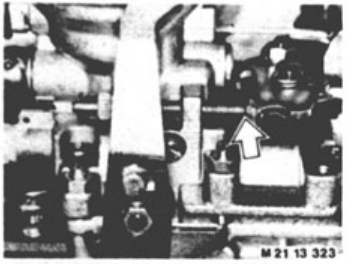
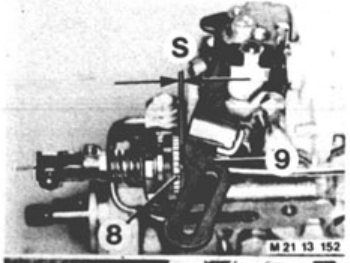
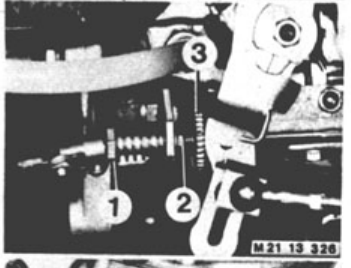


13 00 050 CHECKING / ADJUSTING IDLE SPEED

Requirements:
- Engine at operating temperature (oil temp. > 60° C/140° F)
- Valve clearance correct
- All electric equipment switched off
- Speed lever bears on adjusting screw



Check for play "S" = 0.5 ± 0.3 mm (0.020 ± 0.012") between knurled head screw (8) and lever (9), correcting if necessary.

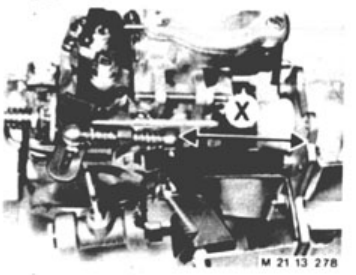


Counterhold on hexagon (1) and unscrew nut (2).
Turn knurled head screw (3) until play "S" is reached.



Start engine and check idle speed* by reading on tachometer in the instrument cluster.
If necessary, loosen nut (1) and turn adjusting screw (2) until correct idle speed* is reached.
Tighten nut (1).
Recheck play "S", correcting if necessary.

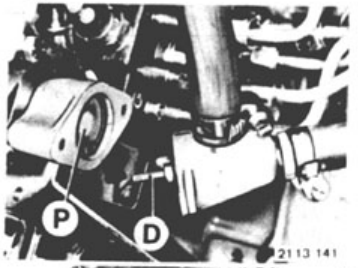
* See Specifications



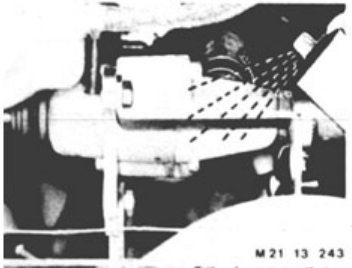
Cars with Automatic Transmission:
Check distance "X" in idle position, correcting if necessary – basic linkage adjustment, see 13 51 340.

13 00 550 CHECKING / ADJUSTING COLD IDLE SPEED DEVICE

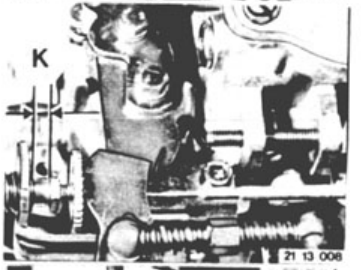
Requirements:
– Coolant temp. < 20° C (68° F)
– Idle speed (warm) correct



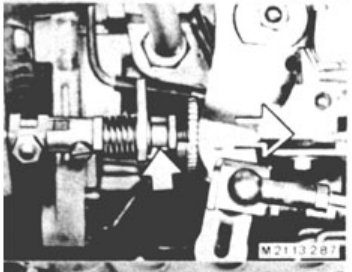
Spring force must keep plate (P) on the circlip.
Installation:
Check for correct seating of expansion element (D).



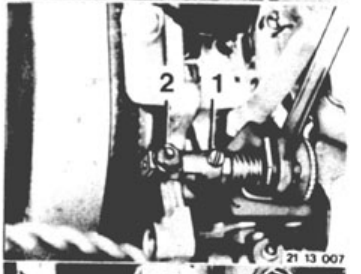
Checking Operation of Expansion Element:
Spray refrigerating spray** on expansion element housing about one minute.



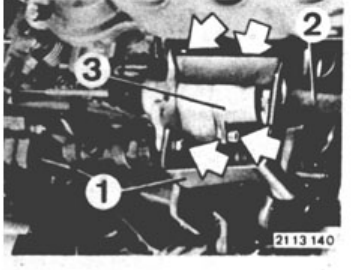
The control device must now be pulled out.
Distance "K" is 5.5 ±0.4 mm (0.216 ±0.016").



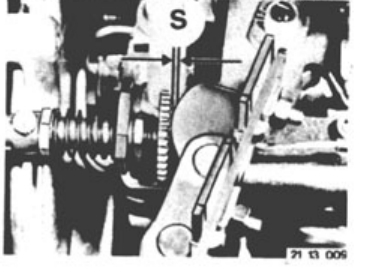
Pull back speed lever by hand slightly.
Operation of the expansion element should pull back the piston with knurled head screw approx. 2 to 3 mm (0.079 to 0.118").
Replace expansion element, if necessary.



Correcting:
Unscrew clamps (1 and 2) and reposition them until distance "K" is reached.
Apply a 10 mm fork wrench to make adjusting easier.
First tighten clamp (2) and then (1).

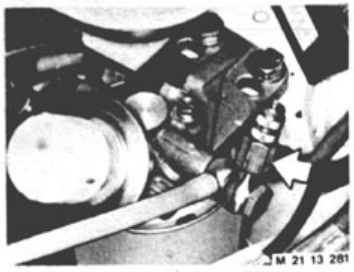


Checking Adjustment:
Unscrew holder (1) for cable.
Pinch hoses (2) shut with clamps.
Unscrew housing (3).



Check play "S" = 0.5 ±0.3 mm (0.020 ±0.012") after correcting, correcting play "S" if necessary.
Check idle speed, correcting if necessary see 13 00 050.

** Source: HWB



13 31 028 CHECKING FUEL DELIVERY PRESSURE

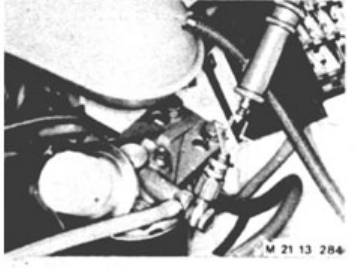
Unscrew hollow union bolt on filter and install adapter 13 5 360.
Use seals.



Insert connector from adapter in handle for vacuum hose (service tester).

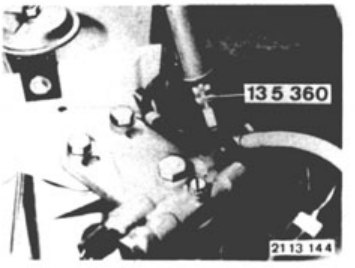


Start and run engine at idle speed until the feed line has been bled.



Connect vacuum hose.
Perform multimeter test (M 21).
Read vacuum* at specified test speed*.

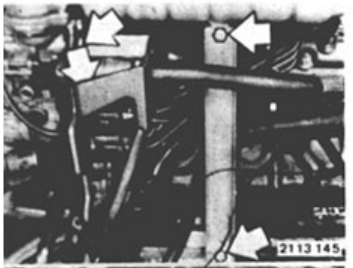
* See Specifications



Max. Vacuum* Exceeded:
Check
– fuel filter,
– lines to fuel tank and
– fuel intake.

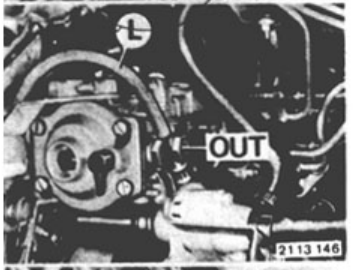
Remove adapter after checking.
The system is bled automatically after starting the engine.

* See Specifications

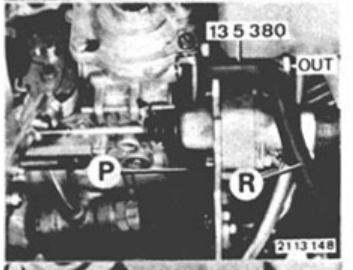


13 51 002 CHECKING INJECTION PUMP INTERNAL PRESSURE

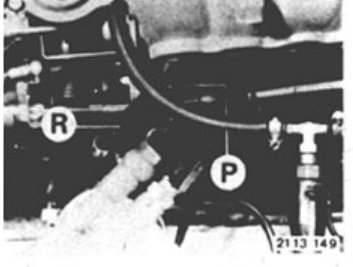
Remove prop for intake manifold (only 324 d).
Unscrew and swing away expansion tank (only 524 td).
Unscrew holder for cable.



Pull off leak oil hose (L) on injection nozzle.
Unscrew hollow union bolt for return hose (OUT).

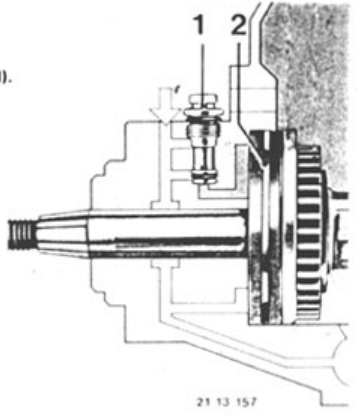


Unscrew and pull out return hose (R) downward.
Install test hose (P) with adapter 13 5 380 and seals.
Route return hose via the cold idle speed device to the adapter and mount with bolt (OUT).



Connect BMW Service Tester on test hose (P) – perform multimeter test (M 19).
Start engine and read pump internal pressure* at test speed*.

* See Specifications



Diagnosing Information:
Internal Pressure Too Low
- Pressure control valve (1) faulty.
- Fuel delivery pump (2) performance insufficient.

Remedy:
Replace injection pump.

Internal Pressure Too High
- Hollow union bolt (OUT) for return hose plugged – clean, if necessary.
- Pressure control valve faulty, replace injection pump if necessary.

Incorrect internal pressure will cause displacement of the injection timing.
This will be noticed on insufficient pressure due to inadequate power or on excessive pressure with hard engine running.

13 51 007 / 008

Correct on the volume adjusting screws of the injection pump in case of excessive black smoke development in the accelerating phase or constant full load driving.

The corrective measures described below require that clear difference is made between

1. acceleration smoke in a range of 1000 to 2500 rpm (only BMW 524 td/ E 28) and
2. full load smoke in the entire speed range (BMW 324 d, 524 d and 524 td - E 28).

Procedures are different accordingly.

Blow deposits of soot out of the exhaust assembly by racing the engine of a stopped car at least five times prior to making corrections on the injection pump.

The tests described below must be performed, insofar as it would not be better to perform them in the course of an inspection.

- Diesel fuel must conform with DIN standards (brand name fuel).
- Check fuel filter for cleanliness and correct intake vacuum.
- Check reference pressure box for correct vacuum (BMW 324 d, 524 d).
- Static basic adjustment.
- Toothed drive belt tightness.
- Coolant and oil must reach normal temperature.
- Check valve clearance.
- Air filter clean.
- Idle speed adjustment.
- Pump internal chamber pressure.
- Oil trap for crankcase breather (unrestricted oil return flow).
- Opening pressure of injection nozzles.
- Check charge pressure (524 td).
- Check compression.
- Contact surfaces of welded sleeve on the full load adjusting screw must be perpendicular to the pump axis and may not be turned clockwise.

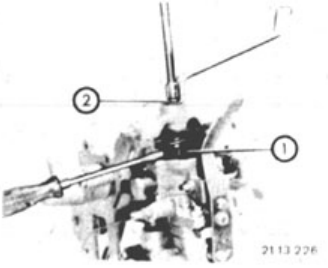
13 51 008

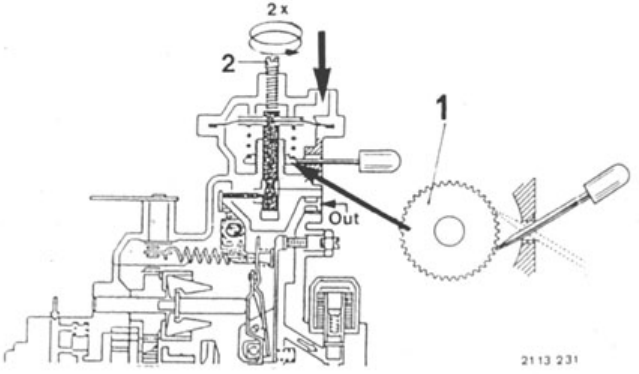
1.1 Correcting Acceleration Smoke
(Only BMW 524 td - E 28)

Pull out the rubber grommet for the diaphragm venting located above the "out bolt" and unscrew the hollow union bolt located behind it, in order to adjust the charge pressure dependent full load stop of 524 td cars.

Mark one tooth in the middle of the tapped bore on the spring retainer with wwhite paint afterwards.

Gear wheel (1) located in the pump can be adjusted by one turn with a screwdriver as shown in the sketch below. Unscrew the locknut and loosen the adjusting screw (2) located on the upper pump cover by two turns afterwards.
Tighten locknut again.
Reinstall rubber grommet with corresponding hollow union bolt.





13 51 007

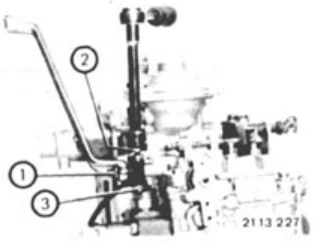
1.2 Correcting Full Load Smoke

If there is excessive black smoke emission during constant full load driving (engine speed greater than 2,500 rpm) in addition to acceleration smoke, proceed to steps described in point 2.2 instead of point 1.1.

Note:
If corrections had been made to the procedures described here, it is not necessary to make another adjustment to point 1.1.

2. Injection Pump Correction (BMW 324 d, 524 d)

Adjustments differ on injection pumps in cars with a naturally aspirated diesel engine.



2.1 Adjusting Screw with Fine Control Gearing (Worm)

Unscrew locknut (1) with a 13 mm ring wrench.
Turn screw (2) only in clockwise direction by max. six turns.
Tighten locknut (1).

Caution!
Turning counterclockwise could damage the worm!
Self-locking nut (3) must not be loosened or tightened!

2.2 Adjusting Screw without Fine Control Gearing

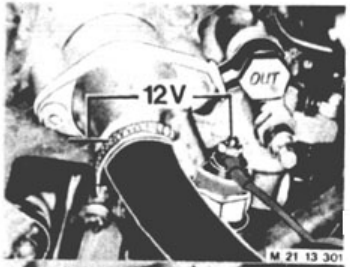
In case of injection pumps without a worm, loosen locknut (1) approx. 1/4th of a turn with a 13 mm ring wrench and simultaneously hold screw (2) in its position (first note position of the screw!).

Turn screw (2) counterclockwise by 20° to max. 40° afterwards (equal to max. 1/8th of a turn).

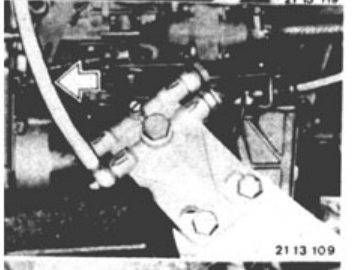
Note:
Evaluate smoke emissions after making corrections.

In so doing a compromise must be found between smoke reduction and power reduction within specifications.

All turned adjusting screws must be sealed again with the special BMW paint, HWB Order No. 81 22 9 407 404.









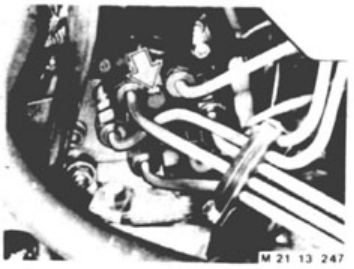
13 51 300 CHECKING ELECTRIC FUEL SHUTOFF

The shutoff receives electric power starting with the "DRIVE" ignition key position. This will be noticed by a loud click when switching on.

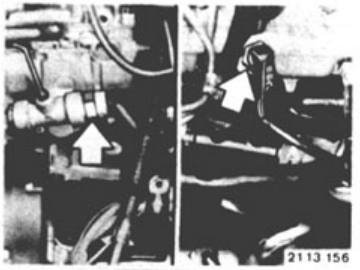
The manual shutoff lever (12) must be used when the electric shutoff fails.

Testing Requirements:
- Fuel in tank
- No visible air bubbles in feed line

1. Turn on ignition and check, whether the shutoff is receiving electric power (approx. 12 volts).

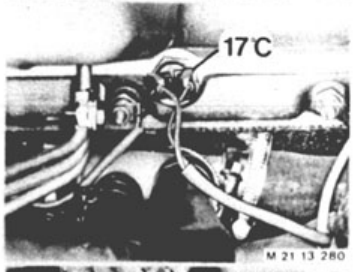


2. Loosen plug on high pressure section about two turns.
   Crank engine with starter and check, whether fuel is running out.
   If necessary, replace shutoff – see repair manual of pertinent model series.

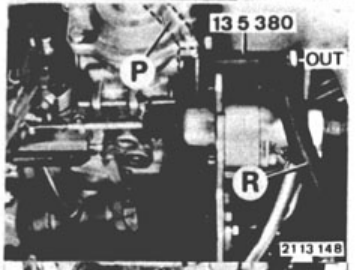


13 51 310 CHECKING ELECTRIC VALVE FOR COLD START SYSTEM (COLD START BOOSTER)

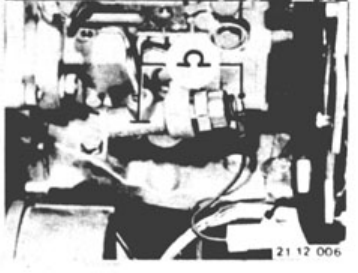
Description:
The electric valves receives electric power from a temperature switch during the cold running phase.
This results in higher pump internal pressure, which "ADVANCES" the injection timing.



Checking:
Bridge temperature switch on a warm engine.
The engine will run much harder due to the advanced injection timing.

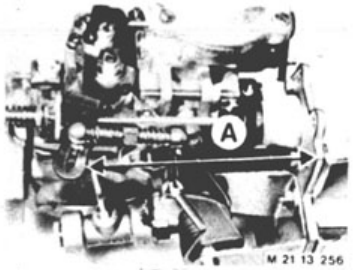


If necessary, check pump internal pressure with the bridged temperature switch.
Replace electric valve, if the pump internal pressure is not higher.



Disconnect wires on valve.
Measure resistance*.

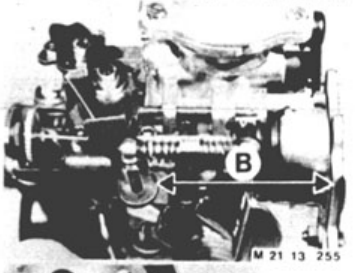
* See Specifications



13 51 340 CHECKING / ADJUSTING OPERATING LEVER ON INJECTION PUMP
– Cars with Automatic Transmission –

Requirements:
– Coolant temp. > 20° C (68° F)
– Idle speed correct

Measure and note distance "A".



Press speed lever against full load stop.
Measure distance "B" and subtract it from distance "A", which gives distance "Y".

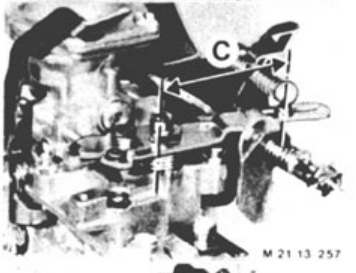
ADJUSTMENT TABLE
Dimensions in millimeter

Y	41	41.5	42	42.5	43	43.5	44	44.5	45	45.5	46	46.5
C	78.1	77.0	76.0	74.9	73.9	73.0	72.0	71.1	70.3	69.4	68.6	67.8
Y	47	47.5	48	48.5	49	49.5	50	50.5	51	51.5	52	52.5
C	67.0	66.3	65.6	64.9	64.2	63.5	62.9	62.3	61.6	61.0	60.5	59.9
Y	53	53.5	54	54.5	55	55.5	56	56.5				
C	59.4	58.8	58.3	57.8	57.3	56.8	56.4	55.9				

Example:

	A	128.7 (5.067")
–	B	72.5 (2.854")
	Y	56.2 (2.213")

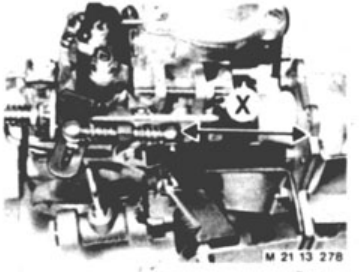
Distance "C", measured from pivot point of speed lever to ball socket, is 56.4 mm (2.220").



Adjusting distance "C" can be found in the table with help of distance "Y".
Distances can be rounded to the values in the table.



To correct distance "C", loosen the ball head and reposition accordingly.



In idle position distance "X" should be 68 ± 0.5 mm (2.677 ± 0.020").
If necessary, correct by changing length of the pull rod.



In full load position distance "Z" should be 29.1 ± 0.5 mm (1.146 ± 0.020").
After finishing adjustments, check throttle cable adjustment for automatic transmission – see 24 00 . . ..

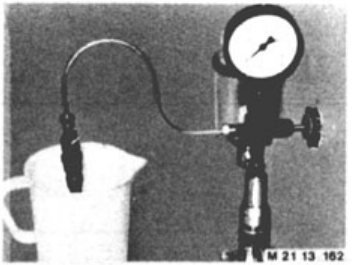


2113 346

13 53 800 CHECKING INJECTION NOZZLE

– Combination Fuel Injector Removed –

Set up tester 00 2 540 on stand.
Plug open line connections with caps when it is necessary to clean the injection nozzles.



M 21 13 162

Mount combination fuel injector on pressure line of tester.
Fill tank with test oil**.
Caution!
Never use gasoline – danger of explosion!



21 13 348

a) Opening Pressure Test

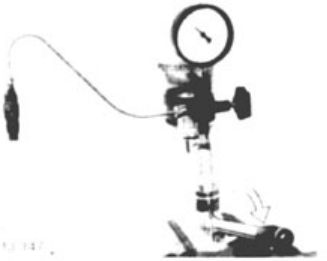
Caution!
Keep hands away from nozzle opening in all tests – danger of injury!
Bleed the line or nozzle by pumping quickly at least 5 times with the manual wheel on the pressure gage closed prior to testing.
If necessary, disconnect the line briefly to bleed roughly.



21 13 348

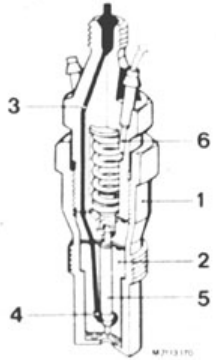
Open manual wheel on pressure gage.
Press down manual lever slowly until the injection nozzle ejects.
Read injection pressure* (bar display, inner scale) on pressure gage.
Pressure must not be lower than the minimum injection pressure.
The max. difference in opening pressure of all six (already used) injection nozzles is 15 bar (213 psi).

* See Specifications
** Source: HWB



b) Injection Nozzle Leak Test

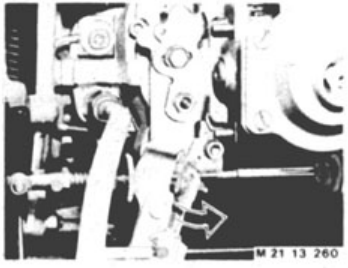
Press down manual lever slowly and hold at point 20 bar (285 psi) below opening pressure.
No drop of fuel should drip from the nozzle within 10 seconds.
Also check for leaks between the nozzle holder upper section and clamping nut.



13 53 . . . FLUSHING INJECTION NOZZLES
– Installed in Car –

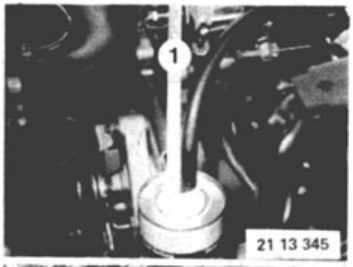
A nozzle needle (5), which is not closing completely because of combustion residue, will be noticed on a loud knocking noise in the engine.





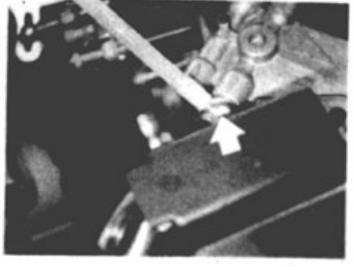
Finding Faulty Injection Nozzle:
Start engine and unscrew the coupling nut on each injection line separately with Special Tool 13 5 020.
The knocking noise will stop, when the coupling nut is loosened on the faulty nozzle.

Remedy:
Accelerate engine having operating temperature from idle speed to high speed several times.
This will flush out the nozzles.
If necessary, clean or replace the combination fuel injector.









13 53 . . . FLUSHING INJECTION NOZZLES
– Installed in Car –
(Only with Mech. Injection Pump)

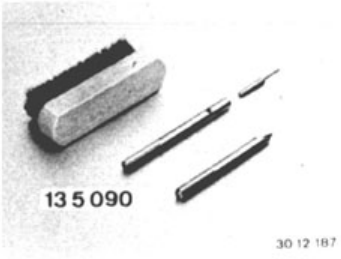
Important!
NOT for application on an electronically regulated injection system (DDE).
Engine at operating temperature.
Disconnect transparent fuel feed hose (1) on fuel filter and insert end of hose without bends in can filled with flushing concentrate**.

Connect pump return hose on the hose connection point about 20 cm (7.874") away from the return or OUT bolt with a 1 meter (3 ft.) long fuel hose having an inside diameter of 8 mm (0.315").
Also insert end of hose extension in the can filled with flushing concentrate**.
Important!
Make sure of absolute cleanliness.

Pull pump relay out of the socket in cars with a subsequently installed intank delivery pump.
Start engine and let it run at different speeds (max. 3000 rpm) until the contents of the can is used up.

Mount fuel lines in their original position again.
Start engine and check for leaks on connections.
Refer to an enclosure of Technical Information 2.87 for instructions on installation of the metering device.

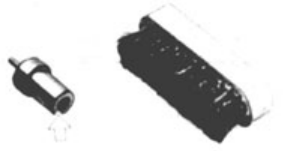
** Source: HWB



30 12 187

Cleaning Nozzles with Scraper Set (13 5 090)
– Nozzle Removed and Disassembled –
(Refer to "Disassembling and Assembling Combination Fuel Injector".)

Do not disassemble a nozzle with an injection begin sender.
Clean the face of a nozzle body with completely pushed in nozzle needle, using a brass brush.



21 13 151

Pull out nozzle needle.
Important!
Nozzle needles and nozzle bodies are matched and must not be mixed up.



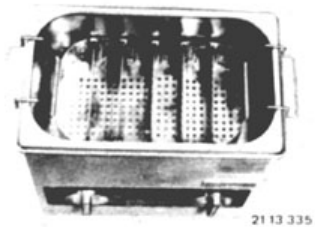
21 13 332

Run seat cleaner into the nozzle body and clean the seat by turning.



21 13 333

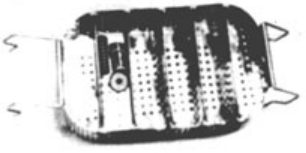
Run injection bore cleaner into the nozzle body and clean the injection bore in the nozzle body.
Wash the intermediate washer, nozzle body and nozzle needle with clean diesel fuel prior to assembling.



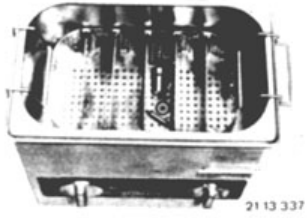
21 13 335

Ultrasonic Cleaning
– Nozzle Removed and Disassembled –
(Refer to "Disassembling and Assembling Combination Fuel Injector".)

Do not disassemble a nozzle with an injection begin sender.
Place the disassembled nozzle body and nozzle needles with thrust pad, springs and washers belonging to a set in a compartment of the cleaning tray.
Important!
Don't mix up components of combination fuel injectors.



21 13 336



21 13 337

Clean parts in the ultrasonic bath 10 to 20 minutes to operating instructions of the equipment with cleaner 13 6 202*.



21 13 338

Wash all cleaned parts including the nozzle body and nozzle needles with clean diesel fuel prior to assembling.

* Source of Supply: Cartool



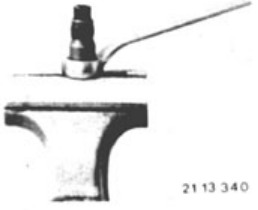
2113 342

Disassembling and Assembling Combination Fuel Injector:
Important!
There is still no approval for disassembling an injection nozzle with an injection begin sender (DDE) due to the complicated adjustment of the inductive sender.



2113 339

Clamp the upper section (2 flat surfaces) of a combination fuel injector in a vise fitted with aluminum jaws.



2113 340

Loosen and unscrew lower section, lift off carefully and leave nozzle with washers on the upper section.



2113 341

Important!
Protect all parts from getting dirty.
Clean parts.
All parts of one combination fuel injector must remain together and not be mixed up.
Replace heat shield each time an already used nozzle is disassembled.



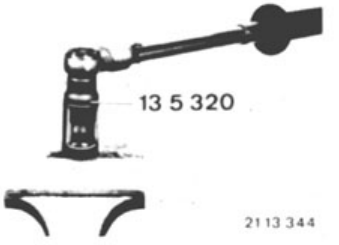
2113 338

Adjusting Injection Nozzle:
Assemble the combination fuel injector with the old shim.



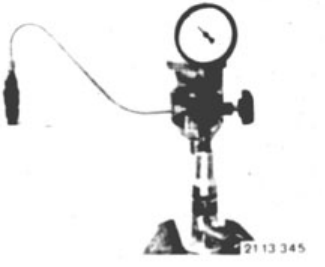
2113 343

Installed Order:
1 Nozzle holder upper section
2 Nozzle holder lower section (clamping nut)
3 Shim
4 Spring
5 Thrust pad
6 Intermediate washer
7 Nozzle needle
8 Nozzle body
9 Heat shield



2113 344

Important!
Make sure parts are absolutely clean when assembling.
Screw on nozzle holder lower section with Special Tool 13 5 320.
Tightening torque*.



2113 345

Check opening pressure – see "Checking Injection Nozzle" in 13 53 800.
Disassemble the combination fuel injector and replace the shim, if there is deviation from the nominal value*
Shims are available in thicknesses from 1.0 to 2.0 mm (0.039 to 0.079") in steps of 0.05 mm (0.002").
A 0.1 mm (0.004") thicker shim will increase the opening pressure by about 10 bar (142 psi).

* See Specifications

Replacing Seal of Combination Injection Nozzle:
Check condition of seal on injection nozzle and replace at the latest after nozzle had been removed and installed several times.



Clamp nozzle on surfaces of the upper section in a vise fitted with aluminum jaws.



Pry up seal with a screwdriver.



Cut off seal with a side snippers.



Push on new seal with inside curve facing up.

Prevent new seal from falling out prior to installation of the combination injection nozzle with a small amount of copper paste (1).**



Install combination injection nozzle in cylinder head carefully.

Seal can no longer be lost by tightening once with the specified torque*.

* See Specifications
** Source of Supply: HWB

TROUBLESHOOTING DIGITAL DIESEL ELECTRONICS (DDE)

1. Engine can not be started
2. Engine hard to start/coolant temp. 20° C (68° F)
3. Warm engine runs erratically at idle speed
4. Engine cuts out while driving
5. Unsatisfactory performance
6. Fuel consumption too high
7. Engine can not be stopped
8. Engine runs hard, black smoke in full load range
9. Foggy-type exhaust gas
10. Unsatisfactory idle from cold engine
11. Engine speed does not pick up in cold state
12. Distribution injection pump too hot
13. Engine stops on its own
14. Engine runs at fast idle speed
15. Engine runs max. 1200 rpm (or 1400 rpm with automatic)
16. Strong vehicle hesitation
17. Engine runs at fast speed
18. Warning lamp lights up

Requirements:
- Starting system okay (battery voltage, starter, ignition lock, etc.).
- Engine in perfect running condition (timing, compression).
- Specified fuel in tank (without contamination, winterproof).
- Connections, plugs and ground points according to wiring diagram.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			
x	x	x	x					x	x											1	Fuel delivery pressure	13 31 028
								x				x								2	Bleed system, check for leaks	13 51 320
x			x			x						x								3	Electric shutoff	13 51 301 *
x	x	x		x			x	x												4	Fuel injectors	13 53 800
				x	x		x	x												5	Air cleaner	13 71 001
	x																			6	Preheating system	12 21 .../12 23 ...
					x			x		x										7	Fuel return, int. pump pressure	13 51 000
x												x								8	Fuel rate control unit	13 61 000
			x									x								9	Injection pump (drive potentiometer)*	
				x								x								10	Fuel filter	
							x													11	Charge pressure sensor conn.	
													x							12	Injection begin control unit	13 61 000 *
														x						13	Accelerator pedal *	
															x					14	Brake switch *	
							x													15	Road speed sender (or lead) *	
				x												x				16	EGR valve (cars with EGR)	
																	x			17	Speed sender (or adjustment)	12 14 ... *
																				18	Engine temperature sensor *	
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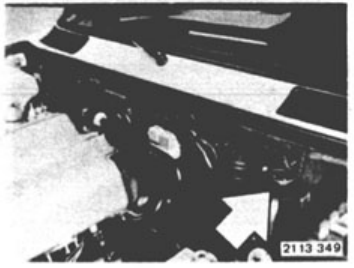
* See BMW Diagnosing System for other troubleshooting of DDE.

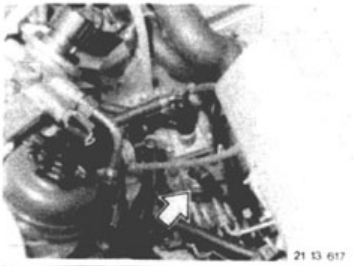




13 00 050 CHECKING IDLE SPEED

Requirements:
- Engine at operating temperature = oil temp. > 60° C (140° F)
- Valve clearance okay
- All electric equipment switched off

Read idle speed* on tachometer in the instrument cluster.
Read out fault memory of DDE self-diagnosis in case of deviation from nominal value.
If applicable, check basic adjustment of the pedal value sender.





13 51 300 CHECKING ELECTRIC FUEL SHUTOFF

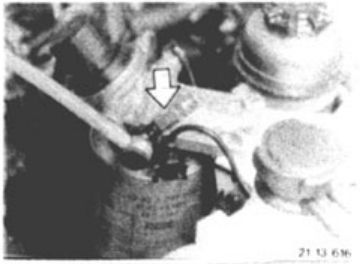
Power is supplied via the control unit to the shutoff from ignition key position DRIVE on. A loud click is heard as it is switched on to indicate this.

If no click is heard, check power supply to the control unit.
Further testing – see BMW diagnosing system.

It is possible to test the safety circuit with help of the BMW diagnosing system as from DDE II (1 control unit) on.
1. Select DDE (acknowledge).
2. Select 500 (acknowledge) – see BMW diagnosing system.

Check electric fuel shutoff in case of negative test results.
Check valve seat for dirt.

* See Specifications



13 31 028 CHECKING FUEL FEED PRESSURE

Unscrew hollow union bolt on filter and install adapter 13 5 360.
Use seals.

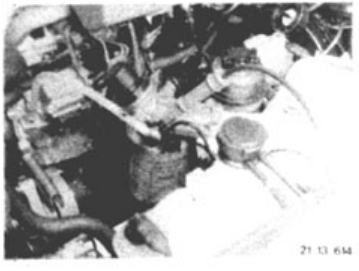


M 21 13 282

Insert connector from adapter in grip for vacuum hose (service tester).



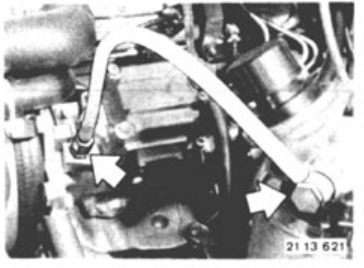
Start engine and check for leaks on connections.
Run engine at idle speed until the feed line has been bled.



Connect vacuum hose.
Perform multimeter test (M 21).
Read vacuum* at specified test speed*.

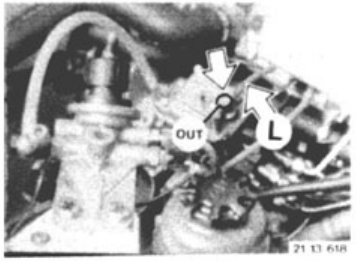
* See Specifications

Measured Vacuum* Exceeded:
Check
– fuel filter,
– lines to fuel tank and
– fuel intake.



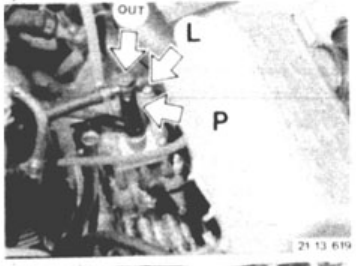
Remove adapter after testing.
System is bled automatically after starting the engine.
Check for leaks on feed line and connections.

* See Specifications

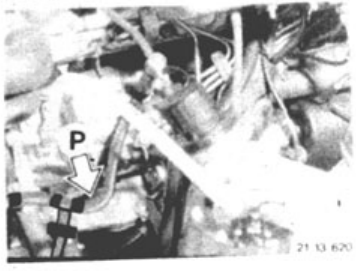


13 51 002 CHECKING INJECTION PUMP PRESSURE

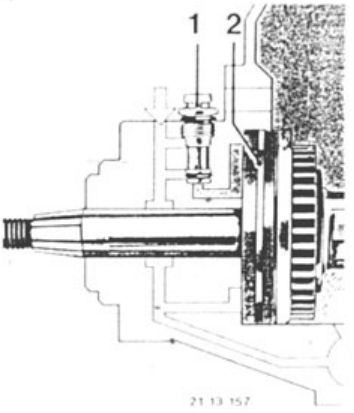
Pull off leak oil hose (L) on injection nozzle.
Unscrew hollow union bolt for return hose (OUT).



Mount test hose (P) with adapter 13 5 380 and gaskets.
Mount return hose on adapter with hollow union bolt "OUT".
Connect leak oil hose (L).



Connect BMW Service Tester on test hose (P).
Put in multimeter test M 19.
Start engine and check for leaks on connections.
Read pump internal pressure* at test speed*.



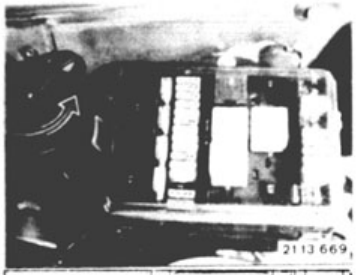
Information for Diagnosis:
Internal Pressure Too Low –
- Pressure control valve (1) faulty
- Insufficient delivery rate from fuel delivery pump

Remedy:
Replace injection pump.

Internal Pressure Too High –
- Hollow union bolt (OUT) for return hose plugged, clean if necessary.
- Pressure control valve faulty, replace injection pump if necessary

Wrong internal pressure will cause displacement of the injection timing.
Insufficient pressure will be noticed by lack of power and excessive pressure by hard engine running.

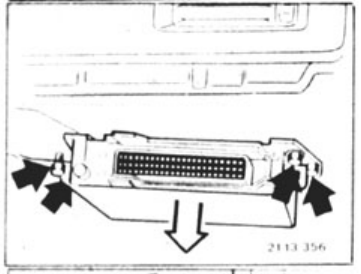
* See Specifications



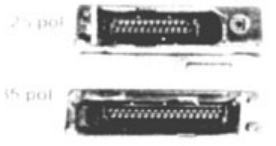
DDE
13 61 000 REMOVING AND INSTALLING CONTROL UNITS

Read fault memories – see BMW diagnosing system.

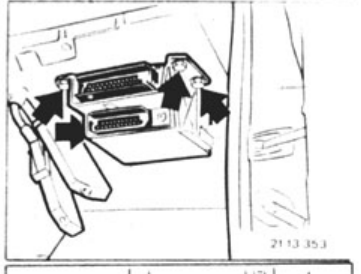
Note:
SB control unit
(25-pin connection)
responsible for:
- injection begin regulation
- self-diagnosis output
- exhaust gas recirculation



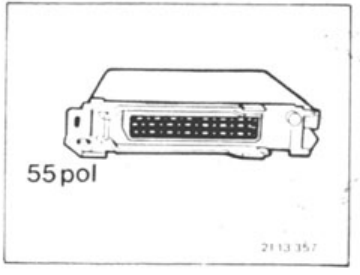
Unscrew cover in glove box.



ME control unit
(35-pin connection)
responsible for:
- start volume control
- volume regulation while driving
- smoke control
- fuel mass correction
- idle speed regulation
- road speed regulation
- automatic transmission activation
- charge pressure regulation
- hesitation control

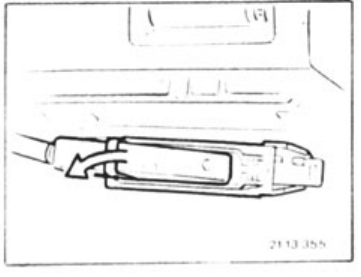


Unscrew screws and remove control units.



DDE II one control unit
(55-pin connection) with 2 computers
Computer I:
- injection begin regulation
- self-diagnosis output
- exhaust gas recirculation

Computer II:
- injection rate regulation with start volume control and full load volume limit
- speed regulation
- running regulation and hesitation control
- smoke control and overheating protection
- road speed regulation



Caution!
Turn off ignition before disconnecting or connecting multiple-pin plugs.

Construction group 13 Fuel system

2 BE Carburettor – 316 Model

	Component survey	13- 51
	Hose routing plan	13- 54
13 00 054	Engine idle speed and CO level – adjust	13- 55
13 11 100	Carburettor – remove and install	13- 56
111	Carburettor insulating flange – replace	13- 56
171	Carburettor cover gasket – replace (Job No. 13 11 241)	
241	Float needle valve	13- 57
. . .	Float level – adjust	13- 58
. . .	Idle speed correction jet – replace	13- 58
387	Compensating flap actuator – replace / check	13- 59
383	Throttle valve actuator – replace / check	13- 60
385	Throttle valve angle sender – replace / check	13- 63
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442	Vacuum box for stage II – remove and install	13- 64
13 31 009	Fuel pump pressure and float needle valve – check for leaks	13- 65
030	Fuel pump – replace	13- 65
. . .	Fuel filter screen – replace	13- 65
12 62 511	Intake pipe temperature sensor – replace / check	13- 65
13 61 000	Control unit – replace	13- 66
13 71 000	Air cleaner – remove and install	13- 66
13 72 001	Air filter cartridge – remove and install	13- 66
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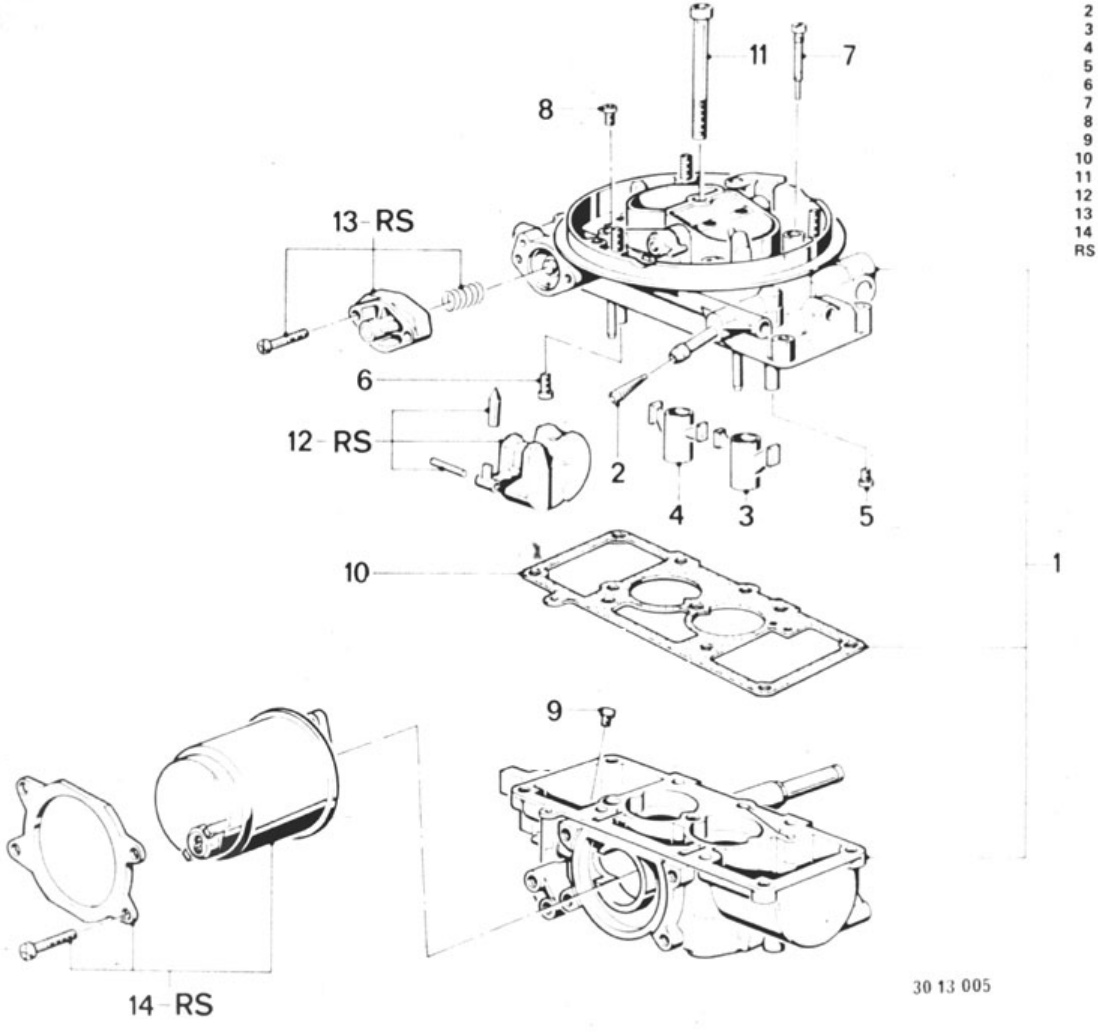
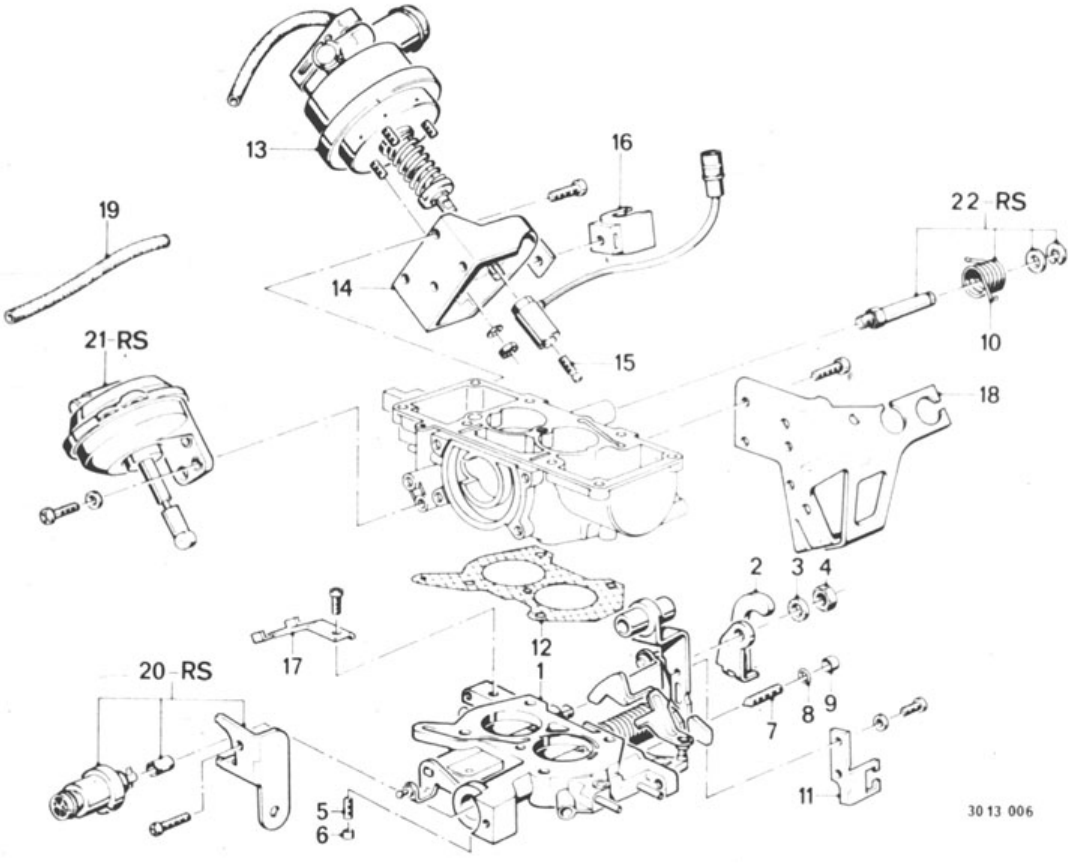
COMPONENT SURVEY



1 = Float housing
2 = Filter screen
3 = Atomizer
4 = Atomizer
5 = Main jet
6 = Main jet
7 = Idle jet
8 = Transition air jet
9 = Transition fuel jet
10 = Cover gasket
11 = Bolt
12 = Float
13 = Valve
14 = Throttling orifice
RS = Repair kit

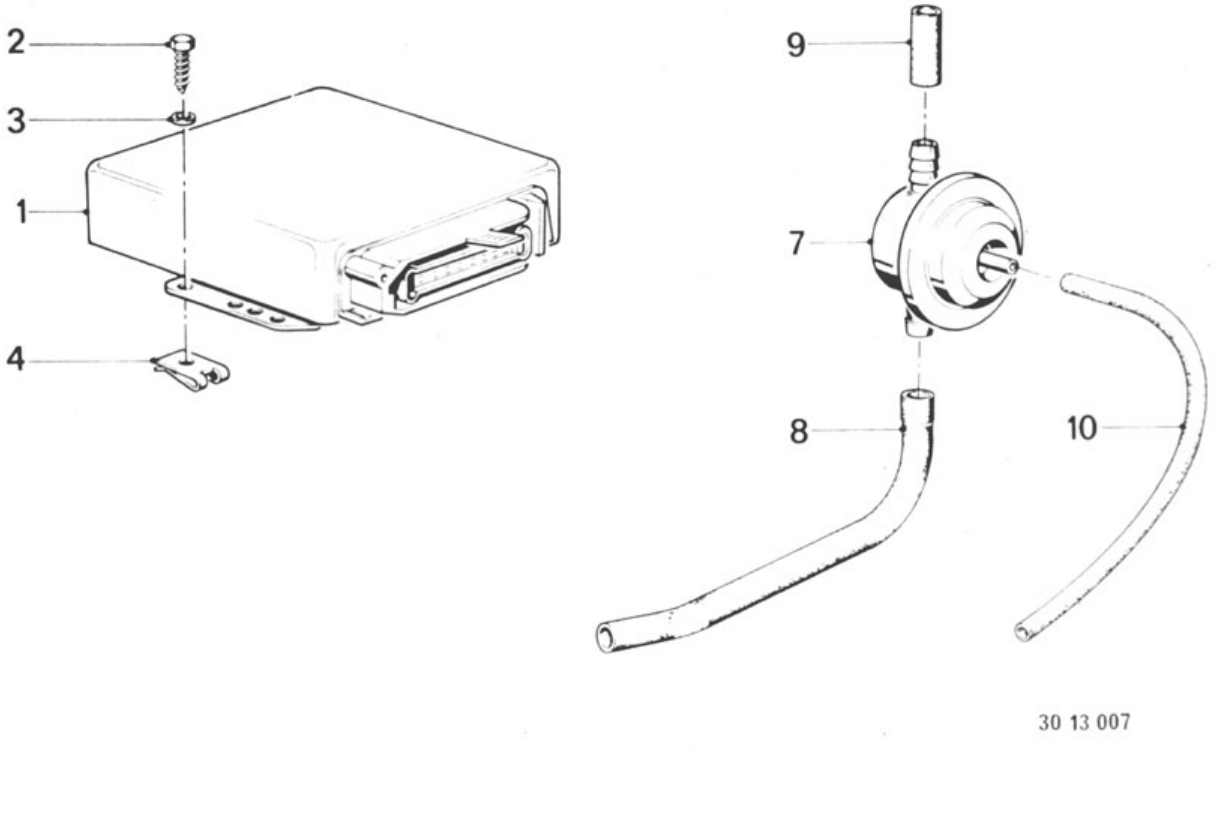
30 13 005

COMPONENT SURVEY



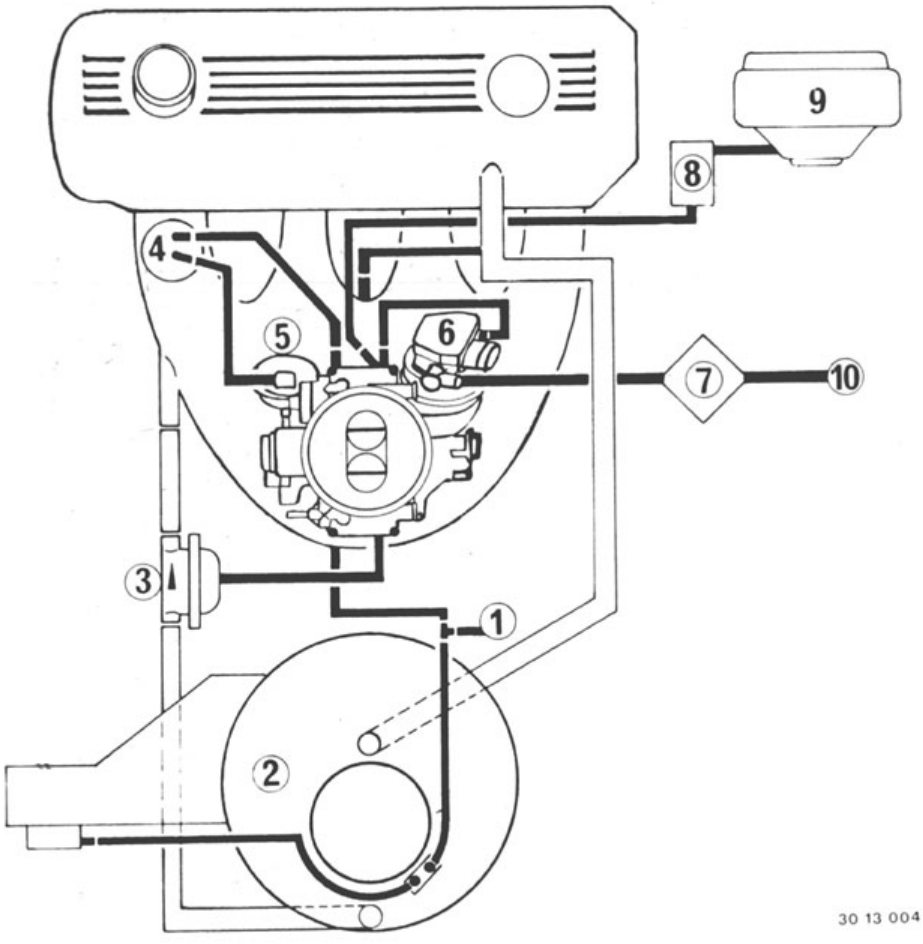
1 = Throttle housing
2 = Lever
3 = Lock washer
4 = Nut
5 = Threaded pin
6 = Cap
7 = Mixture control screw
8 = O-ring
9 = Plug
10 = Spring
11 = Operating lever (cruise control)
12 = Gasket
13 = Throttle positioner
14 = Holder
15 = Threaded pin
16 = Holder
17 = Holder
18 = Holder
19 = Vacuum hose
20 = Throttle potentiometer
21 = Vacuum box – stage II
22 = Shaft
RS = Repair set

COMPONENT SURVEY



1 = Carburetor control unit
2 = Hex. head self-tapping screw
3 = Washer
4 = Adjusting nut
5 = Intake pipe temperature sensor
6 = Seal
7 = Coasting air valve
8 = Hose
9 = Hose
10 = Vacuum hose

2 BE HOSE ROUTING PLAN

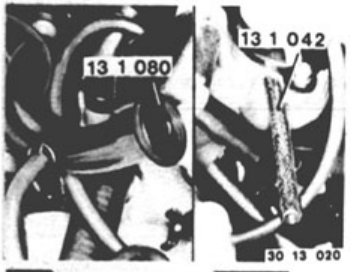


30 13 004

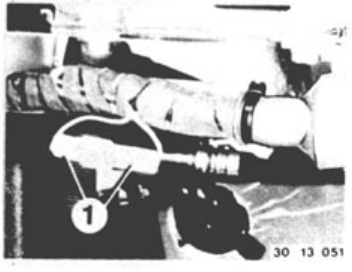
1 = Vacuum connection for passenger compartment temperature sensor (only E 28 / 518)
2 = Air cleaner
3 = Air valve
4 = Intake pipe temperature switch
5 = Vacuum box — stage II
6 = Throttle positioner
7 = Filter
8 = Solenoid
9 = Vacuum box — distributor
10 = Passenger compartment connection

13 00 054 ADJUSTING ENGINE IDLE SPEED / CO TEST

Requirements for Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
Engine in perfect running condition.
Air filter cartridge in perfect condition.
All extra equipment switched off.
BMW service test unit connected according to operating instructions.
Exhaust extraction system switched off for time of test.



Remove and install air cleaner 13 71 000.
Mount air cleaner simulator, Special Tools 13 1 042 and 13 1 080.



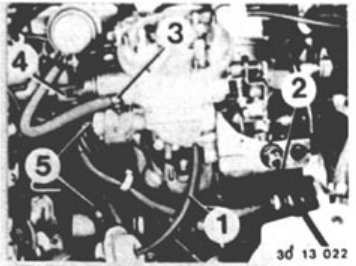
a) Idle Speed
Check engine idle speed*.
See "Troubleshooting" if nominal value is not reached.
Note:
There is no control screw for adjustment of the idle speed.
If customer desires, idle speed can be increased by connecting plug (1) on wire harness.



b) CO Test
Remove anti-tamper lock with Special Tool 13 1 011.
Adjust idle speed CO level* with screw located behind.
Replace anti-tamper lock after completing adjustments.

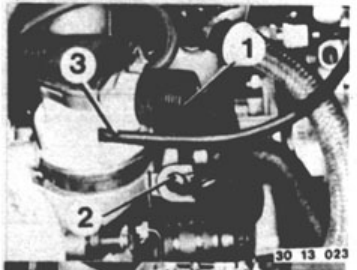
* See nominal value microfilm or Specifications

* See nominal value microfilm

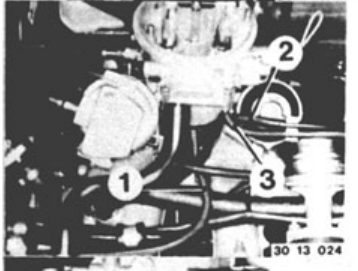


13 11 100 REMOVING AND INSTALLING CARBURETOR

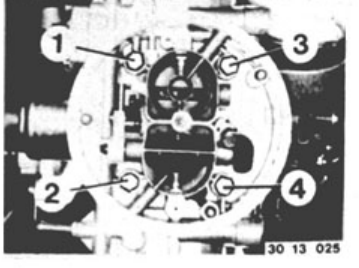
Remove and install air cleaner 13 71 000.
Pull off vacuum line (1).
Disconnect throttle cable (2).
See Groups 35, 24 and 65 for adjusting instructions.
Disconnect fuel line (3).
Pull off plugs (4 and 5).



Pull off plug (1).
Disconnect plug (2).
Pull off vacuum hose (3).
Make vacuum connections to hose routing plan on page 13 - 54.

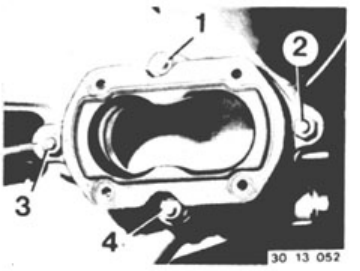


Pull off hoses (1 ... 3).
Make vacuum connections to hose routing plan on page 13 - 54.



Unscrew screws (1 ... 4).
Remove carburetor.
Installation:
Tightening torque*.
Check/adjust engine idle speed* and CO*.

* See Specifications



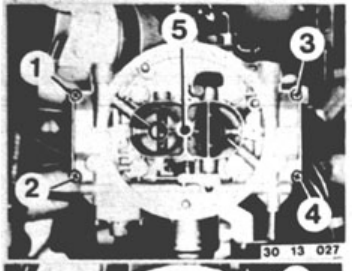
13 11 111 REPLACING INSULATING FLANGE FOR CARBURETOR

Remove and install carburetor 13 11 100.
Unscrew nuts (1 ... 4) and take off insulating flange.

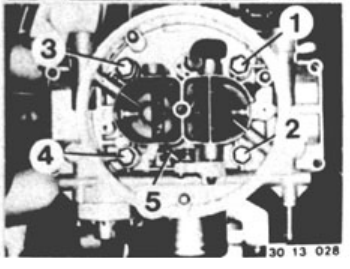


13 11 241 REPLACING FLOAT NEEDLE VALVE

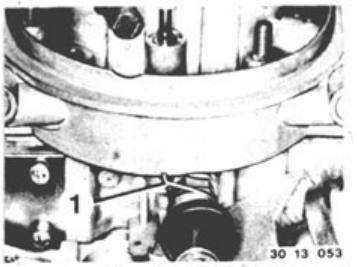
Remove and install air cleaner 13 71 000.
Disconnect fuel hose (1).



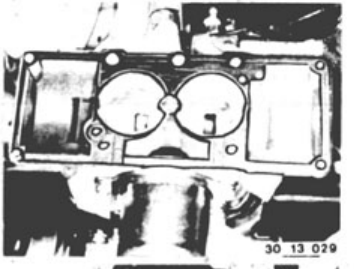
Unscrew screws (1 ... 4).
Unscrew screw (5).
Installation:
Tightening torque*.



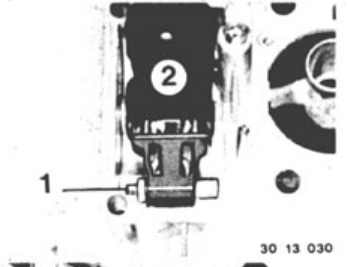
Unscrew screws (1 ... 4).
Disconnect connecting rod (5).
Installation:
Tightening torque*.



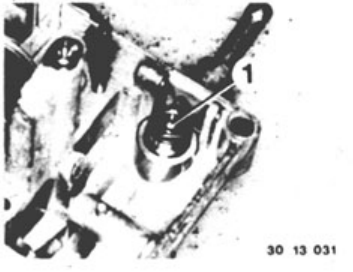
Remove carburetor cover and disconnect spring (1).
Connect spring with same preload (max. 1 turn) after finishing installation.



Installation:
Replace carburetor cover gasket.



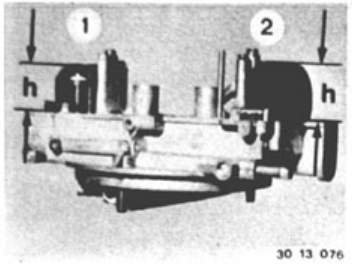
Pull out pin (1) and take off float (2).



Remove float needle valve (1).

* See Specifications

* See Specifications



30 13 076

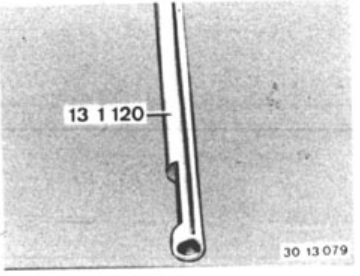
13 11 ... ADJUSTING (CHECKING) FLOAT LEVEL

Remove carburetor cover.
Check float level (h)* of float chambers I and II.
h = 27 to 29 mm (1.063 to 1.142") for float chamber stage I.
h = 29 to 31 mm (1.142 to 1.220") for float chamber stage II.
(The float needle valve must not spring in.)
If nominal value is not reached, check components and their installed position, replacing if necessary.
Check float weight* (5.9 to 6.5 grams), replacing if necessary.

* See Specifications

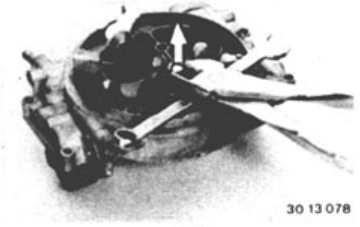
13 11 ... REPLACING IDLE SPEED CORRECTION JET

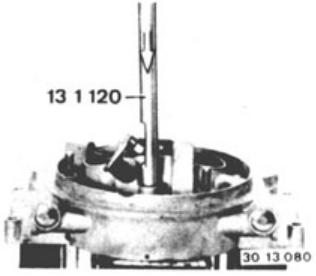
Remove carburetor cover (see "Replacing Float Needle").



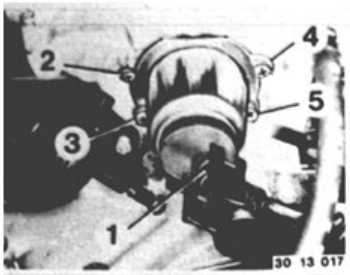
30 13 079

Place a flat iron bar or, for example, an open-ended wrench flat on the carburetor upper section, to avoid damaging the housing while pulling out the idle speed correction jet with a side snippers.
Never drive out the needle from underneath (carburetor would be damaged).
Drive in new idle speed air correction jet with Special Tool 13 1 120.
Check engine idle speed and CO level after assembling.


30 13 078

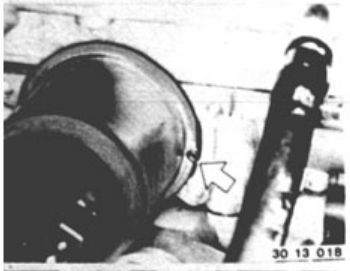


30 13 080

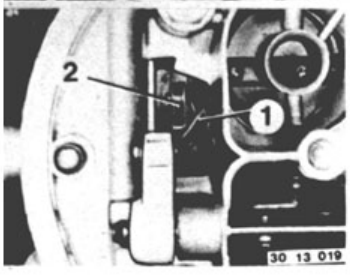


13 11 387 REPLACING INITIAL THROTTLE POSITIONER

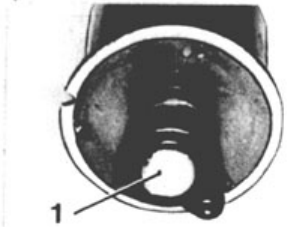
Remove and install air cleaner 13 71 000.
Pull off plug (1) on initial throttle positioner.
Unscrew screws (2 ... 5) and take off initial throttle positioner.



Installation:
Position of initial throttle positioner is given by shape.



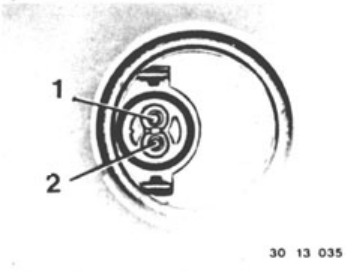
Installation:
Connect connecting rod (1) before tightening initial throttle positioner.
Check whether connecting rod (1) and lever (2) are positioned correctly.



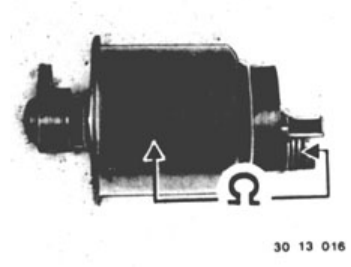
Checking Initial Throttle Positioner:
Check whether adjusting lever (1) moves easily and travels through complete angle range (320°).



Check movement of initial throttle positioner with initial throttle (1) and jet needle (2), repairing if movement is not easy.

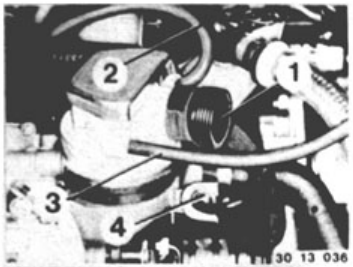


Electric Test:
Check resistance* between connections (1 and 2) with an ohmmeter.



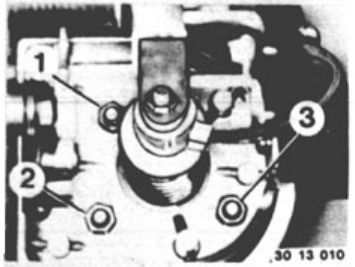
Insulating Resistance:
Check resistance* between housing and both plug connections.

* See Specifications

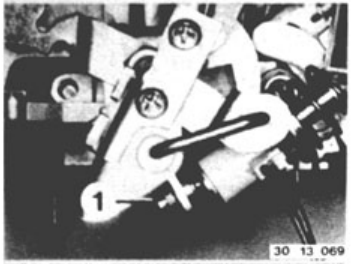


13 11 383 REPLACING / CHECKING THROTTLE POSITIONER

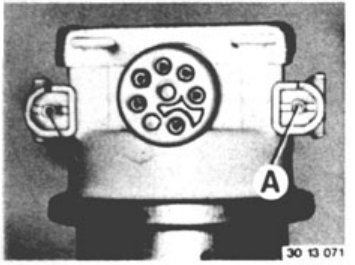
Remove and install air cleaner 13 71 000.
Pull off plug (1).
Pull off vacuum line (2/discharging) and vent line (3/charging).
Disconnect plug (4).



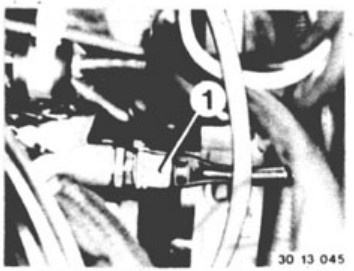
Unscrew nuts (1 ... 3) and take off throttle positioner.
Installation:
Make basic adjustment after finishing installation.



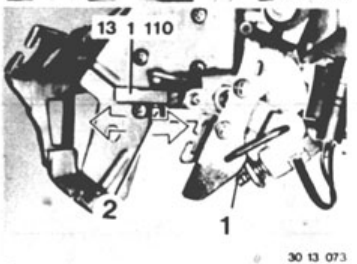
Throttle Positioner Basic Adjustment:
Screw a new adjusting screw (1) in lifting position.



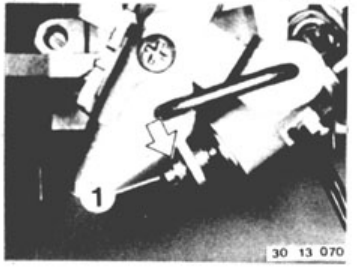
Apply vacuum of approx. 250 (at least 200) mbar on connection (A/discharging).
Vacuum must be held constant.



Pull off plug (1) on intake air pipe temperature sensor and install wire bridge in plug (1).
Turn on ignition.

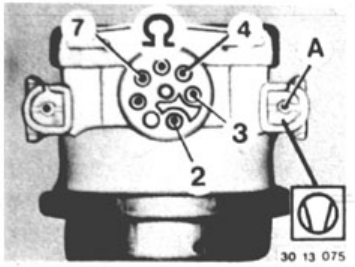


Screw in screw (1) so far until Special Tool 13 1 110 can be moved back and forth quickly between coasting stop (2) and throttle stop screw.
Throttle positioner should not operate when applying special tool.



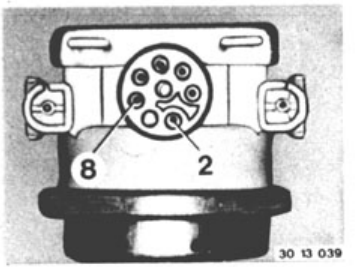
Cut off head of adjusting screw (1) after finishing adjustments.
Check/adjust engine idle speed* and CO*.

* See Specifications



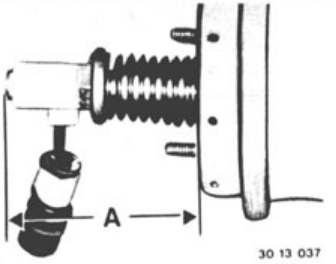
30 13 075

Checking Throttle Positioner
– Leak Test –
Apply voltage (B +) on plug socket (2).
Apply ground on plug socket (3).
Valve opens.
Connect vacuum on connection (A) (throttle positioner moves in) and keep discharging until ohmmeter displays a value between 500 and 700 ohms.
Remove ground from plug socket (3).
Valve closes.
Remove vacuum from connection (A).
Replace throttle positioner, if ohm value display changes by more than 200 ohms within 1 minute.



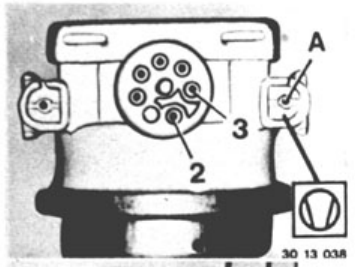
30 13 039

Apply voltage (B +) on plug socket (2).
Apply ground on plug socket (8).
Throttle positioner will be charged and moves out.
Max. moving out time: 1 second.



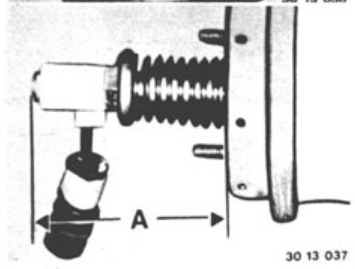
30 13 037

Check distance A = 69.5 ... 71.5 mm (2.736 ... 2.815") (with released idle speed switch).
Replace throttle positioner, if moving out distance (A) or moving out time is not correct.



30 13 038

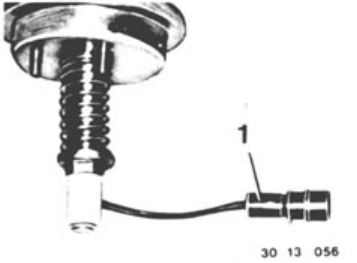
Checking Moving In Distance and Moving In Time:
Apply a constant vacuum of approx. 250 mbar on connection (A/discharging).
Apply voltage (B+) on plug socket (2).
Apply ground on plug socket (3).
Throttle positioner moves in quickly.
Max. moving in time: 1 second.
A check valve is located behind vacuum connection (A).
Check valve must keep fuel vapors away from the electric valve.



30 13 037

Remove voltage from throttle positioner.
Switch off vacuum pump.
Check distance A = 55.8 ... 59.1 mm (2.196 ... 2.327") (idle speed switch released).
Replace throttle positioner, if moving in time or distance (A) is not correct.

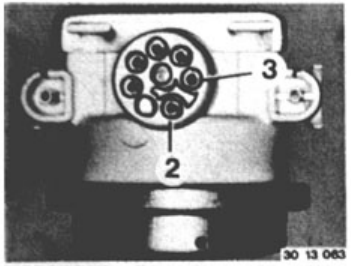
* See Specifications



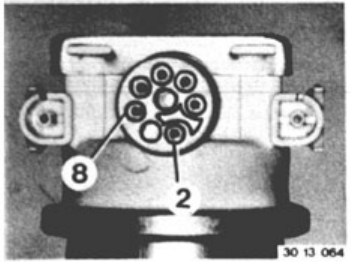
30 13 056

Check resistance* of idle speed switch between plug connections on plug (1).

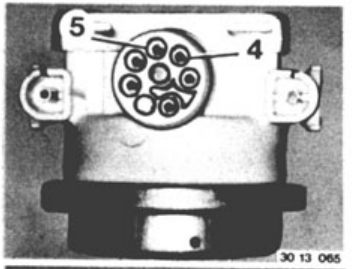
* See Specifications



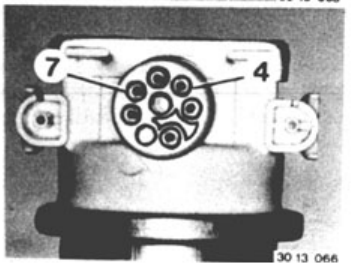
Checking Resistance of Valves
– Discharging Valve –
Check resistance* between plug connections (2 and 3).
Replace throttle positioner, if nominal value is not reached.



– Charging Valve –
Check resistance* between plug connections (2 and 8).
Replace throttle positioner, if nominal value is not reached.



Checking Potentiometer Resistance
– Total Resistance –
Check resistance* between plug connections (4 and 5).
Replace throttle positioner, if nominal value is not reached.

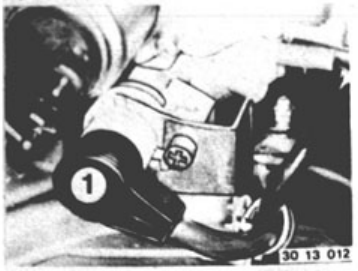


– Loop Resistance –
Check resistance* between plug connections (4 and 7).
Pull back throttle positioner slowly – resistance value should drop continuously.
Check resistance* between plug connections (4 and 7) in run in state.
Replace throttle positioner, if nominal values are not reached.

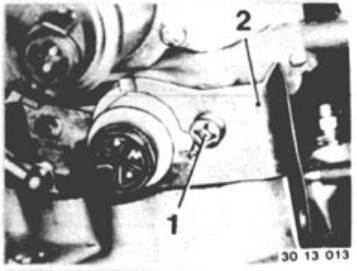
* See Specifications

* See Specifications

13 11 385 REPLACING / CHECKING THROTTLE POTENTIOMETER



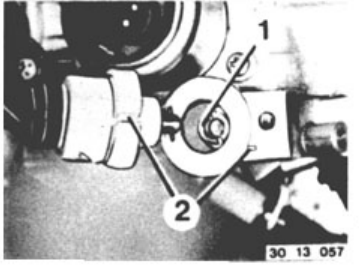
Pull off plug (1) on throttle potentiometer.



Unscrew bolt (1) and take off holder (2).
Remove throttle potentiometer.

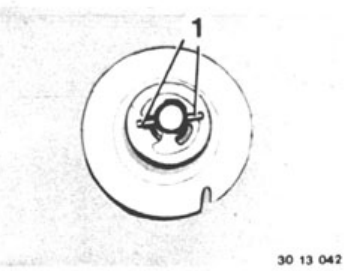


Check coupling (1) between throttle potentiometer and throttle shaft, replacing if necessary.

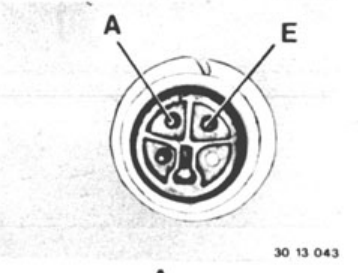


Installation:
Check for correct fit of coupling (1) and arresting slots (2).

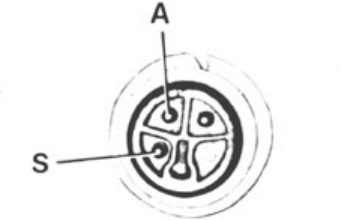
* See Specifications



Checking Throttle Potentiometer:
Check drag lever (1) for easy movement and full angular travel (approx. 90°).
Check spring force of return spring.

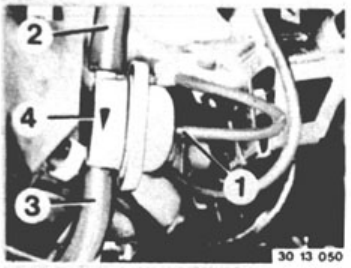


Electric Test:
– Total Resistance –
Check resistance* between plug sockets (E and A).
Replace throttle potentiometer, if nominal value is not reached.



– Loop Resistance –
Check resistance* between plug sockets (E and S) in coasting and full load positions while installed.

* See Specifications

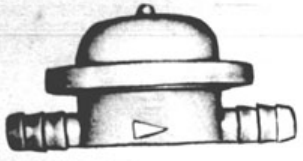


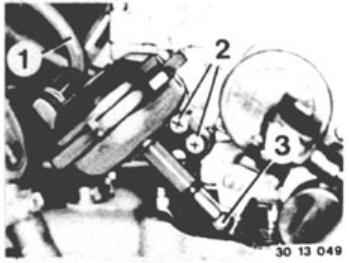
30 13 050

13 11 389 REPLACING / CHECKING COASTING AIR VALVE

Pull off vacuum control hose (1).
Pull off hoses (2 and 3).
Take off air valve (4).

Installation:
Check direction of flow (printed arrow).
Arrow must face toward the intake manifold.
Testing:
Coasting air valve installed.
Run engine.
Increase speed to about 3,000 rpm and shut the throttle valve quickly.
Coasting air valve must switch and open.


30 13 014

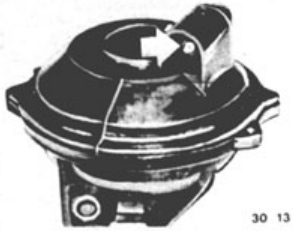


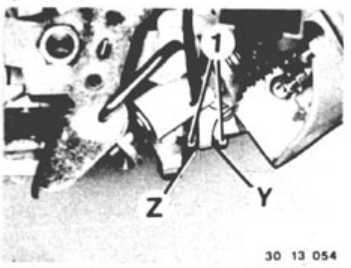
30 13 049

13 11 442 REMOVING AND INSTALLING VACUUM BOX FOR STAGE II

Pull off vacuum hose (1).
Unscrew screws (2).
Disconnect ball-head (3) and take off vacuum box.

Checking Vacuum Box:
Pull off hose on vacuum box.
Supply approx. 300 mbar vacuum to the vacuum box.
Replace vacuum box, if the vacuum drops.


30 13 055



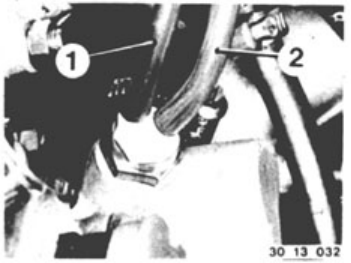
30 13 054

Checking/Adjusting Release and Return of Stage II:
Requirement: throttle valve drive in coasting position.
Vacuum box of stage II ventilated.
Throttle valve of stage II closed.
Adjust distances (Y and Z)* by bending fork (1).
Measure at tightest points.

Throttle Valve Drive Coasting Position:
Pinch the ventilating hose shut with Special Tool 13 3 010.
Start and stop engine again.
Throttle valve drive is in coasting position.


30 13 062

Checking Temperature Valve:
Supply vacuum to temperature valve.
Temperature $<45^{o}$ C (113° F) ⏀ valve closed.
Temperature $>61^{o}$ C (142° F) ⏀valve opened.
(Heat temperature valve to testing temperatures in a water bath.)
A restriction bore in the temperature valve opens a bypass even in closed state (slight leak air).



30 13 032

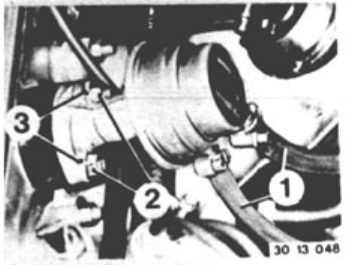
Removing and Installing Temperature Valve:
Disconnect vacuum hoses (1 and 2).
Unscrew and remove temperature valve.
Installation:
Tightening torque*.
See hose routing plan for vacuum connections.

* See Specifications



13 31 009 CHECKING FUEL PUMP PRESSURE AND FLOAT NEEDLE VALVE FOR LEAKS

Remove air cleaner – see 13 71 000.
Connect 10 bar (142 psi) pressure tester (BMW Service Tester) between fuel pump and carburetor.
Run engine at idle speed.
Check fuel pressure*.

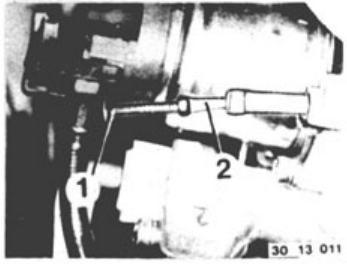


13 31 030 REPLACING FUEL PUMP

Remove air cleaner – see 13 71 000.
Unscrew fuel hoses (1).
Unscrew nuts (2).
Check insulators (3), replacing if necessary.

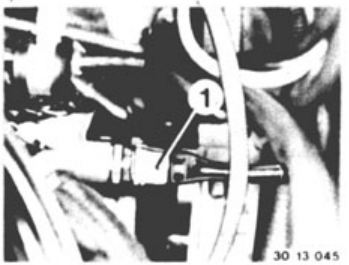


Fuel Filter Screen in Fuel Connection:
Remove air cleaner – see 13 71 000.
Loosen hose clamp and pull off fuel hose (1).



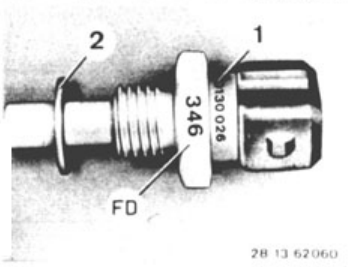
Pull out fuel filter screen with a M 3 screw.

* See Specifications

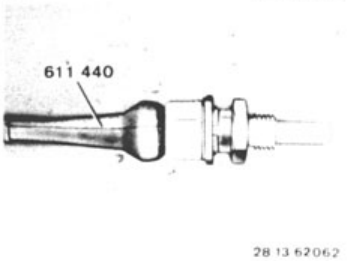


13 62 511 REPLACING / CHECKING INTAKE PIPE TEMPERATURE SENSOR

Pull off plug (1).
Unscrew temperature sensor.
Installation:
Tightening torque*.

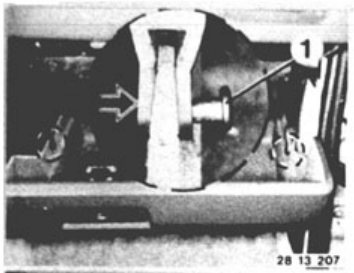


Installation:
Check seal (1), replacing if necessary.
Check code number (2)*.



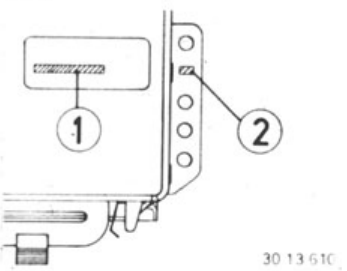
Checking Temperature Sensor:
Connect Jetronic test leads 61 1 440 on the temperature sensor.
Heat temperature sensor to testing temperature* in a water bath and check nominal values*.

* See Specifications

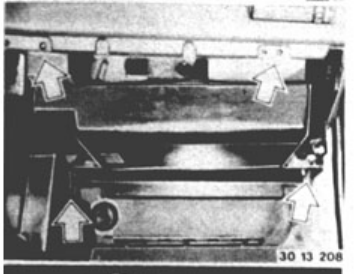


13 61 000 REPLACING CONTROL UNIT

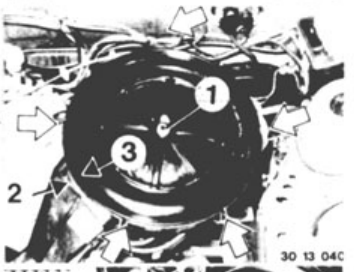
Disconnect battery on ground pole.
Open glove box.
Pull out pins (1) of both retaining straps.



Installation:
Check code number (1)* and manufacturing date (2)*.
Adjust engine idle speed* and CO level*.



Unscrew bolts and lay cover aside.

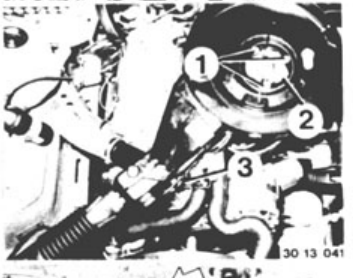


13 71 000 REMOVING AND INSTALLING AIR CLEANER

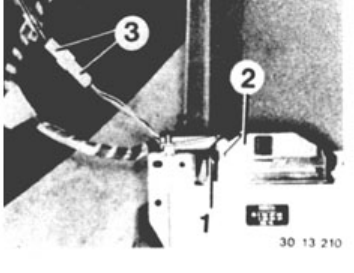
Unscrew nut (1).
Open clamps and take off cover.
Note:
Arrows (2 and 3) face each other.



Unscrew bolts.



Take out air filter cartridge.
Unscrew nuts (1) and take off retainer (2).
Unscrew nut (3).
Pull off hoses and take off air cleaner housing.
Installation:
See hose routing plan on page 13 - 54 for hose connections.



Push back retainer (1) and pull out multiple pin plug (2).
Installation:
Plugs (3) must be connected.
Check for correct connection of plugs (polarity).



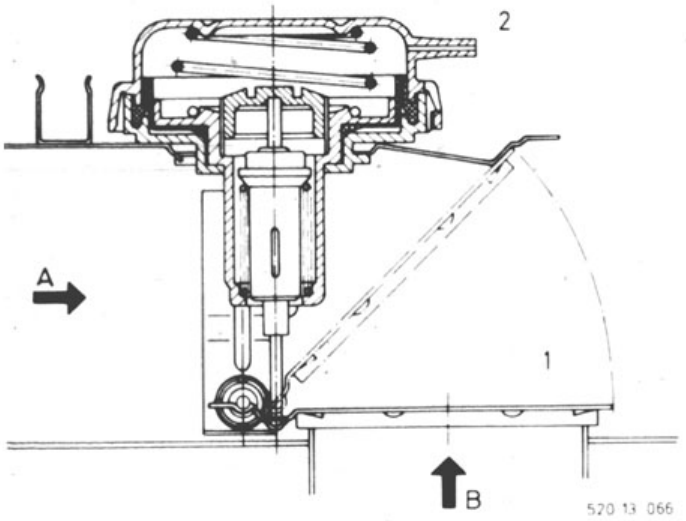
13 72 001 REMOVING AND INSTALLING AIR FILTER CARTRIDGE

See 13 71 000.

* See Specifications or Nominal Value Microfiche

13 73 004 CHECKING / ADJUSTING THROTTLE PLATE FOR WARM AIR REGULATION

1 = Air plate
2 = Vacuum connection
A = Cold air
B = Warm air



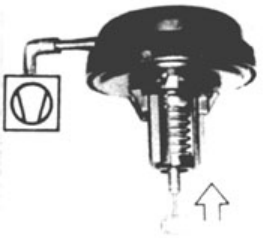
520 13 066

Function of Vacuum Box:
(without air flow and at ambient temperature of approx. + 5° C / 41° F)

Cold air closed as of vacuum of 140 ± 10 mbar.
Warm air closed as of vacuum of 70 ± 10 mbar.

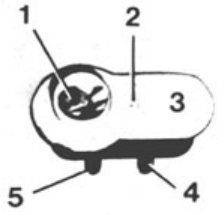
Function of Thermostats:
(with non-functioning vacuum box)

Cold air closed as of ambient temperature of – 20 to – 18° C (– 4 to 0° F).
Warm air closed as of ambient temperature of + 5 to + 3° C (+ 41 to + 37° F).



30 13 068

Checking Vacuum Box:
Supply approx. 300 mbar vacuum to the vacuum box.
The drive lever must move in completely and the vacuum must not drop.



30 13 058

The warm air bore must be closed by the air plate with the engine running and having operating temperature.
There is a fault in the temperature regulator (3), if this position is not reached.
Bores (1 and 2) must not be plugged (dirt).
Brass connection (4) for vacuum box.
Plastic connection (5) for intake pipe connection.

TROUBLESHOOTING FUEL SYSTEM 2 BE

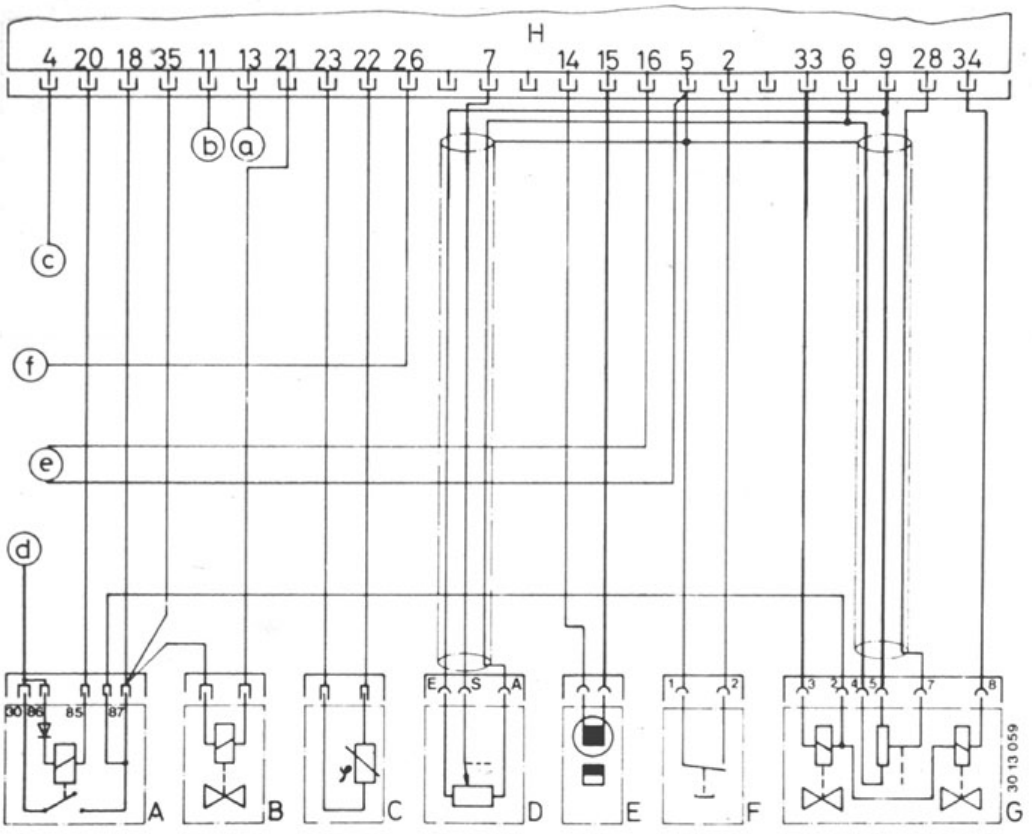
Control Unit No. 0 260 200 002

Testing Requirements:
Engine in perfect running condition (timing, compression, etc.).
Ignition in perfect condition (ignition timing, ignition system, spark plugs, etc.).
Starting in perfect condition (battery voltage, starter, leads, etc.).
Fuel in tank.

1) Engine does not start or hard to start (engine temperature ≤ 20° C/68° F)
2) Engine does not start or hard to start (engine temperature ≥ 60° C/140° F)
3) Engine starts but stops again
4) Unsmooth idling during warm-up phase
5) Idle speed not correct
6) Acceleration hesitation
7) Constant speed hesitation
8) Driving behavior in coast
9) Poor engine pickup
10) Fuel consumption too high
11) Emissions too high at idle speed (CO/HC)
12) Emissions too low at idle speed (CO/HC)
13) Power output insufficient
14) Cold idle speed too high/too low
15) Carburetor floods

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			
X	X																			1	Operating error/driving error	Service explanation
X	X			X	X	X	X	X	X	X	X	X	X	X						2	Carburetor dirty	Clean carburetor
												X								3	Carburetor iced up	13 73 004
X	X					X		X				X								4	Fuel pressure	13 31 009
			X	X	X	X	X			X	X		X	X						5	Fuel shutoff valve stage II	
X	X		X		X	X			X			X		X						6	Fuel grade	Owner's Manual
X	X				X			X				X								7	Fuel filter dirty	
			X	X	X			X	X	X	X	X	X	X						8	Idle speed/CO level adjustments	13 00 054
X	X																			9	Idle speed air correction needle sticks (repair)	
X	X		X	X					X					X						10	Initial throttle positioner – plate	13-83/13 11 307
X				X				X	X			X	X	X						11	Temperature sensor - intake pipe	13-87/13 62 511
					X			X				X								12	Basic setting of throttle stage II	
					X			X				X								13	Vacuum box stage II with temp. valve	13 11 442
X				X			X		X				X							14	Throttle valve positioner	13-84/13 11 583
			X	X			X	X	X				X							15	Idle speed switch	13 - 195
X	X		X	X	X			X	X	X	X	X	X							16	Control unit	13-82/13 61 000
X	X		X	X	X			X	X	X	X	X	X							17	Wire harness	Periphery test
X							X	X	X	X	X	X	X							18	Throttle potentiometer	13-86/13 11 385
X	X	X		X				X	X	X	X	X	X							19	Air cleaner	
X	X	X	X	X			X	X			X	X	X							20	Coasting air valve	13 11 389
								X	X			X								21	Exhaust system	
																				22	Engine breathing	
			X	X		X		X			X	X	X							23	Intake system	
								X		X	X	X		X						24	Fuel float defective, level wrong	
X														X						25	Float needle valve leaks	13 11 241
				X			X													26	Throttle cable adjustment/automatics see Gr. 24/35	
		X	X	X		X		X	X	X	X	X	X							27	Jets	Specifications
				X		X	X	X			X	X	X							28	Throttle valve shafts worn (replace)	
			X	X		X	X					X	X							29	Basic adjustment of throttle valve positioner	
																				30		

2 BE SYSTEM WIRING DIAGRAM



A = Relay
B = Ignition control relay
C = Intake pipe temp. sensor
D = Throttle potentiometer
E = Throttling orifice
F = Idle speed switch
G = Throttle positioner
H = Control unit
a = Idle nominal speed booster (wired to ground)
b = Fuel economy control
c = Terminal 15
d = Voltage B +
e = Ground B –
f = Ignition control unit term. TD
g = Charging solenoid valve
h = Discharging solenoid valve

13 60 020 FUNCTION CHECK FOR 2 BE CARBURETOR (PERIPHERY TEST)

A periphery test for 2 BE systems is given on the following pages.
All measurements are made with test adapter 12 5 460.
Caution!
Do not check with test clips direct on wire harness plug – danger of damaging plug sockets.
Specified nominal values are in reference to testing with BMW service test unit and digital tester II.

Checking ground and voltage supply of control unit.

Connect test adapter on wire harness.
Connect ohmmeter between term. 5 or 16 and vehicle ground.
Ohmmeter must display approx. 0 ohm.
Ohmmeter displaying approx. 0 ohm?

no → Check and repair wires and wire connections.

yes ↓

Connect voltmeter between terminals 5 and 4.
Voltmeter must display battery voltage as from "ignition turned on".
Voltmeter displaying battery voltage?

no → Check and repair wires and wire connections of 3-pin wire harness branch.

yes ↓

Turn off ignition.
Bridge terminals 16 and 20 with piece of wire.
Is there battery voltage between 5 and 18 or 5 and 35?

no → Check and repair wires and wire connections.
Are wires and wire connections okay?

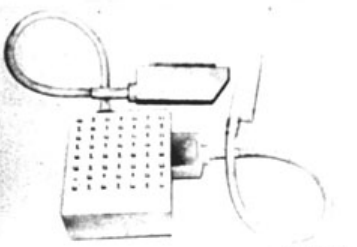
yes → Replace relay.

yes ↓

(Terminals 16 and 20 bridged.)
Is there battery voltage between terminals 33 or 34 and 5?

no → Check and repair wires and wire connections.
Are wires and wire connections okay?

yes → Check throttle positioner.



13 63 007

Checking compensating flap actuator.

→ Connect test adapter on wire harness. Connect ohmmeter between terminals 14 and 15. Ohmmeter displaying nominal value*?

— no → Check and repair wires and wire connections. Are wires and wire connections okay?

— yes → Replace compensating flap actuator.

Compensating Flap Actuator Nominal Values:
0.9 ... (1.3) ... 1.7 ohms

Checking idle speed switch.

→ Connect test adapter on wire harness. Connect ohmmeter between terminals 2 and 5. Ohmmeter displaying nominal value*? (Idle speed switch pressed/accelerator pedal in idle position.)

— no → Check and repair wires and wire connections. Are wires and wire connections okay?

— yes → Replace throttle positioner (idle speed switch).

yes

↓

Operate accelerator pedal (lever lifts off of idle speed switch). Ohmmeter displaying nominal value*? (Idle speed switch released.)

— no → Check and repair wires and wire connections. Are wires and wire connections okay?

— yes → Replace throttle positioner (idle speed switch).

Idle Speed Switch Nominal Values:
Pressed = ∞ ohms
Released = approx. 0 ohm

* Also refer to Specifications

Checking throttle positioner. Potentiometer.

→ Connect test adapter on wire harness.
Pull off plug on throttle potentiometer.
Connect ohmmeter between terminals 6 and 9.
Ohmmeter displaying nominal value*?

no → Check and repair wires and wire connections.
Are wires and wire connections okay?

yes → Replace throttle positioner.

yes ↓

Throttle positioner run out fully (shutting off function).
Connect ohmmeter between terminals 6 and 28.
Ohmmeter displaying nominal value*?

no → Check and repair wires and wire connections.
Are wires and wire connections okay?

yes → Replace throttle positioner.

yes ↓

Throttle positioner in coasting position.
Install wire bridge between 16 and 20.
Install wire bridge between 5 and 33.
Apply approx. 250 (at least 200) mbar vacuum on discharging connection of throttle positioner – throttle positioner runs in.
Connect ohmmeter between terminals 6 and 28.
Ohmmeter displaying nominal value*?
Remove wire bridges.
Connect plug on throttle potentiometer.

no → Check and repair wires and wire connections.
Are wires and wire connections okay?

yes → Replace throttle positioner.

Potentiometer Nominal Values:

Term. Contr. Unit	Term. Thr. Pos.	Coasting Position	Starting Position
6 ... 9	4 ... 5	1400 ... (2000) ... 2600 ohms	
6 ... 28	4 ... 7	0 ... 500 ohms	900 ... 1900 ohms

* See Specifications

Checking throttle positioner. Solenoid valves.

→ Connect test adapter on wire harness.
– Discharging Valve –
Connect ohmmeter between terminals 18 or 35 and 33.
Ohmmeter displaying nominal value*?

no → Check and repair wires and wire connections.
Are wires and wire connections okay?

yes → Replace throttle positioner.

yes

– Charging Valve –
Connect ohmmeter between terminals 18 or 35 and 34.
Ohmmeter displaying nominal value*?

no → Check and repair wires and wire connections.

yes → Replace throttle positioner.

Throttle Positioner Nominal Values:
Solenoid Valves

Terminals Control Unit	Terminals Throttle Positioner	
18/35 ... 33	3 ... 2	35 ... (52.5) ... 80 ohms
18/35 ... 34	8 ... 2	35 ... (52.5) ... 80 ohms

* See Specifications

Checking throttle potentiometer.

Connect test adapter on wire harness.
Pull off plug on throttle positioner.
Connect ohmmeter between terminals 6 and 9.
Ohmmeter displaying nominal value*?
Connect plug on throttle positioner.

no → **Check and repair wires and wire connections.** Are wires and wire connections okay?

yes → **Replace throttle potentiometer.**

yes

Throttle in coasting position.
Install wire bridge between 16 and 20.
Install wire bridge between 5 and 33.
Apply approx. 250 (at least 200) mbar vacuum on discharging connection (vacuum line to carburetor) of throttle positioner – throttle positioner moves in.
Pull off plug on throttle positioner.
Connect ohmmeter between terminals 6 and 7.
Ohmmeter displaying nominal value*?

no → **Check wires and wire connections, or repair.** Are wires and wire connections okay?

yes → **Replace throttle potentiometer.**

yes

Accelerator pedal in full throttle position (for cars with autom. transm. past kickdown point).
Connect ohmmeter between terminals 6 and 7.
Ohmmeter displaying nominal value*?
Connect plug on throttle positioner.
Remove wire bridges.
Disconnect vacuum pump.

no → **Check and repair wires and wire connections.** Are wires and wire connections okay?

yes → **Replace throttle potentiometer.**

Throttle Potentiometer Nominal Values:

Term.	or	Coasting Pos.	Full Thr. Pos.
6 — 9	E — A	1400 — (2000) — 2600 ohms	
6 — 7	A — S	0 — 250 ohms	1300 — 2500 ohms

* See Specifications

Checking ignition control valve. Ignition switching.

→ Connect test adapter on wire harness. Connect ohmmeter between terminals 35 or 18 and 21. Ohmmeter displaying nominal value*?

— no → Check and repair wire and wire connections. Are wires and wire connections okay?

— yes → Replace ignition control relay.

yes ↓

Ignition control still malfunctioning:
- Check idle speed switch
- Check intake pipe temperature sensor
- Check control unit
- Check vacuum lines

Ignition Control Relay Nominal Values:
20 — (31.5) — 50 ohms

Checking intake pipe temperature sensor.

→ Connect test adapter on wire harness. Connect ohmmeter between terminals 22 and 23. Ohmmeter displaying nominal value*?

— no → Check code number* (0 280 130 026). Check and repair wires and wire connections. Are wires and wire connections okay?

— yes → Replace intake pipe temperature sensor.

Intake Pipe Temperature Sensor Nominal Values:

°C (°F) : 1 (2)	= k-ohms
– 10 (+ 14)	= 8.2 — 10.5
+ 20 (+ 68)	= 2.2 — 2.7
+ 80 (+ 176)	= 0.3 — 0.36

* See Specifications

Construction group 13 Fuel system

M40 Engine – Models:
318i Cat. Conv. / Cat. Conv. Provisions and 316i since 9/88

13 00 060	Engine idle speed and CO level – check (cat. conv.)	13-	90
060	Engine idle speed and CO level – check (cat. conv. provisions)	13-	91
13 31 029	Fuel delivery pressure – check	13-	92
. . .	Fuel delivery rate – check	13-	92
030	Fuel pump – remove and install	13-	93
13 32 051	Fuel filter – remove and install	13-	94
13 41 000	Idle control valve – remove and install	13-	95
13 51 200	Fuel pressure regulator – remove and install	13-	96
. . .	Fuel pressure regulator (fuel injection pressure) – check	13-	96
13 54 030	Throttle valve neck – remove and install	13-	97
13 63 544	Throttle valve switch – adjust	13-	98
551	Throttle valve switch – remove and install	13-	98
13 64 501	Fuel injector – remove and install	13-	99
	Fuel injection system – troubleshoot	13-	900
	Pin allocation DME control unit	13-	930



13 00 060 CHECKING ENGINE IDLE SPEED AND CO LEVEL

M 40
Engines with M 1.3 Motronic

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temp. at least 60° C (140° F).
Engine and ignition in perfect running condition.
Connect BMW Service Tester to operating instructions.
A routine check is not necessary.
Put in number of cylinders (4) for idle speed engine test step no. 5.

1) Engine Idle Speed
Check engine idle speed**.
See BMW diagnosing system, if nominal value is not reached.
Check intake system for leaks.

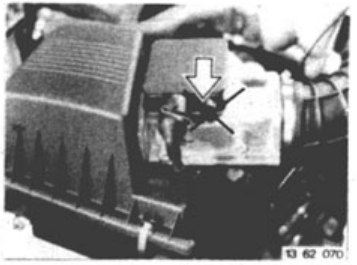
Note:
There is no adjusting screw for idle speed regulation.
Clicking of the idle control valve must be heard and felt when turning on the ignition.



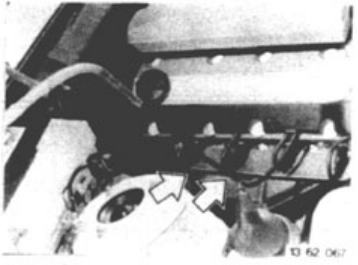


2) Emission Test
Disconnect oxygen sensor plug (not in cars with cat. conv. provisions).
Unscrew bolts.
Connect Special Tools 13 0 090 and 13 0 100 on the exhaust manifold.
Check the idle speed CO level**.
Switch off exhaust extraction for time of testing.
CO Level Too High:
Check fuel injectors, fuel pressure and coolant temperature sensor.
CO Level Too Low:
Check hoses and connections for idle speed control or find air leak points.

** See Nominal Value Microfiche



Important!
Adjustments may not be made on the air flow sensor adjusting screw, since this adjustment is the basis for oxygen sensor or idle speed drive control.



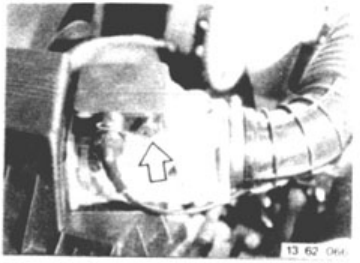
Checking Function of Oxygen Sensor (11 78 010):
Unscrew bolt (1).
Connect Special Tools 13 0 090 and 13 0 100 on the exhaust manifold.
Switch off exhaust extraction for time of emission testing.
Disconnect oxygen sensor plug.
Clamp the vacuum hose (not while engine is running).
Start the engine - CO level rises.
Connect oxygen sensor plug - CO level should go back to the nominal value.
Remove clamp.



13 00 060 CHECKING ENGINE IDLE SPEED AND CO LEVEL (Cars with Provisions for Cat. Conv. Opration)

M 40
Engines with M 1.3 Motronic

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temp. at least 60° C (140° F).
Engine and ignition in perfect running condition.
Connect BMW Service Tester to operating instructions.
Put in number of cylinders (4) for idle speed engine test step no. 5.
A routine check is not necessary.



If the nominal value is not reached, first check whether there are faults in the engine, ignition or fuel injection systems before correcting the CO level.

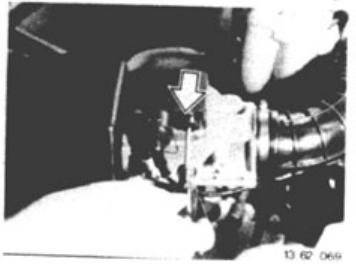
CO Level Too High:
Check
- fuel injectors,
- fuel pressure and
- coolant temperature sensor.

CO Level Too Low:
Check hoses and connections for idle speed regulation and find air leak points.
Also refer to BMW diagnosing system.

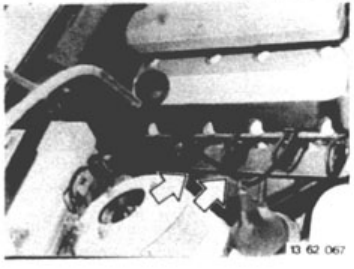


1) Engine Idle Speed
Check engine idle speed**.
See BMW diagnosing syste, if the nominal value is not reached.
Check intake system for leaks.

Note:
There is no adjusting screw for idle speed regulation.
Clicking of the idle control valve must be heard and felt while turning on the ignition.



Remove cap with Special Tool 13 1 011.
Adjust CO level** with a screwdriver applied on the adjusting screw in the air flow sensor.



2) Emission Test
Unscrew bolts.
Connect Special Tool 13 0 100 in tailpipe or on exhaust manifold.
Chec the idle speed CO level**.
Switch off exhaust extraction for time of testing.
If the nominal value is not reached, the CO level** of cyl. 1 and 2 or cyl. 3 and 4 can also be tested separately for troubleshooting.

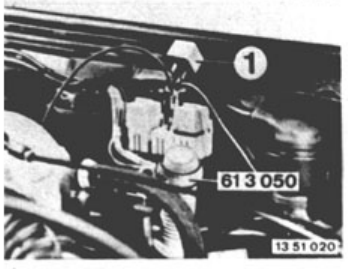
** See Nominal Value Microfiche

** See Nominal Value Microfiche

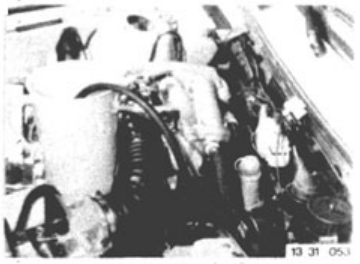


13 31 029 CHECKING FUEL DELIVERY PRESSURE

M 40:
Install pressure tester 13 3 060 with connecting hose and t-adapter 13 3 064 in the fuel feed hose – in front of the fuel pressure regulator.
Shut the fuel return hose with Special Tool 13 3 010.

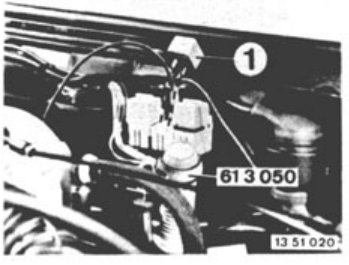


Pull off fuel pump relay (1).
Bridge terminals 87b and 30 with Special Tool 61 3 050.
Check delivery pressure*.



13 31 ... CHECKING FUEL DELIVERY RATE

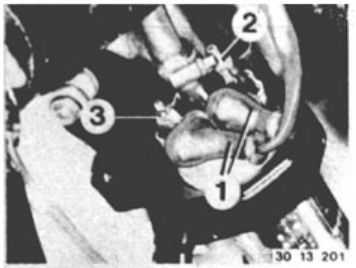
M 40:
Disconnect fuel return hose, install an extension hose and hold end of hose in measuring glass 13 3 020.



Pull off fuel pump relay (1).
Bridge terminals 87 and 30 with Special Tool 61 3 050.
Check delivery rate*.

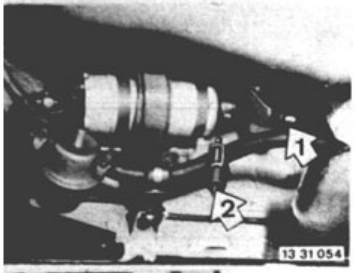
* See Specifications of Gr. 16

* See Specifications of Gr. 16



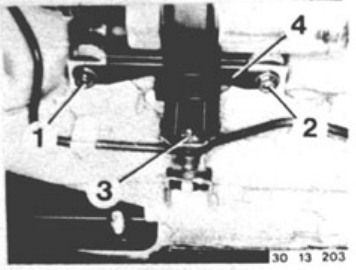
13 31 030 REMOVING AND INSTALLING FUEL PUMP

M 40:
Push back caps (1).
Unscrew nuts (2 and 3) and take off electric leads.



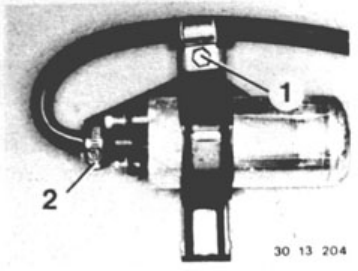
Clamp suction hose (1) and pressure hose (2) with Special Tool 13 3 010.
Loosen hose clamp (3) and pull off hoses.

Note:
Never use squeeze-hose clamps for installation of the pressure hose.

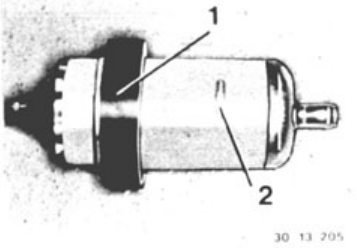


Unscrew nuts (1 ... 3) and take off holder (4).
Take off fuel pump with holder.

Installation:
Check rubber mounts, replacing if necessary.



Unscrew bolt (1).
Loosen hose clamp (2) and pull off fuel hose.
Take fuel pump off of holder.

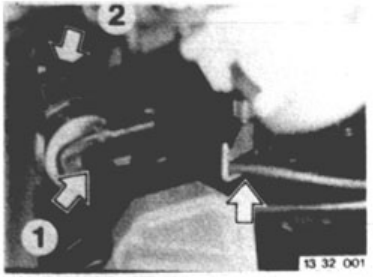


Pull off rubber ring (1).

Installation:
Check code number (2)*.

Intank fuel pump since 3/88 or 1989 models – see Group 16 in Model Repair Manual.

*** See Specifications**

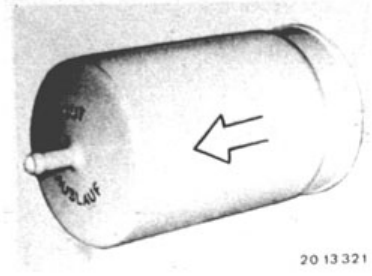


13 32 051 REMOVING AND INSTALLING FUEL FILTER

E 30 / M 40:
Pinch fuel feed hose shut in front of and behind the filter with Special Tool 13 3 010.
Unscrew bolts.
Loosen hose clamps (1 and 2).

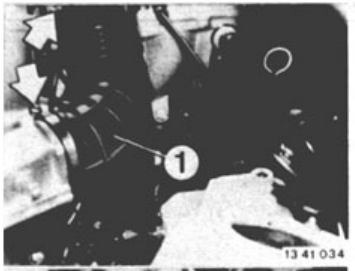


Pull off fuel hoses.
Remove fuel filter.

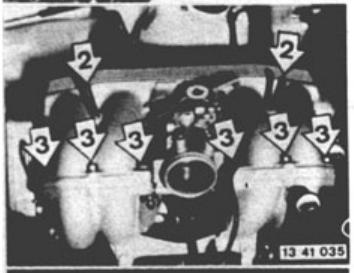


Installation:
Check direction of flow (arrow).

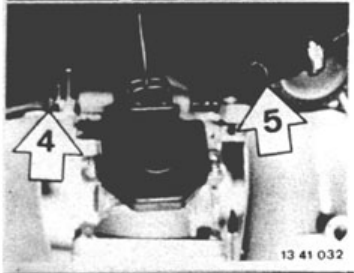
13 41 000 REMOVING AND INSTALLING IDLE SPEED CONTROL VALVE



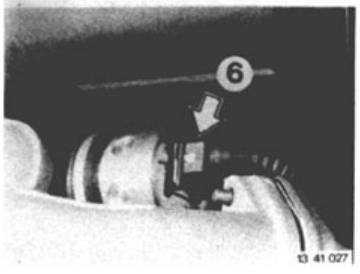
M 40:
Pull off hose (1).



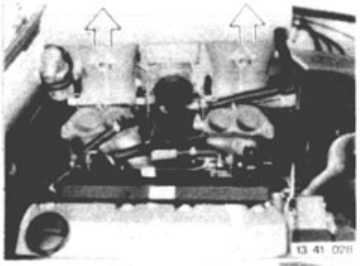
Unscrew bolts (2).
Unscrew nuts (3).



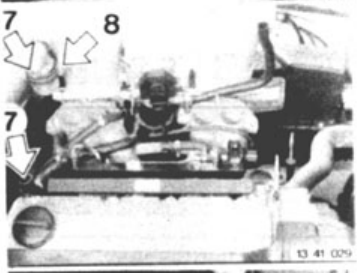
Disconnect hoses (4 and 5).



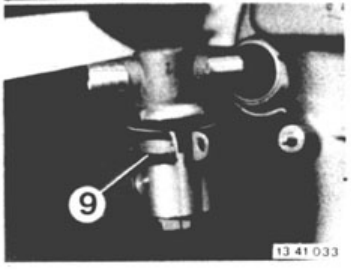
Pull off plug (6).



Pull out and fold up upper section of the intake manifold.
Installation:
Replace gasket.



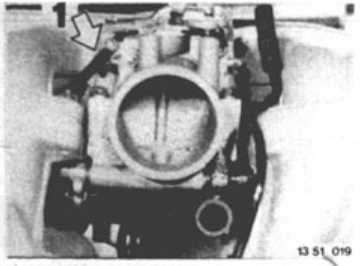
Disconnect hose (7).
Unscrew bolt (8).



Remove idle speed control valve.
Installation:
Check code number (9).
Check idle speed**.

Checking:
The clicking of the idle speed control valve must be heard and felt when turning on the ignition.
Check electric connections – see BMW self-diagnosis.

** See Nominal Value Microfiche

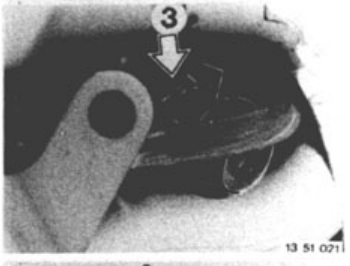


13 51 200 REMOVING AND INSTALLING FUEL PRESSURE REGULATOR

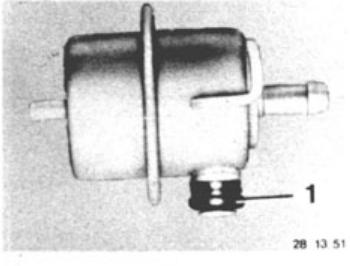
M 40:
Pull off vacuum hose (1).



Unscrew bolts (2).
Pull out and turn fuel pressure regulator.



Disconnect fuel hose (3).
Take off fuel pressure regulator.

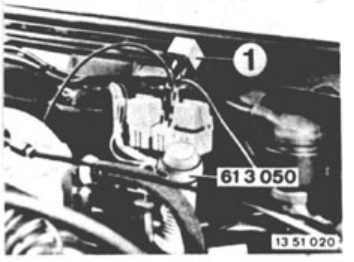


Installation:
Check seal (1), replacing if necessary.
Check code number and manufacturing date.

* See Specifications

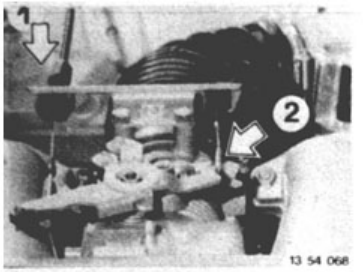


Checking:
Install pressure tester 13 3 060 with connecting hose and t-adapter 13 3 064 in the fuel feed hose – in front of the fuel pressure regulator.



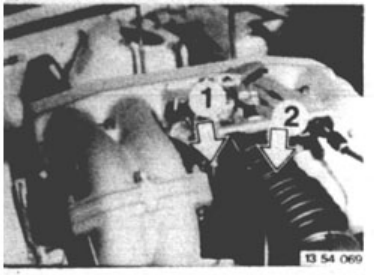
Pull off fuel pump relay (1).
Bridge terminals 87b and 30 with Special Tool 61 3 050.
Read fuel ejection pressure*.

* See Specifications or Nominal Value Microfiche

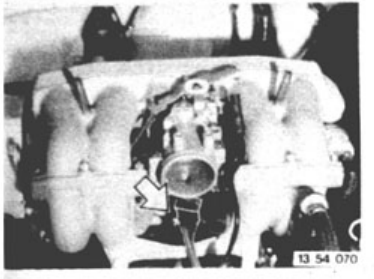


13 54 030 REMOVING AND INSTALLING THROTTLE VALVE NECKS

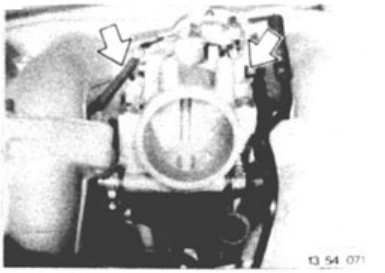
Pull off plastic cap.
Disconnect cables (1 and 2).
1 = For cruise control drive motor
2 = For accelerator pedal



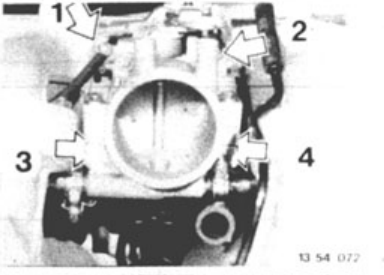
Loosen hose clamp (1) and remove hose (2).



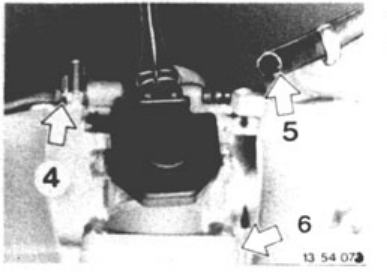
Pull off plug (3) on throttle valve switch.



Pull off vacuum hoses.



Unscrew bolts (1 ... 4).
Take off throttle valve neck.



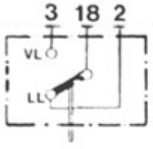
Installation:
Replace gasket (5).
Disconnect hoses (4 and 5).



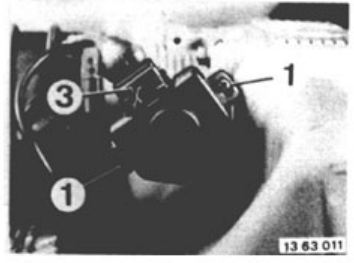
13 63 544 CHECKING / ADJUSTING THROTTLE VALVE SWITCH

Checking Throttle Valve Switch:
There should be approximately 0 ohm between connections 2 and 18 with the throttle valve closed.
There should be approximately 0 ohm between connections 3 and 18 with the throttle valve wide open.
LL = Idle speed
VL = Full load

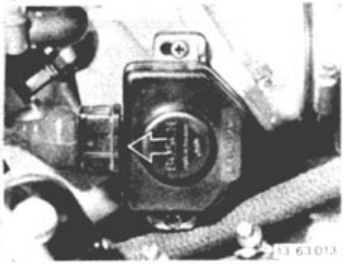
Schaltbild



Wiring diagram drawn with throttle valve in idle speed position.



Adjusting:
Remove throttle valve necks – see 13 54 030.
There must be approximately 0 ohm between connections 2 and 18 with the throttle valve closed.
Adjust by loosening bolts (1) and turning the throttle valve switch.
Open throttle valve after finishing adjustment – resistance should rise immediately to infinite ohms.
Resistance should drop back to approximately 0 ohm when releasing the throttle valve.



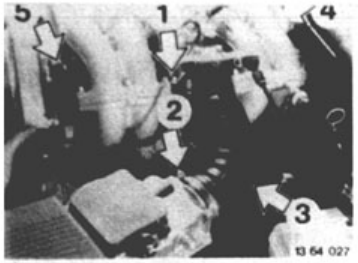
13 63 551 REMOVING AND INSTALLING THROTTLE VALVE SWITCH

Pull off multiple-pin plug (3).



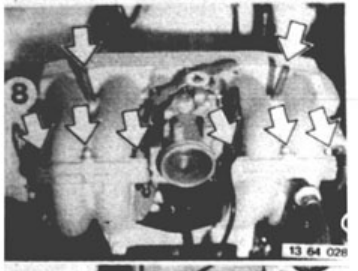
Remove throttle valve necks – see 13 54 030.
Unscrew bolts (1).
Take off throttle valve switch (2).

Installation:
Check code number (1)*.
Adjust throttle valve switch – see 13 63 544.

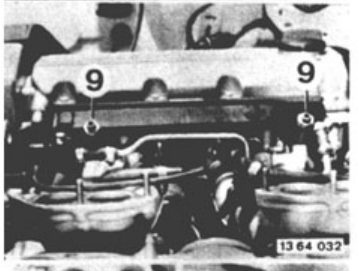


13 64 501 REPLACING ONE FUEL INJECTOR

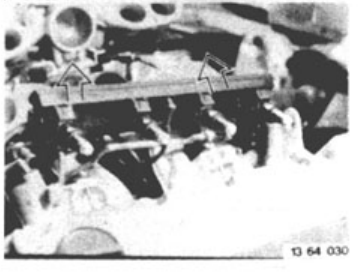
Pull off plastic cap.
Loosen hose clamps (1 and 2).
Pull off hose (3).
Remove hoses (4 and 5).



Unscrew bolts.
Unscrew nuts (8).



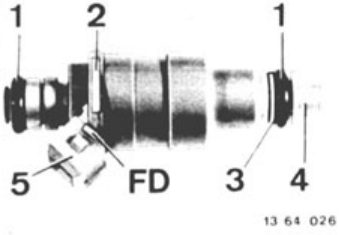
Pull out and fold up upper section of intake manifold.
Unscrew bolts (9).



Push up injection pipe (10) until fuel injectors are lifted out of the guide in the intake manifold.



Lift out circlip (2) and pull off fuel injector.



Installation:
Check O-ring (1), replacing if necessary.
Check code number (2)*.
Fd = Manufacturing date.
Check position of plastic washer (3).
Check color* of plug receptacle (5) or injector guard (4).
Only coat O-rings for installation with vaseline or SAE 90 gear lube.

* See Specifications

1) Cold engine does not start (oil temp. ≤ 20° C / 68° F)
2) Engine starts, but stops again
3) Cold engine hard to start (oil temp. ≤ 20° C / 68° F)
4) Warm engine does not start (oil temp. ≥ 60° C / 140° F)
5) Warm engine hard to start (oil temp. ≥ 60° C / 140° F)
6) Erratic idling during warm-up phase
7) Idle speed not correct
8) Splashing in intake
9) Hesitation while accelerating
10) Knocking while accelerating
11) Hesitation while coasting
12) Misfiring at constant engine speed
13) Poor acceleration/final power output
14) Fuel consumption too high
15) CO/HC values not correct

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		Test Position	Job No.	Page
X			X	X				X				X	X	X						1	Fuel (injection) pressure	13 51 200	
		X		X				X				X								2	Fuel (pump) pressure	13 31 029	
		X		X								X		X						3	Fuel pressure regulator	13 51 200	
																				4			
																				5			
X	X		X	X			X	X		X	X	X	X	X						6	Fuel injectors	13 64 501	
X		X											X	X						7	Cold start valve	13 64 030	
	X																			8	Throttle bypass valve	13 63 060	
		X											X							9	Temperature time switch	13 62 050	
					X							X	X							10	Coolant temperature sensor	13 62 531	
																				11			
													X							12	Throttle switch	13 63 544	
												X								13	Throttle potentiometer	13 63 544	
					X	X				X										14	Throttle housing	13 54 051	
		X		X																15	Throttle positioner	13 54 130	
X	X		X						X	X		X	X							16	Control unit (DME or L-Jetronic)	13 61 000	
X			X									X	X							17	Air flow sensor	13 62 000	
																				18			
																				19			
						X														20	Temperature switch (idle control)		13 - 800
						X														21	Idle control valve – pneumatic	13 41 000	13 - 800
						X														22	*Idle control valve – electric	13 41 000	13 - 800
						X														23	Control unit (idle control)	13 41 010	13 - 800
												X								24	Speed switch	13 63 015	
												X								25	Safety switch	13 63 012	
												X	X							26	Partial load switch	13 63 010	
						X				X										27	3/2 way valve – coasting shutoff	11 72 020	13 - 720
X			X																	28	Fuel pump relay / master relay		
								X				X		X						29	Oxygen sensor	Gr. 11	
																				30			

TROUBLESHOOTING FUEL INJECTION

– See application information on next page. –

Test Requirements:

Engine in perfect running condition (timing, compression, oil carbon deposits, etc.).

Starting system in perfect condition (battery voltage, starter, ignition lock, etc.).

Correct fuel in tank (octane rating, lead/leadless, dirt, etc.).

Connections and plugs okay according to wiring diagram.

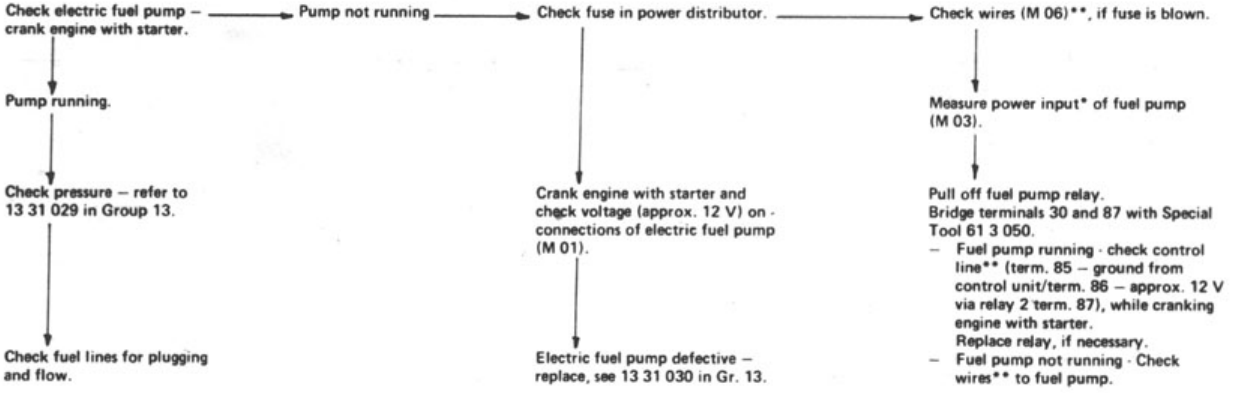
See Troubleshooting DME in Gr. 12 for other test positions.

TEST POSITIONS FOR FUEL INJECTION TROUBLESHOOTING CHART

Note:
Test points have been compiled on the basis of greatest probability, however, under certain circumstances other tests could also be necessary.

Testing instructions refer to the "BMW SERVICE TEST", e.g. engine test step 05 (P 05) or multimeter function (M).
Refer to "BMW service tester operating instructions" for connections.

Note:
Tests 1, 2 and 3 – FUEL PRESSURE
a) No Pressure



* See Specifications
** See Wiring Diagram

b) FUEL PRESSURE Too High

Vacuum hose to or on pressure regulator leaking or bent. → Check fuel return line – routing, flow. → Pressure regulator defective – replace, see 13 51 200 in Group 13.

c) FUEL PRESSURE Too Low

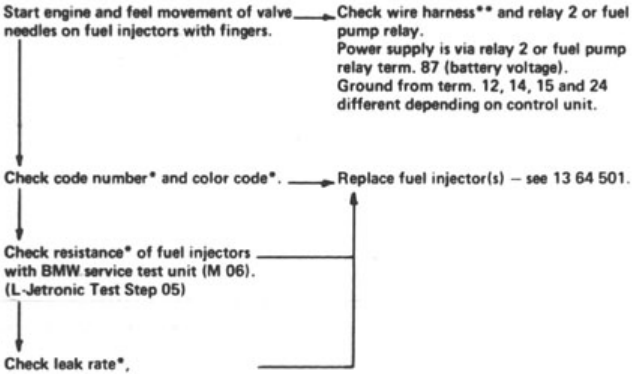
Check fuel feed line – routing and flow. → Check flow in fuel filter. → Check filter screen on fuel intake, cleaning if necessary – see 16 12 000 in Group 16.

↓

Check pressure regulator, replacing if necessary – see 13 51 200 in Gr. 13.

* See Specifications
** See Wiring Diagram

Test Position 6 – FUEL INJECTORS



* See Specifications
** See Wiring Diagram

Test Position 7 – COLD START VALVE

Check code number*. → Replace cold start valve.
Check resistance*.

↓

Power supply** via term. 50 (greater than 9 volts while starting).
Ground supply** via temperature time switch (and 0° C/32° F temp. switch).

↓

Remove cold start valve (fuel line remains connected). → Replace cold start valve.
Plug Jetronic test lead 61 1 440 on cold start valve and connect on B + or B –.
Hold cold start valve in measuring glass 13 3 020.
Operate electric fuel pump.
Cold start valve ejecting fuel?
Spray angle* and flow rate* okay?

↓

Pull off Jetronic test lead 61 1 440 on cold start valve while electric fuel pump is still running. → Replace cold start valve.
Cold start valve must stop fuel flow.
Does cold start valve stop fuel flow?

↓

Leak test: → Replace cold start valve.
A leak rate* of max. 0.3 cc per minute is permissible with electric fuel pump running and Jetronic test lead 61 1 440 disconnected.

* See Specifications
** See Wiring Diagram

Test Position 8 – THROTTLE BYPASS VALVE (ELECTRIC)

Check code number*.
Check tightness on engine (heat transfer). → Replace throttle bypass valve. Tighten throttle bypass valve.

↓

Check with engine running. → Replace throttle bypass valve.
After clamping air hose between "throttle bypass valve and intake manifold" there will be
– speed drop on a cold engine

– no speed drop on a warm engine.

↓

Check hoses for correct routing, tight fit, bends, leaks and porosity.
Check flow in hoses.

↓

Check power supply* (initial voltage with engine running).
Check plug pins for corrosion and good contact.
Check coil resistance* = 30 to 75 ohms.

Additional Information:
Job No. 13 63 060.

* See Specifications
** See Wiring Diagram

Test Point 9 – Temperature Time Switch

Code number*.
Tight fit, good contact of plug connections.
Check coolant level – see Group 17
(air bubbles).
→ Replace temperature time switch.
Repair plug contacts.

↓

Check resistance values* (see nominal value table) (possibly brought to test temperature in a water bath).
→ Replace temperature time switch.

↓

Check wires**.

Nominal Value Table			
Version	Temperature below °C	above °C	Resistance Measured in Ohms between Term. G and Ground (Housing) / Term. W and Ground (Housing)
15°C 8 s	+ 10	+ 20	50 ... 70 / 0 50 ... 70 / ∞
35°C 8 s	+ 30	+ 40	25 ... 40 / 0 50 ... 80 / 100 ... 200
35°C 12 s	+ 30	+ 40	25 ... 80 / 0 50 ... 100 / 200 ... 400

* See Specifications
** See Wiring Diagram

Test Position 10 – COOLANT TEMPERATURE SENSOR

Check code number*.
Check for tight fit, good contact of plug connections and correct level of coolant – see Gr. 17 (air bubbles).
→ Replace coolant temperature sensor.
Repair plug contact.

↓

Check resistance values*
(if necessary heat to test temperature in a water bath).
→ Replace coolant temperature sensor.

↓

Check wires**.

* See Specifications
** See Wiring Diagram

Test Position 12 – THROTTLE SWITCH

Check code number*. ——→ Replace throttle switch.
Check switching points – 13 63 544. Adjust throttle switch.
Check connections and wires**.

Test Position 13 – THROTTLE POTENTIOMETER

Check that throttle potentiometer fits tight.
Check that plug has good contact.
Check wires according to wiring diagram.

↓

Check throttle potentiometer adjustment – 13 63 544.

Test Position 14 – THROTTLE HOUSING

Check throttle cable adjustment. ——→ See Group 24 / 35 / 65.
Check full throttle position.
Eliminate leaks if applicable.
Check synchronization (only with multiple neck).
Check movement of throttle.
Check basic setting of throttle. ——→ See 13 54 051.

Test Position 15 – THROTTLE POSITIONER (If Applicable)

Check tight fit.
Check and adjust setting distances – see 13 54 130.

* See Specifications
** See Wiring Diagram

Test 16 – CONTROL UNIT

Check code number* and manufacturing date*. → Replace control unit, if necessary.
Check for tight fit of control unit plug.
Check for good contact of plug pins.

↓

Check tied back plug connections on wire harness close to control unit plug for conformance with wiring diagram.

↓

Only DME:
Check printed circuit switch position.
See pages 13-250 and 13 - 406a (technical data).

↓

Check power supply** and ground**.
(Check control unit with L-Jetronic testing program, not with DME.)

Test Position 17 – AIR FLOW SENSOR

Check code number* and manufacturing date*. → Replace air flow sensor.
Check contact of plug connections, fit of plug, movement and swinging range of sensor plate.

↓

Electric test: → Replace air flow sensor.
Check air flow sensor with universal test adapter and connecting wire harness (35 or 25 pins).
Test values*.

* See Specifications
** See Wiring Diagram

Test Position 24 – SPEED SWITCH

Check speed relay.
(745 i)

→ Check code number*.
Does installed speed relay have the specified code number*?

→ Replace speed relay.

↓

Check power supply of speed relay.
Plug socket 3 must have ground.
Plug socket 2 must have battery voltage with ignition turned on.
Plug socket 4 must have voltage with engine running.

→ Provide power supply according to wiring diagram.

↓

Connect ohmmeter between plug sockets 5 and 1 on speed relay socket.
Connect tachometer (BMW service test unit).
Speed relay remains installed.
Start engine and boost speed slowly.
Does ohmmeter display approx. 0 ohm up to engine speed of 3050 rpm?

→ Replace speed relay.

↓

Boost engine speed further.
Does ohmmeter display approx. ∞ ohms at engine speed of 3550 rpm?

→ Replace speed relay.

* See Specifications

Test Position 25 – SAFETY SWITCH

Check safety switch.

(745 i)

→ Disconnect wires on safety switch.
Connect ohmmeter on safety switch connection and car ground.
Ohmmeter should display approx. ∞ ohms.
Ohmmeter displaying approx. ∞ ohms?

→ Replace safety switch.

↓

Connect ohmmeter on safety switch connection and car ground.
Connect a regulable air pressure source on safety switch.
Increase pressure slowly.
Does ohmmeter display approx. ∞ ohms up to a pressure of max. 0.94 bar?

→ Replace safety switch.

↓

Ohmmeter should display approx. 0 ohm as from a pressure of at least 0.96 bar.
Ohmmeter displaying correct value?

→ Move ohmmeter connection from car ground to safety switch housing.
Ohmmeter now displaying correct value?

→ Replace safety switch.

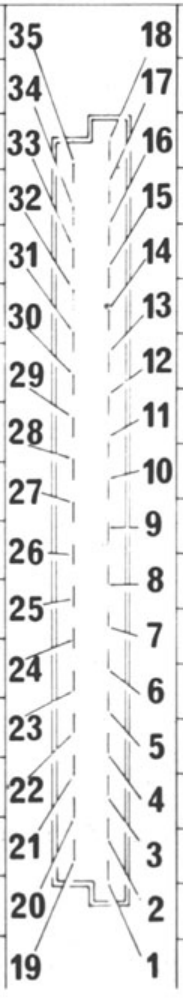
↓

Make ground connection between safety switch and car body.

Plug Connections – DME Control Units
{Signal Shapes} – Location –
{Signal Sizes} (Function)

13-930

Control Unit Code No. 0 261 200 040
0 261 200 011
0 261 200 043
0 261 200 042
0 261 200 045



Power supply for control unit	{Normal Operation Starting Operation}	10 ... 15 V 6 ... 15 V	18	Terminal 30 for injection	
			17	Ground activation for fuel pump relay	
			16	Ground for control unit	
			15	Fuel injectors 4, 5, 6	Final stage / Ground
			14	Fuel injectors 1, 2, 3	Final stage / Ground
			13	Coolant temperature sensor	(resistance – see techn. data)
			12		
Cold start valve switchover			11	Injection ti test outlet (⎍)	(signal for fuel consumption display or on-board computer)
Speed sensor	Negative	Test – see Group 12	10	Performance graph switch from EH	Engine tap
Reference mark sensor	Negative	Test – see Group 12	9	Positive air flow sensor (power supply for air flow sensor)	
Reference mark sensor (TDC signal for control unit)	Positive	Test – see Group 12	8	Speed transmitter positive (speed signal for control unit ⏦ 0 volt)	
			7	Signal outlet air flow sensor (looper)	(signal for drawn-in air volume)
Speed sensor "Coolant" temperature sensor	Shielding Ground	Test – see Group 12 Resistance – see repair manual	6	Ground for air flow sensor Ground for "air" temperature sensor	
"Air" temperature sensor – in air flow sensor –		Resistance – see technical data	5	Ground for control unit electronic ground Shielding for reference mark sensor	
			4	Term. 50 signal from starter	
Ignition ts test outlet		(wire to tachometer in instrument cluster)	3	Full load signal from throttle switch (full load enrichment)	(resistance – see repair manual)
Activation for fuel pump relay			2	Idle signal from throttle switch (idle control working)	(resistance – see repair manual)
Ground ignition final stage (Terminal 1)			1	Positive ignition final stage (terminal 1)	

Control Unit Code No. 0 261 200 061
0 261 200 060
0 261 200 074
0 261 200 073

Power supply for control unit (between 5 and 35)		Normal Operation 10 ... 15 V Starting Operation 6 ... 15 V	35	18	
Terminal 1 for idle control valve (closing)		12 Volt 0 Volt	34	17	Ground for pump relay and idle control valve
Terminal 3 for idle control valve (opening)		12 Volt 0 Volt	33	16	Ground for control unit fuel injectors
			32	15	Fuel injectors 4, 5, 6 Final Stage (switched ground)
			31	14	Fuel injectors 1, 2, 3 Final Stage (switched ground)
			30	13	"Coolant" temperature sensor Resistance – see techn. data
Air conditioner switch (idle speed change)		Turned on 12 Volt Turned off 0 Volt	29	12	
Driving range switch – only with automatic transmission (idle speed change)			28	11	Injection ti test outlet (⎍) Wire for fuel consumption display or on-board computer
Speed sensor	Negative	(test – see Group 12)	27	10	Performance graph switch Transmission tap only 0 261 200 060 0 261 200 061
Reference mark sensor (TDC signal for control unit)	Negative	(test – see Group 12)	26	9	Positive air flow sensor Power supply for air flow sensor
Reference mark sensor (TDC signal for control unit)	Positive	(test – see Group 12)	25	8	Speed sensor Positive Test – see Group 12 Speed signal for control unit
Switch - country version (ground ECE)	(NOx)	only 0 261 200 074 0 261 200 073	24	7	Signal outlet air flow sensor (looper)
Speed sensor	Shielding	(test – see Group 12)	23	6	Ground for air flow sensor Ground for "air" temperature sensor
"Air" temperature sensor – in air flow sensor –		Resistance – see technical data	22	5	Ground for control unit Shielding for reference mark sensor
Ignition t_D test outlet		Wire to tachometer in instrument cluster	21	4	Term. 50 signal from starter
Activation for fuel pump relay			20	3	Full load signal from throttle switch (full load enrichment) Resistance – see repair manual
Ground ignition final stage (Terminal 1)			19	2	Idle signal from throttle switch (idle control working) Resistance – see repair manual
				1	Positive ignition final stage Terminal 1

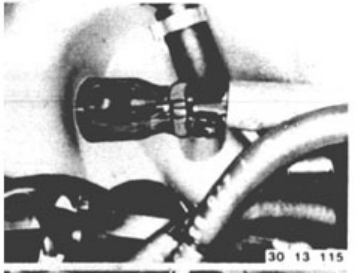
Construction group 13 Fuel system

1.8 lt. – Models:
318i / 318i (Catalytic Converter/US) / 318i (Catalytic Converter/ECE) / 518i

13 00 054	Engine idle speed / CO – adjust	13-	100
13 31 029	Fuel delivery pressure – check	13-	110
. . .	Fuel delivery rate – check	13-	110
030	Fuel pump – remove and install	13-	111
13 32 051	Fuel filter – remove and install	13-	113
13 41 000	Idle control valve – remove and install	13-	120
010	Control unit for idle control valve – remove and install	13-	121
. . .	Running-up safety relay	13-	122
. . .	Basic adjustment of VCO idle speed regulating system	13-	123
13 51 200	Fuel pressure regulator – remove and install	13-	130
. . .	Fuel pressure regulator (fuel injection pressure) – check	13-	130
13 54 030	Throttle housing – remove and install	13-	140
051	Throttle shaft return springs – remove and install	13-	142
13 61 000	Control unit – remove and install	13-	150
13 62 000	Air flow sensor – remove and install	13-	160
050	Temperature time switch – remove and install / check	13-	161
080	Pressure sensor – remove and install	13-	162
531	Coolant temperature sensor – remove and install / check	13-	163
13 63 060	Throttle bypass valve – remove and install / check	13-	170
544	Throttle switch – adjust	13-	171
551	Throttle switch – remove and install	13-	171
13 64 030	Cold start valve – remove and install	13-	180
501	Fuel injector – remove and install	13-	181
12 63 051	Temperature switch 0° C (32° F) – remove and install	13-	181

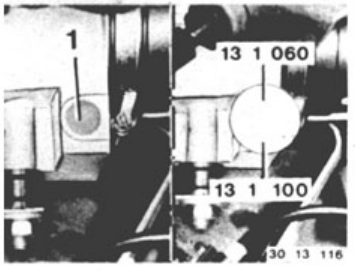
13 00 054 ADJUSTING ENGINE IDLE SPEED (M 10)

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least + 60° C (140° F).
Ignition timing and valve clearance okay.
Air filter cartridge in perfect condition.
All electric equipment switched off.
BMW SERVICE TESTER connected to operating instructions.
Exhaust extraction systems switched off for time of test.



1) Engine Idle Speed:

Adjust engine idle speed* with the air control screw in the bypass bore.



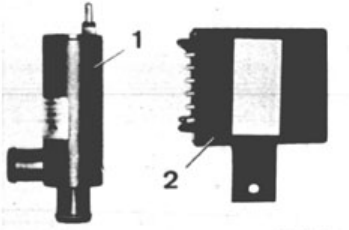
2) CO Test:

Make sure that there are no faults in the engine, ignition or injection systems (see Troubleshooting) before correcting the CO level.
Remove cap (1) with Special Tool 13 1 011.
Adjust CO level* with Special Tool 13 1 060 or 13 1 100 applied on the air control screw in the air flow sensor.

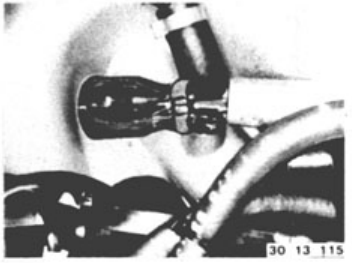
* See Nominal Value Microfiche

13 00 054 ADJUSTING ENGINE IDLE SPEED AND CO LEVEL (M 10 Cat. Conv./ECE)

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
Ignition timing and valve clearance okay.
All electric equipment switched off.
BMW SERVICE TESTER connected to operating instructions.
Outside temperature above 0° C (32° F).



30 13 004

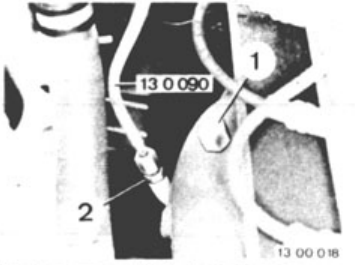

30 13 115

A) Engine Idle Speed:

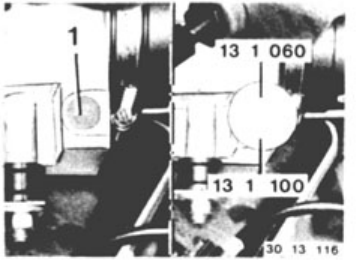
Check engine idle speed*.
If nominal value is not reached, check idle speed valve (1) and idle speed control unit (2) (see Troubleshooting Engine Idle Speed Control), replacing if necessary.
Note:
There is no control screw for idle speed adjustments.

B) Throttle Bypass Valve:

1) Engine Idle Speed:
Adjust engine idle speed* with air control screw in the bypass bore.



13 00 018



30 13 116

2) CO Level:
Disconnect oxygen sensor plug.

Unscrew nut (1).
Connect CO tester, Special Tool 13 0 090, on test connection (2).

Remove cap (1) with Special Tool 13 1 060.
Adjust CO level* with Special Tool 13 1 060 or 13 1 100 applied on air control screw in the air flow sensor.

Install a new anti-tamper lock after finishing adjustments.
Connect oxygen sensor plug.

* See Nominal Value Microfiche

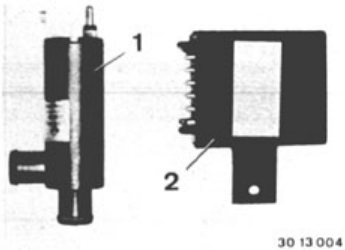
* See Nominal Value Microfiche

13 00 054 CHECKING ENGINE IDLE SPEED CHECKING/ADJUSTING INTEGRATOR VOLTAGE (CO TEST)



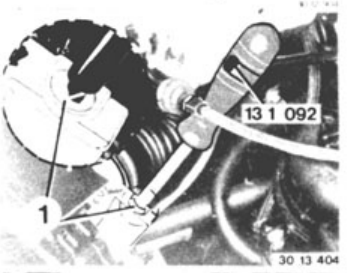
Testing Procedures:
Disconnect oxygen sensor wire.
Keep wire away from car ground.
Nominal value will now appear in display (3).
Connect oxygen sensor wire.
Actual value will now appear in display (3).
Correcting to nominal value is described below.
Nominal value tolerance: ± 0.3 V.

(US)
Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
Ignition timing and valve clearance correct.
All electric equipment switched off.
BMW service test unit connected according to operating instructions.



30 13 004

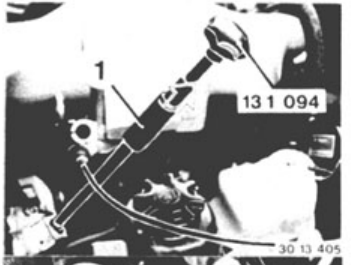
(BMW 318 i)
1) Checking Engine Idle Speed**:
If nominal value is not reached, check idle valve (1) and idle speed regulation control unit (2) (see troubleshooting idle speed regulation), replacing if necessary.
Note:
There is no adjusting screw for idle speed regulation.



30 13 404

Adjusting Integrator Voltage:
Drill hole in anti-tamper lock (1) with Special Tool 13 1 092.

2) Checking/Adjusting Integrator Voltage (CO Test):
Testing Requirements:
Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
Ignition timing and valve clearance correct.
All electric equipment switched off.
BMW service test unit and mixture tester 12 6 400 connected according to operating instructions.
Hose from active carbon filter pulled off on throttle housing and no plugs inserted in open connections.

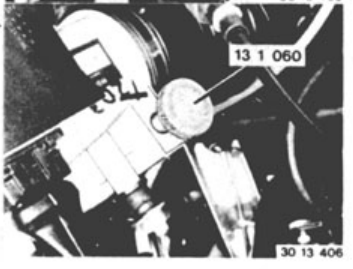


30 13 405

Screw Special Tool 13 1 094 in anti-tamper lock.
Drive special tool and anti-tamper lock out of air flow sensor with impact (1).



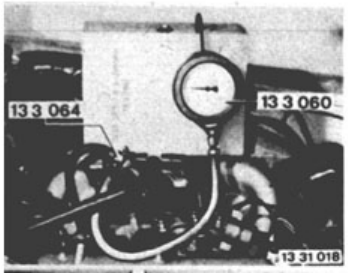
Oxygen sensor must have operating temperature.
Oxygen sensor has operating temperature by running engine at least 30 seconds at speed of approx. 3,000 rpm.
Oxygen sensor is good, if LED (1) starts flashing in at least 3 second intervals after approx. 10 seconds.
If LED does not flash, check oxygen sensor – 11 78 010.



30 13 406

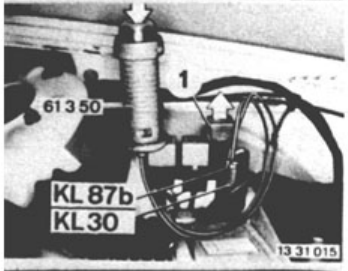
Adjust integrator voltage to nominal value ± 0.3 volt by turning the adjusting screw with Special Tool 13 1 060 or 13 1 100.
Install new anti-tamper lock after finishing adjustment.
Connect oxygen sensor wire.

** See Nominal Value Microfiche

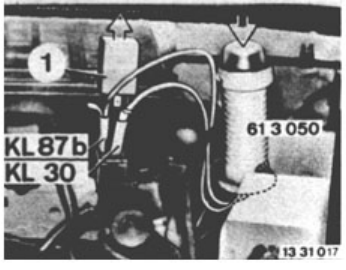


13 31 029 CHECKING FUEL DELIVERY PRESSURE

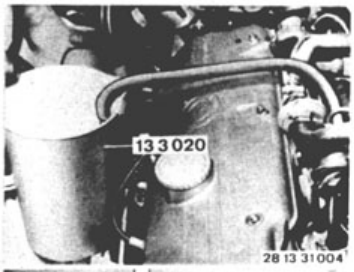
Install pressure tester 13 3 060 with connecting line and t-adapter 13 3 064 in fuel feed line, in front of fuel pressure regulator.
Plug fuel return line with Special Tool 13 3 010.



E 30:
Pull off fuel pump relay (1).
Bridge 87 b and 30 with Special Tool 61 3 050.
Check delivery pressure*.

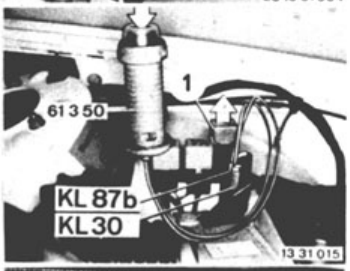


E 28:
Pull off fuel pump relay (1).
Bridge 87b and 30 with Special Tool 61 3 050.
Check delivery pressure*.

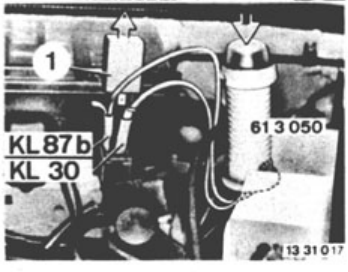


13 31 . . . CHECKING FUEL DELIVERY RATE

Unscrew fuel return line and hold end of line in measuring glass 13 3 020.

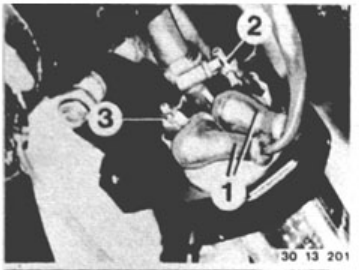


E 30:
Pull off fuel pump relay (1).
Bridge 87 b and 30 with Special Tool 61 3 050.
Check delivery rate*.



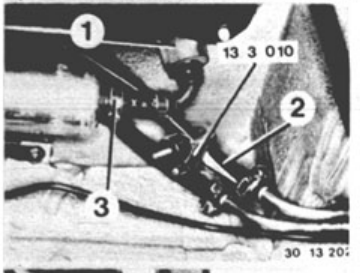
E 28:
Pull off fuel pump relay (1).
Bridge 87b and 30 with Special Tool 61 3 050.
Check delivery rate*.

* See Specifications of Gr. 16

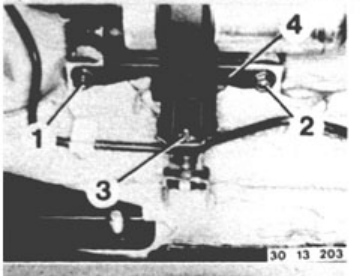


13 31 030 REMOVING AND INSTALLING FUEL PUMP

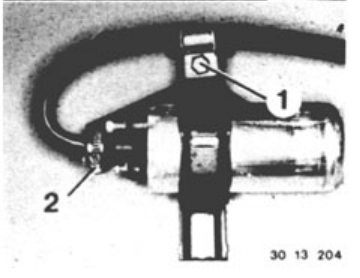
Push back protective caps (1).
Unscrew nuts (2 and 3).
Take off wires.



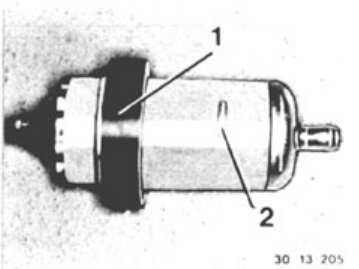
Pinch intake hose (1) and output hose (2) with Special Tool 13 3 010.
Loosen hose clamp (3) and pull off hoses.
Important!
Do not install the output (pressure) hose with squeeze-hose clamps.



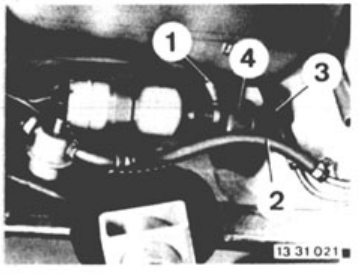
Unscrew nuts (1 ... 3).
Take off holder (4).
Remove fuel pump with bracket.
Installation:
Check rubber mounts, replacing if necessary.



Unscrew bolt (1).
Loosen hose clamp (2) and pull off fuel hose.
Take fuel pump off of bracket.
Important!
Do not install the output (pressure) hose with squeeze-hose clamps.

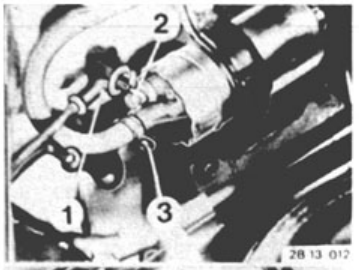


Pull off rubber ring (1).
Installation:
Check code number (2)*.



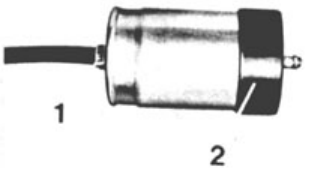
Arrangement of Fuel Pump with Damper Chamber:
1 = Suction line
2 = Pressure line
3 = Return line
4 = Damper chamber

* See Parts Microfiche and Specifications



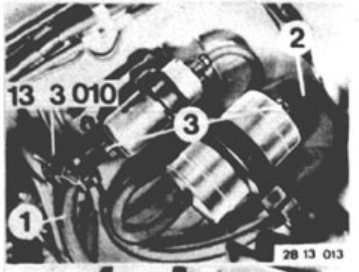
13 31 030 REMOVING AND INSTALLING FUEL PUMP

Push back protective caps (1).
Unscrew nuts (2 and 3).
Take off wires.



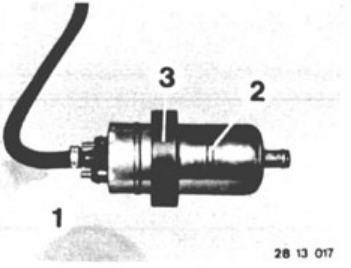
Loosen hose clamp (1) on fuel filter and pull off fuel hose.
Remove rubber ring (2).

Installation:
Check direction of flow.
IN and OUT of filter are marked.
Do not use squeeze-hose clamps.



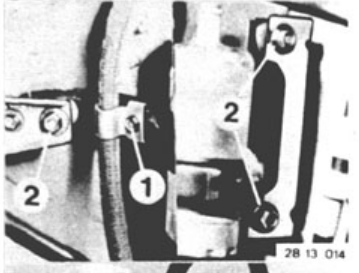
Pinch inlet hose (1) and outlet hose (2) with Special Tool 13 3 010.
Loosen hose clamp (3) and pull off hoses.

Note:
Do not install outlet (pressure) hose with squeeze-hose clamps.

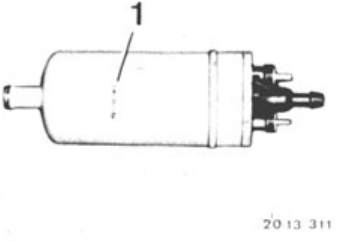


Loosen hose clamp (1) on fuel pump and pull off fuel hose.
Pull off rubber ring (3).

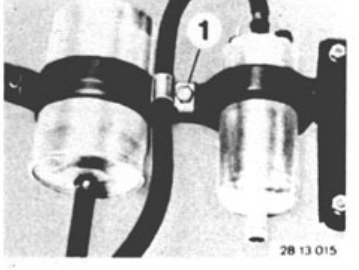
2 = Code number*



Unscrew bolt (1) and nuts (2).
Take off fuel pump with filter.

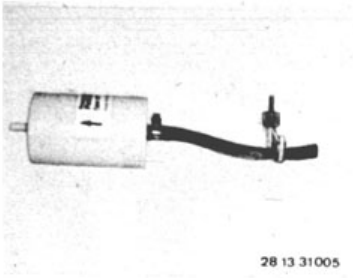


Installation:
Check code number (1)*.



Unscrew bolt (1) and remove clamp.

* See Specifications



28 13 31005

13 32 051 REMOVING AND INSTALLING FUEL FILTER

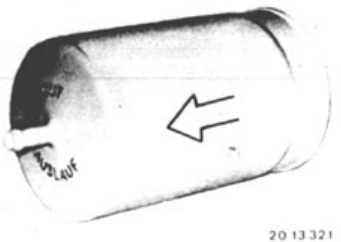
E 30

Note:

Remove fuel filter with fuel feed line and Special Tool 13 3 010.

Installation:

Check direction of flow (arrow).



20 13 321

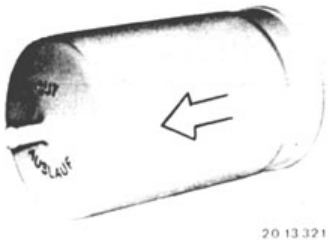
13 32 052 REMOVING AND INSTALLING FUEL FILTER

E 28

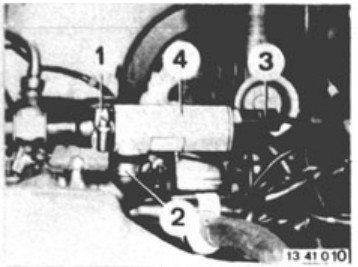
See "Removing and Installing Fuel Pump" – 13 31 030.

Installation:

Check direction of flow (arrow).

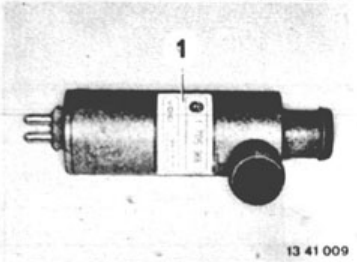


20 13 321



13 41 000 REMOVING AND INSTALLING IDLE CONTROL VALVE

Loosen hose clamps (1 and 2).
Pull off plug (3).
Remove idel control valve (4).



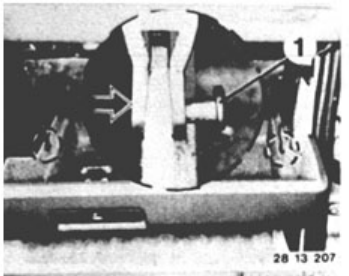
Installation:
Check code number (1)*.
Check idle speed*.



B) With Basic Adjustment Screw
Disconnect strap.
Loosen hose clamps (1 and 2).
Pull off plug (3).
Remove idle control valve.
Installation:
Make basic adjustment.

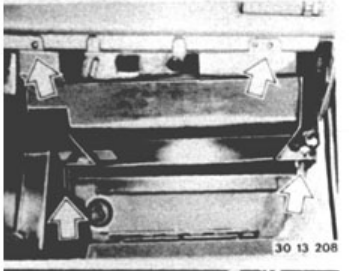
Checking Idle Control Valve:
Supply battery voltage to idle control valve.
Idle control valve must close and be tight.
Idle control valve should be open when without voltage.

* See Specifications + Nom. Value Microfiche



13 41 010 REMOVING AND INSTALLING CONTROL UNIT FOR IDLE SPEED REGULATION

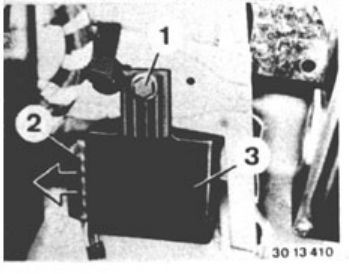
Open glove box.
Pull out pins (1) of both retaining straps.



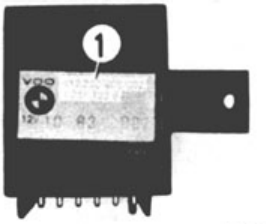
Unscrew screws and take off trim.

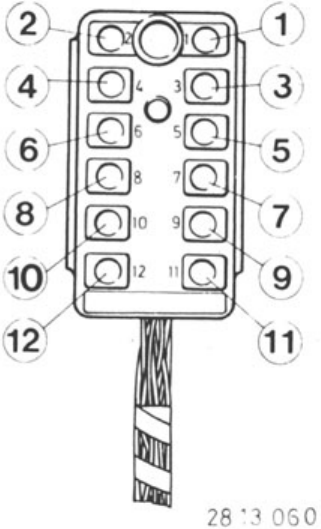


Pull off both plugs for glove box light and lay trim aside.



Unscrew screw (1).
Pull off plug (2).
Remove control unit (3).





Installation:
Check code number (1)*.
Check engine idle speed*.

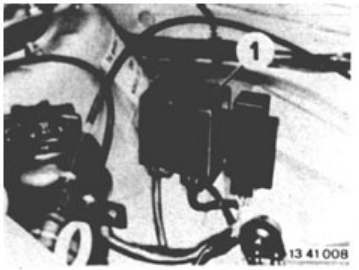
Multiple Pin Plug Connections:

No.	mm	Color	Connection To
1	0.75	BL/RT	Idle valve (A)
2	1.5	GN/GE	Idle valve (A)
3	1	GN	Terminal 1 Ignition coil
4	1.5	BR	Terminal 31
5	0.75	BL/WS	Idle positioner (B)
6	0.5	WS	Temp. switch 45°C/113°F (temp. transmitter)
7	0.5	BL/GE	Conn. automatic transm. N/P
8	–	–	–
9	0.5	BL/WS	Air conditioner switch
10	0.5	BL/GN	Temp. switch 0°C/32°F
11	0.5	BL/WS	Air cond. magn. coupling
12	0.5	BR/BL	L-Jetronic control unit (Pin 2)

Color Codes

BL	blue
BR	brown
GE	yellow
GN	green
RT	red
SW	black
WS	white

* See Specifications and Nominal Value Microfiche



13 41 . . . RUNNING-UP SAFETY RELAY

1 = Running-up safety relay

Function:
This relay switches off the fuel injectors when engine idle speed exceeds 1500 rpm for so long, until the speed drops below 1500 rpm. Coasting shutoff action is stopped when the air conditioner is turned on.

13 41 . . . MAKING BASIC ADJUSTMENT OF VDO IDLE SPEED CONTROL SYSTEM

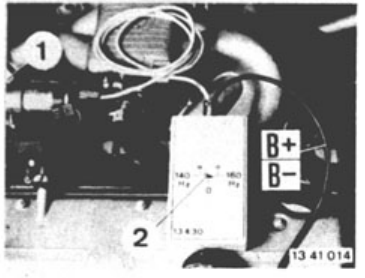
Requirements:
- Engine at operating temperature, i.e. oil temperature at least + 60° C (140° F).
- Ignition timing and valve clearance correct.
- Air filter cartridge in perfect condition.
- All electric equipment switched off.
- Idle speed CO level correct.

Note:
A basic adjustment does not have to be made at certain intervals.



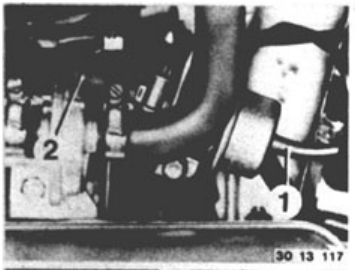
13 41 013

Basic adjustments can only be made with the illustrated metal valve.
This metal valve can be installed retroactively since 9.83.
1 = Basic adjustment screw



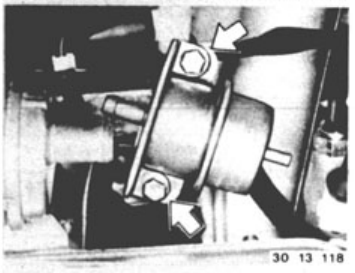
Connect tester 13 4 030 on the car battery and idle control valve.
Set switch (2) to 160 Hz.
Connect speed tester (BMW service tester).
Run engine at idle speed.
Adjust idle speed to 750 + 50 rpm with basic adjustment screw (1).

Remove tester 13 4 030.
Connect plug from engine wire harness on idle control valve again.

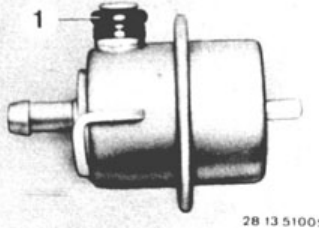


13 51 200 REMOVING AND INSTALLING FUEL PRESSURE REGULATOR

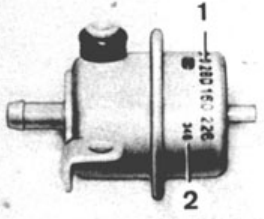
Disconnect air hose (1) and fuel hose (2).



Unscrew bolts (1).
Take off fuel pressure regulator.

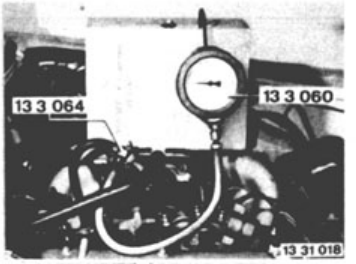


Installation:
Check seal (1), replacing if necessary.

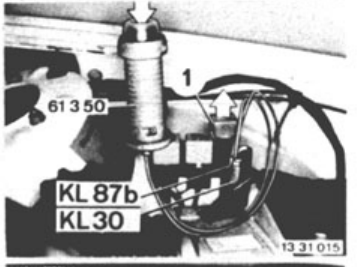


Installation:
Check code number (1)*.
(2) = Manufacturing date

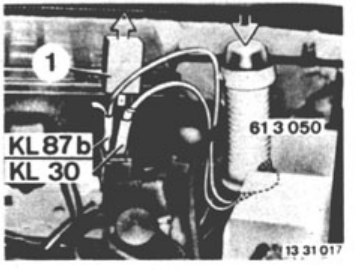
* See Specifications



Checking:
Install pressure tester 13 3 060 with connecting line and t-adapter 13 3 064 in fuel feed line, in front of fuel pressure regulator.

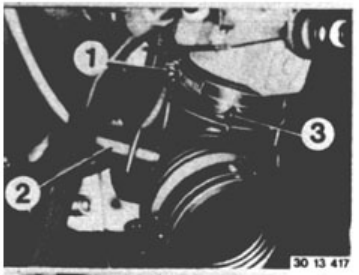


E 30:
Pull off fuel pump relay (1).
Bridge 87b and 30 with Special Tool 61 3 050.
Fuel injection pressure*.



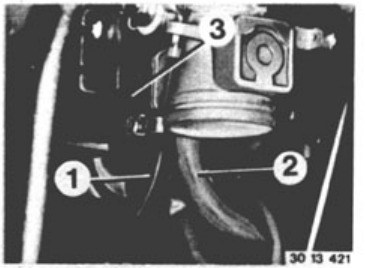
E 28:
Pull off fuel pump relay (1).
Bridge 87b and 30 with Special Tool 61 3 050.
Fuel injection pressure*.

* See Specifications + Nom. Value Microfiche

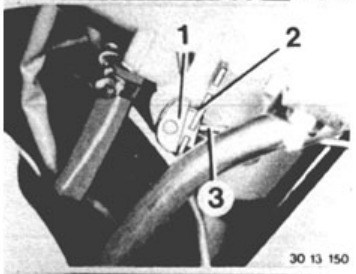


13 54 030 REMOVING AND INSTALLING THROTTLE HOUSING

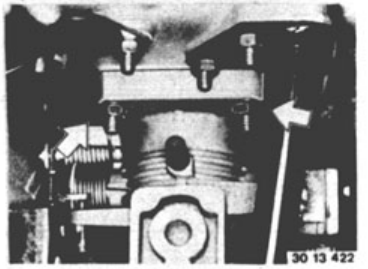
Loosen hose clamp (1).
Pull off hose (2).
Pull off hose (3) on throttle housing.



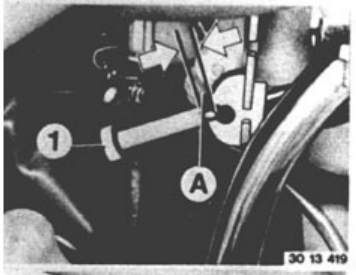
Disconnect water hoses (1 and 2).
Pull off hose (3) for secondary air injection.



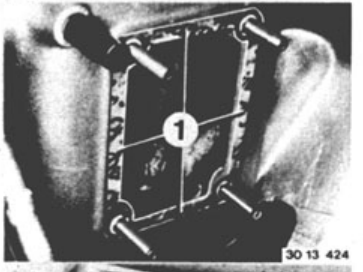
Press adapter (1) out of lever (2).
Disconnect cable (3) on lever (2).
(Disconnect cable for automatic transmission.)



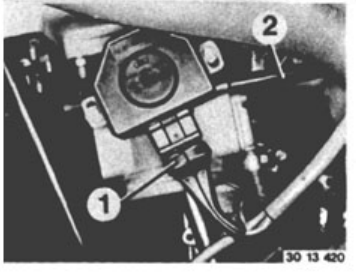
Unscrew four screws.
Take off throttle housing.



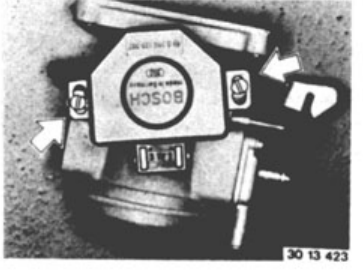
Installation:
Use screw (1) to adjust distance A to 1 ... 2 mm (0.039 to 0.079") with throttle valve closed and accelerator pedal in idle position.



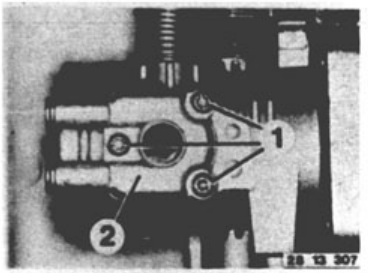
Installation:
Replace gasket (1).



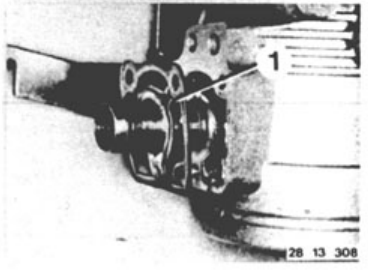
Pull off plug (1) on throttle switch.
Pull off hose (2) for active carbon filter vent.



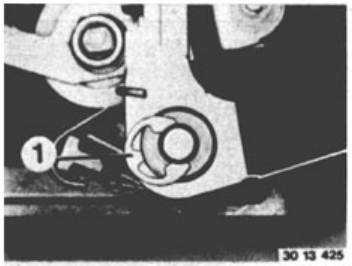
Unscrew screws.
Take off throttle switch.
Installation:
Adjust throttle switch 13 63 544.



Unscrew screws (1).
Take off housing section (2).

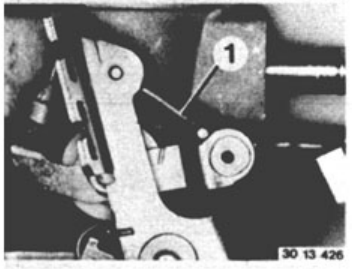


Installation:
Replace gasket (1).

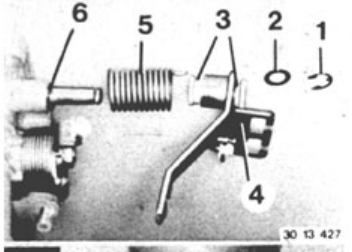


13 54 051 REPLACING RETURN SPRINGS FOR THROTTLE SHAFTS
– Throttle Housing Removed –

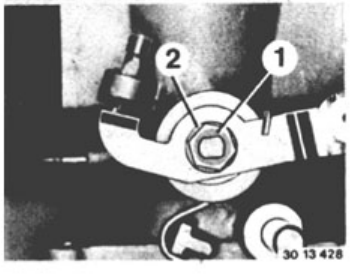
Remove retainer (1).



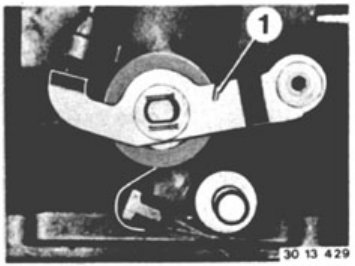
Lift out connecting rod (1).



