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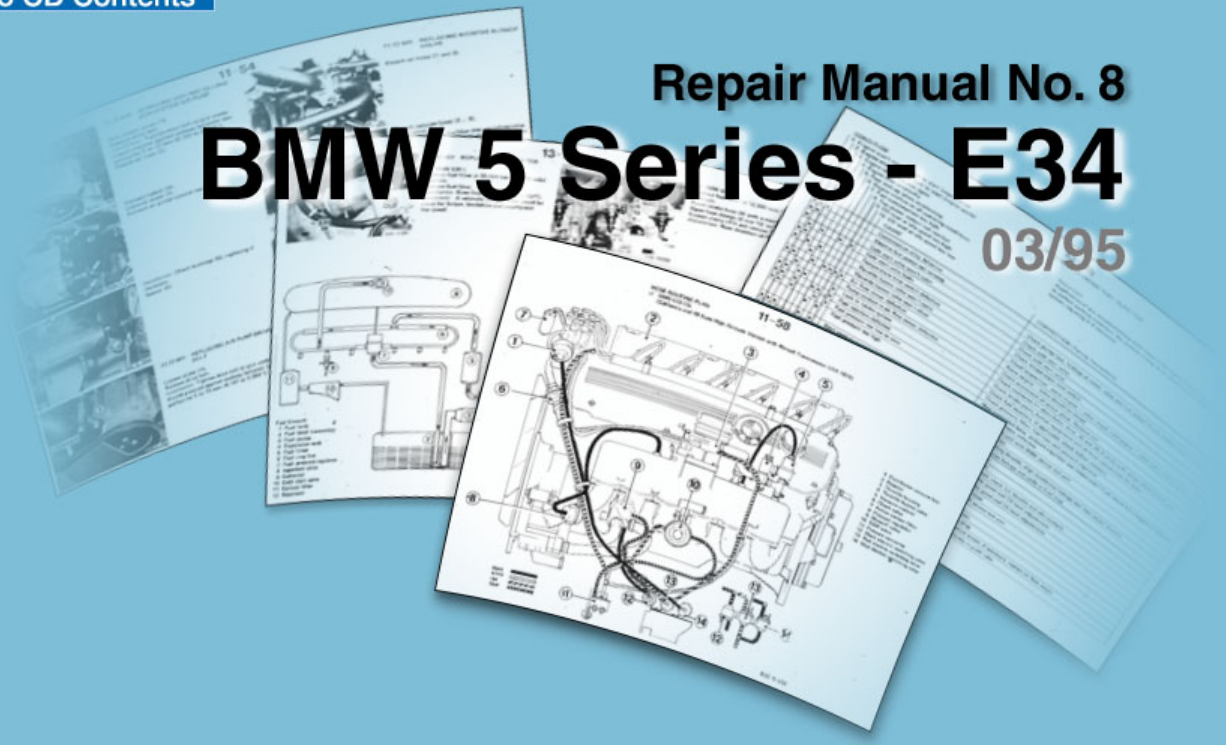

Repair Manual No. 8

BMW 5 Series - E34

03/95

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Foreword

This Repair Manual is intended as an aid in ensuring all necessary maintenance and repair work is carried out expertly and professionally.
It therefore supplements the practical and theoretical training received by our managers and technicians in our service training centers.

As of model year 1985, Repair Manuals are subdivided into:

- Repair Manuals for the specific series

  The Repair Manual (series 3, 5. 6, 7 and 8) describes removal and installation or replacement of components in the vehicle.

- Assembly Repair Manual for BMW automobiles

  The assembly Repair Manual (main groups 11, 12, 13, 23, 24 and 33) describes the removal and installation or replacement of assemblies and removed equipment. The Assembly Repair Manual also includes notes on testing as well as troubleshooting tables.

The Technical Data microfiches is available as a reference for Technical Data (tightening torques, settings etc.)

The Repair Manual (microfiche) illustrates repair and maintenance jobs which can only be carried out on standard, i.e. not subsequently modified, vehicles.

The structure of the Repair Manual corresponds to the numbering system of the Flat Rates Catalogue (FRU numbers).

Cross references to other FRU numbers are intended only as an aid and should not be construed as an extension to the specified working time.

The page numbering 64 – 11/8 means for example:
64 - Main group
11 - Subgroup
8 - Consecutive page number

All special tools referred to in the Repair Manual are listed in the special tools microfiche, Order number 01 99 9 699 422. The use of special tools is illustrated where necessary in the relevant steps.

Generally, only the removal of components is described within the individual working steps in this Repair Manual, installation takes place in the reverse order of removal. If it is necessary to observe special procedures during installation, reference is made to them in the form installation notes.
Deviating from this procedure, both removal and installation are described separately for complicated jobs.

Service information bulletins will keep you updated with any improvements and modifications. As an additional source of information, we recommend the clearly illustrated parts mocrofiches.

BAYERISCHE MOTOREN WERKE AG
CENTRAL SERVICE DEPARTMENT - TECHNICAL

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00 Maintenance and general data

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BMW Maintenance System

The maintenance jobs apply up to model year 93. Refer to inspection sheet as of model year 94.

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BMW Maintenance System – USA

The scope of maintenance work remains valid until model year 93. From model year 94, refer to inspection sheet.

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GENERAL INFORMATION

PRECAUTIONS FOR WORKING WITH PARTS CONTAINING ASBESTOS

Inhaling fine 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 dispose 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.

Important when disconnecting battery!

To disconnect the battery, disconnect the negative lead from the ground connection. Disconnecting the battery will cancel fault memories of control units. Use tester to read out fault memories and print out data on any errors prior to disconnecting battery.
Work on components, terminal connections, etc. could result in errors being stored in the fault memories of the affected control units. If disconnection of the battery is specified in the Repair Manual for the carrying out of repairs, there must always be conformance with this in the interests of safety.

Windshield wipers (wiper motor):
If a fault occurs, the intermittent wipe and wiper stage 1 are switched off with a block protection feature. This block protection feature remains effective even after the fault has been rectified. To cancel the block protection, switch off the ignition (terminals 15 and R) for 3 minutes.

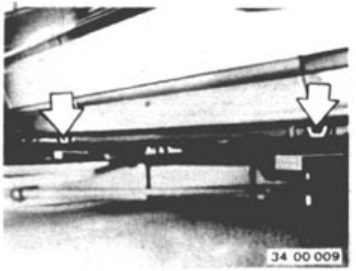
Wipers (CPA motor) CPA = Contact Pressure Adjustment:
If a fault occurs, the CPA motor is switched off by a block protection feature. This block protection feature remains effective even after the fault has been rectified. To switch off the block protection:
1. Disconnect the battery for 30 seconds (caution: cancels fault memories in all control units!) or
2. Automatic cancellation while vehicle is in motion.

Vehicle with interlock system:
If a component of the interlock system was removed and installed or if the installation position of the interlock cable was altered, the following function check must be performed:
1. Move selector lever on automatic transmission to "P".
2. Remove ignition key
3. Press locking button on selector lever
4. If the selector lever can be moved out of "P" setting, the interlock cable must be adjusted, refer to Gr. 25.
5. Switch on ignition
6. Press locking button on selector lever
7. If it is not possible to move the selector lever out of setting "P", the interlock cable must be adjusted, refer to Gr. 25.

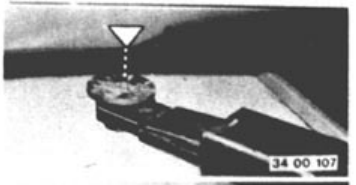
GENERAL INFORMATION

LIFTING VEHICLE ON A LIFTING PLATFORM

Before driving a car on the platform, make sure that there is sufficient clearance between the lifting platform and vehicle (if applicable, spoilers or splash guards, etc.).

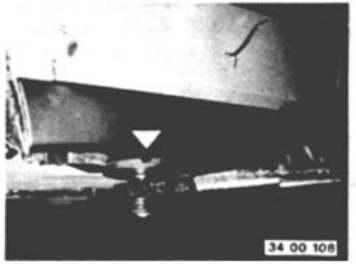


Lifting platforms must conform with local and national legislative measures concerning accident prevention and maintenance.
Arms of a lifting platform must always be applied only on the reinforced points of the frame members.
Ensure that undercoating is not damaged.



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.

Note embossed arrows on M 5 cars.



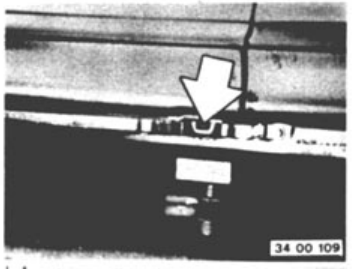
Rear:
Apply rubber block of lifting arm on the rear perpendicular reinforcement of the frame member, which is also provided for application of the car's jack.
Ensure that bottom of fuel tank is not damaged.

Note embossed arrows on M 5 cars.

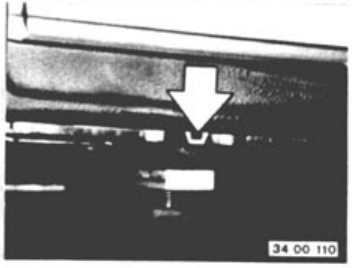
LIFTING VEHICLE ON A WORKSHOP TROLLEY JACK

A workshop trolley jack may also be only applied for lifting the vehicle on the same take-up points described for the lifting platform.

A suitable liner (rubber, wood or plastic) must be used between the jack and vehicle to avoid damaging the undercoating, frame members or floor plate.



Front Take-up Point

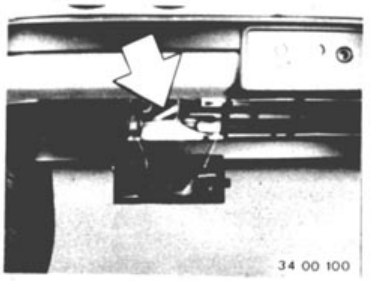


Rear Take-up Point

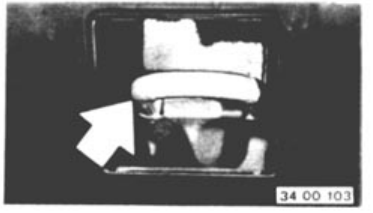
Towing

Please respect any prevailing legislation concerning the towing of vehicles.

Caution!
Follow instructions in the relevant Owner's Manual.



Front towing eye



Rear towing eye

BMW MAINTENANCE SYSTEM 00 00 009 Pre-delivery inspection	General information					
	Repair Manual	Technical Data	Service Information	Operating Fluids	Owner's Manual	Important information!
Interrogate fault memories in diagnosing system.						Refer to operating instructions for BMW diagnosing system.
Brief test.						Connect BMW service tester. Further instructions appear on monitor.
Check / correct engine oil level.				Gr. 11	+	Approved oil only!
Check fuel pipes, tank and hoses for correct routing, condition and leaks.						
Check connections and pipes of brake system for leaks, correct position and damage.						Visual inspection.
Check / adjust parking brake lever travel.	Gr. 34					
Check wheel bolt tightening torque.		Gr. 36				
Check rim size, tire size and type as well as tire inflation pressure (including spare wheel).		Gr. 36	Gr. 36			

BMW MAINTENANCE SYSTEM 00 00 009 Pre-delivery inspection	General information					Important information!
	Repair Manual	Technical Data	Service Information	Operating Fluids	Owner's Manual	
Check function of windshield wipers/washer and aiming of water spray nozzles; remove protective sleeves from wiper blades.					+	
Check acid level and charged condition of battery under rear seat or in trunk and add distilled water if necessary. Charge battery if necessary.			Gr. 00			
Check lights: headlights/additional headlights, parking lights, brake lights, turn signals, tail lights, backup lights, rear fog lights, license plate lights, passenger compartment lights, glovebox light, engine compartment light and trunk light.					+	
Check horn, headlight flasher and hazard warning lights.					+	
Check instrument and sign lights.					+	
Check control and warning lamps in instrument cluster and check control (incl. ABS, airbag).						
Check heating, ventilating and blower.	Gr. 64					
Check function of headlight cleaners and central locks.					+	
Insert and check function of cigar lighter.						

BMW MAINTENANCE SYSTEM 00 00 009 Pre-delivery inspection	General Information					Important information!
	Repair Manual	Technical Data	Service Information	Operating Fluids	Owner's Manual	
Check function of other special equipment.					+	
Initialize sender of remote control system.						
Check data plate, vehicle identification number and engine number.						
Compare ordered car equipment against delivered car equipment.						
Tune in radio station and check for interference with engine running by switching electric equipment on and off.						
Mount hub caps, if applicable wheel rings and tailpipe extension.						
Place tools in toolbox and secure jack and wheel bolt wrench.						
Paste BMW emergency service label on lid of toolbox.						
Place owner's manual/service booklet, list of BMW service stations and BMW emergency service points, spare keys and key holder in glovebox.						
Stamp and make entries in service booklet.						

BMW MAINTENANCE SYSTEM 00 00 009 Pre-delivery Inspection	General Information					Important Information!
	Repair Manual	Technical Data	Service Information	Operating Fluids	Owner's Manual	
Check function of engine, clutch, transmission, final drive, steering, foot and hand operated brakes. In cars with rear disk brakes: break in parking brake. In cars with ABS (ASC): check function of control lamps. Check function of speedometer with odometer and daily trip recorder, tachometer (economy control), clock, temperature gage and fuel gage. Check engine, transmission, steering, final drive, drive shaft boots, fuel system, clutch and brakes for leaks. Remove seat and other protective covers. *Important!* Reset service indicator only in cars up to production date of 9/90.						

BMW Maintenance System	General Information					
00 00 210 BMW break-in period inspection (at 2000 km)	Repair Manual	Technical Data	Service Info	Consumables	Owner's Manual	Important Information
Caution! The break-in period inspection is not required for cars with M51 engine.						
Interrogate fault memory in diagnostic system.						
Brief test.						See Operating Manual BMW Service Test.
Change engine oil and oil filter with engine at operating temperature.	Gr. 11			Gr. 11	+	Use approved oils only. *Caution!* Build up oil pressure with engine running at idle.
Check valve play and adjust if necessary (only M20, M30 and S38 engines).	Gr. 11	Gr. 11				
Change oil in manual transmission at operating temperature (only 535i and M5).	Gr. 23			Gr. 23	+	Always use approved grades of oil
Change oil in rear axle differential at operating temperature. *Caution!* On rear axle differential with black, chromated identification plate and letter "b" on top: perform oil change at 1st engine oil service.		Gr. 33	Gr. 33	Gr. 33		Note Service Information for special oil grade
Change oil in transfer box and front axle differential at operating temperature (525 iX/touring).	Gr. 27/31			Gr. 27/31		Always use approved grades of oil
Final inspection with check for road safety, brakes and steering, indicator and hazard warning lights as well as Check Control messages.					+	

BMW MAINTENANCE SYSTEM 00 00 220 BMW Inspection I	General Information					Important Information!
	Repair Manual	Technical Data	Service Information	Operating Fluids	Owner's Manual	
Interrogate fault memories in diagnosing system.						Refer to operating instructions of BMW diagnosing system.
Brief test.						Refer to operating instructions of BMW service tester.
Replace engine oil and oil filter at operating temperature.	Gr. 11	Gr. 11		Gr. 11	+	Use approved oil. *Important!* Only build up oil pressure with engine idling.
Check / adjust valve clearance (M20, M21, M30 and S38 engines).	Gr. 11	Gr. 11				
Replace spark plugs (not for M40, M50 and M60 engines).		Gr. 12				
Check coolant hoses for leaks; check / correct coolant level and antifreeze concentration.				Gr. 17	+	Replace coolant at least every 2 years.
Check tension and condition of all drive belts, tightening if necessary (not M50, M51 and M60 engines). If necessary replace and invoice separately.	Gr. 12/32/64					
Drain water trap of fuel filter (M21 and M51 engines).	Gr. 13					
Check routing and condition of fuel pipes, tank and hoses as well as for leaks.	Gr. 13/16					
Check condition, routing and suspension of exhaust system as well as for leaks.						

BMW Maintenance System	General Information					
00 00 220 BMW Inspection I	Repair Manual	Technical Data	Service Info	Consumables	Owner's Manual	Important Information
Check power steering/level control for leaks and correct oil level, topping up if necessary.				Gr. 32		
Ensure that steering is free of play; inspect tie rods and front axle joints. Inspect steering unit: steering transmission, linkages, flexible coupling and sleeves.						
Check all gear units for leaks.						Visual inspection
Check oil level in manual transmission and top up if necessary (cars with M21 engine).	Gr. 23			Gr. 23		Use approved oil only
Removing and installing front and rear disk brake linings, checking overall thickness. Replace linings when necessary. Check surface condition of brake disks. Check brake caliper dust covers for leaks. Grease wheel centering on disk wheels.	Gr. 34/36					Wheels: Check tightening torque
Check connections and leads on brake system for leaks (and also check for damage) and correct position. Check that handbrake cables move freely.	Gr. 34					*Caution!* Use approved brake fluid. Change approved grade of brake fluid in accordance with specified Service Interval display or clock symbol, but no later than every 2 years. See SI Gr.00
Check / adjust handbrake lever travel.	Gr. 34					
Check / top up fluid level in expansion tank for brake and clutch hydraulic systems.				Gr. 34		
Check / correct tire pressure (including spare tire). Check tire condition (if wear pattern is uneven, an optional alignment check can be carried out together with wheel alignment: this is a separate invoice item).	Gr. 32	Gr. 36	Gr. 36			Measure depth of tread

BMW MAINTENANCE SYSTEM 00 00 220 BMW Inspection I	General Information					Important Information!
	Repair Manual	Technical Data	Service Information	Operating Fluids	Owner's Manual	
Check function of parking lights, turn signals, tail lights, brake lights, backup lights, rear fog lights, license plate lights, passenger compartment lights, glovebox light, engine compartment light and trunk light.					+	
Check function of headlights and additional headlights.					+	
Check horn, headlight flasher and hazard warning lights.					+	
Check instrument and sign lights.					+	
Check acid level in battery and add distilled water if necessary.			Gr. 00		+	
Check charged condition of battery (high current test).	Gr. 61					
Replace microfilter for heater or heater/air conditioner. Shorten replacement intervals if car is operated in extremely dusty regions.	Gr. 64		Gr. 64			Check data plate in glovebox and Service Information.
Check condition and function of seat belts.	Gr. 72					
Lubricate locks of doors, engine hood and trunk lid with oil or grease and check function. Lubricate all hinges with oil or grease.						
Check / correct level and antifreeze concentration of washing fluid in supply tanks for windshield and headlights. Check / correct intensive cleaning fluid level in tank if applicable.						
Check windshield wipers/washer, wiper blades and aiming of water spray nozzles.					+	
Inspect entire body – not cavities – for rust damage. Repair and invoice separately (enter inspection and repairs in Service Booklet).						Models since 9/90. At latest after 2 years.

BMW MAINTENANCE SYSTEM 00 00 220 BMW Inspection I	General Information					Important Information!
	Repair Manual	Technical Data	Service Information	Operating Fluids	Owner's Manual	
Final inspection with safety test (check ABS and airbag control lamps), cars with rear disk brakes: break in parking brake, check steering, clutch or automatic transmission, springs and shock absorbers visually and check function of power steering. Check control and warning lamps in instrument cluster as well as mirrors and heater blower. Check messages in check control. *Important!* Reset service indicator after inspection I: Switch off all electrical equipment. Switch on ignition – do not run engine. Plug SI-R* with adapter 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 seconds and goes out after approx. 12 seconds. Release inspection button – green lamp goes out. The time-dependent inspection interval is due when the clock symbol lights up together with the INSPECTION sign and has no influence on the green light emitting diodes. If the load and time-dependent inspections occur simultaneously, resetting must be repeated after 10 seconds to have the clock symbol and INSPECTION sign lights go out. *Important!* When the clock symbol lights up in cars since 9/90 only the brake fluid has to be changed. Checking Service Indicator: All five green light emitting diodes must come on. Yellow and possibly red light emitting diodes as well as INSPECTION sign light must go out. SI-R = Service indicator resetter, Order No. 62 1 100. Adapter, Order No. 62 1 140.	Gr. 34				+	

BMW Maintenance System	General Information					
00 00 230 BMW Inspection II = Inspection I + following work	Repair Manual	Technical Data	Service Info	Consumables	Owner's Manual	Important Information
Check pulley tension (only M40 engine). Check / adjust pulley tension (only M21 engine).	Gr. 11 Gr. 11/13	Gr. 11	Gr. 11			
Replace spark plugs (M40, M50 and M60 engine).	Gr. 12	Gr. 12	Gr. 12			
Replace main fuel filter (only cars with diesel engine) If diesel fuel is poor quality, shorten the interval between filter changes.	Gr. 13					
Air cleaner: Replace air filter insert. Shorten intervals accordingly for cars operated in dusty regions.	Gr. 13					
S38 Motor: Replace all Vee belts	Gr. 12/32/64		Gr. 00			
Change oil in manual transmission at operating temperature (except in cars with M40, M50, M51 and M60 engines).	Gr. 23			Gr.23		Use approved oil only
Change oil in automatic transmission at operating temperature (not on 540i).	Gr. 24			Gr. 24		Use approved oil only
Change oil in transfer box and front axle differential at operating temperature (525iX/touring).	Gr. 27/31			Gr. 27/31		Use approved oil only
Change oil in rear axle differential at operating temperature.	Gr. 33			Gr. 33		Use approved oil only
Check rubber gaiters on output shafts.						Visual inspection
Check thickness of parking brake linings. (if necessary, replace - separate invoice item).	Gr. 34	Gr. 34				
With ASC+T: Replace filter insert in inlet.	Gr. 34					
Check park heating.	Gr. 64					

BMW Maintenance System	General Information					
00 00 230 BMW Inspection II = Inspection I + following work	Repair Manual	Technical Data	Service Info	Consumables	Owner's Manual	Important Information
Perform at every 2nd Inspection II:						
Replace toothed drive belt (separate invoice item).	Gr. 11					or every 4 years
Replace main flow fuel filter (cars with gasoline engines).	Gr. 13					
Check clutch drive plate for wear.	Gr. 21					
Change oil in manual transmission at operating temperature (in cars with M40, M50, M51 and M60 engines).	Gr. 23			Gr. 23		Use approved oil only

Caution!
After Inspection II, reset Service Interval display unit: Switch off all electrical equipment. Switch on ignition. Do not run engine. Fit SI-R* into diagnosis receptacle with adapter. Depress and hold recessed, red **INSPECTION** button - green lamp (function control) lights up. Red lamp also lights up after about 3 seconds and goes out again after about 12 seconds. Release **INSPECTION** button - green lamp goes back out.

Time-dependent inspection interval is indicated by a lighted clock symbol in addition to the **INSPECTION** sign and has no influence on the green diode lights. When load and time dependent inspection intervals coincide, the resetting procedures must be repeated after 10 seconds to cancel the clock symbol and the **INSPECTION** sign.

Checking service indicator: All five green diode lights must light up. Yellow (or red) LEDs and **INSPECTION** legend should go out.

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

BMW MAINTENANCE SYSTEM 00 00 245 BMW Annual Check	General Information					Important Information!
	Repair Manual	Technical Data	Service Information	Operating Fluids	Owner's Manual	
Important! No annual checks for cars since 09/90.						Refer ro Service Information of Group 00 to reset the service indicator.
Only replace the brake fluid when the clock symbol lights up (or every 2 years at latest, 750i/L annually).			Gr. 00			
Cars before 09/90:						
Replace brake fluid every 2 years (750i/L annually).				Gr. 34		Use approved brake fluid.
Replace coolant every 2 years (invoice separately).			Gr. 00			
Inspect entire body – not cavities – for rust damage; repair and invoice separately (enter inspection and repairs in Service Booklet).						
Check and adjust headlights and additional headlights.	Gr. 63					
Check fire extinguisher every 2 years (invoiced separately).						
In cars with additional heater: replace glow plugs annually and heat exchanger after 10 years (invoiced separately).						
Invoiced separately:						
Inspect supporting body parts for corrosion, breaks and cracks.						
Check that performed body repairs conform with BMW standards.						
Steering: check steering stops, connections, steering damper and steering assistance for leaks.	Gr. 32					
Brakes: check function of brake master cylinder / brake booster and for leaks.	Gr. 34					

BMW MAINTENANCE SYSTEM 00 00 245 BMW Annual Check	General Information					Important Information!
	Repair Manual	Technical Data	Service Information	Operating Fluids	Owner's Manual	
Important! Reset service indicator for annual check (INSPECTION and Clock Symbol: Switch off all electrical equipment. Switch on ignition – do not run engine. Plug SI-R* with adapter** 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 seconds and goes out after approx. 12 seconds. Release inspection button – green lamp goes out. Service Indicator with Clock Symbol and Red LED: The time-dependent inspection interval is due when the clock symbol lights up together with the INSPECTION sign and has no influence on the green light emitting diodes. If the load and time-dependent inspections occur simultaneously, resetting must be repeated after 10 seconds to have the clock symbol and INSPECTION sign lights go out and activate the green light emitting diodes. Checking Service Indicator: The number of green light emitting diodes does not change by resetting the time-dependent inspection service indicator. The INSPECTION sign and clock symbol lights must go out. * SI-R = Service Indicator resetter, Order No. 62 1 100. ** Adapter, Order No. 62 1 140. New SI-R = Order No. 62 1 110.						

BMW MAINTENANCE SYSTEM 00 00 249 BMW Engine Oil Service	General Information Repair Manual	 Technical Data	 Service Information	 Operating Fluids	 Owner's Manual	Important Information!
Replace engine oil and oil filter at operating temperature.	Gr. 11			Gr. 11		Use approved special oil.
Important! Rear axle final drive with black chrome-plated data plate and letter "b" on it: Replace oil in rear axle final drive at operating temperature (only at 1st Engine Oil Service).	Gr. 33 Gr. 33		Gr. 00	Gr. 33		Use approved oil. *Important!* Only build up oil pressure with engine idling.
Cars with M51 engines: replace oil in rear axle final drive at 1st Engine Oil Service.	Gr. 33		Gr. 00	Gr. 33		Use approved oil.

Important!
Reset service indicator after Oil Service:
Switch off all electrical equipment.
Switch on ignition – do not run engine.
Plug SI-R* with adapter in diagnosis socket.
Push in and hold recessed, 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:
All five green light emitting diodes must come on. Yellow and possibly red light emitting diodes as well as OIL SERVICE sign light must go out.

* SI-R = Service indicator resetter, Order No. 62 1 100.
Adapter, Order No. 62 1 140.

New SI-R = Service indicator resetter, Order No. 62 1 110.

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

BMW MAINTENANCE SYSTEM 00 00 259 BMW Safety Test	General Information Repair Manual	 Technical Data	 Service Information	 Operating Fluids	 Owner's Manual	Important Information!
Interrogate fault memories in diagnosing system.						Refer to instructions of BMW diagnosing system.
Brief test.						Refer to instructions of BMW Service Tester.
Steering Test: Steering gear, linkage, coupling, connections, leaks, oil volume and condition of power steering.	Gr. 32			Gr. 32		Use approved oil only.
Brake Test: Brake pads (remove and install wheels, remove pads), brake disks, pipes, hoses, connections, brake fluid level, parking brake cables, parking brake: break in parking brakes.	Gr. 34					
Important! Replace brake fluid every 2 years at latest.				Gr. 34		Use approved brake fluid.
Tire and Wheel Rim Test: Condition, tire pressure, specified size, tread depth, tire wear pattern (including spare wheel).		Gr. 36		Gr. 36		
Light Test: Headlights, fog lamps (also aiming), parking lights, tail lights, backup lights, license plate lights, instrument and sign lights, control and warning lamps.	Gr. 63				+	
Warning Appliance Test: Horn, headlight flasher, turn signals, hazard warning lights, brake lights, tail fog lights, burglar alarm.					+	
Windshield Wipers/Washer and Headlight Cleaners: Wiper blades, washer (windshield, if applicable headlights and intensive cleaning), supply tank (fluid level/antifreeze), spray nozzle aiming (windshield, if applicable headlights).			Gr. 00	Gr. 00	+	
Seat Belts: Condition and function.	Gr. 72					
Remarks: Invoice repairs and adjustments separately.						

BMW MAINTENANCE SYSTEM 00 00 099 Exchange Engine Inspection after 1,000 km	General Information					
	Repair Manual	Technical Data	Service Information	Operating Fluids	Owner's Manual	Important Information!
Replace engine oil and oil filter at operating temperature.	Gr. 11			Gr. 11	+	Use approved oil. *Important!* Only build up oil pressure with engine idling.
Check coolant hoses for leaks; check / correct coolant level and antifreeze concentration.				Gr. 17	+	Use longterm antifreeze and corrosion inhibitor.
Check / adjust valve clearance (only M30 engines).	Gr. 11	Gr. 11				
Check / correct tension of all drive belts (only M30 engines).	Gr. 12/32/64					

BMW Maintenance System - USA

00 00 009 Pre-Delivery inspection	General Information					Important Information
	Repair Manual	Technical Data	Service Info.	Consumables	Owner's Manual	
Caution! With effect from 1993 model, proceed in accordance with Quality Certification I.			Gr. 00			see SI 00 24 92 (3660)
Interrogate fault memory in diagnosis system. Brief test.						See operating instructions BMW diagnosis system Connect up BMW Service Tester For further instructions, refer to screen display.
Check engine oil level (check lube oil for thinning), if necessary, change oil and oil filter.			Gr. 00	Gr. 11	+	Use approved oil only
Check gasket on filler cover.						
Check coolant hoses for leaks and routing.						Visual inspection
Check mounting of hose clips.						
Check/correct coolant level and concentration.			Gr. 00	Gr. 17	+	Long-term anti-freeze and corrosions protection agent
Check acid level of battery and top up with distilled water if necessary. Check mounting of battery terminals.						
Check spark plugs, replace or clean if required and adjust electrode clearance.	Gr. 12	Gr. 12				
Check mounting and leaktightness of fuel lines, fuel tank and cover and fuel filter. Check fuel injection system is securely mounted. Check for leaks.						Visual inspection
Check routing of exhaust system.						Visual inspection.

BMW MAINTENANCE SYSTEM — USA 00 00 009 Pre-delivery inspection	General Information Repair Manual	Technical Data	Service Information	Operating Fluids	Owner's Manual	Important Information!
Tighten nuts and bolts of steering gear, joint disc, tie rods and front axle. Check whether cotter pins are missing.		Gr. 32/34				Check locks and cotter pins.
Check power steering for leaks.						Visual check, use approved brake fluid, use specified torque.
Check / adjust parking brake lever travel.	Gr. 34					
Check level of fluid in tank for brakes and clutch.		Gr. 34	Gr. 00	Gr. 34		
Check connections and pipes for brake system for leaks, damage and correct position.						Visual inspection.
Check condition of tires, tire size and type as well as tire pressure (including spare wheel).		Gr. 36	Gr. 36		+	
Check tightening torque of wheel bolts. Check wheel rim size and type.		Gr. 36				
Check parking lights, turn signals, brake lights, high and low beam headlights, side marker lights, fog lights, backup lights, license plate lights, passenger compartment lights (also delay system), glovebox light, trunk light and engine compartment light, sun vizor mirror lamp, front and rear map reading lamps.					+	
Check / adjust aiming of headlights.	Gr. 63				+	
Check horn, headlight flasher and hazard warning lamps as well as control lamps.					+	
Set clock.					+	
Program on-board computer and check function of keys and remote control.						

BMW Maintenance System - USA	General Information					
00 00 009 Pre-Delivery inspection	Repair Manual	Technical Data	Service Info.	Consumables	Owner's Manual	Important Information
Check lighting of instrument panel and title block. Check intensity of lighting.					+	
Check control and warning lights, clock, warning buzzer and Check-Control: Check alternator, oil pressure, coolant temperature, indicator lights, brake linings/brake fluid level, fog lamps, Lambda probe, safety belt, ignition key warning buzzer, full beam lamps, fuel gage, ABS and Airbag, Check-Control, gear display.						
Fill tank on screen-wash unit and check anti-freeze concentration.			Gr. 00		+	If necessary, add anti-freeze fluid.
Fill tank on intensive cleaning unit.						
Check wash/wipe system and spray jet setting; Remove protective sleeves from wiper blades.					+	
Check function of intensive cleaning unit.						
Check function of rear screen heating.						
Check function of cigarette lighter.						
Check function of headlight cleaning system.					+	
Radio: check aerial and tuning, adjust radio, check for suppression when engine running and switch all electrical consumers on in sequence, check function of cassette player.	Gr. 65					
Check function of any other optional extras: electrical window regulators, front and rear, sliding/tilting sunroof through all settings, fog lights and setting, electric radio aerial and regulator unit. Check function of other items of equipment fitted by dealer.						

BMW Maintenance System - USA

00 00 009 Pre-Delivery inspection	General Information					Important Information
	Repair Manual	Technical Data	Service Info.	Consumables	Owner's Manual	
Check wing mirror.						
Check function of central locking system.					+	
Check seat adjustment by hand/electrically.						
Check safety belts.						
Check license plate number, chassis number and engine number.						
Check goods received against order items.						
Fit hub caps and, where applicable, decorative wheel trim and exhaust trim.						
Place tools in on-board tool kit; secure car jack and lug wrench.						
Paste BMW Emergency Service telephone number label and annual change of brake fluid.						
Place Owner's Manual, directory of BMW service stations, spare key and key wallet in glove box.						
Battery and accessories warranty certificates.						
If applicable, operating instructions for radio.						
Factory invoice (Monroney sticker).						
Cleaning kit for cassette player.						

BMW MAINTENANCE SYSTEM — USA 00 00 009 Pre-delivery inspection	General information					Important information!
	Repair Manual	Technical Data	Service Information	Operating Fluids	Owner's Manual	
Road test:						
Check acceleration, coasting and brakes (before and during road test).						*Caution!* Stronger braking effect from systems with Politex brake pads.
Check idling speed (rpm).			+			
Check function of Motronic.						
Check car for rattling and grinding noise.						
Check driving behavior and wheel balance.						
Check function of engine, clutch, transmission, final drive, steering (wheels pointing straight ahead); cars with rear brake discs: break in parking brake.	Gr. 34					
Check heating, ventilating and air conditioning.						
Check function of instruments.						
Check function of cruise control.						

BMW MAINTENANCE SYSTEM — USA 00 00 009 Pre-delivery Inspection	General Information					Important Information!
	Repair Manual	Technical Data	Service Information	Operating Fluids	Owner's Manual	
After Road Test:						
Check engine, transmission, steering, final drive, boots on drive shafts, fuel system, clutch, brakes and cooling system for leaks.						Visual inspection.
Inspect and clean passenger compartment.						
Car washed and polished. Underside without damage. Car without scratches or damage.						Visual inspection.
Remove protective covers from seats and inside of car.						
Important! ***Always*** reset the service interval indicator after the pre-delivery inspection: Switch off all electric consumers. Switch on ignition. Do not run engine. Use SI-R* with adapter and plug in diagnosis socket. Push in and hold recessed, red INSPECTION button – green lamp (function control) lights up. Red lamp also lights up after about 3 seconds and goes out after about 12 seconds. Release INSPECTION button – green lamp goes out.						
Checking Service Interval Indicator: All five green diode lights must light up. 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 - USA	General Information					
00 00 215 BMW Pre-delivery inspection at 1200 miles	Repair Manual	Technical Data	Service Info.	Consumables	Owner's Manual	Important Information
Caution! From 1993 model, proceed in accordance with Quality Certification II.			Gr. 00			See SI 00 24 92 (3660)
Interrogate fault memory in diagnosis system. Brief test.						See Operating Manual BMW Diagnosis Systems. Connect up BMW SERVICE TEST unit. For additional instructions, refer to screen display.
Replace oil and oil filter with engine warm.	Gr. 11		Gr. 00	Gr. 11	+	Use approved oil only
Check / adjust valve clearance (only M20 and M30 engines).	Gr. 11	Gr. 11				
Change oil in manual transmission at operating temperature (except for 525i).	Gr. 23		Gr. 00/23		+	Use approved oil only
Change oil in rear axle differential at operating temperature.		Gr. 33	Gr. 00	Gr. 33		Use approved oil only

BMW Maintenance System - USA	General Information					
00 00 220 BMW Inspection I	Repair Manual	Technical Data	Service Info.	Consumables	Owner's Manual	Important Information
Interrogate fault memory in diagnosis system.						Refer to operating instructions BMW Diagnosis System.
Brief test.						Connect up BMW Service Tester. For additional information, refer to screen display.
Replace oil and oil filter with engine warm.	Gr. 11		Gr. 00	Gr. 11	•	Use only approved grades of oil.
Check / adjust valve clearance (only M20, M30 and S38 engines).	Gr. 11	Gr. 11				
Clean joints and bearing points on throttle valve actuating mechanism and oil and grease.						Use Molykote Longterm, HWB Order No. 81 22 9 407 007
Check fuel tank, cover, pipes and connections for leaks.						Visual inspection
Check cooling system and all connections and heating hoses for leaks; check coolant level and concentration and top up if necessary.						Caution! Coolant must be fully drained and changed every 2 years (from date of manufacture).
Change every 2 years.						
Check condition, routing, mounting and leaktightness of exhaust unit.	Gr. 18					
Check oil level in manual transmission and top up if necessary.		Gr. 23	Gr. 00	Gr. 23		Use approved oil only
Check all transmissions for leaks.						Visual inspection
Check power steering for leaks and check/correct fluid level.	Gr. 32		Gr. 00	Gr. 32		
Check condition of wheel suspension, track rods, front axle joints, drop arm and flexible coupling.	Gr. 31/34/36					Use correct tightening; Visual inspection of cotter pins, fuses etc.
Check steering for clearance in straight-ahead setting.	Gr. 32					

BMW Maintenance System - USA	General Information					
00 00 220 BMW Inspection I	Repair Manual	Technical Data	Service Info.	Consumables	Owner's Manual	Important Information
Check/correct oil level in rear axle differential.			Gr. 00	Gr. 33		Use approved grades of oil only.
Remove/install front and rear disk brake linings. Check total thickness. Replace linings when necessary. Check brake disk surface condition.	Gr. 34	Gr. 34	Gr. 36			
Lubricate wheel hubs.						
Check/correct fluid level in expansion tank for brake and clutch hydraulic fluid.	Gr. 34		Gr. 00	Gr. 34		Use approved brake fluid only.
Caution! Change brake fluid every 2 years at the latest.						
Check brake calipers and dust covers for leaks. Check brake connections and pipes for leaks, damage and correct location.	Gr. 34 Gr. 34					Visual inspection
Check parking brake cable for ease of movement. Adjust parking brake.						
Check/correct tire pressure (including spare wheel). Check trunk for fuel vapor (fumes).			Gr. 36		+	
Check condition of tires.						
Uneven tire wear (recommend alignment check using computer tester; to be invoiced separately)	Gr. 32					

BMW Maintenance System - USA	General Information					
00 00 220 BMW Inspection I	Repair Manual	Technical Data	Service Info.	Consumables	Owner's Manual	Important Information
Level control system: check hyrdraulic fluid level in laden vehicle. If necessary, top up hydraulic fluid (not required from 93 model onwards).	Gr. 37			Gr. 37		
Tighten locks on doors, hood and trunk lids, oil, grease and perform a function check. Oil or grease all hinges.						
Check electrolyte level in battery; top up with distilled water if necessary.						
Function check air-conditioning system and flow of refrigerant.	Gr. 64					
Replace microfilters in air-conditioning unit. Shorten interval accordingly for cars operated in dusty regions.	Gr. 64					
Check function of following equipment: Lighting system: headlights, parking lights, reversing lights, license plate light, interior light with delay system, glove box light, engine compartment and trunk lighting. Warning equipment: indicator lights, hazard warning lights, brake lights horn, headlight flash and dip switches. Check/correct beam alignment of headlights. Check function of Check-Control; control lamps for ABS and Airbag.	Gr. 63					

BMW Maintenance System - USA

00 00 220 BMW Inspection I	General Information: Repair Manual	Technical Data	Service Info.	Consumables	Owner's Manual	Important Information
Top up supply tank for windscreen wash unit/check anti-freeze concentration. If necessary, top up fluid for intensive cleaning.				Gr. 00	•	
Check function of wash/wipe unit and check setting of spray jets.						
Check condition and operation of seat belts.						
Final inspection and test run with inspection of operating safety: Brakes, steering, clutch, automatic transmission and mirrors; Break in parking brake.	Gr. 34					*Caution!* Power-assisted braking action of units fitted with Politex brake linings. Break in parking brake. see 34 10 014 in the repair manual.
Check all transmissions for leaks.						Visual inspection
Caution! After inspection I, reset Service Interval Indicator: Switch off all electrical equipment. Switch on ignition. Do not run engine. Use SI-R* with adapter and plug in diagnosis socket. Push in and hold down the red INSPECTION button - green lamp (function check) lights up. Red lamp also lights up after about 3 seconds and goes back out after about 12 seconds. Release inspection button - green lamp goes out -.						
Checking service indicator: All five green diode lights must light up. 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

new SI-R=Service Indicator Resetter, Order No. 62 1 110

BMW Maintenance System - USA 00 00 231 BMW Inspection II = Inspection I + following supplementary procedures	General Information					Important Information
	Repair Manual	Technical Data	Service Info.	Consumables	Owner's Manual	
Check tension and condition of all V-belts and retighten if necessary (except M50, M60 engines). If necessary, replace and invoice separately.	Gr. 12/32/64					
Replace all V-belts on S38 engines and invoice separately.						
Replace spark plugs.		Gr. 12	Gr. 12		+	
Air cleaner: Replace air filter insert. Shorten interval accordingly for cars operated in dusty regions.	Gr. 13					
Replace fuel filter. If dirty fuel is used, shorten interval accordingly. (Recommended in California; mandatory in all other States).	Gr. 16				+	
Check clutch drive disk for wear.	Gr. 21					
Change oil in manual transmission at operating temperature (only 535i, M5).		Gr. 23	Gr. 00	Gr. 23		Use approved oils only
Change oil in automatic transmission at operating temperature.	Gr. 24	Gr. 24	Gr. 00	Gr. 24		Use approved oils only
Perform oil change on rear axle differential at operating temperature.		Gr. 33	Gr. 00	Gr. 33		Use approved grades of oil only.
Check condition on bellows on output shafts.						
Rear disk brakes: Check thickness of parking brake linings.	Gr. 34	Gr. 34				
ASC +T: Replace filter insert in inlet.	Gr. 64					

BMW Maintenance System - USA	General Information					
00 00 231 BMW Inspection II = Inspection I + following supplementary procedures	Repair Manual	Technical Data	Service Info.	Consumables	Owner's Manual	Important Information
Every 2nd inspection II:						
Replace toothed belt (no later than every 50 000 miles). Invoice as separate item.	Gr. 11					
Change oil in manual transmission at operating temperature, (only 525i/iT).		Gr. 23	Gr. 00	Gr. 23		Use approved oils only
Check entire body for rust damage in accordance with warranty terms (at least once every two years).						
Caution! Reset Service Interval Indicator after Inspection II: Switch off all electrical equipment. Switch on ignition. Do not run engine. Use SI-R* with adapter and plug in diagnosis socket. Press and hold down red INSPECTION button - green lamp (function check) lights up. In addition, the red lamp lights up after about 3 seconds and goes back out after about 12 seconds. Release inspection button - green lamp goes out.						
Checking service indicator: All five green diode lights must light up. 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						
new SI-R= Service Indicator Resetter, Order No. 62 1 110						

BMW Maintenance System - USA	General Information					
00 00 240 BMW Annual Inspection (at 11-13 month intervals)	Repair Manual	Technical Data	Service Info.	Consumables	Owner's Manual	Important Information
Caution! Change brake fluid every 2 years at the latest.	Gr. 34		Gr. 00	Gr. 34		Use approved brake fluid
Check master cylinder and servo for correct operation (function check) and leaks. Check/correct beam settings of headlights and fog lamps. Check steering: angle of lock, screw connections, servo assistance.						
Caution! Completely drain coolant every two years (from date of first registration) and check anti-freeze (invoice separately).			Gr. 00	Gr. 17		Use approved anti-freeze.
Check body for damage, refer to BMW 6 year warranty against rust damage.					•	Record Inspections and/or repair work in the operating manual.