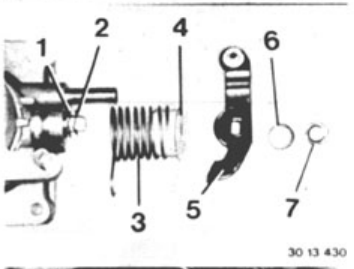
Disconnect spring on operating lever.
Take off parts.
Installation:
Preload spring with about 1/2 turn.
1 = Retainer
2 = Washer
3 = Bearing sleeve
4 = Operating lever
5 = Spring
6 = Lock washer



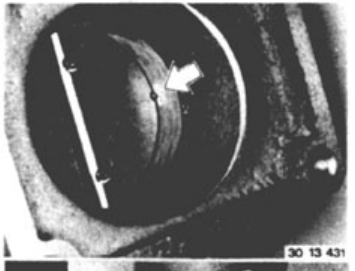
Unscrew nut (1).
Take off lock washer (2).



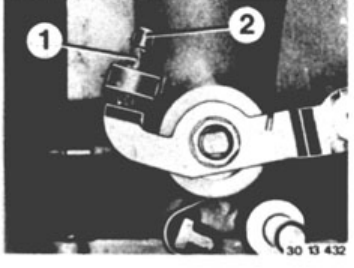
Disconnect return spring (1) on operating lever.
Installation:
Preload return spring with about 1/2 turn.



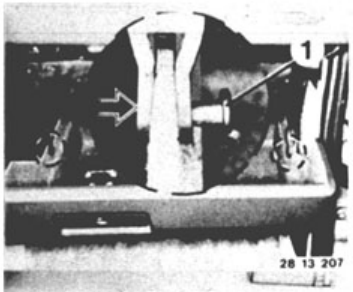
Take off parts.
1 = Washer
2 = Spring washer
3 = Spring
4 = Bearing sleeve
5 = Operating lever
6 = Lock washer
7 = Nut



Installation:
Check or adjust basic setting of throttle valve.
Checking:
When throttle valve is adjusted correctly, there will be slight clearance between housing and throttle valve.
Vacuum bores must not be covered.

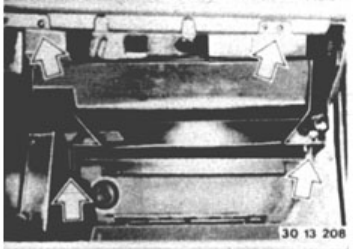


Adjusting (adjustment should not be changed if at all possible):
Turn screw (1) to adjust throttle valve until there is slight clearance between housing and throttle valve.
Lock screw (1) with clear lacquer after finishing adjustment.
Reinstall anti-tamper lock (2).

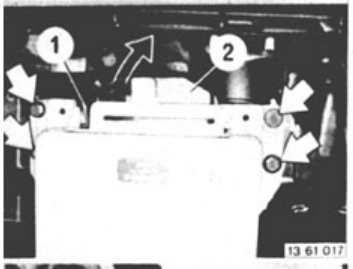


13 61 000 REMOVING AND INSTALLING CONTROL UNIT

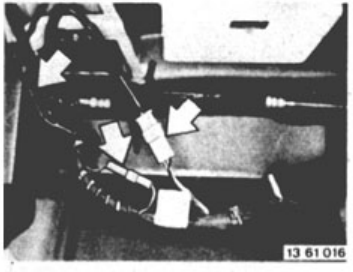
E 30
Open glove box.
Pull off pin (1) of both retaining straps.



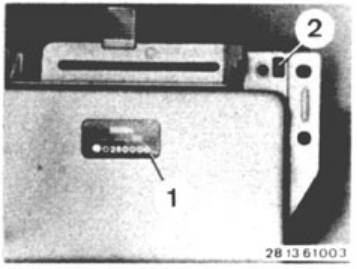
Unscrew trim panel.



Push back lock (1) and pull off plug (2).
Unscrew four mounting screws and take off control unit.

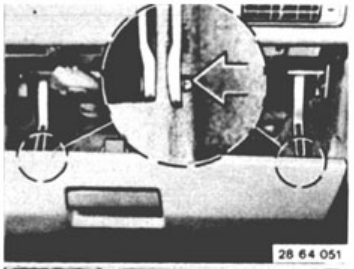


Plug connections – see wiring diagram or Group 12.



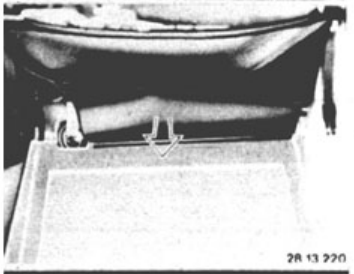
Installation:
Check code number (1)* and manufacturing date (2)*.
Check/adjust engine idle speed* and idle speed CO level*.

* See Specifications and Nominal Values

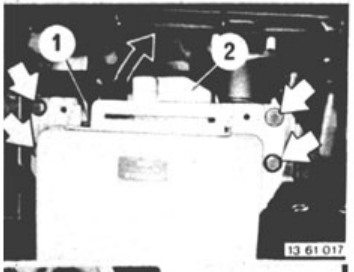


13 61 000 REMOVING AND INSTALLING CONTROL UNIT

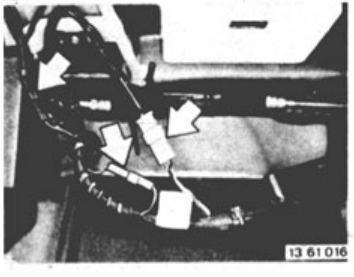
E 28:
Open glove box.
Pull off pins (1) of both retaining straps.



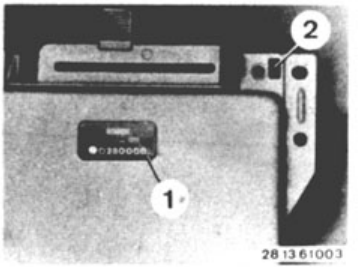
Unscrew trim panel.



Push back lock (1) and pull off plug (2).
Unscrew four mounting bolts and take out control unit.

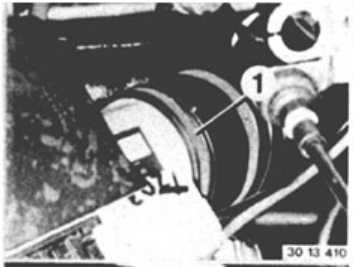


See wiring diagram or Gr. 12 for plug connections.



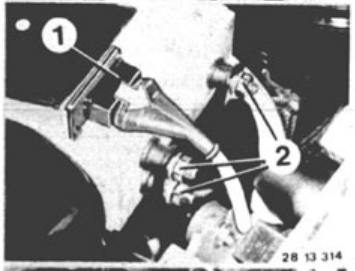
Installation:
Check code number (1)* and manufacturing date (2)*.
Check / adjust engine idle speed* and idle speed CO level*.

* See Specifications + Nom. Value Microfiche



13 62 000 REMOVING AND INSTALLING AIR FLOW SENSOR

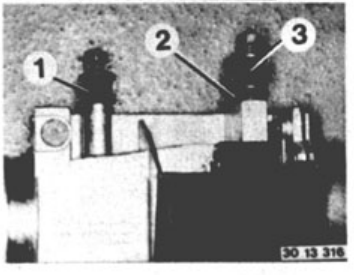
Loosen hose clamp (1) and pull air hose off of air flow sensor.



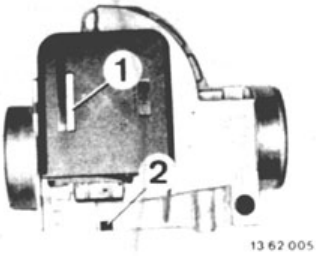
Pull off plug (1).
Loosen nut (2) and take off air flow sensor.



Installation:
Check seal (1), replacing if necessary.

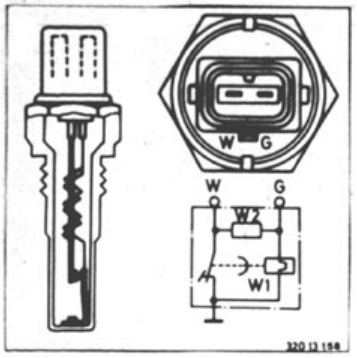


Unscrew mounts (1 ... 3) on air flow sensor.
Check mounts, replacing if necessary.



Installation:
Check code number (1)* and manufacturing date (2)*.
Check engine idle speed* and idle speed CO level*.
Check air flow sensor*.

* See Specifications + Nom. Value Microfiche

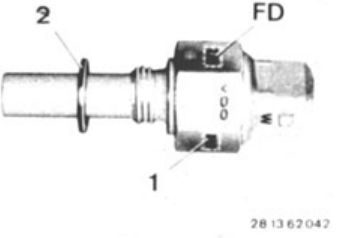


13 62 050 REMOVING AND INSTALLING/ CHECKING TEMPERATURE TIME SWITCH

The temperature time switch regulates the open time of the cold start valve according to coolant temperature.
The open time (e.g. 8 sec.) and switching off temperature (e.g. + 35° C = 95° F) are stamped in the hexagon.



Removing and Installing:
Pull off plug (1).
Unscrew temperature time switch.
Installation:
Tightening torque*.



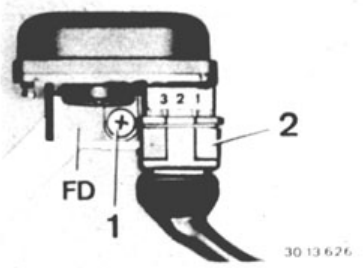
Installation:
Check code number (1)*.
Replace seal (2).
FD = Manufacturing date
Fill and bleed cooling system (Gr. 17).



Checking:
Connect Jetronic test lead 61 1 440.
Check nominal value* with an ohmmeter.
To check the entire temperature range, remove temperature sensor and place it in a water bath heated to testing temperature.
Check resistance* with an ohmmeter.

* See Specifications

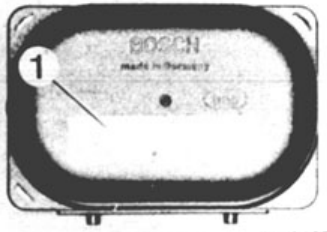
* See Specifications



30 13 626

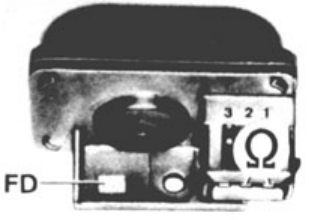
13 62 080 REMOVING AND INSTALLING/ CHECKING PRESSURE SENSOR

Pull off plug (1).
Unscrew screw (2) and remove pressure sensor.
FD = Manufacturing date



30 13 627

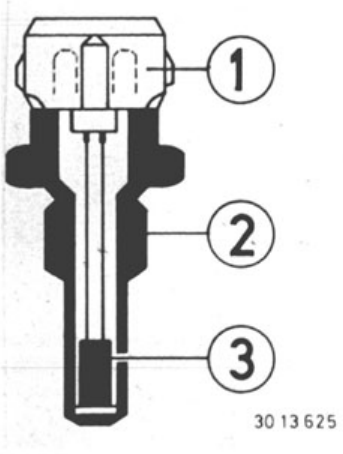
Installation:
Check code number (1)*.



30 13 628

Checking:
There should be approximately 0 ohm between plug connections (1 and 2) with ≤ 880 mbar atmospheric pressure.
There should be approximately ∞ ohms between plug connections (1 and 2) with ≥ 930 mbar atmospheric pressure.

* See Specifications

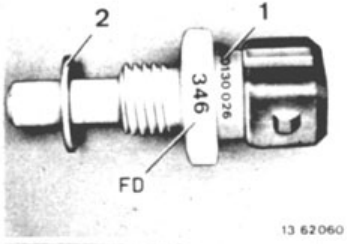


13 62 531 REMOVING AND INSTALLING/ CHECKING COOLANT TEMPERATURE SENSOR

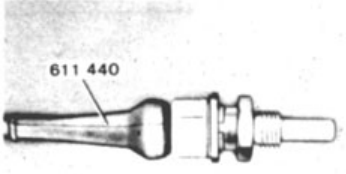
The temperature sensor measures the engine temperature and sends this data as a resistance value to the control unit.
The resistance value drops as temperature rises (NTC).
1 = Plug connection
2 = Housing
3 = NTC resistor



Removing and Installing:
Pull off plug (1).
Unscrew temperature sensor.
Installation:
Tightening torque*.



Installation:
Check code number (1)*.
Replace seal (2).
FD = Manufacturing date
Fill and bleed cooling system (Gr. 17).

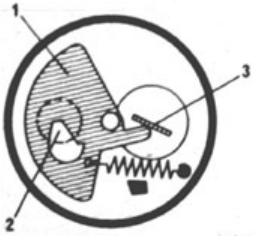


Checking:
Connect Jetronic test lead 61 1 440.
Check nominal value* with an ohmmeter.
To check the entire temperature range, remove temperature sensor and place it in a water bath heated to testing temperature.
Check resistance with ohmmeter*.

* See Specifications

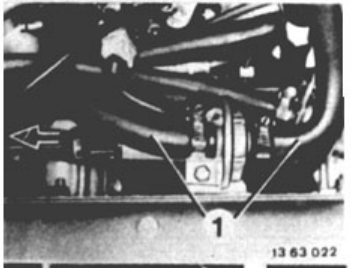
* See Specifications

13 63 060 REPLACING / CHECKING THROTTLE BYPASS VALVE



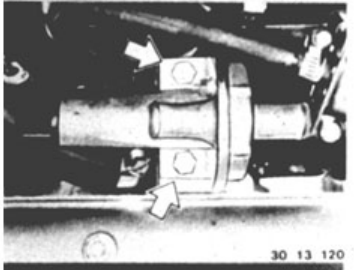
320 13 088

The throttle bypass valve is heated electrically and with heat from the engine.
Electric heating comes from the fuel pump relay simultaneous with switching in the fuel pump.
1 = Shutoff valve
2 = Bypass opening
3 = Bimetal spring



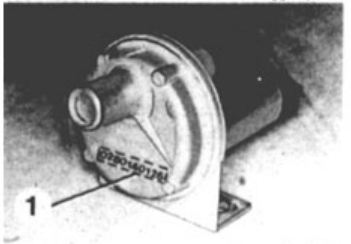
13 63 022

Disconnect both air hoses.
Pull off plug (1).



30 13 120

Unscrew screws and take off throttle bypass valve.

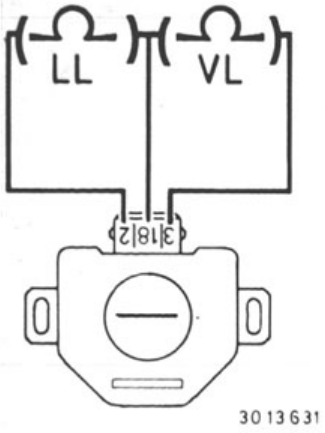


23 13 025

Installation:
Check code number (1)*.

Checking:
There should be no change in engine speed of an engine having operating temperature after pinching shut the air hose between the throttle bypass valve and air intake.
The engine speed of a cold engine must drop when pinching shut the air hose between the bypass valve and air intake.

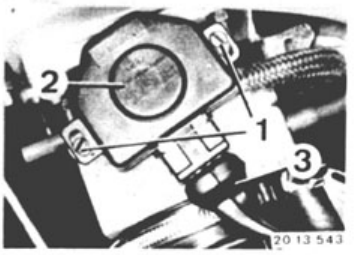
* See Specifications



30 13 631

13 63 544 ADJUSTING THROTTLE SWITCH

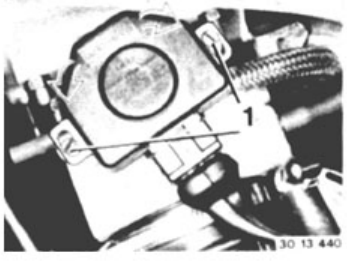
Checking Throttle Switch:
There should be approximately 0 ohm between connections (2 and 18) with throttle valve closed.
There should be approximately 0 ohm between connections (3 and 18) with throttle valve wide open.
LL = Idle
VL = Full load



20 13 543

13 63 551 REMOVING AND INSTALLING THROTTLE SWITCH

Pull off multiple pin plug (3).
Unscrew screws (1).
Remove throttle switch (2).



30 13 440

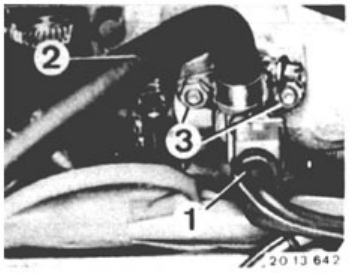
Adjusting:
There should be approximately 0 ohm between connections (2 and 18) with throttle valve closed.
Adjust by loosening screws (1) and turning throttle switch.
Open throttle valve after finishing adjustment – resistance should go immediately to ∞ ohms.
Resistance must drop again to approximately 0 ohm when releasing the throttle valve.



30 13 456

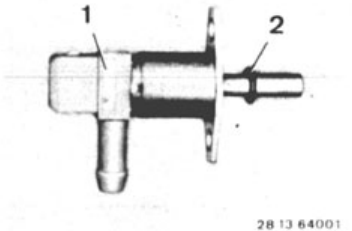
Installation:
Check code number (1)*.
Adjust throttle switch 13 63 544.

* See Specifications



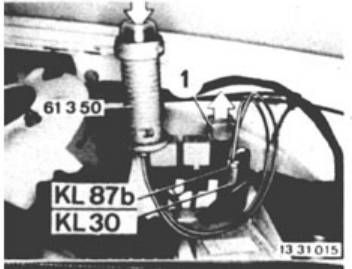
13 64 030 REMOVING AND INSTALLING/ CHECKING COLD START VALVE

Removing and Installing:
Pull off plug (1).
Disconnect fuel line (2).
Unscrew screws (3).
Remove cold start valve.

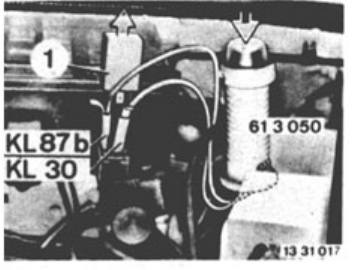


Installation:
Check code number (1)*.
Replace seal (2).

Checking:
Disconnect cold start valve on intake housing.
Fuel line remains connected.

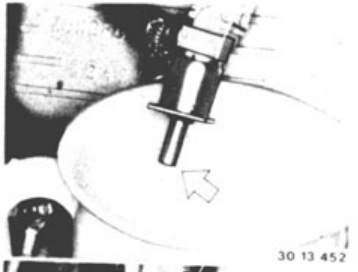


E 30:
Pull off fuel pump relay (1).
Bridge terminals 87b and 30.
Fuel pump runs.

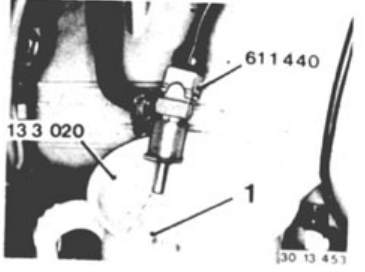


E 28:
Pull off fuel pump relay (1).
Bridge terminals 87b and 30.
Fuel pump runs.

* See Specifications

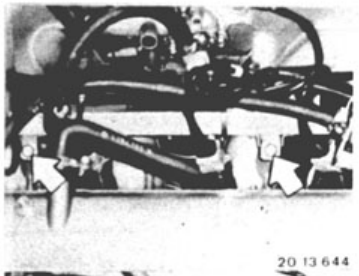


Leak Test:
Check permissible leak rate*.



Checking Fuel Flow Rate and Spray Angle:
Hold cold start valve over measuring glass 13 3 020.
Plug Jetronic test lead 61 1 440 on cold start valve and connect on B + and B –.
Check fuel flow rate* and spray angle (1)*.

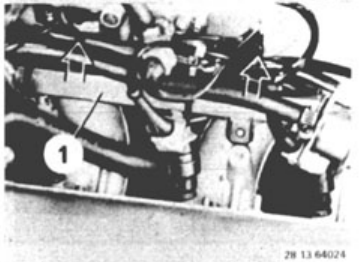
* See Specifications



20 13 644

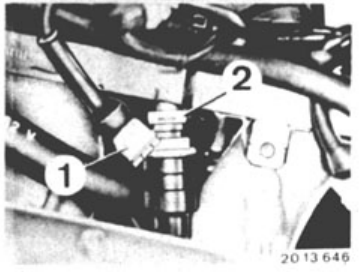
13 64 501 REMOVING AND INSTALLING ONE FUEL INJECTOR

Unscrew screws on injection tube.
Installation:
Mount ground wire with screw.



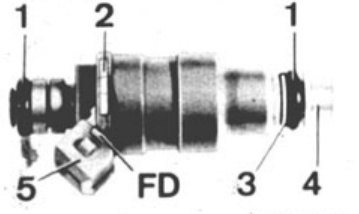
28 13 64024

Push up injection tube (1) until fuel injectors have cleared guide on intake manifold.



20 13 646

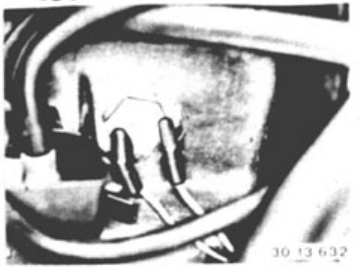
Pull off plug (1).
Lift off retainer (2) and remove fuel injector.



30 13 122

Installation:
Check O-rings (1), replacing if necessary.
Check code number (2)*.
Check location of plastic washer (3).
Check color code* of plug receptacle (5) or spray jet guard (4).
FD = Manufacturing date.
Only coat O-rings with vaseline or SAE 90 gear lube for installation.

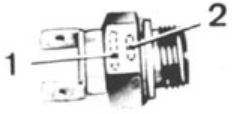
* See Specifications



30 13 632

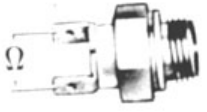
12 63 051 REMOVING AND INSTALLING 0° C (32° F) TEMPERATURE SWITCH

Pull off plug (1).
Unscrew temperature switch.
Installation:
Tightening torque: max. 30 Nm (22 ft. lbs.).



20 13 633

Installation:
Check code number (1)* and switching temperature (2)*.



20 13 634

Checking:
Connect ohmmeter (M 06) on temperature switch.
Ohmmeter should display approx. 0 ohm at temperature < – 8° C (+ 18° F).
Ohmmeter should display approx. ∞ ohms at temperature > + 4° C (+ 39° F).

* See Specifications.

Constrution group 13 Fuel system

2.0 lt. / 2.3 lt. / 2.5 lt. / 2.7 lt. – Models:
320i / 323i / 325i / 325eECE / 325eUS / 520i / 525eECE / 528eUS / 520i-E34 / 525i-E34

13 00 060	Engine idle speed and CO level - check	13-	200
054	Engine idle speed and CO level – adjust	13-	200b
13 31 029	Fuel delivery pressure – check	13-	210
. . .	Fuel delivery rate – check	13-	210
030	Fuel pump – remove and install	13-	212
13 32 051	Fuel filter – remove and install	13-	214
13 41 000	Idle speed control valve – remove and install	13-	220
. . .	Basic adjustment of VDO idle speed control system – perform	13-	222
010	Control unit for idle speed control valve – remove and install	13-	223
13 51 200	Fuel pressure regulator – remove and install	13-	230
. . .	Fuel pressure regulator (fuel injection pressure) – check	13-	230
13 54 030	Throttle valve housing – remove and install	13-	240
051	Return springs of throttle valve shaft – remove and install	13-	241
130	Vacuum control for throttle valve – replace / adjust	13-	243
13 61 . . .	Printed circuit board switch	13-	250
000	Control unit – remove and install	13-	251
13 62 000	Air flow sensor – remove and install	13-	260
050	Temperature switch – remove and install / check	13-	262
080	Pressure sensor – remove and install	13-	263
531	Coolant temperature sensor – remove and install / check	13-	264
13 63 060	Throttle bypass valve – remove and install / check	13-	270
544	Throttle valve switch – adjust	13-	271
551	Throttle valve switch – remove and install	13-	271
13 64 030	Cold start valve – remove and install / check	13-	280
501	Fuel injectors – replace	13-	281
12 63 051	Temperature switch 0° C (32° F) – remove and install	13-	290
060	Temperature switch 45° C (113° F) – remove and install	13-	291
11 73 020	Valve (3/2-way valve) – remove and install / check	13-	292
	Hose routing plan	13-	293
	Engine electronics – troubleshoot	see group 12	

13 00 060 CHECKING ENGINE IDLE SPEED AND CO LEVEL

Cars with Catalytic Converter and Provisions for Cat. Conv. Operation

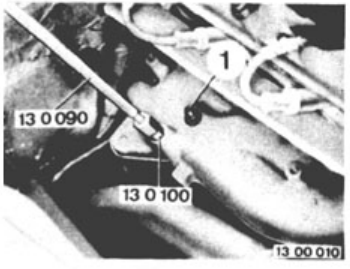
Engines with M 1.1 Motronic:
Identified on inductive sender on vibration damper with 58 teeth and one gap.

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temp. at least 60° C (140° F).
Valve clearance correct.
Engine and ignition in perfect running condition.
Connect BMW Service Tester to operating instructions.
A routine check is not necessary.

Important!
Also valid for cars with provisions for catalytic converter operation.
Adjustments must not be made on the air flow sensor control screw, since this adjustment is the basis for oxygen sensor and idle speed drive control.



13 41 017

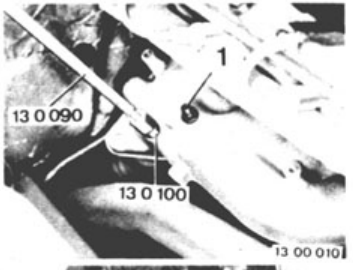


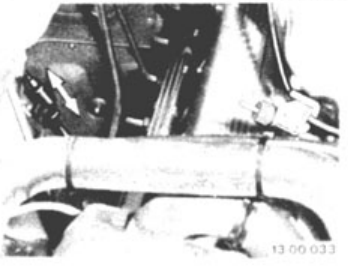
1) Engine Idle Speed
Check engine idle speed**.
See BMW diagnosing system, if the nominal value is not reached.
Check intake system for leaks.

Note:
There is no adjusting screw for idle speed regulation.

2) Emission Test
Disconnect oxygen sensor plug (not in cars with cat. conv. provisions).
Unscrew bolts (1).
Connect Special Tools 13 0 090 and 13 0 100 on exhaust manifold.
Check the idle speed CO level**.
Switch off exhaust extraction for time of testing.
CO Level Too High:
Check fuel injectors, fuel pressure and coolant temperature sensor.
CO Level Too Low:
Check hoses and connections for idle speed control and find air leaks.

** See Nominal Value Microfiche





Checking Function of Oxygen Sensor (11 78 010):

Unscrew bolt (1).
Connect Special Tools 13 0 090 and 13 0 100 on the exhaust manifold.
Switch off exhaust extraction for the time of testing.
Disconnect oxygen sensor plug.
Clamp vacuum hose leading to fuel pressure regulator (not while engine is running).
Start engine – CO level rises.
Connect oxygen sensor plug – CO level must go back to the nominal value.
Remove clamp.

13 00 060 CHECKING ENGINE IDLE SPEED AND CO LEVEL

Cars with Catalytic Converter and Provisions for Cat. Conv. Operation

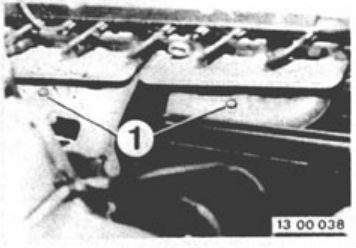
M 20 Engines with M 1.3 Motronic:
Identified on inductive sender on vibration damper with 58 teeth and one gap.

E 34 since beginning of standard production.
E 30 gradually since 3/88.
Control unit identification is possible with the BMW diagnosing system.**

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temp. at least 60° C (140° F).
Valve clearance correct.
Engine and ignition in perfect running condition.
Connect BMW Service Tester to operating instructions.
A routine check is not necessary.

Important!
Also valid for cars with provisions for catalytic converter operation.
Adjustments must not be made on the air flow sensor control screw, since this adjustment is the basis for oxygen sensor and idle speed drive control.


13 41 017

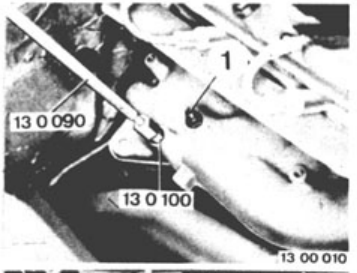


1) Engine Idle Speed
Check engine idle speed.**
See BMW diagnosing system, if the nominal value is not reached.
Check intake system for leaks.

Note:
There is no adjusting screw for idle speed regulation.

2) Emission Test
Disconnect oxygen sensor plug (not in cars with cat. conv. provisions).
Unscrew bolts (1).
Connect Special Tools 13 0 090 and 13 0 100 on exhaust manifold.
Check the idle speed CO level.**
Switch off exhaust extraction for time of testing.
CO Level Too High:
Check fuel injectors, fuel pressure and coolant temperature sensor.
CO Level Too Low:
Check hoses and connections for idle speed control and find air leaks.

**** See Nominal Value Microfiche**





Checking Function of Oxygen Sensor (11 78 010):

Unscrew bolt (1).
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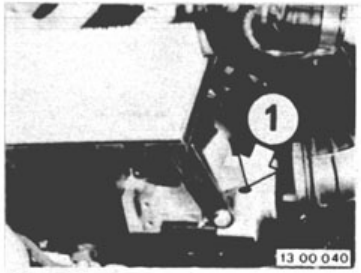
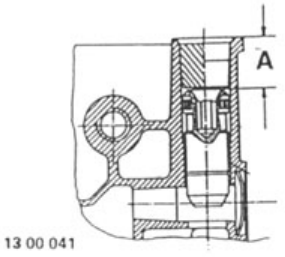
Switch off exhaust extraction for the time of testing.
Disconnect oxygen sensor plug.
Clamp vacuum hose leading to fuel pressure regulator (not while engine is running).
Start engine – CO level rises.
Connect oxygen sensor plug – CO level must go back to the nominal value.
Remove clamp.



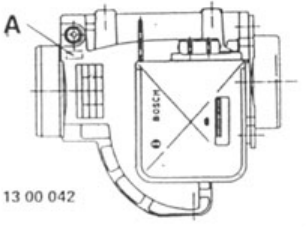
13 00 . . . ENGINE IDLE SPEED / CO LEVEL

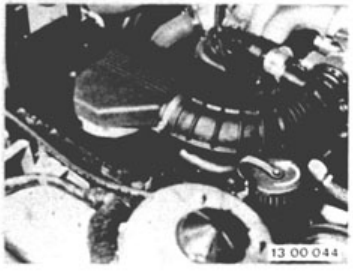
Only for Cars with Provisions for Cat. Converter Operation - M 1.1 Motronic Since 9.87 and M 1.3 Motronic (M 20):
If it is absolutely necessary to adjut the CO level/engine idle speed on air flow sensor control screw (1) or if the control screw was adjusted by mistake, the basic adjustment must be checked or made again when converting to catalytic converter operation or working on the fuel/air mixing system.



13 00 . . . CHECKING BASIC ADJUSTMENT OF AIR FLOW SENSOR CONTROL SCREW

Only for Cars with Provisions for Cat. Converter Operation (Anti-tamper Lock in Cars with Catalytic Converter) - M 1.1 Motronic Since 9.87 and M 1.3 Motronic (M 20):
Measure distance "A" on control screw with a depth gage and compare with value stamped on air flow sensor, adjusting if necessary.



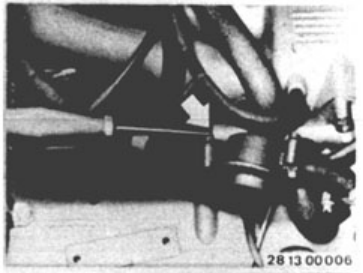


Corrections must never be made, if there is a fault in the fuel/air mixing system.
Read self-diagnosis.
Check for leaks in intake and fuel systems.
Check fuel injectors, temperature sensor and fuel pressure - also refer to 13 00 060.

13 00 054 ADJUSTING ENGINE IDLE SPEED

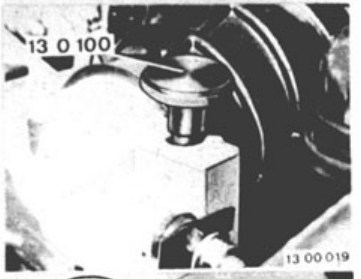
2.0 and 2.3 Ltr. Engines:

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
Ignition timing and valve clearance correct.
Air filter in perfect condition.
All electric consumers switched off.
Connect BMW Service Tester to operating instructions.
Switch off exhaust extraction system for time of emission test.



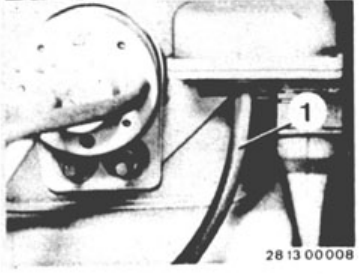
1) Engine Idle Speed

Adjust the engine idle speed* with the bypass screw in the bypass port.



2) Emission Test

First make sure that there are no faults in the engine, ignition or injection systems (see Troubleshooting) prior to correcting the CO level.
Remove cap with Special Tool 13 1 011.
Adjust the CO level* with Special Tool 13 1 100 applied on the bypass screw in the air flow sensor.

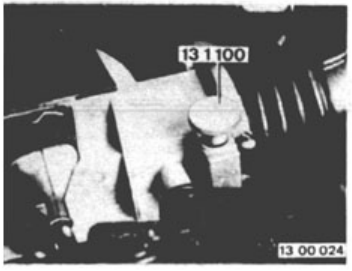


Checking Partial Load Enrichment (until 1984 Plant Shutdown):
Pull off vacuum hose (1) and plug opening – CO level must rise considerably (approx. 2.5 % by volume).

* See Nominal Value Microfiche

13 00 054 ADJUSTING ENGINE IDLE SPEED / EMISSION TEST (M 20 - 2.5 Ltr.)

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temp. at least 60° C (140° F).
Engine, ignition and injection in perfect running condition.
Valve clearance correct.
All electric consumers switched off.
Air filter cartridge in perfect condition.
Connect BMW Service Tester to operating instructions.



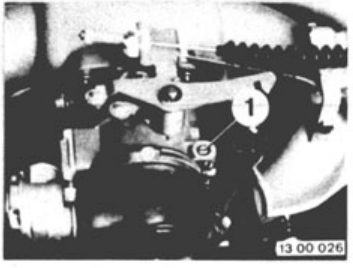
1) Engine Idle Speed
Check engine idle speed*.
Check idle speed control valve, if the nominal value is not reached.
Check or adjust basic setting.
Check intake system for leaks.

Note:
There is no adjusting screw for the engine idle speed.



BASIC ADJUSTMENT FOR IDLE SPEED CONTROL SYSTEM

Run engine at idle speed.
Pull off plug on throttle valve switch.
Apply Special Tool 13 4 010 or 13 4 020 in wire plug.
Idle speed control valve is now tight in basic adjustment position.



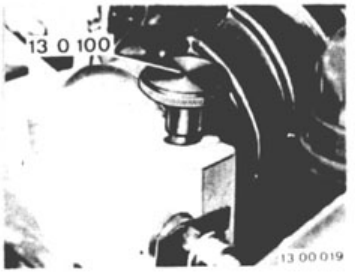
Remove anti-tamper lock.
Adjust engine speed to 760 ± 20 rpm with screw (1).
Install a new anti-tamper lock.

2) Emission Test
Remove anti-tamper lock with Special Tool 13 1 011.
Adjust the CO level* with Special Tool 13 1 100 applied on the bypass screw in the air flow sensor.
Install a new anti-tamper lock.

* See Nominal Value Microfiche

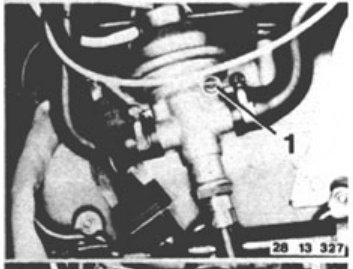
13 00 054 ADJUSTING ENGINE IDLE SPEED AND CO LEVEL (M 20, 2.7 Liter)

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least + 60° C (140° F).
Engine in perfect running condition.
Air filter cartridge in perfect condition.
All electric equipment switched off.
BMW SERVICE TESTER connected to operating instructions.
Exhaust extraction system switched off for time of testing.
Outside temperature above 0° C (32° F).



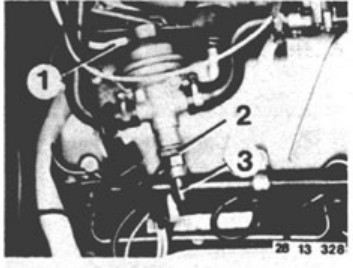
2) CO Level:

Make sure that there are no faults in the engine, ignition or injection systems before correcting the CO level.
Remove anti-tamper lock.
Adjust CO level* with Special Tool 13 1 100 applied on the air control screw in the air flow sensor.



1) Engine Idle Speed:

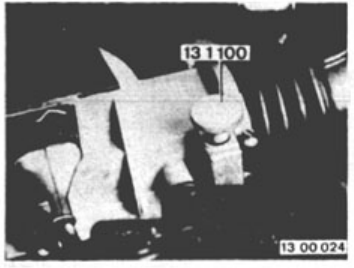
Adjust engine idle speed* with screw (1).



Running Up Speed:
Pull off hose (1) on idle speed control valve and plug openings.
Adjust running up speed* by loosening nut (2) and turning the thermo drive motor (3).
Tighten nut again.

* **See Nominal Value Microfiche and Specifications**

* **See Nominal Value Microfiche and Specifications**



13 00 054 ADJUSTING ENGINE IDLE SPEED / EMISSION TEST (Cars without Cat. Conv. – 525 e Since 1986 Models)

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temp. at least 60° C (140° F).
Ignition timing and valve clearance correct.
All electric consumers switched off.
BMW Service Tester connected to operating instructions.

1) Emission Test

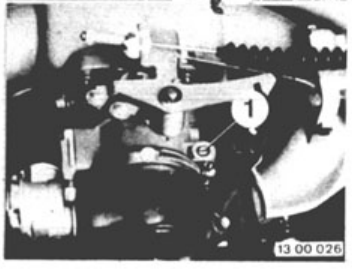
First make sure that there are no faults in the engine, ignition or injection before correcting the CO level.
Remove anti-tamper lock.
Adjust CO level* with Special Tool 13 1 100 applied on the bypass screw in the air flow sensor.
Install a new anti-tamper lock.

2) Engine Idle Speed

Check engine idle speed*.
Check the idle control valve, if the nominal value is not reached.
Check / adjust the basic setting.
Check intake system for leaks.

Note:
There is no adjusting screw for the idle speed.





BASIC SETTING FOR IDLE SPEED CONTROL SYSTEM

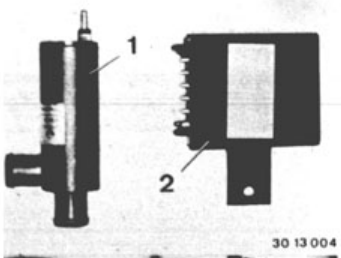
Run engine at idle speed.
Pull off plug on throttle valve switch.
Apply Special Tool 13 4 010 or 13 4 020 in wire plug.
Idle control valve is now tight in basic setting position.

Remove anti-tamper lock.
Adjust speed to 720 ± 20 rpm on screw (1).
Install new anti-tamper lock.
Pull off tool.
Connect plug on throttle valve switch.

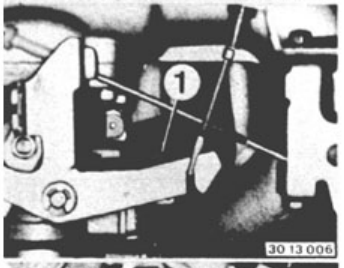
* See Nominal Value Microfiche

13 00 054 ADJUSTING ENGINE IDLE SPEED/EMISSION TEST (Cars with Catalytic Converter)

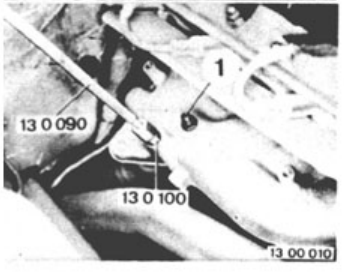
Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
Engine and ignition in perfect running condition.
Valve clearance correct.
All electric consumers switched off.
Connect BMW Service Tester to operating instructions.
Outside temperature above 0° C (32° F).



(BMW 325 e / US)
1) Checking Engine Idle Speed:**
If nominal value is not reached, check idle speed control valve (1) and idle speed control unit (2), replacing if necessary (see trouble-shooting idle speed regulation).
Note:
There is no adjusting screw for idle speed regulation.

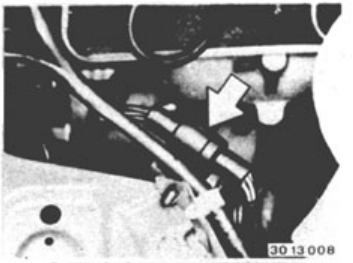


2) Emission Test:
Pull off hose (1) on throttle valve neck.
Plugs are not inserted in open connections.

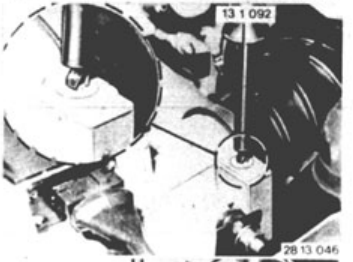


Unscrew screws (1).
Connect Special Tools 13 0 090 and 13 0 100 on exhaust manifold.
Check idle speed CO level.**
Important!
The adjusting screw on the air flow sensor in cars with M 1.1 Motronic (pulse sender on vibration damper) must not be turned.

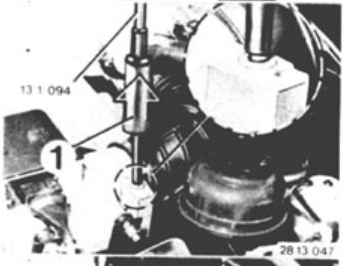
**** See Nominal Value Microfiche**



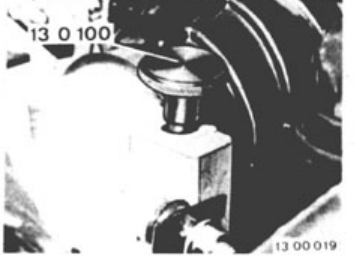
Disconnect oxygen sensor plug.



Drill hole in anti-tamper lock (1) with Special Tool 13 1 092.

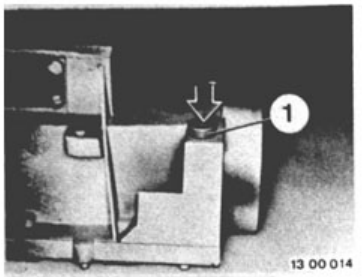


Screw Special Tool 13 1 094 in anti-tamper lock. Drive special tool and anti-tamper lock out of air flow sensor with impact (1).

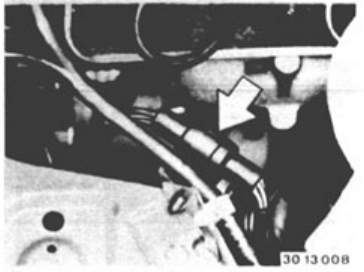


Adjust idle speed CO level* with Special Tool 13 1 100.
Make basic adjustment of idle control system.

*** See Nominal Value Microfiche**



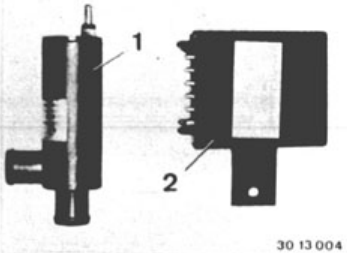
Install new anti-tamper lock (1) in air flow sensor.



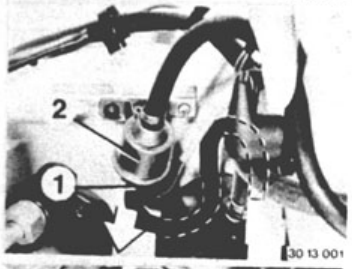
Connect oxygen sensor plug.

13 00 054 ADJUSTING ENGINE IDLE SPEED AND CO LEVEL (BMW 528 e / US)

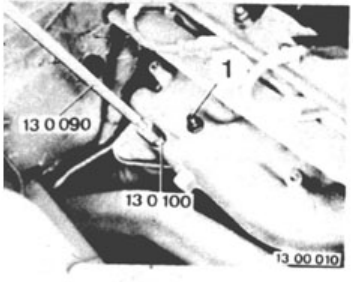
Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C (140 ° F).
Ignition timing and valve clearance okay.
All electric equipment switched off.
BMW SERVICE TESTER connected to operating instructions.
Outside temperature above 0° C (32° F).



1) Engine Idle Speed:
Check engine idle speed*.
If the nominal value is not reached, check idle speed control valve (1) and idle speed control unit (2), replacing if necessary.
Note:
There is no adjusting screw for the engine idle speed.



2) CO Level:
Pull off hose (1) on solenoid valve (2).
Connections remain unplugged (open).

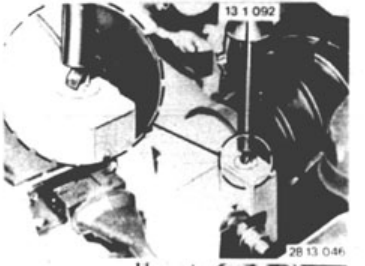


Unscrew screws (1).
Connect Special Tools 13 0 090 and 13 0 100 on the exhaust manifold.
Check idle speed CO level.**

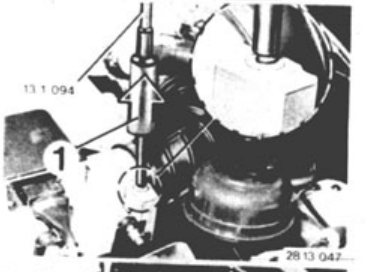
* **See Nominal Value Microfiche**



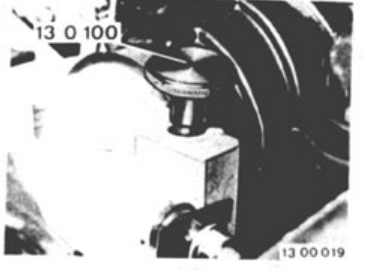
Disconnect oxygen sensor plug.



Drill hole in anti-tamper lock with Special Tool 13 1 092.

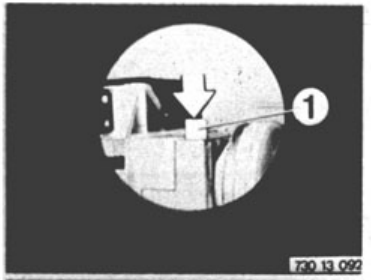


Screw Special Tool 13 1 094 into anti-tamper lock.
Drive special tool and anti-tamper lock out of the air flow sensor with impact (1).



Adjust idle speed CO level* with Special Tool 13 1 100.
Make basic adjustment of idle speed regulating system.

* **See Nominal Value Microfiche**



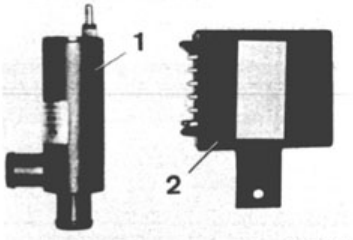
Install new anti-tamper lock (1) in air flow sensor.



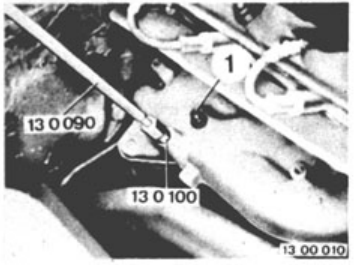
Connect oxygen sensor plug.

13 00 054 **ADJUSTING ENGINE IDLE SPEED AND CO LEVEL (BMW 325 e/ECE with Catalytic Converter)**

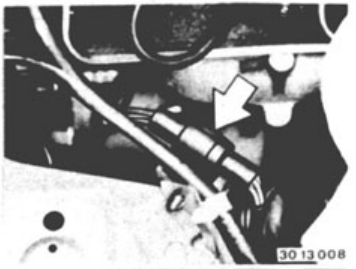
Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
Ignition timing and valve clearance okay.
All electric equipment switched off.
BMW SERVICE TESTER connected to operating instructions.
Outside temperature above 0° C (32° F).



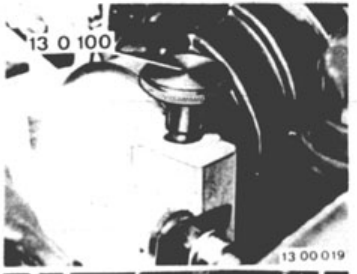
1) Engine Idle Speed:
Check engine idle speed*.
If the nominal value is not reached, check idle speed control valve (1) and idle speed control unit (2), replacing if necessary.
Note:
There is no adjusting screw for the engine idle speed.



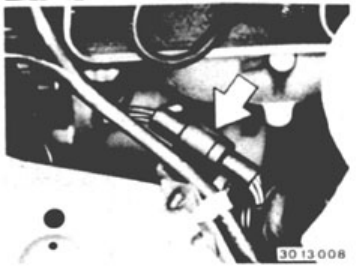
2) CO Level:
Unscrew screws (1).
Connect Special Tools 13 0 090 and 130 100 on the exhaust manifold.
Check idle speed CO level*.



Disconnect oxygen sensor plug.



Adjust CO level* with Special Tool 13 1 100 applied on air control screw in the air flow sensor.
Install a new anti-tamper lock after finishing adjustments.
Make basic adjustment of idle speed regulating system.



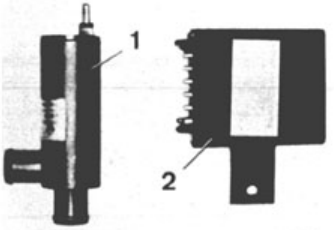
Connect oxygen sensor plug.

* **See Nominal Value Microfiche**

* **See Nominal Value Microfiche**

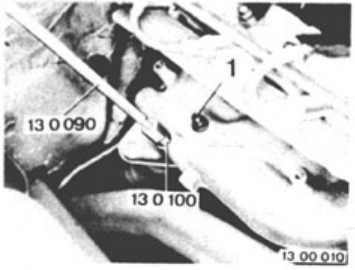
13 00 054 ADJUSTING ENGINE IDLE SPEED AND CO LEVEL (BMW 525 e/ECE with Catalytic Converter)

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
Ignition timing and valve clearance okay.
All electric equipment switched off.
BMW SERVICE TESTER connected to operating instructions.
Outside temperature above 0° C (32° F).

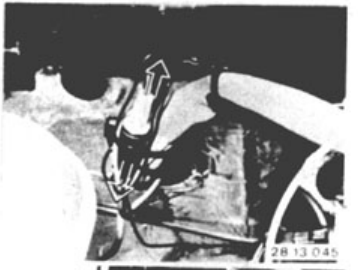


30 13 004

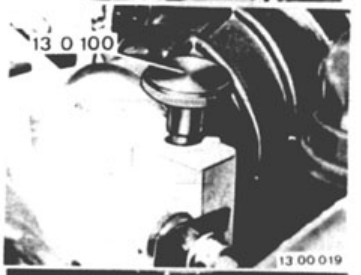
1) Engine Idle Speed:
Check engine idle speed*.
If the nominal value is not reached, check idle speed control valve (1) and idle speed control unit (2), replacing if necessary.
Note:
There is no adjusting screw for the engine idle speed.



2) CO Level:
Unscrew screws (1).
Connect Special Tools 13 0 090 and 13 0 100 on the exhaust manifold.
Check idle speed CO level*.



Disconnect oxygen sensor plug.



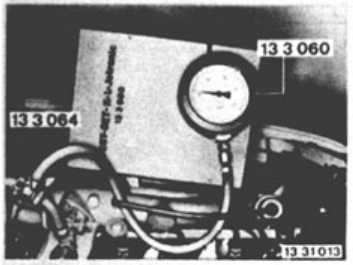
Adjust CO level* with Special Tool 13 1 100 applied on air control screw in the air flow sensor.
Install a new anti-tamper lock after finishing adjustments.
Make basic adjustment of idle speed regulating system.



Connect oxygen sensor plug.

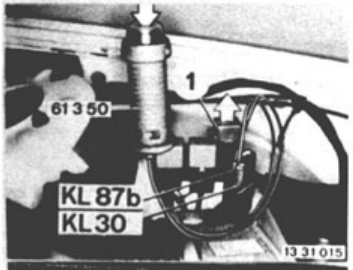
* **See Nominal Value Microfiche**

* **See Nominal Value Microfiche**



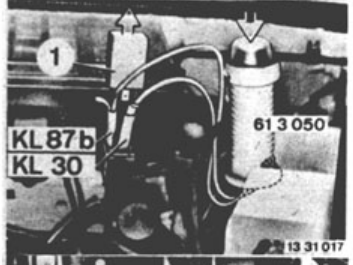
13 31 029 CHECKING FUEL DELIVERY PRESSURE (2.0 and 2.3 Liter)

Install pressure tester 13 3 060 together with connecting hose and Special Tool 13 3 064 in the fuel feed hose, in front of the fuel pressure regulator.
Plug fuel return hose with Special Tool 13 3 010.



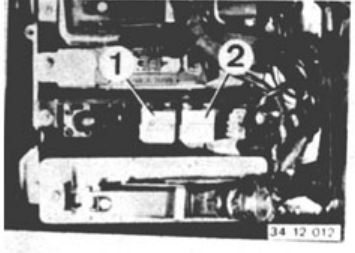
E 30

Pull off fuel pump relay (1).
Bridge terminals 87 b and 30 with Special Tool 61 3 050.
Check delivery pressure*.



E 28

Pull off fuel pump relay (1).
Bridge terminals 87 and 30 with Special Tool 61 3 050.
Check delivery pressure*.

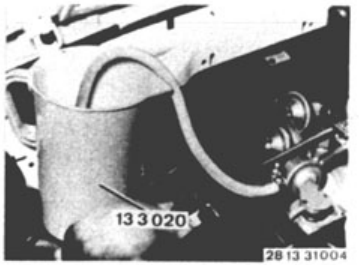


E 34

1 = Master relay
2 = Fuel pump relay

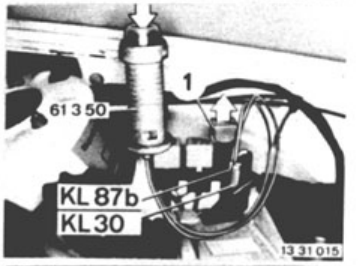
Pull off fuel pump relay (2).
Bridge terminals 87 b and 30 with Special Tool 61 3 050.
Check delivery pressure*.

* See Specifications of Gr. 16



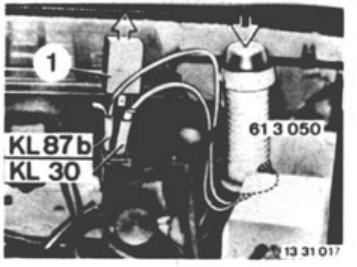
13 31 . . . CHECKING FUEL DELIVERY RATE

Disconnect fuel return hose and hold end of hose in a measuring glass, Special Tool 13 3 020.



E 30

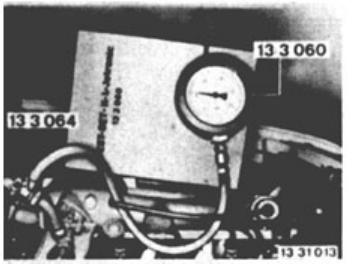
Pull off fuel pump relay (1).
Bridge terminals 87 b and 30 with Special Tool 61 3 050.
Check delivery rate*.



E 28

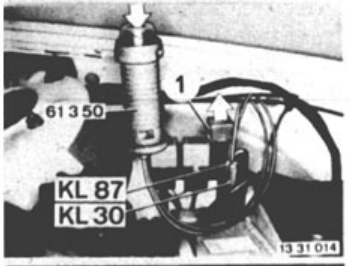
Pull off fuel pump relay (1).
Bridge terminals 87 b and 30 with Special Tool 61 3 050.
Check delivery rate*.

* See Specifications of Gr. 16



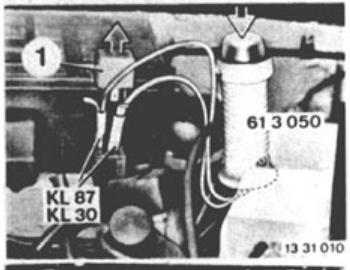
13 31 029 CHECKING FUEL DELIVERY PRESSURE (2.5 and 2.7 Liters)

Install pressure tester 13 3 060 together with a connecting hose and Special Tool 13 3 064 in the fuel feed hose, in front of the fuel pressure regulator.
Plug fuel return hose with Special Tool 13 3 010.



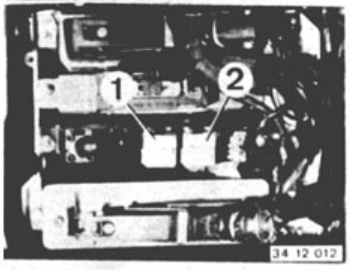
E 30

Pull off fuel pump relay (1).
Bridge terminals 87 and 30 with Special Tool 61 3 050.
Check delivery pressure*.



E 28

Pull off fuel pump relay (1).
Bridge terminals 87 and 30 with Special Tool 61 3 050.
Check delivery pressure*.



E 34

1 = Master relay
2 = Fuel pump relay

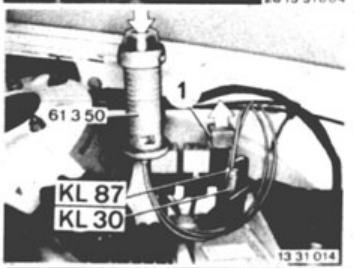
Pull off fuel pump relay (2).
Bridge terminals 87 b and 30 with Special Tool 61 3 050.
Check delivery pressure*.

* See Specifications of Gr. 16



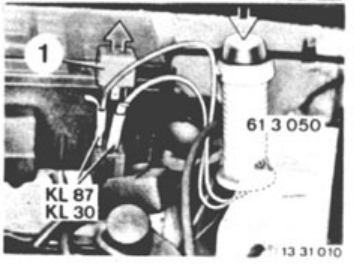
13 31 . . . CHECKING FUEL DELIVERY RATE

Unscrew fuel return hose and hold end of hose in a measuring glass, Special Tool 13 3 020.



E 30

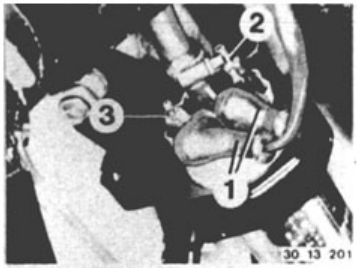
Pull off fuel pump relay (1).
Bridge terminals 87 and 30 with Special Tool 61 3 050.
Check delivery rate*.



E 28

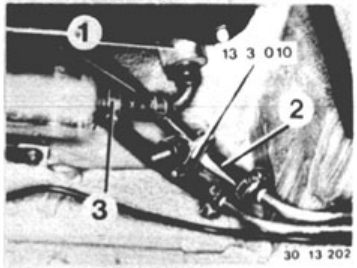
Pull off fuel pump relay (1).
Bridge terminals 87 and 30 with Special Tool 61 3 050.
Check delivery rate*.

* See Specifications of Gr. 16



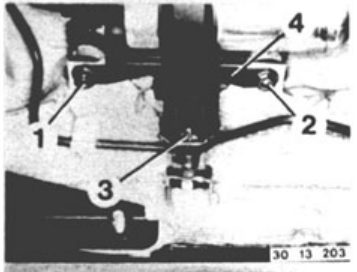
13 31 030 REMOVING AND INSTALLING FUEL PUMP

E 30:
Push back caps (1).
Unscrew nuts (2 and 3) and take off electric leads.



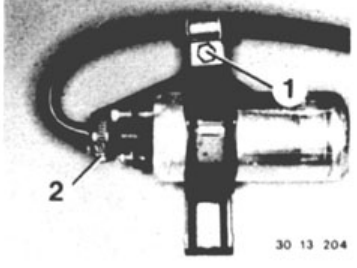
Clamp suction hose (1) and pressure hose (2) with Special Tool 13 3 010.
Loosen hose clamp (3) and pull off hoses.

Note:
Never use squeeze-hose clamps for installation of the pressure hose.

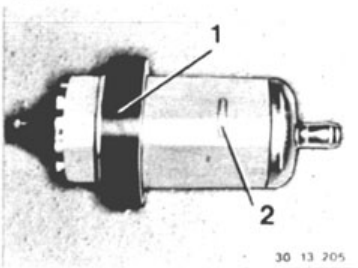


Unscrew nuts (1 ... 3) and take off holder (4).
Take off fuel pump with holder.

Installation:
Check rubber mounts, replacing if necessary.

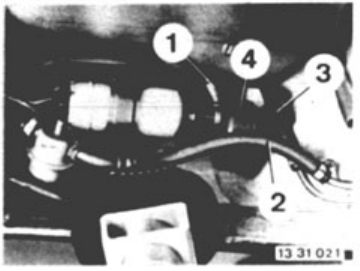


Unscrew bolt (1).
Loosen hose clamp (2) and pull off fuel hose.
Take fuel pump off of the holder.



Pull off rubber ring (1).

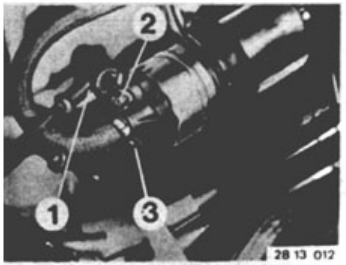
Installation:
Check code number (2)*.



Fuel Pump with Damper Chamber:
1 Suction hose
2 Pressure hose
3 Return hose
4 Damper chamber

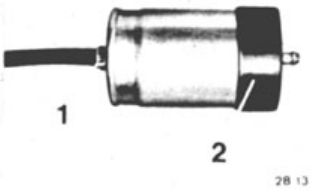
Intank fuel pump since 1988 models – see Group 16 in Model Repair Manual.

*** See Specifications**



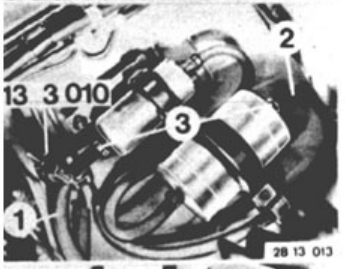
13 31 030 REMOVING AND INSTALLING FUEL PUMP

E 28:
Push back caps (1).
Unscrew nuts (2 and 3) and take off electric leads.



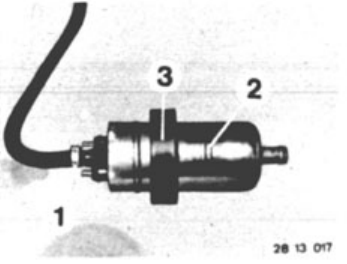
Loosen hose clamp (1) on fuel filter and pull off fuel hose.
Take off rubber ring (2).

Installation:
Inlet and outlet of filter are marked.



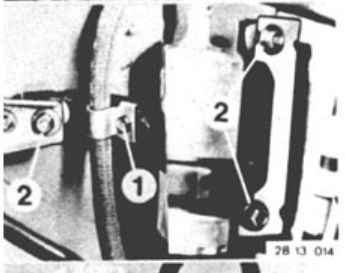
Clamp suction hose (1) and pressure hose (2) with Special Tool 13 3 010.
Loosen hose clamp (3) and pull off hoses.

Note:
Never use squeeze-hose clamps for installation of the pressure hose.

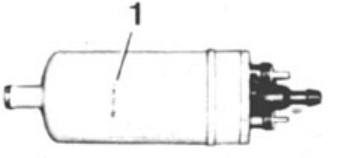


Loosen hose clamp (1) and fuel pump and pull off fuel hose.
Pull off rubber ring (3).

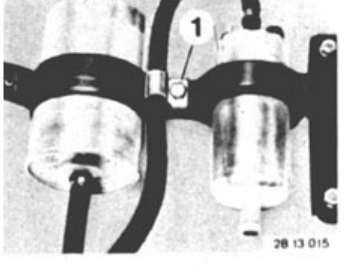
Installation:
Check code number (2)*.



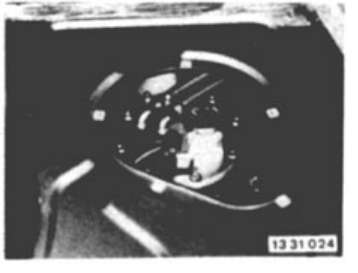
Unscrew bolt (1) and nuts (2).
Take off fuel pump with holder.



Installation:
Check code number (1)*.



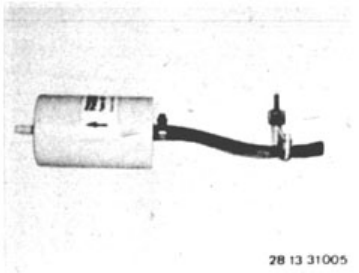
Unscrew bolt (1) and take off clamp.



13 31 . . . REMOVING AND INSTALLING FUEL PUMP

E 34:
Remove intank pump – see 16 12 . . . in the Model Repair Manual.

*** See Specifications**



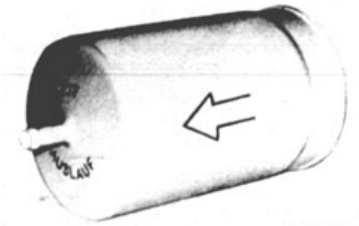
28 13 31005

13 32 051 REMOVING AND INSTALLING FUEL FILTER

E 30

Note:
Remove fuel filter with fuel feed hose and Special Tool 13 3 010.

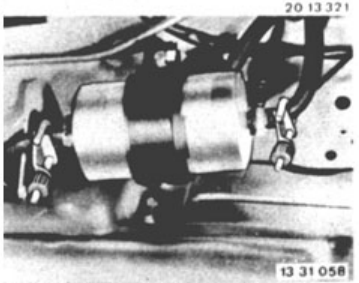
Installation:
Note direction of flow (arrow).



20 13 321

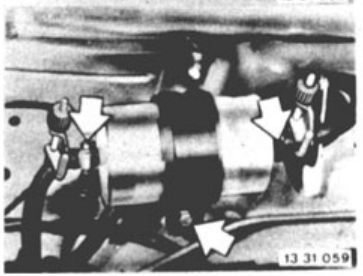
E 34

Unclamp hoses.



13 31 058

Unscrew bolts.
Pull off fuel filter.



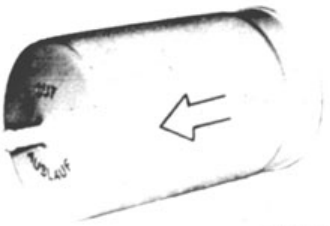
13 31 059

13 32 051 REMOVING AND INSTALLING FUEL FILTER

E 28

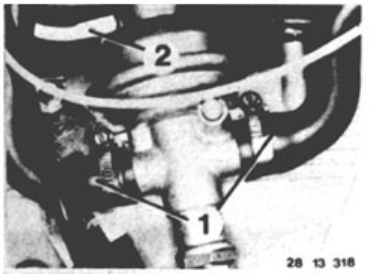
See "Removing and Installing Fuel Pump" 13 31 030.

Installation
Note direction of flow (arrow).

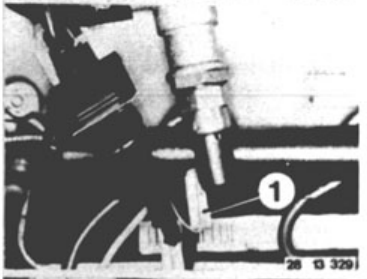


20 13 321

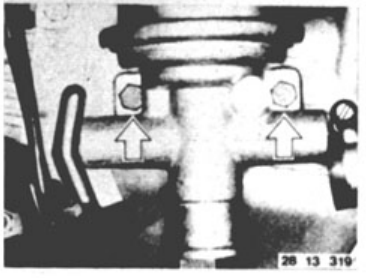
13 41 000 REMOVING AND INSTALLING (REPLACING) IDLE CONTROL VALVE



Disconnect air hoses (1).
Pull off vacuum hose (2).

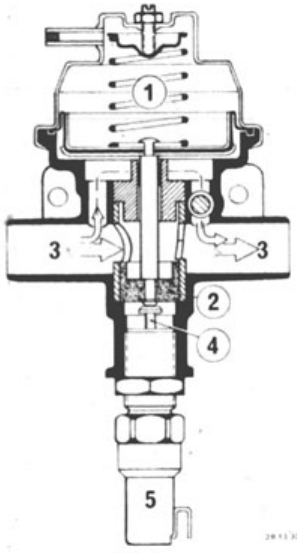


Pull off plug (1).



Unscrew screws and take off idle control valve.
Installation:
Adjust engine idle speed.

The idle speed regulation system consists of idle control valve, 0° C (32° F) air temperature switch, 45° C (113° F) coolant temperature switch and solenoid valve with lines.
The air conditioner switch is also used for activation.

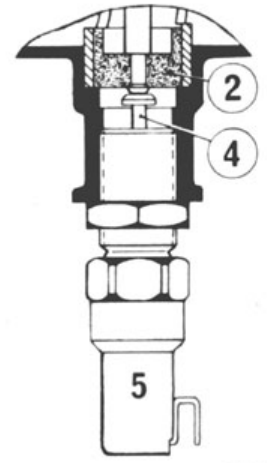


Regulating Unit

Task:
The engine idle speed is regulated by changing the air flow rate in bypass port (3) with valve (2) depending on the intake pressure.
Dropping absolute pressure = rising "vacuum".

Function:
Absolute pressure rises in the intake as engine speed drops.
This means less counterforce on spring (1) and activation of valve (2).
The cross section size of bypass port (3) increases and engine speed picks up.

Or:
Absolute pressure drops in the intake as engine speed rises.
This means greater counterforce on spring (1) and activation of valve (2).
The cross section size of bypass port (3) decreases and engine speed drops.

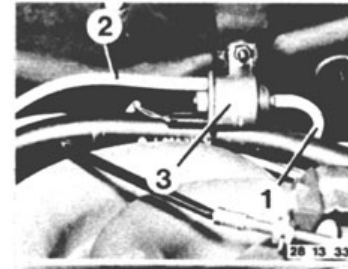


28 13 326

Thermo Operating Motor (5)

Task:
Regulation of engine idle speed with air conditioner switched on and/or coolant temperature below 45° C (113° F) and/or air temperature below 0° C (32° F).
With these operating conditions there is no intake pressure influence on the idle control valve and there is no regulation.

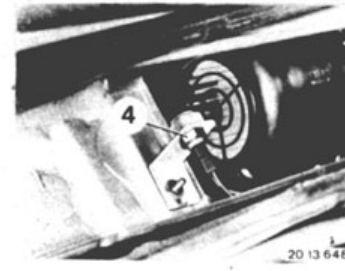
Function:
Depending on temperature of thermo operating motor (5) air valve (2) is lifted by piston (4) and closes part of the bypass port opening.
The remaining bypass port opening determines the air flow rate and consequently the engine speed*.



28 13 330

Solenoid Valve (3)

Task:
Switching supply of intake pressure to idle control valve on and off.
Venting the idle control valve.



20 13 648

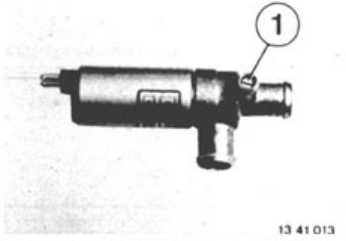
Function:
The solenoid valve receives voltage with the air conditioner switched on and/or coolant temperature below 45° C (113° F) and/or temperature of air below 0° C (32° F).
Pressure line (1) to intake is closed.
Pressure line (2) to idle control valve is vented.
4 = 0° C (32° F) air temperature switch

* See Specifications + Nom. Value Microfiche

13 41 . . . MAKING BASIC ADJUSTMENT OF VDO IDLE CONTROL SYSTEM

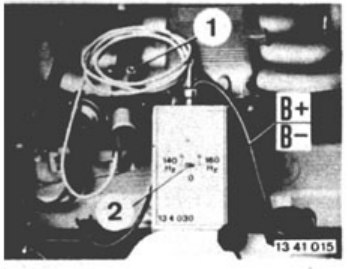
Requirements:
- Engine at operating temperature, i.e. oil temperature at least 60° C (140° F)
- Ignition timing and valve clearance correct.
- Air filter cartridge in perfect condition.
- All electric equipment switched off.
- Idle CO level correct.

Note:
Basic adjustments are not made at certain intervals.



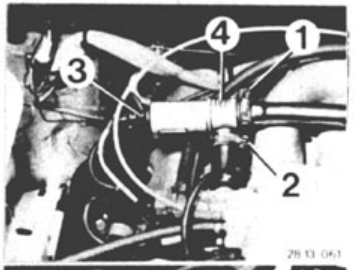
13 41 013

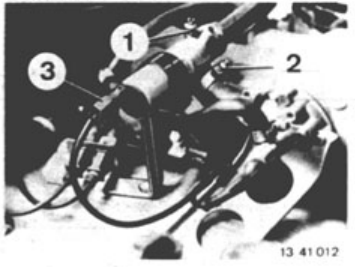
Basic adjustments can only be made with application of the illustrated metal valve. This metal valve can be installed retroactively on a general basis.
1 = Basic adjustment screw



Connect tester 13 4 030 on car battery (B+/B–) and idle control valve.
Set switch (2) to 140 Hz.
Connect speed tester (BMW service tester).
Run engine at idle speed.
Adjust idle speed to 700 ± 50 rpm with basic adjustment screw (1).

Remove tester 13 4 030.
Connect plug from engine wire harness on idle control valve again.





13 41 000 REMOVING AND INSTALLING IDLE CONTROL VALVE

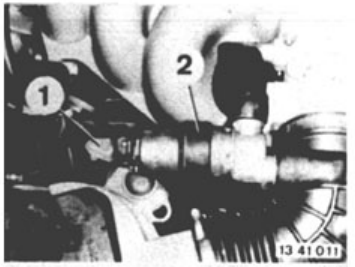
Loosen hose straps (1 and 2).
Pull off plug (3).
Remove idle control valve.
Installation:
Check code number (4)*.
Check idle speed*.

Idle Control Valve with Adjusting Screw:

Disconnect retaining strap.
Loosen hose straps (1 and 2).
Pull off plug (3).
Remove idle control valve.
Installation:
Make basic adjustment.

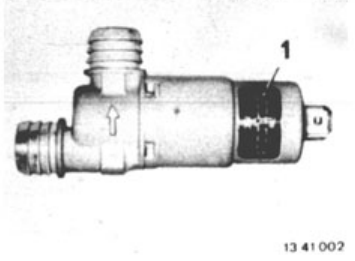
Checking Idle Control Valve:
Apply battery voltage on idle control valve.
Idle control valve must close and be tight.
Idle control valve should be open when without voltage.

* See Specifications and Nominal Values



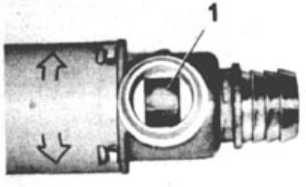
13 41 000 REMOVING AND INSTALLING IDLE SPEED CONTROL VALVE (M 20 B 20 ME-520 i / E 34) (M 20 B 25 ME-325 i/525i / E 34) (M 20 B 27 ME-525 e since 9.85)

Pull of plug (1).
Disconnect retaining strap (2).
Pull idle speed control valve off of hoses and remove.



Installation:
Check code number (1)*.
Check engine idle speed*.

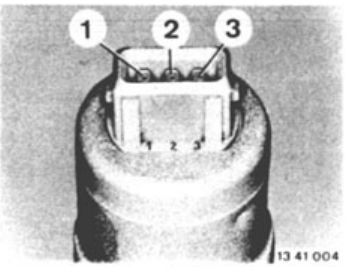
Note:
Check whether idle speed control valve is working by taking hold of it in the hand (the timed power supply will be felt).



<u>Mechanical Test:</u>

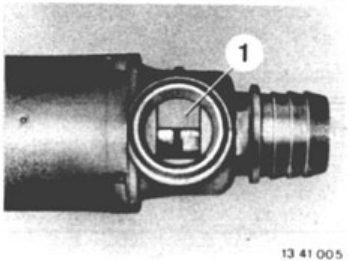
Erratic turning of the idle speed control valve must cause the rotary piston (1) in the idle speed control valve to move.

* See Specifications and Nominal Value Microfiche



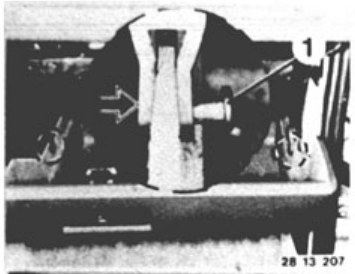
<u>Electric Test:</u>

Measure resistance between terminals (1 and 3).
Nominal value: approx. 40 ohms.
Measure resistance between terminals (2 and 1) or (2 and 3).
Nominal value for each: approx. 20 ohms.



<u>Dynamic Test:</u>

Remove idle speed control valve (plug remains connected).
Open or close rotary piston (1) completely.
Turn on ignition.
Rotary piston must move to and remain in a position of approx. 50 % open.

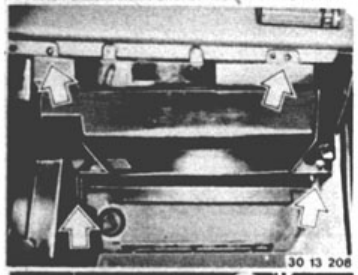


13 41 010 REMOVING AND INSTALLING CONTROL UNIT FOR IDLE CONTROL VALVE

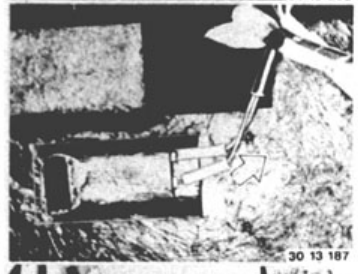
E 30

Open glove box.

Pull out pins (1) of both retaining straps.

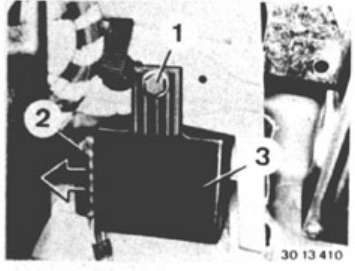


Unscrew screws and take off trim.



Pull off both plugs of glove box light.

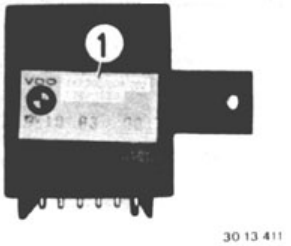
Place trim aside.

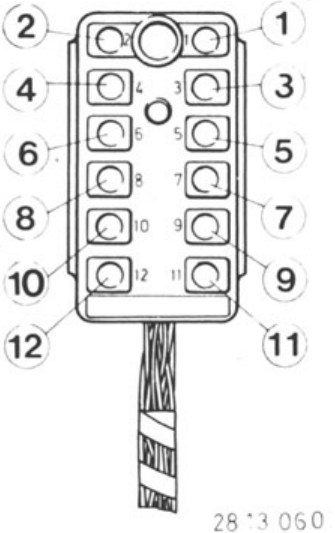


Unscrew screw (1).

Pull off plug (2).

Remove control unit (3).





Installation:

Check code number (1)*.

Check idle speed*.

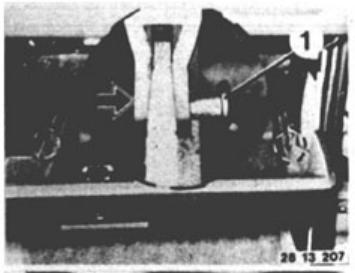
Multiple Pin Plug Connections:

No.	mm²	Color	Connection To
1	0.75	BLRT	Idle control valve A
2	1.5	GNGE	Terminal 15
3	1.0	GN	DME control unit (pin 8)
4	1.5	BR	Terminal 31
5	0.75	BLSW	Idle control valve B
6	0.5	WS	Temp. switch 45°C/113°F
7	0.5	BLBR	Conn. transm. N
8	–	–	–
9	0.5	BLWS	Air conditioner
10	0.5	BLGN	Air temperature switch
11	0.5	BRRT	DME control unit (pin 13)
12	0.5	BRBL	DME control unit (pin 2)

Wire Colors:

BL = blue
BR = brown
GE = yellow
GN = green
RT = red
SW = black
WS = white

* See Specifications + Nom. Value Microfiche

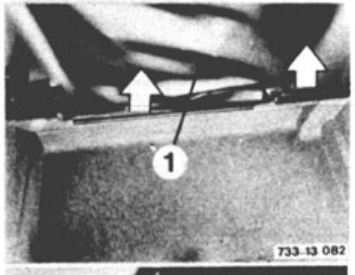


13 41 010 REMOVING AND INSTALLING CONTROL UNIT FOR IDLE CONTROL VALVE

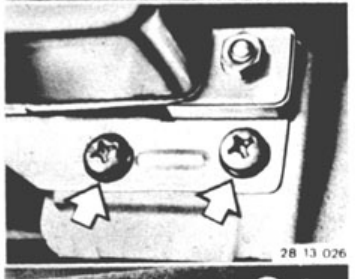
E 28

Open glove box.

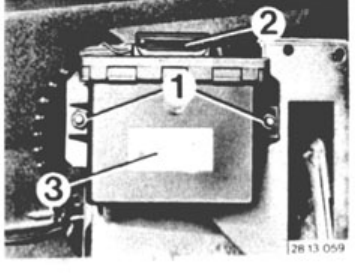
Pull out pins (1) of both retaining straps.



Disconnect cover (1).



Unscrew both screws on left and right sides of control unit.



Unscrew nuts (1).

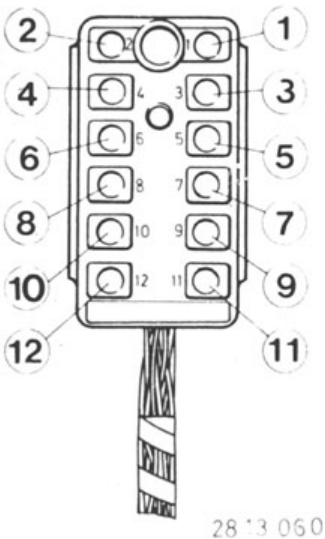
Pull off multiple pin plug (2).

Remove control unit.

Installation:

Check code number (3)*.

Check idle speed*.



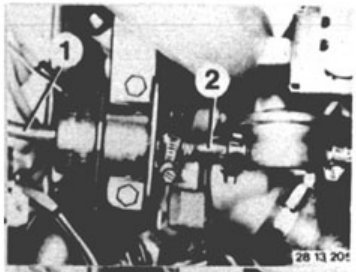
Multiple Pin Plug Connections:

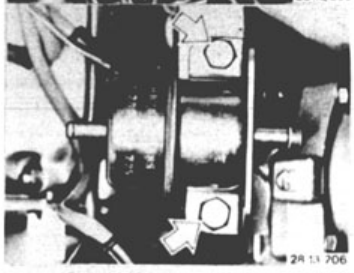
No.	mm²	Color	Connection To
1	0.5	BLRT	Idle control valve A
2	0.5	GNGE	Terminal 15
3	1.0	GN	DME control unit (pin 8)
4	0.5	BR	Terminal 31
5	0.5	BLSW	Idle control valve B
6	0.5	WS	Temp. switch 45°C/113°F
7	0.5	BLBR	Conn. transm. P
8	0.5	BLGE	Conn. transm. N
9	0.5	BLWS	Air conditioner
10	0.5	BLGN	Air temp. switch
11	0.5	BRRT	DME control unit (pin 13)
12	0.5	BRBL	DME control unit (pin 2)

Wire Colors:

BL = blue
BR = brown
GE = yellow
GN = green
RT = red
SW = black
WS = white

* See Specifications + Nom. Value Microfiche

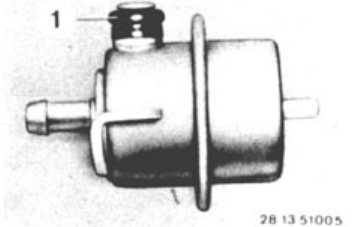




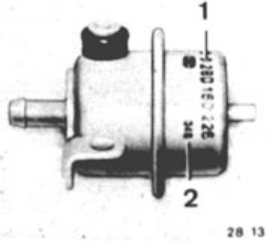
13 51 200 REMOVING AND INSTALLING FUEL PRESSURE REGULATOR

Disconnect air hose (1) and fuel hose (2).

Unscrew screws.
Take off fuel pressure regulator.



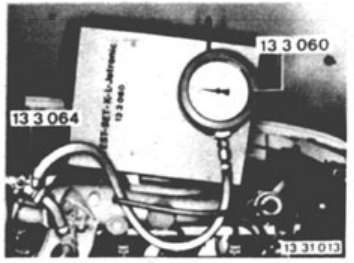
Installation:
Check seal (1), replacing if necessary.



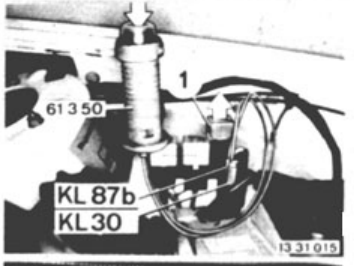
Installation:
Check code number (1)*.

(2) = Manufacturing date

* See Specifications

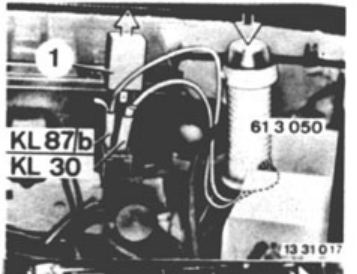


Checking:
Install pressure tester 13 3 060 with a connecting hose and Special Tool 13 3 064 in the fuel feed hose, in front of the pressure regulator.



E 30

Pull off fuel pump relay (1).
Bridge terminals 87 b and 30 with Special Tool 61 3 050.
Fuel injection pressure*.



E 28

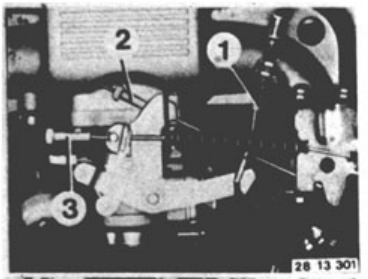
Pull off fuel pump relay (1).
Bridge terminals 87 b and 30 with Special Tool 61 3 050.
Fuel injection pressure*.



E 34

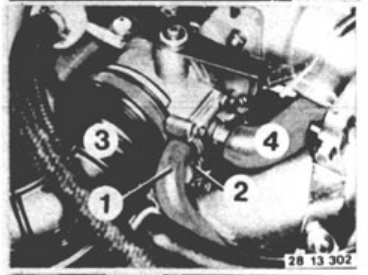
Pull off fuel pump relay (2).
Bridge terminals 87 b and 30 with Special Tool 61 3 050.
Fuel injection pressure*.

*See Specifications or Nominal Value



13 54 030 REMOVING AND INSTALLING THROTTLE HOUSING

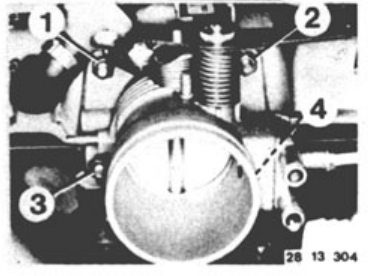
(2.0 ... 2.7 Liter Engines)
1 = Automatic transmission
2 = Accelerator pedal
3 = Cruise control
Installation:
Adjust cables – see Groups 24/35/65.



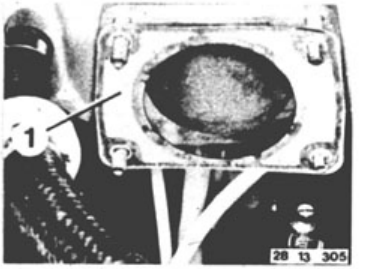
Disconnect water hose (1 and 2).
Disconnect air hoses (3 and 4).
Installation:
Fill and bleed cooling system .



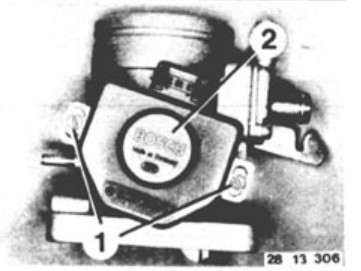
Pull off multiple pin plug (1) on throttle switch.
Pull off vacuum hose (2).



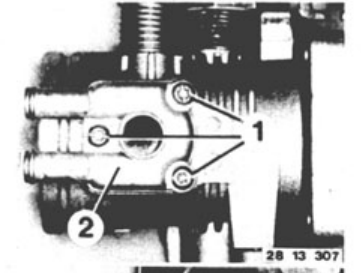
Unscrew nuts (1 ... 4) and remove throttle housing (nut 4 is not shown in picture).



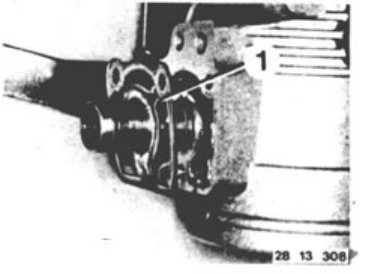
Installation:
Replace gasket (1).



Unscrew screws (1).
Remove throttle switch (2).
Installation:
Adjust throttle switch.

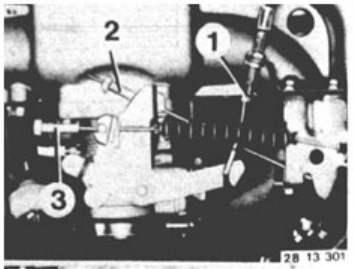


Unscrew screws (1) and take off cover (2).



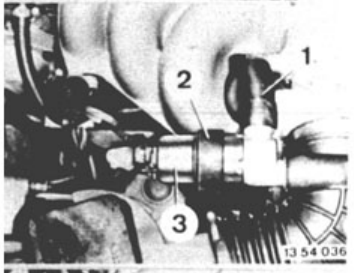
Installation:
Replace gasket (1).
Check engine idle speed* and CO*.

* See Nominal Value Microfiche

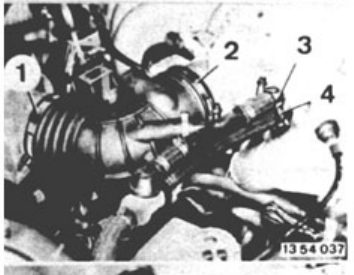


13 54 030 REMOVING AND INSTALLING THROTTLE VALVE NECKS (325 i and 525 e since 9.85/ M 20 - E 34)

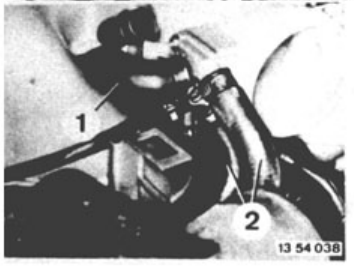
Disconnect cables (1 ... 3).
1 = Automatic transmission
2 = Accelerator pedal
3 = Cruise control
Installation:
Adjust cables - see Groups 24/35/65.



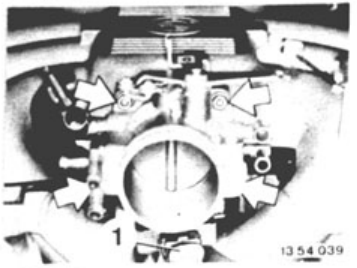
Disconnect retaining strap (2).
Take off and place aside idle speed control valve (3) together with hose (1).



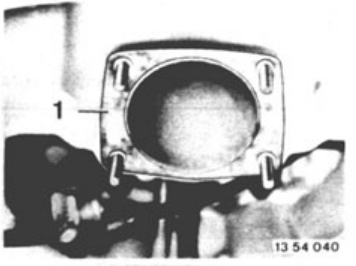
Loosen hose clamps (1 ... 4).
Place intake hose and air hose for brake booster aside.



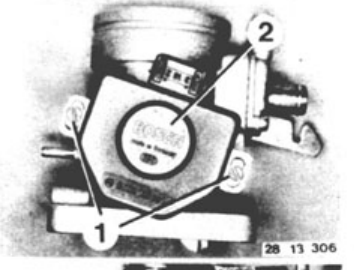
Disconnect air hose (1).
Disconnect and plug coolant hoses (2).
Installation:
Fill and bleed cooling system - see Gr. 17.



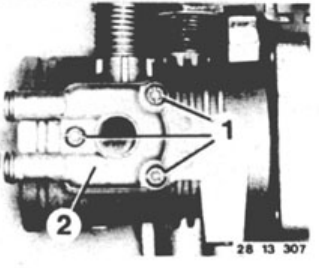
Pull off plug (1) on throttle valve switch.
Unscrew four screws.
Take off throttle valve neck.



Installation:
Replace gasket (1).

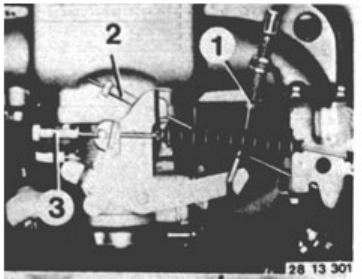


Unscrew screws (1).
Take off throttle valve switch (2).
Installation:
Adjust throttle valve switch.



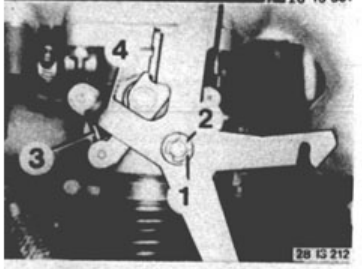
Unscrew screws (1) and take off cover (2).
Installation:
Replace gasket.
Check engine idle speed* and CO level*.

* See Nominal Value Microfiche

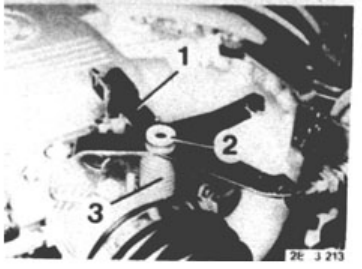


13 54 051 REPLACING THROTTLE SHAFT RETURN SPRING

Disconnect cables (1 ... 3).
1 = Automatic transmission
2 = Accelerator pedal
3 = Cruise control
Installation:
Adjust cables – see Groups 24/35/65.



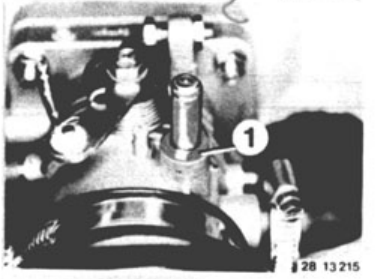
Remove retainer (1).
Take off washer (2).
Disconnect linkage (3) on lever (4).



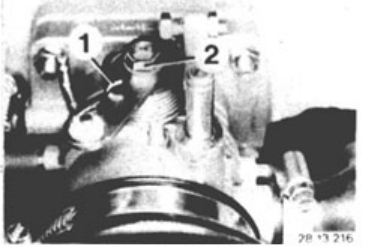
Lift and turn lever (1) to release tension of spring (3).
Take off lever (1).
Installation:
Check bearing sleeves (2), replacing if necessary.
Check spring pre-load.



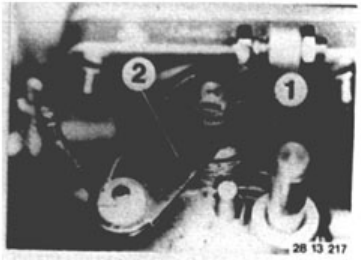
Take off spring (1).



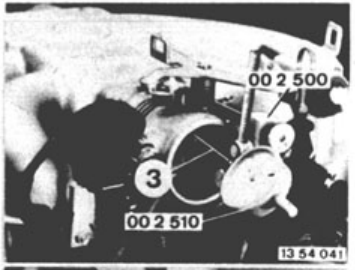
Note:
Check spring washer (1).



Disconnect spring (1).
Unscrew nut (2).
Installation:
Check spring pre-load.

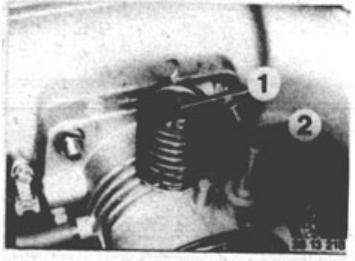


Take off washer (1) and lever (2).

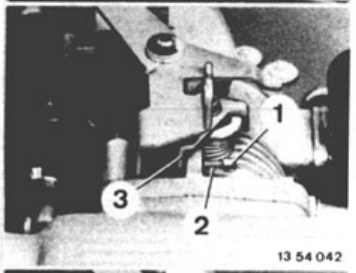


Basic Throttle Valve Adjustment:

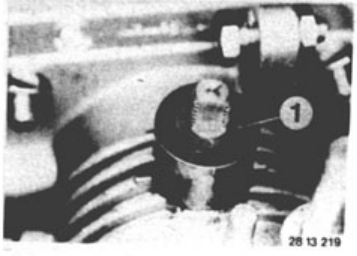
Disconnect air hose on throttle valve neck.
Mount Special Tool 00 2 510 (with extension no. 3) and Special Tool 00 2 500 on the throttle valve neck.
Apply tip of dial gage with preload on edge of throttle valve.



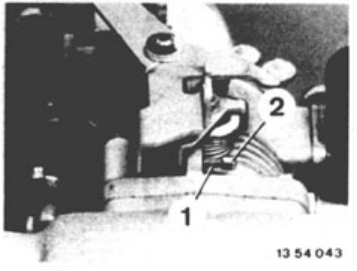
Take off sleeve (1) and spring (2).



Pull off anti-tamper lock (1) and loosen screw (2) until lever (3) no longer bears on screw (2).
Tighten screw (2) again until throttle valve begins to move.



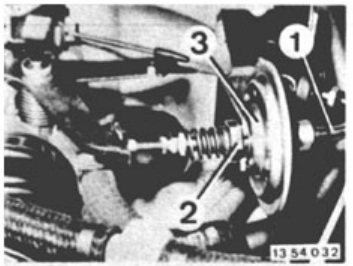
Note corrugated washer (1) and washer (2).

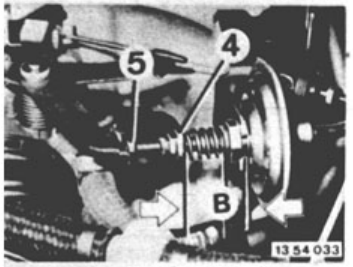


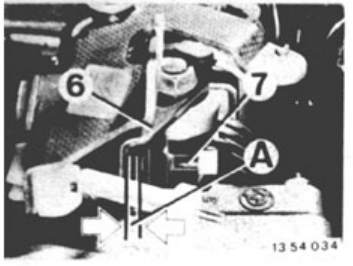
Open throttle valve further by 0.2 - 0.05 mm (0.008 - 0.002") with screw (1).
Lock screw with paint.
Install anti-tamper lock (2).
Open and close throttle valve several times after adjusting to make sure that the throttle valve does not stick.

Check adjustment of throttle valve switch.
Check engine idle speed* and CO level*.

* See Nominal Value Microfiche





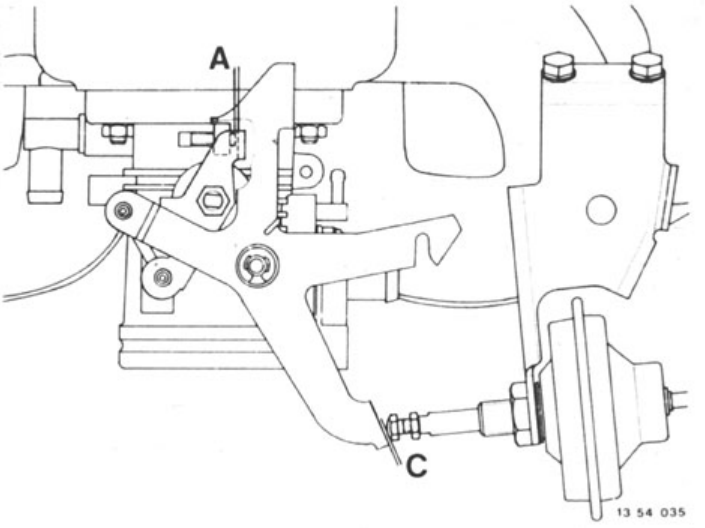


13 54 130 REPLACING / ADJUSTING VACUUM CONTROL FOR THROTTLE VALVE

Pull off hose (1).
Loosen nut (2).
Take off vacuum control (3).

Installation:
Adjust spring distance B = 33 ± 0.3 mm (1.299 ± 0.012") with screw (4).
Adjust distance (A) with screw (5).

A is distance measured between lever (6) and idle stop screw (7) with vacuum control run out.

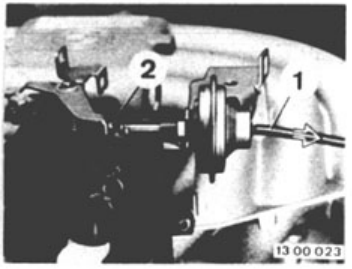


M 20 B 20 and M 20 B 23: A = 3.5 ± 0.1 mm (0.138 ± 0.004")

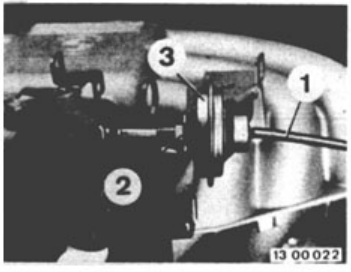
Distance (C) ≙ 1 mm (0.039") is measured with control unit pulled back.

13 54 130 CHECKING/ADJUSTING/REPLACING VACUUM CONTROL FOR THROTTLE VALVE (M 20 B 25 ME 6 – 325 i - 4 All Wheel Drive)

The throttle valve positioner in 325 i-4 (all wheel drive) cars only operates the throttle valve briefly during the control phase of the ABS control unit.
The throttle valve positioner combines with the control phase of ABS – releasing of brakes – locking of wheels through braking torque of engine, by way of operation of the throttle valve.
Depressing the clutch pedal stops operation of the throttle valve positioner (clutch pedal switch).

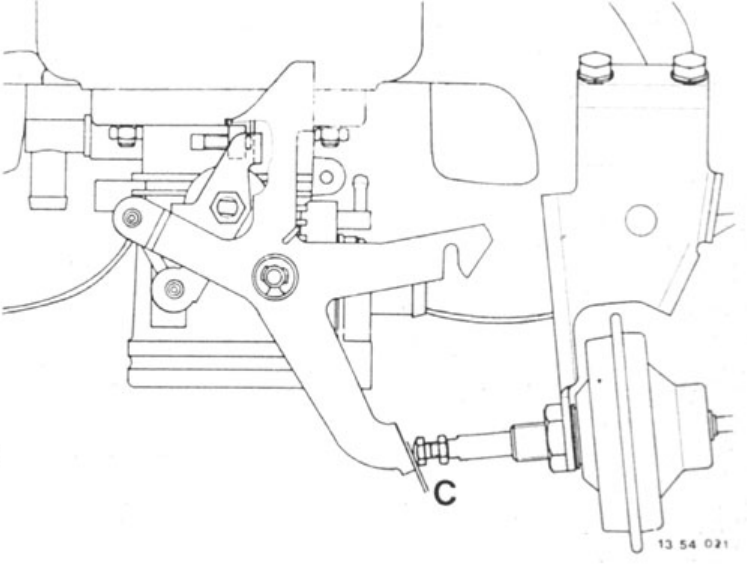


Pull off vacuum hose (1) and plug manifold connection.
Adjust engine speed to 2400 ± 50 rpm with screw (2).
Lock screw (2) again.
After brief acceleration the speed must always remain within tolerances.
Connect vacuum hose again.

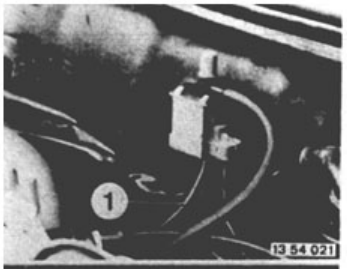


Replacing:
Pull off vacuum hose (1).
Unscrew nut (2).
Take off vacuum control.
Check location of lock washer between vacuum control and bracket.

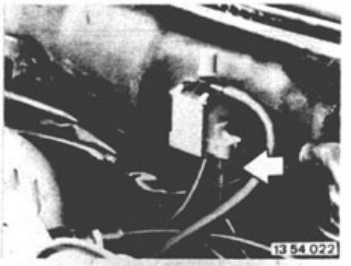
Check distance C.
Distance C is ≥ 1 mm (0.039") when measured with pulled back vacuum control.



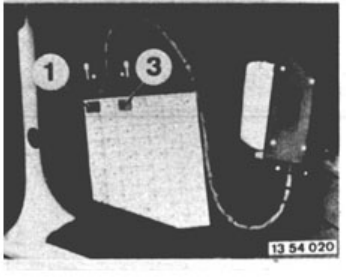
Adjusting:
Requirements:
Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
All electric equipment switched off.
CO level and idle speed basic adjustment correct.
Tachometer (BMW service tester) connected.



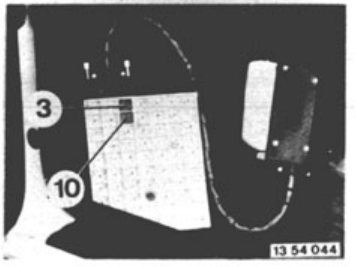
Checking:
Pull off vacuum hose (1).
Connect vacuum pump.
Throttle valve positioner runs in.



Electric Test:
Pull off plug on solenoid valve.
Check resistance (27.5 to 36 ohms) on solenoid valve.



Connect universal adapter on wire harness of ABS control unit.
Bridge terminals 1 and 3.
Turn on ignition.
Throttle valve positioner runs out.



Electric Test (with Wire and Plug Connections):
Connect universal adapter on wire harness of ABS control unit.
Connect ohmmeter between 3 and 10.
Nominal value: 27.5 to 36 ohms.

13 61 . . . PRINTED CIRCUIT SWITCH

With several DME control units a printed circuit switch makes it possible to correct the ignition timing and fuel/air mixture in relatively tight tolerances over the entire engine load range. Adjustments must only be made, if the fuel grade is not correct or the mixture has to be adapted after fully exploiting all other known measures. An unjustified adjustment would lead to unsatisfactory handling and excessive fuel consumption. An increase in power output is not possible with the printed circuit switch.

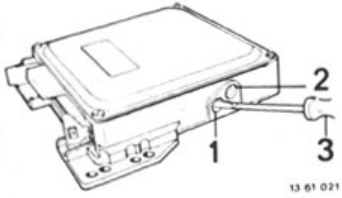
Ignition Timing Correction

If fuel grade is insufficient, the ignition timing can be retarded over the entire performance curve in order to avoid pinging or knocking. This ignition timing change will automatically cause higher fuel consumption.
Consequently the ignition timing should be set back to the basic adjustment as soon as this is permitted by the fuel grade.

Mixture Correction

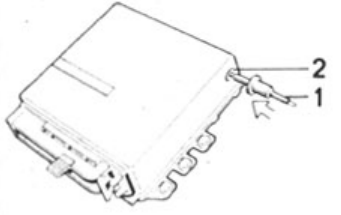
The printed circuit switch permits correction of the mixture over the entire performance curve, in contradiction to the mixture control screw.
A mixture correction is only justified, when there is guarantee that there is no defect in the engine, fuel injection or ignition.

Adjusting Printed Circuit Switch: -- Remove control unit 13 61 000.



13 61 021

Molded Housing:
Remove anti-tamper lock (1) carefully with a screwdriver (3).
Make sure that the printed circuit switch is not subjected to impact.
2 = Diode

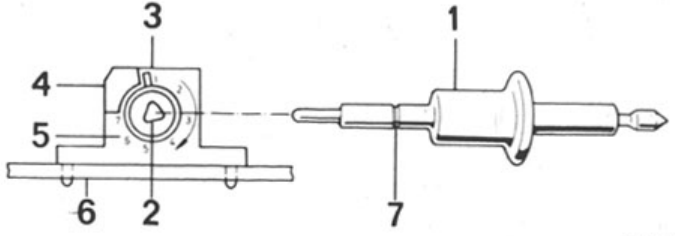


13 61 022

Metal Housing:
Press tool (1) fully into anti-tamper lock (2).
Pull anti-tamper lock (2) out of housing with tool (1).

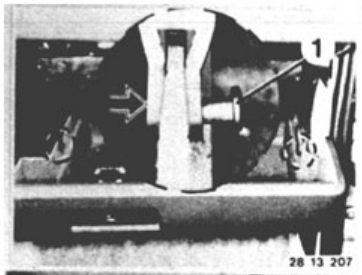
Adjusting:
Only use Special Tool 12 4 010 for adjustments.
Turn printed circuit switch carefully against the left stop.
Count number of catches, if already maladjusted.
See technical data on page 13 - 406a for switch positions and corresponding correction values.
Count switch positions beginning at left stop, making sure that the switch catches and is not in an intermediate position.
Check adjustment with BMW service tester and a test drive.
Install a new (red) cap after finishing adjustments.
Note:
BMW installs blue or black anti-tamper locks (also the manufacturers of control units).

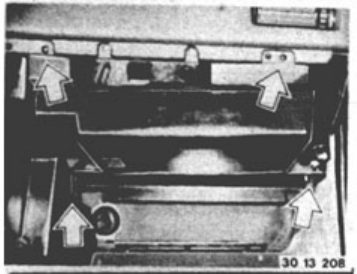
See page 13 - 406a of Technical Data for control values belonging to the switch steps.

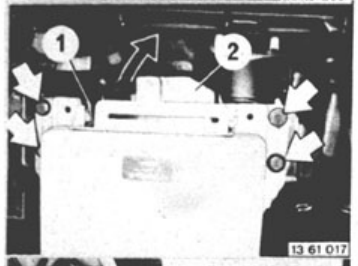


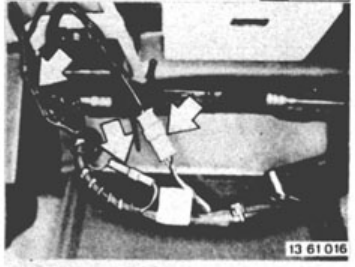
13 61 020

1 = Tool
2 = Bore
3 = Basic setting (left stop)
4 = Stop
5 = Switch positions
6 = Printed circuit board
7 = Nominal break point



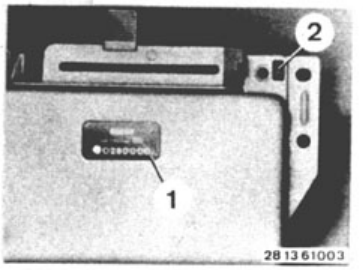




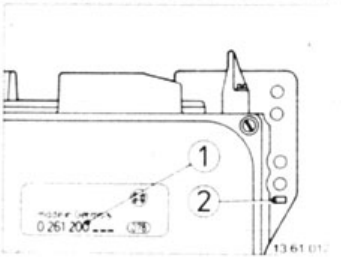


13 61 000 REMOVING AND INSTALLING CONTROL UNIT

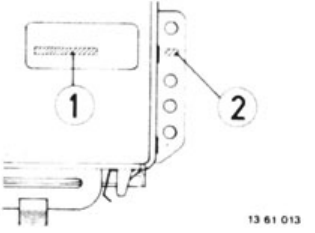
E 30:
Open glove box.
Pull off pins (1) of both retaining straps.



Unscrew trim panel.



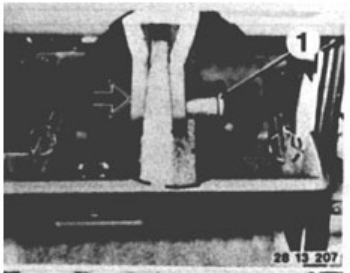
Push back lock (1) and pull off plug (2).
Unscrew four mounting bolts and take out control unit.



See wiring diagram for plug connections.

Installation:
Check code number (1)* and manufacturing date (2)*.
Check / adjust engine idle speed* and idle speed CO level*.

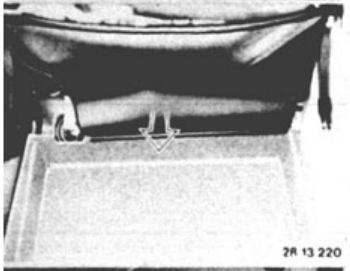
* See Specifications + Nom. Value Microfiche



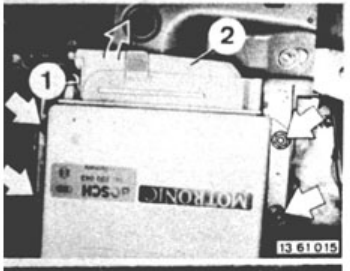
13 61 000 REMOVING AND INSTALLING CONTROL UNIT

E 28

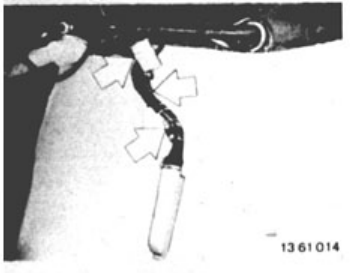
Open glove box.
Pull off shaft (1) of both retaining straps.



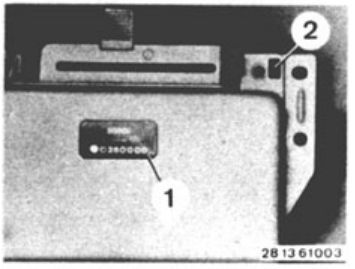
Take out trim panel.

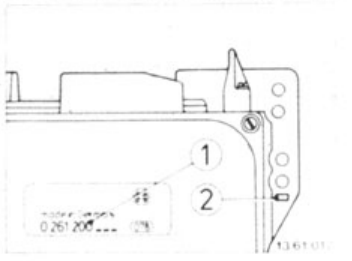


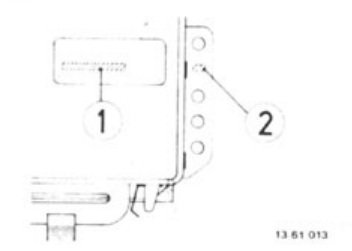
Push back retainer (1) and pull off plug (2).
Unscrew four mounting screws and take off control unit.



Plug connections - see wiring diagram in Group 12.







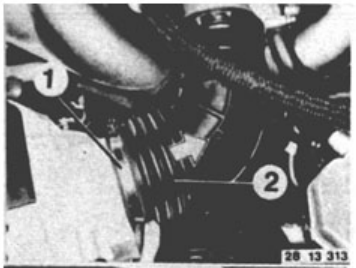
Installation:
Check code number (1)* and manufacturing date (2)*.
Check and adjust idle speed CO level*.

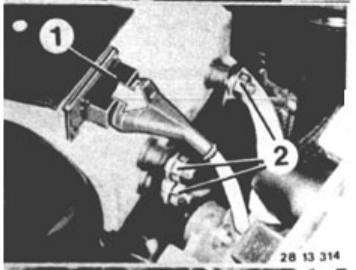
13 61 . . . REMOVING AND INSTALLING CONTROL UNIT

E 34

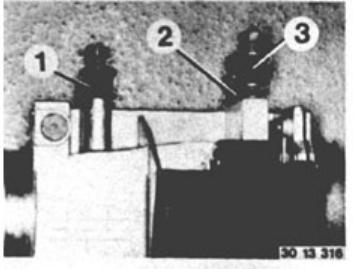
See M 30.

* See Specifications and Nominal Value Microfiche



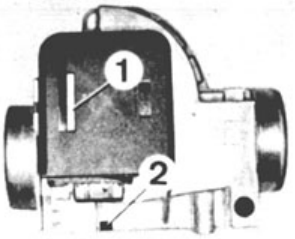






13 62 000 REMOVING AND INSTALLING AIR FLOW SENSOR

Loosen hose clamp (1) and pul air hose off of air flow sensor.



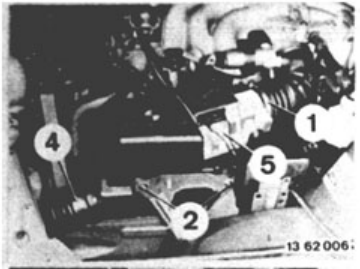
Pull off plug (1).
Unscrew nut (2) and take off air flow sensor.

Installation:
Check seal (1), replacing if necessary.

Unscrew dampers (1 ... 3) on air flow sensor.
Check dampers, replacing if necessary.

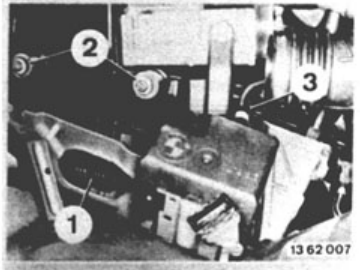
Installation:
Check code number (1)* and manufacturing date (2)*.
Check engine idle speed* and idle speed CO level*.
Check air flow sensor*.

* **See Specifications and Nominal Value Microfiche**

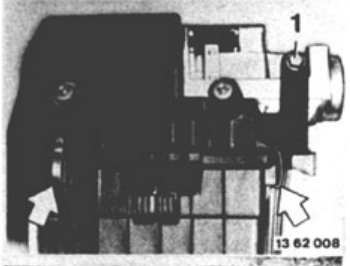


13 62 000 REMOVING AND INSTALLING AIR FLOW SENSOR
(M 20 B 20 ME-520 i / E 34)
(M 20 B 25 ME-325 i/525 i/E 34)
(M 20 B 27 ME-325 e/525 e since 9.85)

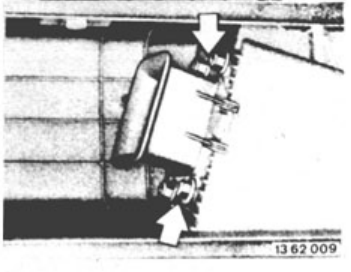
Loosen hose clamp (1)-
Loosen nuts (2).
Pull off hose (4).
Pull off plug (5).



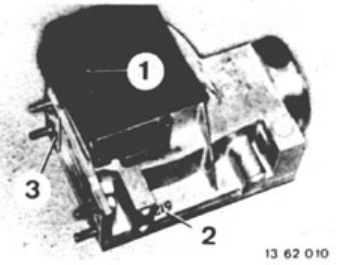
Cut off strap (3).
Take off complete air cleaner.
Installation:
Check rubber mount (1) and dampers (2) and also for correct seating.



Open fasteners (four).
Unscrew screw (1).
Separate housing sections.

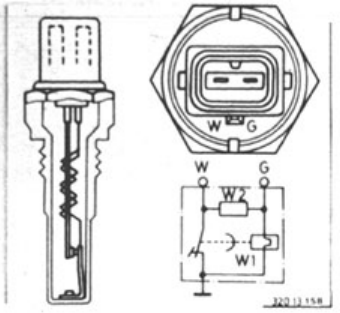


Unscrew nuts.



Installation:
Check code number (1)* and manufacturing date (2)*.
Check engine idle speed* and idle speed CO level*.
Check gasket (3).
Check air flow sensor*.

* **See Specifications and Nominal Value Microfiche**

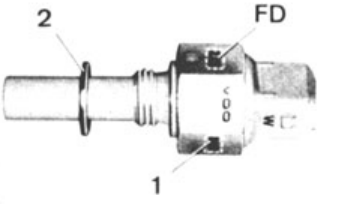


13 62 050 REMOVING AND INSTALLING/ CHECKING TEMPERATURE TIME SWITCH

The temperature time switch regulates the open time of the cold start valve according to coolant temperature.
The open time (e.g. 8 sec.) and switching off temperature (e.g. + 35° C = 95° F) are stamped in the hexagon.



Removing and Installing:
Pull off plug (1).
Unscrew temperature time switch.
Installation:
Tightening torque*.



Installation:
Check code number (1)*.
Replace seal (2).
FD = Manufacturing date
Fill and bleed cooling system (Gr. 17).

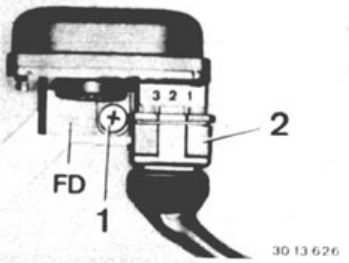


Checking:
Connect Jetronic test lead 61 1 440.
Check nominal value* with an ohmmeter.
To check the entire temperature range, remove temperature sensor and place it in a water bath heated to testing temperature.
Check resistance* with an ohmmeter.

* See Specifications

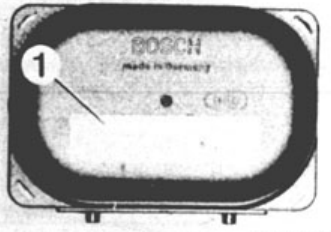
* See Specifications

13 62 080 REMOVING AND INSTALLING/ CHECKING PRESSURE SENSOR



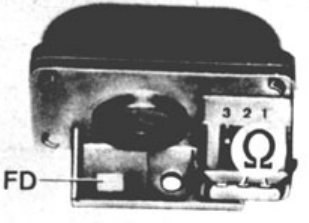
30 13 626

Pull off plug (1).
Unscrew screw (2) and remove pressure sensor.
FD = Manufacturing date



30 13 627

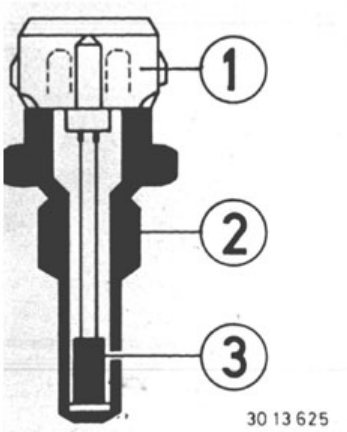
Installation:
Check code number (1)*.



30 13 628

Checking:
There should be approximately 0 ohm between plug connections (1 and 2) with ≤ 880 mbar atmospheric pressure.
There should be approximately ∞ ohms between plug connections (1 and 2) with ≥ 930 mbar atmospheric pressure.

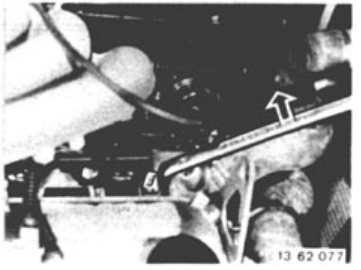
* See Specifications



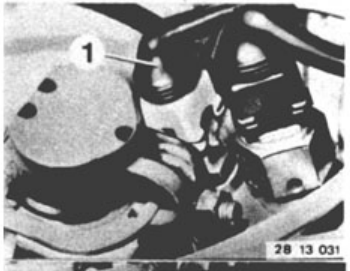
13 62 531 REMOVING AND INSTALLING/ CHECKING COOLANT TEMPERATURE SENSOR

The temperature sensor measures the engine temperature and sends this information in the form of a resistance value to the control unit.
The resistance value drops with rising temperature (NTC).

1 = Plug connection
2 = Housing
3 = NTC resistor

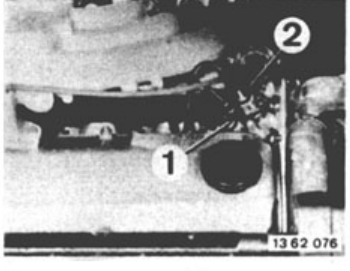


Unscrew temperature sender (2).
Unscrew temperature sensor (1).



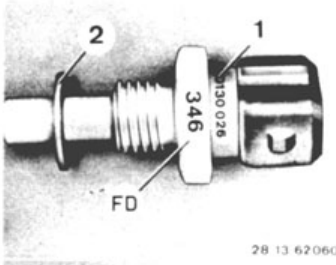
Removing and Installing:

Pull off plug (1).
Unscrew temperature sensor.
Installation:
Tightening torque*.

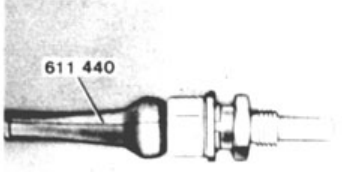


E 34 - M 20

Pull off plugs (1 and 2).
Lift fuel injector plug rail slightly.



Installation:
Check code number (1)*.
Replace seal (2).
FD = Manufacturing date.
Fill and bleed cooling system - see Gr. 17.

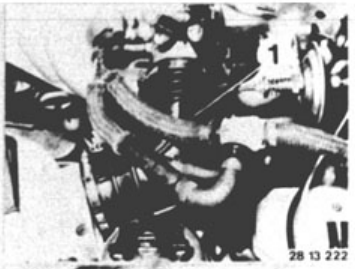


Checking:
Connect Jetronic test leads 61 1 440.
Check nominal value* with an ohmmeter.
If the entire temperature range has to be checked, remove temperature sensor, place it in a water bath heated to testing temperature and check resistance* with an ohmmeter.

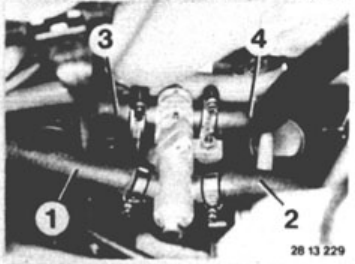
* See Specifications

* See Specifications

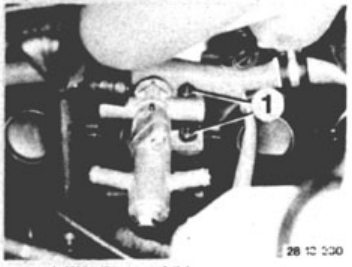
13 63 060 REMOVING AND INSTALLING THROTTLE BYPASS VALVE



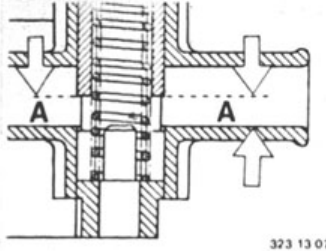
Remove intake cowl (1).



Disconnect water hoses (1 and 2).
Disconnect air hoses (3 and 4).
Installation:
Check coolant level, correcting if necessary.
Bleed cooling system.



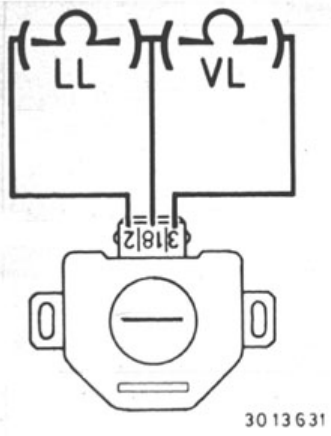
Unscrew nuts (1).
Take throttle bypass valve off of holder.



Checking:
Check distance (A)* on removed valve.

Testing:
There should be no noticeable change in speed of an engine having operating temperature after pinching the air hose between the throttle bypass valve and air intake.
There should be a drop in speed of a cold engine when pinching the air hose between the throttle bypass valve and air intake.

* See Specifications

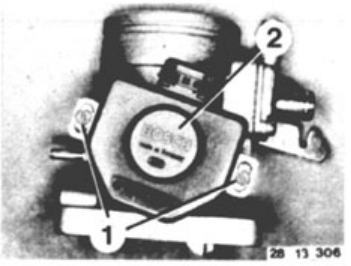


30 13 631

13 63 544 ADJUSTING THROTTLE VALVE SWITCH

Checking Throttle Valve Switch:
There should be approximately 0 ohm between connections 2 and 18 with the throttle valve closed.
There should be approximately infinite ohms between connections 3 and 18 with the throttle valve wide open.

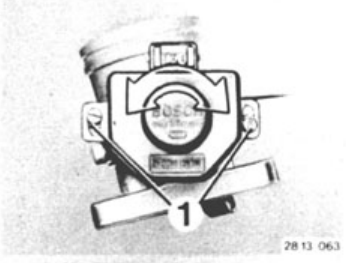
LL = Idle speed
VL = Full load



28 13 306

13 63 551 REMOVING AND INSTALLING THROTTLE VALVE SWITCH

Remove throttle valve neck - see 13 54 030.
Unscrew screws (1).
Take off throttle valve switch (2).



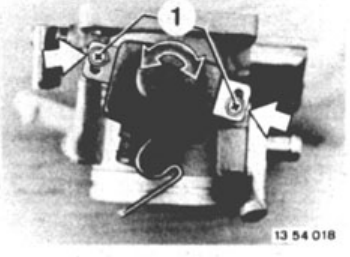
28 13 063

Adjusting (Throttle Valve Neck Removed):
There must be approximately 0 ohm between connections 2 and 18 with the throttle valve closed.
Adjust by loosening screws (1) and turning the throttle valve switch.
Open throttle valve after adjusting - resistance should rise immediately to infinite ohms.
Resistance must drop back to approximately 0 ohm when releasing the throttle valve.



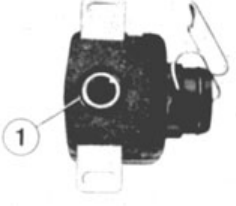
30 13 456

Installation
Check code number (1)*.
Adjust throttle valve switch - see 13 63 544.



13 54 018

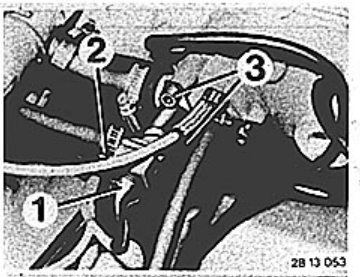
Cars with Independent Electronic Transmission Control:
Adjust as described above.
Check points between plug sockets 4 and 6.



13 54 019

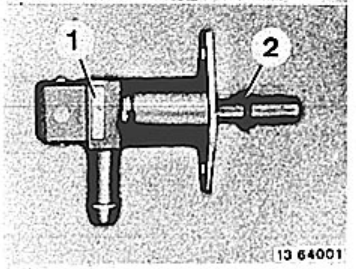
Cars with Independent Electronic Transmission Control:
Check O-ring (1), replacing if necessary.

* **See Specifications**



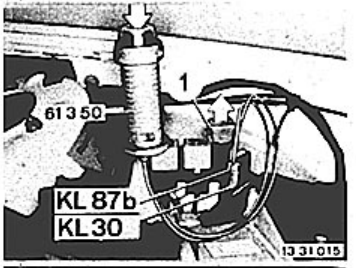
13 64 030 REMOVING AND INSTALLING/ CHECKING COLD START VALVE

Removing and Installing:
Pull off plug (1).
Disconnect fuel line (2).
Unscrew screws (3).
Remove cold start valve.



Installation:
Check code number (1)*.
Replace seal (2).

Checking:
Unscrew cold start valve on intake housing.
Fuel line remains connected.

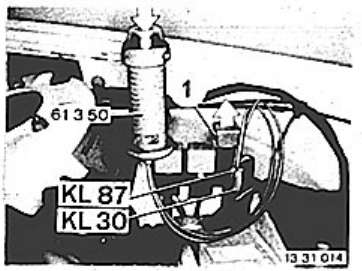


Checking:
L-Jetronic / E 30:
Pull off fuel pump relay (1).
Bridge terminals 87b and 30 with Special Tool 61 3 050.
Check delivery pressure*.

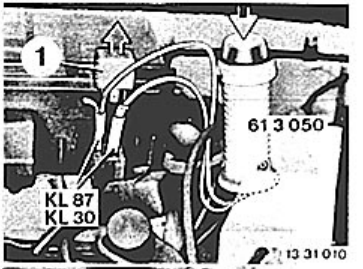


L-Jetronic / E 28:
Pull off fuel pump relay (1).
Bridge terminals 87b and 30 with Special Tool 61 3 050.
Check delivery pressure*.

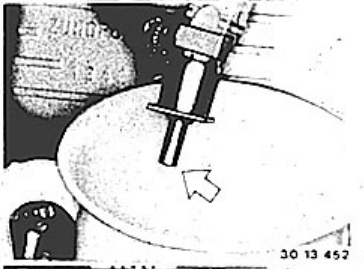
* See Specifications



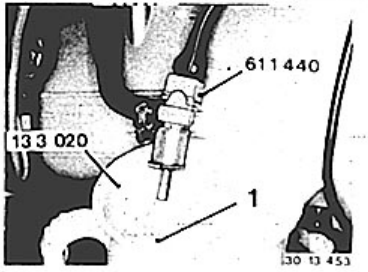
Digital Motor Electronics / E 30:
Pull off fuel pump relay (1).
Bridge terminals 87 and 30 with Special Tool 61 3 050.
Check delivery rate*.



Digital Motor Electronics / E 28:
Pull off fuel pump relay (1).
Bridge terminals 87 and 30 with Special Tool 61 3 050.
Check delivery rate*.

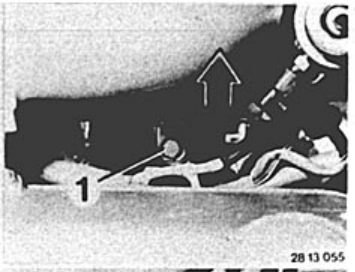


Leak Test:
Check permissible leak rate*.



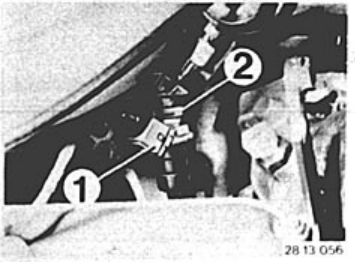
Checking Fuel Flow Rate and Spray Angle:
Hold cold start valve over measuring glass 13 3 020.
Plug Jetronic test lead 61 1 440 on cold start valve and connect with B + and B –.
Check fuel flow rate* and spray angle (1)*.

* See Specifications

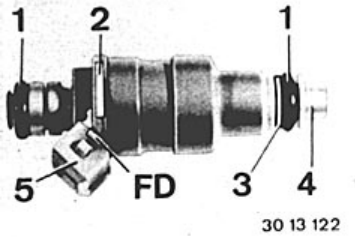


13 64 501 REPLACING FUEL INJECTOR

Unscrew four mounting bolts (1) for injection pipe.
Push up injection pipe until fuel injectors are out of the guide on the intake manifold.

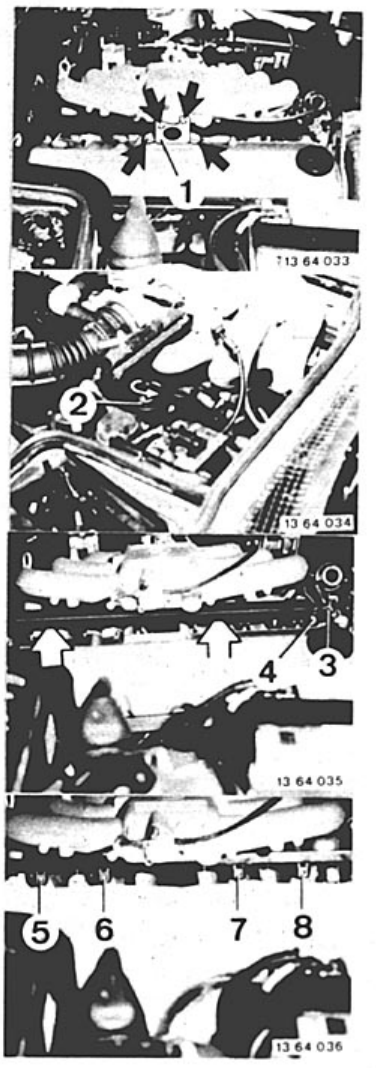


Pull plug (1) off of fuel injector.
Lift out retainer (2) and pull fuel injector out of injection pipe.



Installation:
Check O-rings (1), replacing if necessary.
Check code number (2)*.
Check position of plastic washer (3).
Check color* of plug receptacle (5) or fuel injector guard (4).
FD = Manufacturing date
Coat O-rings lightly with Vaseline only for installation.

* See Specifications



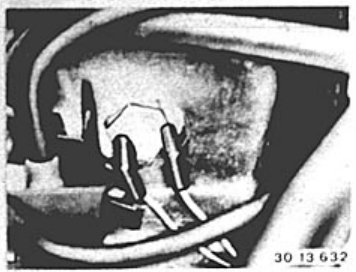
13 64 501 REPLACING FUEL INJECTORS (New Plug Rail)

Unscrew eclamp (1).

Disconnect plug (2).

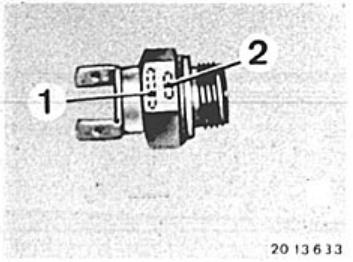
Disconnect coolant temperature sensor plug (3) and DME temperature sensor plug (4).
Pull up and remove plug rail.

Unscrew mounting screws (5 ... 8).
Push up injection pipe until fuel injectors are out of guide on the intake manifold.
Remove fuel injectors separately.
Installation:
Check O-rings, replacing if necessary.
Coat O-rings lightly with Vaseline only for installation.


30 13 632

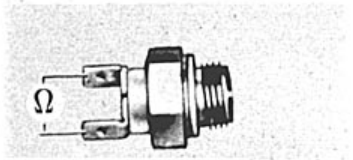
12 63 051 REMOVING AND INSTALLING 0° C (32° F) TEMPERATURE SWITCH

E 30
Pull off plug (1).
Unscrew temperature switch.
Installation:
Torque: max. 30 Nm (22 ft. lbs.).



20 13 633

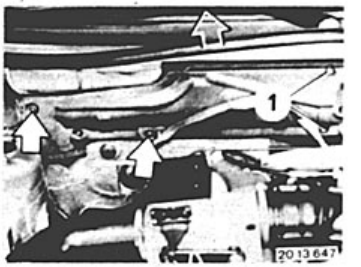
Installation:
Check code number (1)* and switching point (2)*.



20 13 634

Checking:
Connect ohmmeter (M 06) on temperature switch.
Ohmmeter should display about 0 ohm with temperature < – 8° C (+ 18° F).
Ohmmeter should display about ∞ ohms with temperature > 4° C (39° F).

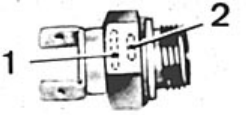
* See Specifications



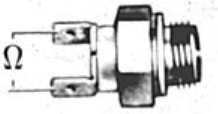
20 13 647



20 13 648



20 13 633



20 13 634

12 63 051 REMOVING AND INSTALLING 0° C (32° F) TEMPERATURE SWITCH

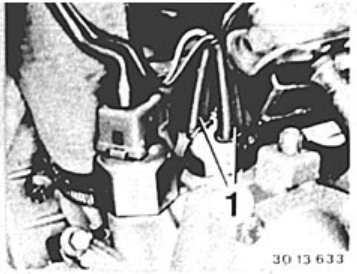
E 28
Unscrew screws (1).
Unscrew screws (2) on left and right sides.
Pull off rubber guard.
Fold cover forward.

Pull off plug (1).
Unscrew temperature switch.
Installation:
Torque: max. 30 Nm (22 ft. lbs.).

Installation:
Check code number (1)* and switching point (2)*.

Checking:
Connect ohmmeter (M 06) on temperature switch.
Ohmmeter should display about 0 ohm with temperature < – 8° C (+ 18° F).
Ohmmeter should display about ∞ ohms with temperature > 4° C (39° F).

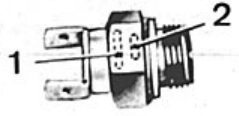
* See Specifications



30 13 633

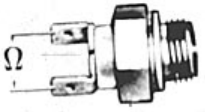
12 63 060 REMOVING AND INSTALLING TEMPERATURE SWITCH 45° C (113° F)

Pull off plug (1).
Remove temperature switch.
Installation:
Tightening torque: max. 30 Nm (22 ft. lbs.).
Fill and bleed cooling system (Group 17).



20 13 633

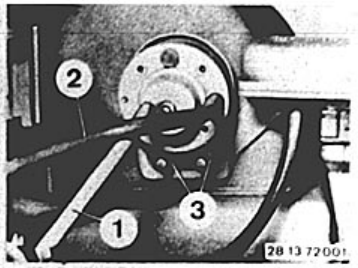
Installation:
Check code number (1)* and switching temperature (2)*.

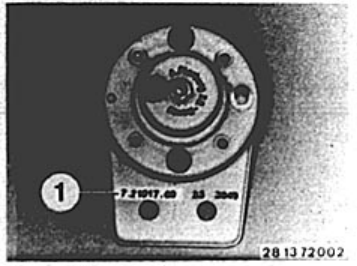


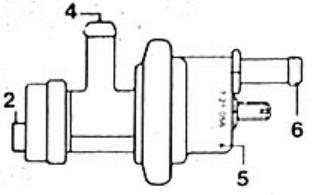
20 13 634

Checking:
Connect ohmmeter (M 06) on temperature switch.
Ohmmeter should display approx. 0 ohm for temperature of $< 30^{\circ}$ C (86° F).
Ohmmeter should display approx. ∞ ohms for temperature of $> 48^{\circ}$ C (118° F).

* See Specifications







13 72 003

13 72 020 REMOVING AND INSTALLING/ CHECKING 3/2 WAY VALVE (Until 1984 Plant Shutdown)

Removing and Installing:
Pull off vacuum hoses (1 = for throttle housing and 2 = for distributor vacuum box).
Unscrew nut (3).
Remove valve.

Installation:
Check code number (1)*.
2.0 Ltr. = 7.21017.00 20 / yellow
2.3 Ltr. = 7.21017.00 23 / blue

Since 9.84:
Check code number (5)*.
2.0 Ltr. = 7.21056.20 / yellow
2.3 Ltr. = 7.21056.23 / blue
6 = To throttle housing
4 = To distributor vacuum box
2 = Venting

Checking and Adjusting:
(in case of engine idling surge or hard re-engagement jolt of coasting shutoff)

A) Troubleshooting

Stop function of coasting shutoff by pulling off plug on throttle switch.
If car still shakes – check drive line!
If car does not shake anymore – check/adjust the 3/2 way valve.

B) Checking/Adjusting 3/2 Way Valve

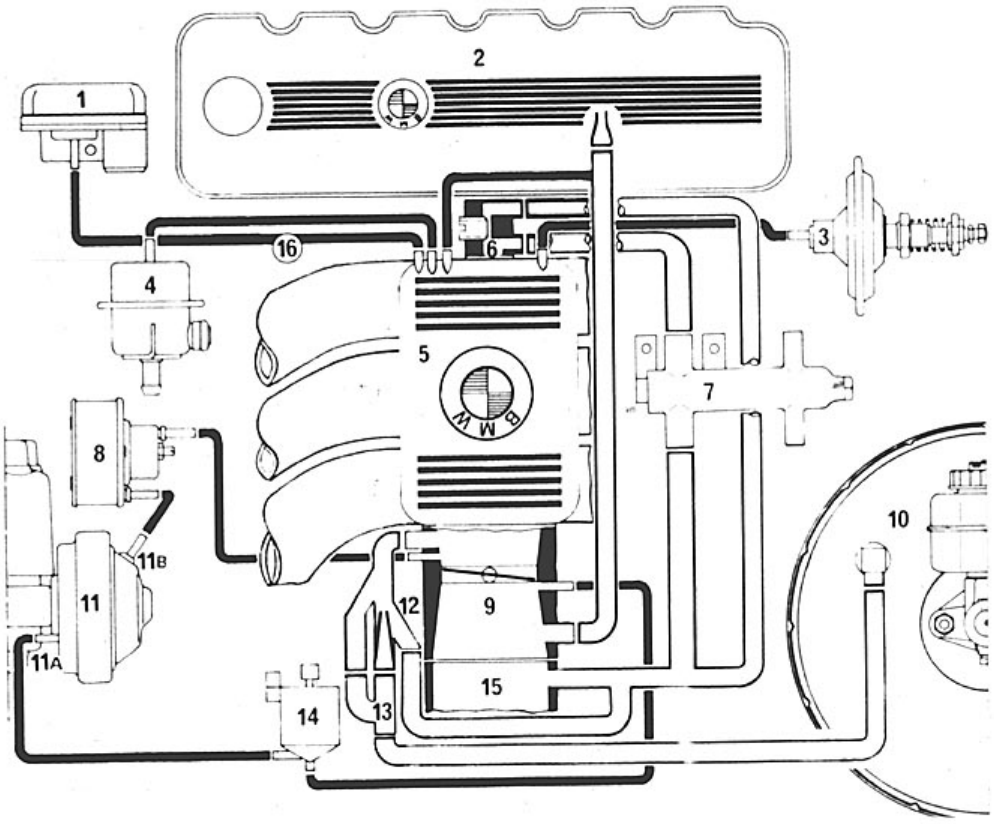
Checking:
Install T-adapter in pressure line between 3/2 way valve and distributor and connect on vacuum tester (in passenger compartment).
Operate car in coasting condition.
Throttle open = 0 mbar display; throttle closed = approx. 600 mbar display.

Adjusting:
Vacuum tester "installed" (in passenger compartment).
Observe fuel consumption indicator and tester in the coasting phase.
When valve adjustment is optimal, the vacuum will collapse as fuel injection cuts in again. (The adjustment should indicate slightly earlier fuel injection since vacuum drop will be displayed in the instrument with delay because of the additional vacuum in the test line which has to be removed).

Adjustments with the adjusting screw (pressure converter - middle) should be made in steps of approx. 1/2 turns.

* See Specifications

HOSE ROUTING PLAN – 2.0 and 2.3 Liter Engines



1 Partial load switch
2 Cylinder head cover
3 Vacuum restriction regulator
4 Fuel pressure regulator
5 Collector
6 Bypass air housing
7 Throttle bypass valve
8 2/3 way valve
9 Throttle housing
10 Brake booster
11 Distributor vacuum box
11A Advance control connection
11B Retard control connection
12 Ejector
13 Double check valve
14 Electric switching valve (CH/S)
15 Intake cowl
16 Inside temp. sensor connection – electric heating

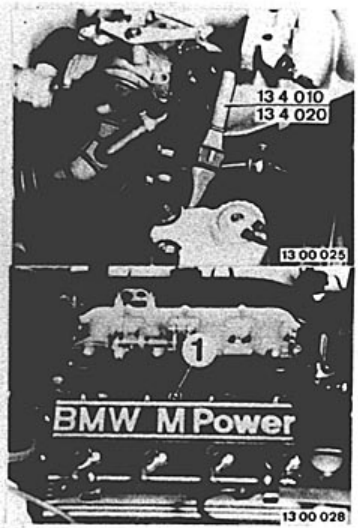
Construction group 13 Fuel system

S14
M3 Model

13 00 054	Engine idle speed and CO level	13- 700
13 31 029	Fuel delivery pressure and rate – check	13- 710
13 41 000	Idle speed control valve – remove and install	13- 713
13 51 200	Fuel pressure regulator – remove and install	13- 720
13 54 030	Throttle valve assembly – remove and install	13- 730
	Throttle valve basic adjustment	13- 731
	Throttle valve linkage basic adjustment	13- 732
13 61 . . .	Plug connections for control unit (conversion)	13- 750
13 62 000	Air mass sensor – remove and install	13- 760
531	Coolant temperature sensor – remove and install	13- 762
13 63 544	Throttle valve switch – adjust	13- 771
551	Throttle valve switch – remove and install	13- 771
13 64 501	Fuel injector – remove and install	13- 781
	General test plan for electronic idle speed control	13- 800

13 00 054 ADJUSTING ENGINE IDLE SPEED / EMISSION TEST (Cars without Cat. Converter)

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
Engine, ignition and fuel injection in good working condition.
Valve clearance correct.
Air filter cartridge in good condition.
All electric consumers switched off.
Connect BMW Service Tester to operating instructions (altitude correction box must be connected).
Mount CO tester in exhaust.
Switch off exhaust extraction for the time of testing.

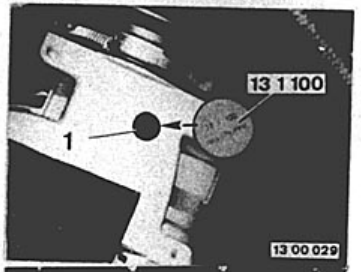


Pull off plug on throttle valve switch and insert Special Tool 13 4 010 in the wire plug.

1) Checking Engine Idle Speed*

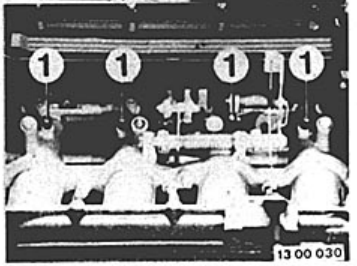
Adjust idle speed with screw (1).

* See Specifications and Nominal Value Microfiche



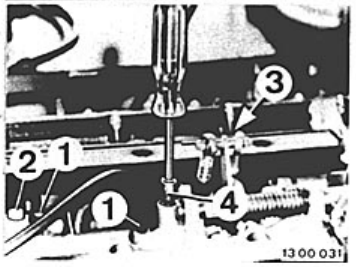
2) Emission Test

Remove cap (1) with Special Tool 13 1 011.
Adjust CO level* with Special Tool 13 1 100 applied on the air control screw in the air flow sensor.



Synchronization:

Requirement – thrust rod adjustment correct (see "Removing and Installing Throttle Valve Necks" in 13 54 030).
Pull off caps (1).
Measure and note intake vacuum on all four throttle valve necks.
Leave caps (1) connected on throttle valve necks not being measured.

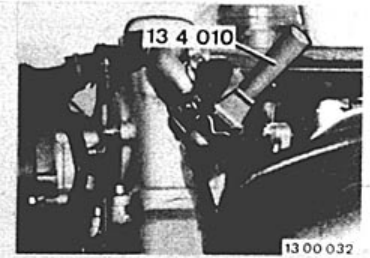


Pull off caps (1).
Connect the vacuum tester (BMW Service Tester M 21).
Adjust each throttle valve neck to the same intake vacuum at idle speed* (screw/3) with screw (4/7 mm wrench socket).
Max. vacuum difference: ± 5 mbar.
Install new anti-tamper locks (2) after finishing adjustments.
Then recheck engine idle speed* and CO level*, correcting if necessary.

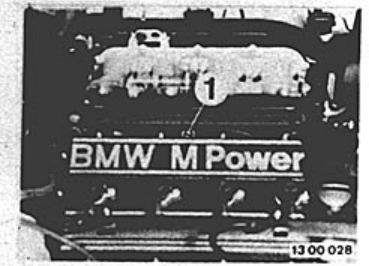
* See Specifications and Nominal Value Microfiche

13 00 054 CHECKING / ADJUSTING ENGINE IDLE SPEED AND CO LEVEL

Car with catalytic converter.
Car with exhaust manifold lacking testing connections.
Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
Valve clearance correct.
Engine and ignition in good working condition.
Connect BMW Service Tester to operating instructions (altitude correction box must be connected.
Mount emission tester in exhaust tailpipe.
Switch off extraction system for exhaust gas during time of testing.

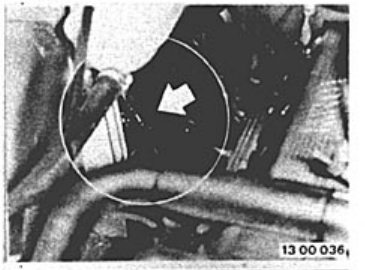


Pull off plug on throttle valve switch and insert Special Tool 13 4 010 in wire plug.



1) Engine Idle Speed

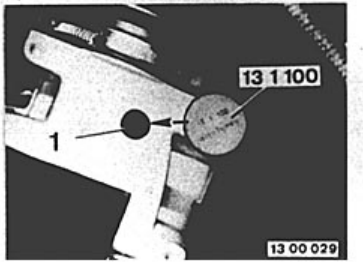
Check engine idle speed.
Adjust engine idle speed with screw (1).



2) Emission Test

Disconnect oxygen sensor plug.
Idle speed CO level cannot be measured in the tailpipe = 0 (zero).
CO Level Displayed:
Remove cap with Special Tool 13 1 011.
Adjust CO-level back to 0 (zero) with Special Tool 13 1 100 applied on the control screw in the air flow sensor.

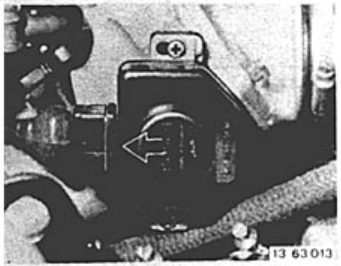
Synchronization: see next page.



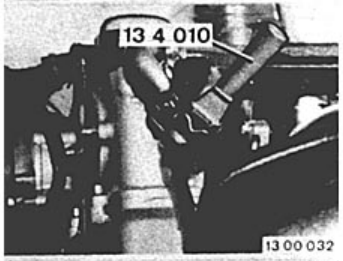
Checking Function of Oxygen Sensor (11 78 010):
Disconnect oxygen sensor plug and adjust CO level to 0.5 ... 1.0 % by volume with Special Tool 13 1 100 applied on the control screw in the air flow sensor (turned clockwise).
Connect oxygen sensor plug – CO level must go back to 0 (zero).
Disconnect oxygen sensor plug again.
Adjust CO level back to 0 (zero) with the control screw (back to original position as well as possible).
Connect oxygen sensor.

13 00 054 ADJUSTING ENGINE IDLE SPEED / EMISSION TEST (Car with Catalytic Converter)

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
Engine, ignition and fuel injection in good working condition.
Valve clearance correct.
Air filter cartridge in good condition.
All electric consumers switched off.
Connect BMW Service Tester to operating instructions (altitude correction box must be connected).
Connect emission tester on testing connections of the manifold.
Switch off exhaust extraction for the time of testing.

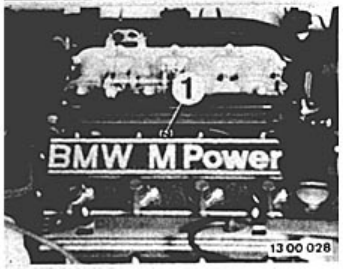


Pull off plug on throttle valve switch and insert Special Tool 13 4 010 in the wire plug.

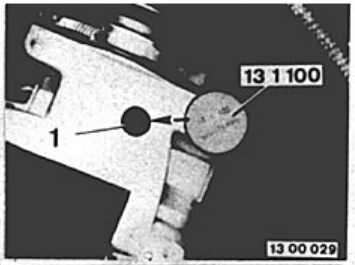


1) Engine Idle Speed*

Check engine idle speed.
Adjust engine idle speed with screw (1).

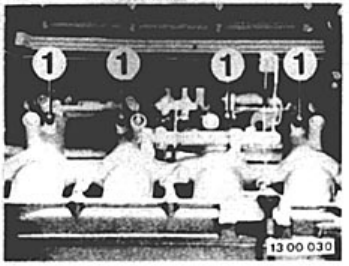


* See Specifications and Nominal Value Microfiche



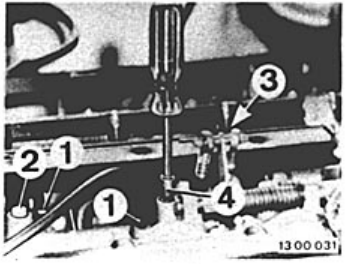
2) Emission Test

Measure CO level with oxygen sensor connected.
Note CO level value.
Disconnect oxygen sensor plug.
Deviation from Nominal Value:
Remove cap (1) with Special Tool 13 1 011.
Adjust CO level to value measured with oxygen sensor connected with Special Tool 13 1 100 applied on control screw in the air flow sensor.



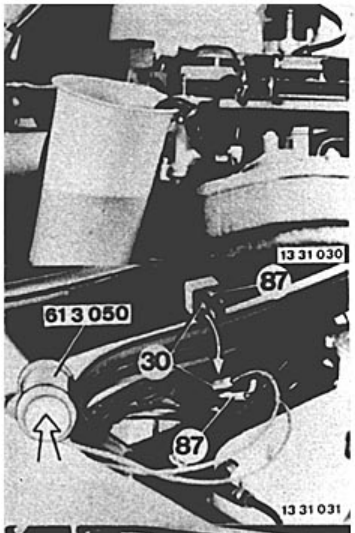
Synchronization:

Requirement – thrust rod adjustment correct (see Removing and Installing Throttle Valve Necks in 13 54 030).
Pull off caps (1).
Measure and note intake vacuum on all four throttle valve necks.
Leave caps (1) connected on throttle valve necks not being measured.



Pull off caps (1).
Connect vacuum tester (BMW Service Tester M 21).
Adjust each throttle valve neck to the same intake vacuum at idle speed* (screw/3) with screw (4/7 mm wrench socket).
Install new anti-tamper locks (2) after finishing adjustments.
Then recheck engine idle speed* and CO level*, correcting if necessary.

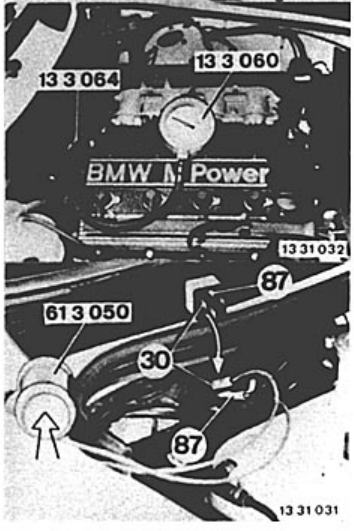
* See Specifications and Nominal Value Microfiche



13 31 029 CHECKING FUEL DELIVERY PRESSURE AND RATE

Checking Fuel Pump Delivery Rate:
Disconnect return line and hold end in Special Tool 13 3 020.

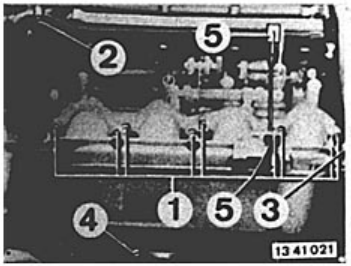
Remove trim on right engine compartment wall.
Pull off fuel pump relay (1).
Bridge terminals 87 and 30 with Special Tool 61 3 050.
Press the button.
Fuel pump runs.
Check delivery rate*.



Checking Fuel Pump Delivery Pressure:
Install Special Tools 13 3 060 and 13 3 064 between return line and hose.
Shut fuel return hose with Special Tool 13 3 010.

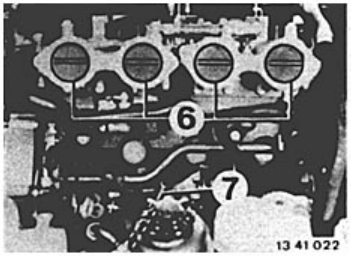
Remove trim on right engine compartment wall.
Pull off fuel pump relay (1).
Bridge terminals 87 and 30 with Special Tool 61 3 050.
Press the button.
Fuel pump runs.
Check delivery pressure*.

* See Specifications of Gr. 16

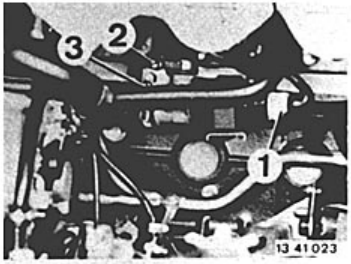


13 41 000 REMOVING AND INSTALLING IDLE SPEED CONTROL VALVE

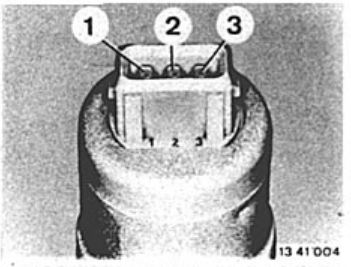
Unscrew capped nuts (1) on all four throttle valve housings.
Unscrew mounting nut.
Loosen hose straps (2 ... 4).
Disconnect throttle cable (5).
Take off air intake manifold, while cutting off the hose between the manifold and crankcase (cannot be pulled off).



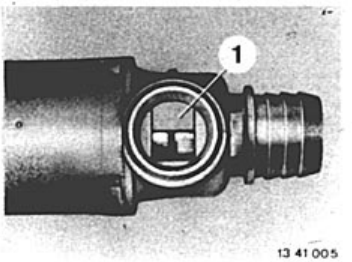
Installation:
Check O-rings (6), replacing if necessary.
Replace hose (7) between manifold and crankcase.



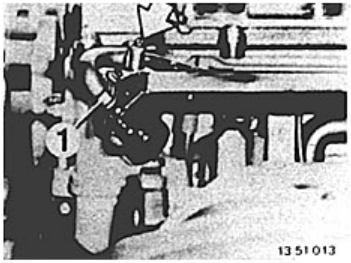
Pull off plug (1).
Disconnect hoses (2 and 3).
Disconnect retaining strap.



Electric Test:
Measure resistance between terminals (1) and (3)
Nominal value: approx. 40 ohms.
Measure resistance between terminals (2) and (1) or (2) and (3).
Nominal value: approx. 20 ohms each.

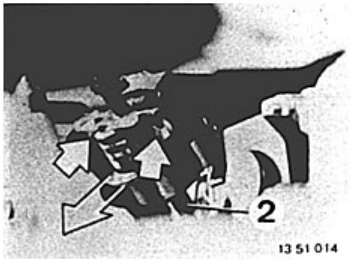


Dynamic Test:
Remove idle speed control valve (plug remains connected).
Open or close rotary piston (1) completely.
Turn on ignition.
Rotary piston should move into and remain in a position of approx. 50 % the cross section opening.

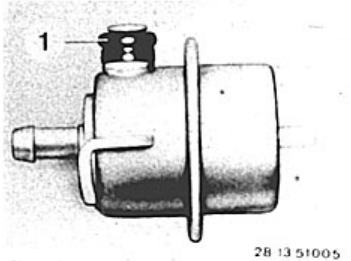


13 51 200 REMOVING AND INSTALLING FUEL PRESSURE REGULATOR

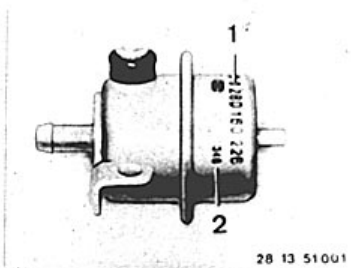
Disconnect fuel hose (1).



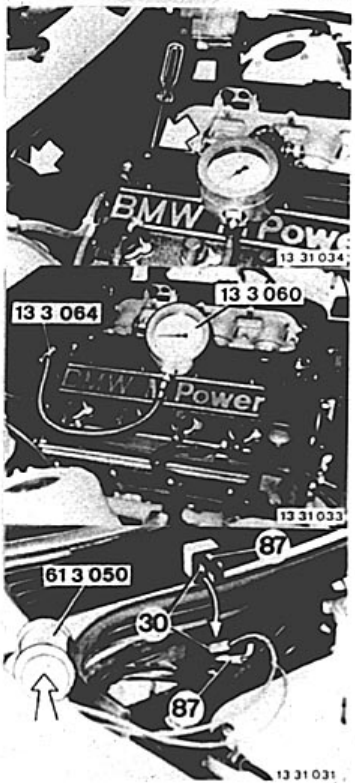
Unscrew bolts.
Pull fuel pressure regulator out of injection pipe.
Pull off vacuum hose (2).



Installation:
Check seal (1), replacing if necessary.



Installation:
Check code number (1)*.
(2) = Manufacturing date

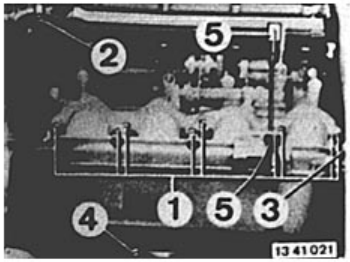


Checking:
Install Special Tools 13 3 060 and 13 3 064 between feed pipe and hose.

Remove trim on engine compartment wall.

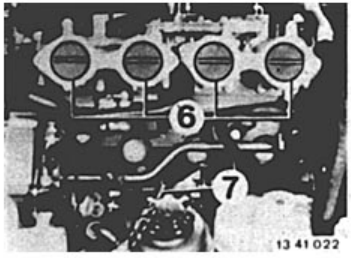
Pull off fuel pump relay (1).
Bridge terminals 87 and 30 with Special Tool 61 3 050.
Press the button.
Fuel pump runs.
Check fuel injection pressure*

* See Specifications/Nominal Value Microfiche

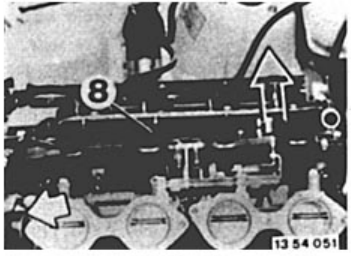


13 54 030 REMOVING AND INSTALLING THROTTLE VALVE HOUSING

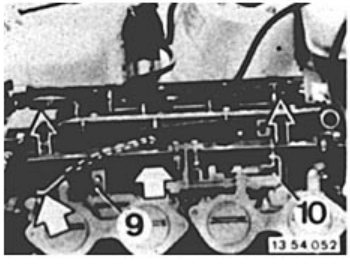
Unscrew capped nuts (1) on all four throttle valve housings.
Loosen hose straps (2 ... 4).
Disconnect throttle cable (5).
Take off air intake manifold and cut off hose between manifold and crankcase (cannot be pulled off).



Installation:
Check O-rings (6), replacing if necessary.
Replace hose (7) between manifold and crankcase.



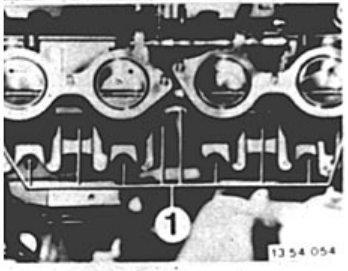
Pull off plug on throttle valve switch.
Pull off plug plate (8) on fuel injectors.



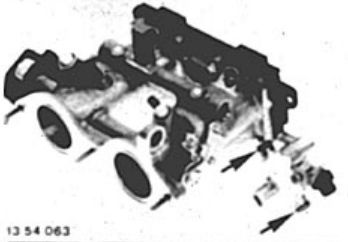
Pull off vacuum hose for fuel pressure regulator.
Unscrew bolts (9 and 10).
Lift off injection pipe with fuel injectors.



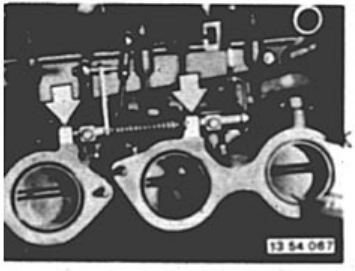
Unscrew nut on joint.
Installation:
Replace self-locking nut.

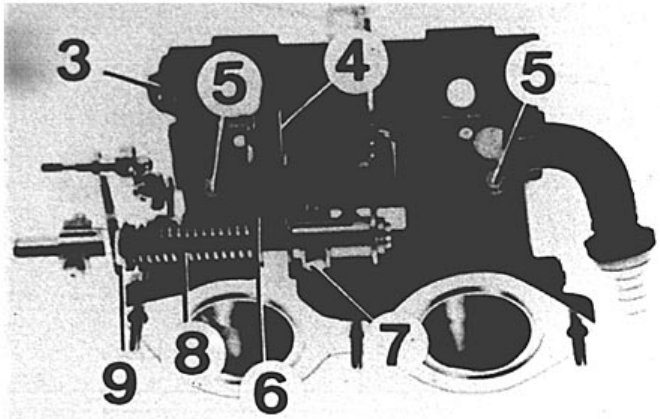


Unscrew torx nuts (1) on all throttle valve housings.
Take off throttle valve housing assembly.



Separate throttle valve housings.
Check O-ring of connecting pipe, replacing if necessary.
Note:
Shaft runs on needle bearings.
Keep dirt off of bearings and don't damage the shaft.



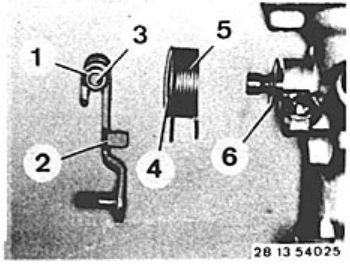


13 54 055

(throttle valve housing of cylinders 3 and 4). Replace gasket (3). Lift out retainer (4). Unscrew throttle screws. Check O-rings (5), replacing if necessary. Take off lever bearing (7), sleeves (6), spring (8) and washer (9).

Installation:

Screw in throttle screws carefully until they fit tight and then loosen 1 and 1/2 turns again. Preload spring (8) by about 1/2 turn.



28 13 54025

Throttle valve adjustment is optimized and secured with paint in the plant.

Note:

Throttle valve housing basic adjustments are only necessary after replacing parts, in case of a loose clamping screw or erroneous adjustment.

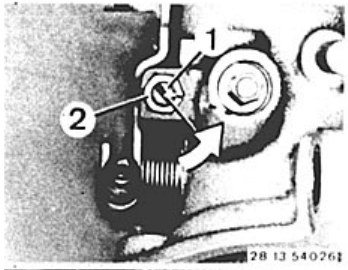
Unscrew nut (1).
Take off throttle lever (2) and screw (3).
Take off sleeve (4) and spring (5).
Check washer (6).

Installation:

Preload spring (5) with about 1/2 a turn.

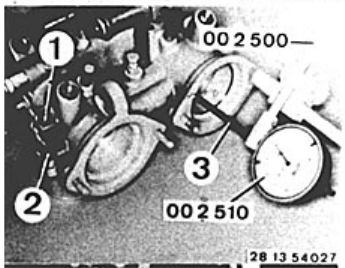
Adjusting Conditions:

Component temperature: approx. 20° C (68° C).



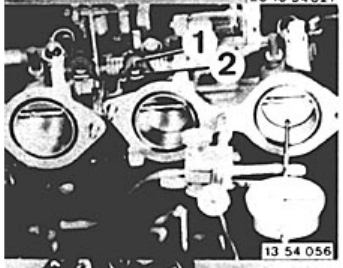
28 13 54026

Loosen nut (2).
Turn idle stop screw (1) about 1/10th of a turn in direction of arrow.
Tighten nut (2) again.



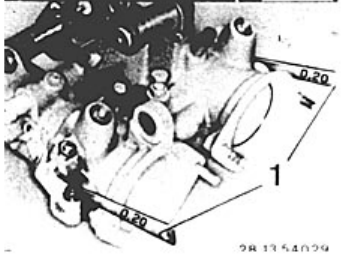
28 13 54027

Close throttle valves.
Press throttle lever against idle stop screw (1) and tighten nut (2).
Mount dial gage 00 2 510 (with extension 3) and Special Tool 00 2 500 on the throttle valve housing.
Dial gage tip bears with preload on throttle valve in the lowest possible position.



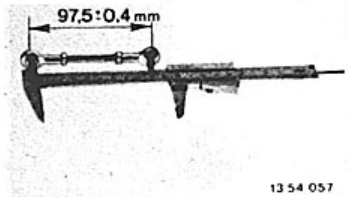
13 54 056

Loosen nut (2).
Adjust the throttle valve lower edge to 0.1 + 0.05 mm (0.004 + 0.002") with idle stop screw (1) (approx. 1/10th of a turn).
Lock idle stop screw (1) and secure with paint.



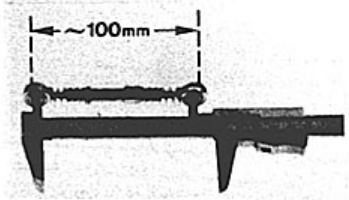
28 13 54029

Checking Axial Clearance:
A 0.2 mm (0.008") feeler gage blade (1) must fit easily on both left and right sides between the circlip or throttle lever and housing with a closed throttle valve and at room temperature of about 20° C (68° F).
Check whether throttle valve moves easily at temperature.



13 54 057

Basic Throttle Valve Linkage Adjustment:
Adjust push rod of throttle valve assemblies for 3rd and 4th cylinders to 97.5 ± 0.4 mm (3.838 ± 0.016").

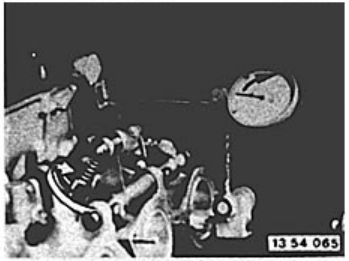


13 54 058

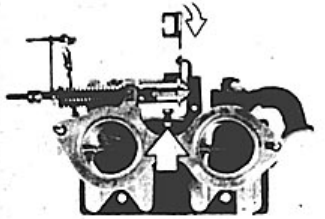
Adjust push rod of throttle valve assemblies for 1st and 2nd cylinders to approx. 100 mm (3.937").


13 54 064

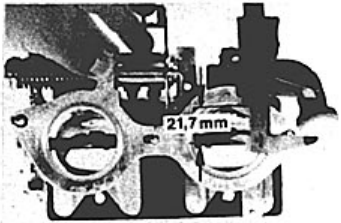
Mount dial gage with holder.
Apply dial gage with preload on the operating lever for 3rd and 4th cylinders.


13 54 065

Shorten the push rod for 1st and 2nd cylinders until the dial gage needle begins to move.
Both throttle levers must bear uniformly on the idle speed stop.

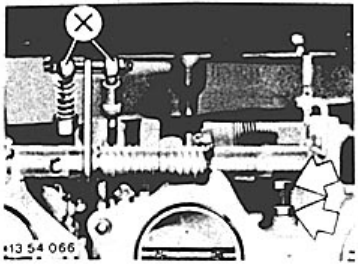

13 54 061

Adjusting Full Load Stop:
Open throttle valves until valves are parallel to the direction of flow.
Turn the full load stop screw until it bears on the stop of the operating lever.



13 54 062

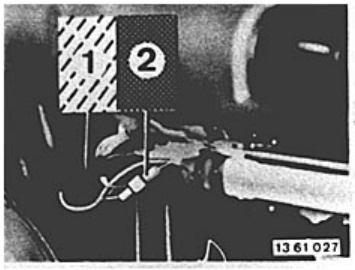
Adjust the distance from the throttle valve upper edge to the throttle valve neck opening to 21.7 ± 1 mm (0.854 ± 0.039") with the full load stop screw.


13 54 066

Important!
Do not change the position of push rods in this adjustment.
Adjust the stop screw in such a manner that any possible slight deviation is distributed equally to both necks.

If the 21.7 ± 1 mm (0.854 ± 0.039") distance can not be reached on all throttle valves by adjusting the full load stop screw, the pertinent components must be replaced.

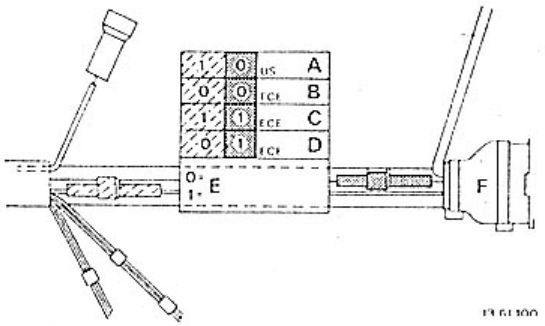
Continued in next column!



13 61 . . . CONTROL UNIT PLUG CONNECTIONS

Plugs (1) and (2) must be disconnected on the control unit plug, or connected, for operation with unleaded gasoline.

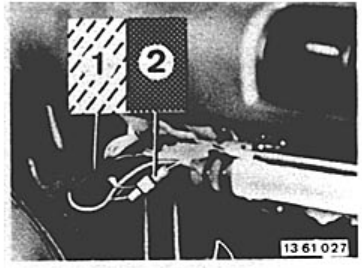
(1) = black
(2) = blue



Plug Connections:
A) 1 + 0 = unleaded premium US
B) 0 + 0 = unleaded regular ECE
C) 1 + 1 = leaded premium ECE
D) 0 + 1 = unleaded premium ECE
E) Plug connection status:
0 = open 1 = closed
F) To control unit

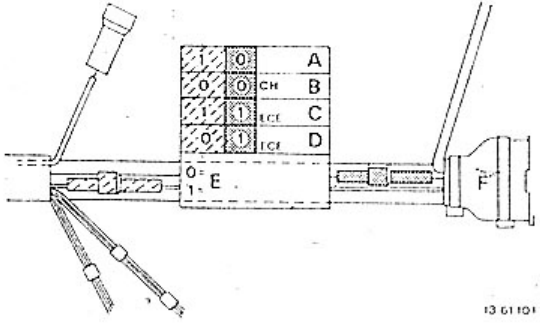
Important!
Plug Connections for 1990 Model Up-dating (also Special Series in 1989):

(1) = black
(2) = blue

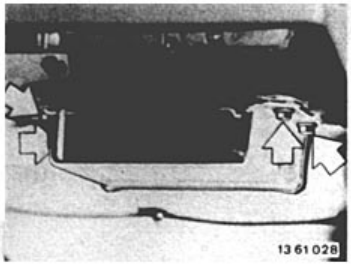


Control Unit No. 1315 263

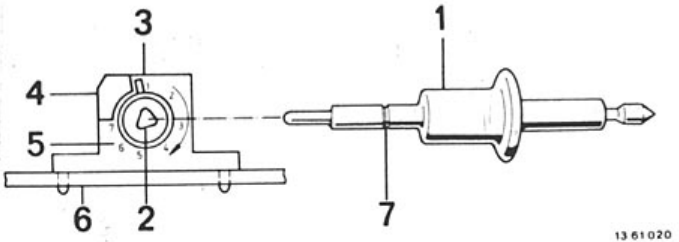
Wire Harness No. 1315 593



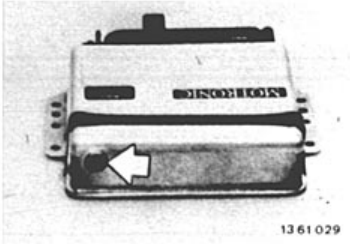
Plug Connections:
A) 1 + 0 =
B) 0 + 0 = unleaded premium 95 RON / Switzerland
C) 1 + 1 = unleaded premium 95 RON / without catalytic converter
D) 0 + 1 = unleaded premium 95 RON / with catalytic converter
E) Plug connection status:
0 = open 1 = closed
F) To control unit


13 61 028

Adjust printed circuit board switch (no longer installed or sealed).

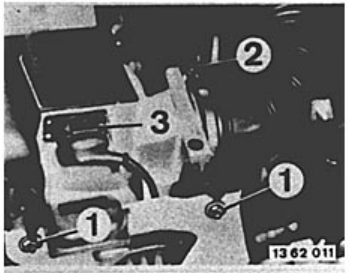


13 61 020


13 61 029

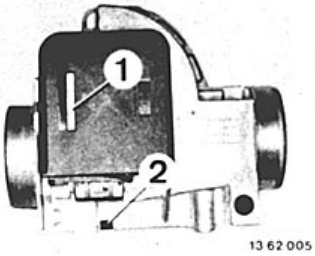
Adjusting Printed Circuit Boards:
Printed circuit board switch should be adjusted to zero (0).
If applicable, check switch adjustment.