BMW MAINTENANCE SYSTEM — USA 00 00 249 BMW Engine Oil Service	General Information					
	Repair Manual	Technical Data	Service Information	Operating Fluids	Owner's Manual	Important Information!
Replace engine oil and oil filter at operating temperature.			Gr. 00	Gr. 11		Use approved oil only.
Reset the service interval indicator after Oil Service: Switch off all electric consumers. Switch on ignition. Do not run engine. Use SI-R* with adapter and plug in diagnosis socket. Push in and hold yellow OIL SERVICE*** button – green lamp (function control) lights up. Yellow lamp also lights up after about 10 seconds and goes out after about 3 seconds. Release OIL SERVICE button – green lamp goes out. Checking Service Interval Indicator After About 10 Seconds: All five green diode lights must light up. Yellow and possibly red diode lights as well as OIL SERVICE sign should go out. *Important!* Do not reset the service interval indicator if the oil is changed additionally (between normal intervals) on request of the customer. *** *Caution!* Resetting with the wrong button cannot be corrected. Service intervals would be mixed up – also refer to BMW Technik bulletins of Group 62 for information.						
* SI-R = Service Indicator Resetter, Order No. 62 1 100 Adapter, Order No. 62 1 140 New Service Indicator Resetter, Order No. 62 1 110						

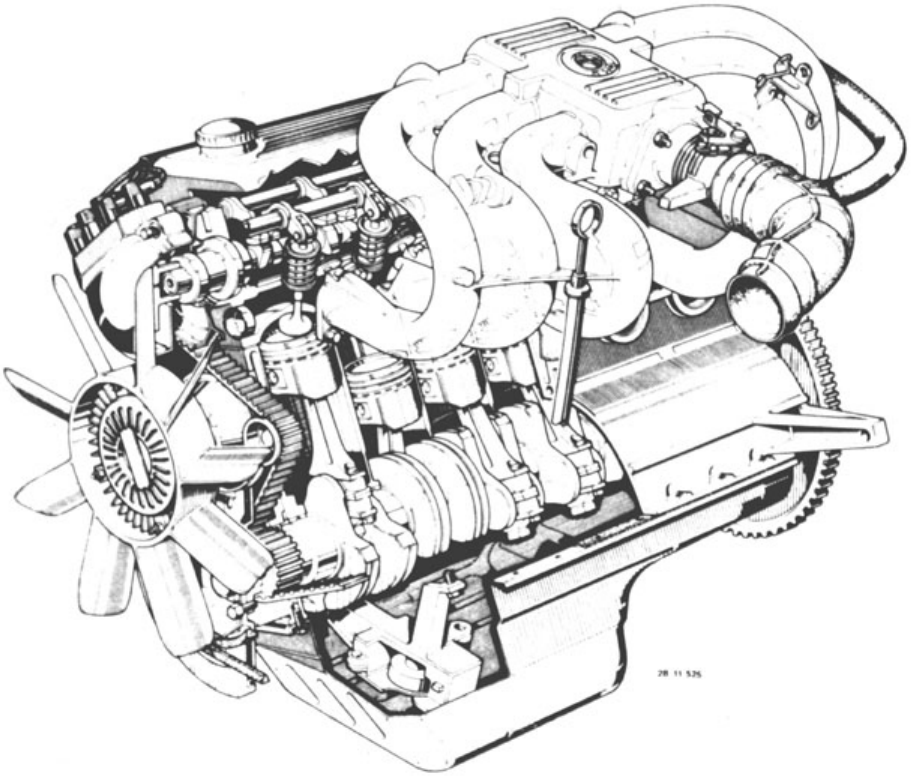
BMW MAINTENANCE SYSTEM — USA 00 00 259 Extra Recommended Service Invoiced Separately	General Information					
	Repair Manual	Technical Data	Service Information	Operating Fluids	Owner's Manual	Important Information!
Steering Test: Steering gear, linkage, coupling, connections, leaks, oil volume and condition of power steering.	Gr. 32		Gr. 00	Gr. 32		Use approved oil only.
Brake Test: Brake pads (remove and install wheels), brake discs, pipes, hoses, connections, brake fluid level, parking brake.	Gr. 34					
Important! Replace brake fluid every 2 years at latest (beginning from date of manufacture).			Gr. 00	Gr. 34		Use approved brake fluid only.
Tire and Wheel Rim Test: Condition, tire pressure, specified size (including spare wheel).		Gr. 36		Gr. 36		
Light Test: Headlights, fog lamps (also aiming), parking lights, tail lights, backup lights, license plate lights, instrument and sign lights, glove box light, engine compartment light, trunk light, control and warning lamps, Check Control, ABS and airbag warning lamps.	Gr. 63					
Warning Appliance Test: Horn, headlight flasher, turn signals, hazard warning lights, stop lights.						
Windshield Wipers/Washer and Headlight Cleaners: Wiper blades, washer (windshield, if applicable headlights and intensive cleaning), supply tank (fluid level/antifreeze), spray nozzle aiming (windshield, if applicable headlights), if applicable level of intensive cleaning fluid.			Gr. 00	Gr. 00	+	
Seat Belts: Condition and function.	Gr. 72					
Clean cassette player head and align rollers every 50 to 100 hours or more often in case of poor sound quality.						
Final inspection and road test with traffic safety check: brakes, steering, clutch or automatic transmission and mirrors.						*Caution!* Stronger braking from systems with Politex brake pads.
Remarks: Invoice repairs and adjustments separately.						

BMW Maintenance System	General Information					
BMW Lambda oxygen sensor service	Repair Manual	Technical Data	Service Info.	Consumables	Owner's Manual	Important Information
Please remember: Replace Lambda sensor every 50 000 miles						
Every 3 years, from date of manufacture :						
BMW Airbag system (SRS) inspection						
Visual inspection to ensure that: All airbag (SRS) components are still in original condition (no change in shape or location). No unauthorized wiring changes, no additional cables or connections on airbag cable harness. The airbag trim and ripcords are not cut, torn or damaged in any way. The airbag must never be treated with cleaning, lubricant or protective agents. Ensure that the correct labels are pasted to (2) the front axle beam and glove box.						

11 Engine M20

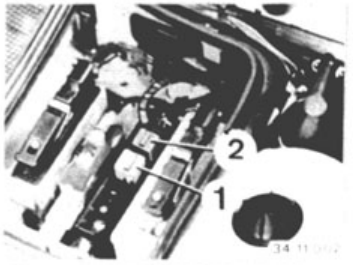
11 00 039	Compression – check	11- 00/2.2
11 00 050	Engine – remove and install	11- 00/2.2
11 11 160	Bearing for oil pump drive shaft – replace	11- 11/2.1
11 12 000	Cylinder head cover – remove and install	11- 12/2.1
11 12 100	Cylinder head – remove and install	11- 12/2.1
11 31 110	Timing belt – replace	11- 31/2.1
11 40 000	Engine oil pressure – check	11- 40/2.1
11 78 . . .	Oxygen sensor – check	11- 78/2.1

For further jobs refer to “Assembly Repair Manual”.



BMW 520 i – M 20 B 20 M
BMW 525 i – M 20 B 25 M

M 20 = Small 6 cylinder
B = Gasoline
20 = Displacement x 100
M. = Motronic

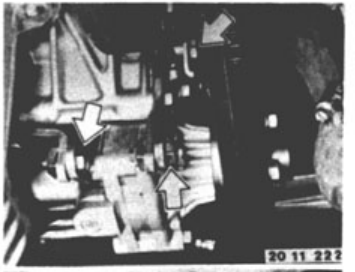


11 00 039 CHECKING COMPRESSION

Take off cover on electric box (in engine compartment at right rear).
Pull off master relay (2).

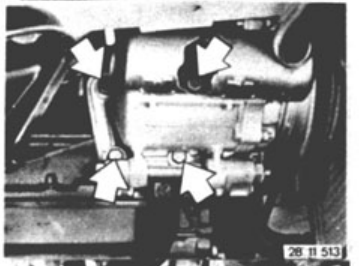


Unscrew all spark plugs.
Press down on accelerator pedal and operate starter until pressure stops rising.
Specifications: 10 to 11 bar (143 to 156 psi) / max. deviation between cylinders = 0.5 bar (7 psi).
Installation:
Tightening torque for spark plugs = 25 Nm (18 ft. lbs.).

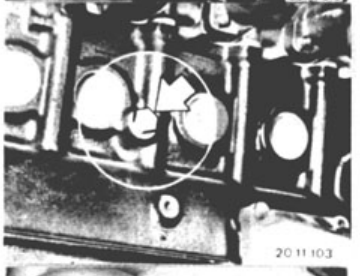


11 00 050 REMOVING AND INSTALLING ENGINE

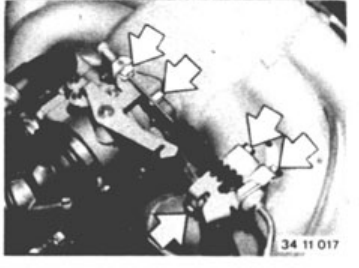
Remove transmission - see Gr. 23/24.
Disconnect battery.
Cars with Power Steering:
Unscrew power steering pump (hoses remain connected).



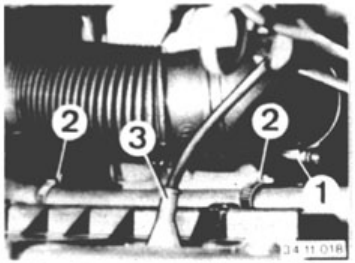
Cars with Air Conditioner:
Unscrew compressor (refrigerant pipes remain connected).
Installation:
Check tightness of drive belt with Special Tool 11 5 020.



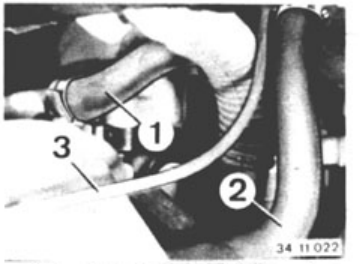
Unscrew plug and drain coolant.
Remove radiator - see 17 11 000.
Remove fan – see 11 52 000.



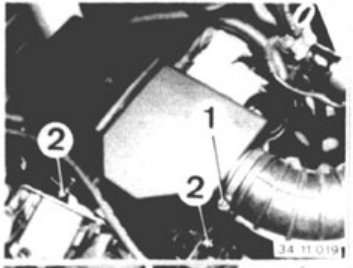
Disconnect cables and unscrew holders.



Loosen clamp (1).
Disconnect hose in holder on air cleaner housing and remove.
Open straps (2) and pull off plug (3).



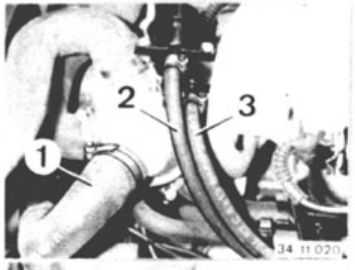
Disconnect heater hoses (1 and 2) and pull off vacuum hose (3).



Loosen clamp (1) and pull off hose.
Loosen nuts (2) and remove air cleaner.



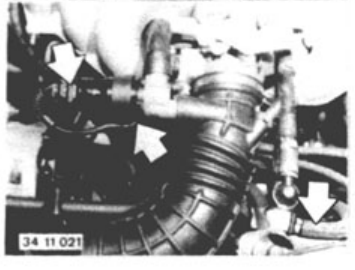
Unscrew coolant pipe.



Disconnect radiator hose (1) and fuel hoses (2 and 3).
Caution!
Don't mix up hoses (2 and 3).



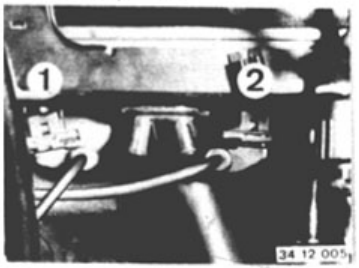
Pull off ignition leads on ignition coil.
Pull off plug (1) on oil pressure switch.
Lift out electric lead duct underneath distributor and place leads aside to the left of the engine.
If applicable, disconnect pipes (2) for oil cooler.



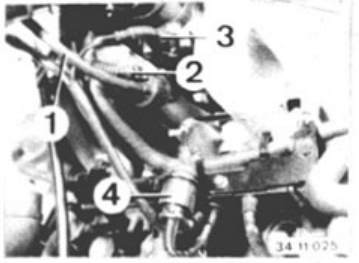
Pull off plug on idle speed control.
Cut off wire strap and pull off vacuum hose for brake booster.



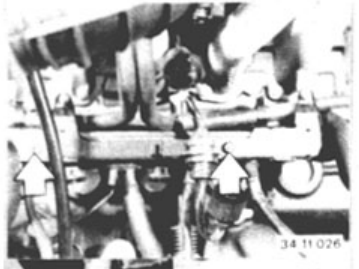
Disconnect connecting lead on starter.
Take off cover (1) and disconnect connecting lead on alternator.
Disconnect plug (2).



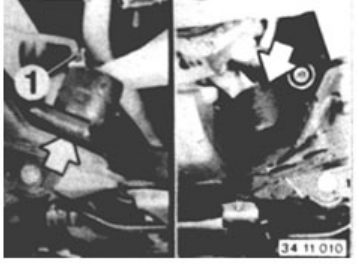
Pull off plugs (1 and 2).
Note:
Plug 1 = reference mark sender
Plug 2 = cylinder identifying sender



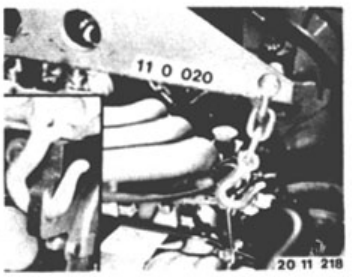
Pull off hose (1) and plugs (2 and 3).
Disconnect plug (4).



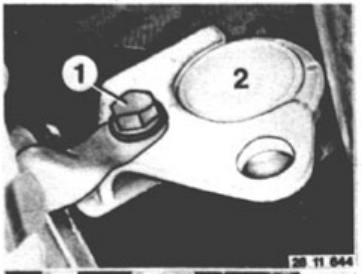
Unscrew nuts and place engine wire harness aside.



Unscrew ground strap (1).
Unscrew engine mounts (left from above, right from below).
Installation:
Guide guidepin into bore in axle carrier.
Tightening torque for engine mounts = 45 Nm (32.5 ft. lbs.).



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



11 11 160 REPLACING BEARING FOR OIL PUMP DRIVE SHAFT

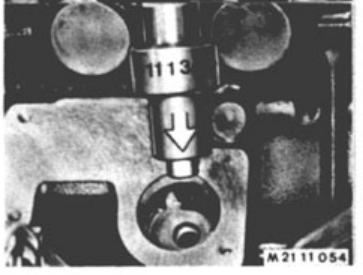
Remove oil pump – see 11 41 000.
Unscrew bolt (1) and lift off cover (2).



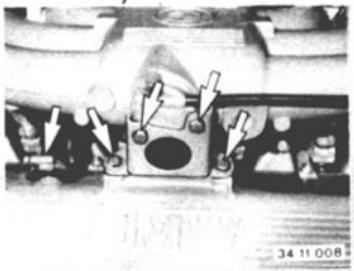
Remove gear wheel (3).
Installation:
Open end of gear wheel shaft faces down.
Check seal (4), replacing if necessary.



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

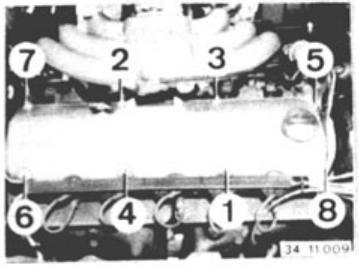


Installation:
Lubricate needle bearing with grease.
Drive in needle bearing against stop with Special Tool 11 1 300.

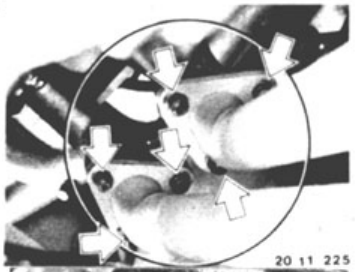


11 12 000 REMOVING AND INSTALLING CYLINDER HEAD COVER

Take off support and venting hose.



Unscrew nuts (1 ... 8) and take off cover.
Installation:
Check gasket, replacing if necessary.
Tighten nuts in order of 1 through 8.
Tightening torque = 9 Nm (6.5 ft. lbs.).



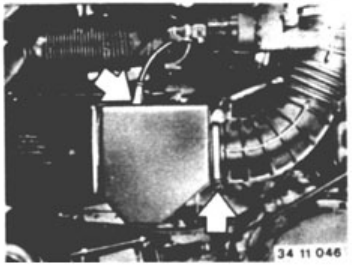
11 12 100 REMOVING AND INSTALLING CYLINDER HEAD

Disconnect battery – see Gr. 00.
Unscrew exhaust pipes on exhaust manifolds and loosen clamp of holder on transmission.
Installation:
Replace gaskets and self-locking nuts.
Coat studs with copper paste**.
Tightening torque = 50 Nm (36 ft. lbs.).
Drain coolant on engine and radiator.
Drain engine oil.
Installation:
Fill and bleed cooling system – see Group 17.



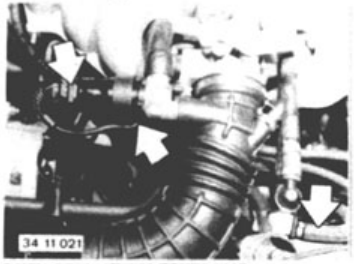


Disconnect cables and unscrew holder.

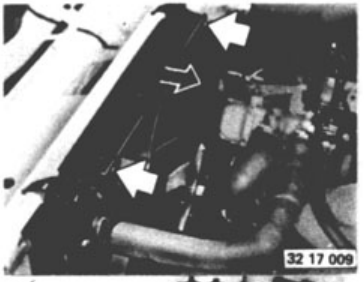


Loosen hose clamp and pull off intake air hose on air cleaner.
Pull off plug on air flow sensor.

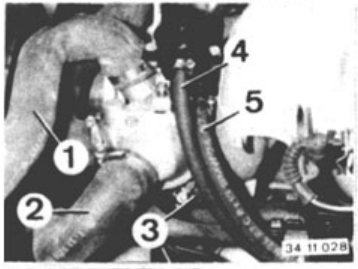
** Source of Supply: HWB



Pull off plug on idle speed control.
Cut off wire strap and pull off vacuum hose for brake booster.



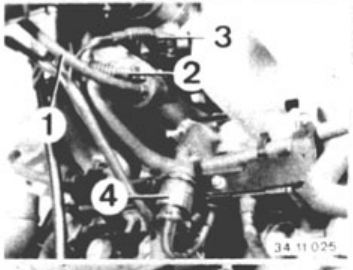
Remove fan – see 11 52 000.
Lift out expansion rivets at left and right top on fan cowl and remove fan cowl.
Installation:
Check for correct seating of bottom guide.



Disconnect radiator hoses (1 and 2), heater hose (3) and fuel hoses (4 and 5).
Installation:
Don't mix up fuel hoses (4 and 5).



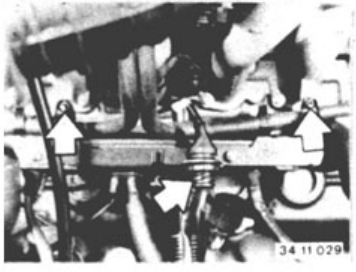
Loosen clamp and take off preheating hose.
Unscrew guide tube for oil dipstick on manifold.
Remove toothed drive belt – see 11 31 110 (conform with specifications in regards to replacing the toothed drive belt).



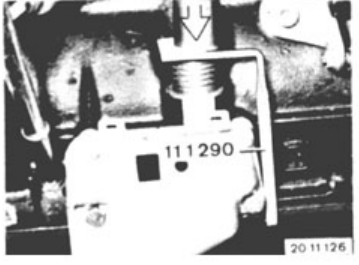
Pull off hose (1) and plugs (2 and 3).
Disconnect plug (4).



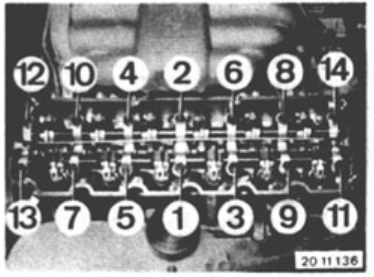
Disconnect heating hose on cylinder head.
Remove cylinder head cover – see 11 12 000.



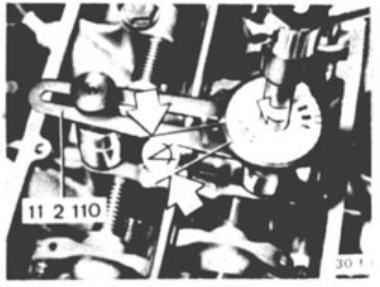
Unscrew knurled nut and take off plug.
Unscrew nuts and take wire connector plate off of intake manifold.



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



Release cylinder head bolts working from outside to inside in sequence 14 ... 1.
Remove cylinder head



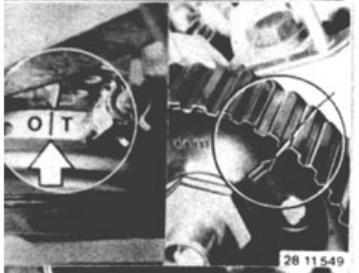
Installation note:
There must be no boil in the blind holes (risk of cracking, incorrect tightening values).
Clean sealing surfaces
Fit cylinder head gasket in position.
Replace cylinder head bolts.
Firmly tighten cylinder head bolts with special tool 11 2 110 or 00 9 120 in the sequence 1 ... 14.
For tightening torque,
refer to Technical Data 11 12 2AZ

11 31 110 REPLACING TOOTHED DRIVE BELT

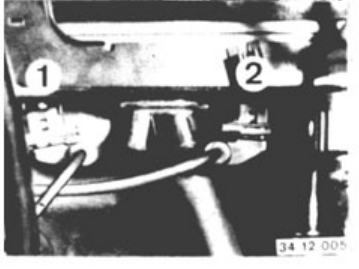
Important!
Always replace an used toothed drive belt with a new belt each time the tensioning roller is loosened, regardless of the number of kilometers or miles used.



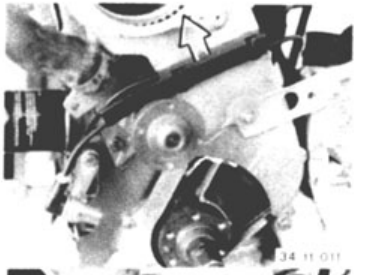
Unscrew distributor cap (1) and distributor rotor (2).
Remove cover (3).
Unscrew bolts (4).



Set cylinder number 1 to TDC by turning the crankshaft (arrow on camshaft sprocket faces mark on cylinder head).
Remove vibration damper – see 11 23 010.



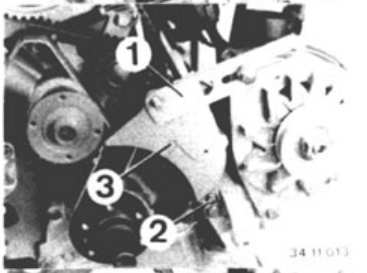
Pull off plugs (1 and 2) on engine harness plate.
Pull off plug on oil pressure switch.



Lift out wire duct (underneath distributor) and place electric leads aside.



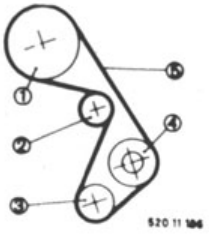
Take off rubber guard (1).
Unscrew nut (2) and take off cover (3).



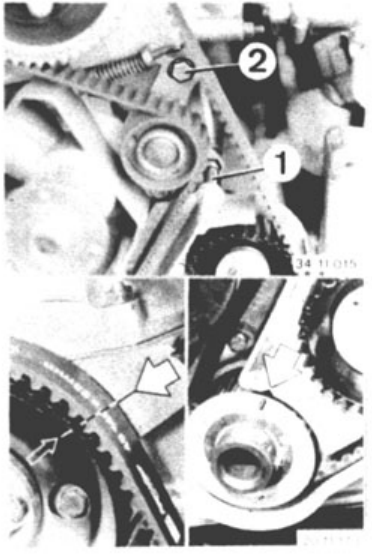
Unscrew clamp (1).
Unscrew screw (2) and take off cover (3).



Loosen bolts (1 and 2).
Press in tensioning roller.
Tighten bolt (2).
Take off toothed drive belt.



Installation:
Install toothed drive belt, starting on the crankshaft sprocket and continuing in opposite direction of engine's rotating direction.
Toothed Drive Belt Layout:
1 Camshaft sprocket
2 Tensioning roller
3 Crankshaft sprocket
4 Intermediate shaft sprocket
5 Toothed drive belt



Tightening Toothed Drive Belt:

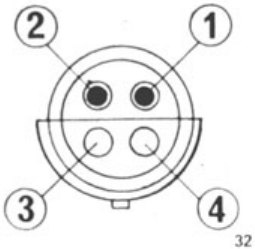
- Loosen bolt (2) (it should be possible to move the tensioning roller with spring force).
- Crank engine once in running direction up to the TDC mark (toothed drive belt tightens itself).
- Check timing (mark on camshaft sprocket must be precisely aligned with mark on cylinder head when crankshaft is in TDC position).
- Mount tensioning tool (tighten bolt 2 first and then bolt 1).

Install label with date and mileage on cylinder head cover after finishing work.



11 40 000 CHECKING ENGINE OIL PRESSURE

Remove splash guard.
Pull off plug on oil pressure switch (underneath right engine carrier) and remove oil pressure switch.
Apply Special Tool 11 4 030 with a seal and connect on BMW Service Tester.
Check oil pressure.
At idle speed: 0.5 to 2 bar (7 to 28 psi)
Max. pressure: 4 to 6 bar (57 to 85 psi)
Installation:
Tightening torque for oil pressure switch = 35 Nm (25 ft. lbs.).



32 11 1

11 78 . . . CHECKING OXYGEN SENSOR

A. Check Heating:
Disconnect plug for oxygen sensor. Connect ohmmeter on jacks 3 and 4 (toward oxygen sensor) and measure resistance (nominal value: < 5 ohms).
1 = Plug for sensor voltage –
2 = Plug for sensor voltage +
3 = Jack for sensor heating
4 = Jack for sensor heating

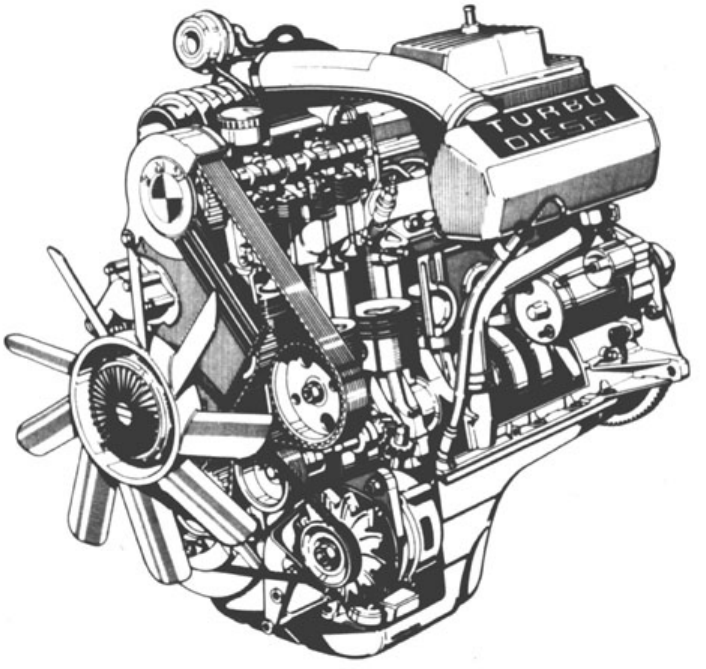
B. Check Signal Voltage:
Perform "Oxygen Sensor Voltage" status call in scope of DME self-diagnosis. Value is measured at idle speed with connected oxygen sensor and switched on oxygen sensor control (about 1 to 2 minutes after starting the engine) and should be between 0.02 and 0.85 V.
If a constant voltage of 0.45 V is measured, the oxygen sensor is not working (oxygen sensor or power supply lead faulty).

11 Engine M21

	Notes	11- 00/1.1
11 00 039	Compression – check	11- 00/1.2
050	Engine – remove and install	11- 00/1.3
11 11 160	Bearing for oil pump drive shaft – replace	11- 11/1.1
11 12 000	Cylinder head cover – remove and install	11- 12/1.1
100	Cylinder head – remove and install	11- 12/1.1
11 13 000	Oil pan – remove and install	11- 13/1.1
11 65 015	Exhaust turbocharger – check bearing play	11- 65/1.1
018	Exhaust turbocharger – check boost pressure	11- 65/1.1
020	Exhaust turbocharger – remove and install	11- 65/1.2
059	Control valve – check and adjust	11- 65/1.3
060	Control valve – remove and install	11- 65/1.3
. . .	Boost pressure sensor – check	11- 65/1.4
11 66 000	Vacuum pump – remove and install/check	11- 66/1.1

For further jobs refer to “Assembly Repair Manual”.

M 21 = Small 6 cylinder
D = Diesel
24 = Displacement x 100
W = Swirl chamber
A = Supercharging



M21 11 191

WORKING INSTRUCTIONS

in Reference to Cleanliness on Fuel System

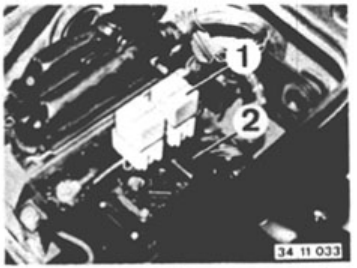
- Clean area around repair point thoroughly (for example, before loosening pipes, hoses, switches, etc.).
- Place removed parts on clean surfaces only and cover with plastic sheet (never use cloths losing lint!).
- Cover or install plugs in open ends of pipes/hoses or openings in components.
- Only install cleaned parts.
  Take new parts out of their packaging only immediately before installation.
- Keep diesel fuel off of coolant hoses - rinse off with water immediately, if necessary.

11 00 039 Checking compression

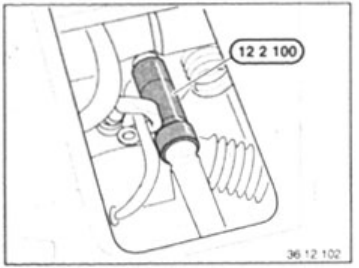
Measuring conditions:
Battery in perfect working order, check acid density if necessary.
Max. coolant temperature 35° C.



Note:
Special tool 11 0 160 can be re-used.

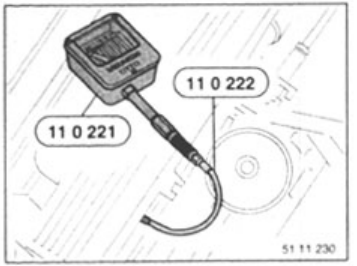


Open cover of E-box.
Disconnect main relay (1) and plug connector (2) from glow plug timer.

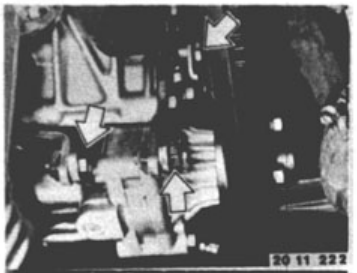


Remove glow plugs with special tool 12 2 100.

Installation note:
Thinly coat thread of glow plugs with copper paste "CRC", see BMW Parts Service.
For tightening torque
refer to Technical Data 12 23 1AZ/2AZ



Fully screw in special tool 11 0 222 and lightly tighten by hand.
Compression tester: Fit special tool 11 0 221, operate starter until pressure no longer increases.
For compression pressure, refer to Technical Data.
All cylinders approx. same value.

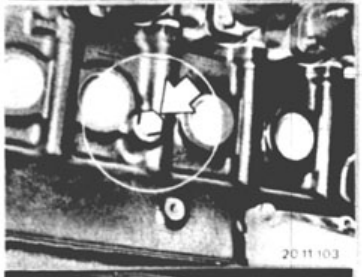


11 00 050 REMOVING AND INSTALLING ENGINE

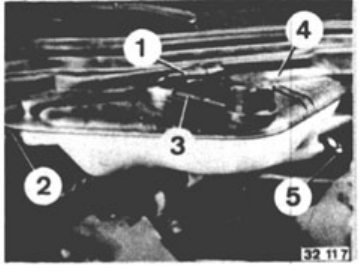
Disconnect battery.
Remove transmission – see Gr. 23 or 24.
Unscrew power steering pump (hoses remain connected).
Installation:
Check drive belt tightness with Special Tool 11 5 020.



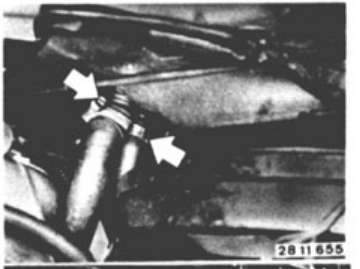
Cars with Air Conditioner:
Unscrew compressor (refrigerant hoses remain connected).
Installation:
Check drive belt tightness with Special Tool 11 5 020.



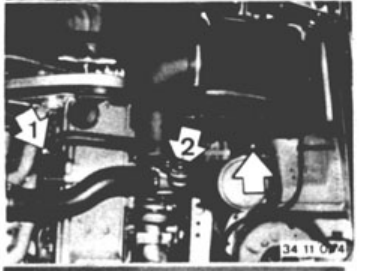
Unscrew plug and drain coolant.
Remove radiator – see 17 11 000.



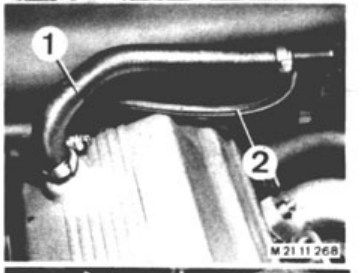
Pull off plug (1).
Unscrew nuts (2) on left and right sides.
Disconnect hoses (3 ... 5) and remove coolant expansion tank.



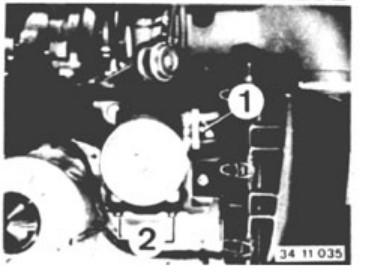
Disconnect heater hoses.
Cars with Automatic Transmission:
Disconnect oil pipes on engine.



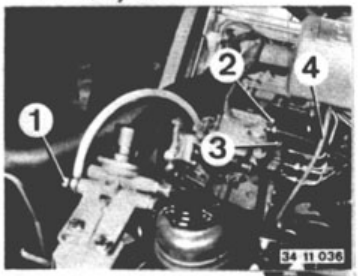
Loosen hose clamps (1 and 2) and pull off hoses.
Unscrew nut and remove air cleaner.



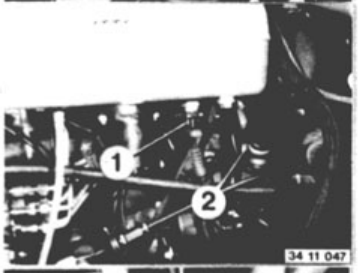
Loosen clamp and pull hose (1) off of cylinder head cover.
Pull off vacuum hose (2).



Unscrew bolt (1) and take off oil pipes (plug open pipes and openings in crankcase).
Unscrew nuts (2), take oil filter housing off of body and suspend from engine on a piece of wire.
Installation:
Check O-rings, replacing if necessary.
Tightening torque for bolt (1) = 22 Nm (16 ft. lbs.).



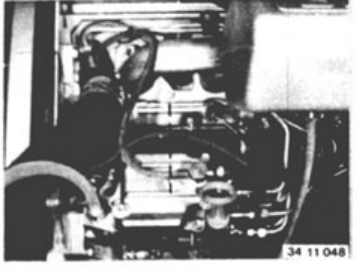
Disconnect fuel pipes (1 and 2).
Unscrew nut (3) and take off electric lead.
Pull off vacuum hose (4).
Installation:
Check seals, replacing if necessary.
Bleed fuel system – see 13 51 320.



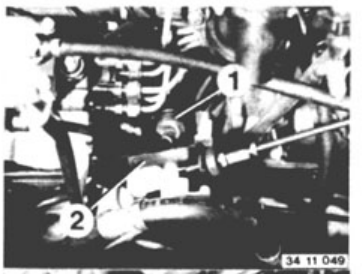
Pull off plug (1) on charge air temperature sensor.
Loosen clamp (2).



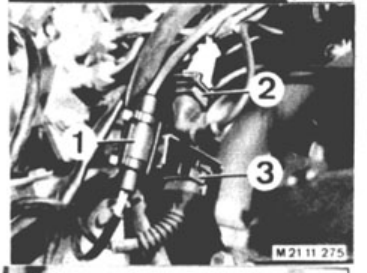
Disconnect connecting leads on starter and alternator.



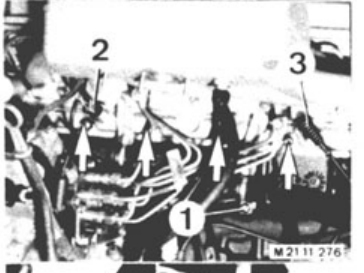
Cut through connecting lead for oil pressure switch.
Installation:
Solder ends of lead together or install a plug connector.



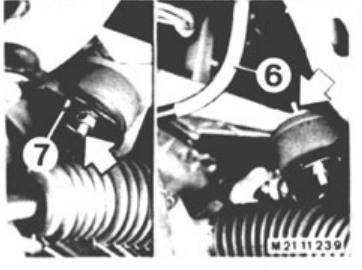
Disconnect plug (1) for injection pump.
Cars with Automatic Transmission:
First unscrew holder (2).



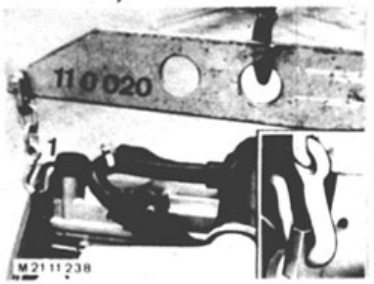
Disconnect plugs (1 ... 3).
If applicable, separate rear connection for oil level switch.



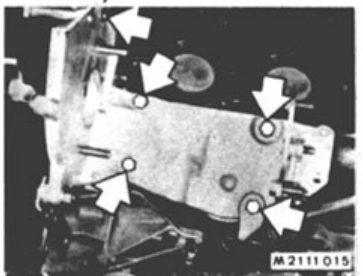
Loosen clamp (1).
Pull off plugs (2 and 3) on temperature sensors.
Disconnect all electric leads on glow plugs.
Cut off wire straps and take wire harness off of engine.



Unscrew ground strap (6) and both engine mounts.
Installation:
Insert guide (7) into bore in axle carrier.
Tightening torque for engine mounts = 45 Nm (32.5 ft. lbs.).

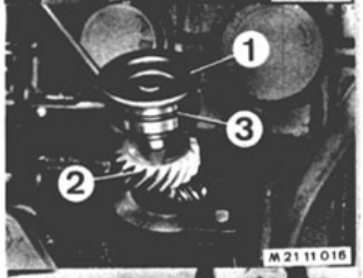


Attach Special Tool 11 0 020 on engine and lift out engine.



11 11 160 REPLACING BEARING FOR OIL PUMP DRIVE SHAFT

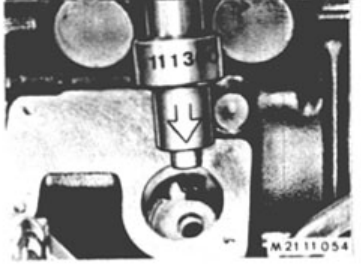
Remove oil pump – see 11 41 000.
Remove injection pump – see 13 51 000.
Unscrew console.



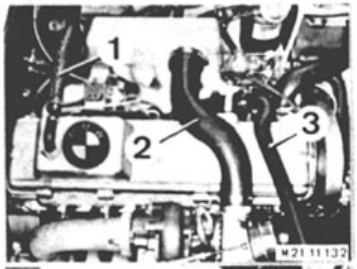
Lift out cap (1).
Remove gear wheel (2).
Installation:
Open end of gear wheel shaft faces down.
Check bearing in cover (1) and seal (3), replacing if necessary.



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.

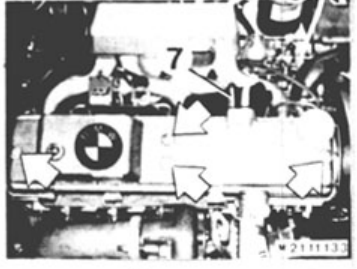


11 12 000 REMOVING AND INSTALLING CYLINDER HEAD COVER

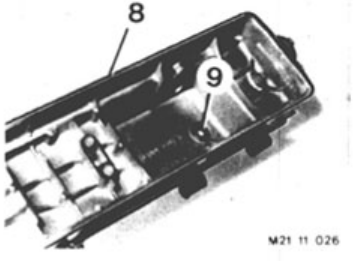
Disconnect hoses (1 ... 3).



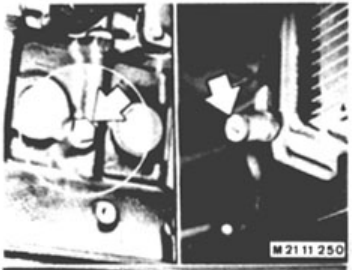
Loosen screws of cover.
Installation:
Tighten cylinder head cover first and then protective cover.



Unscrew oil trap (7).
Unscrew screwed-in sleeves and take off cylinder head cover.
Installation:
Install screwed-in sleeves with seals.
Check seal on oil trap, replacing if necessary.
Tightening torque = 15 Nm (11 ft. lbs.).

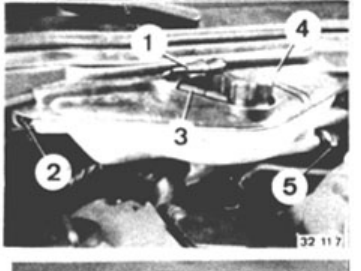


Installation:
Check cylinder head cover gasket (8) and rubber ring (9), replacing if necessary.
Insert rubber ring (9) in cover and lubricate with oil.

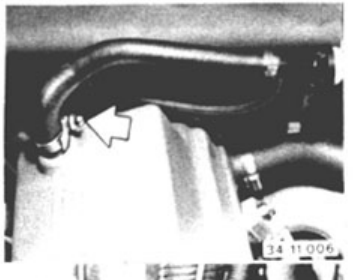


11 12 100 REMOVING AND INSTALLING CYLINDER HEAD

Disconnect battery.
Drain engine oil.
Drain coolant at engine block and radiator.
Installation:
Fill and bleed cooling system – see Gr. 17.



Pull off plug (1).
Unscrew nuts (2) on left and right sides.
Disconnect hoses (3 ... 5) and remove coolant expansion tank.



Loosen clamp and pull off vacuum hose.
Remove turbocharger see 11 65 020.



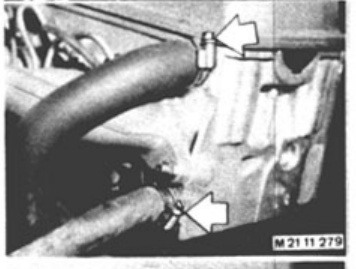
Remove fan – see 11 52 000.
Disconnect coolant hoses on thermostat housing.



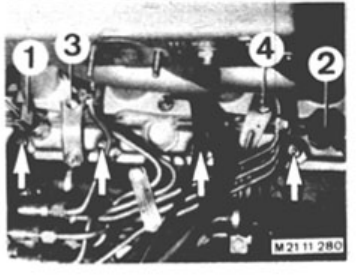
Loosen hose clamp and pull off coolant hose (1).
Pull off leak hose (2) and disconnect on injection pipe.



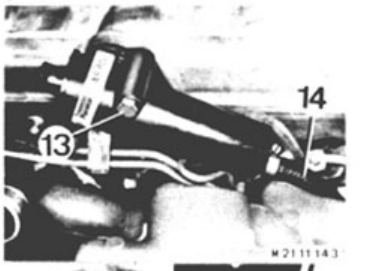
Pull off vacuum hose (1) and plug (2).
Loosen clamp (3).
Unscrew support (4) on manifold and loosen on engine block.



Loosen hose clamps and pull off hoses.



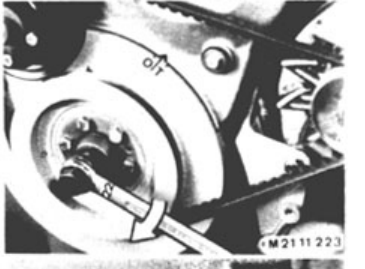
Pull off plugs (1 and 2) on temperature sensors.
Unscrew holders (3 and 4) on cylinder head.
Disconnect all electric leads on glow plugs.



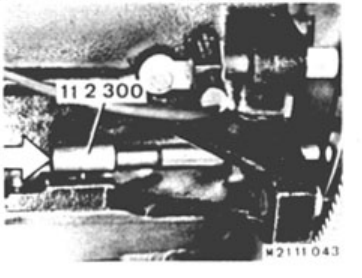
Unscrew oil trap (13).
Pull off hose (14).
Installation:
Check seal, replacing if necessary.



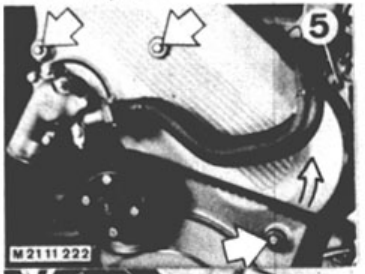
Unscrew injection pipes on injection nozzles and injection pump with Special Tool 13 5 020.
Install protective caps.
Remove cylinder head cover – see 11 12 000.
Installation:
Tightening torque = 20 to 25 Nm (15 to 18 ft. lbs.).
Bleed fuel system see 13 51 320.



Turn cylinder number 1 to TDC cylinder number 6 overlaps.

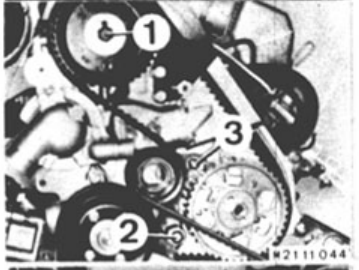


Hold crankshaft with Special Tool 11 2 300.
Caution!
Remove special tool before operating engine.



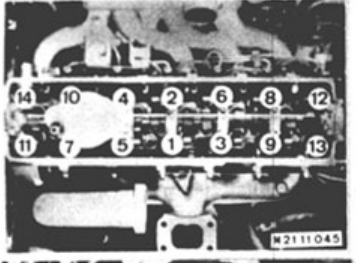
Disconnect hose (5) and unscrew protective cover.

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



Loosen screws (1 and 2) and nut (3).
Loosen toothed belt and take it off of the camshaft sprocket.

Installation:
Install and tighten toothed belt - refer to 11 31 110 in Construction Group Repair Manual.



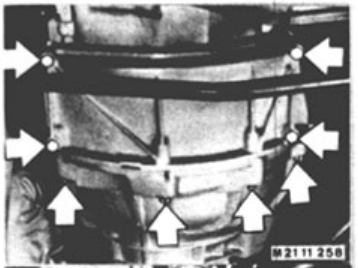
Unscrew bolts in sequence of 14 to 1 and remove cylinder head.

Installation:
Keep oil out of holes (danger of cracking head, falsified torque values).
Clean cylinder head bolts.
Give threads and head bearing surfaces of bolts a light coat of oil.
Replace cylinder head gasket.
Measure piston protrusion - refer to 11 12 101.



Tighten bolts in sequence of 1 to 14 in three steps.
Adjust valve clearance - refer to 11 34 004.
Check static adjustment of injection pump - refer to 13 51 005.
In the third step (cylinder head cover removed again after engine ran warm) tighten the cylinder head bolts regardless of the engine temperature using Special Tool 11 2 110.

* Refer to Specifications

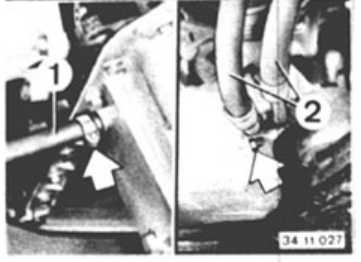


11 13 000 REMOVING AND INSTALLING OIL PAN

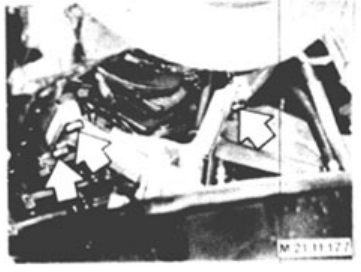
Remove splash guard.
Unscrew reinforcement plate.



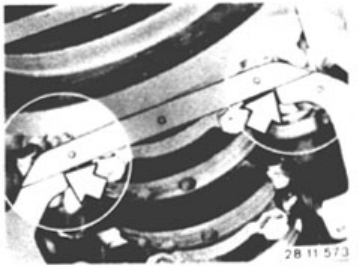
Unscrew bolt and pull out guide tube for oil dipstick from above.
Loosen clamp and pull off venting hose.
Installation:
Replace O-ring on guide tube.



Drain engine oil – see 00 11 209.
Disconnect hose (1).
Cars with Automatic Transmission:
Also unscrew oil pipes (2) on oil pan.
Unscrew oil pan.



Unscrew oil pump and remove oil pan.
Installation:
Install oil pump drive shaft – see 11 41 000.
Replace gasket.



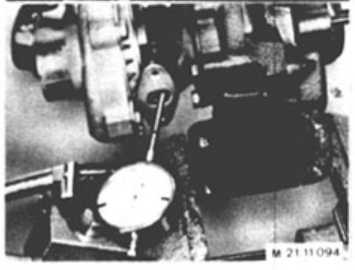
Installation:
Clean sealing surfaces.
Apply a coat of brush-on universal sealing compound** on joints between timing case cover and end cover.

** Source of Supply: HWB



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 by blue smoke) or noise.
Nominal axial play: max. 0.15 mm (0.006").
Apply dial gage on turbocharger shaft and move shaft from stop to stop without turning.
Turn turbocharger shaft and repeat step.

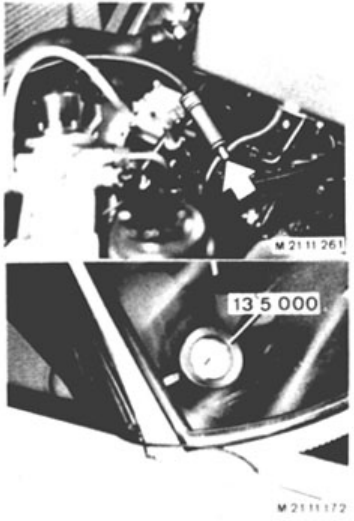


Nominal radial play: max. 0.8 mm (0.031").
Mount dial gage on turbocharger shaft.
Move turbocharger shaft simultaneously on both sides from stop to stop and turn.

11 65 018 CHECKING CHARGE PRESSURE OF TURBOCHARGER

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

Run car in load range.
Read charge pressure (absolute value including atmospheric pressure) from charge pressure sensor display.
Nominal value: max. 1850 + 50 mbar.



Checking in Road Test:
Connect pressure tester 13 5 000 between intake manifold and charge pressure sensor, and place in passenger compartment.
Be careful that hose is not clamped.
Operate car in load range (braking) to check the charge pressure.
Nominal Value:
Measured charge pressure + atmospheric pressure (see 11 65 . . .) = max. 1850 + 50 mbar.
Possible Faults for Incorrect Charge Pressure:
- Bypass regulator (see 11 65 059).
- Charge pressure sensor (see 11 65 . . .).
- Hose connections (check for leaks with spray).
- Turbocharger (shaft hard to turn, bypass).

11 65 020 REMOVING AND INSTALLING TURBOCHARGER

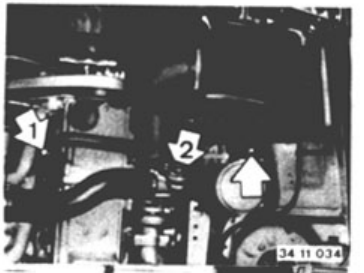
The turbocharger receives oil from the engine oil circuit. Conform with the following points to guarantee sufficient lubrication for the fast running turbocharger.

- Engine oil circuit in perfect condition (specified engine oil, oil level, crankcase breather, etc.).
- Never race engine before the engine oil pressure has been built up (control lamp). Also never stop engine while running at fast speed (turbocharger runs on).
- Never start engine immediately after replacing oil; build up oil pressure first by cranking engine with the starter (disconnect lead for fuel shutoff – see 11 00 039).
- Excessively old engine oil could produce carbon in turbocharger. Carbon will be seen on the turbocharger shaft after taking off the oil pipe. In this case the engine oil and oil filter have to be replaced.

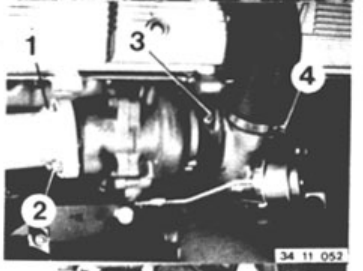
Working On Turbocharger:

- Even minute particles of dirt could lead to destruction of the turbocharger, so that the engine must never be operated without the air cleaner.
- If the hose on the regulating valve is disconnected, this could lead to overcharging and destruction of the engine with the throttle wide open.

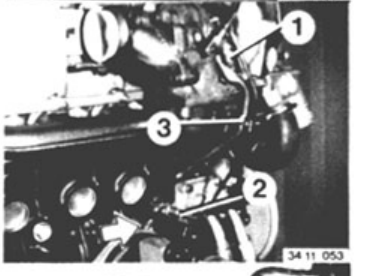
No repairs are approved on the turbocharger.



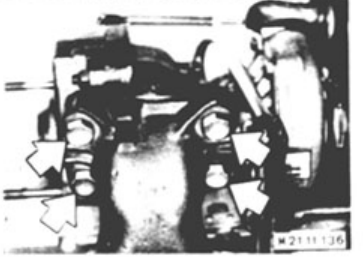
Loosen hose clamps (1 and 2) and pull off hoses.
Unscrew nut and remove air cleaner.



Unscrew nuts (1 and 2).
Disconnect oil pipe (3) and hose (4) on turbocharger.
Installation:
Replace self-locking nuts.
Coat studs with copper paste**.
Tightening Torque:
Nuts (1 and 2) = 30 Nm (22 ft. lbs.) initial and 50 Nm (36 ft. lbs.) final torque.
Oil pipe (3) = 22 Nm (16 ft. lbs.).



Unscrew oil pipes.
Installation:
Check O-ring, replacing if necessary.
Tightening Torque:
Bolt (1) = 22 Nm (16 ft. lbs.).
Pipe (2) = 40 Nm (29 ft. lbs.).
Tighten holder (3) last.

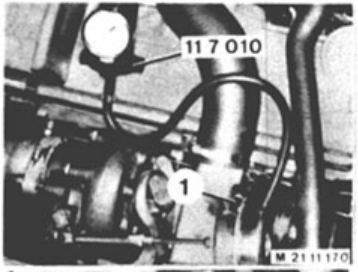


Unscrew bolts and remove turbocharger.
Installation:
Check levelness of sealing surface!
Tightening torque = 25 Nm (18 ft. lbs.).

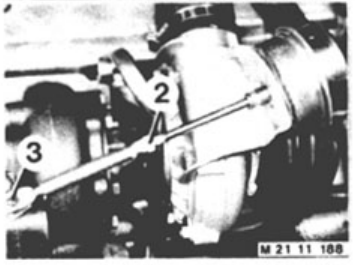
** Source of Supply: HWB

11 65 059 CHECKING AND ADJUSTING CONTROL VALVE

The control valve governs the charge pressure.
A control valve opening too early will be noticed on a drop in engine power and an excessively rich mixture (soot in exhaust).
A bypass valve opening too late will result in excessive charge pressure.



Pull off hose (1) and connect Special Tool 11 7 010.
The control valve begins to open at a pressure of 1120 + 30 bar (15930 + 427 psi) — the regulating rod of a closed control valve must bear without tension on pin (3).



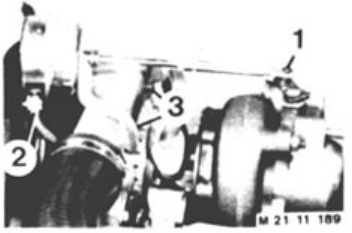
Unscrew nut (2).
Take circlip off of pin (3).
Adjust opening begin of control valve as described above.

Note:
One turn of the rod is equal to 0.05 bar (0.7 psi) pressure.

Installation:
Lock nut (2) with marking paint**.

The regulating rod of a turbocharger installed standard is locked and therefore cannot be turned.
These control valves with lock regulating rods must be replaced when the begin of opening is not correct – see 11 65 060.

** Source of Supply: HWB
HWB No. 81 22 9 407 404



11 65 060 REMOVING AND INSTALLING CONTROL VALVE

Remove circlip (1) and disconnect rod.
Pull off hose (2).
Unscrew bolts (3).

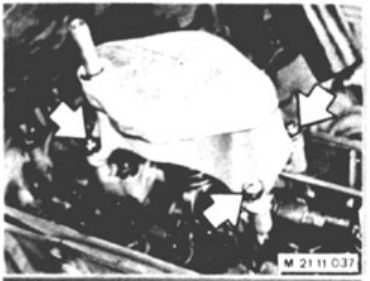
Installation:
Replace bolts (3).
Adjust control valve – see 11 65 059.

11 65 ... CHECKING CHARGE PRESSURE SENSOR

The charge pressure sensor is tested with DDE self-diagnosis by calling the status list.
With the engine stopped the charge pressure sensor should indicate the actual atmospheric pressure.

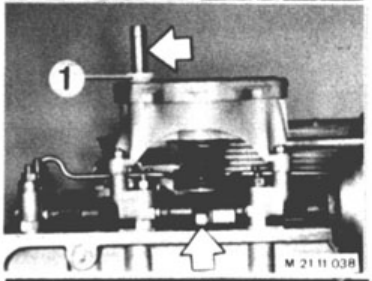
The following table only contains reference values. These values must be allowed a tolerance of ± 70 mbar due to fluctuations in the weather.

Height Above Sea Level In meters	Atmospheric Pressure In mbar
0	1000
500	950
1000	900
1500	850
2000	800

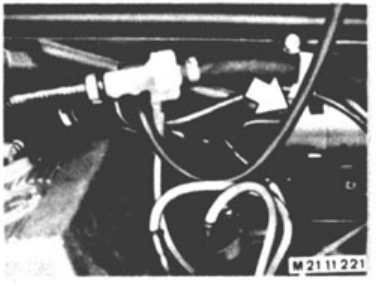


11 66 000 REMOVING AND INSTALLING/ CHECKING VACUUM PUMP

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



Installation:
Mount vacuum pump that pipe adapter is at rear and cam runs in opening of plunger.
Insert seal (1).
Caution!
Never run engine without the vacuum pump – loose cam ring.



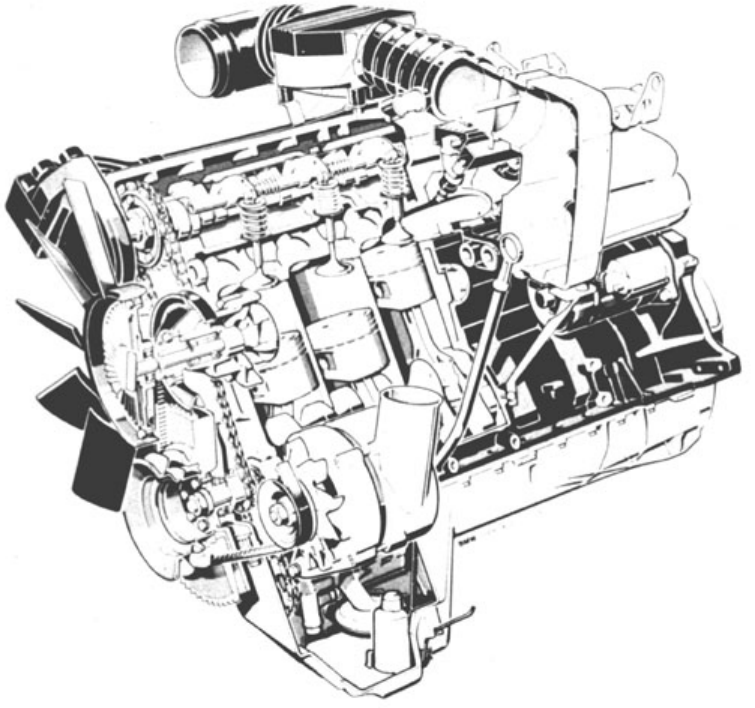
Checking Vacuum Pump Pressure and Orifice:
Connect BMW SERVICE TESTER on the orifice and measure vacuum with the engine running.
Vacuum: at least 530 mbar.

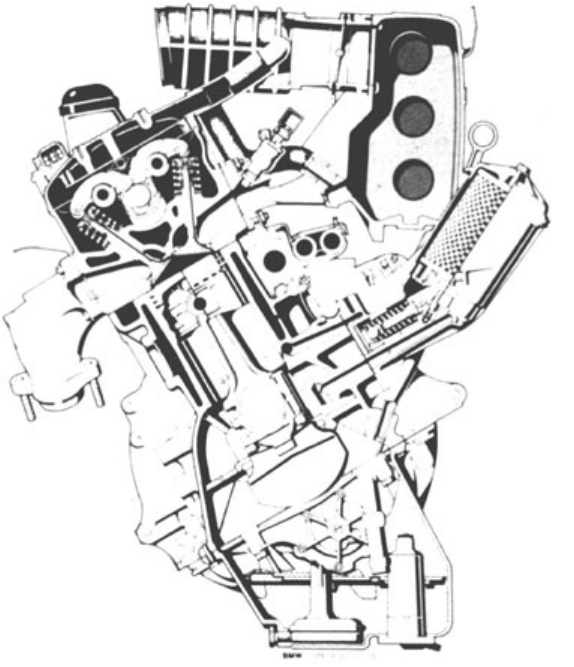
11 Engine M30

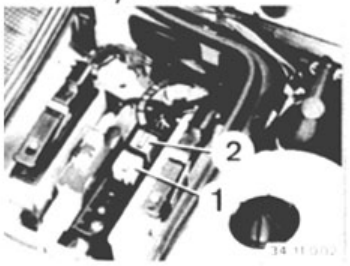
	Engine views (cross sectional view)	11- 00/3.1
11 00 039	Compression of all cylinders – check	11- 00/3.2
050	Engine – remove and install	11- 00/3.2
11 12 000	Cylinder head cover – remove and install	11- 12/3.1
100	Cylinder head – remove and install	11- 12/3.1
11 13 000	Oil pan – remove and install	11- 13/3.1
11 78 012	Oxygen sensor – replace	11- 78/3.1
. . .	Oxygen sensor – check	11- 78/3.2

For further jobs refer to “Assembly Repair Manual”.

M 30 = Large 6 cylinder
B = Gasoline
35 = Displacement x 100
M = Motronic



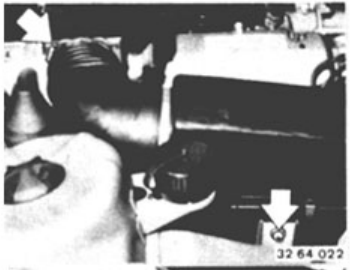




11 00 039 CHECKING COMPRESSION OF ALL CYLINDERS

Pull off relays (1 and 2).

Note:
Do not pull off master relay (2) in cars with EML (electric throttle valve drive).



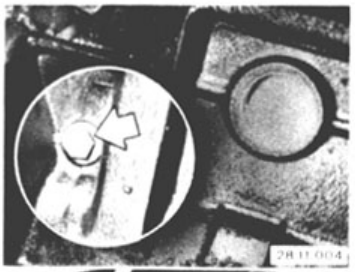
Loosen hose clamp and unscrew nut.
Remove air cleaner.

Note:
Also disconnect terminal 1 on the ignition coil in cars with EML.



Unscrew all spark plugs.
Press down on the accelerator pedal and operate the starter motor so long, until the pressure stops rising.
Specifications:
10 to 11 bar (142 to 156 psi); max. deviation between cylinders = 0.5 bar (7 psi).

Installation:
Tightening torque for spark plugs = 25 Nm (18 ft. lbs.).

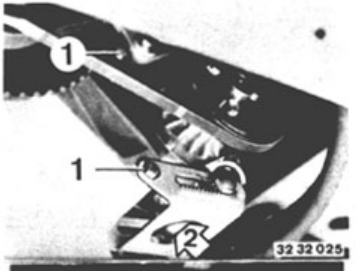


11 00 050 REMOVING AND INSTALLING ENGINE

Disconnect battery – see Group 00.
Remove transmission – see Group 23 or 24.
Unscrew splash guard.
Remove radiator – see 17 11 000.
Unscrew bolt and drain coolant.

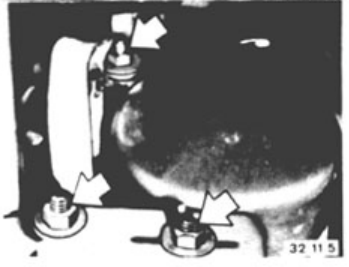


Unscrew nuts and take transmission oil pipes off of the oil pan.



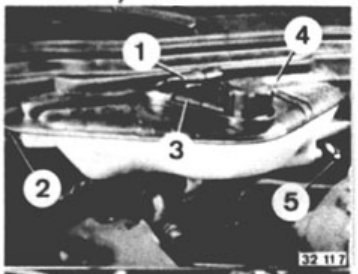
Loosen bolts (1) and nuts (2).
Turn the tensioning pinion and take off drive belt.
Unscrew bolts and take off power steering pump.
Hoses remain connected.

Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.

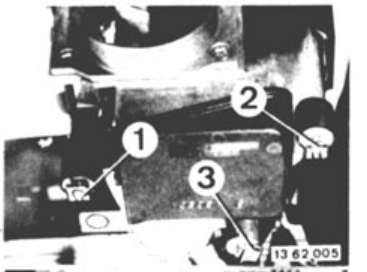


Cars with Air Conditioner:
Unscrew compressor.
Refrigerant hoses remain connected.

Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.



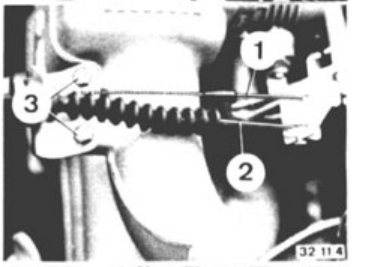
Pull off plug (1) and unscrew nuts (2) on left and right sides.
Disconnect overflow hose (3), compensation hose (4) and coolant hose (5).



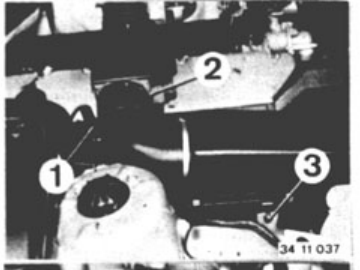
Pull off clamps (1 ... 3).
Remove air flow sensor, pulling vacuum hose off of crankcase breather at same time.
Note:
Picture shows a removed part, since part is covered in installed state.



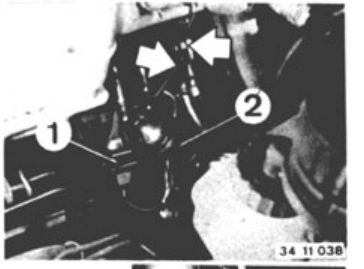
Disconnect coolant hose on heater valve (1) and heater (2).



Disconnect throttle cable (1) and cruise control cable (2) on throttle valve.
Unscrew bolts (3).
Installation:
Adjust throttle cable - see Group 35.
Adjust cruise control cable - see Gr. 65.



Pull off plug (1) on ignition coil.
Loosen clamp (1), unscrew nut (3) and remove air cleaner.



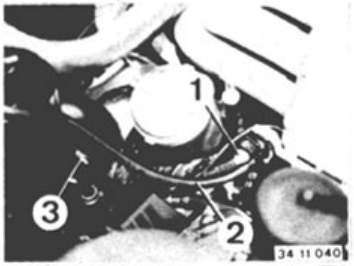
Disconnect plugs (1 and 2).
Disconnect connecting leads on starter.



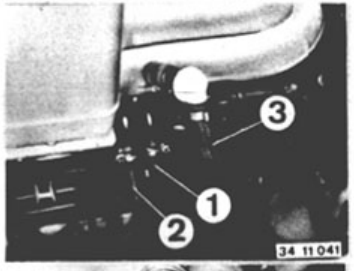
Loosen clamps (1) and pull off hoses.
Pull off plug (2).
Loosen nut (3) and pull idle speed control valve out of intake air hose.



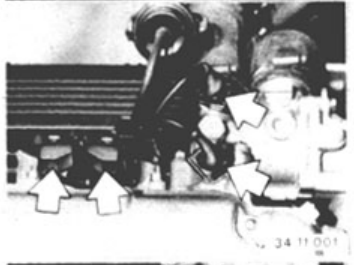
Disconnect oil level switch plug (1).
Disconnect connecting leads on alternator.



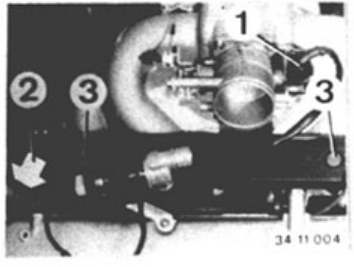
Pull off plug (1) on tank venting valve and hose (2) on carbon canister.
Loosen clamp (3) and pull coolant hose off of alternator.



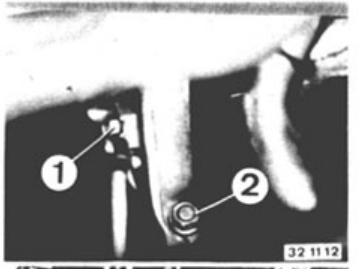
Loosen hose clamps and pull off fuel hoses (1 and 2).
Lift vacuum hose (3) out of brake booster.
Installation:
Don't mix up hoses.
1 = Feed
2 = Return



Pull off all plugs on temperature sensors and electric lead plate.



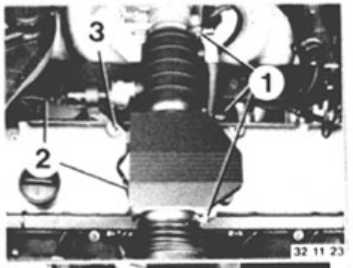
Pull off plug (1) on throttle valve switch and plug (2) on oil pressure switch.
Lift out caps (3) and take off electric lead plate.



Unscrew ground strap (1).
Unscrew nut (2) for engine mounts on left and right sides.
Installation:
Tightening torque for engine mounts = 45 Nm (32.5 ft. lbs.).

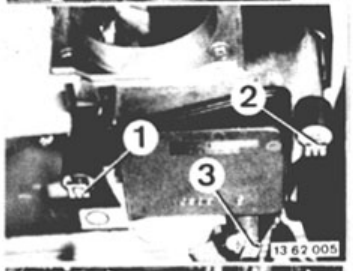


Attach Special Tool 11 0 020 and lift out engine.
Note:
Use Special Tool 11 0 009 additionally on the front end.

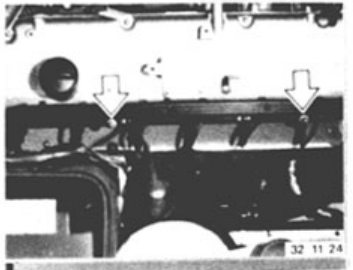


11 12 000 REMOVING AND INSTALLING CYLINDER HEAD COVER

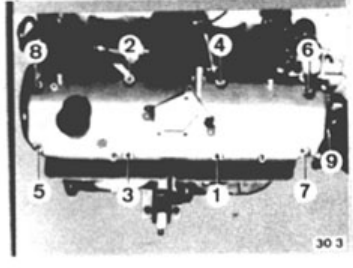
Loosen clamps (1).
Pull off plug (2).
Loosen nut (3) and pull idle control valve out of intake air hose.



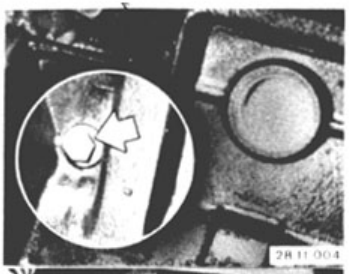
Pull off clamps (1 ... 3).
Remove air flow sensor, pulling vacuum hose off of crankcase breather at same time.
Note:
Picture was taken on removed part, since part cannot be seen when installed.



Pull off ignition leads on ignition coil and spark plugs.
Unscrew nuts and place ignition wire harness aside.

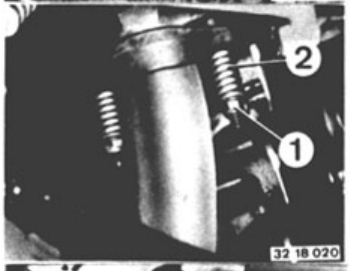


Unscrew nuts and bolt, and take off cylinder head cover.
Installation:
Check gasket, replacing if necessary.
Check for correct seating of gasket.
Tighten nuts and bolt in order of 1 through 9, mounting the idle speed control valve with nut (2).
Tightening torque = 10 Nm (7 ft. lbs.).



11 12 100 REMOVING AND INSTALLING CYLINDER HEAD

Disconnect battery – see Group 00.
Remove splash guard.
Drain engine oil.
Drain coolant at radiator and engine.
Installation:
Fill and bleed cooling system – see Group 17.



Unscrew exhaust pipes on exhaust manifolds and pipe clamps on transmission.
Installation:
Coat tapers of flanges with copper paste "CRC"**.
Torque nuts (1) uniformly to 10 Nm (7 ft. lbs.) to flatten springs (2) and then loosen nuts one and one half turns.
Tighten pipe with compensator (corrugated pipe section) last.

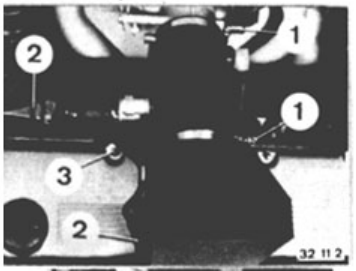


Remove fan – see 11 52 000.
Remove expansion rivets on fan cowl at top left and right.
Installation:
Check for correct seating of top and bottom guides.

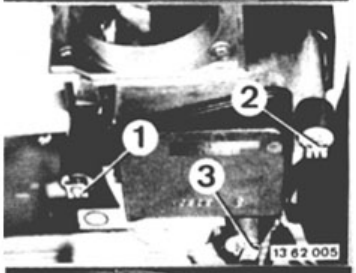


Loosen hose clamp, unscrew nut and remove air cleaner.

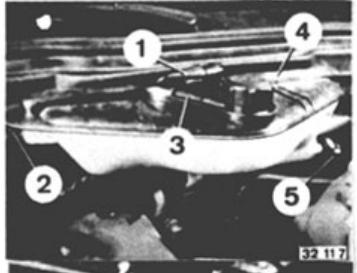
** Source of Supply: HWB



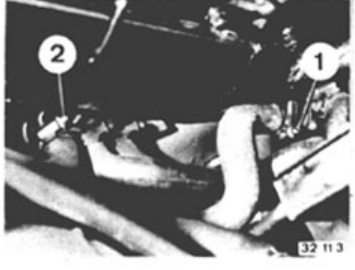
Loosen clamps (1) and pull off hoses.
Pull off plug (2).
Loosen nut (3) and pull idle speed control valve out of intake air hose.



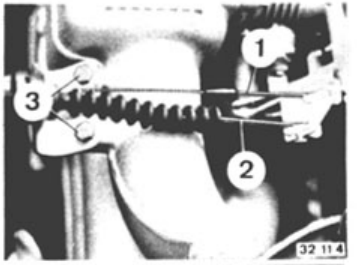
Pull off clamps (1 ... 3).
Remove air flow sensor, pulling vacuum hose off of crankcase breather at same time.
Note:
Picture was taken on removed part, since it cannot be seen when installed.



Pull off plug (1) and unscrew nuts (2) on left and right sides.
Disconnect overflow hose (3), compensating hose (4) and coolant hose (5).



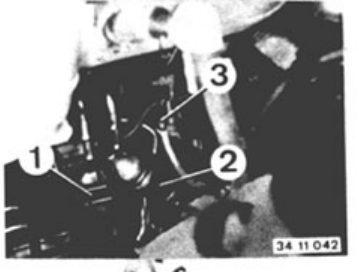
Disconnect coolant hose on heating valve (1) and heater (2).



Disconnect throttle cable (1) and cruise control cable (2) on throttle valve.
Unscrew bolts (3).
Installation:
Adjust throttle cable – see Gr. 35.
Adjust cruise control cable – see Gr. 65.



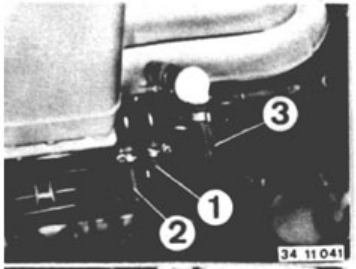
Pull off plugs (1 ... 4).
Loosen clamps (5 and 6) and pull off coolant hoses.



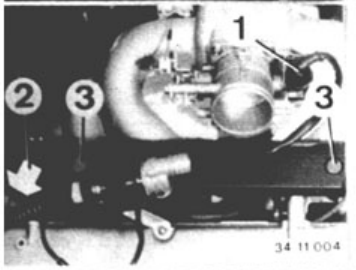
Disconnect plugs (1 and 2).
Disconnect lead (3) on starter.



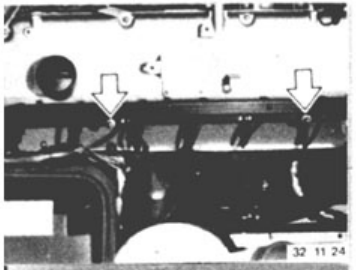
Pull off plug (1) and hose (2) on tank venting valve.



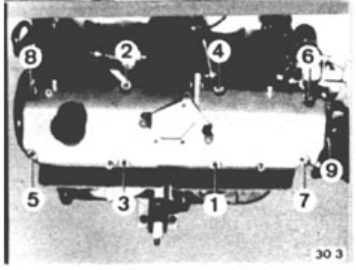
Loosen hose clamps and pull off fuel hoses (1 and 2).
Lift vacuum hose (3) out of brake booster.
Note:
Don't mix up hoses.
1 = Feed
2 = Return



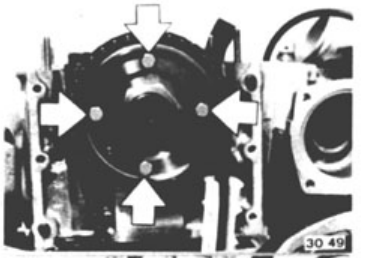
Pull off plug (1) on throttle valve switch and plug (2) on oil pressure switch.
Lift out caps (3) and unscrew electric lead plate.



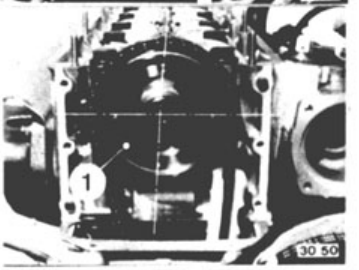
Pull off ignition leads on ignition coil and spark plugs.
Unscrew nuts and place ignition leads aside.



Unscrew cylinder head cover.
Installation:
Check gasket, replacing if necessary.
Check for correct seating of gasket.
Tighten bolts in order of 1 through 9, mounting the idle speed control with bolt (2).
Tightening torque = 10 Nm (7 ft. lbs.).



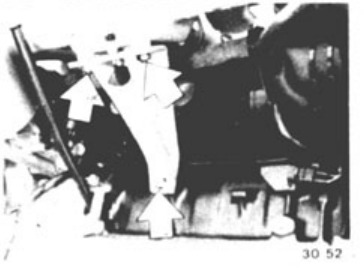
Set cylinder number 1 to TDC.
Remove upper timing case cover – see 11 14 100.
Remove piston for chain tensioner – see 11 31 090.
Unscrew sprocket.



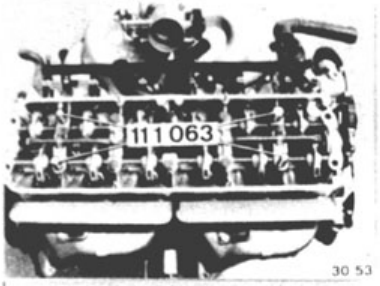
Installation:
Mount timing chain that dowel pin (1) is at bottom left when tapped bores are perpendicular to the engine.
Tightening torque = 10 Nm (7 ft. lbs.).



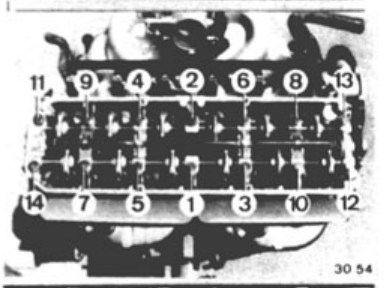
Disconnect hose.



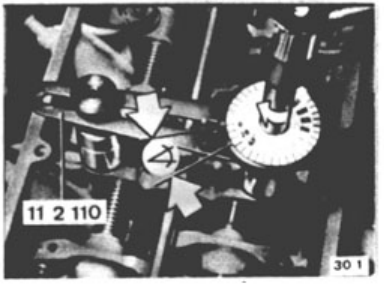
Unscrew support.



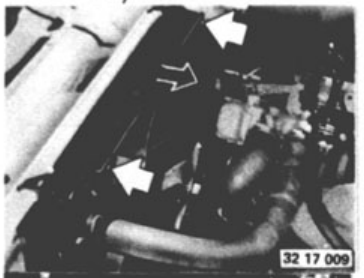
Unscrew cylinder head bolts in order of 14 through 1 (see next picture).
Insert Special Tools 11 1 063 as shown in picture to prevent displacement or turning of rocker arm shafts.
Lift off cylinder head.



Installation:
Replace cylinder head gasket – see 11 12 101.
Mount cylinder head and tighten bolts (washed and lubricated with oil) in order of 1 through 14 in three steps.
Step 1:
Tighten bolts 1 through 6 first, then remove Special Tools 11 1 063 and tighten bolts 7 through 14 afterwards.
Tightening torque = 60 Nm (43 ft. lbs.).
Wait 20 minutes.
Step 2:
Tightening torque = 80 Nm (58 ft. lbs.).
Run engine warm 25 minutes.
Step 3:
Torque angle = 35°.