1 = Special Tool 12 4 010
2 = Hole
3 = Basic setting (left stop)
4 = Stop
5 = Switch positions
6 = Printed circuit board
7 = Predetermined breaking point

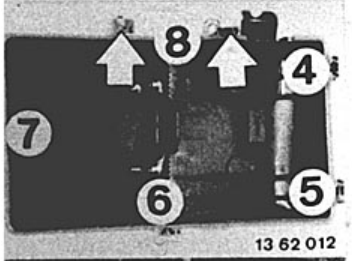


13 62 000 REMOVING AND INSTALLING AIR FLOW SENSOR

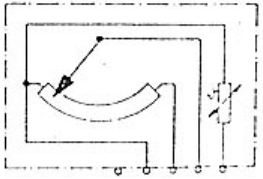
Unscrew nuts (1).
Loosen hose straps (2).
Pull off plug (3).
Open fasteners (4 ... 8).



Checking:
Installation:
Check code number (1)* and manufacturing date (2)*.
Check engine idle speed* and CO level*.
Check air flow sensor*.



Take off upper air cleaner section with air flow sensor.
Check rubber mounts, replacing if necessary.



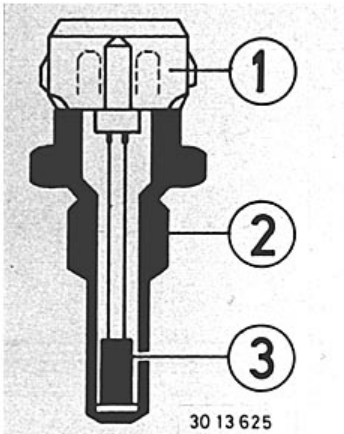
4 3 2 1



Installation:
Check installed position of air filter cartridge (arrows face in direction of flow).

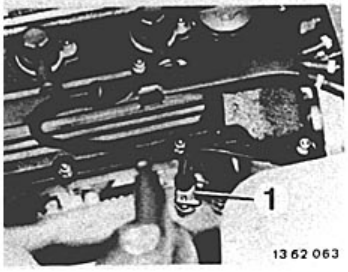


Unscrew screws (9) and take off air flow sensor.
Check gasket between air cleaner and air flow sensor, replacing if necessary.
Installation:
Install screws with liquid bolt cement, HWB No. 81 22 9 400 086.

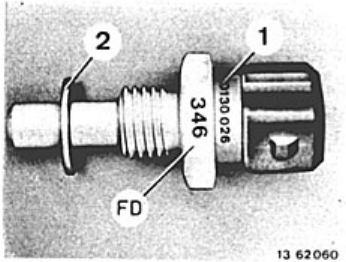


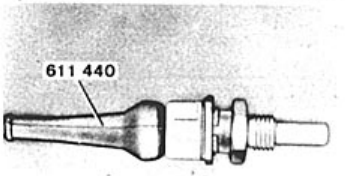
13 62 531 REMOVING AND INSTALLING/ CHECKING COOLANT TEMPERATURE SENSOR

The temperature sensor measures the engine temperature and sends this information to the control unit as a resistance value.
The resistance value drops with rising temperature (NTC).
1 = Plug connection
2 = Housing
3 = NTC resistor



Removing and Installing:
Pull off plug (1).
Unscrew temperature sensor.
Installation:
Tightening torque*.



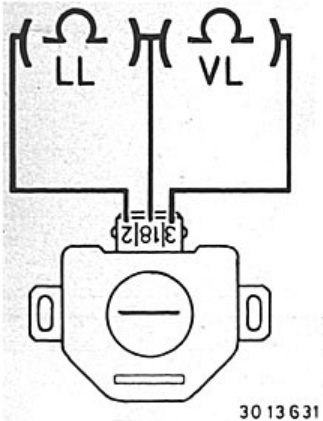


Installation:
Check code number (1)*.
Replace seal (2).
FD = Manufacturing date.
Fill and bleed cooling system (Group 17).

Checking:
Connect Jetronic test leads 61 1 440.
Check nominal value* with an ohmmeter.
To check the entire temperature range, remove and place temperature sensor in a water bath, heat bath to testing temperature and check resistance* with an ohmmeter.

* See Specifications

* See Specifications



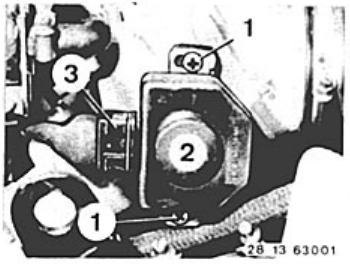
30 13 631

13 63 544 ADJUSTING THROTTLE VALVE SWITCH

Check throttle valve switch.
There should be approximately 0 ohm between connections 6 and 4 with a closed throttle valve.
There should be approximately 0 ohm between connections 5 and 4 with a wide open throttle valve.
LL = Idle
VL = Full load

WIRING DIAGRAM

drawn in idle position of throttle valve.



28 13 63001

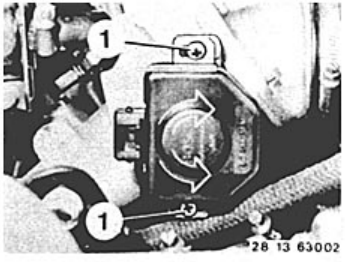
13 63 551 REMOVING AND INSTALLING THROTTLE VALVE SWITCH

Pull off multiple-pin plug (3).
Unscrew screws (1).
Take off throttle valve switch (2).



30 13 456

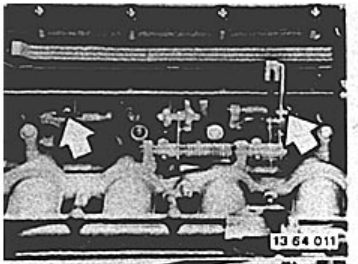
Installation:
Check code number (1)*.
Adjust throttle valve switch – see 13 63 544.



28 13 63002

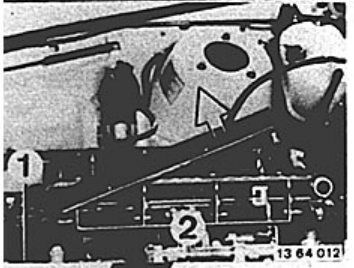
Adjusting:
There must be approx. 0 ohm between connections 6 and 4 with a closed throttle valve.
Adjust by loosening screws (1) and turning the throttle valve switch.
Open throttle valve after adjusting – the resistance should rise immediately to ∞ ohms.
Resistance must drop again to approximately 0 ohm when releasing the throttle valve.

* See Specifications

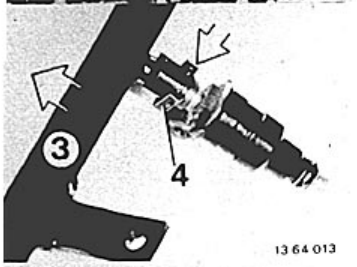


13 64 501 REMOVING AND INSTALLING ONE FUEL INJECTOR

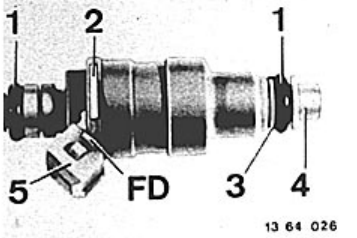
Unscrew screws on injection pipe.



Pull off plug on throttle valve switch (1).
Pull off plug plate (2) on fuel injectors.



Push up injection pipe (3) until fuel injectors are lifted out of guides on throttle valve housings.
Lift out retainer (4) and take off fuel injector.



Installation:
Check O-rings (1), replacing if necessary.
Check code number (2)*.
FD = Manufacturing date
Check position of plastic washer (3).
Check color* of plug receptacle (5) or fuel injector guard (4).
Only coat O-rings with vaseline or SAE 90 gear lube for installation.

* See Specifications

TESTING INSTRUCTIONS FOR ELECTRONIC IDLE REGULATION (VDO) WITH L-JETRONIC

Testing Requirements:
Battery charged – battery voltage at least 11.5 volts.
Components must have room temperature = 23 ± 5° C (73 ± 9° F).
Stated multimeter functions (e.g. M 01) refer to the BMW SERVICE TEST.
Measuring is performed on the disconnected control unit plug for electronic idle regulation.
The following tests do not cover defects which are outside of the electronic idle regulation system.

Idle control valve in perfect working condition.
Piston not seized.
Correct resistance of idle control valve (9 to 10 ohms).
Basic adjustment completed.

1.) Checking Power Supply and Ground of Idle Control Unit

Connect voltmeter (M 01) between term. 2 and car ground.
Turn on ignition.
Voltmeter displaying at least 9 volts?

no → Check green/yellow wire for breaks according to wiring diagram with ohmmeter (M 06). Eliminate breaks.

yes ↓

Connect voltmeter (M 01) between term. 2 and term. 4.
Turn on ignition.
Voltmeter displaying at least 9 volts?

no → Check brown wire for breaks according to wiring diagram with ohmmeter (M 06). Eliminate breaks.

yes ↓

Power supply and ground of idle control unit are okay!

2.) Checking Speed Signal and Idle Signal for Idle Control Unit

a) Speed Signal

Connect voltmeter (M 01) between term. 3 and term. 4.
Turn on ignition.
Voltmeter displaying at least 9 volts?

no → Connect ohmmeter (M 06) between term. 3 and pin 13 of diagnosis socket.
Ohmmeter displaying approx. 0 ohm?

no → Eliminate breaks of green wire.

yes ↓

Speed signal for idle control unit okay!

b) Idle Signal

Connect voltmeter (M 01) between term. 4 and term. 12.
Turn on ignition.
Voltmeter displaying at least 9 volts briefly?
Turn off ignition.

no → Pull off multiple pin plug on throttle switch.
Connect voltmeter (M 01) between center plug contact of plug receptacle and ground
Turn on ignition.
Voltmeter displaying at least 9 volts briefly?

no → Make power supply connections according to wiring diagram.

yes ↓

yes ↓

Press down accelerator pedal several centimeters.
Turn on ignition.
Voltmeter displaying approx. "0" volt?

no → Adjust or replace throttle switch.
Adjust cable.

3.) Checking Idle Control Valve

Pull off plug on idle control valve.
Connect ohmmeter (M 06) on idle control valve.
Ohmmeter displaying 9 to 10 ohms with a component temperature of 23 ± 5° C (73 ± 9° F)?

no → Replace idle control valve.
Check code number* and color code*.

yes

Connect ammeter (M 03) between idle control valve and wire plug.
Run engine having operating temperature** at idle speed.
Ammeter displaying 400 to 500 mA?

no → Check both wires (from control unit to idle control valve) for breaks according to wiring diagram with ohmmeter (M 06).
Eliminate any breaks.
Replace control unit if there are not any breaks.
Check code number* and color code*.

yes

Run engine having operating temperature** at idle speed.
Pull off wire plug on idle control valve.
Engine speed should now rise to approx. 2,000 rpm.
Engine speed okay?

no → Replace idle control valve.
Check code number* and color code*.

yes

Connect wire plug on idle control valve.
Does speed drop to nominal speed?

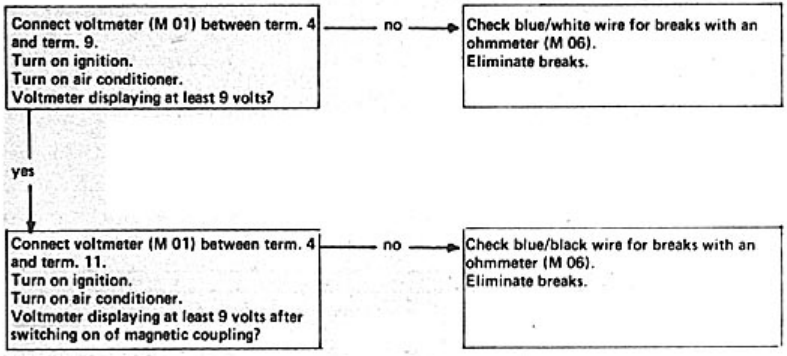
no → Replace idle control valve.
Check code number* and color code*.

yes

Idle control valve okay!

* See Specifications
** Engine oil temperature at least 60° C (140° F)

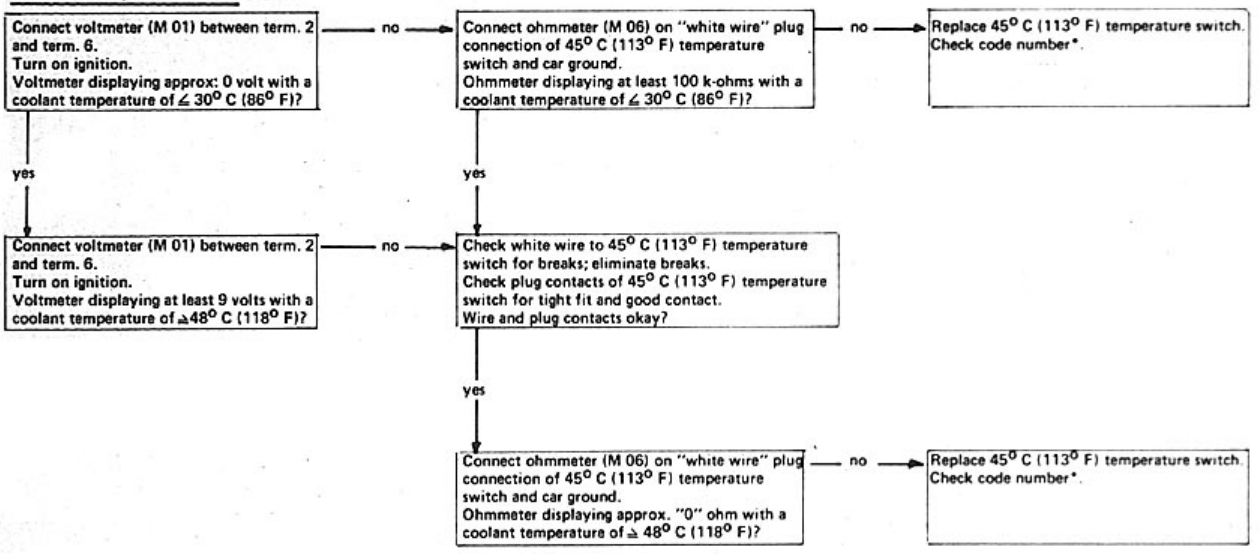
4.) Checking Periphery for Air Conditioner Speed



Important! After engaging a driving range (cars with automatic transmission) always only the nominal idle speed (750 ± 50 rpm) will be regulated (preferred circuit).

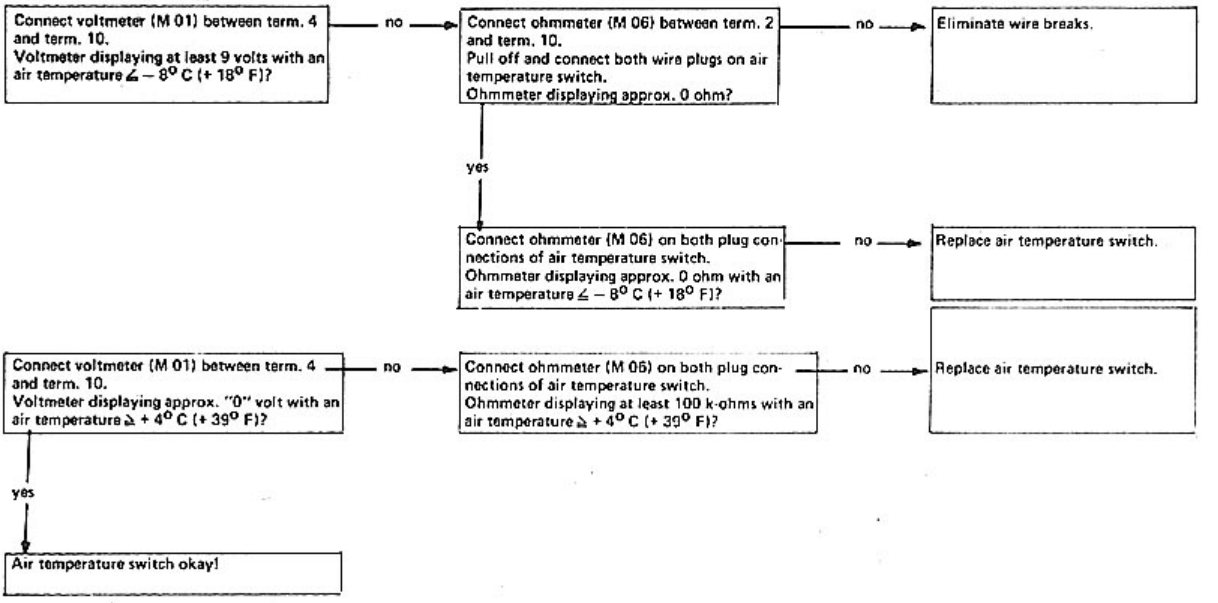
5.) Checking Periphery for Warm-up Speed

a) Coolant Temperature Switch



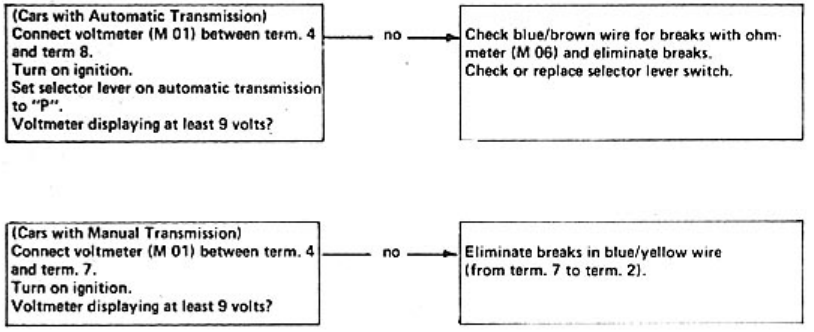
* See Specifications

b) Air Temperature Switch



6.) Preferred Circuit

Important! The nominal idle speed (700 ± 50 rpm) is always regulated when engaging a driving range (cars with automatic transmission).



TESTING INSTRUCTIONS FOR ELECTRONIC IDLE SPEED REGULATION (VDO) WITH DIGITAL MOTOR ELECTRONICS

Testing Requirements:

Battery charged - battery voltage at least 11.5 volts.
Components must have room temperature = 23 ± 5° C (73 ± 9° F).
Stated multimeter functions (e.g. M 01) refer to the BMW SERVICE TEST.
Measuring is performed on the disconnected control unit plug for electronic idle speed regulation.
The following tests do not cover defects which are outside of the electronic idle speed regulation system

Idle control valve in perfect working condition.
Piston not seized.
Correct resistance (9 to 10 ohms) of idle control valve.
Basic adjustment completed.

1.) Power Supply Voltage and Ground of Idle Control Unit

Connect voltmeter (M 01) between term. 2 and car ground.
Turn on ignition.
Voltmeter displaying at least 9 volts?

— no → Check green/yellow wire for breaks according to wiring diagram with ohmmeter (M 06).
Eliminate breaks.

↓ yes

Connect voltmeter (M 01) between term. 2 and term. 4.
Turn on ignition.
Voltmeter displaying at least 9 volts?

— no → Check brown wire for breaks according to wiring diagram with ohmmeter (M 06).
Eliminate breaks.

↓ yes

Power supply voltage and ground of idle control unit okay!

2. Checking Speed Signal and Idle Signal for Idle Control Unit

a) Speed Signal

Terminal 3 must have "terminal 1 signal" with the engine running.

b) Idle Signal

Connect ohmmeter (M 06) between terminal 4 and terminal 12.
Nominal value: 0 ohm.

no → Adjust or replace throttle switch. Adjust cable.

yes

Press down accelerator pedal several centimeters.
Nominal value: ∞ ohms.

no → Adjust or replace throttle switch. Adjust cable.

yes

Idle signal for idle control unit okay!

3.) Checking Idle Control Valve

Pull off plug on idle control valve.
Connect ohmmeter (M 06) on idle control valve.
Ohmmeter displaying 9 to 10 ohms with a component temperature of 23 ± 5° C (73 ± 9° F)?

no → Replace idle control valve.
Check code number* and color code*.

yes ↓

Connect ammeter (M 03) between idle control valve and wire plug.
Run engine having operating temperature** at idle speed.
Ammeter displaying 400 to 500 mA?

no → Check both wires (from control unit to idle control valve) for breaks according to wiring diagram with ohmmeter (M 06).
Eliminate any breaks.
Replace control unit, if there are not any breaks.
Check code number* and color code*.

yes ↓

Run engine having operating temperature** at idle speed.
Pull off wire plug on idle control valve.
Engine speed must rise to approx. 2,000 rpm.
Engine speed okay?

no → Replace idle control valve.
Check code number* and color code*.

yes ↓

Connect wire plug on idle control valve again.
Speed drops to nominal speed?

no → Replace idle control valve.
Check code number* and color code*.

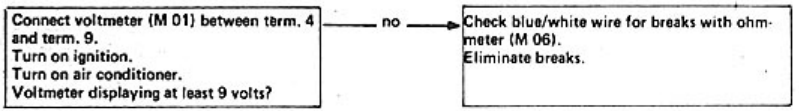
yes ↓

Idle control valve okay!

* See Specifications
** Engine oil temperature at least 60° C (140° F)

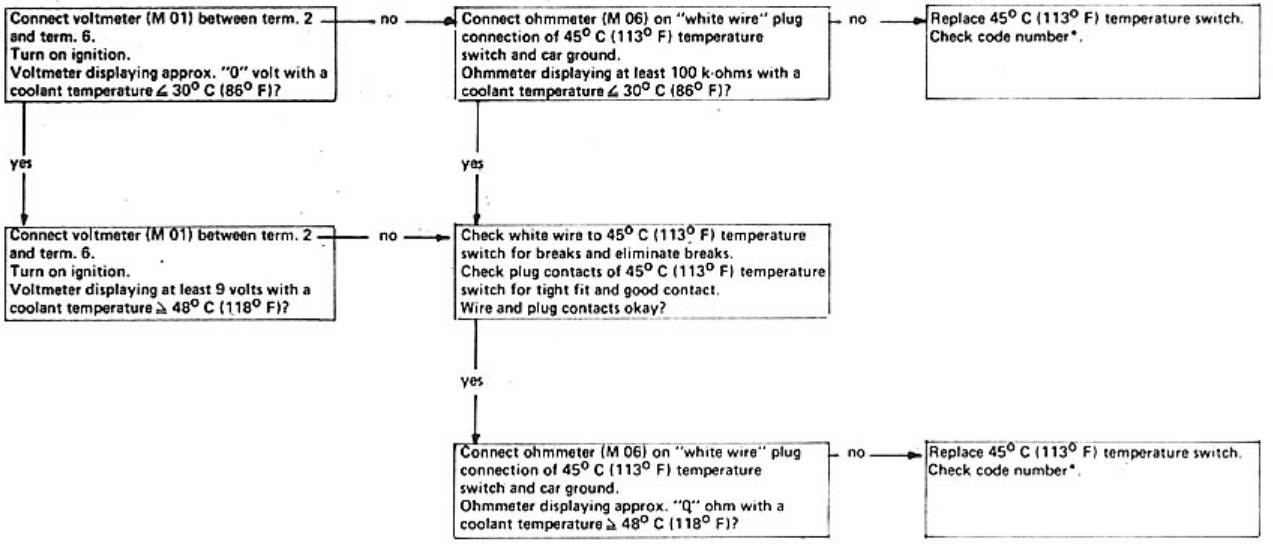
4.) Checking Periphery for Air Conditioner Speed

Important! Always only the nominal idle speed (700 ± 50 rpm) is regulated (preferred circuit) after engaging a driving range (cars with automatic transmission).



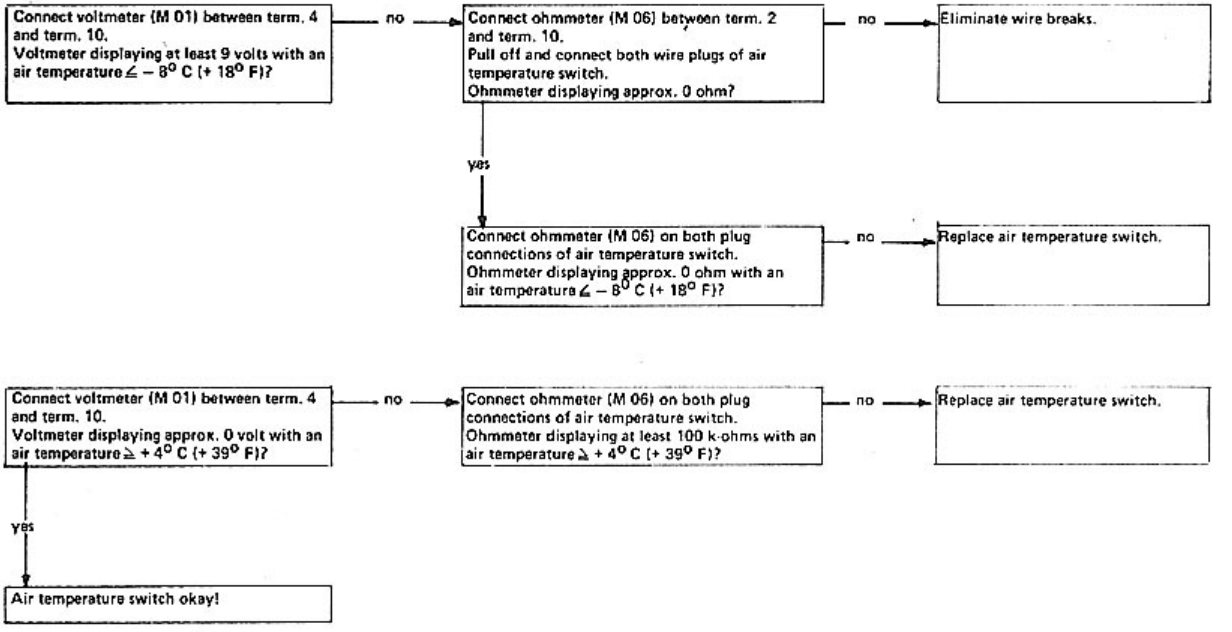
5.) Checking Periphery for Warm-up Speed

a) Coolant Temperature Switch



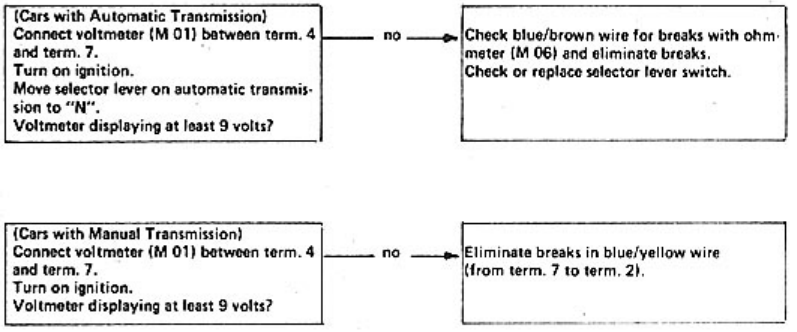
* See Specifications

b) Air Temperature Switch



6.) Preferred Circuit

Important! Nominal idle speed (700 ± 50 rpm) is always regulated when engaging a driving range (cars with automatic transmission).



Construction group 23 Manual transmission

Getrag 242/4 Speed transmission .....

Getrag 240 Manual transmission (overdrive) .....

ZF – S5 – 16 Manual transmission (overdrive) .....

Getrag 245 Five speed manual transmission (sport) .....

Getrag 260 Five speed overdrive transmission .....

Getrag 280 Five speed sport transmission .....

Getrag 265/6 Five speed manual transmission (overdrive) .....

Getrag 265/5 Five speed manual sport transmission .....

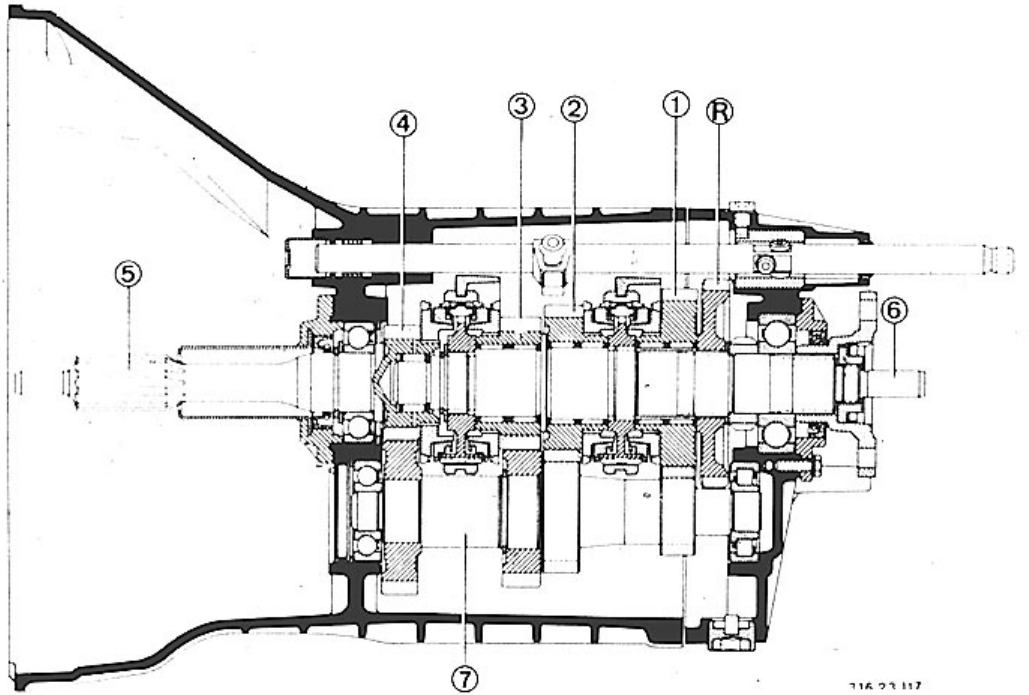
Five speed transmission – type GS5 D 310/4.20 Z (S5-31) .....

Five speed manual transmission – type S5 D 200 G / 250 G .....

Construction group 23 Manual transmission

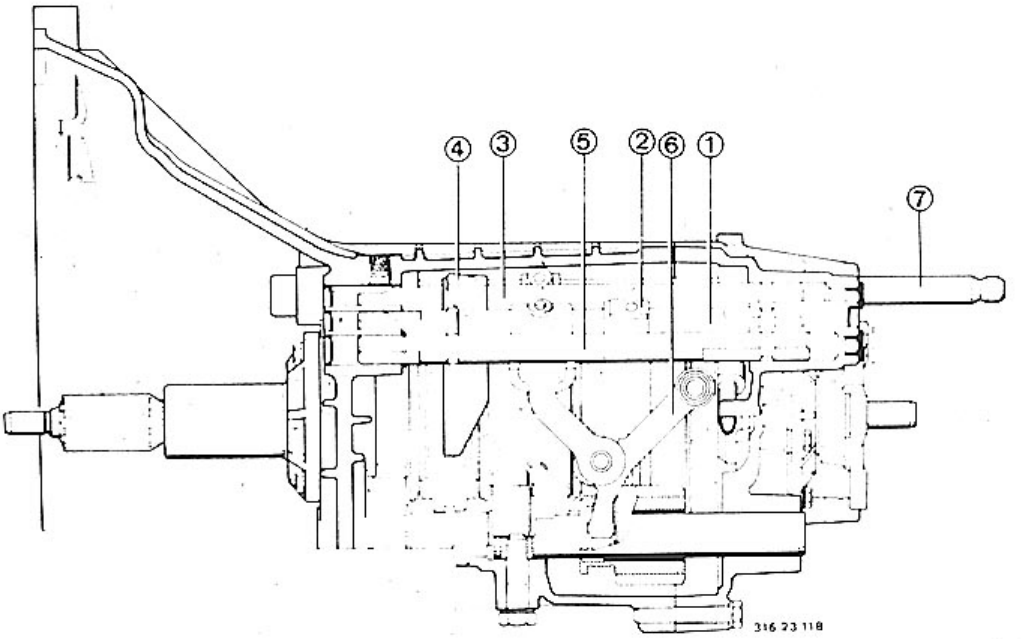
Getrag 242/4 Speed transmission

	Transmission – layout drawing	23- 10
	Shift mechanism – layout drawing	23- 11
23 11 000	Transmission case front section – remove and install/seal	23- 12
621	Cover with guide tube for clutch release bearing – seal or replace	23- 13
23 12 501	Radial oil seal for input shaft – replace	23- 14
531	Radial oil seal for output flange – replace	23- 14
561	Radial oil seal for selector shaft – replace	23- 15
23 21 500	Input and output shaft assembly – remove and install	23- 16
551	Output shaft – replace	23- 20
701	Bearings of all transmission shafts – replace	23- 22
23 22 551	3rd/4th gear set – replace	23- 24
23 23 503	Synchronization – disassemble and assemble	23- 26
23 31 501	1st/2nd and 3rd/4th gear selector forks – replace	23- 27



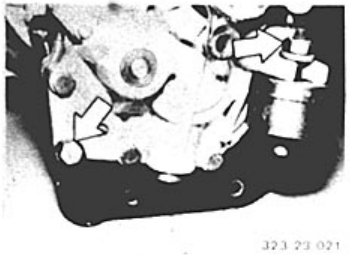
ASSEMBLY DRAWING OF GETRAG 242 FOUR SPEED MANUAL TRANSMISSION

1 First gear
2 Second gear
3 Third gear
4 Fourth gear
R Reverse gear
5 Input shaft
6 Output shaft
7 Layshaft



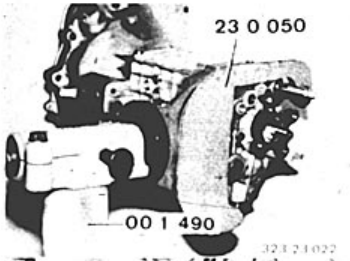
ASSEMBLY DRAWING OF SHIFT MECHANISM for Getrag 242 Four Speed Manual Transmission

1 Selector rod – 1st/2nd gear
2 Selector fork – 1st/2nd gear
3 Selector rod – 3rd/4th gear
4 Selector fork – 3rd/4th gear
5 Selector rod – reverse gear
6 Selector lever
7 Selector shaft


323 23 021

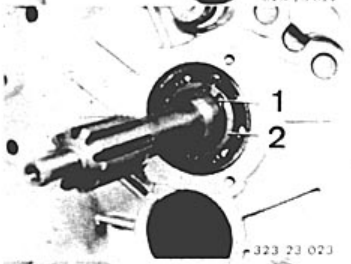
23 11 000 REMOVING AND INSTALLING/ SEALING TRANSMISSION CASE FRONT SECTION

Remove transmission – see 23 00 022 in pertinent model repair manual microfiche beginning with 1985 models.
Unscrew bracket and rubber mounts.



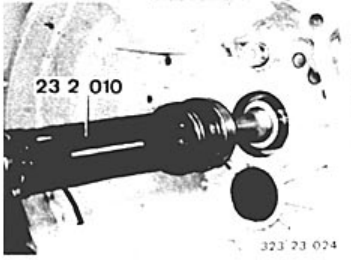
323 23 022

Mount transmission on Special Tools 23 0 050 and 00 1 490.
Drain oil.



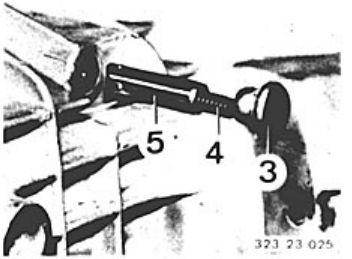
323 23 023

Remove guide sleeve – see 23 11 621.
Remove circlip (1).
Remove support (2).



323 23 024

Pull out grooved ball bearing with Special Tool 23 2 010.
Important!
Shim.



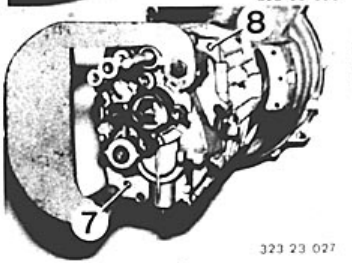
323 23 025

Remove cover (3).
Remove spring (4) and lockpin (5).
Check installed position.



323 23 026

Unscrew bolt (6).
Installation:
Install bolt with bolt cement**.
Tightening torque*.



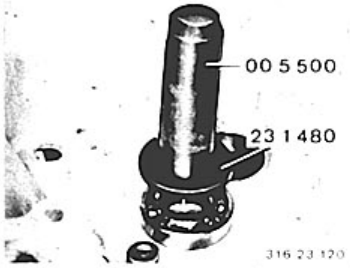
323 23 027

Unscrew transmission case cover mounting bolts.
Drive dowel pins (7 and 8) out of transmission case.

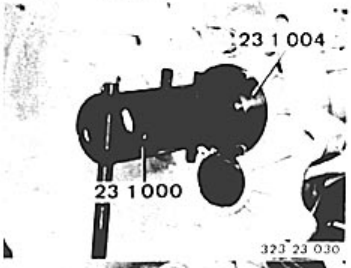

323 23 028

Pull off transmission case.
Installation:
Replace gasket.
Important!
Shims on input shaft and layshaft.

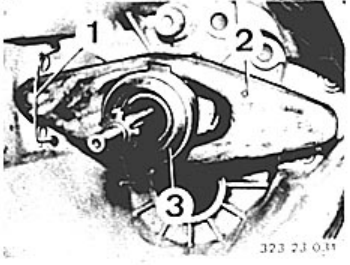
* See Specifications
** Source: HWB



Install a 1 mm (0.039") thick shim.
Drive in grooved ball bearing with Special Tools 23 1 480 and 00 5 500.
Slide case over gear wheel set.

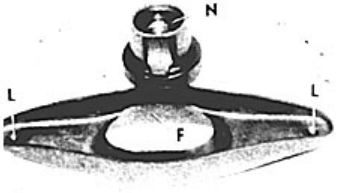


Pull input shaft into grooved ball bearing with Special Tools 23 1 004 and 23 1 000, or push case on to case cover.
Bolt transmission case.
Tightening torque*.
Install lockpins, shims and circlip.



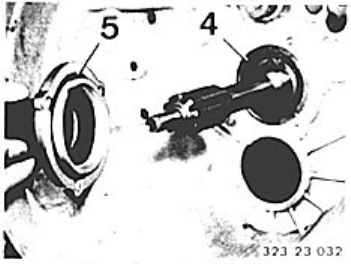
23 11 621 SEALING OR REPLACING COVER FOR CLUTCH RELEASE GUIDE TUBE
– Transmission Removed –

Lift out spring (1) and remove release lever (2) with thrust bearing (3).

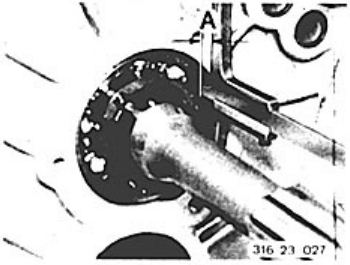


Installation:
Pack lubricating groove (N) with Molykote Longterm 2**.
Coat guides (F) and bearings (L) with Molykote Longterm 2**.
Non-conformance could cause release bearing to seize on guide sleeve.

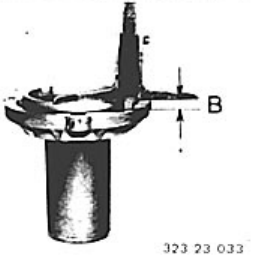
* See Specifications
** Source: HWB



Unscrew guide sleeve.
Important!
Shim (4).
Installation:
Replace O-ring (5).
Tightening torque*.



Measure distance (A) from case to grooved ball bearing.



Measure collar height (B) of guide sleeve.
Take up any play with shims to 0 ... 0.09 mm (0 ... 0.0035").
Example:

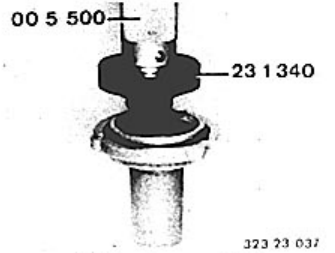
A	5.2 mm (0.205")
– B	4.8 mm (0.189")
	0.4 mm (0.016") shim thickness

* See Specifications



23 12 501 REPLACING RADIAL OIL SEAL FOR INPUT SHAFT
– Transmission Removed –

Remove guide sleeve – see 23 11 621.
Lift out radial oil seal.

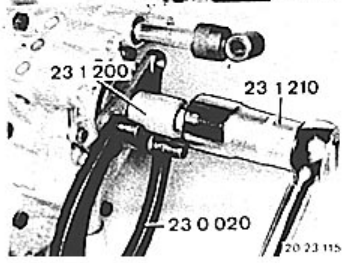


Drive in radial oil seal with Special Tools 23 1 340 and 00 5 500.
Open end faces transmission case.
Lubricate sealing lip with oil.



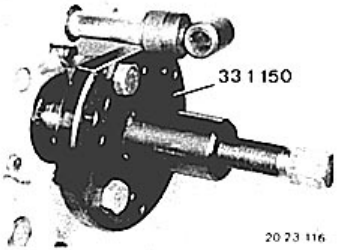
23 12 531 REPLACING RADIAL OIL SEAL FOR OUTPUT FLANGE
– Transmission Removed –

Remove lockplate (1).
Installation:
Replace lockplate.



Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.
Installation:
Install collar nut with bolt cement**.
Tightening torque*.

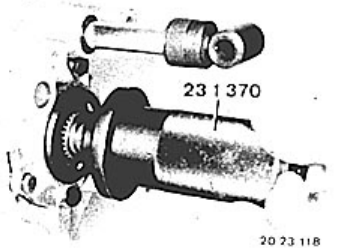
* See Specifications
** Source: HWB



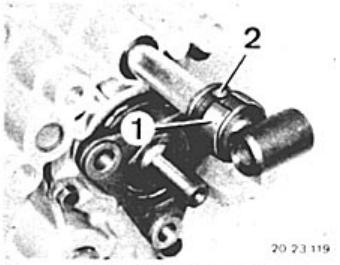
Pull off output flange with Special Tool 33 1 150.



Pull out radial oil seal with Special Tool 00 5 010.

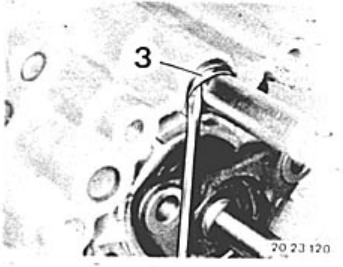


Installation:
Lubricate sealing lip with oil.
Drive in radial oil seal with Special Tool 23 1 370.

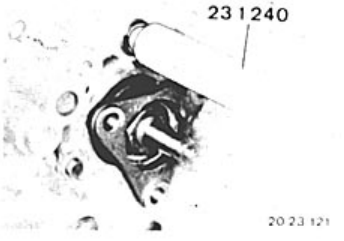


23 12 561 REPLACING RADIAL OIL SEAL FOR SELECTOR SHAFT
– Transmission Removed –

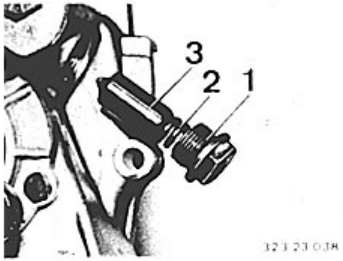
Remove locking sleeve (1).
Drive out pin (2) upwards.
Take off selector rod joint.
Installation:
Install selector rod joint that offset end of bearing sleeve faces toward the right when looking forward in car.



Lift out radial oil seal (3).



Lubricate sealing lip of radial oil seal with oil.
Drive in radial oil seal with Special Tool 23 1 240.



23 21 500 REMOVING AND INSTALLING INPUT AND OUTPUT SHAFTS – TRANSMISSION CASE FRONT SECTION REMOVED –

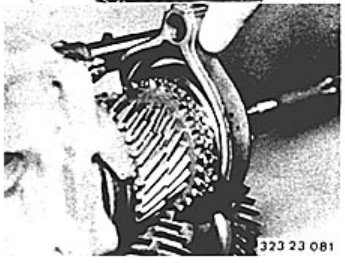
Unscrew plug (1).
Remove spring (2) and lockpin (3).
Installation:
Seal bearing surface of plug (1) with sealing compound**.



Enagage 3rd gear.
Turn input shaft until opening in 3rd gear wheel is aligned with pin.
Knock out pin (4) downward in this position, until selector rod (5) can be pulled out.
Loose balls!
Important!
Knock pin between tooth flanks and operating sleeve.
Installation:
Replace pin.



Remove key (H).
Knock out pin (B).
Unscrew bolt (6) enough that selector shaft can be turned.
Selector arm must face up.
Engage 4th gear.
Press selector fork in operating sleeve firmly and pull out selector shaft forward.
Important!
Rollers.



Remove selector fork.
Installation:
Check wear* of selector fork 23 31 501.

* See Specifications
** Source: HWB



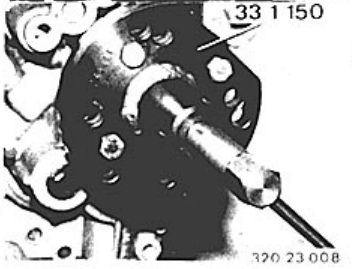
Unscrew bolt (7) enough that selector arm (S) for reverse gear can be removed.
Pull out selector rod (8).
Loose balls!



Remove lockplate.
Installation:
Replace lockplate.

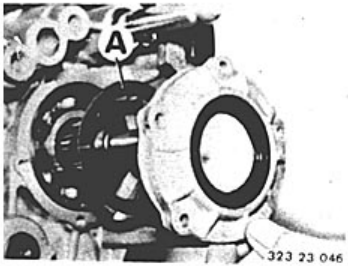


Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.
Installation:
Tightening torque*.
Install collar nut with a bolt locking agent**.

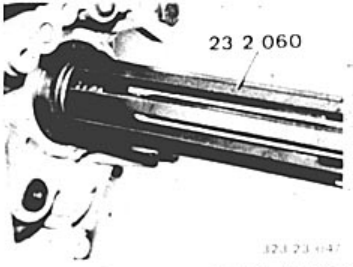


Pull off output flange with Special Tool 33 1 150.

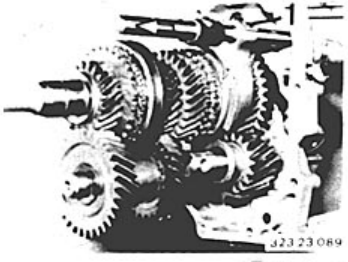
* See Specifications
** Source HWB



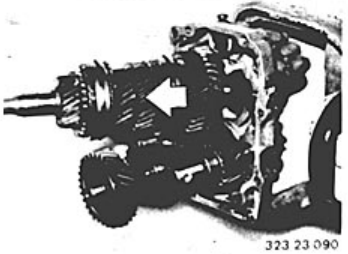
Detach support ring.
Important!
Shim (A).
Installation:
Replace gasket.
Remove old gasket with an adhesive remover*.



Pull grooved ball bearing off of output shaft and out of transmission case cover with Special Tool 23 2 060.

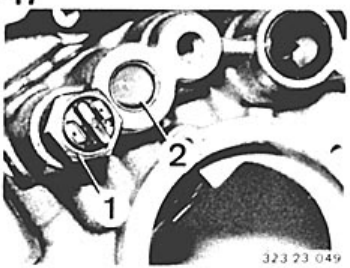


Drive out pin (1).
Pull out 1st/2nd gear selector rod.
Loose balls!
Remove selector fork.
Installation:
Replace pin.

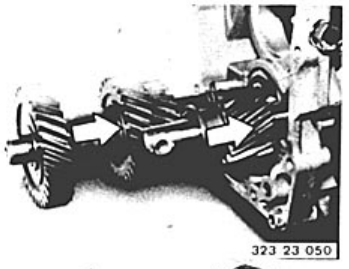


Remove input shaft and output shaft.
Remove layshaft.
Installation:
Check condition of all bearings, replacing if necessary (see 23 21 701).

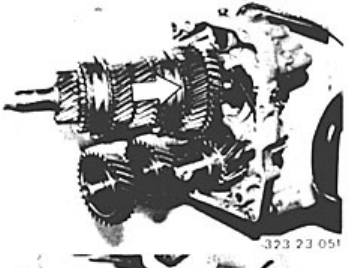
* Source: HWB



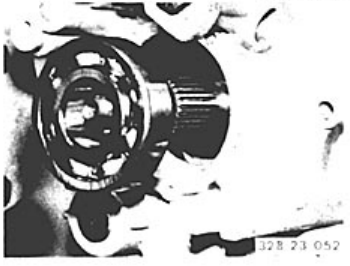
Remove backup light switch (1) and end cover (2).
Installation:
Push down detent balls with a screwdriver applied through open bores.
Replace end cover (2).



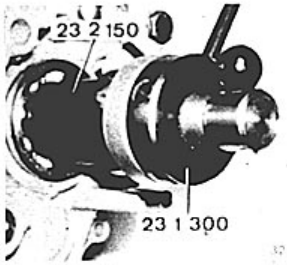
Install layshaft and reverse gear with collar facing forward.
Version with Grooved Ball Bearing:
Heat case rear section in area of ball bearing to about 80° C (176° F) with a hot air blower.



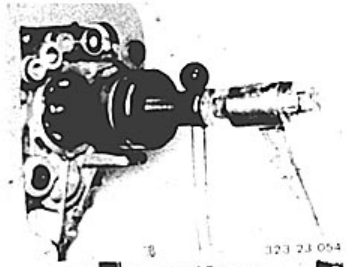
Insert input shaft and output shaft assembly in case rear section.



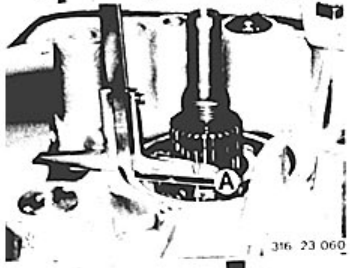
Insert grooved ball bearing in case rear section lightly.



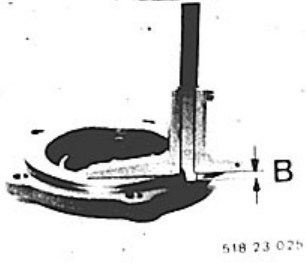
Press grooved ball bearing on output shaft and into case rear section with Special Tools 23 2 150 and 23 1 300.



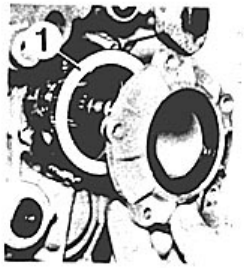
Drive in grooved ball bearing to fit tight by applying light knocks.



Measure distance (A) from case rear section to grooved ball bearing.



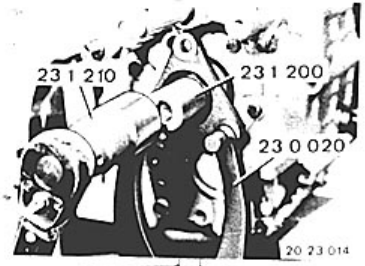
Measure collar height (B) without gasket.
Important!
Use 0.2 mm (0.008") for gasket thickness in calculations.



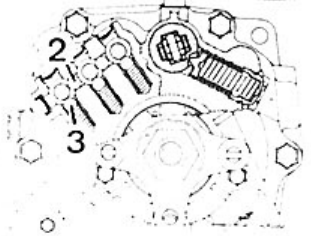
There should not be any play between grooved ball bearing and sealing cover.
All play must be taken up with shims (1).
Example:

A	3.0 mm (0.118")
– B	2.8 mm (0.110")
	0.2 mm (0.008")
+	0.2 mm (0.008") gasket thickness
	0.4 mm (0.016") shim thickness

Tighten sealing cover*.



Mount output flange.
Install collar nut with bolt cement**.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Tighten collar nut with Special Tool 23 2 210.
Tightening torque*.
Install lockplate.



Layout of Detent and Locking Balls:
2 Locking ball
3 Detent ball

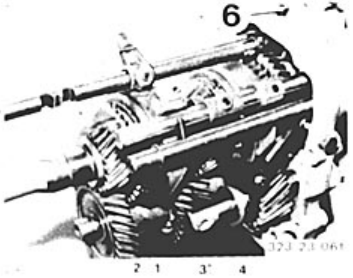


Insert detent balls.
Install selector rod for reverse gear.

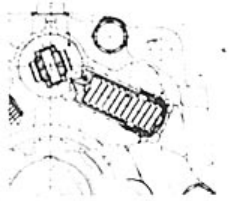
* See Specifications for tightening torque
** Source: HWB



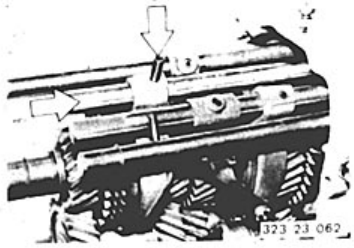
Place 1st/2nd gear selector fork in operating sleeve.
Insert locking and detent balls.
Install selector rod.
Mount selector fork with 6 x 24 mm pin.



Insert 3rd/4th gear selector fork in operating sleeve.
Engage 4th gear.
Install selector shaft; selector arm swung down.
Tighten bolt (6).
Tightening torque*.
Take out 4th gear again.



Install lockpin.
Installation:
Check position of lockpin (1) in bush (2).
Insert spring (3).
Install plug (4) with sealing compound**.
Tightening torque*.

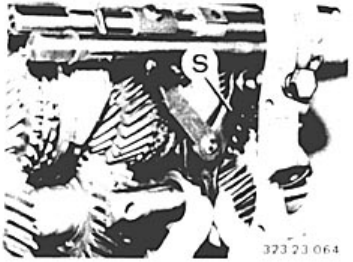


Insert locking and detent balls.
Install 3rd/4th gear selector rod.
Mount selector fork with 6 x 24 mm pin.

* See Specifications
** Source: HWB

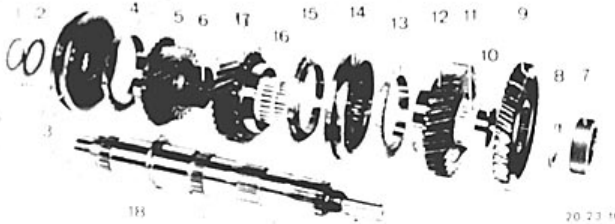


Install backup light switch (1) and end cover (2).

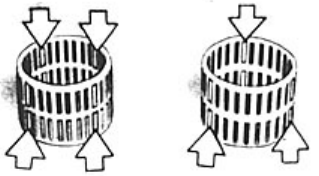


Install selector arm (S) for reverse gear with collar facing case.
Important!
Install selector arm without stress.
Clearance is required between selector arm and groove of reverse gear wheel.
Tightening torque*.

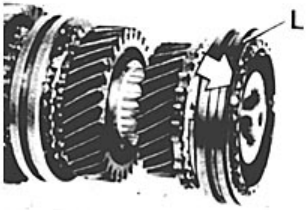
* See Specifications



20 23 105


320 23 114

Important!
Split needle bearings.
Slots without needles are provided in 90° and 120° steps to guarantee uniform support of the needles.



320 23 086

23 21 551 REPLACING OUTPUT SHAFT
– Output Shaft Removed –

Remove circlip (1).
Installation:
Always replace circlip.
Pull support ring (2), synchronizer with sliding sleeve (3), synchromesh ring (4), 3rd gear (5) and needle cage (6) off of output shaft.
Important! – Installation:
Shouldered end of sliding sleeve faces 4th gear.
Press spacer (7), washer (8), reverse gear (9), spacer (10), needle cage (11), 1st gear (12), synchromesh ring (13), synchronizer with sliding sleeve (14), synchromesh ring (15), needle cage (16) and 2nd gear (17) off of output shaft (18).

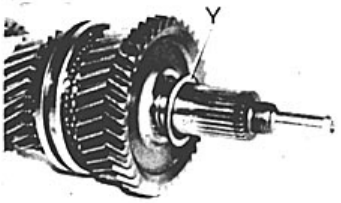
Installation:
Adjust play between circlip and guide sleeve to 0 ... 0.09 mm (0 ... 0.0035") with shims.


323 23 079



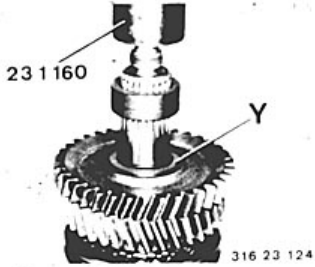
20 23 106

Installation:
Sliding sleeves for 1st/2nd and 3rd/4th gears are different (splines).
Don't mix up sliding sleeves.
1 Sliding sleeve for 1st/2nd gear
2 Sliding sleeve for 3rd/4th gear
Important!
Install sliding sleeve (2) that shouldered end faces 4th gear.



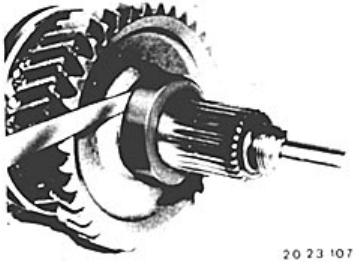
323 23 066

Assemble output shaft.
Important!
Adjust axial play to 0 ... 0.09 mm (0 ... 0.0035") with shim Y.

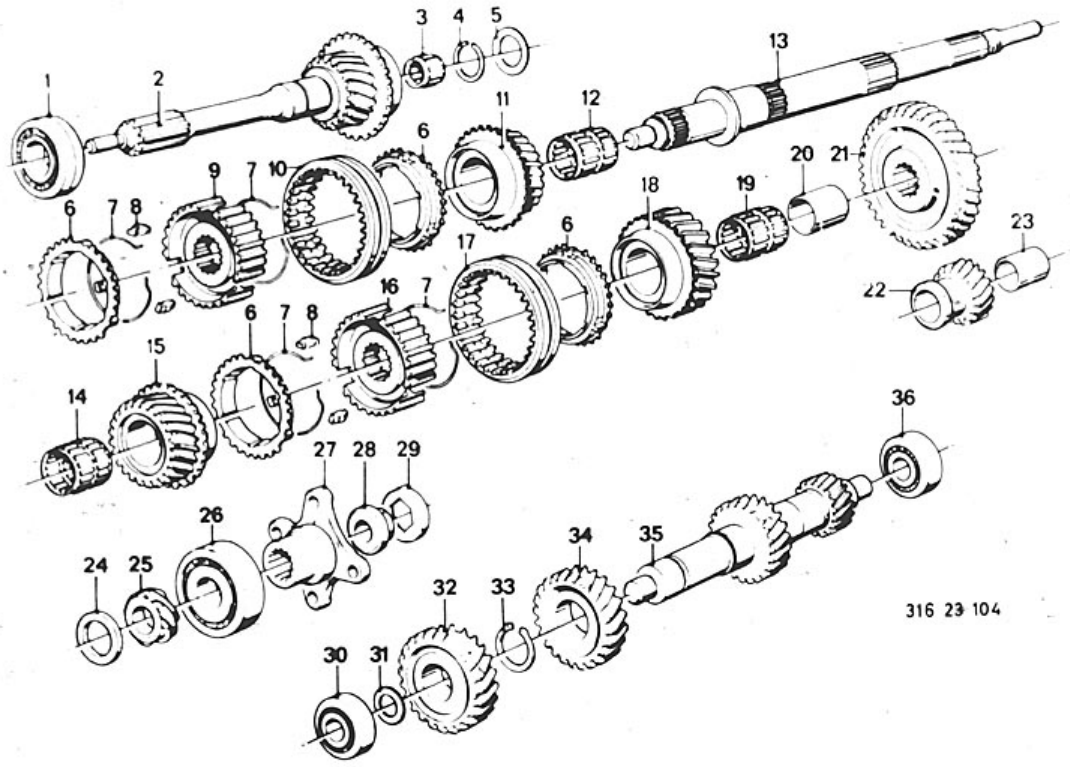


316 23 124

Install shim Y between reverse gear and spacer.
Press spacer against collar of output shaft with Special Tool 23 1 160.


20 23 107

Check axial play.
To correct, remove reverse gear wheel again and replace shim Y with a different one.



Drawing of Gear Set and Bearings:

1 Ball bearing
2 Input shaft with 4th gear
3 Needle bearing
4 Circlip
5 Washer
6 Synchromesh ring
7 Spring
8 Pressure piece
9 Guide sleeve 3rd/4th gear
10 Sliding sleeve 3rd/4th gear
11 3rd gear
12 Needle bearing
13 Output shaft
14 Needle bearing
15 2nd gear
16 Guide sleeve 1st/2nd
17 Sliding sleeve 1st/2nd gear
18 1st gear
19 Needle bearing
20 Bush
21 Reverse gear
22 Reverse gear
23 Bush
24 Washer Y
25 Spacer
26 Ball bearing
27 Output flange
28 Collar nut
29 Lockplate
30 Ball bearing
31 Washer
32 4th gear
33 Circlip
34 3rd gear
35 Layshaft
36 Roller bearing

23 21 701 REPLACING BEARINGS OF ALL TRANSMISSION SHAFTS
– Transmission Removed –



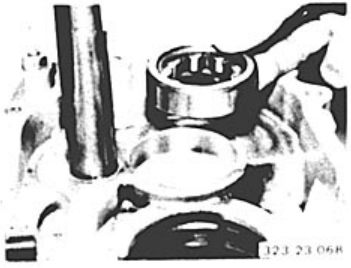
323 21 055

Remove and install input and output shafts – see 23 21 500.

A) Layshaft:

Pull off bearing inner race or grooved ball bearing on layshaft.

Press new bearing inner race and grooved ball bearing on layshaft, without shim.



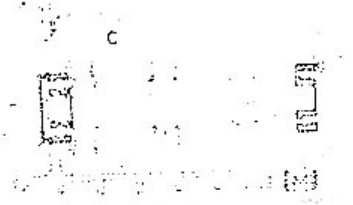
323 23 068

Heat case rear section in area of bearing to about 80° C (176° F) with hot air blower.

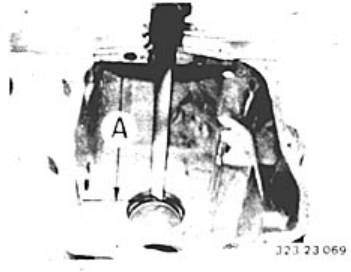
Pull out cylindrical roller bearing.

Installation:

Large diameter end of roller cage faces case rear section.



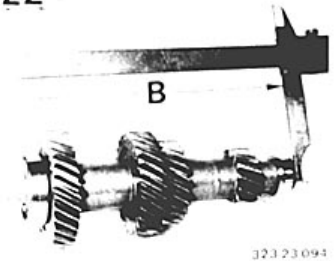
Determine thickness of shim C.



323 23 069

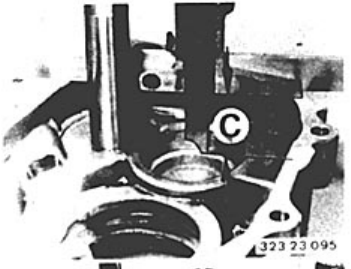
Remove grooved ball bearing in case front section after heating case front section in area of bearing to about 80° C (176° F) with a hot air blower.

Measure distance (A) from case sealing surface to circlip.



323 23 094

Measure distance (B) from bearing inner race to ball bearing inner race.



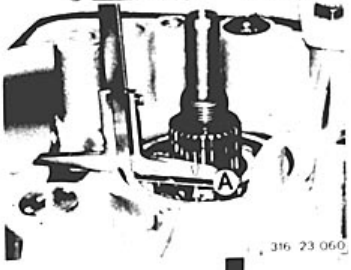
323 23 095

Measure distance C from case sealing surface to bearing outer race on cover without gasket.

Use 0.2 mm (0.008") for gasket thickness in calculations.

Example:

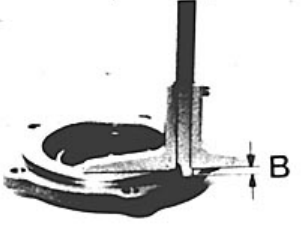
A	170.0 mm (6.693")
+ C	38.7 mm (1.523")
+	0.2 mm (0.008") gasket thickness
	208.9 mm (8.224")
– B	208.5 mm (8.208")
	0.4 mm (0.016")
–	0.1 ...0.2 mm (0.004,..0.008") axial play
	0.2 ...0.3 mm (0.008...0.012") shim th.



316 23 060

B) Output Shaft:

Measure distance A from case cover to grooved ball bearing.

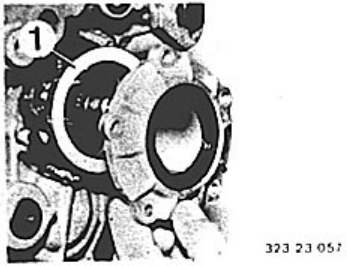


518 23 025

Measure collar height B without gasket.

Important!

Use 0.2 mm (0.008") for gasket thickness in calculations.



There should not be play between grooved ball bearing and sealing cover.
Take up all play with shims (1).
Example:

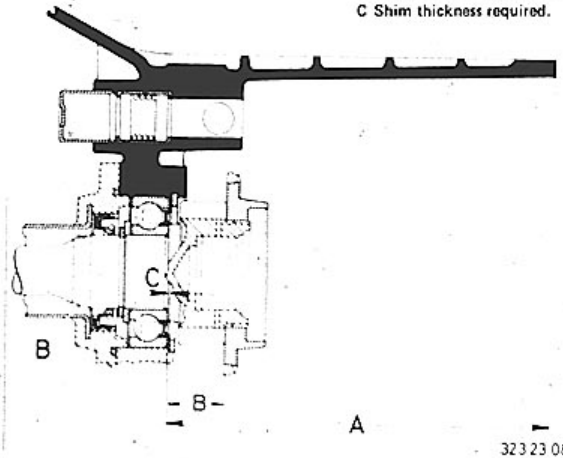
A	3.0 mm (0.118")
– B	2.8 mm (0.110")
	0.2 mm (0.008")
+	0.2 mm (0.008") gasket thickness
	0.4 mm (0.016") shim thickness

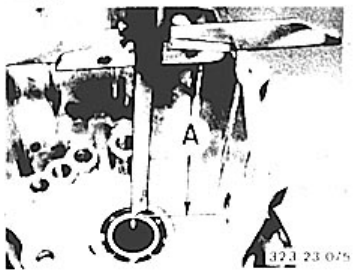
Tighten sealing cover.
Mount and lock output flange.



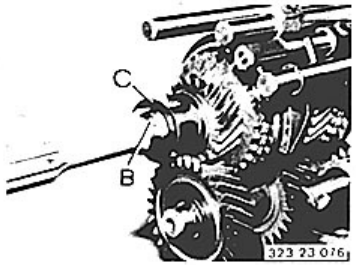
C) Input Shaft:
Install a 1 mm (0.039") shim and drive in grooved ball bearing with Special Tools 23 1 480 and 00 5 500.

A Distance from case sealing surface to grooved ball bearing.
B Actual distance inscribed in input shaft.
C Shim thickness required.





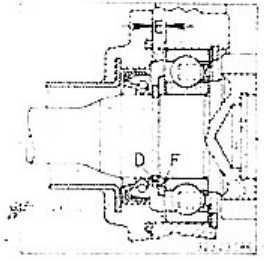
Measure distance A from case sealing surface to grooved ball bearing.



After having actual distances A and B the thickness of shim C can be read in the "C" column.

A mm	B mm	Inscribed Lines	C mm
159.9	24	3 or 4	0.5
	23.9	1 or 2	0.6
159.8	24	3 or 4	0.4
	23.9	1 or 2	0.5
159.7	24	3 or 4	0.3
	23.9	1 or 2	0.4
159.6	24	3 or 4	0.3
	23.9	1 or 2	0.3

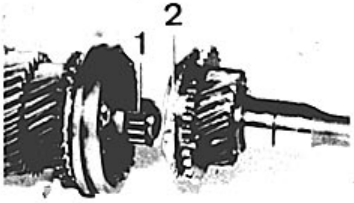
Install shim C on input shaft.



Measure circlip thickness D.
Insert circlip in groove of input shaft.
Measure distance E from circlip to grooved ball bearing.
Determine support ring thickness F.
Example:

E	4.1 mm (0.161")
– D	1.8 mm (0.071")
F	2.3 mm (0.090")

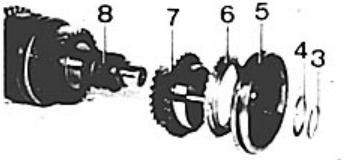
Install support ring F.



323 23 077

23 22 551 REPLACING 3RD AND 4TH GEAR WHEEL SET
– Output Shaft Removed –

Pull input shaft with needle cage (1) and synchromesh ring (2) off of output shaft.



Remove circlip (3).
Pull off support ring (4), guide sleeve (5), synchromesh ring (6) and 3rd gear (7) with needle cage (8).

Installation:
Replace circlip.

Important!
Shouldered end of sliding sleeve (5) faces 4th gear.



323 23 078

Installation:
Adjust play between circlip and guide sleeve to 0 ... 0.09 mm (0 ... 0.0035") with shims.



386 23 091

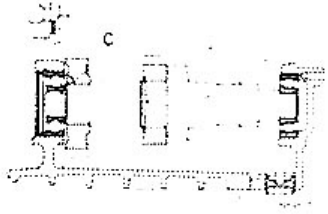
Press 4th gear and grooved ball bearing off of layshaft.

Important!
Shims.

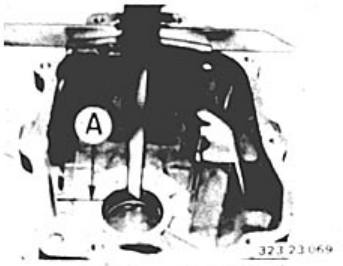
Remove circlip and press off 3rd gear.
Pressing off force: approx. 10 tons.
Pressing on force: approx. 7 tons.

Installation:
Heat gears to 120 ... 150° C (250 ... 300° F) with a hot air blower.

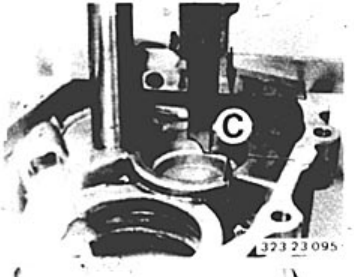
Important!
High collar at bore of 3rd and 4th gears faces toward 2nd gear.



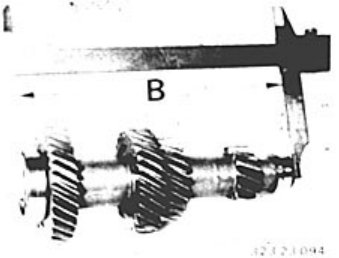
Determine thickness of shim C.



Measure distance A from case sealing surface to circlip.

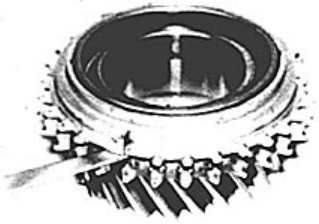


Measure distance C from case sealing surface to bearing outer race on cover without gasket.
Use 0.2 mm (0.008") for gasket thickness in calculations.



Measure distance B from bearing inner race to ball bearing inner race.
Example:

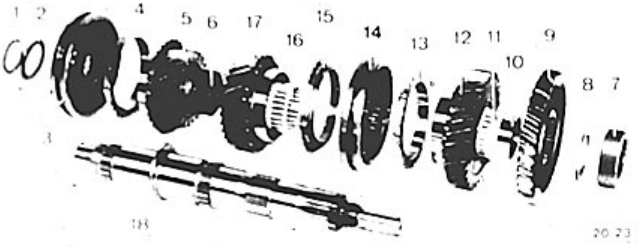
	A	170.0 mm (6.693")
+	C	38.7 mm (1.523")
+		0.2 mm (0.008") gasket thickness
		208.9 mm (8.224")
–	B	208.5 mm (8.208")
		0.4 mm (0.016")
–	0.1...	0.2 mm (0.004...0.008") axial play
	0.2 ...	0.3 mm (0.008...0.012") shim thickness



316 23 095

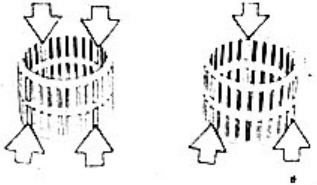
23 23 503 DISASSEMBLING/ASSEMBLING COMPLETE SYNCHRONIZATION
– Transmission Removed –

Remove output shaft – see 23 21 500.
Visually inspect synchromesh rings for wear.
Synchromesh rings must be replaced when distance between synchromesh ring and clutch unit is less than 1.0 mm (0.039").
Important!
Measure in area of stops.
Synchromesh rings should have uniform contact all around.



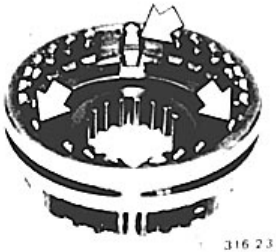
20 23 105

Remove circlip (1).
Installation:
Always replace circlip.
Pull support ring (2), synchronizer with sliding sleeve (3), synchromesh ring (4), 3rd gear (5) and needle cage (6) off of output shaft.
Press spacer (7), washer (8), reverse gear (9), spacer (10), needle cage (11), 1st gear (12), synchromesh ring (13), synchronizer with sliding sleeve (14), synchromesh ring (15), needle cage (16) and 2nd gear (17) off of output shaft (18).



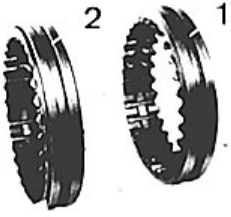
320 23 114

Important!
Split needle bearings:
Slots are provided without needles in steps of 90° or 120° to guarantee uniform support of the needles.



316 23 125

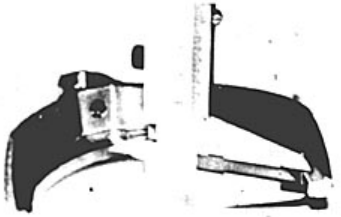
Press sliding sleeve off of synchronizer.
Installation:
Push flat teeth of sliding sleeve over thrust pieces.



Installation:
Sliding sleeves for 1st/2nd gear and 3rd/4th gear are different (splines).
Don't mix up sliding sleeves.
1 Sliding sleeve for 1st/2nd gear
2 Sliding sleeve for 3rd/4th gear
Important!
Install sliding sleeve(2) that shouldered end faces 4th gear.



Offset hooks of synchromeshing springs in an axial groove to each other.
Connect thrust pieces in synchromeshing springs.



316 23 096

23 31 501 REPLACING 1ST/2ND AND 3RD/ 4TH GEAR SELECTOR FORKS

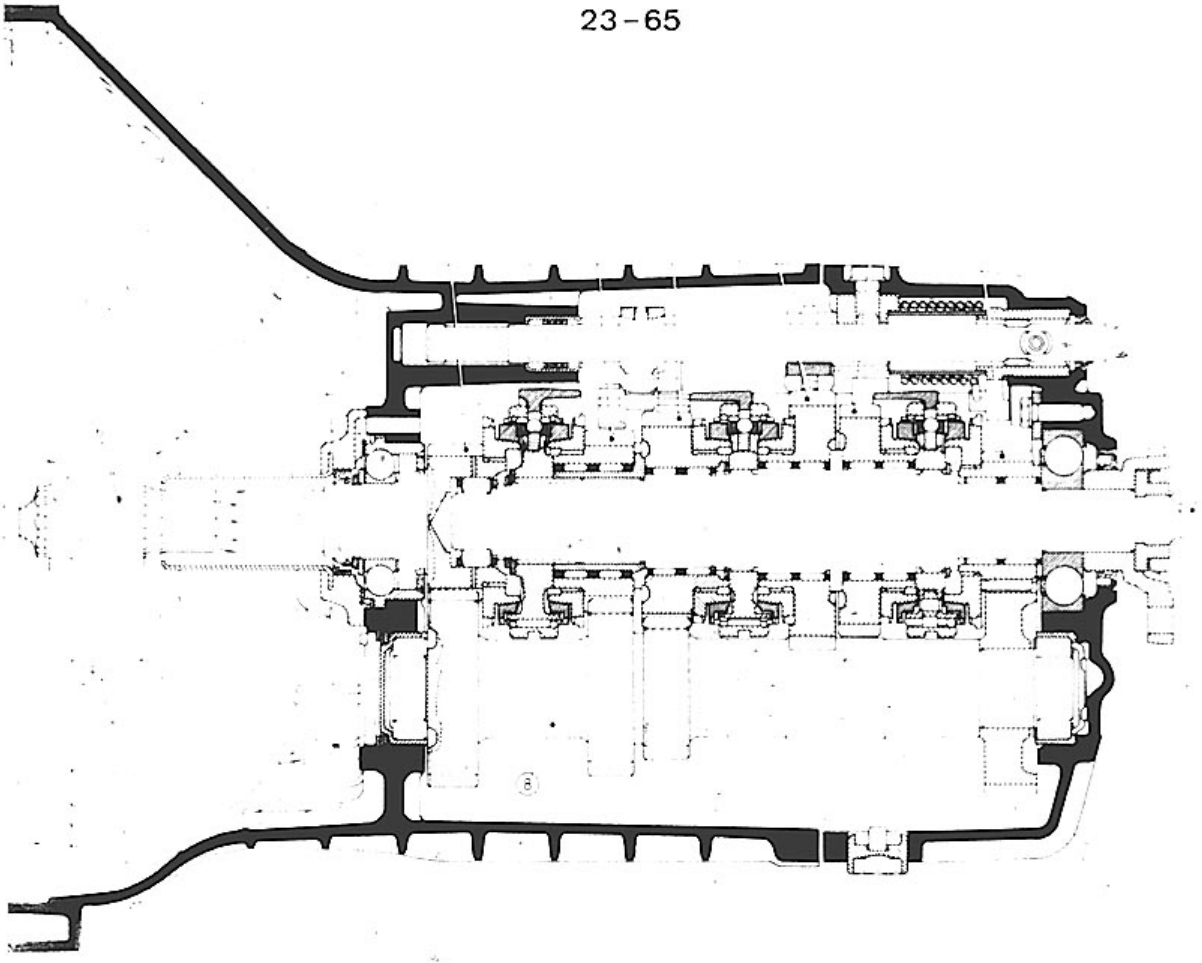
Remove input and output shafts 23 21 500.
Check wear* of selector forks.

* See Specifications

Construction group 23 Manual transmission

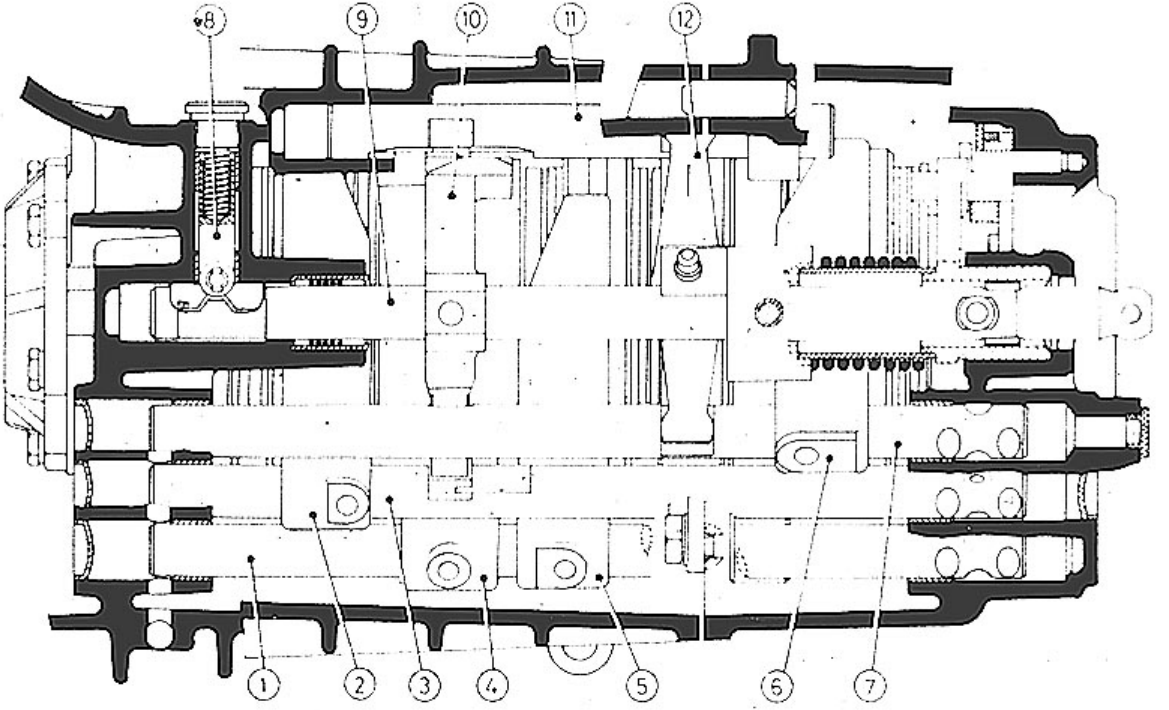
Getrag 240 Manual transmission (overdrive)

	Assembly drawing – transmission	23-	65
	Assembly drawing – shift components	23-	66
23 11 013	Transmission case front section – remove and install / seal	23-	67
623	Guide sleeve for clutch release – remove and install	23-	68
23 12 503	Radial oil seal for input shaft – replace	23-	68a
23 21 503	Input and output shaft assembly – remove and install	23-	69
554	Output shaft – replace	23-	74
703	Bearings of all transmission shafts – replace	23-	77
23 23 505	Synchronisation – disassemble and assemble	23-	81



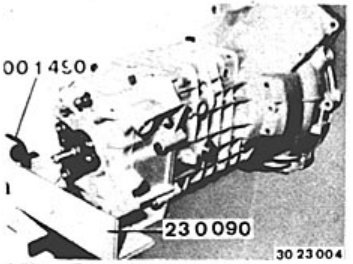
ASSEMBLY DRAWING OF GETRAG 240 FIVE SPEED OVERDRIVE MANUAL TRANSMISSION

1 First gear
2 Second gear
3 Third gear
4 Fourth gear
5 Fifth gear
R Reverse gear
6 Input shaft
7 Output shaft
8 Layshaft



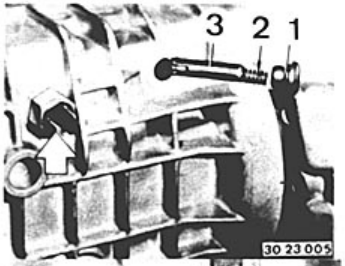
ASSEMBLY DRAWING OF SHIFT PARTS FOR 240 FIVE SPEED OVERDRIVE MANUAL TRANSMISSION

1 Selector rod, 1st/2nd gear
2 Selector fork, 3rd/4th gear
3 Selector rod, 3rd/4th gear
4 Dog
5 Selector fork, 1st/2nd gear
6 Selector fork, reverse/5th gear
7 Selector rod, reverse/5th gear
8 Lockpin
9 Selector shaft
10 Selector arm
11 Selector rail
12 Operating lever

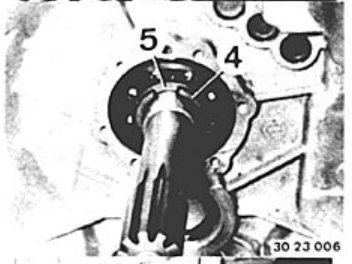


23 11 013 REMOVING AND INSTALLING/ SEALING FRONT TRANSMISSION CASE SECTION

Remove transmission – see pertinent model repair manual microfiche since 1985 models – 23 00 022.
Mount Special Tool 23 0 090 on Special Tool 00 1 490.
Mount transmission on special tool.
Drain oil.



Remove guide sleeve 23 11 623.
Unscrew backup light switch.
Remove cap (1).
Pull out spring (2) and lockpin (3).
Check installed position!



Remove snap ring (4).
Remove washer (5).
Installation:
Always replace circlip.

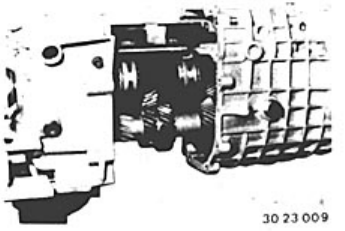


Unscrew bolt (6).
Installation:
Install bolt with a bolt cement**.
Tightening torque*.

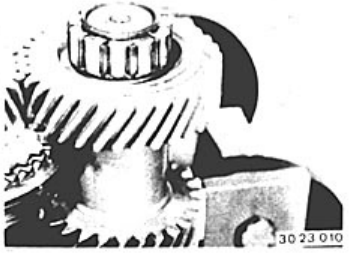
* See Specifications
** Source: HWB



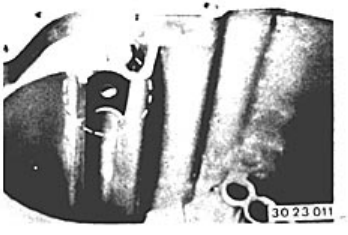
Drive out dowel pins.
Unscrew bolts.
Installation:
Check length of bolts.
Bolt (1) = 8 x 60 mm.



Pull off case front section.
Installation:
Coat sealing surface with sealing compound**.
Sealing surface must be thoroughly clean and dried of oil.

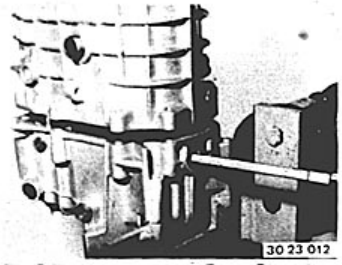


Install roller bearing on layshaft that small diameter end faces up.

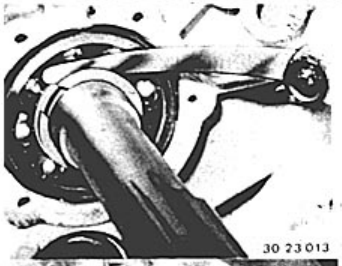


Coat case front section in area of reverse gear shaft with sealing compound**.
Surface must be thoroughly clean and dried of oil.

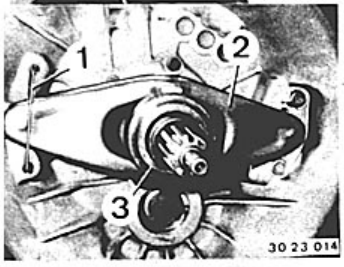
** Source: HWB



Unscrew oil drain plug.
Mount case front section.
Align layshaft through bore for oil drain plug that roller bearing of layshaft slides into bearing shell.
Mount case front section.
Tightening torque*.
Install lockpin.

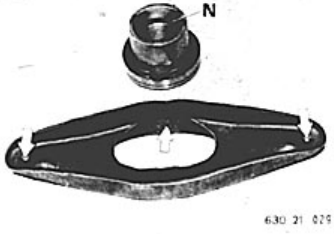


Install spacer and circlip.
Adjust play between bearing race and circlip to 0 ... 0.09 mm (0 ... 0.0035").

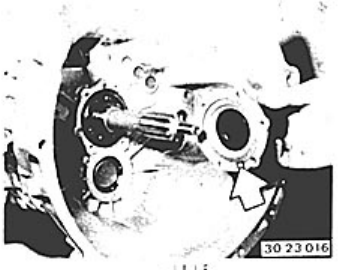


23 11 623 REMOVING AND INSTALLING GUIDE SLEEVE FOR CLUTCH RELEASE
– Transmission Removed –

Lift out spring (1) and remove release lever (2) with thrust bearing (3).



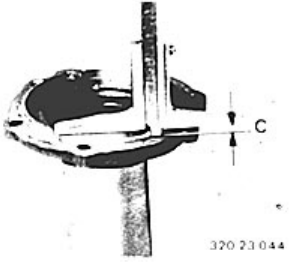
Installation:
Pack lubricating groove (N) with Molykote Longterm 2.
Coat guides (F) and bearings (L) with Molykote Longterm 2.
Non-conformance could cause release bearing to seize on guide sleeve.



Detach guide sleeve.
Important!
Spacer.
Installation:
Install guide sleeve with sealing compound**.
Sealing surface must be thoroughly clean and dried of oil.



Installation:
Adjust play to 0 ... 0.09 mm (0 ... 0.0035").
Determine thickness of spacer.
Measure distance (B) from guide sleeve protrusion to inside surface.

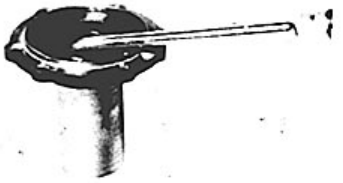


Measure distance (C) from guide sleeve protrusion to outside surface.
Example:

B	4.0 mm (0.157")
– C	2.6 mm (0.102")
	1.4 mm (0.055") spacer thickness

* See Specifications

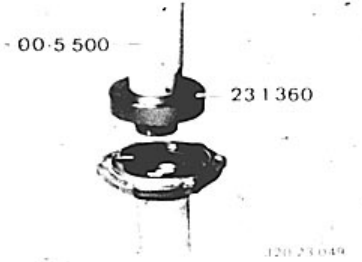
** Source: HWB



320 23 048

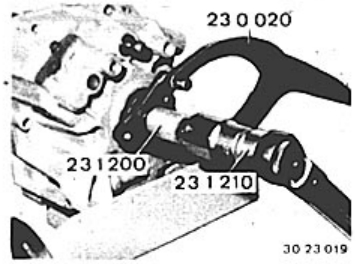
23 12 503 REPLACING RADIAL OIL SEAL FOR INPUT SHAFT - Transmission Removed -

Remove guide sleeve - see 23 11 622.
Lift-out radial oil seal.



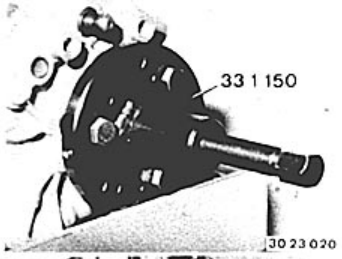
320 23 049

Drive in radial oil seal with Special Tools 23 1 360 and 00 5 500.
Open end faces up.
Lubricate sealing lip with oil.

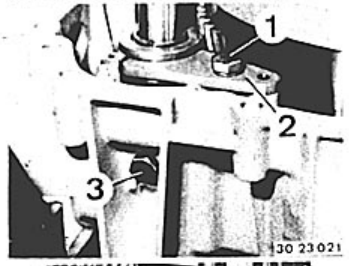


23 21 503 REMOVING AND INSTALLING INPUT AND OUTPUT SHAFT ASSEMBLY
–TRANSMISSION REMOVED–

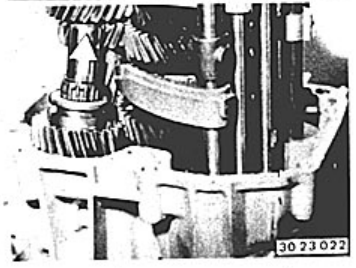
Remove transmission case front section 23 11 013.
Remove lockplate.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.



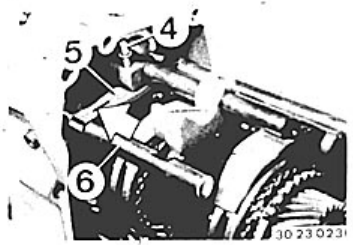
Pull off output flange with Special Tool 33 1 150.



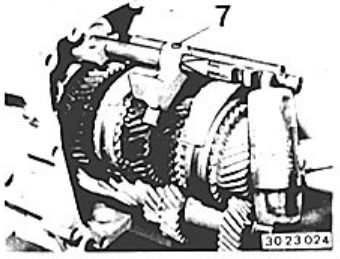
Unscrew bolt (1).
Remove holder (2).
Unscrew bolt (3).



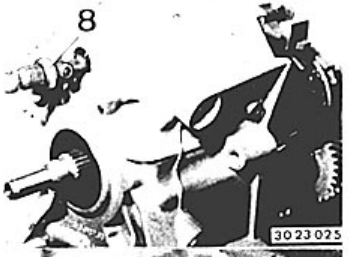
Remove shaft with reverse gear and needle bearing.



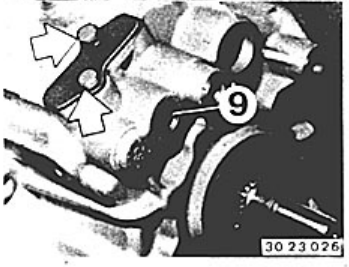
Pull out pin (4) for operating lever (5).
Pull out selector rail (6).
Remove operating lever (5).
Installation:
Install operating lever that notch faces up and in direction of selector rail.



Engage 4th gear.
Drive in pin (7), while counterholding.
Important!
Only drive in pin (7) far enough that selector shaft can be pulled back and out.



Radial oil seal (8) will also be pulled out.
Important!
Rollers on selector shaft.
Installation:
Replace radial oil seal.
Remove selector arm.

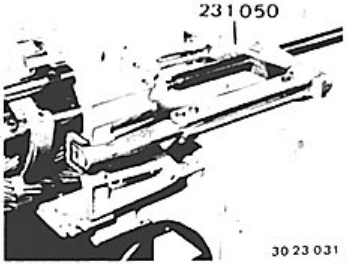


Detach end plate.
Installation:
Install end plate with sealing compound**.
Sealing surface must be thoroughly clean and dried of oil.
Remove end plate (9).
Installation:
Replace end plate.

** Source: HWB

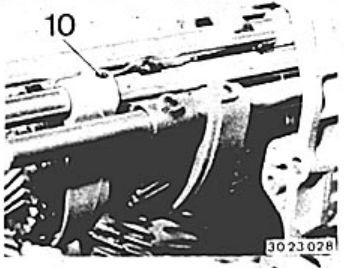


Remove three springs.



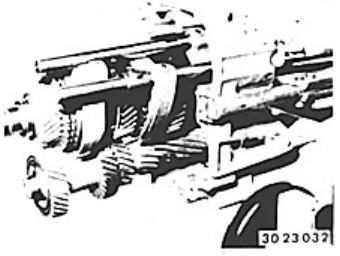
Press input shaft, output shaft and layshaft out of the rear case section with Special Tool 23 1 050.

Important!
Use a piece of wood, aluminum or something similar between the claws of the special tool and sealing surface, to avoid damaging the sealing surface.



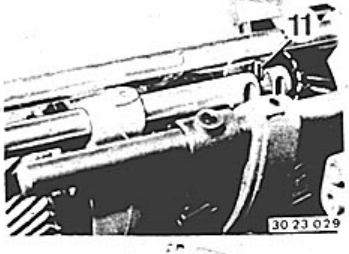
Drive pin (10) out of the 3rd/4th gear shift fork.

Installation:
Install a new pin.



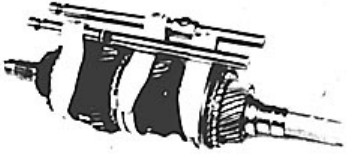
Important!
Make sure that shift rods and the layshaft do not clamp while pressing out. The layshaft must not fall down in this step.

Installation:
Check condition of all bearings, replacing if necessary.

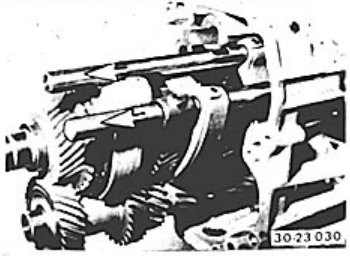


Knock out 3rd/4th gear shift rod forward.

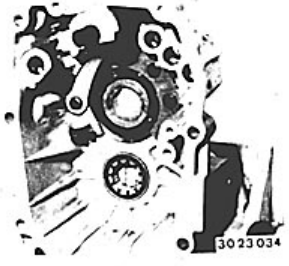
Important!
Lockpin (11) in shift rod.



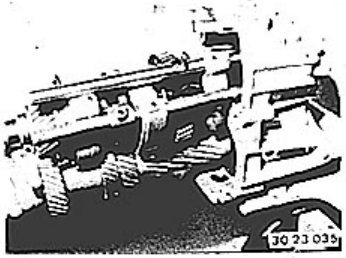
Installation:
Install 3rd/4th gear shift fork and shift rods with shift forks for 1st/2nd and 5th/reverse gears.



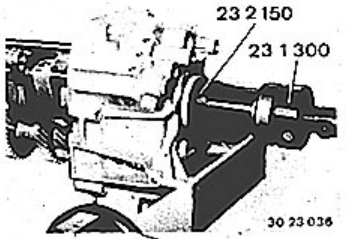
Engage 2nd and reverse gears by moving 1st/2nd and 5th/reverse gear shift rods forward.



Remove all locking and detent balls in rear case section.
Install the roller bearing with the large diameter end facing out.
Lubricate lockpins and locking arms with oil.



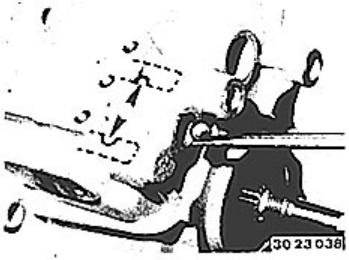
Heat grooved ball bearing inner race in case rear section to approx. 80° C (175° F) with a hot air blower.
Second and reverse gears are engaged.
Insert input shaft, output shaft and layshaft in case rear section.
Align selector rods.



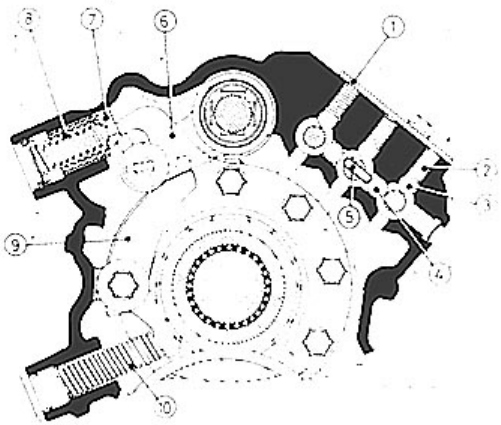
Pull input shaft, output shaft and layshaft into case rear section with Special Tools 23 1 300 and 23 2 150.
Important!
Make sure selector rods and layshaft are not clamped while pulling in parts.



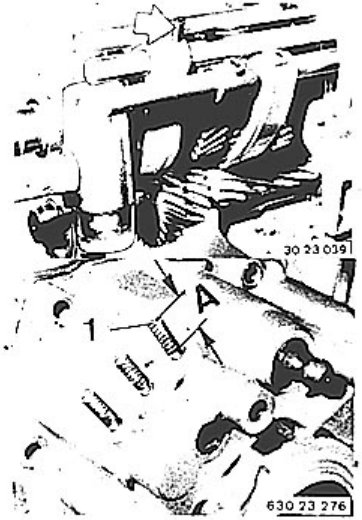
Move selector rods to neutral position.
Slide 3rd/4th gear selector rod through selector forks.
Install lockpin (1) in selector rod with grease.
Push in selector rod up to bore.
Opening in selector rod faces up.



Install two detent balls with grease.
Push in 3rd/4th gear selector rod against lock.

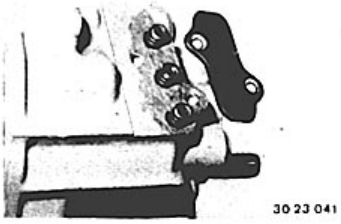


Arrest Assembly:
1 End cover
2 Spring
3 Locking ball
4 Detent ball
5 Lockpin
6 Selector arm
7 Lockpin
8 Spring
9 Locking screw
10 Spring

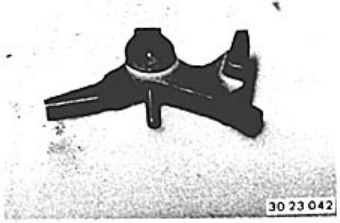


Drive 6 x 24 mm pin into 3rd/4th gear selector fork (counterhold).

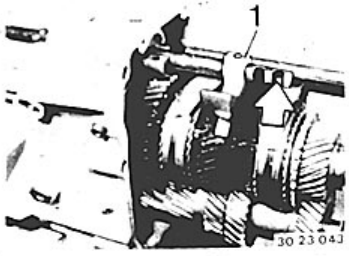
Install 3 locking balls and 3 springs.
Important!
Version with Different Length Springs:
Install the short spring (1) with relaxed length (A) = 15.9 mm (0.626") for 5th/reverse gear selector rod.



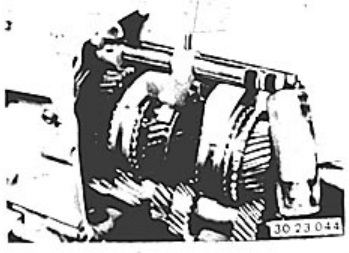
Install end cover after coating with sealing compound**.
Install end cover with sealing compound**.



Drive pin out of selector arm.

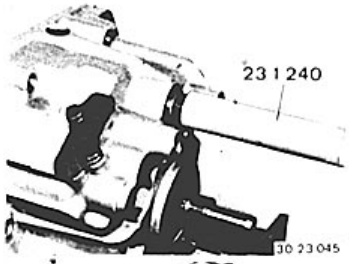


Hold 4 rollers in position with grease.
Slide in selector shaft and install selector arm (1) at same time.
Important!
Opening in selector shaft faces out.



Drive in 6 x 26 mm pin (counterhold).

** Source: HWB

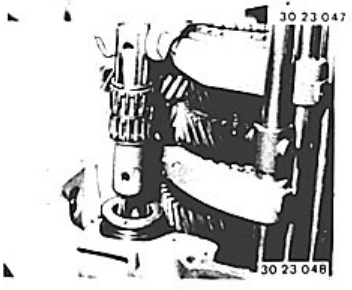


Lubricate sealing lips of radial oil seal with oil.
Drive in radial oil seal with Special Tool 23 1 240.



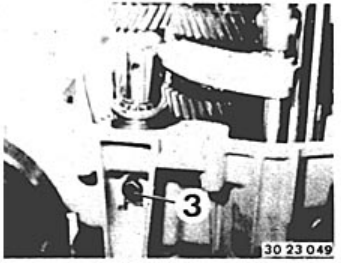
Install selector rail.
Groove (1) in selector rail faces up.
Install operating lever (5) with notch facing up and toward selector rail.
Install pin (4).

Coat case rear section in area of reverse gear shaft with sealing compound**.
Surface must be thoroughly clean and dried of oil.



Install shaft with needle bearing and reverse gear.

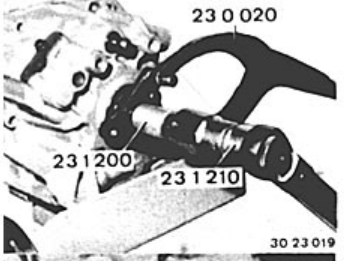
** Source: HWB



Mount shaft with bolt (3).
Install bolt with a locking compound**.



Insert holder (2), press out and secure in this position.

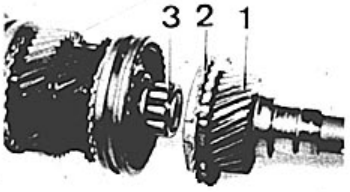


Install output flange.
Install collar nut with a locking compound**.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Tighten* collar nut with Special Tool 23 1 210.



Install lockplate.

* See Specifications for tightening torque
** Source: HWB

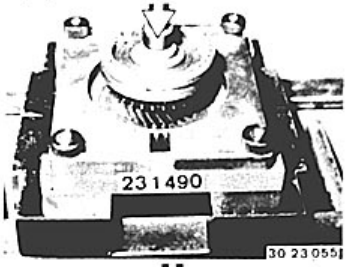


30 23 051

23 21 554 REPLACING OUTPUT SHAFT
– Output Shaft Removed –

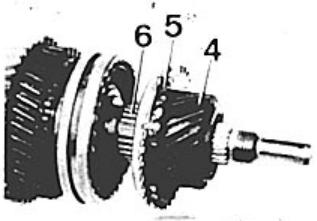
Pull off input shaft (1), synchromesh ring (2) and needle bearing (3).

Note:
To avoid mixing up the synchromesh rings while disassembling the output shaft, it is recommended to mark the synchromesh rings for a pertinent gear wheel.



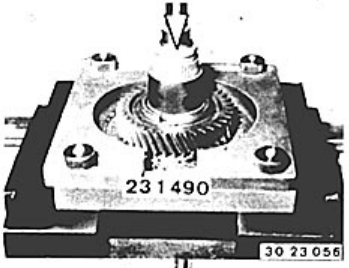
30 23 055

Press off 3rd gear wheel, guide and operating sleeves with Special Tool 23 1 490.
Take off needle bearing.
Pressing-off force*.



30 23 052

Pull off 5th gear wheel (4), synchromesh ring (5) and needle bearing (6).



30 23 056

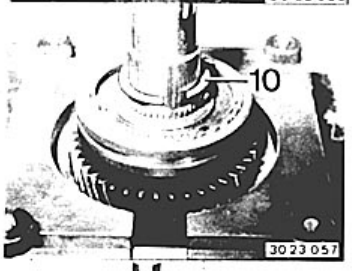
Press off bearing sleeve and 2nd gear wheel with Special Tool 23 1 490.
Remove needle bearing and synchromesh ring.



30 23 053

Lift out circlip (7).
Take off spacer (8).

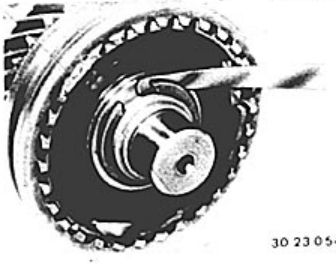
Installation:
Always replace the circlip.



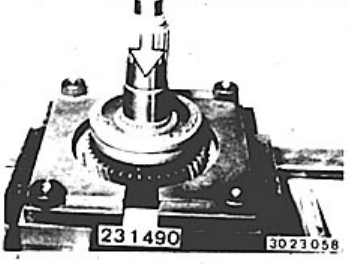
30 23 057

Important!
Circlip (10) must be removed before pressing off the 1st gear wheel.

Installation:
Always replace the circlip.


30 23 054

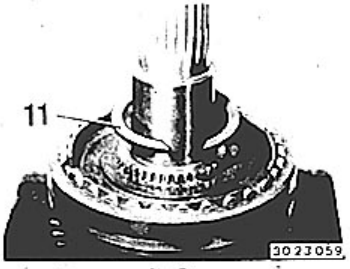
Installation:
Adjust play between the circlip and guide sleeve to 0 ... 0.09 mm (0 to 0.0035").



30 23 058

Press off 1st gear wheel, guide and operating sleeves with Special Tool 23 1 490.
Take off needle bearing.
Pressing-off force*.

* See Specifications

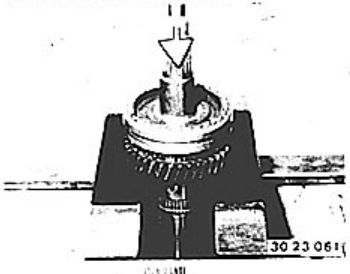


Important!
Circlip (11) must be removed prior to pressing off the reverse gear wheel.

Installation:
Always replace the circlip.



Place output shaft next to the collar.

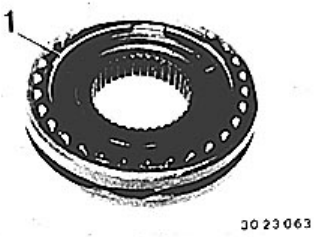


Press guide and operating sleeves as well as reverse gear wheel off of the output shaft.
Take off needle bearing.
Pressing-off force*.

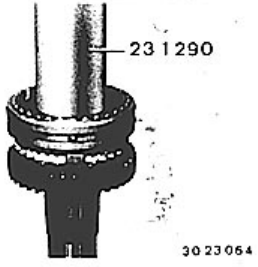


Assembling:
Note:
Check wear of synchromesh rings prior to assembling (see 23 23 505).
Install needle bearing, reverse gear wheel and synchromesh ring (only for version with synchronized reverse gear).
Insert guide and operating sleeves on splines of the output shaft.
Important!
Version with 3 Identification Grooves:
Grooves must face the 5th gear wheel.

* See Specifications

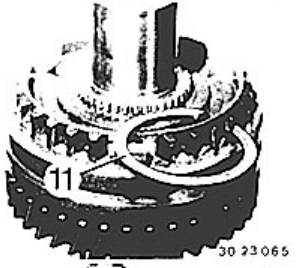


Important!
Version without Synchronized Reverse Gear:
Retainer (1) in the guide sleeve faces the reverse gear wheel.



Press on guide sleeve to fit tight with Special Tool 23 1 290.
Pressing-on force*.

Important!
Make sure that tabs on the synchromesh ring are aligned with openings in the guide sleeve while pressing on.



Shift operating sleeve in direction of the reverse gear wheel.
Adjust guide sleeve to be without play with circlip (11).
Circlips are available from Parts in different thicknesses from 1.7 to 2.0 mm (0.067 to 0.079").
Install circlip (11).

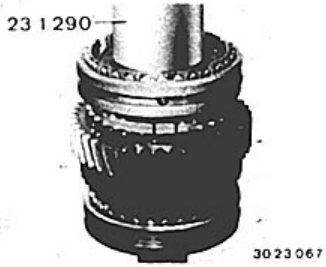


Install needle bearing, 1st gear wheel and synchromesh ring.
Slide guide and operating sleeves on splines of the output shaft.

Shouldered Operating Sleeve Version:
Shouldered end faces 2nd gear wheel.

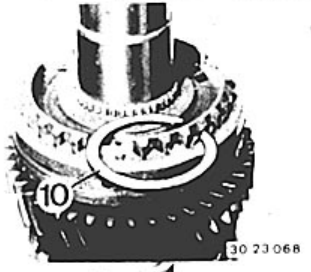
Version with Identification Groove:
Groove faces 1st gear wheel.

* See Specifications



Press on guide sleeve to fit tight with Special Tool 23 1 290.
Pressing-on force*.

Important!
Make sure that tabs on the synchromesh ring are aligned with openings in the guide sleeve while pressing on.



Shift operating sleeve in direction of the 1st gear wheel.
Adjust guide sleeve to be without play.
Circlips are available from Parts in different thicknesses from 1.7 to 2.0 mm (0.067 to 0.079").
Install circlip (10).



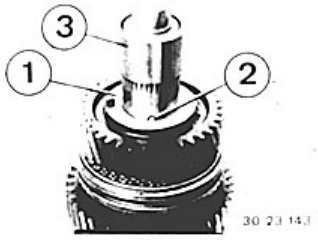
Install needle bearing, synchromesh ring and 2nd gear wheel.

Important!
Collar for the bearing sleeve on the output shaft must protrude slightly.
If necessary, check circlip (10) for correct seating.

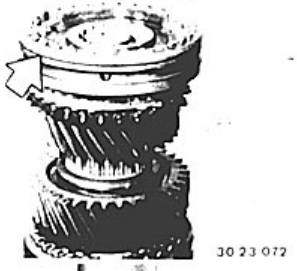


Heat bearing sleeve to about 80° C (175° F) with a hot air blower and install on the output shaft.

* See Specifications

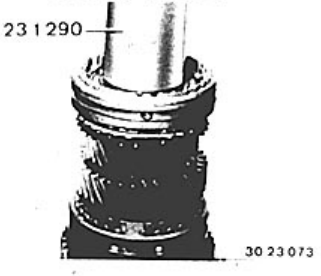


Version with Thrust Washer:
Install thrust washer (1) and ball (2).
Heat bearing sleeve (3) without collar to about 80° C (175° F) with a hot air blower and install on the output shaft.



Install needle bearing, 3rd gear wheel and synchromesh ring.
Install guide and operating sleeves on the splines with the groove facing the 4th gear wheel.

Version with 2 Identification Grooves:
Grooves face the 3rd gear wheel.



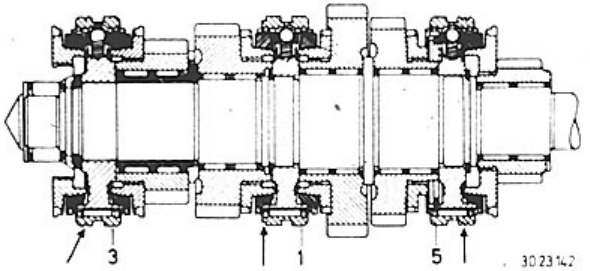
Press on guide sleeve to fit tight with Special Tool 23 1 290.

Important!
Make sure that tabs on synchromesh ring are aligned with openings in the guide sleeve while pressing on.

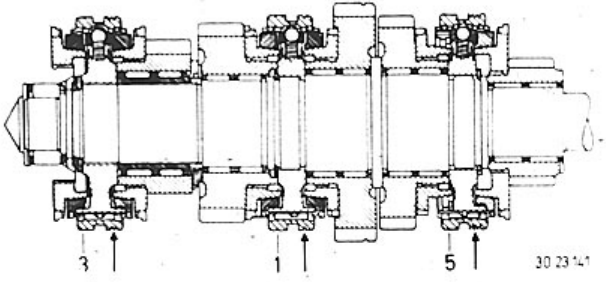
Install spacer and circlip.

Pressing-on force*.

* See Specifications

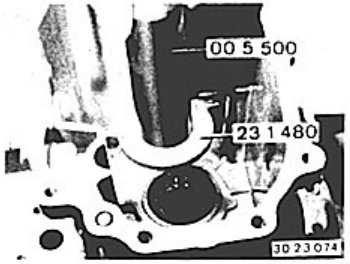


Identification and Installed Location of Operating Sleeves:
Date of introduction: 8.85
Operating sleeve (1) for 1st/2nd gears.
Operating sleeve installed with shouldered end facing 2nd gear wheel.
Operating sleeve (3) for 3rd/4th gears with one identification groove.
Operating sleeve installed with groove facing 4th gear wheel.
Operating sleeve (5) for 5th/reverse gears with two identification grooves.
Operating sleeve installed with grooves facing 5th gear wheel.



Important!
Modified synchronization since 11.87 with new gear wheels, synchromesh rings, guide and operating sleeves, guides, ball and springs.
Identification and Installed Location of Operating Sleeves:
Operating sleeve (1) for 1st/2nd gears with one identification groove.
Operating sleeve installed with groove facing 1st gear wheel.
Operating sleeve (3) for 3rd/4th gears with two identification grooves.
Operating sleeve installed with grooves facing 3rd gear wheel.
Operating sleeve (5) for 5th/reverse gears with three identification grooves.
Operating sleeve installed with grooves facing 5th gear wheel.

Important!
Modified shift components may not be installed in older transmissions (shifting problems).



23 21 703 REPLACING BEARINGS OF ALL TRANSMISSION SHAFTS
– Transmission Removed –

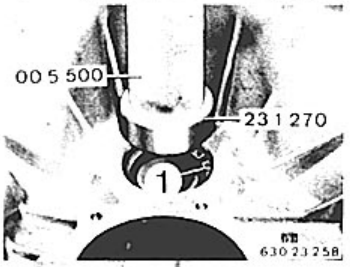
Remove input/output shaft assembly – see 23 21 503.

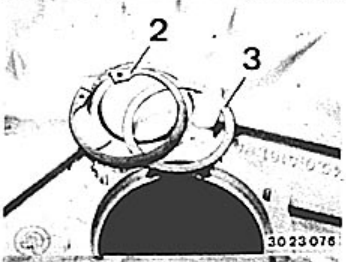
A) Input Shaft, Layshaft in Case Front Section

Input Shaft:
Drive out grooved ball bearing with Special Tools 23 1 480 and 00 5 500.

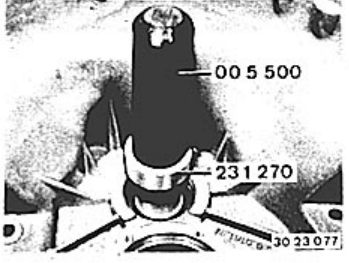
Important!
Collar is on clutch end.

Layshaft:
Loosen circlip (1) with a single knock from Special Tool 23 1 270 used in conjunction with Special Tool 00 5 500.

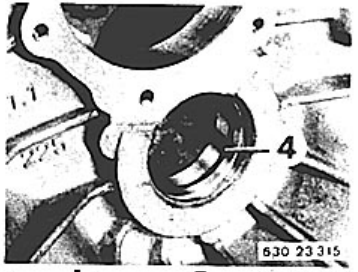




Lift out circlip (2).
Remove spacer (3).



Drive out bearing shell toward the inside with Special Tools 23 1 270 and 00 5 500.



Version with O-ring:
Lift out O-ring (4) with a feeler gage blade.

Installation:
Replace and insert new O-ring coated with engine oil in groove prior to installation of the bearing shell.

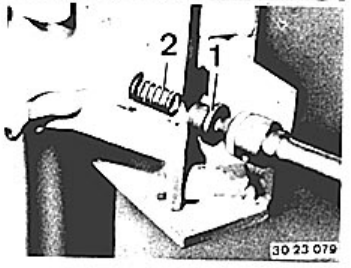
B) Output Shaft, Layshaft in Case Rear Section

Output Shaft:
Unscrew bolt (1).

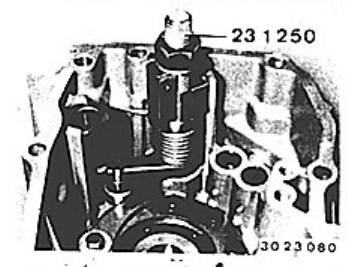
Caution!
Spring pressure.

Remove spring (2).

Installation:
Install bolt with a bolt cement**.

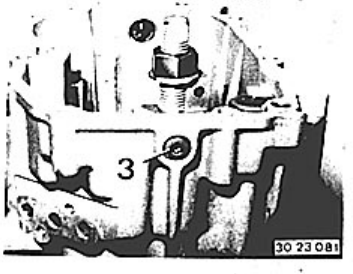


Install Special Tool 23 1 250 for removal of the selector arm.



Remove socket head screw (3).

Installation:
Install screw with a bolt cement**.
Tightening torque*.



* See Specifications
** Source of Supply: HWB



Remove selector arm from above.

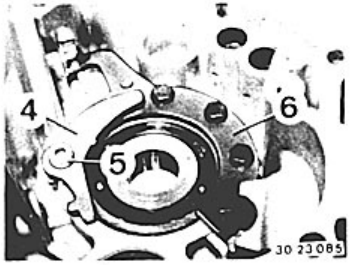
Important!
Roller.



Installation:
Install spring (2).
Insert selector arm with Special Tool 23 1 250.
Swing out selector arm with the roller over locking lever (4).



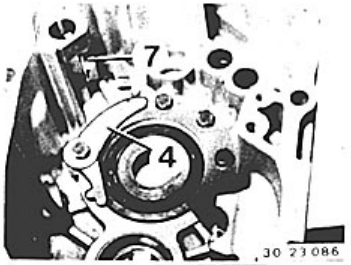
Move end of spring (3) over the raised point into installed position.
Press down on the selector arm in this position (do not knock down).
Install the socket head screw with a bolt cement** and tighten with correct torque* before removing the special tool.



Unscrew bolt.
Take off locking lever (4) and spacer (5).
Remove bearing holder (6).

Installation:
Install bolt with a large washer.

* See Specifications
** Source of Supply: HWB

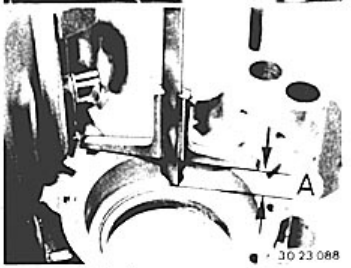


Installation:
Check the installed position of locking lever (4) and thrust pin (7).

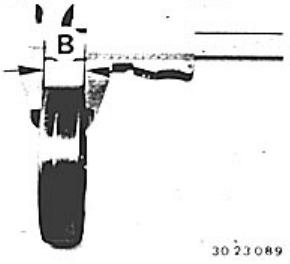


Lift out radial oil seal.
Drive out grooved ball bearing with Special Tools 23 1 120 and 00 5 500.

Important!
Shim X.



Determine thickness of shim X.
Measure distance (A).



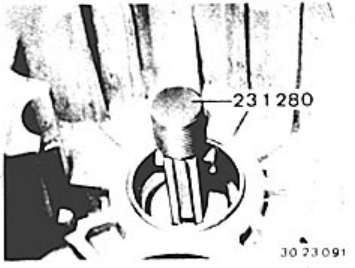
Measure distance (B).

Example:

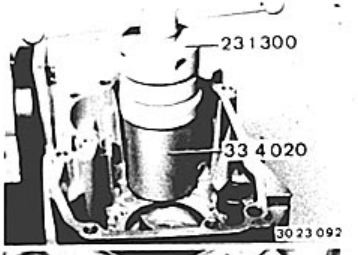
	A =	17.5 mm (0.689")
–	B =	17.0 mm (0.669")
	X =	0.5 mm (0.020") thick shim



Heat rear case section in area of the grooved ball bearing to about 80° C (175° F).
Install shim X.
Install grooved ball bearing.
Closed cage faces in.
If necessary, drive in against the stop with Special Tool 24 1 060.



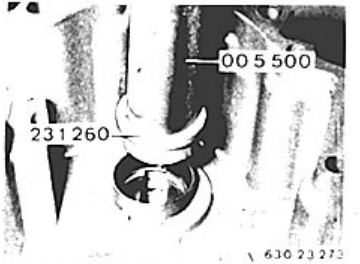
Layshaft:
Apply the stronger end of Special Tool 23 1 280 in the bearing shell.
If applicable, remove the turning lock on the side of the drain plug.



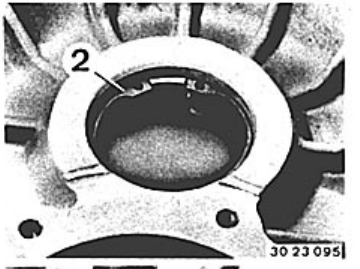
Apply Special Tool 33 4 020.
Screw on Special Tool 23 1 300.
Pull out bearing shell.



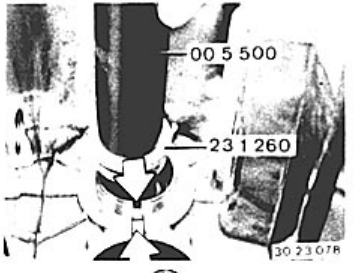
Installation:
Install bearing shell that the slot in the bearing shell is aligned with the bead (turning lock) in the case.



Drive in bearing shell with Special Tools 23 1 260 and 00 5 500.

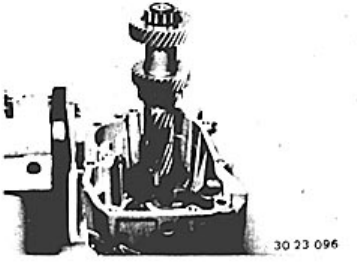


Determining Axial Play of Layshaft:
Install circlip (2).



Install old shims.
Drive in bearing shell to fit tight in the front case section with Special Tools 23 1 260 and 00 5 500.

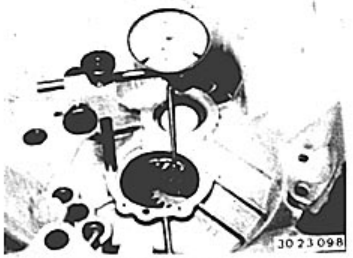
Important!
The oil groove must be aligned with the groove in the case.



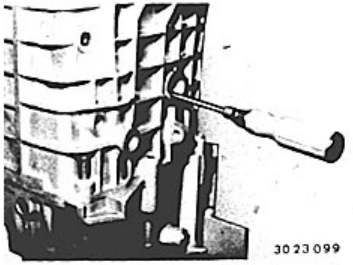
Place layshaft with roller bearings in the rear case section.



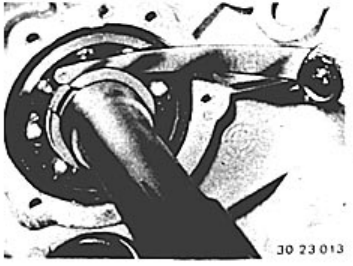
Mount front case section and secure with two bolts opposite each other.
Center front case section slightly with dowel pins.
Unscrew oil filler plug (1).



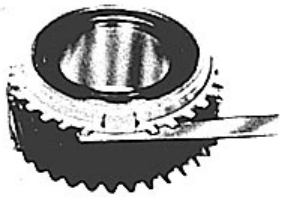
Mount holder with dial gage.
Dial gage must bear on tooth of the layshaft.



Check axial play of the layshaft through the bore for the oil filler plug.
Axial play: 0.13 to 0.23 mm (0.005 to 0.009").
Correct when necessary by removing the bearing shell and replacing the shim with a thicker one.



Install gear wheel set.
Determine thickness of shim for the input shaft.
Install old shim and circlip.
Reduce play to 0 ... 0.09 mm (0 to 0.0035").
Determine thickness of shim for the guide sleeve – see 23 11 623.



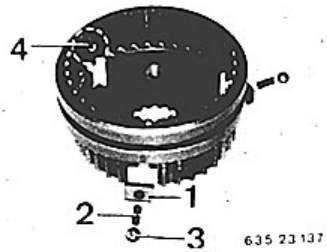
30 23 101

23 23 505 DISASSEMBLING AND ASSEMBLING COMPLETE SYNCHRONIZATION
- Output Shaft Removed -

Disassemble output shaft - see 23 21 554.

Note:
Only use molybdenum coated synchromesh rings for repairs.
Check distance* between synchromesh ring and clutch body.
Measure in area of stops.

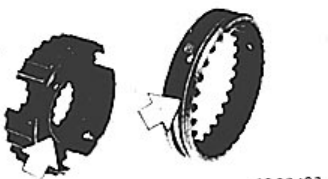
Note:
Twist and press down on synchromesh ring while measuring.
Synchromesh rings should bear on the entire surface uniformly.



635 23 137

Disassemble synchronizer.
Thrust piece (1), spring (2) and ball (3).

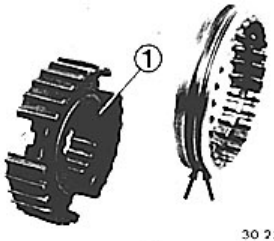
Installation:
Bores (4) or flattened teeth on the operating sleeve must be aligned with ball (3).



30 23 103

Important!
Only for 3rd/4th Gear Synchronization:

Version with One Groove:
Groove of operating sleeve must be on end with the narrow collar.



30 23 144

Version with Two Grooves:
Grooves of operating sleeve must be on end with the wide collar (1).



30 23 104

Install all springs, thrust pieces and balls.

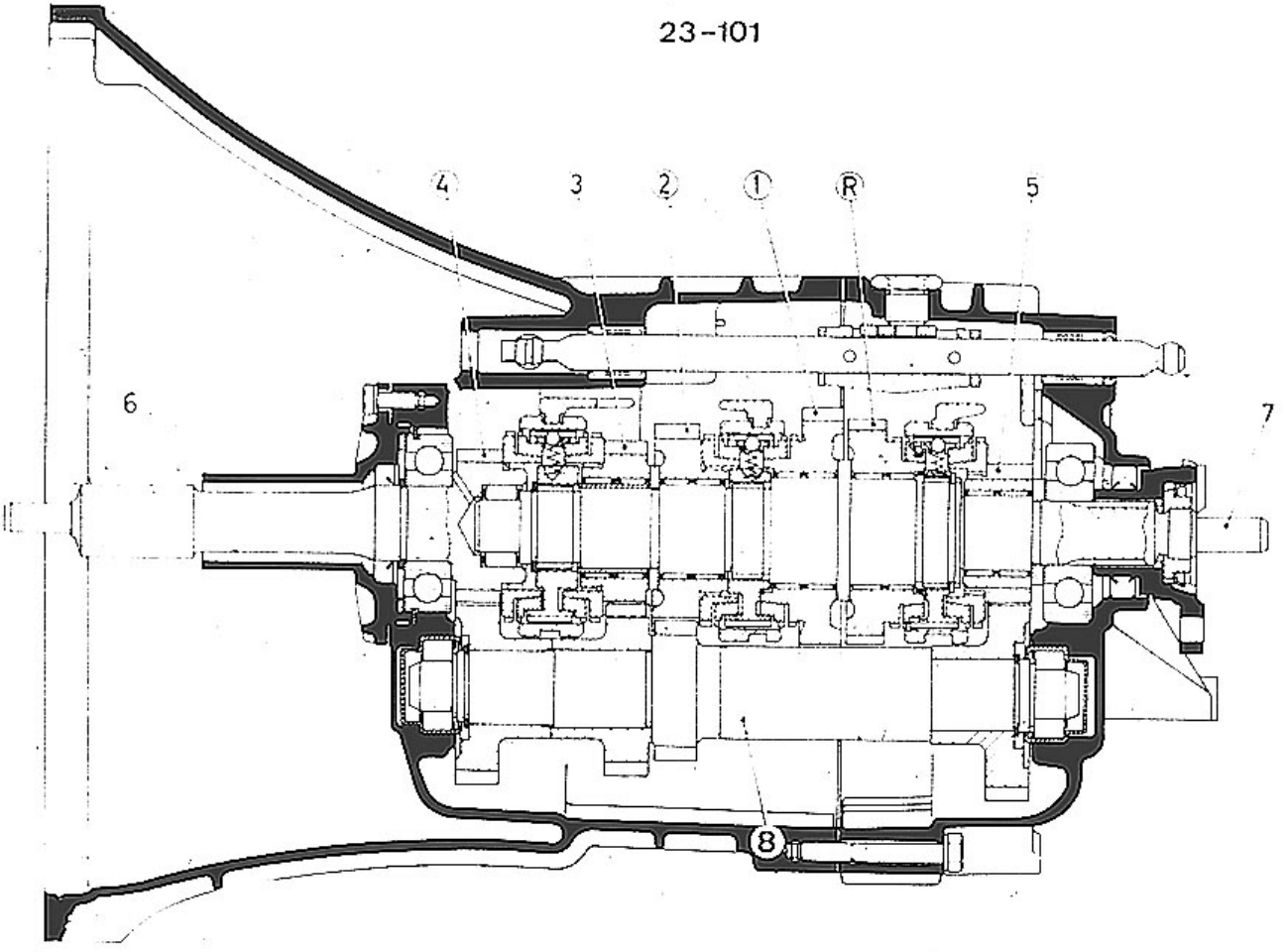
Important!
Shouldered end of thrust pieces faces the operating sleeve.
Insert guide sleeve in operating sleeve to half its length.
Press in balls far enough, until the guide sleeve can be pressed into the operating sleeve.

* See Specifications

Construction group 23 Manual transmission

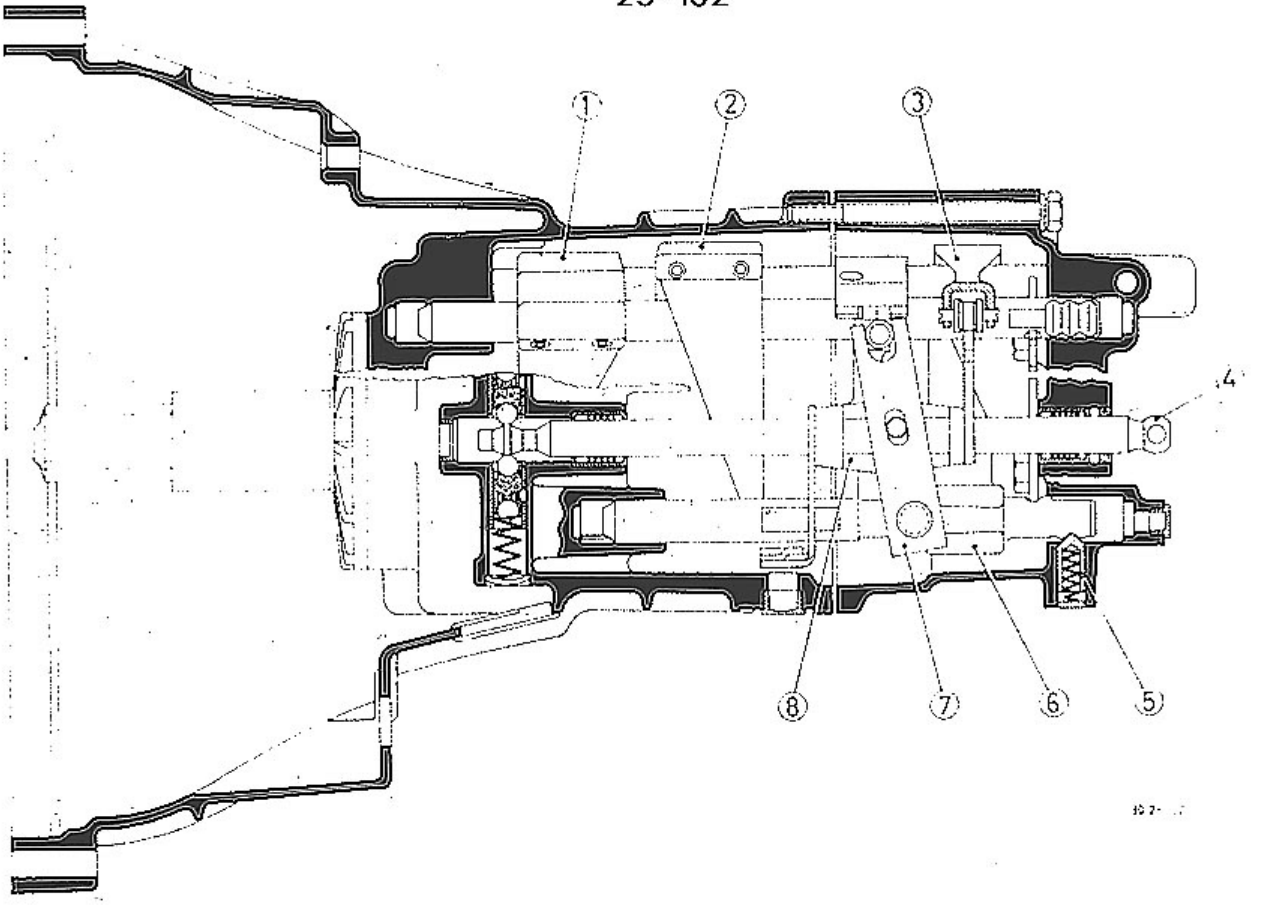
ZF – S5 – 16 Manual transmission (overdrive)

	Drawing – transmission	23- 101
	Drawing – shift components	23- 102
23 11 014	Transmission case front section – remove and install/seal	23- 103
624	Guide sleeve for clutch release – remove and install	23- 106
23 12 504	Radial oil seal for input shaft – replace	23- 108
23 21 504	Input and output shaft assembly – remove and install	23- 109
555	Output shaft – replace	23- 113
704	Bearings of all transmission shafts – replace	23- 118
23 23 506	Synchronization – disassemble and assemble	23- 120



ASSEMBLY DRAWING OF ZF – S5 – 16 FIVE SPEED OVERDRIVE MANUAL TRANSMISSION

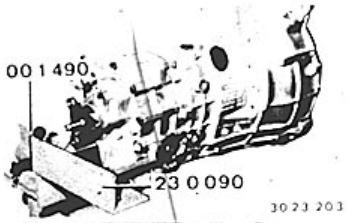
1 First gear
2 Second gear
3 Third gear
4 Fourth gear
5 Fifth gear
R Reverse gear
6 Input shaft
7 Output shaft
8 Layshaft



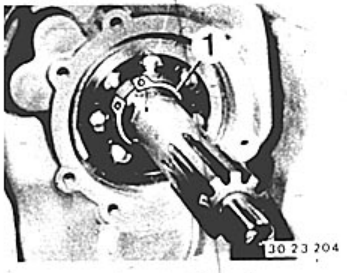
ASSEMBLY DRAWING OF SHIFT PARTS FOR ZF – S5 – 16 FIVE SPEED OVERDRIVE MANUAL TRANSMISSION

1 Selector fork – 3rd/4th gear
2 Selector fork – 1st/2nd gear
3 Leaf spring
4 Selector shaft
5 Stop pin
6 Selector fork – reverse/5th gear
7 Operating lever
8 Selector arm

23 11 014 REMOVING AND INSTALLING/ SEALING TRANSMISSION CASE FRONT SECTION



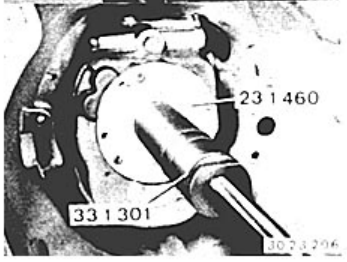
Remove transmission – see pertinent model repair manual microfiche since 1985 models – 23 00 022.
Mount Special Tool 23 0 090 on Special Tool 00 1 490.
Mount transmission on special tool assembly.
Drain oil.



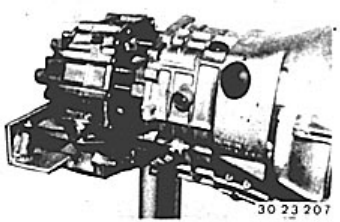
Remove guide sleeve 23 11 624.
Lift out circlip (1).



Unscrew backup light switch.
Drive back cylindrical pins.
Unscrew bolts.



Pull off case front section with Special Tools 23 1 460 and 33 1 301.

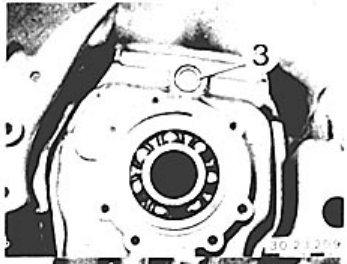


Pull off case front section.

Installation
Replace gasket.
Remove old gasket with adhesive remover**



Important!
Installation
Magnet (2) in case rear section.
Clean magnet.



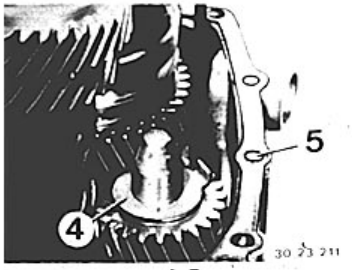
Drive out end cap (3).

Installation
Replace end cap and insert with sealing compound**.

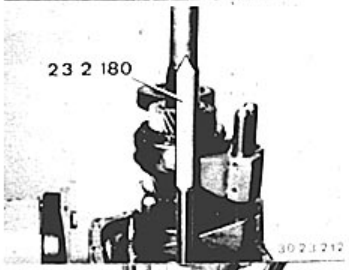


Drive out grooved ball bearing in direction of clutch housing.

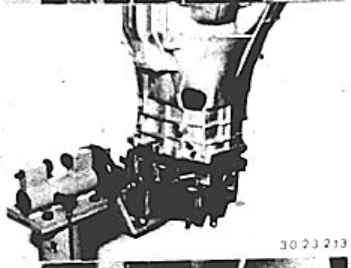
** Source: HWB



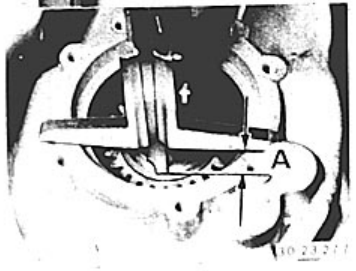
Hold thrust washer (4) on the reverse gear shaft with grease that the angle faces bore (5) in the rear case section.
New version without angle.
Install gasket with grease.



Apply Special Tool 23 2 180 on the shift shaft.

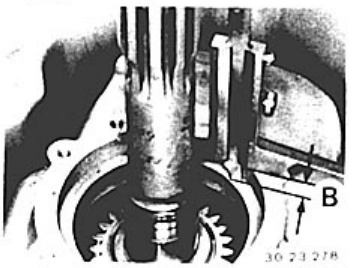


Mount front case section and bolt on rear case section.
Tightening torque*.
Remove Special Tool 23 2 180.
Install end cover for shift shaft.



The axial play of the input shaft has to be adjusted after replacing the case or bearings.
Input shaft must bear on the synchro-mesh ring.
Measure distance (A) from sealing surface of the guide sleeve to the input shaft.

* See Specifications



Measure distance (B) from sealing surface of the guide sleeve to bearing surface of the snap ring.

Important!
If a shim is found between the snap ring and case while removing the bearing, it must be installed again for measuring.



Measure distance (C) from bearing outer race to the snap ring.

Note:
Snap ring must be pressed firmly in the groove for measuring.

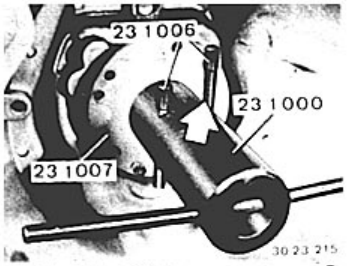
Example:

A	25.5 mm (1.004")
– B	10.3 mm (0.406")
	15.2 mm (0.598")
– C	14.0 mm (0.551")
	01.2 mm (0.047")

Axial play required: 1.1 to 1.3 mm (0.043 to 0.051").
Snap rings are available from Parts in different thicknesses for corrections.



Heat grooved ball bearing inner race and front case section in area of bearing to about 80° C (175° F) with a hot air blower and slide grooved ball bearing on the input shaft as far as possible.



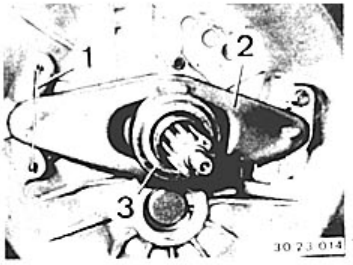
Press grooved ball bearing on to drive shaft or into front case section with Special Tool 23 1 007 used together with Special Tools 23 1 000 and 23 1 006.

Important!
Apply Special Tools 23 1 006 in such a manner that the flat side faces the drive shaft.



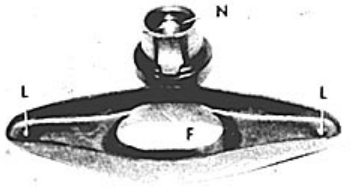
Drive on grooved ball bearing further and further simultaneously with light knocks from a hammer.
Install circlip and reverse gear switch.

Note:
Coat operating pin of the reverse gear switch with oil.

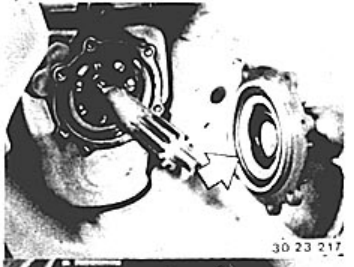


23 11 624 REMOVING AND INSTALLING GUIDE SLEEVE FOR CLUTCH RELEASE
–TRANSMISSION REMOVED–

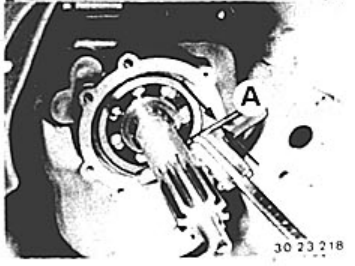
Lift out spring (1) and remove release lever (2) with thrust bearing (3).



Installation:
Pack lubricating groove N with Molykote Longterm 2.
Coat guides F and bearings L with Molykote Longterm 2.
Non-conformance could cause release bearing to seize on guide sleeve.

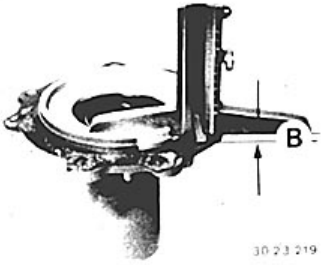


Detach guide sleeve.
Important!
Spacer.
Installation:
Replace gasket.
Remove old gasket with adhesive remover**.



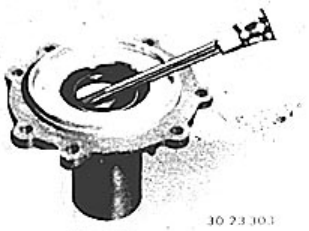
Installation:
Adjust play to 0 ... 0.09 mm (0 ... 0.0035").
Determine thickness of spacer.
Measure distance (A) from sealing surface to bearing outer race.

** Source: HWB



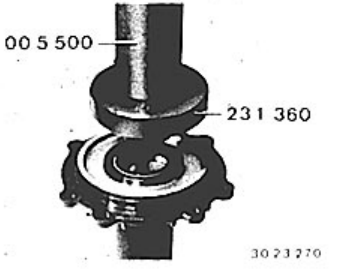
Measure distance (B) from inside surface to sealing surface through opening in guide sleeve, with gasket installed.
Example:

A	5.2 mm (0.205")
– B	3.2 mm (0.126")
	2.0 mm (0.079") spaoer thickness

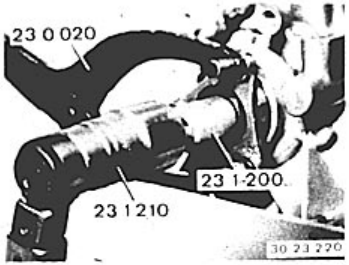


23 12 504 REPLACING RADIAL OIL SEAL FOR INPUT SHAFT
- Transmission Removed -

Remove guide sleeve - see 23 11 624.
Lift out radial oil seal.



Drive in new radial oil seal with Special Tools 23 1 360 and 00 5 500.
Lubricate sealing lip with oil.

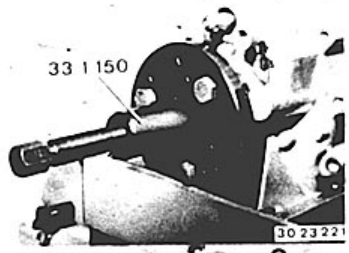


23 21 504 REMOVING AND INSTALLING INPUT AND OUTPUT SHAFT ASSEMBLY
- Transmission Removed -

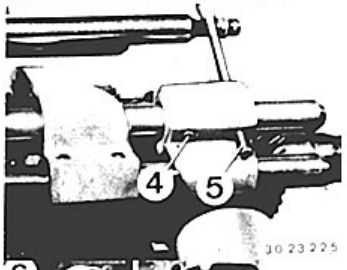
Remove front case section - see 23 11 014.
Lift out lockplate.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.



Pull out three catch pins with a circlip pliers as far as possible.
Catch pins can only be pulled out completely after removal of the lock.



Pull off output flange with Special Tool 33 1 150.



Drive pins (4 and 5) out of the 3rd/4th gear shift fork while counterholding.
New Version:
* pin.



Remove end plugs (1 ... 3).

Caution!
Spring force.

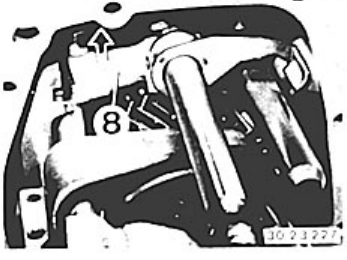
Installation:
Replace end plugs.



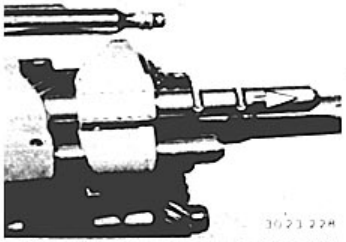
Push back leaf spring (6) for reverse gear with Special Tool 23 2 170 far enough, until shift finger (7) is accessible.
It must be possible to turn the shift shaft back and forth easily.



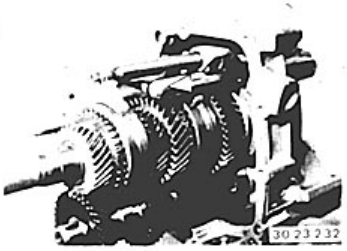
Remove three springs.



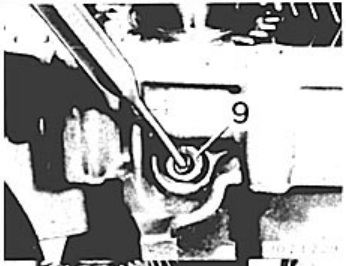
Swing shift finger (8) out of groove in the shift rod.



Pull out 3rd/4th gear shift rod.

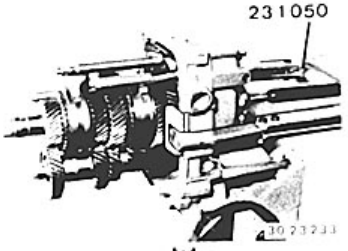


Important!
Engage reverse gear by sliding the operating sleeve forward before pressing out the gear wheel set.

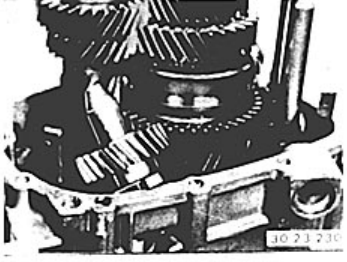


If applicable, remove lock in hexagon socket of bolt.
Unscrew bolt (9).

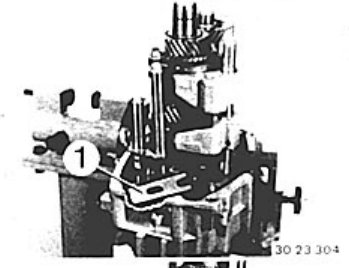
Important!
Seal between case and bolt.



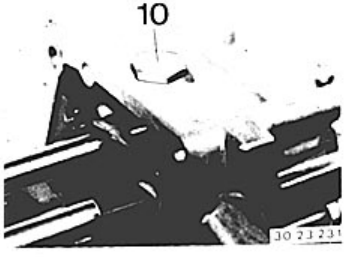
Press input shaft, output shaft and layshaft out of rear case section with Special Tool 23 1 050.
Important!
Use a piece of wood, aluminum or something similar between claws and sealing surface to avoid damaging the sealing surface.
Important!
Make sure that shift rods and layshaft do not clamp while pressing out. Layshaft must not fall down in this step.
Installation:
Check condition of all bearings, replacing if necessary.



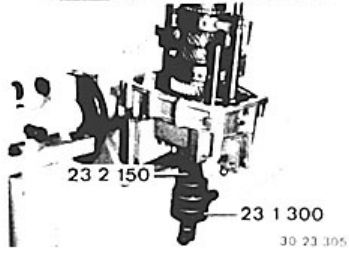
Remove reverse gear shaft, reverse gear wheel with needle bearing and thrust washer.



<u>Installing:</u>
Reverse gear is engaged.
Install input and output shafts with shift rod for 1st/2nd gears, 3rd/4th gear shift fork, shift rod for 5th/reverse gears, shift shaft and layshaft in rear case section.
Important!
Check installed position of operating lever (1).

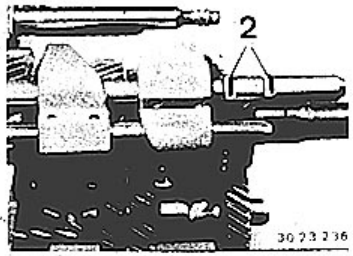


Remove bolt (10) for operating lever.

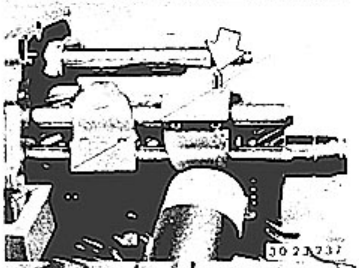


Pull input shaft, output shaft and layshaft into rear case section with Special Tools 23 1 300 and 23 2 150.

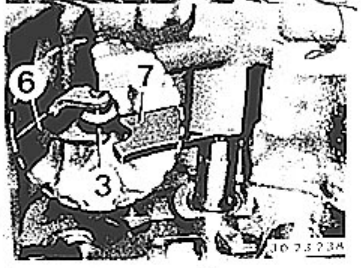
Important!
Make sure that shift rods, shift shaft and layshaft do not clamp while pulling in.



Take out reverse gear.
Slide in 3rd/4th gear shift rod with openings (2) facing up.
New version: one opening.

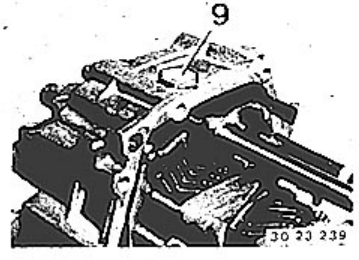


Drive in pins for 3rd/4th gear shift fork while counterholding.
New version: 1 pin.



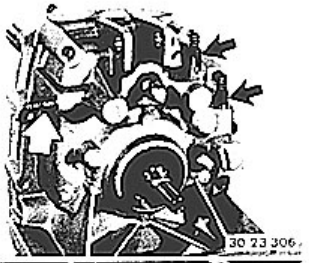
Remove Special Tool 23 2 170 for the leaf spring.

Important!
Roller (3) on leaf spring (6) must engage in the shift finger (7).

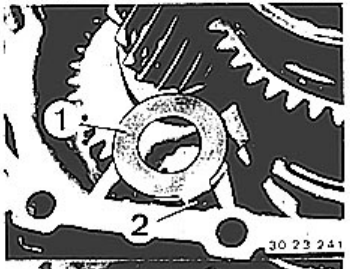


Install bolt (9) for operating lever.
Tip of bolt must engage in bore in operating lever.
Tightening torque*.

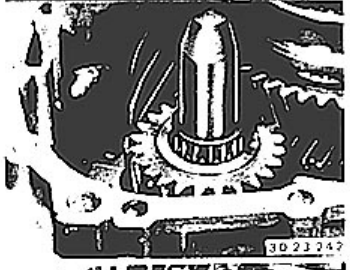
* See Specifications



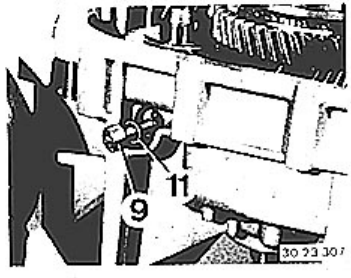
Insert three catch pins with springs in case.
Install new end plugs approx. 0.5 mm (0.020") below the case edge and punch lock slightly.



Install thrust washer (1) with angle (2) in upper opening on the case.
New version: without angle.

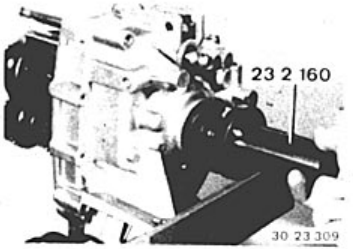


Install reverse gear wheel with long collar facing case, two needle bearings and shaft.

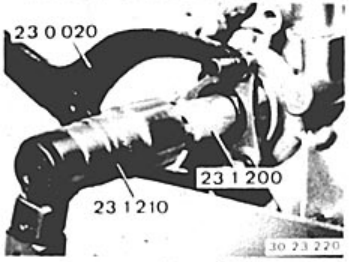


Install seal (11) on bolt.
Tighten bolt (9) to correct torque* and install new locking cap.

* See Specifications



Drive in radial oil seal flush with Special Tool 23 2 160.
Lubricate sealing lip with oil.

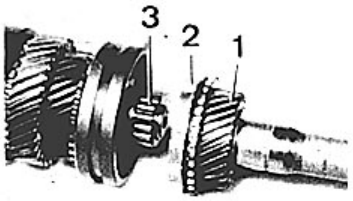


Insert or knock on output flange.
Install collar nut with a bolt cement**.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Tighten collar nut with Special Tool 23 1 210.
Tightening torque*.



Install and lock lockplate in the groove.

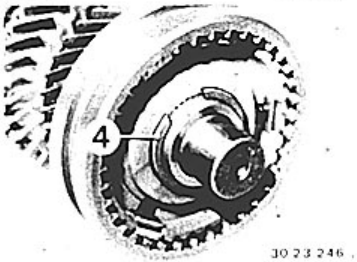
* See Specifications
** Source of Supply: HWB



23 21 555 REPLACING OUTPUT SHAFT
– Output Shaft Removed –

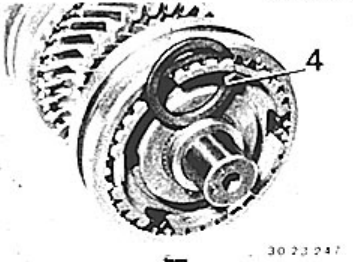
Pull off input shaft (1), brass synchromesh ring (2) and needle bearing (3).

Note:
To avoid mixing up synchromesh rings while disassembling the output shaft, it is recommended to mark synchromesh rings for pertinent gear wheels.

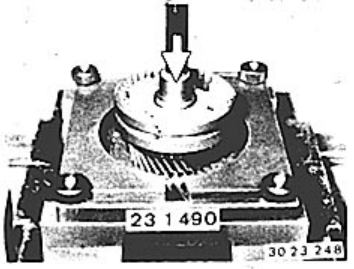


Lift out circlip (4).

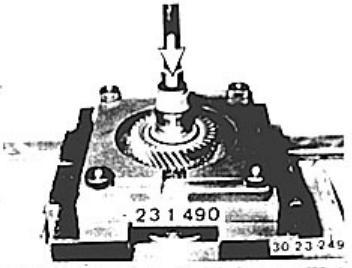
Installation:
Always replace the circlip.



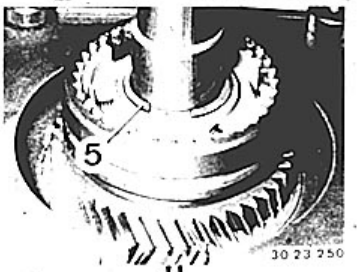
Installation:
Remove guide sleeve play with circlip (4).
Circlips are available in different thicknesses from Parts.



Press 3rd gear wheel, guide and operating sleeves off of the output shaft with Special Tool 23 1 490.
Take off needle bearing.

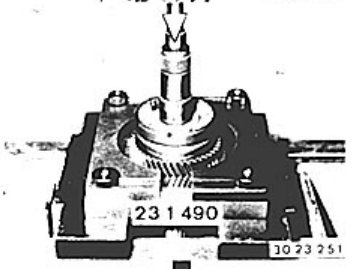


Press bearing sleeve, thrust washer and 2nd gear wheel off of the output shaft with Special Tool 23 1 490.
Take off needle bearing and sintered metal synchromesh ring.

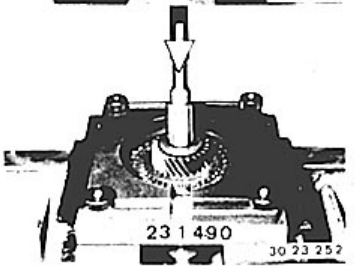


Important!
Circlip (5) must be removed before pressing off the 1st gear wheel.

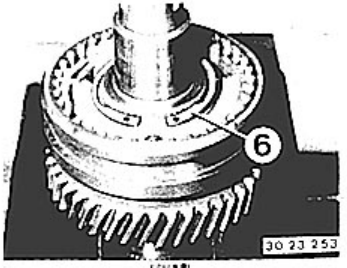
Installation:
Always replace the circlip.



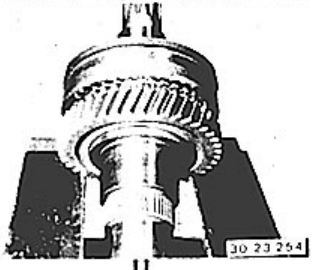
Press 1st gear wheel, guide and operating sleeves off of the output shaft with Special Tool 23 1 490.
Take off needle bearing.



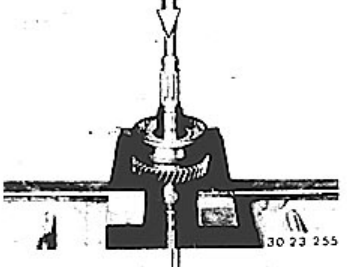
Press thrust washer and 5th gear wheel off of the output shaft with Special Tool 23 1 490.
Take off brass synchromesh ring and needle bearing.



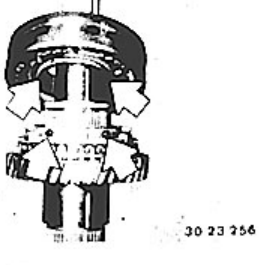
Important!
Circlip (6) must be removed before pressing off reverse gear.
Installation
Always replace circlip.



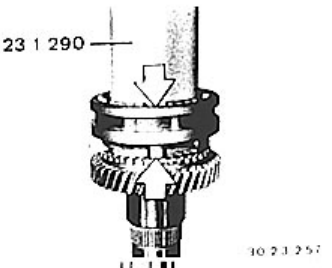
Install output shaft next to collar.



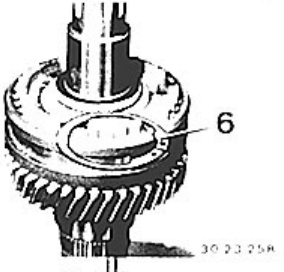
Press guide sleeve with sliding sleeve and reverse gear off of output shaft.
Remove needle bearing.
Only for version with reverse gear synchronization:
Brass synchromesh ring with 6 balls.



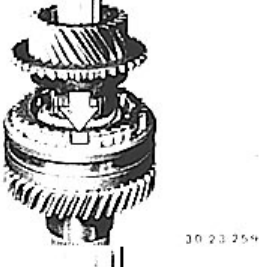
Assembling:
Install needle bearing, reverse gear and brass synchromesh ring with 6 grease held balls (only for version with reverse gear synchronization).
Install guide and sliding sleeve with narrow collar facing reverse gear.



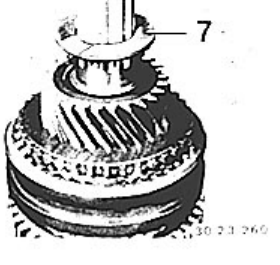
Press on guide sleeve to fit tight with Special Tool 23 1 290.
Important!
Make sure that short tabs of synchromesh ring are aligned with groove in pressure pieces when pressing on guide sleeve.



Move sliding sleeve in reverse gear direction.
Adjust guide sleeve with circlip (6) to take up all play.
Circlips are available from Parts in different thicknesses.
Install circlip (6).



Install brass synchromesh ring with short tabs of synchromesh ring in groove of pressure pieces.
Install needle bearing and 5th gear.



Heat thrust washer (7) to approx. 80° C (175°F) with a hot air blower and install on output shaft.

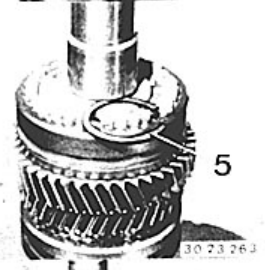


Install needle bearing, 1st gear wheel and sintered metal synchromesh ring.
Install guide and operating sleeves with the narrow collar facing the 1st gear wheel.



Press on guide sleeve to fit tight with Special Tool 23 1 290.

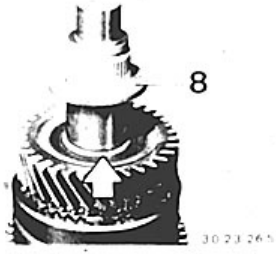
Important!
Make sure that short tabs of synchromesh ring are aligned with groove in thrust pieces while pressing on.



Shift operating sleeve in direction of the 1st gear wheel.
Adjust guide sleeve to be without play.
Circlips are available from Parts in different thicknesses.
Install circlip (5).



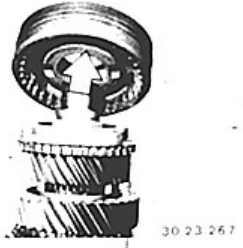
Install sintered metal synchromesh ring with its short tabs in the groove of thrust pieces.
Install needle bearing and 2nd gear wheel.



Important!
Collar for the thrust washer on the output shaft must protrude slightly.
If necessary, check circlip (5) for correct seating.
Heat thrust washer (8) to about 80° C (175° F) with a how air blower and install on the output shaft.

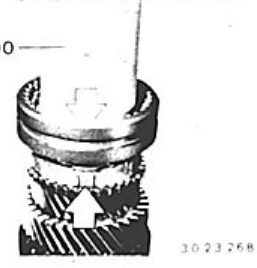


Heat bearing sleeve (9) to about 80° C (175° F) with a hot air blower and install on the output shaft.



Install needle bearing, 3rd gear wheel and brass synchromesh ring.
Install guide and operating sleeves with the long collar facing the 3rd gear wheel.

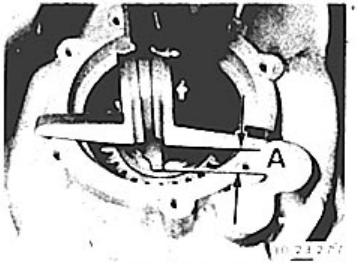
Note:
Version with Identification Groove:
Groove faces the 3rd gear wheel.



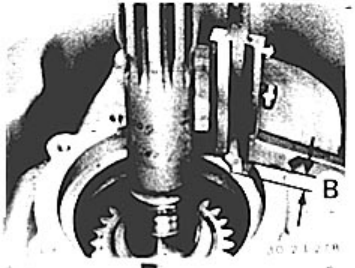
Press on guide sleeve to fit tight with Special Tool 23 1 290.

Important!
Make sure that short tabs on synchromesh ring are aligned with groove in thrust pieces while pressing on.

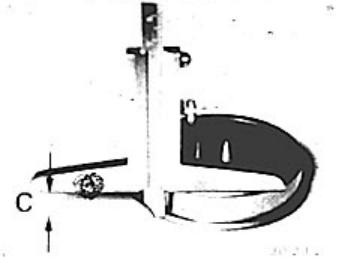
Install circlip.



Adjust axial play of input shaft.
Output shaft and case front section installed.
Input shaft must rest on synchromesh ring.
Measure distance (A) from guide sleeve sealing surface to input shaft.



Measure distance (B) from guide sleeve sealing surface to circlip bearing surface.
Important!
If a spacer had been found between the circlip and case while removing the bearing, it must be installed again for measuring.

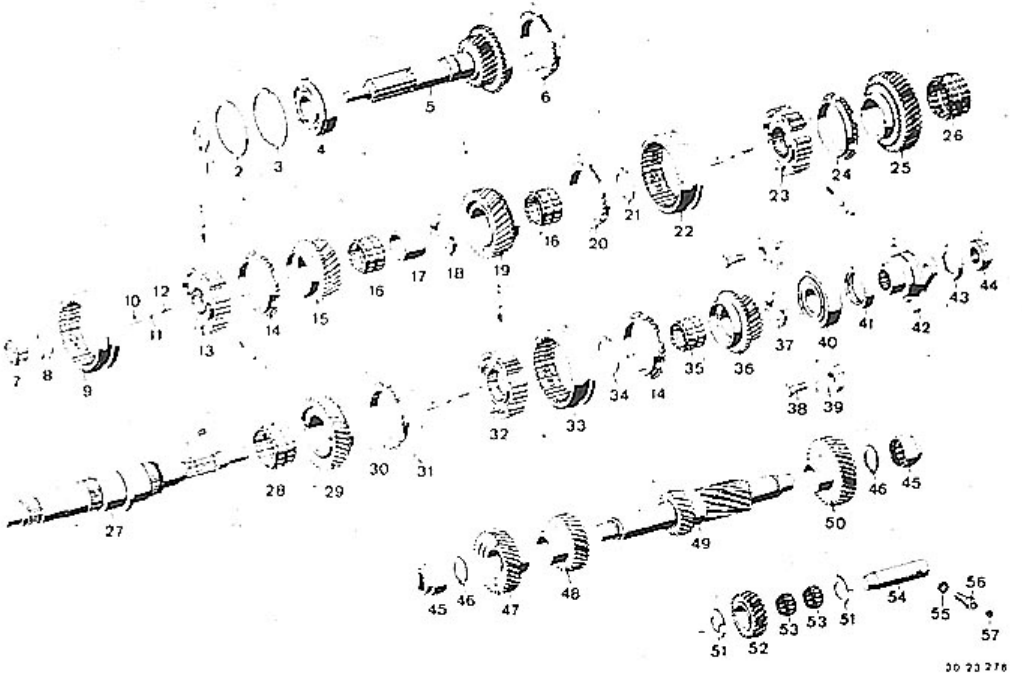


Measure distance (C) from bearing outer race to circlip.
Note
Circlip must be pressed tight in groove for measuring.
Example:

A	25.5 mm (1.003")
– B	10.3 mm (0.405")
	15.2 mm (0.598")
– C	14.0 mm (0.551")
	1.2 mm (0.047")

Axial play required: 1.1 to 1.3 mm (0.043 to 0.051").
Circlips are available from Parts in different thicknesses for making corrections.
Install grooved ball bearing – see 23 11 014.

DRAWING OF GEAR SET AND BEARINGS

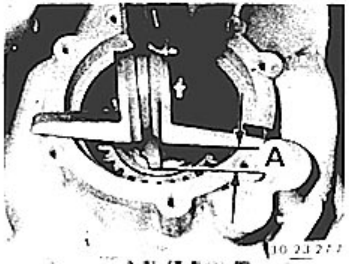


1 Circlip
2 Spacer
3 Circlip
4 Grooved ball bearing
5 Input shaft
6 Synchromesh ring
7 Roller bearing
8 Circlip
9 Sliding sleeve
10 Pressure piece
11 Ball
12 Spring
13 Guide sleeve
14 Synchromesh ring
15 3rd gear
16 Needle bearing
17 Bearing sleeve
18 Thrust washer
19 2nd gear
20 Synchromesh ring
21 Circlip
22 Sliding sleeve
23 Guide sleeve
24 Synchromesh ring
25 1st gear
26 Needle bearing
27 Output shaft
28 Needle bearing
29 Reverse gear
30 Synchromesh ring
31 Ball (six)
32 Guide sleeve
33 Sliding sleeve
34 Circlip
35 Needle bearing
36 5th gear
37 Thrust washer
38 Bolt
39 Clamp
40 Grooved ball bearing
41 Radial oil seal
42 Output flange
43 Lockplate
44 Collar nut
45 Roller bearing
46 Circlip
47 4th gear
48 3rd gear
49 Layshaft
50 5th gear
51 Thrust washer
52 Reverse gear
53 Needle bearing
54 Shaft
55 Seal
56 Bolt
57 Bolt lock

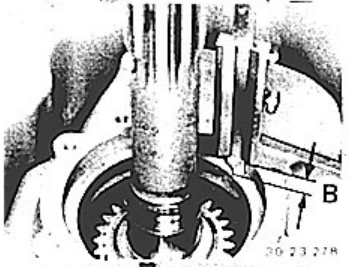


23 21 704 REPLACING BEARINGS OF ALL TRANSMISSION SHAFTS –TRANSMISSION REMOVED–

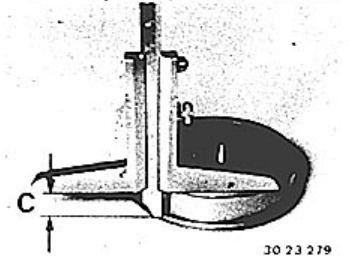
Remove transmission case front section 23 11 014.
A) Input Shaft, Layshaft in Case Front Section:
Input Shaft:
Drive out grooved ball bearing in direction of clutch housing.



Adjust axial play of input shaft.
Case front section attached.
Input shaft must be on synchromesh ring.
Measure distance (A) from guide sleeve sealing surface to input shaft.



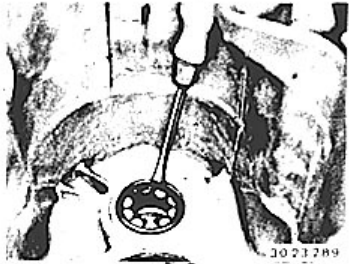
Measure distance (B) from guide sleeve sealing surface to circlip bearing surface.



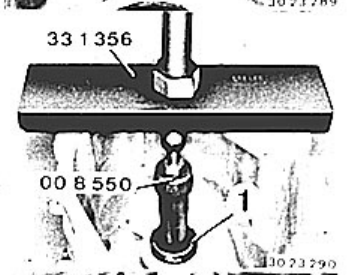
Measure distance (C) from bearing outer race to circlip.
Note:
Circlip must be pressed tight in groove for measuring.
Example:

	A	25.3 mm (0.996")
–	B	10.1 mm (0.398")
		15.2 mm (0.598")
–	C	14.0 mm (0.551")
		1.2 mm (0.047")

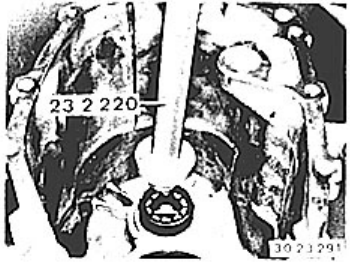
Axial play required: 1.1 to 1.3 mm (0.043 to 0.051").
Different size circlips are available from Parts.



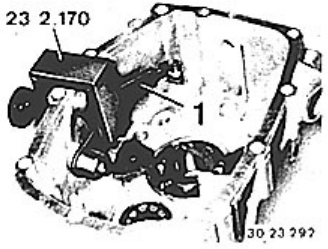
Layshaft:
Destroy roller cage of bearing.
Remove cage with rollers.



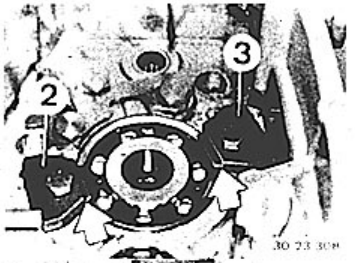
Pull out bearing outer race (1) with Special Tools 00 8 550 (without supports) and 33 1 356.



Heat case front section in area of roller bearing to about 80° C (175° F) with a hot air blower.
Drive in roller bearing with Special Tool 23 2 220.

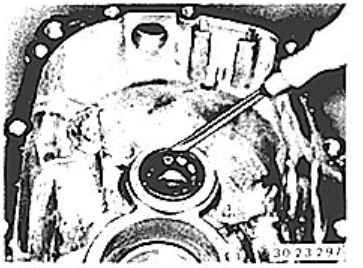


B) Output Shaft, Layshaft in Case Rear Section:
Remove input and output shaft assembly 23 21 504.
Output Shaft:
Remove Special Tool 23 2 170.
Pull off leaf spring (1).

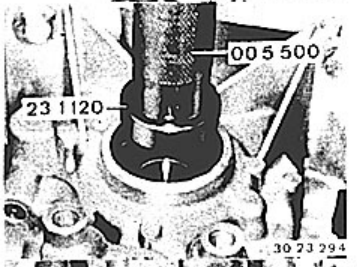


Unscrew bolts.
Take off clamps (2 and 3).

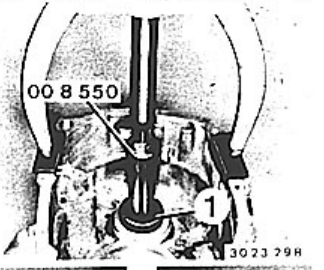
Installation:
Install clamps with curved surface facing the bearing outer race.
Tightening torque*.



Layshaft:
Destroy roller cage of the bearing.
Remove cage with rollers.

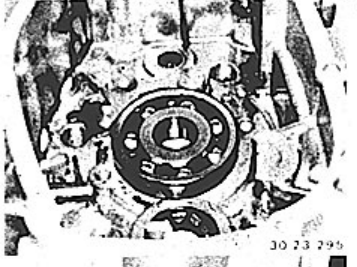


Lift out radial oil seal.
Drive out grooved ball bearing with Special Tools 23 1 120 and 00 5 500.

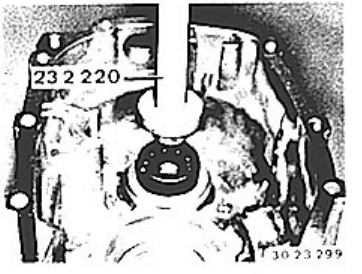


Pull out bearing outer race (1) with Special Tools 00 8 550 and a support.

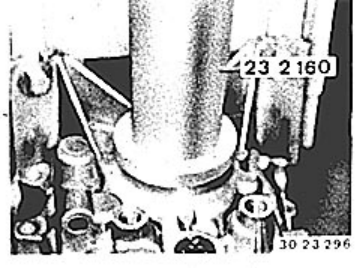
Important!
Use a piece of flat iron or something similar between the support and sealing surface, to avoid damaging the sealing surface.



Heat rear case section in area of the grooved ball bearing to about 80° C (175° F) with a hot air blower.
Install grooved ball bearing.
If applicable, drive in bearing to fit tight with Special Tool 24 1 100.

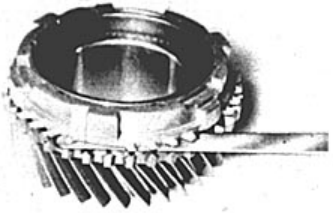


Heat rear case section in area of the roller bearing to about 80° C (175° F) with a hot air blower.
Drive in roller bearing with Special Tool 23 2 220.



Drive in radial oil seal with Special Tool 23 2 160.
Lubricate sealing lip with oil.

* See Specifications

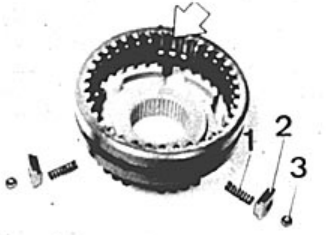


30 23 271

23 23 506 DISASSEMBLING AND ASSEMBLING COMPLETE SYNCHRONIZATION
- Output Shaft Removed -

Disassemble output shaft - see 23 21 555.
Check distance* between synchromesh ring and clutch body.
Measure in area of stop.

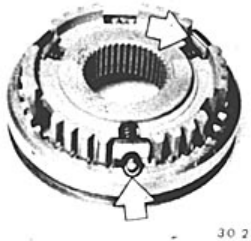
Note:
Twist and press down synchromesh ring for measuring.
Synchromesh rings should bear uniformly on the entire surface.



30 23 272

Disassembling Synchronization:
Press operating sleeve off of guide sleev.
Spring (1), thrust piece (2) and ball (3).

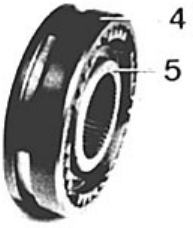
Installation:
Flat teeth of operating sleeve must align with the thrust pieces.



30 23 273

Install all springs, thrust pieces and balls.

Important!
Shouldered end of thrust pieces faces the collar.
Press ball into the operating sleeve one after the other.



30 23 274

1st/2nd Gear Synchronization:
Check installed position of operating sleeve.
Wide surface end (4) of operating sleeve faces thicker collar (5).



30 23 2

5th/Reverse Gear Synchronization:
Check installed position of operating sleeve.
Wide surface end (6) of operating sleeve faces narrow collar (7).