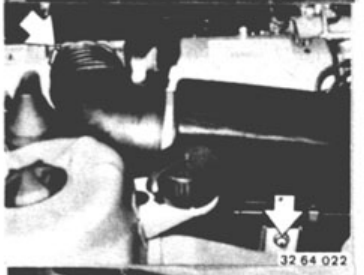


Important!
Keep oil out of cavities in engine block (danger of cracking block, falsified torque values).

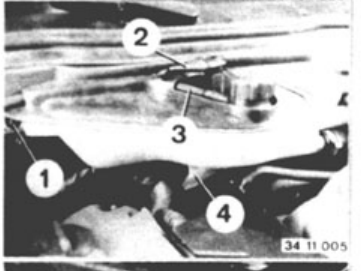


11 13 000 REMOVING AND INSTALLING OIL PAN

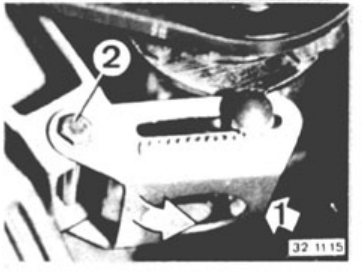
Remove fan – see 11 52 000.
Lift expansion rivets out of fan cowl on left and right sides and remove fan cowl.
Installation:
Check for correct seating of guides.



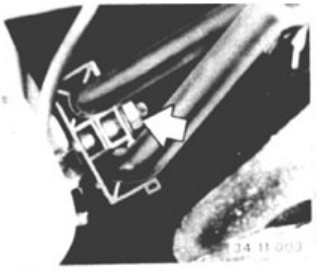
Loosen hose clamp, unscrew nut and remove air cleaner.



Unscrew nuts (1) on left and right sides.
Pull off plug (2) and hose (3), and place coolant expansion tank aside.
Installation:
Check for correct seating of guide (4).



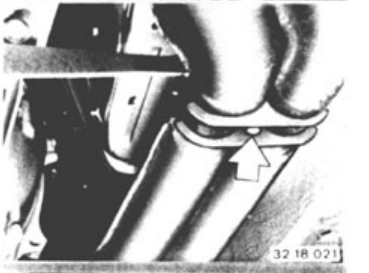
Remove splash guard.
Loosen nut (1).
Unscrew bolt (2) and swing holder for power steering pump aside.



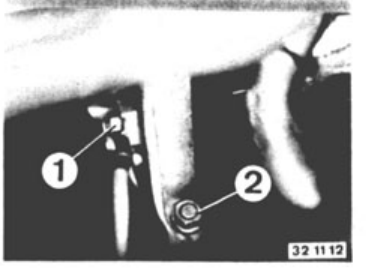
Unscrew nut and take off oil pipes with holder.



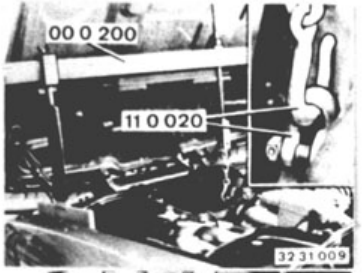
Drain engine oil.
Disconnect plug for oil level switch.



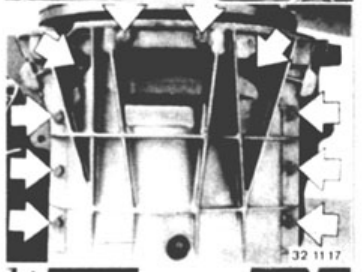
Unscrew exhaust pipe holder.



Unscrew ground strap (1).
Unscrew nut (2) for engine mount on left and right sides.
Installation:
Tightening torque for engine mounts = 45 Nm (32.5 ft. lbs.).



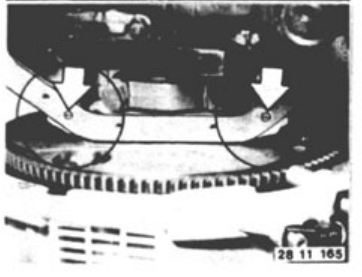
Apply Special Tool 00 0 200.
Attach chain and shackle of Special Tool 11 0 020 on engine and lift engine.



Unscrew oil pan bolts and take off oil pan.

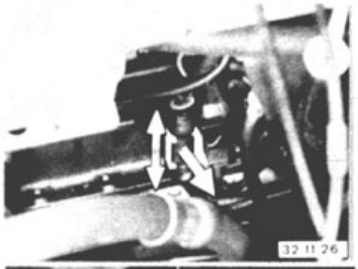


Installation:
Clean sealing surfaces.
Replace oil pan gasket.
Coat joints on timing case cover and ...



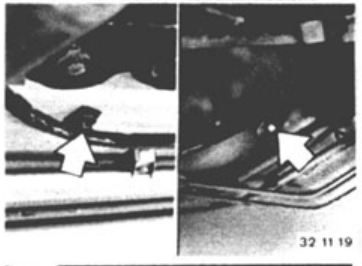
... end cover with brush-on universal sealing compound (Three Bond 1207**).
Tightening torque = 10 Nm (7 ft. lbs.).

** Source of Supply: HWB

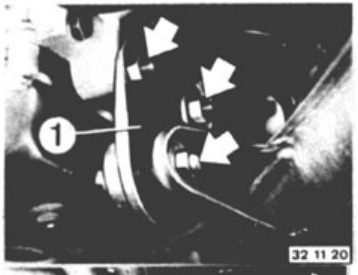


11 78 012 REPLACING OXYGEN SENSOR

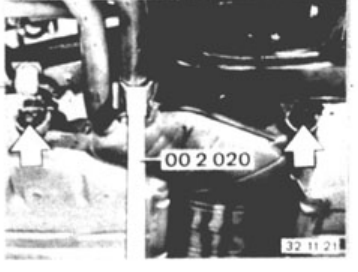
Disconnect plug for oxygen sensor.



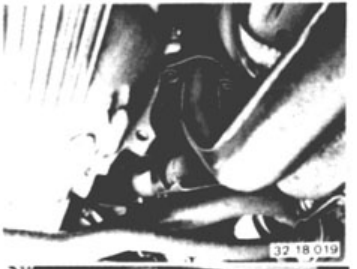
Unscrew nuts and take off electric lead holder.



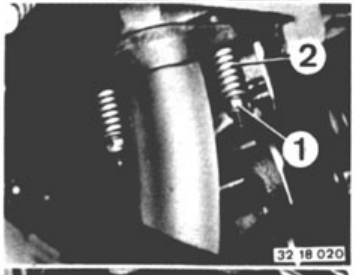
Cars with Automatic Transmission:
Unscrew nuts and lift out holder (1).
Installation:
Tightening torque = 22 Nm (16 ft. lbs.).



Support exhaust assembly with Special Tool 00 2 020.
Lift out rubber holders on left and right sides.



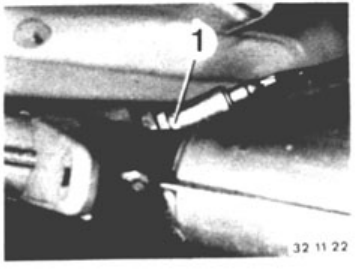
Loosen nuts on connections between exhaust pipes and exhaust manifolds several turns.



Installation:
Torque nuts (1) uniformly to 10 Nm (7 ft. lbs.) to flatten spring (2) and then loosen nuts again by one and one half turns.
Tighten pipe with compensator last.

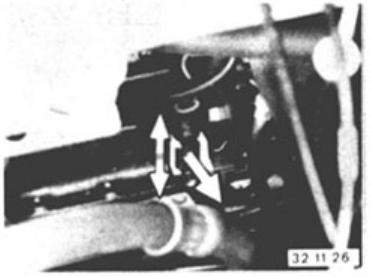


Unscrew nut on holder for final muffler.
Lower exhaust assembly slowly far enough, that the oxygen sensor is accessible.



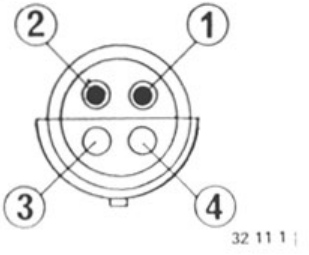
All Models:
Unscrew oxygen sensor (1).
Installation:
Coat threads with Anti-Seize**.
Torque oxygen sensor to 55 Nm (40 ft. lbs.).
Note:
- Never clean oxygen sensors and never let them have contact with lubricants.
- Cover oxygen sensor when undercoating car.

** Source of Supply: HWB



11 78 . . . CHECKING OXYGEN SENSOR

A. Checking Heating:
Disconnect plug for oxygen sensor.



Connect ohmmeter on jacks 3 and 4 (toward oxygen sensor) and measure the resistance (nominal value: < 5 ohms).
1 = Plug for sensor voltage –
2 = Plug for sensor voltage +
3 = Jack for sensor heating
4 = Jack for sensor heating

B. Checking Signal Voltage:
Perform the "Oxygen Sensor Voltage" status call within the scope of DME self-diagnosis. This value is measured at idle speed with the oxygen sensor connected and oxygen sensor control switched on (about 1 to 2 minutes after starting the engine) and should be between 0.02 and 0.85 V.
If a constant voltage of 0.45 V is measured, the oxygen sensor is not working (oxygen sensor or power supply lead faulty).

11 Engine S38

11 00 050	Engine – remove and install	11- 00/8.1
11 12 500	Cylinder head – remove and install	11- 12/8.1
11 34 004	Valve clearance – adjust	11- 34/8.1
11 53 000	Coolant thermostat – remove and install or replace	11- 53/8.1
11 62 140	Exhaust manifolds, both – remove and install/seal or replace	11- 62/8.1

For further jobs refer to “Assembly Repair Manual”.

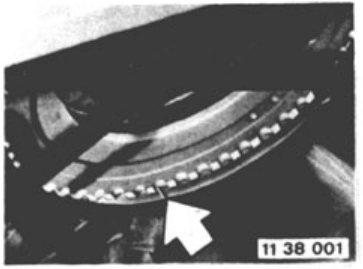
11 00 050 REMOVING AND INSTALLING ENGINE

Note:
If jobs have to be performed on a removed engine, which make it necessary to unscrew the central vibration damper mounting bolt, it must be loosened prior to removal of the engine.

Reason:
This bolt is torqued with about 800 Nm (578 ft. lbs.) and therefore too difficult to loosen on a removed engine.

Tighten the central bolt after installation of the engine to these procedures (loosening is in reverse order).

Crank the engine until the TDC mark faces down perpendicularly.

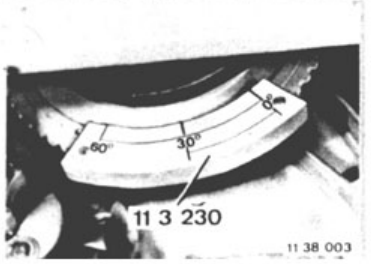


Unscrew pulley.
Apply Special Tool 11 2 240 that the lever arm faces down perpendicularly.
Mount special tool with all of the bolts.
Bolt size: 8 x 20 mm.



Note:
The hole pattern in the flange is asymetric. All bolts can only be screwed in in this position.

Have Special Tool 11 2 240 bear on the right-hand side of the engine carrier.
Apply Special Tool 11 3 230.





Tighten central bolt with a torque wrench and wrench socket.
Procedures:
Step 1 = 60 Nm (43 ft. lbs.) torque
Step 2 = 60° torque angle
Step 3 = 60° torque angle again
Step 4 = 30° torque angle again



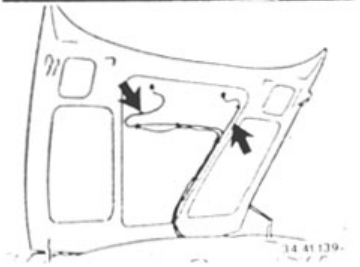
REMOVING AND INSTALLING ENGINE

Disconnect battery ground lead.

Removing Transmission

See Group 23.

Note:
Always use Special Tool 23 1 330 for removal of the transmission.



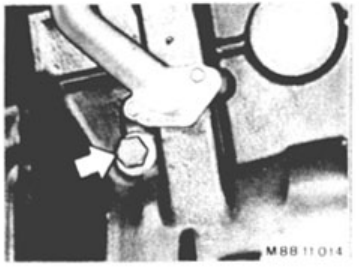
Removing Engine Hood

See Group 41.

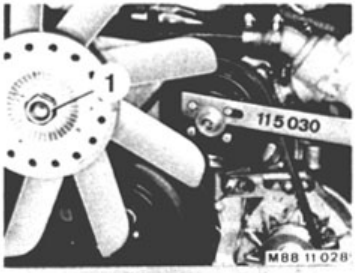
Note:
Supply lines of windshield spray jets do not have connection points, so that the windshield washing hose and wire harness for spray jet heating have to be removed prior to removal of the engine hood.

Removing Radiator with Engine Oil Cooler and Fan Cowl

See Group 17.



Drain remaining coolant on engine block.

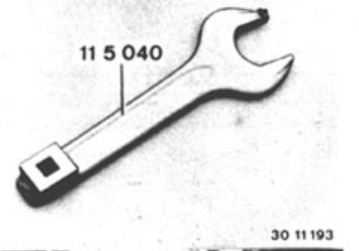


Removing Fan

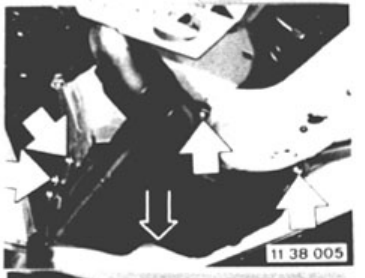
Counterhold on pulley with Special Tool 11 5 030 and unscrew coupling nut (1).

Important!
Left-hand threads = turn clockwise to unscrew.

Installation:
Tightening torque*.

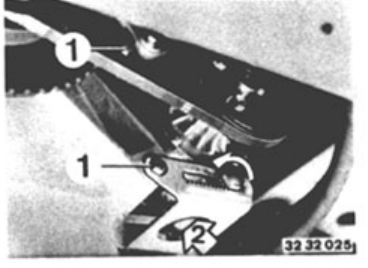


Tighten fan with Special Tool 11 5 040. 40 Nm (29 ft. lbs.) tightening torque is equal to 30 Nm (22 ft. lbs.) setting on a torque wrench.



Removing Air Guide for Alternator

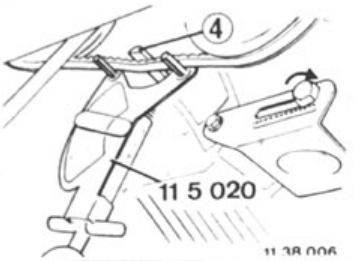
Unscrew air guide.
Loosen hose clamps.
Take off air guide together with connectors.



Removing Power Steering Pump

Loosen bolts (1) and nut (2).
Turn tensioning pinion and take off drive belt.
Unscrew bolts and take off power steering pump.
Hoses remain connected.

* See Specifications



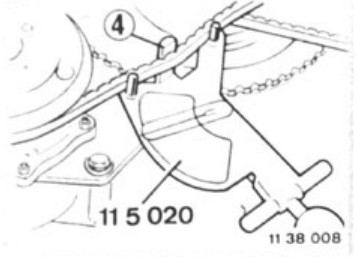
Installation:
Tighten drive belt.
Tighten toothed element with torque of 8 to 8.5 Nm (5.8 to 6.1 ft. lbs.) and lock.
Check drive belt tightness with Special Tool 11 5 020, correcting if necessary.
Hook (4) bears on tip of a tooth.

Important!
Remove the tester to tighten the belt and apply it again only <u>after</u> tightening has been completed.



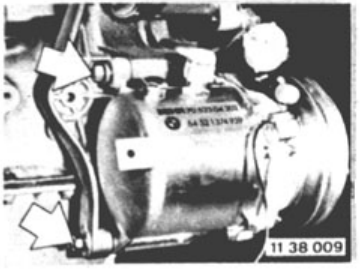
<u>Removing A/C Compressor</u>

Loosen air pump bolts.
Turn tensioning pinion and take off drive belt.



Installation:
Tighten drive belt.
Tighten toothed element with torque of 8 to 8.5 Nm (5.8 to 6.1 ft. lbs.) and lock.
Check drive belt tightness with Special Tool 11 5 020, correcting if necessary.
Hook (4) bears on tip of a tooth.

Important!
Remove the tester to tighten the belt and apply it again only <u>after</u> tightening has been completed.

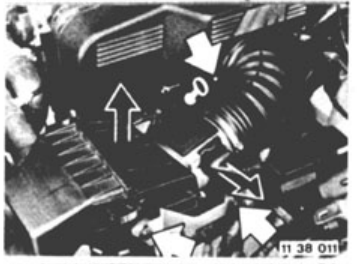


Unscrew compressor.
Refrigerant hoses remain connected.



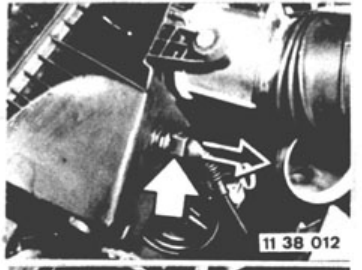
<u>Unscrewing Engine Mounts</u>

Unscrew left and right engine mounts.
Unscrew ground strap on engine carrier.

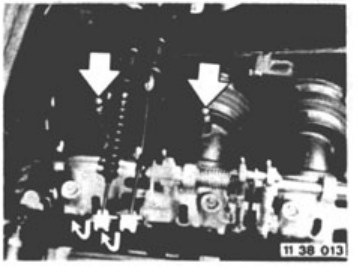


<u>Removing Air Cleaner and Air Flow Sensor</u>

Take off cover for headlights.
Pull off plugs.
Loosen nuts.
Loosen hose clamps.
Lift out air cleaner with air flow sensor.

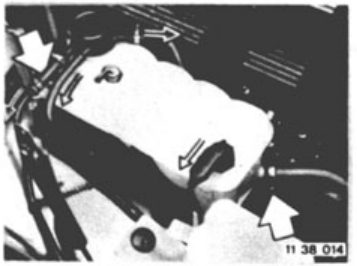


Pull off intake air temperature sensor plug.



<u>Disconnecting Throttle Cable and Cruise Control Cable</u>

Unscrew holder.
Unclip cables on throttle valve lever.

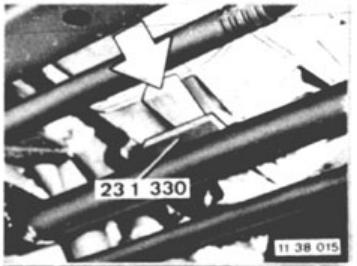


Disconnecting Coolant Hoses

Disconnect hoses and plug on expansion tank.
Remove expansion tank.



Disconnect coolant hoses on heater and heater valve.



Note:
Tilt engine forward as far as possible by inserting a wooden wedge in addition to Special Tool 23 1 330.



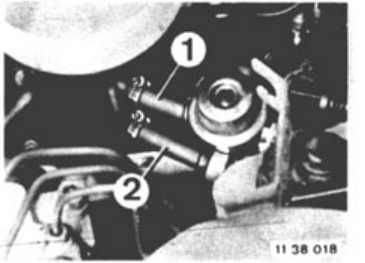
Disconnecting Vacuum Hose for Brake Booster

Pull connector out of the brake booster.



Disconnecting Air Pump Supply Hose

Loosen hose clamps.
Disconnect supply hose on air cleaner.



Disconnecting Fuel Pipes and Hoses

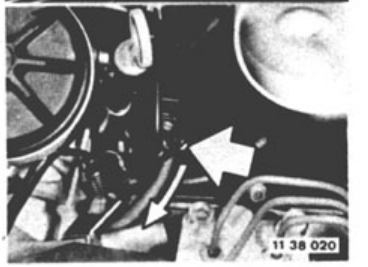
Disconnect feed and return pipes.

1 = Feed
2 = Return



Arrangement of Fuel Pipes on Tank Pipes:

1 = Feed
2 = Return

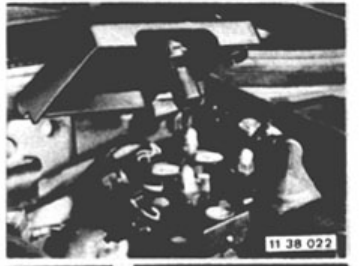


Disconnect tank venting hose on valve.



Disconnecting Engine Wire Harness in Car

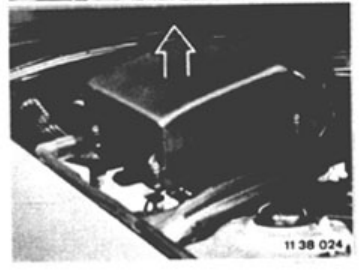
Lift out covers.
Unscrew starter lead on connection point.



Lift out cover.



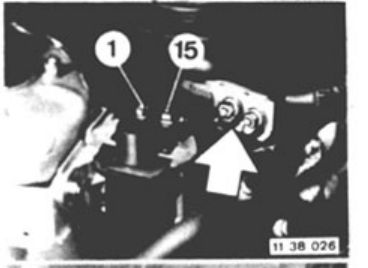
Remove covers.



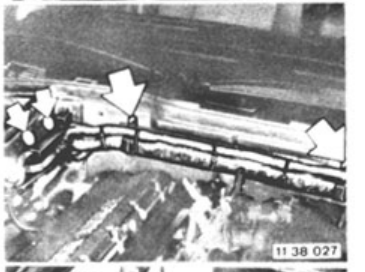
Unscrew cover on electronic box.



Pull off ignition leads on ignition coil.
Lift off cap.



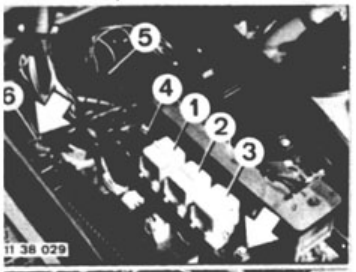
Unscrew leads (1 and 15) on ignition coil.
Unscrew electric lead on ground connection point.



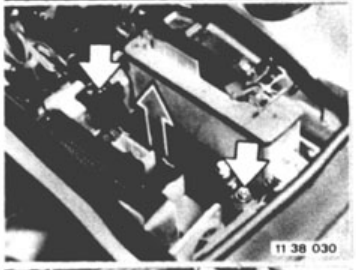
Unscrew holder.
Remove all electric lead straps.



Pull off plug on control unit.
Disconnect plugs (1 and 2).



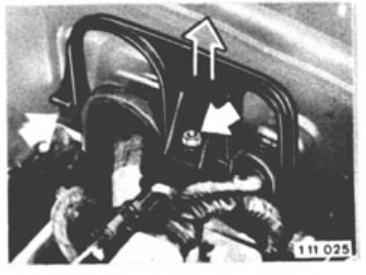
Unscrew electric lead on positive (+) connection point.
Lift out relays (1 ... 3) with sockets.
Disconnect plugs (4 and 5).
Pull off plug on temperature sensor (6).



Unscrew relay holder.



Lift out control unit located underneath.
Pull off plug.



Unscrew holder for rubber grommets.

Installation:
Insert retaining pin in provided bore.



Pull out wire harness with rubber grommet.

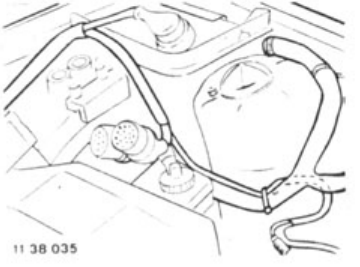
Note:
Suspend the wire harness remaining in the car on the engine compartment wall with a piece of wire.



Unscrew diagnosis socket.
Disconnect engine wire harness plug (bayonet connection).



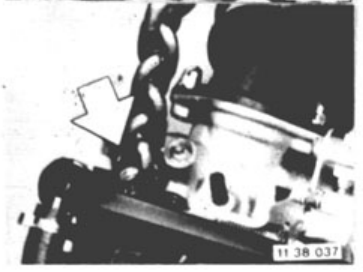
Unscrew holder.



Loosen electric lead straps.
Pull out wire harness.



Attach Special Tool 11 0 020 on engine.
Lift out engine.



Important!
Guide the rear chain between the intake neck and check valve.

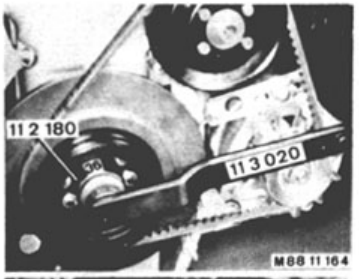
Installation:
Check power steering hose routing.



Installation:
Check air conditioner hose routing.

11 12 500 REMOVING AND INSTALLING CYLINDER HEAD

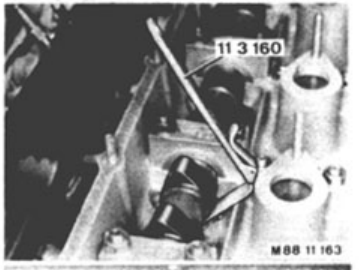
The engine has to be removed to carry out repairs correctly.
Remove engine – see 11 00 050.
Remove and disassemble cylinder head – see Group 11 in the Construction Group Repair Manual.



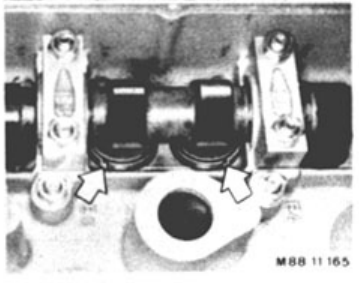
11 34 004 ADJUSTING VALVE CLEARANCE

Remove fan cowl and fan - refer to 11 52 000.
Remove cylinder head cover - refer to 11 12 000.

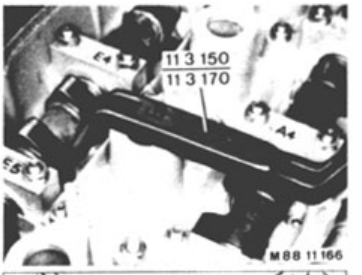
Crank engine using Special Tool 11 3 020.



Measure valve clearance with cams facing up.
Compare measured valve clearance with specified valve clearance*.

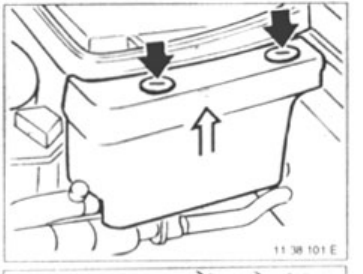


Measured Valve Clearance Outside of Specifications:
Turn opening of tappet as shown.

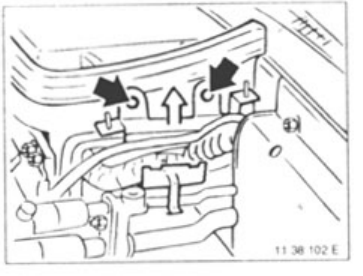


Use Special Tool on M88/3 engines or Special Tool 11 3 170 on S38 engines, guide in appropriately to camshaft "A" or "E" and press down on the tappet.

A = Exhaust
E = Intake

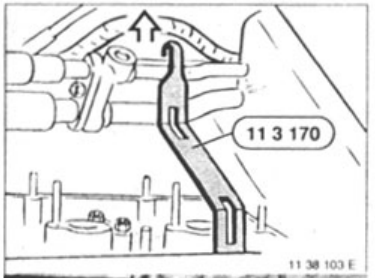


Note:
Plastic cover and wiring holder must be removed for adjustment of intake valves in cyl. no. 6.

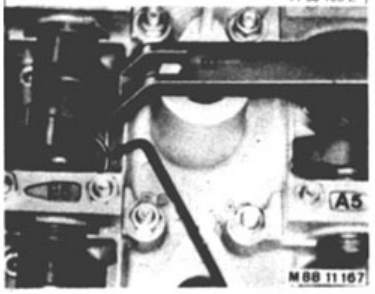


Cut off cable strap and remove holder.

* Refer to Specifications



Press wire harness aside.



Blow out valve shim with air pressure.



Measure the removed valve shim.
Install shim in correct thickness with the lettering facing down.



32 17 007

11 53 000 REMOVING AND INSTALLING OR REPLACING COOLANT THERMOSTAT

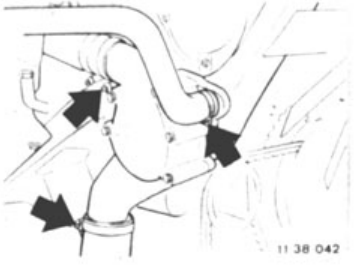
Note:
Procedures are shown on a removed engine in some cases for better understanding.

Drain coolant.



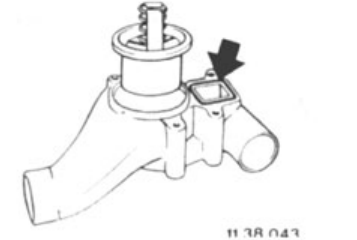
11 38 041

Disconnect coolant hoses on thermostat housing to the coolant pipe.



11 38 042

Unscrew bolts.
Lift off thermostat housing.



11 38 043

Pull thermostat out of housing.

Installation:
Replace rubber seal on coolant port.
Check installed direction of thermostat.

11 62 140 REMOVING AND INSTALLING/ SEALING OR REPLACING BOTH EXHAUST MANIFOLDS

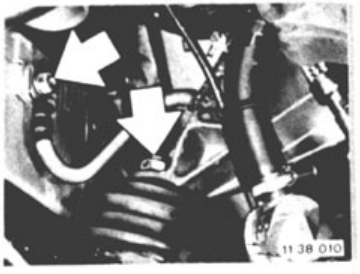
M 5 Models:

Note:
Some of the procedures are shown on a removed engine for better understanding.

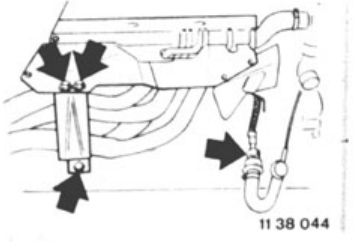
Remove exhaust assembly – see 18 00 020.


32 17 007

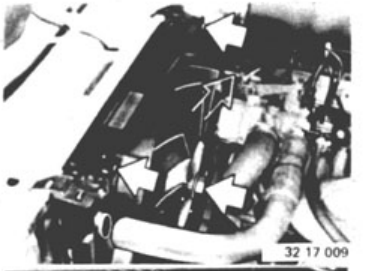
Drain some of the coolant.


11 38 010

Unscrew right engine mount and ground strap.


11 38 044

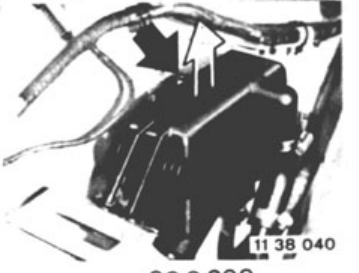
Unscrew air injector bolt.
Unscrew holder for heat shield.


32 17 009

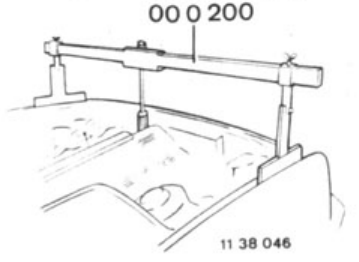
Remove fan cowl.


11 38 014

Remove coolant expansion tank.

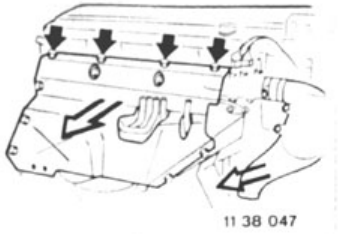

11 38 040

Remove filter housing for air pump.

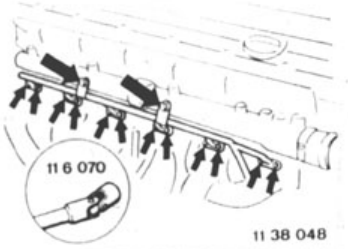


11 38 046

Apply Special Tool 00 0 200.
Lift engine out of the right engine mount as far as possible.

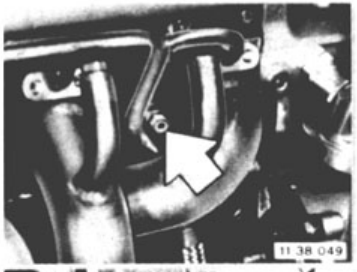


Unscrew and remove heat shield.

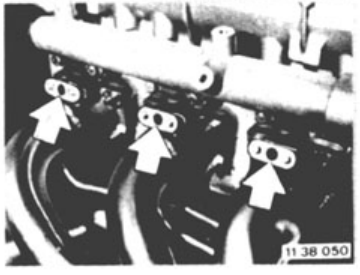


Unscrew air injection pipe.

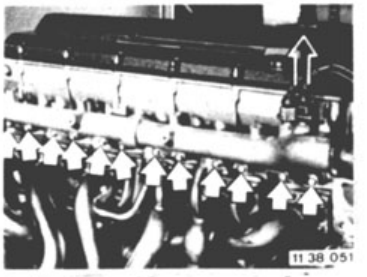
Note:
Use Special Tool 11 6 070.



Important!
Unscrew mounting tab on exhaust manifold at cylinder no. 1.



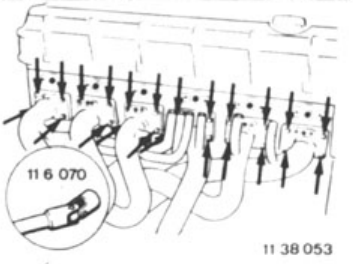
Installation:
Replace gaskets.



Unscrew coolant pipe.

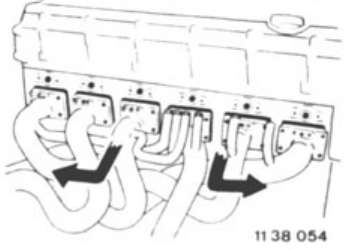


Installation:
Replace seals.



Unscrew both exhaust manifolds on cylinder head.

Note:
Use Special Tool 11 6 070.



Lift both manifolds off of staybolts.
Push back the rear exhaust manifold as far as possible.
Pull out the front manifold forward.
Remove the rear manifold.

11-62/8.3



Installation:
Graphite surfaces of gaskets face the cylinder head.
Use new self-locking nuts.
Tightening torque = 10 ± 1 Nm (7.0 ± 0.5 ft. lbs.).

11 Engine M40

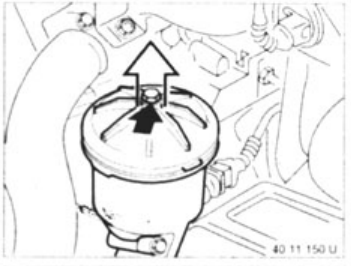
00 00 249	BMW engine oil service	11- 0/40.1
11 00 039	Compression of all cylinders – check	11- 0/40.2
050	Engine – remove and install	11- 0/40.3

For further jobs refer to “Assembly Repair Manual”.

00 00 249 BMW Engine oil service

M40

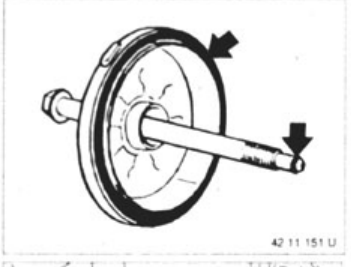
Change engine oil and oil filter



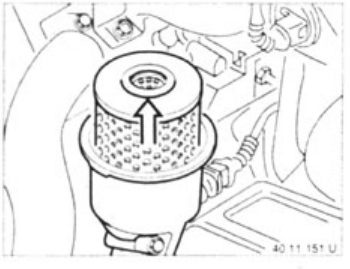
Unscrew oil filter cover

Note:
Oil runs out of the oil filter housing into the oil pan.

Installation:
Replace the sealing ring.
Tightening torque 11 42 2AZ *

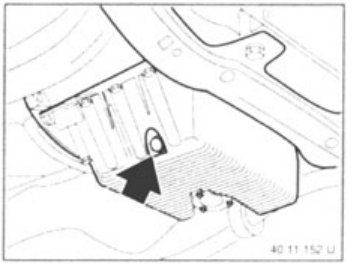


Installation:
Replace sealing ring in oil filter cover and on the screw.



Remove oil filter insert.

* Refer to Technical Data



Once the oil has drained out of the filter housing, open the oil drain plug or draw off the oil using suction.

Installation:
Replace the sealing ring.
Tightening torque 11 13 1AZ *

Pour in engine oil.

Switch on engine and run at idle speed until the oil telltale goes out.

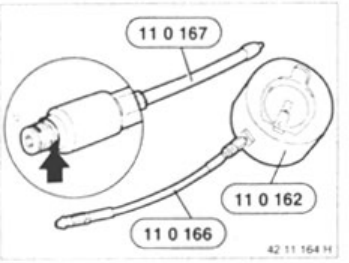
Switch off engine and check oil level

Note:
Park vehicle on level surface.

* Refer to Technical Data

11 00 039 Checking compression of all cylinders

M40

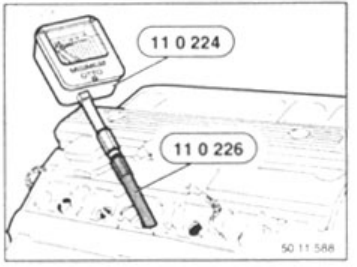


Note:
Special tools 11 0 162 / 166 / 167 can be re-used.



Caution!
High voltage - danger to life!

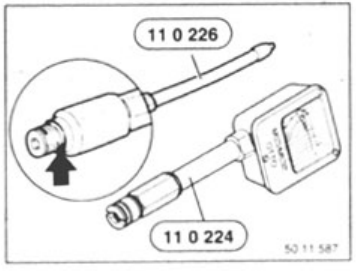
Interrupt power supply to ignition coils (disconnect terminal 1 from ignition coils). Disconnect fuel pump relay, refer to Electrical Troubleshooting Manual (schematics), Series 5 E34 location directory for components 7000.0
Installation location: Electronics box



Depress accelerator pedal and operate starter until compression pressure reaches its maximum level and stops rising.

Compression pressure*

Unscrew and remove all spark plugs, siehe 12 12 011



Screw special tool 11 0 226 into tapped bore for spark plug of cylinder to be tested by hand. Connect up special tool 11 0 224 (compression tester).

Note:
Check that seal is in perfect condition.

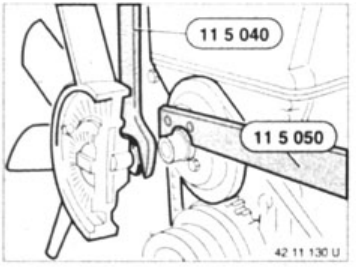
* Refer to Technical Data

11 00 050 Removing and installing engine

M40

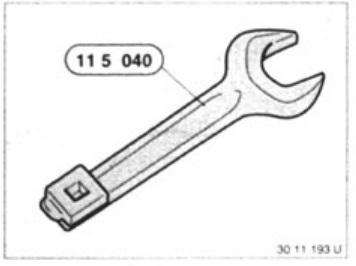
Read out error memories of all control units.
Disconnect battery negative lead.

Remove transmission,
refer to 23 00 022 / 24 00 025



Caution!
Left-hand (ccw) threads.

Brace against pulley wheel with special tool 11 5 050.
Remove cap nut from water pump with special tool 11 5 040.
Remove fan wheel and fan coupling from water pump and remove together with fan shroud.

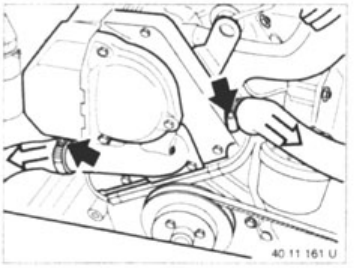


Installation:
Tightening torque 11 52 1AZ *

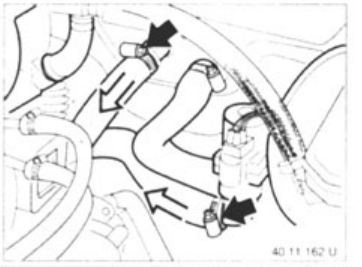
Note:
Tightening torque of 40 Nm when using special tool 11 5 040 is equivalent to 30 Nm on the scale of a torque wrench.

Remove radiator,
refer to 17 11 000.

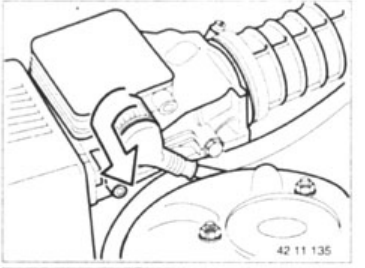
* Refer to Technical Data



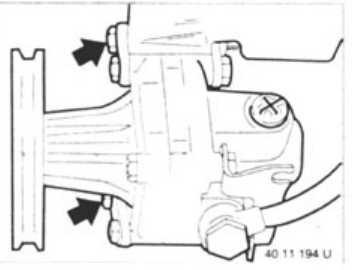
Disconnect coolant hoses on engine.



Disconnect coolant hoses from heating unit and heating valve.



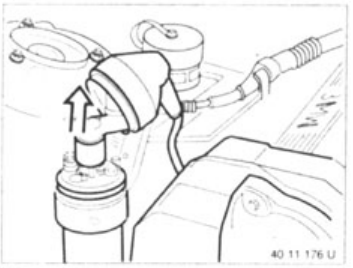
Disconnect plug connection from volume air flow sensor.
Remove upper section of air filter together with volume air flow sensor.



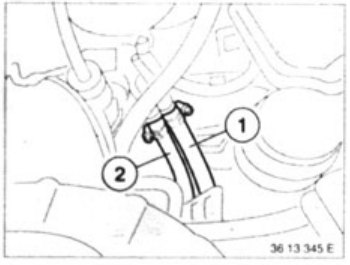
Remove vane pump for power steering from engine and tie back to one side.

Note:
Lines remain connected.

Remove operating (Bowden) cable for accelerator control from throttle, refer to 35 41 421 Repair Manual 3 Series E36.



Remove HT lead from ignition coil.

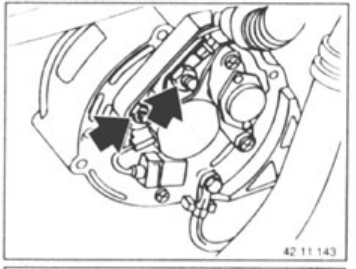


Caution!
Collect any fuel flowing out and dispose of suitably.

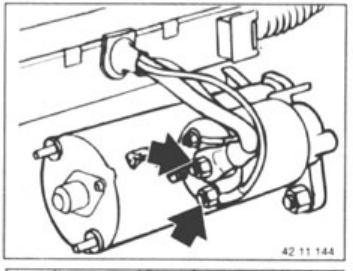
Remove fuel supply and return lines.
Unclip fuel lines from holder.

Installation note:
(1) Fuel supply from fuel filter
Pipe: bare
(2) Fuel return
Pipe: painted black

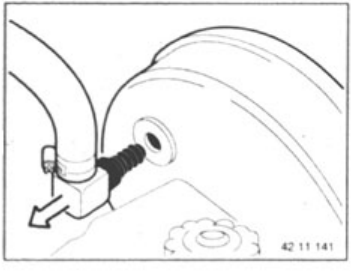
Replace fuel hoses.



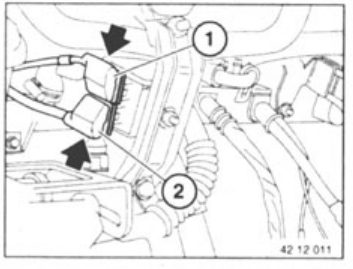
Remove electrical connections from alternator.



Remove electrical connections from starter.

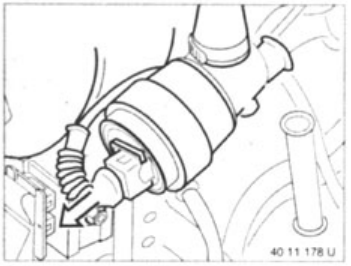


Remove connection piece from brake booster.

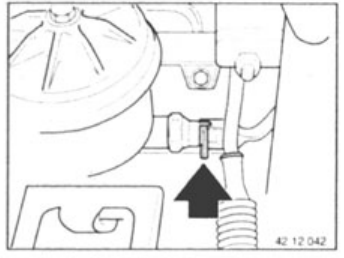


Disconnect both plug-and-socket connections from cable duct.

Installation note:
(1) Cylinder reference sensor
(2) Pulse generator for DME

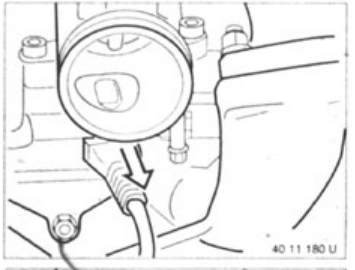


Disconnect plug connection from idle speed control valve.

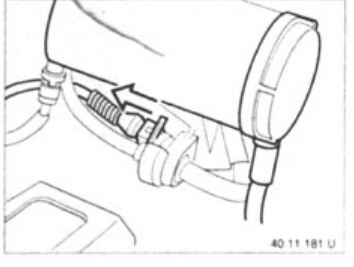


Disconnect plug connection from oil pressure switch.

Note:
Installation location on oil filter housing

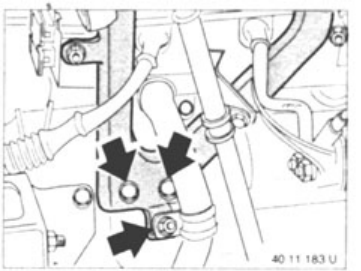


Disconnect plug connection from throttle valve potentiometer.

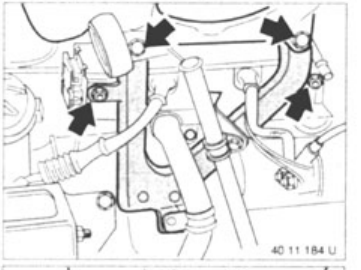


Disconnect plug connection from tank vent valve.

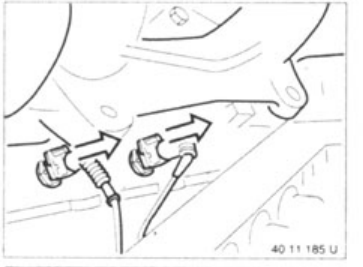
Remove tank vent hose from throttle body.



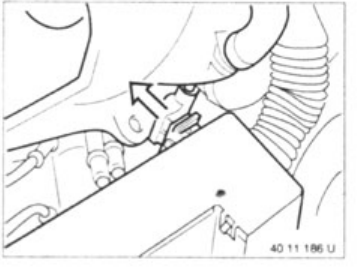
Unfasten clip on hose to expansion tank.
Unfasten lower screw connection for manifold support.



Unfasten upper screw connection for manifold support.
Unfasten screw connection on cable duct.



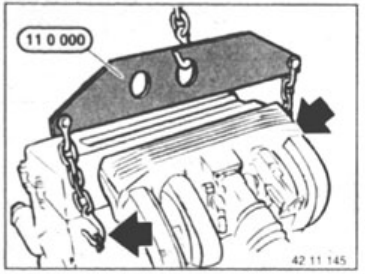
Disconnect both plug connections on temperature sensors on cylinder head.



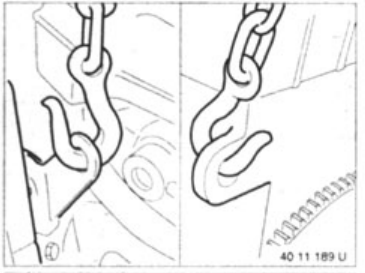
Disconnect plug connection from injection valve strip.

Note:
Plug connection on end of cable duct, near the fuel lines.

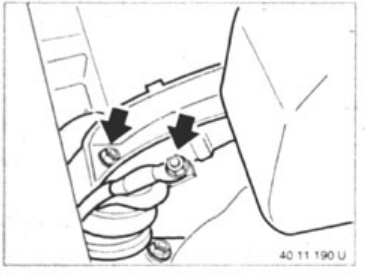
Place electric wire channel to one side.



Attach engine to special tool 11 0 000.



Note:
Front and rear suspension arrangement.



Ground cable and engine mount, left / right: unscrew.

Installation:
Tightening torque 11 81 2AZ*

Lift out engine.

* Refer to Technical Data

11 Engine M43

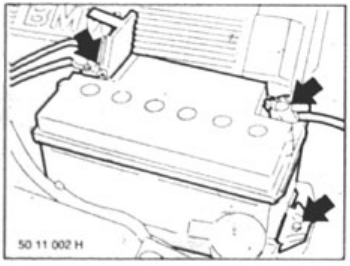
11 00 050 Engine – remove and install 11- 0/43.1

For further jobs refer to “Repair Manual 3 Series E36”.

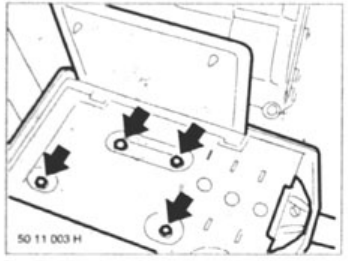
11 00 050 Removing and installing engine

M43

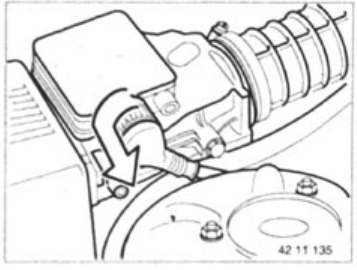
Observe note on disconnecting and connecting battery,
refer to General Information MG12



Disconnect negative battery lead.
Disconnect positive battery lead.
Remove battery.



Remove battery tray.

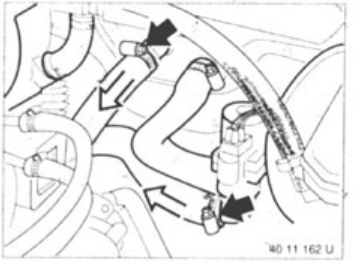


Release plug-and-socket connection.
Remove air cleaner with air mass meter.

Release coolant drain plug on RH side of engine block.
Drain coolant and dispose of suitably.

Installation note:
Fit sealing ring.
For tightening torque refer to Technical Data 11 11 5AZ

Remove radiator, refer to 17 11 000



Disconnect coolant hoses from engine, heater and heating valve.

Remove transmission,
refer to 23 00 22

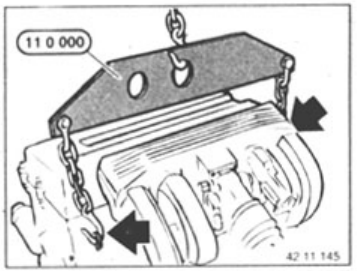
Remove upper section of manifold,
refer to 11 61 040
Repair Manual 3 Series E36

Remove cable duct from bottom section of manifold. Disconnect engine section of wiring harness from engine and place to one side.

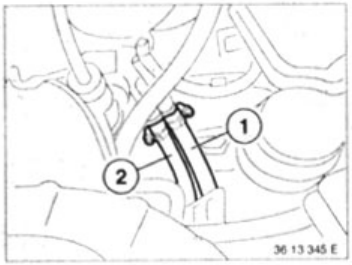
Installation note:
Plug connector assignments, refer to 61 11 051
Repair Manual 3 Series E36

Remove bottom section of manifold,
refer to 11 61 044
Repair Manual 3 Series E36

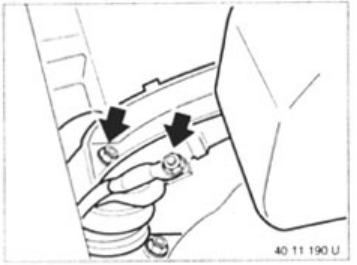
Release ignition coil,
refer to 12 13 512
Repair Manual 3 Series E36



Attach engine to special tool 11 0 000.



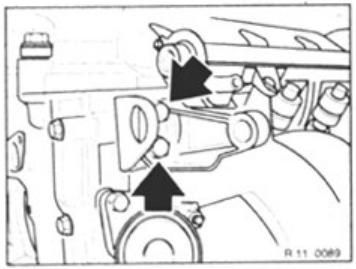
Caution!
Collect any fuel flowing out and dispose of suitably.
Release fuel supply and return lines.
(1) Fuel supply
(from fuel filter pipe: bare)
(2) Fuel return
(pipe: painted black)
Replace fuel hoses.



Release ground lead.
Release upper engine mounts on left and right.
Lift out engine.

Release power steering pump from alternator support bracket and tie to one side,
refer to 32 41 060
Repair Manual 3 Series E36

Note:
Lines remain connected.



Remove front manifold support bracket with lifting bracket.

11 Engine M50

00 00 249	BMW engine oil service	11- 00/50.1
11 00 039	Compression of all cylinders – check	11- 00/50.1
050	Engine – remove and install	11- 00/50.2
11 13 000	Oil pan – remove and install, seal or replace	11- 13/50.1
	• Fan shroud – remove	11- 13/50.1
	• Fan – remove	11- 13/50.1
	• Power steering pump – remove	11- 13/50.1
	• Oil dipstick tube – remove	11- 13/50.2
	• Oil pan – unscrew	11- 13/50.2
	• Pickup tube for oil pump – remove	11- 13/50.2
11 14 110	Bottom timing case cover – remove and install, seal or replace	11- 14/50.1
	• Cylinder head cover – remove	11- 14/50.1
	• Thermostat housing – remove	11- 14/50.2
	• RPM sensor – remove	11- 14/50.2
	• Mounting bracket for tensioner pulley – remove	11- 14/50.3
	• Pulley for water pump – remove	11- 14/50.3
	• Hub for vibration damper – remove	11- 14/50.3
	• Timing case cover – remove	11- 14/50.4
11 31 001	Camshaft (M50) (inlet or exhaust end) – replace	11- 31/50.1
	• Camshaft – remove	11- 31/50.1
001	Camshaft (M50 VANOS) (inlet or exhaust end) – replace	11- 31/50.8
11 36 . . .	Functional description VANOS (variable camshaft control)	11- 36/50.1
. . .	Control unit (VANOS) – troubleshoot	11- 36/50.1
000	VANOS – check function	11- 36/50.2
010	VANOS control unit – remove and install or replace	11- 36/50.3
550	4/2-way valve for VANOS – check or replace	11-36/50.10

For further jobs refer to “Assembly Repair Manual”.

00 00 249 BMW engine oil service

M50

Refer to 00 00 249
Repair Manual 3 Series E36

11 00 039 Testing compression of all cylinders

M50



Caution!
High voltage - risk of fatal injury!
Disconnect power supply to ignition coils.
Observe notes on compression testing, refer to General Information MG12
Repair Manual 3 Series E36

Disconnect fuel pump relay and DME main relay (location: E-box), refer to Electrical Troubleshooting Manual "Schematics" 5 Series E34
7000.0 Component location chart

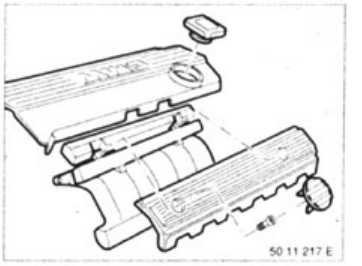
For further procedure, refer to 11 00 039
Repair Manual 3 Series E36

Read out defect code memory.
Repair defect if necessary.
Delete defect code memory.

11 00 050 Removing and installing engine

M50

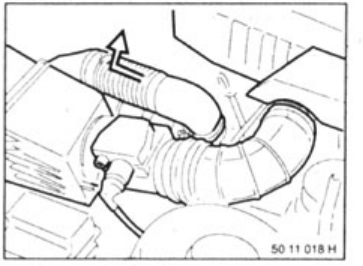
Observe notes on disconnecting and connecting battery,
refer to General Information MG12
Repair Manual 3 Series E36



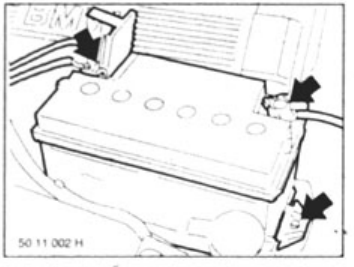
Remove covers.

Remove transmission,
refer to 24 00 022/ 23 00 022 / 023
(4-wheel drive)

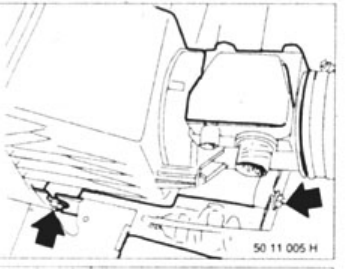
Note:
Additional jobs on 4-wheel drive.
Remove stabilizer bar,
refer to 31 35 000
Remove left and right output shafts,
refer to 31 60 000



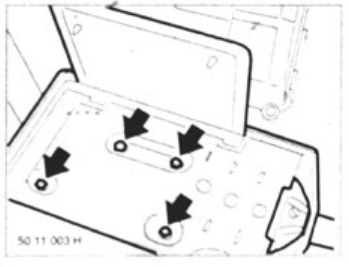
Remove intake duct for alternator cooling air.



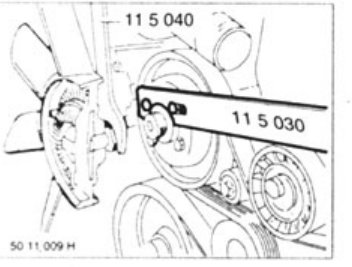
Disconnect negative battery lead.
Disconnect positive battery lead.
Remove battery.



Release plug-and-socket connection.
Release hose clip and retaining screws.
Remove air cleaner with air mass meter.



Remove battery tray.



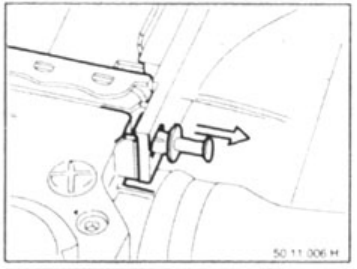
Caution!
Left-hand thread.
Hold pulley with special tool 11 5 030 and release union nut with special tool 11 5 040 from water pump.



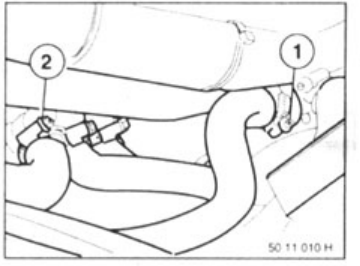
Installation note:
Firmly hold fan with special tool 11 5 040.
For tightening torque,
refer to Technical Data 11 52 1AZ

Note:
When using special tool 11 5 040, a reading of 30 Nm on the scale of the torque wrench corresponds to a tightening torque of 40 Nm.

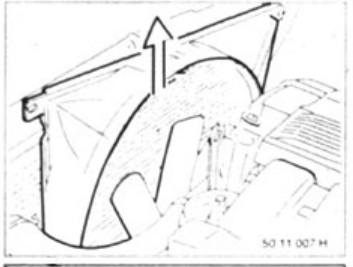
Remove radiator, refer to 17 11 000



Lift out expanding rivet on left and right.

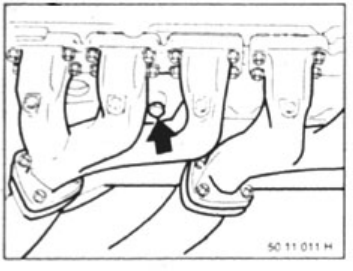


Remove coolant hoses from engine, heating valve (1) and heater (2).



Detach fan with fan clutch from water pump and lift upwards together with fan shroud.

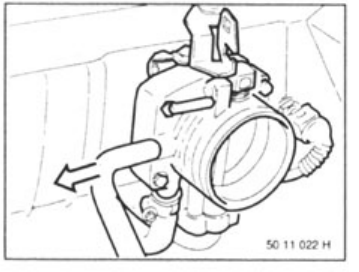
Remove throttle operating (Bowden) cable. This job is described under removing throttle body, refer to 13 54 030



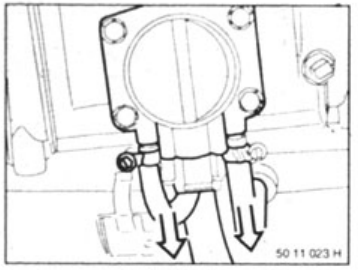
If necessary move protective plate.

Drain off coolant at engine block and dispose of suitably.

Installation note:
Replace gasket.
For tightening torque,
refer to Technical Data 11 11 5AZ

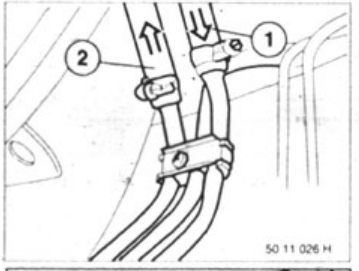


Disconnect hose for tank ventilation.



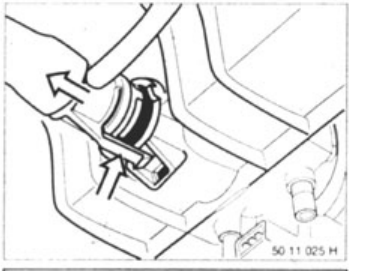
Disconnect hoses for throttle preheating.

Remove injection tube, refer to 13 64 150



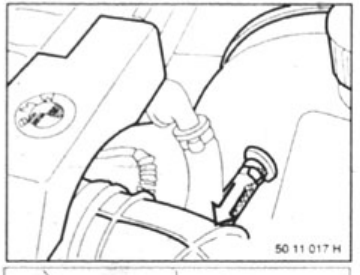
Caution!
Collect any fuel flowing out and dispose of suitably.
(1) Fuel return line
(2) Fuel supply line (from fuel filter)
Remove fuel hoses.

Installation note:
Replace fuel hoses.



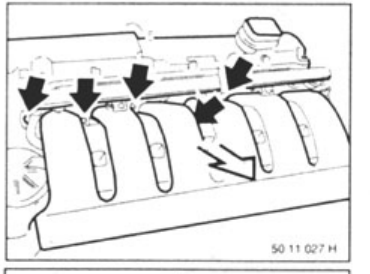
Unclip hose for idle speed control valve from manifold.

Note:
Figure shows connection from below (not visible in vehicle).



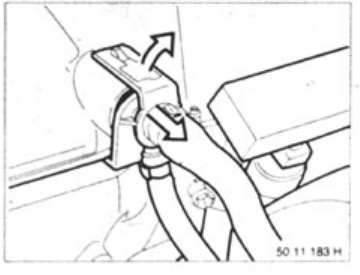
Remove connection piece from brake booster.

Caution!
Close off connection hole.

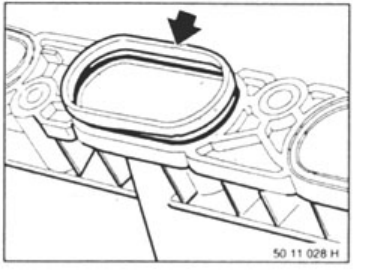


Remove intake air manifold.

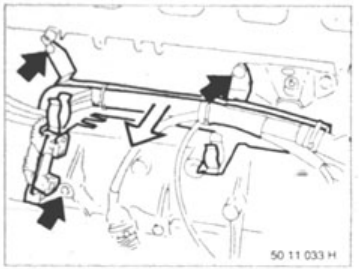
Caution!
Make sure no parts fall into the ports.



Disconnect hoses for cylinder head ventilation.

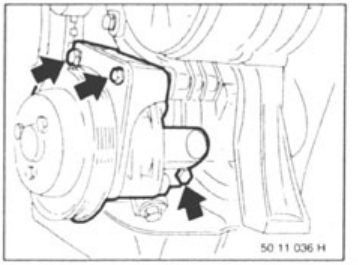


Installation note:
Replace seals.



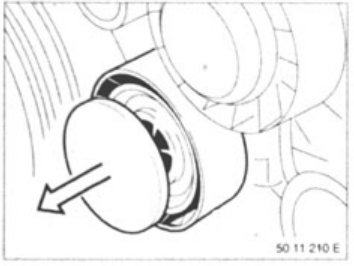
Disconnect engine section of wiring harness from engine.
Release cable duct.
Place wiring harness to one side.

Installation note:
Plug connector assignments, refer to 61 11 051

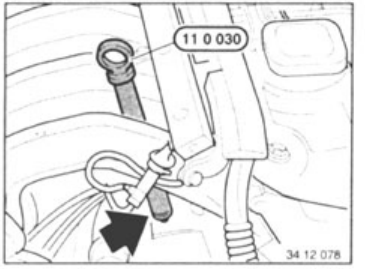


Remove power steering pump.

Note:
Lines remain connected.

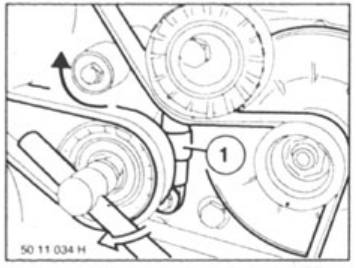


Remove cap from tensioner pulley.

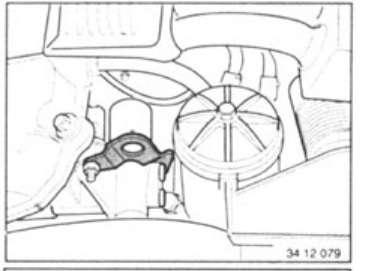


Location of rear mounting.

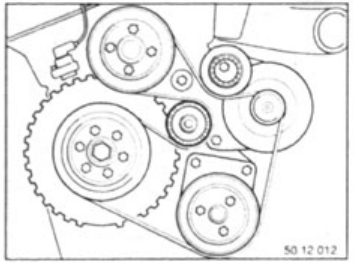
Screw special tool 11 0 030 from above into support bracket on engine block.



Fit hexagon socket wrench in screw for tensioner pulley.
Tensioning element (1) is pressed together by slowly turning in clockwise direction.
Lift off drive belt.

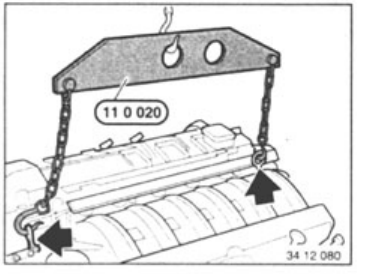


Location of front mounting.

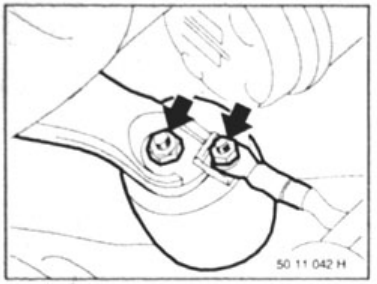


Location of drive belt.

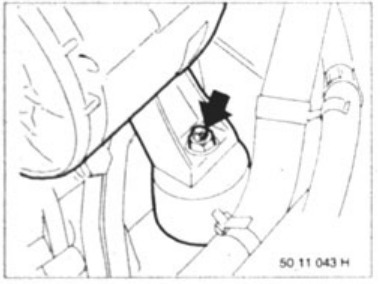
Installation note:
Ensure it is fitted correctly in grooves. Check drive belt for coolant and oil residue, replace if necessary.
The drive belt must be replaced if soiled with hydraulic oil.



Attach special tool 11 0 020 to front and rear of engine.
Tension chain.

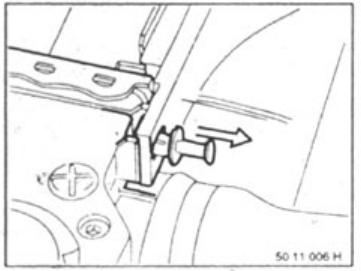


Release engine mount and ground lead on right.



Release left engine mount.

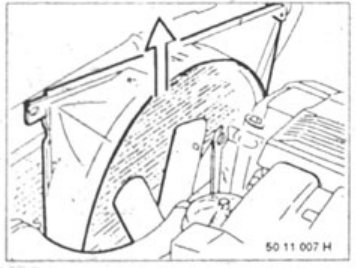
Lift out engine.



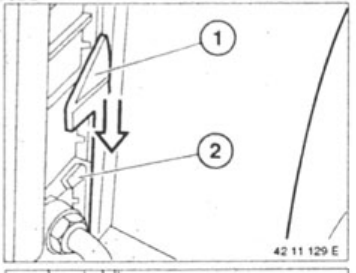
11 13 000 REMOVING AND INSTALLING, SEALING OR REPLACING OIL PAN

o **Removing Fan Cowl**

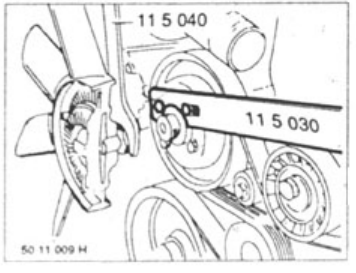
Lift left and right expansion rivets out.



Pull fan cowl out upwards.



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

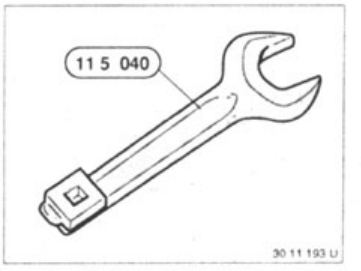


o **Removing Fan**

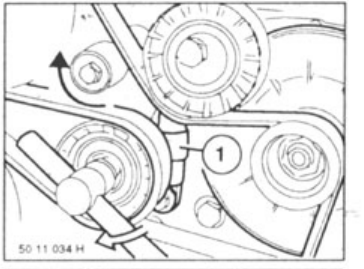
Counterhold on pulley with Special Tool 11 5 030 and unscrew coupling nut from fan.

Note:
Different bolt distances.

Important!
Left-hand threads.



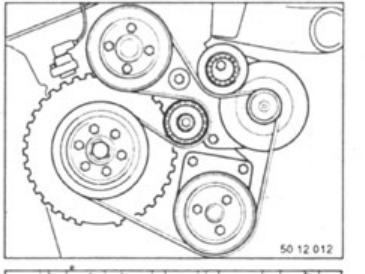
Installation:
Tighten fan using Special Tool 11 5 040. 40 Nm tightening torque is equal to 30 Nm on scale of the torque wrench.



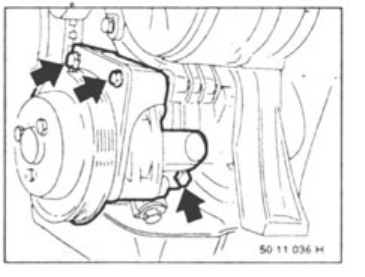
o **Removing Power Steering Pump**

Slacken drive belt:
Insert wrench socket into bolt for the tensioning wheel.
Turning slowly clockwise will push tensioning element (1) together.

Remove drive belt.



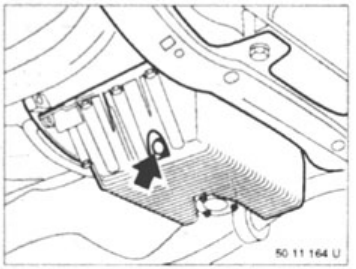
Installation:
Layout of drive belt.
Check for correct seating in the grooves.



Unscrew power steering pump from engine and suspend from car on a piece of wire. Pipes remain connected.

Installation:
Tightening torque*.

* **Refer to Specifications**

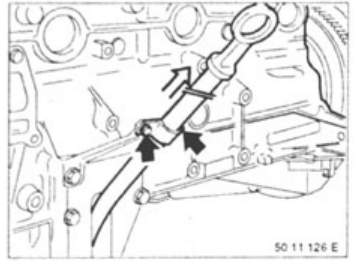


Unscrew oil drain plug and drain the oil.

Installation:
Tightening torque*.

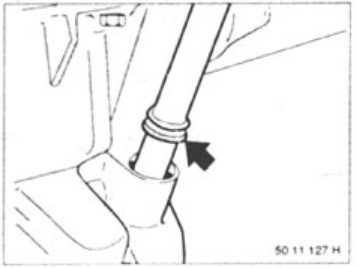
Installation:
Pour in engine oil*.

Start and run engine at high speed (approx. 2500 rpm) until the oil control lamp goes out (about 5 seconds).



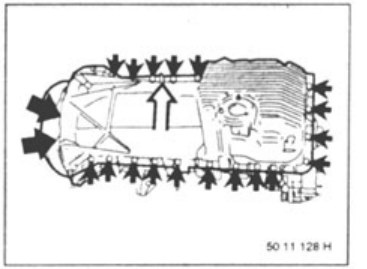
o Removing Guide Tube for Oil Dipstick

Unscrew and pull guide tube out.



Installation:
Replace seal.

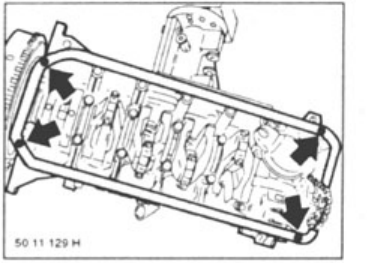
* Refer to Specifications



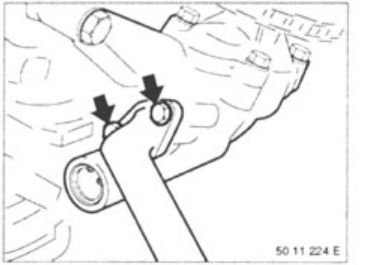
o Unscrewing Oil Pan

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

Pull oil pan out towards the rear after removing the oil pump intake.

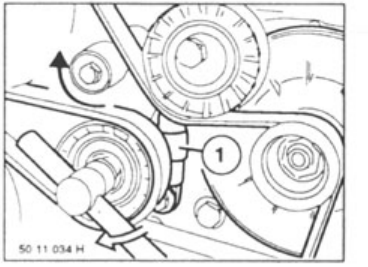


Installation:
Replace gasket.
Fill in joints between the front end of the chain case and rear end of the end cover with permanently elastic sealing compound 3 Bond 1207B black**.



o Removing Oil Pump Intake

Unscrew intake pipe.

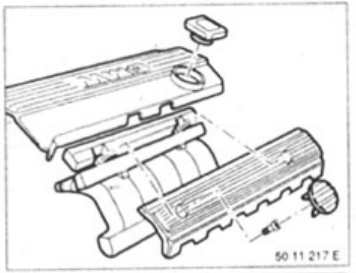


Installation:
Tab on gasket points to intake cage.

** Source of Supply: BMW Parts

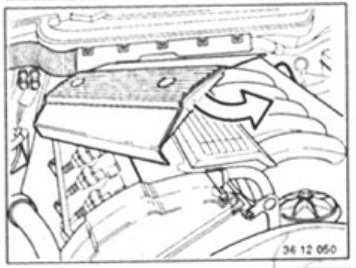
11 14 110 REMOVING AND INSTALLING, SEALING OR REPLACING LOWER TIMING CASE COVER

Remove oil pan – refer to 11 13 000.

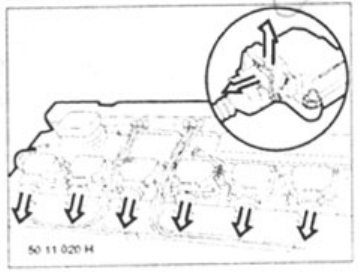


o Removing Cylinder Head Cover

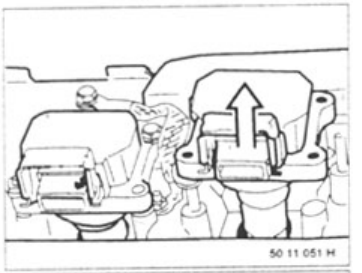
Unscrew cover for ignition coils.



Note:
Lift cover horizontally, pull it forward and then swing it out over the oil filler neck.

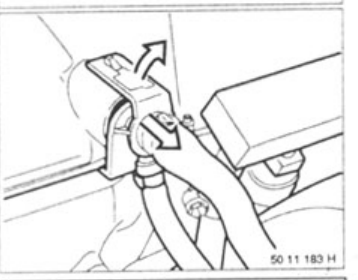


Pull plugs off of ignition coils.
Remove plug rail complete with electric leads.

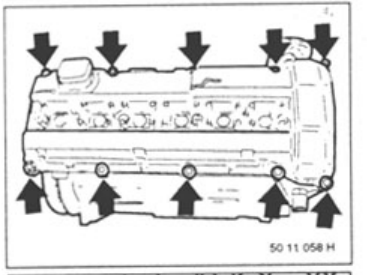


Remove ignition coils.

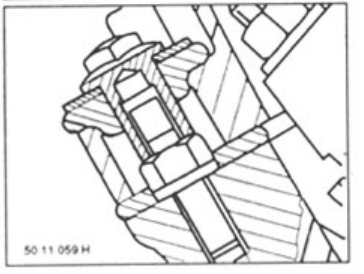
Installation:
Place paper gasket between valve cover and ignition coil (for galvanic separation).



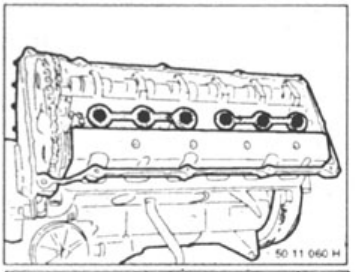
Unclip connection for cylinder head vent.



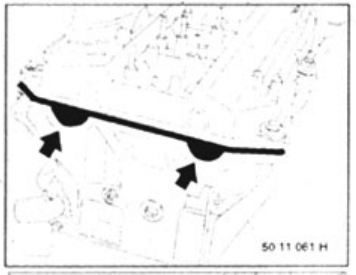
Unscrew cylinder head cover.



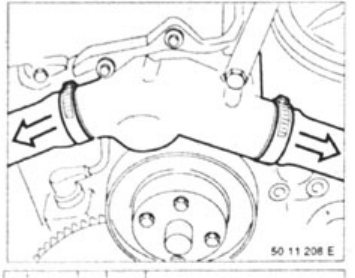
Note:
Cylinder head cover is separated from the cylinder head in regards to transmission of oscillation by using rubber mounts and gaskets.
Check arrangement of rubber elements.



Installation:
Check gaskets, replacing if necessary.
Place gaskets on cylinder head.

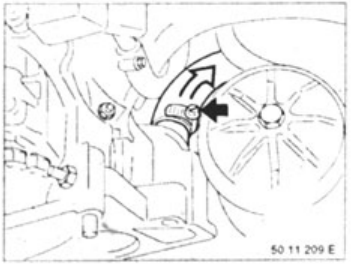


Installation:
Make sure of correct seating of gasket on back of cylinder head when mounting the cylinder head cover.

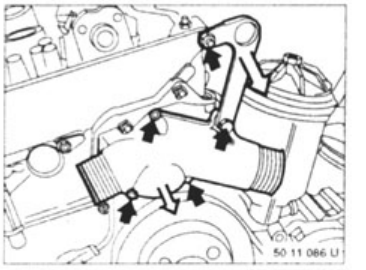


o Removing Thermostat Housing

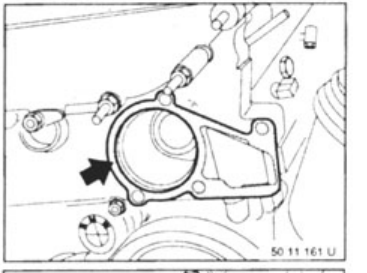
Drain coolant.
Disconnect water hoses from thermostat housing.



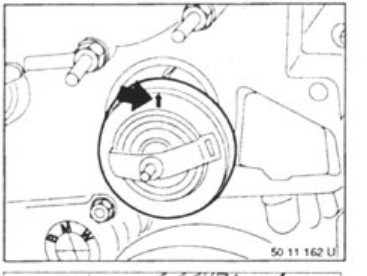
Disconnect water hose behind the oil filter.



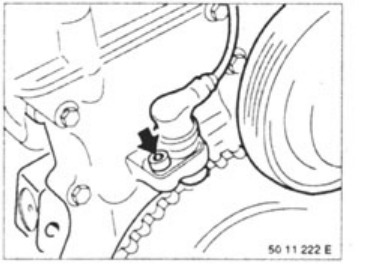
Unscrew suspension eye.
Unscrew thermostat housing.



Installation:
Replace gasket.

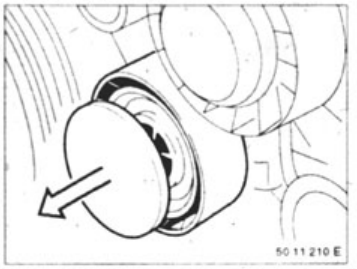


Installation:
Check installed direction.
Vent or arrow faces up.
Replace O-ring.



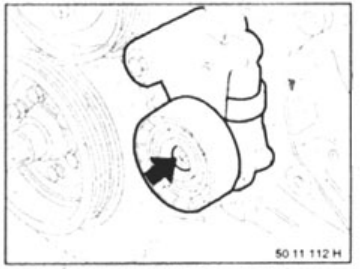
o Removing Speed Sender

Unscrew sender.

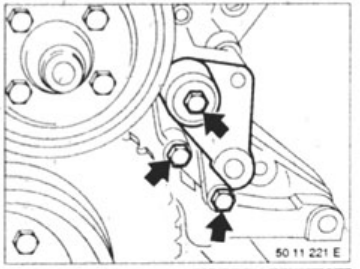


o Removing Tensioning Roller Console

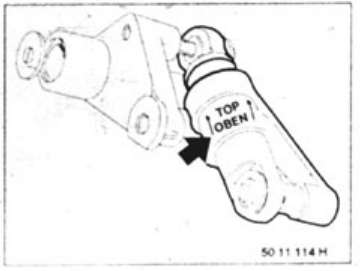
Take off cover.



Unscrew tensioning roller.

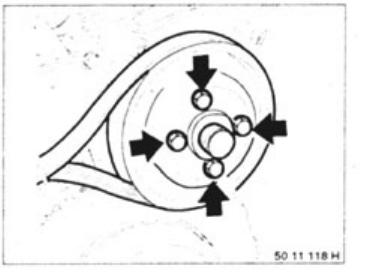


Unscrew console.



Note:
The hydraulic belt tensioner is filled with oil, so that a removed element must always be stored standing upright.
Incorrectly stored elements can normally be bled by compressing several times.

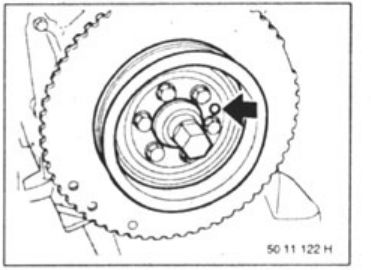
Installation:
Check installed direction.



o Removing Pulley for Water Pump

Hold pulley tight on the drive belt and unscrew bolts.

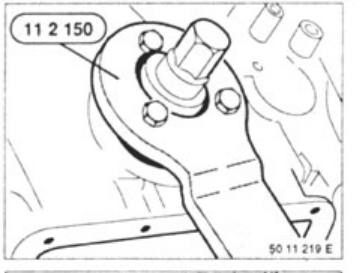
Installation:
Tightening torque*.



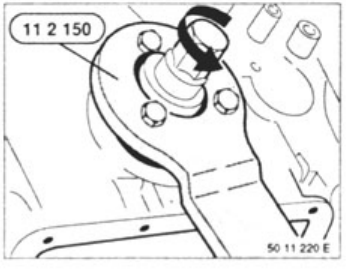
o Removing Vibration Damper Hub

Unscrew vibration damper bolts and take off vibration damper.

Installation:
Align dowel pin bore in vibration damper with the dowel pin.
Tightening torque*.

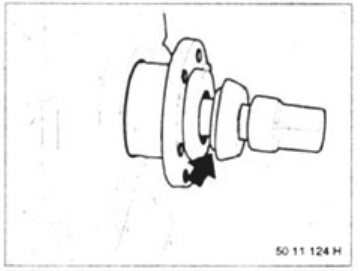


Apply Special Tool 11 2 150.

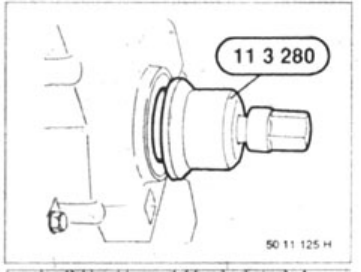


Unscrew central bolt.
Take off washer and hub.

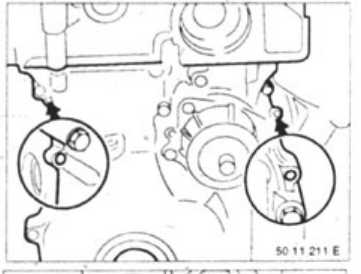
* See Specifications



Installation:
Position hub that groove and woodruff key are aligned.
Shoulder of washer faces hub.
Central bolt tightening torque = 410 Nm.