* See Specifications

Construction group 23 Manual transmission

Getrag 245 Five speed manual transmission (sport)

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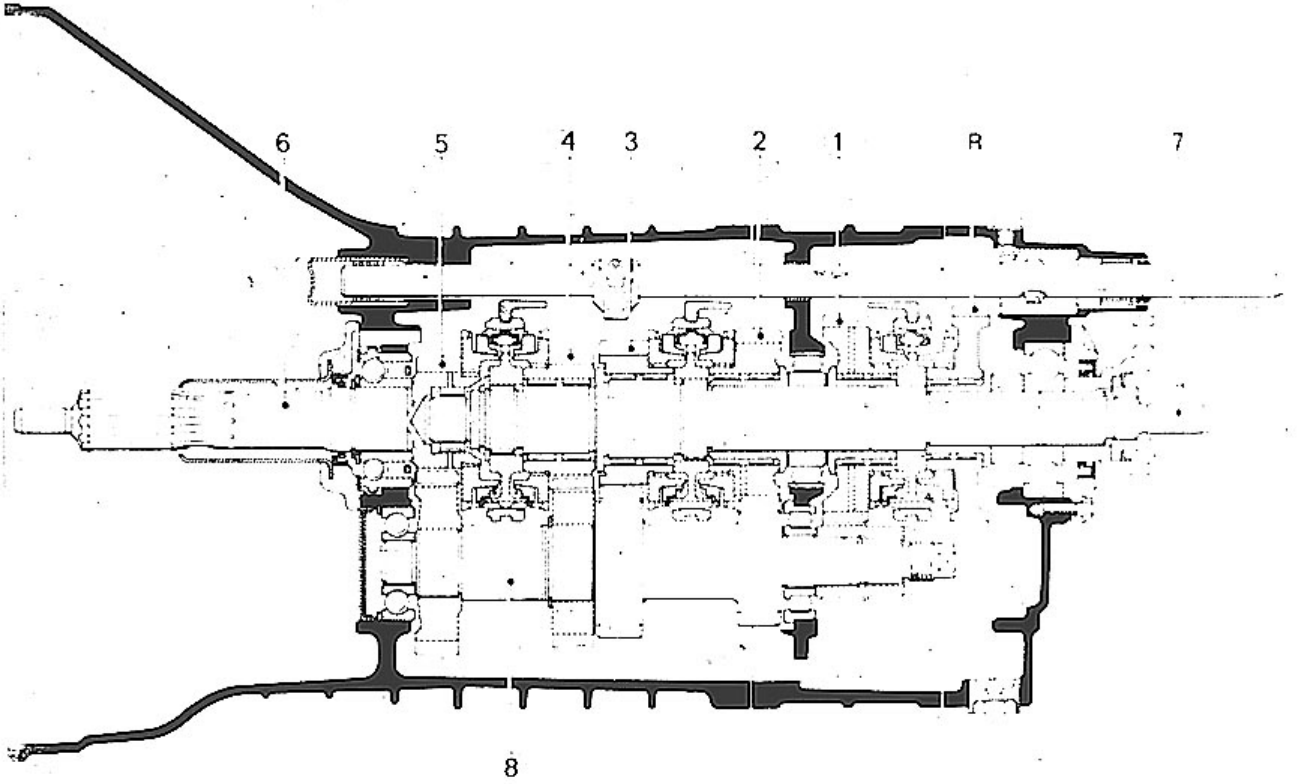
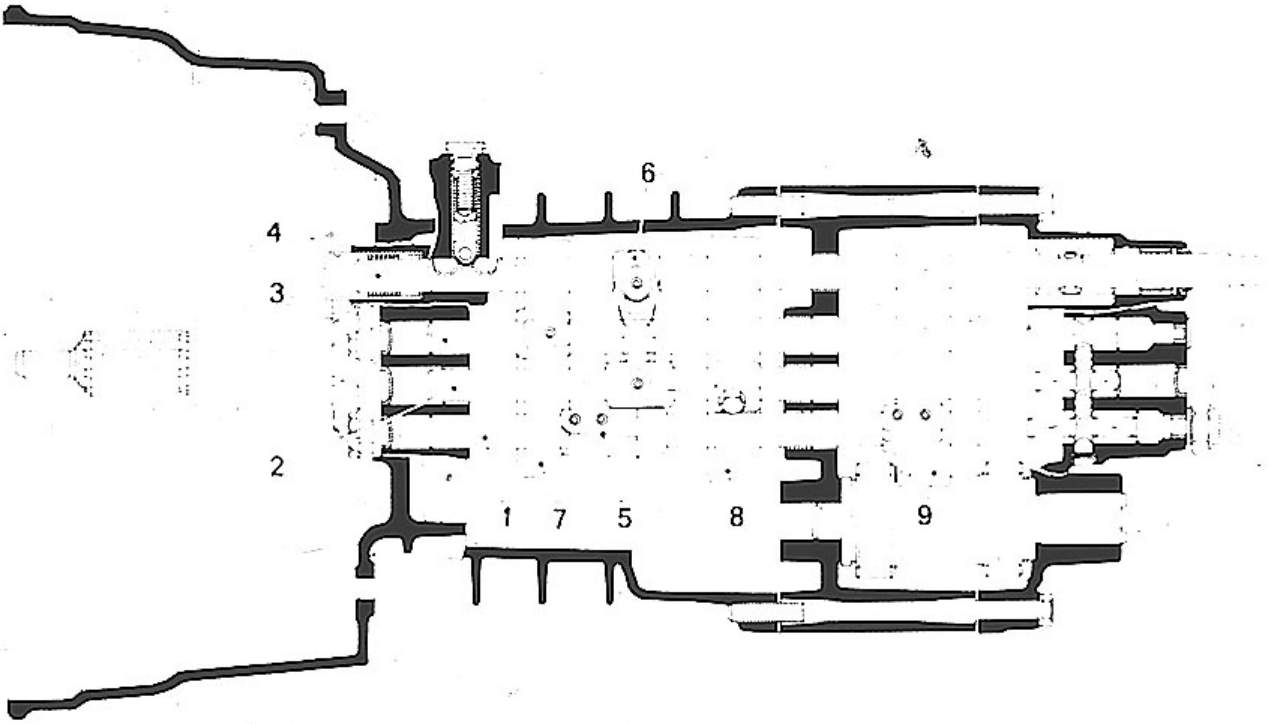


ASSEMBLY DRAWING OF GETRAG 245 FIVE SPEED SPORT MANUAL TRANSMISSION

1 First gear
2 Second gear
3 Third gear
4 Fourth gear
5 Fifth gear
R Reverse gear
6 Input shaft
7 Output shaft
8 Layshaft



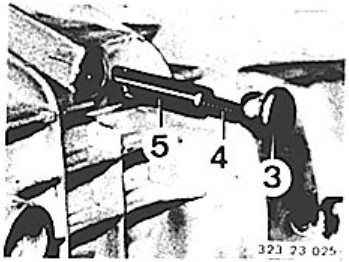
ASSEMBLY DRAWING OF SHIFT PARTS FOR 245 FIVE SPEED SPORT MANUAL TRANSMISSION

1 Selector rod, 1st/reverse gear
2 Selector rod, 2nd/3rd gear
3 Selector rod, 4th/5th gear
4 Selector shaft
5 Dog
6 Selector arm
7 Selector fork 4th/5th gear
8 Selector fork 2nd/3rd gear
9 Selector fork 1st/rev. gear

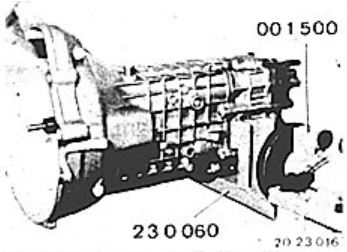


23 11 005 · REMOVING AND INSTALLING/ SEALING TRANSMISSION CASE FRONT SECTION

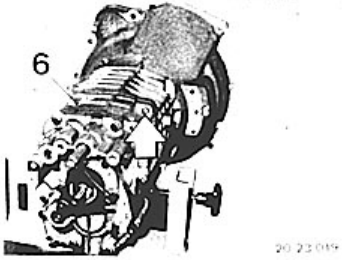
Remove transmission – see pertinent model repair manual microfiche since 1985 models – 23 00 022.
Unscrew brackets for exhaust assembly and rubber mounts.



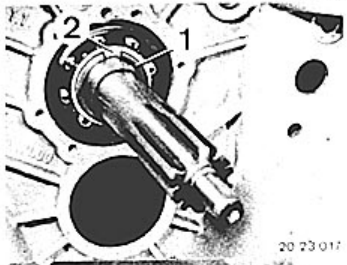
Lift out cover (3).
Remove spring (4) and lockpin (5).
Check installed position.



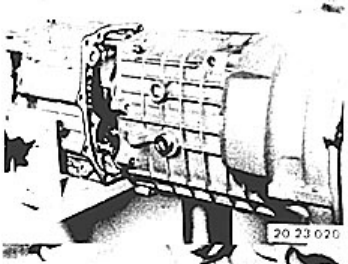
Mount Special Tool 23 0 060 on assembly stand 00 1 490.
Mount transmission on special tool.
Drain oil.



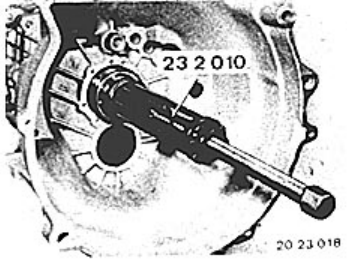
Drive out dowel pins.
Unscrew bolts on cover.
Loosen screw (6).



Remove guide sleeve 23 11 622.
Lift out circlip (1).
Remove spacer (2).
Installation:
Always replace circlip.



Pull off transmission case.
Installation:
Mount transmission case with a surface sealant**.
Sealing surface must be thoroughly cleaned and dried of oil.

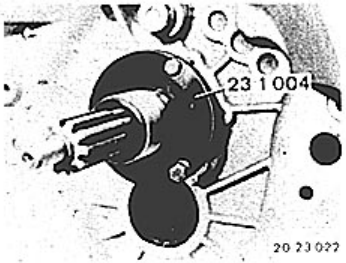


Pull out grooved ball bearing with Special Tool 23 2 020.

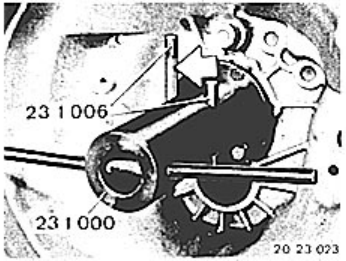


Install and bolt transmission case front section.
Tightening torque*.
Heat grooved ball bearing inner race to about 80° C (175° F) with a hot air blower and slide on to input shaft as far as possible.

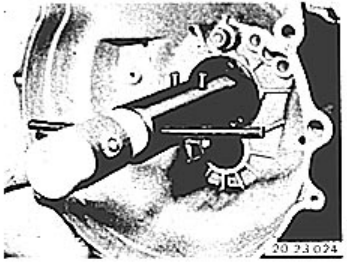
* See Specifications
** Source: HWB



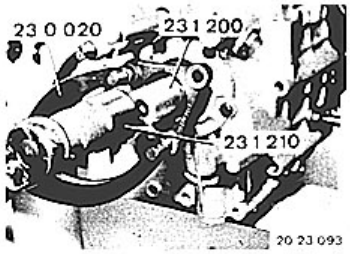
Mount Special Tool 23 1 004 on case with three 6 x 35 mm bolts, but not too tight.



Pull grooved ball bearing into case and on to input shaft with Special Tool 23 1 000 used in conjunction with Special Tools 23 1 006, which are machined flat on one side.
Important!
Insert Special Tools 23 1 006 that flat sides face the input shaft.

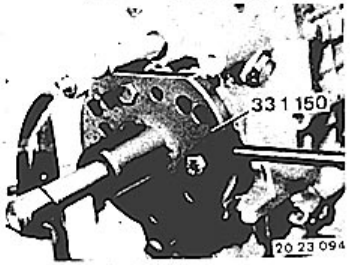


Drive in grooved ball bearing to fit tight by applying light knocks.
Install spacers and circlip.
Install lockpin.

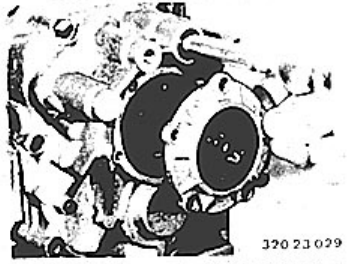


23 11 040 REMOVING AND INSTALLING/ SEALING TRANSMISSION CASE REAR SECTION

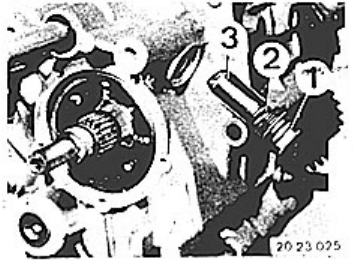
Remove transmission case front section 23 11 005.
Lift off lockplate.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Unscrew nut with Special Tool 23 1 210.
Installation:
Tightening torque*.
Install collar nut with bolt cement**.



Pull off output flange with Special Tool 33 1 150.

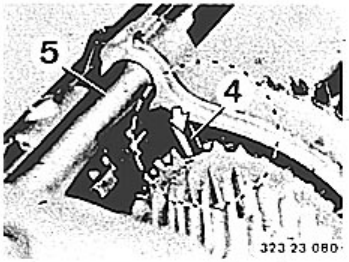


Take off cover.
Important!
Shims.
Installation:
Replace gasket.



Unscrew plug (1)*.
Pull out spring (2) and lockpin (3).
Installation:
Coat bearing surface of plug (1) with a surface sealant**.

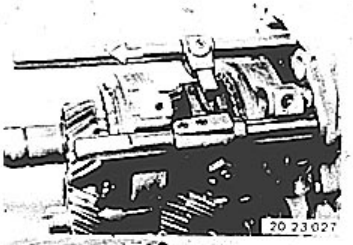
* See Specifications
** Source: HWB



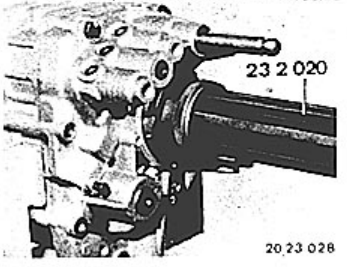
Engage 4th gear.
Turn input shaft until opening in 4th gear aligns with pin.
Drive out pin (4) downward in this position, until selector rod (5) can be pulled out (loose balls).
Important!
Drive pin between tooth flanks of operating sleeve.
Installation:
Replace pin.



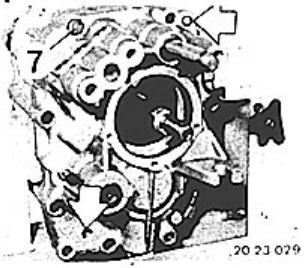
Remove lockwire.
Unscrew bolt (6).
Installation:
Lock bolt with wire.
Pull out 2nd/3rd gear selector rod.



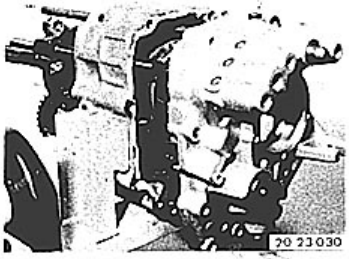
Pull out selector shaft forward as far as possible.



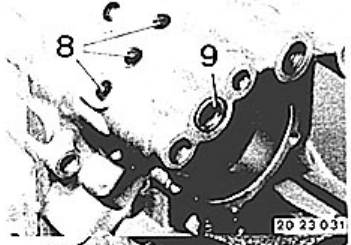
Pull out grooved ball bearing with Special Tool 23 2 020 and the long spindle of Special Tool 23 2 060.



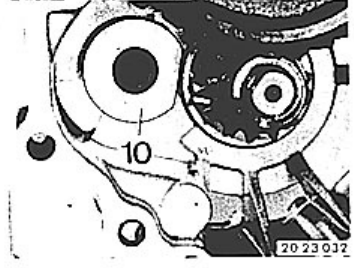
Drive out dowel pins.
Unscrew bolt (7).



Pull off case rear section.
Important!
Spacer between double gear wheel and intermediate case.



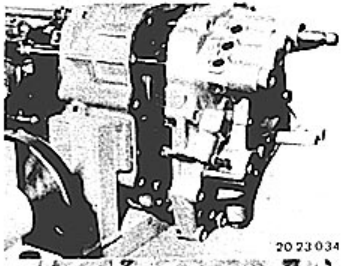
Unscrew backup light switch.
Remove plugs (8 and 9).
Installation:
Replace plugs.



Hold spacer (10) in position with grease.
Check installed position.



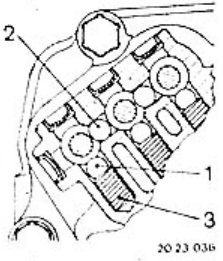
Install needle bearing (1), spacer (2), needle bearing (3) and double gear wheel (4) on shaft.



Coat sealing surface with surface sealant*.
Sealing surface must be cleaned thoroughly and dried of oil.
Slide on rear case section up to spring of locking balls.

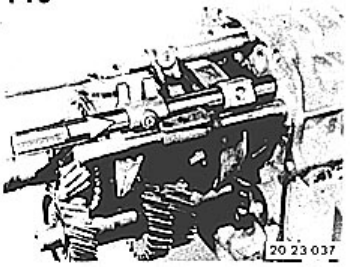


Insert locking balls and press down.
Slide on and bolt rear case section in this position.



Arrangement of Detent and Locking Balls:
1 Locking ball
2 Detent ball
3 Spring

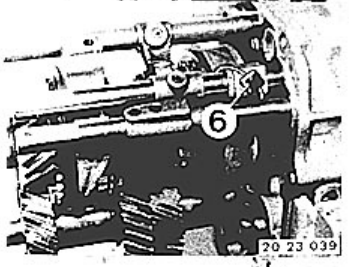
* Source: HWB



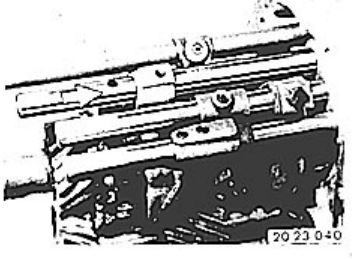
Slide 2nd/3rd gear selector rod into rear case section up to spring.



Insert locking balls.
Insert detent balls and press down.
In this position push selector rod through up to lock.



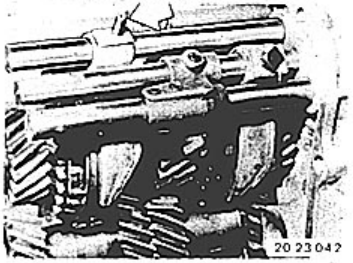
Mount 2nd/3rd gear selector fork with bolt (6) and lock bolt with wire.



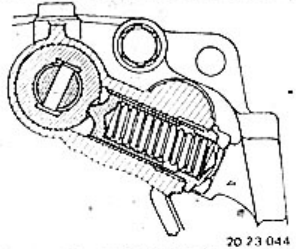
Slide in 4th/5th gear selector rod up to spring on rear case section.



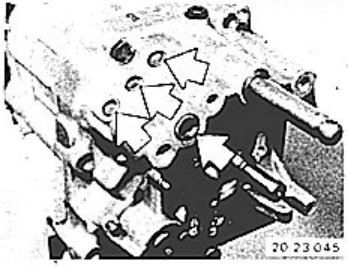
Insert detent balls.
Insert locking balls and press down.
Push 4th/5th gear selector rod through up to lock in this position.



Mount 4th/5th gear selector fork with a 6 x 24 mm pin.

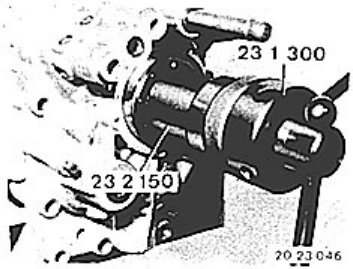


Install lockpin.
Check installed position.
Coat bearing surface of plug with a surface sealant**.
Tightening torque*.

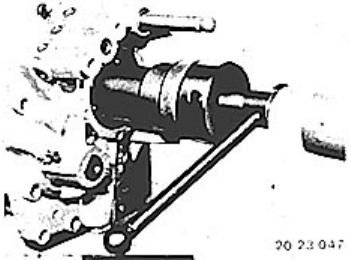


Install all plugs and backup light switch.

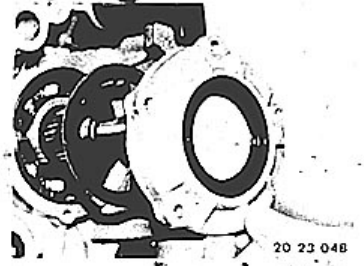
* See Specifications
** Source: HWB



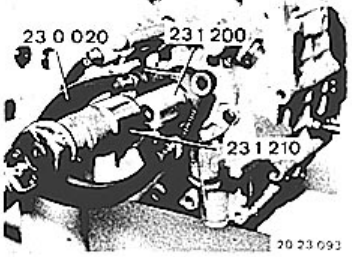
Install and pull grooved ball bearing into rear case section with Special Tools 23 1 300 and 23 2 150.



Drive in grooved ball bearing to fit tight by applying light knocks.

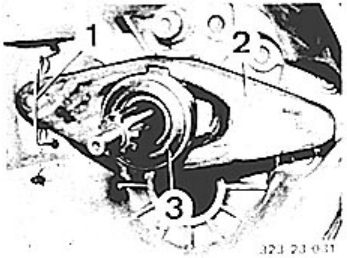


Install gasket.
Insert spacer and mount cover.
Tightening torque*.



Mount output flange.
Install collar nut with bolt cement**.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Tighten collar nut with Special Tool 23 1 210.
Tightening torque*.
Install lockplate.

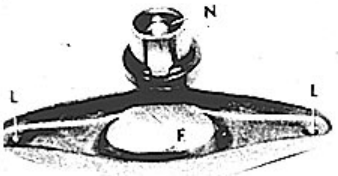
* See Specifications
** Source: HWB



320 23 031

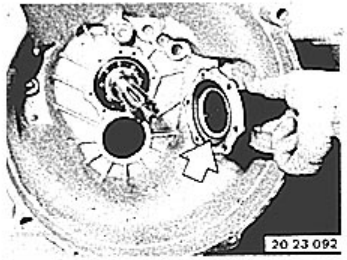
23 11 622 REMOVING AND INSTALLING/ REPLACING CLUTCH RELEASE GUIDE SLEEVE –TRANSMISSION REMOVED–

Lift out spring (1) and remove release lever (2) with thrust bearing (3).



320 23 025

Installation:
Pack lubricating groove (N) with Molykote Longterm 2.
Coat guides (F) and bearings (L) with Molykote Longterm 2.
Non-conformance could cause release bearing to seize on guide sleeve.



320 23 092

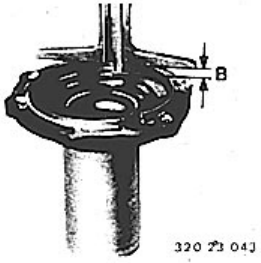
Detach guide sleeve.
Important!
Spacer.
Installation:
Install guide sleeve with surface sealant**.
Sealing surface must be cleaned thoroughly and dried of oil.
Tightening torque*.



320 23 042

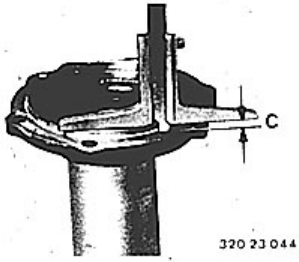
Installation:
If applicable, correct play to 0 ... 0.09 mm (0 ... 0.0035") with a shim.
Determine thickness of shim (spacer).
Measure distance (A) from bearing outer race to case sealing surface.

* See Specifications
** Source: HWB



320 23 043

Measure distance (B) from guide sleeve protrusion to inside surface.



320 23 044

Measure distance (C) from guide sleeve protrusion to outside surface.
Example:

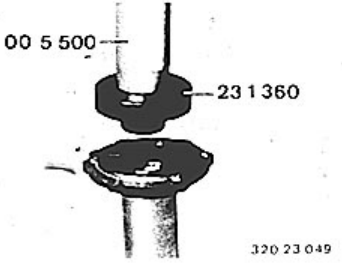
	B	4.0 mm (0.157")
+	A	0.3 mm (0.012")
		4.3 mm (0.169")
–	C	2.8 mm (0.110")
		1.5 mm (0.059") spacer thickness



320 23 048

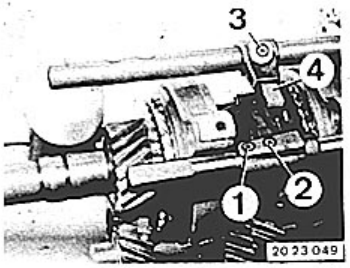
23 12 502 REPLACING RADIAL OIL SEAL FOR INPUT SHAFT –TRANSMISSION REMOVED–

Remove guide sleeve 23 11 622.
Lift out radial oil seal.



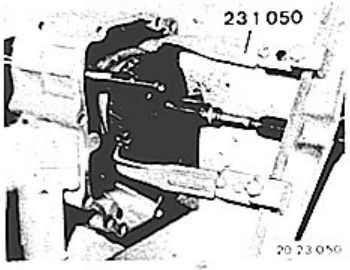
320 23 049

Drive in radial oil seal with Special Tools 23 1 360 and 00 5 500.
Open end faces transmission case.
Lubricate sealing lip with oil.

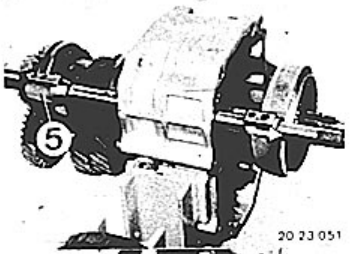


23 21 501 REMOVING AND INSTALLING INPUT AND OUTPUT SHAFT ASSEMBLY – FRONT AND REAR CASE SECTIONS REMOVED

Drive out pins (1 ... 3) while counterholding.
Installation:
Replace pins.
Pull out selector shaft toward rear.
Remove selector arm (4).
Two rollers on selector shaft.



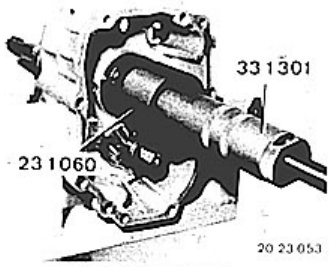
Pull spacer, reverse gear and bearing sleeve off of output shaft with Special Tool 23 1 050.



Take off dog (5).
Pull out selector rod with selector fork and guide sleeve toward rear.



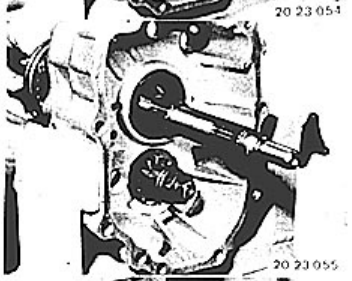
Remove synchromesh ring and 1st gear with needle bearing.



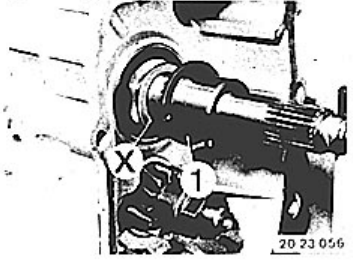
Pull bearing sleeve off of output shaft with Special Tools 23 1 060 and 33 1 301.
Important!
Shim (X).



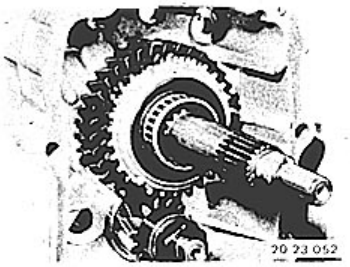
Heat intermediate case in area of layshaft bearing to approx. 80° C (175° F) with a hot air blower.
Pull input shaft/output shaft and layshaft out of intermediate case.
Installation:
Check condition of all bearings, replacing if necessary (see 23 21 703).



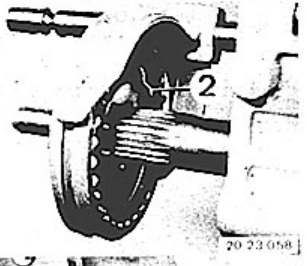
Installation:
Heat intermediate case in area of layshaft bearing to approx. 80° C (175° F) with a hot air blower.
Install input shaft/output shaft and layshaft.



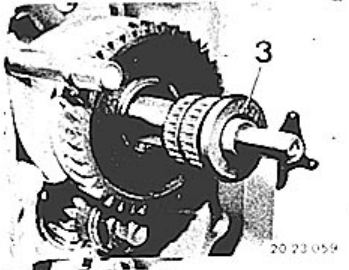
Install shim (X) on output shaft.
Heat bearing sleeve (1) to approx. 80° C (175° F) with a hot air blower and install on output shaft.



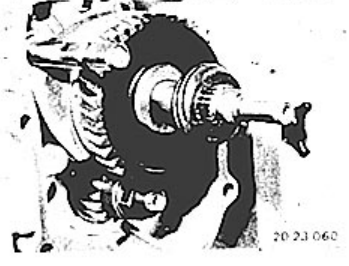
Install needle bearing, 1st gear and synchromesh ring on output shaft.



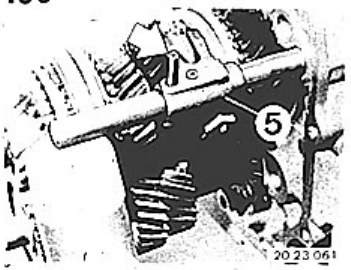
Insert 1st/reverse gear selector rod with selector fork in intermediate case.
Run guide sleeve into selector fork that synchromesh spring (2) faces 1st gear.



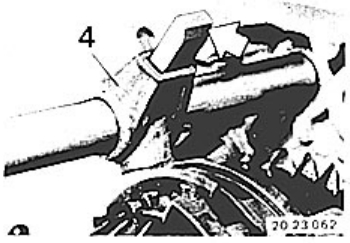
Slide guide sleeve on to spline of output shaft.
Important!
Guide tabs on 1st gear synchromesh ring into guide sleeve.
Install reverse gear and split needle bearing.
Heat bearing sleeve (3) to approx. 80° C (175° F) with a hot air blower and slide on to output shaft.



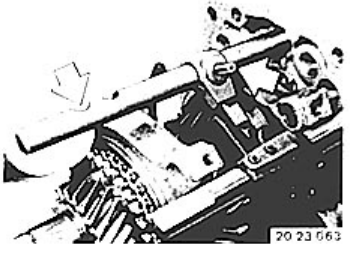
Install spacer.



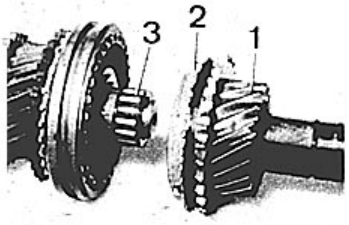
Slide on dog (5) and secure with 6 x 26 mm pins (counterhold).
Install 2nd/3rd and 4th/5th gear selector forks.



Push in selector shaft.
Slide selector arm (4) on to selector shaft in such a manner that bevel on arm faces dog.



Mount selector arm with a 6 x 28 mm pin (counterhold).
Openings in selector shaft must face out.
Install two rollers on selector shaft with grease.



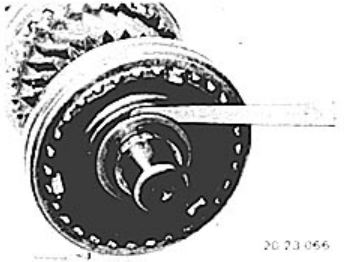
23 21 552 REPLACING OUTPUT SHAFT
– Output Shaft Removed –

Pull off input shaft (1), synchromesh ring (2) and needle bearing (3).

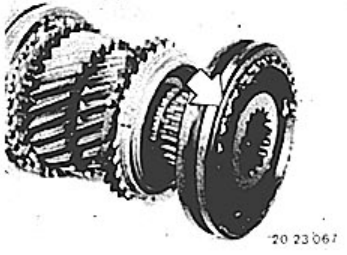
Note:
To avoid mixing up synchromesh rings while disassembling the output shaft, it is recommended to mark synchromesh rings for pertinent gear wheels.



Lift out snap ring (4).
Take off shim (5).

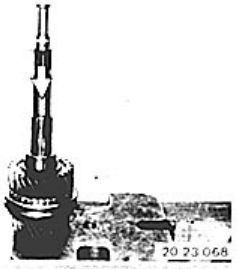


Installation:
Eliminate all play between the snap ring and guide sleeve.
Replace snap ring (4).

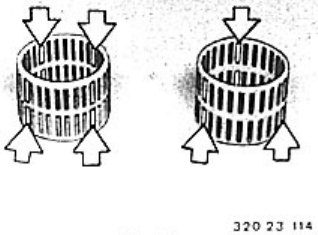


Take off guide sleeve, synchromesh ring, 4th gear wheel and split needle bearing.

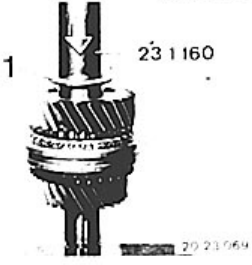
Important! – Installation:
The stepped end of the operating sleeve faces the 5th gear wheel.



Press bearing inner race, bearing sleeve, 2nd gear wheel, synchromesh ring, needle bearing, guide sleeve, synchromesh ring, 3rd gear wheel and needle bearing off of the output shaft.

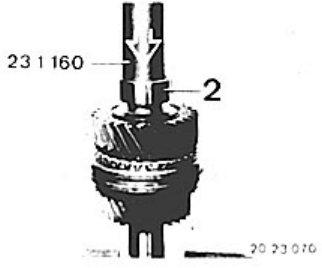


Important!
Split needle bearing:
Slots without needles are provided at angles of 90° and 120° to guarantee uniform bearing of the needles.



Place needle bearing, 3rd gear wheel, synchromesh ring, guide sleeve, synchromesh ring, needle bearing and 2nd gear wheel on the output shaft. Press on bearing sleeve (1) with Special Tool 23 1 160.

Important!
Guide the needle bearing into the bearing sleeve.



Press on bearing inner race (2) with Special Tool 23 1 160.



20 23 071

Determine thickness of shim X.
Measure distance (A) from collar of output shaft to bearing inner race.

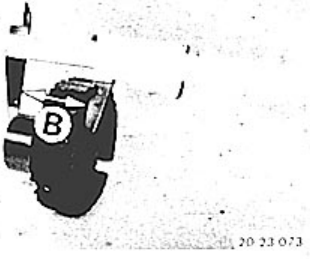


20 23 072

Pull operating sleeve off of 1st/reverse gear guide sleeve.

Installation

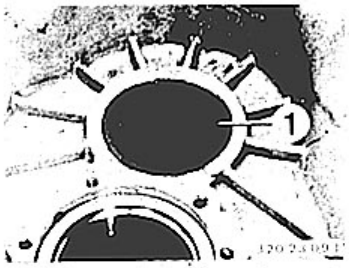
Install operating sleeve that its flat teeth slide over the pressure pieces.



20 23 073

Insert reverse gear bearing sleeve in guide sleeve.
Measure distance (B) from guide sleeve collar to bearing sleeve.
Example:

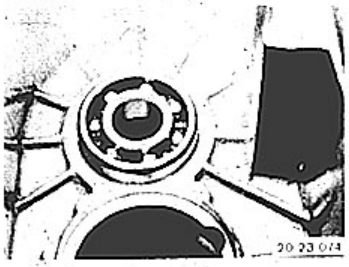
	A	46.8 mm (1.842")
–	B	46,3 mm (1.822")
	X	0.5 mm (0.020")



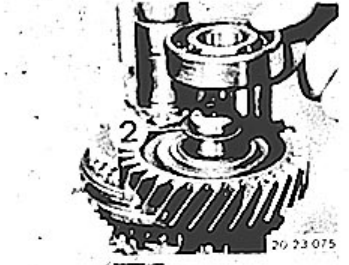
23 21 703 REPLACING BEARINGS OF ALL TRANSMISSION SHAFTS
– Transmission Removed –

A) Input Shaft, Layshaft in Front Case Section:

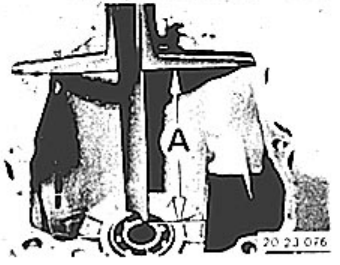
Remove transmission case – see 23 11 005.
Remove end plug (1).
Installation:
Replace end plug and install with sealing compound**.
Remove grooved ball bearing.



Heat transmission case in area of bearing to about 80° C (175° F) with a hot air blower.
Install grooved ball bearing.

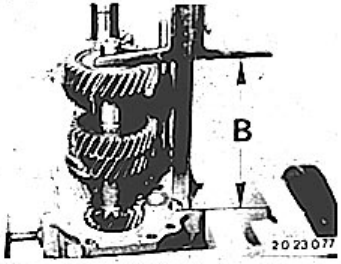


Adjust axial play of layshaft.
Determine thickness of spacer (2) between bearing and layshaft.



Measure distance (A) from case sealing surface to grooved ball bearing.

** Source: HWB



Measure distance (B) from layshaft to sealing surface.
Example:

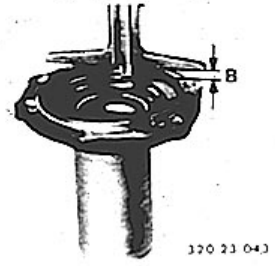
A	155.8 mm (6.134")
– B	155.3 mm (6.114")
	0.5 mm (0.020")
–	0.1 ... 0.2 mm (0.004...0.008") axial pl.
	0.3 ... 0.4 mm (0.012...0.016") spacer



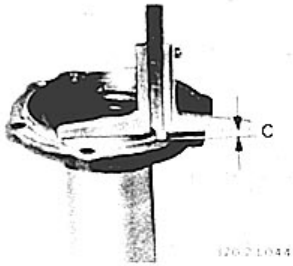
Install front case section.
Adjust play between circlip and bearing inner race to 0 ... 0.09 mm (0 ... 0.0035") with shims.



Adjust play between guide sleeve and bearing outer race to 0 ... 0.09 mm (0 to 0.0035") with shims.
Measure distance (A) from case sealing surface to bearing outer race.



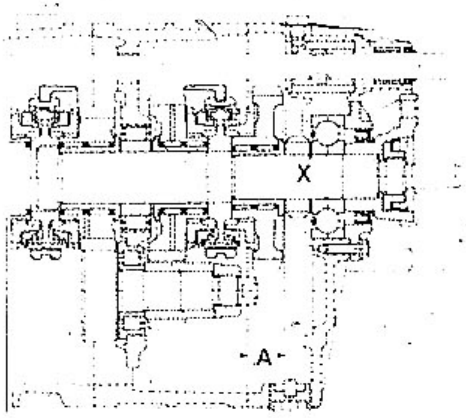
Measure distance (B) from guide sleeve protrusion to inside surface.

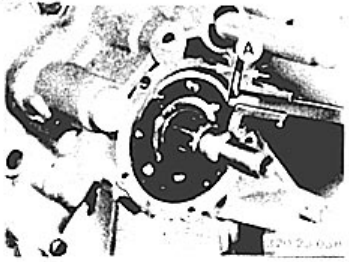


Measure distance (C) from guide sleeve protrusion to outside surface.
Example:

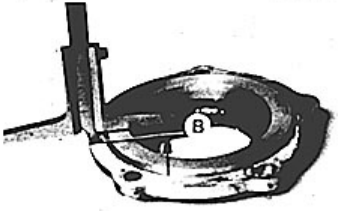
B	4.0 mm (0.157")
+ A	0.3 mm (0.012")
	4.3 mm (0.169")
− C	2.8 mm (0.110")
	1.5 mm (0.059") spacer

B) Output Shaft in Rear Case Section:
Remove rear case section 23 11 040.
Press in grooved ball bearing to fit tight in rear case section. Check distance (A), adjusting with shim X betw. bearing and spacer if necessary.





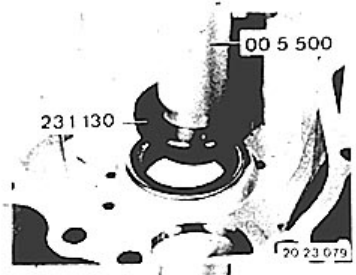
Eliminate play between grooved ball bearing and cover.
Measure distance (A) from case cover to grooved ball bearing.



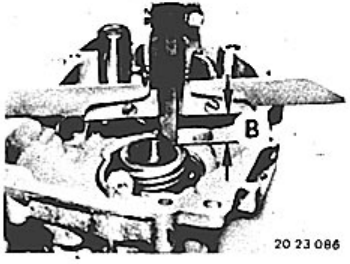
Measure collar height (B), without gasket.
Important!
Use 0.2 mm (0.008") for gasket thickness in calculations.
Example:

A	3.0 mm (0.118")
− B	2.9 mm (0.114")
	0.1 mm (0.004")
+	0.2 mm (0.008") gasket thickness
	0.3 mm (0.012") shim thickness

320 23 039

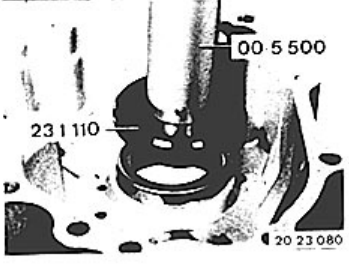


C) Output Shaft, Layshaft in Intermediate Case:
Remove input/output shaft assembly – see 23 21 501.
Drive out roller bearing for output shaft with Special Tools 23 1 130 and 00 5 500.



Install spacer on grooved ball bearing.
Measure distance (B) from sealing surface to spacer.
Example:

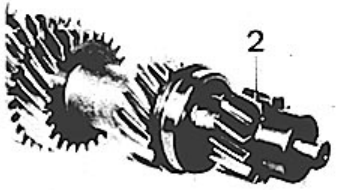
A	22.0 ± 0.1 mm (0.866 ± 0.004") nominal
− B	21.6 mm (0.850")
	0.4 mm (0.016") spacer



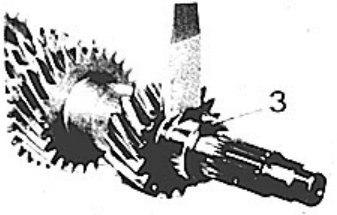
Drive in roller bearing with Special Tools 23 1 110 and 00 5 500.



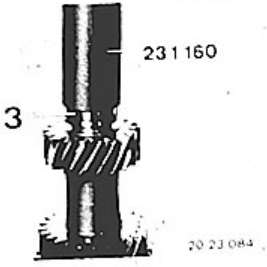
Unscrew collar nut (1).
Installation:
Install collar nut with bolt cement**.
Tightening torque*.



Pull off gear (2).



Take off roller bearing.
Press bearing inner race (3) off of layshaft with, if necessary, Special Tool 00 7 500.



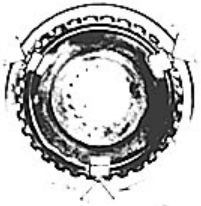
Install bearing inner race (3) with collar facing gear and press on with Special Tool 23 1 160.

* See Specifications
** Source: HWB

23 23 004 DISASSEMBLING/ASSEMBLING COMPLETE SYNCHRONIZATION
– Transmission Removed –



Remove input and output shaft assembly 23 21 501.
Disassemble output shaft 23 21 552.
All synchromesh rings are identical and coated with molybdenum on inside.
Check distance* between synchromesh ring and clutch.
Measure in area of stops.
Synchromesh rings should support uniformly on entire surface.



Press operating sleeve off of synchronizer.
Installation:
Install operating sleeve that its flat teeth slide over pressure pieces.



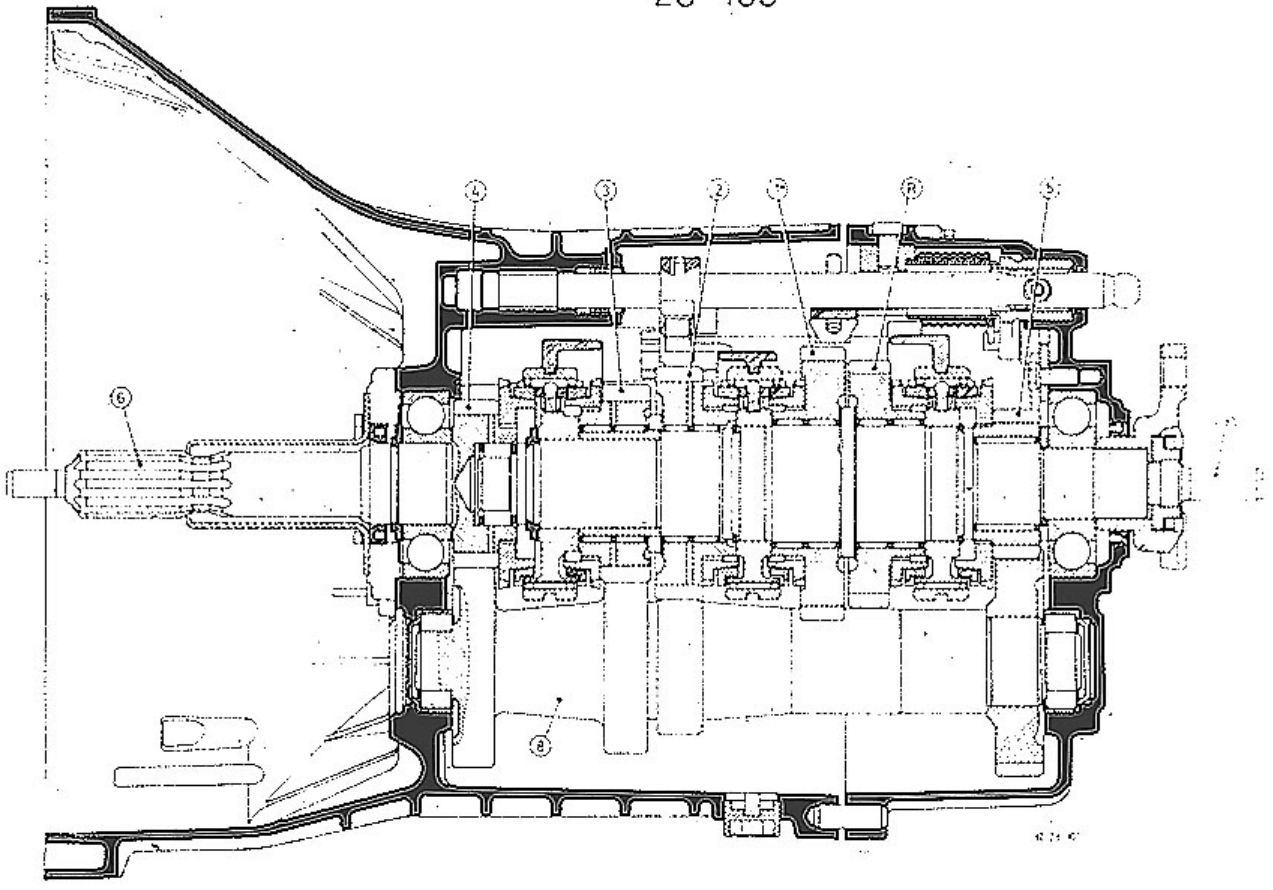
Offset hooks of synchromesh springs in an axial groove to each other.
Engage pressure pieces in synchromesh springs.

* See Specifications

Construction group 23 Manual transmission

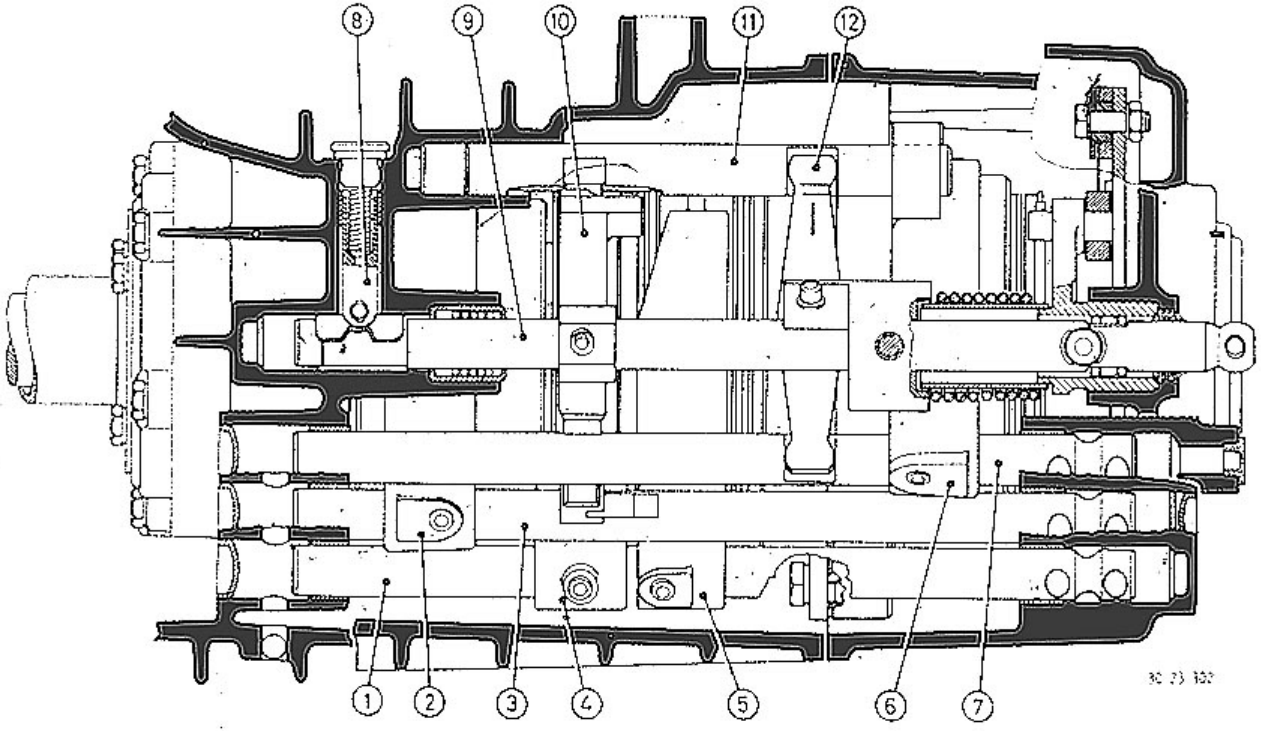
Getrag 260 Five speed overdrive transmission

	Assembly drawing – transmission	23-	165
	Assembly drawing – shift components	23-	166
23 11 013	Transmission case front section – remove and install / seal	23-	169
623	Guide sleeve for clutch release – remove and install	23-	171
23 12 503	Radial oil seal for input shaft – replace	23-	173
23 21 503	Input and output shaft assembly – remove and install	23-	174
554	Output shaft – replace	23-	179
703	Bearings for all transmission shafts – replace	23-	185
23 23 505	Synchronisation – disassemble and assemble	23-	189



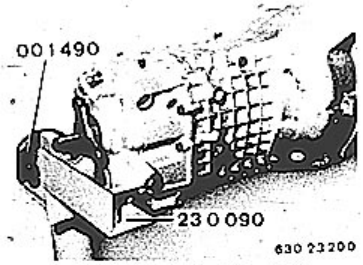
ASSEMBLY DRAWING OF GETRAG 260 FIVE SPEED OVERDRIVE MANUAL TRANSMISSION

1 First gear
2 Second gear
3 Third gear
4 Fourth gear
5 Fifth gear
6 Reverse gear
6 Input shaft
7 Output shaft
8 Layshaft



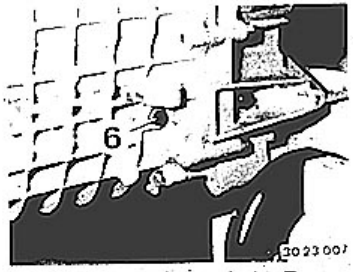
ASSEMBLY DRAWING OF SHIFT MECHANISM FOR GETRAG 260 FIVE SPEED OVERDRIVE MANUAL TRANSMISSION

1 Selector rod — 1st/2nd gear
2 Selector fork — 3rd/4th gear
3 Selector rod — 3rd/4th gear
4 Dog
5 Selector fork — 1st/2nd gear
6 Selector fork — reverse/5th gear
7 Selector rod — reverse/5th gear
8 Lockpin
9 Selector shaft
10 Selector arm
11 Selector rail
12 Operating lever



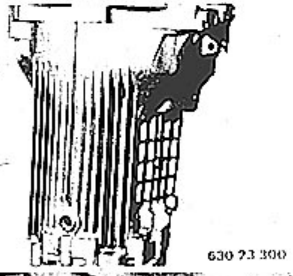
23 11 013 REMOVING AND INSTALLING OR SEALING FRONT CASE SECTION

Remove transmission - see 23 00 022 in model repair manual beginning with 1985 models.
Mount Special Tool 23 0 090 on Special Tool 00 1 490.
Mount transmission on special tool.
Drain oil.



Unscrew bolt (6).

Installation:
Install bolt with a bolt cement**.
Tightening torque*.

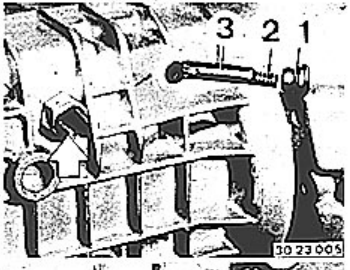


General information:
A stronger 5-speed overdrive transmission type 260/6 is installed in cars with M 30 engine, 3.2 or 3.4 liter, since 9.85.
Identification: additional cooling ribs on lower case section.
The 260/6 overdrive transmission is included in the following description for the former 260/5 transmission.
Transmission Type 260/6 is mentioned when procedures deviate.



Drive out cylindrical pin.
Unscrew bolts.

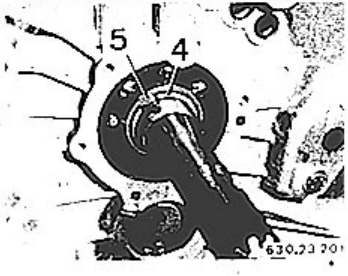
Installation:
Check length of bolts.
Bolt (1) = 8 x 60 mm.



Remove guide sleeve - see 23 11 623.
Unscrew backup light switch.
Lift out cover (1).
Pull out spring (2) and lockpin (3).
Check installed position!

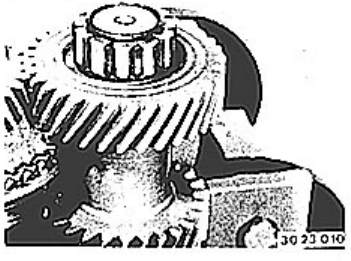


Pull off front case section with Special Tools 23 1 460 and 33 1 301.



Lift out snap ring (4).
Take off washer (5).

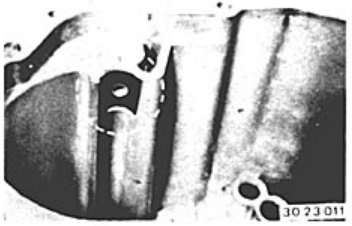
Installation:
Always replace the snap ring.



Place roller bearing on the layshaft in such a manner that the small diameter faces up.

Note:
To avoid seizure of the rollers while mounting the front case section, coat rollers with grease and press in.

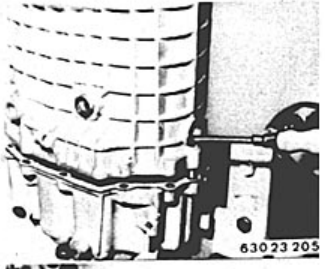
* See Specifications
** Source of Supply: HWB



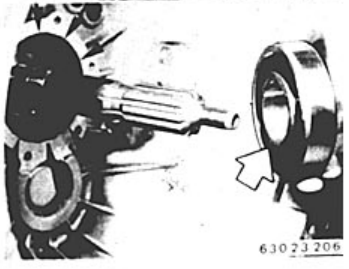
Coat front case section in area of the reverse gear shaft with a surface sealing compound**.
Surface must be cleaned thoroughly and dried of oil.



Remove grooved ball bearing for input shaft.
Important! - Installation:
Inner race of the grooved ball bearing protrudes.
Install with protrusion face the gear set.

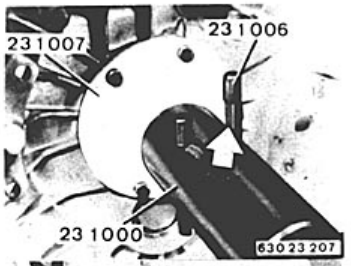


Unscrew oil drain plug.
Coat sealing surface with surface sealing compound**.
Sealing surface must be cleaned thoroughly and dried of oil.
Mount front case section.
Align intermediate shaft through bore for oil drain plug in such a manner, that roller bearing of intermediate shaft slides into the bearing shell.
Tighten front case section bolts.
Tightening torque*.
Install lockpin and reverse gear switch.

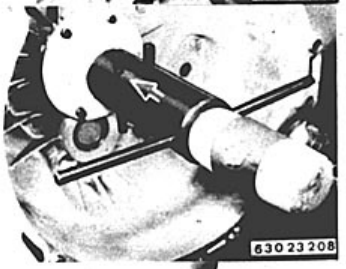


Heat* bearing inner race and front case section in area of grooved ball bearing with a hot air blower.
Push on grooved ball bearing as far as possible.
Protrusion of inner race faces the gear set.

* See Specifications
** Source of Supply: HWB



Press grooved ball bearing on input shaft or into front case section with Special Tools 23 1 007, 23 1 000 and 23 1 006.
Important!
Apply Special Tools 23 1 006 in such a manner, that flat ends face the input shaft.



Drive on grooved ball bearing further continuously and simultaneously apply light knocks from a hammer.

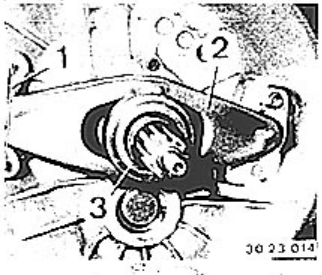


Transmission 260 / 6 or 260 Sport:
The front case section cannot be pressed on due to the uniform thickness of the input shaft.
Double bearing is installed in the front case section.
Heat bearing inner race to about 80° C (175° F) with a hot air blower.
Caution!
Protect plastic cage against heat.
Mount front case section, whereby the input shaft must be pulled out.
Tighten front case section bolts.
Tightening torque*.



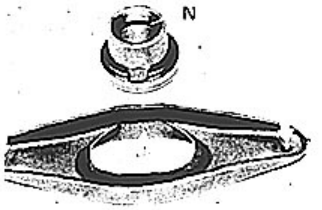
Install shim and circlip.
Reduce any possible play between the bearing inner race and circlip to 0 ... 0.09 mm (0 to 0.0035").

* See Specifications



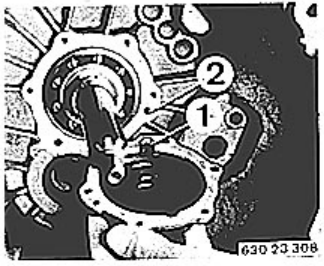
23 11 623 REMOVING AND INSTALLING GUIDE SLEEVE FOR CLUTCH RELEASE (Transmission Removed)

Lift out spring (1) and remove release lever (2) with bearing (3).



Installation:
Fill lubricating groove N with Molykote Longterm 2.
Coat guides F and bearings L with Molykote Longterm 2.
Non-conformance could cause the release bearing to seize on the guide sleeve.

Important!
Use Microlube 261** for version with a double-mass flywheel.

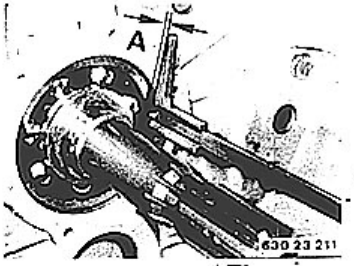


Unscrew guide sleeve.

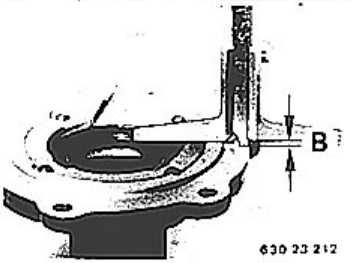
Important!
Spacer.

Installation:
Mount guide sleeve that oil groove (1) is aligned with oil bore (2) in transmission case, or "up/down" marks on guide sleeve are aligned and arrow on face points to middle of layshaft.
Install guide sleeve and bolts with a sealant**.
Sealing surface and bolts must be cleaned thoroughly and dried of oil.
Tightening torque*.

* See Specifications
** Source of Supply: HWB



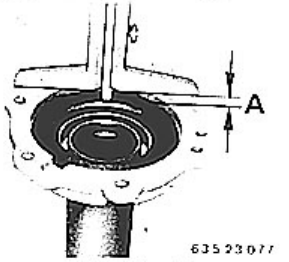
Installation:
Adjust any play to 0 ... 0.09 mm (0 to 0.0035").
Determine thickness of spacer.
Measure distance (A).



Measure distance (B).

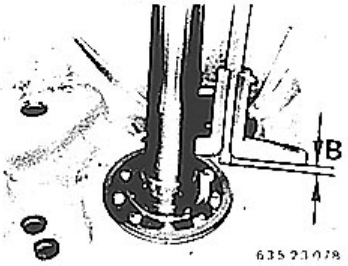
Example:

A	3.0 mm (0.118")
– B	2.6 mm (0.102")
Spacer	0.4 mm (0.016")



260/6 or 260 Sport Transmission:

Installation:
Adjust any play to 0 ... 0.09 mm (0 to 0.0035").
Determine thickness of spacer.
Measure distance (A).



Measure distance (B).

Example:

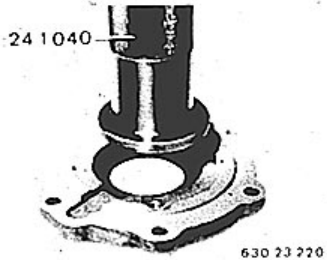
A	3.0 mm (0.118")
– B	2.6 mm (0.102")
Spacer	0.4 mm (0.016")



630 23 219

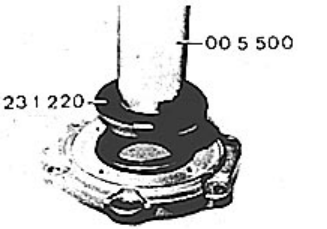
23 12 503 REPLACING RADIAL OIL SEAL FOR INPUT SHAFT
- Transmission Removed -

Remove guide sleeve - see 23 11 622.
Unscrew guide pipe.
Installation:
Install guide pipe and bolts with a surface sealing compound.**
Sealing surface and bolts must be cleaned thoroughly and dried of oil.
Tightening torque*.



630 23 220

Important!
Collar on inside surface of flange.
Drive out radial oil seal in direction of the guide pipe with Special Tool 24 1 040.



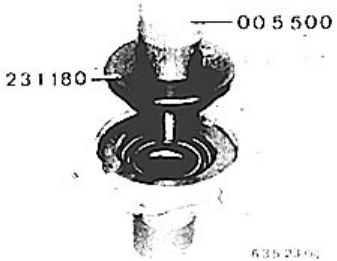
630 23 221

Drive in radial oil seal with Special Tools 23 1 220 and 00 5 500.
Lubricate sealing lip of radial oil seal with oil.



635 23 027

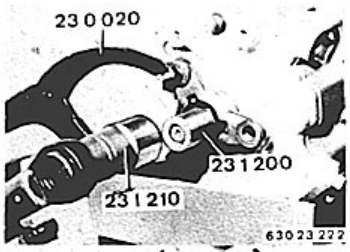
Transmission 260 / 6 or 260 Sport:
Lift out radial oil seal.



635 23 0[illegible]

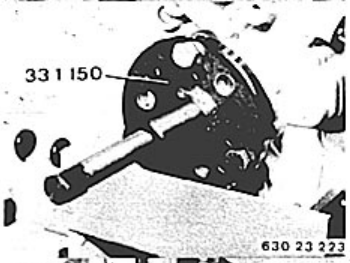
Drive in radial oil seal with Special Tools 23 1 180 and 00 5 500.
Open end faces up.
Lubricate sealing lip with oil.

* See Specifications
** Source of Supply: HWB

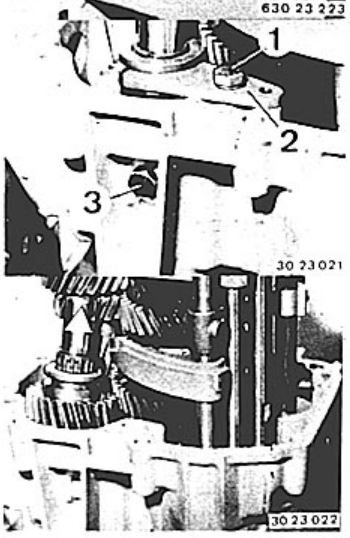


23 21 503 REMOVING AND INSTALLING INPUT AND OUTPUT SHAFT ASSEMBLY
– Transmission Removed –

Remove transmission case front section – 23 11 013.
Remove lockplate.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.
Version with Integrated Vibration Damper:
Hold output flange with Special Tool 23 1 320.

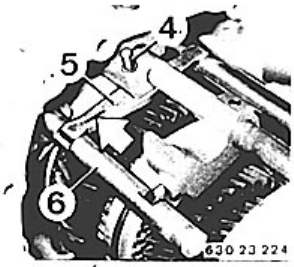


Pull off output flange with Special Tool 33 1 150.

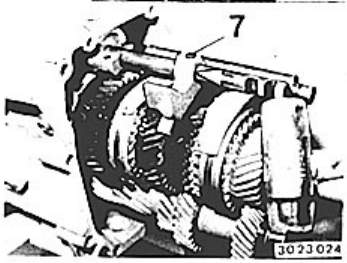


Unscrew bolt (1).
Remove holder (2).
Unscrew bolt (3).

Remove shaft with reverse gear and needle bearing.



Pull out pin (4) for operating lever (5).
Pull out selector rail (6).
Remove operating lever (5).
Installation:
Install operating lever that notch faces up and in direction of selector rail.



Engage 4th gear.
Drive in pin (7), while counterholding.
Important!
Only drive in pin (7) far enough that selector shaft can be pulled back and out.



Radial oil seal (8) will also be pulled out.
Important!
Rollers on selector shaft.
Installation:
Replace radial oil seal.
Remove selector arm.

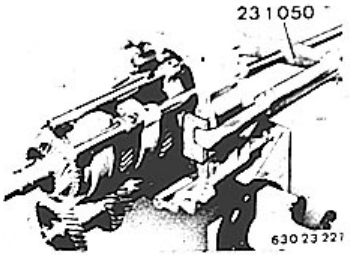


Detach end plate.
Installation:
Install end plate with sealing compound**.
Sealing surface must be cleaned thoroughly and dried of oil.
Remove end plate (9).
Installation:
Replace end plate.

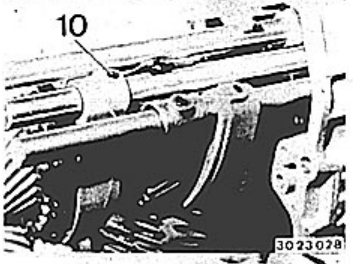
** Source: HWB



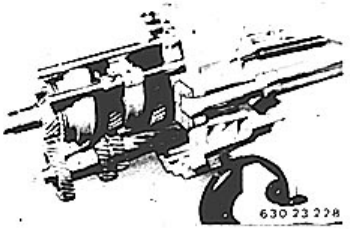
Remove 3 springs and 3 balls.
Note:
Springs differ in length (see installation).



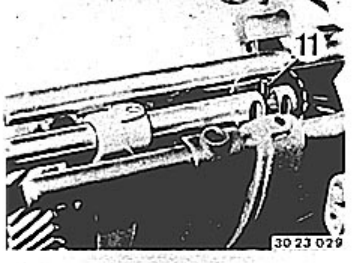
Press input shaft, putput shaft and layshaft out of case rear section with Special Tool 23 1 050.
Important!
To avoid damage on sealing surface, use a piece of wood, aluminum or similar material between claws and sealing surface.



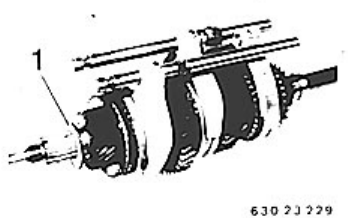
Drive out pin (10) in 3rd/4th gear selector fork.
Installation:
Replace pin.



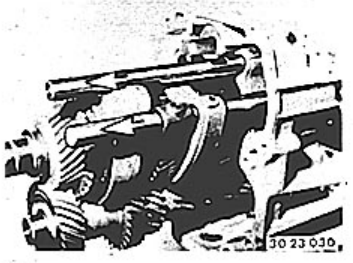
Important!
Be careful not to clamp selector rods and layshaft while pressing out parts.
Layshaft must not tilt off in this step.
Installation:
Check condition of all bearings, replacing if necessary.



Knock out 3rd/4th gear selector fork forward.
Important!
Lockpin (11) in selector fork.



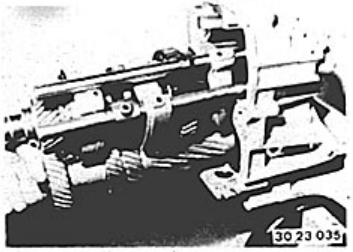
Installing:
Install 3rd/4th gear selector fork and 1st/2nd as well as 5th/reverse gear selector rods with selector forks.
Check thrust washer (1) (only for 260/5).



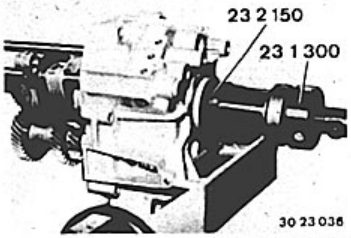
Engage 2nd and reverse gears by pushing 1st/2nd and 5th/reverse gear selector rods forward.



Remove all detent and locking balls from case rear section.
Install roller bearing with large diameter facing out.
Lubricate lockpins and locking levers with oil.
Transmission 260/6:
The radial oil seal for the output flange and the ball bearing inner race must be removed prior to installation of the input and output shafts.

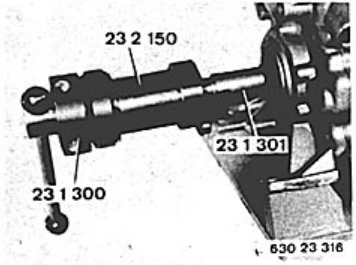


Heat grooved ball bearing inner race in rear case section to about 80° C (175° F) with a hot air blower.
2nd and reverse gears are engaged.
Install input shaft, output shaft and layshaft in rear case section.
Align shift rods.

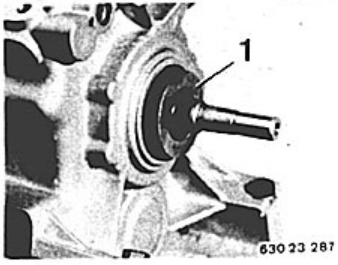


Pull input shaft, output shaft and layshaft into rear case section with Special Tools 23 1 300 and 23 2 150.

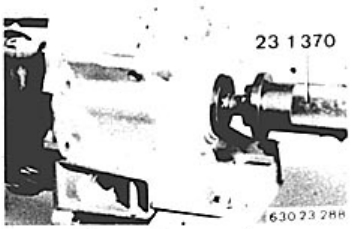
Important!
Make sure shift rods and layshaft are not clamped while pulling in.



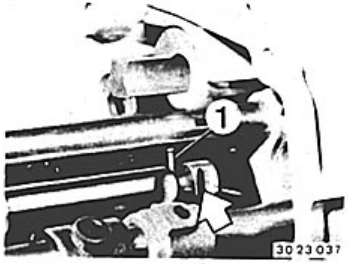
Note:
Screw Special Tool 23 1 301 between both above mentioned special tools for the version with a longer output journal.



260/6 Transmission:
Install input shaft and output shaft with 3rd/4th gear shift forks and 1st/2nd and 5th/reverse gear shift rods or layshaft in the rear case section.
Heat bearing inner race (1) to about 80° C (175° F) with a hot air blower and slide it on the output shaft, pressing on with Special Tool 23 1 160 if necessary.



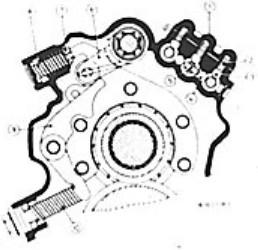
Drive in radial oil seal flush with Special Tool 23 1 370.
Lubricate sealing lip with oil.



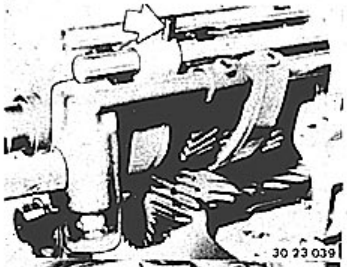
Move shift rods into neutral position.
Push 3rd/4th gear shift rod through the shift forks.
Place lockpin (1) in the shift rod with grease.
Push in shift rod up to the bore.
Opening on shift rod faces up.



Insert two locking balls with grease.
Push in 3rd/4th gear shift rod up to the arrest.



Arrest Assembly:
1 Cap
2 Spring
3 Dentent ball
4 Locking ball
5 Lockpin
6 Selector arm
7 Lockpin
8 Spring
9 Locking lever
10 Spring



Drive 6 x 26 mm pin into 3rd / 4th gear selector fork (counterhold).



Install 3 locking balls and 3 springs.
Important!
Version with Different Length Springs:
Install short spring (1) with relaxed length (A) = 15.9 mm (0.626") for 5th/reverse gear selector rod.

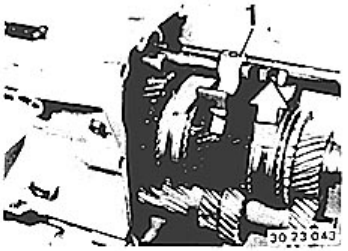


Install end cap after coating with sealing compound**.
Install end cover with sealing compound**.

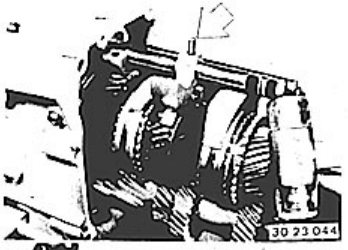


Drive pin out of selector arm.

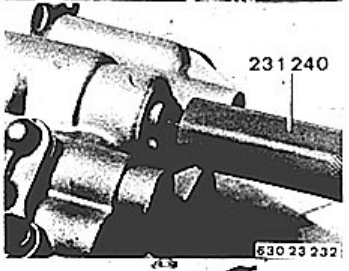
** Source: HWB



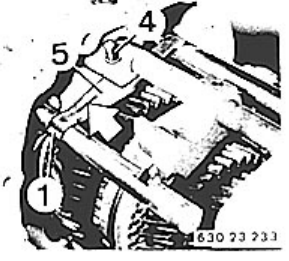
Hold 4 rollers in position with grease.
Slide in selector shaft and install selector arm (1) at same time.
Important!
Opening in selector shaft faces out.



Drive in 6 x 26 mm pin (counterhold).



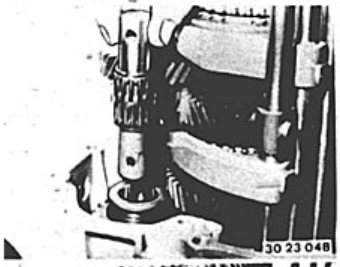
Lubricate sealing lip of radial oil seal with oil.
Drive in radial oil seal with Special Tool 23 1 240.



Install selector rail.
Groove (1) in selector rail faces up.
Install operating lever (5) with notch facing up and toward selector rail.
Install pin (4).



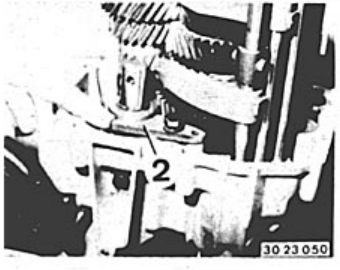
Coat case rear section in area of reverse gear shaft with sealing compound**.
Surface must be cleaned thoroughly and dried of oil.



Install shaft with needle bearing and reverse gear.



Mount shaft with bolt (3).
Install bolt with a bolt cement**.



Insert holder (2), press out and secure in this position.

** Source: HWB

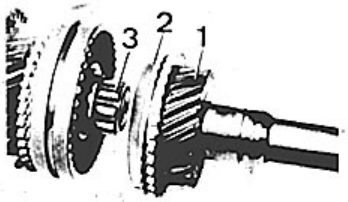


Install output flange.
Install collar nut with a bolt cement**.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Tighten collar nut with Special Tool 23 1 210.
Tightening torque*.
Version with Integrated Vibration Damper:
Hold output flange with Special Tool 23 1 320.



Install lockplate.

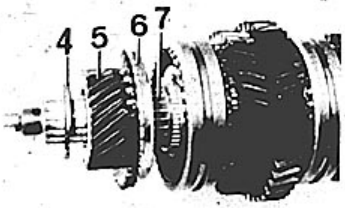
* See Specifications
** Source: HWB



630 23 236

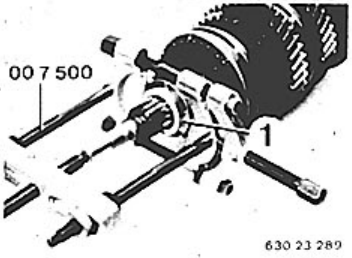
23 21 554 REPLACING OUTPUT SHAFT
– Output Shaft Removed –

Pull off input shaft (1), synchromesh ring (2) and needle bearing (3).
Note:
Synchronization:
To avoid mixing up synchromesh rings, it is recommended to mark sychromesh rings and corresponding gear wheels when disassembling the output shaft.



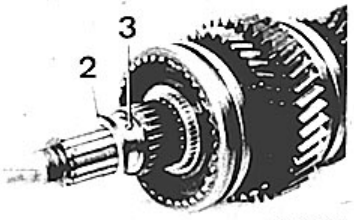
630 23 237

Pull off thrust washer (4), 5th gear (5), synchromesh ring (6) and needle bearing (7).



630 23 289

Transmission 260/6:
Pull ball bearing inner race (1) off of the output shaft with Special Tool 00 7 500.



630 23 290

Transmission 260/6:
Pull off 5th gear wheel and synchromesh ring.
Take off thrust washer (2) and ball (3).
Pull off needle bearing.



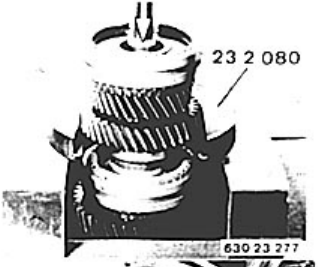
630 23 238

Lift out circlip (8).
Remove spacer (9).
Installation:
Always replace circlip.



630 23 239

Installation:
Adjust play between circlip and guide sleeve to 0... 0.09 mm (0 to 0.0035").



630 23 277

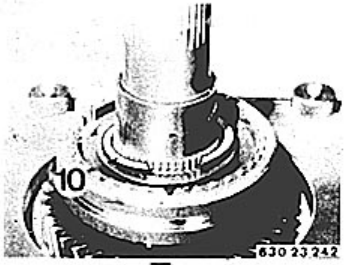
Press 2nd gear, bearing sleeve, 3rd gear, synchromesh ring and guiding sleeve with sliding sleeve off of output shaft with Special Tool 23 2 080.
Pressing off force*.



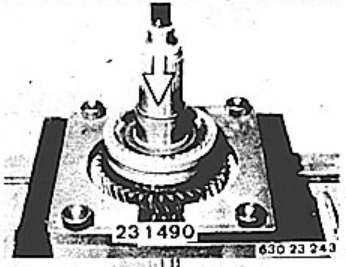
630 23 291

Transmissions 260/6 and 260/5**:
Note thrust washer (2) and ball (3) between 2nd and 3rd gear wheels.

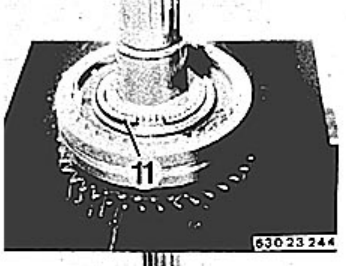
* See Specifications
** Since 7.85



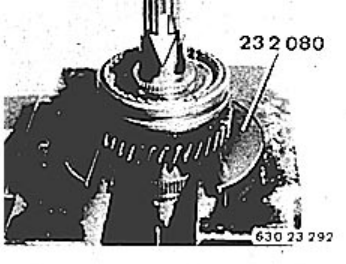
Important!
Circlip (10) must be removed before pressing off the first gear wheel.
Installation:
Always replace circlip.



Press off 1st gear wheel and guide as well as operating sleeve with Special Tool 23 1 490.
Take off needle bearing.
Pressing-off force*.

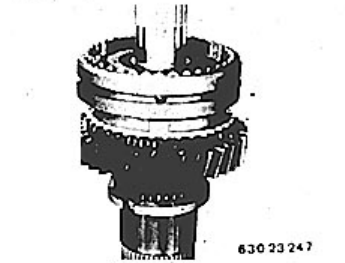


Important!
Circlip (11) must be removed before pressing off the reverse gear wheel.
Installation:
Always replace circlip.s

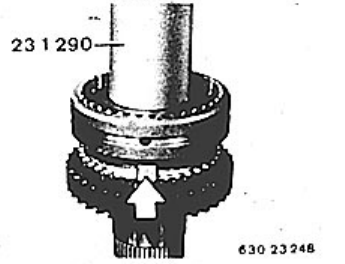


Press off guide as well as operating sleeve and reverse gear wheel with Special Tool 23 2 080, with the bottom end facing the gear wheel.
Take off needle bearing.
Pressing-off force*.

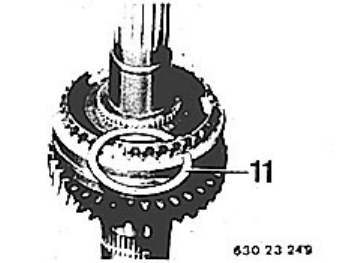
* See Specifications



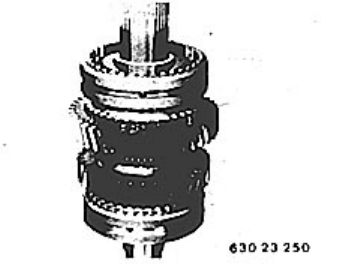
Assembling:
Note:
Check wear of synchromesh rings before assembling (see 23 23 505).
Install needle bearing, reverse gear wheel and synchromesh ring.
Slide guide and operating sleeve on splines of the output shaft.
Transmission 260/6 and 260/5** or 260 Sport:
Shouldered end of operating sleeve faces reverse gear wheel or, for version with 1 groove, 5th gear wheel.



Press on guide sleeve to fit tight with Special Tool 23 1 290.
Pressing-on force*.
Important!
Make sure tabs on synchromesh ring are aligned with openings in the guide sleeve while pressing on.

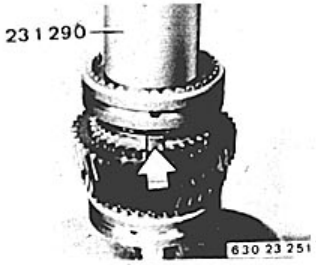


Move operating sleeve in direction of reverse gear wheel.
Adjust guide sleeve to be without play with circlip (11).
Circlips are available from Parts in different thicknesses between 1.7 and 2.0 mm (0.067 and 0.079").
Install circlip (11).



Install needle bearing, 1st gear wheel and synchromesh ring.
Slide guide and operating sleeves on the splines of the output shaft.
Transmission 260/6 and 260/5** or 260 Sport:
Shouldered end of operating sleeve faces the 1st gear wheel or, for version with 2 grooves, 2nd gear wheel.

* See Specifications
** Since 5.85



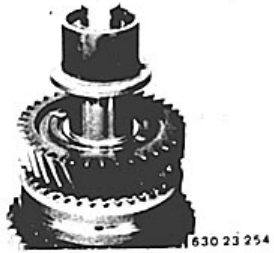
Press on guide sleeve to fit tight with Special Tool 23 1 290.
Pressing-on force*.
Important!
Make sure tabs on synchromesh ring are aligned with openings in the guide sleeve while pressing on.



Move operating sleeve in direction of the 1st gear wheel.
Adjust guide sleeve to remove all play.
Circlips are available from Parts in different thicknesses between 1.7 and 2.0 mm (0.067 and 0.079").
Install circlip (10).



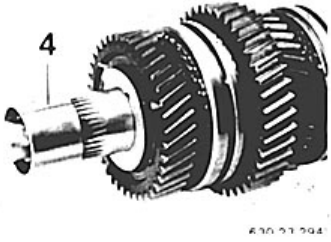
Install needle bearing, synchromesh ring and 2nd gear wheel.
Important!
Collar for bearing sleeve on the output shaft must protrude slightly.
If necessary, check whether circlip (10) seats correctly.



Heat bearing sleeve to about 80° C (175° F) with a hot air blower and install on the output shaft.



Transmission 260/6 and 260/5** or 260 Sport:
Install ball (3) and thrust washer (2) with the opening facing ball (3).

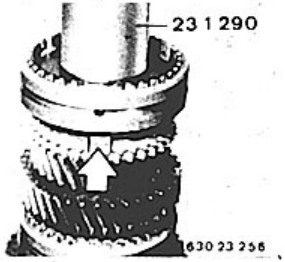


Transmission 260/6 and 260 Sport:
Heat bearing sleeve (4) without collar to about 80° C (175° F) with a hot air blower and install on the output shaft.

** Since 7.85

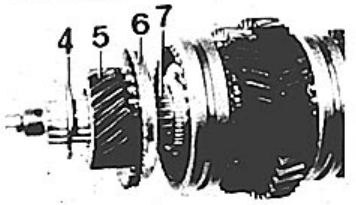

630 23 255

Install needle bearing, 3rd gear wheel and synchromesh ring.
Install guide and operating sleeve on splines with the long collar facing the 3rd gear wheel.
260/5 since 6.85 or 260 Sport:
Shouldered end of operating sleeves faces the 3rd gear wheel or, for version with 3 gr,ooves, the 4th gear wheel.
260/6:
Groove for shift fork is off-center.
Wide flat spot on operating sleeve faces the 3rd gear wheel.



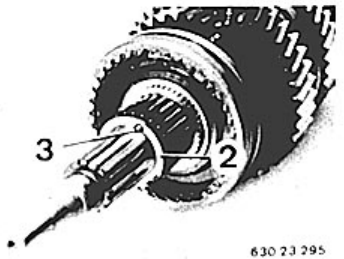
630 23 256

Press on guide sleeve to fit tight with Special Tool 23 1 290.
Important!
Make sure that tabs on synchromesh ring are aligned with openings in the guide sleeve while pressing on.
Install shim and circlip.
Pressing-on force*.



630 23 237

Pull off thrust washer (4), 5th gear wheel (5), synchromesh ring (6) and needle bearing (7).



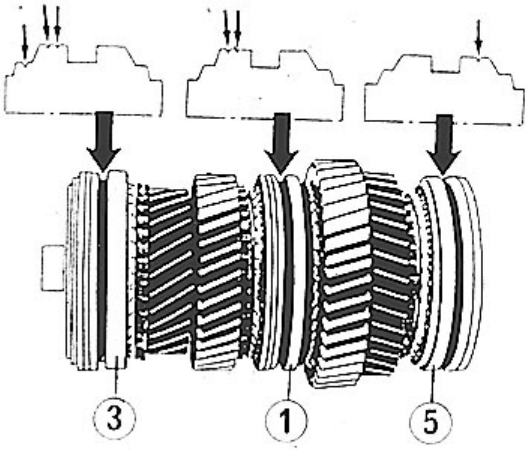
630 23 295

Transmission 260/6:
Slide needle bearing on output shaft.
Insert ball (3).
Install thrust washer (2) with opening facing the ball.
Install synchromesh ring and 5th gear wheel.

* See Specifications


630 23 296

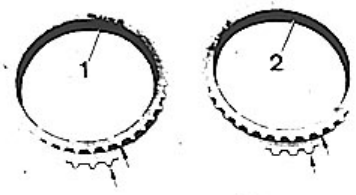
Transmission 260/6:
Heat ball bearing inner race to about 80° C (175° F) with a hot air blower and install on the output shaft.
Important!
The opening in the bearing inner race must engage with the ball (turning lock).



630 23 312

Transmission 260/5:

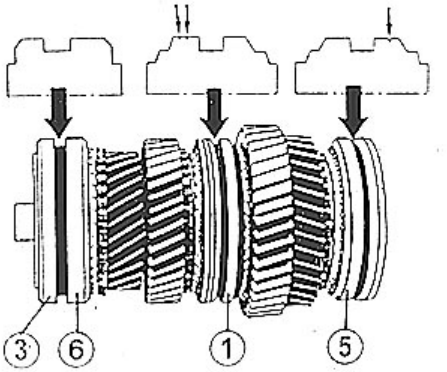
Note:
Modified synchronization since 5.85 with new gear wheels, synchromesh rings, guide and operating sleeves, guides, balls and springs.
Identification: grooves in operating sleeves (check installed position).
Operating sleeves are machined asymmetrically.
Operating sleeve (1), marked with 2 grooves, is installed with shouldered end facing 1st gear wheel or grooves facing 2nd gear wheel.
Operating sleeve (3), marked with 3 grooves, is installed with shouldered end facing 3rd gear wheel or grooves facing 4th gear wheel.
Operating sleeve (5), marked with 1 groove, is installed with shouldered end facing reverse gear wheel or grooves facing 5th gear wheel.



630 23 305

Identification of Synchromesh Rings:
To avoid mixing up synchromesh rings among each other, it is important to note the drawing number and tooth width.
Synchromesh ring (1) for 1st/reverse gears has stamped drawing no. 011.8.0241.00 and narrow teeth.
Synchromesh ring (2) for 2nd ... 5th gears has stamped drawing no. 011.8.0161.00 and wide teeth.

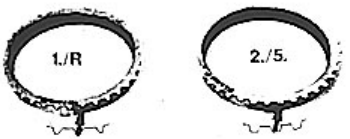
Important!
Modified shift components cannot be used in transmissions manufactured before 5.85 (shifting problems).



630 23 313

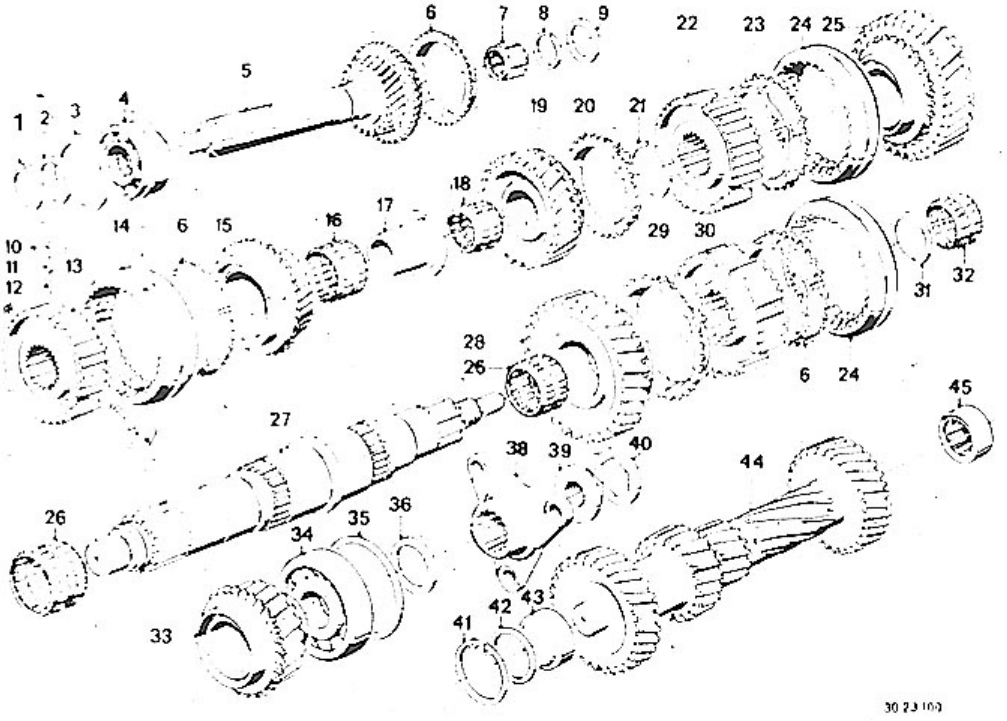
Transmission 260/6:

Note:
Operating sleeves are machined asymmetrically (check installed position).
Install operating sleeve (1) for 1st/2nd gears, marked with 2 grooves, that grooves face the 2nd gear wheel.
Operating sleeve (3) for 3rd/4th gears, without grooves, groove for shift fork is offcenter.
Install operating sleeve that wide land (6) faces the 3rd gear wheel.
Install operating sleeve (5) for 5th/reverse gears with one groove that groove faces the 5th gear wheel.



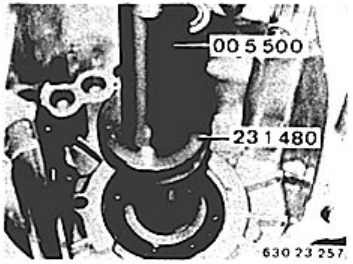
630 23 288

Identification of Synchromesh Rings:
To avoid mixing up synchromesh rings among each other, it is important to note the drawing number and tooth width.
Synchromesh rings for 1st/reverse gears have engraved drawing no. 011.8.0241.10 and narrow teeth.
Synchromesh ring for 2nd gear has engraved drawing no. 011.8.0161.2.
Synchromesh ring for 5th gear has engraved drawing no. 011.8.0161.00.
Synchromesh rings for 2nd ... 5th gears have wide teeth.



Layout of Gear Set and Bearings

1 Circlip
2 Spacer
3 Spacer
4 Bearing
5 Input shaft with 4th gear
6 Synchromesh ring
7 Needle bearing
8 Circlip
9 Spacer
10 Dog
11 Ball
12 Spring
13 Guide sleeve
14 Operating sleeve
15 3rd gear
16 Needle bearing
17 Spacer
18 Needle bearing
19 2nd gear
20 Synchromesh ring
21 Circlip
22 Guide sleeve
23 Synchromesh ring
24 Operating sleeve
25 1st gear
26 Needle bearing
27 Output shaft
28 Reverse gear
29 Synchromesh ring
30 Guide sleeve
31 Circlip
32 Needle bearing
33 5th gear
34 Bearing
35 Spacer
36 Spacer
38 Output flange
39 Collar nut
40 Lockplate
41 Circlip
42 Spacer
43 Bearing
44 Layshaft
45 Bearing

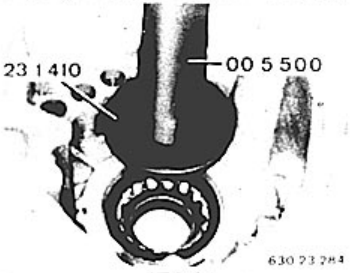


23 21 703 REPLACING BEARINGS OF ALL TRANSMISSION SHAFTS
– Transmission Removed –

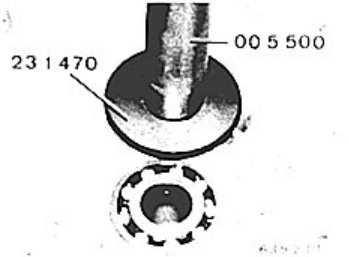
Remove input/output shaft assembly – see 23 21 503.

A) Input Shaft, Layshaft in Front Case Section

Input Shaft:
Drive out grooved ball bearing with Special Tools 23 1 480 and 00 5 500 – see 23 11 013.

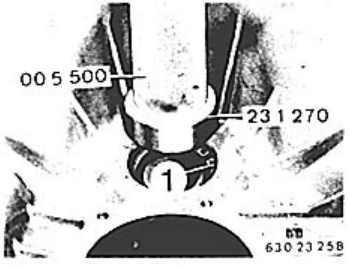


Transmission 260/6:
Drive out double bearing with Special Tools 23 1 410 and 00 5 500.

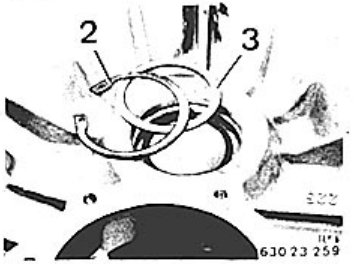


Transmission 260/6:
Heat front case section in area of the bearing to about 80° C (175° F) with a hot air blower.

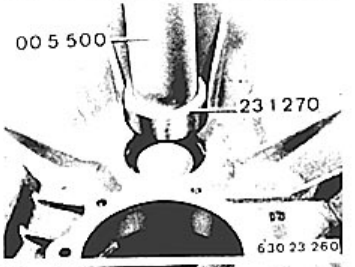
Important!
Install bearings with rollers for gear wheel set, driving in to fit tight with Special Tools 23 1 470 and 00 5 500.



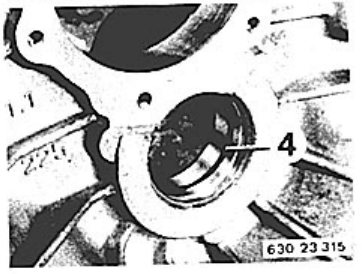
Layshaft:
Loosen circlip (1) with a single knock from Special Tool 23 1 270 used in conjunction with Special Tool 00 5 500.



Lift out circlip (2).
Remove shim (3).

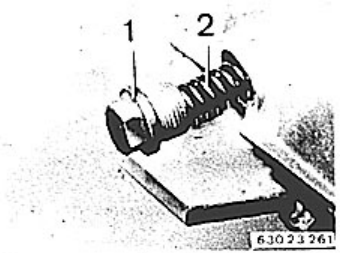


Drive out bearing shell toward inside with Special Tools 23 1 270 and 00 5 500.



Version with O-ring:
Lift out O-ring (4) with a feeler gage blade.

Installation:
Replace O-ring.
Install O-ring in groove and coat it with engine oil prior to installation of the bearing shell.



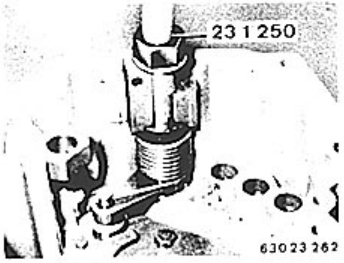
B) Output Shaft, Layshaft in Rear Case Section

Output Shaft:
Unscrew bolt (1).

Caution!
Spring force.

Remove spring (2).

Installation:
Install bolt with a bolt cement**.
Tightening torque*.



Install Special Tool 23 1 250 for removal of the selector arm.



Unscrew socket head screw (3).

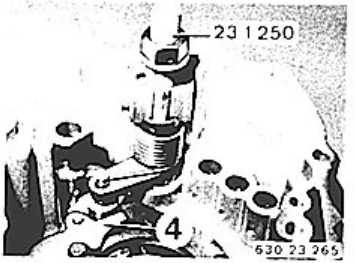
Installation:
Install screw with a bolt cement**.
Tightening torque*.



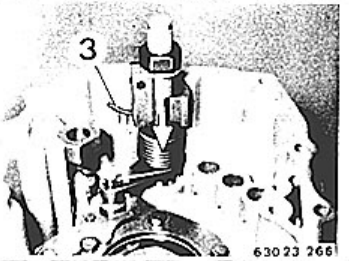
Remove selector arm from above.

Important!
Roller.

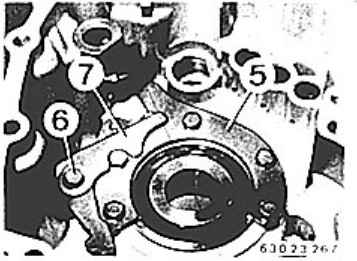
* See Specifications
** Source of Supply: HWB



Installation:
Insert selector arm with Special Tool 23 1 250.
Swing out selector arm with roller over locking lever (4).

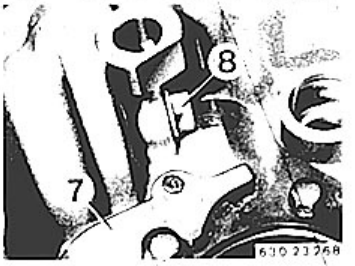


Move end of spring (3) over the raised point into installed position.
Press down on the selector arm in this position (do not knock down).
Install the socket head screw with a bolt cement** and tighten with correct torque* prior to removal of the special tool.



Remove bearing holder (5).

Important!
Do not loosen bolt (6).
Locking lever (7) remains on the bearing holder.



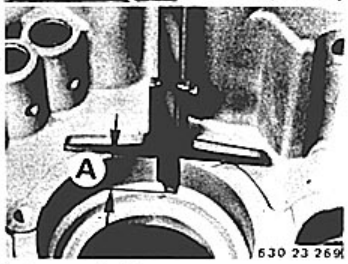
Installation:
Check installed position of locking lever (7) and thrust pin (8).

* See Specifications
** Source of Supply: HWB

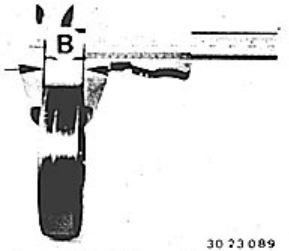


Lift out radial oil seal.
Drive out grooved ball bearing with Special Tools 23 1 120 and 00 5 500.

Important!
Shim X.



Determine thickness of shim X.
Measure distance (A).



Measure distance (B).

Example:
A = 20.3 mm (0.799")
– B = 20.0 mm (0.787")
X = 0.3 mm (0.012") thick shim

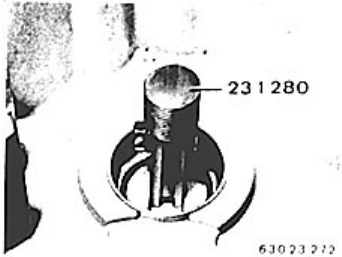


Heat rear case section in area of the grooved ball bearing to about 80° C (175° F) with a hot air blower.
Install shim X.
Install grooved ball bearing.

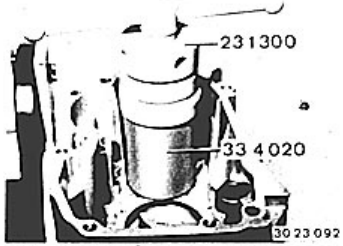
Important!
The grooved ball bearing inner race has a protrusion which faces the gear wheel set.
If necessary, drive in against the stop with Special Tool 23 1 470.

Transmission 260/6:
Split bearing inner races:
The bearing inner race with an opening for a ball (turning lock) must be installed on the output shaft – see "Replacing Output Shaft" in 23 21 554.

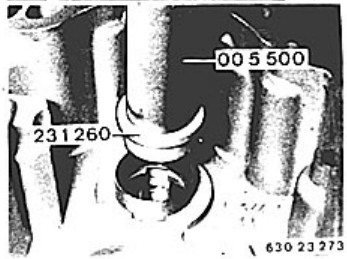




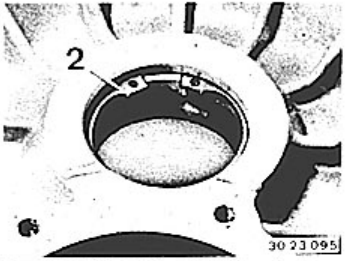
Layshaft:
Insert the stronger end of Special Tool 23 1 280 in the bearing shell.



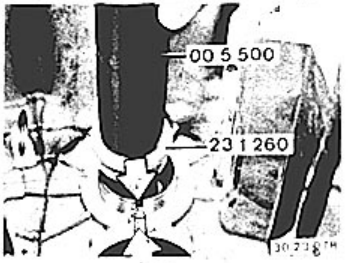
Apply Special Tool 33 4 020.
Screw on Special Tool 23 1 300.
Pull out bearing shell.



Drive in bearing shell with Special Tools 23 1 260 and 00 5 500.

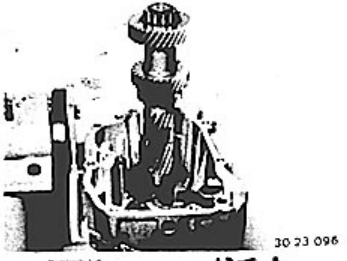


Determining Axial Play of Layshaft:
Install circlip (2).

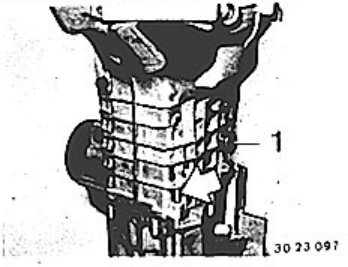


Install old shims.
Drive in bearing shell to fit tight in front case section with Special Tools 23 1 260 and 00 5 500.

Important!
Oil groove must be aligned with groove in the case.



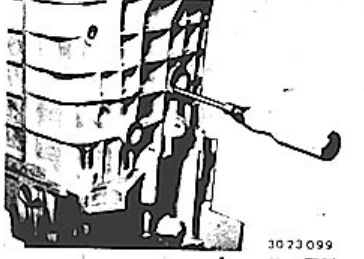
Place layshaft with roller bearings in the rear case section.



Install and mount front case section with two bolts opposite each other.
Center front case section slightly with the dowel pins.
Unscrew oil filler plug (1).



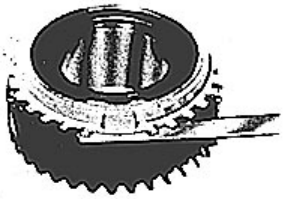
Mount holder with dial gage.
Dial gage must be applied on a tooth of the layshaft.



Check axial play of the layshaft through the bore for the oil filler plug.
Axial play = 0.13 to 0.23 mm (0.005 to 0.009").
Correct, when necessary, by removing the bearing shell and installing a thicker shim.



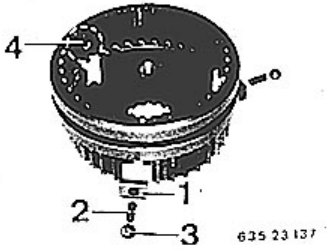
Install gear wheel set.
Determine thickness of shim for input shaft.
Install old shim and circlip.
Reduce play to 0 ... 0.09 mm (0 to 0.0035").
Determine thickness of shim for the guide sleeve – see 23 11 623.



30 23 101

23 23 505 DISASSEMBLING AND ASSEMBLING COMPLETE SYNCHRONIZATION – Output Shaft Removed –

Disassemble output shaft – see 23 21 554.
Note:
Only use molybdenum coated synchromesh rings for repairs.
Check distance* between synchromesh ring and clutch.
Measure in area of stops.
Note!
The synchromesh ring must be pressed on by screwing for measurements.
Synchromesh rings must bear uniformly on the entire surface.



635 23 137

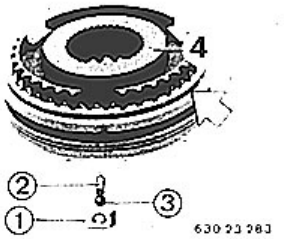
Disassemble synchronization.
Thrust piece (1), spring (2) and ball (3).
Installation:
Bore (4) in operating sleeve must be aligned with ball (3).



30 23 104

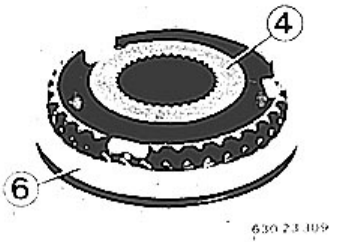
Install all springs, thrust pieces and balls.
Important!
Shouldered end of thrust pieces faces sliding sleeve.
Place guide sleeve halfways in sliding sleeve.
Push in balls far enough until guide sleeve can be pressed into sliding sleeve.

* See Specifications



630 23 083

Modified Synchronization Since 5.85:
Sliding sleeves with asymmetric splines.
Thrust pieces (1), spring (2) and balls (3) in weaker version.
Installation:
Bevelled ends of thrust pieces face the sliding sleeve.
For the 3rd/4th gear guide sleeve it is important to make sure that the bevelled end of sliding sleeve (marked with 3 grooves) faces the long collar (4) of the guide sleeve.



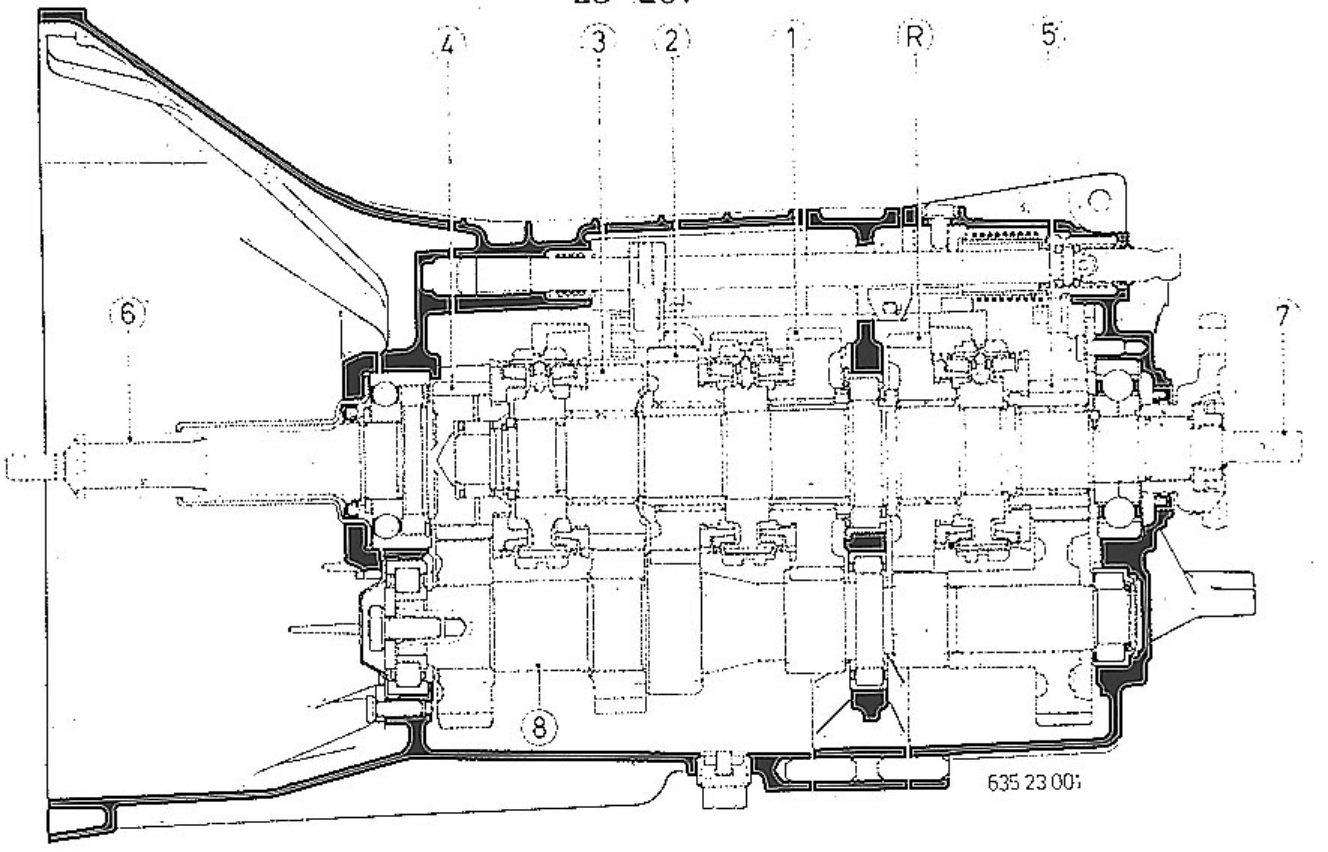
630 23 109

Groove for selector fork is offcenter.
Wide land (6) of sliding sleeve must face long collar (4) of the guide sleeve.

Construction group 23 Manual transmission

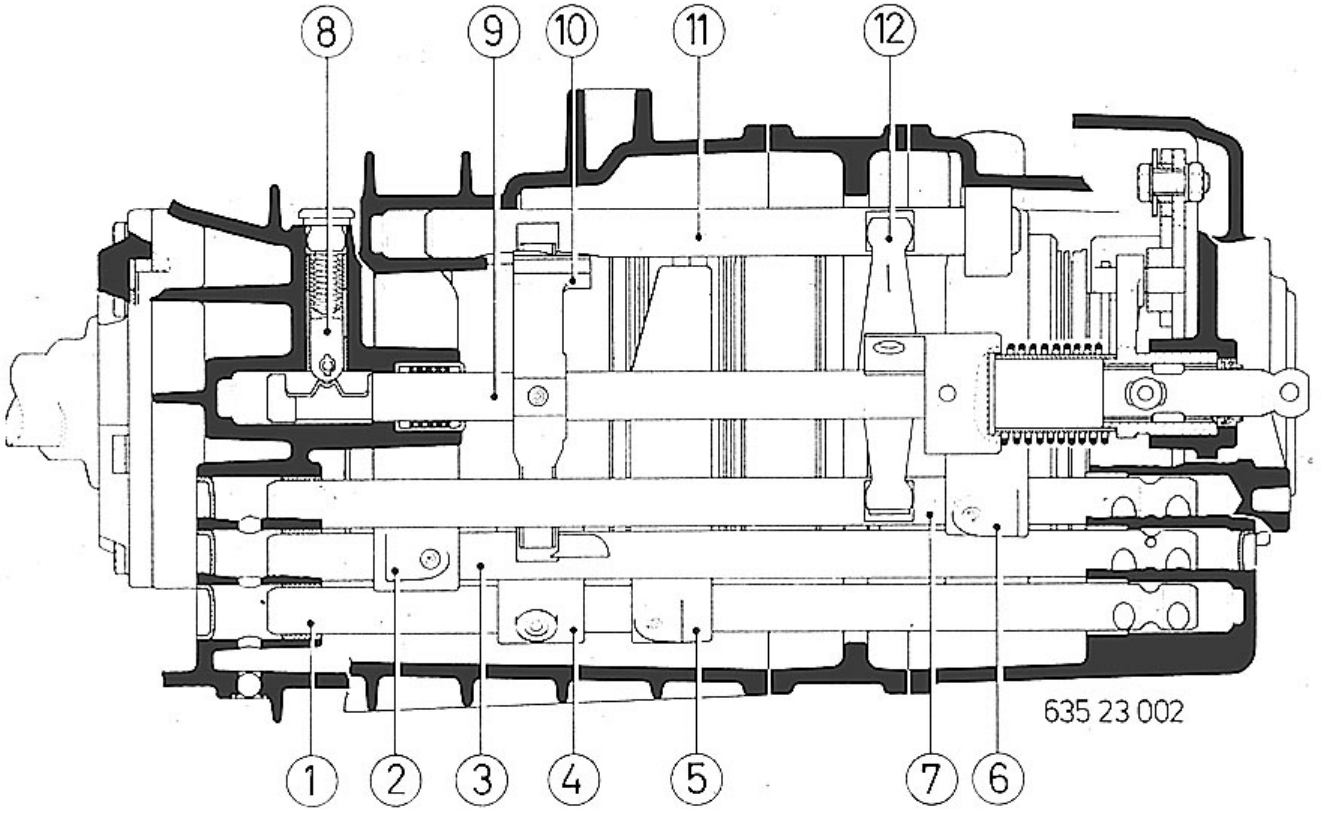
Getrag 280 Five speed sport transmission

	Transmission – assembly drawing	23-	201
	Shift components – assembly drawing	23-	202
23 11 006	Transmission case front and rear sections – remove and install / seal	23-	203
622	Guide sleeve for clutch release – remove and install / seal	23-	210
23 12 502	Radial oil seal for input shaft – replace	23-	211
23 12 501	Input and output shaft assembly – remove and install	23-	212
552	Output shaft – replace	23-	215
702	Bearings for all transmission shafts – replace	23-	220
23 23 504	Synchronisation – disassemble and assemble	23-	224



ASSEMBLY DRAWING 05 GETRAG 280 FIVE SPEED SPORT MANUAL TRANSMISSION

1 First gear
2 Second gear
3 Third gear
4 Fourth gear
5 Fifth gear
R Reverse gear
6 Input shaft
7 Output shaft
8 Layshaft



280/Sport Shift Components

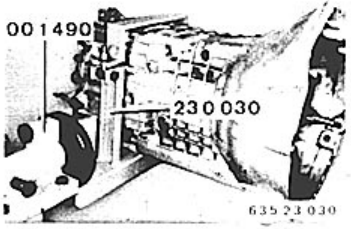
1 Selector rod – 1st/2nd gear
2 Selector fork – 3rd/4th gear
3 Selector rod – 3rd/4th gear
4 Drive
5 Selector fork – 1st/2nd gear
6 Selector fork – reverse/5th gear
7 Selector rod – reverse/5th gear
8 Lockpin
9 Shift shaft
10 Shift arm
11 Shift rail
12 Reversing lever

Continued in next column!


32 23018

23 11 006 REMOVING AND INSTALLING OR SEALING FRONT AND REAR CASE SECTIONS

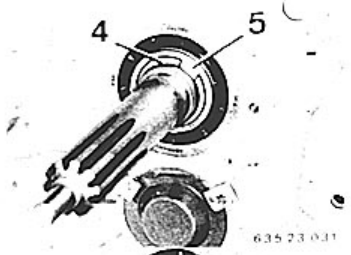
Remove transmission – see 23 00 022 in the Model Repair Manual.
Unscrew rubber mounts.



635 23 030

Mount Special Tool 23 0 030 on Special Tool 00 1 490.
Unscrew filler plug.
Drain oil.
Mount transmission on special tool.

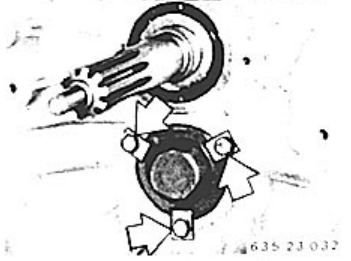
Important!
Use correct oil grade – see Operating Fluids.
Oil volume*.



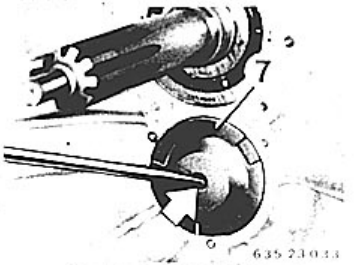
635 23 031

Remove guide sleeve – see 23 11 622.
Lift out snap ring (4).
Take off washer (5).

Installation:
Always replace the snap ring.


635 23 032

Unscrew sealing cover mounting bolts.



635 23 033

Puncture through the middle of sealing cover (7).
Pry out sealing cover (7) with a screwdriver.

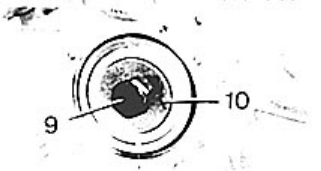
Installation:
Replace sealing cover.



635 23 034

Take off sealing cover.

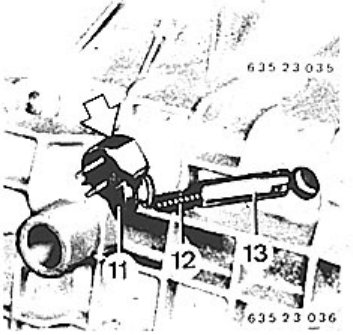
Important!
Shim (8).



635 23 035

Engage 4th gear.
Unscrew bolt (9) while holding the output flange with Special Tool 23 0 020.
Take off washer (10).

Installation:
Install bolt (9) with a bolt cement**.

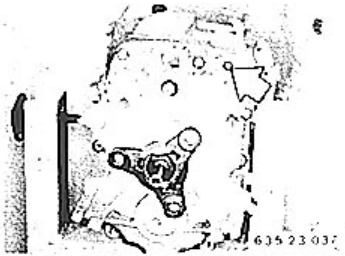


635 23 036

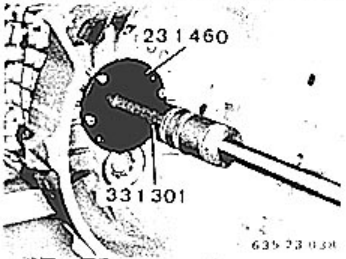
Unscrew backup light switch.
Lift out cover (11).
Pull out spring (12) and lockpin (13).
Check the installed position.

* See Specifications

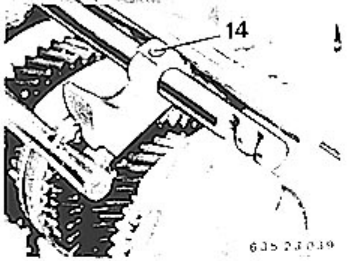
** Source of Supply: HWB



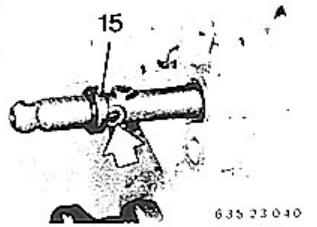
Knock back cylindrical pins.
Unscrew mounting bolts.



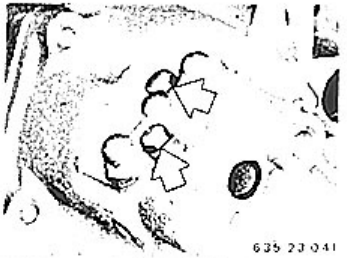
Pull off case front section with Special Tools 23 1 460 and 33 1 301.



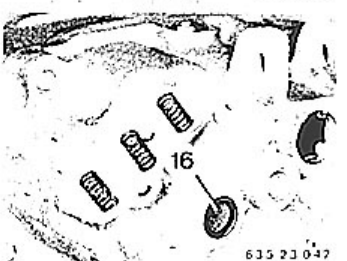
Fourth gear is engaged.
Drive pin (14) out of selector shaft (counterhold).



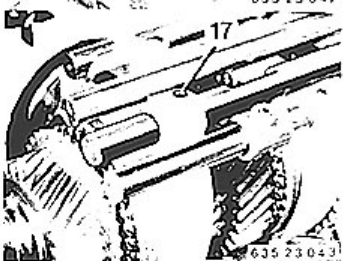
Drive out selector shaft toward rear.
Radial oil seal (15) will also be pulled out.
Important!
Needles on selector shaft.
Take off selector arm.
Installation:
Replace radial oil seal.



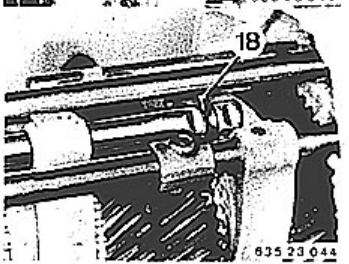
Remove end cap.
Installation:
Install end cap with sealing compound**.



Remove 3 springs.
Remove plug (16).
Installation:
Replace plug.

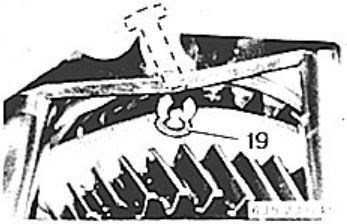


Take out fourth gear.
Drive pin (17) out of 3rd/4th gear selector rod (counterhold).

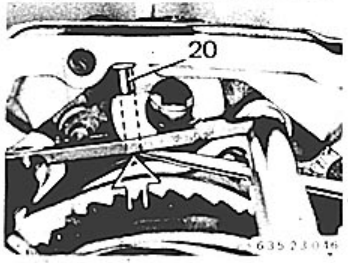


Knock out 3rd/4th gear selector rod toward front.
Important!
Lockpin (18).

** Source: HWB



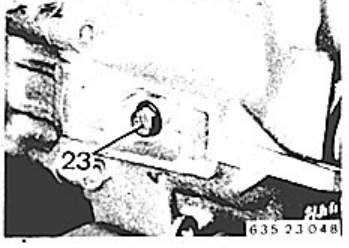
Pull off retainer (19) on shaft bolt for operating lever.



Push up shaft bolt (20).

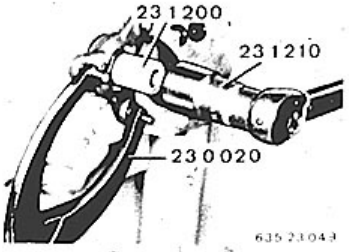


Pull out selector rail (21) forward.
Take off operating lever (22).
Installation:
Mark on operating lever faces up.

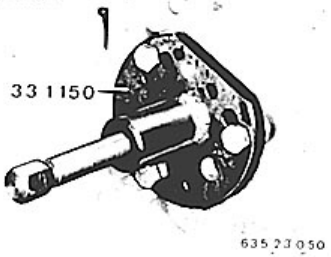


Unscrew bolt (23) for reverse gear shaft.
Installation:
Install bolt with bolt cement**.

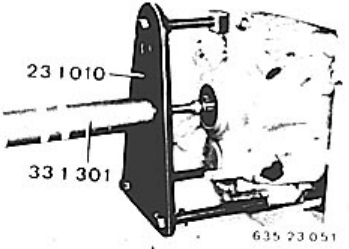
** Source: HWB



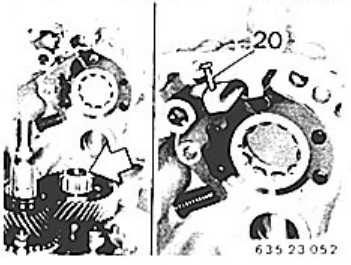
Lift out lockplate.-
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.



Pull off output flange with Special Tool 33 1 150.

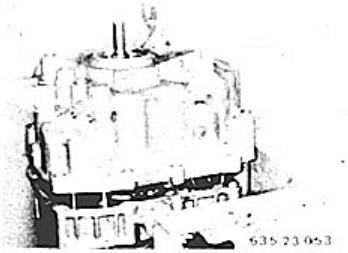


Knock back dowel pins.
Pull off case rear section with Special Tools 23 1 010 and 33 1 301.

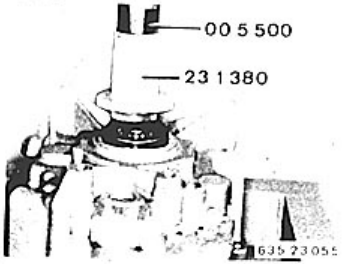


Coat sealing surface with sealing compound**.
Sealing surface cleaned thoroughly and dried of oil.
Install roller bearing with small diameter of plastic cage facing up.
Important!
Shaft bolt (20) for operating lever must be installed and bearing inner race removed, by lifting out radial oil seal, before mounting case rear section.

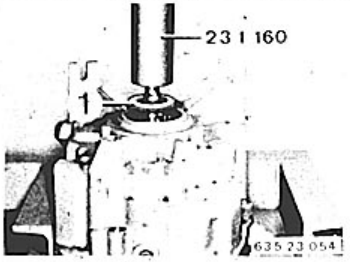
** Source: HWB



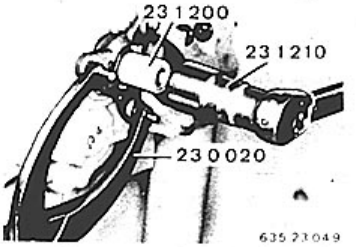
Mount rear case section.
Center 1st/2nd gear selector rod.
Drive in dowel pins.



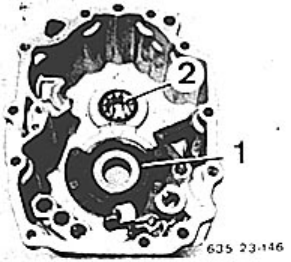
Drive in radial oil seal with Special Tools 23 1 380 and 00 5 500.
Lubricate sealing lip with oil.



Heat bearing inner race (1) to about 80° C (175° F) with a hot air blower and install it on the output shaft, pressing it on with Special Tool 23 1 160 when necessary.



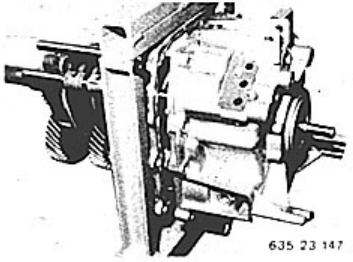
Mount the output flange.
Install collar nut with a bolt cement**
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020 and tighten the collar nut with Special Tool 23 1 210.
Tightening torque*.



Version with Closed Bearing (1):
Install roller bearing (2) with the large diameter end facing up.
Hold rollers in position with grease.
Coat the sealing surface with a sealing compound**.
Sealing surface must be thoroughly cleaned and dried of oil.

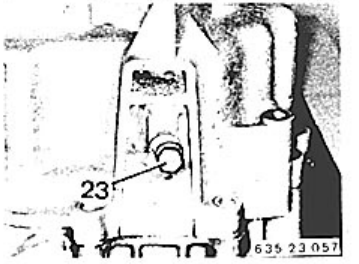


Install lockplate.



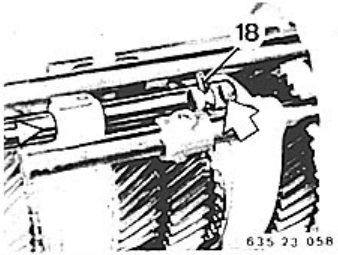
Heat ball bearing inner race to about 80° C (175° F) with a hot air blower.
Mount rear case section in horizontal position of the gear wheel set.
Align 1st/2nd and 5th/reverse gear selector rods with the bores.
Mount cover up to the transfer case.
Turn the gear wheel set during this step to have roller bearing slide into the layshaft.
Drive in dowel pin.

** Source of Supply: HWB

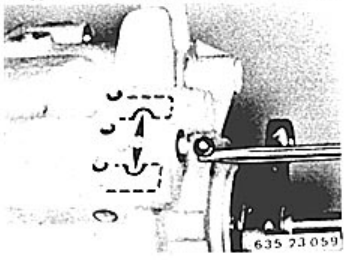


Install bolt (23) for the reverse gear shaft with a bolt cement** and tighten with correct torque*.

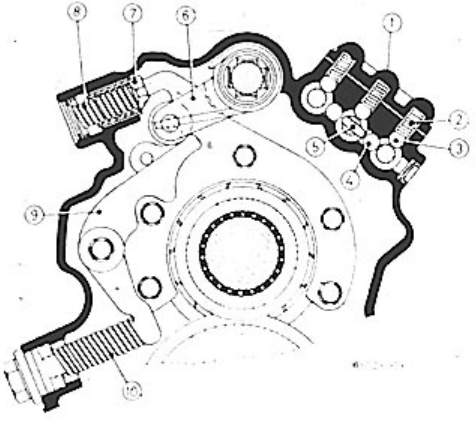
* See Specifications
** Source of Supply: HWB



Push 3rd/4th gear selector rod through the selector fork.
Install lockpin (18) in the selector rod with grease.
Push in selector rod up to the bore.
Opening in selector rod faces up.

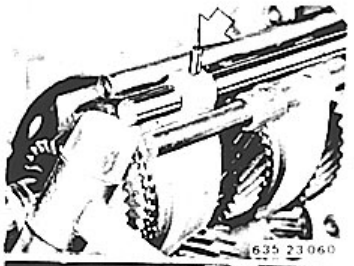


Install two locking balls with grease.
Push in 3rd/4th gear selector rod up to the arrest.



Arrest Layout:

1 End cap
2 Spring
3 Arresting ball
4 Locking ball
5 Lockpin
6 Selector arm
7 Lockpin
8 Spring
9 Locking lever
10 Spring

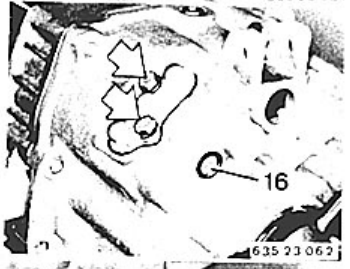


Drive 6 x 26 mm dowel pin into the 3rd/4th gear selector fork (counterhold).

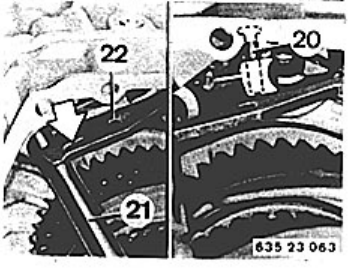


Insert three arresting balls and three springs.

Important!
Check length of spring.
Untensioned length of
springs (1) = 20 mm (0.787") and
spring (2) = 16 mm (0.630").

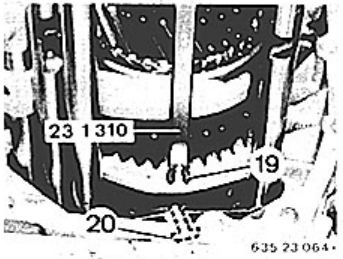


Coat end cap with a sealing compound** and tighten with correct torque*.
Install end cover (16) with a sealing compound**.

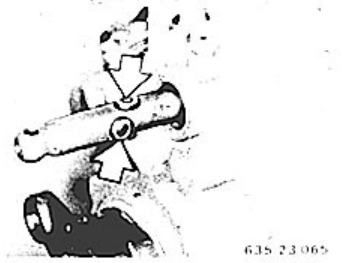


Install shift rail (21).
Push up shaft bolt (20) and install the reversing lever (22) with the mark facing up and toward the shift rail.

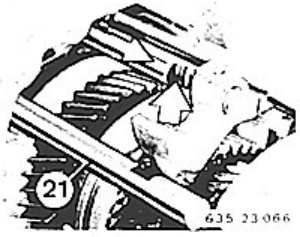
* See Specifications
** Source of Supply: HWB



Set input shaft upright.
Push shaft bolt (20) in direction of the gear wheel set.
Install circlip (19) with Special Tool 23 1 310.

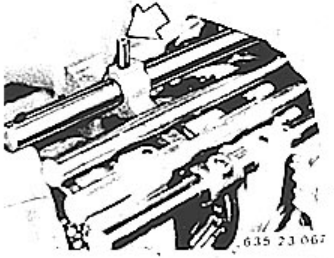


Hold the four rollers in position with grease.

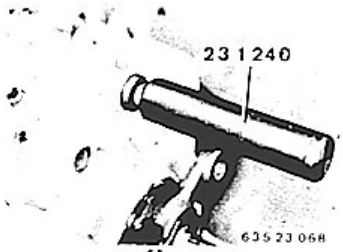


Insert shift arm.
Push in shift shaft.

Important!
Opening in shift shaft faces shift rail (21).



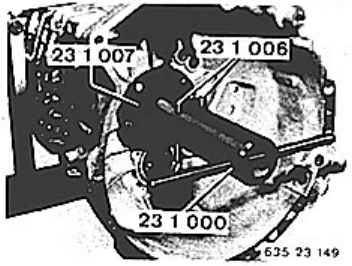
Drive in 6 x 26 mm dowel pin (counterhold).



Lubricate sealing lip of the radial oil seal with oil.
Drive in radial oil seal with Special Tool 23 1 240.



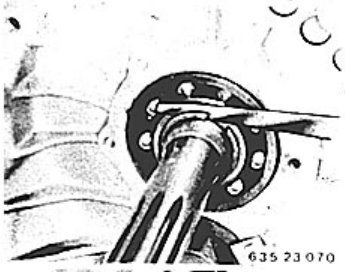
Coat sealing surface with a sealing compound**.
Sealing surface must be thoroughly cleaned and dried of oil.
Heat bearing inner race for input shaft to about 80° C (175° F) with a hot air blower.
Mount front case section while pulling out the input shaft.
Tighten front case section with correct torque*.



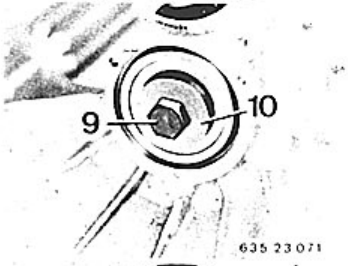
Version with Closed Bearing:
Coat sealing surface with a sealing compound**.
Sealing surface must be thoroughly cleaned and dried of oil.
Heat ball bearing inner race to about 80° C (175° F) with a hot air blower.
Mount case as far as possible.
Mount Special Tool 23 1 007 on the front case section.
Press grooved ball bearing on the input shaft or front case section on the gear wheel set with Special Tools 23 1 000 and 23 1 006.

Important!
Apply Special Tools 23 1 006 (dowel pins) that the flattened ends face the input shaft.

* See Specifications
** Source of Supply: HWB



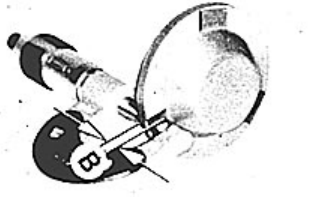
Install shim and circlip.
Reduce any play between the bearing inner race and circlip to 0 ... 0.09 mm (0 to 0.0035").



Engage 4th gear.
Install washer (10) and bolt (9).
Install bolt with a bolt cement**.
Tighten bolt (9) with correct torque* while holding the output flange with Special Tool 23 0 020.



Determine thickness of shim between the bearing outer race of the layshaft and sealing cover.
Measure distance (A) from bearing outer race to case opening for the mounting tabs.



Measure wall thickness (B) of the sealing cover, measuring on the recess for the mounting tab.

Example:

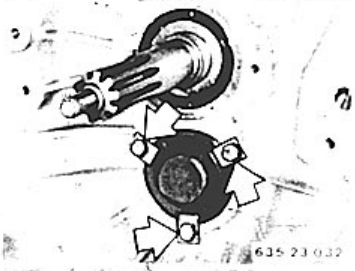
A = 1.4 mm (0.055")
– B = 0.9 mm (0.035")
0.5 mm (0.020") thick shim

* See Specifications
** Source of Supply: HWB

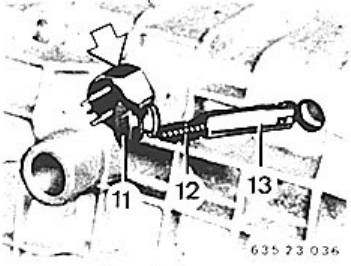


Hold shim of determined thickness in position with grease.
Drive in sealing cover (7) to fit tight with Special Tool 33 4 020.

Important!
Install sealing cover that recesses on the sealing cover are aligned with openings on the case.

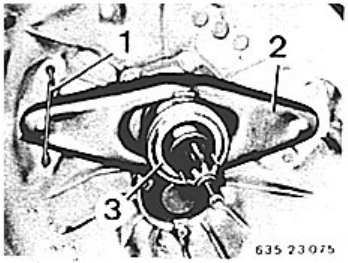


Tighten tabs with correct torque*.
Install bolts with a bolt cement**.



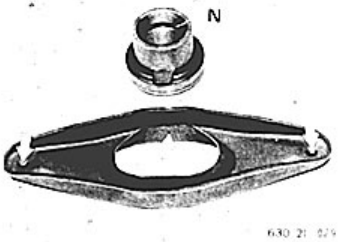
Install lockpin (13), spring (12) and cover (11).
Check installed position of the lockpin.

* See Specifications
** Source of Supply: HWB



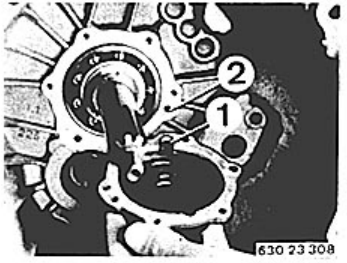
23 11 622 REMOVING AND INSTALLING GUIDE SLEEVE FOR CLUTCH RELEASE
– Transmission Removed –

Lift out spring (1) and remove release lever (2) with thrust bearing (3).



Installation:
Fill lubricating groove N with Molykote Longterm 2.
Coat guides F and bearings L with Molykote Longterm 2.
Non-conformance could cause seizure of the release bearing on the guide sleeve.

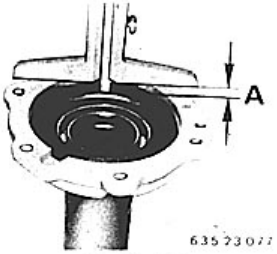
Important!
Use Microlube 261** on version with a double-mass flywheel.



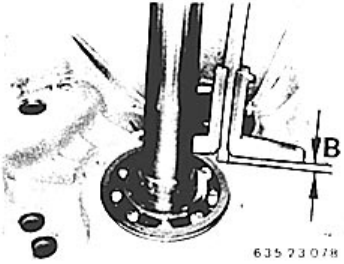
Unscrew guide sleeve.

Important!
Shims.

Installation:
Mount guide sleeve that oil groove (1) is aligned with oil bore (2) in transmission case or arrow on face points to middle of the layshaft.
Install guide sleeve and bolts with a sealing compound**.
Sealing surface and bolts must be cleaned thoroughly and dried of oil.
Tightening torque*.



Installation:
Eliminate any play.
Max. axial preload on bearing outer race = 0.1 mm (0.004").
Determine thickness of shim.
Measure distance (A).

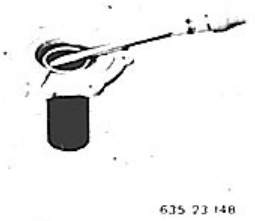


Measure distance (B).

Example:
A = 3.0 mm (0.118")
– B = 2.6 mm (0.102")
0.4 mm (0.016") thick shim

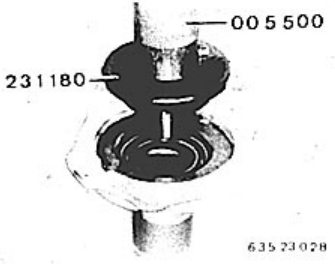
* See Specifications
** Source of Supply: HWB

23 12 502 REPLACING RADIAL OIL SEAL FOR INPUT SHAFT –TRANSMISSION REMOVED–



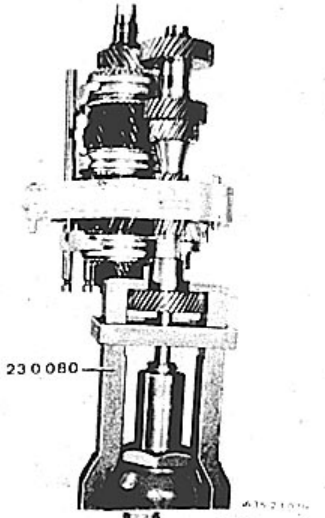
635 23 148

Remove guide sleeve 23 11 622.
Lift out radial oil seal.



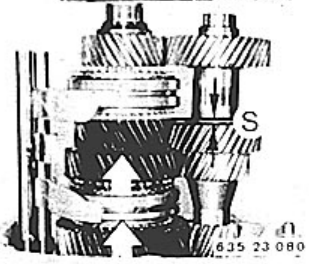
635 23 028

Drive in radial oil seal with Special Tools 23 1 180 and 00 5 500.
Open end faces up.
Lubricate sealing lip with oil.

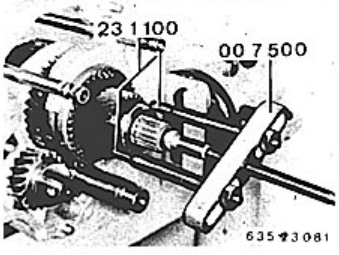


23 21 501 REMOVING AND INSTALLING INPUT/OUTPUT SHAFT ASSY. –CASE FRONT AND REAR SECTIONS REMOVED–

Clamp Special Tool 23 0 080 in a vise.
Take intermediate case with gear set off of Special Tool 23 0 030 and mount on Special Tool 23 0 080.
Pull off 5th gear.
Pulling off force*.

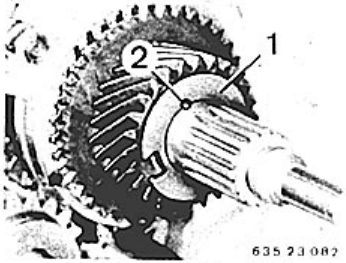


Caution!
To avoid damaging the 3rd gear when pulling off 5th gear, make sure that play (S) is always provided between 3rd gear and layshaft.
Push up output shaft if necessary.

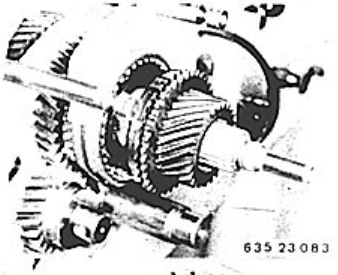


Take up intermediate case with gear set in Special Tool 23 0 030 again.
Pull bearing inner race off of output shaft with Special Tools 23 1 100 and 00 7 500.
Machine pulling hooks accordingly to fit in slots.

* See Specifications



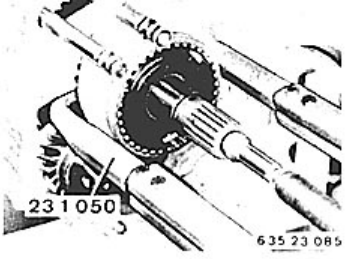
Take off washer (1) and ball (2).



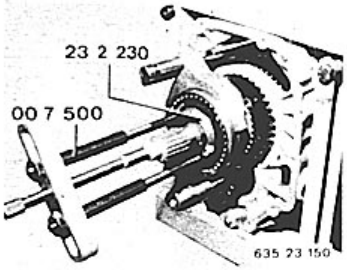
Pull off 5th gear with synchromesh ring and split needle bearing.



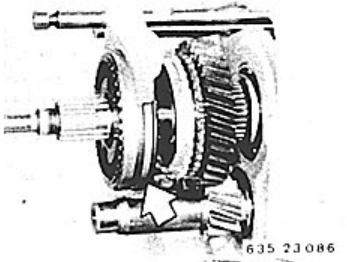
Remove circlip (3).
Installation:
Replace circlip.



Pull off reverse gear with operating rod and guide sleeve, with Special Tool 23 1 050.

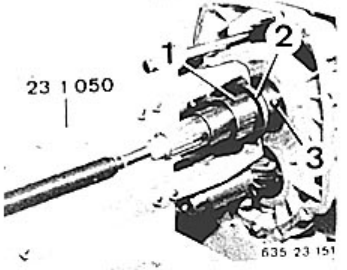


For the version with a pre-tensioned toothed washer on the gear wheel the guide sleeve must be pulled off of the output shaft with help of Special Tool 23 2 230 used together with Special Tool 00 7 500 (Kukko).

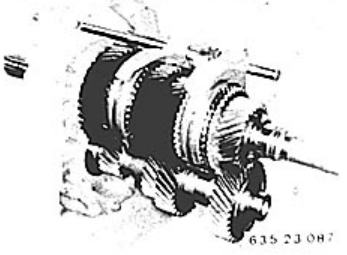


Take guide sleeve with shift fork and shift rod, synchromesh ring, reverse gear and needle bearing off of the output shaft.

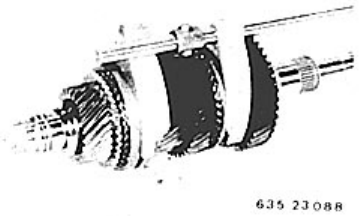
Important!
Installation:
Shouldered end of operating sleeve must face the reverse gear.



Version with Bearing Sleeve:
Drive output shaft forward with light knocks from a plastic hammer until the pulling-off claws can be applied.
Pull bearing sleeve (1) and thrust washer (2) off of the output shaft using Special Tool 23 1 050 (Kukko).
Remove ball (3).

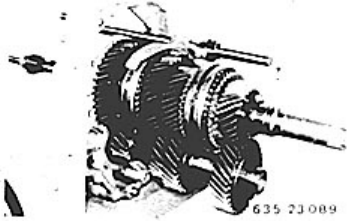


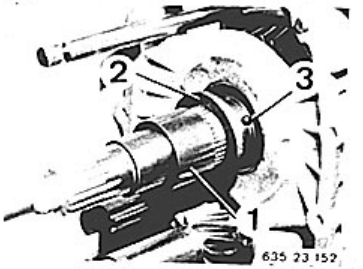
Pull input shaft, output shaft with 1st/2nd gear shift rod, 3rd/4th gear shift fork and layshaft out of the intermediate case.



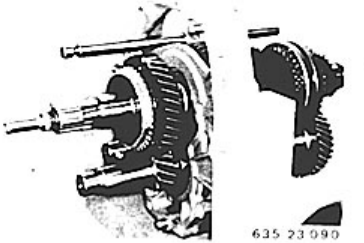
Take shift rod with 1st/2nd gear shift fork and 3rd/4th gear shift fork off of the gear set assembly.

Installation:
Insert input shaft, output shaft with 1st/2nd gear shift rod and layshaft into the intermediate case.





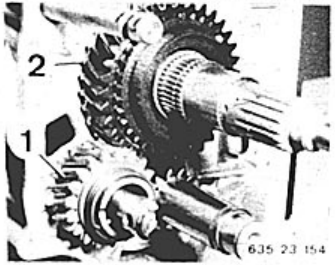
Version with Bearing Sleeve:
Insert ball (3) and push thrust washer (2) on.
Heat bearing sleeve (1) to about 80° C with a hot air blower and push on to the output shaft.



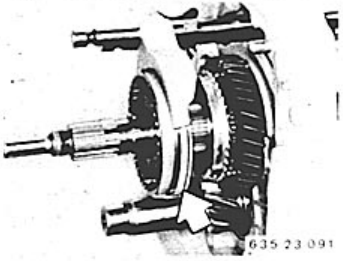
Install needle bearing, reverse gear and synchromesh ring on the output shaft.



Version with Tensioned Tooth Rings:
Install needle bearing and reverse gear wheel.
Push on intermediate wheel (1) up to the tooth ring.
Turn tooth ring on intermediate wheel until the teeth of the intermediate gear wheel and layshaft mesh.

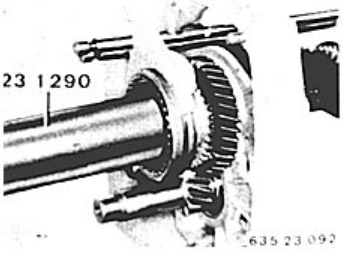


Push on intermediate gear wheel in this position up to the tooth ring of the gear wheel.
Turn tooth ring (2) on the gear wheel until the teeth of the gear wheel and intermediate gear wheel (1) mesh.
Mount intermediate gear wheel against the bearing surface.



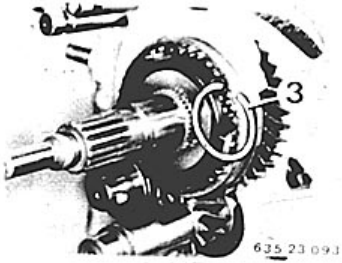
Install guide sleeve with operating sleeve and selector rod with 5th/reverse gear selector fork on the output shaft.

Important!
Stepped end of the operating sleeve must face the reverse gear wheel.



Drive on guide sleeve by applying light knocks with Special Tool 23 1 290.

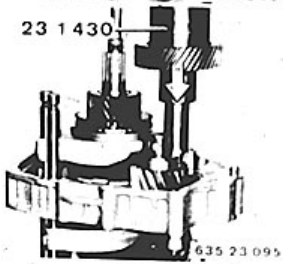
Important!
Tabs on synchromesh ring must be aligned with openings of guide sleeve.



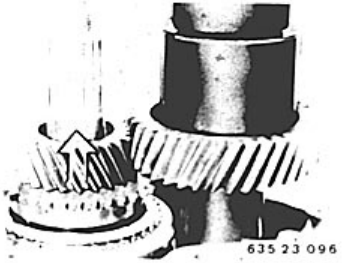
Move operating sleeve in direction of the reverse gear wheel.
Adjust guide sleeve free of play with circlip (3).
Circlips are available from Parts in different thicknesses from 1.7 to 2.0 mm (0.067 to 0.079").
Install circlip (3).



Install synchromesh ring and 5th gear wheel.

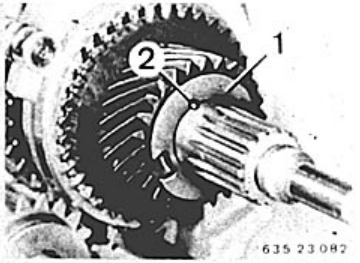


Take transfer case with gear wheel set off of Special Tool 23 0 030 and set up in a press.
Lubricate pressing surface of the layshaft with oil.
Heat 5th gear wheel uniformly to 150° C (300° F), checking temperature with a thermocolor crayon.
Install 5th gear wheel on the layshaft and press on to fit tight with Special Tool 23 1 430.
Pressing-on force*.



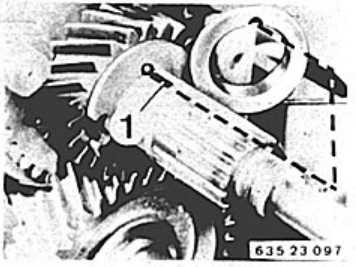
Important!
Lift and turn the 5th gear wheel until the teeth mesh.

* See Specifications



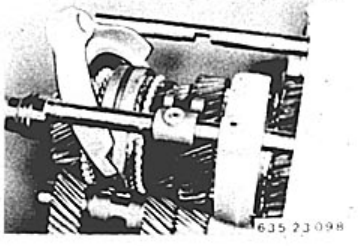
Install split needle bearing.
Insert ball (2) with grease.
Push on washer (1).

Note:
A transmission with code OH does not have a ball.

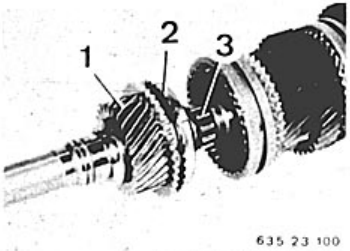


Installation:
Heat ball bearing inner race to about 80° C (175° F) with a hot air blower and push it on the output shaft.

Important!
Turning lock:
Opening on bearing inner race must engage on ball.
Draw line (1) to make installation of the bearing race easier.



Mount 3rd/4th gear selector fork.

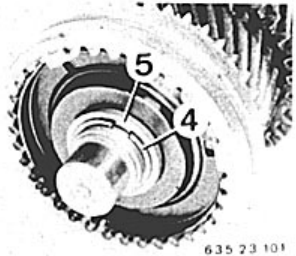


635 23 100

23 21 552 REPLACING OUTPUT SHAFT
– Output Shaft Removed –

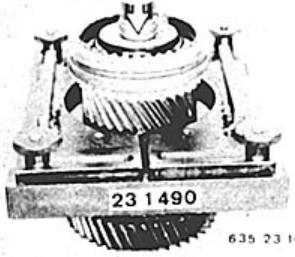
Pull off input shaft (1), synchromesh ring (2) and needle bearing (3).

Note:
To avoid mixing up synchromesh rings while disassembling the output shaft, it is recommended to mark synchromesh rings for pertinent gear wheels.



635 23 101

Lift out circlip (4).
Take off shim (5).



635 23 102

Press off 3rd gear wheel with guide and operating sleeves with Special Tool 23 1 490.
Take off needle bearing.
Pressing-off force*.

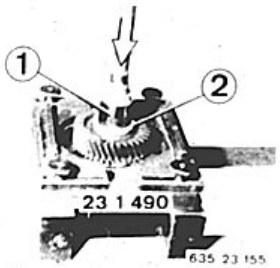


635 23 103

Lift out circlip (6).

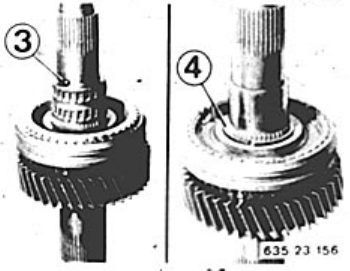
Installation:
Replace circlip.

*** See Specifications**



635 23 155

Version with Bearing Sleeve:
Press 2nd gear wheel with bearing sleeve (1) and thrust washer (2) off of the output shaft with Special Tool 23 1 490.



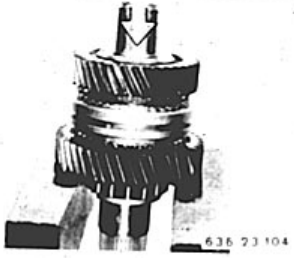
635 23 156

Take off ball (3), needle bearing and 2nd gear synchromesh ring.
Lift out circlip (4).

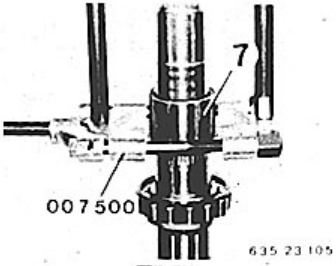
Installation:
Replace circlip.


635 23 157

Press guide and operating sleeves for 1st /2nd gears with 1st gear wheel off of the output shaft.
Take off needle bearing.

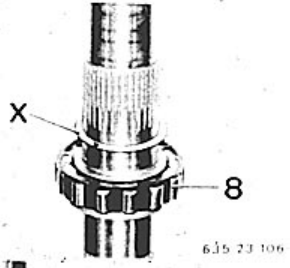

635 23 104

Press 2nd gear wheel, guide sleeve and 1st gear wheel off of the output shaft.



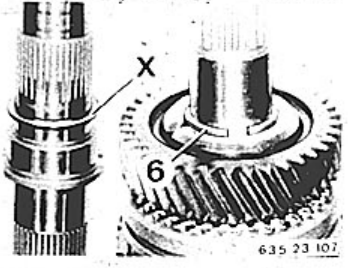
635 23 105

Pull collar (7) off of the output shaft with Special Tool 00 7 500.



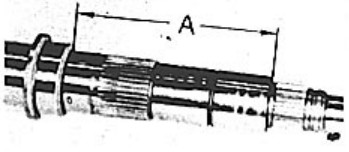
635 23 106

Take off shim (X) and roller bearing (8).



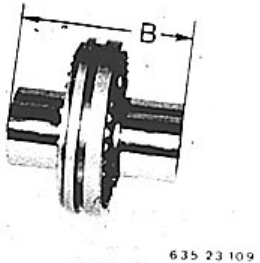
635 23 107

Important!
Determine thickness of shim (X) and circlip (6) before reinstalling the gear wheel set.
Shims are available in thicknesses from 0.3 to 0.5 mm (0.012 to 0.020") and circlips from 1.7 to 1.9 mm (0.067 to 0.075") from Parts.



635 23 108

Determine thickness of shim X.
Measure distance (A) from collar of 3rd/4th gear guide sleeve to bearing surface of 1st gear collar.
For example: 128.3 mm (5.051").

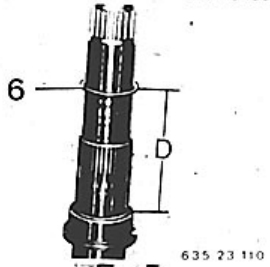


635 23 109

Assemble 1st gear collar, 1st/2nd gear guide sleeve and 2nd gear collar.
Measure distance (B).
For example: 93.1 mm (3.665").

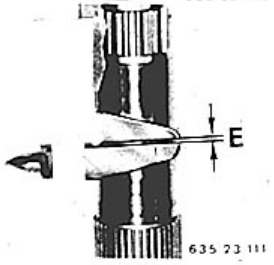
Example:

	A =	128.3 mm (5.051")
–	B =	93.1 mm (3.665")
		35.2 mm (1.386")
–	C =	34.7 mm (1.366") adjustment
	X =	0.5 mm (0.020") thick shim



635 23 110

Determine thickness of circlip (6).
Install old circlip in groove.
Measure distance (D) from bearing surface of 1st gear collar to lower edge of circlip.
Circlip must be pressed firmly in the groove while measuring.
For example: 93.6 mm (3.685").

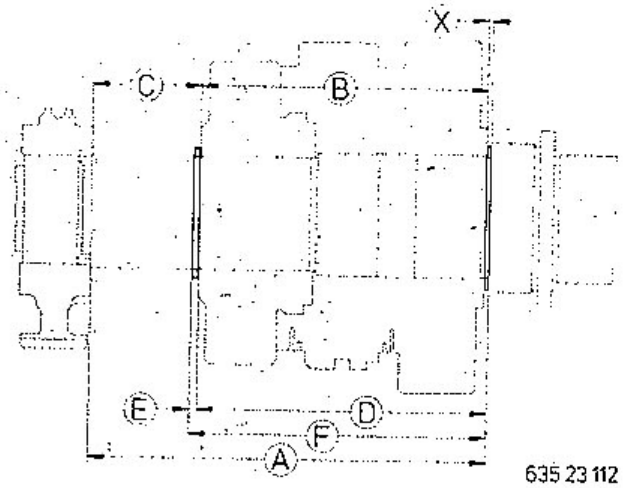


635 23 111

Measure thickness (E) of the circlip.
For example: 1.9 mm (0.075")

Example:

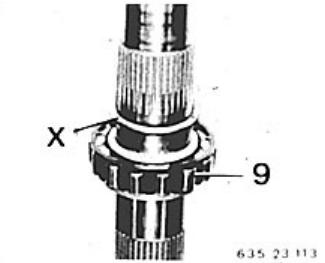
	D =	93.4 mm (3.677")
+	E =	1.9 mm (0.075")
	F =	95.3 mm (3.752")



635 23 112

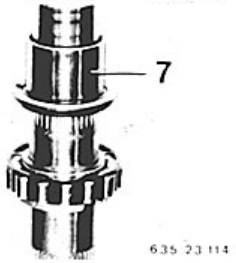
Beispiel:
Example:
B = 93.1 mm
+ X = 0.5 mm (0.020")
G = 93.6 mm (3.685")

F = 95.3 mm (3.752")
G = 93.6 mm (3.685")
E = 1.7 mm (0.067") thick circlip
E = 1.7 mm Sicherungsring



635 23 113

Install roller bearing (9) with the small diameter end of the plastic cage facing the collar.
Install shim (X) of determined thickness.



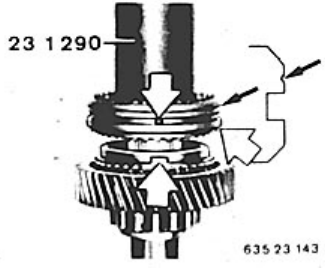
635 23 114

Heat collar (7) to about 80° C (175° F) with a hot air blower.
Install collar.



635 23 115

Install needle bearing, 1st gear wheel and synchromesh ring on the output shaft.

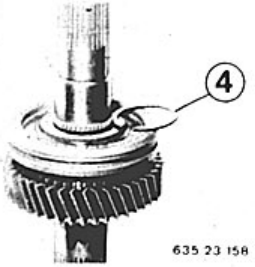


635 23 143

Install 1st/2nd gear guide sleeve with the stepped end of the operating sleeve facing the 1st gear wheel.
Version with Groove:
Groove faces 2nd gear wheel.
Press on guide sleeve to fit tight with Special Tool 23 1 290.
Pressing-on force*.

Important!
Make sure tabs on synchromesh ring are aligned with opening in guide sleeve while pressing on.

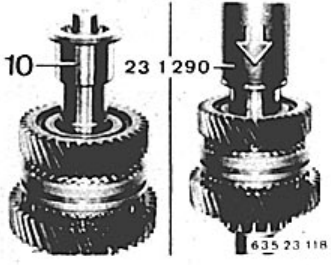
* See Specifications



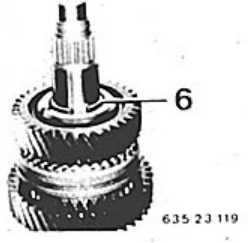
Install circlip (4) if still available. Play of the guide sleeve must be eliminated with the circlip. Circlips are available from Parts in different thicknesses from 1.7 to 1.95 mm (0.067 to 0.077").



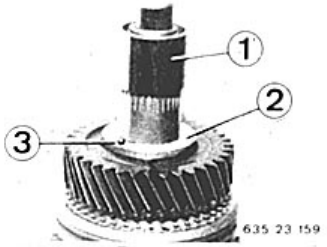
Install synchromesh ring, needle bearing and 2nd gear wheel.



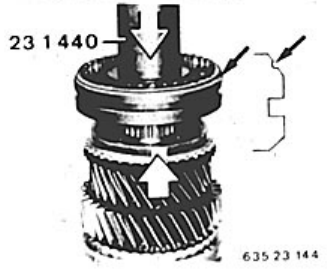
Heat collar (10) to about 80° C (175° F) with a hot air blower and install it on the output shaft, pressing it on to fit tight with Special Tool 23 1 290 when necessary.
Turn the 2nd gear wheel to prevent seizure of the needle bearing.



Install circlip (6) of determined thickness.

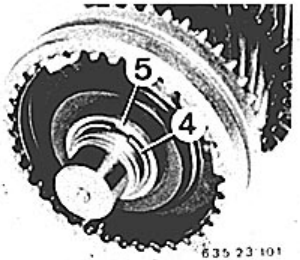


Install ball (3) and thrust washer (2). Heat bearing sleeve (1) to about 80° C (175° F) with a hot air blower and install it on the output shaft.



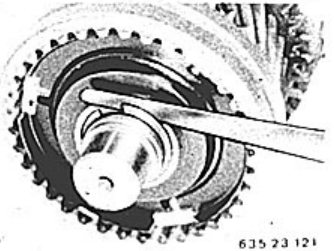
Install needle bearing, 3rd gear wheel and synchromesh ring.
Install 3rd/4th gear guide sleeve with the stepped end facing the 3rd gear wheel and press on with Special Tool 23 1 440.
Version with Groove:
Groove faces the 4th gear wheel.

Important!
Tabs on the synchromesh ring must be aligned with openings in the guide sleeve.



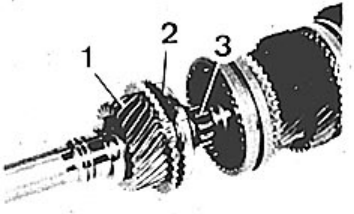
635 23 101

Install shim (5) and circlip (4).



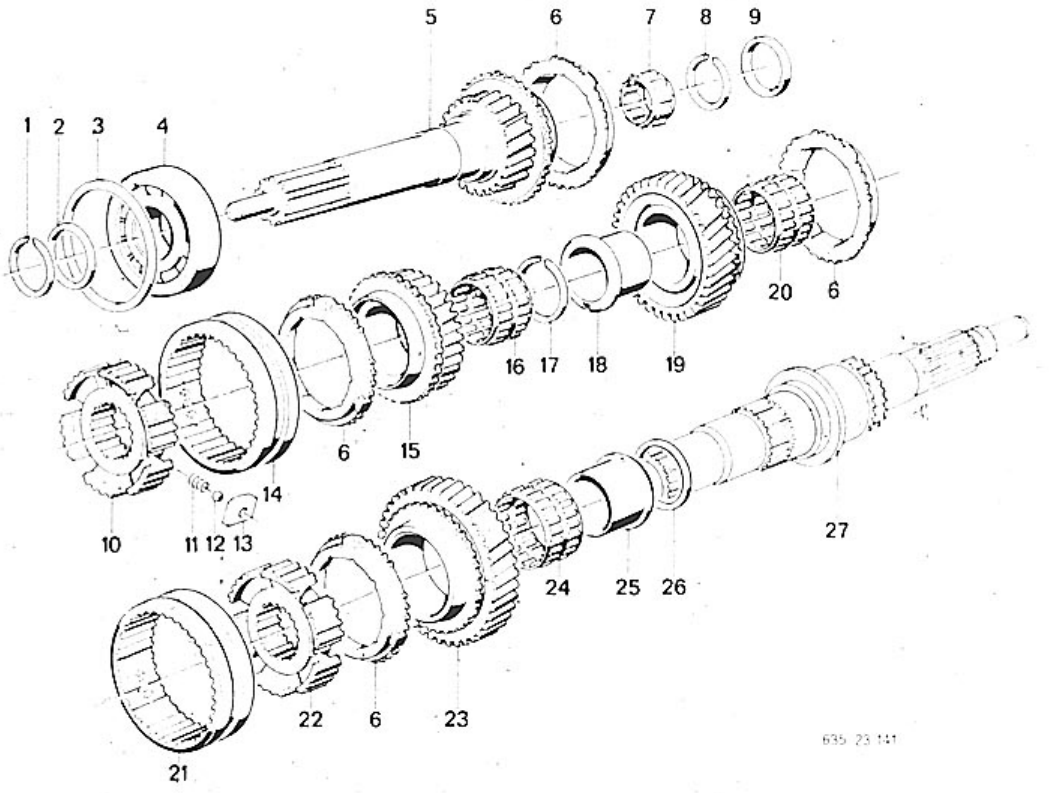
635 23 121

Installation:
Reduce play between the circlip and g
sleeve to 0 ... 0.09 (0 ... 0.0035").



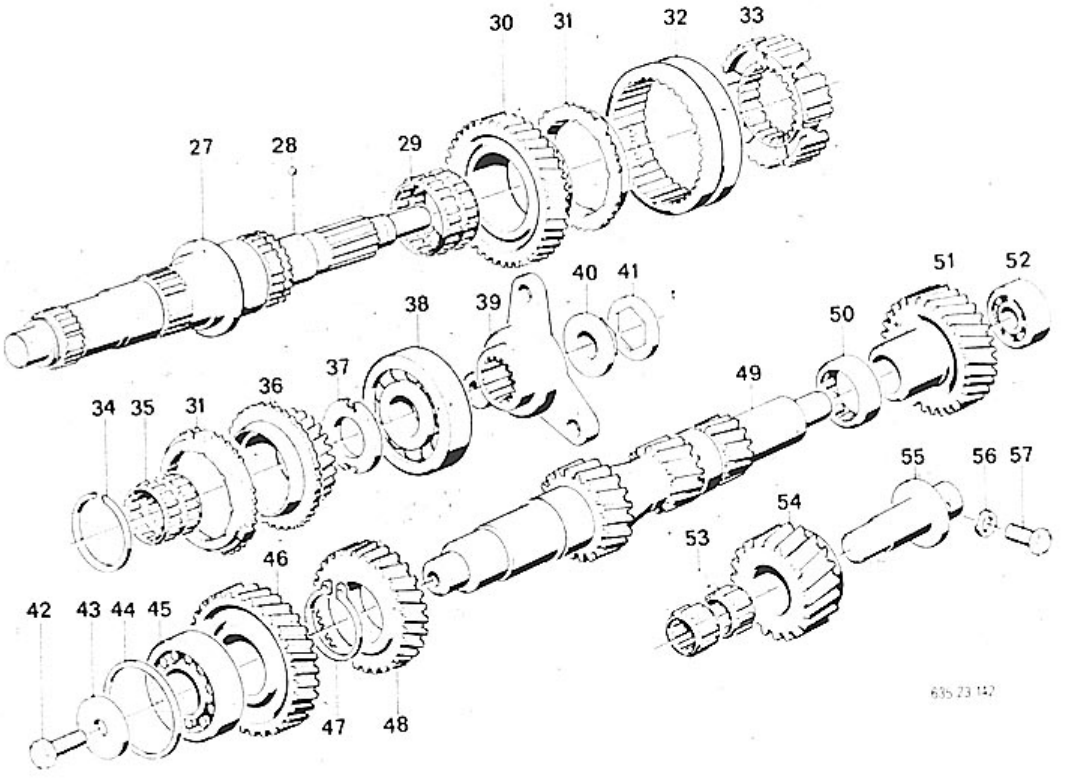
635 23 100

Install needle bearing (3), synchromesh ring (2) and input shaft (1).



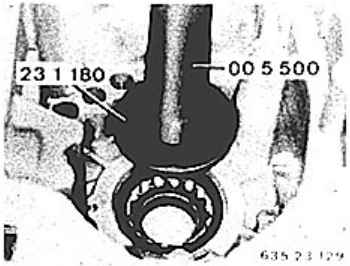
Layout of Gears and Bearings

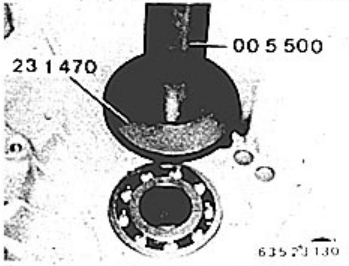
1 Circlip
2 Spacer
3 Spacer
4 Bearing
5 Drive shaft with 4th gear
6 Synchromesh ring
7 Needle bearing
8 Circlip
9 Spacer
10 Guide sleeve
11 Spring
12 Ball
13 Drive
14 Operating sleeve
15 3rd gear wheel
16 Needle bearing
17 Circlip
18 Spacer
19 2nd gear wheel
20 Needle bearing
21 Operating sleeve
22 Guide sleeve
23 1st gear wheel
24 Needle bearing
25 Spacer
26 Spacer
27 Output shaft

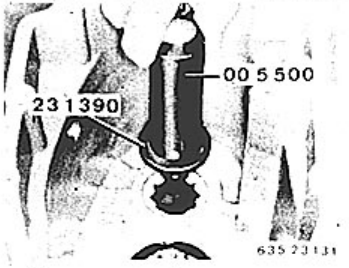


Layout of Gears and Bearings

27 Output shaft
28 Ball
29 Needle bearing
30 Reverse gear wheel
31 Synchromesh ring
32 Operating sleeve
33 Guide sleeve
34 Circlip
35 Needle bearing
36 5th gear wheel
37 Thrust washer
38 Ball bearing
39 Output flange
40 Collar nut
41 Lockplate
42 Bolt
43 Washer
44 Spacer
45 Ball bearing
46 4th gear wheel
47 Circlip
48 3rd gear wheel
49 Layshaft
50 Roller bearing
51 5th gear wheel
52 Roller bearing
53 Needle bearing
54 Reverse gear
55 Shaft
56 Washer
57 Bolt





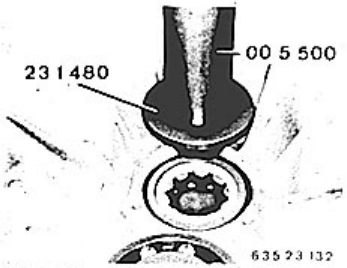


23 21 702 REPLACING BEARINGS OF ALL TRANSMISSION SHAFTS –TRANSMISSION REMOVED–

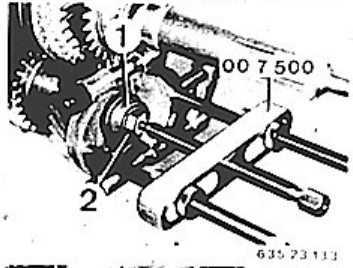
A) Input Shaft, Layshaft in Case Front Section:
Remove case front and rear sections 23 11 006.
Remove input/output shaft assy. 23 21 501.
Drive out bearing with Special Tools 23 1 180 and 00 5 500.

Heat case front section in area of bearing to approx. 80° C (175° F) with a hot air blower.
Important!
Install bearing with rollers facing gear set, driving in to fit tight with Special Tools 23 1 470 and 00 5 500 if necessary.

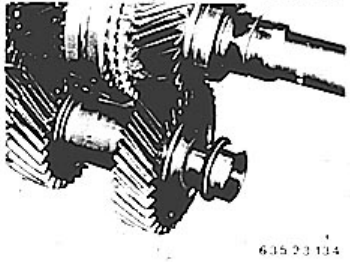
Layshaft:
Drive out roller bearing with Special Tools 23 1 390 and 00 5 500.



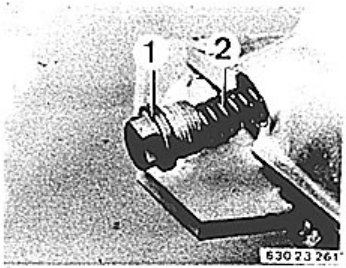
Heat case front section in area of bearing to approx. 80° C (175° F) with a hot air blower.
Drive in roller bearing with Special Tools 23 1 480 and 00 5 500.
Determine thickness of spacer between bearing outer race and sealing cover (see 23 11 006).



Pull bearing inner race (1) off of layshaft with Special Tool 00 7 500.
Caution!
Bolt (2) must be screwed in tapped bore to avoid damage on threads.



Heat new bearing inner race to approx. 80° C (175° F) with a hot air blower and install on layshaft.
If necessary, drive on to fit tight with Special Tool 23 1 160.



B) Output Shaft, Layshaft in Case Rear Section:
Output Shaft:
Unscrew bolt (1).
Caution!
Spring force!
Remove spring (2).
Installation:
Install bolt with bolt cement**.



Install Special Tool 23 1 250 to remove the selector arm.

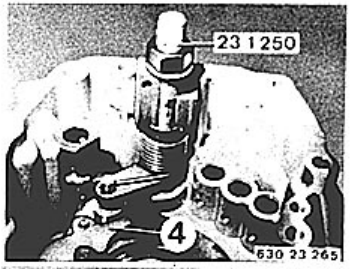


Remove socket head screw (3).
Installation:
Install screw with bolt cement**.
Tightening torque*.

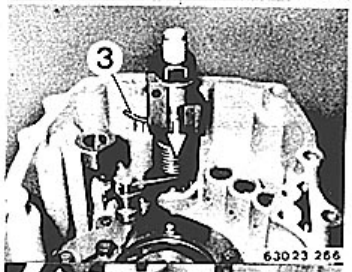


Remove selector arm from above.
Important!
Roller.

* See Specifications
** Source: HWB



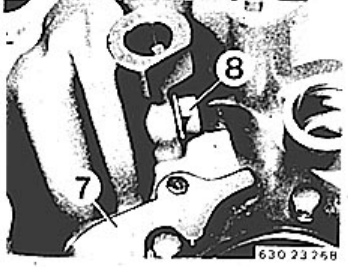
Installation:
Insert selector arm with Special Tool 23 1 250.
Swing out selector arm with roller above locking lever (4).



Move end of spring (3) over boss into installed position.
Push down (do not knock down) selector arm in this position.
Mount selector arm with socket head screw before removing special tool.
Install bolt with bolt cement**.
Tightening torque*.



Remove bearing holder (5).
Important!
Don't unscrew bolt (6).
Locking lever (7) remains on bearing holder.

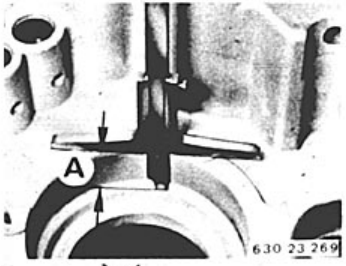


Installation:
Check installed position of locking lever (7) and thrust pin (8).

* See Specifications
** Source: HWB



Lift out radial oil seal.
Drive out grooved ball bearing with Special Tools 23 1 120 and 00 5 500.
Important!
Spacer (D).



Determine thickness of spacer (D).
Measure distance (A).

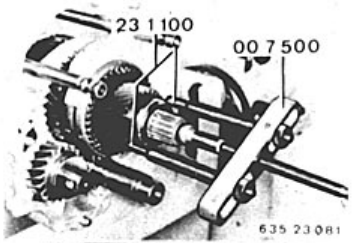


Measure distance (B).
Example:

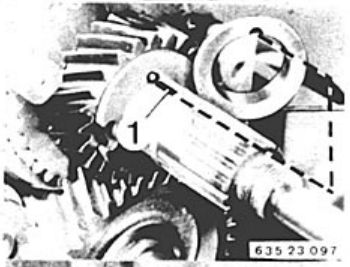
	A	20.3 mm (0.799")
–	B	20.0 mm (0.787")
	D	0.3 mm (0.012") spacer thickn.



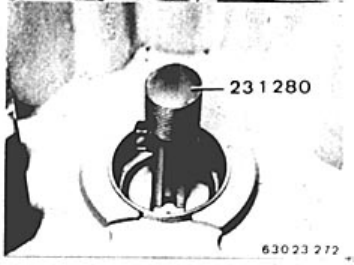
Heat case rear section in area of grooved ball bearing to approx. 80° C (175° F).
Insert spacer (D).
Install grooved ball bearing.
If necessary, drive in bearing against stop with Special Tool 23 1 470.