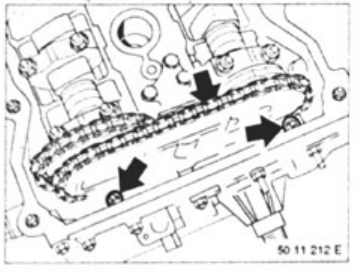


Installation:
Press in new radial oil seal flush using Special Tool 11 3 280 together with the central bolt with the timing case cover mounted.

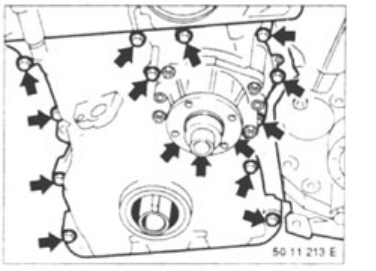


o **Removing Timing Case Cover**

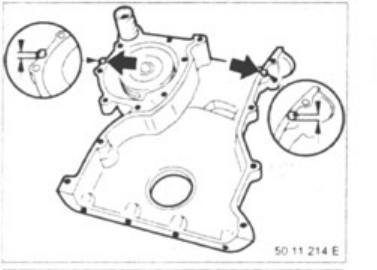
Drive out dowel pins on timing case cover toward rear (diameter of punch less than 5 mm).



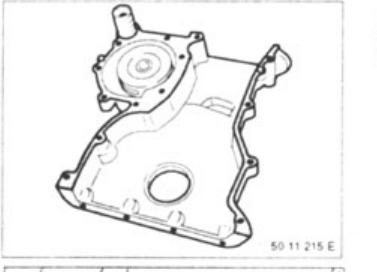
Unscrew timing case cover from cylinder head.
Pull up bolts.



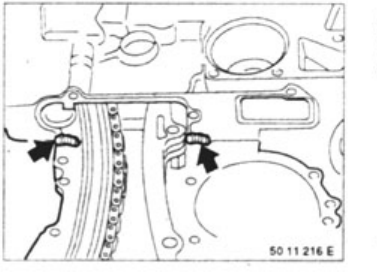
Unscrew timing case cover from engine block and lift off cover.



Installation:
Clean sealing surfaces.
Drive dowel pins into timing case cover that they protrude by about 2 to 3 mm.

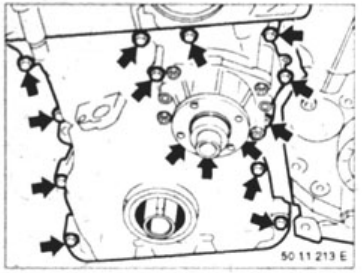


Installation:
Hold new gaskets on timing case cover with a small amount of grease.

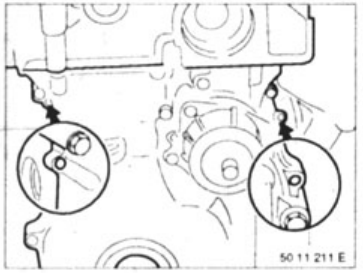


Installation:
Produce beads of permanently elastic sealing compound* on left and right transitions to the cylinder head gasket.

* **Source of Supply: BMW Parts**



Installation:
Mount cover and screw in screws finger tight.



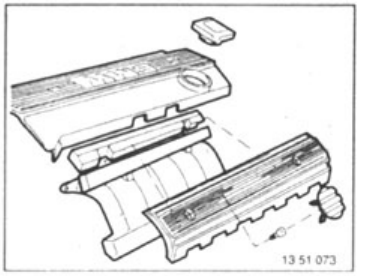
Installation:
Drive in dowel pins flush from front end.

Installation:
Tighten bolts on cylinder head and engine block alternately and uniformly in several steps.
Tightening torque*.

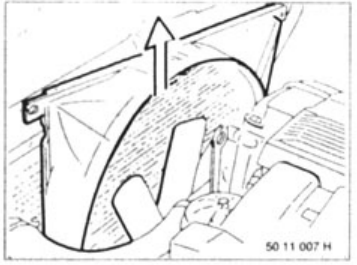
* **See Specifications**

11 31 001 REPLACING CAMSHAFT (M50)
(Intake or Exhaust)

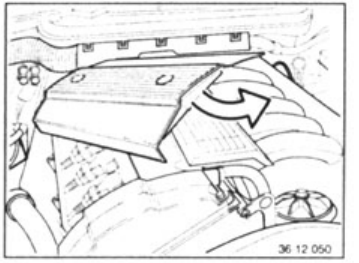
Note:
Intake or exhaust camshaft can be replaced in the car.



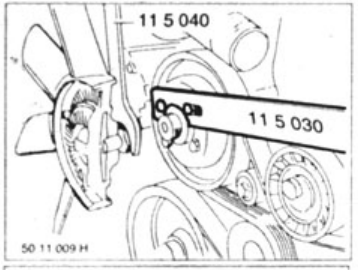
Remove covers.



Remove fan cowl.



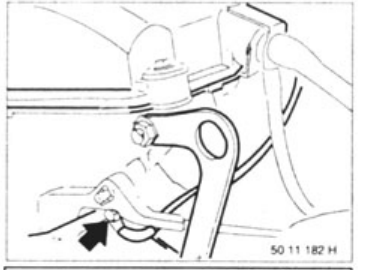
Note:
Lift cover horizontally, pull forward and then swing it out over the oil filler neck.



Remove fan using Special Tools 11 5 030 and 11 5 040.

Note:
Left-hand threads.

Installation:
Set torque wrench to 30 Nm and tighten fan bolt using Special Tool 11 5 040.

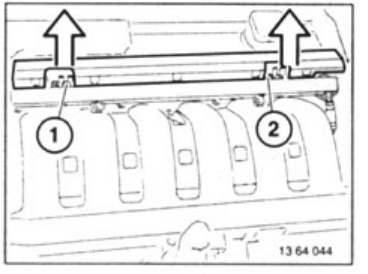


Unscrew ground strap on timing case cover.

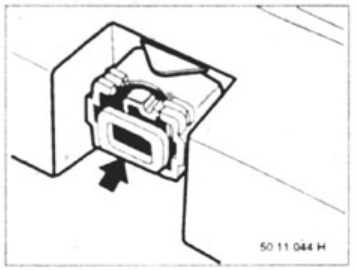


o Removing Camshaft

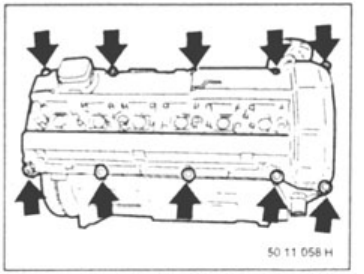
Caution!
The camshaft could be damaged or broken if it is removed / installed without use of special tools.
Valves could also be bent through contact with the piston crowns.
Conformance with procedures and sequence is absolutely essential.



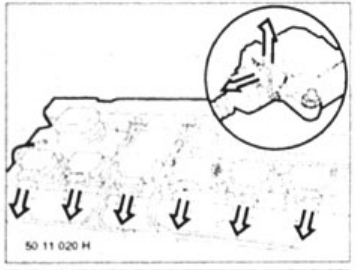
Unscrew screws (1 and 2).
Pull off plug rail.



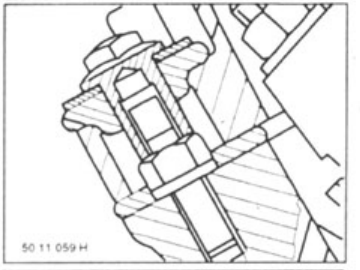
Important!
Watch out for rubber seals.



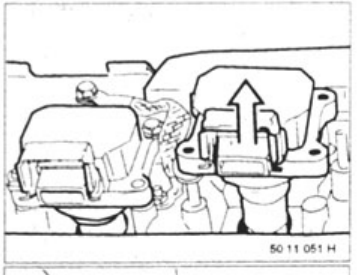
Unscrew cylinder head cover.



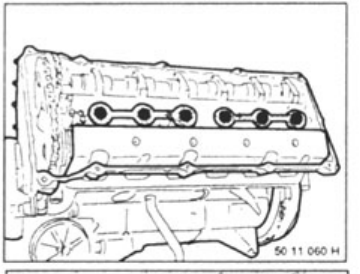
Pull plugs off of ignition coils.
Remove plug rail together with wires.



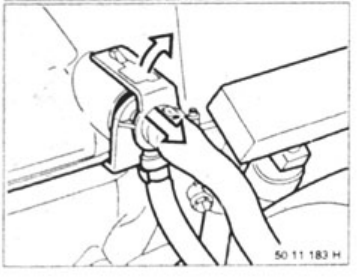
Note:
Rubber mounts and gaskets separate the cylinder head cover from the cylinder head to prevent transmission of oscillation.
Check arrangement of rubber mounts.



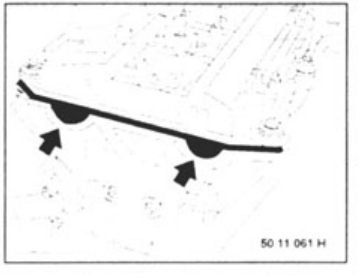
Remove ignition coils.



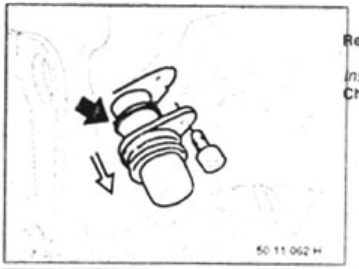
Installation:
Check gaskets, replacing them if necessary.
Place gaskets on cylinder head.



Unclip connection for cylinder head vent.

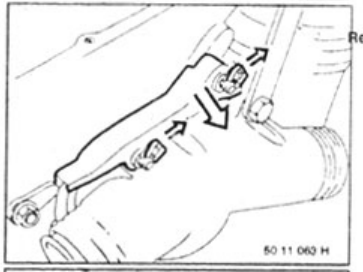


Installation:
Check for correct seating of the gasket on the back of the cylinder head when mounting the cylinder head cover.

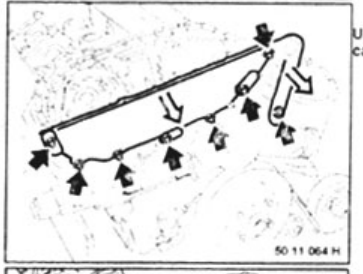


Remove sender.

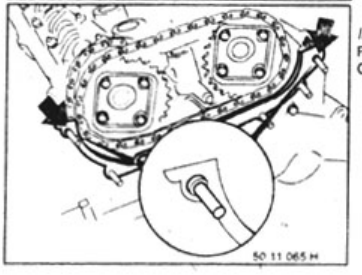
Installation:
Check seal, replacing it if necessary.



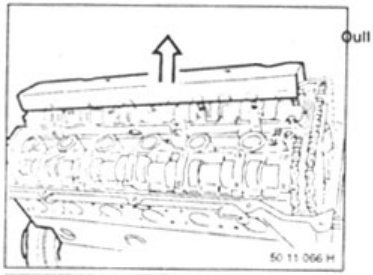
Remove wiring duct.



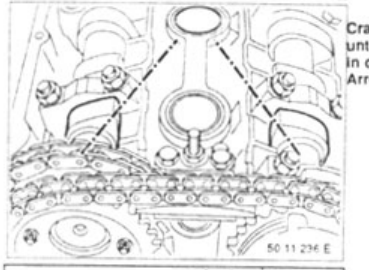
Unscrew suspension eye and upper timing case cover.



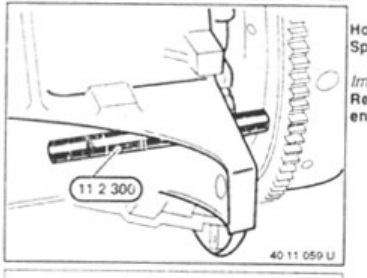
Installation:
Replace gasket.
Check for dowel sleeves.



Pull off cover.

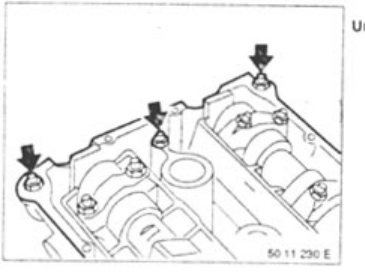


Crank engine in its direction of rotation until the peaks of intake and exhaust cams in cylinder no. 1 face each other.
Arrows on the sprockets point up.

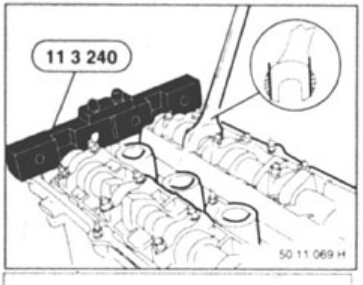


Hold crankshaft in TDC position using Special Tool 11 2 300.

Important!
Remove special tool before operating the engine.



Unscrew both valve cover mounting studs.

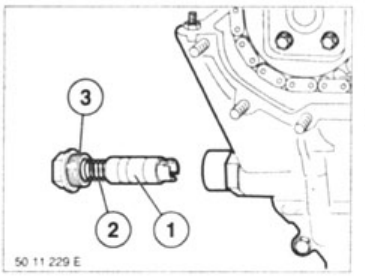


Installation:
Align and hold camshaft in position using Special Tool 11 3 240.
Camshafts can be turned on the hexagon using a 24 mm wrench.

Important!
Don't damage the bearing strip.
If necessary, machine the open-ended wrench accordingly.



Important!
If the camshaft alignment has to be corrected to such an extent that valves are moved in cylinders 1 and 6, first turn the crankshaft in the engine's direction of rotation approx. 30° away from TDC and then turn the camshaft back.
This prevents contact between valves and piston crowns.
Install both chain tensioners after assembling has been completed.
Crank engine several times in its direction of rotation.
Recheck camshaft alignment.

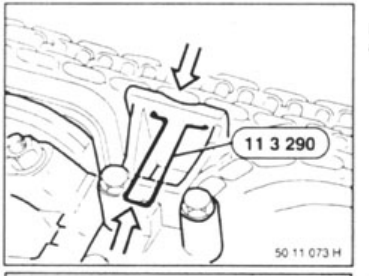


Unscrew bolt (3).

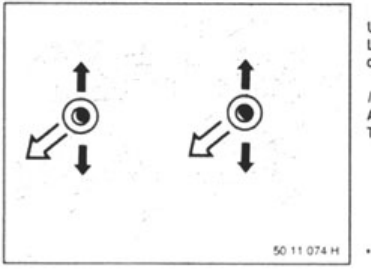
Caution!
Strong spring force.

Remove spring (2) and plunger (1).

Installation:
Insert chain tensioning plunger (1) in such a manner that guide tabs engage in the tensioning rail.
Install spring (2) and bolt (3).
Replace seal.
Tightening torque*.



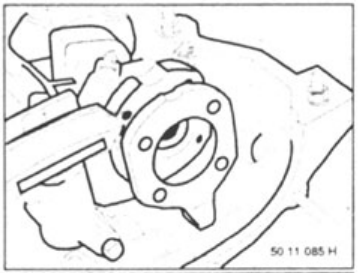
Press down on upper chain tensioner and arrest it by inserting Special Tool 11 3 290.



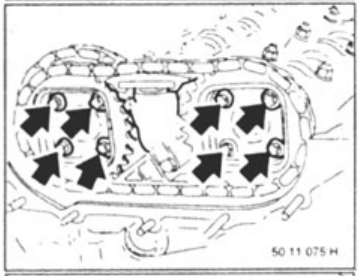
Unscrew sprockets.
Lift off both sprockets together with the chain.

Installation:
Arrows on the sprockets point up.
Tightening torque*.

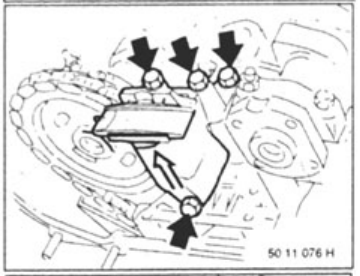
* Refer to Specifications



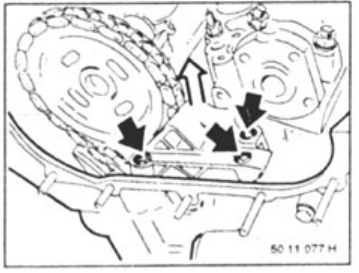
Installation:
Apply pulse sender on the intake camshaft.



Installation:
Tighten bolts only after finishing installation of the chain system and lower chain tensioner as well as loosening the upper chain tensioner.
Tightening torque*.

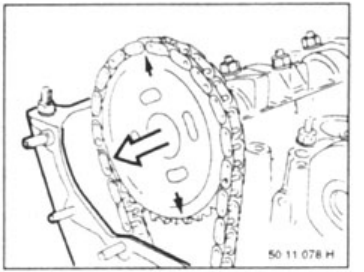


Unscrew console for upper chain tensioner.

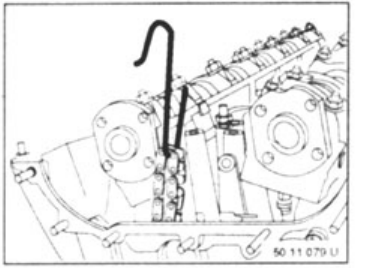


Unscrew chain guide.

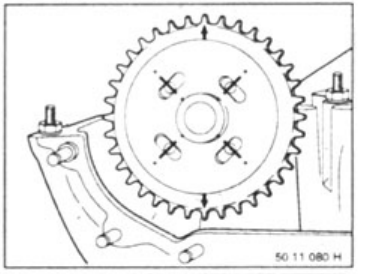
* Refer to Specifications



Lift off sprocket together with chain.

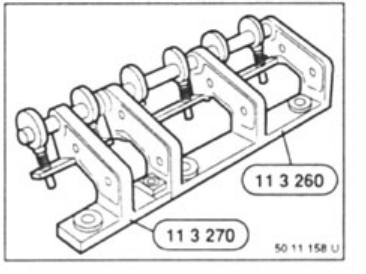


Important!
Use a piece of wire to prevent the chain from sliding doown.

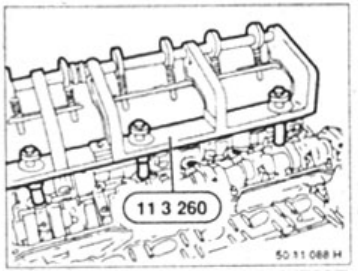


Installation:
Arrow on the sprocket points up.

Mount sprocket in such a manner that the tapped bores are on the left-hand side of the slots, as mounting the chain tensioner will cause the sprocket to be turned to the left.

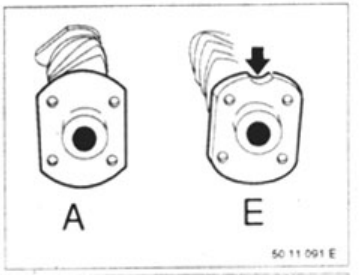


Prepare Special Tool 11 3 260 for a six cylinder engine.



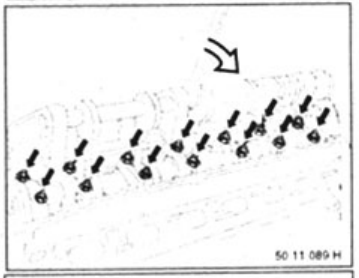
Unscrew spark plugs.

Apply special tool and screw into spark plug tapped bores tight.
Tightening torque = 23 Nm.



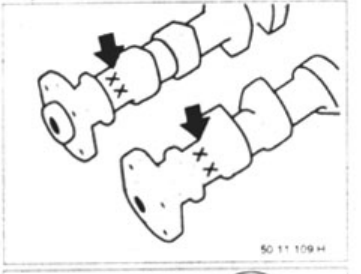
Installation:
Identification of camshafts on flange for sprockets:

E Intake camshaft
A Exhaust camshaft



Apply tension on bearing caps by turning the eccentric shaft.
Unscrew all bearing cap bolts.

Installation:
Tightening torque*.

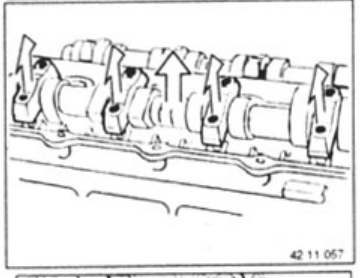


Identification on front end of camshafts:

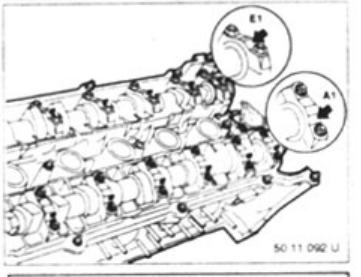
1st letter:
E Intake
A Exhaust

2nd letter:
A 2.5 liter
B 2.0 liter

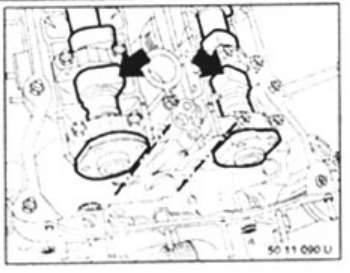
Example:
EB = Intake 2.0 liter



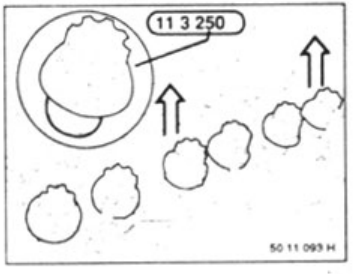
Loosen and remove special tool.
Lift out bearing caps and camshaft.



Installation:
Bearing caps are marked
A1 to A7 for the exhaust side or
E1 to E7 for the intake side,
whereby the marks can be read from the intake side.



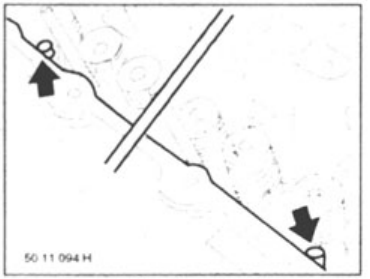
Installation:
Install camshafts that peaks of cams for intake and exhaust valves in cylinder no. 1 face each other.



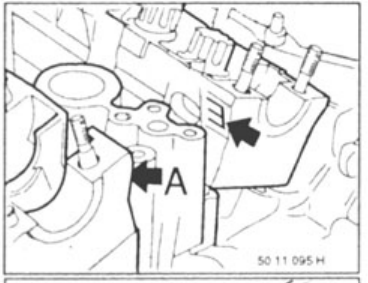
Suck valve clearance compensators tight using Special Tools 11 3 250.

Lift out bearing strip complete with valve tappets.

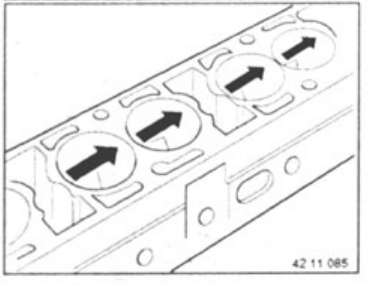
* Refer to Specifications



Installation:
Check for centering sleeves on mounting studs for bearings 2 and 7.



Installation:
Bearing strips are marked with "A" for the exhaust side or "E" for the intake side.



Installation:
Inspect bearing surfaces of valve clearance compensators for wear (scoring).

11 31 001 Replacing camshaft (M50 VANOS) (intake or exhaust end as required)

Refer to 11 31 001 (M50 VANOS)
Repair Manual 3 Series E36

11 36 ... DESCRIPTION OF VANOS (Variable Camshaft Control)

The control unit is activated by the pertinent engine control unit. The control unit operates a regulating element via a solenoid. In this manner engine oil pressure is supplied to both sides of a hydraulic plunger.

The hydraulic plunger is held in one of both possible positions by way of mechanical stops and applied engine oil pressure. A rotating splined shaft gear is integrated in the hydraulic plunger. This splined shaft gear uses its helical bevel splines to convert the plunger stroke into rotation of the camshaft – relative to the driven chain sprocket.

Hydraulic plungers with the splined shaft gear are located in a pressure cast aluminum housing on the face end of the cylinder head, coaxial to the intake camshaft.

The nominal positions of the intake camshaft (advanced or retarded) are different for M50 B20 and M50 B25 engines. Adjustment of the camshaft is activated by the pertinent engine control unit depending on engine load, engine speed and coolant temperature.

The 4/2-way operating valve is designed in such a manner that when one pressure chamber is pressurized, the other is without pressure (feedback). As soon as the operating valve's solenoid receives current, it moves the control piston against spring force into advanced position via an armature. A coil spring is provided for return to the retarded position. Consequently the camshaft is automatically adjusted in retarded direction in case of a faulty solenoid or activation failure.

In this manner it is still possible to start the engine even when the control unit fails. It would not be possible to start the engine were the camshaft adjusted in advanced timing direction.

The control edges of the valve are designed in such a manner that the emergency operation properties of the engine are guaranteed even when the control piston would seize in an undefined intermediate position.

11 36 ... TROUBLESHOOTING VANOS CONTROL UNIT

Interrogate the fault memory of the engine control unit.
If no faults are stored in the memory: refer to "Checking Function of VANOS" in 11 36 000.

M50 B20:

M50 B20 engines are fitted with an engine control unit from "Siemens".
Designation: MS 40.1

Faults which could be stored in the control unit's fault memory:

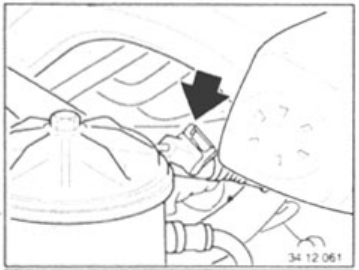
1) Feedback of intake camshaft's position. If the camshaft is not adjusted or only adjusted inadequately after activation and triggered operation, this is stored in the fault memory.
2) Testing of final stages
3) Short to positive
4) Short to ground
5) Breaks in wiring

M50 B25:

M50 B25 engines are fitted with an engine control unit from "Bosch".
Designation: DME M 3.3.1

Faults which could be stored in the control unit's fault memory:

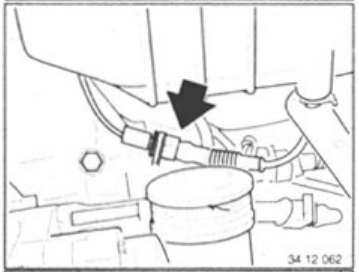
1) Testing of final stages
2) Short to positive
3) Short to ground
4) Breaks in wiring



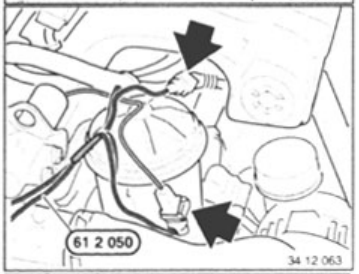
11 36 000 Checking function of VANOS

Interrogate fault memory of the engine control unit.

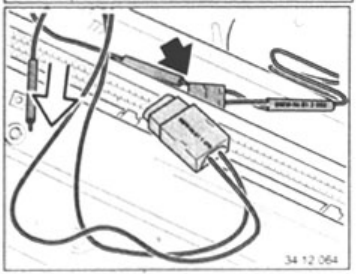
The VANOS control unit plug is located behind the oil filter tied back on the engine wire harness.



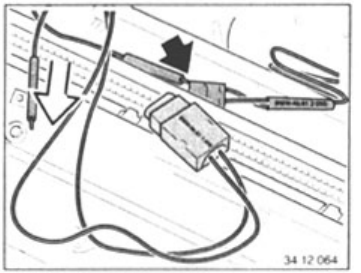
Remove air guide for alternator.
Disconnect plug.



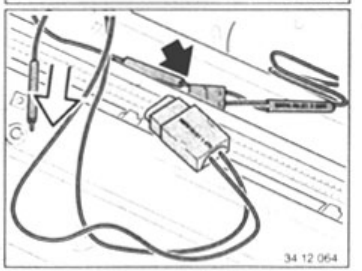
Connect special tool 61 2 050 on engine wire harness and solenoid.



Switch on ignition.
Connect special tool 61 1 476 to one pin of the 2-pin plug of special tool 61 2 050.
Connect special tool 61 2 050 to vehicle ground.
Switching of the solenoid must be heard and felt.
If the solenoid valve fails to switch, refer to next page.

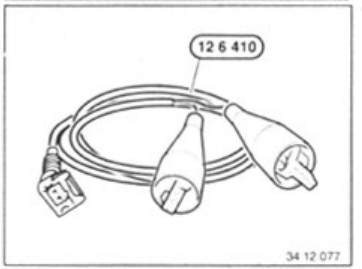


Connect special tool 61 2 050 to vehicle ground and, if the solenoid valve fails to respond, special tool 61 2 050 must be inserted in the other chamber of the two-pin plug connection of special tool 61 1 476.
Again connect special tool 61 2 050 to vehicle ground.
Switching of the solenoid must be heard and felt.



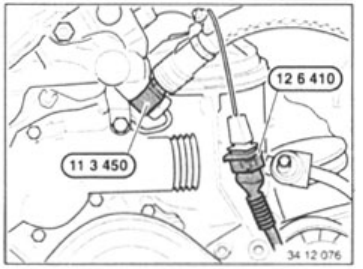
Dynamic Test:
Start and run engine at idle speed.
Again connect special tool 61 2 050 to vehicle ground.
Engine runs extremely roughly or dies.

If the solenoid is not operated in this test, another test must be carried out with special tool 12 6 410.



Connect special tool 12 6 410 to plug of solenoid. Connect the red clip to the battery's positive connection point. Connect the black clip to vehicle ground.

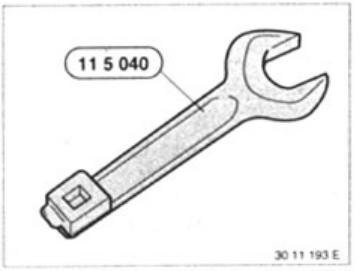
Caution!
Reversing the terminals on the special tool will destroy the installed diode on the VANOS solenoid valve. The solenoid valve remains serviceable but current spikes can give rise to faults in the vehicle circuit.



Switching of the solenoid must be heard and felt.
If the solenoid is now operated, check the wiring from the engine control unit to the solenoid.
If the solenoid is not operated, also refer to: Electrical Troubleshooting Manual.

11 36 010 Removing and installing or replacing VANOS control unit

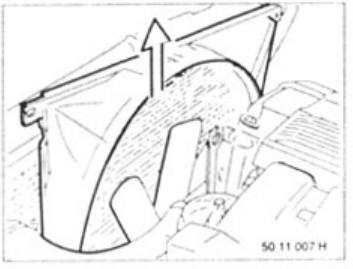
M50



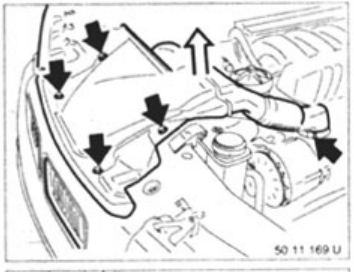
Installation note:
Set torque wrench to 30 Nm, tighten fan screw in conjunction with special tool 11 5 040.



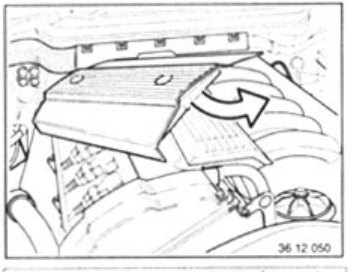
Caution!
If disassembled assembled incorrectly, there is a danger that the valves will be bent by contact with the piston crown.
Follow order of assembly exactly.



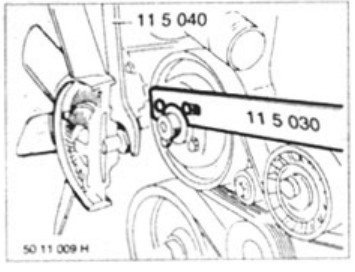
Remove fan with fan clutch from water pump and remove together with fan shroud.



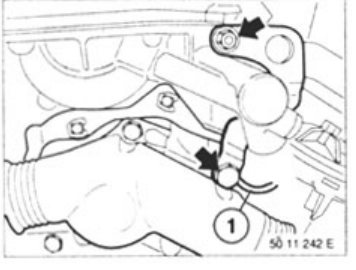
Remove complete air duct assy. for alternator.



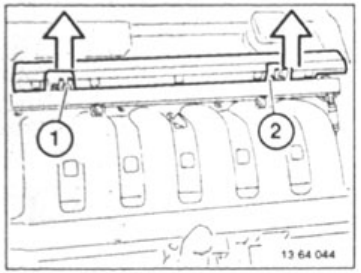
Remove cover.



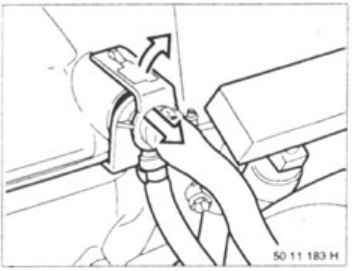
Caution!
Left-hand thread.
Firmly hold pulley with special tool 11 5 030.
Release union nut with special tool 11 5 040 from water pump.



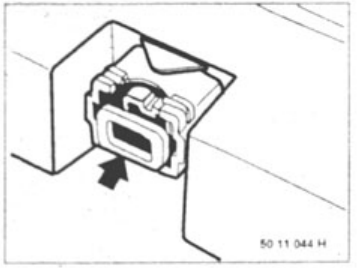
Unscrew ground strap (1) on timing case cover.



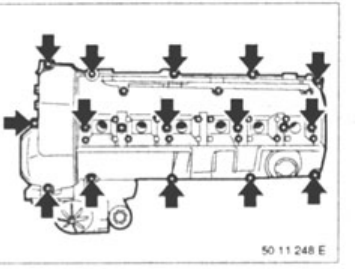
Unscrew screws (1 and 2).
Pull off plug rail.



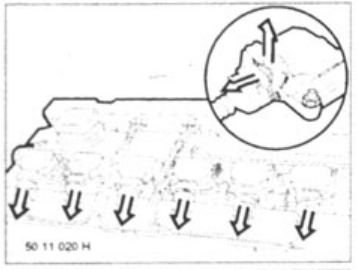
Unclip connector for cylinder head vent.



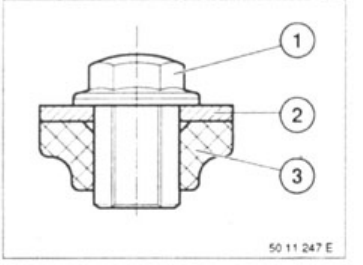
Important!
Watch out for rubber seals.



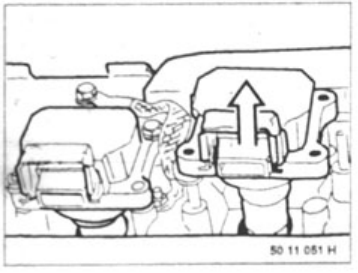
Unscrew cylinder head cover.



Pull plugs off of ignition coils.
Remove plug rail together with wires.

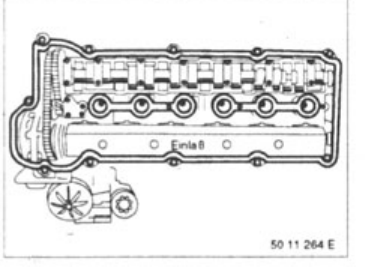


Note:
Rubber mounts and gaskets separate the cylinder head cover from the cylinder head to prevent transmission of oscillation.
1 Capped nut
2 Washer
3 Rubber mount

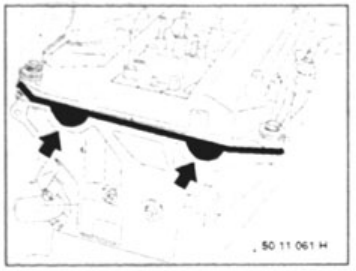


Remove ignition coils.

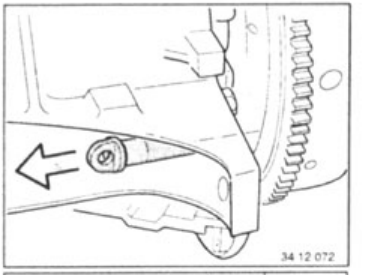
Installation:
Secure ground straps on ignition coils for cylinder no. 3 and cylinder no. 6.



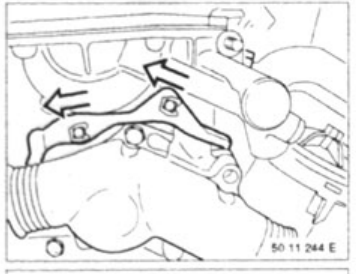
Installation:
Check gaskets, replacing them if necessary.
Place gaskets on the cylinder head.



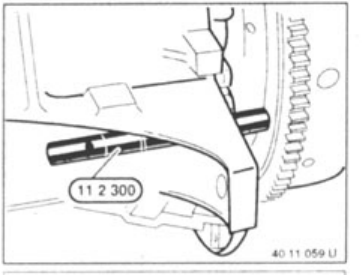
Installation:
Check for correct seating of the gasket on the cylinder head's backside when mounting the cylinder head cover.



Pull dust guard out of the special tool bore.

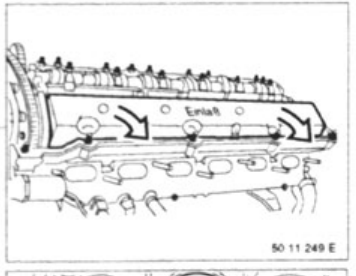


Remove electric wire duct.

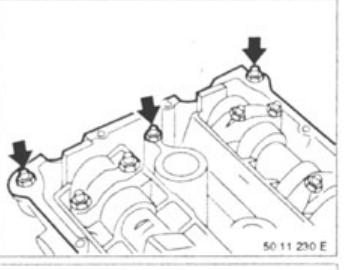


Hold crankshaft in TDC position using Special Tool 11 2 300.

Caution!
Remove the special tool before operating the engine.

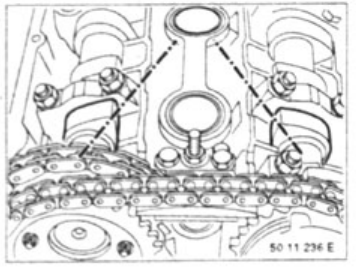


Pull off plastic cover for the intake camshaft.

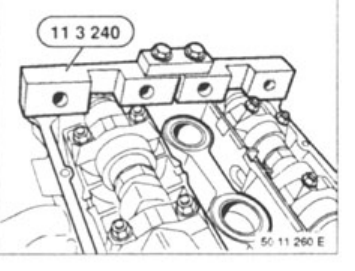


Unscrew studs.

Installation:
Tightening torque*.

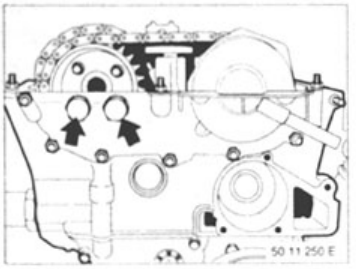


Crank engine in its direction of rotation until the cam peaks of the intake and exhaust camshafts in cylinder no. 1 point to each other.

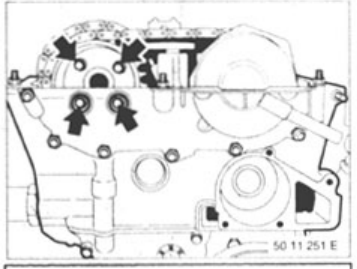


Hold camshafts in position using Special Tool 11 3 240.

* Refer to Specifications

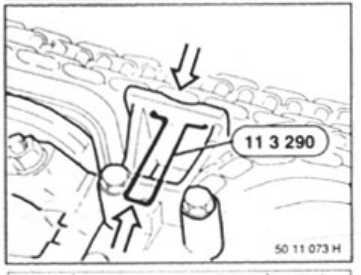


Screw plugs out of the control unit.

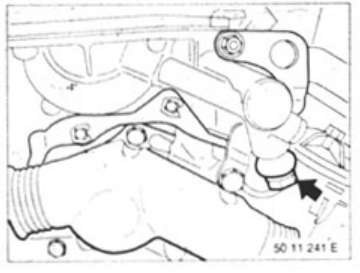


Loosen bolts.

Installation:
Tightening torque*.

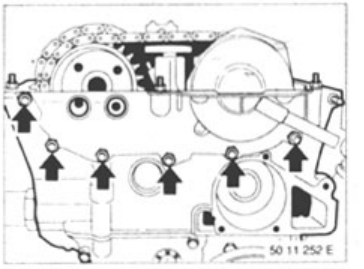


Press down on chain tensioner from above and lock using Special Tool 11 3 290.



Unscrew oil pressure pipe.
Disconnect solenoid plug.

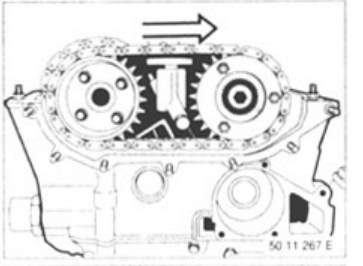
* Refer to Specifications



Unscrew nuts.

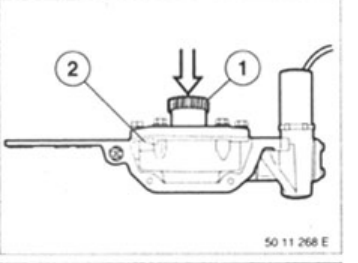
Installation:
Tightening torque*.

Remove VANOS control unit.

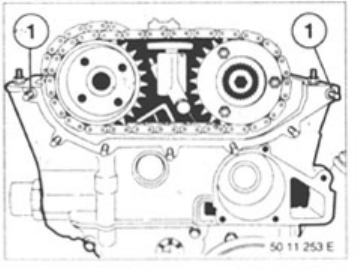


Install VANOS control unit.

Turn sprockets with mounted secondary chain clockwise as far as stop.

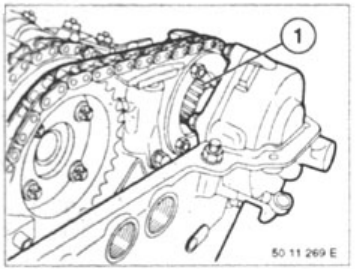


Push back control unit's splined shaft (1) into housing (2) as far as stop.

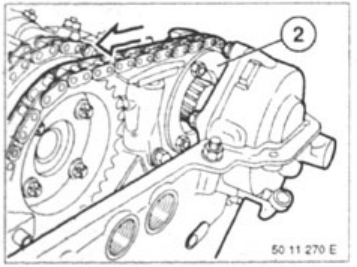


Check for dowel sleeves (1).
Apply liquid sealant Three Bond 1209** on butt corners of separating plane between cylinder head and VANOS control unit.
Replace gasket.

* Refer to Specifications
** Source of Supply: BMW Parts

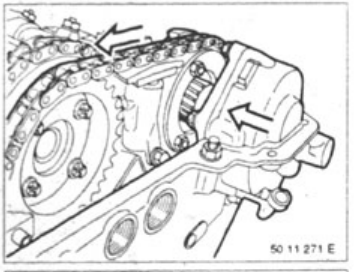


Apply VANOS control unit and turn splined shaft (1) until the splines mesh.

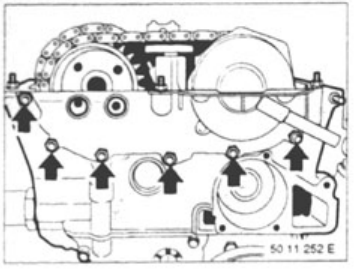


Turn sprockets with mounted chain counterclockwise by hand far enough that the splined shaft meshes in the splines of sprocket (2).

Important!
It is absolutely essential to ensure that the "FIRST" suitable tooth meshes.

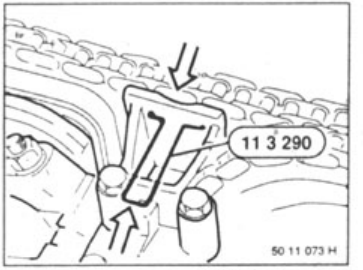


Move VANOS control unit in direction of the cylinder head.
Guiding the helical bevel splined shaft into the helical bevel splined sprocket turns the sprockets with mounted chain counterclockwise.
Guide the chain with sprockets in counterclockwise direction by hand.

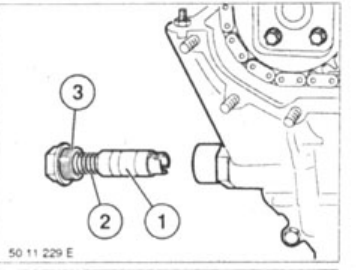


Tighten nuts.
Tightening torque*.

* Refer to Specifications



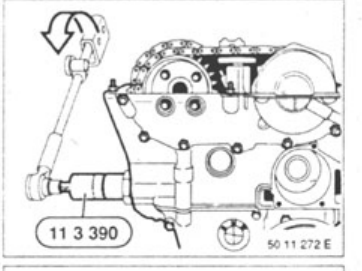
Remove Special Tool 11 3 290.



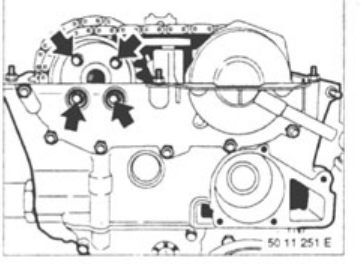
Unscrew primary chain tensioner (3).

Caution!
Strong spring force.

Remove spring (2) and plunger (1).

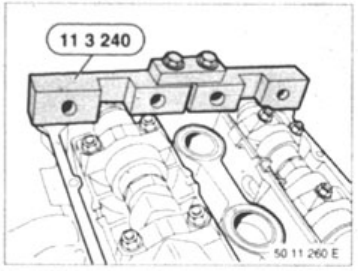


Preload tensioning rail with help of Special Tool 11 3 390 by tightening the setscrew to 1.3 Nm using Special Tool 00 2 050 or a standard torque wrench.

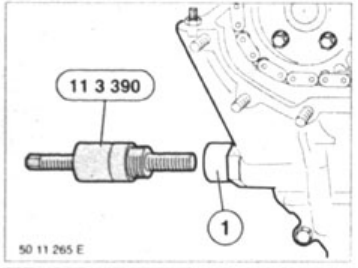


Tighten sprocket bolts of the exhaust camshaft in two steps.
Tightening torque*.

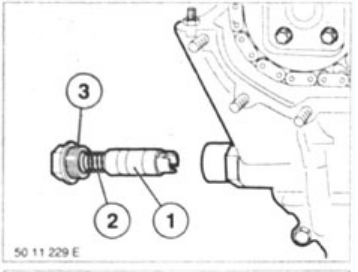
* Refer to Specifications



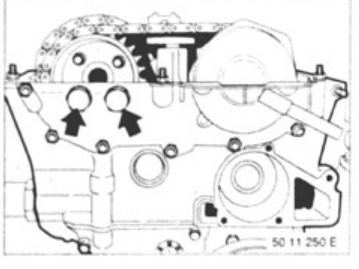
Remove special tool 11 3 240.



Remove special tool 11 2 390.

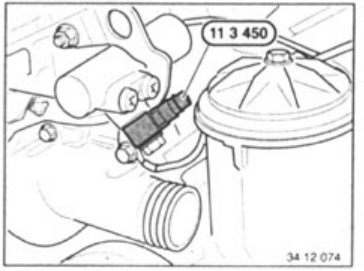


Install chain tensioner plunger (1) in such a manner that the guide tabs engage in the tensioning rail.
Install spring (2) and bolt (3) together with a new seal.
Tightening torque 11 31 7AZ*

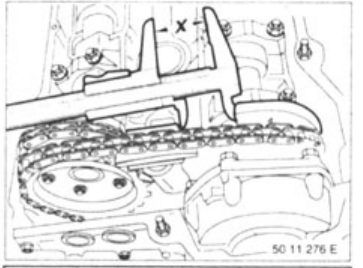


Install plugs with new seals.
Tightening torque 11 36 3AZ*

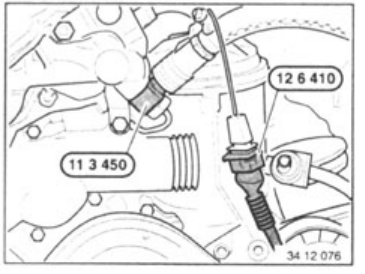
* Refer to Specifications



Check function of VANOS control unit. Mount special tool 11 3 450 together with the oil pressure pipe coupling.
Connect up compressed air (2....8 bar).

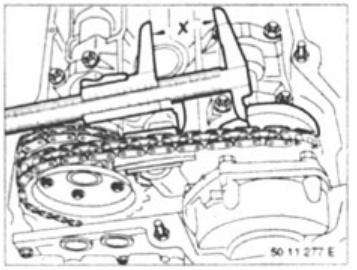


Measure distance (1) between secondary tensioner and edge on sender gear. Note the measured distance.



Connect special tool 12 6 410 to the plug of the solenoid for VANOS. Connect positive clip to battery connection point.
Connect negative clip to vehicle ground to adjust the camshaft.

Caution!
Reversing the terminals on the special tool will destroy the installed diode on the VANOS solenoid valve. The solenoid valve remains serviceable but current spikes can give rise to faults in the vehicle circuit.

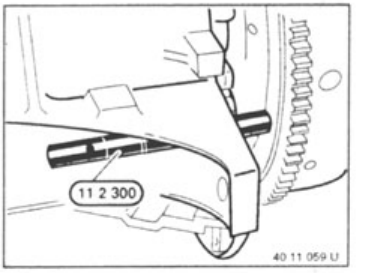


Measure distance (2) between secondary tensioner and edge on sender gear.
Note the measured distance.

Determine control travel:
Distance 2
– Distance 1
= Control travel

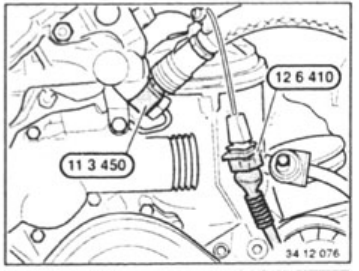
The control travel must be at least 8.5 mm.

Important!
The control unit must be readjusted if the control travel is less than 8.5 mm.

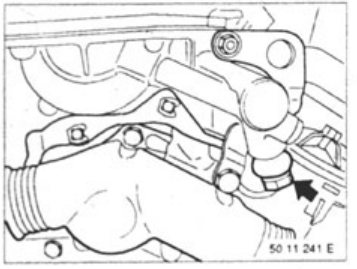


Remove Special Tool 11 2 300.

Assemble engine.

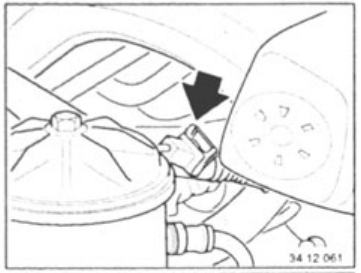


Remove Special Tools 11 3 450 and 12 6 410.



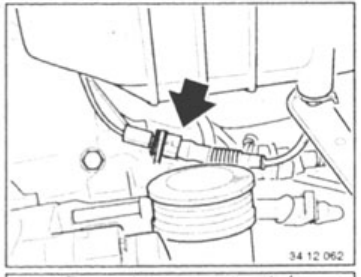
Mount oil pressure pipe with new seals.
Tightening torque*.
Connect solenoid plug.

* Refer to Specifications

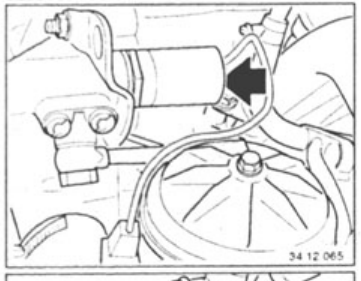


11 36 550 CHECKING / REPLACING 4/2-WAY VALVE FOR VANOS

Switch off ignition.
The VANOS control unit plug is located behind the oil filter tied back on the engine wire harness.

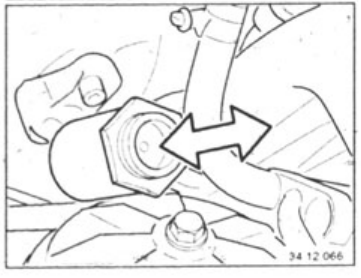


Remove air guide for alternator.
Disconnect plug.



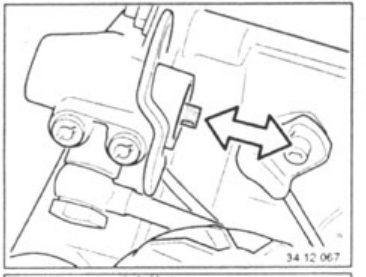
Unscrew VANOS solenoid.

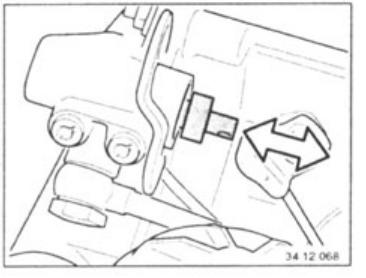
Installation:
Tightening torque*.
Check seal, replacing it if necessary.



Move the plunger back and forth to ensure that it moves easily.

* Refer to Specifications





Move plunger of the hydraulic piston back and forth.
The hydraulic piston must be moved easily. The complete VANOS control unit must be replaced if the hydraulic piston is hard to move.

11 Engine M51

00 02 249 BMW engine oil service (changing engine oil and oil filter) 11- 00/51.1
11 00 039 Compression – check 11- 00/51.2
050 Engine – remove and install 11- 00/51.3
- Transmission – remove 11- 00/51.3
- Radiator and intercooler – remove 11- 00/51.3
- Remaining coolant from engine – drain 11- 00/51.3
- Exhaust manifold with intake pipe – remove 11- 00/51.3
- Vacuum lines – remove 11- 00/51.4
- Electrical connections – disconnect from engine 11- 00/51.4
- Fuel line – remove 11- 00/51.5
- Water hoses – remove 11- 00/51.5
- A/C compressor – remove 11- 00/51.6
- Hydraulic pump for power steering - remove 11- 00/51.6
- Engine – lift out 11- 00/51.7

For further jobs refer to “Assembly Repair Manual".

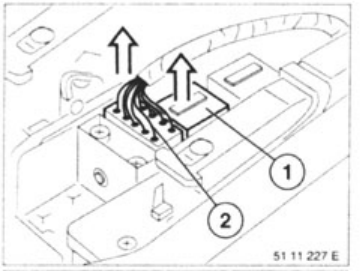
M51 engine

00 00 249 BMW Engine oil service (changing engine oil and oil filter)

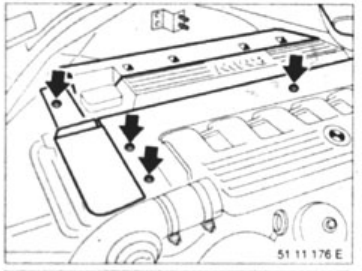
Refer to 00 00 249,
Repair Manual 3 Series E36

11 00 039 CHECKING COMPRESSION

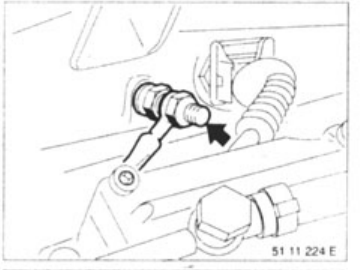
Testing Conditions:
Battery in perfect condition – check acid density if necessary.
Engine temperature = max. 35° C coolant temperature.



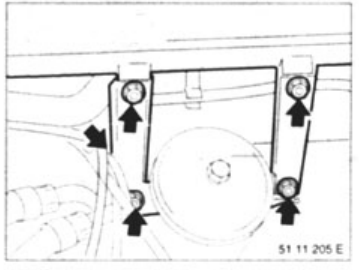
Pull off electric fuel pump relay (1) and plug on preheating time control unit (2).



Unscrew cover for intake manifold.

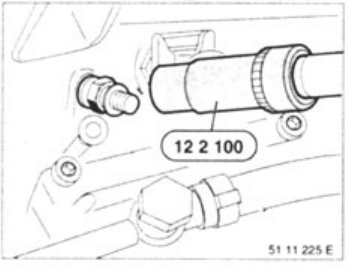


Unscrew electric connections on glow plugs.



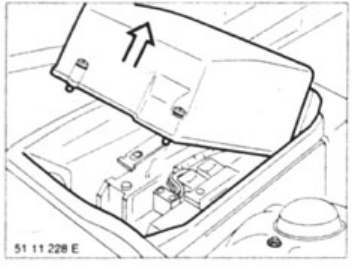
Unscrew support.
Unclip holder.

Caution!
Don't touch electric connections on the starter.

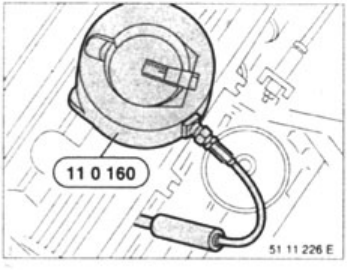


Unscrew glow plugs using Special Tool 12 2 100 (also refer to Group 12).

Installation:
Coat threads with copper paste CRC**.
Tightening torque*.



Unscrew cover on electronic box.



Diesel Test Probe:
Screw in Special Tool 11 0 222 full distance and tighten lightly by hand.
Compression Recorder:
Plug in Special Tool 11 0 221.
Operate starter so long until pressure stops rising.
Minimum compression*.
Approximately same value for all cylinders.

Use Special Tool 11 0 160.

* Refer to Specifications
** Source of Supply: BMW Parts

Engine M51

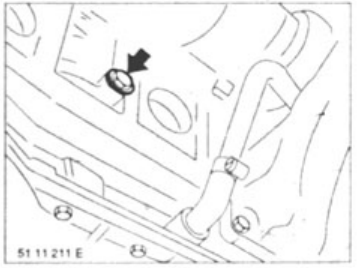
11 00 050 REMOVING AND INSTALLING ENGINE

o Removing Transmission:

Remove transmission - refer to Group 23 or 24.

o Removing Radiator and Charge Air Cooler:

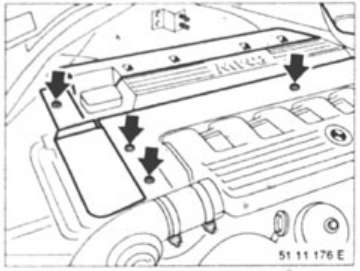
Remove radiator and charge air cooler - refer to Group 17.



o Draining Residual Coolant from Engine:

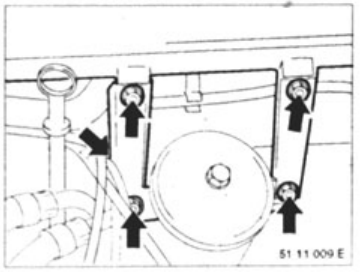
Unscrew and remove plug from engine block.
Drain coolant.

Installation:
Replace seal.

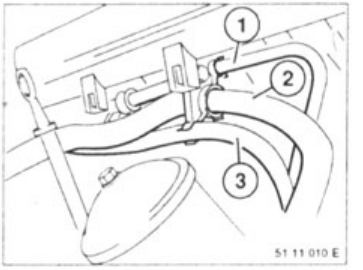


o Removing Intake Manifold with Intake Pipes:

Unscrew covers for intake manifold.

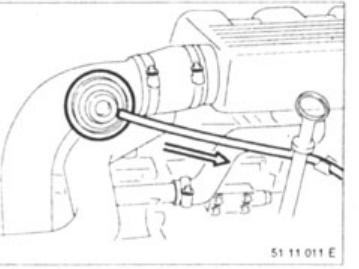


Unscrew supports.
Unclip holders.

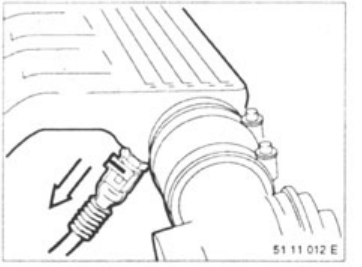


Unclip hoses from holders.

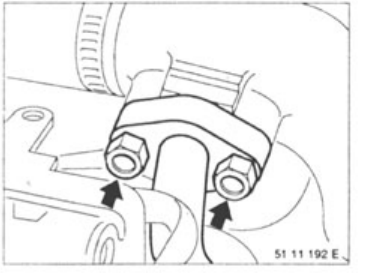
1 = Vacuum hose for brake booster
2 = Coolant hose to heater
3 = Fuel hose to injection pump



Pull vacuum hose off of EGR vacuum unit.



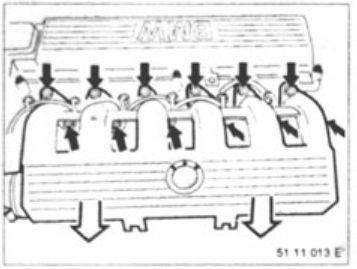
Pull temperature sensor plug off of intake manifold.



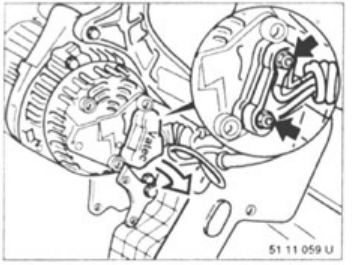
Unscrew EGR pipe.

Installation:
Tightening torque*.

* Refer to Specifications

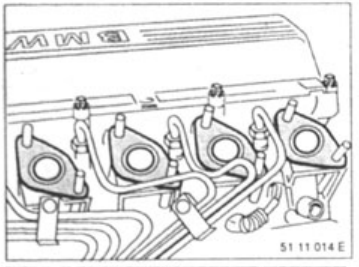


Unscrew intake manifold.

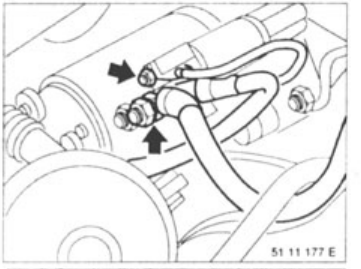


o Disconnecting Electric Leads from Engine:

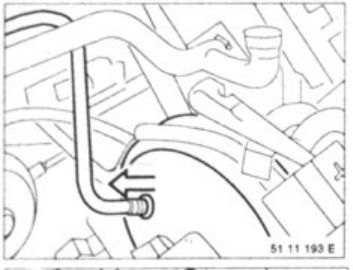
Lift cover for electric connections off of alternator.
Disconnect leads from alternator.



Installation:
Replace gaskets.

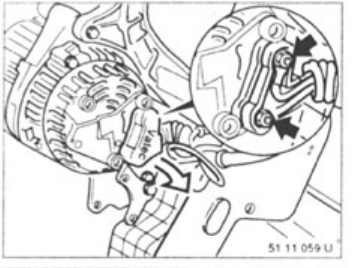


Unscrew leads from starter.

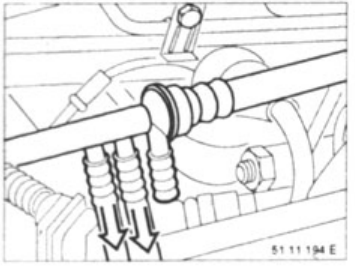


o Disconnecting Vacuum Pipes:

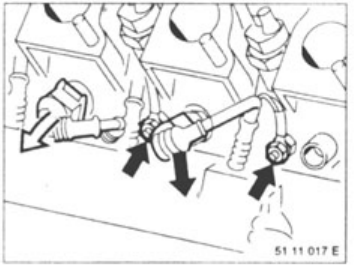
Unclip vacuum pipe on brake booster.



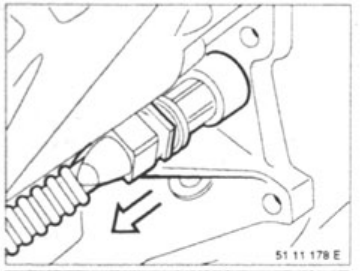
Lift lead cover off of alternator.
Unscrew connections.



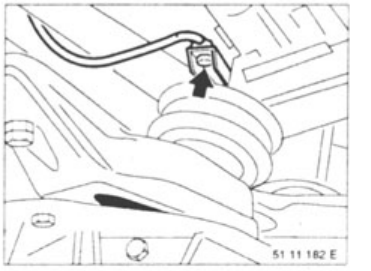
Pull EGR and radiator shutter control hoses off.



Unscrew connections for temperature sender and glow plugs.



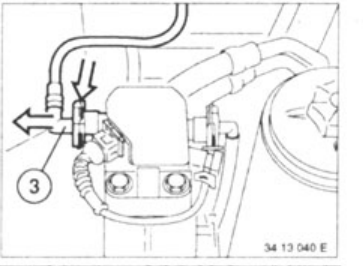
Disconnect speed sender plug.



Unscrew ground strap from right carrier member.



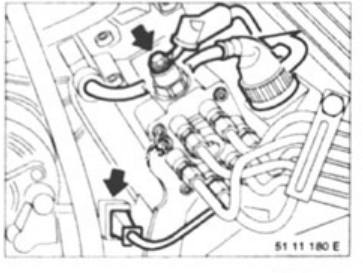
Pull plug off of oil pressure switch.



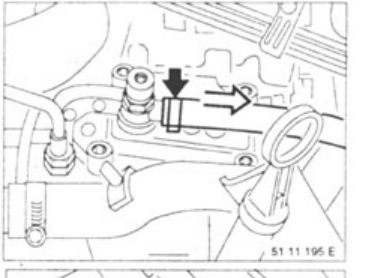
o **Disconnecting Fuel Pipe:**

Press retainer downwards and pull connector (3) out of filter housing.

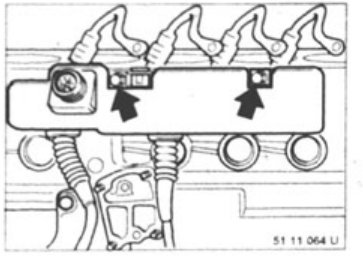
Installation:
Pay attention to seal.



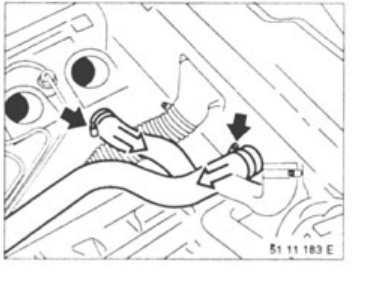
Disconnect injection pump central plug and connections for shut-off and solenoid.



Disconnect return pipe at injection pump.

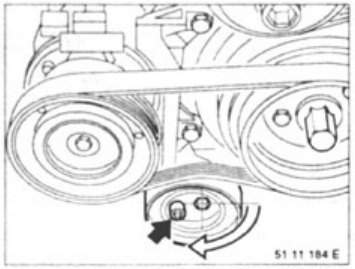


Unscrew electric lead channel from engine.



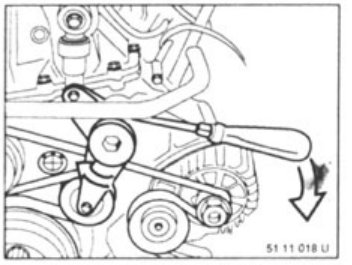
o **Disconnecting Water Hoses:**

Disconnect water hoses to heater, on engine and on heater separating wall.



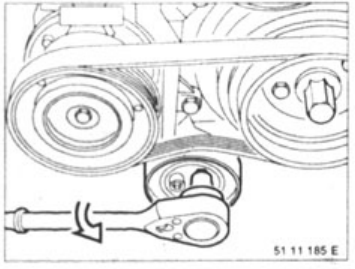
o Removing A/C Compressor:

Loosen bolt and slacken multi-tooth belt.



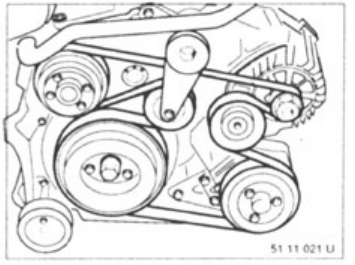
o Removing Power Steering Pump:

Remove ribbed drive belt:
Slacken the automatic belt tensioner with a suitable lever (e.g. thick screwdriver) and remove ribbed drive belt.

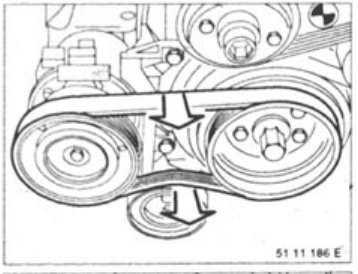


Installation:
Turn tensioning roller counterclockwise using a torque wrench applied in the hexagon socket.

Tensioning procedures - refer to Group 64.

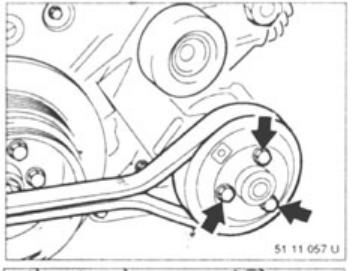


Important!
Pay attention to arrangement of belt.
Place multi-tooth belt in grooves correctly.

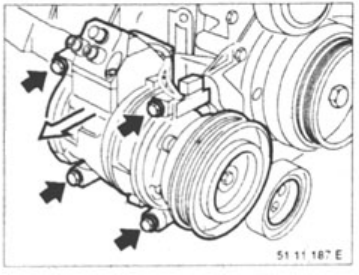


Remove multi-tooth belt.

Installation:
Make sure that multi-tooth belt is placed precisely in grooves.

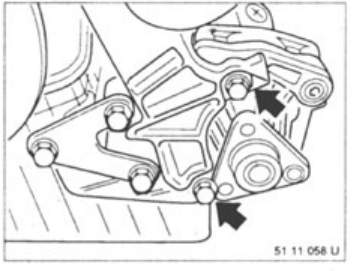


Hold pulley tight with help of ribbed drive belt.
Unscrew bolts.

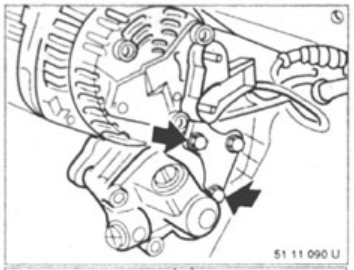


Unscrew A/C compressor from console and suspend from car on piece of wire.
Lines remain connected.

Installation:
Pay attention to dowel sleeve.

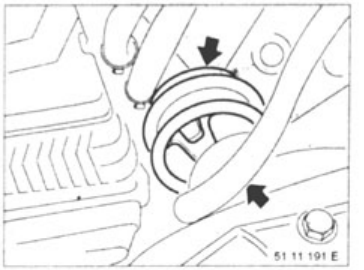


Unscrew bolts on face.



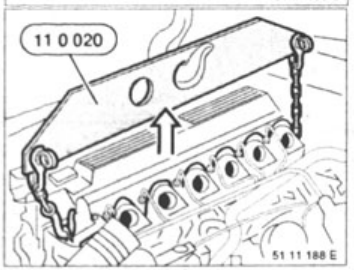
Unscrew bolts on back.

Remove power steering pump and suspend from car on piece of wire.
Lines remain connected.



Unscrew engine mount at left top and loosen nut at bottom.

Installation:
Tightening torque*.

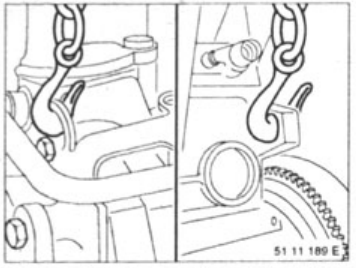


o Lifting Engine Out:

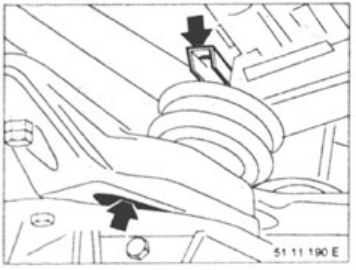
Attach Special Tool 11 0 020 on engine.

Lift engine out.

Important!
A removed engine with installed hydraulic valve clearance compensators must not be left standing on its end for longer than 10 minutes, as otherwise oil would run out of the compensators so that they will no longer function.



Arrangement of suspension at front and rear



Unscrew engine mount at right top and loosen nut at bottom.

Installation:
Tightening torque*.

* Refer to Specifications

* Refer to Specifications

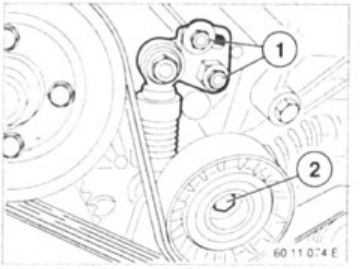
11 Engine M60

11 00 050	Engine – remove and install	11- 00/60.1
11 12 004	Cylinder head covers, both – remove and install/seal	11- 12/60.1
	Cylinder head cover, left – remove	11- 12/60.1
	Cylinder head cover, right – remove	11- 12/60.2
005	Cylinder head cover, left – remove and install/seal	11- 12/60.5
006	Cylinder head cover, right – remove and install/seal	11- 12/60.5
105	Cylinder head, left – remove and install	11- 12/60.5
106	Cylinder head, right – remove and install	11- 12/60.5
107	Cylinder heads, both – remove and install	11- 12/60.5
110	Cylinder head gasket, left – replace	11- 12/60.5
111	Cylinder head gasket, right – replace	11- 12/60.5
112	Cylinder head gaskets, both – replace	11- 12/60.5
11 13 010	Oil pan upper section – remove and install or replace	11- 13/60.1
020	Oil pan lower section – remove and install or replace	11- 13/60.4
11 14 080	Upper timing case cover, left – remove and install, seal or replace	11- 14/60.1
085	Upper timing case cover, right – remove and install, seal or replace	11- 14/60.3
141	Radial oil seal in lower timing case cover – replace	11- 14/60.5
151	Crankshaft radial oil seal (transmission end) – replace	11- 14/60.6
11 22 500	Flywheel – remove and install or replace	11- 22/60.1
11 23 010	Vibration damper – remove and install or replace	11- 23/60.1
031	Hub for vibration damper – remove and install or replace	11- 23/60.2
11 28 010	Alternator drive belt – replace	11- 28/60.1
11 31 010	Camshaft timing – adjust	11- 31/60.1
011	Camshaft, left – replace	11- 31/60.1
015	Camshaft, right – replace	11- 31/60.1
11 41 000	Oil pump – remove and install or replace	11- 41/60.1
11 42 020	Full flow oil filter, complete – remove and install, seal or replace	11- 42/60.1
11 51 000	Water pump – remove and install or replace	11- 51/60.1
011	Pulley on water pump – replace	11- 51/60.2
11 53 000	Coolant thermostat – remove and install or replace	11- 53/60.1
325	Coolant manifold – remove and install or replace	11- 53/60.2
11 61 050	Intake air manifold – remove and install	11- 61/60.1
11 62 142	Exhaust manifolds, left, both – remove and install or replace	11- 62/60.1
143	Exhaust manifolds, right, both – remove and install or replace	11- 62/60.3

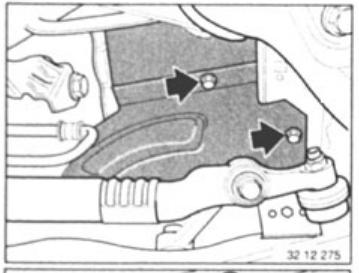
For further jobs refer to “Repair Manual 7 Series E38”.

11 00 050 REMOVING AND INSTALLING ENGINE

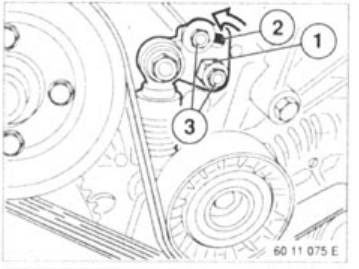
Interrogate fault memories.
Disconnect battery ground lead.
Remove manual transmission (refer to Gr. 23) or automatic transmission (refer to Gr. 24).
Remove radiator - refer to 17 11 000.



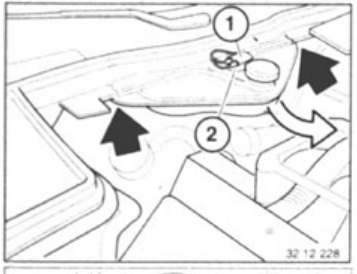
Unscrew tensioner for poly-V-belt.
Unscrew bolts (1 and 2).
Remove alternator - refer to 12 31 020.
Unscrew power steering pump - refer to Group 32.
Pipes remain connected.



Unscrew left and right heat sheilds on front axle carrier.



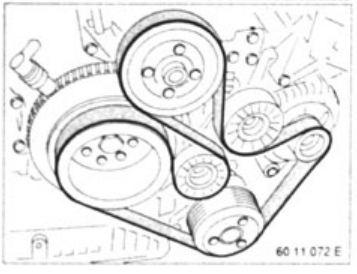
Installation:
Preload holder for tensioner on hexagon (1) up to end of slot (2).
Tighten nut (3).



Remove complete coolant expansion tank.



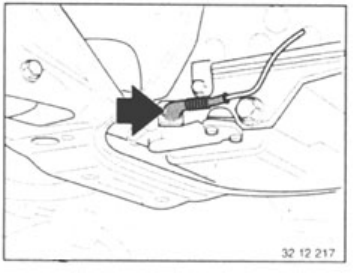
Remove left and right engine mounts.
Remove ground strap from engine support arm.



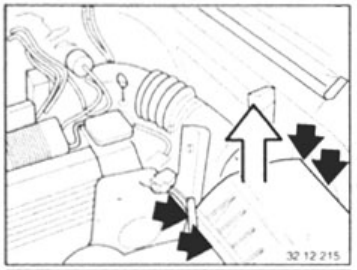
Remove poly-V-belt.

Installation:
Check poly-V-belt for signs of coolant and oil, replacing it if necessary.

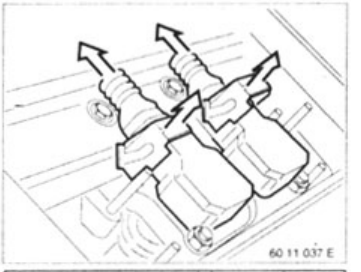
Important!
Always replace a poly-V-belt dirtied with hydraulic oil.



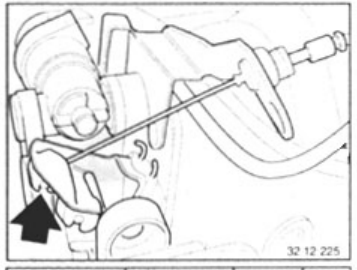
Disconnect plug on oil level switch and remove wiring guide.



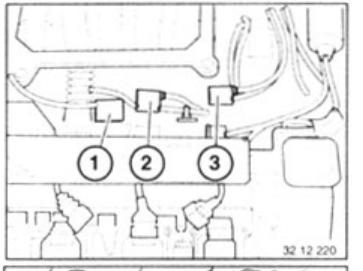
Remove upper section of air cleaner together with air mass meter.



Remove right and left cylinder head cover.
Disconnect plug-and-socket connections on right and left ignition coils.

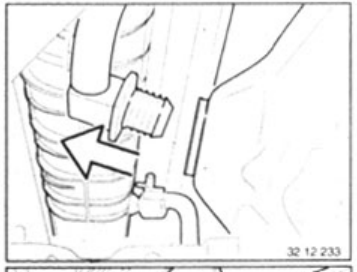


Remove complete throttle operating (Bowden) cable assy. at throttle body.

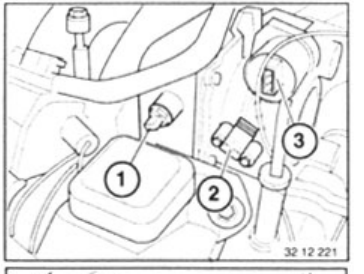


Disconnect cables from starter and alternator at battery (+) terminal point. .
Disconnect all plug-and-socket connections at cable duct on right.
3 = TDC sensor
1 and 2 = Knock sensors

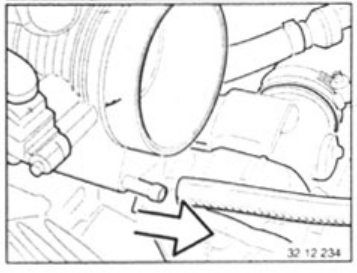
Caution!
Interchanging plug-and-socket connections 1 and 2 causes engine damage!
Observe notes on knock sensors, refer to 12 14 610



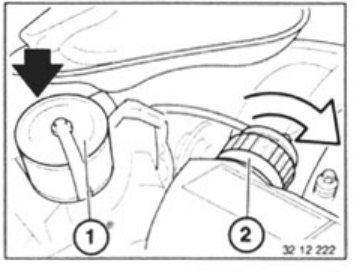
Remove vacuum line at brake booster.



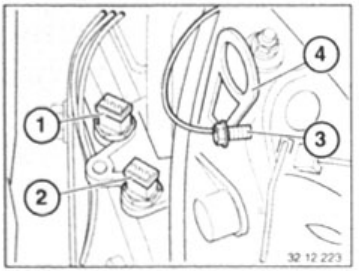
Disconnect all cables at right cable duct.
1 = Intake air temperature
2 = Throttle potentiometer
3 = idle actuator



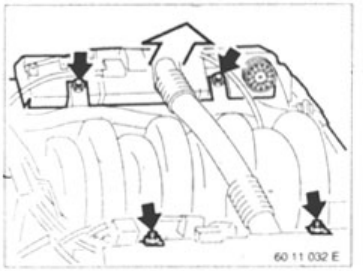
Disconnect tank ventilation hose at throttle body.



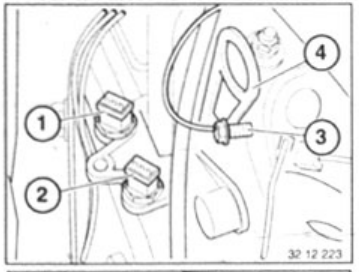
Disconnect all cables at rear right cable duct.
1 = Unclip diagnosis socket from holder.
2 = Engine plug connector.



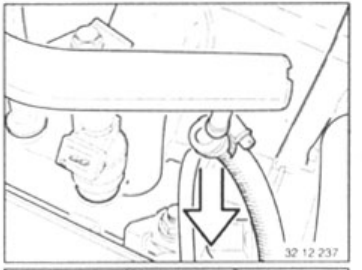
Unscrew common ground lead of ignition coils in area of rear engine mount (4).



Disconnect all cables at front left cable duct. Remove left and right cable duct from retaining fixture and fold back.

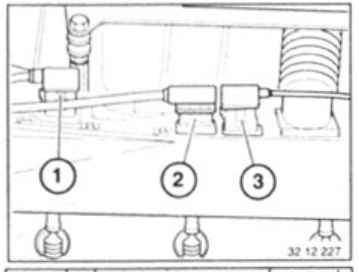


Disconnect plug-and-socket connections of temperature sensors.
1 = Coolant temperature sensor for remote thermometer (black)
2 = Coolant temperature sensor for digital engine electronics control unit (white)



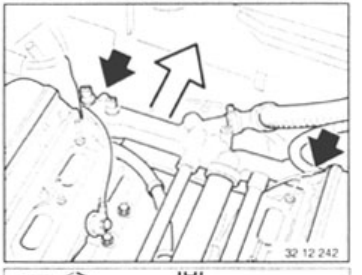
Caution!
Collect any fuel flowing out and dispose of suitably.
Disconnect fuel supply and return lines at injection tube.

Installation note:
Replace plastic hose.

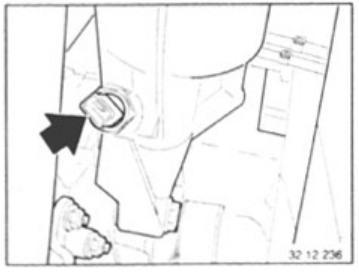


Disconnect all plug-and socket connections at left cable duct.
1 = Camshaft sensor
2 and 3 = Knock sensors

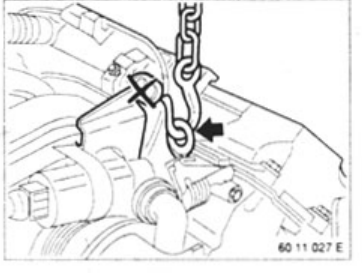
Caution!
Interchanging plug-and-socket connections 2 and 3 causes engine damage!
Observe notes on knock sensors, refer to 12 14 611



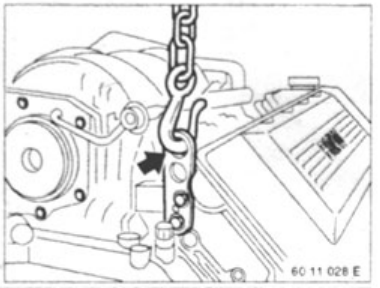
Disconnect all coolant hoses at coolant accumulator.