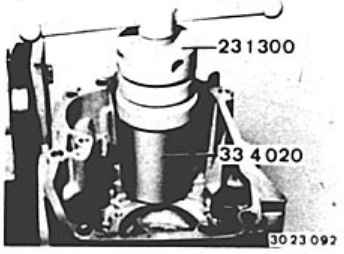
Pull bearing inner race off of output shaft with Special Tools 23 1 100 and 00 7 500.
Machine Special Tools 23 1 100 accordingly to fit in slots.



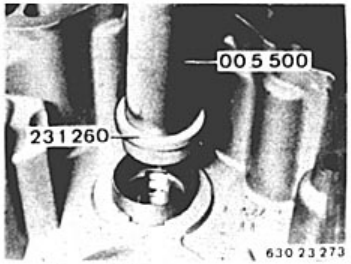
Heat ball bearing inner race to approx. 80° C (175° F) with a hot air blower and install on output shaft.
Important!
Turning lock.
Opening in bearing inner race must engage in ball.
Draw line (1) to make installation of bearing race easier.



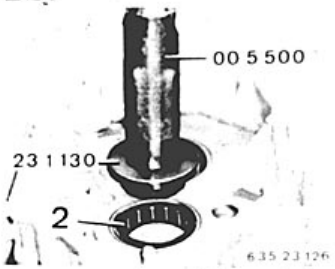
Layshaft:
Insert Special Tool 23 1 280 in bearing shell.



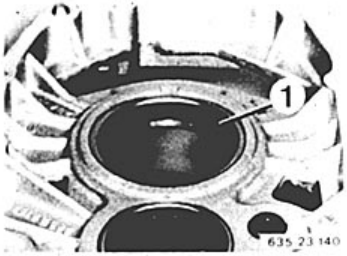
Apply Special Tool 33 4 020.
Screw on Special Tool 23 1 300.
Pull out bearing shell.



Drive in bearing shell with Special Tools 23 1 260 and 00 5 500.

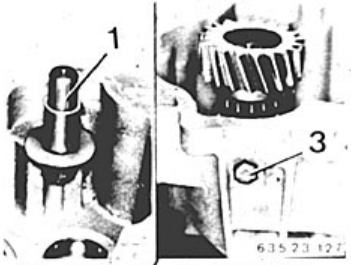


Drive out (and in) roller bearing (2) with Special Tools 23 1 130 and 00 5 500.
The roller bearing must be flush.



C) Output Shaft, Layshaft, Reverse Gear Wheel in Transfer Case

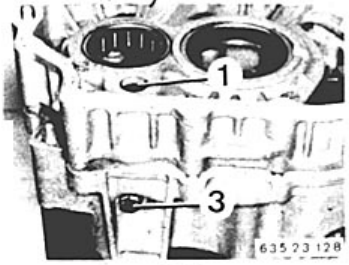
Output Shaft:
Check whether bearing outer race (1) can be reused.
The bearing outer race can be replaced only together with the complete transfer case.
Replacing the roller bearing on the output shaft requires removal of the output shaft – see 23 21 552.



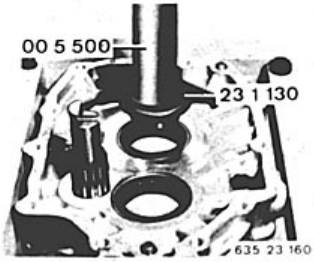
Mount reverse gear shaft (1) on the rear case section with bolt (3).
Install needle bearing and reverse gear wheel.



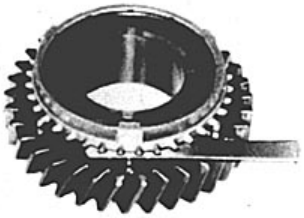
The reverse gear wheel shaft must be removed for removal of the roller bearing of the layshaft.
Press or drive out reverse gear wheel shaft (1).



Take transfer case off of Special Tool 23 0 030.
Heat bore for reverse gear wheel shaft to about 80° C (175° F) with a hot air blower.
Place transfer case on reverse gear wheel shaft (1) and center the bores of the case bolts.
Unscrew bolt (3) and take the transfer case off of the rear case section.



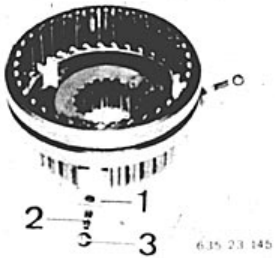
Version with Two Roller Bearings in Transfer Case:
Drive out (and in) both roller bearings with Special Tools 23 1 130 and 00 5 500.
The circlip must be removed for replacement of the needle bearing for the reverse gear wheel.



635 23 136

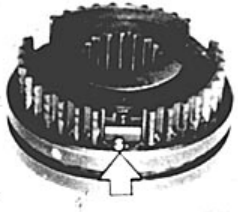
23 23 504 DISASSEMBLING AND ASSEMBLING COMPLETE SYNCHRONIZATION – Output Shaft Removed –

Disassemble output shaft – see 23 21 552.
All synchromesh rings are identical and have a molybdenum coat on the inside.
Check distance* between the synchromesh ring and clutch body.
Measure in the area of the stops.
Synchromesh rings should bear uniformly all around on the entire surface.



635 23 145

Disassemble synchronizer.
Thrust piece (1)
Spring (2)
Ball (3)



Installation:
Install all springs, thrust pieces and balls.

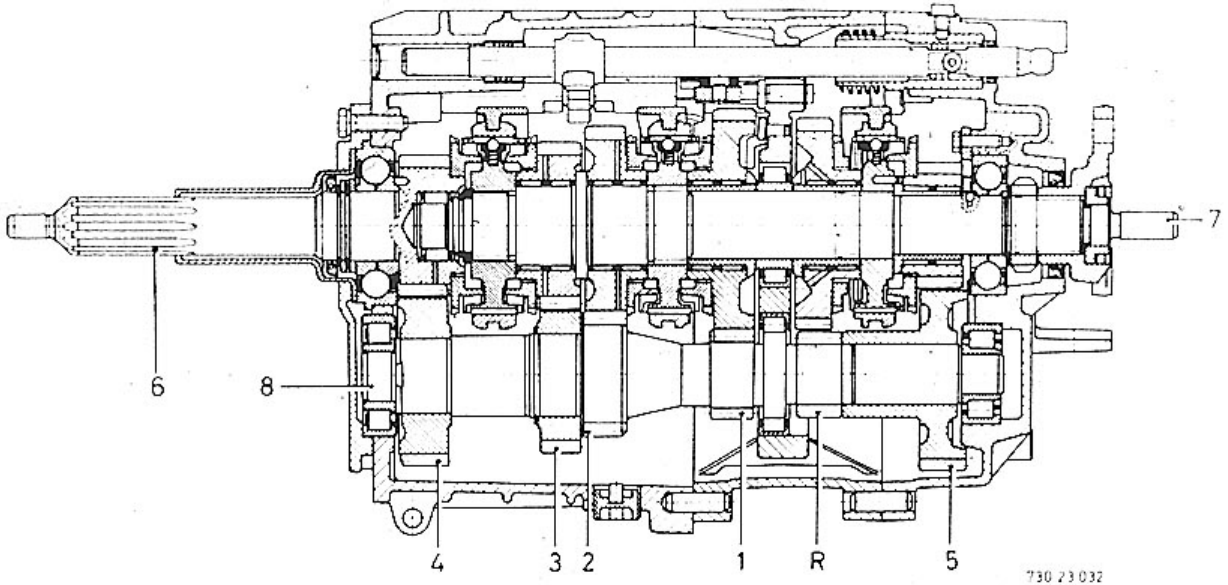
Important!
Domed surface of thrust pieces (2) faces the shifting sleeve.
Insert synchronizer in the operating sleeve half its distance.
Press in balls so far that the synchronizer can be pressed into the operating sleeve.

* See Specifications

Construction group 23 Manual transmission

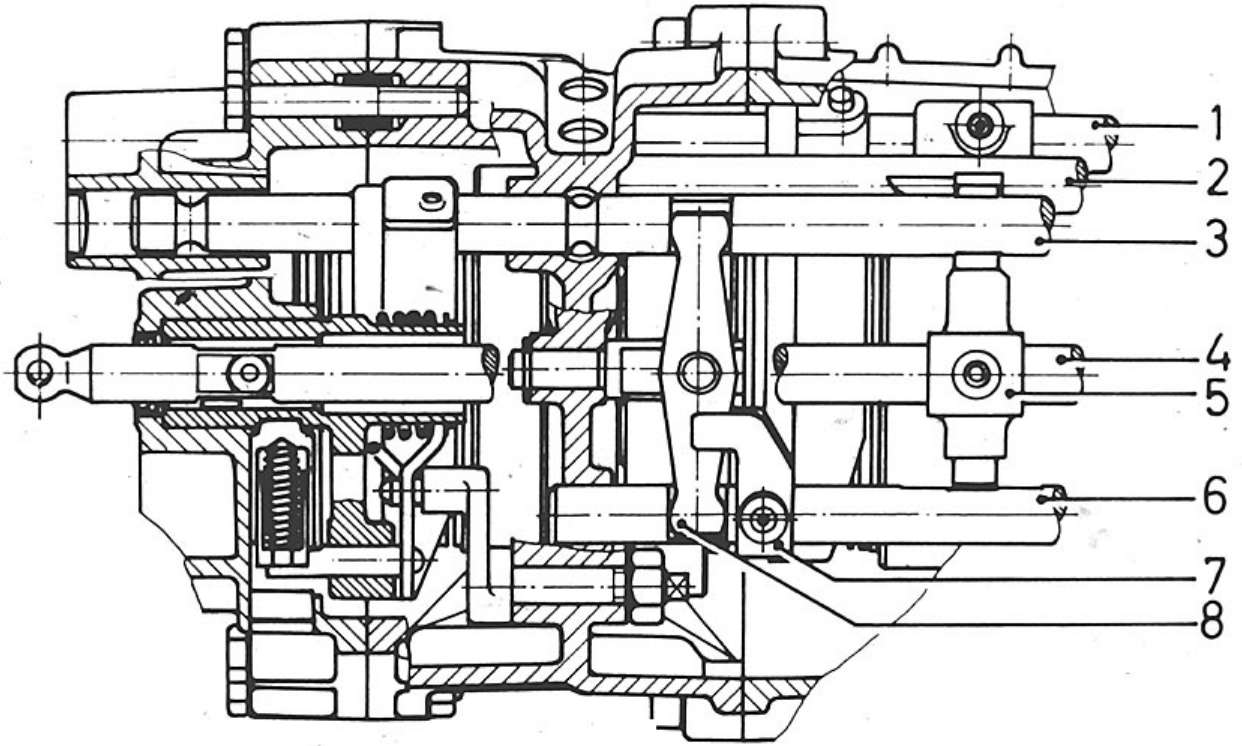
Getrag 265/6 Five speed manual transmission (overdrive)

	Transmission assembly drawing	23- 300
	Shift mechanism assembly drawing	23- 301
23 11 013	Transmission case front section – remove and install/seal	23- 302
022	Transmission case rear section – remove and install/seal	23- 304
610	Clutch release guide tube – replace	23- 307
623	Cover with clutch release guide tube – remove and install/seal	23- 307
23 12 503	Radial oil seal for input shaft – replace	23- 308
533	Radial oil seal for output flange – replace	23- 308
563	Radial oil seal for selector shaft – replace	23- 309
23 21 503	Input and output shaft assembly – remove and install	23- 310
554	Output shaft – replace	23- 316
703	Bearings of all transmission shafts – replace	23- 318
23 23 505	Synchronization – disassemble and assemble	23- 321



Assembly Drawing of Getrag 265/6 Five Speed Manual Transmission (Overdrive)

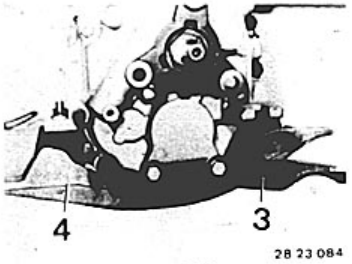
1 First gear
2 Second gear
3 Third gear
4 Fourth gear
5 Fifth gear
R Reverse gear
6 Input shaft
7 Output shaft
8 Layshaft



Assembly Drawing of Shift Parts for
Getrag 265/6 Overdrive Transmission

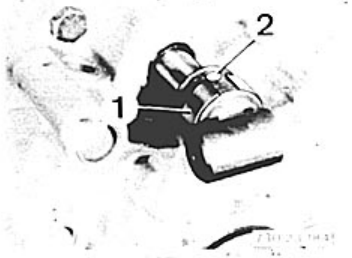
730 23 033

1 Selector rod – 1st/2nd gear
2 Selector rod – 3rd/4th gear
3 Selector rod – 5th/rev. gear
4 Selector shaft
5 Selector arm
6 Selector rail
7 Dog
8 Reversing lever

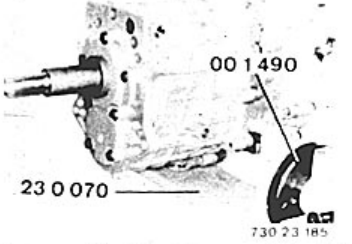


23 11 013 REMOVING AND INSTALLING/ SEALING TRANSMISSION CASE FRONT SECTION

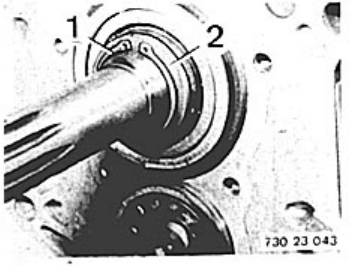
Remove transmission – see 23 00 022 in repair manual for pertinent model series.
Unscrew exhaust holder (3) and cross member (4) with rubber mounts.



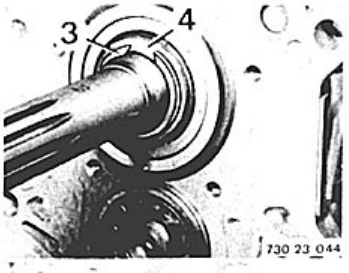
Engage 3rd gear.
Push back spring sleeve (1).
Drive out cylindrical pin (2).
Pull off selector rod.
Pull off selector rod joint.



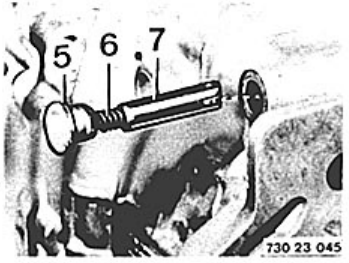
Mount transmission on Special Tool 23 0 070 in conjunction with Special Tool 00 1 490.
Drain oil.



Remove guide flange 23 11 623.
Lift out circlip (1).
Take off grooved washer (2).
Installation:
Position grooved washer that groove faces the circlip.



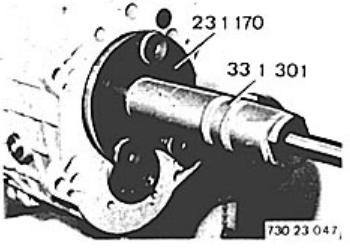
Lift out circlip (3).
Remove washer (4).
Installation:
Always replace circlip.



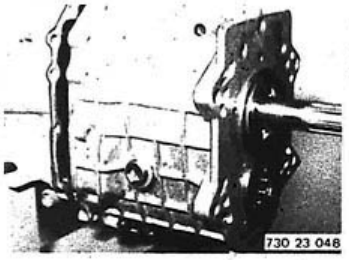
Lift out end cap (5).
Remove spring (6) and lockpin (7).
Installation:
Check installed position.
Remove backup light switch.



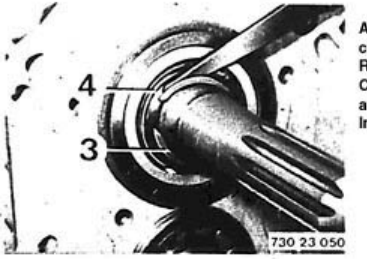
Drive out cylindrical pin.
Unscrew bolts.



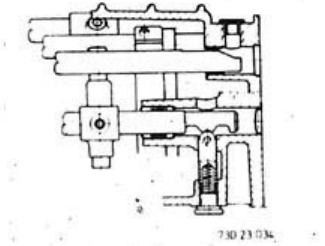
Pull off transmission case front section with Special Tools 23 1 170 and 33 1 301.



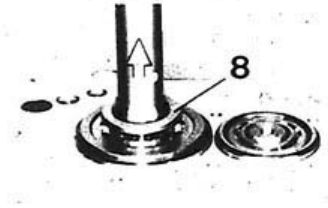
Coat seal surfaces with Loctite 573
Sealing surfaces must be cleaned thoroughly and dried of oil.
Install front portion of transmission*).



Adjust play between washer (4) and circlip (3).
Required max. play 0.09mm.
Circlips (3) in various thicknesses are available from spare parts service.
Install grooved washer and circlip.

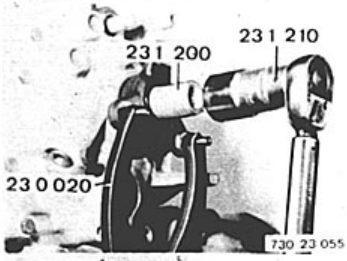


Install retaining bolts and reversing light switch.
Arrangement of retaining bolts.



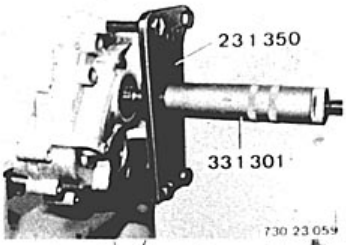
Heat bearing inner race (8) to approx. 80oC using hot air blower, and slide bearing onto driveshaft.
Simultaneously drawing on the driveshaft.

*) See Torque values

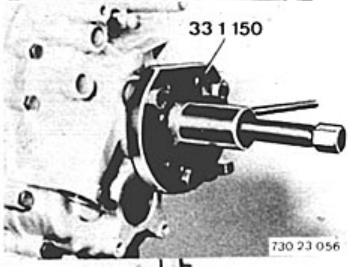


23 11 022 REMOVING AND INSTALLING/ SEALING TRANSMISSION CASE REAR SECTION

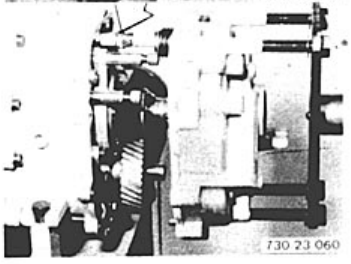
Lift out lockplate.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.
Installation:
Tightening torque*.



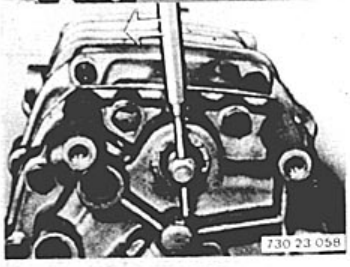
Knock back centering pin.
Pull off transmission case rear section with Special Tools 23 1 350 and 33 1 301.



Pull off output flange with Special Tool 33 1 150 if necessary.



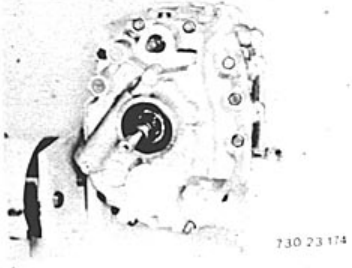
Take off rear section.
Important!
Rollers on selector shaft.



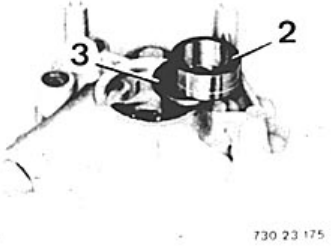
Caution!
Make sure 2nd gear is engaged before pulling off cover.
Swing selector shaft to the left against stop and slide forward.



Lift out radial oil seal.
Installation:
Replace radial oil seal.

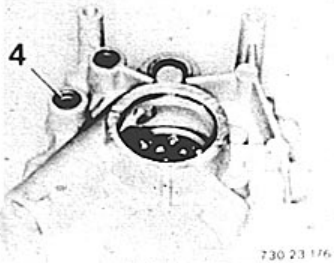


Unscrew rear case section mounting bolts.

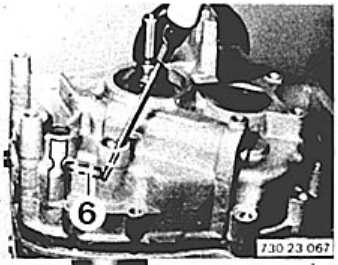


Remove spacer (2) and ball bearing inner race (3).

* See Specifications



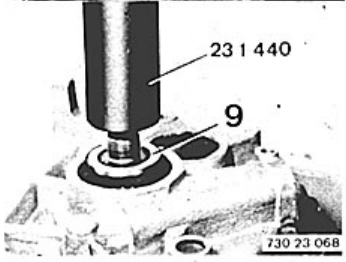
Knock out end cap (4).
Installation:
Replace and install end cap with Loctite No. 573.



Press lockpin (6) into opening of 1st/2nd gear selector rod.
Push on and bolt down transmission case rear section.
Tightening torque*.
Drive in centering pin.
Install end cap (4).



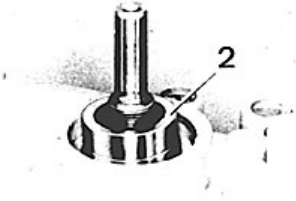
Position output shaft upright.
Second gear is engaged.
Adjust reverse/5th gear selector rod until opening of 5th gear selector rod is aligned with end of 1st/2nd gear selector rod.



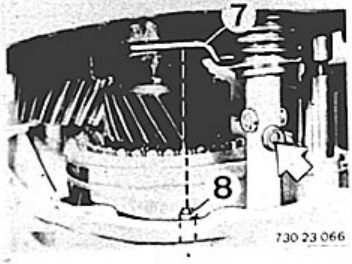
Heat bearing inner race (9) to about 80° C (175° F) with a hot air blower and slide on to output shaft, if necessary knocking on against ball bearing with Special Tool 23 1 440.



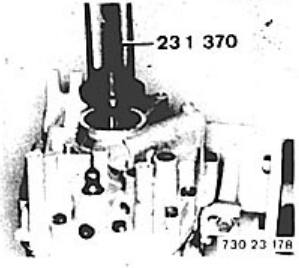
Coat sealing surfaces with Loctite No. 573.
Sealing surfaces must be cleaned thoroughly and dried of oil.
Important!
Lockpin (6) must move easily and face down.



Install spacer (2).

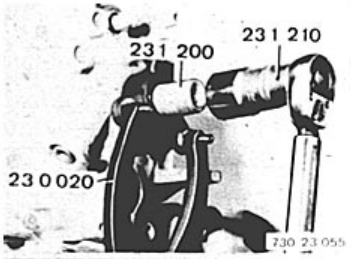


Hold rollers in position with grease.
Mount transmission case rear section.
Make sure spring (7) of selector arm engages on lever (8).

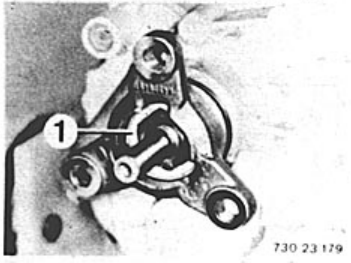


Drive in radial oil seal flush with Special Tool 23 1 370.

* See Specifications

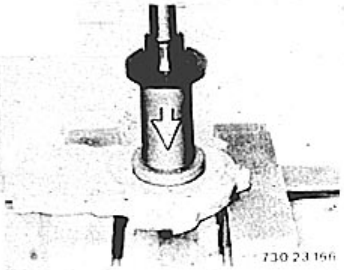


Mount output flange.
Install collar nut with Loctite No. 270.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Tighten collar nut with Special Tool 23 1 210.
Tightening torque*.



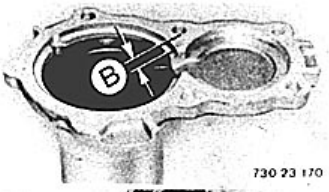
Install lockplate (1).

* See Specifications



23 11 610 REPLACING CLUTCH RELEASE GUIDE TUBE.
– Transmission Removed –

Remove guide flange, see 23 11 623.
Press out guide tube.

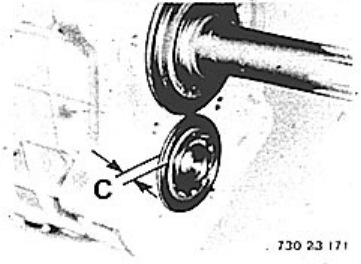


Measure distance (B).
Example:

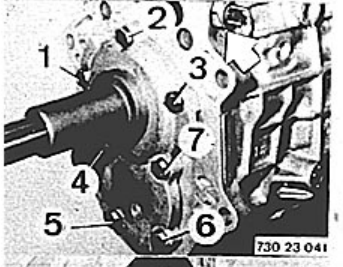
B	8.1 mm (0.319")
– A	7.8 mm (0.307")
	0.3 mm (0.012") spacer thickness



Heat guide flange to about 80° C (175° F) with a hot air blower.
Install guide tube.
Note:
Check turning lock (1).
Install radial oil seal.

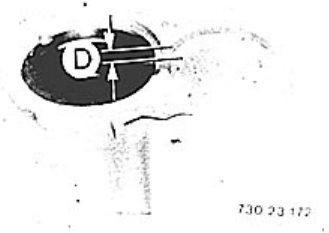


Adjust roller bearing play between layshaft and guide flange.
Measure distance (C) from case to roller bearing outer race.



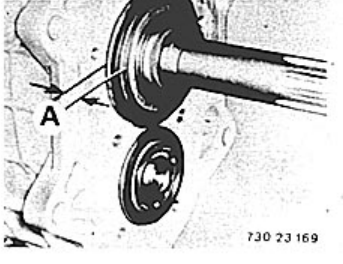
23 11 623 REMOVING AND INSTALLING/ SEALING COVER WITH GUIDE TUBE FOR CLUTCH RELEASE

Unscrew cover.
Important!
Spacers.
Important! – Installation:
Check length of bolts.
Bolts (1 ... 3) = 8 x 30 mm.
Bolts (4 ... 7) = 8 x 22 mm.

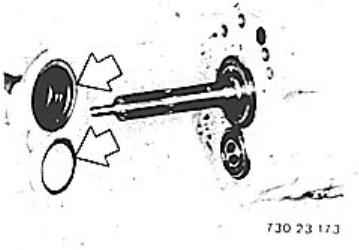


Measure distance (D).
Example:

D	4.8 mm (0.189")
– C	4.3 mm (0.169")
	0.5 mm (0.020")
– 0.1 ...	0.2 mm (0.004 ... 0.008") axial play
	0.3 mm (0.012") spacer thickness

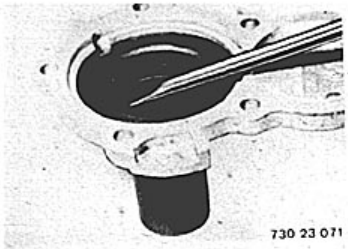


Adjust ball bearing between input shaft and guide flange to 0 ... 0.09 mm (0 to 0.0035").
Measure distance (A) from case to ball bearing.



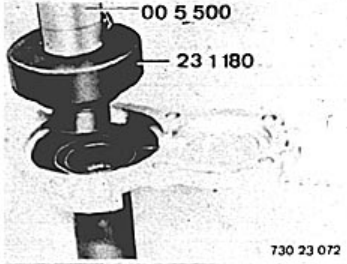
Coat sealing surfaces with Loctite No. 573.
Sealing surfaces must be cleaned thoroughly and dried of oil.
Hold spacers of calculated thickness in position with grease.
Mount cover.
Install bolts with Loctite No. 573.
Tightening torque*.
Threads cleaned to remove old cement.

* See Specifications


730 23 071

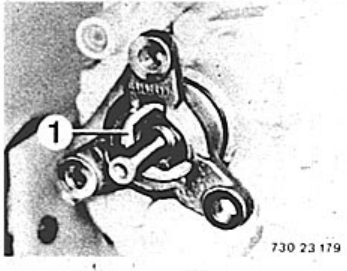
23 12 503 REPLACING RADIAL OIL SEAL FOR INPUT SHAFT
– Transmission Removed –

Remove cover with guide tube 23 11 623.
Lift out radial oil seal.



730 23 072

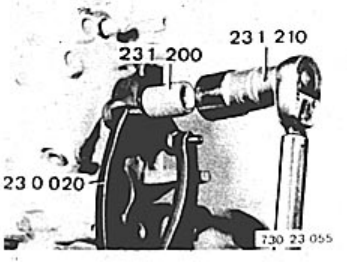
Drive in radial oil seal against stop with Special Tools 23 1 180 and 00 5 500.
Open end faces transmission.
Lubricate sealing lip with oil.



730 23 179

23 12 531 REPLACING RADIAL OIL SEAL FOR OUTPUT FLANGE
– Transmission Removed –

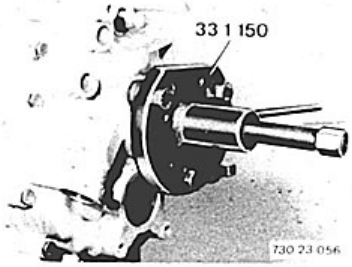
Remove lockplate (1).
Installation:
Replace lockplate.



730 23 055

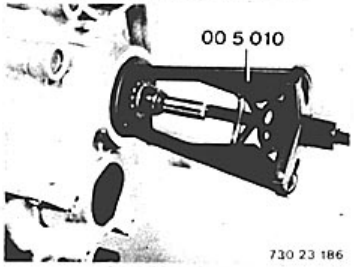
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.
Installation:
Install collar nut with a bolt cement**.
Tightening torque*.

* See Specifications
** Source: HWB



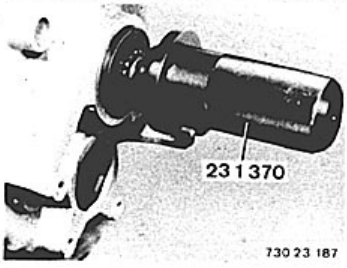
730 23 056

Pull off output flange with Special Tool 33 1 150.



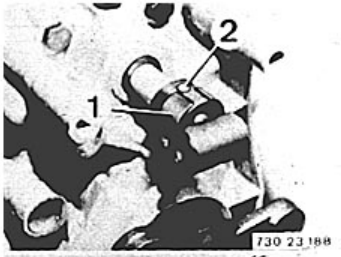
730 23 186

Pull out radial oil seal with Special Tool 00 5 010.



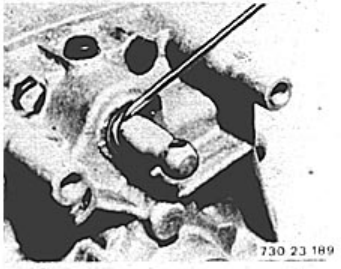
730 23 187

Installation:
Lubricate sealing lip with oil.
Drive in radial oil seal with Special Tool 23 1 370.



23 12 563 REPLACING RADIAL OIL SEAL FOR SELECTOR SHAFT
– Transmission Removed –

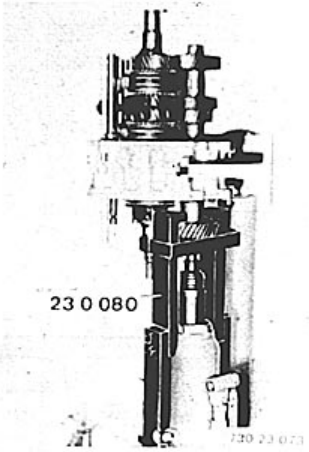
Engage third gear.
Push away locking sleeve (1) and drive out cylindrical pin (2).



Lift out radial oil seal.

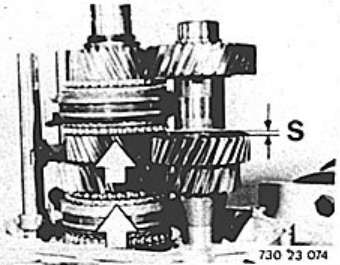


Lubricate sealing lip of radial oil seal with oil.
Drive in radial oil seal with Special Tool 23 1 240.

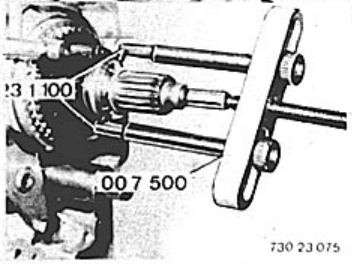


23 21 503 REMOVING AND INSTALLING INPUT AND OUTPUT SHAFT ASSEMBLY
– Transmission Case Front and Rear Sections Removed –

Swing down output shaft.
Pull 5th gear off of layshaft with Special Tool 23 0 080.
Bearing inner race will also be pulled off.
Pressing off force*.
Caution!
Support pulling tool to prevent it from falling down and causing injury.

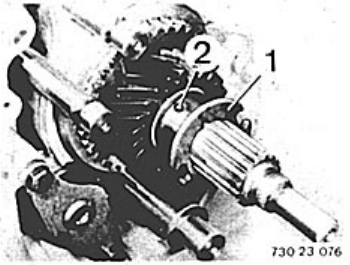


Important!
When installing 5th gear always remember to provide play (S) between 3rd gear and layshaft, to avoid damage to 3rd gear.
Push up output shaft if necessary.



Pull bearing inner race off of output shaft with Special Tools 23 1 100 and 00 7 500.

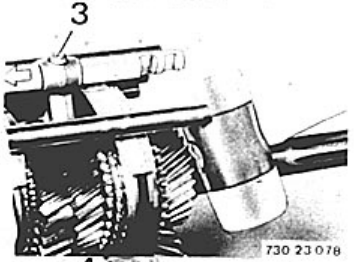
* See Specifications



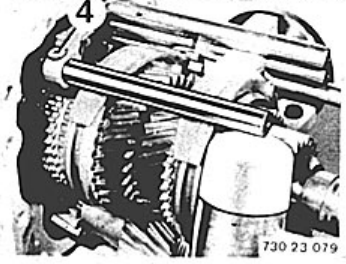
Take off washer (1) and ball (2).



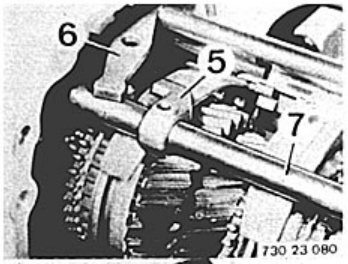
Pull off 5th gear with synchromesh ring and split needle bearing.



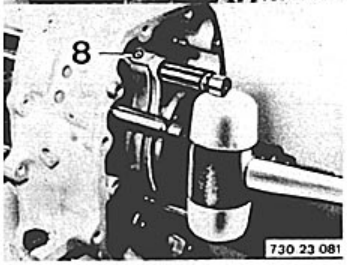
Remove needles on selector shaft.
Drive out pin (3) in selector shaft, while counterholding.
Pull out selector shaft toward rear.
Remove selector arm.
Installation:
Replace pin.



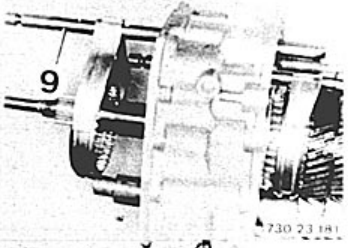
Engage 2nd gear.
Drive out pin (4), while counterholding.
Installation:
Replace pin.



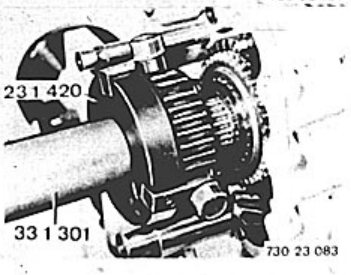
Pull or take off turning lock (5) and reversing lever (6).
Pull out selector rail (7) forward.
Disengage second gear.



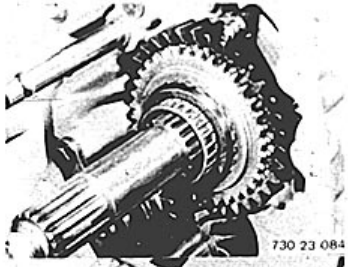
Pull out 5th gear selector rod with selector fork and operating sleeve toward rear far enough, that pin (8) can be driven out while counter-holding.
Important!
Loose balls, springs and slides.
Installation:
Replace pin.



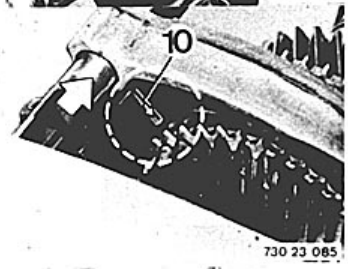
Pull off operating sleeve and 5th gear selector fork.
Pull out selector rod (9) forward.
Important!
Loose balls.



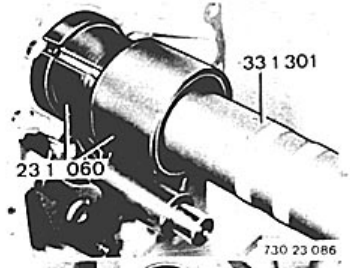
Pull guide sleeve and bearing inner race off of output shaft with Special Tools 23 1 420 and 33 1 301.
Important Information!
Mount knurled head screws in recesses of the guide sleeve with a pliers.



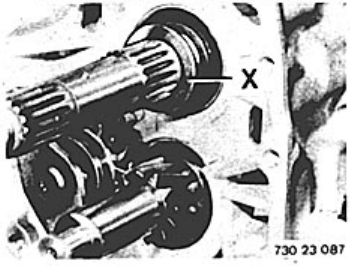
Remove synchromesh ring.
Pull off reverse gear and needle bearing.



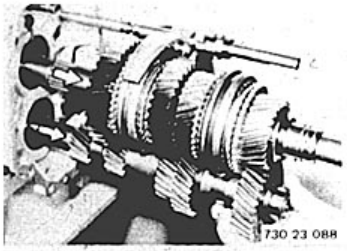
Engage third gear.
Drive out pin (10).
Important!
Drive in pin on to tooth of 3rd gear until selector rod can be pulled out forward.
Remove 3rd/4th gear selector fork.
Loose balls.
Installation:
Replace pin.



Pull out output shaft toward rear far enough, that bearing inner race can be pulled off with Special Tools 23 1 060 and 33 1 301.



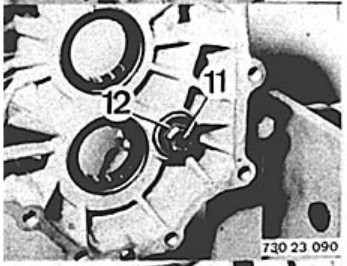
Remove shim X.
Installation:
Determine thickness of shim X – see 23 21 554.



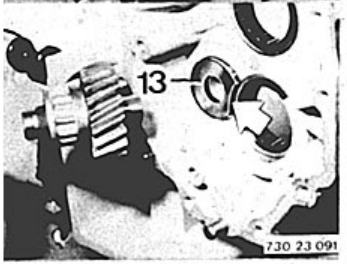
Pull out input and output shaft assembly with layshaft and 1st/2nd gear selector rod in intermediate case.
Important!
Loose balls.



Detach holder.



Unscrew bolt (11), while counterholding on front of shaft.
Installation:
Install bolt with Loctite No. 270.
Tightening torque*.
Remove washer (12).

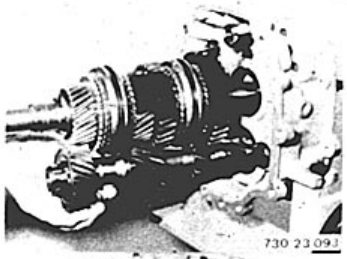


Knock out reverse gear shaft.
Installation:
Check installed position of thrust washer (13).
Check needle bearing, replacing if necessary.
Check condition of all bearings, replacing if necessary (see 23 21 703).

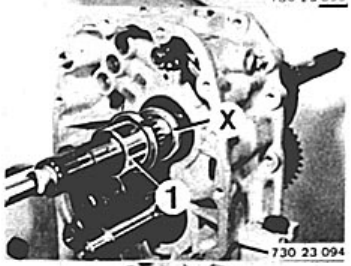
* See Specifications



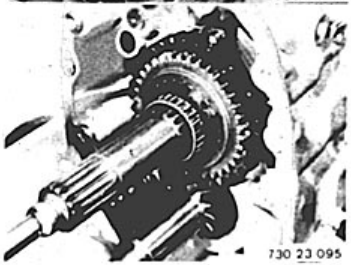
Installation:
Install and mount reverse gear.
Stepped collar of reverse gear faces out.
Tightening torque*.



Install input shaft, output shaft and layshaft in intermediate case.

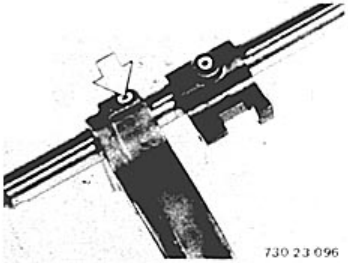


Install shim X.
Heat bearing sleeve (1) to approx. 80° C (175° F) with a hot air blower and install on output shaft.

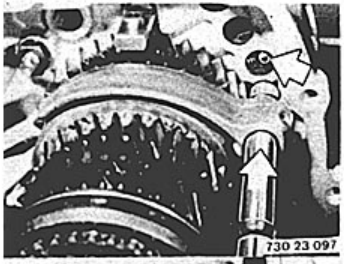


Install needle bearing and reverse gear.

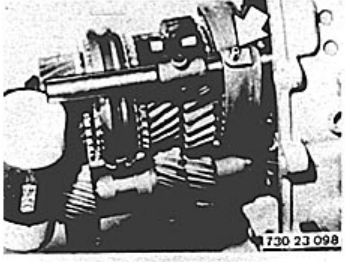
* See Specifications



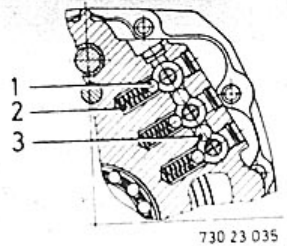
Drive pin out of 1st/2nd gear selector fork.
Installation:
Replace pin.



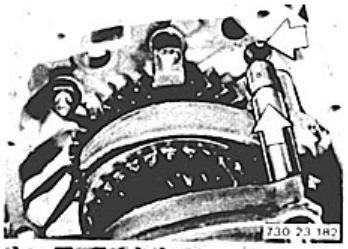
Mount 1st/2nd gear selector fork.
Push in 1st/2nd gear selector rod up to spring.
Insert locking balls and press down.
Push in selector rod against arrest in this position.



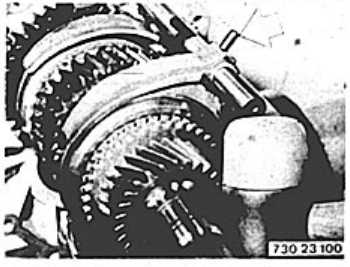
Drive in 6 x 32 mm pin, while counterholding.



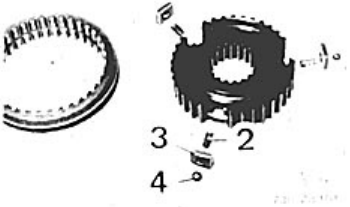
Layout of Selector Arrest:
1 Locking ball
2 Spring
3 Detent ball



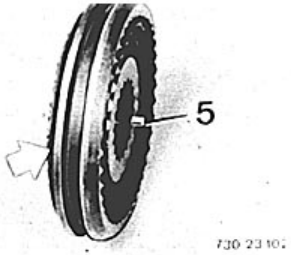
Mount 3rd/4th gear selector fork.
Insert detent ball.
Push in selector rod up to spring.
Insert locking balls and press down.
Push in selector rod against arrest in this position.



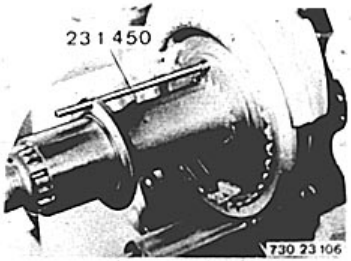
Drive in 6 x 26 mm pin, while counterholding.



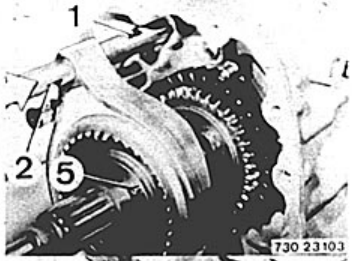
Assemble synchronizer.
Installed Order:
Springs (2), thrust parts (3) and balls (4).
Curved surface of thrust parts (3) faces operating sleeve.



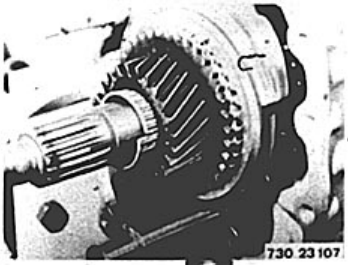
Important!
Stepped end of sliding sleeve must be opposite centering pin (5).



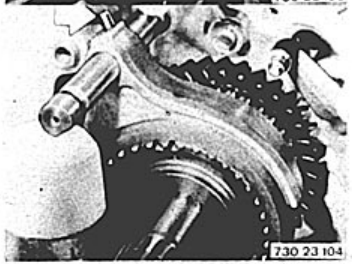
Place Special Tool 23 1 450 in centering pin.
Heat bearing sleeve to about 80° C (175° F) with a hot air blower and push on to output shaft.



Install guide sleeve.
Centering pin (5) faces 5th gear.
Install 5th/reverse gear selector fork.
Install detent ball.
Push in selector rod up to spring.
Insert locking balls and press down.
Push in and turn selector rod that openings (1 and 2) are always opposite locking balls.



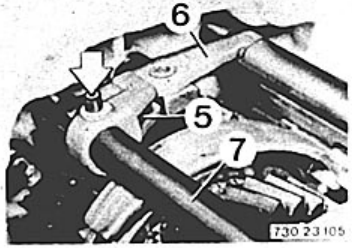
Install split needle bearing, synchromesh ring and fifth gear.



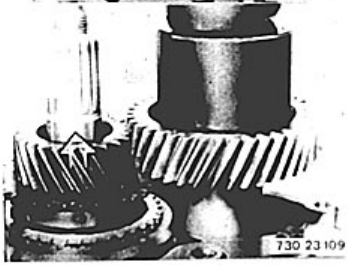
Push in selector rod far enough that 6 x 26 mm pin can be driven in, while counterholding
Push in selector rod and guide sleeve against arrest.



Detach intermediate case on mounting bracket and set up on a press.
Lubricate pressing surface of layshaft with oil.
Heat 5th gear uniformly to correct temperature with a hot air blower.
Press on 5th gear to fit tight with Special Tool 23 1 430.
Pressing on force*.

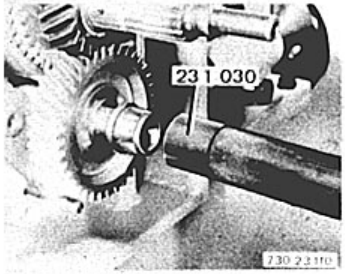


Install reversing lever (6).
Smooth side faces down.
Insert selector rail (7).
Push on turning lock (5).
Lock with a 6 x 26 mm pin.

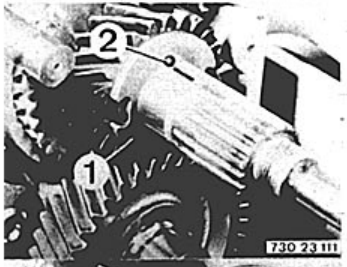


Important!
Lift and turn 5th gear until teeth mesh.

* See Specifications



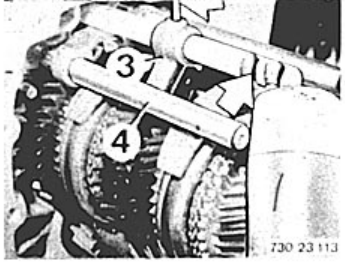
Heat bearing inner race to approx. 80° C (175° F) with a hot air blower and install on layshaft.
If necessary, drive on with Special Tool 23 1 030.
Collar of bearing race faces gear.



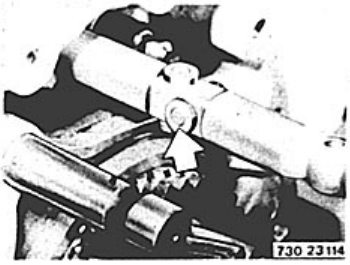
Insert ball (2) with grease.
Push on washer (1).



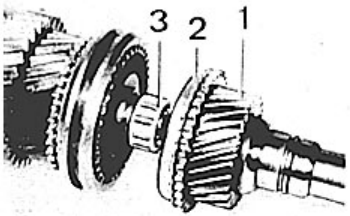
Installation!
Heat ball bearing inner races to about 80° C (175° F) with a hot air blower and install on output shaft.
Important!
Turning lock.
Opening in bearing inner race must engage in ball.
Draw line (1) to make installation of bearing race easier.



Install selector shaft, while pushing on selector arm (3) with long finger facing 3rd/4th gear selector rod.
Important!
Arrest on selector shaft faces selector rail (4).
Drive in 6 x 32 mm pin, while counterholding.



Hold four rollers in position on selector shaft with grease.

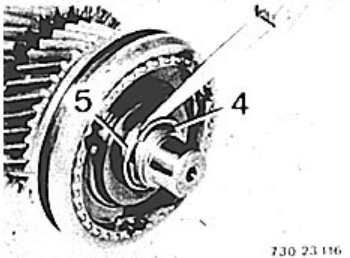


730 23 115

23 21 554 REPLACING OUTPUT SHAFT
– Output Shaft Removed –

Pull off input shaft (1), synchromesh ring (2) and needle bearing (3).

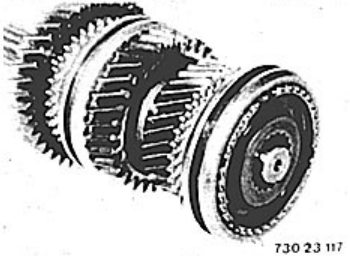
Note:
To avoid mixing up synchromesh rings while disassembling the output shaft. It is recommended to mark the synchromesh rings for pertinent gear wheels.



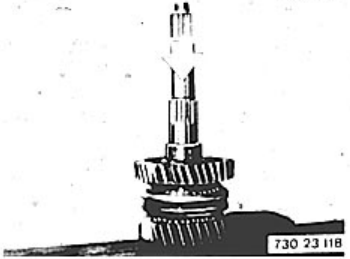
730 23 116

Lift out snap ring (4).
Take off washer (5).

Installation:
Reduce play between the snap ring and guide sleeve to 0 ... 0.09 mm (0 to 0.0035").
Always replace the snap ring.


730 23 117

Pull off guide sleeve, synchromesh ring, 3rd gear wheel and needle bearing.

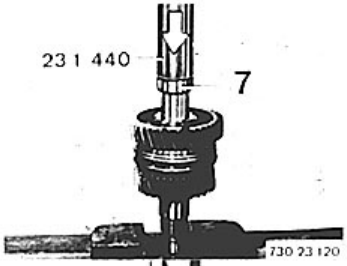

730 23 118

Press 2nd gear wheel, needle bearing, synchromesh ring, guide sleeve, synchromesh ring, 1st gear wheel, needle bearing with bearing sleeve and bearing inner race off of the output shaft.
Check all needle bearings, replacing when necessary.
Check synchromesh ring – see 23 23 505.


730 23 119

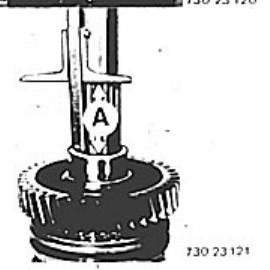
Install needle bearing, 2nd gear wheel, synchromesh ring and guide sleeve with stepped groove facing the 1st gear wheel.
Install bearing sleeve and needle bearing in the 1st gear wheel.
Install synchromesh ring.
Press in output shaft.

Important!
Guide synchromesh ring with tabs into the operating sleeve.



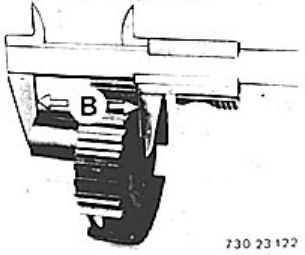
730 23 120

Heat bearing inner race (7) to about 80° C (175° F) with a hot air blower and install it on the output shaft, pressing it on with Special Tool 23 1 440 when necessary.



730 23 121

Determine thickness of shim X.
Measure distance (A) from collar of the output shaft to the bearing inner race.

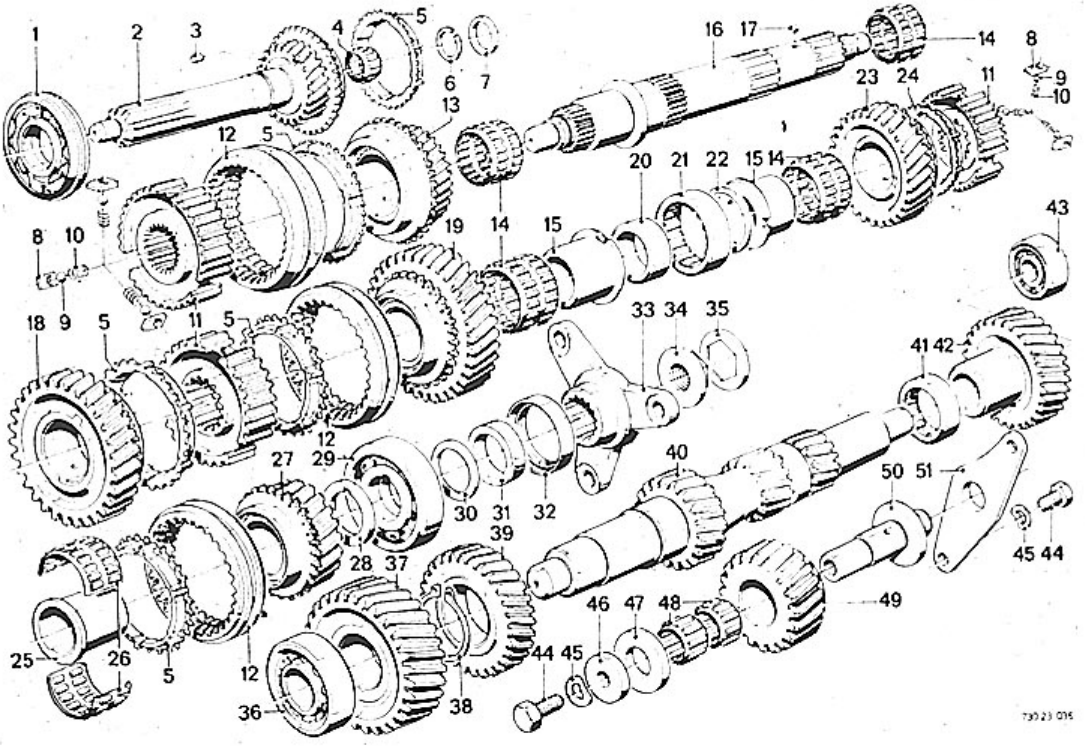


730 23 122

Place bearing sleeve for the reverse gear in the guide sleeve.
Measure distance (B) from collar of the guide sleeve to the bearing sleeve.

Example:
A = 52.2 mm (2.055")
– B = 52.0 mm (2.047")
X = 0.2 mm (0.008") thick shim

23-317



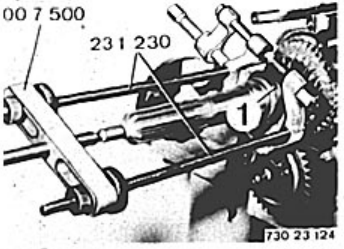
1 Ball bearing
2 Input shaft with 4th gear
3 Turning lock
4 Needle bearing
5 Synchromesh ring
6 Snap ring
7 Washer
8 Thrust part
9 Ball
10 Spring
11 Guide sleeve
12 Sliding sleeve
13 3rd gear
14 Needle bearing
15 Bearing sleeve
16 Output shaft
17 Ball
18 2nd gear
19 1st gear
20 Bearing race
21 Roller bearing
22 Shim X
23 Reverse gear
24 Circlip
25 Bearing sleeve
26 Split needle bearing
27 5th gear
28 Washer
29 Ball bearing
30 Washer
31 Speedometer drive gear
32 Radial oil seal
33 Output flange
34 Collar nut
35 Lockplate
36 Roller bearing
37 4th gear
38 Circlip
39 3rd gear
40 Layshaft
41 Roller bearing
42 5th gear
43 Roller bearing
44 Bolt
45 Washer
46 Washer
47 Thrust washer
48 Needle bearing
49 Reverse gear
50 Bearing shaft
51 Bearing holder



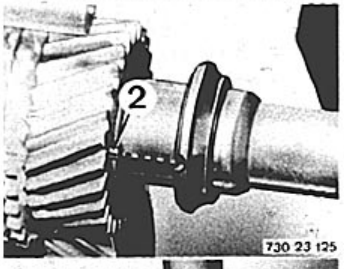
23 21 703 REPLACING BEARING OF ALL TRANSMISSION SHAFTS
– Transmission Removed –

A) Input Shaft, Layshaft in Case Front Section:

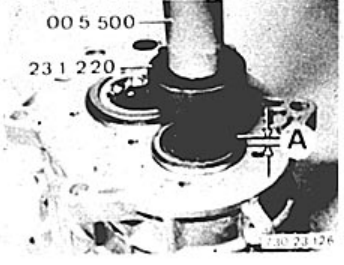
Remove case front section 23 11 013.
Drive ball bearing out of and into case with Special Tools 23 1 190 and 00 5 500.
Important!
Install ball bearing that collar faces out.



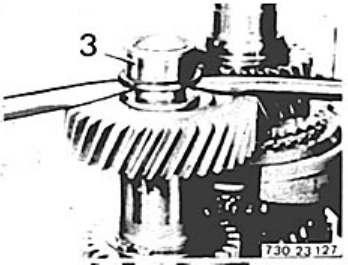
Pull bearing inner race (1) off of input shaft with Special Tools 23 1 230 and 00 7 500.



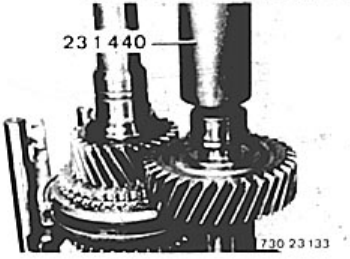
Installation:
Heat bearing inner race to about 80° C (175° F) with a hot air blower and install on input shaft.
Important!
Turning lock.
Pin (2) must be in opening of bearing inner race.



Drive layshaft roller bearing out and in with Special Tools 23 1 220 and 00 5 500.
Protrusion A = approx. 5 mm (0.197").
Install roller bearing that open end faces in.



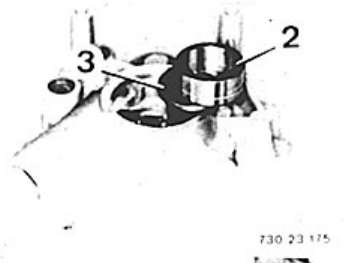
Press bearing inner race (3) off of layshaft with a screwdriver.

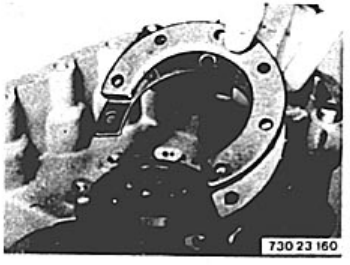


Installation:
Heat bearing inner race to about 80° C (175° F) and install on layshaft, driving on to fit tight with Special Tool 23 1 440 if necessary.
Collar of bearing inner race faces gear.

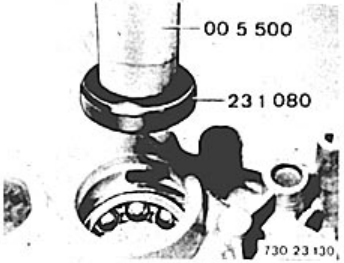
B) Output Shaft, Layshaft in Case Rear Section:

Remove case rear section 23 11 022.
Lift out radial oil seal.
Remove spacer (2) and bearing inner race (3).

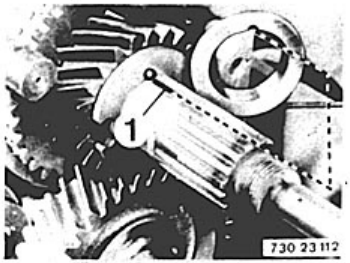




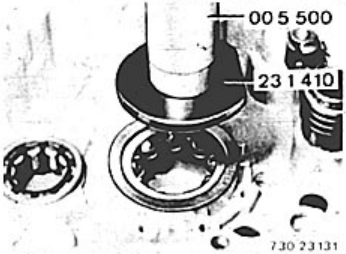
Unscrew bolts.
Remove bearing holder.



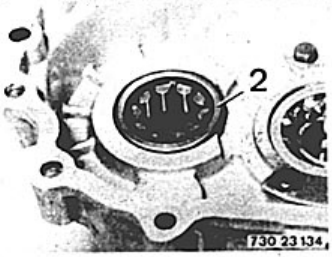
Drive out ball bearing with Special Tools 23 1 080 and 00 5 500.



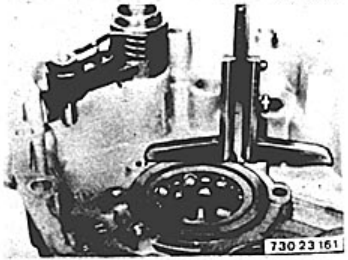
Installation:
Heat ball bearing inner race to about 80° C (175° F) with a hot air blower and slide on to output shaft.
Important!
Opening in bearing inner race must engage in ball.
Draw line (1) to make installation of bearing race easier.



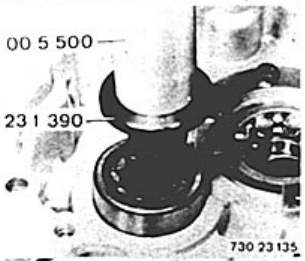
Drive in ball bearing with Special Tools 23 1 410 and 00 5 500.



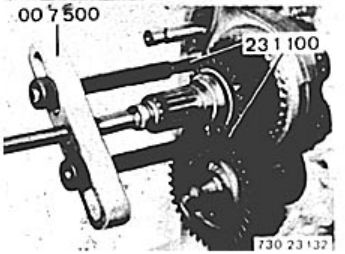
Heat case rear section to approx. 80° C (175° F) with a hot air blower.
Lift out roller bearing (2).
Installation:
Insert bearing that large diameter end of plastic cage faces up.



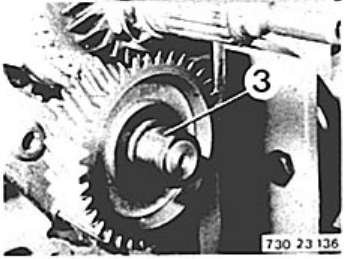
Adjust play between bearing holder and case rear section with shims.
Mount bearing holder.
Tightening torque*



Heat case rear section to about 80° C (175° F) with a hot air blower.
Install roller bearing, driving in with Special Tools 23 1 390 and 00 5 500.

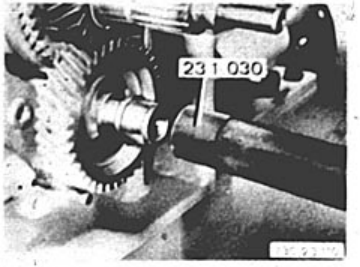


Pull ball bearing inner race off of output shaft with Special Tools 23 1 100 and 00 7 500.

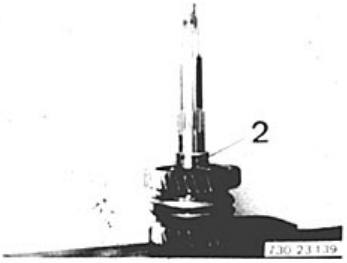


Bearing inner race (3) can only be pulled off together with the 5th gear (see 23 21 503).

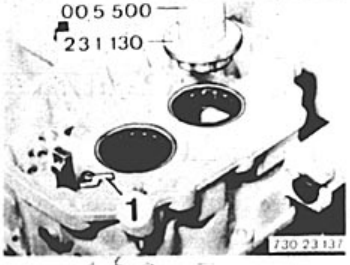
* See Specifications



Heat new bearing inner race to about 80° C (175° F) with a hot air blower and install on layshaft, driving on with Special Tool 23 1 030 if necessary.
Collar of bearing race faces gear.

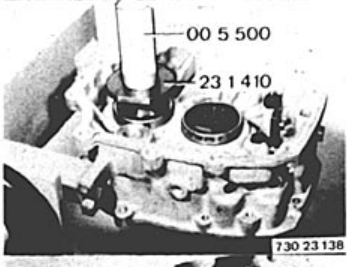


Check condition of bearing inner race (2) on output shaft, replacing if necessary.
If replacement is necessary, press gear set off of output shaft (see 23 21 554).



C) Output Shaft, Layshaft in Intermediate Case:

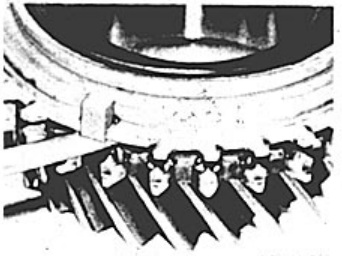
Remove input and output shaft assembly 23 21 503.
Drive roller bearings for input shaft and layshaft out of intermediate case with Special Tools 23 2 130 and 00 5 500.
Important!
Unscrew and turn oil plate (1) in case of roller bearing for output shaft.



Drive roller bearings for output shaft and layshaft into intermediate case with Special Tools 23 1 410 and 00 5 500.
Drive in roller bearings flush.



Bolt down oil plate (1) in vertical installed position.



23 23 505 DISASSEMBLING/ASSEMBLING ENTIRE SYNCHRONIZATION
– Output Shaft Removed –

Disassemble output shaft (see 23 21 554).
All synchromesh rings are identical and coated with molybdenum on the inside surface.
Measure distance between synchromesh ring and clutch body*.
Measure in area of stops.
Synchromesh rings must rest uniformly on entire surface.



Disassemble synchronization.
Thrust piece (1), spring (2) and ball (3).
Installation:
Bore (4) in operating sleeve must be aligned with ball (3).



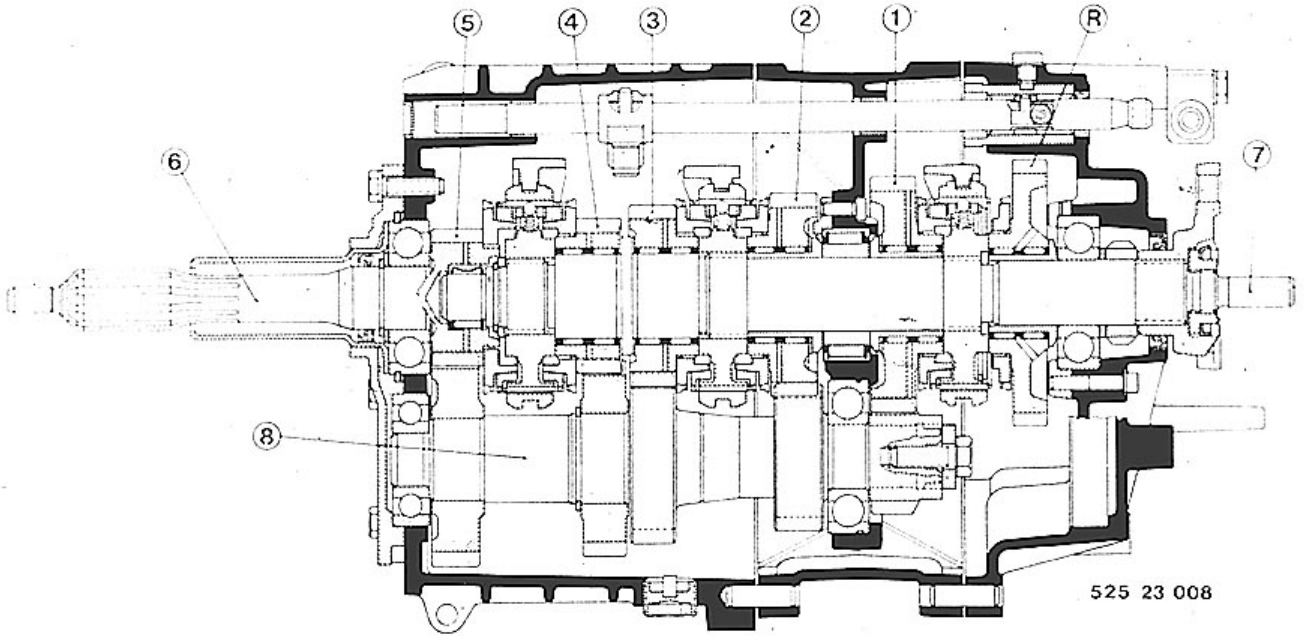
Installation:
Install all springs, thrust pieces and balls.
Important!
Curved surface of thrust pieces faces operating sleeve.
Insert guide sleeve half way in sliding sleeve.
Press in balls far enough that guide sleeve can be pressed into sliding sleeve.

* See Specifications

Construction group 23 Manual transmission

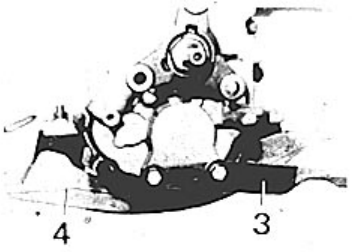
Getrag 265/5 Five speed sport transmission

	Transmission – layout drawing	23- 350
23 11 005	Transmission case front section – remove and install/seal	23- 352
040	Transmission case rear section – remove and install/seal	23- 354
622	Cover with guide tube for clutch release – remove and install/seal	23- 357
23 12 502	Radial oil seal for input shaft – replace	23- 357a
532	Radial oil seal for output flange – replace	23- 357a
562	Radial oil seal for shift shaft – replace	23- 357b
23 21 501	Input and output shaft assembly – remove and install	23- 358
552	Output shaft – replace	23- 361
702	Bearings of all transmission shafts – replace	23- 363
23 23 504	Synchronization – disassemble and assemble	23- 365



Assembly Drawing of 265 Five Speed Manual Transmission (Sport)

1 First gear
2 Second gear
3 Third gear
4 Fourth gear
5 Fifth gear
R Reverse gear
6 Input shaft
7 Output shaft
8 Layshaft

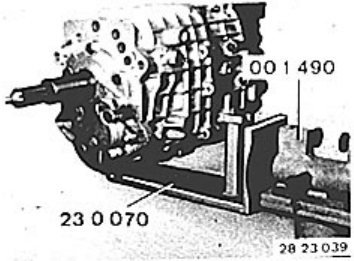


23 11 005 REMOVING AND INSTALLING/ SEALING TRANSMISSION CASE FRONT SECTION

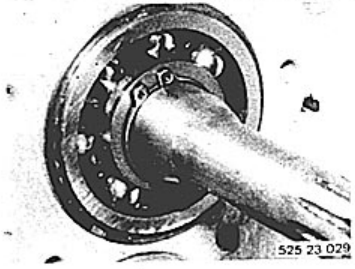
Remove transmission – see 23 00 022 in repair manual for pertinent model series.
Unscrew exhaust holder (3) and cross member (4) with rubber mounts.



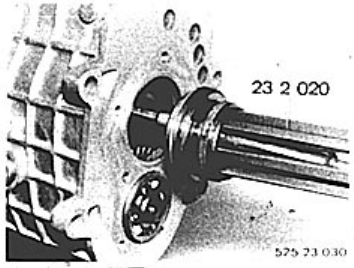
Engage third gear.
Push back spring sleeve (1).
Drive out pin (2).
Pull off selector rod.
Pull off selector rod joint.
Note:
Install selector rod joint with offset side facing left when looking forward in car.



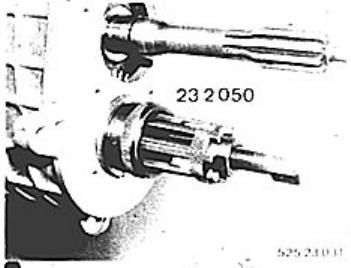
Mount transmission on Special Tool 23 0 070 in Special Tool 00 1 490.
Drain oil.



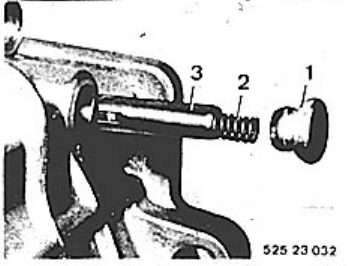
Remove cover with guide tube 23 11 623.
Remove circlip.
Remove spacer.



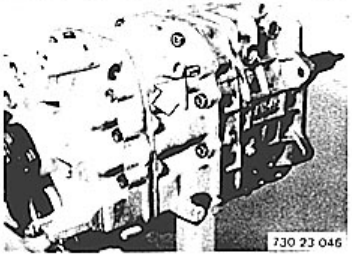
Pull grooved ball bearing out of input shaft with Special Tool 23 2 020.
Important!
Spacer.



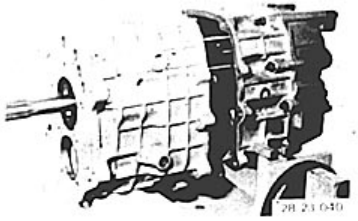
Pull grooved ball bearing out of layshaft with Special Tool 23 2 050.



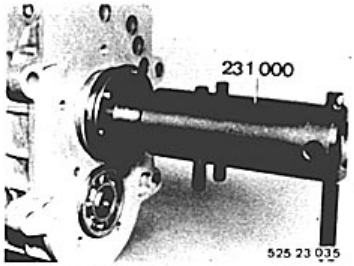
Lift off cap (1).
Remove spring (2) and lockpin (3).
Installation:
Check installed position.
Install cap with sealing compound.



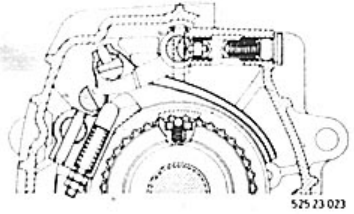
Unscrew backup light switch.
Important!
Seal.
Unscrew case front section on intermediate case.



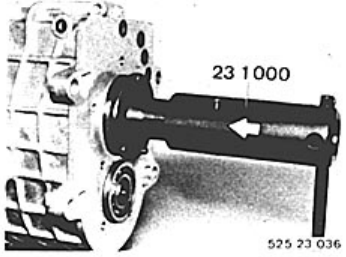
Pull off case front section.
Installation:
Replace gasket.



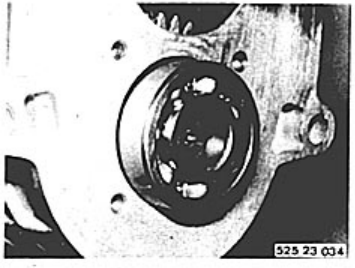
Heat grooved ball bearing inner race to about 80° C (175° F) with a hot air blower and press on to input shaft with Special Tool 23 1 000.



Mount case front section.
Tightening torque*.
Install backup light switch and lockpin.
Check position of lockpin.

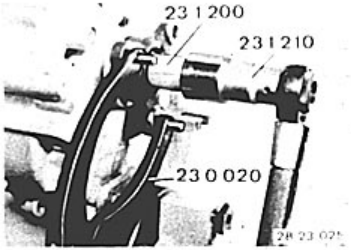


Remove pressure pin.
Drive in grooved ball bearing to fit tight.
Install spacer and circlip.
Mount cover.



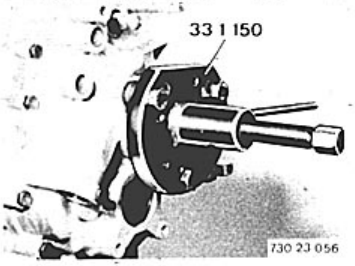
Heat grooved ball bearing inner race and case front section in area of bearing to about 80° C (175° F) with a hot air blower and drive on to layshaft.

* See Specifications

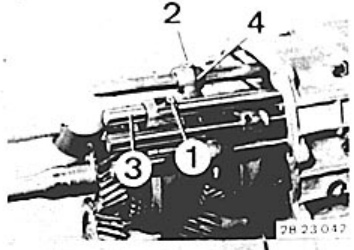


23 11 040 REMOVING AND INSTALLING/ SEALING TRANSMISSION CASE REAR SECTION

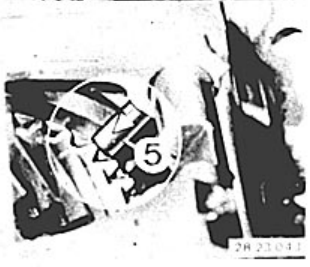
Remove case front section 23 11 012.
Remove lockplate.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 1 020.
Unscrew collar nut with Special Tool 23 1 210.



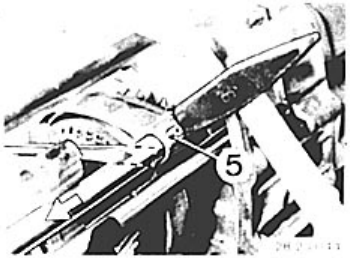
Pull off output flange with Special Tool 33 1 150.



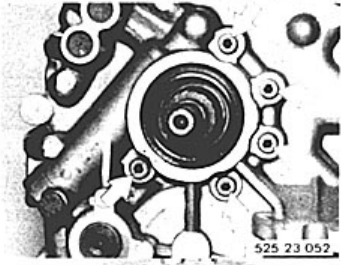
Drive out pins (1 and 2), while counterholding.
Pull out 4th/5th gear selector rod (3).
Swing up and pull selector arm (4) off of selector shaft.
Installation:
Replace pins.



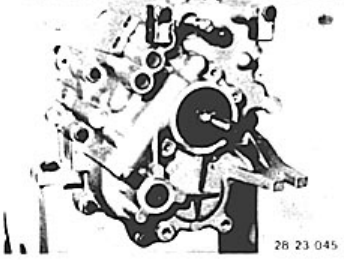
Engage third gear.
Drive out pin (5).
Important!
Drive pin on to center tooth of 3rd gear wheel.
Installation:
Replace pin.
Pull out 2bd/3rd gear selector rod.



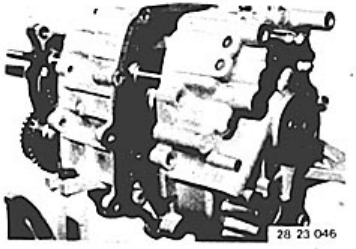
Second Disassembling Method:
Drive out pin (5) from bottom to top far enough while counterholding, and then pull out pin (5).
Installation:
Replace pin.
Pull out 2nd/3rd gear selector rod.



Unscrew bolts.



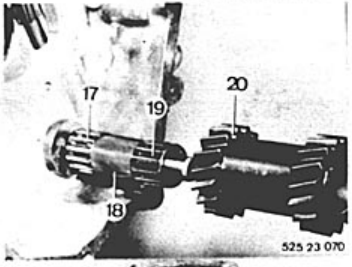
Unscrew bolts.
Knock back dowel pins.



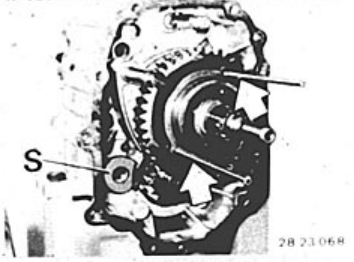
Heat case rear section in area of output shaft and layshaft to about 80° C (175° F) with a hot air blower.
Pull off case rear section.
Replace gasket.



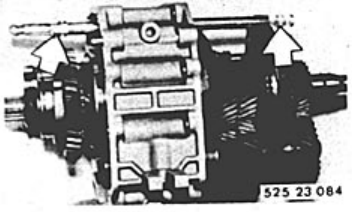
Drive out sealing caps (6 and 7).



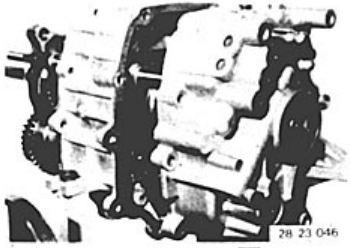
Slide on needle bearing (17), spacer (18), needle bearing (19) and double gear (20).



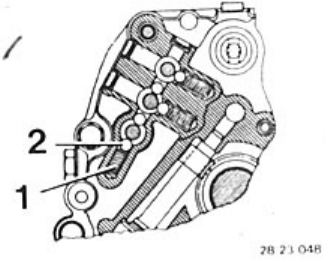
Screw two guide pins in retaining ring.
Hold spacer (S) in position with cement.
Check installed position.



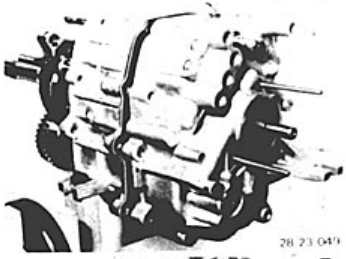
Hold rollers on selector shaft with grease.
Install selector shaft that openings on selector rod face out toward case.



Heat case rear section in area of input shaft and layshaft to about 80° C (175° F) with a hot air blower.
Hold gasket in position with grease.



Push on case rear section up to spring (1).
Insert locking ball (2).

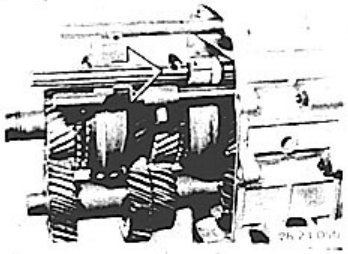


Push on case rear section against intermediate case.

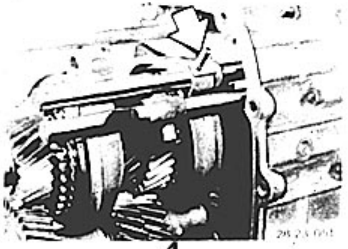


Screw in three bolts.
Remove guide pins and mount support ring on case rear section.
Tightening torque*.

* See Specifications



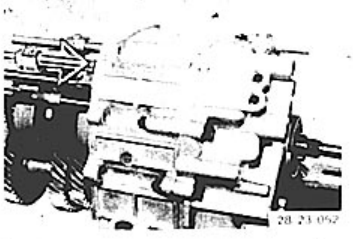
Push in 2nd/3rd gear selector rod up to spring.
Insert locking and detent balls.
Push in selector rod against arrest.



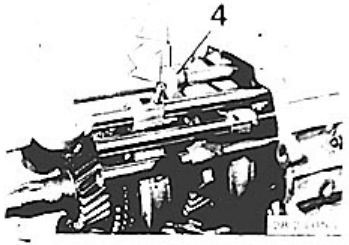
Mount 2nd/3rd gear selector fork with a 6 x 26 mm pin.



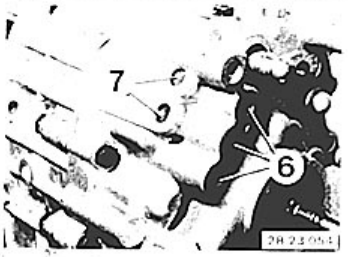
Place selector arm (4) on selector shaft with bevelled side facing down prior to installing the 4th/5th gear selector rod.



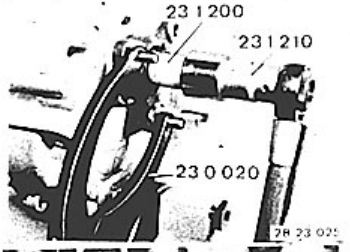
Push in 4th/5th gear selector rod up to spring.
Insert locking and detent balls.
Push in selector rod against arrest.



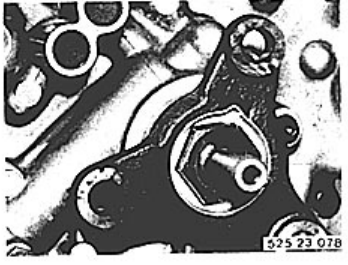
Mount 4th/5th gear selector fork with a 6 x 26 mm pin and selector arm (4) with a 6 x 28 mm pin.



Install new sealing caps (6 and 7) with a sealing compound.

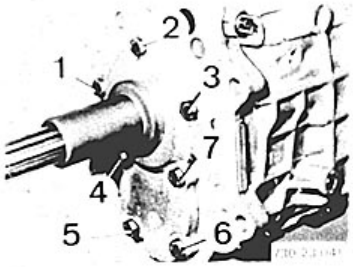


Mount output flange.
Install collar nut with a bolt cement**.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Tighten collar nut with Special Tool 23 1 210.
Tightening torque*.



Install lockplate.

* See Specifications
** Source: HWB



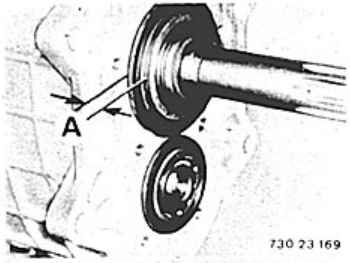
23 11 622 REMOVING AND INSTALLING OR SEALING COVER WITH GUIDE PIPE FOR CLUTCH RELEASE
– Transmission Removed –

Unscrew cover.
Installation:
Replace gasket.

Important!
Gasket is omitted since 9.86.
The cover must be sealed with a sealing compound and the sealing surface must be thoroughly cleaned and dried of oil.**
Note:
The gasket must be installed again on versions with a gasket.

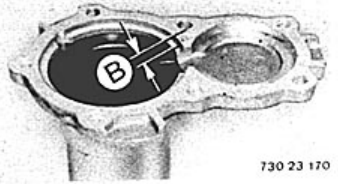
Important!
Shims.

Important! – Installation:
Check length of bolts.
Bolts (1 ... 3) = 8 x 30 mm.
Bolts (4 ... 7) = 8 x 22 mm.



730 23 169

Eliminate ball bearing play between the input shaft and guide flange.
Max. axial preload on the bearing outer race = 0.1 mm (0.004").
Measure distance (A) from case to the ball bearing.



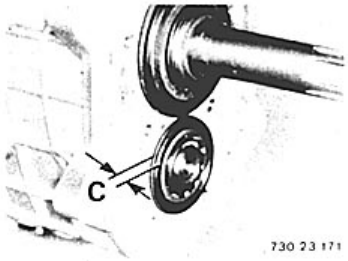
730 23 170

Measure height of collar (B) without gasket.

Important!
Use 0.2 mm (0.008") for thickness of the gasket.

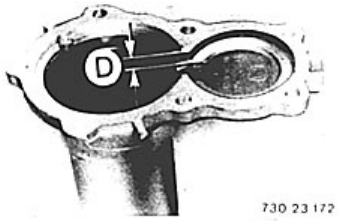
	B	=	8.0 mm (0.315")
–	A	=	7.9 mm (0.311")
			0.1 mm (0.004")
+			0.2 mm (0.008") gasket
			0.3 mm (0.012") shim

** **Source of Supply: HWB**



730 23 171

Eliminate roller bearing play between layshaft and guide flange.
Measure distance (C) from case to roller bearing outer race.

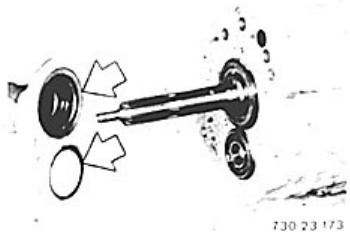


730 23 172

Measure distance (D) without gasket.

Important!
Use 0.2 mm (0.008") for thickness of the gasket.
Example:

	D	=	4.8 mm (0.189")
–	C	=	4.5 mm (0.177")
			0.3 mm (0.012")
+			0.2 mm (0.008") gasket
			0.5 mm (0.020")
–	0.1 ... 0.2 mm (0.004...0.008") axial pl.		
	0.3 ... 0.4 mm (0.012...0.016") shim		


730 23 173

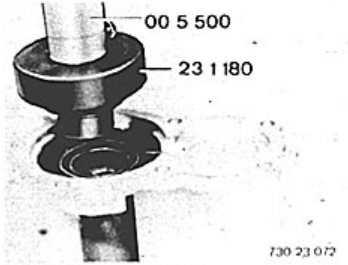
Install new gasket.
Hold shims of determined thickness in position with grease.
Mount cover.
Install bolts with a sealing compound.**
Clean threads of old bolts.
Tightening torque*.

* **See Specifications**
** **Source of Supply: HWB**

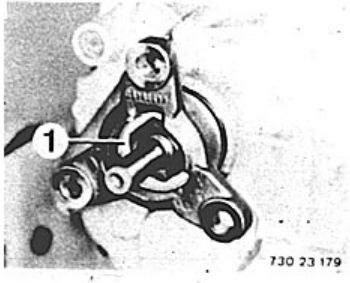


23 12 502 REPLACING RADIAL OIL SEAL FOR INPUT SHAFT
– Transmission Removed –

Remove cover with guide pipe – see 23 11 622.
Pry out radial oil seal.



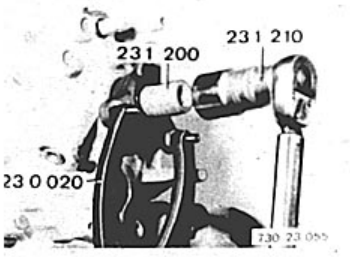
Drive in radial oil seal against the stop with Special Tools 23 1 180 and 00 5 500.
Open end faces the transmission.
Lubricate sealing lip with oil.



23 12 532 REPLACING RADIAL OIL SEAL FOR OUTPUT FLANGE
– Transmission Removed –

Lift out lockplate (1).

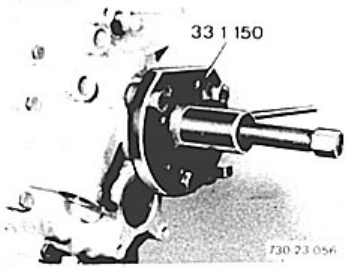
Installation:
Replace lockplate.



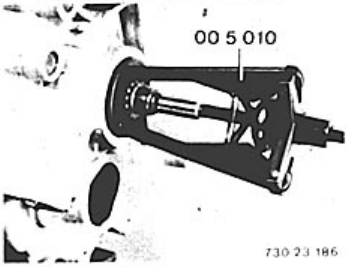
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.

Installation:
Install collar nut with a bolt cement.**
Tightening torque*.

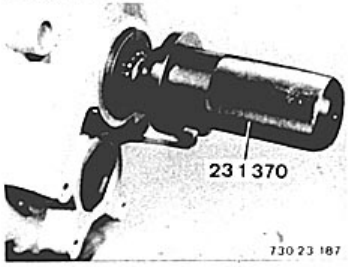
* **See Specifications**
** **Source of Supply: HWB**



Pull off output flange with Special Tool 33 1 150.



Pull out radial oil seal with Special Tool 00 5 010.

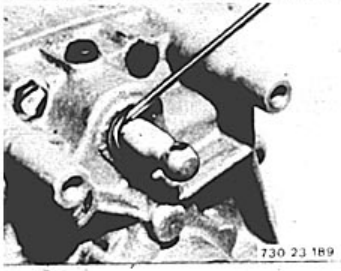


Installation:
Lubricate sealing lip with oil.
Drive in radial oil seal with Special Tool 23 1 370.



23 12 562 REPLACING RADIAL OIL SEAL FOR SHIFT SHAFT
– Transmission Removed –

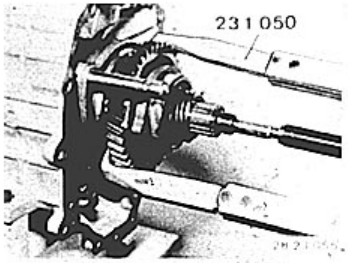
Engage 3rd gear.
Push locking sleeve (1) aside and drive out dowel pin (2).



Lift out radial oil seal.

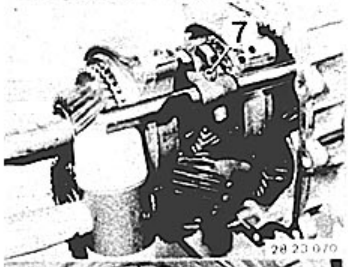


Lubricate sealing lip of the radial oil seal with oil.
Drive in radial oil seal with Special Tool 23 1 240.

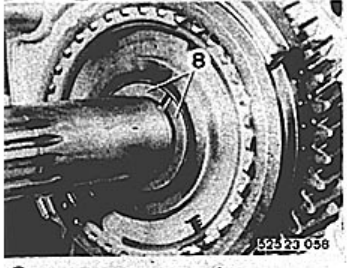


23 21 501 REMOVING AND INSTALLING INPUT AND OUTPUT SHAFT ASSEMBLY
– Front and Rear Case Sections Removed –

Pull out selector shaft.
Use Special Tool 23 1 050 to pull off spacer or, for version with speedometer drive, speedometer drive gear, shim, grooved ball bearing, spacer, support ring and reverse gear on output shaft.



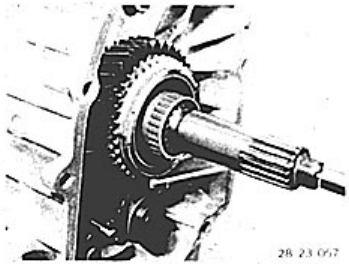
Drive out pin (7) while counterholding.



Remove split thrust washer (8).



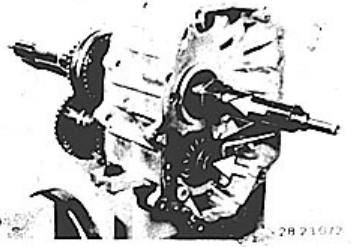
Pull 1st/reverse gear selector rod with guide sleeve and synchromesh ring off of output shaft, also pulling off drive (9) on the selector rod.



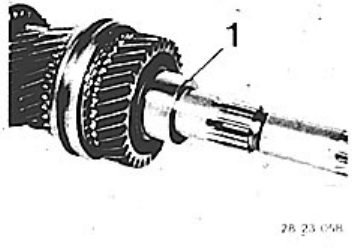
Pull off synchromesh ring, 1st gear and needle bearing.



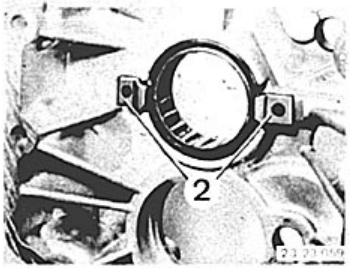
Unscrew bolts.
Move output shaft axially.
Take off retainers.



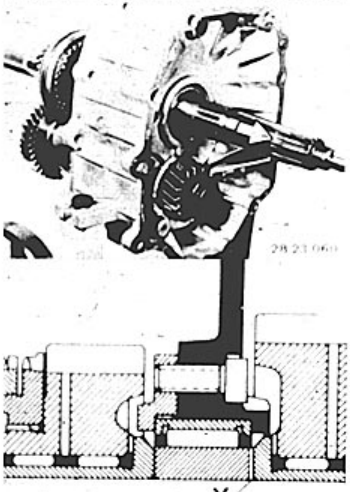
Pull output shaft and layshaft out of intermediate case simultaneously, or knock out if necessary...



Installation:
Press off output shaft (see 23 21 552).
Assemble output shaft up to bearing inner race (1).

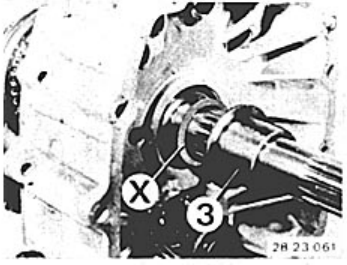


Heat bearing bore of output shaft in intermediate case to approx. 80° C (175° F) with a hot air blower.
Install roller bearing and torque* with holding stories (2).
Install cylinder head bolts with a bolt cement.**



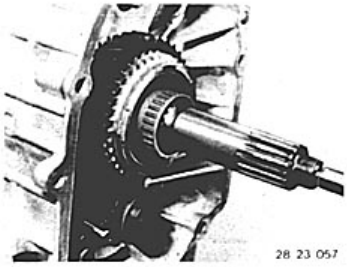
Heat bearing bore of layshaft in intermediate case to approx. 80° C (175° F) with a hot air blower.
Install output shaft and layshaft in the intermediate case simultaneously.

Important!
Determine shim thickness X (see 23 21 702) after installation of the output shaft.

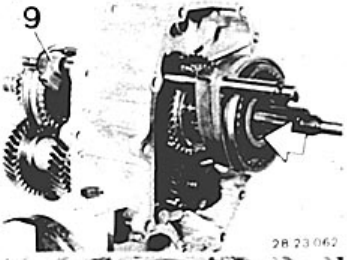


Install shim X if necessary.
Heat collar sleeve (3) to approx. 80° C (175° F) with a hot air blower and install on the output shaft.

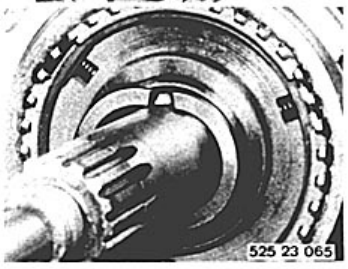
* See Specifications
** Source: HWB



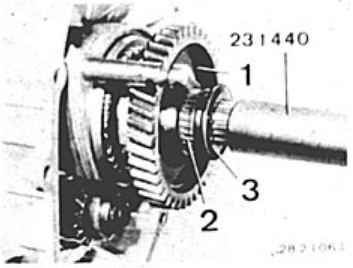
Mount needle bearing, 1st gear wheel and synchromesh ring on output shaft.



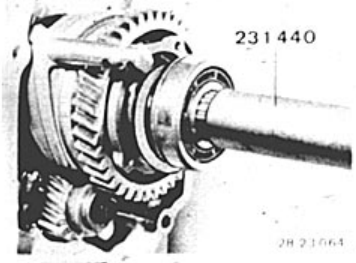
Mount guide sleeve, selector fork and selector rod.
Important!
Stepped end of internal splines/guide sleeve faces reverse gear wheel and stepped end of sliding sleeve faces 1st gear wheel.
Guide tabs on synchromesh ring into openings of guide sleeve.
Slide on dog (9) and secure with a 6 x 32 mm pin.



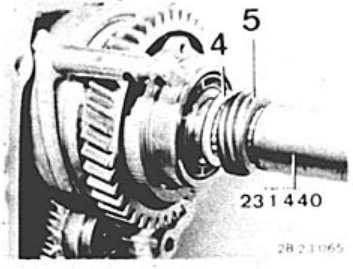
Insert split ring in groove.



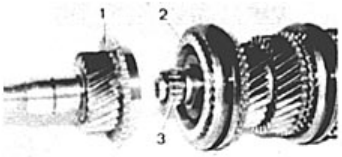
Install synchromesh ring, reverse gear (1), needle bearing (2) and collar (3), driving on to fit tight with Special Tool 23 1 440 if necessary.
Heat collar to about 80° C (175° F) with a hot air blower to make installation easier.



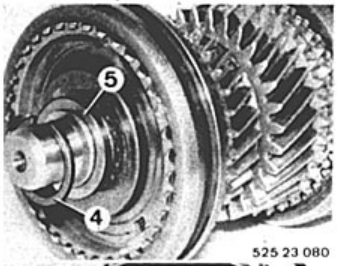
Install a 0.5 mm (0.020") thick shim, support ring, spacer and grooved ball bearing on output shaft, driving on to fit tight with Special Tool 23 1 440 if necessary.



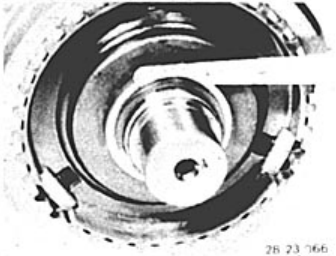
Install spacer or, for version with speedometer drive, 2.5 mm (0.098") thick shim (4) and speedometer drive gear (5) on output shaft, driving on to fit tight with Special Tool 23 1 440 if necessary.



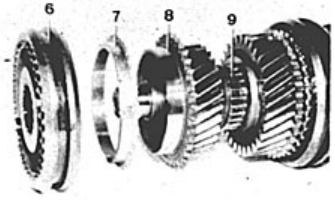
525 23 079



525 23 080



28 23 066



525 23 081

23 21 522 DISASSEMBLING AND ASSEMBLING INPUT AND OUTPUT SHAFTS
– Output Shaft Removed –

Pull input shaft (1), synchromesh ring (2) and needle bearing (3) off of the output shaft.

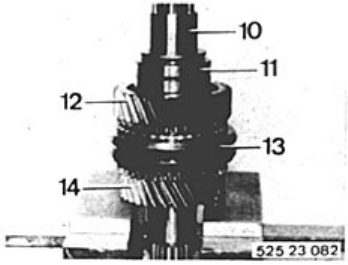
Note:
To avoid mixing up synchromesh rings while disassembling the output shaft, it is recommended to mark synchromesh rings for pertinent gear wheels.

Take off circlip (4) and shim (5).

Installation:
Replace circlip.

Installation:
Eliminate all play between the guide sleeve and circlip with shims.

Pull guide sleeve (6), synchromesh ring (7), 4th gear wheel (8) and needle bearing (9) off of the output shaft.

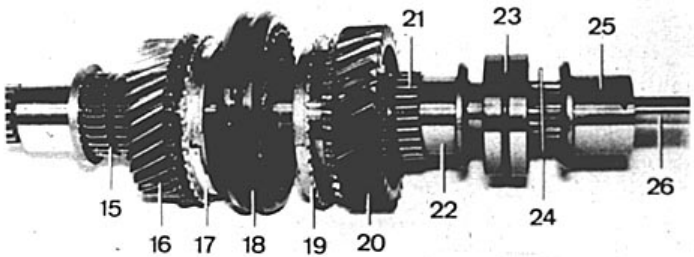


525 23 082

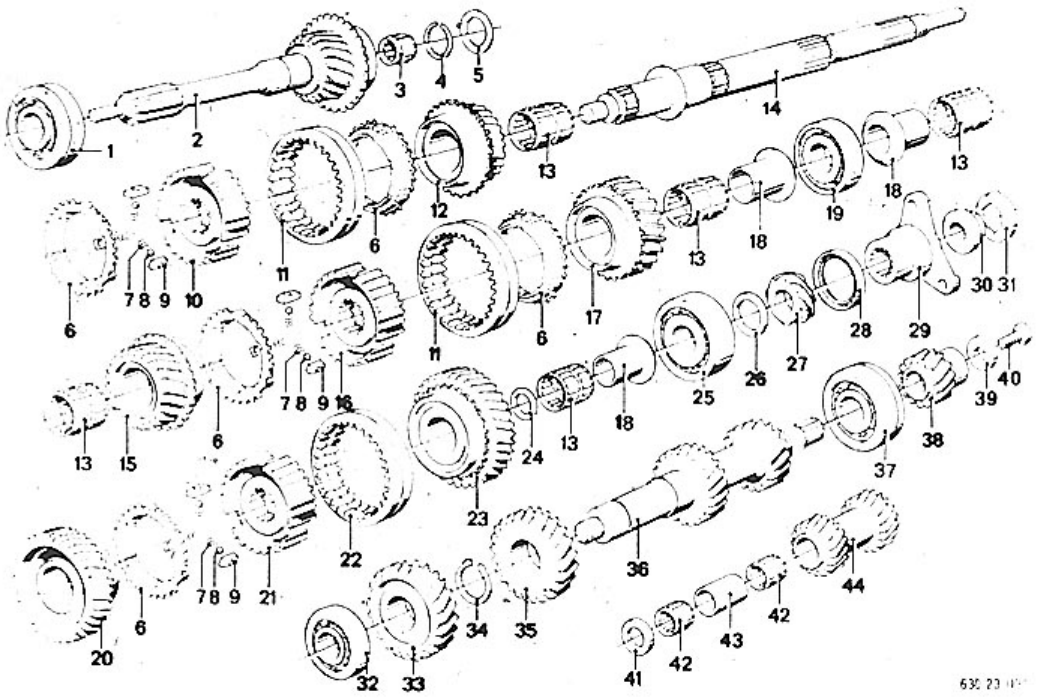
Press collar (10), bearing (11), 2nd gear wheel (12), guide sleeve (13) and 3rd gear wheel (14) off of the output shaft.
Check synchronization – see 23 23 504.

Installed Order:
Needle bearing (15), 3rd gear wheel (16), synchromesh ring (17), guide sleeve (18), synchromesh ring (19), 2nd gear wheel (20), needle bearing (21), collar (22), collar (25) and output shaft (26).
Check roller bearing (23), replacing if necessary.

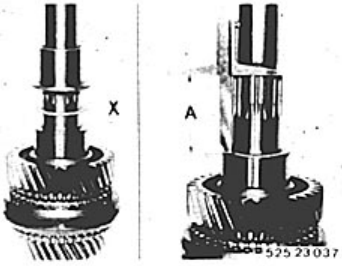
Important!
Assemble the output shaft without shim (24) and collar (25).



525 23 083

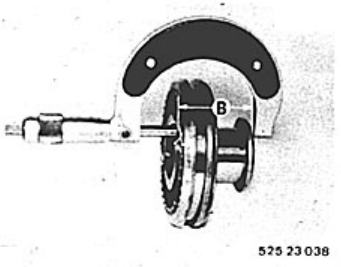


1 Ball bearing
2 Input shaft with 5th gear
3 Needle bearing
4 Circlip
5 Spacer
6 Synchromesh ring
7 Spring
8 Ball
9 Thrust part
10 Guide sleeve
11 Operating sleeve
12 4th gear
13 Needle bearing
14 Output shaft
15 3rd gear
16 Guide sleeve
17 2nd gear
18 Bearing sleeve
19 Ball bearing
20 1st gear
21 Guide sleeve
22 Operating sleeve
23 Reverse gear
24 Spacer
25 Ball bearing
26 Spacer
27 Speedometer gear/spacer
28 Radial oil seal
29 Output flange
30 Collar nut
31 Lockplate
32 Ball bearing
33 5th gear
34 Circlip
35 4th gear
36 Layshaft
37 Ball bearing
38 1st gear
39 Washer
40 Bolt
41 Thrust washer
42 Needle bearing
43 Sleeve
44 Double gear



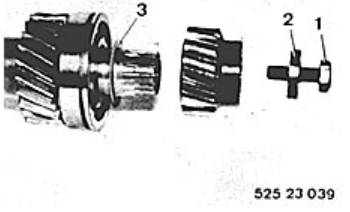
23 21 702 REPLACING BEARINGS FOR ALL TRANSMISSION SHAFTS
– Transmission Removed –

Remove input/output shaft assembly 23 21 501.
Disassemble output shaft 23 21 552.
Determine thickness of shim X.
Install 3rd gear with needle bearing, synchromesh ring, guide sleeve, synchromesh ring, 2nd gear with needle bearing, collar and bearing inner race on output shaft.
Heat bearing inner race to about 80° C (175° F) with a hot air blower.
Measure distance A from collar of output shaft to bearing inner race.
A = 52.6 mm (2.071").

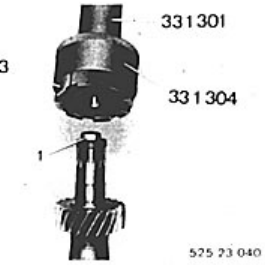


Measure distance B from guide sleeve internal spline to outer edge of collar.
B = 52.4 mm (2.063").
Example:

A	52.6 mm (2.071")	
– B	52.4 mm (2.063")	
X	0.2 mm (0.008")	shim thickness



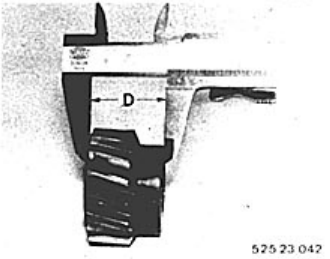
Unscrew bolt (1) and take off washer (2).
Press 1st gear off of layshaft with two screwdrivers.
Important!
Shim (3).



Pull grooved ball bearing off of layshaft with Special Tool 33 1 301 used together with Special Tools 33 1 303 and 33 1 304.
Caution!
Screw in bolt (1) to fit tight to avoid damaging threads.

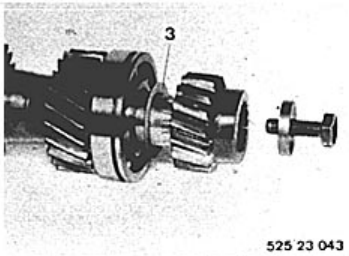


Press on new bearing.
Measure distance C from layshaft to grooved ball bearing.
C = 34.9 mm (1.374").



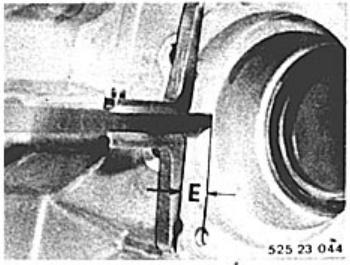
Measure thickness D of 1st gear – layshaft.
D = 34.7 mm (1.366").
Example:

C	34.9 mm (1.374")	
– D	34.7 mm (1.366")	
	0.2 mm (0.008")	shim thickness



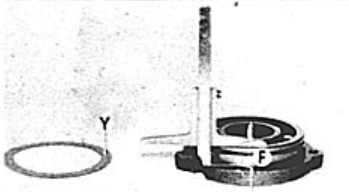
525 23 043

Install shim (3) of determined thickness.
Heat 1st gear wheel to about 80° C (175° F) with a hot air blower and install it on the layshaft.
Install bolt with a bolt cement**.
Tightening torque*.



525 23 044

Eliminate grooved ball bearing play of output shaft between the case and support ring.
Measure case depth E.
E = 13.1 mm (0.516")



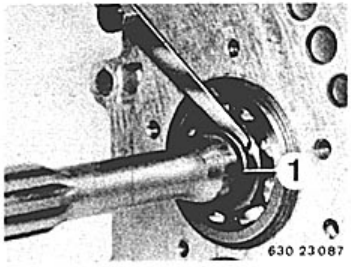
525 23 045

Place grooved ball bearing in support ring and measure distance F from grooved ball bearing to support ring.
F = 12.9 mm (0.508")

Example:

	E	=	13.1 mm (0.516")
–	F	=	12.9 mm (0.508")
	Y	=	0.2 mm (0.008") thick shim

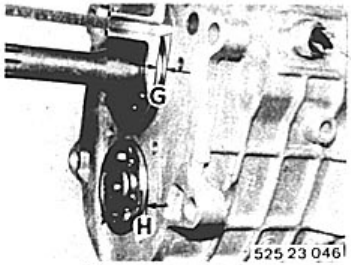
Important!
Shim Y must be installed between the grooved ball bearing and support ring.



630 23 087

Install complete gear wheel set.
Mount front case section.
Install circlip (1).
Measure distance between the circlip and grooved ball bearing inner race and eliminate play with shims.

* See Specifications
** Source of Supply: HWB

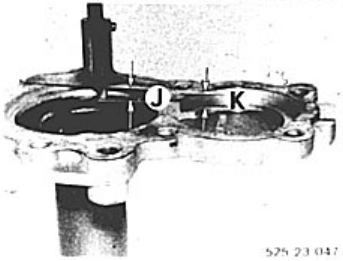


525 23 046

Eliminate play of grooved ball bearings on input shaft and layshaft to the guide flange.
Max. axial preload on bearing outer race = 0.1 mm (0.004").

Input Shaft:
G = 7.0 mm (0.275")

Layshaft:
H = 4.6 mm (0.181")



525 23 047

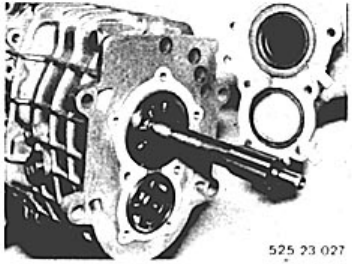
Measure distances J and K without gasket.
J = 7.5 mm (0.295") input shaft
K = 5.1 mm (0.201") layshaft
Important!
Use 0.2 mm (0.008") for thickness of gasket.
Input Shaft:

	J	=	7.5 mm (0.295")
–	G	=	7.0 mm (0.181")
			0.5 mm (0.020")
+			0.2 mm (0.008") gasket
			0.7 mm (0.028") thick shim

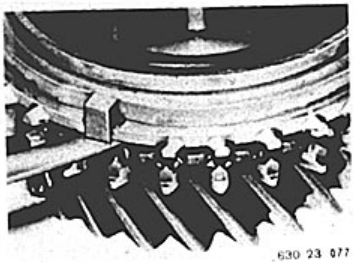
Layshaft:

	K	=	5.1 mm (0.201")
–	H	=	4.6 mm (0.181")
			0.5 mm (0.020")
+			0.2 mm (0.008") gasket
			0.7 mm (0.028")
–	0.1 ... 0.2 mm (0.004...0.008") axial pl.		
	0.5 ... 0.6 mm (0.020...0.024") shim		

Hold shim in position with grease.
Install gasket.
Important!
Gasket is omitted since 9.86.
Cover must be sealed with a sealing compound** and sealing surface must be thoroughly cleaned and dried of oil.
Note:
Gasket must be installed again on versions with a gasket.
Mount guide flange.
Install bolts with a sealing compound**.
Note length of bolts.
Tightening torque*


525 23 027

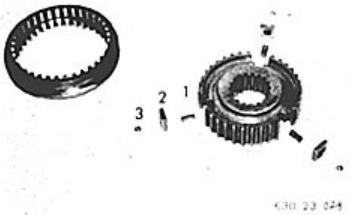
* See Specifications
** Source of Supply: HWB



630 23 077

23 23 504 DISASSEMBLING/ASSEMBLING ENTIRE SYNCHRONIZATION
– Output Shaft Removed –

Disassemble output shaft 23 21 552.
Synchromesh rings for 1st through 4th and reverse gears are machined brass rings, while ring for 5th gear is brass with molybdenum coat.
Note:
Only use molybdenum coated synchromesh rings for repairs.
Check distance* between synchromesh ring and clutch.
Measure in area of stops.
Synchromesh rings should be supported firmly on the entire surface.



630 23 078

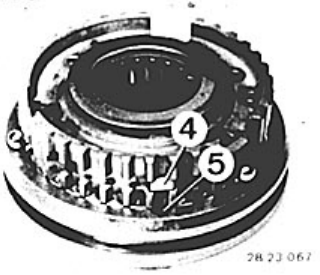
Disassemble synchronization.
Spring (1), thrust piece (2) and ball (3).
Installation:
The flat teeth of the operating sleeve must be aligned with the thrust pieces.



630 23 079

Installation:
Install all springs, thrust pieces and balls.
Important!
Curved surfaces of thrust pieces face operating sleeve.
Insert half of guide sleeve in operating sleeve.
Press in balls far enough that guide sleeve can be pressed into operating sleeve.

* See Specifications



28 23 067

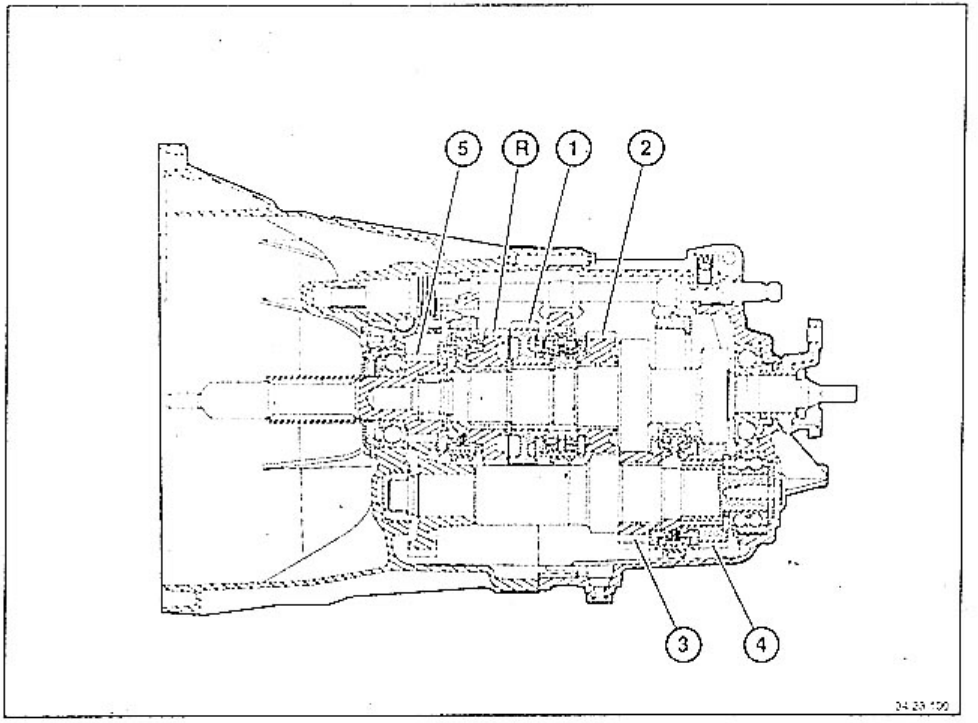
REVERSE GEAR SYNCHRONIZATION (WITH CENTRIFUGAL ARREST)

Install guide sleeve in operating sleeve that tab (4) on locking lever is aligned with opening (5) in operating sleeve.
Shouldered end of internal spline (guide sleeve) and opening (operating sleeve) are mounted in same plane.

Construction group 23 Manual transmission

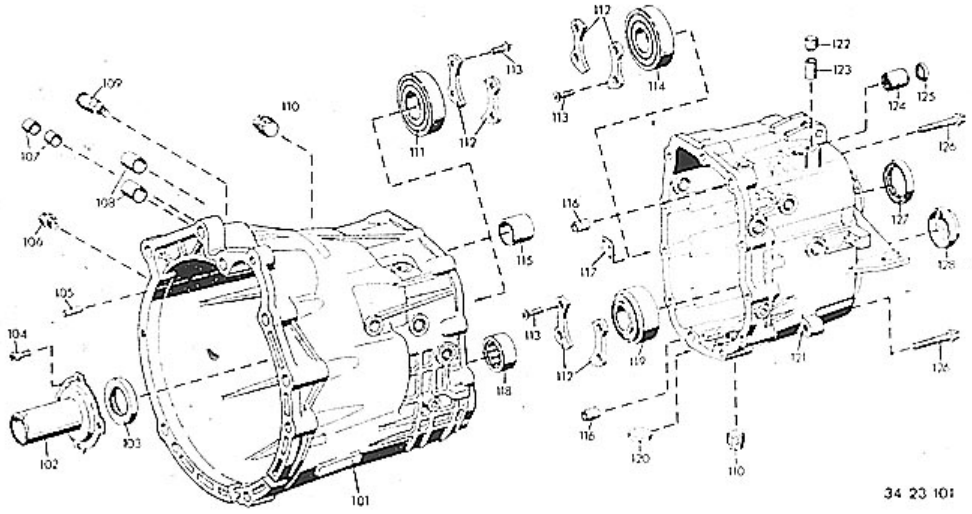
Five speed transmission – type GS5 D 310/4.20 Z (S5-31)

	Transmission – layout drawing	23- 400
	Front and rear case sections – layout drawing	23- 401
	Gears and shafts – layout drawing	23- 402
	Shift elements – layout drawing	23- 403
23 12 505	Radial oil seal for input shaft – replace	23- 404
23 21 502	Input and output shaft assembly – remove and install	23- 405
705	Bearings of all transmission shafts – replace	23- 414
23 23 507	Synchronization – disassemble and assemble	23- 416



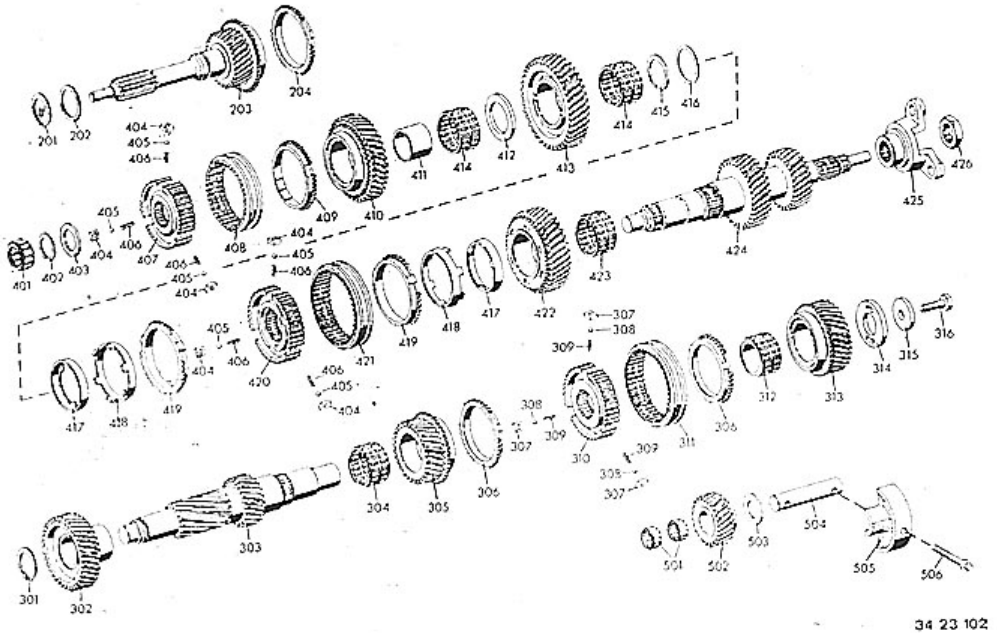
Cross Section Drawing View of Typo GS 5 D 310/4.20 Z (S 5-31) Transmission

1 First gear
2 Second gear
3 Third gear
4 Fourth gear
R Reverse gear



Drawing of Front and Rear Case Sections

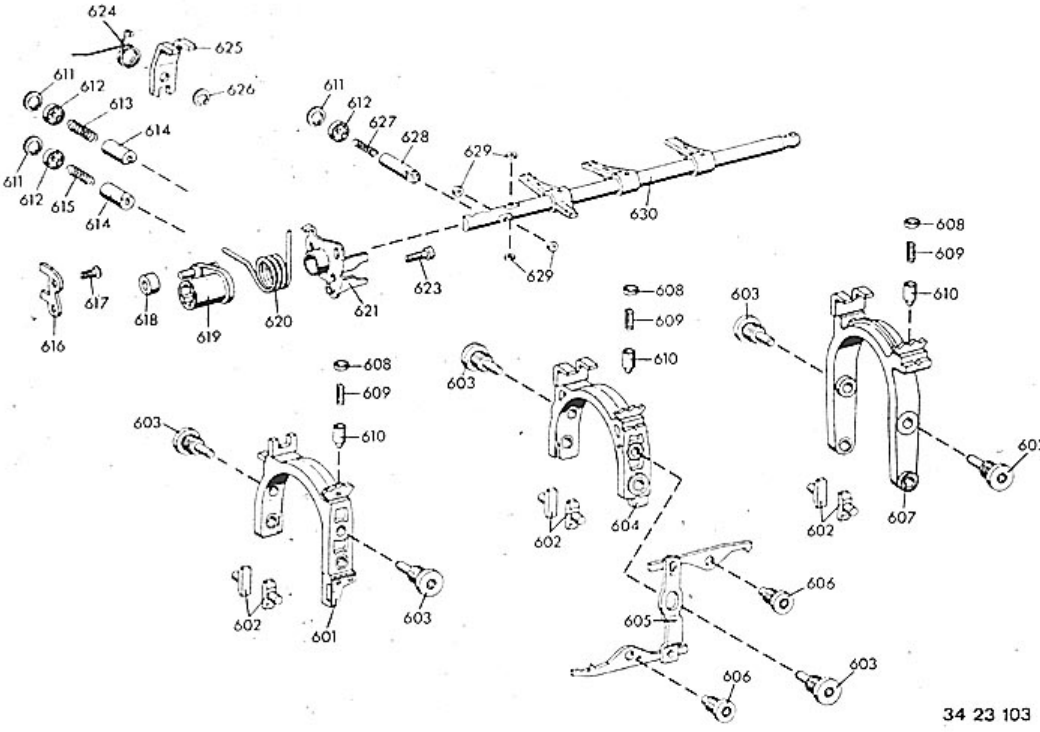
101	Front case section
102	Guide tube
103	Radial oil seal
104	Bolts
105	Dowel pin
106	Plug
107	Plain bearing
108	Plain bearing
109	Shaft
110	Plug
111	Ball bearing
112	Element
113	Bolts
114	Ball bearing
115	Plain bearing
116	Sleeves
117	Plate
118	Needle bearing
119	Ball bearing
120	Magnet
121	Rear case section
122	Cap
123	Sleeve
124	Ball sleeve
125	Radial oil seal
126	Bolts
127	Radial oil seal
128	Cover



Drawing of Gears and Shafts

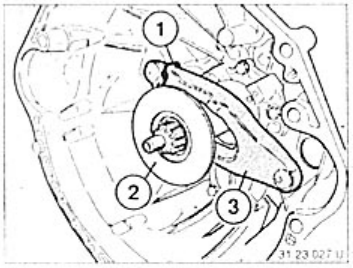
201 Circlip
202 Spacer
203 Input shaft
204 Synchromesh ring
301 Circlip
302 5th gear
303 Layshaft
304 Needle bearing
305 3rd gear
306 Synchromesh ring
307 Thrust piece
308 Ball
309 Spring
310 Guide sleeve
311 Operating sleeve
312 Needle bearing
313 4th gear
314 Thrust washer
315 Washer
316 Bolt
401 Grooved ball bearing
402 Circlip
403 Spacer
404 Thrust piece
405 Ball
406 Spring
407 Guide sleeve
408 Operating sleeve
409 Synchromesh ring
410 Reverse gear
411 Bearing sleeve
412 Washer
413 1st gear
414 Needle bearing
415 Circlip
416 Spacer
417 Inner race
418 Intermediate ring
419 Outer race
420 Guide sleeve
421 Operating sleeve
422 2nd gear
423 Needle bearing
424 Output shaft
425 Output flange
426 Collar nut
501 Needle bearing
502 Reverse gear
503 Thrust washer
504 Reverse gear shaft
505 Half-shell
506 Bolt

23–403



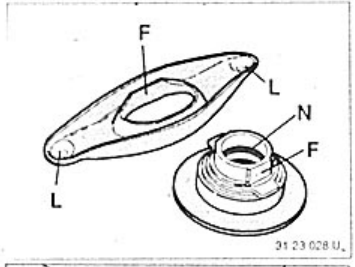
Drawing of Shift Elements

601	5th/reverse gear shift arm
602	Slide
603	Bearing shaft
604	1st/2nd gear shift arm
605	Locking lever
606	Shoulder shaft
607	3rd/4th gear shift arm
608	Cap
609	Spring
610	Catch pin
611	Circlip
612	Plug
613	Spring
614	Locking pin
615	Spring
616	Stop plate
617	Bolt
618	Roller
619	Selector arm
620	Spring
621	Gate plate
623	Bolt
624	Spring
625	Reversing lever
626	Retainer
627	Spring
628	Catch pin
629	Roller
630	Shift shaft

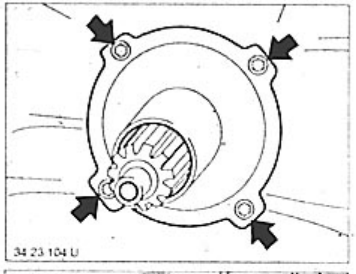


23 12 505 REPLACING RADIAL OIL SEAL FOR INPUT SHAFT

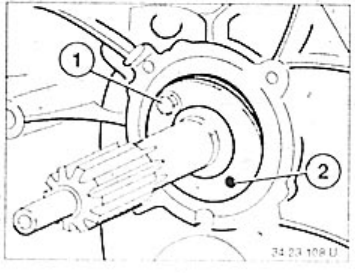
Remove transmission – refer to 23 00 023 in Model Repair Manual.
Lift out spring (1) and remove release lever (3) together with release bearing (2).



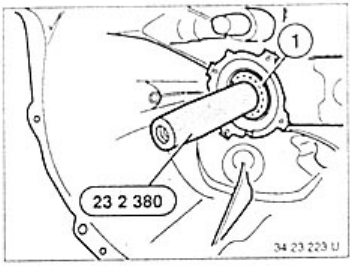
Installation:
Fill lubricating groove (N) with Molykote Longterm 2.
Coat guides (F) and bearings (L) with Molykote Longterm 2.
Non-conformance could cause seizure of the release bearing on the guide sleeve.



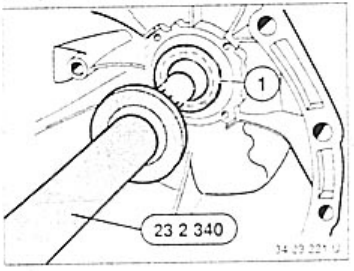
Unscrew guide tube.



Remove radial oil seal.
Locate and puncture bores (1 and 2) with a scriber.
Drive in radial oil seal to one side as far as stop.
Screw a suitable self-tapping screw into the opposite bore.
Remove radial oil seal by pulling out on the self-tapping screw (pliers).

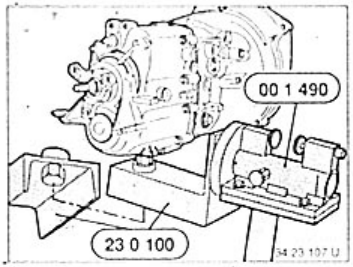


Lubricate sealing lip of radial oil seal with ATF.
Apply Special Tool 23 2 380 on the input shaft.
Slide on radial oil seal (1) as far as case.



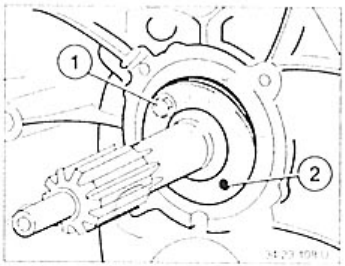
Pull off Special Tool 23 2 380.
Drive in radial oil seal (1) flush with Special Tool 23 2 340.
Mount guide tube.
Tightening torque*.

* See Specifications

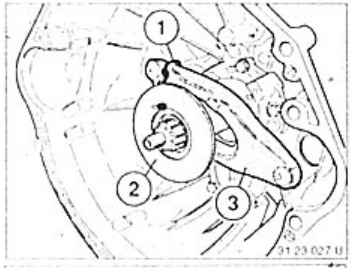


23 21 502 REMOVING AND INSTALLING INPUT AND OUTPUT SHAFT ASSEMBLY

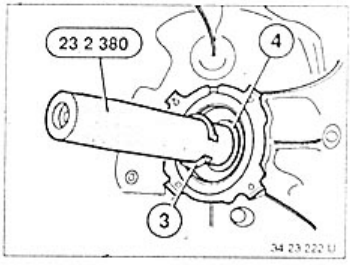
Remove transmission – refer to 23 00 023 in Model Repair Manual.
Unscrew drain plug.
Drain oil.
Screw Special Tool 23 0 100 into drain plug bore and secure.
Take up Special Tool 23 0 100 in Special Tool 00 1 490.



Remove radial oil seal.
Locate and puncture bores (1 and 2) with a scriber.
Drive in radial oil seal to one side as far as stop.
Screw a suitable self-tapping screw into the opposite bore.
Remove radial oil seal by pulling out on the self-tapping screw (pliers).



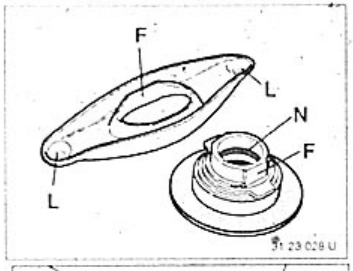
Lift out spring (1) and remove release lever (3) together with release bearing (2).



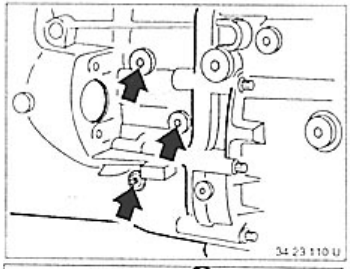
Caution!
Special Tool 23 2 380 must be used on the input shaft to remove circlip (3) so that the input shaft is not damaged.

Lift out circlip (3) and pull off over Special Tool 23 2 380.
Take off spacer (4).

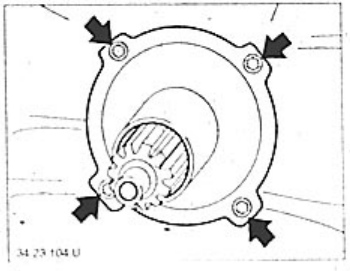
Installation:
Replace circlip (3).



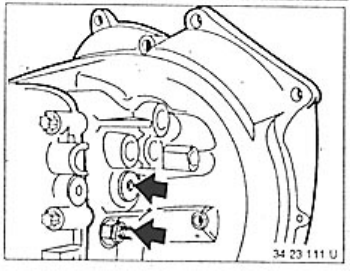
Installation:
Fill lubricating groove (N) with Molykote Longterm 2.
Coat guides (F) and bearings (L) with Molykote Longterm 2.
Non-conformance could cause seizure of the release bearing on the guide sleeve.



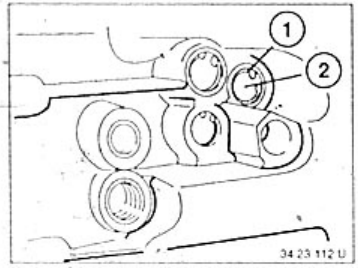
Unscrew left bearing shaft bolt and reverse gear shaft bolt in the front case section.



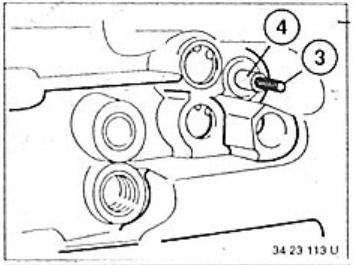
Unscrew guide tube.



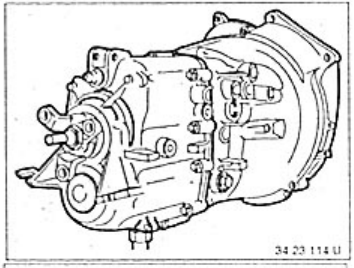
Unscrew reverse gear switch and right bearing shaft bolt in the front case section.



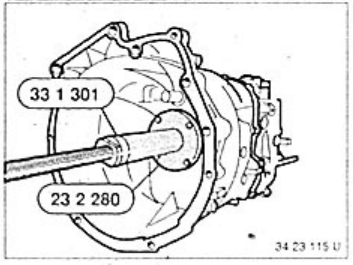
Lift out circlip (1).
Remove sealing cap (2).



Lift out spring (3) and catch pin (4).

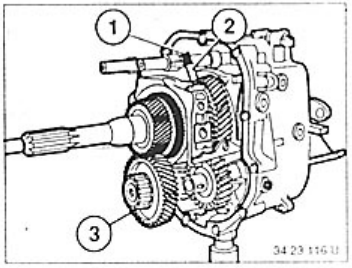


Unscrew case bolts.

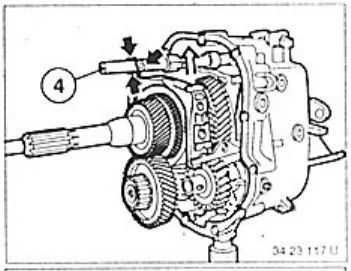


Pull off front case section using Special Tools 23 2 280 and 33 1 301.

Installation:
Bearings or elements of the bearing brackets could be damaged while pulling off the front case section.
Always replace bearings or elements.

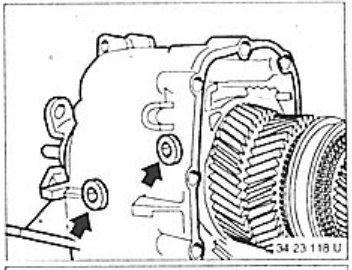


Remove loose spring (1) and thrust pin (2).
Take off needle bearing (3).

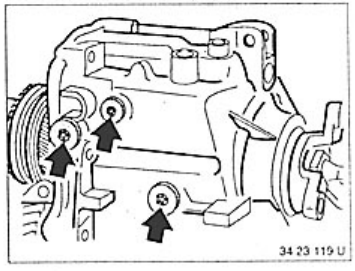


Pull out shift shaft (4).

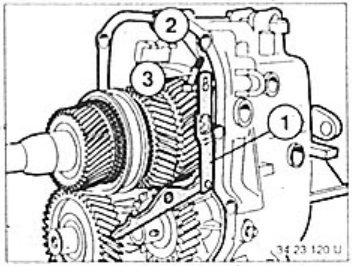
Important!
Needles on shift shaft.
Take off 5th/reverse gear shift arm upwards.



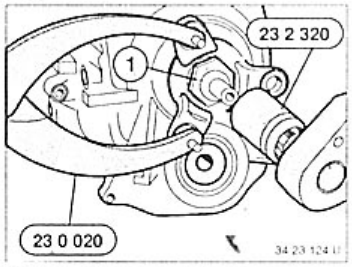
Remove two bearing shafts on the right-hand side.



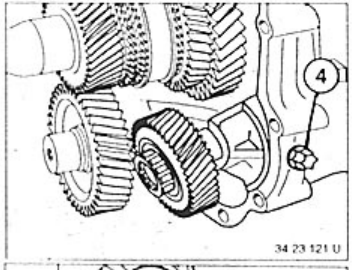
Remove three bearing shafts on the left-hand side.



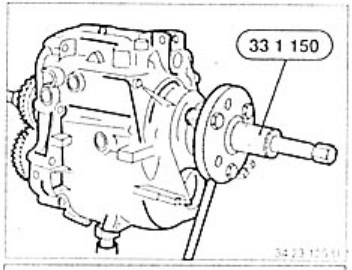
Remove complete locking lever (1).
Remove spring (2) and thrust pin (3).



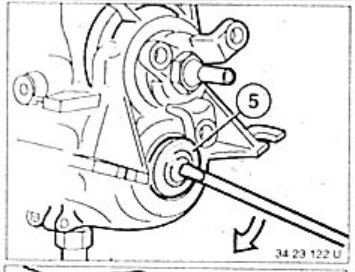
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut (1) with Special Tool 23 2 320.



Unscrew bolt (4).
Remove reverse gear with needle bearings, thrust washer, shaft anf half-shell.

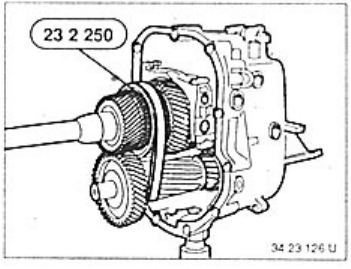


Pull off output flange using Special Tool 33 1 150.

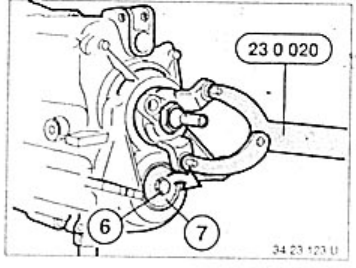


Puncture through middle of sealing cap (5).
Lever out sealing cap (5) with a screwdriver inserted into the hole.

Installation:
Replace sealing cap.



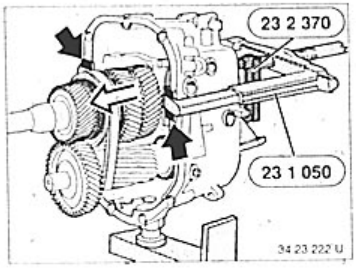
Compress gear set at 5th/reverse gear operating sleeve with layshaft.
Use Special Tool 23 2 250.



Engage a gear by hand.
Hold output flange with Special Tool 23 0 020.
Unscrew bolt (6).

Important!
Left-hand threads.

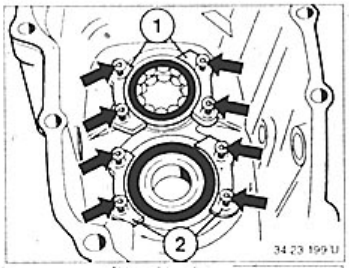
Remove washer (7).
Take out engaged gear.



Apply Special Tool 23 2 370 on output shaft and layshaft.
Apply Special Tool 23 1 050 on case sealing surface and middle of Special Tool 23 2 370.

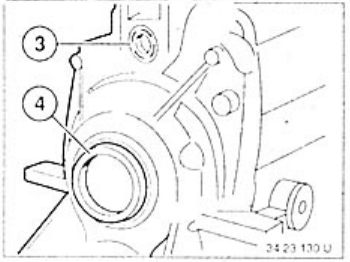
Important!
Use a piece of wood, plastic or similar on the sealing surfaces.
Press out gear set and layshaft uniformly.
Make sure that the gear set and layshaft do not clamp while pressing out.

Installation:
The bearings or elements of the bearing brackets could be damaged while pressing out the input shaft and output shaft.
Always replace bearings or elements after removal.

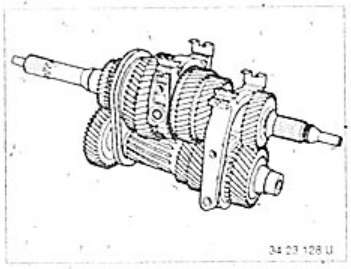


Replace bearings or elements for bearing brackets of the output shaft/layshaft (also refer to 23 21 705).
Screw on elements (1 and 2).

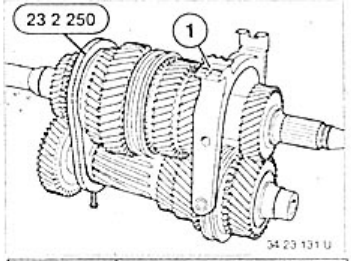
Installation:
Install bolts with a bolt cement**.
Tightening torque*.



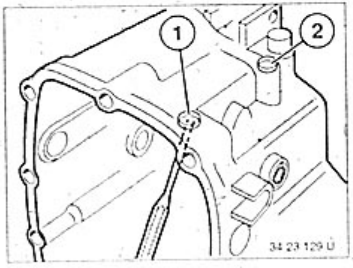
Lever out radial oil seals (3 and 4) for the output shaft and shift shaft.



Take out gear set with 1st/2nd and 3rd/4th gear shift arms and layshaft.

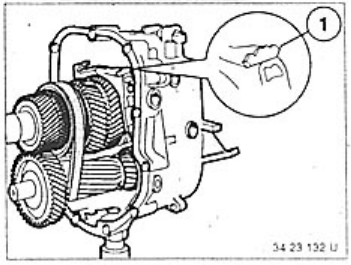


Compress the gear set at the 5th/reverse gear operating sleeve with the layshaft.
Use Special Tool 23 2 250.
Place 3rd/4th gear shift arm with slide on the 3rd/4th gear operating sleeve.
Have the shift arm bear on the 3rd gear of the output shaft.
Install shift arm with lock (1) in direction of the left-hand side input shaft.



Installing:
Clean the case.
Drive out sealing caps (1 and 2) on the rear case section from inside to outside using a mandrel.

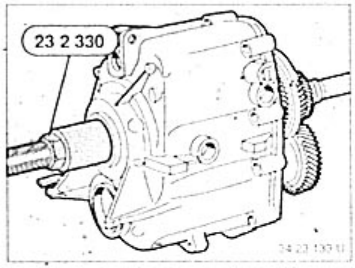
Installation:
Replace sealing caps.



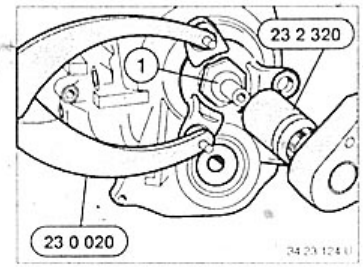
Place gear set with shift arm in the rear case section.
Place 1st/2nd gear shift arm with slide in the 1st/2nd gear operating sleeve.

Important!
Mount the shift arm with lock (1) in direction of the left-hand side input shaft.

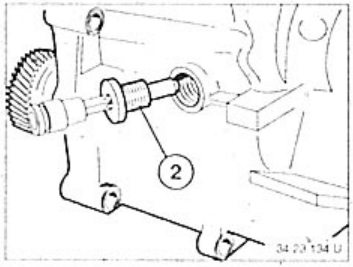
* See Specifications
** Source of Supply: BMW Parts



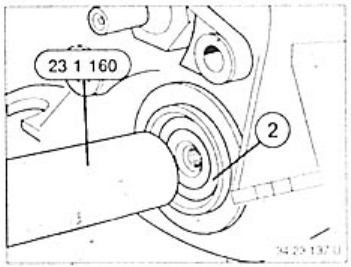
Apply Special Tool 23 2 330 on the output shaft journal.
Pull output shaft in to fit tight with Special Tool 23 2 330.
Make sure that shift arms and layshaft are not canted while pulling in; align if necessary.
Remove Special Tool 23 2 330.



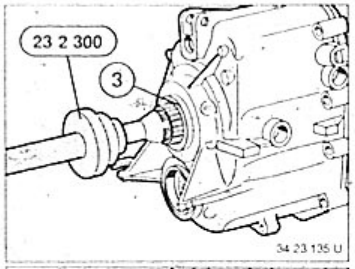
Install collar nut (1) with bolt cement** that its flat side faces the output flange.
Hold output flange with Special Tool 23 0 020.
Tighten collar nut with Special Tool 23 2 320.
Tightening torque*.



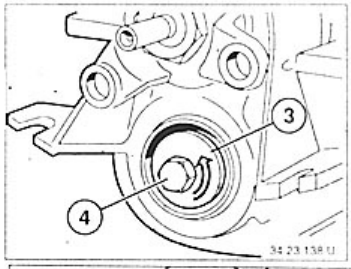
Center the 3rd/4th gear shift arm with the bore in the case by hand.
Screw in bearing shaft (2) on left and right sides separately by hand in this position and then tighten them.
Tightening torque*.



Heat ball bearing inner race (2) for layshaft to about 80° C with a hot air blower.
Press on ball bearing inner race (2) to fit tight with Special Tool 23 1 160; drive on with light knocks if necessary.

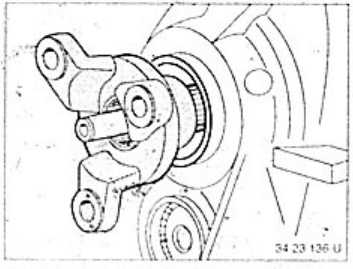


Lubricate sealing lip of radial oil seal with oil.
Drive in radial oil seal (3) for the output flange with Special Tool 23 2 300.

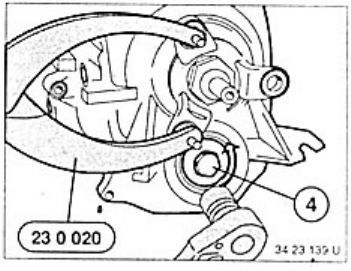


Install washer (3) and bolt (4) with bolt cement**.

Important!
Bolt (4) has left-hand threads.



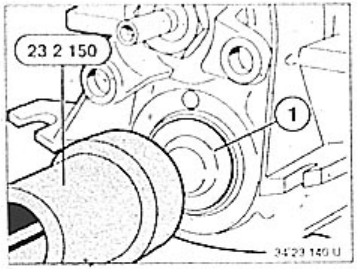
Heat output flange to about 80° C with a hot air blower.
Slide output flange on to the output shaft.
If necessary, drive on to fit tight with Special Tool 23 1 160.



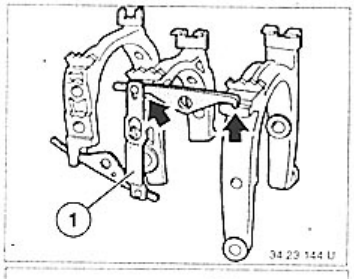
Remove Special Tool 23 2 250 from the gear set.
Engage a gear.
Hold output flange with Special Tool 23 0 020.
Tighten bolt (4).
Tightening torque*.
Disengage the gear.

* See Specifications

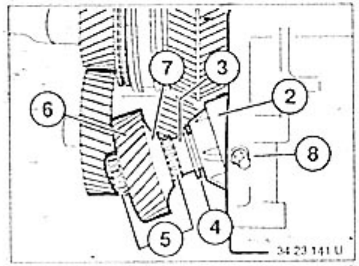
* See Specifications
** Source of Supply: BMW Parts



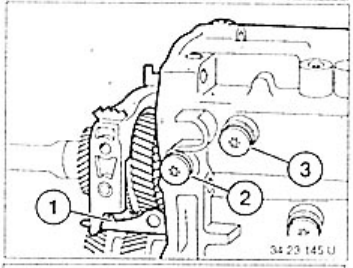
Insert and drive in sealing cap (1) flush with Special Tool 23 2 150.



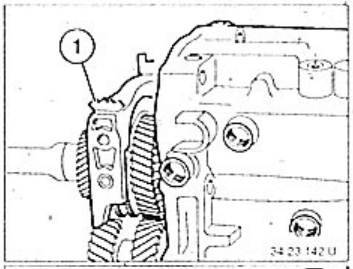
Swing locking lever (1) towards the inside and in so doing attach it in the openings of the 1st/2nd and 3rd/4th gear shift arms.



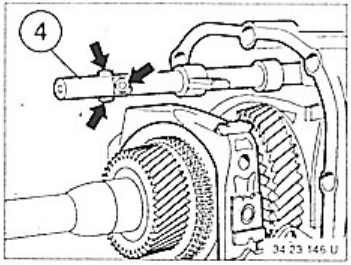
Coat half-shell (2) in area of the bolt bore with a sealing compound** and install.
Install shaft (3), thrust washer (4), needle bearing (5) and reverse gear (6) with shoulder (7) facing the case.
Coat shoulder of the bolt head with sealing compound**.
Install bolt (8) with bolt cement**, but do not tighten.



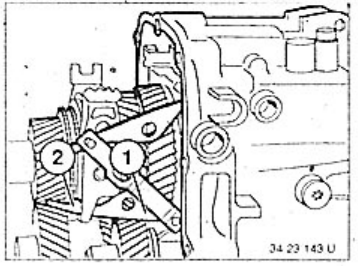
Center locking lever (1) with the bores by hand.
Install bearing shafts (2 and 3) on left and right sides by hand and then tighten them. Tightening torque*.
Check movement of the locking lever.



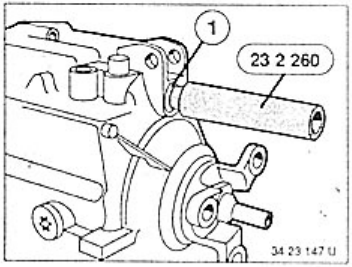
Install 5th/reverse gear shift arm and slide with catch (1) facing to the left in the 5th/reverse gear operating sleeve.



Guide in shift shaft (4) horizontally.
Hold four needles in position with grease.



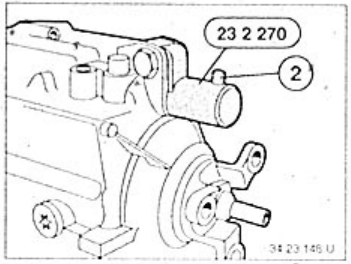
Guide in locking lever (1) with long tongue (2) in the slot of the 5th/reverse gear shift arm.



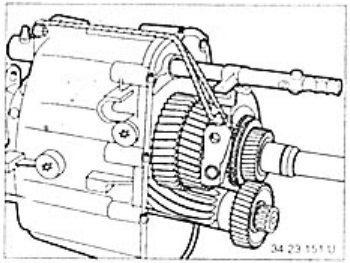
Drive in radial oil seal (1) for the shift shaft with Special Tool 23 2 260.

* See Specifications
** Source of Supply: BMW Parts

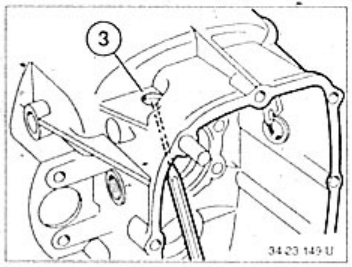
* See Specifications



Hold the shift shaft in neutral position with Special Tool 23 2 270.
Use a 8 mm bolt and cylindrical pin (2) from the shift joint or a suitable mandrel for holding the shift shaft.

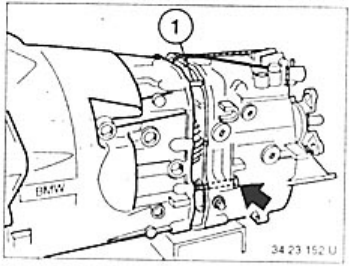


Hold the 5th/reverse gear shift arm in horizontal position with a piece of string to make installation easier.

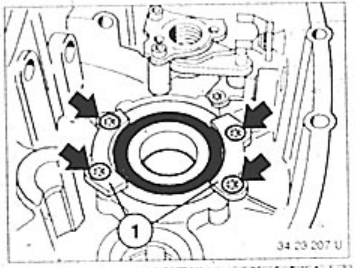


Clean the front case section.
Drive out sealing cap (3) for the catch pin from inside to outside using a punch.

Installation:
Replace sealing cap.

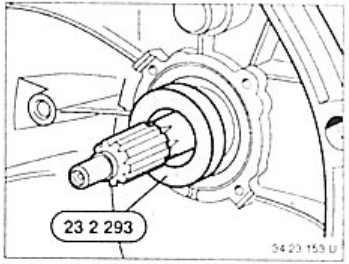


Mount the front case section as far as centering pins (1).
Screw two 8 x 75 mm bolts into the rear case section opposite each other on the left and right sides to center the case.

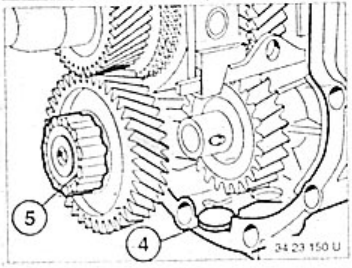


Replace bearings or elements for bearing brackets of the output shaft (also refer to 28 21 705).
Unscrew elements (1).

Installation:
Install bolts with a bolt cement**.
Tightening torque*.



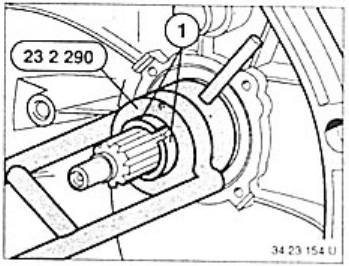
Place Special Tool 23 2 293 (thrust ring) from Special Tool 23 2 290 in the front case section.



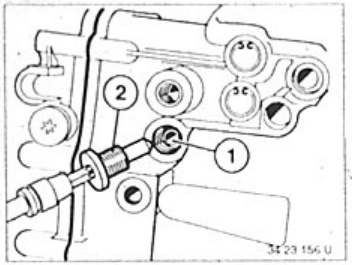
Place magnet (4) in the rear case section.
Install needle bearing (5) with the small diameter end on the outside.

Note:
Coat needles with grease and press them in to avoid canting of the needles when mounting the front case section.
Clean and coat case sealing surfaces with a sealing compound**.

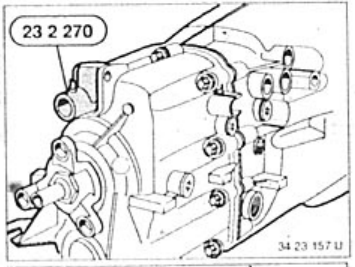
* See Specifications
** Source of Supply: BMW Parts



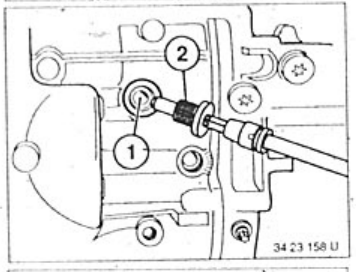
Apply Special Tool 23 2 290 on the input shaft.
Place supporting shells (1) on the input shaft that the tapered sides face in.
Unscrewing the spindle presses the front case section on to the input shaft.



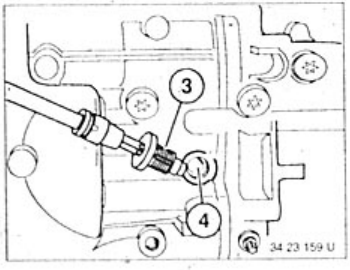
Press the front case section on only so far that the piece of string can still be removed after installation of the right bearing shaft.
Center 5th/reverse gear shift arm (1) with the bore and screw in the right bearing shaft (2) by hand, but do not tighten.
Remove piece of string.
Press on the front case section as far as stop.



Remove complete Special Tool 23 2 290.
Remove centering bolts from case.
Bolt front case section to rear section.
Tightening torque*.
Remove Special Tool 23 2 270 from shift shaft.

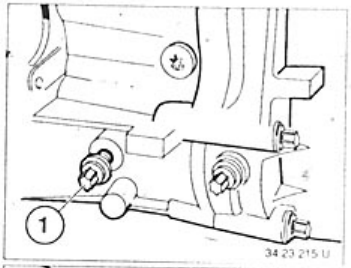


Center 5th/reverse gear shift arm (1) with the bore and screw in the left bearing shaft (2) by hand.
Tighten left and right bearing shafts (2).
Tightening torque*.

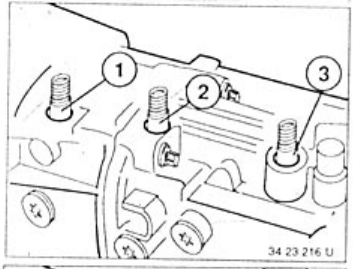


Install bearing shaft (3) for the locking lever.
This requires turning the transmission until bore (4) in the locking lever is aligned with the bore in the case.
In this position screw in bearing shaft (3) by hand and then tighten:
Tightening torque*.

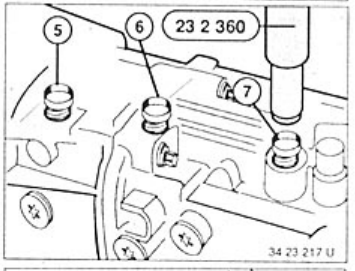
* See Specifications



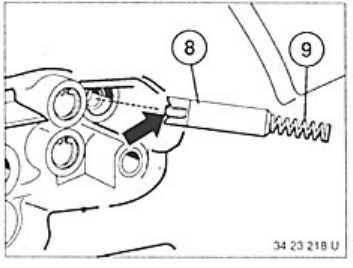
Coat shoulder of the bolt head with a sealing compound**.
Install bolt (1) for the reverse gear shaft bolt with a bolt cement**.
Tighten bolt bolts.
Tightening torque*.



Place catch pins (1 ... 3) with springs in the shift arms.



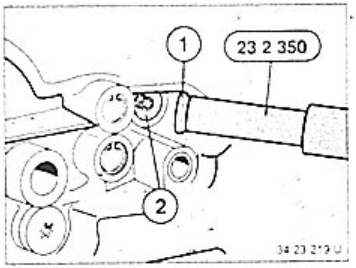
Knock in sealing caps (5 ... 7) with Special Tool 23 2 360.



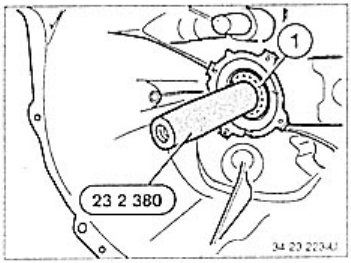
Catch pin (8) and spring (9)

Important!
Check installed position of catch pin (8).
Roller must be horizontal.

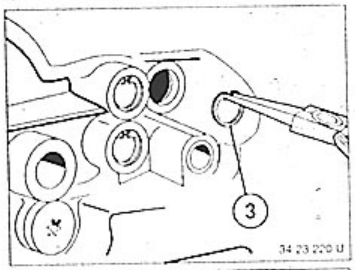
* See Specifications
** Source of Supply: BMW Parts



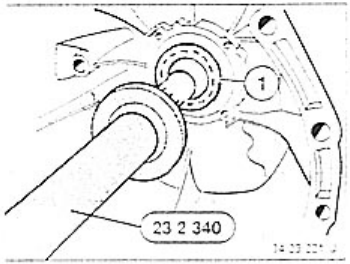
Install sealing cap (1) in bore (2) with help of Special Tool 23 2 350 and push in as far as possible.



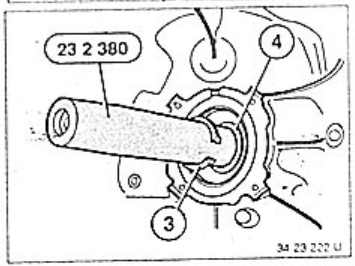
Lubricate sealing lip of the radial oil seal with ATF.
Apply Special Tool 23 2 380 on the input shaft.
Push on radial oil seal (1) as far as the case.



Install circlip (3) and press in as far as groove with Special Tool 23 2 350.
Check for correct seating of the circlip (visual inspection).
Install the reverse gear switch.



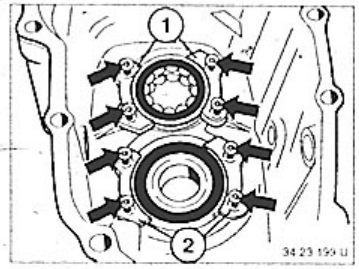
Remove Special Tool 23 2 380.
Drive in radial oil seal (1) flush with Special Tool 23 2 340.
Mount guide tube.
Tightening torque*.



Install spacer (4).

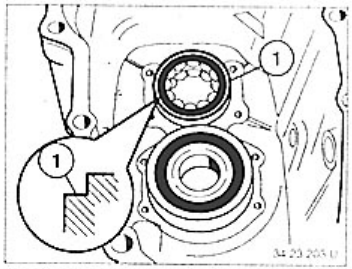
Caution!
Special Tool 23 2 380 must be used on the input shaft while installing circlip (3) to avoid damaging the input shaft.
Slide circlip (3) over Special Tool 23 2 380 and install it in the groove.
The circlip must seat in the groove without play.
Replace circlip with a circlip of correct thickness.
Circlips are available in different thicknesses in steps from 2.2 to 2.6 mm.

* See Specifications

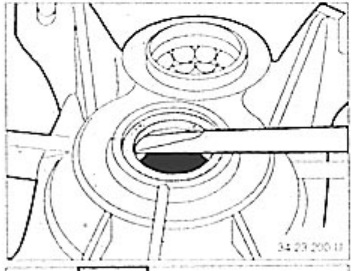


23 21 705 REPLACING BEARINGS OF ALL TRANSMISSION SHAFTS
– Input and Output Shafts Removed –

Rear Case Section:
Unscrew bolts.
Remove elements (1 and 2).

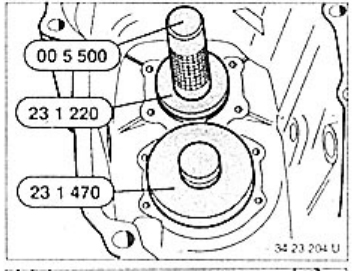


Heat rear case section in area of the ball bearing uniformly to about 80° C with a hot air blower.
Install ball bearings for output shaft and layshaft.
Insert ball bearing for the layshaft with the shouldered end (1) facing in.

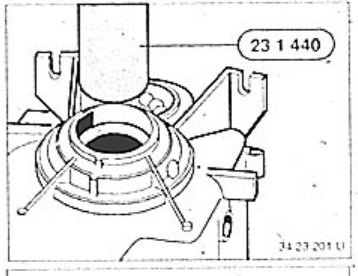


Lever out radial oil seal for the output flange.

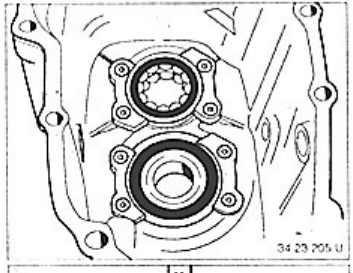
Installation:
Replace radial oil seal.



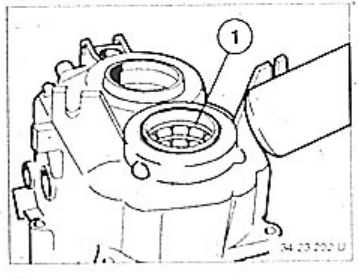
If necessary, drive in ball bearings to fit tight.
Use Special Tool 23 1 470 for the output shaft and Special Tool 23 1 220 for the layshaft in conjunction with Special Tool 00 5 500.



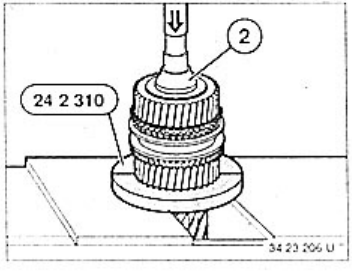
Drive out the ball bearing for the output shaft toward the inside, using Special Tool 23 1 440.



Install elements.
Install bolts with a bolt cement and tighten.**
Tightening torque*.

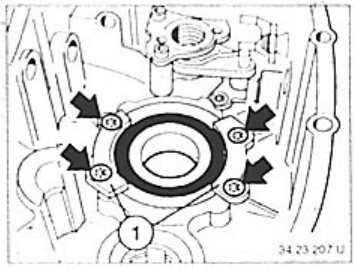


Layshaft:
Heat case in area of the ball bearing to about 80° C with a hot air blower.
Remove ball bearing (1) toward the inside.
Clean the rear case section to remove dirt.



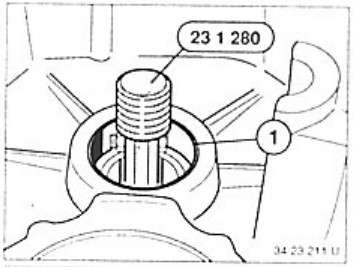
The 3rd/4th gear has to be pressed off with Special Tool 23 2 310 to be able to replace bearing inner race (2).
Removal – refer to "Replacing 3rd/4th Gear Synchronization" in 23 23 507.

* **See Specifications**
** **Source of Supply: BMW Parts**



Bearings in Front Case Section

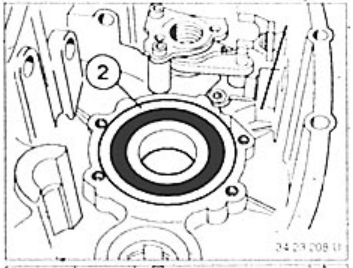
Input shaft:
Unscrew bolts.
Remove elements (1).



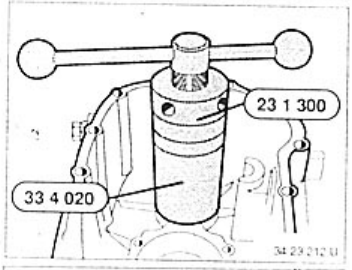
Layshaft:

1 = bearing shell for needle bearing

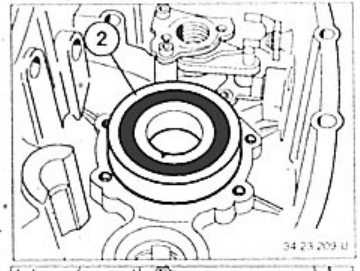
Place Special Tool 23 1 280 in bearing shell (1).



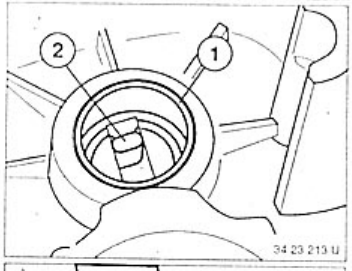
Heat case in area of the ball bearing to about 80° C with a hot air blower.
Pull out ball bearing (2); if necessary drive it out from outside to inside with help of Special Tool 23 1 440.



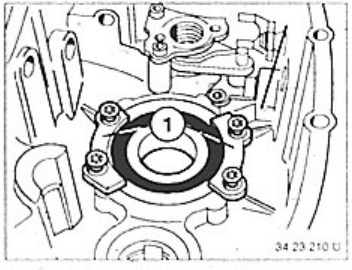
Apply Special Tool 33 4 020.
Screw on Special Tool 23 1 300.
Pull bearing shell out.



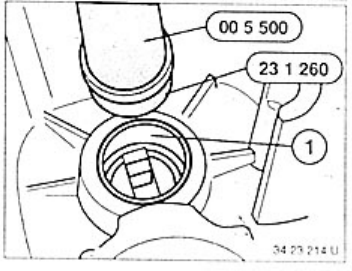
Heat case in area of the ball bearing to about 80° C with a hot air blower.
Install ball bearing (2); if necessary drive it in to fit tight with Special Tool 23 1 470.



Installation:
Insert bearing shell (1) that the slot in the bearing shell is aligned with beads (2) (turning lock) in the case.

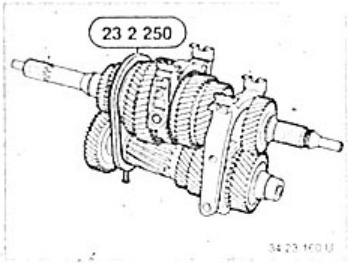


Install elements (1).
Install bolts with a bolt cement and tighten.**
Tightening torque*.



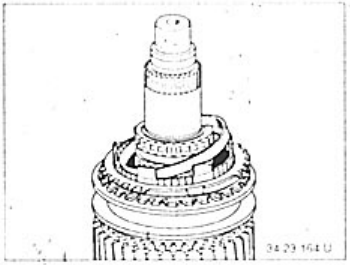
Drive in bearing shell (1) with Special Tools 23 1 260 and 00 5 500.

* See Specifications
** Source of Supply: BMW Parts

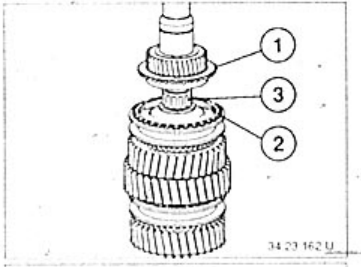


23 23 507 DISASSEMBLING AND ASSEMBLING COMPLETE SYNCHRONIZATION

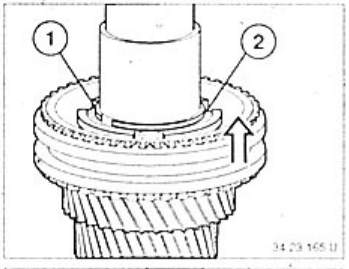
Remove input and output shaft assembly – see 23 21 502.
Pull off 1st/2nd and 3rd/4th gear shift arms.
Remove Special Tool 23 2 250.



Pull off the needle bearing, synchromesh ring, intermediate ring and outer race.



Pull off input shaft (1), synchromesh ring (2) and needle bearing (3).

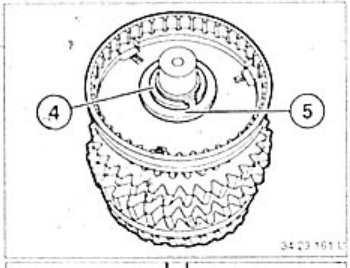


Pull off the 1st/2nd gear operating sleeve.

Important!
Loose thrust pieces, balls and springs.

Lift out circlip (1).
Take off spacer (2).

Installation:
Replace circlip (1).

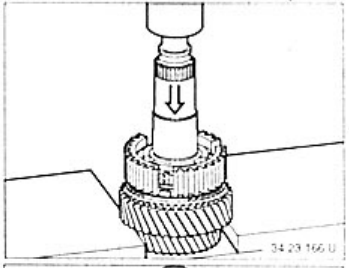


Clamp gear set in a vise fitted with soft jaws on the output shaft.
Pull off the 5th/reverse gear operating sleeve.

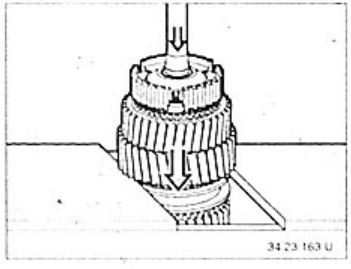
Important!
Loose thrust pieces, balls and springs.

Remove circlip (4) and spacer (5).

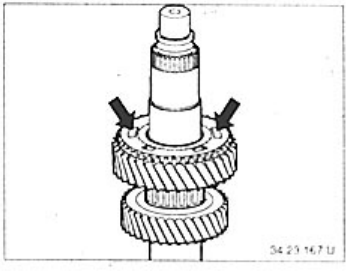
Installation:
Replace circlip (4).



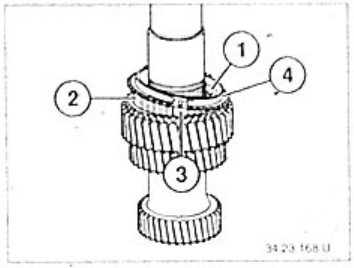
Place pressing-off liners on the 2nd gear.
Press the guide sleeve, 2nd gear with synchromesh ring and needle bearing off of the output shaft.



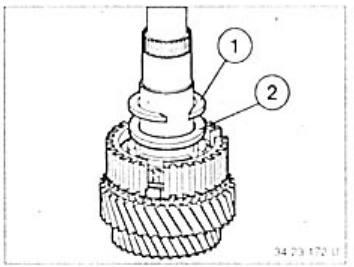
Move the 1st/2nd gear operating sleeve in direction of the 2nd gear.
Place pressing-off liners on the 1st gear.
Press the guide sleeve, reverse gear with synchromesh ring, needle bearing and bearing sleeve, 1st gear and thrust washer off of the output shaft.



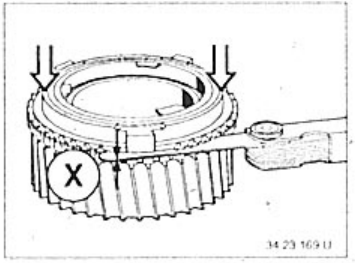
Assembling Gear Set:
Mount needle bearing and 2nd gear with the openings facing up.



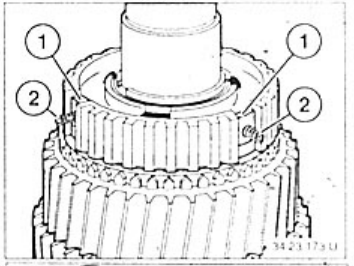
Install synchronization, consisting of:
inner race (1), intermediate ring (2) with dogs (3) in the openings of the 1st gear and synchromesh ring (4).



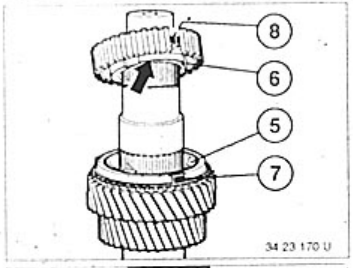
Install spacer (2).
Insert circlip (1).
The circlip must seat in the groove without play; if necessary replace spacer (1).
Spacers are available in different thicknesses in steps from 1.8 to 2.05 mm.



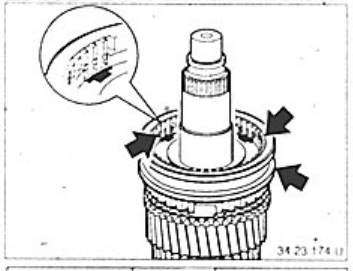
Inspect the 2nd gear synchronization for wear.
Measure distance X between the gear and synchromesh ring.
In so doing press down uniformly on the synchromesh ring by hand.
Specification: at least 0.9 mm.
Actual new part distance: 1.1 ... 1.6 mm.
When replacing, all three parts must be replaced at one time.



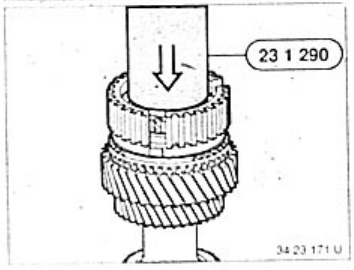
Place three thrust pieces (1) and three springs (2) in the opening of the guide sleeve.



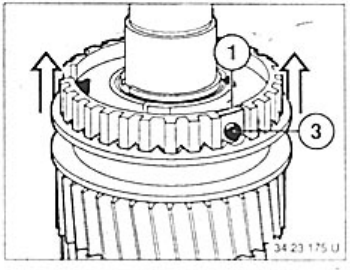
Heat guide sleeve to about 80° C with a hot air blower.
Mount the guide sleeve with the long shoulder facing the 2nd gear.
When mounting make sure that dogs (5) of the inner race are aligned with openings (6) in the gear.
In addition dogs (7) on the synchromesh ring must engage in grooves (8) of the guide sleeve.



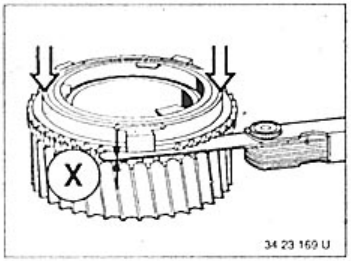
Mount the 1st/2nd gear operating sleeve with the flat side facing up or the bevelled side facing the 2nd gear.
The three set-back or opened teeth must point to the springs



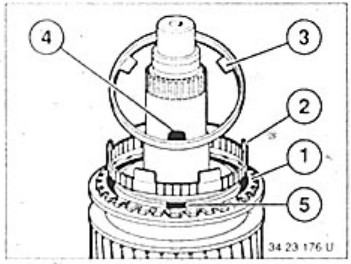
Press on guide sleeve to fit tight with Special Tool 23 1 290.



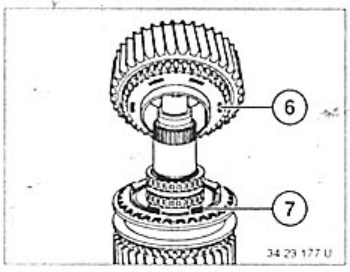
Tilt thrust pieces (1) out of the operating sleeve separately far enough that balls (3) can be placed on the springs.
Push in balls (3) and simultaneously press the thrust pieces into the operating sleeve.
Pull the operating sleeve upwards uniformly as far as the lock (neutral position).



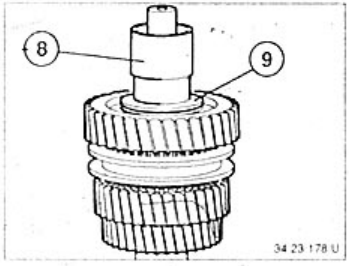
Inspect the 1st gear synchronization for wear.
Measure distance X between the gear and synchromesh ring.
In so doing press down uniformly on the synchromesh ring by hand.
Specification: at least 0.9 mm.
Actual new part distance: 1.1 ... 1.6 mm.
When replacing, all three parts must be replaced at one time.



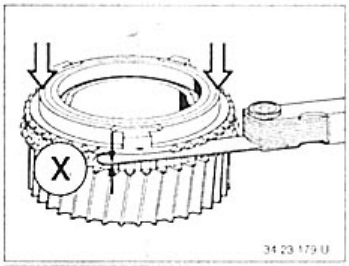
Install synchromesh ring (1), intermediate ring (2) and inner race (3) with dogs (4) in openings (5) of the guide sleeve.



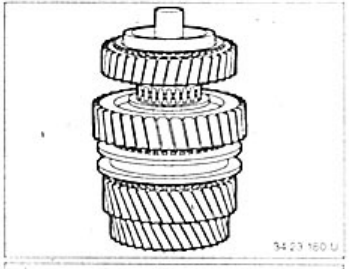
Mount needle bearing.
Install the 1st gear with grooves (6) facing the dogs (7).



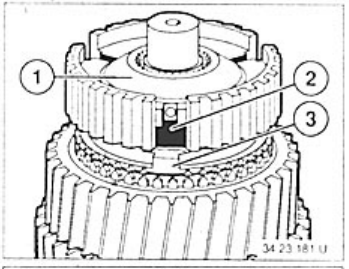
Heat thrust washer (9) and bearing sleeve (8) to about 80° C with a hot air blower and install then on the output shaft, pressing on if necessary.
Use Special Tool 23 1 290 for thrust washer.
Use Special Tool 33 1 342 for bearing sleeve.



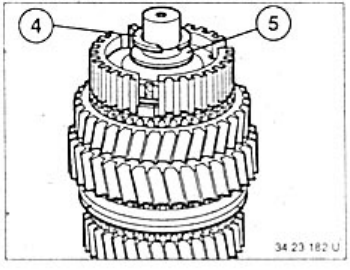
Inspect the reverse gear synchronization for wear.
Measure distance X between the gear and synchromesh ring.
In so doing press down uniformly on the synchromesh ring by hand.
Specification: at least 0.5mm.
Actual new part distance: 0.7 ... 1.15 mm.



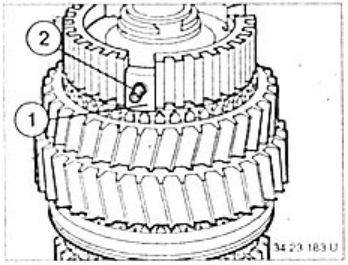
Mount the needle bearing and reverse gear.



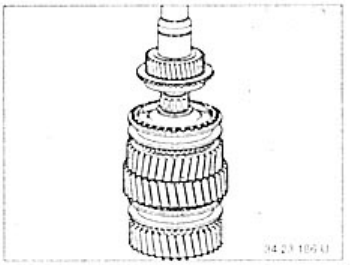
Place the reverse gear synchromesh ring on the reverse gear cone.
Heat the 5th/reverse gear guide sleeve to about 80° C with a hot air blower and install it on the output shaft with conical end (1) facing up; if necessary press on to fit tight with Special Tool 33 1 342.
Make sure that dogs (3) engage in opening (2).



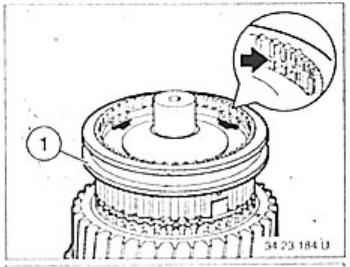
Install spacer (5) and circlip (4).
Circlip (4) must seat in the groove without play; replace spacer if necessary.
Spacers are available in different thicknesses in steps from 3.6 to 4.0 mm.
Knock in the circlip slightly.



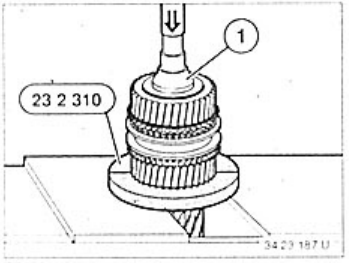
Place three thrust pieces (1) and three springs (2) in the opening of the guide sleeve.



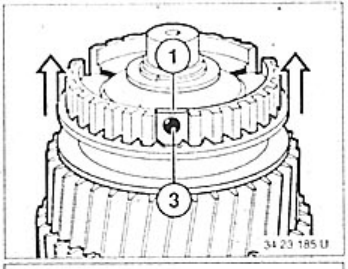
Install synchromesh ring.
Install needle bearing and input shaft with the 5th gear.



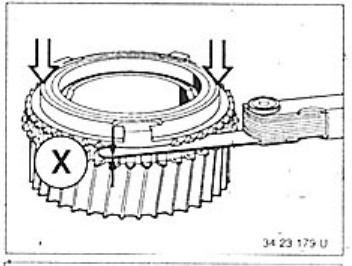
Install the operating sleeve with shouldered end (1) facing the reverse gear.



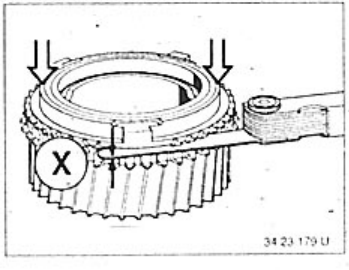
Layshaft:
Replace the 3rd/4th gear synchronization.
Apply Special Tool 23 2 310 on the 3rd gear.
Press bearing inner race (1), thrust washer, 4th gear with needle bearing, synchronization and 3rd gear with needle bearing off of the layshaft.



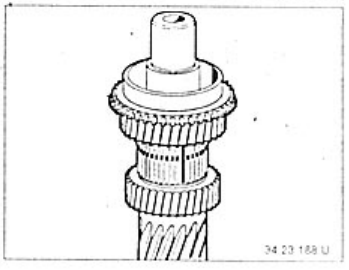
Tilt thrust pieces (1) out of the operating sleeve separately far enough that ball (3) can be placed on the springs.
Press balls (3) in and simultaneously push the thrust pieces into the operating sleeve.
Install the 5th gear synchromesh ring in the operating sleeve.
Pull the operating sleeve upwards uniformly as far as the lock (neutral position).



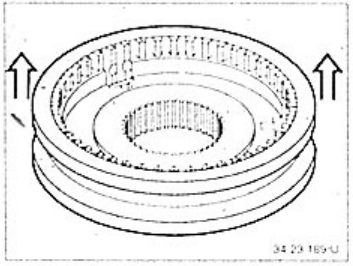
Assembling:
Inspect the 3rd/4th gear synchronization for wear.
Measure distance X between the gear and synchromesh ring.
In so doing press down uniformly on the synchromesh ring.
Specification: at least 0.75 mm.
Actual new part distance: 0.95 ... 1.35 mm.



Inspect the 5th gear synchronization for wear.
Measure distance X between the gear and synchromesh ring.
In so doing press down uniformly on the synchromesh ring.
Specification: at least 0.75 mm.
Actual new part distance: 0.95 ... 1.35 mm.

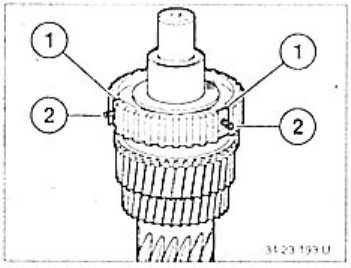


Install needle bearing and 4th gear.

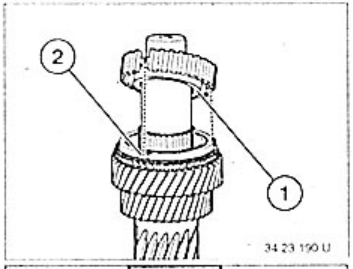


Pull the 3rd/4th gear operating sleeve off of the guide sleeve.

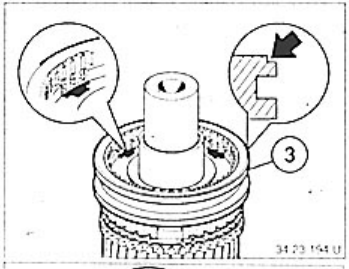
Important!
Loose balls, springs and thrust pieces.



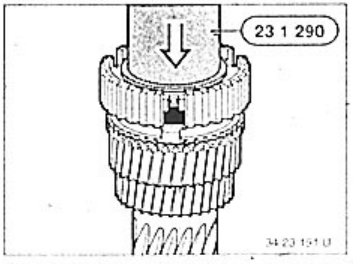
Insert three thrust pieces (1) and three springs (2) into the opening of the guide sleeve.



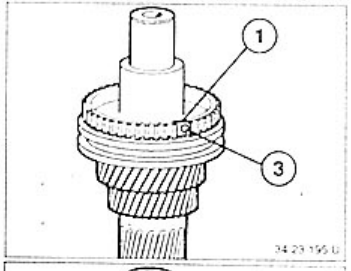
Place the synchromesh ring on the 3rd gear cone.
Heat the 3rd/4th gear guide sleeve to about 80° C with a hot air blower.
Install the guide sleeve with long shoulder (1) facing the 3rd gear.
When installing make sure that dogs (2) are aligned with the openings in the guide sleeve.



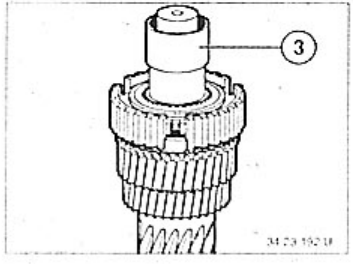
Install the 3rd/4th gear operating sleeve with the shouldered end (3) facing up.
The three set-back or opened teeth must point to the springs.



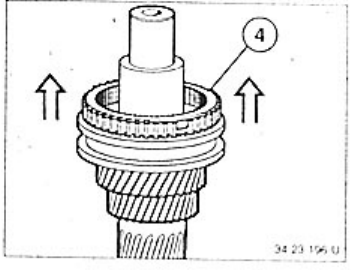
If necessary, press the guide sleeve on to fit tight with help of Special Tool 23 1 290.



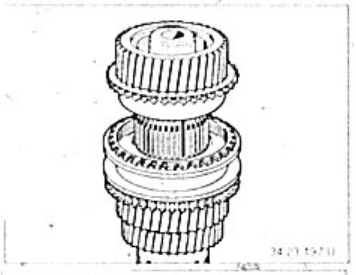
Tilt thrust pieces (1) out of the operating sleeve separately far enough that balls (3) can be placed on the springs.
Press balls (3) in and simultaneously push the thrust pieces into the operating sleeve.



Heat bearing inner race (3) to about 80° C with a hot air blower and install it on the layshaft.
If necessary, press it on to fit tight with help of Special Tool 33 1 342.

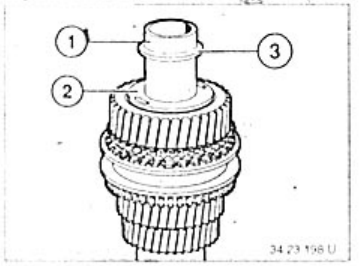


Install synchromesh ring (4) in the openings of the guide sleeve.
Pull the operating sleeve upwards uniformly as far as the lock (neutral position).



Install needle bearing and 4th gear.

Important!
Needle bearings are selected by the manufacturers according to certain tolerances and have a green color code.
Do not mix up with other needle bearings.

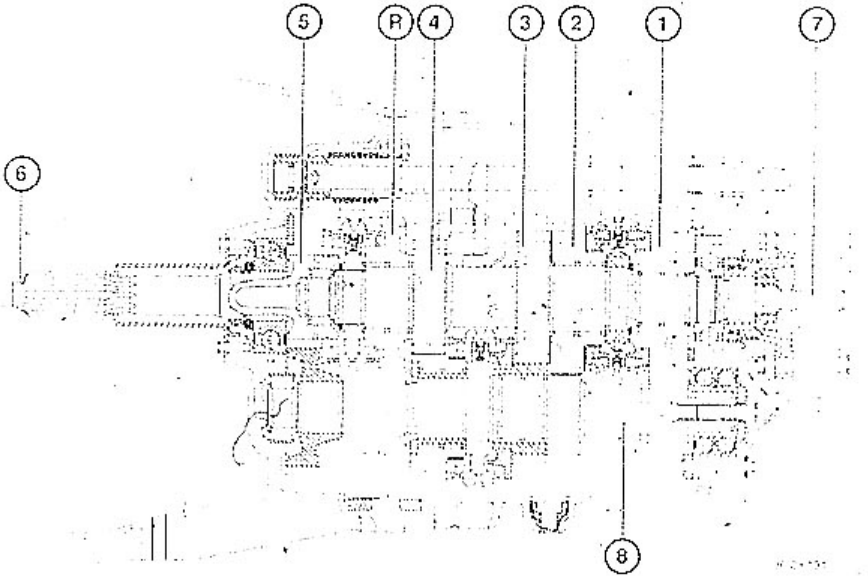


Heat thrust washer (2) and bearing inner race (1) to about 80° C with a hot air blower and install on the layshaft with shoulder (3) facing down.
If necessary, press them on to fit tight with help of Special Tool 23 1 160.

Construction group 23 Manual transmission

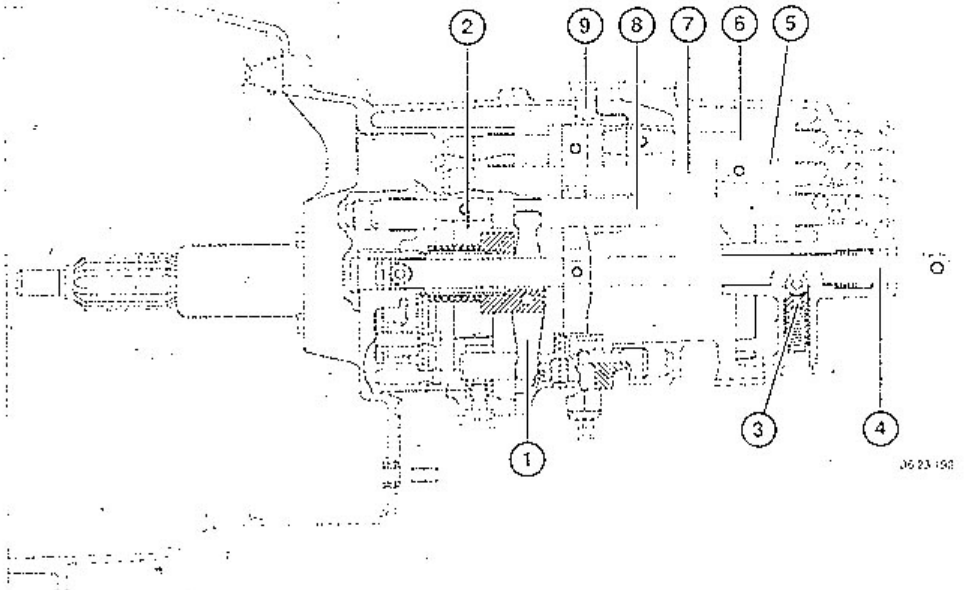
Five speed manual transmissions – type S5 D 200 G / 250 G

	Transmission – layout drawing	23- 450
	Shift elements – layout drawing	23- 451
23 12 506	Radial oil seal for input shaft – replace	23- 452
23 21 505	Input and output shaft assembly – remove and install	23- 453
706	Bearings of all transmission shafts – replace	23- 461
23 23 508	Synchronization – disassemble and assemble	23- 464



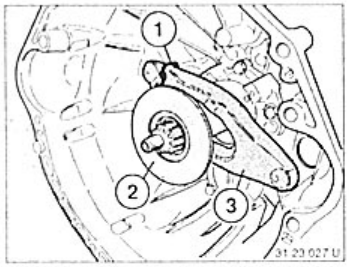
Cross Section Drawing of Transmission

1 First gear
2 Second gear
3 Third gear
4 Fourth gear
5 Fifth gear
R Reverse gear
6 Input shaft
7 Output shaft
8 Layshaft



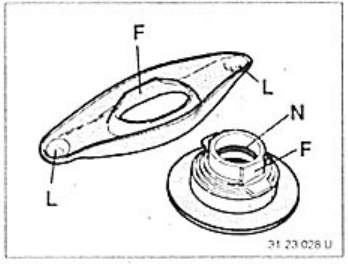
Cross Section Drawing of Shift Elements

1 Reversing lever
2 5th/reverse gear shift fork
3 Lock pin
4 Shift shaft
5 1st/2nd gear shift fork
6 3rd/4th gear shift rod
7 1st/2nd gear shift rod
8 5th/reverse gear shift rod
9 3rd/4th gear shift fork

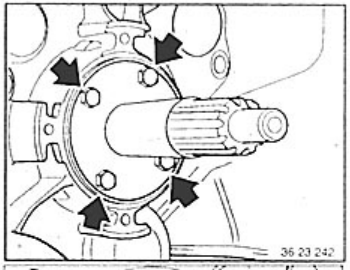


23 12 506 REPLACING RADIAL OIL SEAL FOR INPUT SHAFT

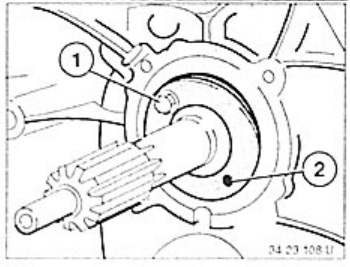
Remove transmission – refer to 23 00 023 in Model Repair Manual.
Lift out spring (1) and remove release lever (3) together with release bearing (2).



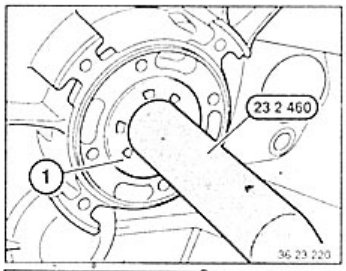
Installation:
Fill lubricating groove (N) with Klüber Microlube GL 261**.
Coat guides (F) and bearings (L) with Klüber Microlube GL 261**.
Non-conformance could cause seizure of the release bearing on the guide sleeve.



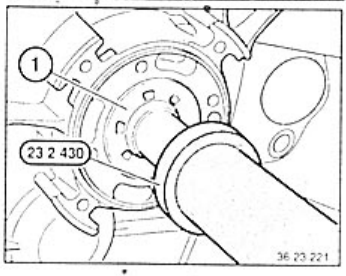
Unscrew guide tube.



Remove radial oil seal.
Locate and puncture through bores (1 and 2) with a scriber.
Drive in radial oil seal to one side as far as stop.
Screw a suitable self-tapping screw into the opposite bore.
Remove radial oil seal by pulling out on the self-tapping screw (use pliers).



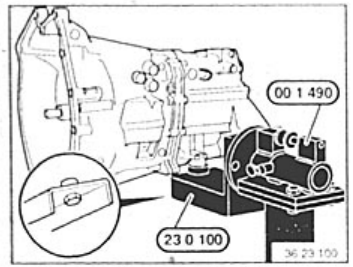
Lubricate sealing lip of radial oil seal with ATF.
Apply Special Tool 23 2 460 on the input shaft.
Slide on radial oil seal (1) as far as case.



Pull off Special Tool 23 2 460.
Drive in radial oil seal (1) flush with Special Tool 23 2 430.
Use a plastic hammer to drive in seal.
Mount guide tube.
Install bolts with bolt cement Loctite No. 242.
Tightening torque*.

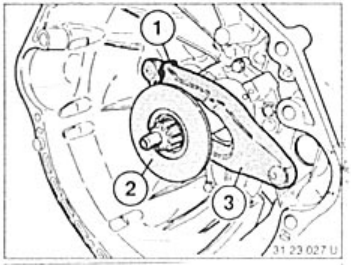
** Source of Supply: BMW Parts

* See Specifications

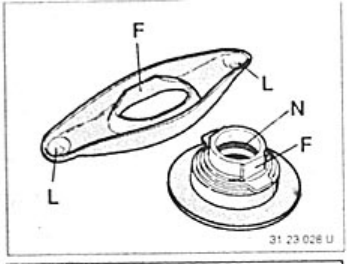


23 21 505 REMOVING AND INSTALLING INPUT AND OUTPUT SHAFT ASSEMBLY

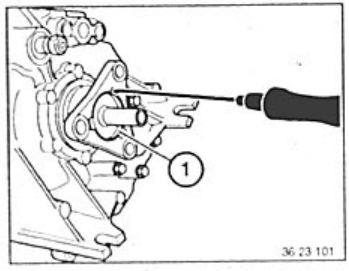
Remove transmission – refer to 23 00 023 in Model Repair Manual.
Unscrew drain plug.
Drain oil.
Screw Special Tool 23 0 100 into oil drain plug bore and secure.
Take up Special Tool 23 0 100 in Special Tool 00 1 490.



Lift out spring (1) and remove release lever (3) together with release bearing (2).



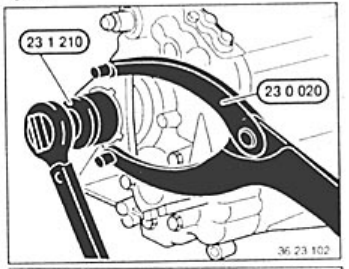
Installation:
Fill lubricating groove (N) with Klüber Microlube GL 261**.
Coat guides (F) and bearings (L) with Klüber Microlube GL 261**.
Non-conformance could cause seizure of the release bearing on the guide sleeve.



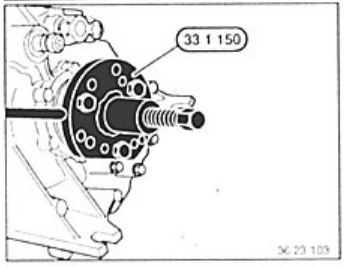
Lift out lock plate (1).

Installation:
Replace lock plate.

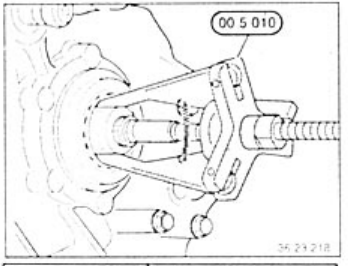
** Source of Supply: BMW Parts



Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.

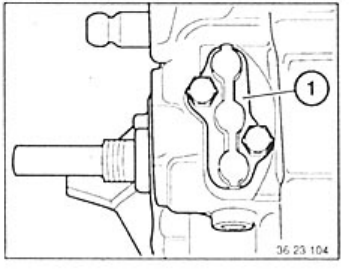


Pull off output flange by hand.
If too difficult, pull off output flange with Special Tool 33 1 150.

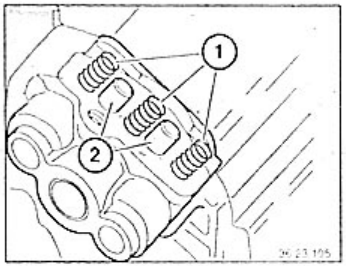


Pull out radial oil seal with Special Tool 00 5 010.

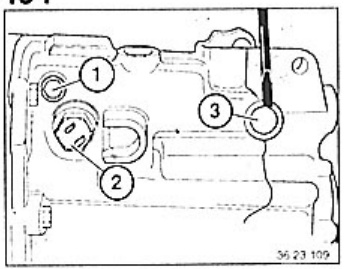
Installation:
Replace radial oil seal.



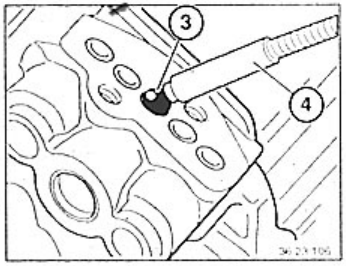
Unscrew end cover (1).



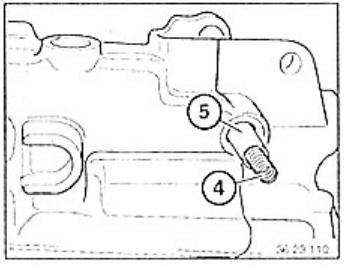
Remove springs (1) and pins (2).



Unscrew bolt (1) and reverse gear switch (2).
Lever out end cap (3).

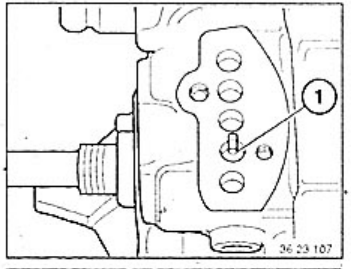


Remove arresting and locking balls (3) with help of magnet (4).

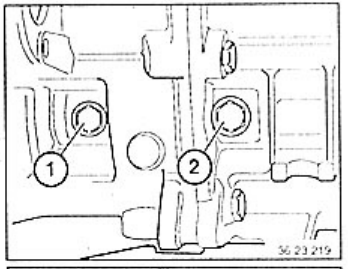


Remove spring (4) and catch pin (5).

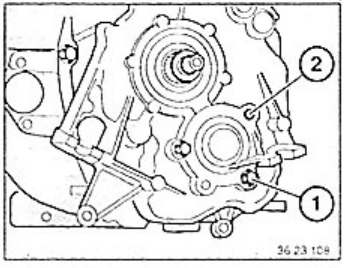
Installation:
Check installed position.



Position lock pin (1) in the middle.
To hold in this position the second gear must be engaged by hand.

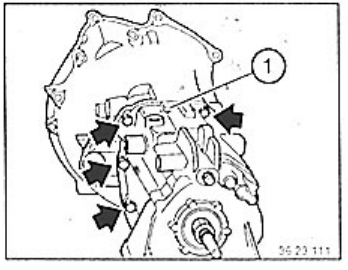


Unscrew reverse gear shaft mounting bolts (1 and 2).

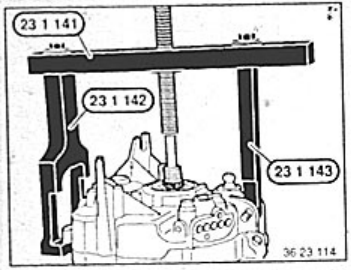


Unscrew four bolts (1) from cover.

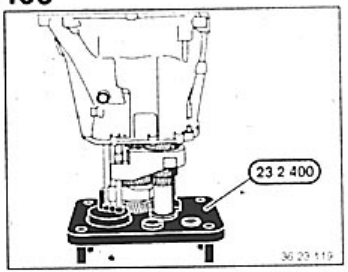
Important!
Pay attention to insulators (2) under heads of bolts.



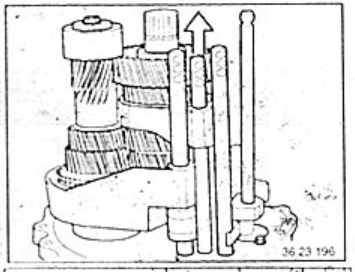
Loosen transmission case bolts.
Drive out two cylindrical pins (1) with a mandrel.



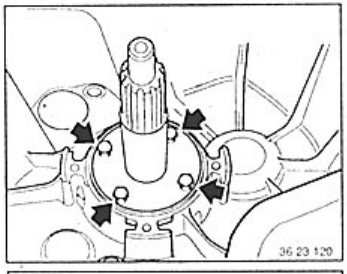
Remove transmission from Special Tool 00 1 490 and turn transmission to have it standing upright.
Mount Special Tool 23 1 141 on lower case section with help of Special Tools 23 1 142 and 23 1 143.
Pull off rear case section.



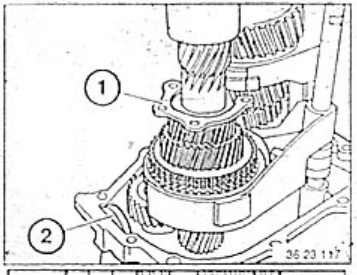
Place gear assembly set and front case section on Special Tool 23 2 400.



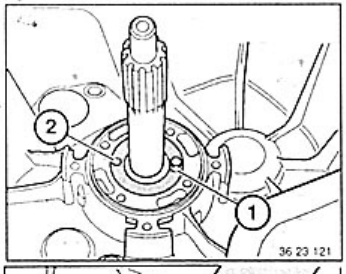
Disengage second gear by hand (neutral).



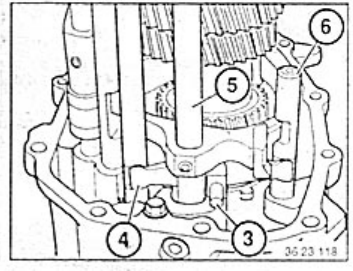
Unscrew guide tube.



Remove holder (1) and magnet (2).

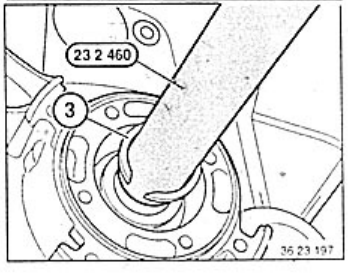


Remove radial oil seal.
Locate and puncture through bores (1 and 2) with a scriber.
Drive in radial oil seal to one side as far as stop.
Screw a suitable self-tapping screw into the opposite bore.
Remove radial oil seal by pulling out on the self-tapping screw (use pliers).



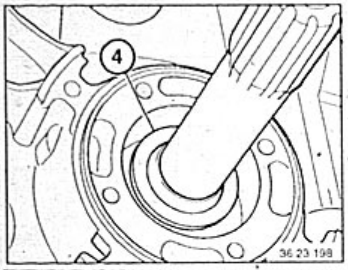
Remove shaft pin (3) and reversing lever (4).
Take off shift rail (6).
Pull out shift shaft (5).

Important!
Rollers.

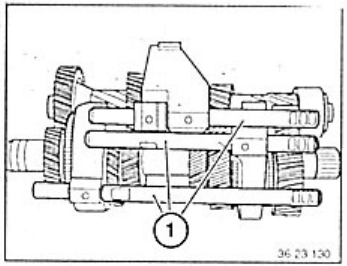


Important!
Special Tool 23 2 460 must be used on the input shaft when removing circlip (3), in order to avoid damaging the input shaft.
Lift out first circlip (3) and pull off over Special Tool 23 2 460.

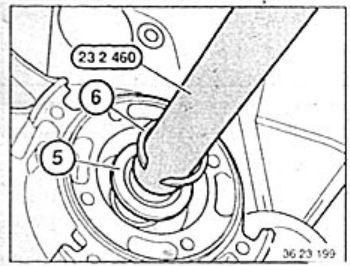
Installation:
Replace circlip (3).



Pull off Special Tool 23 2 460.
Remove locking ring (4).



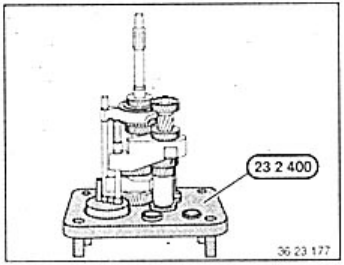
Take gear assembly set with shift rods (1) off of Special Tool 23 2 400.



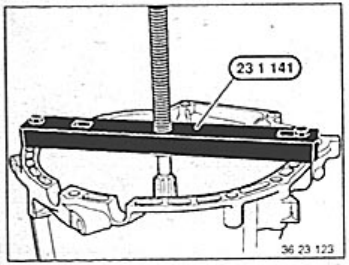
Important!
Special Tool 23 2 460 must be used on the input shaft when removing circlip (6), in order to avoid damaging the input shaft.
Lift out second circlip (6) and secure to Special Tool 23 2 460.
Pull Special Tool 23 2 460 with circlip (6) off of input shaft.

Installation:
Replace circlip (6).

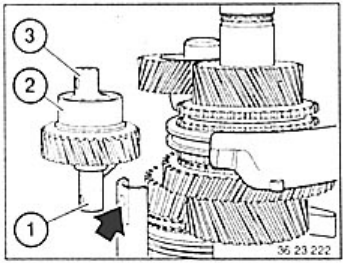
Lift out spacer (5).



Installation:
Place complete gear assembly set with shift rods in Special Tool 23 2 400.

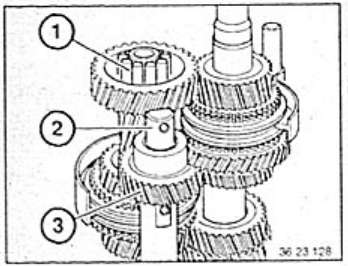


Apply Special Tool 23 1 141 on front transmission case section and secure on outside with two bolts.
Pull front case section off of gear assembly set.

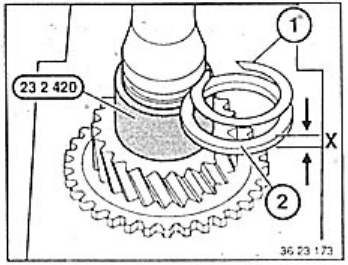


Install reverse gear with collar (2) facing up and shaft with long end (1) in Special Tool 23 2 400 and secure with one bolt.

Important!
Coat outside of short end (3) of reverse gear shaft with Loctite No. 574**.

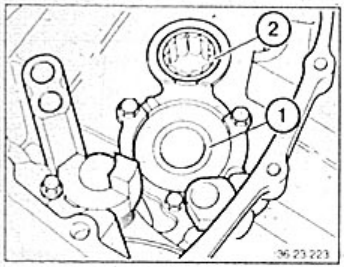


Remove roller bearing (1).
Remove reverse gear (3) and shaft (2).

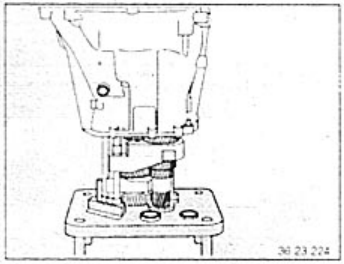


Check axial play of input shaft.
Apply Special Tool 23 2 420 on input shaft.
Install spacer (2) and new circlip (1) in groove.
Measure axial play with a feeler gage blade.
Axial play = 0.04 mm.
Spacer (2) is available from Parts with thickness X of 2.3 to 2.65 mm.

** Source of Supply: BMW Parts

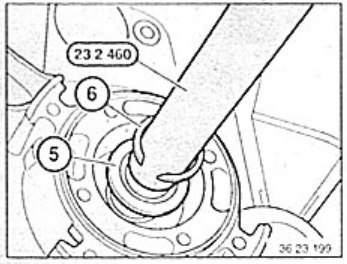


Align shift rods with each other.
Heat bearing inner race (1) of input shaft in front case section to about 110 ... 120° C (with hot air blower).
The heated temperature must be reached precisely — check with a temperature tester**.
Align shift rods with each other.
Insert roller bearing (2) after heating with viscous grease in the bearing sleeve that the large diameter end faces up.



Mount front case section carefully.
Fifth gear synchromesh ring could seize.

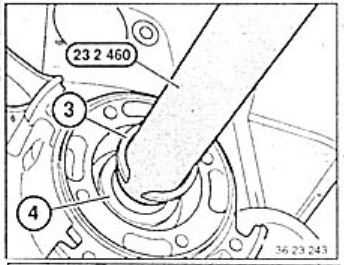
Note!
After assembling the complete transmission the fifth gear synchromesh ring can be loosened again by turning the input or output shaft.



Install spacer (5).

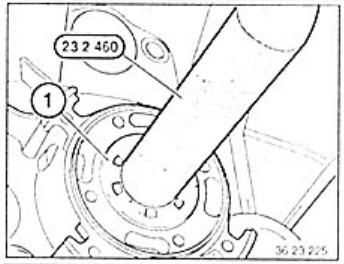
Important!
Special Tool 23 2 460 must be used on the input shaft when installing circlip (6), in order to avoid damaging the input shaft.
Slide circlip (6) over Special Tool 23 2 460 and into the second groove.

** Source of Supply: BMW Parts

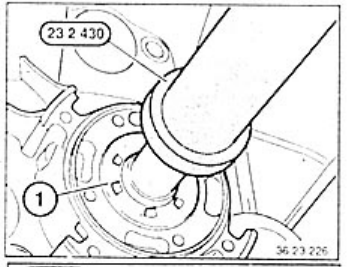


Insert locking ring (4).

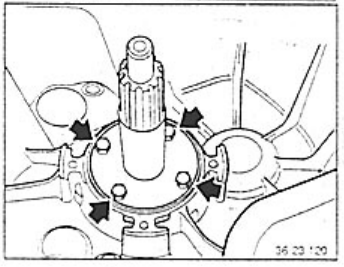
Important!
Special Tool 23 2 460 must be used on the input shaft when installing circlip (3), in order to avoid damaging the input shaft.
Slide circlip (3) over Special Tool 23 2 460 and into the first groove.



Lubricate sealing lip of radial oil seal with ATF.
Slide on radial oil seal (1) over Special Tool 23 2 460 as far as case.
Pull off Special Tool 23 2 460.

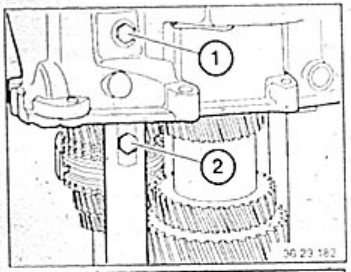


Drive in radial oil seal (1) with Special Tool 23 2 430.
Use a plastic hammer for driving in.

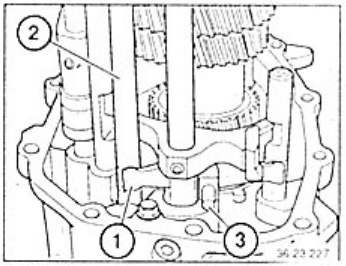


Mount guide tube.
Install bolts with bolt cement Loctite No. 242**.
Tightening torque*.

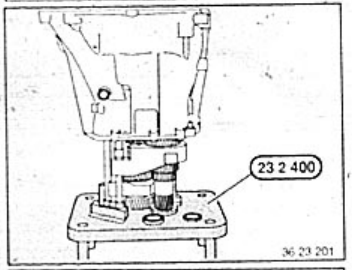
* See Specifications
** Source of Supply: BMW Parts



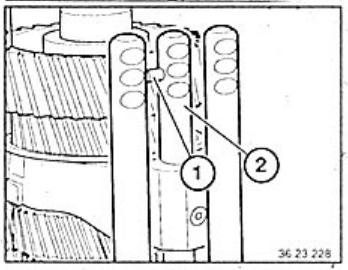
Mount reverse gear shaft on front case section.
Install bolt (1) with bolt cement Loctite No. 242** and tighten.
Tightening torque*.
Loosen bolt (2) on Special Tool 23 2 400.



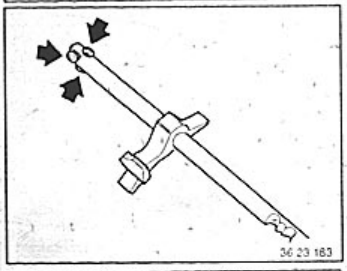
Install reversing lever with large round surface (1) facing 1st/2nd gear shift rod (2).
Ground surface must point towards case.
Hold reversing lever in position with pin (3).



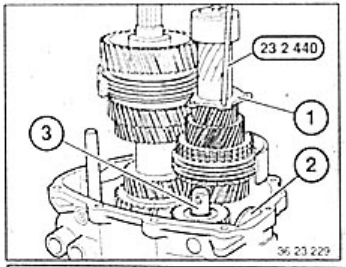
Take front case section with gear assembly set off of Special Tool 23 2 400.
Position front case section with gear assembly set upright.



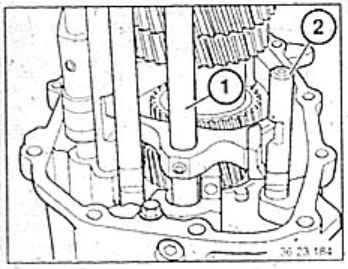
Install lock pin (1) lubricated with grease in 1st/2nd gear shift rod (2) and secure in the middle.



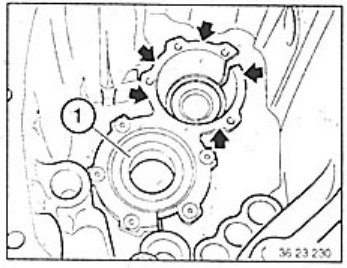
Hold four rollers on the shift shaft with help of grease.



Clean and coat case sealing surfaces with Loctite No. 574**.
Mount holder (1) on 2nd gear of the layshaft with the straight end pointing towards the bearing.
Special Tool 23 2 440 must be screwed in for later assembly work.
Place magnet (2) in opening.
Align shift rods with each other.
Coat outside of reverse gear shaft (3) with Loctite No. 574**.



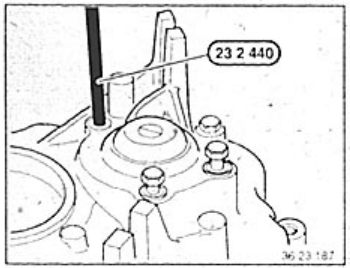
Place shift shaft (1) in front case section.
Install shift rail (2) with opening facing up towards case.



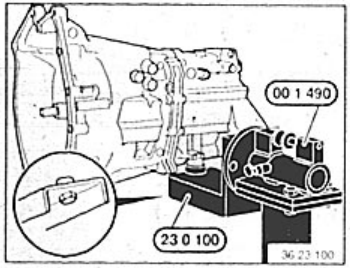
Lift out radial oil seal for shift shaft.
Heat bearing inner race (1) and rear case section in area of bearing to 110 ... 120° C (with hot air blower).
The heated temperature must be reached precisely — check with a temperature tester**.

* See Specifications
** Source of Supply: BMW Parts

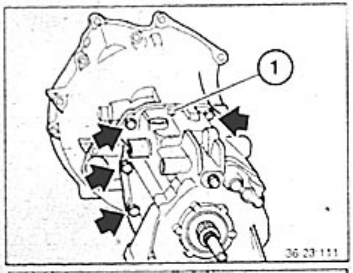
** Source of Supply: BMW Parts



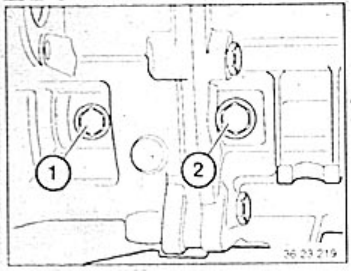
Mount rear case section as far as stop.
Install three bolts with new seals.
Remove Special Tool 23 2 440.
Screw in fourth bolt with a new seal.
Tighten all bolts.
Tightening torque*



Lightly secure front and rear case sections with two bolts located opposite each other.
Take up transmission in Special Tools 23 0 100 and 00 1 490 again.

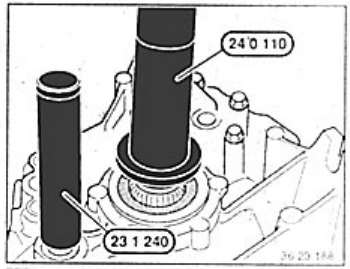


Drive in dowel pins (1).
Screw in and tighten all case bolts.
Tightening torque*.

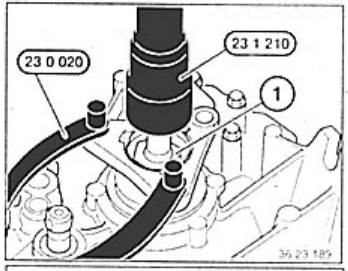


Loosen bolt (1) slightly.
Install reverse gear shaft bolt (2) with bolt cement Loctite No. 242**.
Tighten bolts (1 and 2).
Tightening torque*.

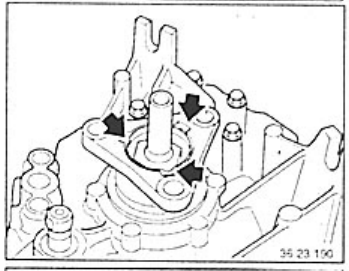
* See Specifications
** Source of Supply: BMW Parts



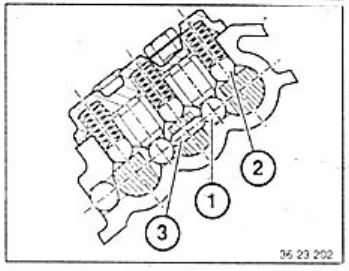
Install radial oil seals for shift shaft and output shaft.
Coat sealing lips with ATF.
Drive in radial oil seal for output shaft with Special Tool 24 0 110 and radial oil seal for shift shaft with Special Tool 23 1 240.
Use a plastic hammer for driving in.



Heat output flange to about 80° C (with hot air blower) and install on output shaft, driving on to fit tight if necessary.
Install collar nut (1) with bolt cement Loctite No. 242**.
Hold output flange with Special Tool 23 0 020.
Tighten collar nut with Special Tool 23 1 210.
Tightening torque*.



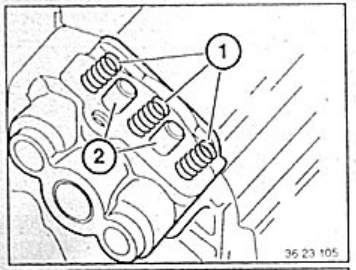
Install and secure lock plate.



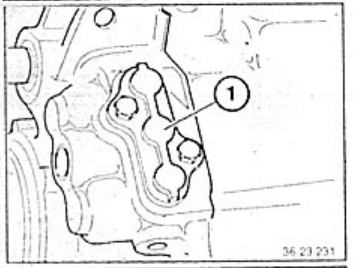
Install arresting and locking balls.

1 = Locking ball
2 = Arresting ball
3 = Lock pin

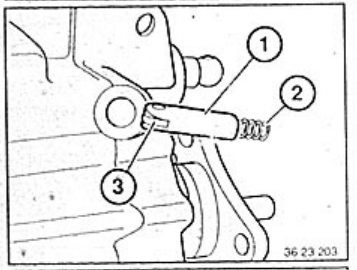
* See Specifications
** Source of Supply: BMW Parts



Install springs (1) and dowel pins (2).

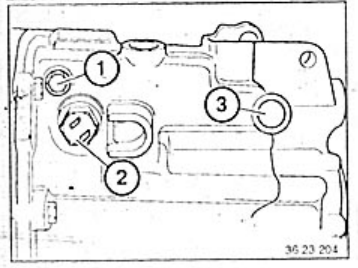


Mount end cover (1).
Install bolts with bolt cement Loctite No. 242** and tighten.
Tightening torque*.



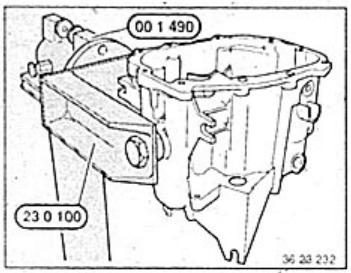
Install catch pin (1) and spring (2).

Important!
Roller (3) must be horizontal in direction of shifting.



Install bolt (1) with bolt cement Loctite No. 242** and tighten.
Screw in reverse gear switch (2).
Tightening torque*.
Drive in end cap (3).

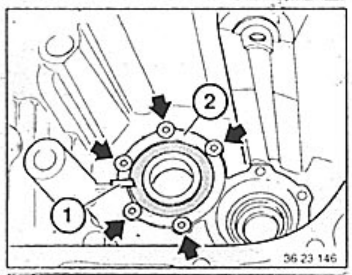
* See Specifications
** Source of Supply: BMW Parts



23 21 706 REPLACING BEARINGS OF ALL TRANSMISSION SHAFTS
– Input and Output Shafts Removed –

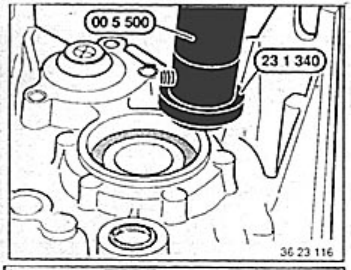
Rear Case Section – Output Shaft Bearing:

Take up rear case section on Special Tools 23 0 100 and 00 1 490.

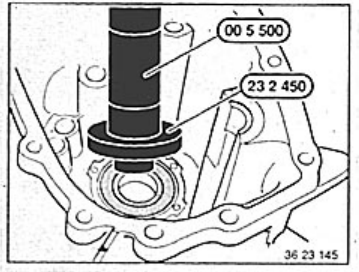


Unscrew holder (2).
Remove oil scraper plate (1) if installed.

Installation:
Also secure oil scraper plate (1).
Install bolts with bolt cement Loctite No. 242.**
Tightening torque*.

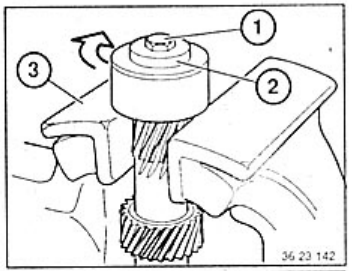


Drive out output shaft bearing from outside to inside with Special Tools 23 1 340 and 00 5 500.



Heat rear case section in area of bearing for output shaft to about 80° C (with hot air blower).
Install bearing, driving it in to fit tight with help of Special Tools 23 2 450 and 00 5 500 if necessary.

* See Specifications
** Source of Supply: BMW Parts



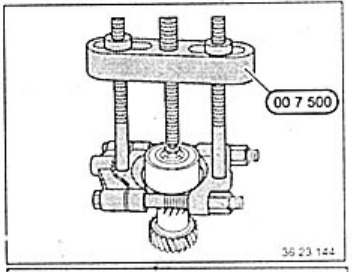
Layshaft Bearing:

Clamp layshaft in a vise fitted with two soft jaws (3).
Remove bolt (1).

Important!
Left-hand threads.

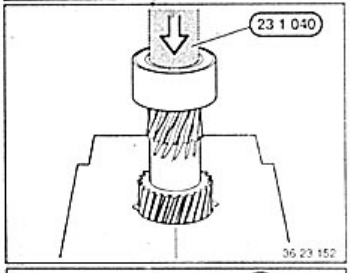
Remove washer (2).
Take layshaft out of vise.

Installation:
Bolt (1) must be replaced.

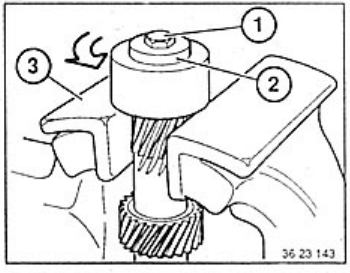


Pull ball bearing off of layshaft with Special Tool 00 7 500.
This requires screwing in the mounting bolt without washer again.

Important!
Bolt has left-hand threads.

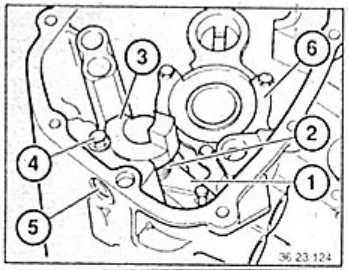


Heat bearing inner race to about 80° C (with hot air blower) and install on layshaft; if necessary press it on with help of Special Tool 23 1 040.



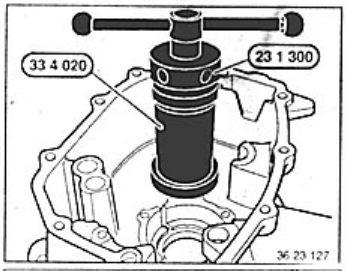
Clamp layshaft in a vise fitted with two soft jaws (3) again to tighten bolt (1).
Install washer (2).
Install new bolt (1) with bolt cement Loctite No. 242 and tighten.**
Tightening torque*.

* See Specifications
** Source of Supply: BMW Parts

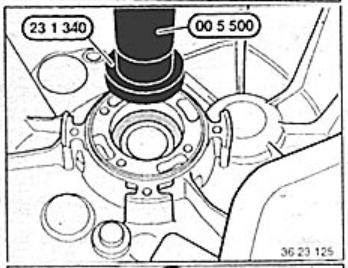


Front Case Section – Input Shaft Bearing:

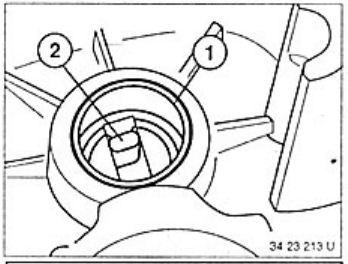
Remove selector arm (1).
This is done by unscrewing bolts (4 and 5) and then removing console (3), spring (2) and selector arm (1).
Unscrew holder (6).



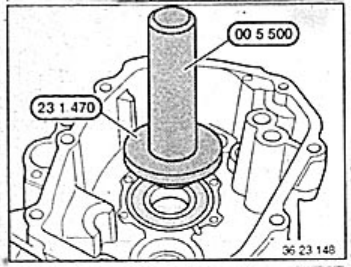
Apply Special Tool 33 4 020.
Screw on Special Tool 23 1 300.
Pull out bearing shell.



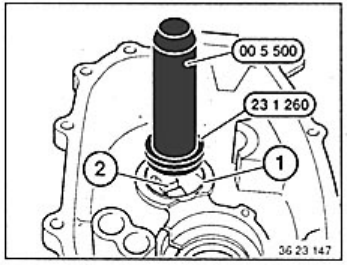
Drive out bearing from inside to outside with Special Tools 23 1 340 and 00 5 500.



Installation:
Install bearing shell (1) that slot in bearing shell is aligned with anti-turning bead (2) in case.

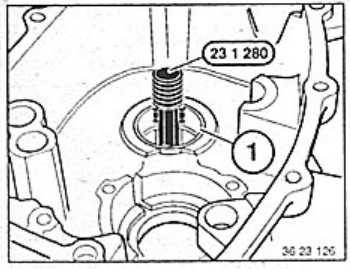


Heat front case section in area of bearing to about 80° C (with hot air blower).
Install bearing; if necessary drive it in to fit tight with help of Special Tools 23 1 470 and 00 5 500.



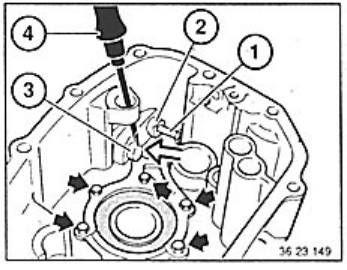
Drive in bearing shell (1) with Special Tools 23 1 260 and 00 5 500.

2 = Anti-turning bead (2)



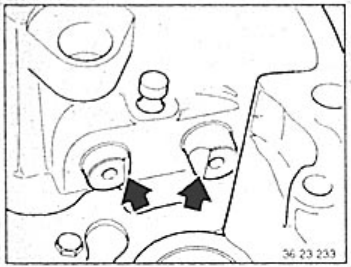
Layshaft Bearing:

Place Special Tool 23 1 280 in bearing shell (1)

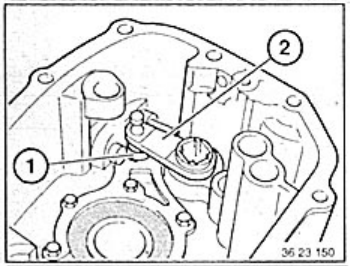


Install holder as follows.
Push lock pin (2) towards outside with bolt (1).
Push lock pin (3) towards outside with screwdriver (4).
Install holder and secure with bolts.
Install bolts with bolt cement Loctite No. 242.**
Tightening torque*.
Remove bolt (1).

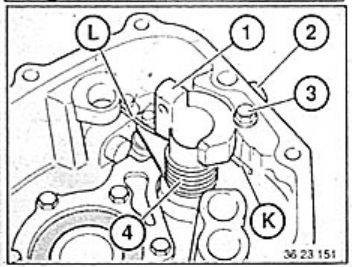
*** See Specifications**
**** Source of Supply: BMW Parts**



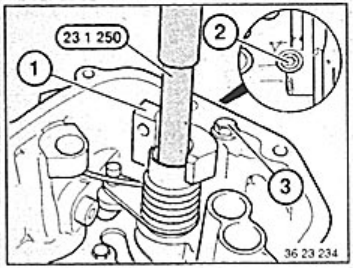
Check installed position of pressure pins.
Bevelled surfaces must point inwards towards each other.



Install roller (1) with selector arm (2).

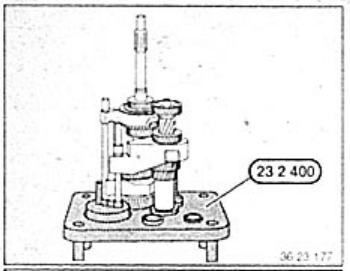


Install spring (4) and sleeve (1).
Attach short arm (K) of spring on case and long arm (L) in groove of selector arm.
Coat head of bolt (2) with Loctite No. 574** on inside.



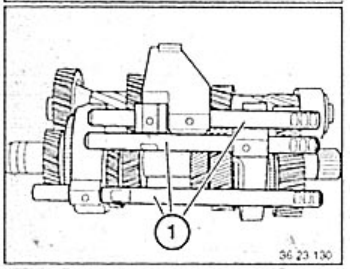
For easier installation (strong spring force) apply Special Tool 23 1 250 in selector arm and press sleeve (1) towards case.
In this position install bolt (2) with bolt cement Loctite No. 242** and tighten lightly.
Tighten bolt (2) to final torque last.
Tightening torque*.

* See Specifications
** Source of Supply: BMW Parts

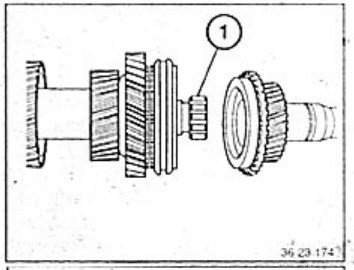


23 23 508 DISASSEMBLING AND ASSEMBLING COMPLETE SYNCHRONIZATION

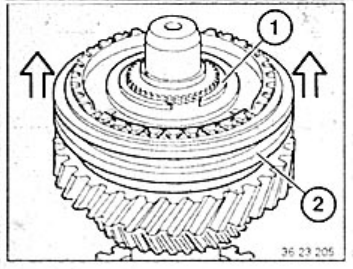
Remove input and output shaft assembly – refer to 23 21 505.
Remove gear assembly set with shift rods from Special Tool 23 2 400.



Pull off shift rods (1).
Remove layshaft from gear assembly set.



Pull off input shaft, needle bearing (1) and 5th gear synchromesh ring.

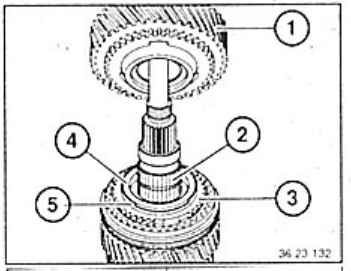


For easier installation, place output shaft in Special Tool 23 2 400.
Pull 5th/reverse gear operating sleeve (2) off of guide sleeve.

Important!
Loose thrust pieces, balls and springs.

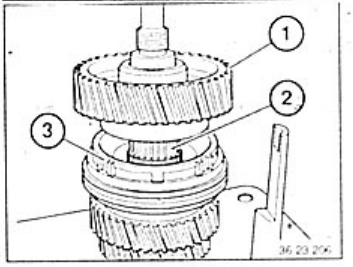
Lift out circlip (1).

Installation:
Replace circlip.

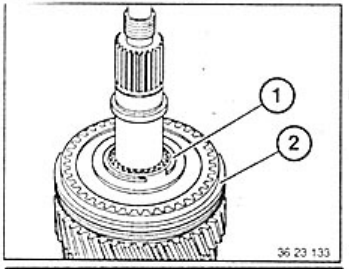


Turn output shaft around so that output end faces up.

Double Taper Synchronization:
Pull 1st gear (1), needle bearing (2), synchromesh ring (3), conical ring (4),and friction ring (5) off of output shaft.



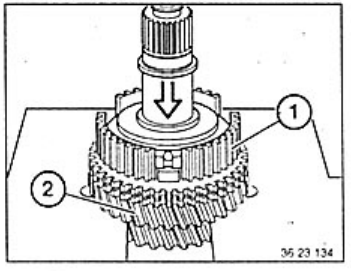
Single Taper Synchronization:
Pull 1st gear (1), needle bearing (2) and synchromesh ring (3) off of output shaft.



Lift out circlip (1).
Pull off 1st/2nd gear operating sleeve (2).

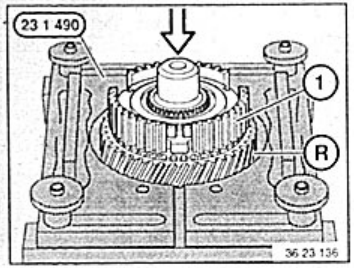
Important!
Loose thrust pieces, balls and springs.

Installation:
Replace circlip (1).

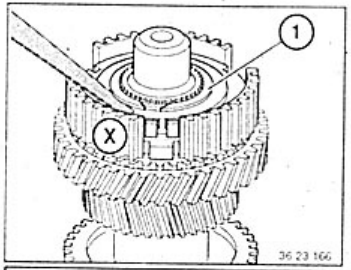


Press 2nd gear (2) and guide sleeve (1) off of output shaft.
Pressing-off force*.

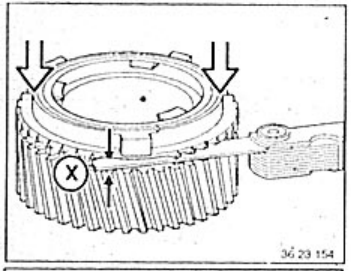
* See Specifications



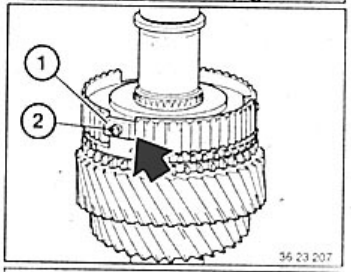
Using Special Tool 23 1 490, press reverse gear, synchromesh ring and guide sleeve (1) off of output shaft.
Pressing-off force*.



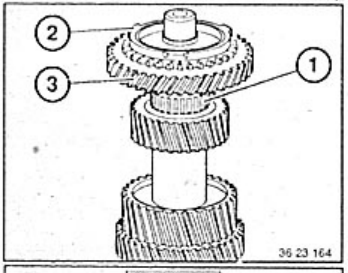
Install suitable circlip (1).
Circlips are available from Parts in thicknesses from 2.0 to 2.3 mm in steps of 0.05 mm.
Max. premissible axial play X = 0.04 mm.



Inspect all synchronization components for wear prior to assembling the gear assembly set.
Also determine gap X between synchromesh ring and concerned gears.
Measure in area of stops.
Press synchromesh ring uniformly in direction of the taper.
Gaps* of different gears.

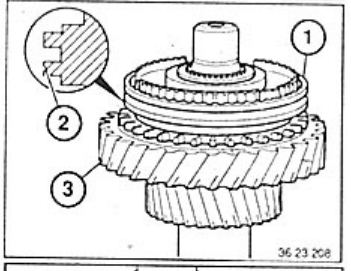


Place three thrust pieces (1) with bevels facing out and springs (2) in opening of guide sleeve.

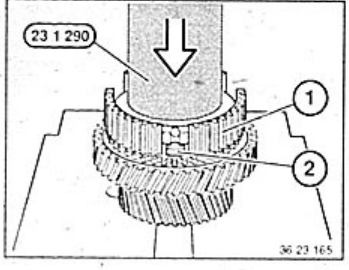


Assembling Gear Assembly Set:
Install needle bearing (1), reverse gear (3) and synchromesh ring (2).

Note:
Lightly lubricate bearing surfaces on needle bearing (1) and synchromesh ring (2) with ATF.

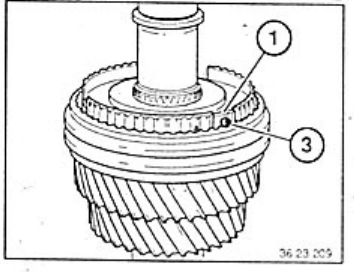


Mount operating sleeve (1) with identification groove (2) facing reverse gear (3).



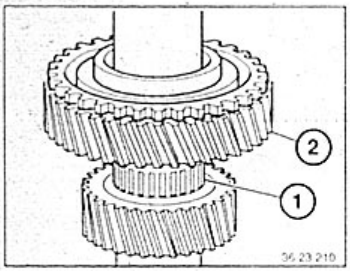
Heat 5th/reverse gear guide sleeve (1) to about 120° C (with hot air blower) and install on output shaft; if necessary press on to fit tight with help of Special Tool 23 1 290.

Important!
Make sure that stops (2) engage in opening of the guide sleeve while pressing on.
Pressing-on force*.



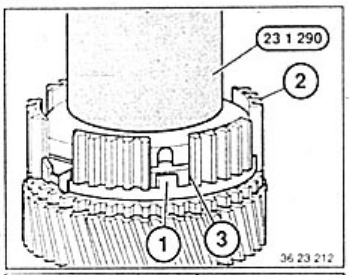
Tilt thrust pieces (1) out of operating sleeve separately far enough that balls (3) can be placed on the springs.
Press balls (3) towards inside and simultaneously press thrust pieces into the operating sleeve.
Place 5th gear synchromesh ring in the operating sleeve.
Pull operating sleeve upwards uniformly as far as lock (neutral position).

* See Specifications



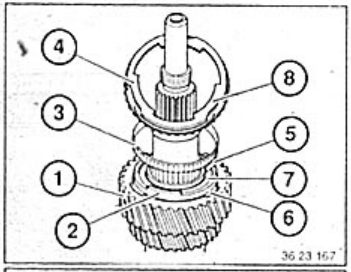
Turn output shaft around so that the output end faces up.
Install needle bearing (1) and 2nd gear (2) on output shaft.

Note:
Lubricate bearing surfaces on needle bearing with ATF.



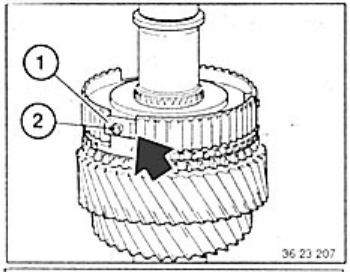
Single Taper Synchronization:

Heat 1st/2nd gear guide sleeve to about 120° C (with hot air blower).
Install guide sleeve that stops (1) point towards opening (3) of guide sleeve (2).
Press on guide sleeve (2) to fit tight with Special Tool 23 1 290.
Make sure that stops (1) engage in opening of the guide sleeve while pressing on.
Pressing-on force*.

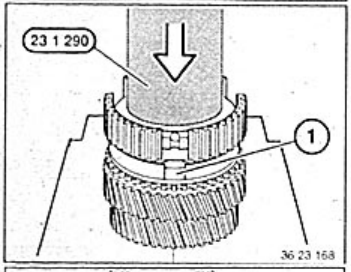


Double Taper Synchronization:

Important!
The complete synchronization must be replaced when it is necessary to replace 1st/2nd gear synchronization.
Install conical ring (2), friction ring (3) and synchromesh ring (4) in such a manner that tabs (5) of friction ring engage in opening (6) of 2nd gear (1).
Tabs (8) on synchromesh ring (4) engage in opening (7).

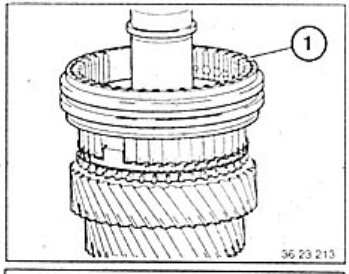


Insert three thrust pieces (1) with bevel facing out and three springs (2) into opening of guide sleeve.



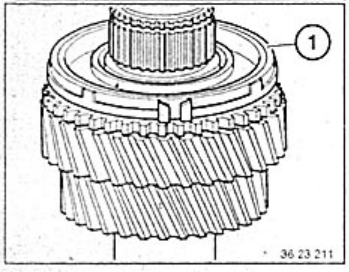
Heat 1st/2nd gear guide sleeve to about 120° C (with hot air blower) and install on output shaft; if necessary press on to fit tight with help of Special Tool 23 1 290.

Important!
Make sure that stops (1) engage in opening of the guide sleeve while pressing on.
Pressing-on force*.



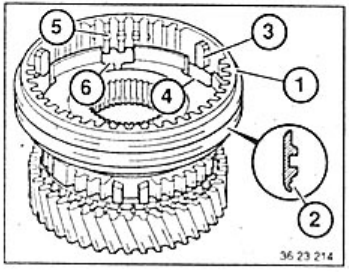
Double Taper Synchronization:

Install operating sleeve (1).



Single Taper Synchronization:

Install synchromesh ring (1).

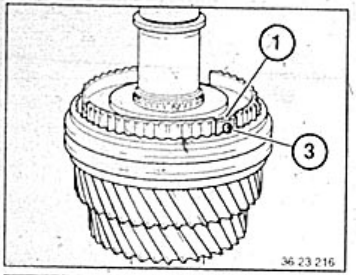


Single Taper Synchronization:

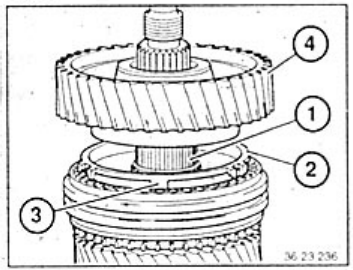
Install operating sleeve (1) with identification groove (2) pointing towards 2nd gear.
Tab (3) on operating sleeve faces center of opening (4) or teeth with grooves (5) towards opening (6) of slides.

* See Specifications

* See Specifications



Tilt thrust pieces (1) out of operating sleeve separately far enough that balls (3) can be placed on the springs.
Press balls (3) towards inside and simultaneously press thrust pieces into the operating sleeve.

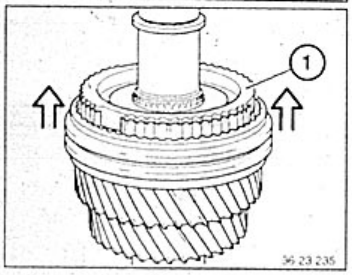


Single Taper Synchronization:

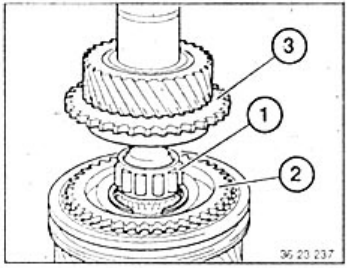
Install needle bearing (1).
Install synchromesh ring (2) with tabs (3) facing the slides.

Note:
Lubricate bearing surfaces on needle bearing and synchromesh ring with ATF.

Install 1st gear (4).



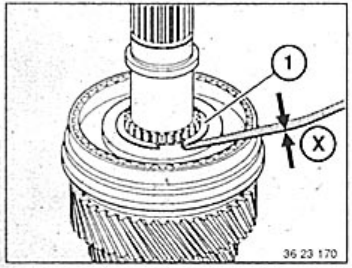
Place 1st gear synchromesh ring (1) into openings of guide sleeve.
Pull up operating sleeve uniformly as far as lock (neutral position).



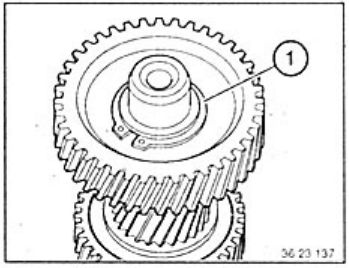
Install roller bearing (1), 5th gear synchromesh ring (2) and input shaft on output shaft (3).

Note:
Lubricate bearing surfaces on needle bearing and synchromesh ring with ATF.

Lift input and output shaft assembly off of Special Tool 23 2 400 and lay aside.



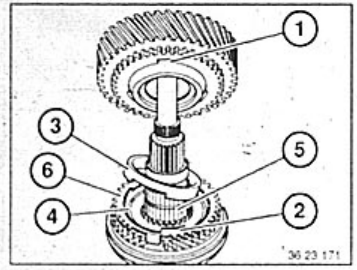
Install suitable circlip (1).
Circlips are available from Parts in thicknesses from 2.0 to 2.3 mm in steps of 0.05 mm.
Max. permissible axial play X = 0.04 mm.



Layshaft:

3rd/4th gear synchronization:
Place layshaft in Special Tool 23 2 400 to install synchronization.
Lift out circlip (1).

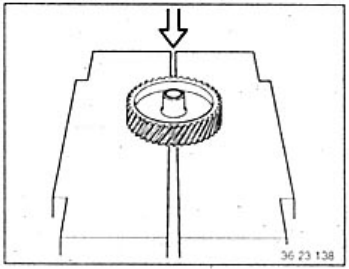
Installation:
Replace circlip (1).



Double Taper Synchronization:

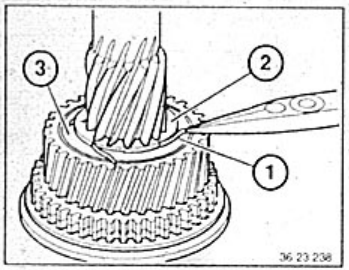
Install needle bearing (5).
Insert synchromesh ring (6), friction ring (4) and conical ring.
Mount 1st gear.

Important!
Tab (3) must engage in opening (4) and tab (2) in opening (1).
Lubricate bearing surfaces on needle bearing and synchromesh ring with ATF.



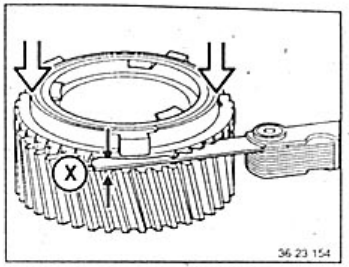
Take up layshaft in a press.
Select bearing surface on constant gear as large as possible.
Press constant gear off of layshaft.
Pressing-off force*.

* See Specifications

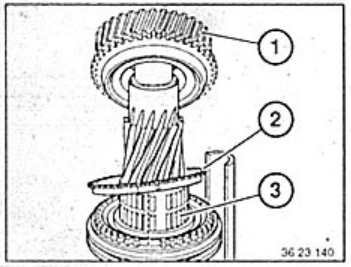


Remove locking ring (1) after unbending four tabs towards outside with a pliers.
Remove support (2) (two parts) and thrust washer (3).

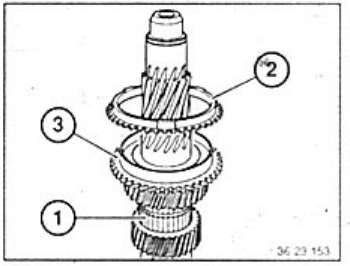
Installation:
Replacing locking ring (1).



Inspect components of synchronization for wear prior to assembling.
Measure gap X between synchromesh ring and concerned gears for this purpose.
Measure in area of stops.
Press synchromesh ring uniformly in direction of taper.
Gap* of different gears.

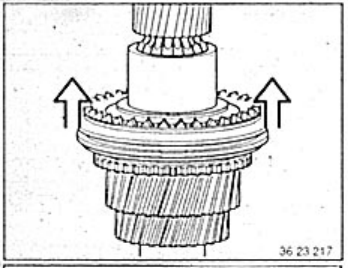


Remove 4th gear (1), synchromesh ring (2) and needle bearing (3).



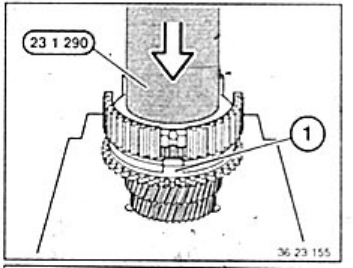
Install needle bearing (1), 3rd gear (3) and synchromesh ring (2).

Note:
Lubricate bearing surfaces on needle bearing and synchromesh ring with ATF.



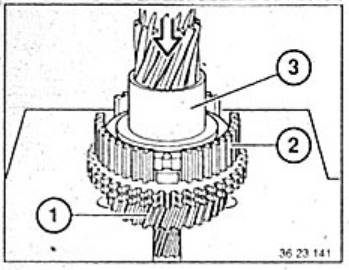
Pull off 3rd/4th gear operating sleeve upwards.

Important!
Loose thrust pieces, balls and springs.

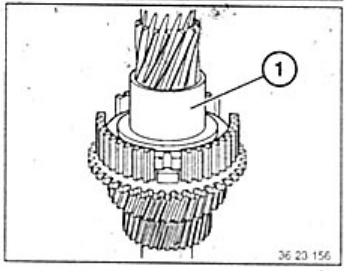


Heat guide sleeves to about 120° C (with hot air blower) and install on layshaft.
Install 3rd/4th gear guide sleeve and press on to fit tight with help of Special Tool 23 1 290.

Important!
Make sure that stops (1) engage in opening of guide sleeve while pressing on.
Pressing-on force*.



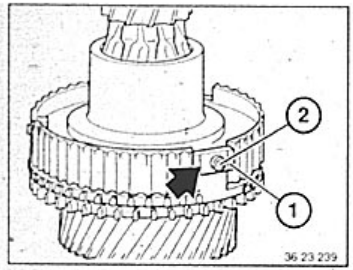
Take up layshaft in a press.
Press 3rd gear (1), guide sleeve (2) and bearing sleeve (3) off of layshaft.
Pressing-off force*.



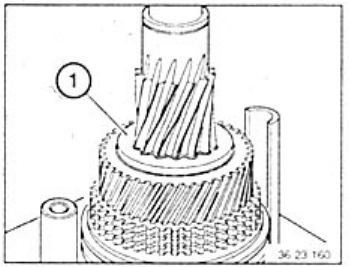
Heat bearing inner race (1) to about 80° C (with hot air blower) and push on to layshaft as far as stop.

* See Specifications

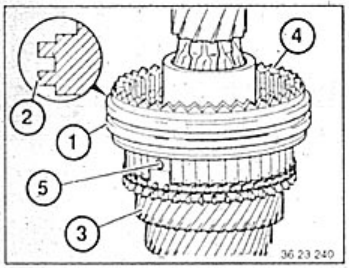
* See Specifications



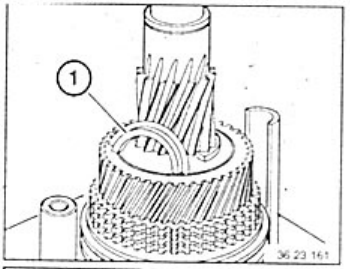
Place three thrust pieces (1) with bevel facing out and three springs (2) in opening of guide sleeve.



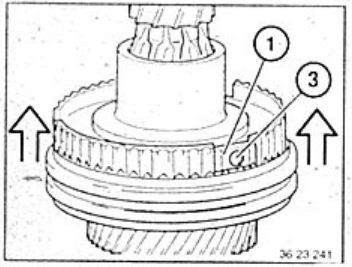
Install thrust washer (1) over splines as far as the bearing surface.



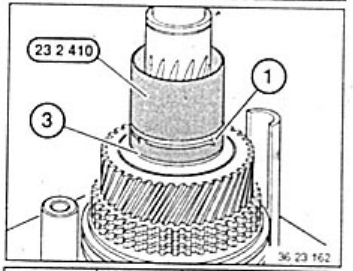
Install operating sleeve (1) with groove (2) pointing towards 3rd gear (3).
Three ground out teeth (4) must point towards springs (5) or slides.



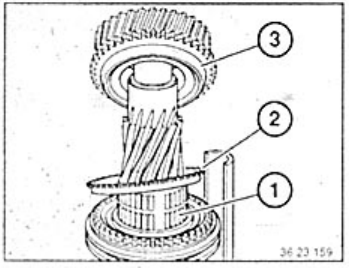
Install support (two parts) with small diameter (1) pointing down in groove.
The axial play must be adjusted after replacing the support.
Max. axial play = 0.04 mm.
Supports are available from Parts in thicknesses from 2.9 to 3.15 mm in steps of 0.05 mm.



Tilt thrust pieces (1) out of operating sleeve separately far enough that balls (3) can be placed on the springs. Press balls (3) towards inside and simultaneously press thrust pieces into the operating sleeve.
Place 3rd gear synchromesh ring in the operating sleeve.
Pull up operating sleeve uniformly as far as the lock (neutral position).

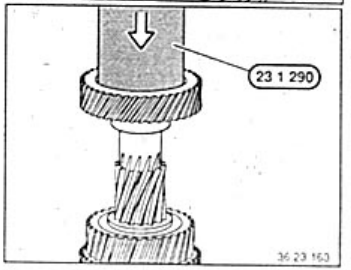


Apply Special Tool 23 2 410 on layshaft.
Clip in locking ring (1) with the four tabs in groove (3).



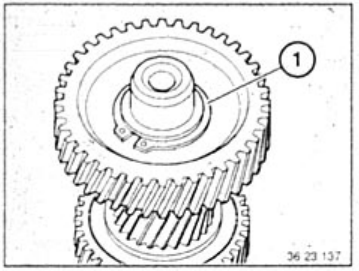
Install needle bearing (1), synchromesh ring (2) and 4th gear (3) on layshaft.

Note:
Lubricate bearing surfaces on needle bearing and synchromesh ring with ATF.

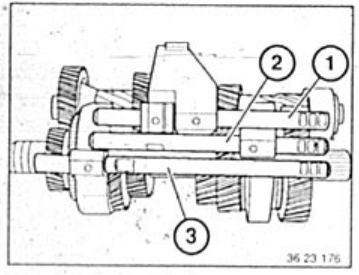


Heat constant gear to about 180° C (with heating plate).
Check temperature with temperature tester**.
Place layshaft in a press.
Install constant gear on layshaft and press on to fit tight with Special Tool 23 1 290.
Pressing-on force*.

* See Specifications
** Source of Supply: BMW Parts



Install circlip (1).



Assemble layshaft with input shaft and output shaft.
Install 3rd/4th gear shift rod (1), 1st/2nd gear shift rod (2) and 5th/reverse gear shift rod (3).

Construction group 24 Automatic transmission

4 HP-22/24

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	Power flow diagrams	24- 151
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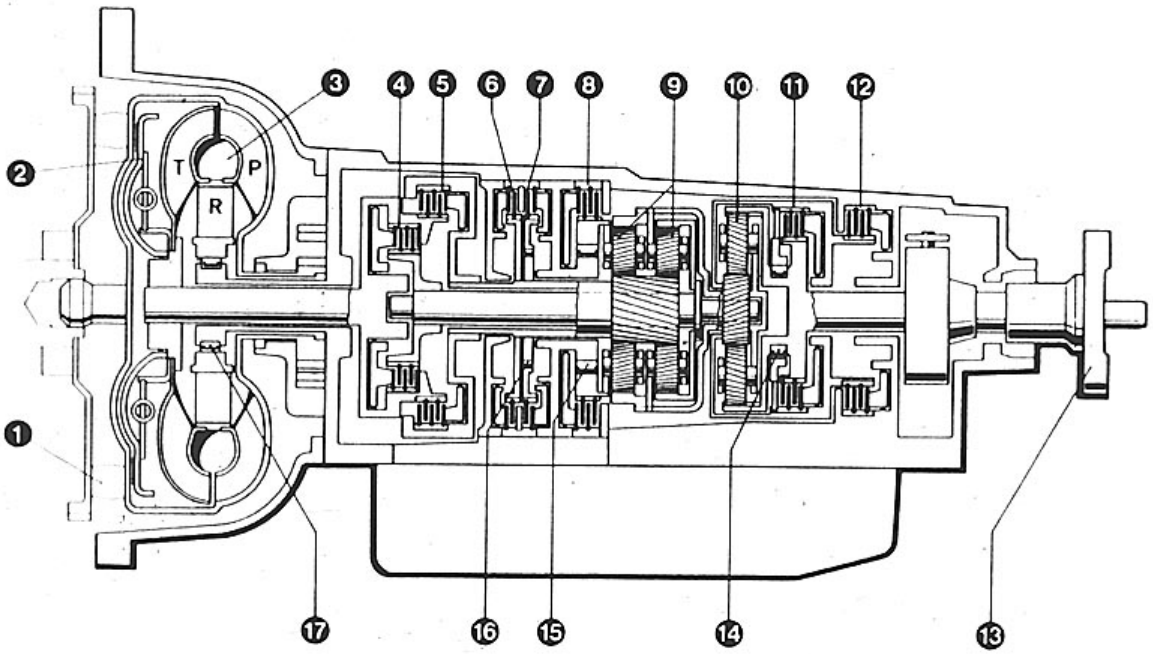
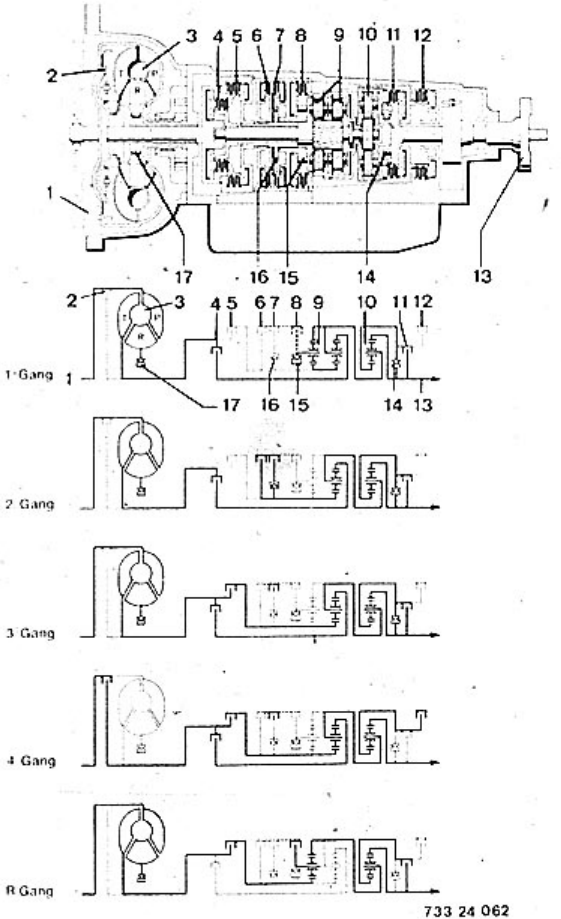
24 16 502	Transfer plate – replace	24- 161b
24 23 022	Plate clutches and brakes – replace	24- 162
24 31 002	Primary pump – remove and install	24- 172
24 40 003	Torque converter – remove and install	24- 173



4 HP -22/24 Assembly Drawing

1 Input
2 Converter lockup clutch
3 Hydrodynamic torque converter
P = Impeller
R = Stator
T = Turbine
4 Clutch A
5 Clutch B
6 Clutch C'
7 Clutch C
8 Clutch D
9 Planet gear set
10 Planet gear set – 4th gear
11 Clutch E
12 Clutch F
13 Output
14 One-way clutch
15 One-way clutch
16 One-way clutch
17 One-way clutch

4 HP -22/24 Power Flow Diagrams



1st Gear
Clutches 4 and 11 are engaged.
Front planet gear carrier of gear set 9 supports on one-way clutch 15 during acceleration and is cancelled while coasting.
Planet gear set 10 rotates as a block.
In selector lever position 1 clutch 8 is also engaged in 1st gear, to have engine brake.

2nd Gear
Clutches 4, 6, 7 and 11 are engaged.
One-way clutch 15 is cancelled.
Hollow shaft is fixed with sun gear of planet gear set 9.
Planet gear set 10 rotates as a block.

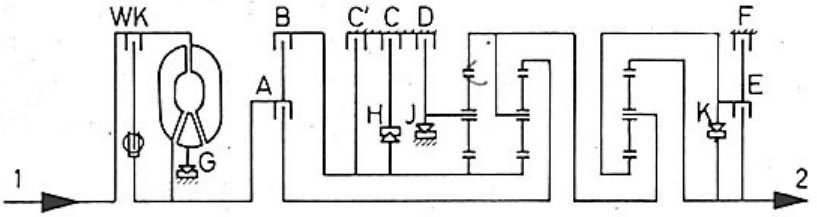
3rd Gear
Clutches 4, 5, 7 and 11 are engaged.
One-way clutches 15 and 16 are cancelled.
Planet gear sets 9 and 10 rotate as a block at ratio of 1 to 1.

4th Gear
Clutches 4, 5, 7 and 12 are engaged.
One-way clutches 14, 15 and 16 are cancelled.
Planet gear set 9 rotates as a block.
Hollow shaft is fixed with sun gear of planet gear set 10.
Torque converter 3 is locked by clutch 2 as from a certain road speed.

Reverse Gear
Clutches 5, 8 and 11 are engaged.
Output shaft's direction of rotation is reversed via the held front planet gear carrier of gear set 9.
Planet gear set 10 rotates as a block.

4 HP -22/24 Transmission Layout

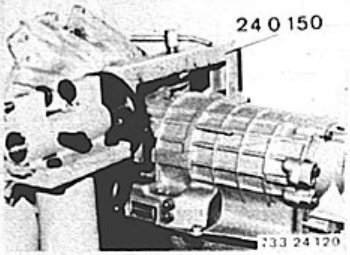
1 Input
2 Output
WK Converter lockup clutch
A ... F Clutches
G ... K One-way clutches



635 24 013

4 HP - 22 / H + EH Closed Shift Elements
4 HP-24/EH
WK = Converter lockup clutch
RS = Reverse gear lock
X = Activated clutches and brakes
(X) = Depending on operating state
*) = Only with EH
+ = Activated solenoid valve
(+) = Depending on operating state
/ = Solenoid valve without current

Gear	Clutch			Brake				One-way Clutch				WK	Solenoid Valve*)			
	A	B	E	C'	C	D	F	G	H	J	K		WK	RS	1	2
1st	X		X			(X)		(X)		X	X				+	+
2nd	X		X	X	X			(X)	X		X				/	+
3rd	X	X	X		X			(X)			X	(X)	(+)		/	/
4th	X	X			X		X	(X)				(X)	(+)		+	/
R		X	X			X		(X)						+	+	+



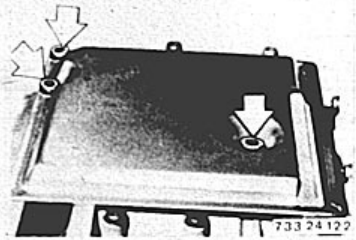
24 00 082 DISASSEMBLING AND ASSEMBLING TRANSMISSION

Remove transmission – see 24 00 022 in Model Repair Manual from 1985 models on.

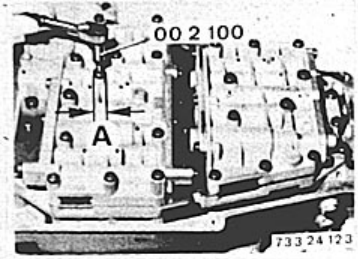
Note:
Stronger 4 HP-24 automatic transmission is included in the following scope. 4 HP-24 transmission is mentioned when procedures are different.
Torque converter is removed.
Mount transmission on Special Tool 24 0 150 in Special Tool 00 1 490.

Caution!
Tighten bolts only finger tight to avoid distorting the transmission case.

A) Disassembling

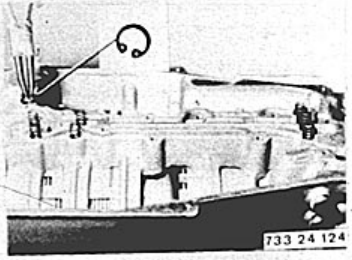


Unscrew oil sump.
Unscrew oil filter screen.
Unscrew Torx bolts with Special Tool 00 2 100.



Unscrew valve body.
Unscrew Torx bolts with Special Tool 00 2 100.

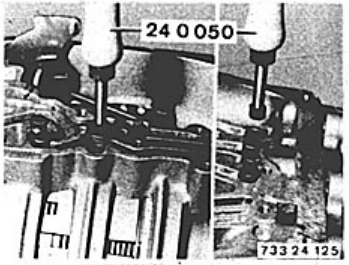
Important!
Only unscrew bolts with head size A = 12 mm (0.472").
The socket for the transmission wire harness must be removed for the EH version.



Lift out eight circlips.
Remove eight springs.

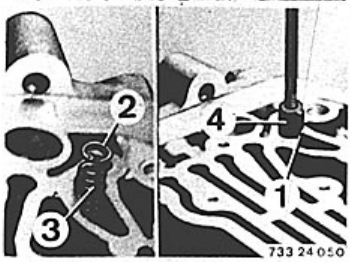
Installation:
Install long springs for the output.

EH Transmission:
Only three circlips and three springs have to be removed for cylinder F (output end).

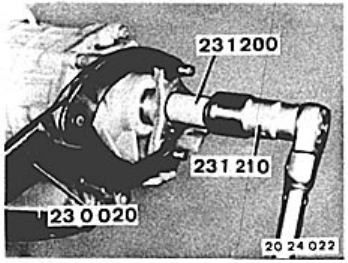


Pull out eight sealing sleeves with Special Tool 24 0 050.

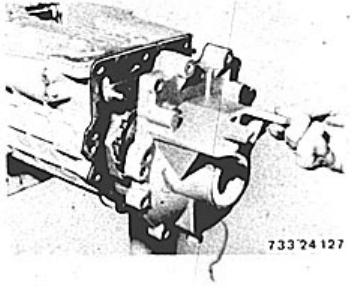
EH Transmission:
Only remove three sealing sleeves for cylinder F (output end).



Important!
Lubricating oil supply for cylinder F gear set was improved gradually since 7.85.
Circlip (2), spring (3) and sealing sleeve (4) must be removed at bore (1) additionally when assembling.
Pull sealing sleeve (4) out of the bore with a M 6 x 65 bolt.
Cant bolt slightly for this purpose.

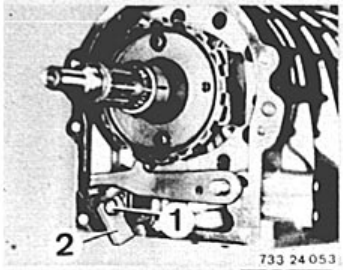


Lift off lockplate.
Use Special Tool 23 1 200 only for the version with a three-hole flange.
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.
Pull off output flange.

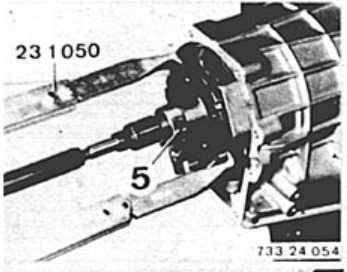


Unscrew transmission extension.

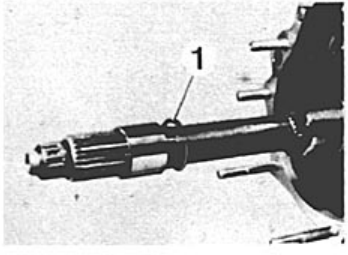
Installation:
Replace gasket.



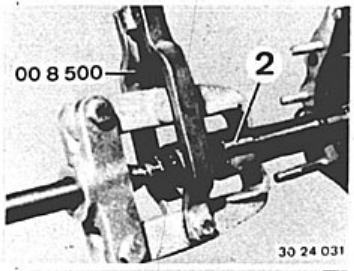
Loosen screw (1) enough with Special Tool 00 2 100 that bracket (2) can be folded down.
Remove parking lock pawl, spring and bearing pin.
Caution!
Spring force.



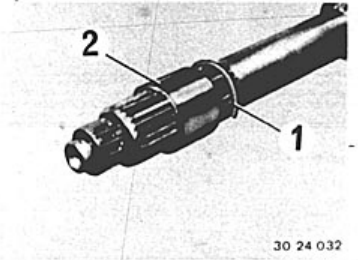
Pull off parking lock gear with regulator.
Note:
Check axial shim between output flange and parking lock gear.
Version with Spacer (5):
The parking lock gear must be pulled off with Special Tool 23 1 050.



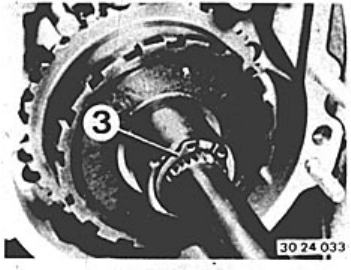
Version with Transfer Box:
Lift out and slide snap ring (1) forward.
Installation:
Replace snap ring.



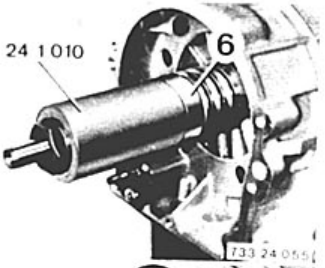
Pull bearing sleeve (2) off of the input shaft with Special Tool 00 8 500.



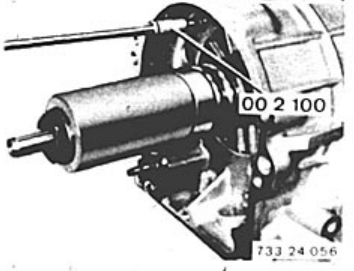
Installation:
Install snap ring (1) in groove of output shaft.
Heat bearing sleeve (2) to approx. 80° C (175° F) with a hot air blower and slide it on to the output shaft against snap ring (1).



Lift out circlip (3).
Pull off parking lock gear with regulator.



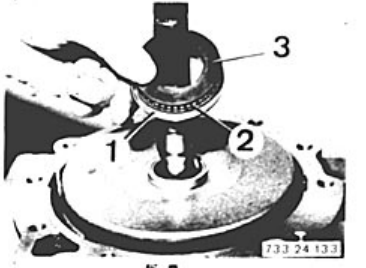
Place Special Tool 24 1 010 on output shaft and secure with collar nut.
Note:
For version with spacer (5) a suitable pipe (6) must be used to take up the distance between case and special tool sleeve.



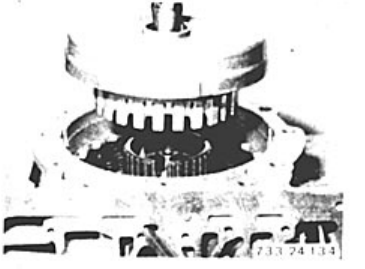
Unscrew Torx screws with Special Tool 00 2 100.



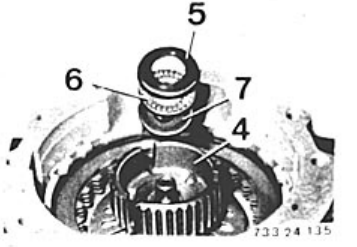
Set transmission upright.
Unscrew converter bell housing and transfer plate.
Note:
Only remove inner bolts of hole circle.



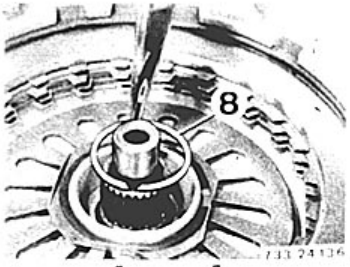
Remove angled washer (1), axial bearing (2) and thrust washer (3).



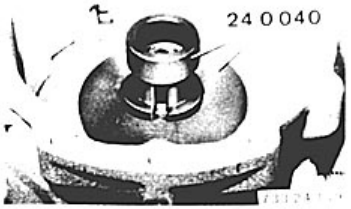
Remove input shaft with clutch A.



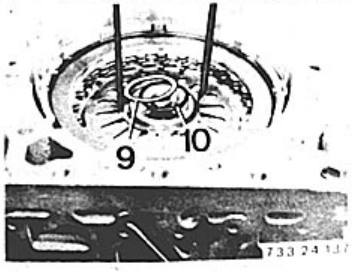
Remove plate carrier (4) for clutch A with angled washer (5), axial bearing (6) and thrust washer (7).



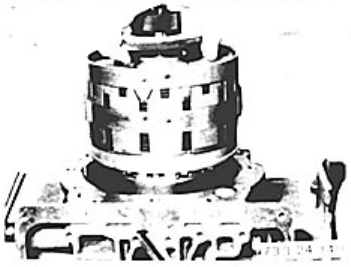
Remove snap ring (8) with help of two screwdrivers.
Installation:
Replace snap ring (8).



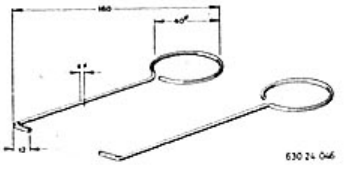
Apply Special Tool 24 0 040 on intermediate shaft.



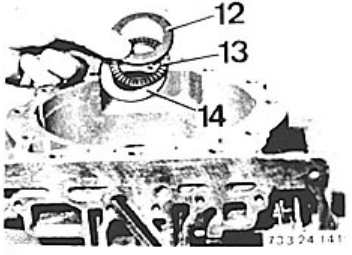
Pull out clutch B with two locally made hooks.
Installation:
Lift clutch until resistance is noticed and push back again.
Pull out clutch with one firm pull.
This will also pull out support (9) and seal (10).



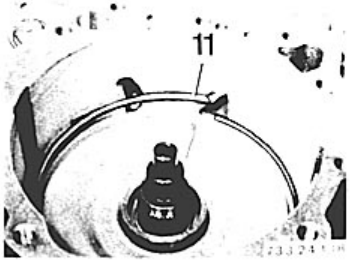
Pull out entire set.



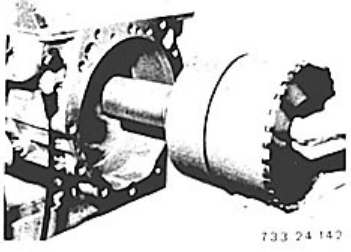
Sketch for local manufacture of hooks.
Dimensions in mm.



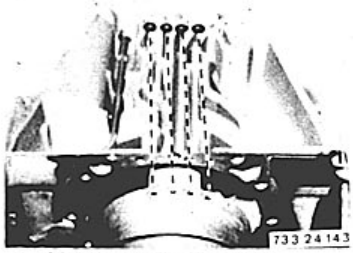
Remove angled washer (12), axial bearing (13) and thrust washer (14).



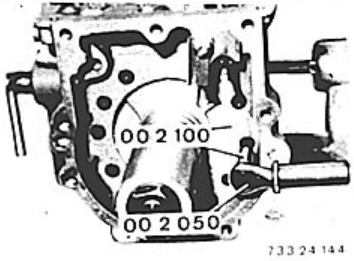
Lift out snap ring (11).



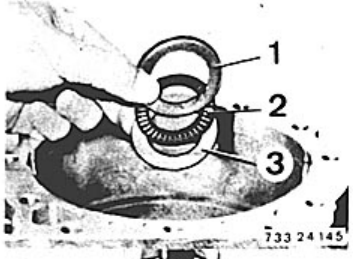
Position transmission case horizontally.
Remove 4th gear clutch set.



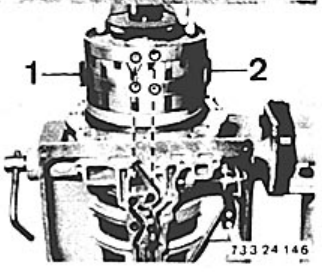
B) Assembling:
Install 4th gear clutch set.
Guide clutch set into transmission case that 4 oil feed bores are aligned with bores in case.



Bolt down clutch set with Special Tools 00 2 100 and 00 2 050.
Tightening torque*.

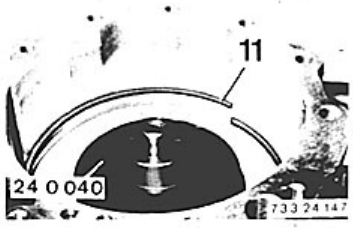


Set transmission upright.
Insert thrust washer (3), axial bearing (2) and angled washer (1) with collar facing up.
If necessary, use vaseline on shaft of clutch set.

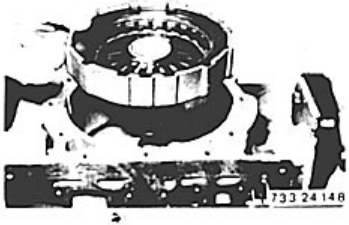


Place entire set in case.
Four oil feed bores must be aligned with bores in case.
Springs (1 and 2) must be in center of cylinder groove.

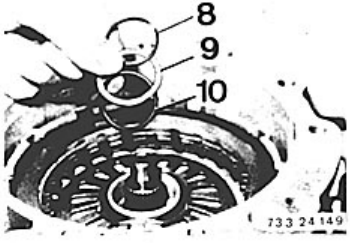
* See Specifications



Insert snap ring (11).
Remove Special Tool 24 0 040.



Insert and press clutch B against stop.



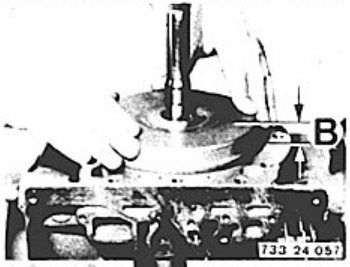
Install seal (10), support (9) and snap ring (8).



Insert plate carrier (4).
Install thrust washer (7) and axial bearing (6).



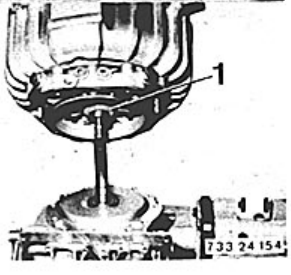
Paste angled washer (1) on cylinder A with grease (vaseline).



Insert clutch A and move it back and forth until splines of plate carrier and plates mesh.
Note:
Clutch A is in correct installed position, when distance (B) between cylinder A and case sealing surface is approx. 8 mm (0.315").
4 HP 24:
Distance (B) = approx. 25 mm (1").



Install angled washer (3) with collar facing up and axial bearing (2).



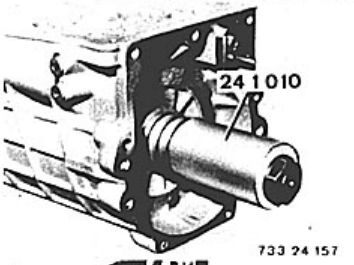
Paste on gasket and thrust washer (1) with grease (vaseline).



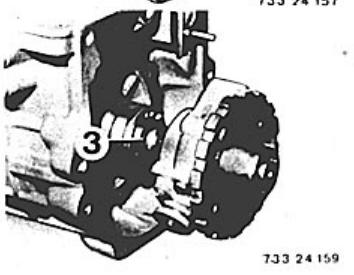
Install converter bell housing and tighten all bolts.
Tightening torque*.



Check axial play of input shaft.
Mount Special Tool 24 0 010 to hold input shaft.
Apply Special Tool 00 2 510 (dial gage).
Check axial play by pulling input shaft.
Specification: 0.2 to 0.4 mm (0.008 to 0.016").
If play deviates, take off converter bell housing again and replace thrust washer with a thicker or thinner one.
Recheck axial play.
Bolt down converter bell housing.
Tightening torque*.

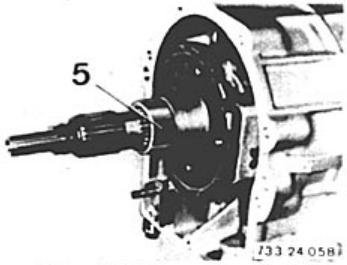


Remove Special Tool 24 1 010.

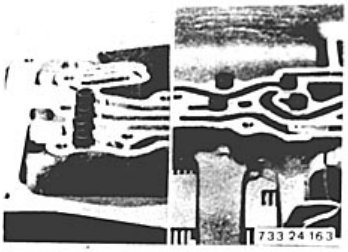


Lubricate O-ring (3) with ATF.
Slide on parking lock gear with regulator.
Note:
Install shim between the regulator and output flange for version without a spacer.

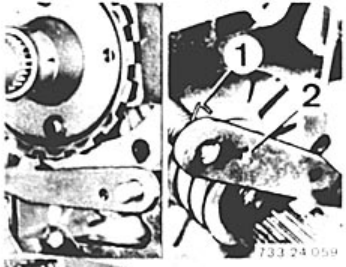
* See Specifications



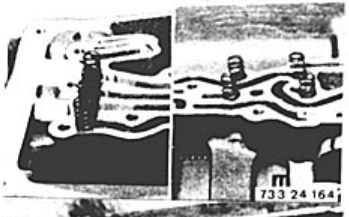
Important!
Version with Spacer (5):
Heat spacer (5) to about 80° C (175° F) with a hot air blower after mounting the parking lock gear and push spacer on to output shaft.



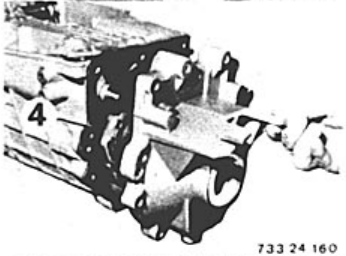
Install 8 sealing sleeves.
Press in sealing sleeves against the stop with a suitable mandrel.
Be careful not to damage the sealing sleeves.
EH Transmission:
Only 3 sealing sleeves have to be installed at cylinder F (output end).



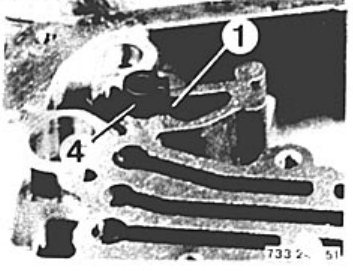
Install parking lock pawl.
Connect return spring (1) in bore (2) of parking lock pawl.



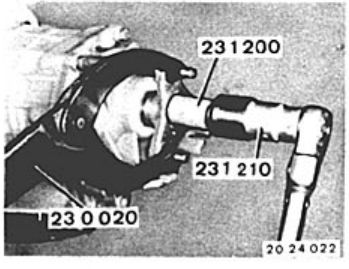
Install 8 springs and 8 circlips.
Important!
Longer springs must be installed to face cylinder F (output end).
EH Transmission:
Only 3 springs have to be installed on cylinder F (output end).



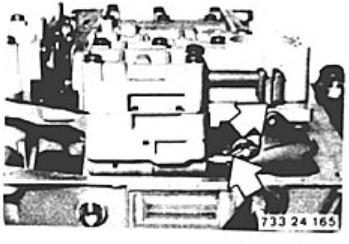
Paste on gasket (4) with grease.
Bolt on transmission extension.
Tightening torque*.



Note:
Version with Improved Lubrication on Cylinder F Gear Set:
Install sealing sleeve (4) in bore (1) with the tab facing the oil bore.
Press in sealing sleeve against the stop with a suitable mandrel.
Install spring and circlip.

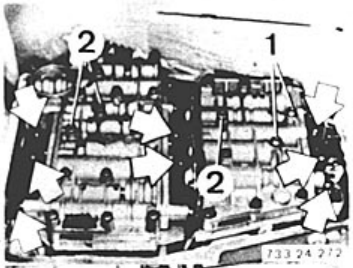


Install output flange.
Screw on collar nut with Hylomar SQ-32 M universal sealing compound.
Apply Special Tool 23 1 200 only for the version with a three-hole flange.
Hold output flange with Special Tool 23 0 020.
Tighten collar nut with Special Tool 23 1 210.
Tightening torque*.
Install lockplate.

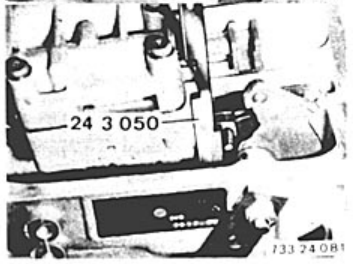


Mount valve body that selector valve can be connected in operating finger of pawl.
This requires pulling throttle cable slightly, so that accelerator cam does not clamp on throttle pressure valve.

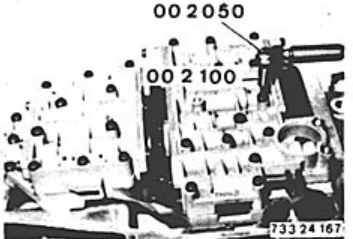
* See Specifications



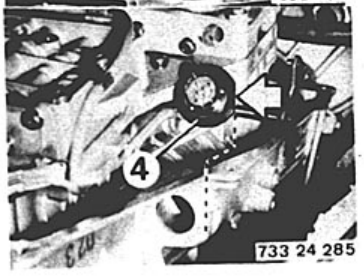
Screw in mounting bolts for valve body.
Important!
Bolts differ in length.
Bolts (1) – 65 mm long.
Bolts (2) – 60 mm long.



Align valve body with Special Tool 24 3 050.
Distance between valve body case and throttle pressure piston must be 11.5 mm (0.453").

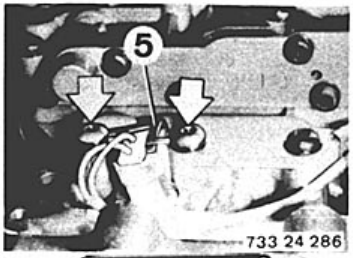


Tighten valve body bolts with correct tightening torque*.
Tighten bolts with Special Tools 00 2 100 and 00 2 050.

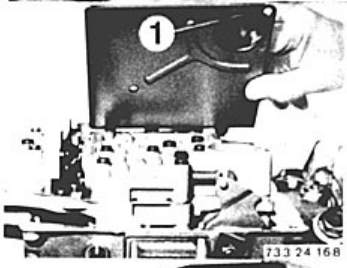


EH Transmission:
Check O-ring (4), replacing if necessary.
Insert socket with flat side facing out and bolt.
Tightening torque*.

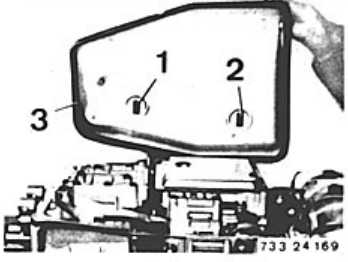
* See Specifications



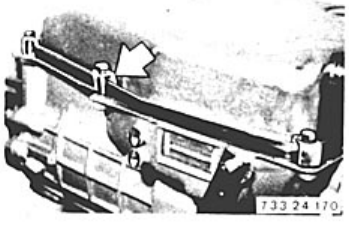
Note:
Also mount pulse transmitter on control unit.
Engage tabs of holder (5) in grooves of plug.



Install O-ring (1) between valve body and oil filter screen.
Install and bolt down oil filter screen.
Tightening torque*.
Check length of bolts.
65 mm long.



Place magnets (1 and 2) in oil sump.
Install gasket (3).



Install oil sump and tighten bolts with brackets.
Tightening torque*.
Important!
Both brackets,with straight, short legs must be mounted on straight side of oil sump.

* See Specifications

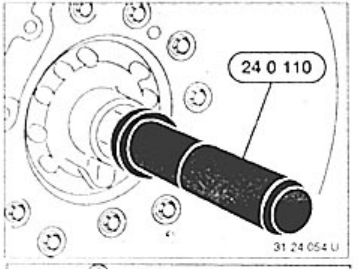


24 12 003 REPLACING RADIAL OIL SEAL FOR TORQUE CONVERTER

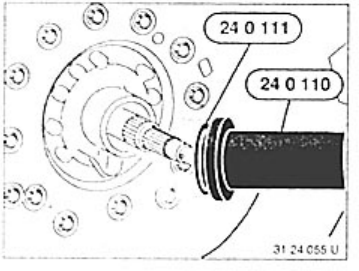
Remove torque converter – see 24 40 003.
Lift out radial oil seal.



Lubricate sealing lip with ATF.
Drive in radial oil seal to fit tight with Special Tool 24 0 090.

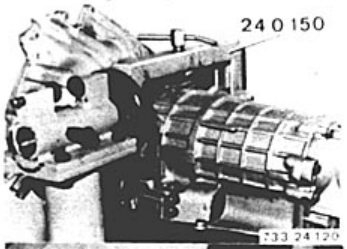


4 HP-24 Transmission:
Drive in radial oil seal to fit tight with Special Tool 24 0 110.
Special Tool 24 0 110 can also be used on 4 HP-22 transmissions.



Important!
Modified oil pump body since Transmission No.
1 113 936 for 4 HP-22 or
0 029 160 for 4 HP-24.
Radial oil seal must be installed 1.0 mm (0.039") deeper.
Drive in radial oil seal to fit tight with Special Tools 24 0 110 and 24 0 111.

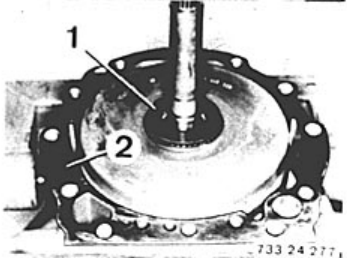
24 16 502 REPLACING TRANSFER PLATE
– Transmission Removed –



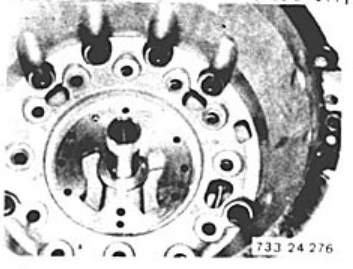
Remove torque converter 24 40 003.
Mount transmission on Special Tool 24 0 150 in conjunction with an assembly stand.
Important!
Only screw in bolts finger tight to avoid case distortion.



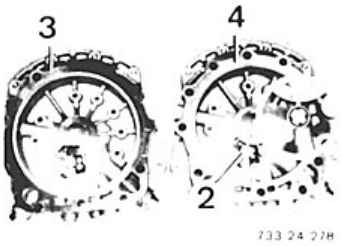
Unscrew converter bell housing and transfer plate, removing the inner bolts only and loosening the outer bolts for this purpose.



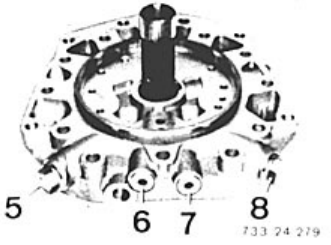
Lift off converter bell housing.
Installation:
Thrust washer (1), needle cage and angled washer.
Note:
Axial play of input shaft can be adjusted with thrust washer (1).
Replace gasket (2).



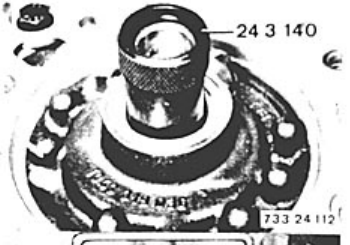
Remove primary pump (see 24 31 002).
Unscrew bolts.
Lift converter bell housing off of transfer plate.



A transfer plate with venting valve (2) is used since Transmission No. 170 195.
The venting valve provides faster clutch A pressure dropping.
Only use transfer plates with a venting valve for repairs.
Transfer plate (3) without venting valve.
Transfer plate (4) with venting valve.



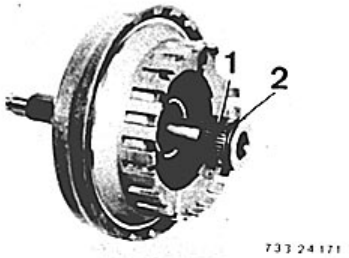
Transfer plugs (5 ... 8).
Check seals, replacing if necessary.
Tightening torque*.



Mount transfer plate on converter bell housing with the outer bolts which must be screwed in finger tight.
Align bores for inner bolts.
Install primary pump and check running with Special Tool 24 3 140.



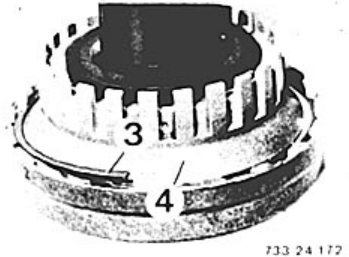
Mount converter bell housing and tighten all bolts to correct torque*.
Check axial play of input shaft.
Hold input shaft with Special Tool 24 0 010.
Apply Special Tool 00 2 510 (dial gage).
Check axial play by pulling input shaft.
Specification: 0.2 to 0.4 mm (0.008 to 0.016").
If play deviates, remove converter bell housing again and install a thicker or thinner thrust washer.
Recheck axial play.
Tighten converter bell housing bolts.
Tightening torque*.
* See Specifications



733 24 171

24 23 022 REPLACING PLATE TYPE CLUTCHES AND BRAKES

Disassemble transmission – see 24 00 080.
Important!
When repairing clutch A, check the transfer plate for an installed ventilating valve – see 24 16 502.
If necessary, install a transfer plate with a ventilating valve.
Clutch A:
Press out input shaft (1).
Check O-ring (2), replacing if necessary.

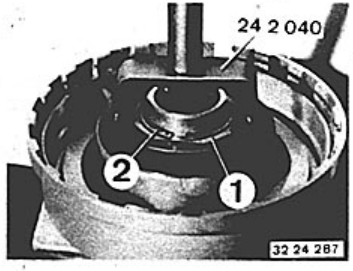


733 24 172

Compress clutch set and remove snap ring (3).
Remove plate carrier (4).


733 24 173

Lift out plate set and diaphragm spring.
4 HP 24:
Without diaphragm spring.
Important!
Note quantity of steel and lined plates.

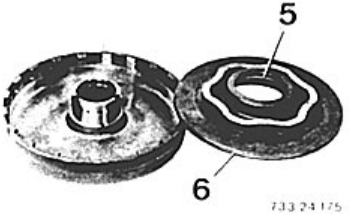


4 HP 24:
Bend open lockplate (1).
Press down on diaphragm spring with Special Tool 24 2 040.
Lift out snap ring (2).
Installation:
Replace and lock lockplate.
Install diaphragm spring with curved surface facing up.



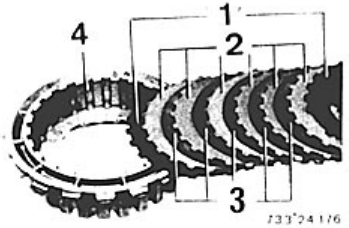
733 24 174

Press out clutch A piston with compressed air applied through oil bore.



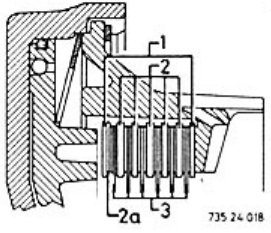
733 24 175

Installation:
Replace O-rings (5 and 6).
Lubricate O-rings with a light coat of ATF to make installation easier.



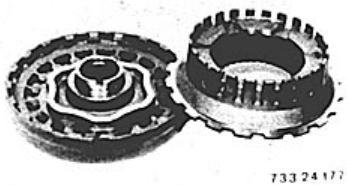
733 24 176

Installed Order of Plates:
Insert noted quantity of removed steel and lined plates alternately, beginning with spring and steel plates.
1 Spring plates
2 Steel plates 1.8 mm (2.1 mm for 750 i)
3 Lined plates
4 Plate carrier



735 24 018

BMW 745 i:
Watch installed order of plates.
1 Spring plates
2 Steel plates 1.8 mm
2a Adjusting plate 1.8 or 1.2 mm
3 Lined plates
Important!
Only use complete installation kit for repairs.

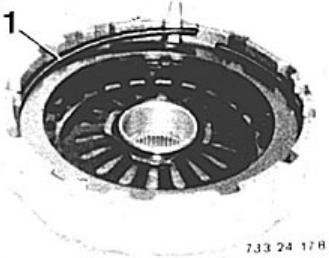

733 24 177

Place diaphragm spring in input shaft case with curved surface facing down.
Insert plate set with plate carrier.
Compress clutch set and insert snap ring.



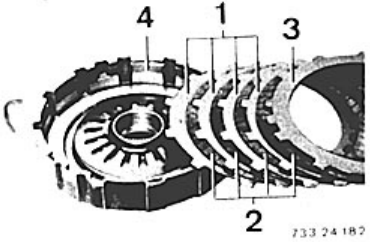
733 24 181

Installation:
Check O-rings (4 and 5), replacing if necessary. Lubricate O-rings with a light coat of ATF to make installation easier.



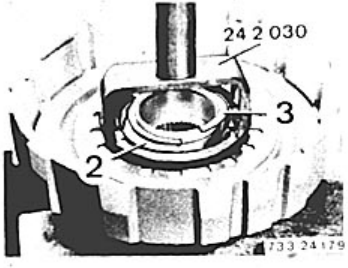
733 24 178

Clutch B:
Remove snap ring (1).
Remove steel and lined plates.
Important!
Note quantity of steel and lined plates.



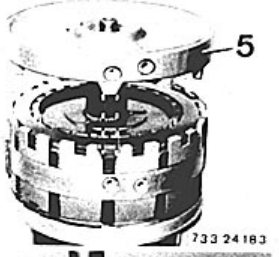
733 24 182

Installed Order of Plates:
Insert noted quantity of removed steel and lined plates alternately, beginning with a steel plate.
1 Steel plates (1.8 mm)
(2.1 mm for BMW 635 CSi, 735i, 745i, 750i)
2 Lined plates
3 End plate (4.5 mm)
(3.0 mm for BMW 750 i)
4 Housing
Important!
Insert end plate with ground surface facing lined plate.



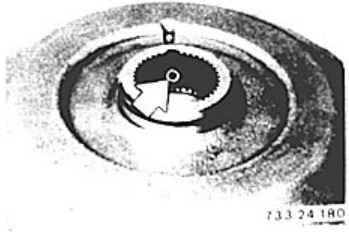
733 24 179

Bend open lockplate (2).
Press down on diaphragm spring with Special Tool 24 2 030 and remove snap ring (3).
Installation:
Replace and lock lockplate.
Install diaphragm spring with curved surface facing up.



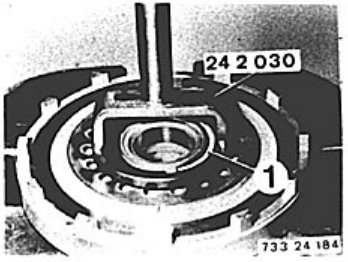
733 24 183

Clutch C' and C:
To make this step easier, place complete set in a suitable pipe and clamp in a vise.
Remove Special Tool 24 0 040.
Lift off centering plate (5).
Installation:
Bevelled beads must engage in bevelled openings.



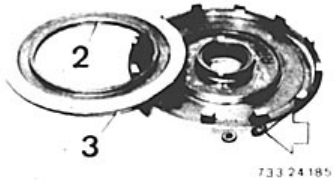
733 24 180

Press out clutch B piston with compressed air applied through oil bore.



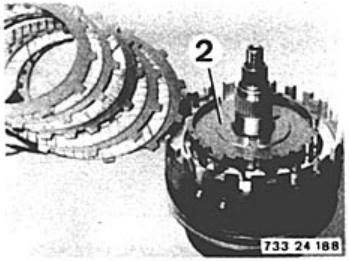
733 24 184

Press down on diaphragm spring with Special Tool 24 2 030 and lift out split retaining ring (1).
Installation:
Insert diaphragm spring with curved surface facing up.



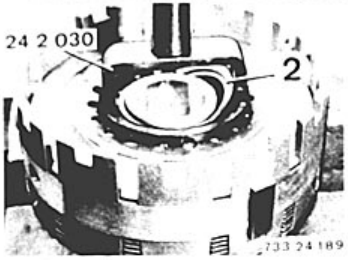
Press out piston for clutch C' with air pressure applied through the oil bore.

Installation:
Check O-rings (2 and 3), replacing if necessary.
Coat O-rings lightly with ATF to make installation easier.



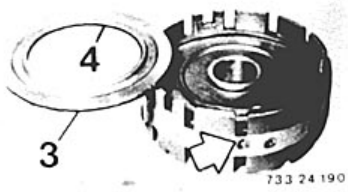
Remove all steel and lined plates.

Note:
Note number of steel and lined plates.
Pull out one-way clutch (2).



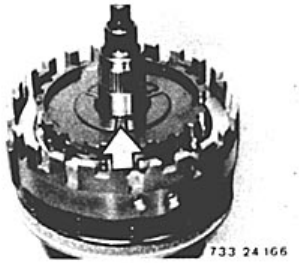
Press down disc spring with Special Tool 24 2 030 and lift out split retaining ring (2).

Installation:
Install disc spring with curved surface facing up.



Press out piston for clutch C with air pressure applied through the oil bore.

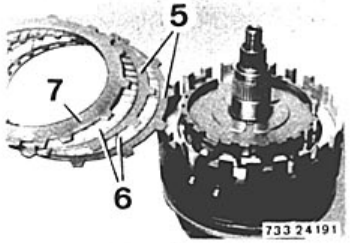
Installation:
Check O-rings (3 and 4), replacing if necessary.
Coat O-rings lightly with ATF to make installation easier.



Install one-way clutch.

Important!
Bent tabs or the word "oben" (= top) must be visible.

4 HP-24:
Rivet heads must be on top.



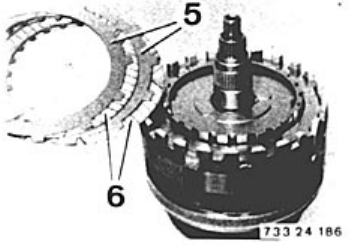
Installed Order:
Install noted number of removed steel and lined plates alternately, beginning with a steel plate.
5 Steel plates (1.8 mm)

Important!
Thickness of steel plates is different for 635 CSi and 735 i cars (1.5 mm and 2.1 mm).
4 HP-24: 1.8 mm and 2.1 mm.
2.1 mm for all plates since Transm. No. 21 250.
Thinner steel plate (1.5 mm) must be mounted on the piston end.

6 Lined plates
7 End plate (4.5 mm)

Important!
Install end plate that the middle tooth of a group of three teeth bears in the opening of the cylinder.



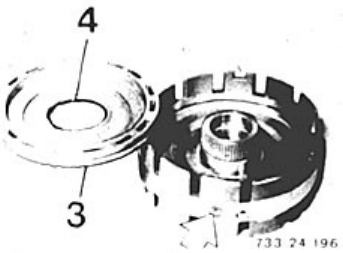


Installed Order for C':
Install noted number of removed steel and lined plates alternately, beginning with a steel plate.
5 Steel plates (1.8 mm)
6 Lined plates

Important!
Thickness of steel plates is different for 635 i and 735 i cars (1.5 mm and 2.1 mm). Thinner steel plate (1.5 mm) must be mounted on the piston end.
4 HP-24: 1.8 mm and 2.1 mm.



6 Lined plates
Important!
External splines of steel plates must not be placed in bevelled openings of cylinder.



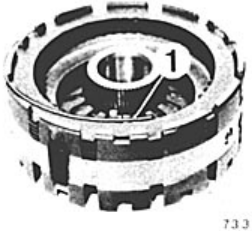
Press out clutch D piston with compressed air applied through oil bore.
Installation:
Check O-rings (3 and 4), replacing if necessary. Lubricate O-rings with a light coat of ATF to make installation easier.



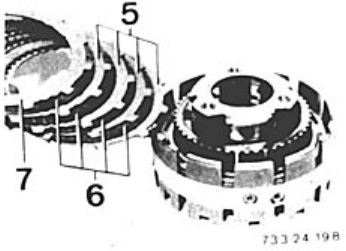
Clutch D:
Clutches C' and C removed.
Lift clutch member with clutch D off of planet gear set.



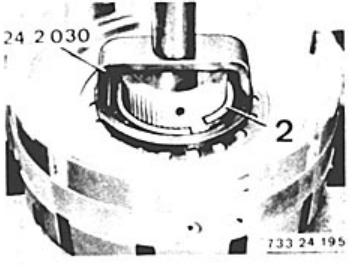
Place planet plate with one-way clutch on hub of cylinder D.



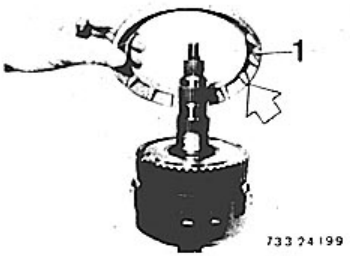
Remove snap ring (1).
Remove outer and lined plates.
Important!
Note quantity of steel and lined plates.



Installed Order of Plates:
Insert noted quantity of removed steel and lined plates alternately, beginning with a steel plate.
5 Steel plates (1.8 mm)
1,2 mm for BMW 745 i, 750 i
6 Lined plates
7 End plate (1.2 mm)
Insert clutch body with clutch D in planet gear set.



Press down on diaphragm spring with Special Tool 24 2 030 and lift out snap ring (2).
Installation:
Insert diaphragm spring with curved surface facing up.



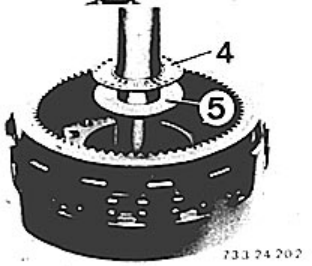
Disassemble planet gear set.
Remove support ring (1).
Installation:
Mount support ring with fins facing down.



Take off planet gear set (2).



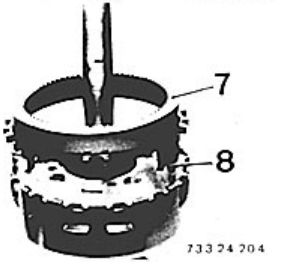
Pull out sun gear shaft (3).



Remove axial bearing (4) and thrust washer (5).



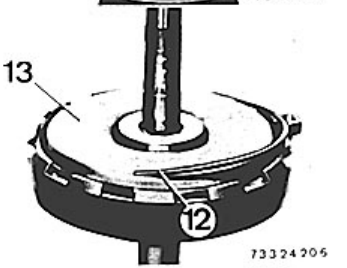
Lift out snap ring (6).



Remove hollow gear (7) and planet plate (8).



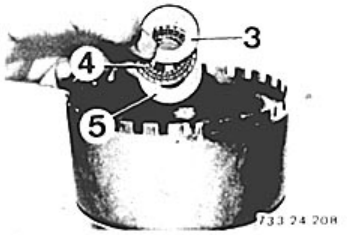
Remove thrust washers (9) and axial bearing (10).
Take off spacer (11).



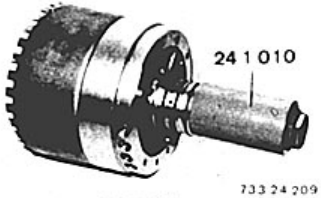
Lift out snap ring (12).
Take off hollow gear (13).



Clutches E and F:
Remove sun gear (1) and planet carrier (2).



Remove angled washer (3), axial bearing (4) and thrust washer (5)
Installation:
Install angled washer (3) with collar facing planet carrier.



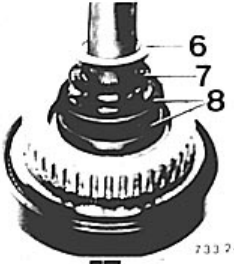
Take off Special Tool 24 1 010.



Lift cylinder F off of cylinder E.



Lift off cylinder E on output shell.



Take off thrust washer (6), axial bearing (7) and steel/copper angled washer (8).



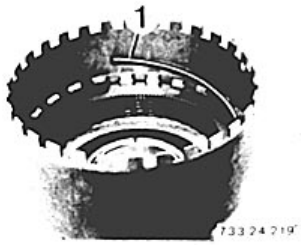
Installation:
Mount cylinder E and turn until it rests on stop.
Cylinder must rest on copper angled washer.
When holding output shaft it must now be possible to turn cylinder E clockwise.
It should lock in opposite direction.



Clutch F:
Lift out snap ring (1).



Remove plate set.
Important!
Note quantity of steel and lined plates.



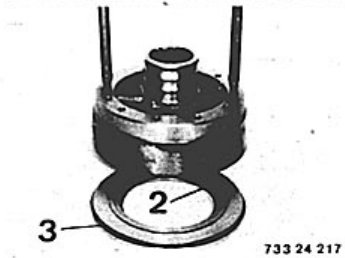
Clutch E:
Lift out snap ring (1).



Remove piston for clutch F.
Press down on diaphragm spring with Special Tool 24 2 020 and lift out the split retaining ring (1).
Installation:
Insert diaphragm spring with curved surface facing up.



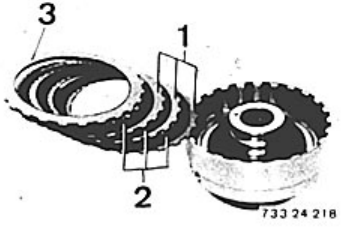
Remove plate set.
Important!
Note quantity of steel and lined plates.



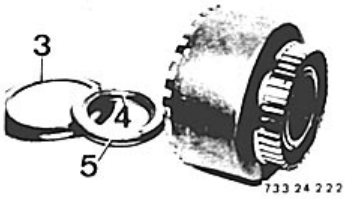
Press out piston for clutch F with two suitable mandrels.
Installation:
Check O-rings (2 and 3), replacing if necessary. Lubricate O-rings with a light coat of ATF to make installation easier.



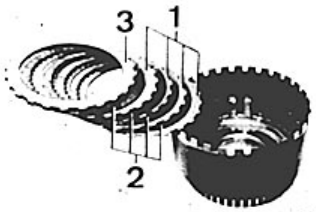
Remove piston for clutch E.
Press down on diaphragm spring with Special Tool 24 2 020 and remove the split retaining ring (2).
Installation:
Insert diaphragm spring with curved surface facing up.



Installed Order of Plates:
Insert noted quantity of removed steel and lined plates alternately, beginning with a steel plate.
1 Steel plates (2.1 mm)
2 Lined plates
3 End plate (4.5 mm)

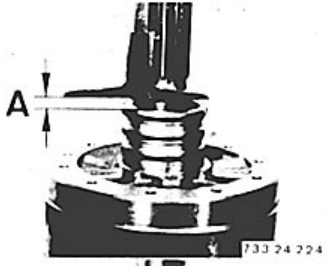


Lift off thrust plate (3).
Press out clutch E piston with compressed air applied through oil bore.
Installation:
Check O-rings (4 and 5), replacing if necessary. Lubricate O-rings with a light coat of ATF to make installation easier.



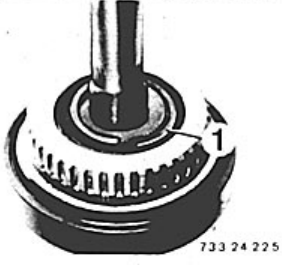
733 24 223

Installed Order of Plates:
Insert noted quantity of removed steel and lined plates alternately, beginning with a steel plate.
1 Steel plates (1.5 mm)
2 Lined plates
3 End plate (4.5 mm)



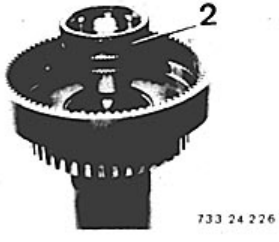
733 24 224

Connect cylinders E and F by turning.
Collar on output shaft will protrude by distance A = approx. 10 mm (0.394") when installed correctly.
Apply Special Tool 24 1 010.
Install planet gear carrier and sun gear



733 24 225

Removing One-way Clutch:
Lift out snap ring (1).



733 24 226

Press out output shaft (2).



733 24 227

Lift off plate carrier (3).

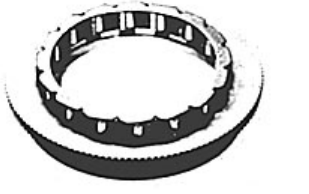


733 24 228

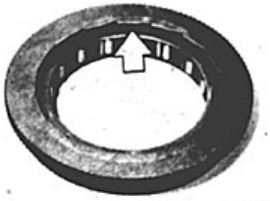
4 HP - 22:
Lift out snap ring (1).
Lift off one-way clutch.


733 24 228

Pull or press off one-way clutch.


733 24 229

Press one-way clutch cage out of outer race carefully.
Caution!
Needles could pop out of cage.



733 24 230

Installation:
Place one-way clutch cage on outer race and align.
Press in one-way clutch cage against stop and then turn until metal edge engages in holding groove of outer race.



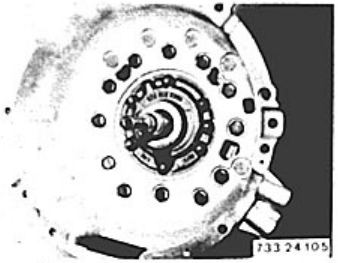
733 24 231

Use plate carrier (3) to turn one-way clutch outer race clockwise and mount race on inner race.



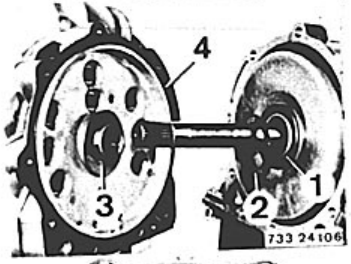
733 24 232

Clearance between one-way clutch inner race and outer race should be at least 0.1 mm (0.004").

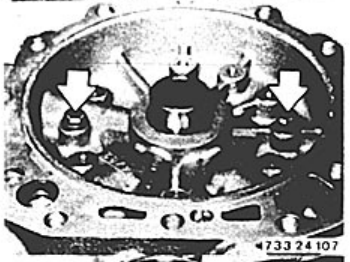


24 31 002 REMOVING AND INSTALLING PRIMARY PUMP

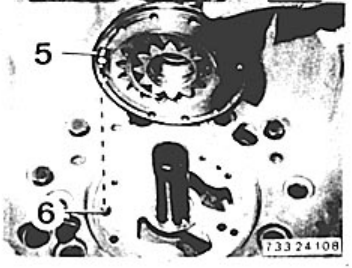
Remove torque converter – see 24 40 003.
Take off converter bell housing with connecting plate.



Installation:
Mount angled washer (1) with collar facing needle bearing (2) on input shaft.
Hold thrust washer (3) on converter bell housing with grease.
Replace gasket (4).



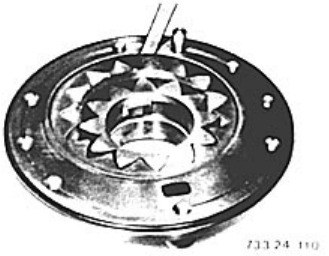
Unscrew primary pump on converter bell housing.
Loosen two bolts opposite each other by only several turns.
Loosen primary pump on converter bell housing with several light knocks.



Remove primary pump.
Installation:
Centering pin (5) must engage in bore (6).



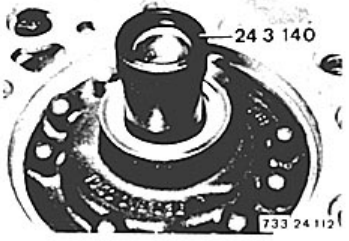
Installation:
Primary pump, consisting of pump body (7), hollow gear (8) and impeller (9), may only be replaced as an assembly.
Check O-ring (10), replacing if necessary.
Important!
Install hollow gear (8) and impeller (9) that punch marks face up.



Check radial play* between driven gear and pump body, while turning gear 360°.

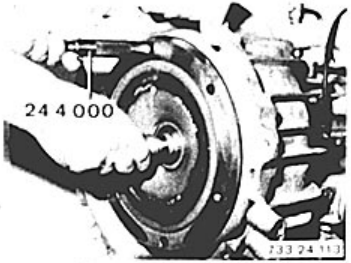


Check axial play* of both gears to face surface with a precision depth micrometer.



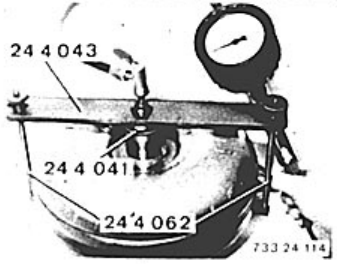
Check running of primary pump with Special Tool 24 3 140.

* See Specifications



24 40 003 REMOVING AND INSTALLING TORQUE CONVERTER

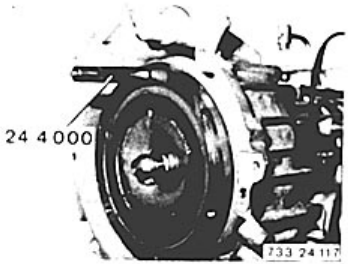
Remove transmission – see 24 00 022 in pertinent model repair manual microfiche beginning with 1985 models.
Pull torque converter out of primary pump carefully with Special Tool 24 4 000.
Caution!
Escaping ATF.



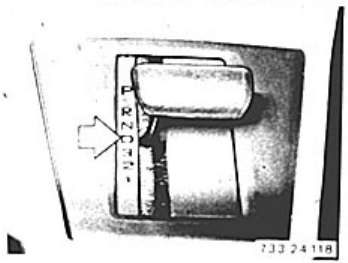
Installation:
Check torque converter for leaks with Special Tools 24 4 041, 24 4 043 and 24 4 062 or 24 4 044 for 4 HP 24.
Test pressure: 0.5 bar (7 psi).
Important!
Always use Special Tool 24 4 043 to prevent injury.



A torque converter must be replaced when bearing surface on converter shaft is damaged.



Turn slightly to guide openings on converter into primary pump carefully, using Special Tool 24 4 000.
Important!
Be careful not to damage converter bearings and seal while guiding in.
Converter is in its correct installed position, if drive ring is below case edge.



Checking Installed Torque Converter:
Engine and transmission oil must have operating temperature.
Engine must produce full rated power.
Start engine.
Pull on parking brake and operate brake pedal firmly.
Move selector lever to D and press accelerator pedal to full throttle.
Read stall speed* from tachometer.



Important!
Never test stall speed longer than 10 seconds to prevent damage from excessive heat.

Stall Speed Much Above Specified Value*:
a) Converter oil volume insufficient – correct oil level.
b) Slip in clutches – check clutches.

Stall Speed Much Below Specified Value*:
a) Engine power insufficient – check engine.
b) Converter or pump defective – replace converter or check pump.

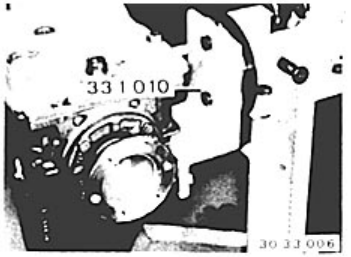
Torque converters cannot be cleaned with conventional workshop equipment and must be replaced when a transmission had been defective or an oil filter screen torn.
Converter identification*.

* See Specifications

Construction group 33 Rear axle

Transmission type K = side cover with 4 bolts

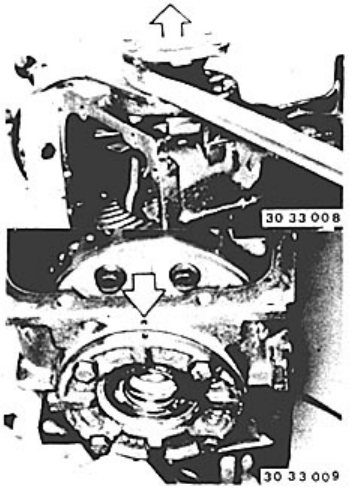
33 11 011	Shaft seal and input flange of final drive – replace	33- 101
512	Shaft seal for input flange – replace	33- 103
621	Shaft seal for drive flange – replace	33- 105
731	Both bearings for differential case – replace	33- 106
33 12 526	Bearing for drive pinion – replace	33- 111
551	Drive pinion with ring gear – replace	33- 117
	Basic information on tooth contact pattern adjustments	33- 126
33 13 611	Differential gears – replace	33- 128
	Limited slip differential (25 %) – general information	33- 130
33 14 520	Limited slip differential assembly – replace	33- 130
593	Limited slip differential – disassemble and assemble	33- 136



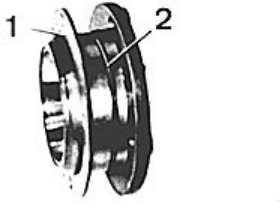
33 11 011 REPLACING SHAFT SEAL FOR FINAL DRIVE INPUT FLANGE

Remove final drive – see 33 10 010 in pertinent model repair manual microfiche beginning with 1985 models.
Mount final drive on Special Tool 33 1 010.
Drain oil.
Take off case cover.
Installation:
Replace gasket. Tightening torque*.
Add oil. Oil volume*.
Refer to Gr. 33 in Operating Material Binder for approved oil.

Press off drive flanges with a tire iron.



Punch mark both bearing caps.
Unscrew both bearing caps.
Important!
Don't mix up bearing caps and spacers.
Secure spacers on bearing cap with a piece of wire, if necessary.
Installation:
Tightening torque*.

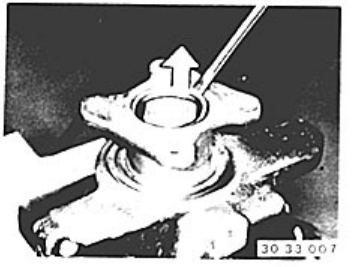


Differential case bearings and backlash are adjusted with shims (1).
Check O-ring (2), replacing if necessary.

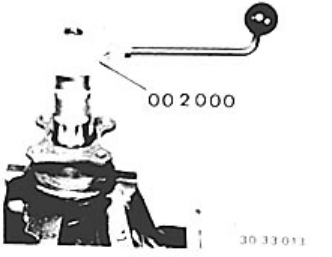
* See Specifications



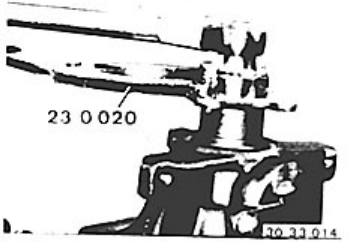
Remove differential assembly.
Important!
Don't bend pulse spider!



Remove lockplate.

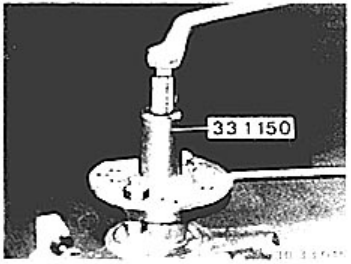


Measure friction torque with torque meter 00 2 000 and note value.
Important!
The measured friction torque value + friction torque of new shaft seal (20 Ncm/1.7 in. lbs.) must be reached when assembling, but not exceeded.

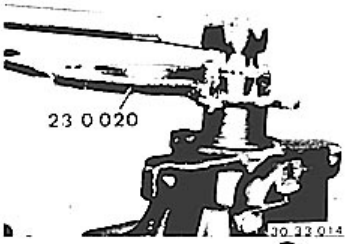


Hold input flange with Special Tool 23 0 020 and unscrew collar nut.
Installation:
Tightening torque*.

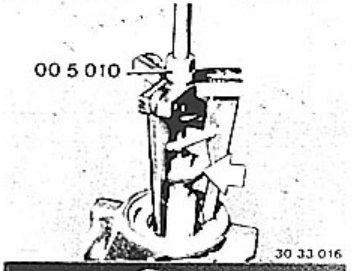
* See Specifications



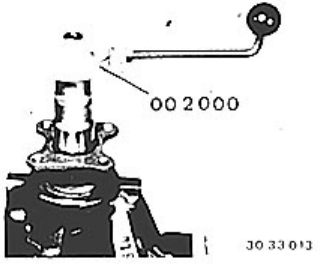
Pull off input flange with Special Tool 33 1 150.



Tighten input flange with the collar nut in steps, measuring the friction torque between steps.

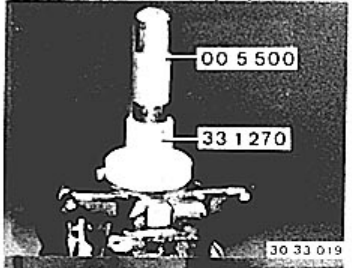


Pull out shaft seal with Special Tool 00 5 010 and thrust piece.

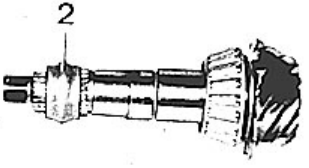


Adjust drive pinion bearing to friction torque value measured prior to disassembling and add 20 Ncm (2 in. lbs.) for new shaft seal.
Example:

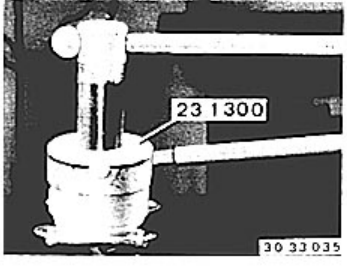
Measured torque		60 Ncm (5 in. lbs.)
New shaft seal	+	20 Ncm (2 in. lbs.)
Pinion bearing adjusted to		80 Ncm (7 in. lbs.)



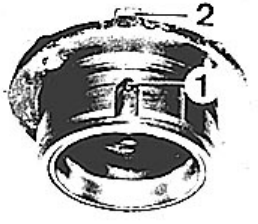
Dip shaft seal in final drive gear lube and drive in seal flush with Special Tools 33 1 270 and 00 5 500.



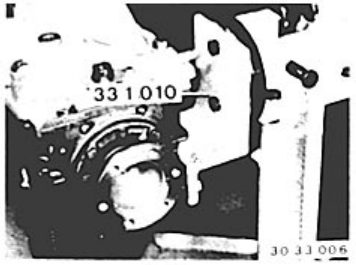
If friction torque value (see example) is exceeded, replace bushing (2) and repeat measuring procedures.
This requires removing and installing drive pinion – see 33 12 551.
Installation:
DRive in new lockplate with Special Tools 33 4 050 and 00 5 500.



Press new input flange on to input shaft with Special Tool 23 1 300, do not tighten.
The bushing does not have to be replaced when replacing the input flange.

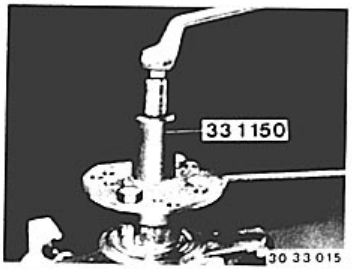


Installation:
Install complete differential again, checking for correct installation of bearing caps.
The differential bores (1) always face up when the differential is installed correctly and this can be seen on the outside by way of tab (2).
If applicable, check backlash and tooth contact pattern.
See 33 12 551 for additional information.



33 11 512 REPLACING SHAFT SEAL FOR INPUT FLANGE
– Final Drive Removed –

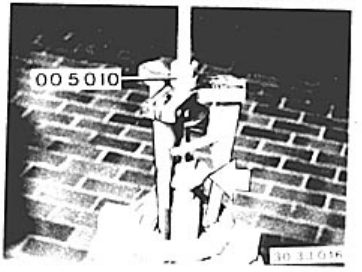
Removing and installing final drive – see 33 10 010 in pertinent model repair manual beginning with 1985 models.
Mount final drive on Special Tool 33 1 010.
Drain oil.
Installation:
Pour in oil – oil volume*.
Refer to Gr. 33 in Operating Material Binder for approved oil.



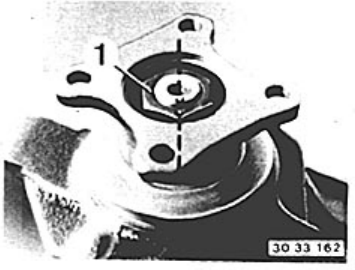
Pull off input flange with Special Tool 33 1 150.



Lift out lockplate.
Installation:
Drive in new lockplate with Special Tools 33 4 050 and 00 5 500.

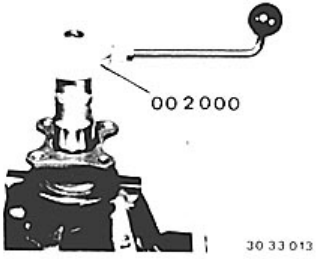


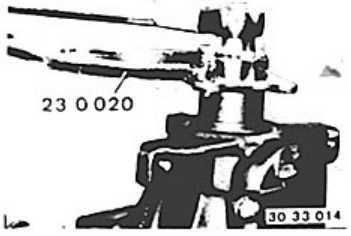
Pull out shaft seal with Special Tool 00 5 010 and a suitable thrust piece.



Punch-mark position of nut (1) to input shaft.

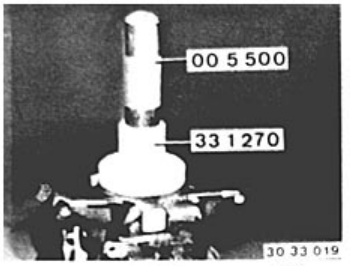
Installation:
If bearing surface on input flange is scored seriously, replace the input flange.
Important!
If the input flange has to be replaced, measure the friction torque with the old input flange.
If applicable, tighten nut to the punch mark, measure and note friction torque value – see 33 11 011.
The old shaft seal does not have to be installed for measuring.





Unscrew nut (1), counterholding on flange with Special Tool 23 0 020.

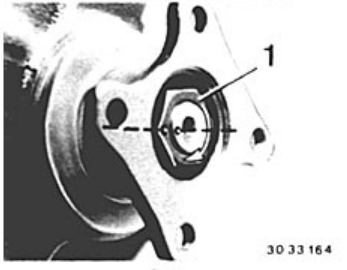
* See Specifications



Dip new shaft seal in final drive gear lube** and drive in seal flush with Special Tools 33 1 270 and 00 5 500.



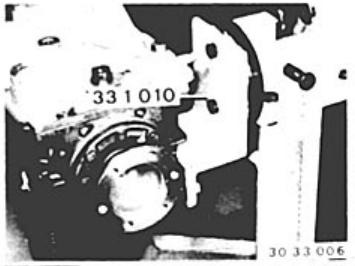
Press on input flange, if necessary with Special Tool 23 1 300; do not tighten.

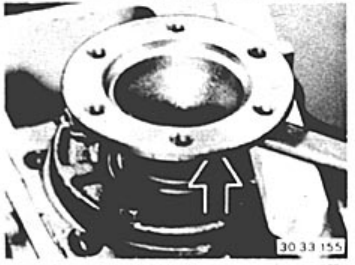


Tighten input flange with collar nut (1) and then turn nut further until punch marks are aligned precisely.
Caution!
Never tighten collar nut past the punch marks and then back again, since then the bushing will have to be replaced – see 33 12 551.
Installation:
Replace lockplate.
Pour in final drive gear lube**.



** See Gr. 33 in Operating Material Binder







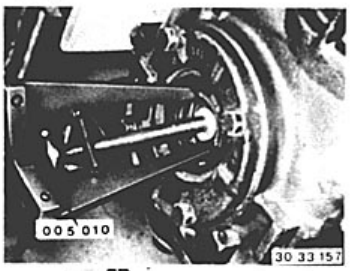
33 11 621 REPLACING SHAFT SEAL FOR DRIVE FLANGE

– Final Drive Removed –

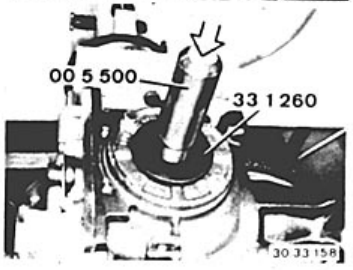
Remove final drive – see 33 10 010 in pertinent model repair manual microfiche beginning with 1985 models.
Mount final drive on Special Tool 33 1 010.

Press off drive flange with tire irons.

Installation:
Prior to installation of drive flange, place wire snap ring (1) in groove of differential case that both ends of wire snap rings are recessed in groove.
This will prevent lateral bending of ring.
Press in drive flange by hand and turn slightly until wire snap ring is heard to engage.
Replace stretched snap rings.



Pull out shaft seal with Special Tool 00 5 010 in conjunction with a pressure piece.



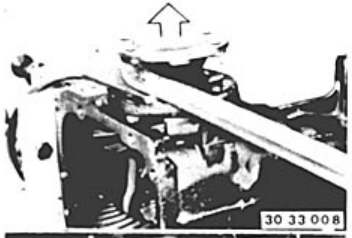
Installation:
Dip shaft seal in final drive oil.
Drive in shaft seal against stop with Special Tools 33 1 260 and 00 5 500.
Replace drive flange with a seriously scored bearing surface.

* See Specifications

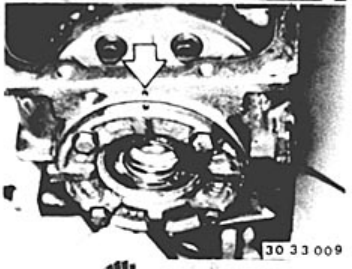


33 11 731 REPLACING BOTH BEARINGS FOR DIFFERENTIAL CASE
– Final Drive Removed –

Remove final drive – see 33 10 010 in repair manual microfiche for models beginning with 1985 models.
Mount final drive on Special Tool 33 1 010.
Drain oil.
Unscrew case cover.
Installation:
Replace gasket.
Tightening torque*.
Add oil – oil volume*.
See Group 33 in Operating Material Binder for grade of oil.



Remove differential – see 33 13 010.
Pry off drive flanges with a tire iron for this purpose.



Mark bearing cap with punch marks and unscrew.
Important!
Don't mix up bearing caps and shims to make friction torque adjustments easier.

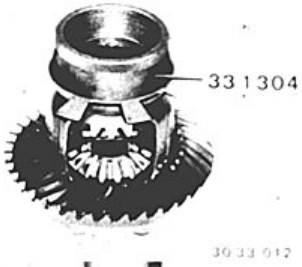


Remove complete differential case.
Important!
Don't bend the pulse spider.

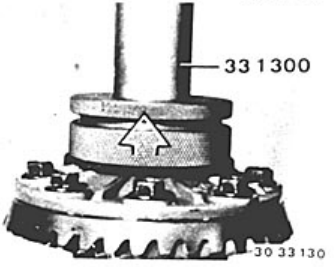
* See Specifications



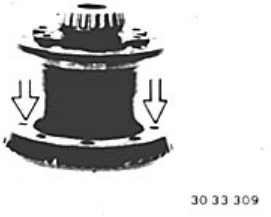
Press pulse spider off of differential case.
Important!
Don't bend the pulse spider.



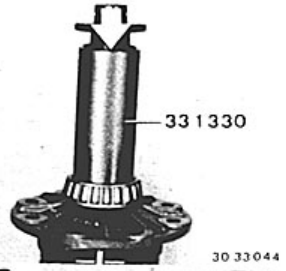
Installation:
Press on pulse spider with Special Tool 33 1 304.



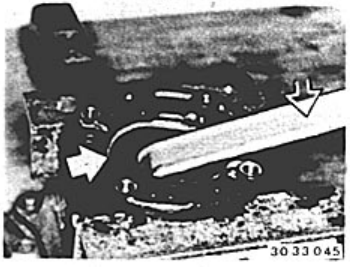
Pull off tapered roller bearing on differential case with Special Tool 33 1 300.



Remove ring gear (cold).



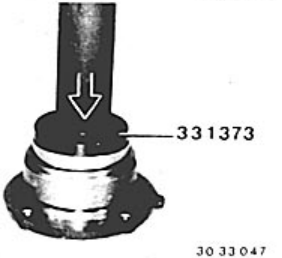
Installation:
Press on new tapered roller bearings cold with Special Tool 33 1 330.
Important!
Always only use both bearings of one make.



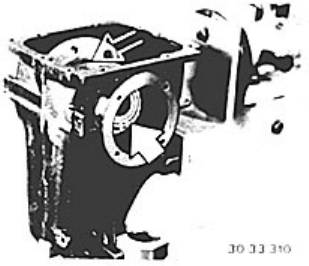
Lift shaft seals out of both bearing caps.



Press out bearing outer race with Special Tools 33 1 350 and 33 1 351.
Important!
Special Tool 33 1 351 must engage in the bearing outer race.

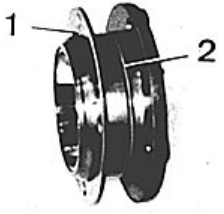


Installation:
Press in new bearing outer races with Special Tool 33 1 373.

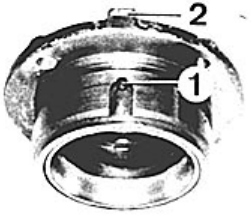


If only the differential bearings are being replaced, the drive pinion can remain installed and the differential case is installed without the ring gear for determination of shim thickness.
Important!
Note make of bearings – this is required to determine the friction torque.

Lubricate new bearings with approved final drive gear lube** thoroughly and let them drip dry.



Install side bearing caps marked with belonging shims (1), but at first without O-rings (2). Tighten bearing cover bolts on the side opposite the ring gear uniformly.
Tightening torque*.

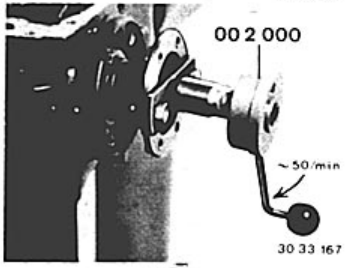


The compensating bore (1), which is recognized on the outside by tab (2), always faces up in installed position of the transmission.

* See Specifications
** See Gr. 33 in Operating Material Binder


30 33 311

The initial axial force of the differential case bearings (4000 N = 882 lbs.) can be determined with the friction torque*.
Tighten bolts of the second bearing cap uniformly only enough, that the differential can still be turned easily.



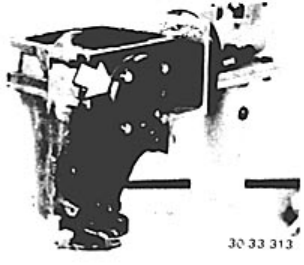
30 33 167

Apply an output flange on the side tightened to the tightening torque and measure the friction torque with a locally made clamp with a welded nut and friction torque meter 00 2 000.
Turn friction torque meter at speed of approx. 50 rpm.



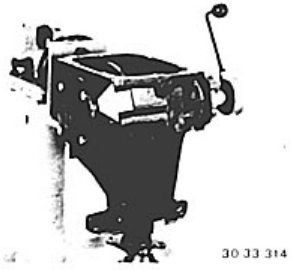
30 33 312

The friction torque* specified in the differential case bearing* table should be reached, but not exceeded.
If new shaft seals have already been installed, 20 Ncm (2 in. lbs.) must be added for each seal in which an output shaft runs while measuring.

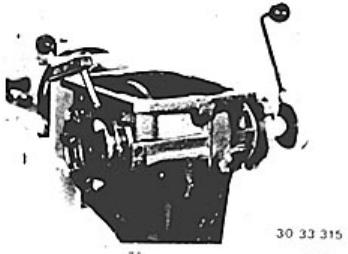

30 33 313

If the specified friction torque is not reached, even though both bearing caps are tigthened with correct tightening torque*, a thinner shim must be installed opposite the ring gear end and the measurement repeated.

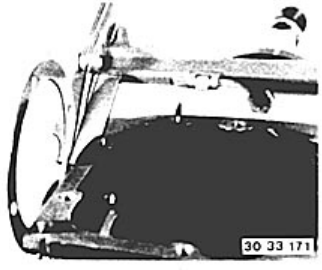
* See Specifications


30 33 314

If the friction torque is reached, even though the second bearing cap has not yet been tightened to the correct tightening torque*, a thicker shim must be used on the ring gear end and the measuring procedures repeated.


30 33 315

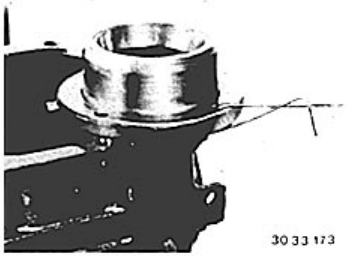
To make finding the shim thickness easier, the distance between the shim and case can be measured with a feeler gage blade and added to the thickness of the used shim.


30 33 171

Example:
Second bearing cap not bolted tight (bolts screwed in uniformly).
Specified friction torque* (e.g. 190 Ncm = 16.5 in. lbs.) is reached and new shaft seals have not yet been installed.

Gap measured with blade	0.20 mm (0.008")
Used shim	1.40 mm (0.055")
Install shim of thickness and repeat measurement.	1.60 mm (0.063")

* See Specifications


30 33 173

Remove differential.
Match side covers and shim of determined thickness, and don't mix them up.

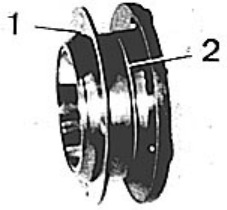

30 33 041

Installation:
Clean tapped bores thoroughly (tapper).
Heat ring gear to max. 100° C (212° F), checking temperature with a thermo-color pencil.
Mount ring gear with two locally manufactured staybolts for guiding.



30 33 042

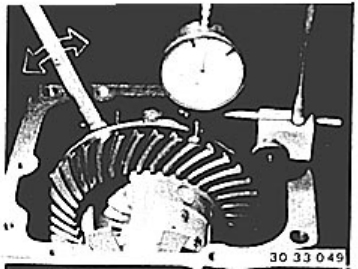
Install new bolts with Loctite No. 270 and tighten in order of 1 ... 8.
Tightening torque*.
Then tighten bolts with correct torque angle*.



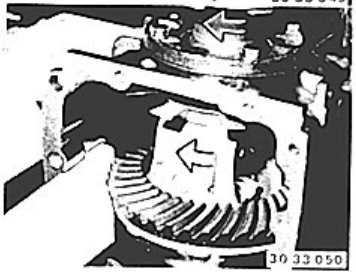
30 33 048

Install differential with ring gear and pulse gear.
Install side cover as marked with corresponding washers (1) and new O-rings (2).
Tightening torque*.

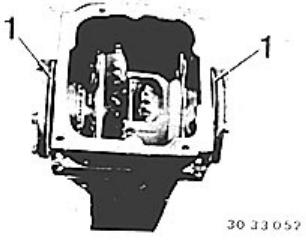
* See Specifications


30 33 049

Backlash / Tooth Contact Adjustment:
Mount Special Tool 00 2 500 and measure the backlash*.
Important!
The tooth contact pattern is always most important for a perfectly adjusted pinion/ring gear. See "Replacing Drive Pinion with Ring Gear" – 33 12 551 – for basic information on tooth contact pattern adjustments.


30 33 050

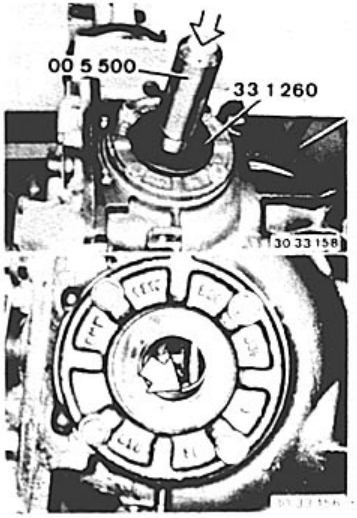
To check the tooth contact pattern, coat the ring gear teeth with printer's ink, turn in both directions several times and stop ring gear suddenly with a piece of hard wood.



30 33 052

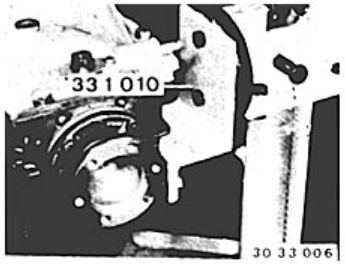
Correct backlash* and tooth contact pattern by changing the thickness of both shims (1).
If backlash is excessive, use a thinner shim on the ring gear end.
If backlash is too small, use a thicker shim on the ring gear end.
An axial displacement of the ring gear by 0.01 mm (0.0004") will cause a change in backlash of 0.0076 mm (0.0003").
Important!
The total thickness of both shims must not be changed.
If a thinner or thicker shim is required to correct the tooth contact pattern, the total thickness must be corrected with the second shim, since otherwise the friction torque of bearings would be changed again.

* See Specifications



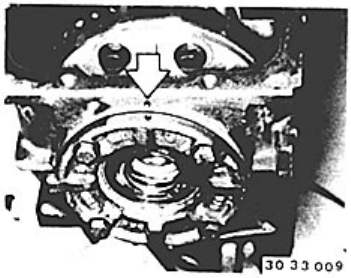
Installation:
Dip shaft seal in final drive oil.
Drive in shaft seal against stop with Special Tools 33 1 260 and 00 5 500.
Replace drive flange with a seriously scored bearing surface.

Installation:
Prior to installation of drive flange, place wire snap ring (1) in groove of differential case that both ends of wire snap rings are recessed in groove.
This will prevent lateral bending of ring.
Press in drive flange by hand and turn slightly until wire snap ring is heard to engage.
Replace stretched snap rings.

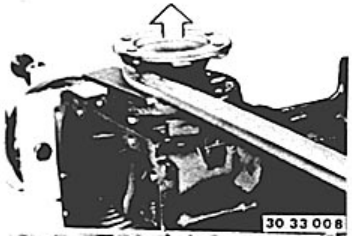


33 12 526 REPLACING BEARINGS FOR DRIVE PINION
– Final Drive Removed –

Remove final drive – see 33 10 010 in repair manual microfiche for models beginning with 1985 models.
Mount final drive on Special Tool 33 10 010.
Drain oil.
Unscrew case cover.
Installation:
Replace gasket.
Tightening torque*.
Pour in oil – oil volume*.
See Group 33 in Operating Material Binder for approved oil grades.



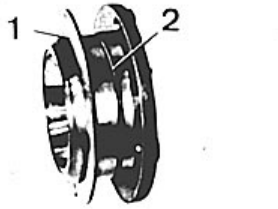
Punch mark both bearing caps.
Unscrew bolts of both bearing caps and take off bearing caps (turn if necessary, since seals suck tight).
Important!
Don't mix up bearing caps and shims.
If necessary, fasten shims on bearing caps with pieces of wire.
Installation:
Tightening torque*.



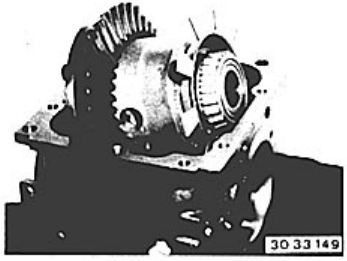
Pry off drive flanges with a tire iron.



Installation:
Prior to installation of drive flange, place wire snap ring (1) in groove of differential case that both ends of wire snap rings are recessed in groove.
This will prevent lateral bending of ring.
Press in drive flange by hand and turn slightly until wire snap ring is heard to engage.
Replace stretched snap rings.



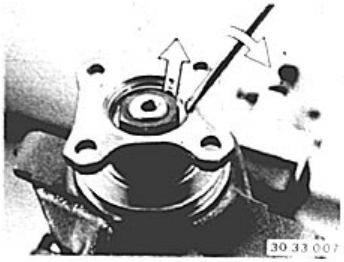
The axial initial force (4000 N = 882 lbs.) of differential bearings and the backlash of the ring gear and pinion are adjusted with shims (1).



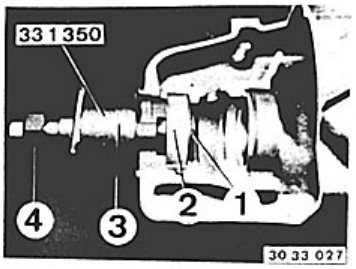
Remove complete differential case.
Important!
Don't bend the pulse spider.

* See Specifications

* See Specifications

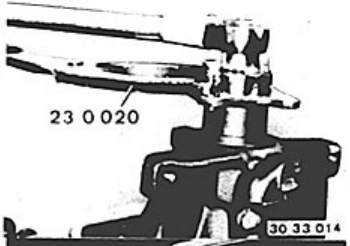


Lift out lockplate.

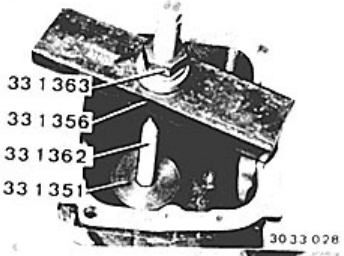


Pull out front bearing outer race with Special Tool 33 1 350.

1 Spreader
2 Front bearing outer race
3 Puller bell housing
4 Pressure bolt



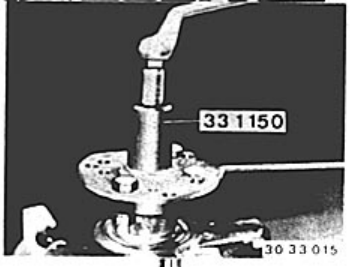
Hold input flange with Special Tool 23 0 020 and unscrew collar nut.



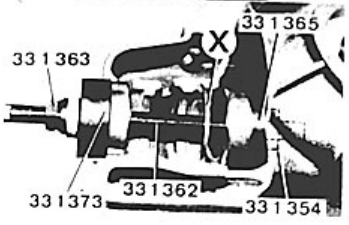
Pull out rear bearing outer race with Special Tool 33 1 360.

Puller head	33 1 361
Threaded spindle	33 1 362
Bearing bridge	33 1 356
Pressure nut	33 1 363

Important!
Shim (X) is located underneath the rear bearing outer race.
It will be needed again for pinion/ring gear adjustments.

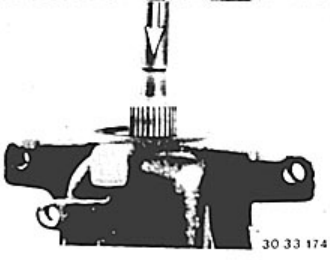


Pull off input flange with Special Tool 33 1 150.
Friction torque* is specified for the new bearings and friction torque of the old bearings does not have to be measured.



Install old shim (X) in front of the rear bearing outer race.
Pull in bearing outer races with Special Tool 33 1 360.
Puller consists of:

Puller disc for front outer race	33 1 373
Puller disc for rear outer race	33 1 365
Threaded spindle	33 1 362
Pressure nut	33 1 363
Nut	33 1 354



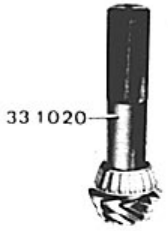
Press out drive pinion.
Caution!
Be careful not to damage threads.



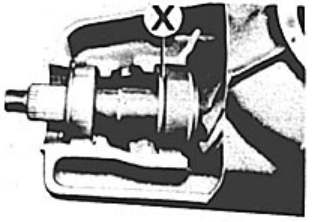
Pull tapered roller bearing off of the drive pinion with Special Tool 33 1 300.
Caution!
Don't damage the pinion – use soft aluminum jaws or pieces of wood.

* See Specifications

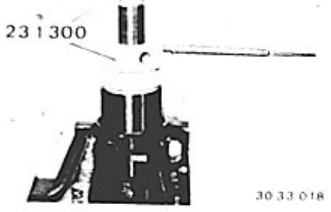
* See Specifications



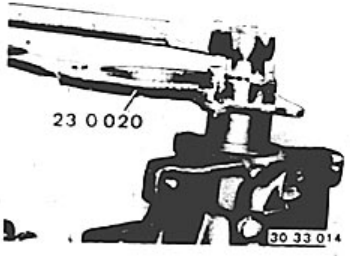
Press new tapered roller bearing on to the drive pinion with Special Tool 33 1 020.
Important!
Always only use same make bearings for both.



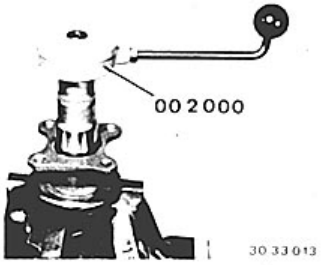
Install the drive pinion with new tapered roller bearings, but without a clamping sleeve, to determine the correct thickness of shim (X).



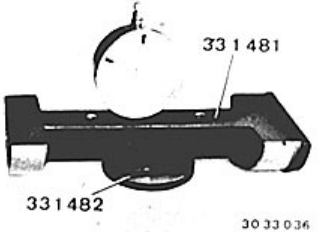
Install drive pinion in the rear bearing outer race.
Pull front tapered roller bearing on to the drive pinion with Special Tool 23 1 300 in conjunction with a spacing sleeve.



Mount input flange.
Adjust the friction torque of the drive pinion tapered roller bearings to 250 Ncm (22 in. lbs.) by tightening the collar nut carefully.



Important!
Measure the friction torque continuously while tightening at certain intervals with Special Tool 00 2 000.



Block Distance of Drive Pinion:
Mount dial gage in Special Tool 33 1 481.
Place Special Tool 33 1 481 with dial gage on Special Tool 33 1 482 and adjust the dial gage to zero (0) with preload.



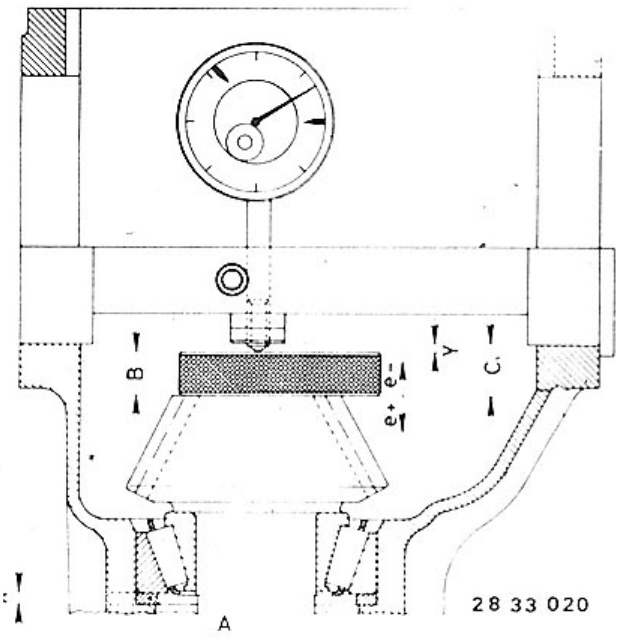
Place Special Tool 33 1 482 on the drive pinion.
Place Special Tool 33 1 481 in the case.
Determine value Y:
Basic distance C = 9.02 mm (0.355")
Master disc B B = 7.00 mm (0.275")

Examples for Determination of Correct Thickness for Shim (X)

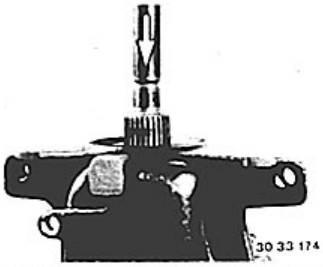
Example I		Example II	
C	9.02 mm (0.355")	C	9.02 mm (0.355")
e +	0.10 mm (0.004")	e –	0.10 mm (0.004")
C nominal	9.12 mm (0.359")	C nominal	8.92 mm (0.351")
Y measured on dial gage	1.92 mm (0.075")	Y measured on dial gage	2.12 mm (0.083")
+ master disc thickness B	7.00 mm (0.276")	+ master disc thickness B	7.00 mm (0.276")
C actual	8.92 mm (0.351")	C actual	9.12 mm (0.359")
C nominal	9.12 mm (0.359")	C actual	9.12 mm (0.359")
C actual –	8.92 mm (0.351")	C nominal –	8.92 mm (0.351")
a	0.20 mm (0.008")	a	0.20 mm (0.008")
Master disc A	4.10 mm (0.161")	Master disc A	3.90 mm (0.153")
a –	0.20 mm (0.008")	a +	0.20 mm (0.008")
Thickness of shim X	3.90 mm (0.153")	Thickness of shim X	4.10 mm (0.161")

If C nominal is greater than C actual, "a" is subtracted from thickness of shim "X" (–).

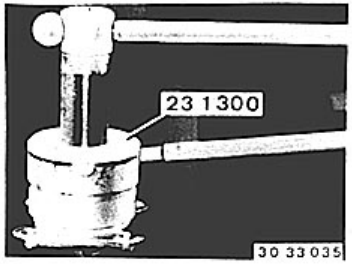
If C nominal is smaller than C actual, "a" is added to thickness of shim "X" (+).



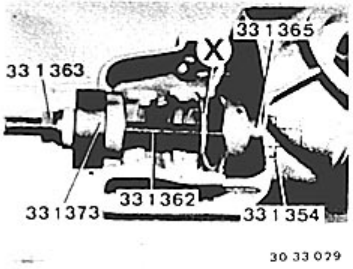
Permissible tolerances for thickness (X) result from the tolerances for shims depending on their thickness; 0.01 to 0.03 mm (0.0004 to 0.0012").



Remove drive pinion after determining the thickness of shim (X).
Important!
Note make of bearings – this information is needed for determination of the friction torque.



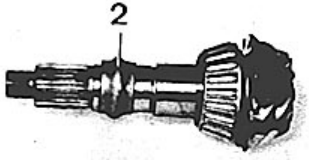
Press (don't pull) input flange on to the input shaft with Special Tool 23 1 300.
The axial preload force of pinion tapered roller bearings (5000 N = 1102 lbs.) can be determined with help of the friction torque.



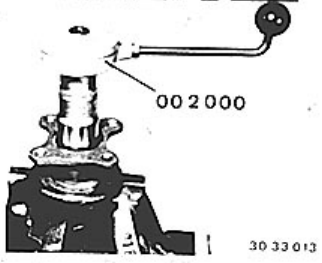
Remove rear bearing outer race and install again with shim (X) in determined thickness.



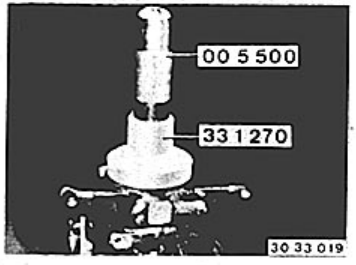
Tighten input flange with the collar nut in steps, measuring the friction torque after each step (see below).



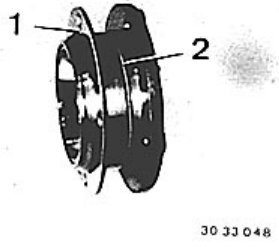
Install drive pinion with a new clamping sleeve (2).



Measure friction torque* with Special Tool 00 2 000 and a suitable socket.
Important!
The relation between friction torque and preload force differs depending on the make of bearings.
Refer to the pinion bearing table* for specified friction torque and add 20 Ncm (2 in. lbs.) for the new shaft seal.

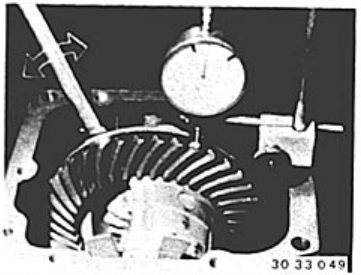


Dip shaft seal in final drive gear lube and drive in flush with Special Tools 33 1 270 and 00 5 500.



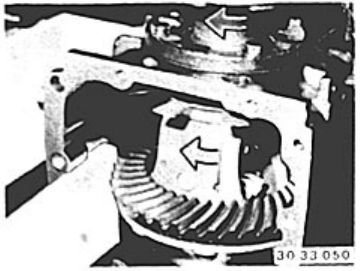
Install differential.
Install side covers as marked with corresponding washers (1) and new O-rings (2).
Tighten bolts uniformly.
Tightening torque*.

* See Specifications

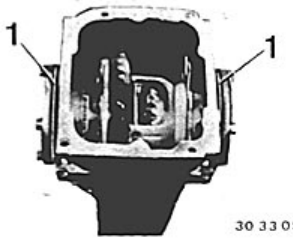


– Backlash/Tooth Contact Pattern Adjustment –
Mount Special Tool 00 2 500 and measure backlash* with dial gage.
Important!
The tooth contact pattern is always most important for a perfectly adjusted pinion/ring gear set.

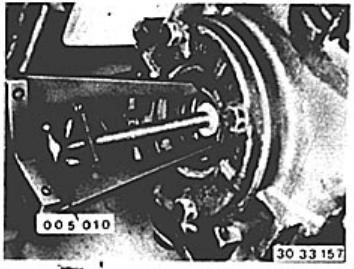
Refer to 33 12 551 "Replacing Drive Pinion with Ring Gear" for basic information on tooth contact pattern adjustments.



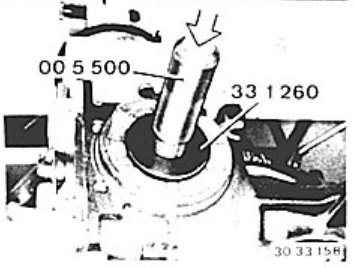
To check the tooth contact pattern, coat the ring gear teeth with printer's ink, turn in both directions several times and stop ring gear suddenly with a piece of hard wood.



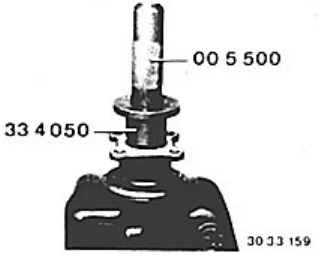
Correct backlash* and tooth contact pattern by changing the thickness of both shims (1).
If backlash is excessive, use a thinner shim on the ring gear end.
If backlash is too small, use a thicker shim on the ring gear end.
An axial displacement of the ring gear by 0.01 mm (0.0004") will cause a change in backlash of 0.0076 mm (0.0003").
Important!
The total thickness of both shims must not be changed.
If a thicker or thinner shim is required on the one side to correct the tooth contact pattern, the other shim must also be changed again to have the original total thickness – if not, the friction torque of the bearings would be changed.
Determine friction torque of differential bearings – see 33 11 731 "Replacing Differential Bearings".



Pull out old shaft seals with Special Tool 00 5 010 in conjunction with a thrust piece.

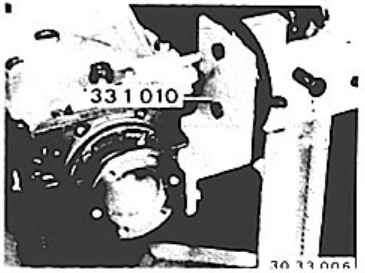


Installation:
Dip new shaft seals in final drive gear lube. Drive in shaft seals against the stop with Special Tools 33 1 260 and 00 5 500. Replace a drive flange with seriously scored bearing surfaces.



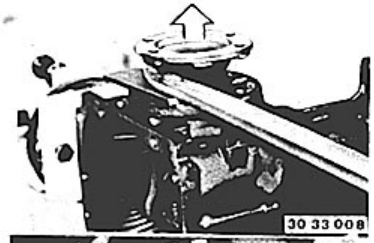
Drive in new lockplate with Special Tools 33 4 050 and 00 5 500.

* See Specifications

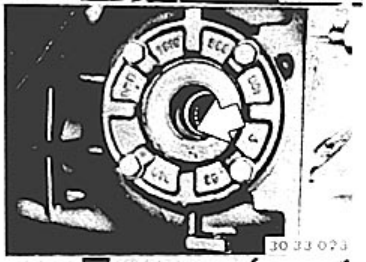


33 12 551 REPLACING DRIVE PINION WITH RING GEAR
– Final Drive Removed –

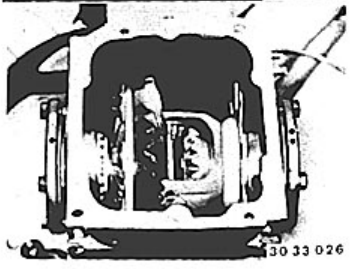
See 33 10 010 in microfilmed repair manual of cars beginning with 1985 models for information on removing and installing final drive.
Mount final drive on Special Tool 33 1 010.
Drain oil.
Unscrew case cover.
Installation:
Replace gasket.
Tightening torque*.
Pour in oil – oil volume*.
See Group 33 in Operating Material Binder for approved oil.



Press off both drive flanges with a tire iron.

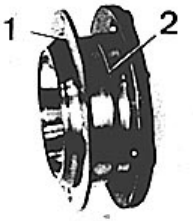


Installation:
Place round wire snap ring (1) in groove of differential case prior to installation of the drive flange, that both ends are recessed in the groove.
This prevents lateral bending of the ring.
Press in drive flange by hand and while turning slightly, until the round wire snap ring is heard to engage.
Replace stretched snap rings.



Punch mark both bearing caps.
Unscrew and remove both bearing caps.
Important!
Don't mix up bearing caps and shims.
Fasten shims, if applicable, on bearing caps with pieces of wire.
Installation:
Tightening torque*.

* See Specifications



Differential case bearings and backlash are adjusted with shims (1).
Check O-ring (2), replacing if necessary.



Remove complete differential case.
Caution!
Don't bend the pulse spider.

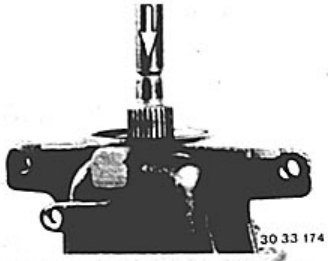


Lift out lockplate.
Hold with Special Tool 23 0 020 and unscrew nut (1).

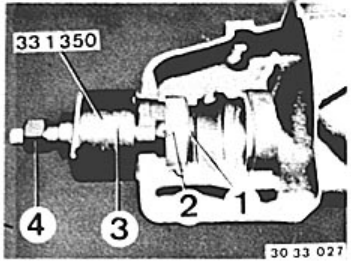


Pull off input flange with Special Tool 33 1 150.
Specified friction torque* is given for the new drive pinion bearings and the friction torque of the old bearings does not have to be measured.

* See Specifications

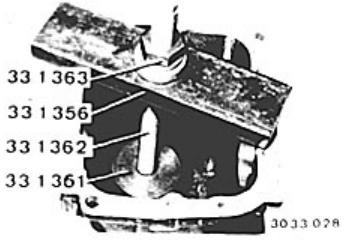


Press out drive pinion.



Pull out front bearing outer race with Special Tool 33 1 350.

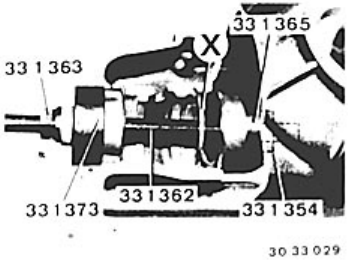
1 Spreader
2 Front bearing outer race
3 Puller bell housing
4 Pressure bolt



Pull out rear bearing outer race with Special Tool 33 1 360.
Puller consists of:

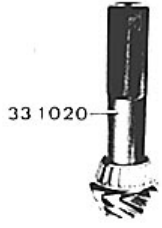
Puller head	33 1 361
Threaded spindle	33 1 362
Bearing bridge	33 1 356
Pressure nut	33 1 363

Important!
Shim (X) is located underneath the rear bearing outer race.
It will be needed again for pinion/ring gear adjustments.



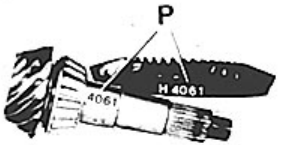
Install old shim (X) in front of the rear bearing outer race.
Pull in bearing outer races with Special Tool 33 1 360.
Puller consists of:

Puller disc for front outer race	33 1 373
Puller disc for rear outer race	33 1 365
Threaded spindle	33 1 362
Pressure nut	33 1 363
Nut	33 1 354



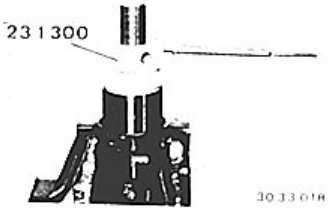
Press new tapered roller bearing inner race on to the new drive pinion with Special Tool 33 1 020.

Important!
Replace both drive pinion bearings, using only one make.



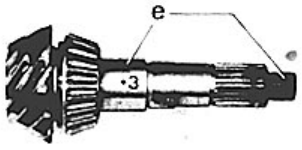
30 33 031

Important!
Drive pinions and ring gears are paired for optimal smooth running in special machines. Pairing code (P) is inscribed electrically on the pinion and ring gear.
Never install ring gear and drive pinion with different pairing codes (P) together.
H = Gleason hypoid teeth (helical shape).



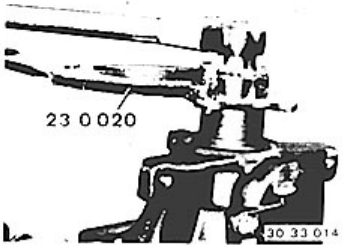
30 33 018

Install drive pinion in rear bearing outer race. Press (don't pull) front tapered roller bearing on to drive pinion with Special Tool 23 1 300 and a suitable spacing sleeve.



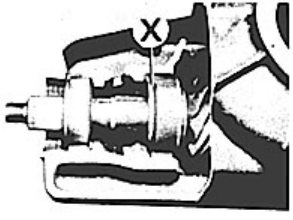
30 33 032

The inscribed number with "+" or "–" is the deviation from basic distance C in hundreths of millimeters and is required for adjustment of the tooth contact pattern with shims.
+ e is added to C.
– e is subtracted from C.



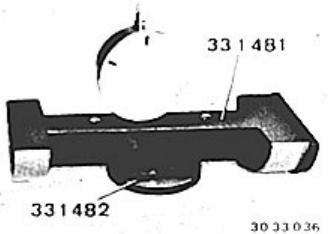
30 33 014

Mount input flange.
Tighten the collar nut in steps, measuring the friction torque after each step with Special Tool 00 2 000 and adjusting the friction torque to 250 Ncm (22 in. lbs.) with the collar nut.



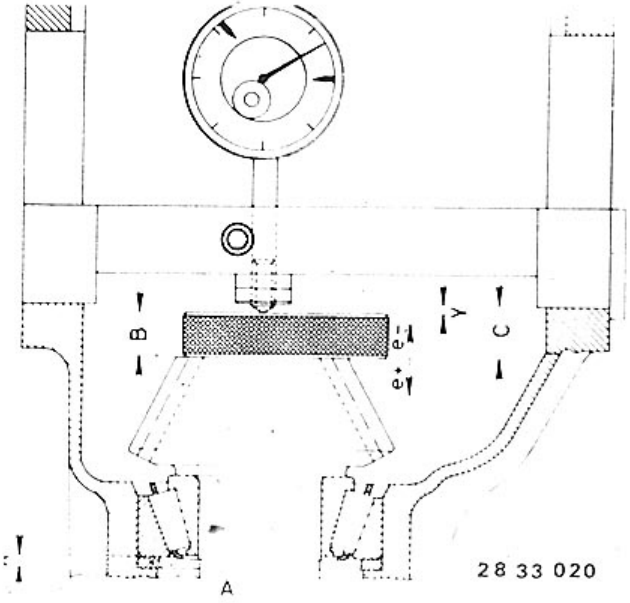
30 33 033

To determine the thickness of shim (X), install drive pinion with new tapered roller bearings, but without bush.



– Drive Pinion Block Distance –
Mount dial gage in Special Tool 33 1 481.
Place Special Tool 33 1 481 with dial gage on Special Tool 33 1 482 and set dial gage to 0 (zero) with pre-load.

Place Special Tool 33 1 482 on drive pinion.
Insert Special Tool 33 1 481 in case.
Determine value Y.
Basic distance C = 9.02 mm (0.355")
Gage disc B = 7.00 mm (0.276")



Example I

C	9.02 mm (0.355")
e +	0.10 mm (0.004")
C nominal	9.12 mm (0.359")
Y measured on dial gage	1.92 mm (0.075")
+ gage thickness B	7.00 mm (0.276")
C actual	8.92 mm (0.351")
C nominal	9.12 mm (0.359")
C actual –	8.92 mm (0.351")
a	0.20 mm (0.008")
Gage A	4.10 mm (0.161")
– a	0.20 mm (0.008")
Shim thickness X	3.90 mm (0.153")

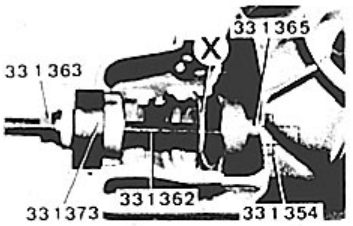
If C nominal is larger than C actual, "a" is subtracted (–) from shim thickness X.

Example II

C	9.02 mm (0.355")
e –	0.10 mm (0.004")
C nominal	8.92 mm (0.351")
Y measured on dial gage	2.12 mm (0.083")
+ gage thickness B	7.00 mm (0.276")
C actual	9.12 mm (0.359")
C actual	9.12 mm (0.359")
C nominal –	8.92 mm (0.351")
a	0.20 mm (0.008")
Gage A	3.90 mm (0.153")
+ a	0.20 mm (0.008")
Shim thickness X	4.10 mm (0.161")

If C nominal is smaller than C actual, "a" is added (+) to shim thickness X.

Permissible tolerances for distance (X) result from the tolerances for pertinent shim thickness available in steps from 0.01 to 0.03 mm (0.0004 to 0.0012").



30 33 029

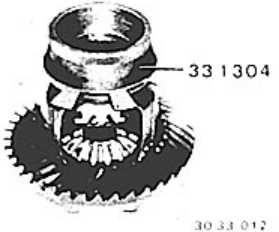
Remove drive pinion and rear bearing outer race.
Press in shim (X) of determined thickness and bearing outer race.

Important!
Do not install the drive pinion at this point, since it is first necessary to measure and adjust the friction torque of the new differential case bearing.



30 33 011

Press pulse spider off of differential case.
Caution!
Be careful not to bend the pulse spider.



30 33 012

Installation:
Press on pulse spider with Special Tool 33 1 304.



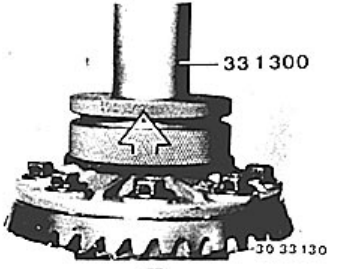
30 33 041

Remove ring gear (cold).
Installation:
New:
Heat ring gear to max. 100° C (212° F), checking temperature with a thermochrome pencil.
Mount ring gear with two locally made stay-bolts as guides.



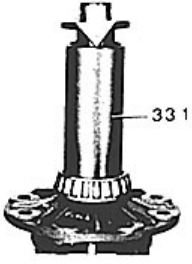
30 33 042

Install new bolts with Loctite No. 270 and tighten in order of (1 ... 8).
Tightening torque*.
Tighten bolts to torque angle*.



30 33 130

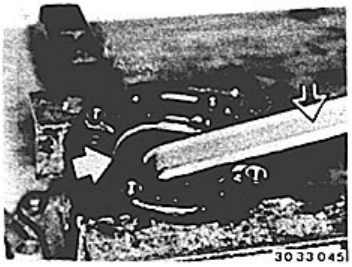
Pull off tapered roller bearing on differential case with Special Tool 33 1 300.



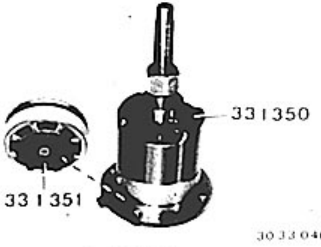
30 33 044

Installation:
Press on new tapered roller bearing inner races cold with Special Tool 33 1 330.

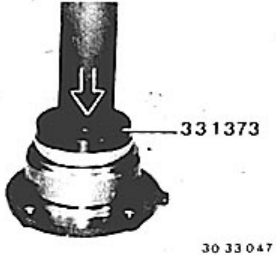
* See Specifications



Lift shaft seals out of both bearing caps.

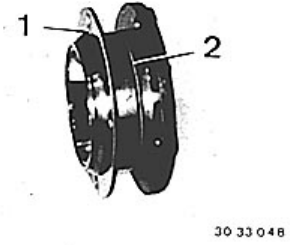


Press out bearing outer race with Special Tools 33 1 350 and 33 1 351.
Important!
Special Tool **33 1 351** must engage in the bearing outer race.

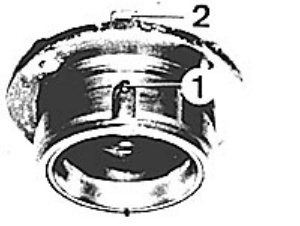


Installation:
Press in new bearing outer races with Special Tool 33 1 373.
*

The following 12 steps can only be omitted, if the differential case bearings were not replaced.
Install differential case with new ring gear and new bearings.
Lubricate bearings thoroughly with approved final drive gear lube** and let them drip dry.

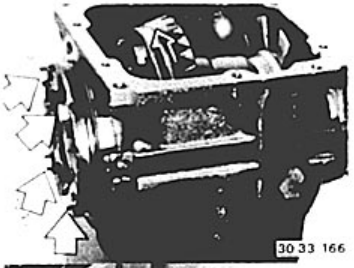


Install side bearing caps as marked with corresponding shims (1), but without O-rings (2) at first.
Tighten mounting bolts of bearing cap opposite the ring gear end uniformly with the correct tightening torque*.

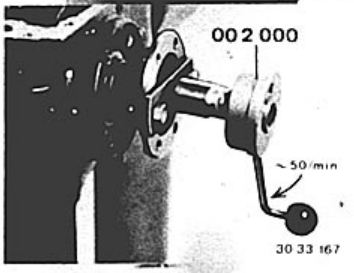


The compensating bore (1), which is recognized on the outside by tab (2), always faces up in installed position of the transmission.

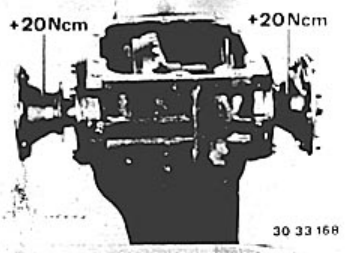
* See Specifications
** See Gr. 33 in Operating Material Binder



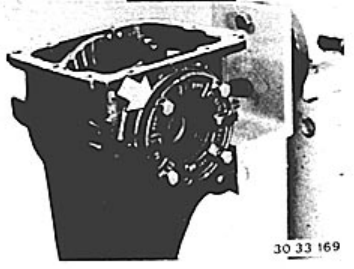
Determining Friction Torque of New Differential Case Bearings:
The axial preload force of differential case bearings (4000 N = 882 lbs.) can be determined with help of friction torque*.
Tighten bolts of second bearing cap uniformly only enough, that the differential can still be turned easily.



Install an output flange on the side opposite the ring gear and determine the friction torque with help of a locally manufactured holder and welded nut as well as friction meter 00 2 000.
Drive friction tester at speed of approx. 50 rpm.

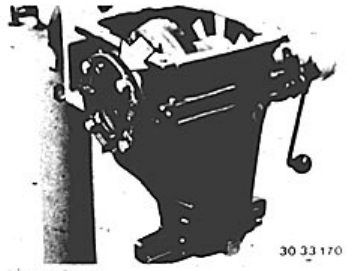


The friction torque* specified in the differential case bearing table* should be reached, but not exceeded.
If new shaft seals had already been installed, 20 Ncm (2 in. lbs.) must be added for each seal in which the output shaft runs while measuring.



If the given friction torque is not reached, even though both bearing caps are tightened to the correct tightening torque*, install a thinner shim opposite the ring gear and repeat the measuring procedures.

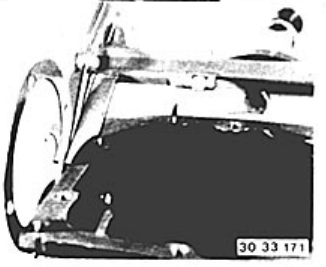
* See Specifications



If the friction torque is reached, even though the second bearing cap has not yet been tightened to the correct thightening torque*, a thicker shim must be used on the ring gear end and the measuring procedures repeated.



To make finding the shim thickness easier, the distance between the shim and case can be measured with a feeler gage blade can added to the thickness of the used shim.

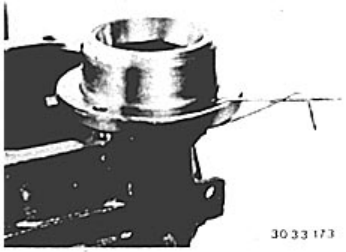


Example:
Second bearing cap not tightened (bolts screwed in uniformly).
Specified friction torque* (e.g. 190 Ncm = 16.5 in. lbs.) reached and shaft seals not yet installed.

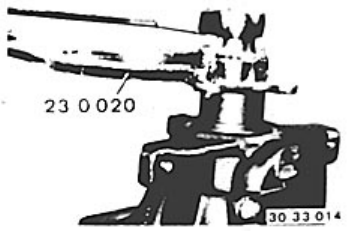
Gap measured with blade of feeler gage	0.20 mm (0.008")
Used shim thickness	1.40 mm (0.055")
Install shim of thickness	1.60 mm (0.063")

and measure friction torque again.

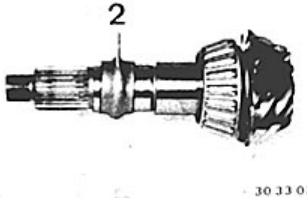
* See Specifications



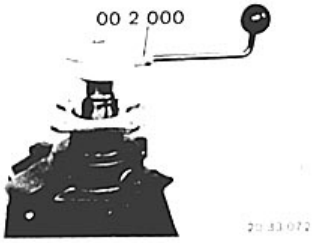
Remove differential for installation of the drive pinion.
(If differential case bearings had not been replaced, proceed from this point.)
Important!
Match side covers and corresponding shims of determined thickness; don't mix them up.



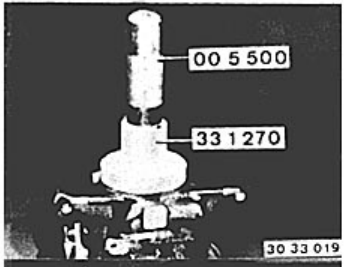
Tighten input flange with the collar nut in steps, measuring the friction torque after each step (see below).



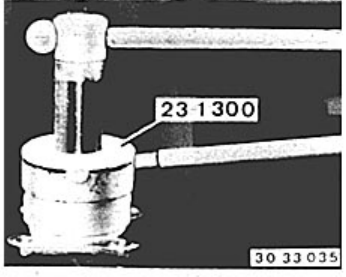
Install drive pinion with new clamping sleeve (2).



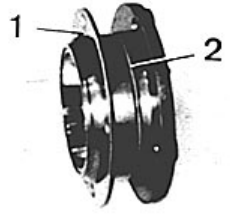
Measure friction torque* with Special Tool 00 2 000 and a suitable wrench socket.
Important!
The relation between friction torque and preload differs depending on the make of bearings.
Take the friction torque specified in the pinion bearing table* and add 20 Ncm (2 in. lbs.) for the new shaft seal.



Dip shaft seal in final drive gear lube and drive in flush with Special Tools 33 1 270 and 00 5 500.

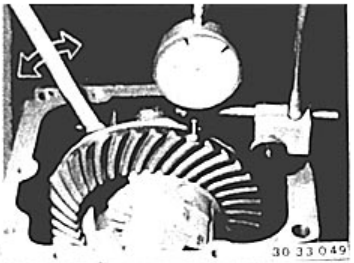


Press (don't pull) input flange on to the input shaft with Special Tool 23 1 300.
The axial preload force of drive pinion bearings (5000 N = 1102 lbs.) can be determined with help of the friction torque.



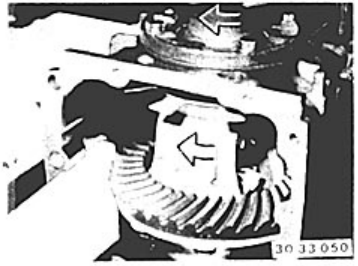
Install differential.
Install side covers as marked with corresponding washers (1) and new O-rings (2).
Tighten bolts uniformly.
Tightening torque*.

* See Specifications

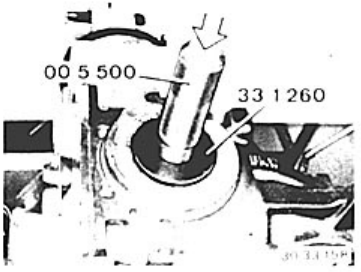


– Backlash/Tooth Contact Pattern Adjustment –
Mount Special Tool 00 2 500 and measure backlash* with dial gage.
Important!
The tooth contact pattern is always most important for a perfectly adjusted pinion/ring gear set.

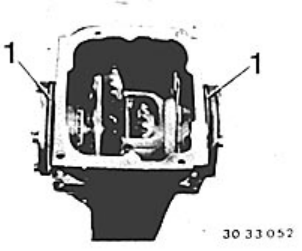
See following pages for general information on tooth contact pattern adjustments.



To check the tooth contact pattern, coat the ring gear teeth with printer's ink, turn in both directions several times and stop ring gear suddenly with a piece of hard wood.



Installation:
Dip new shaft seals in final drive gear lube. Drive in shaft seals against the stop with Special Tools 33 1 260 and 00 5 500. Replace a drive flange with seriously scored bearing surfaces.



Correct backlash* and tooth contact pattern by changing the thickness of both shims (1).
If backlash is excessive, use a thinner shim on the ring gear end.
If backlash is too small, use a thicker shim on the ring gear end.
An axial displacement of the ring gear by 0.01 mm (0.0004") will cause a change in backlash of 0.0076 mm (0.0003").
Important!
The total thickness of both shims must not be changed.
If a thinner or thicker shim is required to correct the tooth contact pattern, the total thickness must be corrected with the second shim, since otherwise the friction torque of bearings would be changed again.



Drive in new lockplate with Special Tools 33 4 050 and 00 5 500.

* See Specifications

GENERAL INFORMATION ON TOOTH PATTERN ADJUSTMENTS

Gleason Teeth

A Correct tooth pattern without load.

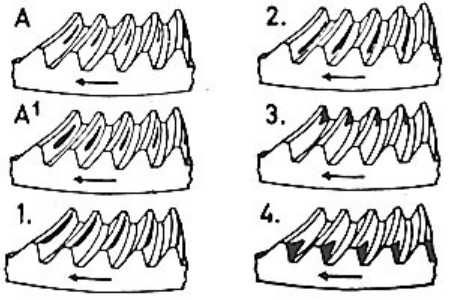
A 1 Loads will shift tooth contact pattern outward slightly.
Moving the ring gear will mainly change the backlash, but will also displace the contact pattern in longitudinal direction of the teeth.
Moving the drive pinion will displace the contact pattern in favor of tooth height, but the backlash will be altered just very slightly.
Here are the four basically incorrect contact patterns, which usually occur in combination.
Knowing these patterns will facilitate making adjustments.

1. High, narrow contact pattern (tip contact) on ring gear. Move drive pinion toward ring gear shaft and perhaps correct backlash by backing ring gear off of drive pinion.

2. Deep, narrow contact pattern (root contact) on ring gear. Move drive pinion away from ring gear shaft and perhaps correct backlash by moving in ring gear.

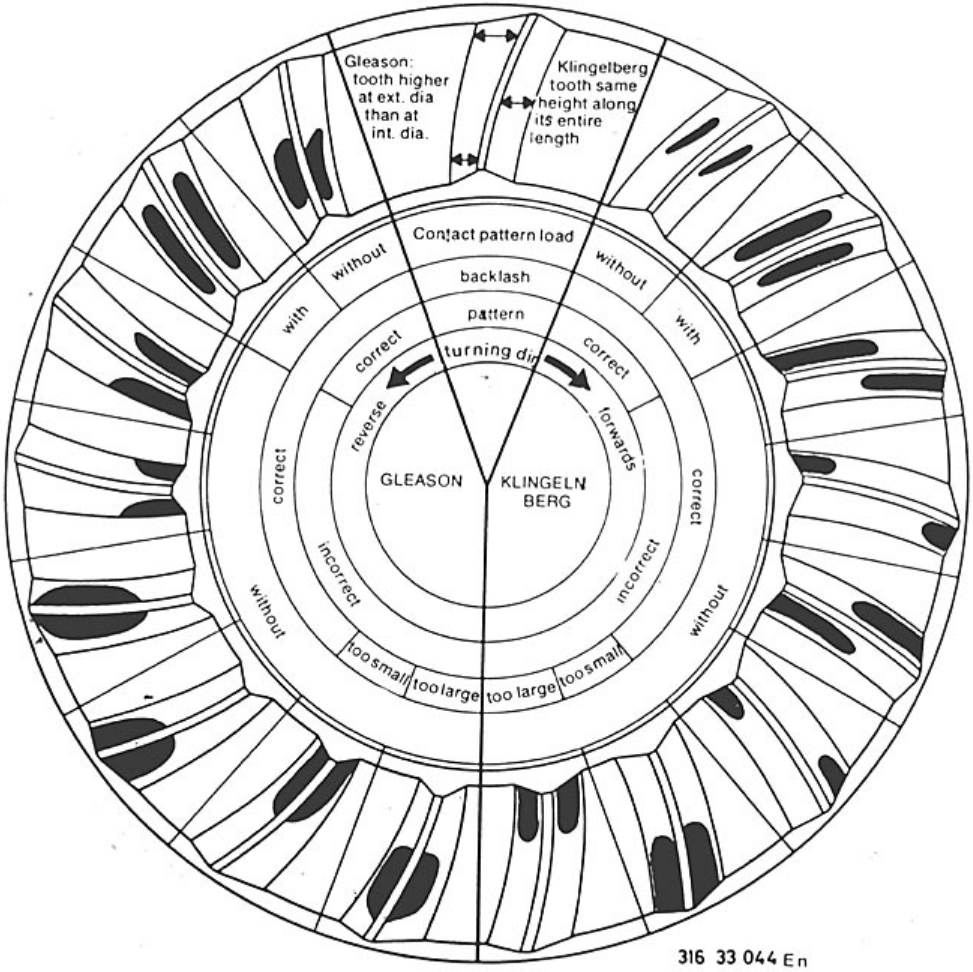
3. Short contact pattern on small tooth end (toe contact) of ring gear. Move ring gear away from drive pinion. Maybe move pinion closer to ring gear shaft.

4. Short contact pattern on large tooth end (heel contact) of ring gear. Move ring gear toward drive pinion. Perhaps back drive pinion away from ring gear shaft.



2H 33 030

Adjustment of contact pattern





30 33 012

33 13 611 REPLACING DIFFERENTIAL SIDE GEARS
– Differential Removed –

See 33 12 551 "Replacing Drive Pinion and Ring Gear" for removal of differential.
Press off the pulse spider.
Installation:
Press on pulse spider with Special Tool 33 1 304.


30 33 041

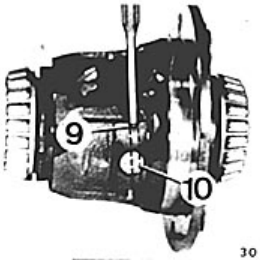
Remove ring gear (cold).
Important!
If the bearings must also be replaced, install the ring gear only after determination of the friction torque – see "Replacing Bearings for Differential Case – 33 11 724.
Installation:
Clean tapped bores thoroughly (tapper).
Heat ring gear to max. 100° C (212° F), checking temperature with a thermo-color pencil.
Mount ring gear with two locally manufactured staybolts for guiding.
Important!
Use new ring gear bolts.



30 33 042

Installation:
Install new bolts with Loctite No. 270 and tighten in order of 1 through 8.
Tightening torque*.
Tighten bolts to torque angle*.

* See Specifications

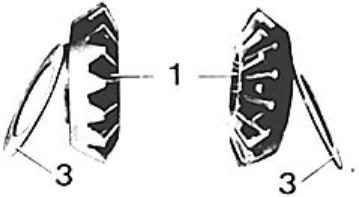


30 33 053

Drive out key (9) and differential shaft (10).
Installation:
The bore in differential shaft (10) is countersunk on one end.
Drive in key (9) from this end.

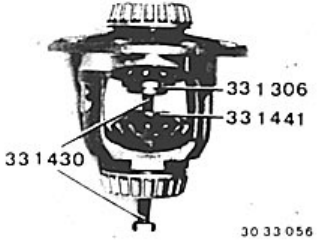

30 33 054

Turn out differential bevel gears with drive flange.
Remove differential side gears with shims (2).



30 33 108

Install both new differential side gears (1) with diaphragm springs (3) (Part No. 33 13 1 201 538), but without shims (2), to measure the thickness of shims.
Center differential side gears with the drive flange.
(If there are 2 diaphragm springs and 2 shims in this transmission as an exception, refer to measuring procedures on page 228).



30 33 056

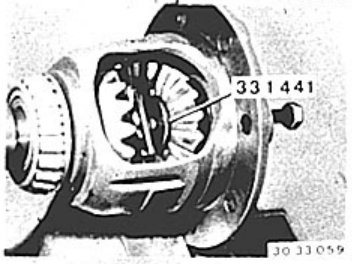
Insert Special Tool 33 1 306 on one side.
Screw in Special Tool 33 1 441 with Special Tool 33 1 431.
Tighten special tool bolt to spread differential side gears so far apart, that the drive flange can just barely be turned.


30 33 057

Install differential bevel gears exactly opposite each other.
Move differential gears to installed position by turning drive flange.
Remove special tools.

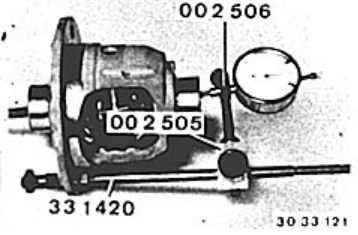

30 33 058

Drive in differential gear shaft.
Turn differential bevel gears with the drive flange and stop them at the highest point of tooth mesh (hardest to turn).



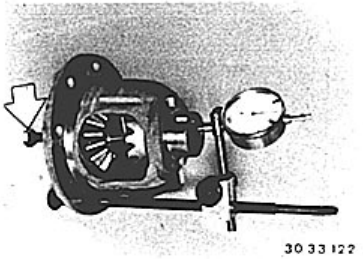
30 33 059

Install Special Tools 33 1 441 and 33 1 431 for measuring.
If applicable, open up Special Tool 33 1 441 slightly to make it easier to insert the dial gage.
Screw in bolt far enough, that the shaft gear is on "block".

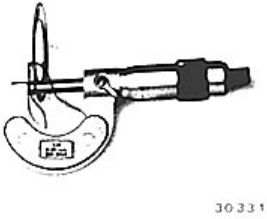


30 33 121

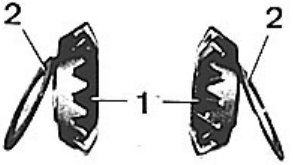
Mount dial gage with holder, consisting of Special Tools 33 1 420, 00 2 505 and 00 2 506, on the differential case.
Set dial gage on blocked shaft gear to zero with pre-load.


30 33 122

Loosen Special Tool 33 1 431.
Read dial gage and note value as well as end.
For example:
Ring gear end 0.36 mm (0.014").
Repeat measurement on opposite shaft end and note value, for example
0.28 mm (0.011").


30 33 123

Remove differential side gears and diaphragm springs.
Important!
Don't mix up differential side gears and diaphragm springs.
Measure diaphragm springs with a micrometer and note values as well as ends.
For example:
1.16 mm (0.046") ring gear end and
1.18 mm (0.047") opposite end.
Determine correct shim thickness with consideration for play of 0.02 to 0.07 mm (0.0008 to 0.0028").



30 33 055

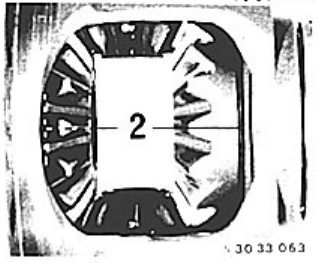
Example:

	Ring Gear End	Opposite End
Diaphragm spring	1.16 mm	1.18 mm
+ measured value	0.36 mm	0.28 mm
	1.52 mm	1.46 mm
– play	0.02 mm	0.02 mm
	1.50 mm	1.44 mm

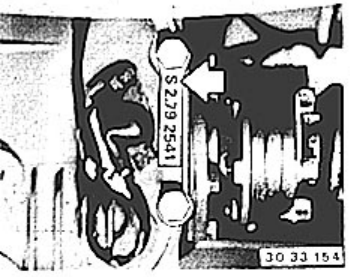
Thickness of shims:
1.50 mm and 1.45 mm

Shims (2) are available in 0.05 mm thickness steps.

Install shims (2) of determined thickness.



30 33 063



LIMITED SLIP DIFFERENTIAL WITH 25 % LOCKING RATIO

The limited slip differential is marked with a "S" on the case or data plate.
A limited slip differential has the following advantages.

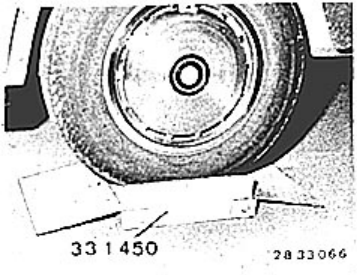
a) Prevention of wheel slip when driving on rough road surfaces.

b) Prevention of wheel slip when moving off with different traction underneath left and right sides of car wheels.

c) Prevention of wheel slip when driving fast on wet roads.

d) Prevention of wheel slip on inside of curve when driving fast in curves.

e) Prevention of slip when driving fast on roads with different traction between left and right.



Checking Function Without Removing:

a) Level workshop floor.

b) Drive car with left wheel on Special Tool 33 1 450.

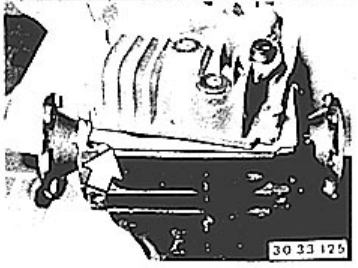
c) Release parking brake completely.

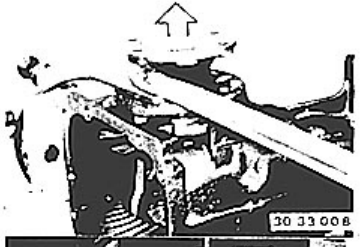
d) Engage 1st gear and accelerate engine.

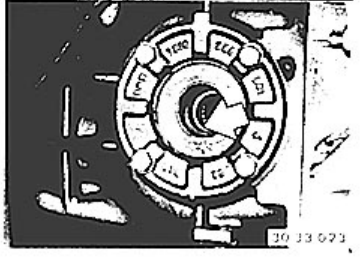
e) Function of limited slip differential is okay, if the car can be driven off of Special Tool 33 1 450.

Important!
Drive off of fixture slowly!









33 14 520 REPLACING LIMITED SLIP DIFFERENTIAL ASSEMBLY – Final Drive Removed –

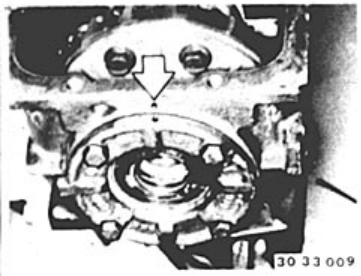
Remove final drive – see 33 10 010 in repair manual of pertinent model series beginning with 1985 models.
Drain oil.
Mount final drive on Special Tool 33 1 010.
Installation:
Add oil. Oil volume*.
Refer to Gr. 33 in Operating Material Binder for approved oil.

Detach transmission cover.
Installation:
Replace gasket.
Tightening torque*.

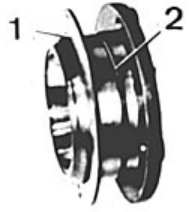
Pry off both drive flanges with a tire iron.

Installation:
Before installation of the drive flange, place round wire snap ring (1) in groove of the differential case that both ends are recessed in groove.
This prevents lateral bending of the ring.
Push in and turn drive flange slightly by hand until round wire snap ring is heard to engage.
Replace stretched snap rings.

* See Specifications



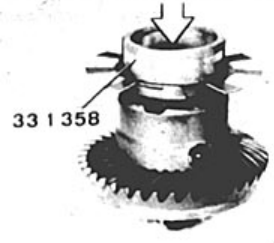
Unscrew both bearing caps.
Important!
Mark bearing caps – don't mix up bearing caps and shims.
Installation:
Tightening torque*.



Differential case bearings and backlash are adjusted with shims (1).
Check O-ring (2), replacing if necessary.
Important!
Changing the total thickness of shims (1) will change the friction torque value.
After adjusting the friction torque, the backlash and tooth contact pattern will have to be adjusted again – see 33 12 551.



Remove complete limited slip differential.
Installation:
Don't bend the pulse spider.



Press off pulse spider.
Installation:
Press on pulse spider with Special Tool 33 1 304.

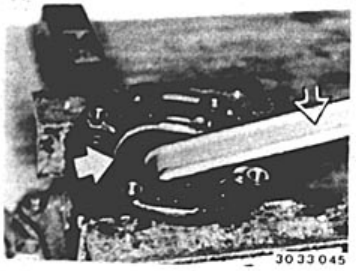
* See Specifications

Remove ring gear (cold).





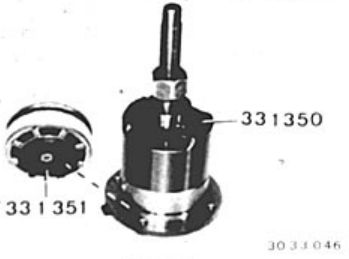
Press new tapered roller bearings on to new differential case with limited slip cold with Special Tool 33 1 330.
Important!
Only install both bearings of same make.
Note make, which is needed later to determine the friction torque.



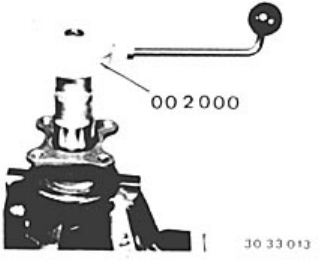
Lift shaft seals out of both bearing caps.



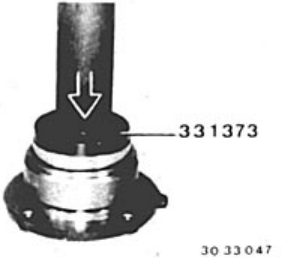
If applicable, replace shaft seal for input flange – see 33 11 512.



Press out bearing outer race with Special Tools 33 1 350 and 33 1 351.
Important!
Special Tool 33 1 351 must engage in bearing outer race.



If applicable, replace drive pinion – see 33 12 551.



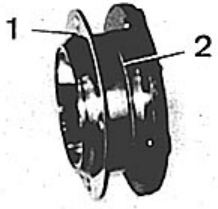
Installation:
Press in new bearing outer races with Special Tool 33 1 373.
Important!
Only use same make bearings for both bearings.



30 33 319

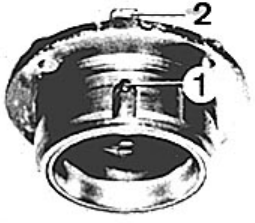
Install new limited slip differential with new bearings.
Use both bearings of same make.
Note make.

Lubricate new bearings with approved final drive gear lube** thoroughly and let them drip dry.



30 33 048

Install side bearing caps as marked with corresponding shims (1), but without O-rings (2) at first.
Tighten bolts of bearing cap opposite the ring gear end uniformly to correct tightening torque*.



30 33 148

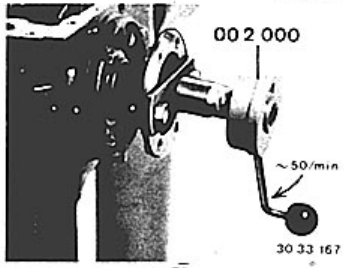
The compensating bore (1), recognized on the outside by tab (2), always faces up in installed position of the transmission.

* See Specifications
** See Gr. 33 in Operating Material Binder



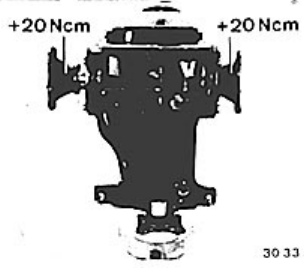
30 33 311

Axial preload force of differential case bearings (4000 N = 882 lbs.) can be determined with help of the friction torque*.
Tighten bolts of second bearing cap only enough, however uniformly, that the differential can still be turned easily.



30 33 167

Install an output flange on the end opposite the ring gear and determine the friction torque with help of a locally manufactured holder with welded nut and friction tester 00 2 000.
Turn friction tester at approx. 50 rpm.



30 33 312

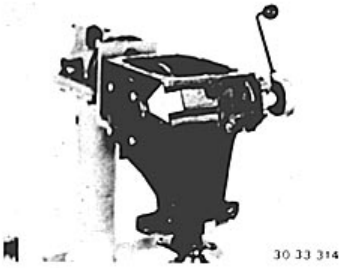
The friction torque* specified in the differential case bearing table* should be reached, but must not be exceeded.
If new shaft seals had already been installed, 20 Ncm (2 in. lbs.) must be added for each seal in which the output shaft runs while measuring.



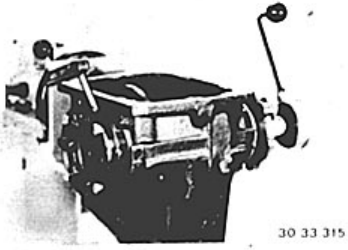
30 33 313

If the given friction torque is not reached, even though both bearing caps are tightened to the correct tightening torque*, a thinner shim must be used on the end opposite the ring gear and the measuring procedures repeated.

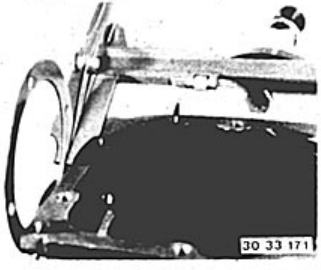
* See Specifications


30 33 314

If the friction torque is reached, even though the second bearing cap is not yet tightened to correct tightening torque*, use a thicker shim on the ring gear end and repeat the measuring procedures.


30 33 315

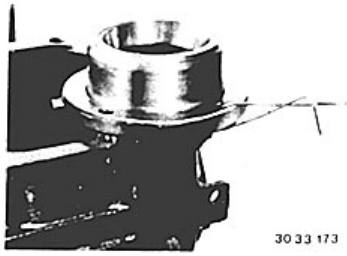
To make finding the thickness of shims easier, the distance between the shim and case can be measured with a feeler gage blade and this value is then added to the thickness of the used shims.


30 33 171

Example:
Second bearing cap not tightened fully (bolts screwed in uniformly).
Specified friction torque* (e.g. 190 Ncm = 16.5 in. lbs.) is reached, but without shaft seals.

Gap measured with blade of feeler gage	0.20 mm (0.008")
Used shim thickness	1.40 mm (0.055")
Install shim of thickness and measure again.	1.60 mm (0.063")

* See Specifications


30 33 173

Remove differential case.
Arrange side covers and shims of determined thickness – don't mix them up.

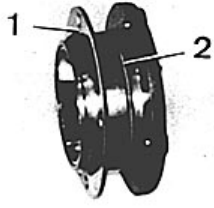

30 33 126

Installation:
Clean tapped bores thoroughly (with tapper).
Heat ring gear to max. 100° C (212° F), checking temperature with a thermo-color pencil.
Mount ring gear with two locally manufactured staybolts for guiding.



30 33 127

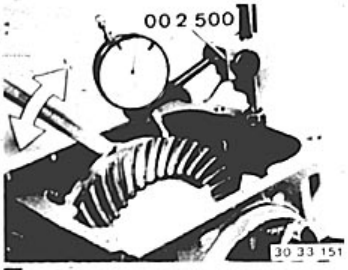
Install new bolts with Loctite No. 270 and tighten in order of 1 ... 8.
Tightening torque*.
Then tighten to torque angle*.



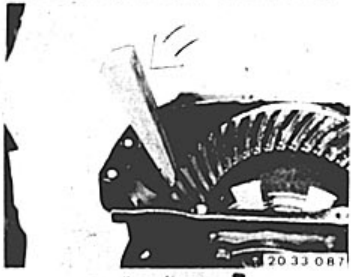
30 33 048

Install differential with ring gear and pulse gear.
Install side covers as marked with corresponding washers (1) and new O-rings (2).
Tightening torque*.

* See Specifications



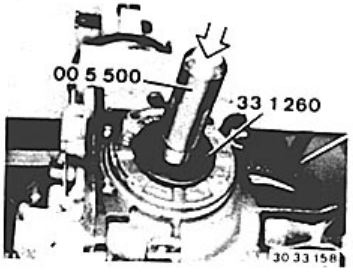
Backlash/Tooth Contact Adjustments:
Mount Special Tool 00 2 500 and measure the backlash*.
Important!
The tooth contact pattern is always most important for a perfectly adjusted pinion/ring gear set.
See "Replacing Drive Pinion with Ring Gear" in 33 12 551 for general information on tooth contact pattern adjustments.



To check the tooth contact pattern, coat ring gear with printer's ink, turn several times in both directions and then stop the ring gear suddenly with a piece of hard wood.



The backlash* and tooth contact pattern are corrected by changing the thickness of both shims (1).
If the backlash is too large, install a thinner shim on the ring gear end.
If the backlash is too small, install a thicker shim on the ring gear end.
An axial displacement of the ring gear by 0.01 mm (0.0004") will change the backlash by 0.076 mm (0.0003").
Important!
The total thickness of both shims may no longer be changed.
If a thicker or thinner shim was required to correct the tooth contact pattern, the total thickness must be corrected with the second shim, since otherwise the friction torque of the bearings would be changed again.



Installation:
Dip shaft seal in final drive gear lube.
Drive in shaft seal against the stop with Special Tools 33 1 260 and 00 5 500.
Replace a drive flange with seriously scored bearing surfaces.

* See Specifications



30 33 131

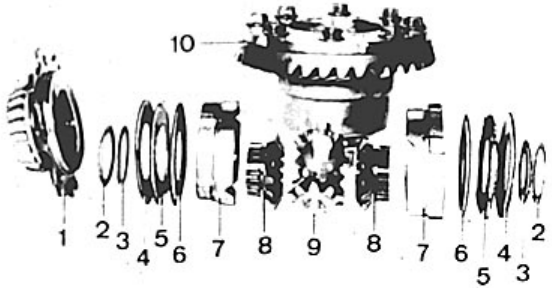
33 14 593 DISASSEMBLING/ASSEMBLING LIMITED SLIP DIFFERENTIAL – Final Drive Removed –

Remove limited slip differential – see Replacing Limited Slip Differential – 33 14 520.
Unscrew case cover mounting bolts.
Take off case cover.



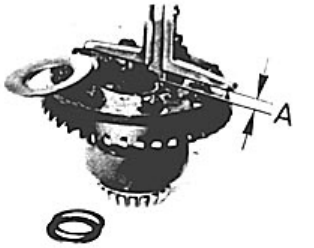
30 33 132

Turn case upside down and let parts slide out.
Installed Order:
(1) case cover, (2) diaphragm spring, (3) thrust washer, (4) diaphragm spring, (5) outer plate, (6) inner plate, (7) thrust ring, (8) differential side gear, (9) differential gears with differential shafts, (10) differential case.



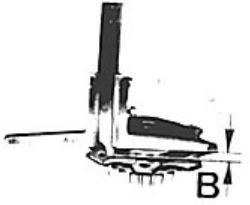
30 33 133

Check all parts for wear, e.g. molybdenum coat, splines, etc..
Installation:
Lubricate all parts with approved final drive oil before assembling.



30 33 134

Install following parts in correct installed order to measure the pre-load.
Outer plates (5), inner plates (6), thrust rings (7), differential side gears (8) and differential gears with differential shafts (9).
Measure distance A from case edge to outer plate, e.g. A = 10.8 mm (0.425").



30 33 135

Measure distance B on cover, e.g. B = 6.8 mm (0.268").



30 33 136

Place both diaphragm spring curved surfaces together.
Measure distance C on diaphragm springs, e.g. C = 3.6 mm (0.142").

An installed clearance of 0.1 to 0.4 mm (0.004 to 0.016") is required to prevent pressing the diaphragm springs flat.

Example:

B (cover)	6.8 mm (0.268")
C (diaphr. sprg.)	3.6 mm (0.142")
A (case)	10.8 mm (0.425")
Sum of B + C	10.4 mm (0.409")
Installed clearance D	0.4 mm (0.016")

Correct any deviation in installed clearance D by installing outer plates of correct thickness.



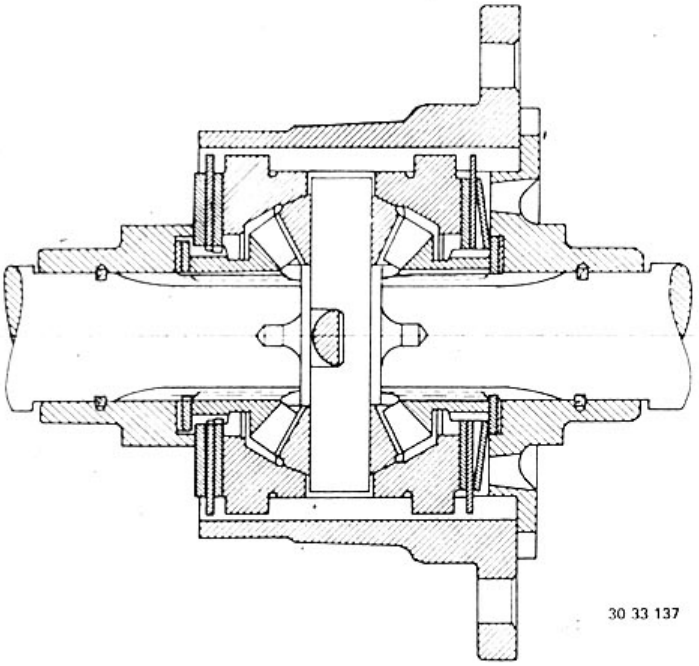
30 33 138

Remove all parts from case and insert with the additional parts, diaphragm springs (2) and thrust washers (3).

Mount case cover (10) and press on firmly, but do not bolt.

The pre-load of small diaphragm springs (2) should produce an uniform gap all around (check with a feeler gage blade).

If there is no clearance between cover and case, check diaphragm springs (2) and thrust washers (3).

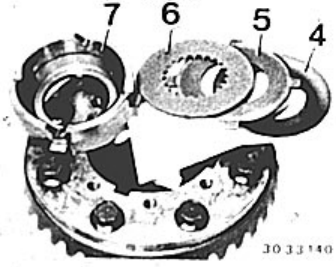


30 33 137



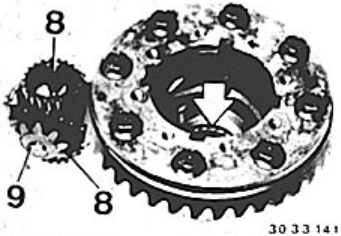
30 33 139

Installed Order:
Install diaphragm spring (2) with inside curved surface facing up to differential shaft.
Insert thrust washer (3) with oil pockets facing up to differential shaft.



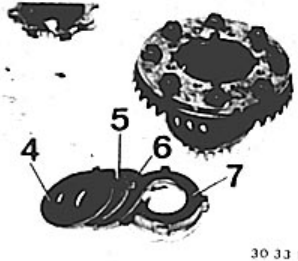
30 33 140

Insert diaphragm spring (4) with inside curved surface facing differential shaft and outer plate (5) with four tabs.
Insert molybdenum coated inner plate (6) and thrust ring (7).



30 33 141

Install differential side gear (8) by turning into guides or splines of inner plate.
Install differential gears with shafts (9) and a second differential side gear (8).



30 33 142

Install thrust ring (7), molybdenum coated inner plate (6) and outer plate (5).
Insert diaphragm spring (4) with inside curved surface facing down to differential shaft.

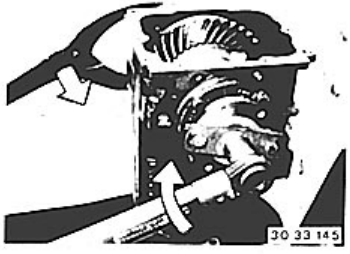


30 33 143

Install diaphragm spring (2) with inside curved surface facing up and thrust washer (3) with oil pockets facing up in case cover, using grease.


30 33 144

Mount case cover with washers (being careful that washers do not slide out).
Install bolts with Loctite No. 270 and tighten cover uniformly.
Installation:
Tightening torque*.


30 33 145

Check slip torque* of differential lock by holding one and driving other differential side gear.
Make up tool locally for this purpose by, for example, welding a nit on a drive flange which is no longer required.

* See Specifications

CONVERSION AND COMPARISON TABLE OF STANDARD UNITS OF MEASUREMENT

Physical Size	Standard Sign DIN 1301	Equivalent
Length (meter)	m	1 m = 1 000 mm 1 km = 1 000 m 1 µm = 0.001 mm
Area (square meter)	sq. m	1 sg. m = 10^6 sq. mm 1 sq. mm = 0.01 sq. cm
Volume (cubic meter)	cu. m	1 cu. m = 10^6 cu. cm 1 cu. dm = 0.001 cu. m
Angle (degree, radiant)	0, rad	1 rad = 1 $\frac{\text{m arc}}{\text{m radius}} \approx 57^o$ $1^o = \pi / 180$ rad
Mass (kilogram)	kg	1 kg = 1 000 g 1 g = 1 000 mg 1 t = 1 Mg = 1 000 kg
Density (kilogram per cubic meter)	kg/cu. m	1 kg/cu. m = 0.001 kg/cu. dm 1 kg/cu. dm = 1 kg/l
Time (second)	s	1 min = 60 s 1 h = 60 min
Frequency	Hz	1 Hz = 1/s
Rotary frequency (speed)	1/s, 1/min	1 U/min = 1/min = 1 rpm 1/min = 1/60 s
Velocity	m/s	1 m/s = 3.6 km/h
Acceleration	m/s^2	
Force (newton)	N	1 N = 1 kgm/s^2 1 kp = 9.81 N
Pressure (pascal)	Pa	1 at = 1 kp/sq. cm = 0.981 bar = 98 066.5 Pa 1 m WS = 9 806.65 Pa = 9 806.65 N/sq. m 1 Torr = 1.333 224 mbar 1 mm Hg = 133.322 Pa = 133.322 N/sq. m 1 N/sq. m = 1 Pa 1 kg/sq. mm = 9.81 N/sq. mm

CONVERSION AND COMPARISON TABLE OF STANDARD UNITS OF MEASUREMENT

Physical Size	Standard Sign DIN 1301	Equivalent
Mechanical tension	N/sq. mm	1 N/sq. m = 1 Pa 1 kp/sq. mm = 9.81 N/sq. mm
Energy, work, heat quantity (joule)	J	1 J = 1 Nm 1 kWh = 3.6 MJ 1 kpm = 9.81 1 cal = 4.1868 J
Torque (newton meter)	Nm	1 kpm = 9.81 Nm
Power (watt)	W	1 kW = 1 000 W 1 W = 1 Nm/s = 1 J/s 1 PS = 736 W = 75 kpm/s
Viscosity — dynamic	Pas	1 Pas = 1 Ns/sq. m 1 P = 0.1 Pas = 1 g/cms
Viscosity — Kinematic	sq. m/s	1 sq. m/s = 1 Pas (cu. m/kg) 1 St = 1 sq. cm/s = 0.0001 sq. m/s
Temperature (Celsius) (Kelvin)	^{o}C K	$0^{o}C = 273.15$ K 1 grd ≙ $1^{o}K = 1$ K = $1^{o}C$ (temperature difference)
Electric current (ampere)	A	1 mA = 0.001 A 1 kA = 1 000 A
Electric voltage (volt)	V	1 V = 1 W/A 1 mV = 0.001 V
Electric resistance (ohm)	Ω	1 Ω = 1 V/A = 1/S
Magnetic flow (weber)	Wb	1 Wb = 1 Vs 1 M = 10 - 8 Wb
Magnetic flow density (tesla)	T	1 T = 1 Wb/sq. m
Magnetic field strength	A/m	1 A/m = 1 N/Wb
Light strength (candela)	cd	

B 18

a) 316
b) 316i
c) 316i Catalyst

11 00 ... Engine in General

Bore	mm	89
Stroke	mm	71
Effective displacement	cm^3	1766
Compression ratio		a) 9.5 : 1 b) 9.5 : 1 c) 8.2 : 1
Power (to DIN 70020) / at engine speed	KW/ rpm	a) 66/5500 b) 77/5800 c) 75/5800
Max. top speed	rpm	6200
Max. constant speed	rpm	6000
Max. torque / at engine speed	Nm/ rpm	a) 140/4000 b) 145/4500 c) 140/4500
Compression (approx. same value for all cylinders	bar	at least 10 ... 11
Idling speed	rpm	850 + 50

11 00 ... Engine Oil Consumption

Oil consumption can be measured for the first time after the car has been driven approximately 7,500 km. Oil consumption will be stable only after this distance. Measuring oil consumption requires that the engine does not leak.

Precise consumption can be determined by weighing. Drain engine oil having operating temperature. Allow 5 minutes drip time. Weigh and pour in specified amount of new engine oil. Drive car 1,000 km. Drain engine oil at operating temperature and weigh. Allow 5 minutes drip time. Engine oil density at room temperature is approx. 0.9 km/cubic dm (dm^3).

Max. permissible oil consumption when measured* by weighing: 0.07 ltr. / 100 km.

Example:

Poured in oil	—	drained oil	=	consumed oil.
4,500 g	—	3,600 g	=	900 g

900 : density 0.9 = 1,000 cm^3 = 1 liter per 1,000 kilometers

Possible Causes for Excessive Oil Consumption:

1. Running-in process not completed.
2. Seals for valve stems damaged.
3. Pistons seized.
4. Piston rings installed wrong, broken or worn.
5. Excessive running clearance between valve stem and valve guide.

* Refer to Group 11 of Operating Fluids

11 11 ... Crankcase

Cylinders Bore dia.	mm (in.)	$89.00^{+0.01}$ ($3.5039^{+0.0004}$)
Intermediate size	mm (in.)	$89.08^{+0.01}$ ($3.5071^{+0.0004}$)
1st oversize	mm (in.)	$89.25^{+0.01}$ ($3.5138^{+0.0004}$)
2nd oversize	mm (in.)	$89.50^{+0.01}$ ($3.5236^{+0.0004}$)
Surface finish	Rt (μ)	3 to 4
Max. cyl. bore out-of-true	mm (in.)	0.01 (0.0004)
Max. cyl. bore conicity	mm (in.)	0.01 (0.0004)

ENGINE M 10 11 – 13		B 18	

11 12 ... Cylinder Head		
Cylinder head height (machining limit)	mm (in.)	128.6 (5.063)

11 12 ... Valve Guide		
Valve guide dia. – bore dia.		
Standard size	mm (in.)	14.0 u6 – 14.0 M7 (0.5512)
Oversize 1	mm (in.)	14.1 u6 – 14.1 M7 (0.5551)
Oversize 2	mm (in.)	14.2 u6 – 14.2 M7 (0.5590)
Oversize 3	mm (in.)	14.3 u6 – 14.3 M7 (0.5630)
Total length	mm (in.)	50.5 (1.988)
Valve guide inside diameter (installed)		
Standard size	mm (in.)	8.0 H7 (0.3150)
Oversize 1	mm (in.)	8.1 H7 (0.3189)
Oversize 2	mm (in.)	8.2 H7 (0.3228)
Installing temperature		
Cylinder head	°C (°F)	+ 50 (+ 120)
Valve guide	°C (°F)	– 150 (– 240)
Valve guide protrusion	mm (in.)	15 (0.590)

ENGINE M 10 11 – 14		B 18	

11 12 ... Valve Seat Inserts

Valve seat insert dia. – bore dia. (distance "D")		
Intake		
Standard size	mm (in.)	47.15 g6 (1.8563) – 47.00 H7 (1.8504)
Oversize 0.2 mm (0.0079")	mm (in.)	47.35 g6 (1.8642) – 47.20 H7 (1.8583)
Oversize 0.4 mm (0.0157")	mm (in.)	47.55 g6 (1.8720) – 47.40 H7 (1.8661)
Exhaust		
Standard size	mm (in.)	40.15 g6 (1.5807) – 40.00 H7 (1.5748)
Oversize 0.2 mm (0.0079")	mm (in.)	40.35 g6 (1.5886) – 40.20 H7 (1.5827)
Oversize 0.4 mm (0.0157")	mm (in.)	40.55 g6 (1.5964) – 40.40 H7 (1.5905)
Valve seat insert height – bore depth (distance "H")		
Standard size	mm (in.)	7.2 h11 (0.2835) – 7.35 H11 (0.2894)
Oversize 0.2 mm (0.0079")	mm (in.)	–
Oversize 0.4 mm (0.0157")	mm (in.)	–
Installing temperature		
Valve seat insert	°C (°F)	– 150 (– 240)
Cylinder head	°C (°F)	+ 50 (+ 120)

11 12 ... Valve Seats

Valve seat angle	°	45
Correction angles	°	15 / 75
Valve seat width (distance "B")		
Intake	mm (in.)	1.3 to 2.0 (0.051 to 0.079)
Exhaust	mm (in.)	1.3 to 2.0 (0.051 to 0.079)
Valve seat diameter (distance "M")		
Intake	mm (in.)	44.6 (1.756)
Exhaust	mm (in.)	36.6 (1.441)

11 21 ... Crankshaft and Bearings			– Double Classification –
Ground sizes of main bearing journals			
Standard size	red	mm (in.)	$55.00\ ^{-0.010}_{-0.020}$ ($2.1653\ ^{-0.0004}_{-0.0008}$)
	blue	mm (in.)	$55.00\ ^{-0.020}_{-0.029}$ ($2.1653\ ^{-0.0008}_{-0.0011}$)
Undersize 1	red	mm (in.)	$54.75\ ^{-0.010}_{-0.020}$ ($2.1555\ ^{-0.0004}_{-0.0008}$)
	blue	mm (in.)	$54.75\ ^{-0.020}_{-0.029}$ ($2.1555\ ^{-0.0008}_{-0.0011}$)
Undersize 2	red	mm (in.)	$54.50\ ^{-0.010}_{-0.020}$ ($2.1457\ ^{-0.0004}_{-0.0008}$)
	blue	mm (in.)	$54.50\ ^{-0.020}_{-0.029}$ ($2.1457\ ^{-0.0008}_{-0.0011}$)
Undersize 3	red	mm (in.)	$54.25\ ^{-0.010}_{-0.020}$ ($2.1358\ ^{-0.0004}_{-0.0008}$)
	blue	mm (in.)	$54.25\ ^{-0.020}_{-0.029}$ ($2.1358\ ^{-0.0008}_{-0.0011}$)
Radial crankshaft bearing play		mm (in.)	0.03 to 0.07 (0.0012 to 0.0027)

11 21 ... Crankshaft and Bearings

Ground sizes of crankshaft thrust bearing		
Standard size	mm (in.)	$30.0\ ^{+0.053}_{+0.020}$ ($1.1811\ ^{+0.0021}_{+0.0008}$)
Oversize 1	mm (in.)	$30.2\ ^{+0.064}_{+0.024}$ ($1.1890\ ^{+0.0025}_{+0.0009}$)
Oversize 2	mm (in.)	$30.4\ ^{+0.064}_{+0.025}$ ($1.1968\ ^{+0.0025}_{+0.0010}$)
Oversize 3	mm (in.)	$30.6\ ^{+0.064}_{+0.025}$ ($1.2047\ ^{+0.0025}_{+0.0010}$)
Axial crankshaft play	mm (in.)	0.085 to 0.174 (0.0033 to 0.0068)

B 18

11 21 ... Crankshaft and Bearings

Ground sizes of conrod bearing journals Standard size	mm (in.)	$48.00 \begin{smallmatrix} -0.009 \\ -0.025 \end{smallmatrix}$ ($1.8898 \begin{smallmatrix} -0.0003 \\ -0.0010 \end{smallmatrix}$)
Undersize 1	mm (in.)	$47.75 \begin{smallmatrix} -0.009 \\ -0.025 \end{smallmatrix}$ ($1.8799 \begin{smallmatrix} -0.0003 \\ -0.0010 \end{smallmatrix}$)
Undersize 2	mm (in.)	$47.50 \begin{smallmatrix} -0.009 \\ -0.025 \end{smallmatrix}$ ($1.8701 \begin{smallmatrix} -0.0003 \\ -0.0010 \end{smallmatrix}$)
Radial conrod bearing play	mm (in.)	0.03 to 0.07 (0.0012 to 0.0027)
		– Double Classification –
Ground sizes of conrod bearing journals Standard size	mm (in.)	47.975 to 47.991 (1.8888 to 1.8894)
Undersize 1 0 25 mm (0.0098")	mm (in.)	47.725 to 47.741 (1.8789 to 1.8796)
Undersize 2 0.50 mm (0.0197")	mm (in.)	47.475 to 47.491 (1.8691 to 1.8697)
Undersize 3 0.75 mm (0.0295")	mm (in.)	47.225 to 47.241 (1.8592 to 1.8599)
Radial conrod bearing play	mm (in.)	0.020 to 0.055 (0.0008 to 0.0022)

11 21 ... Crankshaft and Bearings

Max. imbalance of crankshaft (dynamic without flywheel)	gcm	50
Measuring planes		Center of bearing journals
Take-up		Ends of crankshaft in points
Balancing speed	rpm	500
Max. runout on center main bearing journal (crankshaft running on outer bearing journals)	mm (in.)	0.1 (0.004)
Crankshaft throw	mm (in.)	71 ± 0.1 (2.795 ± 0.004)
Max. surface finish of bearing journals	Rt (μ)	1.5 (0.059)

		B 18	

11 22 ... Flywheel

Max. axial runout measured on outside diameter	mm (in.)	0.1 (0.004)
Minimum flywheel thickness (distance "A")	mm (in.)	$23.6_{-0.1}$ ($0.929_{-0.004}$)

11 24 ... Connecting Rods and Bearings

Big conrod end bore dia.	mm (in.)	52.000 to 52.010 (2.0472 to 2.0476)
		– Double Classification –
Big conrod end bore dia. Red	mm (in.)	52.000 to 52.008 (2.0471 to 2.0475)
Blue	mm (in.)	52.009 to 52.016 (2.0476 to 2.0479)
Conrod bushing – outside dia.	mm (in.)	24.060 to 24.100 (0.9472 to 0.9488)
inside dia.	mm (in.)	$22\ ^{+0.003}_{+0.008}$ ($0.8661\ ^{+0.0001}_{+0.0003}$)
Max. deviation in parallel of conrod bores with bearing shells at distance of 150 mm (5.905")	mm (in.)	0.04 (0.0016)
Max. distortion to one side		0° 30′
Max. deviation in weight of connecting rods in one engine (without bearing shells)	g	± 4
Big end	g	± 2
Small end	g	± 2

11 25 ... Pistons		Pistons and pins are matched – only replace together as pairs.
Weight class (die-stamped or engraved)		max. weight difference of individual pistons 10 grams + or –
Identification on piston		piston diameter, arrow for direction of installation and compression ratio
Piston dia. (checkpoint "A") Standard size	mm (in.)	88.97 (3.503)
Intermediate size	mm (in.)	89.05 (3.506)
Oversize 1	mm (in.)	89.22 (3.512)
Oversize 2	mm (in.)	89.47 (3.522)
Piston running clearance	mm (in.)	0.02 to 0.05 (0.0008 to 0.0020)
Max. total wear clearance betw. pistons and cylinders (used engine)	mm (in.)	0.15 (0.006)

11 25 ... Piston Rings

Groove 1 (plain compression ring)		
End clearance	mm (in.)	0.3 to 0.7 (0.012 to 0.027)
Side clearance	mm (in.)	0.06 to 0.09 (0.0024 to 0.0035)
Groove 2 (tapered edge compression ring)		
End clearance	mm (in.)	0.2 to 0.4 (0.008 to 0.016)
Side clearance	mm (in.)	0.03 to 0.072 (0.0012 to 0.0028)
Groove 3 (bevelled edge oil scraper ring)		
End clearance	mm (in.)	0.25 to 0.5 (0.010 to 0.020)
Side clearance	mm (in.)	0.02 to 0.06 (0.0008 to 0.0024)

11 31 ... Camshaft			
Drive		single roller chain	
11 31 ... Chain Tensioner Piston			
Piston length	mm (in.)	62 (2.441)	
Relaxed spring length	mm (in.)	155.5 (6.122)	
11 33 ... Rocker Arms			
Radial clearance	mm (in.)	0.016 to 0.052 (0.0006 to 0.0020)	

11 34 ... Valves

Valve clearance for intake and exhaust valves At max. 35° C (95° F) coolant temperature	mm (in.)	0.20 (0.008)
At operating temperature (thermostat activated)	mm (in.)	0.25 (0.010)
Min. valve head edge thickness – machining limit (distance "A") Intake	mm (in.)	1.3 (0.051)
Exhaust	mm (in.)	2.0 (0.079)
Valve head dia. (distance "T") Intake	mm (in.)	46 (1.811)
Exhaust	mm (in.)	38 (1.496)
Valve stem dia. (distance "S") Standard size	mm (in.)	8.0 (0.315)
Oversize 1	mm (in.)	8.1 (0.319)
Oversize 2	mm (in.)	8.2 (0.323)
Max. wear clearance between valve stem and valve guide (tilt clearance "K")	mm (in.)	0.8 (0.031)

11 40 ... Oil Supply

Lubricating system		forced circulation with pressure control valve in filtered oil circuit
Oil grade		see Service Information of Gr. 00
Total oil volume	ltr. (US/Imp pts)	4.0 (8.4 / 7.0)
Oil volume in filter	ltr. (US/Imp pts)	0.25 (0.5 / 0.4)
Oil consumption in liters (US/Imp. pints) per 100 kilometers (60 miles) (see page 00 · 3)		max. 0.15 (0.32 / 0.26)

11 41 ... Oil Pump

Design		Eaton
Oil pressure at idle speed	bar (psi)	0.5 to 2.0 (7 to 28)
Oil pressure at top speed	bar (psi)	4.0 to 6.0 (57 to 85)
Radial clearance between outer rotor and pump body	mm (in.)	0.1 to 0.15 (0.004 to 0.006)
Axial clearance between rotor and pump body	mm (in.)	0.04 to 0.1 (0.0016 to 0.0039)
Gap between inner and outer rotors	mm (in.)	0.12 to 0.20 (0.005 to 0.008)
Relaxed spring length	mm (in.)	68 (2.677)
Distance between flange and inner rotor	mm (in.)	42.7 (1.681)

11 42 ... Oil Filter		
Full flow oil filter bypass valve opening pressure	bar (psi)	2.5 (35)
11 51 ... Water Pump		
Clearance between cover in body and impeller	mm (in.)	0.8 to 1.2 (0.031 to 0.047)
Distance from upper edge of flange to end of shaft	mm (in.)	3.0 to 3.5 (0.118 to 0.138)

11 52 ... Fan Clutch		
Design		temperature and speed controlled visco fan clutch
Switching-on temperature	°C (°F)	82 ± 4 (180 ± 7)
Switching-off temperature	°C (° F)	≥60 (140)
Fan dia./no of blades	mm (in.)	420 (16.535) / 8
Fan speed at 3500 rpm engine speed (clutch operated)	rpm	2500 ± 100
Axial play of rotor	mm (in.)	max. 0.4 (0.016)
Radial play of rotor	mm (in.)	0.5 (0.020)
11 53 ... Thermostat (Coolant)		
Opening temperature (stamped in thermostat)	°C (°F)	approx. 80 (175)

ENGINE M 20 11 - 30		B 20 a) 320i, 520i b) 320i, 520i Catalyst	B 25 a) 325i, 525i b) 320i, 525i Catalyst
11 00 ... Engine in General			
Bore	mm	80	84
Stroke	mm	66	75
Effective displacement	cm^3	1990	2494
Compression ratio		a) 9.4 : 1 b) 8.8 : 1	a) 9.4 : 1 b) 8.8 : 1
Power (to DIN 70020) / at engine speed	KW/ rpm	95/6000	a) 126/5800 b) 125/5800
Max. top speed	rpm	6200	6200
Max. constant speed	rpm	6000	6000
Max. torque / at engine speed	Nm/ rpm	a) 174/4000 b) 164/4300	a) 226/4000 b) 222/4300
Compression (approx. same value for all cylinders)	bar	at least 10 ... 11	at least 10 ... 11
Idling speed	rpm	760 ± 40	760 ± 40

11 00 ... Engine Oil Consumption

DETERMINING OIL CONSUMPTION

Oil consumption can be measured for the first time after the car has been driven approximately 7,500 km. Oil consumption will be stable only after this distance. Measuring oil consumption requires that the engine does not leak.

Precise consumption can be determined by weighing. Drain engine oil having operating temperature. Allow 5 minutes drip time. Weigh and pour in specified amount of new engine oil. Drive car 1,000 km. Drain engine oil at operating temperature and weigh. Allow 5 minutes drip time. Engine oil density at room temperature is approx. 0.9 km/cubic dm (dm^3).

Max. permissible oil consumption when measured* by weighing: 0.07 ltr. / 100 km.

Example:

Poured in oil	—	drained oil	=	consumed oil.
4,500 g	—	3,600 g	=	900 g

900 : density 0.9 = 1,000 cm^3 = 1 liter per 1,000 kilometers

Possible Causes for Excessive Oil Consumption:

1. Running-in process not completed.
2. Seals for valve stems damaged.
3. Pistons seized.
4. Piston rings installed wrong, broken or worn.
5. Excessive running clearance between valve stem and valve guide.

* Refer to Group 11 of Operating Fluids

		B 20	B 25
11 11 ... Crankcase			
Cylinder bore diameter Standard size	mm (in.)	80.00 $^{+0.01}$ (3.1496 $^{+0.0004}$)	84.00 $^{+0.01}$ (3.3071 $^{+0.0004}$)
Intermediate size	mm (in.)	80.08 $^{+0.01}$ (3.1527 $^{+0.0004}$)	84.08 $^{+0.01}$ (3.3102 $^{+0.0004}$)
Oversize 1	mm (in.)	80.25 $^{+0.01}$ (3.1594 $^{+0.0004}$)	84.25 $^{+0.01}$ (3.3169 $^{+0.0004}$)
Oversize 2	mm (in.)	80.50 $^{+0.01}$ (3.1693 $^{+0.0004}$)	84.50 $^{+0.01}$ (3.3267 $^{+0.0004}$)
Surface finish	Rt (µ)	3 to 4	
Max. cyl. bore out-of-true	mm (in.)	0.02 (0.0008)	0.03 (0.0012)
Max. cyl. bore conicity	mm (in.)	0.02 (0.0008)	

		B 20	B 25
11 12 ... Cylinder Head			
Cylinder head height (machining limit)	mm (in.)	124.7 (4.909)	
11 12 ... Valve Guides			
Valve guide dia. -- bore dia.			
Standard size	mm (in.)	13.2 u6 – 13.2 M7 (0.5197)	
Oversize 1	mm (in.)	13.3 u6 – 13.3 M7 (0.5236)	
Oversize 2	mm (in.)	13.4 u6 – 13.4 M7 (0.5275)	
Total length	mm (in.)	43.5 (1.713)	
Valve guide inside diameter (installed)			
Standard size	mm (in.)	7.0 H7 (0.2756)	
Oversize 1	mm (in.)	7.1 H7 (0.2795)	
Oversize 2	mm (in.)	7.2 H7 (0.2835)	
Installing temperature			
Cylinder head	°C (°F)	+ 50 (+ 120)	
Valve guide	°C (°F)	– 150 (– 240)	
Valve guide protrusion	mm (in.)	14.5 (0.571)	

		B 20	B 25
11 12 ... Valve Seat Inserts			
Valve seat insert dia. – bore dia. (distance "D")			
Intake			
Standard size	mm (in.)	42.15 g6 – 42.00 H7 (1.6594 – 1.6535)	43.15 g6 – 43.00 H7 (1.6988 – 1.6929)
Oversize 0.2 mm (0.0079")	mm (in.)	42.35 g6 – 42.20 H7 (1.6673 – 1.6614)	43.35 g6 – 43.20 H7 (1.7067 – 1.7008)
Oversize 0.4 mm (0.0157")	mm (in.)	42.55 g6 – 42.40 H7 (1.6752 – 1.6693)	43.55 g6 – 43.40 H7 (1.7146 – 1.7086)
Exhaust			
Standard size	mm (in.)	37.65 g6 – 37.50 H7 (1.4823 – 1.4764)	
Oversize 0.2 mm (0.0079")	mm (in.)	37.85 g6 – 37.70 H7 (1.4901 – 1.4842)	
Oversize 0.4 mm (0.0157")	mm (in.)	38.05 g6 – 37.90 H7 (1.4980 – 1.4921)	
Valve seat insert height – bore depth (distance "H")			
Standard size	mm (in.)	7.3 h11 (0.287) $-7.0^{+0.2}_{-0.1}$ ($0.275^{+0.008}_{-0.004}$)	
Oversize 0.2 mm (0.008")	mm (in.)	7.5 h11 (0.295) $-7.2^{+0.2}_{-0.1}$ ($0.283^{+0.008}_{-0.004}$)	
Oversize 0.4 mm (0.016")	mm (in.)	7.7 h11 (0.303) $-7.4^{+0.2}_{-0.1}$ ($0.291^{+0.008}_{-0.004}$)	
Installing temperature			
Valve seat insert	°C (°F)	+ 50 (+ 120)	
Cylinder head	°C (°F)	– 150 (– 240)	

Valve seat inserts installed flush with cylinder head plane.

		B 20		B 25	
11 12 ... Valve Seats					
Valve seat angle	o	45			
Correction angles	o	15/75			
Valve seat width (distance "B")					
Intake	mm (in.)	1.65 ± 0.35 (0.065 ± 0.014)			
Exhaust	mm (in.)	1.65 ± 0.35 (0.065 ± 0.014)			
Valve seat diameter (distance "M")					
Intake	mm (in.)	38.6 (1.520)		40.6 (1.598)	
Exhaust	mm (in.)	32.6 (1.283)		34.6 (1.362)	

			B20	B 25
11 21 ... Crankshaft and Bearings				
Double classification				
Ground sizes of main bearing journals				
Standard size	red	mm	60.00 $^{-0.010}_{-0.020}$	
	blue	mm	60.00 $^{-0.020}_{-0.029}$	
Undersize 1	red	mm	59.75 $^{-0.010}_{-0.020}$	
	blue	mm	59.75 $^{-0.020}_{-0.029}$	
Undersize 2	red	mm	59.50 $^{-0.010}_{-0.020}$	
	blue	mm	59.50 $^{-0.020}_{-0.029}$	
Radial crankshaft bearing play		mm	0.03 ... 0.07	

B 20

B 25

11 21 ... Crankshaft and Bearings

			B 20	B 25
Triple Classification				
Ground sizes of main bearing journals				
Standard size	yellow	mm	59.984 ... 59.990	
	green	mm	59.977 ... 59.983	
	white	mm	59.971 ... 59.976	
Undersize 1 (0.25 mm)	yellow	mm	59.734 ... 59.740	
	green	mm	59.727 ... 59.733	
	white	mm	59.721 ... 59.726	
Undersize 2 (0.050 mm)	yellow	mm	59.484 ... 59.490	
	green	mm	59.477 ... 59.483	
	white	mm	59.471 ... 59.476	
Radial crankshaft bearing play		mm	0.020 ... 0.046	

11 21 ... Crankshaft and Bearings

Ground sizes of crankshaft thrust bearing		
Standard size	mm (in.)	$25.0 \begin{smallmatrix}+0.053\\+0.020\end{smallmatrix}$ $(0.9842 \begin{smallmatrix}+0.0021\\+0.0008\end{smallmatrix})$
Oversize 1	mm (in.)	$25.2 \begin{smallmatrix}+0.053\\+0.020\end{smallmatrix}$ $(0.9921 \begin{smallmatrix}+0.0021\\+0.0008\end{smallmatrix})$
Oversize 2	mm (in.)	$25.4 \begin{smallmatrix}+0.053\\+0.020\end{smallmatrix}$ $(1.0000 \begin{smallmatrix}+0.0021\\+0.0008\end{smallmatrix})$
Axial crankshaft play	mm (in.)	0.08 to 0.163 (0.0031 to 0.0064)

		B 20	B 25
11 21 ... Crankshaft and Bearings			
Ground sizes of conrod bearing journal			
Standard size	mm (in.)	44.975 to 44.991 (1.7707 to 1.7713)	
Undersize 1 0.25 mm (0.010")	mm (in.)	44.725 to 44.741 (1.7608 to 1.7614)	
Undersize 2 0.50 mm (0.020")	mm (in.)	44.475 to 44.491 (1.7510 to 1.7516)	
Radial conrod bearing play	mm (in.)	0.020 to 0.055 (0.0008 to 0.0022)	

		B 20	B 25
11 21 ... Crankshaft and Bearings			
Max. imbalance of crankshaft (dynamic without flywheel)	gcm	25	
Measuring planes		center of bearing journals 1 and 7	
Take-up		rollers on main bearings 2 and 6	
Balancing speed	rpm	400	
Max. runout on center main bearing journal (crankshaft running on outer bearing journals)	mm (in.)	0.15 (0.006)	
Crankshaft throw	mm (in.)	66 ± 0.1 (2.598 ± 0.004)	75 ± 0.1 (2.953 ± 0.004)
Max. surface finish of bearing journals	Rt (μ)	1.5	

		B 20	B 25
11 22 ... Flywheel			
Max. axial runout measured on outside diameter	mm (in.)	0.1 (0.004)	
Minimum flywheel thickness (distance "A")	mm (in.)	$25.1_{-0.1}$ ($0.988_{-0.004}$)	
11 23 ... Vibration Damper			
Max. radial runout	mm (in.)	0.2 (0.008)	
Max. axial runout	mm (in.)	0.3 (0.012)	
Diameter	mm (in.)	200 (7.874)	235 (9.252)
Color		black	–

	B 20		B 25

11 24 ... Connecting Rods and Bearings

Conrod bush –	outside dia.	mm (in.)	24.060 to 24.100 (0.9472 to 0.9488)
	Inside dia.	mm (in.)	$22 \begin{smallmatrix}+0.003\\+0.008\end{smallmatrix}$ ($0.8661 \begin{smallmatrix}+0.0001\\+0.0003\end{smallmatrix}$)
Max. deviation in parallel of conrod bores with bearing shells at distance of 150 mm (5.905")		mm (in.)	0.04 (0.0016)
Max. distortion to one side		o	0° 30'
Max. deviation in weight of connecting rods in one engine (without bearing shells)		g	± 4
	Big end	g	± 2
	Small end	g	± 2
Big conrod bore dia.	Red	mm (in.)	48.000 to 48.008 (1.8898 to 1.8900)
	Blue	mm (in.)	48.009 to 48.016 (1.8901 to 1.8904)

		B 20	B 25
11 25 ... Pistons		Pistons and pins are matched – only replace together in pairs.	
Weight class (die-stamped or engraved)		weight difference of individual pistons maximum 10 grams + or –	
Identification on piston		piston diameter, arrow for direction of installation and compression ratio	
Piston dia. (checkpoint "A") Standard size	mm (in.)	79.98 (3.149)	83.98 (3.306)
Intermediate size	mm (in.)	80.06 (3.152)	84.06 (3.309)
Oversize 1	mm (in.)	80.23 (3.159)	84.23 (3.316)
Oversize 2	mm (in.)	80.48 (3.168)	84.48 (3.326)
Piston running clearance	mm (in.)	0.01 to 0.04 (0.0004 to 0.0016)	
Max total wear clerance between pistons and cylinders (used engine)	mm (in.)	0.15 (0.006)	0.12 (0.005)

	B 20		B 25	

11 25 ... Piston Rings

Groove 1 (plain compression ring)		
End clearance	mm (in.)	0.2 ... 0.5 (0.008 ... 0.020)
Side clearance	mm (in.)	0.04 ... 0.08 (0.0016 ... 0.0031)
Groove 2 (tapered compression ring)		
End clearance	mm (in.)	0.2 ... 0.5 (0.008 ... 0.020)
Side clerance	mm (in.)	0.03 ... 0.07 (0.0012 ... 0.0027)
Groove 3 (bevelled oil scraper ring)		
End clearance	mm (in.)	0.2 ... 0.5 (0.008 ... 0.020)
Side clearance	mm (in.)	0.02 ... 0.05 (0.0008 ... 0.0020)

		B 20		B 25	
11 31 ... Camshaft					
Drive		toothed belt			
Axial running clearance	mm (in.)	max. 0.2 (0.008)			
11 33 ... Rocker Arms					
Radial play	mm (in.)	0.016 to 0.052 (0.0006 to 0.0020)			

		B 20	B 25
11 34 ... Valves			
Clearance of intake and exhaust valves			
At max. 35° C (95° F) coolant temperature	mm (in.)	0.25 (0.010)	
At operating temperature (thermostat activated)	mm (in.)	0.30 (0.012)	
Min. valve head edge thickness (machining limit distance "A")			
Intake	mm (in.)	1.3 (0.051)	–
Exhaust	mm (in.)	2.0 (0.079)	–
Head dia. (distance "T")			
Intake	mm (in.)	40 (1.575)	42 (1.653)
Exhaust	mm (in.)	34 (1.338)	36 (1.417)
Stem dia. (distance "S")			
Standard size	mm (in.)	7.0 (0.275)	
Oversize 1	mm (in.)	7.1 (0.279)	
Oversize 2	mm (in.)	7.2 (0.283)	
Max. wear clearance between valve stem and valve guide (tilt clearance "K")	mm (in.)	0.8 (0.031)	

	B 20		B 25

11 40 ... Oil Supply

Lubricating system	forced oil circulation with pressure control valve in filtered oil circuit		
Oil grade	see Service Information of Gr. 00		
Total oil volume ltr. (US/Imp. pts.)	4.25 (9.0 / 7.5)		4.25 + 0.75 (9.0 + 1.6 / 7.5 + 1.3) in oil cooler (only to be filled after repairing)
Oil volume in oil filter ltr. (US/Imp. pts.)	0.25 (0.53 / 0.44)		
Oil consumption in liters (US/Imp. pints) per 100 kilometers (60 miles) see page 00 - 3	max. 0.15 (0.32 / 0.26)		

11 41 ... Oil Pump

Design	gear type		
Oil pressure at idle speed bar (psi)	0.5 to 2.0 (7 to 28)		
Oil pressure at top speed bar (psi)	4.0 to 6.0 (57 to 85)		
Relaxed spring length mm (in.)	44 (1.732)		

11 52 ... Fan Clutch

Design			speed controlled visco fan clutch
9 blade fan Control speed	(cold)	rpm	2300 to 2700
	(warm)	rpm	2000 to 2400
8 blade fan Control speed	(cold)	rpm	2900 to 3700
	(warm)	rpm	2600 to 3400
Axial play of rotor		mm (in.)	max. 0.4 (0.016)
Radial play of rotor		mm (in.)	0.5 (0.020)

11 52 ... Fan Clutch

Design		temperature and speed controlled visco fan clutch
Switching-on temperature	°C (°F)	82 ± 4 (180 ± 7)
Switching-off temperature	°C (°F)	⩾ 60 (140)
Fan dia. / no. of blades	mm (in.)	420 (16.535) / 9
Fan speed at 3500 rpm engine speed (clutch operated)	rpm	2400 ± 100
Axial play of rotor	mm (in.)	max. 0.4 (0.016)
Radial play of rotor	mm (in.)	0.5 (0.020)

11 53 ... Thermostat (Coolant)

Opening temperature (stamped in thermostat)	°C (°F)	approx. 80 (175)

ENGINE M 21 11 – 50	D 24 W	D 24 WA

11 00 ... Engine in General

Bore	mm (in.)	80 (3.150)	
Stroke	mm (in.)	81 (3.189)	
Effective displacement	cc	2443	
Compression ratio		22 : 1	
Power (to DIN 70020) at engine speed	KW/rpm	63 / 4600	85 / 4800
Max. engine speed	rpm	5150 + 100	5350 ± 100
Max. constant engine speed	rpm	4600	4800
Max. torque at engine speed	Nm(ft lbs)/rpm	152 (110) / 2500	220 (159) / 2400
Compression (approx. same value for all cylinders)	bar (psi)	> 20 (284)	

11 00 ... Engine Oil Consumption

DETERMINING OIL CONSUMPTION

Oil consumption can be measured for the first time after the car has been driven approximately 7,500 km. Oil consumption will be stable only after this distance. Measuring oil consumption requires that the engine does not leak.

Precise consumption can be determined by weighing. Drain engine oil having operating temperature. Allow 5 minutes drip time. Weigh and pour in specified amount of new engine oil. Drive car 1,000 km. Drain engine oil at operating temperature and weigh. Allow 5 minutes drip time. Engine oil density at room temperature is approx. 0.9 km/cubic dm (dm^3).

Max. permissible oil consumption when measured* by weighing: 0.07 ltr. / 100 km.

Example:

Poured in oil	—	drained oil	=	consumed oil.
4,500 g	—	3,600 g	=	900 g

900 : density 0.9 = 1,000 cm^3 = 1 liter per 1,000 kilometers

Possible Causes for Excessive Oil Consumption:

1. Running-in process not completed.
2. Seals for valve stems damaged.
3. Pistons seized.
4. Piston rings installed wrong, broken or worn.
5. Excessive running clearance between valve stem and valve guide.

* Refer to Group 11 of Operating Fluids

		D 24 W	D 24 WA
11 11 ... Crankcase			
Cylinder bore diameter Standard size	mm (in.)	$80.00^{+0.01}$ ($3.1496^{+0.0004}$)	
Intermediate size	mm (in.)	$80.08^{+0.01}$ ($3.1527^{+0.0004}$)	
Oversize 1	mm (in.)	$80.25^{+0.01}$ ($3.1594^{+0.0004}$)	
Surface finish (plateau honed)	Rz (µ)	6 to 10	
Max. cyl. bore out-of-true	mm (in.)	0.014 (0.0005)	
Max. cyl. bore conicity	mm (in.)	0.014 (0.0005)	

	D 24 W	D 24 WA
11 12 ... Cylinder Head		
Cylinder head height (cylinder head may not be reground) mm (in.)	148 ± 0.1 (5.827 ± 0.004)	
Max. distortion over entire length of cylinder head mm (in.)	0.05 (0.002)	
11 12 ... Valve Guide		
Valve guide inside diameter (installed)		
Standard size mm (in.)	7.0 H7 (0.275)	
Oversize 1 mm (in.)	7.1 H7 (0.279)	
Oversize 2 mm (in.)	7.2 H7 (0.283)	
Valve guide protrusion mm (in.)	13.5 (0.531)	

		D 24 W	D 24 WA
11 12 ... Valve Seat			
Valve seat angle	°	45	
Correction angles	°	0/65	
Valve seat width (distance "B")			
Intake	mm (in.)	1.75 ± 0.25 (0.069 ± 0.010)	
Exhaust	mm (in.)	2.75 ± 0.25 (0.108 ± 0.010)	
Valve stem dia. (distance "M")			
Intake	mm (in.)	33.6 (1.323)	
Exhaust	mm (in.)	29.6 (1.165)	
Valve retrusion (distance "R")			
Intake	mm (in.)	0.65 to 0.85 (0.025 to 0.033)	
Exhaust	mm (in.)	0.85 to 1.05 (0.033 to 0.041)	
11 12 ... Burner			
Burner retrusion (distance "B")	mm (in.)	0.02 to 0.07 (0.0008 to 0.0027)	

	D 24 W	D 24 WA
11 21 ... Crankshaft and Bearings	– Triple Classification –	
Ground sizes of main bearing journals		
Standard size yellow mm (in.)	59.984 to 59.990 (2.3615 to 2.3618)	
green mm (in.)	59.977 to 59.983 (2.3613 to 2.3615)	
white mm (in.)	59.971 to 59.976 (2.3610 to 2.3612)	
Undersize 1 0.25 mm (0.010") yellow mm (in.)	59.734 to 59.740 (2.3517 to 2.3520)	
green mm (in.)	59.727 to 59.733 (2.3514 to 2.3517)	
white mm (in.)	59.721 to 59.726 (2.3512 to 2.3514)	
Undersize 2 0.50 mm (0.020") yellow mm (in.)	59.484 to 59.490 (2.3419 to 2.3421)	
green mm (in.)	59.477 to 59.483 (2.3416 to 2.3418)	
white mm (in.)	59.471 to 59.476 (2.3414 to 2.3416)	
Radial crankshaft bearing play mm (in.)	0.020 to 0.046 (0.0008 to 0.0018)	

	D 24 W	D 24 WA

11 21 ... Crankshaft and Bearings

Ground sizes of crankshaft thrust bearing Standard size	mm (in.)	$25.0\ ^{+0.053}_{+0.020}$ ($0.9842\ ^{+0.0021}_{+0.0008}$)
Oversize 1	mm (in.)	$25.2\ ^{+0.053}_{+0.020}$ ($0.9921\ ^{+0.0021}_{+0.0008}$)
Oversize 2	mm (in.)	$25.4\ ^{+0.053}_{+0.020}$ ($1.0000\ ^{+0.0021}_{+0.0008}$)
Axial crankshaft play	mm (in.)	0.08 to 0.163 (0.0031 to 0.0064)
		– Double Classification –
Ground sizes of conrod bearing journals Standard size	mm (in.)	44.975 to 44.991 (1.7707 to 1.7713)
Undersize 1	mm (in.)	44.725 to 44.741 (1.7608 to 1.7614)
Undersize 2	mm (in.)	44.475 to 44.491 (1.7510 to 1.7516)
Radial conrod bearing play	mm (in.)	0.020 to 0.055 (0.0008 to 0.0022)

	D 24 W	D 24 WA

11 21 ... Crankshaft and Bearings

Max. imbalance of crankshaft (dynamic without flywheel)	gcm	50
Measuring planes		center of bearing journals 1 and 7
Take-up		with rollers on main bearings 2 and 6
Balancing speed	rpm	400
Max. runout on center main bearing journal (crankshaft running on outer bearing journals)	mm (in.)	0.15 (0.006)
Crankshaft throw	mm (in.)	81 ± 0.1 (3.189 ± 0.004)
Max. surface finish of bearing journals	Rz (µ)	1.5 (micro carrying share in 1 mm (0.039") cutting depth tpi_1 = 70 %)

ENGINE M 21 11 – 57	D 24 W	D 24 WA	
11 22 ... Flywheel			
Max. axial runout measured on outside diameter	mm (in.)	0.1 (0.004)	
Min. flywheel thickness (distance "A")	mm (in.)	$32.1_{-0.1}$ ($1.264_{-0.004}$)	
11 23 ... Vibration Damper			
Max. radial runout	mm (in.)	0.2 (0.008)	
Max. axial runout	mm (in.)	0.3 (0.012)	
Diameter	mm (in.)	235 (9.252)	
Color		gray	

	D 24 W	D 24 WA

11 24 ... Connecting Rods and Bearings

Conrod bush –	outside dia.	mm (in.)	28.060 to 28.100 (1.1047 to 1.1063)
	inside dia.	mm (in.)	$26^{+0.003}_{+0.008}$ ($1.0236^{+0.0001}_{+0.0003}$)
Max. deviation in parallel of conrod bores with bearing shells at distance of 150 mm (5.905")		mm (in.)	0.04 (0.0016)
Max. displacement to one side		o	0° 30'
Max. deviation in weight of connecting rods in one engine (without bearing shells)		g	± 4
	Big end	g	± 2
	Small end	g	± 2

– Double Classification –

Big conrod end diameter Red	mm (in.)	48.000 to 48.008 (1.8898 to 1.8900)
Blue	mm (in.)	48.009 to 48.016 (1.8901 to 1.8904)

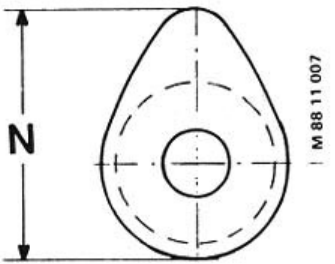
	D 24 W	D 24 WA
11 25 ... Pistons	Pistons and pins are matched – only replace together in pairs.	
Weight class (die-stamped or engraved)	+ or – (max. weight difference of all pistons 10 grams)	
Identification on piston	piston dia., arrow for installed direction, compression ratio	
Piston dia. (checkpoint "A") Standard size mm (in.)	Alcan 79.965 (3.1482) KS 79.950 (3.1476) König/Mahle 79.965 (3.1482)	König/Mahle 79.945 (3.1474)
Intermediate size mm (in.)	Alcan 80.045 (3.1514) KS 80.030 (3.1508) König/Mahle 80.045 (3.1514)	König/Mahle 80.025 (3.1506)
Oversize 1 mm (in.)	Alcan 80.215 (3.1581) KS 80.200 (3.1575) König/Mahle 80.215 (3.1581)	König/Mahle 80.195 (3.1573)
Piston running clearance mm (in.)	Alcan 0.026 to 0.054 (0.0010 to 0.0021) KS 0.034 to 0.076 (0.0013 to 0.0030) König/Mahle 0.026 to 0.054 (0.0010 to 0.0021)	König/Mahle 0.046 to 0.074 (0.0018 to 0.0029)
Max. total wear clearance between pistons and cylinders (used engine) mm (in.)	0.15 (0.006)	

		D 24 W	D 24 WA
11 25 ... Piston Rings			
Groove 1 (keystone ring)			
End clearance	mm (in.)	0.2 to 0.4 (0.008 to 0.016)	
Side clearance	mm (in.)	0.06 to 0.14 (0.0024 to 0.0055)	
Groove 2 (taper face ring)			
End clearance	mm (in.)	0.2 to 0.4 (0.008 to 0.016)	
Side clearance	mm (in.)	0.05 to 0.08 (0.0020 to 0.0031)	
Groove 3 (oil scraper ring with spring)			
End clearance	mm (in.)	0.25 to 0.50 (0.010 to 0.020)	
Side clearance	mm (in.)	0.03 to 0.06 (0.0012 to 0.0024)	

	D 24 W	D 24 WA

11 31 ... Camshaft

Drive		toothed belt	
Axial running clearance	mm (in.)	0.15 to 0.33 (0.006 to 0.013)	
Cam distance "N"			
Intake cams	mm (in.)	34.237 (1.3479)	34.023 (1.3395)
Exhaust cams	mm (in.)	34.241 (1.3481)	34.241 (1.3481)
Max. wear on used cam peaks	mm (in.)	0.1 (0.004)	



	D 24 W	D 24 WA
11 34 ... Valves		
Intake and exhaust valve clearance "V" At max. 35° C (95° F) coolant temperature mm (in.)	0.30 (0.012)	
At operating temperature (thermostat activated) mm (in.)	0.35 (0.014)	
Valve head dia. (distance "T") Intake mm (in.)	35 (1.378)	
Exhaust mm (in.)	31 (1.220)	
Valve retrusion (distance "R") Intake mm (in.)	0.65 to 0.85 (0.025 to 0.033)	
Exhaust mm (in.)	0.85 to 1.05 (0.033 to 0.041)	
Stem dia. (distance "S") Standard size mm (in.)	7.0 (0.275)	
Oversize 1 mm (in.)	7.1 (0.279)	
Oversize 2 mm (in.)	7.2 (0.283)	
Max. wear play between valve stem and valve guide (tilt clearance "K") mm (in.)	0.8 (0.031)	

		D 24 W	D 24 WA
11 40 ... Oil Supply			
Lubricating system		forced oil circulation with pressure control valve in filtered oil circuit	
Oil grade		see Service Information of Gr. 00	
Total oil volume	ltr. (US/Imp pts.)	5.25 (11.1/9.2)	5.75 (12.1/10.1)
	ltr. (US/Imp. pts.)		6.50 (13.7/11.4) with oil cooler (only filled after repairing)
Oil volume in oil filter	ltr. (US/Imp pts.)	1.25 (2.6 / 2.2)	
Oil consumption in liters (US/Imp. pints) per 100 kilometers (60 miles) see page 00 - 3		max. 0.15 (0.32 / 0.26)	

		D 24 W	D 24 WA
11 41 ... Oil Pump			
Design		gear-type	
Oil pressure at idle speed	bar (psi)	0.5 to 2.0 (7 to 28)	
Oil pressure at top speed	bar (psi)	4.0 to 6.0 (57 to 85)	
Relaxed spring length	mm (in.)	71.6 (2.819)	

		D 24 W	D 24 WA	
11 51 ... Water Pump				
Clearance between cover in body and impeller	mm (in.)	0.4 to 0.8 (0.016 to 0.031)		
Upper edge of flange to end of shaft	mm (in.)	11.2 ± 0.1 (0.441 ± 0.004)		

		D 24 W	D 24 WA
11 52 ... Fan Clutch			
Design		temperature and speed controlled visco fan clutch	
Switching-on temperature	°C (°F)	92 ± 4 (198 ± 7)	82 ± 4 (180 ± 7)
Switching-off temperature	°C (°F)	⩾60 (140)	
Fan dia. / no. of blades	mm (in.)	420 (16.535) / 9	
Fan speed at engine speed of 3500 rpm (clutch activated)	rpm	2400 ± 100	
Max. axial play of rotor	mm (in.)	0.4 (0.016)	
Radial play of rotor	mm (in.)	0.5 (0.020)	

		D 24 W	D 24 WA	
11 53 ... Thermostat (Coolant)				
Opening temperature (stamped in thermostat)	°C (°F)	approx. 80 (175)		
11 61 ... Charging Pressure Blowoff Valve				
Opening pressure	bar (psi)		1.0 ± 0.1 (14 ± 1.4)	
11 65 ... Turbocharger				
Charging pressure (in load range above 2500 rpm)	bar (psi)		0.76 to 0.90 (11 to 13)	
Maximum bearing play				
Axial	mm (in.)		0.15 (0.006)	
Radial	mm (in.)		0.80 (0.031)	
11 66 ... Vacuum Pump				
Minimum vacuum	mbar	530		

11 - 400 Engine

		M40 B16	M40 B18	M43 B16	M43 B18
11 00 Engine - General					
In-line engine	Cylinders	4	4	4	4
Bore	mm	84	84	84	84
Stroke	mm	72	81	72	81
Effective displacement	cm^3	1596	1796	1596	1796
Compression ratio	:1	9.0	8.8	9.7	9.7
Net output (DIN 70 020)	KW	75/5500 *	85/5500 *		
at	rpm	73/5500 **	83/5500 **	75/5500	85/5500
Max. engine speed	rpm	6200	6200	6200	6200
Max.continuous engine speed	rpm	6000	6000	6000	6000
Max. torque	Nm	143/4250 *	165/4250 *		
at	rpm	141/4250 **	162/4250 **	150/3900	168/3900
Compression (roughly equal readings for all cylinders)	bar	min. 10 - 11	min. 10 - 11	min. 10 - 11	min. 10 - 11

* without catalytic converter

** with catalytic converter

11 - 401 Engine		M40 B16	M40 B18	M43 B16	M43 B18
11 11 Engine block					
Bore dia.	mm	$84.00^{+0.014}$			
Bore intermnediate size	mm	$84.080^{+0.014}$			
1st overbore	mm	$84.250^{+0.014}$			
2nd overbore	mm	$84.500^{+0.014}$			
Maximum cyl.-bore ovality	mm	0.01			
Maximum cyl.-bore taper	mm	0.01			

11 - 402 Engine		M40 B16	M40 B18	M43 B16	M43 B18
11 12	Cylinder head with cover				
Cylinder head height - factory		141.0		141.0	
Planing limit*	mm	140.55		140.55	
Valve guides not available as replacement parts					
Valve guide internal diameters (installed)					
Factory	mm	7.0 H7		7.0 H7	
Stage 1	mm	7.1 H7		7.1 H7	
Stage 2	mm	7.2 H7		7.2 H7	
Deflection angle*, max. (between valve and guide)	mm	0.5		0.5	

* See Repair Manual

	M40 B16	M40 B18	M43 B16	M43 B18
11 12 Cylinder head and cover				
Valve seat angle °	45°			
Correction angle Outside °	15°			
Inside °	60°			
Valve seat width (Dimension"B")				
Intake mm	1.65 ± 0.25			
Exhaust mm	2.0 ± 0.25			
Valve seat diameter				
Intake Outside diameter mm	dia. 41.4			
Exhaust Outside diameter mm	dia. 35.6			

		M40 B16	M40 B18	M43 B16	M43 B18
11 21	**Crankshaft and bearings**				
	Main bearing journal undersizes				
Factory	yellow mm		59.984 ... 59.990		
	green mm		59.977 ... 59.983		
	white mm		59.971 ... 59.976		
1st undersize	yellow mm		59.734 ... 59.740		
(U 0.25)	green mm		59.727 ... 59.733		
	white mm		59.721 ... 59.726		
2nd undersize	yellow mm		59.484 ... 59.490		
(U 0.50)	green mm		59.477 ... 59.483		
	white mm		59.471 ... 59.476		
Crankshaft bearing radial clearance	mm		0.020 ... 0.046		

	M40 B16	M40 B18	M43 B16	M43 B18
11 21 Crankshaft and main bearings				
Crankshaft main bearing oversizes				
Factory mm	25.0 F8			
1st oversize mm	25.2 F8			
2nd oversize mm	25.4 F8			
Crankshaft end float mm	0.080 ... 0.163			
Conrod journal undersizes				
Factory mm	44.975 $^{+0.016}$			
1st undersize mm	44.725 $^{+0.016}$			
2nd undersize mm	44.475 $^{+0.016}$			
Connecting rod bearing radial clearance mm	0.010 ... 0.052			
Max. allowed runout at center main journal as measured at main bearings 1 & 5 mm	0.15			

11 - 406 Engine		M40 B16	M40 B18	M43 B16	M43 B18
11 22	Flywheel				
	Max. axial runout as measured at periphery mm			0.1	

11 - 407 Engine		M40 B16	M40 B18	M43 B16	M43 B18
11 23 Harmonic balancer					
Maximum radial runout	mm	0.40			
Maximum end float	mm	0.60			

		M40 B16	M40 B18	M43 B16	M43 B18
11 24	**Connecting rods and bearings**				
Big-end diameter, large	mm		48.000 $^{+0.016}$		
Wristpin bushing Outside diameter	mm		24.000 $^{+0.031}$		
Inside diameter	mm		22.005 $^{+0.007}$		
Parallel deviation of connecting rod bores at 150 mm distance, with inserts	max. mm		0.04		
Max. twist to one side	max. °		0.5		
Allowed weight difference between connnecting rods (without inserts)	g		±4		
Big end	g		± 2		
Wristpin end	g		± 2		

11 - 409 Engine		M40 B16	M40 B18	M43 B16	M43 B18
11 25 Pistons with rings and wristpins					
Pistons and wristpins are matched - always replace in sets					
Piston diameter					
Factory - Stage 0	mm			83.985	
Stage 00	mm			84.065	
1st oversize +0.25	mm			84.235	
2nd oversize +0.50	mm			84.485	
Piston installation clearance	mm			0.01 ... 0.04	
Max. allowed wear between piston and cylinder wall (used engine)	mm			0.15	

		M40 B16	M40 B18	M43 B16	M43 B18
11 25	**Pistons with rings and wristpins**				
	1st groove (top compression ring)				
	End gap mm	0.2 ... 1.0 *	0.2 ... 1.0 *	0.2 ... 1.0 *	0.2 ... 1.0 *
	Groove clearance mm	0.02 ... 0.20 *	0.02 ... 0.20 *	0.02 ... 0.20 *	0.02 ... 0.20 *
	2nd groove (taper-face ring)				
	End gap mm	0.2 ... 1.0 *	0.2 ... 1.0 *	0.2 ... 1.0 *	0.2 ... 1.0 *
	Groove clearance mm	0.020 ... 0.1 *	0.020 ... 0.1 *	0.020 ... 0.1 *	0.020 ... 0.1 *
	3rd groove (oil-scraper ring with spring)				
	End gap mm	0.2 ... 1.0 *	-	-	-
	Groove clearance mm	0.020 ... 0.1 *	-	-	-
	3rd groove (3-piece steel band ring)				
	End gap mm	-	0.4 ... 1.4	0.4 ... 1.4	0.4 ... 1.4
	Groove clearance mm	-	not measured	not measured	not measured

* Wear limit.

		M40 B16	M40 B18	M43 B16	M43 B18
11 31	Camshaft				
Pilot bearing (camshaft)					
Width	mm	23 H9			
Pilot bearing (cylinder head)					
Width	mm	23 d8			
Runout	Radial mm	0.020 ... 0.061			
	End float mm	0.065 ... 0.150			

		M40 B16	M40 B18	M43 B16	M43 B18
11 34	**Valves and springs**				
	Head diameter				
	Intake mm	42			
	Exhaust mm	36			
	Stem diameter				
	Intake mm	$6.975^{-0.015}$			
	Exhaust mm	$6.96^{-0.015}$			
	Repair valves **In addition to the standard valves, the following oversizes are also available**				
	Stem diameter Intake 1st oversize mm	$7.1^{-0.025 \ldots -0.040}$			
	2nd oversize mm	$7.2^{-0.025 \ldots -0.040}$			
	Stem diameter Exhaust 1st oversize mm	$7.1^{-0.040 \ldots -0.055}$			
	2nd oversize mm	$7.2^{-0.040 \ldots -0.055}$			

11 - 413 Engine		M40 B16	M40 B18	M43 B16	M43 B18
11 40 Lubrication system					
Oil specification *					
Engine oil consumption *					
Oil capacity with filter change	ltr.			4.0	
Without filter change	ltr.			3.75	

* See Specifications for Fuels. Fluids and Lubricants

11 - 414 Engine			M40 B16	M40 B18	M43 B16	M43 B18
11 41	Oil pump with filter screen and drive					
	Oil pressure. at idle	min. bar	0.5			
	Bypass opening pressure	bar	4.3 ± 0.2			

		M40 B16	M40 B18	M43 B16	M43 B18
11 52 Fan					
Fan clutch Lockup temperature	° C	92 ± 4			
Release temperature	° C	60			
Tilt play of bearing (156 mm diameter)	mm	± 0.65			

11 - 416 Engine		M40 B16	M40 B18	M43 B16	M43 B18
11 53	Thermostat and connections				
	Starts to open at (stamped on housing) ° C		88		95

M 42 B 18

11 00 ... Engine in General

Design		in-line, 4 cylinders
Bore	mm (in.)	84 (3.307)
Stroke	mm (in.)	81 (3.189)
Effective displacement	cm^3 ($in.^3$)	1796 (109.5)
Compression ratio		10.0 : 1
Power output (to DIN 70 020)	KW	100
at engine speed	rpm	6000
Max. engine speed	rpm	6500
Max. torque	Nm (ft. lbs.)	172 (124)
at engine speed	rpm	4600
Compression pressure (approx. same value for all cylinders)	bar (psi)	at least 10 to 11 (142 to 156)

11 00 ... Engine Oil Consumption

DETERMINING OIL CONSUMPTION

Oil consumption can be measured for the first time after the car has been driven approximately 7,500 km. Oil consumption will be stable only after this distance. Measuring oil consumption requires that the engine does not leak.

Precise consumption can be determined by weighing. Drain engine oil having operating temperature. Allow 5 minutes drip time. Weigh and pour in specified amount of new engine oil. Drive car 1,000 km. Drain engine oil at operating temperature and weigh. Allow 5 minutes drip time. Engine oil density at room temperature is approx. 0.9 km/cubic dm (dm^3).

Max. permissible oil consumption when measured* by weighing: 0.07 ltr. / 100 km.

Example:

Poured in oil	—	drained oil	=	consumed oil.
4,500 g	—	3,600 g	=	900 g

900 : density 0.9 = 1,000 cm^3 = 1 liter per 1,000 kilometers

Possible Causes for Excessive Oil Consumption:

1. Running-in process not completed.
2. Seals for valve stems damaged.
3. Pistons seized.
4. Piston rings installed wrong, broken or worn.
5. Excessive running clearance between valve stem and valve guide.

* Refer to Group 11 of Operating Fluids

M 42 B 18

11 11 ... Crankcase

Cylinders Bore dia.	mm (in.)	$84.000^{+0.014}$ ($3.3071^{+0.0006}$)
Intermediate size	mm (in.)	$84.080^{+0.014}$ ($3.3103^{+0.0006}$)
1st oversize	mm (in.)	$84.250^{+0.014}$ ($3.3170^{+0.0006}$)
2nd oversize	mm (in.)	$84.500^{+0.014}$ ($3.3268^{+0.0006}$)
Surface finish	Rt (µ)	3 ... 4
Max. cyl. bore out-of-true	mm (in.)	0.01 (0.0004)
Max. cyl. bore conicity	mm (in.)	0.01 (0.0004)

M 42 B 18

11 12 ... Cylinder Head

Cylinder head height Standard size	mm	140.0
Machined limit *	mm	139.55
Valve guides		valve guides are not available as replacement parts
Valve guide inside dia. (installed) Standard size	mm	7.0 H7
Oversize 1	mm	7.1 H7
Oversize 2	mm	7.2 H7
Max. tilt clearance "K" (wear between valve and valve guide)	mm	0.5

* Refer to Repair Manual

11 12 ... Valve Seat Inserts

Valve seat insert dia. / bore dia. (distance D)		
Intake		
Standard size	mm (in.)	34.1 k6 / 34.0 H7 (1.3426 / 1.3386)
Oversize 0.2 mm (0.008")	mm (in.)	34.3 k6 / 34.2 H7 (1.3504 / 1.3465)
Oversize 0.4 mm (0.016")	mm (in.)	34.5 k6 / 34.4 H7 (1.3583 / 1.3544)
Exhaust		
Standard size	mm (in.)	31.6 k6 / 31:5 H7 (1.2441 / 1.2402)
Oversize 0.2 mm (0.008")	mm (in.)	31.8 k6 / 31.7 H7 (1.2520 / 1.2481)
Oversize 0.4 mm (0.016")	mm (in.)	32.0 k6 / 31.9 H7 (1.2599 / 1.2559)
Valve seat insert height		
Intake		
Standard size	mm (in.)	$7.3^{-0.1}$ ($0.287^{-0.004}$)
Oversize 0.2 mm (0.008")	mm (in.)	$7.5^{-0.1}$ ($0.295^{-0.004}$)
Oversize 0.4 mm (0.016")	mm (in.)	$7.7^{-0.1}$ ($0.303^{-0.004}$)
Exhaust		
Standard size	mm (in.)	$7.3^{-0.1}$ ($0.287^{-0.004}$)
Oversize 0.2 mm (0.008")	mm (in.)	$7.5^{-0.1}$ ($0.295^{-0.004}$)
Oversize 0.4 mm (0.016")	mm (in.)	$7.7^{-0.1}$ ($0.303^{-0.004}$)
Installing temperature		
Valve seat insert	°C (°F)	- 150 (- 240)
Cylinder head	°C (°F)	+ 20 (+ 68)

M 42 B 18

11 12 ... Valve Seats

Valve seat angle	degr.	45°
Correction angles Outside	degr.	15°
Inside	degr.	60°
Valve seat width (dimension "B") Intake	mm	1.65 ± 0.25
Exhaust	mm	1.65 ± 0.25
Valve seat outside diameter Intake	mm	32.4
Exhaust	mm	30.1

11 21 ... Crankshaft and Bearings

Ground sizes of main bearing journal			
Standard size	yellow	mm (in.)	59.984 ... 59.990 (2.3616 ... 2.3618)
	green	mm (in.)	59.977 ... 59.983 (2.3613 ... 2.3615)
	white	mm (in.)	59.971 ... 59.976 (2.3611 ... 2.3613)
Undersize 1	yellow	mm (in.)	59.734 ... 59.740 (2.3517 ... 2.3520)
0.25 mm (0.0098")	green	mm (in.)	59.727 ... 59.733 (2.3515 ... 2.3517)
	white	mm (in.)	59.721 ... 59.726 (2.3512 ... 2.3514)
Undersize 2	yellow	mm (in.)	59.484 ... 59.490 (2.3419 ... 2.3421)
0.59 mm (0.0232")	green	mm (in.)	59.477 ... 59.483 (2.3416 ... 2.3418)
	white	mm (in.)	59.471 ... 59.476 (2.3414 ... 2.3416)
Radial crankshaft bearing play		mm (in.)	0.020 ... 0.058 (0.0008 ... 0.0023)

11 21 ... Crankshaft and Bearings

Ground sizes of crankshaft thrust bearing		
Standard size	mm (in.)	$25.0^{+0.053}_{+0.020}$ ($0.9843^{+0.0021}_{+0.0008}$)
Oversize 1	mm (in.)	$25.2^{+0.053}_{+0.020}$ ($0.9921^{+0.0021}_{+0.0008}$)
Oversize 2	mm (in.)	$25.4^{+0.053}_{+0.020}$ ($1.0000^{+0.0021}_{+0.0008}$)
Axial crankshaft play	mm (in.)	0.08 ... 0.163 (0.0031 ... 0.0064)

11 21 ... Crankshaft and Bearings

Ground sizes of conrod bearing journal		
Standard size	mm (in.)	$45.00^{+0.009}_{+0.025}$ ($1.7717^{+0.0004}_{+0.0010}$)
Undersize 1	mm (in.)	$44.75^{+0.009}_{+0.025}$ ($1.7618^{+0.0004}_{+0.0010}$)
Undersize 2	mm (in.)	$44.50^{+0.009}_{+0.025}$ ($1.7520^{+0.0004}_{+0.0010}$)
Radial conrod bearing play	mm (in.)	0.020 ... 0.055 (0.0008 ... 0.0022)

M 42 B 18

11 21 ... Crankshaft and Bearings

Max. crankshaft imbalance (dyn. without flywheel)	gcm	25
Measuring planes		middle of main bearing
Take-up		with rollers on main bearings 1 and 5
Balancing speed	rpm	400
Max. runout on middle main bearing journal (crankshaft running on outer bearing journals)	mm (in.)	0.15 (0.006)
Crankshaft throw	mm (in.)	81.0 ± 0.1 (3.189 ± 0.004)
Max. surface finish of bearing journals	Rt (μ)	1.5

11 22 ... Flywheel

Max. runout measured on outside diameter	mm (in.)	0.1 (0.004)
Min. thickness of flywheel (distance "A")	mm (in.)	max. 23.2 mm (0.913") between friction surface and bolted surface of clutch housing (→ shell flywheel)

M 42 B 18

11 24 ... Connecting Rods and Bearings

Big conrod end bore dia. Red	mm	48.000 ... 48.008
Blue	mm	48.009 ... 48.016
Conrod bush Outside dia.	mm	24.060 ... 24.100
Inside dia.	mm	$22^{+0.010}_{+0.005}$
Max. deviation in parallel of conrod bores with bearing shells at distance of 140 mm	mm	0.04
Max. displacement to one side		0' - 30'
Max. deviation in weight of connecting rods in one engine (without bearing shells)	g	± 4
Big end	g	± 2
Small end	g	± 2

M 42 B 18

11 25 ... Pistons		Pistons and pins are matched - always only replace together.
Weight class (die-stamped or engraved)		max. difference in weight among pistons: 10 g + or -
Identification on piston		
Engine type / displacement		1.8 / 10
Compression ratio		
Piston dia. (checkpoint "A")		
Standard size	mm (in.)	83.98 (3.3063)
Intermediate size	mm (in.)	84.06 (3.3094)
Oversize 1	mm (in.)	84.23 (3.3161)
Oversize 2	mm (in.)	84.48 (3.3260)
Piston running clearance	mm (in.)	0.01 ... 0.04 (0.0004 ... 0.0016)
Max. total wear clearance between piston and cylinder (used engine)	mm (in.)	0.15 (0.0059)

		M 42 B 18
11 25 ... Piston Rings		
Groove 1 (plain compression ring)		
End clearance	mm (in.)	0.2 ... 0.4 (0.008 ... 0.016)
Side clearance	mm (in.)	0.02 ... 0.052 (0.0008 ... 0.0020)
Groove 2 (taper face ring)		
End clearance	mm (in.)	0.2 ... 0.4 (0.008 ... 0.016)
Side clearance	mm (in.)	0.020 ... 0.052 (0.0008 ... 0.0020)
Groove 3 (oil scraper ring with hose-lined spring)		
End clearance	mm (in.)	0.2 ... 0.45 (0.008 ... 0.018)
Side clearance	mm (in.)	0.020 ... 0.055 (0.0008 ... 0.0022)

11 31 ... Camshaft

Axial play	mm (in.)	0.15 ... 0.33 (0.006 ... 0.013)
Radial play	mm (in.)	0.020 ... 0.054 (0.0008 ... 0.0021)
Cam height	mm (in.)	47.7 ± 0.06 (1.8779 ± 0.0024)

M 42 B 18

11 34 ... Valves

Valve head diameter		
Intake	mm	33.0
Exhaust	mm	30.5
Valve stem diameter		
Intake	mm	6.975 / 5.975 ** - 0.015
Exhaust	mm	6.960 * / 5.960 ** - 0.015
Following valve versions are available for repairs in addition to the standard valves		
Valve stem diameter		
Intake	mm	7.075 / 6.075 ** - 0.015
Exhaust	mm	7.060 * / 6.060 ** - 0.015
Head oversize	mm	0.2
Identification on stem		R1
Valve stem diameter		
Intake	mm	7.175 / 6.175 ** - 0.015
Exhaust	mm	7.160 * / 6.160 ** - 0.015
Head oversize	mm	0.4
Identification on stem		R2

* Exhaust valves are sodium filled.
Refer to information in Construction Group Repair Manual and Service Information Bulletins.

** Since 9.92

11 40 ... Oil Supply

Lubricating system		forced oil circulation with pressure control valve in unfiltered oil circuit
Oil grade		see Service Information Group 00
Oil change volume with oil filter	ltr. (US/Imp. pts.)	4.85 (10.25/8.54)
without oil filter	ltr. (US/Imp. pts.)	4.39 (9.28/7.73)

M 42 B 18

11 41 ... Oil Pump

Oil pump design		internal gear-type pump
Oil pressure		
at idle speed	bar (psi)	1.3 ... 2.0 (18 ... 28)
at maximum speed	bar (psi)	4.0 ... 4.3 (57 ... 61)
Radial play of outer rotor/ pump body	mm (in.)	0.120 ... 0.196 (0.0047 ... 0.0077)
Axial play		
Inner rotor	mm (in.)	0.02 ... 0.065 (0.0008 ... 0.0026)
Outer rotor	mm (in.)	0.04 ... 0.09 (0.0016 ... 0.0035)
Length of relaxed spring	mm (in.)	84.1 (3.311)

11 42 ... Oil Filter

Full flow oil filter bypass opening pressure	bar (psi)	$2.5^{+0.5}$ (36^{+7})

		M 42 B 18
11 53 ... Thermostat (Coolant)		
Opening temperature (stamped in thermostat)	°C (°F)	88 (190)

ENGINE 11 - 800		S 14 a) M 3 b) 320is a*) M 3 / E 2	M 88/3 M 635 CSi
11 00 ... Engine in General			
- European Version -			
Bore	mm	93.4	93.4
Stroke	mm	a) 84.0 b) 72.6	84.0
Effective displacement	cm^3	a) 2302 b) 1990	3453
Compression ratio		a) 10.5 : 1 b) 10.8 : 1 a*) 11.0 : 1	10.5 : 1
Power (to DIN 70020) / at engine speed	KW / rpm	a) 147/6900 b) 141/6900 a*) 162/6750	210/6500
Governed shutoff speed	rpm	7240 ± 80	6900
Max. constant speed	rpm	6900	6500
Max. torque / at engine speed	Nm / rpm	a) 245/4750 b) 210/4900	340/4500
Compression (approx. same value for all cylinders)	bar	at least 10 ... 11	at least 10 ... 11

ENGINE 11 – 800a	S 14 M 3	S 38 B 35 M 5/E 28; M 635 CSi	S 38 B 36 M 5/E 34

11 00 ... Engine in General		- Catalytic Converter Version-		
Bore	mm (in.)	93.4 (3.677)		
Stroke	mm (in.)	84 (3.307)	84 (3.307)	86 (3.386)
Effective displacement	cc	2302	3453	3535
Compression ratio		10.5 : 1	9.8 : 1	10.0 : 1
Power (to DIN 70 020)	KW	143	191	232
at engine speed	rpm	6750	6500	6900
Top engine speed	rpm	7250	6900	7200
Max. constant engine speed	rpm	6900	6500	6900
Max. engine torque	Nm (ft. lbs.)	230 (166)	330 (239)	360 (260)
at engine speed	rpm	4750	4500	4750
Compression pressure (approx. same value for all cylinders)	bar (psi)	at least 10 to 11 (142 to 156)		

11 00 ... Engine Oil Consumption

DETERMINING OIL CONSUMPTION

Oil consumption can be measured for the first time after the car has been driven approximately 7,500 km (4,500 miles). Oil consumption will be stable only after this distance. Measuring oil consumption requires that the engine does not leak.

Permissible oil consumption could be up to 0.15 liter/100 kilometers.

Precise consumption can be determined by weighing. Drain engine oil having operating temperature. All 5 minutes drip time. Weigh and pour in specified amount of new engine oil. Drive car 1,000 km (600 miles). Drain engine oil at operating temperature and weigh. Allow 5 minutes drip time. Engine oil density at room temperature is approx. 0.9 km/cubic dm.

Example: poured in oil – drained oil = consumed oil.

4,500 g – 3,600 g = 900 g

900 : density 0.9 = 1,000 cu. cm = 1 liter per 1,000 kilometers (600 miles).

Possible Causes for Excessive Oil Consumption:

1. Running-in process not completed.
2. Seals for valve stems damaged.
3. Pistons seized.
4. Piston rings installed wrong, broken or worn.
5. Excessive running clearance between valve stem and valve guide.

ENGINE 11 – 801	S 14	M 88 - 3	S 38
11 11 ... Crankcase			
Cylinder bore diameter Standard size	mm (in.)	$93.40^{+0.01}$ ($3.6771^{+0.0004}$)	
Intermediate size	mm (in.)	$93.45^{+0.01}$ ($3.6791^{+0.0004}$)	
Oversize 1	mm (in.)	$93.60^{+0.01}$ ($3.6850^{+0.0004}$)	
Oversize 2	mm (in.)	$93.80^{+0.01}$ ($3.6929^{+0.0004}$)	
Surface finish	Ra (µ)	0.2 to 0.4	
Max. cyl. bore concentricity	mm(in.)	± 0.005 (0.0002)	
Max. cyl. bore conicity	mm (in.)	0.01 (0.0004)	

ENGINE 11 - 802		S 14	M 88/3	S 38 B 36
11 12 ... Cylinder Head				
New cylinder head height	mm	96.00 ± 0.03	96.00 ± 0.03	96.00 ± 0.07
Combustion chamber volume with valves and spark plugs	cm^3	43 ± 0.5		
11 12 ... Valve Guides				
Valve guide dia. - bore dia.				
Standard size	mm	12.00 x6 - 12.00 H7	12.00 x6 - 12.00 H7	12.00 x6 - 12.00 H7
Oversize 1	mm	12.20 x6 - 12.20 H7	12.20 x6 - 12.20 H7	12.20 x6 - 12.20 H7
Oversize 2	mm	12.40 x6 - 12.40 H7	12.40 x6 - 12.40 H7	12.40 x6 - 12.40 H7
Total length	mm	43.5 ± 0.2	45	45
Valve guide inside dia. (installed)				
Standard size	mm	7.0 H7	7.0 H7	7.0 H7
Oversize 1	mm	7.1 H7	7.1 H7	7.1 H7
Oversize 2	mm	7.2 H7	7.2 H7	7.2 H7
Installing temperature Cylinders head	°C	+ 150	+ 150	+ 150
Valve guide	°C	- 150	- 150	- 150
Valve guide protrusion	mm	15	15	15

ENGINE 11 – 803	S 14	M 88 · 3	S 38

11 12 ... Valve Seat Inserts

Valve seat insert dia. - bore dia. (distance "D")			
Intake			
Standard size	mm (in.)	40.15 g6 (1.581) – 40.00 H7 (1.575)	
Oversize 0.2 mm (0.008")	mm (in.)	40.30 g6 (1.587) – 40.15 H7 (1.581)	
Oversize 0.4 mm (0.016")	mm (in.)	40.45 g6 (1.592) – 40.30 H7 (1.587)	
Exhaust			
Standard size	mm (in.)	36.15 g6 (1.423) – 36.00 H7 (1.417)	
Oversize 0.2 mm (0.008")	mm (in.)	36.45 g6 (1.435) – 36.30 H7 (1.429)	
Oversize 0.4 mm (0.016")	mm (in.)	36.75 g6 (1.447) – 36.60 H7 (1.441)	
Valve seat insert height – bore depth (distance "H")			
Standard size	mm (in.)	$7.00 _{-0.02}$ ($0.2756 _{-0.0008}$) – 7.20 ± 0.01 (0.2835 ± 0.0004)	
Oversize 0.2 mm (0.008")	mm (in.)	$7.15 _{-0.02}$ ($0.2815 _{-0.0008}$) – 7.35 ± 0.01 (0.2837 ± 0.0004)	
Oversize 0.4 mm (0.016")	mm (in.)	$7.30 _{-0.02}$ ($0.2874 _{-0.0008}$) – 7.50 ± 0.01 (0.2953 ± 0.0004)	
Installing temperature			
Valve seat insert	°C (°F)	– 150 (– 240)	
Cylinder head	°C (°F)	+ 150 (+ 300)	

ENGINE 11 – 804	S 14	M 88 · 3	S 38

11 12 ... Valve Seats

Valve seat angle	o	45
Correction angles	o	35 / 60
Valve seat width (distance "B") Intake	mm (in.)	$1.2^{+0.1}$ ($0.047^{+0.004}$)
Exhaust	mm (in.)	$1.4^{+0.1}$ ($0.055^{+0.004}$)
Valve seat dia. (distance "V") Intake	mm (in.)	$36.6^{+0.1}$ ($1.441^{+0.004}$)
Exhaust	mm (in.)	$31.4^{+0.1}$ ($1.236^{+0.004}$)

		S 14	M 88 · 3	S 38
11 12 ... Timing Case				
Camshaft bearings				
Bore diameter	mm (in.)	$30\ ^{+0.020}_{+0.007}$ ($1.1811\ ^{+0.0008}_{+0.0003}$)		
Bucket tappets				
Bore diameter	mm (in.)	$37.5\ ^{+0.016}$ ($1.4764\ ^{+0.0006}$)	$35.0\ ^{+0.016}$ ($1.3779\ ^{+0.0006}$)	$37.5\ ^{+0.016}$ ($1.4764\ ^{+0.0006}$)
Tappet clearance	mm (in.)	0.025 to 0.066 (0.0010 to 0.0026)		

	S 14	M 88-3	S 38
11 21 ... Crankshaft and Bearings		– Double Classification –	
Ground sizes of main bearing journals			
Standard size red mm (in.)	55.00 $^{-0.010}_{-0.020}$ (2.1653	60.00 $^{-0.010}_{-0.020}$ (2.3622 $^{-0.0004}_{-0.0008}$)	
blue mm (in.)	55.00 $^{-0.020}_{-0.029}$ (2.1653	60.00 $^{-0.020}_{-0.029}$ (2.3622 $^{-0.0008}_{-0.0011}$)	
Undersize 1 0.25 mm (0.010") red mm (in.)	54.75 $^{-0.010}_{-0.020}$ (2.1555	59.75 $^{-0.010}_{-0.020}$ (2.3523 $^{-0.0004}_{-0.0008}$)	
blue mm (in.)	54.75 $^{-0.020}_{-0.029}$ (2.1555	59.75 $^{-0.020}_{-0.029}$ (2.3523 $^{-0.0008}_{-0.0011}$)	
Undersize 2 0.50 mm (0.020") red mm (in.)	54.50 $^{-0.010}_{-0.020}$ (2.1457	59.50 $^{-0.010}_{-0.020}$ (2.3425 $^{-0.0004}_{-0.0008}$)	
blue mm (in.)	54.50 $^{-0.020}_{-0.029}$ (2.1457	59.50 $^{-0.020}_{-0.029}$ (2.3425 $^{-0.0008}_{-0.0011}$)	
Undersize 3 0.75 mm (0.030") red mm (in.)	54.25 $^{-0.010}_{-0.020}$ (2.1358	59.25 $^{-0.010}_{-0.020}$ (2.3317 $^{-0.0004}_{-0.0008}$)	
blue mm (in.)	54.25 $^{-0.020}_{-0.029}$ (2.1358	59.25 $^{-0.020}_{-0.029}$ (2.3327 $^{-0.0008}_{-0.0011}$)	
Radial crankshaft bearing play mm (in.)		0.03 to 0.07 (0.0012 to 0.0027)	

			S 14	M 88-3 / S 38
11 21 ... Crankshaft and Bearings				– Triple Classification –
Ground sizes of main bearing journals				
Standard size	yellow	mm (in.)	54.984 to 54.990 (2.1647 to 2.1649)	59.984 to 59.990 (2.3616 to 2.3618)
	green	mm (in.)	54.977 to 54.983 (2.1644 to 2.1647)	59.977 to 59.983 (2.3613 to 2.3615)
	white	mm (in.)	54.971 to 54.976 (2.1642 to 2.1644)	59.971 to 59.976 (2.3610 to 2.3612)
Undersize 1 0.25 mm (0.010")	yellow	mm (in.)	54.734 to 54.740 (2.1549 to 2.1551)	59.734 to 59.740 (2.3517 to 2.3520)
	green	mm (in.)	54.727 to 54.733 (2.1546 to 2.1548)	59.727 to 59.733 (2.3514 to 2.3517)
	white	mm (in.)	54.721 to 54.726 (2.1544 to 2.1546)	59.721 to 59.726 (2.3512 to 2.3514)
Undersize 2 0.50 mm (0.020")	yellow	mm (in.)	54.484 to 54.490 (2.1450 to 2.1453)	59.484 to 59.490 (2.3419 to 2.3421)
	green	mm (in.)	54.477 to 54.483 (2.1447 to 2.1450)	59.477 to 59.483 (2.3416 to 2.3418)
	white	mm (in.)	54.471 to 54.476 (2.1445 to 2.1447)	59.471 to 59.476 (2.3414 to 2.3416)
Undersize 3 0.75 mm (0.030")	yellow	mm (in.)	54.234 to 54.240 (2.1352 to 2.1354)	59.234 to 59.240 (2.3320 to 2.3323)
	green	mm (in.)	54.227 to 54.233 (2.1349 to 2.1351)	59.227 to 59.233 (2.3318 to 2.3320)
	white	mm (in.)	54.221 to 54.226 (2.1347 to 2.1349)	59.221 to 59.226 (2.3315 to 2.3317)
Radial crankshaft bearing play		mm (in.)		0.020 to 0.046 (0.0008 to 0.0018)

ENGINE 11 – 808	S 14	M 88-3	S 38

11 21 ... Crankshaft and Bearings

Ground sizes of crankshaft thrust bearing		
Standard size	mm (in.)	$30.0\ ^{+0.064}_{+0.025}$ ($1.1811\ ^{+0.0025}_{+0.0010}$)
Oversize 1	mm (in.)	$30.2\ ^{+0.064}_{+0.025}$ ($1.1890\ ^{+0.0025}_{+0.0010}$)
Oversize 2	mm (in.)	$30.4\ ^{+0.064}_{+0.025}$ ($1.1968\ ^{+0.0025}_{+0.0010}$)
Oversize 3	mm (in.)	$30.6\ ^{+0.064}_{+0.025}$ ($1.2047\ ^{+0.0025}_{+0.0010}$)
Axial crankshaft play	mm (in.)	0.085 to 0.174 (0.0033 to 0.0068)

ENGINE 11 – 809	S 14	M 88-3	S 38
11 21 ... Crankshaft and Bearings			
Ground sizes of connecting rod bearing journals Standard size mm (in.)		47.975 to 47.991 (1.8888 to 1.8894)	
Undersize 1 / 0.25 mm (0.010") mm (in.)		47.725 to 47.741 (1.8789 to 1.8796)	
Undersize 2 / 0.50 mm (0.020") mm (in.)		47.475 to 47.491 (1.8691 to 1.8697)	
Undersize 3 / 0.75 mm (0.030") mm (in.)		47.225 to 47.241 (1.8592 to 1.8599)	
Radial conrod bearing play mm (in.)		0.03 to 0.07 (0.0012 to 0.0027)	
		– Double Classification –	
Ground sizes of connecting rod bearing journals Standard size mm (in.)		47.975 to 47.991 (1.8888 to 1.8894)	
Undersize 1 / 0.25 mm (0.010") mm (in.)		47.725 to 47.741 (1.8789 to 1.8796)	
Undersize 2 / 0.50 mm (0.020") mm (in.)		47.475 to 47.491 (1.8691 to 1.8697)	
Undersize 3 / 0.75 mm (0.030") mm (in.)		47.225 to 47.241 (1.8592 to 1.8599)	
Radial conrod bearing play mm (in.)		0.020 to 0.055 (0.0008 to 0.0022)	

ENGINE 11 – 810	S 14 a) M 3 b) 320 is	M 88 / 3	a) S 38 B 35 b) S 38 B 36

11 21 ... Crankshaft and Bearings

Max. imbalance of crankshaft (dynamic without flywheel)	gcm	10	25	
Measuring planes		on main bearings 1 and 5 - center of bearing journal	on main bearings 1 and 7 - center of bearing journal	
Take-up		on main bearings 1 and 5	on main bearings 1 and 7	
Balancing speed	rpm	500		
Max. runout on center main bearing journal (crankshaft running on outer bearing journals)	mm (in.)	0.1 (0.004)		
Crankshaft throw	mm (in.)	a) $84.0^{+0.1}$ ($3.307^{+0.004}$) b) $72.6^{+0.1}$ ($2.858^{+0.004}$)	84 ± 0.1 (3.307 ± 0.004)	a) 84 ± 0.1 (3.307 ± 0.004) b) 86 ± 0.1 (3.386 ± 0.004)
Max. surface finish of bearing journals	Rt (μ)	2		

ENGINE 11 – 811	S 14	M 88-3	S 38
11 22 ... Flywheel			
Max. axial runout measured on outside diameter mm (in.)	0.1 (0.004)		
Min. flywheel thickness (distance "A") mm (in.)	$29.1_{-0.1}$ ($1.145_{-0.004}$)	$26.6_{-0.1}$ ($1.047_{-0.004}$)	
11 23 ... Vibration Damper			
Max. radial runout mm (in.)	0.3 (0.012)	0.2 (0.008)	
Max. axial runout mm (in.)	0.3 (0.012)	0.4 (0.016)	
Diameter mm (in.)	122 (4.803)	245 (9.646)	
Color	–	white	

ENGINE 11 – 812	S 14	M 88-3	S 38

11 24 ... Connecting Rods and Bearings			
Big conrod end bore dia.	mm (in.)	52.000 to 52.010 (2.0472 to 2.0476)	
		– Double Classification –	
Big conrod end bore diameter Red	mm (in.)	52.000 to 52.008 (2.0472 to 2.0475)	
Blue	mm (in.)	52.009 to 52.016 (2.0476 to 2.0479)	
Conrod bush – outside dia.	mm (in.)	24.000 to 24.021 (0.9449 to 0.9457)	
inside dia.	mm (in.)	22.020 to 22.024 (0.8669 to 0.8671)	
Max. deviation in parallel of conrod bores with bearing shells at distance of 150 mm (5.905")	mm (in.)	0.04 (0.0016)	
Max. displacement to one side	o	0° 30'	
Max. deviation in weight of all connecting rods in one engine (without bearing shells)	g	± 4	
Big end	g	± 2	
Small end	g	± 2	

11 25 ... Pistons		Pistons and pins are matched – only replace them together in pairs.
Weight class (die-stamped or engraved)		+ or – (weight difference of individual pistons max. 10 grams)
Identification on piston		piston diameter, installed direction arrow, compression ratio
Piston dia. (checkpoint "A") Standard size	mm (in.)	93.35 (3.675)
Intermediate size	mm (in.)	93.40 (3.677)
Oversize 1	mm (in.)	93.55 (3.683)
Oversize 2	mm (in.)	93.75 (3.691)
Piston running clearance	mm (in.)	0.03 to 0.06 (0.0012 to 0.0024)
Max. total wear clearance between piston and cylinder (used engine)	mm (in.)	0.15 (0.006)

ENGINE 11 - 814		S 14	M 88/3	S 38 B 34 S 38 B 36
11 25 ... Piston Rings				
Groove 1 **(plain compression ring)**				
Height	mm		$1.5\ ^{-0.010}_{-0.022}$	
End clearance	mm		0.30 ... 0.55	
Side clearance	mm		0.06 ... 0.09	
Groove 2 **(tapered face compression ring)**				
Height	mm		$1.5\ ^{-0.010}_{-0.025}$	
End clearance	mm		0.30 ... 0.55	
Side clearance	mm		0.06 ... 0.09	
Groove 3 **(bevelled oil scraper ring with spring)**				
Height	mm	$3.0\ ^{-0.010}_{-0.022}$		$*\ 2.5\ ^{-0.010}_{-0.022}$
End clearance	mm		0.25 ... 0.50	
Side clearance	mm		0.02 ... 0.05	

	S 14 a) M 3 a*) M 3/E 2	M 88 / 3	a) S 38 B 35 b) S 38 B 36

11 31 ... Camshaft

Drive		double roller chain	single roller chain	double roller chain
Camshaft bearing dia.	mm (in.)		30 - 0.020 (1.1811 - 0.0008) - 0.033 - 0.0013	
Camshaft bearing play Radial	mm (in.)		0.027 to 0.053 (0.0011 to 0.0021)	
Axial	mm (in.)		0.1 to 0.15 (0.004 to 0.006)	
Cam dimension "N" Intake	mm (in.)	a) 43.71 (1.721) a*) 44.10 (1.736)	41.84 (1.647)	a) 43.71 (1.721) b) 44.10 (1.736)
Exhaust	mm (in.)	a) 43.71 (1.721) a*) 43.71 (1.721)	41.84 (1.647)	a) 43.71 (1.721) b) 44.10 (1.736)

S 14	M 88-3	S 38

11 31 ... Chain Tensioner

Relaxed spring length	mm (in.)	159 ± 0.5 (6.260 ± 0.020)
Chain tensioner piston dia.		
Stage 1	mm (in.)	19.462 to 19.468 (0.7662 to 0.7664)
Stage 2	mm (in.)	19.468 to 19.474 (0.7664 to 0.7667)
Chain tensioner cylinder dia.		
Stage 1	mm (in.)	19.500 to 19.507 (0.7677 to 0.7680)
Stage 2	mm (in.)	19.507 to 19.513 (0.7680 to 0.7682)

ENGINE 11 – 817	S 14	M 88 / 3	a) S 38 B 35 b) S 38 B 36
11 34 ... Valves			
Intake and exhaust valve clearance At max. 35° C (95° F) coolant temperature mm (in.)	0.26 to 0.35 (0.010 to 0.014)	0.3 to 0.35 (0.012 to 0.014)	a) 0.30 to 0.35 (0.012 to 0.014) b) 0.28 to 0.33 (0.011 to 0.013)
At operating temperature (thermostat activated) mm (in.)	0.34 to 0.39 (0.013 to 0.015)	0.35 to 0.4 (0.014 to 0.016)	
Min. valve head edge thickness, machining limit (distance "A") Intake mm (in.) Exhaust mm (in.)		0.50 (0.020) 0.95 (0.037)	
Valve head dia. (distance "T") Intake mm (in.) Exhaust mm (in.)		37 - 0.1 (1.457 - 0.004) 32 - 0.1 (1.260 - 0.004)	
Valve stem dia. (distance "S") Standard size mm (in.) Oversize 1 mm (in.) Oversize 2 mm (in.)		7.0 (0.275) 7.1 (0.279) 7.2 (0.283)	
Max. wear clearance between valve stem and valve guide (tilt clearance "K") Intake mm (in.) Exhaust mm (in.)		0.65 (0.025) 0.80 (0.031)	

ENGINE 11 – 818	S 14	M 88 / 3	a) S 38 B 35 b) S 38 B 36

11 40 ... Oil Supply

Lubricating system		forced oil circulation with pressure control valve in filtered oil circuit		
Oil grade		see Service Information of Gr. 00		
Oil change volume With oil filter	ltr. (US/Imp. pts.)	4.4 (9.3 / 7.7)	5.75 (12.1 / 10.1)	
Without oil filter	ltr. (US/Imp. pts.)	4.1 (8.7 / 7.2)	5.0 (10.6 / 8.8)	
Additionally for repairs after draining oil cooler	ltr. (US/Imp. pts.)	0.55 (1.2 / 1.0)	0.75 (1.6 / 1.3)	

11 41 ... Oil Pump

Design		Eaton rotor-type pump		
Oil pressure at idle speed	bar (psi)	0.5 to 2.0 (7 to 28)		
Oil pressure at top speed	bar (psi)	4.0 to 6.0 (57 to 85)		a) 4.0 to 6.0 (57 to 85) b) 3.0 to 4.0 (43 to 57)

ENGINE 11 – 819	S 14	M 88 / 3	a) S 38 B 35 b) S 38 B 36

11 52 ... Fan Clutch

Design		temperature and speed controlled visco fan clutch	
Switching-ontemperature	°C (°F)	90 ± 4 (194 ± 7)	82 ± 4 (180 ± 7)
Switching-offtemperature	°C (°F)	≥ 45 (113)	≥ 60 (140)
Fan blade dia.	mm (in.)	400 (15.748)	420 (16.535)
Number of fan blades		8	9
Fan speed at engine speed of 3,500 rpm (clutch switched on)	rpm	2000 ± 100	2400 ± 100

11 53 ... Thermostat (Coolant)

Opening temperature (stamped in thermostat)	°C (°F)	approx. 80 (175)	a) 80 (176) b) 79 (174)

		3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
12 11 ... Distributor							
Code		*316:* 0 237 005 010 *316 Low Compression:* GR, YU 0 237 005 009					
High tension distributor for DME							
Coil resistance	KΩ	1.1 ± 10 %	1.1 ± 10 %	1.1 ± 10 %	1.1 ± 10 %	1.1 ± 10 %	1.1 ± 10 %
Clearance between stator and rotor teeth	mm	0.3 ... 0.7	0.3 ... 0.7	0.3 ... 0.7	0.3 ... 0.7	0.3 ... 0.7	0.3 ... 0.7

		3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
12 12 ... Distributor							
Resistors in Secondary Circuit							
Angled plugs/shielded plugs	KΩ	1 ± 20 %					
Spark plug connectors	KΩ	5 ± 10 %					
Ignition lead at 20° C	mΩ/m	20					
Distributor rotor	KΩ	1 ± 30 %					
Position sender							
Coil resistance	Ω	80 ± 10 %					

	S 14	S 38	S 50	S 70

12 12 ... Spark Plugs

Designation	Bosch X5 DTC *US:* Bosch X5 DC	Bosch Y6 DC	Bosch Y5 DDC	Bosch F8 LCR2

12 - 4 Engine electrical system	M 10	M 20	M 30	
12 12 . . . Spark plugs				
Designation	Bosch W8 DC Further information: See Service information Group 12 Engine electrical systems Spark plugs All models	*B 20:* Bosch W8 LCR Bosch W8 LPR *B 25:* up to 12/86 Bosch W7 DCR from 12/86 Bosch W8 LCR Bosch W8 LPR *B 27:* up to 12/86 Bosch W9 LC from 12/86 Bosch W8 LCR Bosch W8 LPR *B 27 US:* Bosch WR9 LS Further information: See Service Information Group 12	Bosch W8 DC with DME: Bosch W8 LCR Bosch W8 LPR	

12 - 5 Engine electrical system	M 40	M 42	M 43	M 50
12 12 . . . Spark plugs				
Designation	*E 30:* Bosch F8 LCR *E 36:* Bosch F04 DAR NGK BCPR 6ER	*E 30:* NGK BCPR 7ER *E 36:* Bosch F7 LDCR *E 30 US:* NGK BCPR 6ER *E 36 US:* Bosch F7 LDCR	Bosch F7 LDCR	up to 9/92 Bosch F03 DAR NGK BCPR 7ER from 9/92 NGK BKR 6EK *US:* up to 9/91 NGK BCPR 7ER from 9/91 Bosch F04 DAR

12 - 7 Engine electrical system		3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
12 12 . . . Ignition components, spark plugs							
Designation							
Further information: Consult most recent Service information:							
Electrode gap	mm	0.7 $^{+0.1}$ *M models:* 0.6 $^{+0.1}$ with triangle ground electrode: 0.9 $^{-0.1}$	0.7 $^{+0.1}$ with triangle ground electrode: 0.9 $^{-0.1}$	0.7 $^{+0.1}$ *M models:* 0.6 $^{+0.1}$ with triangle ground electrode: 0.9 $^{-0.1}$	0.7 $^{+0.1}$ *M models:* 0.6 $^{+0.1}$	0.7 $^{+0.1}$	0.7 $^{+0.1}$
Firing order							
4 cylinder	1, 3, 4, 2						
6 cylinder	1, 5, 3, 6, 2, 4						
8 cylinder	1, 5, 4, 8, 6, 3, 7, 2						
12 cylinder	1, 7, 5, 11, 3, 9 6, 12, 2, 8, 4, 10						

12 - 8 Engine electrical system		3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
12 12 . . . Ignition components, spark plugs							
Cylinder recognition sensor							
Coil resistance at 20° C	Pin 1 and 2 Ω	< 1	< 1	< 1	< 1	< 1	< 1
	Pin 2 and Pin 3 MΩ	> 10	> 10	> 10	> 10	> 10	> 10
12 13 . . . Ignition coil							
Primary winding resistance	Ω	0.82	0.82	a) 0.5 b) 0.37	a) 0.5 b) 0.37	a) 0.5 b) 0.37	a) 0.5 b) 0.37
Secondary winding resistance	KΩ	8.25	8.25	a) 6.0 b) 9.0	a) 6.0 b) 9.0	a) 6.0 b) 9.0	a) 6.0 b) 9.0
Primary inductance	mH	5.6	5.6	a) 3.7 b) 5.8	a) 3.7 b) 5.8	a) 3.7 b) 5.8	
Secondary inductance	H	31	31	a) 31 b) 44	a) 31 b) 44	a) 31 b) 44	
Ignition coil for stationary voltage distribution		*M 42*	*M 50, M 42, M 43*	*M 50, M 60*		*M 60*	
Primary winding resistance	Ω	ca. 0.8	ca. 0.8	ca. 0.8		ca. 0.8	
Secondary winding resistance		n.a.	n.a.	n.a.		n.a.	

	3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
12 14 . . . Pulse sensor (DME)						
Coil resistance at 20° C						
Ω	540 ± 10 %	540 ± 10 %	540 ± 10 %	540 ± 10 %	540 ± 10 %	540 ± 10 %
	M models:		*M models:*	*M models:*		
Ω	960 ± 10 %		960 ± 10 %	960 ± 10 %		
	M 42 (stationary voltage distribution):	*M 50, M42, M43* (stationary voltage distribution):	*M 50 , M 60* (stationary voltage distribution):		*M 60* (stationary voltage distribution):	
Ω	1280 ± 10 %	1280 ± 10 %	1280 ± 10 %		1280 ± 10 %	
Gap:						
Inductive pulse sensor/toothed wheel						
mm	1.0 ± 0.3	1.0 ± 0.3	1.0 ± 0.3	1.0 ± 0.3	1.0 ± 0.3	1.0 ± 0.3
	M 3 (Ev. II):					
mm	1.6 + 0.2					

		3 Series E 30 3 Series E 36	5 Series E 34
12 21 ... Heating Time Control Unit			
Max. heating time with coolant temperature Below 60° C	sec.	*M 21:* 5 / *M 51:* 5	*M 21:* 5 / *M 51:* 5
Above 60° C	sec.	0	0
Saftey switch-off after	sec.	8^{+5}	8^{+5}
Glow plug fuse	A	80	80
12 23 ... Glow Plugs			
Testing voltage	V	12 ± 0.5	12 ± 0.5
Max. current consumption of one glow plug after approx. 5 sec. operation	A	13 ... 15	13 ... 15
after approx. 20 sec. operation	A	12	12
Temperature after about 5 sec. operation	° C	approx. 800	approx. 800
Glow plug resistance at 20° C	Ω	0.4 ... 0.6	0.4 ... 0.6
Current consumption of all glow plugs at 20° C measured with current clips of BMW Service Tester	A	60 ... 80	60 ... 80

12 31 ... Alternator

Rated voltage	V	14
Rated current / power	A / W	65 / 910 80 / 1120 90 / 1260 105 / 1470 115 / 1610 140 / 1960
Shielded capacitor		
Capacitance	µ F	2.2 ± 20 %

12 - 12 Engine electrical system		3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
12 32 . . . Voltage regulator							
Regulated voltage at 1500 rpm Engine speed/ no elecetrical devices on	V	13.5 ... 14.2 (at 30° C to 60° C at regulator)	13.5 ... 14.2 (at 30° C to 60° C at regulator)	13.5 ... 14.2 (at 30° C to 60° C at regulator)	13.5 ... 14.2 (at 30° C to 60° C at regulator)	13.5 ... 14.2 (at 30° C to 60° C at regulator)	13.5 ... 14.2 (at 30° C to 60° C at regulator)
Constant voltage regulator (vehicles with battery in trunk or below rear seat only)						14.3 ± 0.1V	14.3 ± 0.1V
12 41 . . . Starter							
Rated output	KW	*M 42: 1.4* *M 40: 1.4* *M 10: 1.1* *M 20: 1.4* *M 21: 2.2* *S 14: 1.4*	*M 40: 1.4* *M 42: 1.4* *M 43: 1.4* *M 50: 1.7* *S 50: 1.4*	*M 20: 1.4* *M 30: 1.7* *M 21: 2.2* *M 50: 1.7* *S 38 : 1.7* *M 60: 1.7*	*M 30: 1.5* *M 30: 1.7*	*M 30: 1.5* *M 30: 1.7* *M 70: 2.2* *M 60: 1.7*	*M 70: 2.2* *M 60: 1.7*
Armature endfloat	mm	0.1 . . . 0.2	0.1 . . . 0.2	0.1 . . . 0.2	0.1 . . . 0.2	0.1 . . . 0.2	0.1 . . . 0.2
Carbon brush length	min. mm	13	13	13	13	13	13
Test voltage	V	12 ± 0.3	12 ± 0.3	12 ± 0.3	12 ± 0.3	12 ± 0.3	12 ± 0.3

		3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
12 41 ... Solenoid Switch							
Current consumption at term. 50 (with rated voltage)							
With rated power of 1.1 ... 1.7 KW							
Pull-in winding	A	40					
Hold-in winding	A	7.5					
With rated power of 2.2 KW							
Pull-in winding	A	60					
Hold-in winding	A	10					

	3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
12 61 ... Oil Pressure Switch						
Switch-on pressure bar	**0.2 ... 0.5**					
Oil Level Switch						
Note: **Max. 200 mA testing load.**						
Measured against vehicle ground						
Level okay	**1 kΩ ± 1 %**					
Static at connection 1						
Level too low	**0 ... 0.2 Ω**					
Level okay	**0 ... 0.2 Ω**					
Dynamic at connection 2						
Level too low	**∞ Ω**					

		3 Series E 30	5 Series E 34
12 62 ... Coolant Temperature Sender			
Coolant temperature resistance between conn. G 1 and ground		*M 21*	*M 21*
at 60° C	- G 1 Ω	134 ± 13.5	134 ± 13.5
at 90° C	- G 2 Ω	51.2 ± 4.3	51.2 ± 4.3
12 62 ... Heating Time Control			
Heating time control resistance between conn. G 2 and ground		*M 21*	*M 21*
at 20° C	Ω	1134 ± 125	1134 ± 125
at 60° C	Ω	272 ± 27	272 ± 27
at 90° C	Ω	114 ± 11	114 ± 11

12 63 ... Temperature Sender for Cold Start Aid

		M 21	*M 21*
Operating voltage	V	9 ... 15	9 ... 15
Switch-off temperature	° C	17 ± 2	17 ± 2
Switch-on temperature	° C	11 ... 14	11 ... 14
Fuel Preheating Temperature Switch 5.5° C		*M 21*	*M 21*
Switch-on temperature (with dropping temperature)	° C	5.5 ± 2.5	5.5 ± 2.5
Switch-off temperature (with rising temperature)	° C	- 0.5 ± 2.5	- 0.5 ± 2.5

		3 Series E 30	5 Series E 34
12 64 ... Fuel Filter Heater			
Current consumption of heating element 5 seconds after switching on	A	*M 21* 9 ± 2	*M 21* 9 ± 2
Testing voltage	V	12 ± 0.5	12 ± 0.5
Current consumption with max. heating output	A	*M 51* 12.5 ± 1	*M 51* 12.5 ± 1
Testing voltage	V	12 ± 0.5	12 ± 0.5

13 00 ... General Information

Engine Type	Model	Engine Code on Data Plate	Idling Speed in RPM	CO in % by Volume*	1)	2)	3) Month/ Year	4) RPM
M10B18	316i / A	18 4E 9	850 / 900 ± 50	0.2 ... 1.2	+/o	-/+	9/87	6200
M40B16	316i / A	16 4E 1	800 ± 40	0.7 ± 0.5	+/o	-/+	9/88	6200
M40B18	318i / A	18 4E 1	800 ± 40	0.7 ± 0.5	+/o	-/+	9/87	6200
M42B18	318is	18 4S 1	850 ± 40	0.7 ± 0.5	+/o	-/+	9/89	6500
M20B20	320i / A	20 6E E	760 ± 40	0.7 ± 0.5	+/-	-/+	9/87	6400
M50B20	320i / A	20 6S 1	700 ± 40	0.7 ± 0.5**	+/o	-/+	1/91	6500
M20B27	325e / A	27 6K B	720 ± 40	0.2 ... 1.2	+/-	-	9/86	5250
M20B25	325iA / X	25 6E 2	760 ± 40	0.7 ± 0.5	-	+	9/86	6400
M20B25	325i / A	25 6K 1	760 ± 40	0.7 ± 0.5	+/o	-/+	12/86	6400
M20B25	325iX / A	25 6K 1	760 ± 40	0.7 ± 0.5	+/o	-/+	12/86	6400
M50B25	325i / A	25 6S 1	700 ± 40	0.7 ± 0.5**	+/o	-/+	1/91	6500
S14B23	M3	23 4E A	880 ± 50	1.0 ± 0.5	-	+	9/86	7240
S14B23	M3	23 4E A	880 ± 50	0.8 ± 0.4	+	+	9/86	7240
S14B20	320is	20 4E A	880 ± 50	1.0 ± 0.5	-	+	9/87	7240
S14B23	M3 / E2	23 4S 1	880 ± 50	1.0 ± 0.5	-	+	6/88	7240
S14B23	M3	23 4S 2	880 ± 50	0.8 ± 0.4	+/o	+	5/89	7280
S14B23	M3	23 4S 2	880 ± 50	0.8 ± 0.4	+/o	+	9/89	7280
S50B30	M3	50 6S 1	800 ± 40	0.8 ± 0.4	+/o	+	11/92	7280

1) + = With catalytic converter
   − = Without catalytic converter
   o = Prepared for catalytic converter

2) CO can be adjusted:
   + = Yes
   − = No

3) Manufactured since

4) Shutoff speed (up to 6400 ± 40 rpm from 6400 ± 80 rpm)

* Measured in front of catalyst in cars with catalytic converter

** 0.5 - 1.5 in cars prepared for catalytic converter

13 00 ... General Information

Engine Type	Model	Engine Code on Data Plate	Idling Speed in RPM	CO in % by Volume*	1)	2)	3) Month/ Year	4) RPM
M40B18	518i / A	18 4E 1	800 ± 40	0.7 ± 0.5	+/o	-/+	9/89	6200
M20B20	520i / A	20 6K A	760 ± 40	0.7 ± 0.5	+/o	-/+	4/88	6400
M50B20	520i / A	20 6S 1	800 ± 40	0.7 ± 0.5**	+/o	-/+	4/90	6500
M50B20	520i / A	20 6S 1	700 ± 40	0.7 ± 0.5**	+/o	-/+	9/90	6500
M20B25	525i / A	25 6K 1	760 ± 40	0.7 ± 0.5	+/o	-/+	4/88	6400
M50B25	525i / A	25 6S 1	800 ± 40	0.7 ± 0.5**	+/o	-/+	4/90	6500
M50B25	525i / A	25 6S 1	700 ± 40	0.7 ± 0.5**	+/o	-/+	9/90	6500
M30B30	530i / A	30 6K A	800 ± 50	0.7 ± 0.5	+/o	-	4/88	6400
M60B30	530i / A	30 8S 1	600 ± 50	0.7 ± 0.5	+/o	-/+	5/92	6400
M30B35	535i / A	34 6K B	800 ± 50	0.7 ± 0.5	+/o	-	4/88	6200
M60B40	540i / A	40 8S 1	600 ± 50	0.7 ± 0.5	+/o	-/+	5/92	6400
S38B36	M5	36 6S 1	890 ± 50	0.8 ± 0.4	+	+	9/88	7250
S38B36	M5	36 6S 2	970 ± 40	0.8 ± 0.4	+	+	7/89	7250
S38B38	M5	38 6S 1	920 ± 50	0.8 ± 0.4	+	+	9/92	7250
M30B35	635CSi /A	34 6E C	800 ± 50	1.0 ± 0.5	-	+	9/87	6200
M30B35	635CSi /A	34 6K B	800 ± 50	0.7 ± 0.5	+/o	-	9/87	6200
S38B35	M635CSI	35 6E Y	850 ± 50	1.0 ... 1.5	-	+	6/87	6800
S38B35	M635CSi	35 6E E	850 ± 50	0.8 ± 0.4	+	+	6/87	6800

1) + = With catalytic converter
   – = Without catalytic converter
   o = Prepared for catalytic converter

2) CO can be adjusted:
   + = Yes
   – = No

3) Manufactured since

4) Shutoff speed (up to 6400 ± 40 rpm from 6400 ± 80 rpm)

* Measured in front of catalyst in cars with catalytic converter

** 0.5 - 1.5 in cars prepared for catalytic converter

13 41 ... Idling Speed Control

Engine Type	Part Number	Code	Since (Month/Year)
M40B16	1 709 932	0 280 140 519	
M40B16	1 727 797	0 280 140 529	9/90
M40B18	1 709 932	0 280 140 519	
M40B18	1 727 797	0 280 140 529	9/90
M42B18	1 709 932	0 280 140 519	
M42B18	1 727 797	0 280 140 529	9/90
M20B20	1 286 065	0 280 140 509	9/84
M20B20	1 726 209	0 280 140 524	6/88
M20B25	1 286 065	0 280 140 509	
M20B25	1 726 209	0 280 140 524	6/88
M20B27	1 286 065	0 280 140 509	12/86
M20B27	1 726 209	0 280 140 524	6/88
M50B20	1 726 209	0 280 140 524	
M50B20	1 748 005*	0 280 140 533	6/92
M50B25	1 726 209	0 280 140 524	
M50B25	1 738 981		6/92
S14B23	1 286 065	0 280 140 509	
S50B30	1 733 090	0 280 140 532	10/92
M30B30	1 286 065	0 280 140 509	
M30B35	1 286 065	0 280 140 509	
M60B30	1 733 090	0 280 140 532	4/92
M60B40	1 733 090	0 280 140 532	5/92
S38B35	1 286 065	0 280 140 509	
S38B36	1 286 065	0 280 140 509	
S38B38	1 733 090	0 280 140 532	11/91

* For MS40 DME

13 53 ... Pressure Regulator

Engine Type	Part Number	Code	Rated Pressure (bar)
M40B16	1 715 114	0 280 160 285	3.0 ± 0.06
M40B16	1 715 114	721 19 711	3.0 ± 0.06
M40B16	1 721 992/1 729 320	0 280 160 503	3.0 ± 0.06
M40B18	1 715 114	0 280 160 285	3.0 ± 0.06
M40B18	1 721 992/1 729 320	0 280 160 503	3.0 ± 0.06
M40B18	1 715 114	712 19 711	3.0 ± 0.06
M42B18	1 721 992	0 280 160 503	3.0 ± 0.06
M42B18	1 747 078	0 280 160 503	3.0 ± 0.06
M20B20	1 711 540	0 280 160 248	2.5 ± 0.05
M20B25	1 711 541	0 280 160 249	3.0 ± 0.06
M50B20	1 721 992	0 280 160 503	3.0 ± 0.06
M50B20	1 747 078	0 280 160 503	3.0 ± 0.06
M50B25	1 726 385	0 280 160 504	3.5 ± 0.06
M50B25	1 731 615	0 280 160 504	3.5 ± 0.06
S14B23	1 284 897	0 280 160 226	3.0 ± 0.06
S50B30	1 715 685	0 280 160 500	3.0 ± 0.06
M30B30	1 711 541	0 280 160 249	3.0 ± 0.06
M30B35	1 711 541	0 280 160 249	3.0 ± 0.06
M60B30	1 731 615	0 280 160 504	3.5 ± 0.06
M60B30	1 731 615	7.21 548.01	3.5 ± 0.06
M60B40	1 731 615	0 280 160 504	3.5 ± 0.06
M60B40	1 731 615	7.21 548.01	3.5 ± 0.06
S38B35	1 711 541	0 280 160 249	3.0 ± 0.06
S38B36	1 715 685	0 280 160 500	3.0 ± 0.06
S38B38	1 731 615	0 280 160 504	3.5 ± 0.06
M70B50	1 715 685	0 280 160 500	3.0 ± 0.06
M70B50	1 725 625	7.21 548.00	3.0 ± 0.06

13 61 ... Control Units

	Version Code	Country Version	HG = Man. Transm. AG = Autom. Transm. EH = Elec./Hydr. Transm.	BN = Reg. Grade Unleaded BS = Prem. Grade Unleaded S = Prem. Grade Leaded	Catalytic Converter
Model: 316i / A Engine Type: M40B16 Basic Control Unit Hardware No.: 1 721 427; 1 727 312; 1 734 179, 1 739 035, 1 739 653 (E30/5) Code: 0 261 200 174	C01E	ECE	HG	BN	with
	C21E	ECE	AG	BN	with
	F01E	ECE	HG	BN	prepared for
	F21E	ECE	AG	BN	prepared for
	E41E	Golf	HG	BN	without
	E61E	Golf	AG	BN	without
Model: 318i / A Engine Type: M40B18 Basic Control Unit Hardware No.: 1 717 605; 1 721 660; 1 721 743; 1 722 699; 1 727 009; 1 727 982; 1 727 679; 1 727 678; 1 727 734 (Japan) Code: 0 261 200 157; 0 261 200 387	C01E	ECE	HG	BN	with
	C21E	ECE/Japan	AG	BN	with
	F01E	ECE	HG	BN	prepared for
	F21E	ECE	AG	BN	prepared for
	E41E	Golf	HG	BN	without
	E61E	Golf	AG	BN	without

13 61 ... Control Units

	Version Code	Country Version	HG = Man. Transm. AG = Autom. Transm. EH = Elec./Hydr. Transm.	BN = Reg. Grade Unleaded BS = Prem. Grade Unleaded S = Prem. Grade Leaded	Catalytic Converter
Model: 316i / A	C01E	ECE	HG	BN	with
Engine Type: M40B16	C21E	ECE	EH	BN	with
Basic Control Unit Hardware No.:	F01E	ECE	HG	BN	prepared for
1 727 493; 1 734 709; 1 739 038;	F21E	ECE	EH	BN	prepared for
1 739 534	E41E	Golf	HG	BN	prepared for
Code: 0 261 200 522	E61E	Golf	EH	BN	prepared for
Model: 318i / A	C01E	ECE	HG	BN	with
Engine Type: M40B18	C21E	ECE	EH	BN	with
Basic Control Unit Hardware No.:	F01E	ECE	HG	BN	prepared for
1 727 491; 1 734 710; 1 739 039; 1 739 041;	F21E	ECE	EH	BN	prepared for
1 739 108 (ECE)					
Code: 0 261 200 520					
Model: 318is	801E	ECE	HG	BS	with
Engine Type: M42B18	B01E	ECE	HG	BS	prepared for
Basic Control Unit Hardware No.:	801E	A/S/CH/AUS	HG	BS	with
1 721 720; 1 727 900; 1 734 060;					
1 734 131; 1 734 659; 1 739 045 (US);					
1 739 678 (US)					
Code: 0 261 200 175; 0 261 200 950					
Model: 318is	801E	ECE	HG	BS	with
Engine Type: M42B18	B01E	ECE	HG	BS	prepared for
Basic Control Unit Hardware No.:					
1 734 501; 1 739 371; 1 739 423;					
1 739 679					
Code: 0 261 200 950					

13 61 ... Control Units

	Version Code	Country Version	HG = Man. Transm. AG = Autom. Transm. EH = Elec./Hydr. Transm.	BN = Reg. Grade Unleaded BS = Prem. Grade Unleaded S = Prem. Grade Leaded	Catalytic Converter
Model: 320i / A Engine Type: M20B20 Basic Control Unit Hardwar No.: 1 714 997; 1 722 200 Code: 0 261 200 152	C05E	ECE	HG	BN	with
	C25E	ECE	AG	BN	with
	C35E	ECE	EH	BN	with
	D01E	A	HG	BN	with
	D21E	A	AG	BN	with
	D31E	A	EH	BN	with
	C81E	S/CH/AUS	HG	BN	with
	CA1E	S/CH/AUS	AG	BN	with
	CB1E	S/CH/AUS	EH	BN	with
	CC5E	J	HG	BN	with
	CE5E	J	AG	BN	with
	CF5E	J	EH	BN	with
Model: 320i / A Engine Type: M20B20 Basic Control Unit Hardwar No.: 1 722 180; 1 722 420 Code: 0 261 200 163	A05E	ECE	HG	BS	prepared for
	A25E	ECE	AG	BS	prepared for
	A35E	ECE	EH	BS	prepared for

13 61 ... Control Units

	Version Code	Country Version	HG = Man. Transm. AG = Autom. Transm. EH = Elec./Hydr. Transm.	BN = Reg. Grade Unleaded BS = Prem. Grade Unleaded S = Prem. Grade Leaded	Catalytic Converter
Model: 320i / A Engine Type: M20B20 Basic Control Unit Hardware No.: 1 722 266; 1 726 388; 1 726 962; 1 726 101; 1 726 682; 1 730 574; 1 730 573 (Conv.): 1 735 333 (Conv.); 1 735 363 Code: 0 261 200 172; 0 261 200 381	C05E	ECE	HG	BN	with
	C25E	ECE	AG	BN	with
	C35E	ECE	EH	BN	with
	C81E	A	HG	BN	with
	CA1E	A	AG	BN	with
	CB1E	A	EH	BN	with
	CC5E	J	HG	BN	with
	CE5E	J	AG	BN	with
	CF5E	J	EH	BN	with
	A05E	ECE	HG	BS	prepared for
	A25E	ECE	AG	BS	prepared for
	A35E	ECE	EH	BS	prepared for
	A45E	Golf	HG	BS	without
	A65E	Golf	AG	BS	without
	A75E	Golf	EH	BS	without

13 61 ... Control Units

	Version Code	Country Version	HG = Man. Transm. AG = Autom. Transm. EH = Elec./Hydr. Transm.	BN = Reg. Grade Unleaded BS = Prem. Grade Unleaded S = Prem. Grade Leaded	Catalytic Converter
Model: 325I / A	C05E	ECE	HG	BN	with
Engine Type: M20B25	C25E	ECE	AG	BN	with
Basic Control Unit Hardware No.:	C35E	ECE	EH	BN	with
1 714 998; 1 722 210	C85E	US/A/CH/S/AUS	HG	BN	with
	CA5E	US/A/CH/S/AUS	AG	BN	with
Code:	CB5E	US/A/CH/S/AUS	EH	BN	with
0 260 200 153; 0 261 200 153;	CE5E	J	AG	BN	with
0 261 200 164	CF5E	J	EH	BN	with
Model: 325I / A	A05E	ECE	HG	BS	prepared for
Engine Type: M20B25	A25E	ECE	AG	BS	prepared for
Basic Control Unit Hardware No.:	A35E	ECE	EH	BS	prepared for
1 722 190; 1 722 430	A45E	Golf	HG	BS	without
	A65E	Golf	AG	BS	without
Code:	A75E	Golf	EH	BS	without
0 261 200 153; 0 261 200 164					

13 61 ... Control Units

	Version Code	Country Version	HG = Man. Transm. AG = Autom. Transm. EH = Elec./Hydr. Transm.	BN = Reg. Grade Unleaded BS = Prem. Grade Unleaded S = Prem. Grade Leaded	Catalytic Converter
Model: 325IX / A Engine Type: M20B25 Basic Control Unit Hardware No.: 1 714 998; 1 722 210 Code: 0 260 200 153	C03E	ECE	HG	BN	with
	C23E	ECE	AG	BN	with
	C33E	ECE	EH	BN	with
	C83E	US	HG	BN	with
	CA3E	US	AG	BN	with
	CB3E	US	EH	BN	with
Model: 325IX / A Engine Type: M20B25 Basic Control Unit Hardware No.: 1 722 190; 1 722 430 Code: 0 261 200 164	A03E	ECE	HG	BS	prepared for
	A23E	ECE	AG	BS	prepared for
	A33E	ECE	EH	BS	prepared for
	A43E	Golf	HG	BS	without
	A63E	Golf	AG	BS	without
	A73E	Golf	EH	BS	without

13 61 ... Control Units

	Version Code	Country Version	HG = Man. Transm. AG = Autom. Transm. EH = Elec./Hydr. Transm.	BN = Reg. Grade Unleaded BS = Prem. Grade Unleaded S = Prem. Grade Leaded	Catalytic Converter
Model: 325i / A Engine Type: M20B25 Basic Control Unit Hardware No.: 1 722 269 Code: 0 261 200 173	C01E	ECE	HG	BN	with
	C21E	ECE	AG	BN	with
	C31E	ECE	EH	BN	with
	C81E	US/A/CH/S/AUS	HG	BN	with
	CA1E	US/A/CH/S/AUS	AG	BN	with
	CB1E	US/A/CH/S/AUS	EH	BN	with
	CE1E	J	AG	BN	with
	CF1E	J	EH	BN	with
Model: Z1 Engine Type: M20B25 Basic Control Unit Hardware No.: 1 726 837; 1 730 524 Code: 0 261 200 385	C05E	ECE	HG	BN	with

13 61 ... Control Units

Model: 325i / A
Engine Type: M20B25
Basic Control Unit Hardware No.:
1 722 269; 1 726 366; 1 726 102;
1 726 600; 1 726 683; 1 726 686;
1 730 523 (only AG); 1 730 529;
1 730 576; 1 730 527 (US);
1 735 364 (not US); 1 735 365

Code:
0 261 200 173; 0 261 200 380;
0 261 200 382; 0 261 200 525 (US)

Version Code	Country Version	HG = Man. Transm. AG = Autom. Transm. EH = Elec./Hydr. Transm.	BN = Reg. Grade Unleaded BS = Prem. Grade Unleaded S = Prem. Grade Leaded	Catalytic Converter
C05E	ECE	HG	BN	with
C25E	ECE	AG	BN	with
C35E	ECE	EH	BN	with
C85E	US/A/CH/S/AUS	HG	BN	with
CA5E	US/A/CH/S/AUS	AG	BN	with
CB5E	US/A/CH/S/AUS	EH	BN	with
CE5E	J	AG	BN	with
CF5E	J	EH	BN	with
A05E	ECE	HG	BS	prepared for
A25E	ECE	AG	BS	prepared for
A35E	ECE	EH	BS	prepared for
A45E	Golf	HG	BS	without
A65E	Golf	AG	BS	without
A75E	Golf	EH	BS	without

13 61 ... Control Units

	Version Code	Country Version	HG = Man. Transm. AG = Autom. Transm. EH = Elec./Hydr. Transm.	BN = Reg. Grade Unleaded BS = Prem. Grade Unleaded S = Prem. Grade Leaded	Catalytic Converter
Model: 325IX / A Engine Type: M20B25 Basic Control Unit Hardware No.: 1 722 269; 1 726 366; 1 726 600; 1 726 683 (Conv.); 1 730 529; 1 730 575; 1 730 576; 1 726 367; 1 726 686; 1 730 438; 1 730 523; 1 730 528 (US); 1 735 365 (AG); 1 735 366 (US) Code: 0 261 200 173; 0 261 200 351; 0 261 200 380; 0 261 200 382	C03E	ECE	HG	BN	with
	C23E	ECE	AG	BN	with
	C33E	ECE	EH	BN	with
	C83E	US	HG	BN	with
	CA3E	US	AG	BN	with
	CB3E	US	EH	BN	with
	A03E	ECE	HG	BS	prepared for
	A23E	ECE	AG	BS	prepared for
	A33E	ECE	EH	BS	prepared for
	A43E	Golf	HG	BS	prepared for
	A63E	Golf	AG	BS	prepared for
	A47E	Golf	EH	BS	prepared for

13 61 ... Control Units

	Version Code	Country Version	HG = Man. Transm. AG.= Autom. Transm. EH = Elec./Hydr. Transm.	BN = Reg. Grade Unleaded BS = Prem. Grade Unleaded S = Prem. Grade Leaded	Catalytic Converter
Model: 320i / A	*	ECE	HG	BS	with
Engine Type: M50B20	*	ECE	HG	BS	prepared for
Basic Control Unit Hardware No.:	*	ECE	EH	BS	with
1 735 614; 1 730 784;	*	ECE	EH	BS	prepared for
1 738 376 Ratio I;					
1 738 931 Ratio II (not US);					
1 748 037 Ratio III					
1 748 401 Ratio IV					
Code:					
0 261 200 405					
* Version Code:					
See Parts Catalog					
Model: 325i / A	*	ECE	HG	BS	with
Engine Type: M50B25	*	ECE	HG	BS	prepared for
Basic Control Unit Hardware No.:	*	ECE	EH	BS	with
1 735 614; 1 730 784;	*	ECE	EH	BS	prepared for
1 738 376 Ratio I;					
1 738 931 Ratio II (not US);					
1 748 037 Ratio III					
1 748 401 Ratio IV					
Code:					
0 261 200 405					

* Version Code:
See Parts Catalog

13 61 ... Control Units

	Version Code	Country Version	HG = Man. Transm. AG = Autom. Transm. EH = Elec./Hydr. Transm.	BN = unleaded regular BS = unl. prem. BSP = unleaded prem. plus S = leaded prem.	Cataiytic Converter
DME M1.2					
Model: M5 (E 34)					
Engine Type: S38B36	801E	ECE	HG	BS	with
Basic Control Unit Hardware No.:	A01E	ECE	HG	BS	prepared for
1 315 408; 1 316 941; 1 317 113	881E	US	HG	BS	with
Code:	B01E	ZA	HG	S	without
0 261 200 350	B81E	Tropics	HG	S	without
	B41E	Golf	HG	S	without
DME M3.3					
Model: M5 (E 34)					
Engine Type: S38B38	*	ECE	HG	BS	with
Basic Control Unit Hardware No.:	*	CH	HG	BS	with
1 317 417					
Code: 0 261 200 412					
DME M3.3					
Model: M3 (E 36)					
Engine Type: S50B30	*	ECE	HG	BSP	with
Basic Control Unit Hardware No.:	*	Sv/CH	HG	BSP	with
1 317 909					
Code: 0 261 203 075					

* Version Code:
See Parts Catalog

FUEL SYSTEM 13 - 71 DME	Plug Code 0 = Opened 1 = Closed black/blue	Country Version	HG = Man. Transm. AG = Autom. Transm. EH = Elec./Hydr. Transm.	BN = Reg. Grade Unleaded BS = Prem. Grade Unleaded S = Prem. Grade Leaded	Catalytic Converter
13 61 ... Control Units					
Model: M3 / Convertible					
Engine Type: S14B23	1 / 1	ECE	HG	S	without
Control Unit No.:	0 / 1	ECE	HG	BS	with
1 311 899; 1 312 777 (E2)	0 / 0	ECE	HG	BN	with
Code:	1 / 0	US/J	HG	BS	with
0 261 200 071; 0 261 200 090 (E2)					
Model: M3 / Convertible					
Engine Type: S14B23	1 / 1	ECE	HG	BS	without
Control Unit No.:	0 / 1	ECE	HG	BS	with
1 315 263 (E1)	0 / 0	CH	HG	BS	with
Code:					
0 261 200 091 (E1)					
Model: 320is					
Engine Type: S14B20	- / -	It	HG	S	without
Control Unit No.:					
1 312 005					
Code:					
0 261 200 087					

13 62 ... Air Flow Sensor

Engine Type	Part Number	Code	Country Version	1) Color Code	Since (Month/Year)
M40B16	1 714 502	0 280 200 201	ECE		9/88
M40B16	1 734 653	0 280 200 205	ECE		4/91
M40B18	1 714 503	0 180 202 203	ECE		
M40B18	1 734 657	0 280 202 135	ECE		4/91
M42B18	1 714 503	0 180 202 203	ECE		
M20B20	1 710 546	0 280 202 090	ECE	A	
M20B20	1 710 539	0 280 202 083	ECE		4/88
M20B20	1 710 545	0 280 202 093	ECE		9/87
M20B25	1 286 615	0 280 202 082	ECE	B	
M20B25	1 710 545	0 280 202 093	ECE		9/87
M20B25*	1 710 543	0 280 202 092	ECE		
S14B20	1 307 486	0 280 203 028	ECE		
S14B23	1 307 486	0 280 203 028	ECE	C	
M30B30	1 286 064	0 208 203 027	ECE	B	
M30B35	1 286 064	0 208 203 027	ECE	B	
S38B35	1 307 019	0 280 203 025	ECE		

* With cyclone separator

1) A = light blue
B = red
C = green

13 62 ... Coolant Temperature Sensor

Test Values:

at - 10 ± 1° C = 8.2 ... 10.5 KΩ
at + 20 ± 1° C = 2.2 ... 2.7 KΩ
at + 80 ± 1° C = 0.3 ... 0.36 KΩ

Engine Type	Part Number	Code	Code
M40B16	1 709 966	323 805/009/001	0 280 130 026
M40B18	1 709 966	323 805/009/001	0 280 130 026
M42B18	1 709 966	323 805/009/001	0 280 130 026
M20B20	1 709 966	323 805/009/001	0 280 130 026
M20B20	1 709 966	323 805/009/001	0 280 130 026
M20B20	1 709 966	323 805/009/001	0 280 130 026
M20B25	1 709 966	323 805/009/001	0 280 130 026
M50B20	1 709 966	323 805/009/001	0 280 130 026
M50B25	1 709 966	323 805/009/001	0 280 130 026
S14B23	1 709 966	323 805/009/001	0 280 130 026
S50B30	1 401 945		
M30B30	1 709 966	323 805/009/001	0 280 130 026
M30B30	1 709 966	323 805/009/001	0 280 130 026
M30B30	1 709 966	323 805/009/001	0 280 130 026
M30B35	1 709 966	323 805/009/001	0 280 130 026
M30B35	1 709 966	323 805/009/001	0 280 130 026
M30B35	1 709 966	323 805/009/001	0 280 130 026
M60B30	1 288 158		0 280 130 037
M60B40	1 288 158		0 280 130 037
S38B35	1 709 966	323 805/009/001	0 280 130 026
S38B36	1 709 966	323 805/009/001	0 280 130 026
S38B38			
M70B50	1 707 366		0 280 130 056*

* + EML

13 64 ... Fuel Injectors

Engine Type	Part Number	Static Flow Rate approx. cm^3/min.	1) Test Pressure bar	Coil Resistance approx. Ω at 20° C	Code	Plug Color	Approx. Ejection Angle
M40B16	1 706 162	170	3.0 ± 0.05	15 ... 17.5	0280150715	blue	30
M40B18	1 706 162	170	3.0 ± 0.05	15 ... 17.5	0280150715	blue	30
M40B16	1 734 776	170	3.0 ± 0.05	15 ... 17.5	0280150715	blue	30
M40B18	1 734 776	170	3.0 ± 0.05	15 ... 17.5	0280150715	blue	30
M40B16	1 731 357	170	3.0 ± 0.05		D 3762 FA	blue	
M40B18	1 731 357	170	3.0 ± 0.05		D 3762 FA	blue	
M42B18	1 706 176	220	3.0 ± 0.05	15 ... 17.5	0280150714	yellow	30
M42B18	1 726 983*	220	3.0 ± 0.05	15 ... 17.5	0280150714	yellow	30
M42B18	1 739 242	220	3.0 ± 0.05		D 3761 FA	orange	
S14B20	1 273 272	236	3.0 ± 0.05	2 ... 3	0280150201	gray	30
S14B23	1 273 272	236	3.0 ± 0.05	2 ... 3	0280150201	gray	30
M50B30	1 310 641	270	3.0 ± 0.05		0280150701	Ivory	30
M20B20	1 706 414	155	2.5 ± 0.05	15 ... 17.5	0280150716	white	30
M20B20	1 726 989	155	2.5 ± 0.05	15 ... 17.5	0280150716	white	30
M20B20	1 706 162	170	3.0 ± 0.05	15 ... 17.5	0280150715	blue	30
M20B27	1 706 414	155	2.5 ± 0.05	15 ... 17.5	0280150716	white	30
M20B25	1 706 162	170	3.0 ± 0.05	15 ... 17.5	0280150715	blue	30
M50B20	1 730 059	170	3.0 ± 0.05	15 ... 17.5	0280150414	gray	20
M50B25	1 730 060	180	3.5 ± 0.05	15 ... 17.5	0280150415	green	20

1) With leak rate of 1 drop per minute
* US Version

13 64 ... Fuel Injectors

Engine Type	Part Number	Static Flow Rate approx. cm^3/min.	1) Test Pressure bar	Coil Resistance approx. Ω at 20° C	Code	Plug Color	Approx. Ejection Angle
M30B30	1 706 176	220	3.0 ± 0.05	15 ... 17.5	0280150714	yellow	30
M30B30	1 726 983	220	3.0 ± 0.05	15 ... 17.5	0280150714	yellow	30
M30B30	1 726 988	220	3.0 ± 0.05	15 ... 17.5	0280150714	yellow	30
M30B35	1 706 176	220	3.0 ± 0.05	15 ... 17.5	0280150714	yellow	30
M30B35	1 726 983	220	3.0 ± 0.05	15 ... 17.5	0280150714	yellow	30
M30B35	1 730 292	220	3.0 ± 0.05	15 ... 17.5	73366	yellow	30
M60B30	1 736 908	240	3.5 ± 0.05		0280150778	red	30
M60B30	1 747 406	240	3.5 ± 0.05		D 3763 FA	red	
M60B40	1 736 908	240	3.5 ± 0.05		02801150778	red	30
M60B40	1 747 406	240	3.5 ± 0.05		D 3763 FA	red	
S38B35	1 273 272	235	3.0 ± 0.05	2 ... 3	0280150201	gray	30
S38B36	1 310 641	270	3.0 ± 0.05		0280150701	Ivory	30
S38B38	1 310 641	270	3.0 ± 0.05		0280150701	Ivory	30
S38B38	1 317 446	290	3.0 ± 0.05		D 3764 FA	green	
M70B50	1 706 162	170	3.0 ± 0.05	15 ... 17.5	0280150715	blue	30
M70B50	1 731 357	170	3.0 ± 0.05		D 3762 FA	blue	22

1) With leak rate of 1 drop per minute

13 00 ... General Information

Engine Type	Model	Engine Code on Data Plate	Idling Speed in RPM	Idling Speed with Air Cond. ON in RPM	Shutoff Speed in RPM	Fuel Injection	Since (Month/ Year)
M21 D24	324d	24 6D A	750 ± 50		5150 ± 100	mech.	
M21 D24	324d	24 6D B	750 ± 50	860 ± 50	5300 ± 100	DDE-2	12/88
M21 D24	324td	24 6T B	750 ± 50	860 ± 50	5300 ± 100	DDE-1	
M21 D24	324td	24 6T B	750 ± 50	860 ± 50	5300 ± 100	DDE-1	

13 31 ... Fuel Supply

		324d/A	324td/A	524td/A
Fuel feed vacuum measured after filter at				
approx. 2000 rpm	mbar	- 40 ... - 60	- 40 ... - 60	
4000 rpm	mbar	- 80	- 80	
max.	mbar	- 200	- 200	
Pressure with intank pump	mbar			200

13 51 ... Distributor Injection Pump

Code		324d/A	324d/A (DDE)	324td/A	524td/A
		VE 6/10 F 2300 R 206	VE 6/10 E 2400 R 206/1	VE 6/10 E 2400 R 206/1	VE 6/10 E 2400 R 206/1
Internal pump pressure (operating temperature)					
at 750 rpm	bar	≥ 1.5	≥ 4	≥ 4	≥ 4
at 2000 rpm	bar	> 4	> 5	> 5	> 5
at 4500 rpm	bar	≥ 7.5	≥ 7	≥ 7	≥ 7
(cold running)					
at 750 rpm	bar	>	>	>	>
Static injection pump setting (new adjustment)					
Adjustment in TDC position (ignition pos. in cyl. no. 1)	mm	0.74 ± 0.02	1.05 ± 0.02	1.05 ± 0.02	1.05 ± 0.02
Testing value (without new adjustment afterwards)	mm	0.74 ± 0.02	1.05 ± 0.02	1.05 ± 0.02	1.05 ± 0.02

		324d/A	324td/A	524td/A - E 34
13 51 ... Electric Shutoff Valve (on Distributor Injection Pump)				
Switching-on voltage	V	at least 10	at least 10	at least 10
Resistance at 20° C	Ω	7.5 ± 1	7.5 ± 1	7.5 ± 1
13 51 ... Electric Cold Start Valve				
Testing voltage	V	12	—	—
Resistance at 20° C	Ω	4.5 ± 1	—	—
13 51 ... Control Box for Absolute Pressure Dependent Injection Rate				
Regulating pressure of control box (absolute)	mbar	705 ± 15	—	—

FUEL SYSTEM 13 - 104		324d/A	324td/A	524td/A - E 34
DIESEL		since 3/87		
13 53 ... Combination Fuel Injector				
Nozzle holder	Code	KCA 30 S 50	KCA 30 S 57/ [1] KCA 30 S 56	KCA 30 S 57/ [1] KCA 30 S 56
	Paint dot	white	red	red
Injection nozzle	Code	DNO SD 286	DNO SD 286	DNO SD 286
Opening (injection) pressure Adjusted value	bar	130 ... 138	150 ... 158	150 ... 158
Minimum value	bar	120	140	140
Maximum value		140	160	160
Testing oil for injection nozzle tester		Shell Calibration Fluid V 1404	Shell Calibration Fluid V 1404	Shell Calibration Fluid V 1404
Max. deviation in opening pressure among all injection nozzles	bar	10	10	10
Shims Thickness	mm	1.0 ... 2.0	1.0 ... 2.0	1.0 ... 2.0
Thickness steps	mm	0.05	0.05	0.05
Shim thickness = opening pressure difference	mm/bar	0.1 = 10	0.1 = 10	0.1 = 10

[1] With needle motion sensor

FUEL SYSTEM 13 - 105 DIESEL		324td	324td A	Version	524td	524td A	Version
13 61 ... DDE I Control Units							
SB (AS) 25 pin connector	Code	0 281 001 063	0 281 001 065	3 T 1/2	0 281 001 078	0 281 001 079	5 T 1
	BMW No.	2 241 706	2 241 710	3 T 1/2	2 242 212	2 242 214	5 T 1
ME (MLG) 35 pin connector	Code	0 281 001 064	0 281 001 066	3 T 3	0 281 001 077	0 281 001 080	5 T 3
	BMW No.	2 244 177	2 244 178	3 T 3	2 242 946	2 242 948	5 T 3
SB (AS) 25 pin connector	Code	0 281 001 063	0 281 001 065	3 T 3	0 281 001 078	0 281 001 079	5 T 3
	BMW No.	2 241 706	2 241 710	3 T 3	2 242 947	2 242 049	5 T 3
ME (MLG) 35 pin connector	Code	0 281 001 089	0 281 001 091	3 T 4	0 281 001 077	0 281 001 080	5 T 4
since 5/88	BMW No.	2 242 963	2 242 965	3 T 4	2 242 967	2 242 969	5 T 4
since 10/88	BMW No.	2 243 212	2 243 213	3 T 4	2 243 184 *	2 243 211 *	5 T 4
SB (AS) 25 pin connector	Code	0 281 001 088	0 281 001 090	3 T 4	0 281 001 078	0 281 001 079	5 T 4
since 5/88	BMW No.	2 242 964	2 242 966	3 T 4	2 242 968	2 242 970	5 T 4
ME (MLG) 35 pin connector	Code	0 281 001 089	0 281 001 091	3 T 5	0 281 001 077	0 281 001 080	5 T 5
since 12/88	BMW No.	2 243 113	2 243 115	3 T 5	2 243 117	2 243 119	5 T 5
SB (AS) 25 pin connector	Code	0 281 001 088	0 281 001 090	3 T 5	0 281 001 078	0 281 001 079	5 T 5
since 12/88	BMW No.	2 243 114	2 243 116	3 T 5	2 243 118	2 243 120	5 T 5

* Only for replacement

FUEL SYSTEM 13 - 106 DIESEL		324td	324td A	Version	524td	524td A	Version
13 61 ... Control Units							
ME (MLG) 35 pin connector	Code	0 281 001 089	0 281 001 092	3 T 6	0 281 001 077	0 281 001 080	5 T 6
	BMW No.	2 243 618	2 243 620	3 T 6	2 243 622	2 243 624	5 T 6
SB (AS) 25 pin connector	Code	0 281 001 088	0 281 001 088	3 T 6	0 281 001 078	0 281 001 078	5 T 6
	BMW No.	2 243 619	2 243 619	3 T 6	2 243 623	2 243 623	5 T 6
ME (MLG) 35 pin connector	Code	0 281 001 089	0 281 001 092	3 T 7	0 281 001 077	0 281 001 080	5 T 7
since 7/90	BMW No.	2 244 124	2 244 125	3 T 7	2 244 126	2 244 127	5 T 7
Diesel Engine Vehicles with Catalytic Converter							
ME (MLG) 35 pin connector	Code	0 281 001 089	0 281 001 091	3 T 6	0 281 001 077	0 281 001 080	5 T 6
	BMW No.	2 243 618	2 243 620	3 T 6	2 243 622	2 243 624	5 T 6
SB (AS) 25 pin connector	Code	0 281 001 123	0 281 001 123	3 C 6	0 281 001 122	0 281 001 122	5 C 6
	BMW No.	2 243 915	2 243 915	3 C 6	2 243 916	2 243 916	5 C 6
ME (MLG) 35 pin connector	Code	0 281 001 089	0 281 001 091	3 T 7	0 281 001 077	0 281 001 080	5 T 7
	BMW No.	2 244 124	2 244 125	3 T 7	2 244 126	2 244 127	5 T 7

FUEL SYSTEM 13 - 107 DIESEL		324d	324d A	Version
13 61 ... Control Units				
DDE 2 55 pin connector	Code	0 281 001 082	0 281 001 083	3 S 1
	BMW No.	2 243 028	2 243 029	3 S 1
DDE 2 55 pin connector	Code	0 281 001 082	0 281 001 083	3 S 2
since 6/89	BMW No.	2 243 292	2 243 293	3 S 2

	ME 3T3	ME 3T4	ME 3T5 ME 3T6 ME 3T7	ME 5T3	ME 5T4	ME 5T5 ME 5T6 ME 5T7
Permitted Combination of DDE-1 Control Units						
	SB 3T1			SB 5T1	SB 5T1	SB 5T1
	SB 3T2					
	SB 3T3			SB 5T3	SB 5T3	SB 5T3
		SB 3T4	SB 3T4	SB 5T4	SB 5T4	SB 5T4
		SB 3T5	SB 3T5	SB 5T5	SB 5T5	SB 5T5
		SB 3T6	SB 3T6	SB 5T6	SB 5T6	SB 5T6
		SB 3T7	SB 3T7	SB 5T7	SB 5T7	SB 5T7

Also refer to Service Information of Group 13.

Important!
Basically a control unit may only be replaced by one of the same or better version.

		324td	324td A	524td - E 34	524td A - E 34
13 62 ... Charge Pressure Sensor					
	Code	0 281 002 0218			
	BMW No.	13 62 2 241 599			
Power supply	V	5 ± 0.25			

FUEL TANK AND LINES 16 - 300		316/i 318i/s 324d 324td	320i 325i 320is	M 3 M 3 C
16 11 ... Fuel Tank				
Tank volume / reserve	ltr.	55 / 5	63 / 6	55 / 6
With additional tank	ltr.		70 / 6	70 / 6
Venting: discharged outdoors via expansion tank. With catalytic converter via carbon canister into intake system.				
16 14 ... Electric Fuel Pump				
Code		05 80 464 032	644 29 20	05 80 464 032
Operating pressure	bar	3	3	3
Delivery rate at 12 V (pump removed, tested with testing fluid, approx. 20° C, 3 bar counterpressure)	ltr /min.	1.9	2.1	1.9
Delivery rate (tested with installed pump and counterpressure – see Repair Manual Gr. 13)	cm^3/30 sec.	875	875	875
Typical power consumption	A	5	7	5

FUEL TANK AND LINES 16 - 301		3 Series E 30 a) 316 b) 318 c) 324d d) 324td	3 Series E 30 320i 325i	3 Series E 30 M 3
16 14 ... Fuel Level Sender				
* Plastic version ** Addition tank Code		a/b) 817/036/001* a/b) 817 1013 1010 c/d) 817/031/002	right 817/022/007 left 802/033/001	802/029/001** 817/1010 1010 817/036/006*
Resistance at conn. G With empty tank	Ω	58.8 ± 1.9	right 58.8 ± 1.9 left 66.1 ± 2.1	58.8 ± 1.9
With full tank	Ω	32. ± 0.7	right 3.2 ± 0.7 left	3.2 ± 0.7
16 14 ... Fuel Intake with Transfer Pump				
Current consumption at 13 V	A	1.4	1.4	1.4
Delivery pressure at + 20° C	bar	0.2	0.2	0.2

RADIATOR 17 - 1		E 30 M10	E 30 M40B16 M40B18	E30 M42B18	E 30 M20B20	E 30 M20B25	E 30 M21D24	M3 S14
17 10 ... Cooling System in General								
Coolant volume (incl. heater)	ltr.	7	7	6.4	10.5	10.5	12	9
With integrated air conditioner	ltr.				11.0	11.0		
Coolant specifications		See Operating Fluids						
Testing pressure for cooling system	bar	1.0	1.0	1.0	1.0	1.0	1.0	1.0
17 11 ... Cooling Systen Cap								
Pressure valve opens at	bar	1.0 ± 0.1	1.0 ± 0.1	1.0 ± 0.1	1.0 ± 0.1	1.0 ± 0.1	1.0 ± 0.1	1.5 ± 0.1
Vacuum valve opens at (absolute)	bar	0.9	0.9	0.9	0.9	0.9	0.9	0.9
17 11 ... Radiator								
Testing pressure	bar	1.5	1.5	1.5	1.5	1.5	1.5	1.5

RADIATOR 17 - 2	E 30 M10	E 30 M40B16 M40B18	E 30 M42B18	E 30 M20B20	E 30 M20B25	E 30 324td M21D24	M3 S14
17 11 ... Transmission Oil Cooler (Integrated in Radiator) — Models with Automatic Transmission							
Operating pressure bar	8						
Testing pressure bar	12						
17 40 ... Electric Fan							
Code / Type	0 130 703 206 / IPL 12V						
Testing voltage V	12.7 ... 13.3						
Current consumption - stage I / II A	11 / 30						
Speed - stage I / II rpm	1400 / 2400						
17 20 ... Engine Oil Cooler							
Oil volume (incl. hoses) ltr.	0.75						
Testing pressure bar	16						

All Models

21 21 ... Clutch

Lateral runout deviation of diaphragm springs to pressure plate	mm	0.6
Drive plate Minimum thickness	mm	7.5
Permitted lateral runout	mm	0.5

Transmission Survey	3 Series E 30 / E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
Getrag 240/5 Overdrive	316 ... 318is 320i ... 324d	518i, 520i			
ZF-S5-16/5 Overdrive	*M 10:* 316 ... 318i 320i	520i			
Getrag 260/5 Overdrive	324td, 325i	524td ... 525i *M 50:* 520i, 525i			
Getrag 260/5 Sport	325i				
Getrag 260/6 Overdrive		530i ... 535i	635CSi	730i ... 735i	
Getrag 265/6 Sport	320is, M 3				
Getrag 280/5 Sport		M 5	M 635CSi		
Getrag GS 6 S 560/4.25 G (286/6)					850i
S 5 D 200 G	*E 36:* 316i, 318i	520i			
S 5 D 310 Z	*E 36:* 325i	525i			
S 5 D 250 G	325i				

23 00 ... Transmission in General

		240/5 Overdrive	ZF-S5-16 Overdrive	260/5 Overdrive	260/5 Overdrive 524td	260/5 Sport
Oil grade		see Operating Fluids	see Operating Fluids	see Operating Fluids	see Operating Fluids	see Operating Fluids
Oil volume	ltr.	1.05 (1.15*)	1.05 (1.15*)	1.25 (1.35*)	1.25 (1.35*)	1.25 (1.35*)
1st gear	Number of teeth	33 x 41/26 x 14	35 x 43/27 x 15	34 x 41/26 x 14	35 x 42/26 x 13	32 x 41/28 x 14
	Ratio	3.72	3.73	3.83	4.35	3.35
2nd gear	Number of teeth	33 x 35/26 x 22	35 x 33/27 x 21	34 x 37/26 x 22	35 x 38/26 x 22	32 x 39/28 x 22
	Ratio	2.02	2.04	2.20	2.33	2.03
3rd gear	Number of teeth	33 x 28/26 x 27	35 x 31/27 x 30	34 x 30/26 x 28	35 x 30/26 x 29	32 x 31/28 x 26
	Ratio	1.32	1.34	1.40	1.39	1.36
4th gear	Number of teeth	—	—	—	—	—
	Ratio	—	—	1.0	1.0	1.0
5th gear	Number of teeth	33 x 26/26 x 41	35 x 24/27 x 38	34 x 26/26 x 42	35 x 26/26 x 43	32 x 27/28 x 38
	Ratio	0.81	0.80	0.81	0.81	0.81

* For initial filling or exchange transmission

		240/5 Overdrive	ZF-S5-16 Overdrive	260/5 Overdrive	260/5 Overdrive 524td	260/5 Sport
23 00 ... Transmission in General						
Reverse gear	Number of teeth	33 x 24 x 38 26 x 14 x 24	35 x 41 27 x 15	34 x 21 x 37 26 x 14 x 21	35 x 22 x 36 26 x 13 x 22	32 x 21 x 37 28 x 14 x 21
	Ratio	3.45	3.54	3.46	3.73	3.02
23 11 ... Case and Covers						
Temperature for installation of bearings	°C	80				
23 21 ... Transmission Shafts						
Axial play (axial bearing clearance) of:						
Output shaft	mm	0 ... 0.09				
Input shaft	mm	0 ... 0.09	1.1 ... 1.3	0 ... 0.09	0 ... 0.09	0 ... 0.09
Layshaft	mm	0.1 ... 0.2	—	0.1 ... 0.2	0.1 ... 0.2	0.13 ... 0.23
Output journal on output shaft Radial runout	mm	0.07				
Output flange Radial runout	mm	0.07				
Axial runout	mm	0.1				

		240/5 Overdrive	ZF-S5-16 Overdrive	260/5 Overdrive	260/5 Sport
23 22 ... Gears (Layshaft)					
Pressing-off force at ambient temp. 3rd gear	tons	—	approx. 7.5	—	—
4th gear	tons	—	approx. 8.0	—	—
5th gear	tons	4.5 ... 5.5	approx. 8.0	5.5 ... 6.8	5.5 ... 6.8
Pressing-on force at temp. 3rd gear	tons ° C	— —	— —	— —	— —
4th gear	tons ° C	— —	0.015 150 ... 180	— —	— —
5th gear	tons ° C	4.5 ... 5.5 approx. 120	— —	4.9 ... 6.8 approx. 120	4.9 ... 6.8 approx. 120
23 23 ... Guide Sleeves					
Pressing-off force (max.) 1st/2nd and 5th/reverse gears	tons	3.0	—	3.7	3.7
3rd/4th gears	tons	2.7	—	3.0	3.0
Pressing-on force (max.) 1st/2nd and 5th/reverse gears	tons	2.1	0.08	2.5	2.5
3rd/4th gears	tons	1.9	—	2.1	2.1
Bearing sleeve temp.	° C	approx. 80	approx. 80	approx. 80	approx. 80

		240/5 Overdrive	ZF-S5-16 Overdrive	260/5 Overdrive	260/5 Sport
23 23 ... Synchronization					
Distance between synchromesh ring and clutch body					
New condition	mm	1.0 ... 1.3			
Max. wear limit size	mm	0.8			
Reverse gear					
New condition	mm	0.5 ... 0.6			
Max. wear limit size	mm	0.4			
23 31 ... Internal Shift Components					
Shift fork guide width					
1st ... 5th gears					
Wear limit	mm	4.8			

23 00 ... Transmission in General

		260/6 Overdrive	265/5 Sport	265/6 Overdrive	280/5 Sport
Oil grade		see Operating Fluids	see Operating Fluids	see Operating Fluids	see Operating Fluids
Oil volume	ltr.	1.25 (1.35*)	1.5 (1.7*)	1.5 (1.7*)	1.25 (1.35*)
1st gear	Number of teeth	34 x 41 / 26 x 14	38 x 36 / 23 x 16	34 x 38 / 26 x 13	34 x 43 / 26 x 16
	Ratio	3.83	3.72	3.82	3.51
2nd gear	Number of teeth	34 x 37 / 26 x 22	38 x 32 / 23 x 22	34 x 37 / 26 x 22	34 x 35 / 26 x 22
	Ratio	2.20	2.40	2.19	2.08
3rd gear	Number of teeth	34 x 30 / 26 x 28	38 x 31 / 23 x 29	34 x 31 / 26 x 29	34 x 29 / 26 x 28
	Ratio	1.40	1.77	1.39	1.35
4th gear	Number of teeth	—	38 x 26 / 23 x 24	—	—
	Ratio	1.0	1.26	1.0	1.0
5th gear	Number of teeth	34 x 26 / 26 x 42	—	34 x 23 / 26 x 37	34 x 26 / 26 x 42
	Ratio	0.81	1.0	0.81	0.81

* For initial filling or exchange transmission

		260/6 Overdrive	265/5 Sport	265/6 Overdrive	280/5 Sport
23 00 ... Transmission in General					
Reverse gear	Number of teeth	34 x 21 x 37 26 x 14 x 21	38 x 16 x 41 23 x 16 x 16	34 x 19 x 34 26 x 12 x 19	34 x 19 x 34 26 x 12 x 19
	Ratio	3.46	4.23	3.70	3.71
23 11 ... Case and Covers					
Temperature for installation of bearings	°C	80	80	80	80
23 21 ... Transmission Shafts					
Axial play (axial bearing clearance) of:					
Output shaft	mm	0 ... 0.09	0 ... 0.09	0 ... 0.09	0 ... 0.09
Input shaft	mm	0 ... 0.09	0 ... 0.09	0 ... 0.09	0 ... 0.09
Layshaft	mm	0.1 ... 0.2	0.1 ... 0.2	0.1 ... 0.2	—
Output journal on output shaft Radial runout	mm	0.07	0.07	0.07	0.07
Output flange Radial runout	mm	0.07	0.07	0.07	0.07
Axial runout	mm	0.1	0.1	0.1	0.1

		260/6 Overdrive	265/5 Sport	265/6 Overdrive	280/5 Sport
23 22 ... Gears (Layshaft)					
Pressing-off force at ambient temp.					
3rd gear	tons	—	5 ... 7	5 ... 7	5 ... 7
4th gear	tons	—	5 ... 7	5 ... 7	5 ... 7
5th gear	tons	5.5 ... 6.8	9 ... 10	9 ... 10	9 ... 10
Pressing-on force at temp.					
3rd gear	tons	—	—	—	—
	° C	—	—	—	—
4th gear	tons	—	—	—	—
	° C	—	—	—	—
5th gear	tons	4.9 ... 6.8	5 ... 6	5 ... 6	5 ... 6
	° C	approx. 120	approx. 150	approx. 150	approx. 150
23 23 ... Guide Sleeves					
Pressing-off force (max.)					
1st/2nd and 5th/reverse gears	tons	3.7	—	—	—
3rd/4th gears	tons	3.0	—	—	—
Pressing-on force (max.)					
1st/2nd and 5th/reverse gears	tons	2.5	—	—	—
3rd/4th gears	tons	2.1	—	—	—
Bearing sleeve temp.	° C	approx. 80	approx. 80	approx. 80	approx. 80

		260/6 Overdrive	265/5 Sport	265/6 Overdrive	280/5 Sport
23 23 ... Synchronization					
Distance between synchromesh ring and clutch body					
New condition	mm	1.0 ... 1.3			
Max. wear limit size	mm	0.8			
Reverse gear					
New condition	mm	0.5 ... 0.6			
Max. wear limit size	mm	0.4			
23 31 ... Internal Shift Components					
Shift fork guide width					
1st ... 5th gears					
Wear limit	mm	4.8			

23 00 ... Transmission in General

		S 5 D 200 G / 250 G	S 5 D 310 Z	S 6 S 560 G
Oil grade			see Operating Fluids	
Oil volume	ltr.	1.0 (1.1*)	1.2 (1.3*)	2.3 (2.5*)
1st gear	Number of teeth	40 x 46 / 29 x 15	43 x 41 / 30 x 14	42 x 47 / 29 x 16
	Ratio	4.23	4.20	4.25
2nd gear	Number of teeth	40 x 42 / 29 x 23	43 x 40 / 30 x 23	42 x 42 / 29 x 24
	Ratio	2.52	2.49	2.53
3rd gear	Number of teeth	40 x 43 / 29 x 29	43 x 36 / 30 x 31	42 x 36 / 29 x 31
	Ratio	1.67	1.67	1.68
4th gear	Number of teeth	40 x 41 / 29 x 35	43 x 32 / 30 x 37	42 x 29 / 29 x 34
	Ratio	1.22	1.24	1.23
5th gear	Number of teeth	—	—	—
	Ratio	1.0	1.0	1.0

* For initial filling

		S 5 D 200 G / 250 G	S 5 D 310 Z	S 6 S 560 G
23 00 ... Transmission in General				
6th gear	Number of teeth	—	—	42 x 31 / 29 x 54
	Ratio	—	—	0.83
Reverse gear	Number of teeth	40 x 25 x 41 / 29 x 14 x 25	43 x 23 x 38 / 30 x 14 x 23	42 x 23 x 43 / 29 x 16 x 23
	Ratio	4.04	3.89	3.89
23 11 ... Case and Cover				
Temperature for bearing installation	°C	approx. 80	approx. 80	approx. 80
23 21 ... Transmission Shafts				
Max. axial play (axial bearing clearance) of Output shaft	mm	0 ... 0.09	0 ... 0.09	0 ... 0.09
Input shaft	mm	0.04	—	—
Layshaft	mm			
Max. radial runout of output journal on output shaft	mm	0.07	0.07	0.07
Output flange Max. radial runout	mm	0.07	0.07	0.07
Max. axial runout	mm	0.1	0.1	0.1

		S 5 D 200 G / 250 G	S 5 D 310 Z	S 6 S 560 G
23 22 ... Gears (Layshaft)				
Pressing off and on force 5th gear	KN	50 ... 70		
23 23 ... Guide Sleeves				
Pressing off and on force	KN	10 ... 20		
23 23 ... Synchromesh Ring				
Distance between synchromesh ring and clutch body New condition				
1st/2nd gear	mm	1.3 ... 2.1	1.1 ... 1.6	
3rd gear	mm	1.1 ... 1.5	0.95 ... 1.35	
4th/5th gear	mm	0.9 ... 1.5	0.95 ... 1.35	
Max. wear distance	mm	0.8	0.8	0.8
Reverse gear New condition	mm	1.1 ... 1.7	0.7 ... 1.15	
Max. wear distance	mm	0.5	0.5	0.5

316 A
316 iA
318 iA
320 iA

24 00 . . . Transmission in General

Designation		ZF - 4 HP - 22/H
Code letter on data plate		see Parts Catalog
Ratio	1st gear	2.48
	2nd gear	1.48
	3rd gear	1.0
	4th gear	0.73
	reverse	2.09
Oil grade		see Operating Fluids
Total oil filling volume (transmission and torque converter empty)	ltr. (US/Imp. pts.)	6.4 (13.53/11.26)
Oil change volume (transmission at operating temperature)	ltr. (US/Imp. pts.)	3.0 (6.34/5.28)

24 00 ... Shift Points

		316 A	316 IA	316 IA**	318 IA 318 iA K	320 IA	320 IA K
Selector lever in D Accel. pedal at partial throttle Shift point at engine speed (rpm)	1-2	2100 ... 2200	2400 ... 2500	2400 ... 2500	2200 ... 2300	2400 ... 2500	2400 ... 2500
	2-3	2200 ... 2500	2500 ... 2600	2500 ... 2700	2300 ... 2600	2400 ... 2500	2400 ... 2600
	3-4	2200 ... 2300	2500 ... 2600	2500 ... 2600	2300 ... 2500	2400 ... 2500	2400 ... 2500
	CL closed	2600 ... 2700	2800 ... 2900	2900 ... 3000	2600 ... 2800	2700 ... 2800	2700 ... 2800
	CL opened	2100 ... 2200	2100 ... 2200	2200 ... 2400	2100 ... 2200	2100 ... 2200	2100 ... 2200
Shift point at road speed (km/h)	1-2	16 ... 17	15 ... 16	14 ... 15	15 ... 16	14 ... 15	14 ... 15
	2-3	31 ... 39	24 ... 33	27 ... 34	29 ... 37	23 ... 32	25 ... 33
	3-4	45 ... 52	40 ... 47	40 ... 45	43 ... 49	38 ... 45	38 ... 45
	CL closed	84 ... 90	84 ... 90	79 ... 83	86 ... 90	81 ... 86	78 ... 83
	CL opened	82 ... 87	82 ... 87	77 ... 81	83 ... 88	79 ... 84	75 ... 80
Selector lever in D Accel. pedal at full throttle Shift point at engine speed (rpm)	1-2	4200 ... 4900	3800 ... 4500	4700 ... 5400	4600 ... 5300	3900 ... 4600	4700 ... 5400
	2-3	5000 ... 5400	4700 ... 5200	5000 ... 5500	5000 ... 5400	4800 ... 5300	5000 ... 5500
	3-4	4600 ... 5000	4400 ... 4800	4700 ... 5000	4600 ... 5000	4500 ... 4800	4700 ... 5000
	*4-3	2600 ... 2900	2500 ... 2700	2600 ... 2900	2600 ... 2900	2500 ... 2700	2500 ... 2800
	3-2	2800 ... 3100	2900 ... 3100	2900 ... 3200	3000 ... 3200	2800 ... 3100	2900 ... 3100
	2-1	2400 ... 2700	2600 ... 2800	2700 ... 3100	2800 ... 3100	2500 ... 2700	2700 ... 3100
Shift point at road speed (km/h)	1-2	45 ... 54	40 ... 49	44 ... 51	47 ... 56	38 ... 47	41 ... 54
	2-3	91 ... 100	86 ... 95	80 ... 88	87 ... 96	83 ... 91	83 ... 91
	3-4	124 ... 135	118 ... 128	109 ... 118	119 ... 129	114 ... 123	113 ... 123
	*4-3	102 ... 112	96 ... 106	89 ... 98	97 ... 107	92 ... 102	92 ... 102
	3-2	67 ... 76	62 ... 72	58 ... 67	64 ... 73	59 ... 68	59 ... 68
	2-1	32 ... 44	25 ... 39	32 ... 43	35 ... 47	23 ... 37	33 ... 45

* CL closed prior to shift
** 1989 Models

		316 A	316 IA	316 IA**	318 IA 318 iA K	320 IA	320 IA K
24 00 ... Shift Points							
Selector lever in D Accel. pedal at kickdown Shift point at engine speed (rpm)	1-2 2-3 3-4 4-3 3-2 2-1	5300 ... 5900 5500 ... 5900 – immediately 3700 ... 4000 3000 ... 3400	4900 ... 5500 5200 ... 5600 – immediately 3600 ... 3800 2900 ... 3300	5400 ... 6000 5500 ... 5900 5900 ... 6100 4100 ... 4200* 3800 ... 4000 3000 ... 3500	5300 ... 6000 5500 ... 5900 5900 ... 6100 4100 ... 4200* 3700 ... 4000 3000 ... 3400	4900 ... 5600 5300 ... 5700 – immediately 3600 ... 3900 2900 ... 3400	5400 ... 6100 5500 ... 6000 6180 ... 6250 4200 ... 4250* 3500 ... 3900 3000 ... 3300
Shift point at road speed (km/h)	1-2 2-3 3-4 4-3 3-2 2-1	58 ... 66 101 ... 110 – immediately 96 ... 105 48 ... 58	53 ... 61 96 ... 104 – immediately 90 ... 100 43 ... 53	51 ... 58 89 ... 96 143 ... 147 140 ... 144* 84 ... 92 41 ... 51	55 ... 63 96 ... 105 155 ... 159 151 ... 156* 91 ... 100 46 ... 56	51 ... 59 92 ... 100 – immediately 86 ... 95 41 ... 51	51 ... 59 92 ... 100 162 ... 164 157 ... 159* 86 ... 95 41 ... 51
Manual shift at engine speed (rpm)	4-3 3-2 2-1	immediately 3300 ... 3700 2600 ... 3100	immediately 3100 ... 3500 2200 ... 2800	immediately 3300 ... 3700 2500 ... 3100	immediately 3300 ... 3700 2500 ... 3100	immediately 3100 ... 3500 2300 ... 3000	immediately 3100 ... 3500 2300 ... 3000
Manual shift at road speed (km/h)	4-3 3-2 2-1	immediately 97 ... 108 52 ... 61	immediately 92 ... 103 47 ... 57	immediately 85 ... 95 45 ... 54	immediately 93 ... 103 49 ... 59	immediately 88 ... 99 45 ... 54	immediately 88 ... 99 45 ... 54
Reverse gear interlock at road speed (km/h)		20 ... 22	19 ... 21	18 ... 19	19 ... 21	18 ... 20	18 ... 20

* CL closed prior to shift
** 1989 Models

AUTOMATIC TRANSMISSION ZF – 4 HP – 22/H 24 – 304	316 A 316 iA	318 iA 318 iA K	320 iA	320 iA K	
24 00 Oil Pressure					
Pump pressure with selector lever in D 1st gear					
Idle bar (psi)	6.0 ... 7.5 (86 ... 107)				
Kickdown bar (psi)	9.1 ... 10.1 (130 ... 144)		9.6 ... 10.6 (137 ... 151)		
Engine speed rpm	approx. 4,000				
2nd ... 4th gears Idle bar (psi)	4.6 ... 5.8 (66 ... 82)				
Kickdown bar (psi)	7.2 ... 8.0 (103 ... 114)		7.6 ... 8.5 (108 ... 121)		
Reverse gear Idle bar (psi)	11.0 ... 13.0 (157 ... 185)				
Kickdown bar (psi)	14.8 ... 16.7 (211 ... 237)		15.7 ... 17.6 (224 ... 250)		
Converter pressure with selector lever in D – CL closed – bar (psi)	max. 0.7 (10)				
24 21 ... Input Shaft					
Axial play of input shaft mm (in.)	0.2 ... 0.4 (0.008 ... 0.016)				
24 30 ... Valve Body					
Distance adjusted between valve body and needle on throttle piston mm (in.)	11.5 (0.453)				

AUTOMATIC TRANSMISSION ZF–4 HP–22/H 24 – 305		316 A	316 iA	318 iA 318 iAK	320 iA	320 iAK	
24 40 ... Torque Converter							
Converter diameter	mm (in.)	230 (9.055)					
Code		V 2	U 4	R 5	V 2		
Stall speed	rpm	2100 ... 2300	2100 ... 2300	2100 ... 2300	2150 ... 2400		
Journal diameter	mm (in.)	32 (1.260)					

		325 iA 325 iXA	324 dA 324 tdA

24 00 . . . Transmission in General

Designation		ZF - 4 HP - 22/H	
Code letters on data plate		see Parts Catalog	
Ratios	1st gear	2.48	2.73
	2nd gear	1.48	1.56
	3rd gear	1.00	1.00
	4th gear	0.73	0.73
	reverse	2.09	2.09
Oil grade		see Operating Fluids	
Total oil filling volume (transmission and torque converter empty)	ltr. (US/Imp. pts.)	7.5 (15.85/13.20)	
Oil change volume (transmission at operating temperature)	ltr. (US/Imp. pts.)	3.0 (6.34/5.28)	

24 00 ... Shift Points

		325 IA	325 IAK	325 IXA	325 IXAK	324 dA	324 tdA
Selector lever in D Accel. pedal at partial throttle Shift point at engine speed (rpm)	1-2 2-3 3-4 CL closed CL opened	2300 ... 2400 2400 ... 2600 2400 ... 2460 2500 ... 2600 1900 ... 2000		2300 ... 2400 2400 ... 2600 2400 ... 2500 2500 ... 2600 1900 ... 2000		2100 ... 2200 2100 ... 2200 2100 ... 2200 2200 ... 2300 1800 ... 2000	2700 ... 2800 2700 ... 2800 2700 ... 2800 2700 ... 2800 1500 ... 1600
Shift point at road speed (km/h)	1-2 2-3 3-4 CL closed CL opened	17 ... 18 33 ... 41 48 ... 55 80 ... 83 77 ... 83		16 ... 17 31 ... 39 46 ... 52 76 ... 82 74 ... 79		20 ... 21 32 ... 33 47 ... 53 84 ... 90 81 ... 87	21 ... 22 32 ... 34 50 ... 55 77 ... 79 72 ... 76
Selector lever in D Accel. pedal at full throttle Shift point at engine speed (rpm)	1-2 2-3 3-4 *4-3 3-2 2-1	4200 ... 4900 5000 ... 5400 4600 ... 5000 2600 ... 2900 2800 ... 3000 2400 ... 2800		4200 ... 4900 5000 ... 5400 4600 ... 5000 2600 ... 2900 2800 ... 3100 2500 ... 2800		3300 ... 3900 4000 ... 4400 3800 ... 4100 2200 ... 2400 2400 ... 2500 2300 ... 2400	3400 ... 3900 3900 ... 4300 3700 ... 3900 2000 ... 2200 2700 ... 2800 2700 ... 2800
Shift point at road speed (km/h)	1-2 2-3 3-4 *4-3 3-2 2-1	48 ... 57 97 ... 106 131 ... 142 107 ... 118 70 ... 80 31 ... 44		46 ... 54 92 ... 101 125 ... 136 102 ... 113 67 ... 77 31 ... 44		36 ... 43 80 ... 88 115 ... 125 95 ... 104 55 ... 65 32 ... 35	38 ... 46 80 ... 89 115 ... 124 95 ... 104 58 ... 66 32 ... 36

* CL closed prior to shift

24 00 ... Shift Points

		325 IA	325 IA K	325 IXA	325 IXA K	324 dA	324 tdA
Selector lever in D	1-2		5300 ... 6000	5300 ... 6000		4200 ... 4900	4200 ... 4800
Accel. pedal at kickdown	2-3		5500 ... 5900	5500 ... 5900		4500 ... 4900	4300 ... 4600
Shift point at engine speed (rpm)	3-4		6100 ... 6200	6000 ... 6100		–	–
	*4-3		4200 ... 4300	4100 ... 4200		immediately	immediately
	3-2		3700 ... 4000	3700 ... 4000		2900 ... 3100	3000 ... 3200
	2-1		2900 ... 3300	2900 ... 3300		2400 ... 2700	2800 ... 3000
Shift point at road speed (km/h)	1-2		61 ... 70	61 ... 70	59 ... 66	47 ... 56	50 ... 57
	2-3		107 ... 116	107 ... 116	102 ... 111	89 ... 97	89 ... 97
	3-4		175 ... 177	175 ... 177	166 ... 168	–	–
	*4-3		169 ... 171	169 ... 171	161 ... 163	immediately	immediately
	3-2		101 ... 111	101 ... 111	96 ... 105	83 ... 92	84 ... 92
	2-1		50 ... 61	50 ... 61	43 ... 58	37 ... 47	40 ... 50
Manual shift at engine speed (rpm)	4-3		immediately	immediately		immediately	immediately
	3-2		3300 ... 3700	3300 ... 3700		2700 ... 3000	2300 ... 2600
	2-1		2500 ... 3000	2500 ... 3000		2100 ... 2600	2100 ... 2500
Manual shift at road speed (km/h)	4-3		immediately	immediately	immediately	immediately	immediately
	3-2		103 ... 114	103 ... 114	98 ... 109	93 ... 104	85 ... 96
	2-1		55 ... 65	55 ... 65	52 ... 62	48 ... 58	51 ... 60
Reverse gear interlock at road speed (km/h)			21 ... 23	21 ... 23	20 ... 22	26 ... 28	28 ... 30

* CL closed prior to shift

AUTOMATIC TRANSMISSION ZF – 4 HP – 22/H 24 – 309	325 iA	325 iA K	325 iXA	325 iXA K	324 dA	324 tdA
24 00 ... Oil Pressure						
Pump pressure with selector lever in D 1st gear						
Idle bar (psi)	6.0 ... 7.5 (86 ... 106)					
Kickdown bar (psi)	9.0 ... 11.0 (128 ... 156)					
Engine speed rpm	approx. 4,000					
2nd ... 4th gears Idle bar (psi)	4.6 ... 6.0 (66 ... 85)					
Kickdown bar (psi)	7.0 ... 9.0 (100 ... 128)					
Reverse gear Idle bar (psi)	11.0 ... 14.0 (157 ... 199)					
Kickdown bar (psi)	17.0 ... 20.0 (242 ... 284)					
Converter pressure with selector lever in D – CL closed – bar (psi)	maximum 0.7 (10)					
24 21 ... Input Shaft						
Axial play of input shaft mm (in.)	0.2 ... 0.4 (0.008 ... 0.016)					
24 30 ... Valve Body						
Distance adjusted between valve body and needle on throttle piston mm (in.)	11.5 (0.453)					

		325 iA	325 iA K	325 iXA	325 iXA K	324 dA	324 tdA
24 31 ... Primary Pump							
Radial play	mm (in.)	0.09 ... 0.14 (0.0035 ... 0.0055)					
Axial play	mm (in.)	0.03 ... 0.06 (0.0012 ... 0.0024)					
24 40 ... Torque Converter							
Converter diameter	mm (in.)	260 (10.236)					
Code		W 2				A 5	P 7
Stall speed	rpm	2100 ... 2300	2200 ... 2400	2100 ... 2300	2100 ... 2300	2150 ... 2350	2150 ... 2350
Journal diameter	mm (in.)	32 (1.260)					
24 61 ... Downshift Preventing Control Unit							
Bosch No.		0260 002 020	0260 002 032				

	320 iAK	325 iA	325 iAK	325 iXA	325 iXAK

24 00 ... Transmission in General

Designation		ZF - 4 HP - 22/EH	
Code on data plate		see Parts Catalog	
Ratios	1st gear	2.48	
	2nd gear	1.48	
	3rd gear	1.00	
	4th gear	0.73	
	reverse	2.09	
Oil grade		see Operating Fluids	
Total oil filling volume (transmission and torque converter empty)	ltr. (US/Imp. pts.)	7.5 (15.85 / 13.20)	
		320 iAK: 6.4 (13.53/11.26)	
Oil change volume (transmission at operating temperature)	ltr. (US/Imp. pts.)	3.0 (6.34 / 5.28)	

24 00 ... Shift Points

		320 iA K	325 iA	325 iA K	325 iXA	325 iXA K
Program E Selector lever in D Accel. pedal in partial throttle Shift at engine speed (rpm)	1–2	2000 ... 2300	2000 ... 2200			
	2–3	2300 ... 2500	2000 ... 2200			
	3–4	2700 ... 2900	2100 ... 2250			
	CL closed	2600 ... 2700	2300 ... 2400			
	CL opened	2100 ... 2300	1880 ... 2000			
Shift at road speed (km/h)	1–2	13 ... 18	17 ... 22			
	2–3	32 ... 38	30 ... 37			
	3–4	68 ... 73	53 ... 59			
	CL closed	89 ... 94	83 ... 89			
	CL opened	80 ... 86	77 ... 84			
Selector lever in D Accel. pedal in full throttle Shift at engine speed (rpm)	1–2	4800 ... 5300	4100 ... 4600			
	2- 3	4500 ... 4800	4300 ... 4800			
	3–4**	4800 ... 5000	4600 ... 4800			
	4–3**	2900 ... 3100	2800 ... 3000			
	3--2	2900 ... 3000	2700 ... 2900			
	2–1	2600 ... 2700	2400 ... 2500			
Road speed shift (km/h)	1–2	45 ... 51	47 ... 53			
	2–3	74 ... 79	83 ... 89			
	3–4**	131 ... 137	138 ... 144			
	4–3**	109 ... 114	116 ... 122			
	3–2	62 ... 68	66 ... 72			
	2–1	31 ... 37	31 ... 37			

* CL closed prior to shift

AUTOMATIC TRANSMISSION ZF – 4 HP – 22/EH 24 – 313		320 iA K	325 iA	325 iA K	325 iXA	325 iXA K	
24 00 ... Shift Points							
Program E Selector lever in D Accel. pedal in kickdown Engine speed shift (rpm)	1–2 2–3 3–4** 4–3** 3–2 2–1	5500 ... 6000 5700 ... 6000 6000 ... 6200 4300 ... 4400 3600 ... 3800 3000 ... 3200	5400 ... 5900 5600 ... 5900 6100 ... 6300 4300 ... 4500 3500 ... 3700 2900 ... 3100				
Road speed shift (km/h)	1–2 2–3 3–4** 4–3** 3–2 2–1	52 ... 58 95 ... 100 164 ... 170 160 ... 165 87 ... 92 43 ... 49	63 ... 69 110 ... 116 183 ... 189 177 ... 183 96 ... 102 51 ... 57				
Manual shift at engine speed (rpm)	4–3** 3–2 2–1	4300 ... 4400 3100 ... 3300 2400 ... 2700	4300 ... 4500 3000 ... 3200 2300 ... 2600				
at road speed (km/h)	4–3** 3–2 2–1	160 ... 166 89 ... 94 45 ... 50	178 ... 184 94 ... 100 50 ... 57				
Reverse gear interlock at road speed	km/h	4.6 ... 10.0	5.0 ... 11.0				

** CL closed prior to shift

AUTOMATIC TRANSMISSION ZF – 4 HP – 22/EH 24 – 314	320 iA K	325 iA	325 iA K	325 iXA	325 iXA K	
24 00 ... Oil Pressure						
Pump pressure – selector lever in D 1st gear						
Idle bar (psi)	6.0 ... 7.5 (86 ... 106)					
Kickdown bar (psi)	9.0 ... 11.0 (128 ... 156)					
Engine speed rpm	approx. 4,000					
2nd ... 4th gears Idle bar (psi)	4.6 ... 5.8 (66 ... 82)					
Kickdown bar (psi)	7.0 ... 9.0 (100 ... 128)					
Reverse gear Idle bar (psi)	11.0 ... 13.0 (157 ... 185)					
Kickdown bar (psi)	17.0 ... 20.0 (242 ... 284)					
Converter pressure selector lever in D and CL closed bar (psi)	max. 0.7 (10)					
24 21 ... Input Shaft						
Axial play of input shaft mm (in.)	0.2 ... 0.4 (0.008 ... 0.016)					

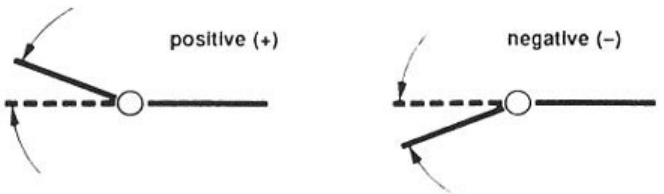
24 31 ... Primary pump		
Designation		ZF - 4 HP - 22/EH
Radial play	mm (in.)	0.09 ... 0.14 (0.0035 ... 0.0055)
Axial play	mm (in.)	0.03 ... 0.06 (0.0012 ... 0.0024)
24 40 ... Torque Converter		
Diameter	mm (in.)	260 (10.236) 320 iK: 230 (9.055)
Code		W 2 320 IK: V 2
Stall speed	rpm	2200 ... 2400 320 iK: 2200 ... 2500 325 iA: 2100 ... 2300
Journal dia.	mm (in.)	32 (1.260)
24 61 ... AEGS Control Unit		
Code letter		see Parts Catalog
24 61 ... Downshift Prevention Control Unit		
Bosch No.		0 260 002 022

26 00... Propeller Shaft In General

Grease for slide	Longterm 2 *
Grease for constant velocity joints	Optimol *
Volume of grease for constant velocity jouit g	80

Explanation of Deflection Angles:

Propeller shaft angled upwards = positive (+) deflection angle
Propeller shaft angled downwards = negative (–) deflection angle



* Source of Supply: BMW Parts

		3 Series E 30 Manual Transmission Engine M10 M40 M42 S14	3 Series E 30 Automatic Transmission Engine M10 M40 M42 S14
26 11 ... Propeller Shaft E 30			
Deflection torque of universal joints	Ncm	20 ... 70	20 70
Preload of center mount in forward direction	mm	4 ... 6	4 ... 6
Deflection angle Transmission / propeller shaft		- 0° 27' ... + 0° 33'	- 0° 25' ... + 0° 35'
Center mount		- 0° 48' ... + 0° 12'	- 0° 50' ... + 0° 10'
Propeller shaft / final drive		- 0° 10' ... + 0° 50'	- 0° 10' ... + 0° 50'

26 11 ... Propeller Shaft E 30

		3 Series E 30 Manual Transmission Engine M20 M21	3 Series E 30 Automatic Transmission Engine M20 M21	3 Series E 30 Four Wheel Drive
Deflection torque of universal joints	Ncm	20 ... 70	20 ... 70	20 ... 70
Preload of center mount in forward direction	mm	4 ... 6	4 ... 6	—
Deflection angle Transmission / propeller shaft		- 0° 47' ... + 0° 13'	- 0° 49' ... + 0° 11'	- 0° 42' ... - 1° 42'
Center mount		- 1° 10' ... - 0° 10'	- 1° 08' ... - 0° 08'	—
Propeller shaft / final drive		- 0° 10' ... + 0° 50'	- 0° 10' ... + 0° 50'	+ 0° 17' ... + 1° 17'

27 00 ... Transfer Box in General

Oil grade	approved ATF – see Service Information
Oil change volume (flows out of filler plug bore) ltr. (US/Imp. pts.)	0.5 (1.06/0.88)
New oil filling volume ltr. (US/Imp. pts.)	0.53 (1.12/0.93) *

27 11 ... Case and Cover

Visco clutch locking torque at 150 rpm Nm (ft. lbs.)	70 (51)
Temp. for bearing installation ° C (° F)	80 (175)

27 21 ... Transmission Shafts

Axial play between input and output shafts at shim mm (in.)	0.4 ... 0.6 (0.016 ... 0.024)
Radial runout of output journal mm (in.)	0.07 (0.0028)
Axial runout of output flange mm (in.)	0.07 (0.0028)

23 71 ... Transmission Bearings

Pressing-in force tons	2.4

* In case of a new filling, pour in part of the oil volume > 0.06 ltr. (0.13 US/0.11 Imp. pts.) through the removed vent.

31 10 ... Front Axle and Suspension

		3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
Track width/rim offset with car loaded down to normal position (see page 32-100)	mm	1405 / 35 *325 IX:* 1420 / 47 *M 3:* 1412 / 30 1418 / 27	1408 / 47 1418 / 42 *M3:* 1422 / 41	1470 / 20 / 19 *M 5:* 1474 / 20 *525IX:* 1468 / 54	1429 / 22 *M 635 CSI:* 1431 / 22	1530 / 20 1532 / 19	1554 / 15 *850CSI:* 1564 / 10
Wheelbase	mm	2570 *325 IX:* 2571	2703 *With power steering:* 2698 *M3:* 2710	2761	2678	2833 *750IL:* 2947	2687

		3 Series E 30 Sedan	3 Series E 30 Conv.	3 Series E 30 318iS 320iS-2	3 Series E 30 touring	3 Series E 30 320iS-4	3 Series E 30 4WD	3 Series E 30 M 3
31 10 ... Front Axle and Suspension								
Ride level height (lower edge of wheel house to rim flange at middle of wheel) with car loaded down to normal position (see page 32-100)	mm · 10							
	with 14" rim	565	570		565	565	565	
	with 15" rim	578	583		578	578	578	556
	with 16" rim							568
	with TD rim	569	574		569	569	569	
M-Technik running gear	with 14" rim	550	550	545; *AUS* 557	545		550	
	with 15" rim	563	563	558; *AUS* 570	558		563	
	with TD rim	554	554	549; *AUS* 561	549		554	
Without wheel house panel	with 14" rim						568	
	with 15" rim						581	
	with TD rim						572	
M-Technik running gear without wheel house panel	with 14" rim						553	
	with 15" rim						566	
	with TD rim						557	
Sport Evo	with 16" rim							572
Measuring and correcting car ride level height				refer to Model Repair Manual				
Max. deviation from nominal value for all wheels together	mm			10				

	3 Series E 36	3 Series E 36 M 3
31 10 ... Front Axle and Suspension		
Ride level height (lower edge of wheel house to rim flange at middle of wheel) with car loaded down to normal position (see page 32-100) mm · 10		
with 15" rim	576	
Sport running gear with lower position with 15" rim	561	
with 17" rim		585
Measuring and correcting car ride level height	refer to Model Repair Manual	
Max. deviation from nominal value for all wheels together mm	10	

	3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
31 21 ... Wheel Bearings						
Type	bearing units lubricated for entire service life and cannot be disassembled					
Max. axial runout of wheel hub mm	0.1					
31 31 ... Spring Strut Shock Absorbers						
Amount of oil filled between spring strut and absorber cartridge (all approved grades of engine oil) – excluding gas pressure absorbers cm^3	20 ... 25	—	*518I, 520I:* 42 ... 47	30 ... 35	20 ... 35	—
	325 IX: 14 ... 18		*524td ... 535I:* 20 ... 25 *525iX:* —			
Shock absorber test values	refer to Service Information of Gr. 37					

31 33 ... Springs

Important!
Only install pairs of springs with the same BMW number (located on end of spring) and same color code (either with or without stripe of red paint) on one axle.
Refer to the parts microfiche for a survey of springs to vehicle type and,if applicable, special equipment (such as: air conditioner, sport suspension, etc.) and date of introduction.

Part numbers can be determined with help of the BMW number on springs and therefore a spring found in the parts microfiche for a certain vehicle type.

Example:

1. Spring with red color code:
   number on spring, e.g. 1 125 332
   add 1 = part number 1 125 333

2. Spring without red color code:
   number on spring, e.g. 1 125 332
   add 2 = part number 1 125 334

Also refer to Model Repair Manual.

31 - 9 Front final drive unit		3 Series E30	5 Series E 34
31 50 . . . Front differential unit			
Lubricant: see Specifications for Fuels, Fluids and Lubricants			
Capacity (initial filling)	ltr.	0.7	0.7
31 52 . . . Ring and pinion assembly			
Tooth pattern		Gleason	Gleason
Number of teeth: Ring/pinion = Conversion ratio	i	*325iX:* 40 / 11 = 3.64	44/13 = 3.38
		325iX Cat A touring (sp)*:* 43 / 11 = 3.91	
		325iX A: 41 / 11 = 3.73	
		*325iX Cat *A touring:* 41 / 10 = 4.10	
Friction torque:			FAG: 1.47. . . 2.1
Pinion bearings (new bearings)	Nm	1.53. . . 3.19	Timken: 1.25. . . 2.65
Shaft seal installed	Nm	0.2	0.2
Backlash	mm	0.06 . . . 0.13	0.06 . . . 0.13

* (sp) = Sports transmission
* (cat) = catalytic converter

		3 Series E 30	5 Series E 34
31 52 ... Differential			
Residual axial play of shaft gears	mm	0.01 ... 0.07	0.01 ... 0.07
Differential bearing friction torque (new bearing)	Nm	1.18 ... 2.6	1.3 ... 2.6
31 60 ... Output Shaft			
Design		with constant velocity joints	with constant velocity joints
Grease filling for each joint	gr	80	80

32 00 ... Front Wheel Alignment

	3 Series E 30	3 Series E 30 M-Technic	3 Series E 30 Four Wheel Drive	3 Series E 30 Four Wheel Drive M-Technic
See page 32-100 for testing conditions!				
Total toe	0° 18' ± 5'	0° 18' ± 5'	0° ± 5'	0° ± 5'
Camber *	- 40' ± 30'	- 1° 10' ± 30' *318iS AUS:* - 1° ± 30'	- 1° ± 30' *touring:* - 1° 30' $^{+15'}_{-30'}$	- 1° 20' ± 30'
Toe difference angle * with 20° inside wheel lock	- 1° 40' ± 30'	- 1° 50' ± 30'	- 1° 10' ± 30'	- 1° 10' ± 30'
Kingpin inclination *				
with ± 10° wheel lock	13° 52' ± 30'	14° 22' ± 30'	12° 40' ± 30'	12° 40' ± 30'
with ± 20° wheel lock	14° 15' ± 30'	14° 45' ± 30'	12° 58' ± 30'	12° 58' ± 30'
Caster *				
with ± 10° wheel lock	8° 30' ± 30'	8° 46' ± 30'	1° 33' ± 30'	1° 33' ± 30'
with ± 20° wheel lock	8° 46' ± 30'	9° 03' ± 30'	1° 35' ± 30'	1° 35' ± 30'
Front wheel displacement	0° ± 15'	0° ± 15'	0° ± 15'	0° ± 15'
Maximum wheel lock				
Inside wheel approx.	41.3°	41.3°	37.7°	37.7°
Outside wheel approx.	33.9°	33.9°	33.8°	33.8°
Approx. turning circle m	10.5	10.5	11.1	11.1

* Deviation between left and right: max. 30'

32 00 ... Rear Wheel Alignment	3 Series E 30 Sedan touring 320iS-4	3 Series E 30 Convertible	3 Series E 30 M-Technic Sedan Convertible	3 Series E 30 M-Technic touring 320iS-2 318iS	3 Series E 30 4 Wheel Drive	3 Series E 30 4 Wheel Drive M-Technic
See page 32-100 for testing conditions!						
Total toe	0° 22' ± 7'	0° 23' ± 7'	0° 31' ± 7'	0° 28' ± 7'	0° 25' ± 7'	0° 30' ± 7'
Camber *	- 2° ± 30'	- 1° 50' ± 30'	- 2° 30' ± 30'	- 2° 20' ± 30' *318iS AUS:* - 2° ± 30'	- 2° ± 30'	- 2° 30' ± 30'
Geometrical axis deviation	0° ± 15'	0° ± 15'	0° ± 15'	0° ± 15'	0° ± 15'	0° ± 15'

* Deviation between left and right: max. 30'

32 00 ... Front Wheel Alignment

		M 3	M 3 Evo 90	
See page 32-100 for testing conditions!				
Total toe		0° 17' ± 5'	0° 17' ± 5'	
Camber *		- 42' ± 30'	- 55' ± 30'	
Toe difference angle * with 20° inside wheel lock		- 1° 50' ± 30'	- 1° 51' ± 30'	
Kingpin inclination * with ± 10° wheel lock		14° 11' ± 30'	14° 24' ± 30'	
with ± 20° wheel lock		14° 11' ± 30'	14° 24' ± 30'	
Caster * with ± 10° wheel lock		9° 8' ± 30'	9° 18' ± 30'	
with ± 20° wheel lock		9° 8' ± 30'	9° 18' ± 30'	
Front wheel displacement		0° ± 15'	0° ± 15'	
Maximum wheel lock Inside wheel	approx.	38°	38°	
Outside wheel	approx.	32.8°	32.8°	
Approx. turning circle	m	11.1	11.1	

* Deviation between left and right: max. 30'

32 00 ... Rear Wheel Alignment

	M 3 until 1989 models	M 3 since 1990 models	M 3 Evo 90
See page 32-100 for testing conditions!			
Total toe	0° 24' ± 7'	0° 28' ± 7'	0° 28' ± 7'
Camber *	- 2° 20' ± 30'	- 2° 20' ± 30'	- 2° 20' ± 30'
Geometrical axis deviation	0° ± 15'	0° ± 15'	0° ± 15'

* Deviation between left and right: max. 30'

		3 Series E 30	3 Series E 36
32 11 ... Steering Gear			
Slip torque – steering gear removed (within 360° = 1/2 steering wheel turn to each side from middle position)	Nm	0.9 ... 1.3	0.9 ... 1.1
Outside of middle position	Nm	max. 2.0	max. 2.0

32 13 ... Power Steering Gear

		3 Series E 30	3 Series E 36	5 Series E 34 4WD	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
Oil grade		see Operating Fluids						
Oil volume in hydraulic circuit	ltr.	1.2	1.2	1.2	1.2	2.0	2.4	
Oil volume in hydraulic circuit with ride level control	ltr.	1.6		1.8	1.8		3.0	2.4
Ratio					14.5 *M 5:* 13.5	13.5	14.5	13.5
Friction torque rise in pressure point in comparison with torque outside of middle position	Nm				0.4 ... 0.6	0.4 ... 0.6	0.4 ... 0.6	0.4 ... 0.6
Friction torque outside of pressure point measured on Steering wheel max.	Nm				1.4 *M 5:* 1.5	1.4	1.4	1.4
Steering gear max.	Nm				1.0	1.0	1.0	1.0
New condition	Nm				0.9 ... 1.2	0.9 ... 1.2	0.9 ... 1.2	0.9 ... 1.2
Friction torque in pressure point measured on Steering wheel	Nm				1.2 ... 1.8 *M 5:* 1.6 ... 2.2	1.2 ... 1.8	1.2 ... 1.8	1.2 ... 1.8
Steering gear	Nm				1.0 ... 1.4	1.0 ... 1.4	1.0 ... 1.4	1.0 ... 1.4
New condition	Nm				1.8 ... 2.0	1.8 ... 2.0	1.8 ... 2.0	1.8 ... 2.0

32 41 ... High Pressure Power Steering Pump / Tandem Pump

		3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
Rated pressure (with engine running at idling speed)							
Impeller pump	max. bar	110 ... 120	110 ... 120	130 ± 10 *4WD:* 110 + 10	100 ... 120 *M 635 CSi:* 110 ... 120	130 ± 10	130 ± 10
Piston pump	min. bar			120 *4WD:* 200		120	200

32 41 ... Narrow / Ribbed Drive Belt

	3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
Designation	*316 ... 318i:* 9.5 x 800 *320i:* 9.5 x 810 *325i:* 9.5 x 825 *324d/td:* 9.5 x 865	*M 40:* 9.5 x 730 *M 50:* 6k x 1560 *M51:* 5 PK x 1815	*M 30:* 9.5 x 865 *M 20:* 9.5 x 820 *M 5:* 9.5 x 825 *M 50:* 6k x 1560 *M51:* 5 PK x 1815	9.5 x 900	9.5 x 865 *M 70:* 6 K x 1080	6 K x 1080

	All Models except for →	→ E 24 E 31 Convertible M 3 M 5
Testing Conditions for Wheel Alignment		
Car loaded down to normal position	Car with complete equipment for normal driving with 2 x 68 kg on front seats (seats in middle position), 1 x 68 kg on rear seat (middle), 1 x 21 kg in trunk (middle) and full fuel tank.	Car with complete equipment for normal driving with 2 x 68 kg on front seats (seats in middle position), 1 x 14 kg in trunk (middle) and full fuel tank.
Wheel Alignment Test Conditions:		
1. Specified rims and tires	see Group 36	see Group 36
2. Uniformly worn tire treads		
3. Specified tire pressure	see label on car	see label on car
4. Specified wheel bearing play	see Group 31	see Group 31
5. Check car ride level height in normal position (see above). *Important!* Repair car if value deviates from specifications (refer to Repair Manual).	refer to Groups 31 / 33,	refer to Groups 31 / 33,
6. Specified car ride level height	Specified height ± 2 mm, refer to Groups 31 / 33, adjust be loading or unloading car.	Specified height ± 2 mm E 36 M 3 ± 1 mm, refer to Groups 31 / 33, adjust be loading or unloading car.

33 00 ... Rear Axle in General

		3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
Track width / rim offset with car loaded down to normal position (see page 32-100)	mm	1399 / 35 *325iX:* *1404 / 47* *M 3:* 1424 / 30 1430 / 27	1431 / 42 1421 / 47 *M 3:* 1444 / 41	1495 / 20 / 19 / 54 *M 5:* 1496 / 20	1432 / 22	1558 / 20 / 19	1562 / 15 *850 CSi:* 1554 / 19

33 00 ... Rear Axle and Suspension

	3 Series E 30 Sedan	3 Series E 30 Convertible	3 Series E 30 318IS 320IS-2	3 Series E 30 touring	3 Series E 30 320IS-4	3 Series E 30 4 Wheel Dr	3 Series E 30 M 3
Ride level height (lower edge of wheel house to rim flange at middle of wheel) with car loaded down to normal position (see page 32-100) mm · 10							
with 14" rims	505	510		505	505	510	
with 15" rims	518	523		518	518	523	529
with 16" rims							531
with TD rims	509	514		509	509	514	
M-Technic running gear with 14" rims	490	490	495;500 AUS	495		495	
with 15" rims	503	503	508;513 AUS	508		508	
with TD rims	494	494	499;504 AUS	499		499	
Without wheel house panel with 14" rims						513	
with 15" rims						526	
with TD rims						517	
M-Technic running gear without wheel house panel with 14" rims						498	
with 15" rims						511	
with TD rims						502	
Sport Evo with 16" rims							541
(Refer to Group 31 in Model Repair Manual for instructions on measuring the ride level height.)							
Max. deviation from nominal value among all wheels mm				10			

33 - 7 Final drive unit	3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
33 10 . . . Types K/M/G differential unit						
Lubricant	see Specifications for Fuels, Fluids and Lubricants	see Specifications for Fuels, Fluids and Lubricants	see Specifications for Fuels, Fluids and Lubricants	see Specifications for Fuels, Fluids and Lubricants	see Specifications for Fuels, Fluids and Lubricants	see Specifications for Fuels, Fluids and Lubricants
Capacity according to differential type* approx. ltr.	*K: 316 ... 324d* 0.9	*K: 316i...320i* 1.1	*M: 518 i... 530i* 1.7	*G:* 1.9	*M:* 1.7	*G:* 1.9
	M: 324td ... M 3 1.7	*M: 324td...M 3* 1.7	*G: 535i ... M 5* 1.9		*G:* 1.9	*G: 850CSi* 1.9
						(initial filling with cooling circuit 2.7 ltr.)

* Type K
= Four-bolt side cover
Type M
= Six-bolt side cover
Type G
= Eight-bolt side cover

33 12 . . . Final-drive conversion ratios
3 Series E 30

	3 Series E30 4-door sedan	3 Series E30 Touring	3 Series E30 Convertible
316	3.91		
316i	4.10 / from 09/88 4.27	4.27	-
316iA	3.91	4.45	-
318i	4.10		
318i Cat	4.10	4.27	4.27
318iA Cat	4.45	4.45	4.45
318iA Cat Switzerland/Austria	-	-	4.10
318is	4.10	-	-
320i	4.10	4.27	4.27
320iA	4.45	4.45	4.45

33 12 . . . Final-drive conversion ratios 3 Series E30	3 Series E30 4-door sedan	3 Series E30 Touring	3 Series E30 Convertable
324d	3.45	-	-
324dA	3.45	-	-
324td	3.25	3.25	-
324tdA	3.25	3.25	-
325i	3.73	3.	3.73
325i with Sports transmission	3.91		3.91
325iA	3.73	1	3.73
325iA USA/Canada/Australia	-	.	4.10
325iA Japan	-	.10	-
325iX	3.64	-	-
325iX with Sports transmission	3.91	-	-
325iXA	3.73	-	-
325iX at Cat	3.91	3.91	-
325iXA at Cat	3.91	4.10	-
325iXA Switzerland/Austria	-	3.91	-
325iXA Scandanavia	-	3.91	-
M3	3.25	-	3.25
M3 Evo.II/III	3.15 / Conversion to i= 3.25 possible	-	-

33 12 ... Drive Pinion and Backlash

Backlash	mm	0.06 ... 0.14
Ring gear installing temperature	°C	80 ... 100
Max. input flange radial runout	mm	0.07
Approx. shaft seal friction torque	Nm	0.20

			3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
Pinion bearing friction torque, according to differential type (see front) and bearing manufacturer. Note: Thoroughly lubricate bearings with differential lubricant*, allowing excess to drip off.								
K	FAG	Nm			1.60 . . . 3.36			
	SKF	Nm			1.40 . . . 2.60			
	Timken	Nm			1.45 . . . 2.65			
	Koyo	Nm			1.27 . . . 2.65			
M	FAG	Nm			1.58 . . . 3.26			
	SKF	Nm			1.30 . . . 2.50			
	Timken	Nm			1.25 . . . 3.40			
	Koyo	Nm			1.23 . . . 2.73			
G	FAG	Nm			2.20 . . . 5.19			
	SKF	Nm			2.00 . . . 4.30			
	Timken	Nm			2.30 . . . 5.16			
	Koyo	Nm			2.38 . . . 4.76			

* See BMW Specifications for Fuels, Fluids and Lubricants

REAR AXLE 33 - 20		3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
33 13 ... Differential							
Play between diaphragm spring / shim and differential side gear	mm	0.03 ... 0.1 *325iX:* 0.03 ... 0.08	0.03 ... 0.1	0.03 ... 0.1	0.03 ... 0.1	0.0 ... 0.07	0.0 ... 0.07

			3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
Friction torque on differential casing bearings (both), according to differential type (see front) and bearing manufacturer. Note Thoroughly lubricate bearings with differential lubricant*, allowing excess to drip off.								
K	FAG	Nm			1.18 . . . 2.62			
	SKF	Nm			1.20 . . . 2.40			
	Timken	Nm			1.28 . . . 2.60			
	Koyo	Nm			1.20 . . . 2.62			
M	FAG	Nm			1.10 . . . 2.44			
	SKF	Nm			1.00 . . . 2.00			
	Timken	Nm			0.70 . . . 2.56			
	Koyo	Nm			1.40 . . . 2.60			
G	FAG	Nm						
	SKF	Nm						
	Timken	Nm			1.80 . . . 3.80			
	Koyo	Nm			1.40 . . . 3.40			

* See BMW Specifications for Fuels, Fluids and Lubricants

REAR AXLE 33 - 22		3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32
33 14 Final Drive with Limited Slip Differential						
Slip torque with one each differential side gear held tight and driven (plates lubricated with approved final drive gear lube)	Nm	30 ... 50	30 ... 50 *324td ... M 3:* 50 ... 75	50 ... 75	50 ... 75	110 ... 130
Optional outer plate thickness	mm	1.9 / 2.0 / 2.1				
Inner plate thickness	mm	2.0				
33 19 Electro-hydraulic Limited Slip Differential						
Minimum gas charging pressure in pressure reservoir	bar			*525i 4WD:* 25		

REAR AXLE 33 - 23	3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
33 21 ... Output Shaft						
Grease filling for each joint (grease supplied with "dust cover" repair kit) g	80	80 *M 3:* Final dr. end 85 Wheel end 100	80	120	80	*850I Manual ECE:* 140 *Final drive end:* 85 *Wheel end:* 100
Cement for dust covers	Bostik 1513 red / Epple 4841 red			Bostik 1513 red / Epple 4841 red		
Sealing compound for end covers and protective caps	Curil T / Stucarit Dicht-Gel 309/4	Curil T / Stucarit Dicht-Gel 309/4	Curil T / Stucarit Dicht-Gel 309/4	Curil T / Stucarit Dicht-Gel 309/4	Curil T / Stucarit Dicht-Gel 309/4	Curil T / Stucarit Dicht-Gel 309/4

REAR AXLE 33 - 24	3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
33 41 ... Wheel Bearings						
Double-row, angular ball bearing lubricated for service life and not to be disassembled						
Max. axial wheel bearing play mm	0.05 ... 0.1	0.06 ... 0.08	0.06 ... 0.08	0.06 ... 0.08	0.06 ... 0.08	0.06 ... 0.08
33 52 ... Shock Absorbers						
Shock absorber test values	refer to Service Information of Gr. 37					

33 53 .. Coil Springs

Important!
Install only pairs of springs with same BMW number (located on end of spring) and same color code (either *with* or *without* stripe of red paint) on one axle.
Refer to the parts microfiche for a survey of springs to vehicle type and, if applicable, special equipment (e.g. air conditioner, sport suspension, etc.) as well as introduction dates.

The BMW number on the spring can be used to determine the part number and therefore springs on the parts microfiche belonging to a car.

Example:

1. Spring *with* red color code:
   number on spring, e.g. = 1 125 326
   add 1 for part number = 1 125 327

2. Spring *without* red color code:
   number on spring, e.g. = 1 125 326
   add 2 for part number = 1 125 328

34 00 ... Brakes In General

		3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
Brake fluid		refer to Operating Fluids					
Leak test with engine stopped; if applicable discharge vacuum reservoir by operating brake pedal firmly about 10 times							
Approx. force on pedal	N	500	500	500	675	500	500
Equal to approx. line pressure	bar	45 *since 4.87:* 40	38 *M 3:* 32	34	50	34 *H 31 system:* 30	25
Max. pressure drop within 2 min.		8 %	8 %	8 %	8 %	8 %	8 %
Brake booster function test (with engine running)							
Force on pedal	N	200	200	200	200	200	200
Line pressure	bar	70 ... 80 *since 4.87:* 60 ... 70	*9" Mastervac: (LSC 65)* 50 ... 60 *10" Mastervac: (LSC 80)* 63 ... 73 *M 3:* 50 ... 60	70 ... 90	70 ... 90	70 ... 90 *H 31 system:* 75	75

		3 Series E 30	6 Series E 24
34 11 ... Front Wheel Brakes			
Brake pads	Type	Textar T 444 *USA:* Jurid 506 *M 3:* Jurid 595 *USA:* Energit 582	Jurid 595
Min. pad thickness without backplate	mm	2.0	
Brake disc minimum thickness (MIN TH) is stamped in brake disc shell	mm	*solid:* 11.1 *vented:* 20.4 *M 3:* 23.4	23.4
Maximum machining limit per friction ring side (M-models may not be machined)	mm	0.8	0.8

		3 Series E 30	6 Series E 24
34 11 ... Front Wheel Brakes			
Max. thickness deviation within braking surface	mm	0.02	
Max. axial runout of braking surface (measured on largest diameter of braking surface)			
Disc installed	mm	0.2	
Disc removed	mm	0.05	
Surface finish of braking surfaces (fine ground)	Ra µ	1.5 ... 3.5	
Brake disc diameter	mm	260	282 *M 635 CSI:* 330

		3 Series E 30	6 Series E 24
34 21 ... Rear Wheel Brakes (Discs)			
Brake pads	Type	Jurid 508 *USA:* Jurid 506* *M3:* Jurid 547 *USA:* Energit 582	Jurid 508
Min. pad thickness without backplate	mm	2.0	
Brake disc minimum thickness (MIN TH) is stamped in brake disc shell	mm	8.4 *325iX touring:* 18.4	8.4
Maximum machining limit per friction ring side (M-models may not be machined)	mm	0.8	0.8

34 21 ... Rear Wheel Brakes (Discs)

		3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
Max. thickness deviation within braking surface	mm	0.02					
Max. axial runout (measured on largest diameter of braking surface							
Disc installed	mm	0.2					
Disc removed	mm	0.05					
Surface finish of braking surface (fine ground)	Ra µ	0.5 ... 3.5					
Brake disc diameter	mm	258 *325iX touring:* 255	280 *M3:* 312	300	272	300	324 *850CSI:* 328

		3 Series E 30	3 Series E 36	5 Series E 34
34 21 ... Rear Wheel Brakes (Drums)				
Brake liners (always use same type liners only on one axle)	Type	Energit 551 FF	Energit 551 FF	Energit 550
Machining limit "final size" /always machine both drums of one axle)	mm	229.5	229.5	251.0
Min. liner thickness	mm	1.5	1.5	1.5
Max. radial runout of braking surfaces	mm	0.05	0.05	0.05
Surface finish of braking surfaces (fine ground)	Ra µ	1.5 ... 3.5	1.5 ... 3.5	1.5 ... 3.5

		3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
34 33 ... Brake Booster							
Simple Mastevac	Type	T52/3/255 *since 4.87:* T52/4/255	*4 cyl.:* LSC 65 *6 cyl.:* LSC 80 *with ABS:* T52/4A/255	LSC 80			
Tandem Mastervac	Type	*4 wheel drive:* 8" 9" LSC115T		*M 5, touring, 4WD:* LSC 115 LT2		*6 cyl., 8 cyl.:* LSC 115 LT2	
Power flow regulator with reservoir Max. operating pressure in steering circuit	bar				130	130	130
Upper switching pressure	bar				52 ... 57	52 ... 57	52 ... 57
Lower switching pressure	bar				36 ... 41	36 ... 41	36 ... 41

		3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
34 41 ... Parking Brake							
Parking brake drum diameter	mm	160.8	160 *M 3:* 180	180	180	180	180
Max. radial runout of braking surface	mm	0.1					
Surface finish of braking surface (fine ground)	Ra µ	1.5 ... 3.5					
Min. brake liner thickness	mm	1.5					

BRAKES 34 - 14		3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
34 50 ... ABS							
Additional information		refer to Nominal Value microfiche					
34 51 ... Hydraulic Control Unit							
Hydr. control unit for ABS	Code	0 265 100 013 *M 3:* 0 265 200 035	34.51-1 158403 *since 05.92:* 34.51-1090428 *M 3:* 34.51-2227215	0 265 201 022	0 265 201 009 *M 635 CSI:* 0 265 201 008	0 265 201 020 *750I:* 0 265 201 022	0 265 201 020 0 265 201 022
Hydr. control unit for ABS/ASC + T	Code		34.51-1090700			0 265 106 013	0 265 106 013
Distance (A) between signal sender and pulse wheel (without bearing clearance) Front	mm	0.18 ... 0.71		0.18 ... 0.71	0.18 ... 0.71	0.18 ... 0.71	0.13 ... 0.91
Rear	mm	0.15 ... 0.88		0.15 ... 0.88	0.15 ... 0.88	0.15 ... 0.88	0.06 ... 0.89

34 52 ... Electronic Control Unit							
		3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
ABS	Code	0 265 103 004 *since 88:* 0 265 103 041 *325iX:* 0 265 105 011/ 019		0 265 100 045/ 049	0 265 100 021	0 265 100 045/ 049	0 265 100 045/ 049
ABS-ASC	Code					0 265 106 003	0 265 106 003
ABS-ASC + T	Code					0 265 106 005 0 265 106 013	0 265 106 003 0 265 106 013

PEDALS 35 - 1		3 Series E 30 a) M 20 engine b) M 40 engine	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
35 21 ... Brake Pedal							
Distance A* from lower edge of pedal to firewall	mm	235 $^{+10}$	225 $^{+10}$	245 $^{+10}$	246 $^{+10}$	245 $^{+10}$	245 $^{+10}$
Brake light switch adjusting distance B*	mm	6 $_{-0.5}$	—	6 $_{-0.5}$	6 $_{-0.5}$	6 $_{-0.5}$	—
Max. pull rod - reversing lever / stop distance A*	mm	—	—	0.5	—	0.5	—
35 31 ... Clutch Pedal							
Distance B* from lower edge of pedal to fire wall	mm	253 $^{+11}$	260 $^{+10}$	265 $^{+10}$	271 $^{+11}$	265 $^{+10}$	259 $^{+10}$
Over-center helper spring adjusting distance D*	mm	a) 33 b) —					

Specified distances are only reference values and do not consider installation tolerances. Distances without consideration for carpets.

* Refer to Repair Manual for checkpoints.

PEDALS 35 - 2		3 Series E 30 a) M 20 engine b) M 40 engine	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
35 41 ... Accelerator Pedal							
Full load stop screwed adjusting distance C*							
Manual transmission	mm	a) 52 b) 52	62	46	46	46	46
Automatic transmission	mm	a) 60 b) 51	54	54	51	54	54
EH transmission	mm	a) 60 b) —	51	51	51	51	51
Lubricant for bearings		Renocal FN 745 from Fuchs in Mannheim Glissando from VW 745 from Texaco					

Specified distances are only reference values and do not consider installation tolerances.
Distances without consideration for carpets.

* Refer to Repair Manual for checkpoints.

			3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
Control Distances for Pedals								
Spacing between accelerator pedal and brake pedal								
Manual transm.	J*	mm	50	50	65	65	65	65
Autom. transm.	K*	mm	62	60	60 + 10	71	60 + 10	70
Spacing between tunnel and brake pedal								
Manual transm.	F*	mm	132	135 ± 5	144	143	144 ± 5	144 ± 5
Autom. transm.	G*	mm	144	145 ± 5	140 + 10	156	150 ± 5	150 ± 5
Spacing between brake pedal and clutch pedal	H*	mm	50	50	60	50	60	60

Specified distances are only reference values and do not consider installation tolerances.
Distances without consideration for carpets.

* Refer to Repair Manual for checkpoints.

PEDALS	3 Series E 30
35 - 1 R	RHD

35 21 ... Brake Pedal Distances			
Control distance	A	mm	273
Pedal travel	C	mm	174 – 9

35 21 ... Pull Rod Distances			
Min. screwed-in depth	A	mm	21 + 1
Basic setting	B	mm	722.5 ± 1
Auxiliary distance	C	mm	639.5 ± 1
Distance from bore to end of pivot	D	mm	41.5

35 31 ... Clutch Pedal Distances			
Control distance	D	mm	269 + 11
Pedal travel	E	mm	151 + 11

35 41 ... Accelerator Pedal Distances					
Control distance	C		Manual Transmission	Automatic Transmission	Elec./Hydr. Transmission
M20 engine		mm	55	61	61
M40 engine		mm	47	52	

PEDALS	3 Series E 30
35 - 2 R	RHD

Pedal Side Spacing Control Distances			
Distance from tunnel to clutch pedal	F	mm	128 ± 5
Distance from tunnel to brake pedal	G	mm	187 ± 5
Distance between clutch and brake pedals	H	mm	52
Distance between brake and accelerator pedals	J	mm	52
Lubricant for bearing surfaces			Renocal FN 745 from Fuchs in Mannheim

		Steel Rims All Models	Aluminum Rims All Models
36 10 . . . Wheels			
Max. radial runout of tire (rim with tire)	mm (in.)	2.0 (0.079)	1.6 (0.063)
Max. axial runout of tire (rim with tire)	mm (in.)	2.0 (0.079)	1.6 (0.063)
Max. radial runout of rim	mm (in.)	1.0 (0.039)	0.6 (0.024)
Max. axial runout of rim	mm (in.)	1.0 (0.039)	0.6 (0.024)
Max. dynamic imbalance for each wheel	gcm	180	
Max. imbalance for each side	g	90	
Elimination of imbalance		up to 60 g with one weight or more than 60 g with two weights	
Approved rims and tires		see Service Information of Group 36	

	3 Series E 30	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31

37 00 ... General Data

Oil grade		refer to Operating Fluids	refer to Operating Fluids	refer to Operating Fluids	refer to Operating Fluids	refer to Operating Fluids
Approximate oil volume	ltr.	Circulating system 1.6	LAD/Circulating system 2.75	Hydraulic control unit 1.5	Hydraulic control unit 1.5	
				LAD/Circulating system 3.0	LAD/Circulating system 3.0	
Weight to adjust / check car ride level height	kg	200	200 *touring:* 280		200	

			3 Series E 30	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
37 12 ... Regulating Rod							
Basic length		mm	154 ± 1		139 ± 0.5	277.5 ± 0.5	
37 12 ... Shock Absorbers							
Shock absorber test			refer to Service Information for shock absorber test values				
37 12 ... Ride Level Height Control Valve							
LAD / Circulating System							
Pressure	P max.	bar	120 ± 5	120 ± 5	120 ± 5	120 ± 5	
	P min.	bar	30 ± 3	30 ± 3	30 ± 3	30 ± 3	

	5 Series E 34 touring and four wheel drive touring with sport running gear	5 Series E 34 M 5 touring	3 Series E 30 7 Series E 32 5 Series E 34 sedan models
37 12 ... Ride Level Height Control			
Ride level height (lower edge of wheel house to rim flange at center of wheel) with car loaded down to normal position (refer to page 32-100) in mm [+4]			refer to Group 33
15" rims	507		
16" rims	520	529	
17" rims		545	
TR 415 rims	521		
TD 390 rims	511		
Tolerance for ride level height control mm	+ 10	+ 10	
Ride level height control wheel camber warning switch in mm [+3]			
15" rims	517		
16" rims	530	529	
17" rims		545	
TR 415 rims	531		
TD 390 rims	521		

		3 Series E 30	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
37 21 ... Pressure Reservoirs						
Charging pressure at 20° C	bar	23 ± 0.5	23 ± 0.5	23 ± 0.5	23 ± 0.5	
37 21 ... LAD / Circulating System Pump						
Max. pressure at 20° C oil temperature	bar	> 120	> 120	> 120	> 120	
Circulating pressure at 20° C oil temperature	bar	20 ... 30	20 ... 30	20 ... 30	20 ... 30	
61 31 ... Hydraulic Switch - Hydraulic Control Unit						
Switching points						
High pressure	bar	110 ± 12	110 ± 12	110 ± 12	110 ± 12	
Low pressure	bar	28 ... 34	28 ... 34	28 ... 34	28 ... 34	

51 . . . Cements, Sealing Compounds

Arcella sheets on doors, carpets (only E 30 and E 24)	HWB Universal Cement
Weatherstrips on doors and trunk lid	HWB Profile Rubber Cement HWB Fast Drying Cement
Paintable seams	HWB Body Sealing Compound
Sheet metal screwed connections	Sealing Tape
Undercoating	BMW Undercoating from HWB 3 M Body Plast (anti-drumming effect) from HWB
Body protection for bores, damaged paint finish etc.	BMW Primer – BMW Parts Microfiche
Window cement (only E 30 / M 3, E 34, E 32)	Window Cement Repair Kit from HWB
Window repairs (stone damage)	Window Repair Kit from HWB
Rubber and plastic parts Hinges and door locks	Silicone Spray from HWB
Key holder light	Varta V 625 U 1.5 V 100 mAh
Infrared sender (only E 32)	Varta V 625 PX 1.35 V 350 mAh

ELECTRICAL SYSTEM 61 - 1	3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
61 20 ... Battery						
Rated voltage V	12					
Capacity in Ah (cold testing current in A)	46 (250) 50 (265) 66 (300) 90 (450)	46 (250) 50 (265) 65 (300) 75 (380) 85 (410)	50 (265) 75 (380) 85 (410)	66 (300) 90 (450)	84 (410) 85 (410) 92 (450)	65 (300)

	3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31

61 31 ... Switches

Oil pressure switch		
Switching-on pressure	bar	0.2 ... 0.5
Temperature switch for additional fan		optionally double temperature switch or single switches
Double temperature switch		
Switching-on temp. - stage I/II	°C	93 ± 3 / 103 ± 3
Switching-off temp. - stage I/II	°C	89 + 3 / 98 ± 3
Temperature switch 91° C		
Switching on/off temperature	°C	91 ± 2 / 84 + 2
Temperature switch 99° C		
Switching on/off temperature	°C	99 + 2 / 92 + 2

	3 Series E 30	3 Series E 36	5 Series E 34	6 Series E 24	7 Series E 32	8 Series E 31
61 31 ... Switches						
Door lock heating control unit Outside temp. in °C/heating time in sec.	- 15 / 27 ... 35 0 / 13 ... 10 + 25 / 5 ... 7	Central lock module controlled	Central body electronic controlled	- 15 / 27 ... 35 0 13 ... 10 + 25 / 5 ... 7	Central body electronics controlled	Central body electronics controlled
Current consumption of door lock heating ring A	3 ... 6	approx. 7	approx. 7	3 ... 6	approx. 7	approx. 7
Brake pad wear sensors Warning with pad thickness of at least mm	1.5					
maximum mm	3.5					
61 66 ... Windshield Washing Fluid Pump						
Min. delivery pressure bar	1.5					
61 67 ... Headlight Washing Fluid Pump						
Fog lamp/headlight pump at least bar		$2.5^{+0.5}$	$2.5^{+0.5}$		$2.5^{+0.5}$	$2.5^{+0.5}$
Dual pump left/right running at least bar		$2.5^{+0.5}$	$2.5^{+0.5}$		$2.5^{+0.5}$	$2.5^{+0.5}$

62 11 ... Coding Plug

Coding number (refer to Parts Catalog for part numbers)	*316 (only Belgium)* 01 *316i Cat./Cat. V.* 03 *324d (as replacement)* 05 *325i/4WD Conv.* 10 *M 3* 11 *320i without Cat/Conv.* 15 *320i Cat.* *325i Cat. Conv.* 15 *324td, 324 d* 16 *318i Cat.* 18	*M 635 CSi* 07 *635 CSi, 635 CSi Cat.* 19

All Models
except for
3 Series E 30 and 6 Series E 24

62 11 ... Coding Plug

Coding number	Coding via self-diagnosis — refer to Test Plan

62 12 ... Speedometer

		3 Series E 30		3 Series E 36	5 Series E 34	
Display range	km/h	200	240/260	220/260	240	260/280
Distance pulse K	Pulse/km	4 878	4 838	7 712	4 651	4 534
Displayed value/frequency	km/h / Hz	40/54	40/54	40/52	40/52	40/50
		80/108	80/108	80/104	80/103	80/101
		120/163	120/161	120/157	120/155	120/151
		160/217	160/215	160/209	160/207	160/202
		200/271	200/269	200/261	200/258	200/252
			240/326	240/313	240/310	240/302

LIGHTS 63 - 1		3 Series E 30	3 Series E 36	5 Series E 34
63 12 ... Headlights				
Light bulb for low beam ECE	Type	H 1 12 V 55 W	H 1 12 V 55 W	H 1 12 V 55
Light bulb for low beam USA	Type	9006	9006	9006
Light bulb for high beam ECE	Type	H 1 12 V 55 W	H 1 12 V 55 W	H 1 12 V 55 W
Light bulb for high beam USA	Type	9005	9005	9005
Light bulb for parking light	Type	H L 12 V 4 W	W 10/5 12 V 5 W	W 10/5 12 V 5 W
63 13 ... Front Turn Signals				
Light bulb ECE	Type	P 25-1 12 V 21 W	P 25-1 12 V 21 W	P 25-1 12 V 21 W
Light bulb USA	Type		12 V 21/5 W	12 V 21/5 W
63 13 ... Additional Front Turn Signals				
Light bulb ECE	Type	W 10/5 12 V 5 W	W 10/5 12 V 5 W	W 10/5 12 V 5 W
63 17 ... Front Fog Lamps				
Light bulb ECE	Type	H3 Y C 12 V 55 W	H 1 12 V 55 W	H 1 12 V 55 W
Light bulb USA	Type	9006	9006	9006

		3 Series E 30	3 Series E 36	5 Series E 34
63 21 ... Tail Light Assemblies				
Light bulb - brake light	Type	P 25-1 - 12 V 21 W	P 25-1 - 12 V 21 W	P 25-1 - 12 V 21 W
Light bulb - turn signal	Type	P 25-1 - 12 V 21 W	P 25-1 - 12 V 21 W	P 25-1 - 12 V 21 W
Light bulb - tail light	Type	R 19/10 - 12 V 10 W	R 19/10 - 12 V 10 W	R 19/5 - 12 V 5 W
Light bulb - rear fog light	Type	P 25-1 - 12 V 21 W	P 25-1 - 12 V 21 W	P 25-1 - 12 V 21 W
Light bulb - backup light	Type	P 25-1 - 12 V 21 W	P 25-1 - 12 V 21 W	P 25-1 - 12 V 21 W
63 26 ... License Plate Lights				
Light bulb	Type	C 11 - 12 V 5 W	C 11 - 12 V 5 W	C 11 12 V 5 W

63 31 ... Interior Lights

		3 Series E 30	3 Series E 36	5 Series E 34
Inside reading lamp front	Type		halogen 12 V 10 W	
Inside reading lamp rear	Type		soffit 12 V 10 W	
Pass. compartment lamp front	Type		soffit 12 V 10 W	soffit 12 V 15 W
Pass. compartment lamp rear	Type		soffit 12 V 5 W	K - 12 V 10 W
Pass. compartment lamp	Type	K - 12 V 10 W		
Trunk light	Type	C 11 - 12 V 5 W	soffit 12 V 10 W	K - 12 V 10 W
Glove box light	Type	a) T 8/4 - 12 V 4 W b) C 11 - 12 V 5 W	soffit 12 V 5 W	C 11 - 12 V 5 W
Engine compartment light	Type	L - 12 V 5 W	soffit 12 V 10 W	L - 12 V 5 W
Symbol light bulbs	Type	W 12/1.2 - 12 V 1.2 W	W 12/1.2 - 12 V 1.2 W	W 12/1.2 - 12 V 1.2 W
LCD module display	Type			W 5/1.2 - 12 V 1.2 W
Footwell entrance lamp	Type			
Make-up light	Type		soffit 12 V 5 W	

		3 Series E 30	3 Series E 36	5 Series E 34
64 11 ... Control Unit				
Code		see Parts Catalog	see Parts Catalog	see Parts Catalog
Operating voltage	V	0 ... 15	9 ... 15	0 ... 15
Control range	°C	14.5 ± 3 ... 55.5 ± 4.5		14.5 ± 3 ... 55.5 ± 4.5
Timing (for water valve)	sec.	3.3 ± 0.7	3.6	3.3 ± 0.7

	3 Series E 30	3 Series E 36	5 Series E 34
64 11 ... Inside Temperature Sensor			
Code (without air conditioner)	see Parts Catalog		see Parts Catalog
Resistance depending on temperature °C/kΩ	0 / 32.4 ... 37.7 5 / 24.8 ... 28.9 10 / 19.4 ... 22.1 15 / 15.1 ... 17.2 20 / 12.0 ... 13.3 25 / 9.5 ... 10.5 30 / 7.5 ... 8.4 35 / 5.9 ... 6.8 40 / 4.7 ... 5.4		0 / 32.4 ... 37.7 5 / 24.8 ... 28.9 10 / 19.4 ... 22.1 15 / 15.1 ... 17.2 20 / 12.0 ... 13.3 25 / 9.5 ... 10.5 30 / 7.5 ... 8.4 35 / 5.9 ... 6.8 40 / 4.7 ... 5.4
Resistance between connections 1 and 3 (PTC resistance) only at 25° C (only with air conditioner) Ω	24.5 ... 42		24.5 ... 42

	3 Series E 30	3 Series E 36	5 Series E 34

64 11 ... Heater Temperature Sensor

Code	see Parts Catalog
Resistance depending on temperature °C/kΩ	- 20 / 84.39 ... 109.61 - 10 / 48.58 ... 62.09 0 / 28.89 ... 36.40 20 / 11.13 ... 13.83 25 / 9.00 ... 11.00 60 / 2.19 ... 2.78 100 / 0.58 ... 0.77

64 ... Intake Air Temperature Sensor

Code			1 378 850
Resistance depending on temperature °C/kΩ			0 / 2.69 ... 3.46 10 / 1.74 ... 2.11 20 / 1.15 ... 1.32 25 / 0.95 ... 1.05 30 / 0.76 ... 0.87 30 / 0.76 ... 0.87 40 / 0.49 ... 0.60

64 11 ... Blower Motor

Code		3 Series E 30	3 Series E 36	5 Series E 34
		see Parts Catalog	see Parts Catalog	see Parts Catalog
Testing voltage	V	13 ± 0.26	13 ± 0.26	13 ± 0.26
Operating voltage	V	9 ... 15	9 ... 15	9 ... 15
Approx. current consumption	A	12	29	12
Maximum speed	rpm	3600 ... 4000	3600 ... 4000	3600 ... 4000
Max. axial play	mm	1.0	1.0	1.0

HEATER AND AIR CONDITIONER 64 - 15		3 Series E 30	3 Series E 36	5 Series E 34
64 50 ... Air Conditioner in General				
Refrigerant volume R 12 *	g	975 ± 25	1200 ± 25	1925 ± 25
		M 3: 875 ± 25	—	*M 5, td:* 1500 ± 25
R 134 a *	g	800 ± 25	1000 ± 25	*with round pipe condenser:* 1550 ± 25 *with flat pipe condenser:* 1450 ± 25
Min. charging pressure	bar	10	10	10
Refrigerant machine oil R 12		81 22 9 407 028 *	81 22 9 407 028 *	81 22 9 407 028 *
R 134 a		81 22 9 407 724 *	81 22 9 407 724 *	81 22 9 407 724 *
Volume for R 12 compressors Drum-type compressor	cm^3	300	—	300
Impeller-cell compressor	cm^3	200	200	200
for R 134 a compressors Nippondenso	cm^3	—	120 ± 20	180 ± 20
Seiko Seiki	cm^3	—	120 ± 20	160 * 30
Solenoid clutch current consumption	A	3.3	3.3	3.3

* Source of Reference: Parts and Accessories Catalog

All Models

64 50 ... Air Conditioner in General

Amount of refrigerant machine oil filled after replacement of		
Drier	g	10
Evaporator	g	approx. 40
Condenser	g	20
Pipe	g	approx. 10

All Models

64 51 ... Evaporator Sensor

Resistance depending on temperature	°C/kΩ	- 5 / 11.4 ... 11.9 0 / 8.8 ... 9.2 5 / 6.8 ... 7.2 10 / 5.3 ... 5.6 15 / 4.2 ... 4.5 20 / 3.3 ... 3.6 25 / 2.6 ... 2.9 30 / 2.1 ... 2.3 35 / 1.7 ... 1.9

64 51 ... Expansion Valve

Inlet pressure	bar	14
Outlet pressure	bar	1.8
Leak test with leak detector at pressure of	bar	1 ... 2

64 53 ... Safety Switch (Single Switch — High Pressure Pressostat)		
Testing voltage	V	13 ± 0.26
Switching-off pressure (with dropping pressure)	bar	25.2 ... 27.7
Switching-on pressure (with rising pressure)	bar	20.0 ... 22.5
Operating pressure	bar	0.034 ... 35
64 53 ... Safety Switch (Low Pressure Pressostat)		
Testing voltage	V	13 ± 0.26
Switching-off pressure (with dropping pressure)	bar	1.72 ... 2.22
Switching-on pressure (with rising pressure)	bar	2.0 ... 2.4
Operating pressure	bar	0.034 ... 35

00-1

Tightening Torque Reference Values

Applicable only for shank bolts with standard and fine metric threads to DIN 13, sheet 13, and nuts with a nut height of 0.8 x d to DIN 934 and exclusively for μ total = 0.125 (bolt phosphated, nut without surface treatment or galvanized; lubricated state: not lubricated or also lubricated with oil).

The tightening torque for cadmium-plated bolts or nuts (μ total ≈ 0.08 to 0.09) must be ≈ 30 % less than that in the table when the degree of bolt material exploitation is the same.

The values given in this table are applicable to bolted connections conforming with the conditions described above.

Not applicable with use of different surface treatment or lubricated state of threads as well as with deviating nut height.

Not applicable for bolts with expansion shanks, self-locking bolts or nuts as well as for the bolting together of parts made of different materials.

	Max. Tightening Torque Msp (Nm)							
Threads	Property Class to DIN 267							
	5.6	5.8	6.6	6.8	6.9	8.8	10.9	12.9
M 4	1.3	1.8	1.6	2.1	2.4	2.9	4.1	4.9
M 5	2.7	3.6	3.2	4.3	4.8	5.9	8.3	10
M 6	4.7	6.2	5.6	7.5	8.4	9.9	14	16.5
M 8	11	15	14	18	20	24	34	40
M 8 x 1	12	16	14.5	19.5	22	26	36	44
M 10	23	30	27	36	40	47	66	79
M 10 x 1	25	34	30	40	45	54	75	91
M 12	39	52	47	62.5	70	82	115	140
M 12 x 1.5	41	54.5	49	65.5	73.5	87	123	147
M 14	62	82.5	74.5	99	110	130	180	220
M 14 x 1.5	67	89.5	80.5	107	120	143	200	240
M 16	94.5	126	113	150	170	200	280	340
M 16 x 1.5	101	135	121	162	182	216	303	364
M 18	130	174	166	209	235	280	390	470
M 18 x 1.5	147	195	176	234	264	313	440	527
M 20	184	245	220	295	330	390	550	660
M 20 x 1.5	204	272	245	326	367	435	612	734

Extracted from BMW Standard N 600 02.0

			Type	Nm
11 11	**Engine block**			
1AZ	Main bearing cap bolts* Cleaned and lubricated	M10	M10 / M20 / M30	60
			M21	65
			M88-3 / S38 / S14 / M40 / M43 M42 / M50 / S50 / M51	1. Initial torque 20 2. Turn additional 50°
2AZ	Main bearing cap bolts* Do not remove coating from bolts		M70 / M60 / S70	1. Initial torque 20 2. Turn additional 70°

* Assemble engine with new bolts

			Type	Nm
11 11	Engine Block			
3AZ	Main bearing cap inclined bolts Collar bolts** or spacer bolts	M8	M60	1. 20 Nm torque 2. 45° torque angle
	Hex. head bolts	M8 10.9	M70 / S70	34 **
	Threaded support sleeves		M70 / M60 / S70	10
4AZ	Struts/bracing shell	M10	All	43
		M8	All	22
5AZ	Coolant drain plug in crankcase	M12x1.5	All	30
		M14x1.5	M70 / S70 / M60	28
			All others	40
6AZ	Main oil bore plugs	M16x1.5	All	34

** When repairing replace hexagon head bolts with washers against collar bolts.

		Type	Nm
11 12	Cylinder head and Cover		
1AZ	Cylinder head bolts *	M10	1. 60 NM torque 15 minute settling time 2. 33 ± 3° torque angle 25 minute warm-running time 3. 25 ± 5° torque angle

* Replace, wash and oil cylinder head bolts.

			Type	Nm
11 12	Cylinder Head and Cover			
2AZ	Cylinder head bolts *			
	Hexagoh head bolt **	M10	M20	1. 40 + 5 Nm torque 15 minute settling time 2. 60 + 5 Nm torque 25 minute warm-running time 3. 25 + 5° torque angle
	Torx head bolt **	M10	M20	1. 30 Nm torque 2. 90° torque angle 3. 90° torque angle No settling time No warm-running time

* Replace, wash and oil cylinder head bolts.
** When repairing, only use Torx head bolts.

		Type	Nm
11 12	Cylinder Head and Cover		
3AZ	Cylinder head bolts *	M21	1. 50 + 10 Nm torque 2. 90 ± 5° torque angle for bolts 1-10 73 ± 3° torque angle for bolts 11-14 15 minute warm-running time 3. 90 ± 5° torque angle
4AZ	Cylinder head bolts *	M30	1. 60 ± 2 Nm torque 20 minute settling time 2. 80 ± 2 Nm torque 25 minute warm-running time 3. 35 ± 5° torque angle

* Replace, wash and oil cylinder head bolts.

			Type	Nm
11 12	Cylinder head and cover			
5AZ	Cylinder head bolts*	M11	M51	1. Initial torque 80 2. Loosen all bolts 1/2 turn 3. Initial torque 50 4. Turn additional 90° 5. Turn additional 90° Run engine 25 min. 6. Turn additional 90°
6AZ	Cylinder head bolts*	M10 M11	M40 / M42 / M43 / M50 S50	1. Initial torque 30 2. Turn additional 90° 3. Turn additional 90°

* Replace, clean and lubricate cylinder head bolts

			Type	Nm
11 12	Cylinder Head and Cover			
7AZ	Cylinder head bolts *			
	Hexagon head bolt **	M10	M70	1. 30 Nm torque 15 minute settling time 2. 120° torque angle
	Torx head bolt **	M10	M70 / S70	1. 30 Nm torque 2. 120° torque angle
8AZ	Cylinder head bolts *	M10	M60	1. 30 ± 2 Nm torque 2. 80° torque angle 3. 80° torque angle

* Replace, wash and oil cylinder head bolts.
** When repairing, only use Torx head bolts.

			Type	Nm
11 12	Cylinder Head and Cover			
9AZ	Cylinder head bolts *	M12	M88-3 / S38 B35 / S14	1. 50 Nm torque 2. 80 Nm torque 15 minute settling time 3. 100 Nm torque
10AZ	Cylinder head bolts *	M12	S38 B36 / S38 B38	1. 20 Nm torque 2. 60° torque angle 3. 70° torque angle

* Replace, wash and oil cylinder head bolts.

			Type	Nm
11 12	Cylinder Head and Cover			
11AZ	Cylinder head cover	M6	All	10
		M7	All	15
		M8	M21	15
12AZ	Oil trap to cylinder head cover	M8	M21	17
13AZ	Timing case to cylinder head	M7	All	15
		M8	All	20

			Type	Nm
11 13	Oil Pan			
1AZ	Oil drain plug			
	Wrench size 17 mm	M12x1.5	All	35
	Wrench size 19 mm	M22x1.5	All	60

			Type	Nm
11 14	Housing covers			
1AZ	Timing chain cover, upper and lower	M6	all	10
		M8	all	22
		M10	all	47
2AZ	Front/rear end cover to engine block	M6	all	10
		M8	all	22
3AZ	Studs to timing chain cover		M51	65

		Type	Nm
11 22	Flywheel		
1AZ	Flywheel to crankshaft		
		M40 / M42 / M43 M51Automatic	120 *
		M60 manual transmission	105 **
		all others	105 *

* Assemble with new microencapsulated bolts.

** T50 Torx bolts for dual mass flywheel
Do not use bolt locking fluid.
Bolts form an integral part of the flywheel.
Lubricate threads of bolts.

			Type	Nm
11 23	Vibration Damper			
1AZ	Pulley to crankshaft		M10	190
2AZ	Vibration damper hub to crankshaft *	M18x1.5	M20 / M21 / M50	410
		M24x1.5	M30 / M88-3 / S14 / S38 B35	440
		M18x1.5	M51 / M60 / M70 / S70	1. 100 + 10 Nm torque 2. 60° torque angle 3. 60° torque angle 4. 30° torque angle
		M20x1.5	S38 B36	1. 150 Nm torque 2. Loosen 3. 60 Nm torque 4. 60° torque angle 5. 60° torque angle 6. 30° torque angle
		M12x1.5	S38 B38 / S50 B30	1. 60 Nm torque 2. 50° torque angle 3. 50° torque angle

* Replace bolts.

			Type	Nm
11 23	**Harmonic balancer**			
3AZ	V-belt pulley and harmonic balancer at hub	10.9 M8 bolt	S38 B36 / S38 B38	34
		M8	all others	22
4AZ	V-belt pulley to harmonic balancer	8.8 M8 bolt	S38 B36 /S38 B38 /S50 B30	22
5AZ	Toothed-belt pulley with hub/ hub to crankshaft*	M16x1.5	M40	310
			M42 / M43	330

* Use new bolts for assembly

		Type	Nm
11 24	Connecting rods and bearings*		
1AZ	Rod bolts*	M10 / M30	55
		M20 / M21 / M40 / M42 / M43 M50 / M51 / M70 / S70	1. Initial torque 20 2. Turn additional 70°
		M60	1. Application torque 5 2. Initial torque 20 3. Turn additional 80°
		M88-3	1. Initial torque 30 2. Turn additional 50°

* Replace, clean and lubricate rod bolts

		Type	Nm
11 24	Connecting Rods and Bearings		
1AZ	Conrod bolts *	S14 / S38 B35 / S38 B36 S38 B38	1. 15 Nm torque 2. 30 Nm torque 3. 60° torque angle
		S50 B30	1. 20 Nm torque 2. 65° torque angle

* Replace, wash and oil conrod bolts.

				Type	Nm
11 28		Poly-V-belt with tensioner and idler pulley			
	1AZ	Idler lever to alternator bracket	M10 * 10.9	M43	90

* Use new bolt for assembly

				Type	Nm
11 31	Camshaft				
1AZ	Camshaft bearing cap		M6	all	10
			M7	all	15
			M8	all	20
2AZ	Toothed-belt pulley to camshaft		M10	M20 / M21 / M40	65
3AZ	Chain sprocket to camshaft flange		M6	M60	15
				all others	10
			M7	M50 / M50 VANOS	1. Application torque 5 2. Joining torque 22
				all others	15
4AZ	Chain sprocket to camshaft			M51	1. Joining torque 20 2. Turn additional 35°
5AZ	Spline to intake camshaft		M14 x 1,5	M50 VANOS	1. Joining torque 40 2. Turn additional 60°

			Type	Nm
11 31	Camshaft			
6AZ	Flange to camshaft		M30	145
7AZ	Chain tensioner screw plug	M22x1.5	M50	50
			all others	40
8AZ	Cylinder for chain tensioner plunger	M26x1.5	M50	70
			all others	50
9AZ	Bearing flange to engine block	M6 x 20	M60	13

			Type	Nm
11 33	Rocker arms and bearings			
1AZ	Lock screw in rocker arm	M6	M10 / M20 / M30	10
	Lock screw in rocker arm	M6	M21	8

			Type	Nm
11 35	Layshaft			
1AZ	Toothed-belt pulley to layshaft	M10	M20 / M21	60

			Type	Nm
11 36	Variable valve timing			
1AZ	4/2 directional-control valve to VANOS casing		M50 VANOS	30
2AZ	Banjo bolt to VANOS controller	M14x1.5	M50 VANOS	32
3AZ	Plug screw to VANOS controller	M22x1.5	M50 VANOS	50
4AZ	Plug screw to hydraulic plunger	M36x1	M50 VANOS	60
5AZ	VANOS hydraulic line to oil filter assembly bracket		M50 VANOS	50
6AZ	Collar nut to spline	M6	S50 B30	8
7AZ	Cover to VANOS controller	M5 *	S50 B30	4
8AZ	Filter screw to VANOS controller		S50	12

* Secure bolts with Loctite

			Type	Nm
11 41	Oil pump with filter screen and drive			
1AZ	Screw plug for pressure-relief valve		M10 / M30	40
			M20	30
2AZ	Oil pump to engine block	M8	all	22
3AZ	Oil pump cover	M6	all	10
4AZ	Chain sprocket to oil pump	M6	M10 / M30	10
		M10	M60	47
		Left-hand thread M10x1	M50 / S50	25
		M10x1	all others	25

			Type	Nm
11 42	Oil filter and lines			
1AZ	Disposable filter (cartridge)		all	hand tight (according to manufacturer's instructions)
2AZ	Full-flow oil filter element (cover)	M8	all	22
		M10	all	33
		M12	all	33
		Cover bolt	all	25
3AZ	Oil filter housing (line) to block	M8	all	22
		M20x1.5	M20 B25	40

			Type	Nm
11 42	Oil filter and lines			
4AZ	Oil filter drain plug			
		Banjo bolt	M21 / M88-3 / S38	20
		Aluminum bolt	M21	10
		Bolt in threaded insert	M21	23
5AZ	Oil drain line at oil filter and upper pan section (banjo bolt)		M60 / M70 / S70	30
6AZ	Oil lubrication line to bearings and camshafts	M6	all	10
7AZ	Oil line to cylinder head for camshaft lubrication	Banjo bolt M8x1	all	10
		M5	all	5

			Type	Nm
11 42	Oil filter and lines			
8AZ	Oil radiator oil lines to oil filter housing	M8	all	22
9AZ	Oil lines to turbocharger	M8	all	22
10AZ	Oil lines from turbocharger to engine block			
	Banjo bolt	M16x1.5	all	40
11AZ	Oil line to turbocharger			
	Banjo bolt		all	25
	Union nut		all	30

			Type	Nm
11 51	Water pump and drive			
1AZ	Water pump to engine block	M8	all	22
		M6	all	10

			Type	Nm
11 52	Fan			
1AZ	Fan clutch to water pump Union nut	Left-hand thread	all	40

			Type	Nm
11 53	Thermostat and connections			
1AZ	Thermostat housing	M6	all	10
2AZ	Bleed screw	M8	all	8

			Type	Nm
11 61	Intake manifold			
1AZ	Intake manifold to cylinder head	M8	all	22
		M7	all	15
		M6	all	10
2AZ	Sound insulation shield to bracket	M6	M60	8

			Type	Nm
11 62	Exhaust manifold			
1AZ	Exhaust manifold to cylinder head*	M6	all	10
		M7	M50	20
			all others	15
	Install upper row of studs with locking fluid	M8	all	22
	Retorque after 2000 km Loosen bolt first	M8	M21	12

* Apply Molykote HSC paste to exhaust nuts and bolts.

			Type	Nm
11 62	Exhaust manifold			
2AZ	Exhaust manifold to cylinder head*	M10	M30 / 745i Turbo	
	When mounting on new cylinder head or with new studs			28
	Subsequent mounting			15
	Retorque after 2000 km Loosen bolts first Install studs with Molykote HSC			15
	Protrusion from head: Short studs Long studs	 88 + 1.0 mm 98 + 0.5 mm		

* Apply Molykote HSC paste to exhaust nuts and bolts.

			Type	Nm
11 65	Intake boost unit with control device			
1AZ	Turbocharge to exhaust manifold	M10	M21	25
			M30 / M51	45
2AZ	Bypass valve to charge tract	M8	M30	25
3AZ	Ring nut to exhaust manifold		M30	220
4AZ	Bolts on recirculation valve	M6	M30	10
5AZ	Charge tract to exhaust manifold	M8	M30	22
6AZ	Oil return flange to turbocharger	M8	M30	22
7AZ	Oil return line to turbocharger	Banjo bolt	M51	10
8AZ	Threaded plug to oil return	M16	M30	45
9AZ	Control line to bypass valve/turbocharger		M30	30

				Type	Nm
11 66	Vacuum pump				
1AZ	Vacuum pump to cylinder head		M6	all	10
			M8	M51	22
		microencapsulated	M9	M51	22

		Type	Nm
11 78	Emissions-control, Lambda oxygen sensor		
1AZ	Lambda sensor	all	55

			Type	Nm
11 81	Engine mounts			
1AZ	Rubber bushing to front suspension subframe	M8	all	22
		M10	all	42
2AZ	Rubber bushing to engine support bracket	M8	all	22
		M10	all	42
3AZ	Engine support bracket to engine	M8	all	22
		M10	all	42

		Type	Nm
12 11	Distributor		
1AZ	Distributor	M20	22
		M10, M30	10
2AZ	Distributor rotor to adapter with DME	All	2.8
3AZ	High tension distributor cap	All	4

12-2 Engine electrical system

			Type	Nm
12 12	Spark plugs			
1AZ	Spark plugs (unlubricated)	M 12 x 1.25	S 14, M 88-3, S 38, S 50	25
		M 14 x 1.25	M 10, M 20, M 30, M 40, M43 M 50, M 60, M 70, S 70	30
12 13	Ignition coil			
1AZ	Primary connections	Kl. 1	all	3.0
		Kl. 15	all	4.5

		Type	Nm
12 14	Electronic Switch or Control Units		
1AZ	TCI control unit	All	2.5
2AZ	Knock sensor	745 IA	13
		All	20
3AZ	Speed and reference mark senders	All with DME	7

		Type	Nm
12 21	Preheating Relay		
1AZ	Terminal 30 wire to glow plug relay	M51	4
2AZ	80 A fuse for glow plug relay	M51	2
12 23	Glow Plugs		
1AZ	Glow plug	M21	25
2AZ	Glow plug 4"	M21, M51	20
3AZ	Wire to glow plug	M21, M51	4

			Type	Nm
12 31	Alternator with drive and mountings			
1AZ	Wires to alternator			
		Kl. D+	M 10, M 20	5
			all others	7
		Kl. B +	S 38 B38	8
			all others	13
2AZ	Pulley		all	45
3AZ	Pulley (poly-V-belt)		all	55
4AZ	Rear bracket		all	3.5
5AZ	Cylinder bolt for wiring bracket		all	3.5

			Type	Nm
12 41	Starter and Mounting Parts			
1AZ	Starter		All	50
2AZ	Support to starter	M5	All	5
3AZ	Support to crankcase		All	47
4AZ	Wires to starter			
	Terminal 30h	M5	All	5
	Terminal 50	M6	All	6
	Terminal 30	M8	All	12

			Type	Nm
12 42	Starter Wiring			
1AZ	Battery positive connection point in power distributor	M8	E32, E34, E31	8
2AZ	Battery positive connection point in power distributor	M8	E36	20
12 52	Plug Connectors, Terminals			
1AZ	Holder for modules	M6	E36	9
2AZ	Ground connections Flange nut		E36	16

		Type	Nm
12 61	Oil pressure, oil temperature, oil level display		
1AZ	Oil pressure switch Note: Lubricate threads	M 10, M 40, M 42 M 21, M 51, M 20, M 50, M30, M 60, M 70, S 70	40
		M 88-3, S 14, S 50, S 38, M 43	20

		Type	Nm
12 62	Coolant Temperature		
1AZ	Temperature sensor to water flange (glow time/coolant temperature gage)	M21	18
		M51	13
2AZ	Temperature switch (5.5° C / 17° C) to fuel filter / cylinder head	M21	18
3AZ	Coolant temperature sensor	S38, S50	13
		All others	20
4AZ	Temperature gage sender to cylinder head	All	19
5AZ	Temperature gage sender to coolant flange	S50	13
6AZ	Temperature sensor - air	S50, S38	13
7AZ	Temperature sensor - oil	S50, S38	13

		Type	Nm
12 63	Switches and Relays		
1AZ	Temperature switch for electronic box	E32, E34, E31	15
12 72	Senders for Control Unit		
1AZ	Lever to pedal value sender	All	9
2AZ	Pedal value sender to pedal console	All	5

		Type	Nm
12 90	Control Unit Box		
	Assembly of upper and lower sections	E32, E34, E36	5
	Center section to body	E32, E34	3

			Type	Nm
13 11	Carburetor			
1AZ	Carburetor to intake manifold		All	10
2AZ	Carburetor to insulating flange		All	10
3AZ	Insulating flange to intake manifold		All	10
3AZ	Idling shutoof valve	max.	All	5
4AZ	Flow valve	max.	All	28
5AZ	Throttle valve assembly to float housing	max.	All	9
6AZ	Throttle valve neck to intake manifold		All	10
7AZ	Throttle valve control to carburetor	max.	2 BE	3
8AZ	Warm-up regulator to engine		All	23

			Type	Nm
13 31	Fuel Pump with Drive and Pipes			
1AZ	Fuel pump to engine		All	12
2AZ	Fuel pipe coupling bolt	M8	All with K-Jetronic	9
3AZ	Fuel pipe coupling bolt	M12	All with K-Jetronic	20
4AZ	Fuel pipe to pressure regulator		All with L-Jetronic	30
5AZ	Return pipe connector to pressure regulator		All with L-Jetronic	27

			Type	Nm
13 32	Fuel Filter			
1AZ	Fuel pipe to filter housing and injection pump			
	Coupling nut	M14x1.5	M21, M51	14
	Adapter	M12x1.5	M21, M51	9
	Coupling bolt	M14x1.5	M21, M51	14
2AZ	Fuel filter to holder	M8	M51	22

		Type	Nm
13 51	Injection Pump		
1AZ	Plug for high pressure section of injection pump	M21, M51	30
2AZ	Distributor injection pump to holder	M21, M51	22
3AZ	Electric shutoff to injection pump	M21, M51	20 ± 5
4AZ	Electric cold start valve to injection pump	M21	20
5AZ	Coupling bolt (OUT) to injection pump (fuel return)	M21, M51	25
6AZ	Pressure valve holder to injection pump	M21, M51	45
7AZ	Expansion element housing (temperature dependent idling speed boost) to injection pump	M21	18
8AZ	Distributor injection pump to flange and console	M21, M51	22

		Type	Nm
13 52	Injection Pump Drive		
1AZ	Toothed belt pulley to injection pump	M21	47
2AZ	Chain sprocket to injection pump	M51	50
3AZ	Chain tensioner	M51	15

		Type	Nm
13 53	Fuel Injecttion Nozzles and Pipes		
1AZ	Injection nozzle combination (assembly)	M21, M51	80
2AZ	Injection nozzle combination to cylinder head	M21	40
		M51	65
3AZ	Injection pipe (coupling nut) to injection pump and nozzle combination	M21, M51	20

		Type	Nm
13 62	Senders for Control Unit		
1AZ	Temperature time switch	All except diesels	25
2AZ	Coolant temperature sensor	All except diesels and M60	13
		M60	18
3AZ	Temperature switch	All	28
4AZ	Air temperature sensor	All	13

		Type	Nm
13 64	Fuel Injectors		
1AZ	Fuel Injector to Intake manifold	All	10
2AZ	Coupling nut on fuel injector	All with K-Jetronic	25

			Type	Nm
16 11	Fuel Tank and Mounting Parts			
1AZ	Fuel tank to body			
	Bolt	M8	E30, E31, E32, E34, E36	23
	Nut	M8	E30	25
			E24	45
	Retaining strap			8
2AZ	Connecting pipe to fuel tank		E30	25
3AZ	Heat shield to fuel tank		E30	8.5
			E24	10
			E31	3
4AZ	Drain plug on fuel tank		All	25

			Type	Nm
16 12	Fuel Supply			
1AZ	Pump assembly to metal-bonded mount		All with fuel injection	6.5
2AZ	Holder to fuel pump or fuel reservoir		All with fuel injection	6.5
3AZ	Electric connections on fuel pump		All with fuel injection	2
4AZ	Electric connections on fuel pump	M4	All with fuel injection	1.2
5AZ	Electric connections on fuel pump	M5	All with fuel injection	1.6
6AZ	Plastic nut on cover for fuel pipes		E30	2
7AZ	Hose clamps 10 ... 16 mm dia.		All	2

		Type	Nm
16 13	Fuel Vapor Venting		
1AZ	Fuel vapor venting tank to body	E24	3
		E30	4.5

		Type	Nm
16 14	Fuel Pump		
1AZ	Fuel level sender to fuel intake	All with transfer pump in tank	2
		E32	8
2AZ	End ring for fuel tank (fuel level sender/pump)		
	26.5 mm high	E34, E31	40
	31.5 mm high (new)	E36, E34, E31	55

		Type	Nm
17 00	Coolant		
1AZ	Coolant hoses 32 ... 48 mm dia.	All	2.5
2AZ	Bleeder screw (8 mm wrench size) on thermostat housing	All	8
3AZ	Level switch (30 mm wrench size) to coolant expansion tank	All	3

			Type	Nm
17 11	Radiator and Mounting Parts			
1AZ	Radiator to body			
	Self-tapping screw	B6.3	All	9
	Screw	M6	All	10
2AZ	Drain plug on radiator		All	2.5
3AZ	Temperature switch to radiator (91° / 99° C)	max.	All	15
4AZ	Expansion tank to body		All	9

			Type	Nm
17 21	Engine Oil Cooler			
1AZ	Engine oil cooler to body		All	14
	Oil cooler vapor extraction guide to trim panel	B4.8	M3 E36	4

			Type	Nm
17 22	Oil Cooler Pipes			
1AZ	Pipes to engine oil cooler		All	28
2AZ	Pipes to oil filter head		M3 E36	25
3AZ	Holder to oil cooler pipes		All	6
4AZ	Oil cooler pipe holder to alternator	M6	M3 E36	10

			Type	Nm
17 22	Oil Cooler Pipes			
5AZ	Coupling nuts on transmission oil cooler (on radiator) and on transmission	M18x1.5	All	20
		M22x1.5	5 HP 30	28
6AZ	Oil pipes to transmission Coupling bolt	M16x1.5	All	37
7AZ	Oil pipes to transmission oil cooler		A 5 S 300 J	28
	Coupling bolt	M14x1.5	All	27
8AZ	Adapters to transmission	M14x1.5 and M16x1.5	All	37
9AZ	Oil hose to oil pipe		745i A	28
10AZ	Oil pipe holder to cooler		745i A	2
11AZ	Oil pipe holder to body		745i A	6.5
12AZ	Oil cooler to transmission		5 HP 30	10

18-1 Exhaust system

			Type	Nm
18 00	Exhaust system, complete			
1AZ	Exhaust pipe to exhaust manifold or turbocharger			
	Spring-loaded version Tighten down nuts evenly until spring is against block then loosen 1.5 turns		M30 / M70	10
	Tighten nuts until spring is tensioned to 27 ± 1 mm		M51	-
2AZ	Exhaust pipe to flow conductor		745i A	25
3AZ	Resonator clamp	M8	all	15

Listings are for non-standard torques.
For standard torques consult Torque Specifications.

			Type	Nm
21 11	Bellhousing			
1AZ	Bellhousing to engine block	M 8	all	27
		M 10	all	51
		M 12	all	86

				Type	Nm
21 21	Clutch and clutch disk				
1AZ	Clutch to flywheel				
	6-point bolt 8.8		M8	all	24
	Cylinder bolt 8.8		M8	all	24
	6-point bolt	10.9	M8	S38 B36 * / S14 *	34
	Cylinder bolt	10.9	M8	all	34

* Replace bolt and taper sleeve.

		Type	Nm
21 52	Clutch release mechanism (hydraulic)		
1AZ	Union nuts for hydraulic lines	all	16
2AZ	Master cylinder to mounting bracket	all	22
3AZ	Master cylinder dowel screw	all	22
4AZ	Master cylinder to pedal assembly	all	10
5AZ	Slave cylinder to bellhousing/ transmission casing	all	22

			Type	Nm
23 00	Transmission Assembly			
1AZ	Transmission to engine			
	Hexagon head bolts	M8	All	25
		M10	All	49
		M12	All	74
	Torx bolts	M8	All	22
		M10	All	43
		M12	All	72

			Type	Nm
23 00	Transmission Assembly			
2AZ	Transmission to clutch housing	M12	All	76
3AZ	Reinforcement plate to transmission	M8	All	23
4AZ	Oil drain plug / filler plug		All	50
			S 6 S 560 G	52

			Type	Nm
23 11	Case and Covers			
1AZ	Transmission case rear/front sections		All	22
2AZ	Cover with guide tube/transmission case	M8x22	All	18
		M8x30	All	25
		M6	All	10
3AZ	Bearing cap/sealing flange		All	10.5
4AZ	Reverse gear shaft to transfer case		All	49
5AZ	Reverse gear shaft holder to transfer case		All	25

			Type	Nm
23 11	Case and Covers			
6AZ	Reverse gear shaft to case	M8	All	25
			S 5 D 310 Z	20
		M10	All	45
7AZ	Support for reverse gear shaft	M8	240 / 260	25
8AZ	Mount bracket to rear case section	M6	240 / 260 / 265 / 280	10
9AZ	Mounting tabs for sealing cover	M6	280	10
10AZ	Mount to layshaft			
	(Installed with bolt cement)	M10	S 5 D 200 G	1. 70 Initial torque 2. Loosen 3. 60 final torque
			S 5 D 310 Z	30
			280	60

			Type	Nm
23 11	Case and Covers			
11AZ	Plug on rear case section	M20	All	60
		M16	240	40
		M22	260 / 280	60
12AZ	Sealing caps on rear case section	M6	240 / 260 / 280	10
13AZ	Reversing bolt to reversing lever		ZF S 5/16/S 5 D 310 Z	43
14AZ	Clamping claws to rear case section		ZF S-5/16/S 5 D 310 Z	33
15AZ	Locking plate screws		ZF S-5/16/S 5 D 310 Z	9

			Type	Nm
23 11	Case and Covers			
16AZ	Holder to transfer case	M6	265/Sport	9
17AZ	Holder to rear case section		S 5 D 310 Z / S 5 D 200 G / 250 G	10

			Type	Nm
23 21	Transmission Shafts			
1AZ	Output flange Collar nut installed with bolt cement		All	1. 170 initial torque 2. Loosen 3. 120 final torque
2AZ	Gear wheel to layshaft	M10	265/Sport	60

		Type	Nm
23 31	Interior Shift Components		
1AZ	Shift arms to transmission case	S 5 D 310 Z	45

			Type	Nm
23 71	Transmission Suspension			
1AZ	Transmission mounts (rubber) to cross member	M10	All	42
2AZ	Transmission cross member to body	M10	All	42
		M8	All	21
3AZ	Mount bracket to transmission	M8	All	21

			Type	Nm
24 00	Transmission Assembly			
1AZ	Transmission to engine			
	Hexagon head bolts	M8	All	24
	Hexagon head bolts	M10	All	45
	Hexagon head bolts	M12	All	82
	Torx bolts	M8	All	21
	Torx bolts	M10	All	42
	Torx bolts	M12	All	63
2AZ	Reinforcement plate to transmission	M8	All	23

			Type	Nm
24 11	Transmission Case, Oil Sump			
1AZ	Transmission extension	M8	All	25
			A 4 S 310 R	32
2AZ	Guard	M6	All	9
3AZ	Converter bell housing	M8	All	25
		M10	4 HP-22/24	46
			A 4 S 310 R	42
4AZ	Plug on transfer plate	M10	All	16
		M14	4 HP-22/24	40
		M20	4 HP-22/24	50

			Type	Nm
24 11	Transmission Case, Oil Sump			
5AZ	Oil sump	M6	All	9
			4 HP-22/24 / A 5 S 310 Z	7
			A 5 S 300 J	9
			A 4 S 310 R	12
			A 5 S 560 Z	10
6AZ	Oil drain plug	M10	All	16
			A 4 S 310 R	25
			A 5 S 300 J	35
			A 5 S 560 Z	50
7AZ	Oil filler plug		A 4 S 310 R	33
			A 5 S 300 J	40
			A 5 S 310 Z / A 5 S 560 Z	100

			Type	Nm
24 11	Transmission Case, Oil Sump			
8AZ	Oil filler pump		3 HP-22	105
			4 HP-22/24 / A 5 S 310 Z	98
9AZ	Plug	M18	All	43
10AZ	Oil bore plugs		A 5 S 300 J	8
			A 5 S 310 Z / A 5 S 560 Z	15

		Type	Nm
24 13	Transmission Extension, Bearings, Seals		
1AZ	Slotted nut / output flange	A 5 S 310 Z / A 5 S 560 Z	120

		Type	Nm
24 21	Input, Intermediate and Output Shafts		
1AZ	Output flange collar nut	A 5 S 300 J	225
		All	100

				Type	Nm
24 22		Planetary gear set			
	1AZ	Brake coupling D/G to transmission casing	M 8	A5S 310Z	1. Screw in all bolts until firm contact is made. 2. Center bolt 30 3. Two outside bolts 15, then 30 4. Starting at center, all bolts to 63

			Type	Nm
24 23	Shift clutches			
1AZ	Torx bolts for clutch F to transmission casing	M 6	4 HP-22/24	10

			Type	Nm
24 30	Hydr./elec. control elements			
1AZ	Shift body to transmission	M 6	3 HP-22	11
		M 6	4 HP-22/24/A5S 310Z	8
			A4S 310R	20
		M6 x 12	A5S 560Z	6
		M6 x 55		8
2AZ	Valve body to shift body	M 6	all	5

			Type	Nm
24 31	Fluid pump			
1AZ	Fluid pump to casing	M 6	all	11
			A4S 310R	20
2AZ	Fluid filter screen		all	8
			A5S 310Z / A5S 560Z	6
3AZ	Fluid pump housing		A4S 310R	20
			A5S 310Z	10
4AZ	Tube fittings, fluid radiator lines to transmission		A5S 300J / A4S 310R	28

			Type	Nm
24 32	Governor			
1AZ.	Governor flange to transmission	M 8	all	16
2AZ	Threaded stud to centrifugal governor	M 6	all	3
3AZ	6-point nut to threaded stud		all	10
4AZ	6-point bolt to centrifugal governor	M 6	all	11
5AZ	Governor housing to hub	M 6	4 HP 22/H	11

			Type	Nm
24 34	Shift valves, parking lock			
1AZ	Pressure regulator to valve body	M 6	4 HP-22/24 EH/A5S 310Z	5
			A4S 310R	10
2AZ	Solenoid valve to valve body	M 6	4 HP-22/24 EH/A5S 310Z	5
			A4S 310R	10
			A5S 560Z	6
3AZ	Guide plate for parking lock mechanism		A5S 310Z	10
			A5S 560Z	23
4AZ	Pulse generator	M5	A5S 310Z	5
			A5S 300J	6
			A5S 560Z	6
		M8		23

			Type	Nm
24 35	Wiring harness, shift elements and gauge			
1AZ	Transmission socket to casing	M 26	4 HP-22/24 EH/A5S 310Z	12
			A4S 310R	14

			Type	Nm
24 40	Torque converter			
1AZ	Torque converter to flywheel	M 8	all	26
		M 10	all	49
			A4S 310R/A5S 310Z/ A5S 300J / A5S 560Z	45

			Type	Nm
24 51	External shift linkage			
1AZ	Selector lever to transmission	M 8	all	9
			A4S 310R	20
			A5S 300J	15

		Type	Nm
24 52	Internal shift mechanism		
1AZ	Shift segment to shaft	A4S 310R	22

		Type	Nm
24 71	Transmission mounts		
1AZ	Cross member to floorpan	all	21
2AZ	Rubber bushings to cross member/ transmission	all	21
3AZ	Support tube to engine subframe	E36	42
4AZ	Rubber bushing to support tube	E36	21
5AZ	Support plate	E36	21

		Type	Nm
25 11	Shift Console - Manual Transmission		
1AZ	Front console to shift console	All with sheet metal console	25
2AZ	Shift console to transmission	All with sheet metal console	23
3AZ	Rear shift console to body	All	11
4AZ	Aluminum shift arm console to transmission	E30 M 3	21.5
5AZ	Aluminum shift arm to console	E30 M 3	11
6AZ	Shift arm console to body	All	21
		E31	9
7AZ	Adjustable shift rod (clamp)	E31	23

		Type	Nm
25 16	Shift Console - Automatic Transmission		
1AZ	Cable sleeve to holder - shift console and transmission	All	10
2AZ	Clamping screw on transmission	All	11
3AZ	Shift console to tunnel	All	7
4AZ	Switch to shift console	All	4.5

26-1 Driveshaft

			Type	Nm
26 11	Driveshaft assembly			
1AZ	Front coupling to driveshaft and transmission	M10/8.8	all	48
		M10/10.9	all	64
		M14	E 31	160
		M12/8.8	E 32, E 34, E 36	81
		M12/10.9	E 32, E 34, E 36	100
			M3, M5	115
2AZ	Driveshaft U-joint to transmission	M 10	all	64
		M 12	E 32, E 31	95
3AZ	Thrust piece clamp ring after installation in vehicle		all	10
			E 30 4WD	22

			Type	Nm
26 11	Propeller Shaft Assembly			
4AZ	Propeller shaft to drive flange (rear axle)			
	Universal joint			
	Squeeze nut *	M10	All	64
	Ribbed nut	M10	All	90
	Constant velocity joint			
	Squeeze nut *	M8	All	32
	Ribbed nut	M8	All	43
		M10	All	64
5AZ	Pivot to center propeller shaft journal with Loctite (version without slide)		All	97
6AZ	Center mount to body		All	21

* After loosening connection only use ribbed nuts with higher tightening torque.

TRANSFER BOX
- Four Wheel Drive -

			Type	Nm
27 00	Transfer Box In General			
1AZ	Transfer box to manual transmission	M10	All	42
2AZ	Transfer box to automatic transmission	M8	All	23
3AZ	Coupling to manual transmission and transfer box	M12	All	90
4AZ	Case bolts	M8	All	25
5AZ	Electromagnetic clutch to case	M8	All	25
6AZ	Output flange Collar nut installed with Loctite 270 or Hylogrip bolt cement		All	110

			Type	Nm
27 00	Transfer Box in General			
7AZ	Plug	M24x1.5 M14x1.5	All	33
		M18x1.5	All	23
8AZ	Transmission cross member to rubber mounts	M12	All	80
	Transmission cross member to body	M8	All	24

		Type	Nm
31 00	General information		
	For screwed connections, which can influence handling, it is also important to have the "car loaded down to normal position" in addition to the tightening torque.		
	Car in normal position:		
	Car with complete equipment for normal operation loaded down with 2 x 68 kg on front seats (seats in center position), 1 x 68 kg on rear seat (center), 1 x 21 kg in trunk (middle) and full fuel tank.	All models except those listed below	
	Car with complete equipment for normal operation loaded down with 2 x 68 kg on front seats (seats in center position), 1 x 14 kg in trunk (middle) and full fuel tank.	E24, E31, M3, M5, Convertibles	

			Type	Nm
31 10	Front Axle Suspension			
1AZ	Front axle carrier to engine carrier	M10 9.8	All	47
		M10 8.8	All	42 (325iX with Loctite)
		M12	All	77
		M12 12.9	E36 *	105
2AZ	Front end of front axle carrier to body	M10 8.8	E34 525iX	47
3AZ	Rear end of front axle carrier to body (shoulder bolt)		E34 525iX	59
4AZ	Front axle carrier with reinforcement to engine carrier		E31	47
5AZ	Reinforcement to side member		E31	42
6AZ	Reinforcement to bracket and bracket to body		E31	42
7AZ	Reinforcement (sleeve) to body		E31	127

* Always replace and lubricate bolts with LM 48 paste.

		Type	Nm
31 12	Control Arms and Struts		
1AZ	Leading strut to front axle carrier (tightened with car in normal position - see page 31 - 1)	E12, E24 until 5.82	80
		E23	135
2AZ	Control arm to front axle carrier (tightened with car in normal position - see page 31 - 1 - not E31)	E21, E12, E24 until 5.82, E32, E34, E31	77.5
3AZ	Control arm (ball joint) to front axle carrier	E30, E36	85
		E30 325iX	100
4AZ	Control arm to spring strut	E21, E30	65
5AZ	Control arm to pivot mount/spring strut	E30 325iX	85 93 (polystop nut)
		E34 525iX	80

		Type	Nm
31 12	Control Arms and Struts		
6AZ	Control arm to steering knuckle	E36	62
7AZ	Control arm bracket to engine carrier	E30	42
		E36	47
8AZ	Ball joint for control arm to front axle carrier	E34 525iX	77
9AZ	Control arm to ball joint	E34 525iX	80
10AZ	Control arm bracket to front axle carrier	E34 525iX	47
11AZ	Trailing strut to body (tightened with car in normal position - see page 31 - 1)	E28, E24 after 5.82	130
12AZ	Trailing strut to tie rod arm	E28, E24 after 5.82, E32, E34, E31	93

			Type	Nm
31 21	Wheel Bearings and Steering Knuckle			
1AZ	Collar nut (bearing unit)		E28, E24 after 5.82, E30, E32, E34, E31, E36	290
2AZ	Output shaft to drive flange		E30 325iX, E34 525iX	250
3AZ	Castle nut (refer to Repair Manual for tightening instructions)		E21, E12, E24 until 5.82, E23	
4AZ	Steering knuckle to spring strut	M12x20	E36	107 *
	Fit bolt	M12x42	E36	107

* Bolts are micro-encapsulated - always replace.

			Type	Nm
31 31	Spring Struts			
1AZ	Spring strut mount to wheel house		All	22
2AZ	Shock absorber piston rod to mount		E21, E23, E12, E24 until 5.82	80
		M14	All	64
	(with external hexagon piston rod)	M12	All	64
	(with internal hexagon piston rod)	M12	All	44
3AZ	Spring strut shock absorber to pivot mount		E34 525iX	80

		Type	Nm
31 32	Shock Absorbers		
1AZ	Screw-on ring for spring strut shock absorber	All	130

			Type	Nm
31 35	Stabilizer			
1AZ	Holder to front axle carrier or body		E21	50
			E12, E24 until 5.82	45
		M8	All	22
2AZ	Stabilizer to control arm (tightened with car in normal position - see page 31 - 1)		E21	130
3AZ	Stabilizer link to control arm and stabilizer (tightened with car in normal position - see page 31 - 1)	M8	E23	25
		M10	E23	50
4AZ	Stabilizer link to control arm		E34 525iX	22
5AZ	Stabilizer link to stabilizer		E34 525iX	78

		Type	Nm
31 35	Stabilizer		
6AZ	Push rod to spring strut and stabilizer		
	(yellow chrome-plated)	E28	20
	(white chrome-plated)	E28, E24 after 5.82	33
	(yellow)	E32, E24 after 5.82, E28, E34, E31	59 *
7AZ	Push rod to spring strut and stabilizer	M3, E36	59 *
		325IX	47
8AZ	Push rod (with pivot) to stabilizer	E30	47
9AZ	Pivot to control arm	E30, E36	42

* Flat surfaces on ball head for application of wrench must be parallel to absorber axis.

		Type	Nm
31 50	Front Axle Final Drive		
1AZ	Front axle final drive to engine oil pan	E30, E34	42
2AZ	Filler plug	E30	53
		E34	70
3AZ	Drain plug	E30	20
		E34	70
4AZ	Pinion/ring gear to front axle final drive	E30	22
5AZ	Bearing cap to front axle final drive	E30	22
6AZ	Front axle final drive case bolts	E34	74 ± 4

		Type	Nm
31 52	Ring Gear / Pinion with Bearings		
1AZ	Pinion collar nut	E34	at least 170
2AZ	Ring gear bolt *	E30	1. 50 + 5 Nm torque 2. 60 - 5° torque angle

* Always replace bolts. Clean tapped bores in ring gear. Use bolt cement (source of supply: BMW Parts).

		Type	Nm
31 60	Output Shaft		
1AZ	Output shaft console to engine oil pan	E30, E34	22

32-1 Steering and front-end alignment

				Type	Nm
32 00	Steering				
1AZ	Steering gear to front axle subframe			E 21	50
				E 21 (Hydro)	41
				E 12, E 24 up to 5.82, E 23	42 ± 4
			M 10	E 28, E 24 from 5.82, E 30, E 32*, E 34*, E 31*, E 36	42
			M 12	E 28, E 24 from 5.82, E 32, E 34, E31	80 ± 8
			M12 10.9	E 32/3	110 ± 13

* Class 10.9 bolts must be used for assembly

		Type	Nm
32 13	Power Steering Gear		
1AZ	End cover for worm	E12, E24 until 5.82	34
2AZ	End cover for sector shaft	E12, E24 until 5.82	31
3AZ	Lock nut of adjusting screw for piston motion	E12, E24 until 5.82	6
4AZ	Lock nut of adjusting screw	All	27
5AZ	Oil drain plug	All	42

			Type	Nm
32 13	Power Steering Gear			
6AZ	Ring nut	(with 2.5 mm dia. wire)	E30	120
		(with 2.5 mm dia. wire)	E30	150
7AZ	Valve housing to case		E30	18
8AZ	Pressure piece cover		E30	18
9AZ	Pipes (coupling bolts) to steering gear	M10	E30	10
		M12	E30	20
10AZ	Coupling bolt with hexagon socket		525iX	20
11AZ	Pipe (pipe cringe) to steering gear		E30, E36	8

		Type	Nm
32 21	Steering Arms		
1AZ	Tie rod to ball joint (castle nut)	E21	60
2AZ	Tie rod to rack	E21, E30	75
		E36	71
3AZ	Tie rod castle nut/self-locking nut *Important!* Tie rods with cotter pin holes may not be bolted on with self-locking nuts.	All except E34 525iX	36.5 ± 3.5
		E34 525iX	50
4AZ	Tie rod clamping bolt (tightened with car in normal position - see page 31 - 1)	All	14
5AZ	Tie rod castle nut	E36, E34 525iX	45

			Type	Nm
32 21	Steering Arms			
6AZ	Steering drop arm to steering gear (torque value may be exceeded until position to lockplate is correct)	M22	All	at least 140
		M26	E23	at least 180
			E32, E34	59
			E31	70
7AZ	Steering guide arm to front axle carrier	M10	All	42
		M12	All	85

			Type	Nm
32 21	Steering Arms			
8AZ	Tie rod arm to spring strut			
		wire lock	E12, E24 until 5.82	55
		Loctite No. 270	E28, E24 after 5.82, E23	62 *
			E32, E34, E31	110 *
			M3	30 *
9AZ	Tie rod arm to control arm		E12, E24 until 5.82, E23, M3	66
			E28, E24 after 5.82, E32, E34, E31	93
10AZ	Leading strut to tie rod arm		E23	93
11AZ	Trailing strut to tie rod arm		E32, E34, E31	93

* Clean threads of tapped bores and bolts.

			Type	Nm
32 31	Steering Column			
1AZ	Universal joint / coupling to steering gear / steering spindle		E12, E24 until 5.82	25
			E21, E30, E28, E23, E24 after 5.82, E32, E34, E31	22
			E36	19
2AZ	Steering wheel control console to dashboard carrier and pedal assembly console	M8	All	22
3AZ	Hexagon head bolt on steering wheel control console	M10x115	E12, E24 until 5.82	25
		M8x110	E28, E24 after 5.82	22
		M10x170	E23	27

Refer to Repair Manual for E32, E34 and E31 models.

		Type	Nm
32 31	Steering Column		
4AZ	Clamp / shackle for outer steering tube	All	22
		E23	10
5AZ	Airbag: Steering column to holder	All	18
6AZ	Steering column to dashboard	All	22
7AZ	Steering column to arm	All	14

			Type	Nm
32 33	Steering Wheel			
1AZ	Steering wheel to steering spindle	nut	All	80
		bolt	All	63

		Type	Nm
32 34	Airbag and Airbag Steering Wheel		
1AZ	Airbag unit to steering wheel	All	8
2AZ	Crash sensor to wheel house	All	10

			Type	Nm
32 41	Pump and Oil Supply			
1AZ	Power steering pump console to crankcase (use spacers) - refer to Service Information of Group 32		All	22
2AZ	Pump support to engine carrier		E32 M60	22
3AZ	Hose connections on power steering pump and steering gear	M14	All	35
		M16	All	40
4AZ	Hose connections on power flow regulator		All	40

33-1 Final drive and rear suspension

			Type	Nm
33 11	Differential housing with cover			
1AZ	Housing cover	M 10/8.8	all	45
		M 10/10.9	E 31	90
2AZ	Side covers (in continuous sockets, coat bolts with Loctite 270)	M 8	all except E 36	22
		M 8*	E 36	1. Initial torque 10 +2 2. Turn additional 40° +5°
3AZ	Filler and drain plugs		all	70
4AZ	Drive flange, right side	M 10	E 34 4WD	59
5AZ	Drive flange, left side	M 14x1.5*	E 34 4WD	1. Initial torque 90 2. Turn additional 100° +4°

* Always replace bolts

			Type	Nm
33 12	Ring and pinion assembly with bearings			
1AZ	Ring gear to differential housing	M 10*	all	1. Intial torque 50 +5 2. Turn additional 60° -5°
		M 12x1.5*	all	1. Intial torque 100 +10 2. Turn additional 50° +5°
		M 14x1.5*	all	1. Intial torque 100 +10 2. Turn additional 30° +4°

* Always use new bolts for assembly. Bolts clean with no oil or grease; secure with Loctite 270.

			Type	Nm
33 12	Ring and pinion assembly with bearings			
2AZ	Drive flange to crown wheel	M 20	K	min. 175
		M 20	M	min. 185
		M 22	G	min. 210

Type K = Side cover with 4 bolts
Type M = Side cover with 6 bolts
Type G = Side cover with 8 bolts

			Type	Nm
33 14	Limited-slip differential with bearings			
1AZ	Cover to differential housing	M 8*	all	33
		M 10*	all	47

* Secure bolts with Loctite 270

			Type	Nm
33 17	Differential mountings			
1AZ	Differential to subframe		E 21	90
			E 12, E 24 up to 5.82	80
			E 28 and E 24/5.82, E 30 E 32, E 34, E23	123
		front	E 36	95
		rear	E 36, E 31	77
2AZ	Differential to swing mounting, swing mounting to floorpan		E 30, E 21	90
3AZ	Differential to rubber bushing		E 12, E 28, E 24, E 23	87
			E 34, E 32	77
4AZ	Differential cover rubber bushing to floorpan		E 30	87
5AZ	Differential carrier to housing cover	M 12/8.8	E 32	81
		M 12/10.9	E 32, E 34	102

			Type	Nm
33 21	**Axle shafts**			
1AZ	Axle shaft to differential and drive flange			
	Cylinder bolt	M 10	all	83
		M 10 with locking teeth*	all	96
		M 12	all	110
	Torx bolt	M 10	all	83
		M 8 with ribbed teeth*	all	64
		M 10 with ribbed teeth*	all	100
2AZ	Drive flange to axle shaft		E 30	200
	(collar nut lightly lubricated)		E 36 except M3	250
			E 31, E36 M3	300

* Replace bolts and washers

			Type	Nm
33 32	**Rear suspension**			
1AZ	Trailing arm to rear subframe (Tighten in normal position, see p. 31-1)		all	67
		10.9	all	77
			M 5-E 34	79 ± 8*
2AZ	Trailing arm to floorpan	M 14x1.5	E 31	127
3AZ		M 18x1.5	E 31	278
4AZ	Trailing arm to wheel carrier (taper pin and socket must be grease-free!)		E 31	80
5AZ	Control arm to rear subframe		E 31	95
6AZ	Support arm to rear subframe	M 14x1.5	E 31	127
7AZ	Control arm to wheel carrier		E 31	150
8AZ	Upper control arm to wheel carrier	M 14x1.5	E 31	127

* With special tool 33 3 060
Set torque wrench to 55 Nm

			Type	Nm
33 32	Rear suspension			
16AZ	Angle brace to body		E 21, E 30	28
17AZ	Radius rod to floorpan	M 8/8.8	all	25
		M 8/10.9	E 30	30
18AZ	Secondary control arm to trailing arm and rear subframe (Tighten in normal position, see p. 31-1)	M 14x1.5	all	127
19AZ	Brace to rear subframe	M 12x1.5	E 32, E 34	110

			Type	Nm
33 33	**Rear subframe**			
1AZ	Rubber bushings to rear subframe		E 21, E 23	95
			E 21, E 28, E 24	40
2AZ	Threaded studs to floorpan		E 36	120
3AZ	Rear subframe with rubber bushings to floorpan	M 12x1.5	E 36	77
		M 14x1.5	all	140
4AZ	Rear rubber bushing to floorpan	M 10*	E 32, E34	45
5AZ	Rear subframe to rear rubber bushings	M 12	E 32, E34	77

* Bolts and threads free of oil and grease; secure with Loctite 270

			Type	Nm
33 52	Shock absorbers			
1AZ	Shock absorber to trailing arm, support arm/control arm (Tighten in normal position, see p.31-1)		E 12, E 24, E 23, E 28 E 32, E 34	127
			E 21	54
			E 30	87
			E 36	100
			E 31	115
		10.9 bolt	E 30, E 34, E 32	130
2AZ	Strut shock absorber to spring dome		E 21, E 30	15
3AZ	Nut and locknut/self-locking nut		E 28, E 34, E 24, E 23	25
4AZ	Shock absorber to rubber bushing		E 30	15
5AZ	Shock absorber with rubber bushing to body	M 8	all	22

			Type	Nm
33 55	Anti-roll bar			
1AZ	Anti-roll bar to trailing arm (Tighten in normal position, see p.31-1)	M 8	E 30, E 31	22
		M 10	E 31	42

			Type	Nm
34 00	Testing and Bleeding Brakes			
1AZ	Bleeder valve	wrench size 7 mm	All	5
		wrench size 9 mm	All	6
34 11	Front Wheel Brakes			
1AZ	Brake disc to wheel hub		All	16
2AZ	Brake caliper to steering knuckle (bolts oiled lightly)		E30 325iX, E36, E34, E32, E31	110
			E21, E12, E24, E23	95
			E28, E24 after 5.82, E30	123
3AZ	Guide bolt	wrench size 7 mm	E28, E34, E24 after 5.82, E30, E32, E31, E36	30 - 5
4AZ	Bolts to guidepin (always replace)		E30	35

			Type	Nm
34 21	Rear Wheel Brakes			
1AZ	Brake drum/disc to wheel hub		All	16
2AZ	Wheel cylinder to brake backplate		All	10
3AZ	Brake backplate to trailing arm		All	65
4AZ	Brake caliper to trailing arm / brake backplate		All	67
5AZ	Guide bolt	wrench size 7 mm	All	30 - 5

34-3 Brakes

			Type	Nm
34 31	**Master cylinder**			
1AZ	Master cylinder to vacuum booster		E 30	24
			E 32	21
			E 28, E 34, E 36	26
2AZ	Master cylinder to hydraulic booster		E 24, E 28, E 31*, E 32*, E 34*	28
34 32	**Brake lines**			
1AZ	Brake hose couplings	M 10 x 1	all	19
		M 12 x 1	all	17

* Replace Allen bolt with a 6-point bolt, see BMW Parts Service

		Type	Nm
34 33	Brake Booster		
10AZ	Hydraulic pipe to pressure reservoir on power flow regulator	E32, E31	47
11AZ	Hydraulic pipe to pressure reservoir	E32, E31	40
12AZ	Brake booster to pedal assembly console	All	22
34 50	Antislip Control Systems (ABS, ASC)		
	ASC + T filter bowl to filter head	E31, E32, E34	15

		Type	Nm
35 11	Pedal Assembly Console		
1AZ	Console to body	All	22
2AZ	Nut on shaft	All	27

		Type	Nm
35 21	Brake Pedal and Linkage		
1AZ	Piston rod lock nut	All	27
2AZ	Nut on shaft	All	27
3AZ	Pull rod Nut for pivot	All	27
4AZ	Left and right reversing lever Nut on shaft bolt	All	27
5AZ	Support to console Brake booster	All	22
6AZ	Support to console Reversing lever	All	27

		Type	Nm
35 31	Clutch Pedal and Linkage		
1AZ	Piston rod lock nut		
2AZ	Spring lock nut	All	6
3AZ	Piston rod shaft bolt	All	22
4AZ	Master cylinder to pedal assembly console	All	9
5AZ	Spring-pedal shaft bolt	All	22
6AZ	Clutch pedal Nut on eccentric bolt	All	22

		Type	Nm
35 41	Accelerator Pedal and Linkage		
1AZ	Full throttle stop	All	10

		Type	Nm
36 10	Wheels		
1AZ	Wheel bolts	All	100 ± 10

		Type	Nm
36 11	Wheel Rims		
1AZ	Blade rim to base rim (bolts coated with blue Loctite No. 243)	All	9

			Type	Nm
37 12	Ride Level Control System			
1AZ	Pressure pipe connections (electrical system)		All	14
2AZ	Pressure pipe connections (circulating system)		E32, E34	20
3AZ	Pressure pipe connection on tandem pump		E32, E34	31
4AZ	Nuts on angled joint of regulating linkage		E32, E34	3
5AZ	Regulating arm to stabilizer		All	9
6AZ	Nut on regulating rod threads		E32	2
7AZ	Ride level control valve holder to rear axle	M8	E32, E34	22
		M6	E32, E34	9
8AZ	Ride level control valve to holder		E32, E34, E30 touring	9

		Type	Nm
37 14	Electric Components		
1AZ	Wheel camber warning switch to console	E32, E34	9
2AZ	Angled joint of jointed rod	E32, E34	5
3AZ	Hydraulic switch to distributor	E24, E32	25
4AZ	Hydraulic switch to hydraulic control unit	E24, E32	27
5AZ	Solenoid valve to hydraulic control unit	E24, E32	55
37 21	Pressure Reservoir		
1AZ	Pressure reservoir to body	All	9

			Type	Nm
51 11	Front Bumper			
1AZ	Bumper to bracket	M6	E32	9
		M8	E36	22
		M10	E34	43
2AZ	Bumper with bracket to impact absorber	M10	E31	22 *
		M10	E36	55 *
		M12	E30 mod. '88, E32, E34	48
3AZ	Impact absorber / bracket to engine carrier		E30, E24	23
		M6	E31, E32, E34, E36	9
		M10	E32, E34	48

* Install bolts with bolt cement

		Type	Nm
51 11	Front Bumper		
4AZ	Bumper to side panel	E30	7
5AZ	Bracket to side panel	E36	6
6AZ	Bumper support (behind front fog lamp)	E36	3
7AZ	Front fog lamp bracket	E36	2.5

			Type	Nm
51 12	Rear Bumper			
1AZ	Bumper to bracket	M10	E31	40
		M8	E32, E34, E36	22
		M10	E34	42
2AZ	Bumper with bracket to impact absorber	M10	E36	42 *
		M12	E30 mod. '88, E31, E32, E34	48
3AZ	Impact absorber / bracket to body		E30, E24	23
		M6	E31, E32, E34	9
		M8	E36	22

* Install bolt with bolt cement

		Type	Nm
51 12	Rear Bumper		
4AZ	Bumper to side panel	E30	7
5AZ	Bracket to side panel	E36	3
6AZ	Lower trim panel bracket to body	E36	8.5
7AZ	Lower trim panel screw	E36	2.5

			Type	Nm
51 16	Mirrors, Finishers, Ashtrays, Consoles			
1AZ	Mirror to front door		E31, E36	6
2AZ	Center console	plastic nut	E30	5
51 21	Front Door Locks			
1AZ	Door lock to front door		E31, E36	9 *
2AZ	Outside handle to front door		E31, E36	10
3AZ	Door striker to body		E24, E30	24
			E31, E32, E34	28

* Install bolt with bolt cement.

		Type	Nm
51 22	Rear Door Locks		
1AZ	Door lock to rear door	E36	9 *
2AZ	Outside handle to rear door	E36	10
3AZ	Door striker to body	E32, E34	24
51 26	Central Lock Drive		
1AZ	Central lock drive to lock	All	2

* Install bolt with bolt cement.

			Type	Nm
54 12	Mechanical Sun Roof Components			
1AZ	Cable cover to cassette		E36	1.3
2AZ	Lid to gate		All	6 *
			E34 touring	5 *
3AZ	Rail to cassette	M4	E31, E32, E34	1.8
		M5	E32, E34	2.8
4AZ	Cable cover to cassette		E36	1.3
5AZ	Floating roof liner to gate		E36	3.5
6AZ	Cassette to body	M5	E34 touring, E36	3.5

* Replace screw or nut.

		Type	Nm
54 13	Electric Sun Roof Components		
1AZ	Motor to cassette	E31, E32, E34, E36	2.8
		E34 touring	3.5
54 34	Power Convertible Top		
1AZ	Hydraulic pipes on electric/hydr. top	E30	8.5
2AZ	Valves on hydraulic control unit	E30	2.0

54-3 Tilt sunroof, convertible top

			Type	Nm
54 34	Electrically operated convertible top			
3AZ	Motor and gear unit Top actuating mechanism to body/mount		E 30	10
4AZ	Motor and gear unit Top actuating mechanism to body		E 30, E 36	10*
5AZ	Drive lever to motor and gear unit	M 6	E 30	3
6AZ	Crank arm to motor and gear unit	M 12	E 30	12,5
7AZ	Slide rods to drive lever	M 4	E 30	1,2
8AZ	Slide rods to convertible top	M 10	E 30	25

* Coat bolts with locking fluid prior to assembly

			Type	Nm
61 13	Plug Connections			
1AZ	Door plug connection to body		All	5
2AZ	Fuse box Screws for safety fuse	M6	All	5
3AZ	Ground or positive connection points		All	5

61-2 General vehicle electrical system

			Type	Nm
61 31	Switches			
1AZ	Temperature switch	91 °C	all	14
		99 °C	all	14
2AZ	Oil presure switch Note: Lubricate threads		M 10, M 40, M 42 M 21, M 51 M 20, M 30, M 50 M 60, M 70, S 70	40
			M 88-3, S 14, S 50, S 38 M 43	20
3AZ	Reversing lamp switch		all	20
4AZ	Light switch on instrument panel		E 36	2
5AZ	Transmission switch to shift console		all	4.5

			Type	Nm
61 61	Windshield Wipers			
1AZ	Wiper motor to wiper console	M6	E31	6
			E36	10
2AZ	Parked position stop to wiper console		E31	15
3AZ	Wiper contact pressure motor to wiper console		E31	6
4AZ	Motor crank to wiper motor	M8	All	27
5AZ	Wiper shaft nut to body		E31, E36, E32, E34	12
6AZ	Holder to firewall	M6	E31	9
	screws in firewall		E36 Coupe	10

		Type	Nm
62 16	Car Electrical System Senders		
1AZ	Screws for speedometer sender	All	6.6 ... 8.4

			Type	Nm
64 12	Additional Heater with Controls			
1AZ	Additional heater to body floor		All	4.5
2AZ	Glow plug		E24	17.5
			E31, E32, E34	4
3AZ	Temperature sensor		E31, E32, E34	0.5
4AZ	Oil control plug and oil filler plug		All	16
5AZ	Mounting screws	M5	All	6
		M6	All	10
		M8	All	24
		M10	All	48
6AZ	Screws for filter cover		All	0.9

		Type	Nm
64 21	Air and Water Hoses / Pipes		
1AZ	Studs on heat exchanger	E36	3
2AZ	Studs on double-pipe	E36	2
3AZ	Nuts on double-pipe	E36	3.5
64 51	Air Conditioner (Evaporator), Control Units		
1AZ	High / medium pressure pressostat	All	25 *
2AZ	Low pressure pressostat	All	19 *
3AZ	Three-way safety switch	All	25

* Bolt cement, Part No. 81 22 9 407 144

		Type	Nm
64 52	Compressor		
1AZ	Compressor to engine	all	22
2AZ	Solenoid clutch spring plate	all	20
3AZ	Torque wrench pretension for new poly-V-belt	M40, M42, M43, M51	7...8.5
		S50	16...17
	for used poly-V-belt	M40, M42, M43, M51	5...6.5
		S50	12
4AZ	Special tool pretension for new poly-V-belt	M40, M42, M43, M51	77...83 scale graduations
		S50	100 scale graduations
	für gelaufene Keilrippenriemen	M40, M42, M51	66...73 scale graduations
		S50	70 scale graduations

			Type	Nm
64 53	Condenser and Drier with Pipes			
1AZ	Pipe connections	5/8"	All	20
		3/4"	All	39
		7/8"	All	42
		11/16"	All	48

		Type	Nm
65 11	Radio		
1AZ	Headless screw for radio installation	All	0.5

72 - 1	EQUIPMENT AND ACCESSORIES FOR BODY	Type	Nm
72 11	Seat Belts		
1AZ	Seat belt to body or seat	All	48
2AZ	Belt height control bolts	All	24
3AZ	Seat belt to seat	E31	47 *
4AZ	Seat belt to backrest	E31	24
5AZ	Headrest to backrest	E31	24

* Install bolt with bolt cement