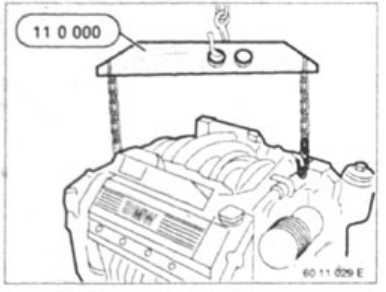
Disconnect plug-and-socket connection at oil pressure switch.
Remove wire from holder.



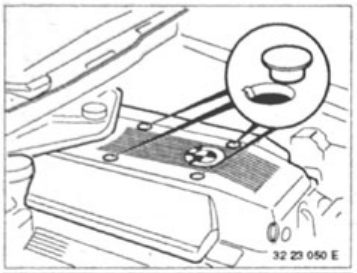
Caution!
Lift engine only at the lifting lugs provided for this purpose.
Location of front engine lifting point.



Arrangement of Rear Engine Suspension



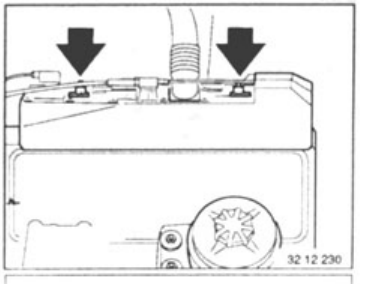
Lift out engine using Special Tool 11 0 000.
Clean engine.



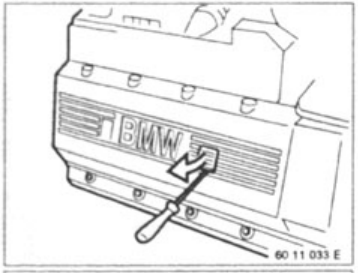
11 12 004 REMOVING AND INSTALLING / SEALING BOTH CYLINDER HEAD COVERS

Left Cylinder Head Cover:

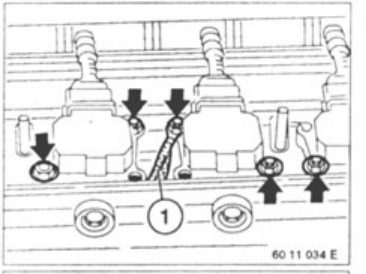
Remove caps from collector, remove clips and unscrew screws.



Unscrew nuts of wiring duct holders.

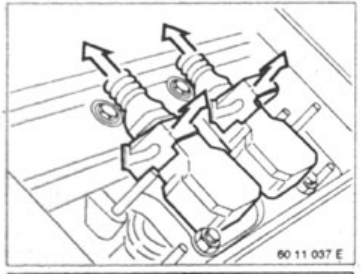


Remove cap from cylinder head cover, remove clips and unscrew screws.

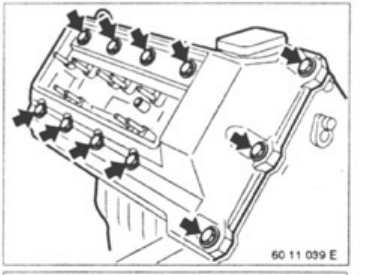


Unscrew all ignition coil nuts.

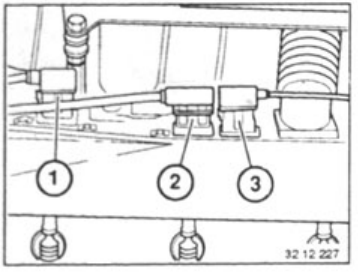
Installation:
Secure ground strap (1) to ignition coils of cylinders 3 and 7.



Disconnect plugs on ignition coils.

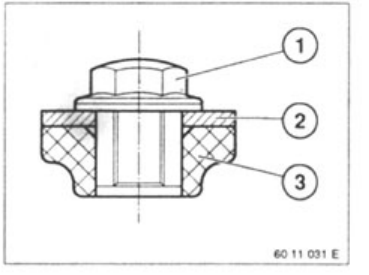


Unscrew cylinder head cover screws.

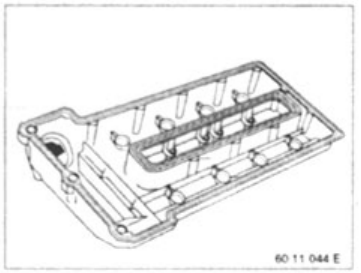


Disconnect all plugs on left-hand wiring duct.
1 = Camshaft sender
2 and 3 = Knock sensors (refer to Gr. 12)

Important!
Mixing up plugs 2 and 3 would lead to engine damage!
Also refer to information in Group 12!

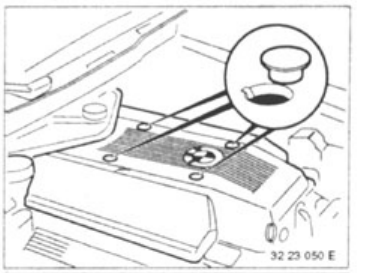


Installation:
Arrangement of cylinder head cover installation:
1 = Nut
2 = Washer
3 = Rubber mount



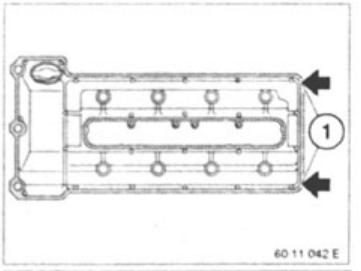
Installation:
Check gasket, replacing it if necessary.

Coat outer and inner grooves as well as sealing surfaces of cylinder head cover and cylinder head all around with rubber lubricant, e.g. glycerine or similar.
Press inner gasket into cylinder head cover groove free of distortion, beginning at the four corners.

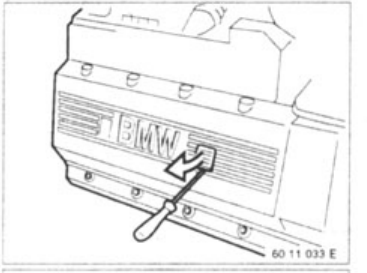


Right Cylinder Head Cover:

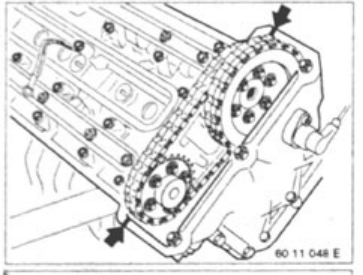
Remove caps from collector, remove clips and unscrew screws.



Installation:
Align the outer gasket loosely on the cover groove.
Locate gasket in the cover groove beginning at the rear corner radii (1) and press into groove free of tension.



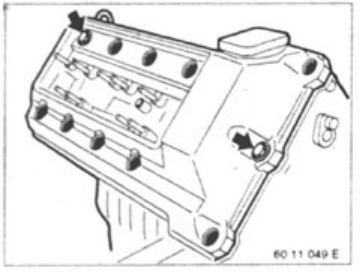
Remove cap from cylinder head cover, remove clips and unscrew screws.



Installation:
Coat joint surfaces with liquid sealant Hylomar SQ 32 Special**.

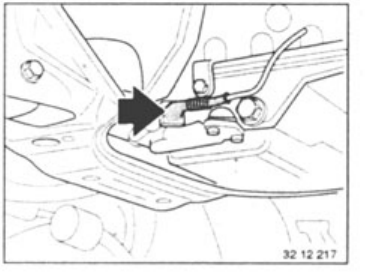


Disconnect plugs on ignition coils.

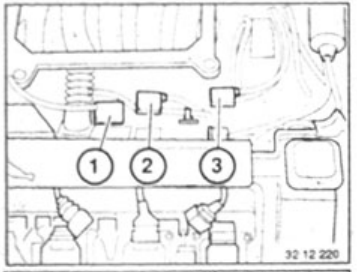


Installation:
Check for correct seating of gasket.
Install two nuts at opposite points without preloading them.
Align the cover.
Tighten nuts diagonally from inside to outside.

** Source of Supply: BMW Parts



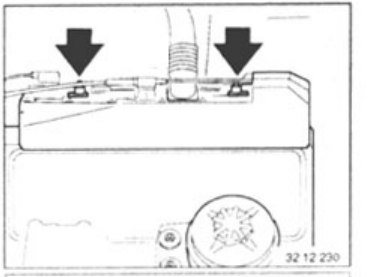
Disconnect plug on oil level switch.
Remove wiring guide.



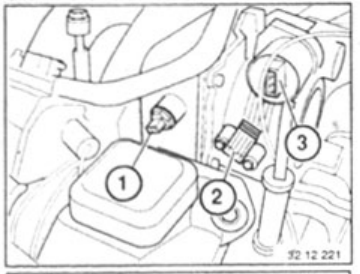
Disconnect all plugs on right-hand wiring duct.
1 and 2 = Knock sensors (refer to Gr. 12)

Important!
Mixing up plugs 1 and 2 could lead to engine damage!
Also refer to information in Group 12!

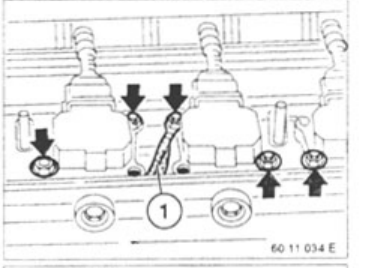
3 TDC sender (pulse sender on vibration damper)



Unscrew nuts of wiring duct holders.

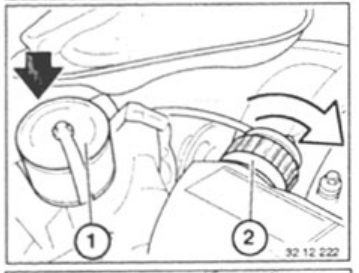


Disconnect plugs.
1 Intake air temperature sensor
2 Throttle valve potentiometer
3 Idle speed control

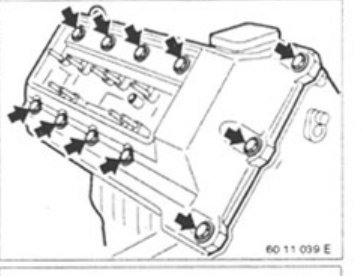


Unscrew nuts on all ignition coils.

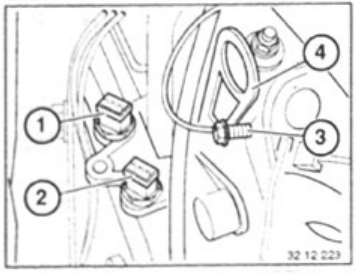
Installation:
Secure ground strap (1) to ignition coils for cylinders 3 and 7.



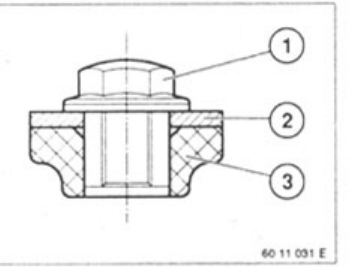
Disconnect plugs.
1 Diagnosis plug (unclip from holder)
2 Engine plug



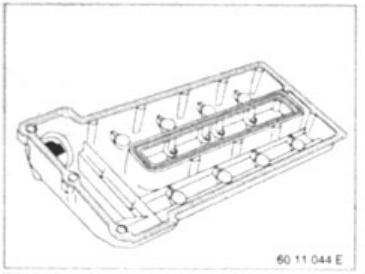
Unscrew cylinder head cover screws.



Close to Rear Engine Suspension Eye:
1 Temperature sensor for temperature gage (black)
2 Temperature sensor for Digital Motor Electronics (white)
3 Ground lead of ignition coils

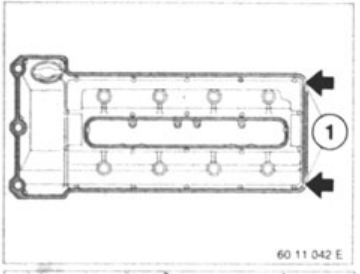


Installation:
Arrangement of cylinder head cover installation:
1 = Nut
2 = Washer
3 = Rubber mount

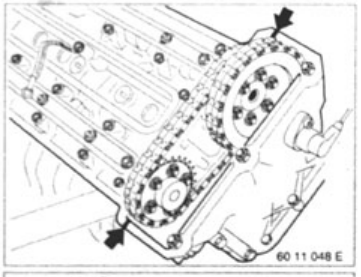


Installation note:
Check gasket and replace if necessary.

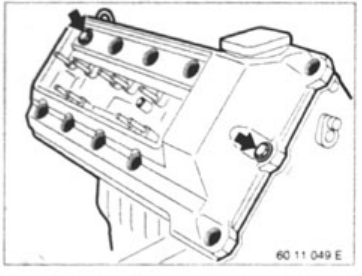
Coat outer and inner groove as well as sealing surface of cylinder head cover all round with rubber lubricant, e.g. glycerine or similar. Starting from the four corner points, evenly (i.e. without tension) press inner gasket into groove in cylinder head cover.



Installation note:
Align outer gasket on groove in cylinder head cover. Starting at the rear corner radii (1) fix gasket in groove in cylinder head cover and evenly press in free of tension.



Installation note:
Coat joint areas of parting line with liquid sealing compound Hylomar SQ 32 Special**.



Installation note:
Check gasket is fitted correctly. tighten two nuts at opposite points without pretension. Align cover. Firmly tighten nuts crosswise working from inside to outside.

** Source of supply: BMW Parts Service

11 12 005 Removing and installing / sealing left cylinder head cover

This job is described under job instructions 11 12 004.

11 12 006 Removing and installing/ sealing right cylinder head cover

This job is described under job instructions 11 12 004.

11 12 105 Removing and installing left cylinder head

Refer to 11 12 105
Repair Manual 7 Series E38

11 12 106 Removing and installing right cylinder head

Refer to 11 12 106
Repair Manual 7 Series E38

11 12 107 Removing and installing both cylinder heads

Remove engine, refer to 11 00 050
Further procedure, refer to 11 12 105/106
Repair Manual 7 Series E38

11 12 110 Replacing left cylinder head gasket

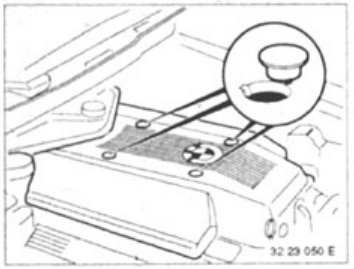
Refer to 11 12 105
Repair Manual 7 Series E38

11 12 111 Replacing right cylinder head gasket

Refer to 11 12 106
Repair Manual 7 Series E38

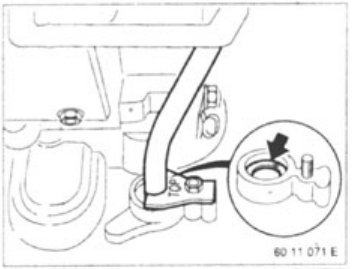
11 12 112 Replacing both cylinder head gaskets

Remove engine, refer to 11 00 050
Further procedure, refer to 11 12 105/106
Repair Manual 7 Series E38

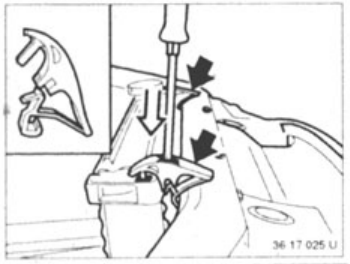


11 13 010 REMOVING AND INSTALLING OR REPLACING UPPER SECTION OF OIL PAN

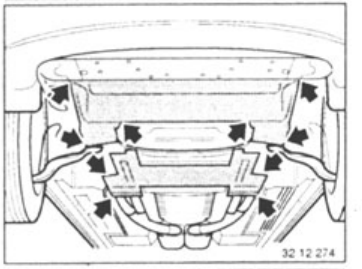
Remove caps from collector.



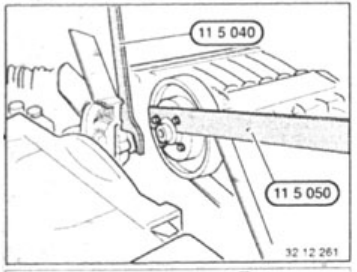
Installation:
Replace O-ring.



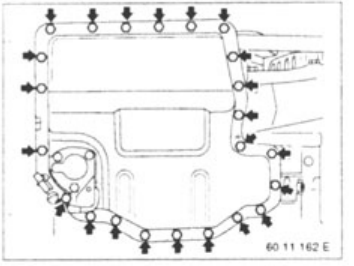
Remove clips on radiator from above.



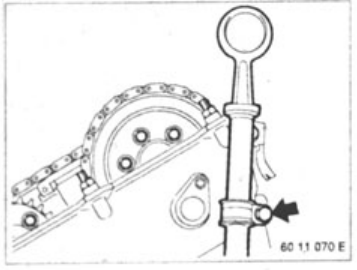
Remove rear engine splash guard (not 730iA).



Unscrew fan using Special Tools 11 5 040 and 11 5 050.

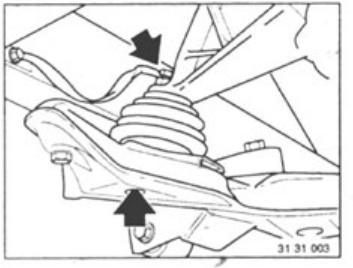


Remove complete lower section of oil pan - refer to 11 13 020.



Unscrew screw for oil dipstick guide tube.

Installation:
Tightening torque*.



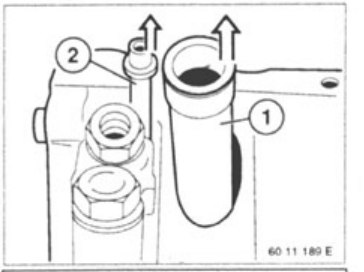
Unscrew bolts of left and right engine mounts at bottom.

Installation:
Secure ground strap on engine mount.
Tightening torque*.

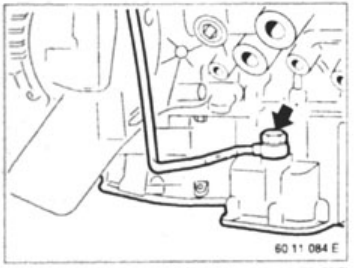
* Refer to Specifications

* Refer to Specifications

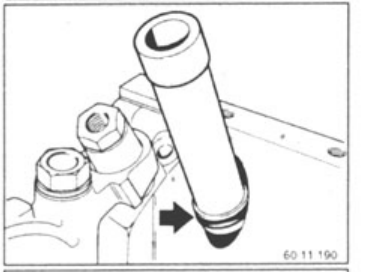
Unscrew power steering pump at holder.
Unscrew oil pipes for automatic transmission at power steering pump.



Pull
1 fresh oil pipe and
2 pure oil pipe
out of crankcase.

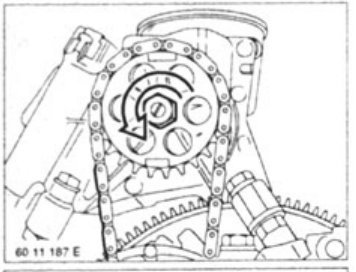


Unscrew oil return pipe from oil filter at oil pan.



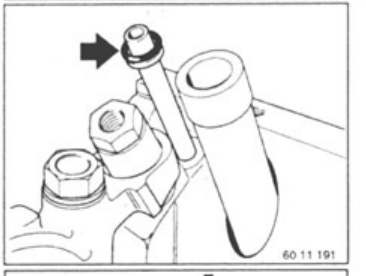
Installation:
Check seal, replacing it if necessary.
Lubricate seal lightly with oil.

Important!
Don't damage seal on edge of the case.

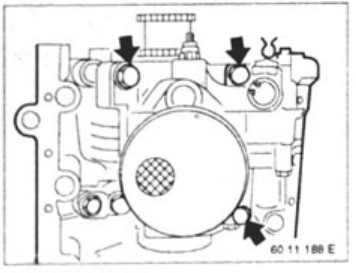


Unscrew sprocket bolt.
Remove sprocket together with chain.

Installation:
Tightening torque*.

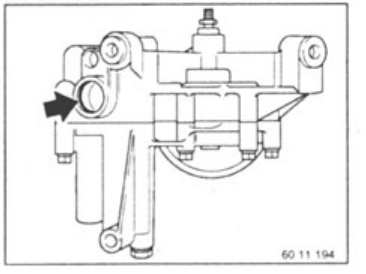


Installation:
Install pure oil pipe in crankcase.
Check seal, replacing it if necessary.



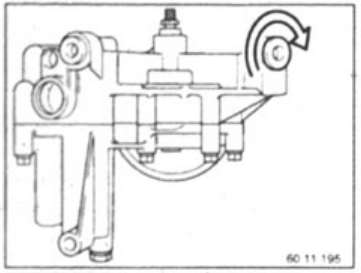
Unscrew oil pump bolts.
Remove oil pump.

Installation:
Tightening torque*.

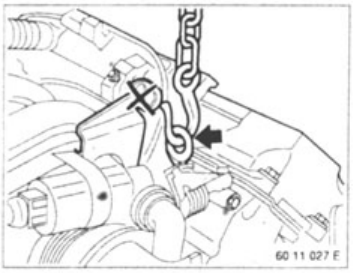


Installation:
Check seal in oil pump, replacing it if necessary.

* Refer to Specifications

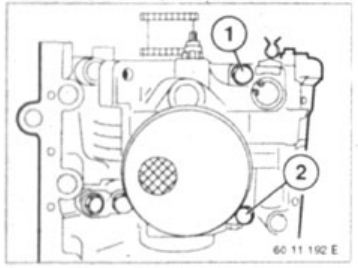


Installation:
Screw hexagon adapter back into oil pump as far as stop.



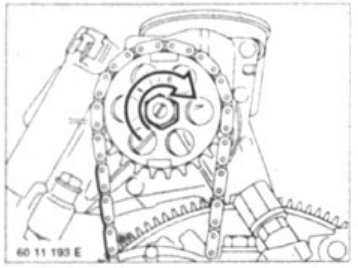
Attach Special Tool 00 0 200 in front engine suspension eye and lift engine.

Caution!
Observe distance between engine and firewall while lifting the engine.

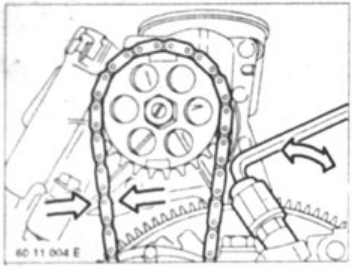


Installation:
Mount oil pump and tighten bolts (1 and 2).

Installation:
Clean uper section of oil pan and sealing surfaces.
Replace gasket.

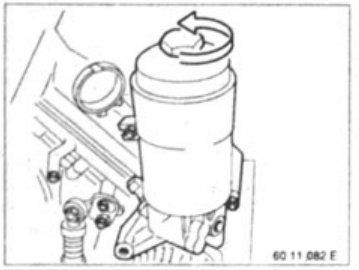


Installation:
Mount sprocket together with chain and tighten central nut.



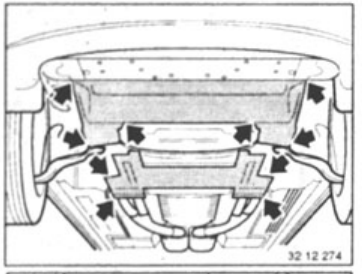
Installation:
Adjust chain sag (10 æ 2 mm) by turning hexagon adapter in oil pump.
Install and tighten bolt.
Tightening torque*.

* Refer to Specifications

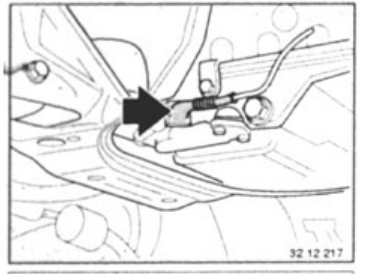


11 13 020 REMOVING AND INSTALLING OR REPLACING LOWER SECTION OF OIL PAN

Unscrew cover for oil filter to have the engine oil run back into the oil pan.
Drain engine oil.

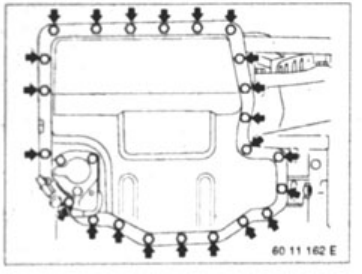


Unscrew front engine splash guard.



Disconnect oil level switch plug.
Unscrew screws.

Installation:
Replace O-ring.
Tightening torque*.



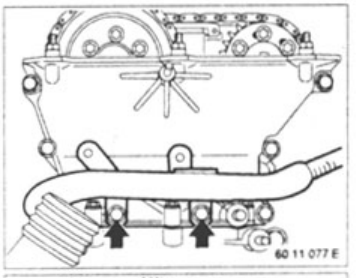
Unscrew bolts for lower section of oil pan.

Installation:
Clean sealing surfaces.
Replace gasket.
Tightening torque*.

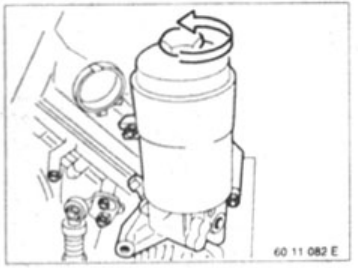
* Refer to Specifications

11 14 080 REMOVING AND INSTALLING OR REPLACING LEFT UPPER TIMING CASE COVER

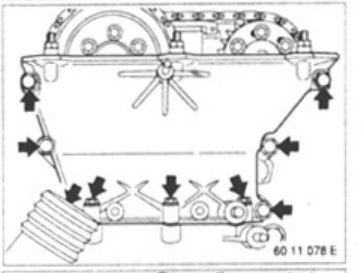
Remove left cylinder head cover - refer to 11 12 005.
Remove alternator - refer to 12 31 020.



Unscrew battery positive wire on alternator.
Unscrew protective tube mounting screws.
Place wire aside.

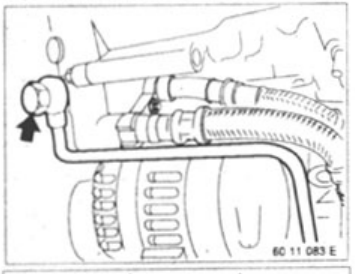


Unscrew cover of oil filter.



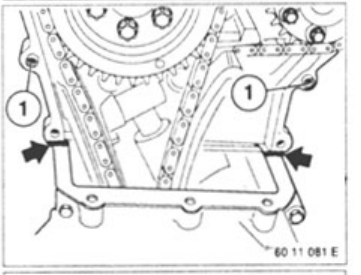
Unscrew timing case cover bolts.

Installation:
Tightening torque*.

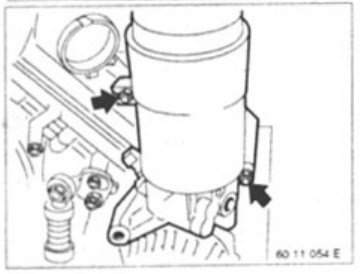


Unscrew return pipe at oil filter housing.

Installation:
Tightening torque*.

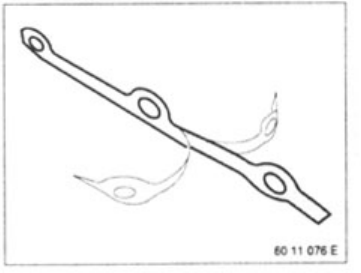


Installation:
Check for correct seating of dowel sleeves (1).
Coat corners of joint surfaces between cylinder head and cylinder head gasket with liquid sealant Hylomar SQ 32 Special**.



Unscrew full flow oil filter housing nuts.

Installation:
Tightening torque*.

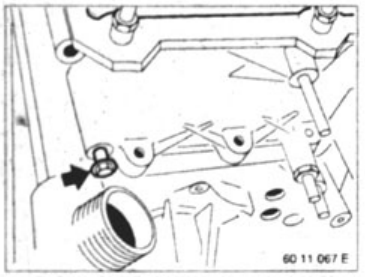


Installation:
Clean sealing surfaces to remove oil.
Replace gasket.

Important!
Pull off protective sheet.

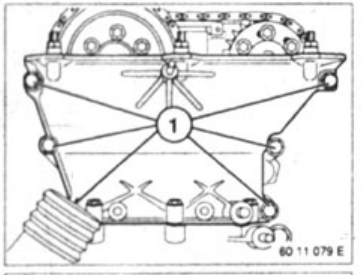
* Refer to Specifications

* Refer to Specifications
** Source of Supply: BMW Parts

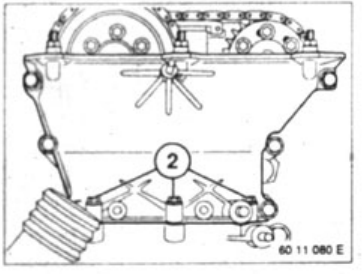


Installation:
Check for correct seating of gaskets.
Mount timing case cover together with inserted bolt.

Important!
Bolt cannot be guided in subsequently.



Installation:
Install all bolts.
Screw in bolts (1) until cover contacts cylinder head free of play, but do not yet tighten bolts.

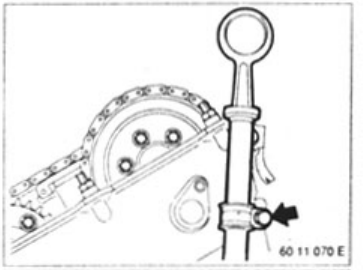


Installation:
Tighten timing case cover bolts (2) in two steps and then tighten bolts (1) in two steps.
Tightening torque*.

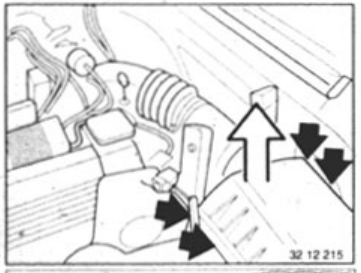
* Refer to Specifications

11 14 085 REMOVING AND INSTALLING OR REPLACING RIGHT UPPER TIMING CASE COVER

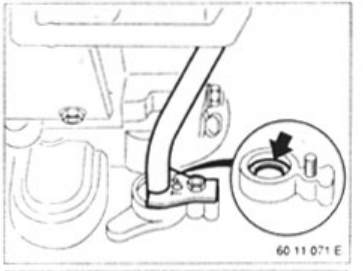
Remove right cylinder head cover - refer to 11 12 006.



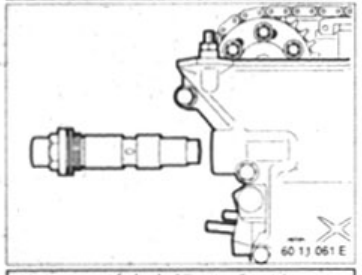
Unscrew screw for oil dipstick guide tube.



Remove air cleaner upper section together with mass air flow sensor.

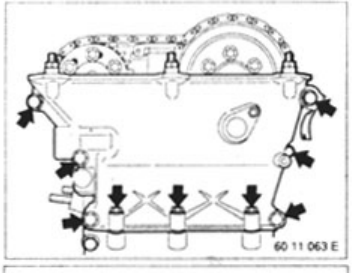


Unscrew nut.
Replace O-ring.

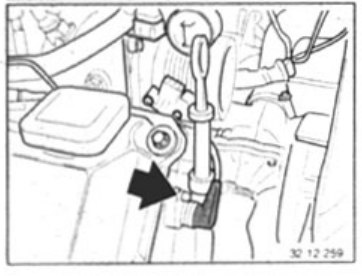


Remove chain tensioner.

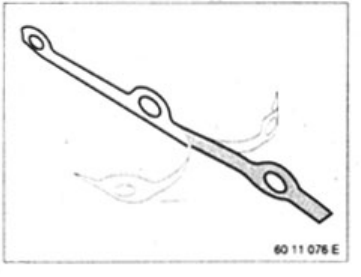
Installation:
Replace gasket.
Tightening torque*.



Unscrew timing case cover bolts.

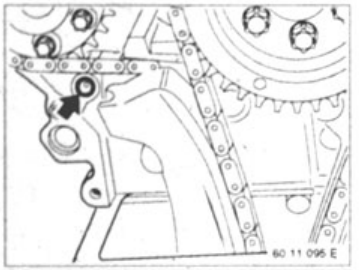


Unscrew camshaft sender screw.

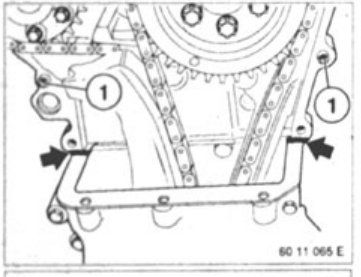


Installation:
Clean sealing surfaces.
Remove protective sheet on gaskets!

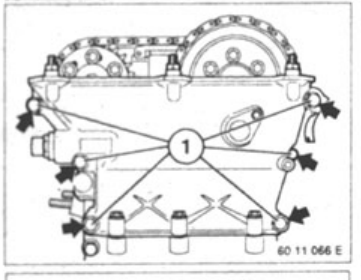
* Refer to Specifications



Important!
Replace seal of oil supply for hydraulic tensioning element in timing case cover.
Only use original BMW parts for replacements.

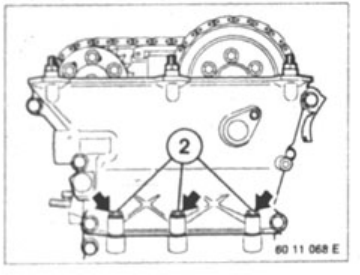


Installation:
Check for correct seating of dowel sleeves (1).
Coat corners of joint surfaces between cylinder head and cylinder head gasket with liquid sealant Hylomar SQ 32 Special**.



Installation:
Check for correct seating of gaskets.
Press tensioning rail inwards firmly.
Mount timing case cover.
Install all bolts.

Screw in bolts (1) until cover contacts cylinder head free of play, but do not yet tighten bolts.

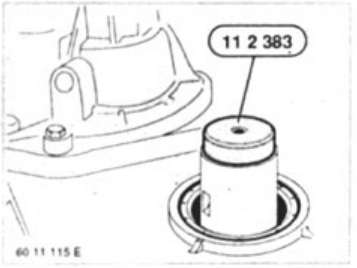


Installation:
Tighten timing case cover bolts (2) in two steps and then tighten bolts (1) in two steps.
Tightening torque*.

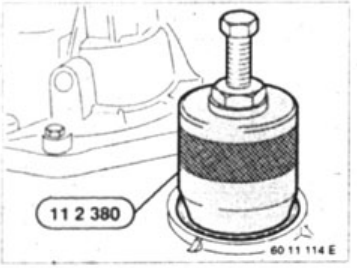
* Refer to Specifications
** Source of Supply: BMW Parts

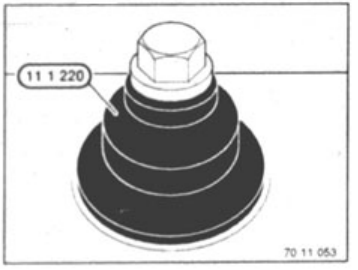
11 14 141 REPLACING RADIAL OIL SEAL IN LOWER TIMING CASE COVER

Remove hub for vibration damper - refer to 11 23 031.



Press out radial oil seal using Special Tool 11 2 380 (contains Special Tool 11 2 383).





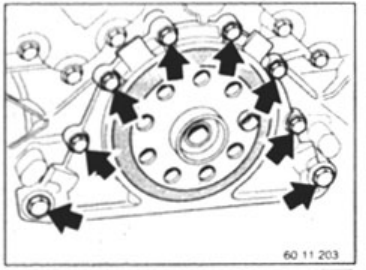
Installation:
Install radial oil seal in timing case cover flush using Special Tool 11 1 220 and central bolt.

11 14 151 Replacing Radial seal on Crankshaft (transmission end)

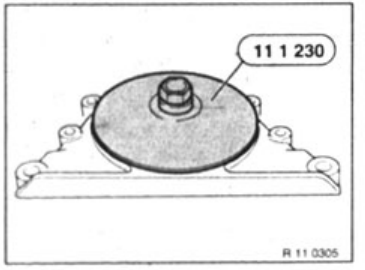
Removing flywheel,
see 11 22 000.



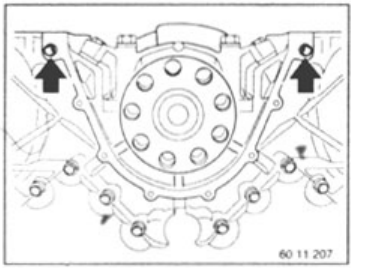
Removing part of the oil pan screws.



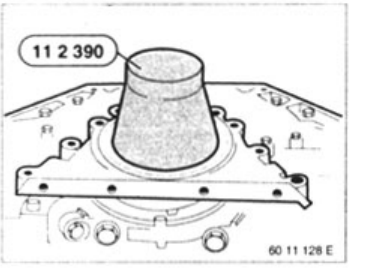
Rear end cover; unfasten screws.



Installation instruction:
Drive radial seal into end cover using special tools 00 5 500 and 11 1 230.



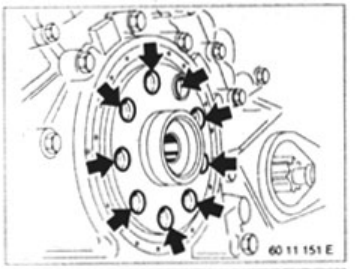
Installation instruction:
Clean sealing face and replace gasket.
Check that bushes are correctly located.



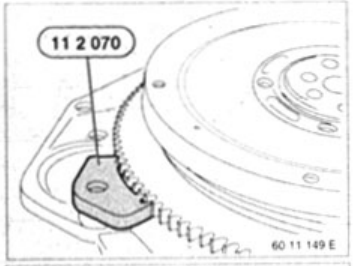
Installation instruction:
Fit special tool 11 2 390 on crankshaft.
Coat sealing lip of radial seal with oil.
Slide on cover and tighten down.

11 22 500 Removing and installing or replacing flywheel

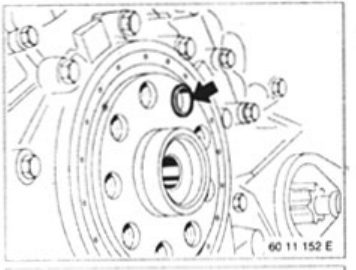
(Remove clutch)



Installation note:
Clean thread for flywheel bolts in crankshaft.

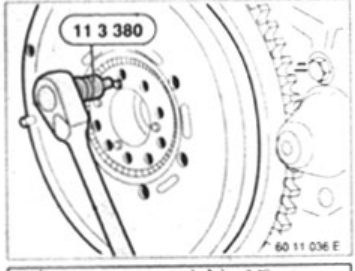


Block flywheel with special tool 11 2 070.



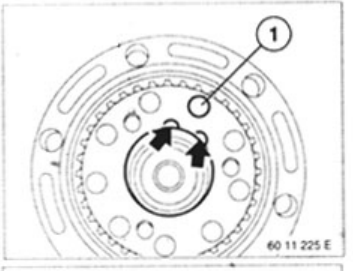
Installation note:
The flywheel (ZMS) has a special (shorter) fitted sleeve.

Caution:
Replace only by original BMW spare part.

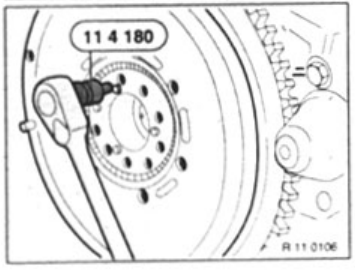


M60/3.0 litre up to 11.93

Caution!
Release and tighten flywheel (dual mass flywheel) only with special tool 11 3 380.
For tightening torque,
refer to Technical Data 11 22 1AZ



Installation note:
The position of the fitted sleeve (1) in the dual mass flywheel is marked by two notches next to the bolt hole.



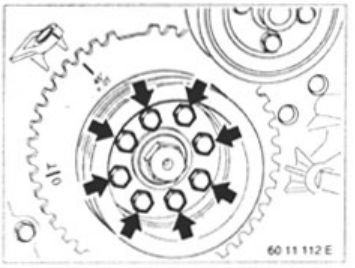
All M60/4.0 litre and M60/3 litre after 11.93

Caution!
Release and tighten flywheel (dual mass flywheel) only with special tool 11 4 180.
For tightening torque, refer to Technical Data 11 22 1AZ

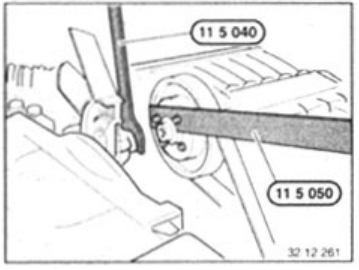


Caution!
Flywheel bolts are a component part of the flywheel.
Do not fit flywheel bolts with bolt sealing compound.
Lightly oil thread of bolts.
Only tighten to specified tightening torque.
Overtightened flywheel bolts can cause the special tool to break during subsequent disassembly.

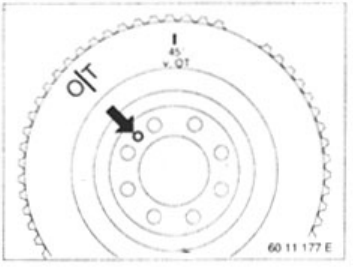
11 23 010 Removing and installing or replacing vibration damper



Release vibration damper bolts.



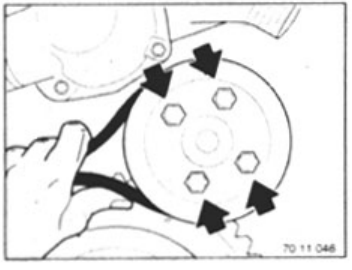
Caution!
Left-hand thread.
Remove fan, use special tools 11 5 040 and 11 5 050 for this purpose.



Installation note:
Align fitted hole in vibration damper with fitted locating pin.
Fit vibration damper bolts.

For tightening torque,
refer to Technical Data 11 23 3AZ

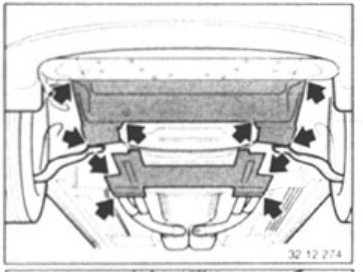
Remove drive belt for alternator,
refer to 11 28 010



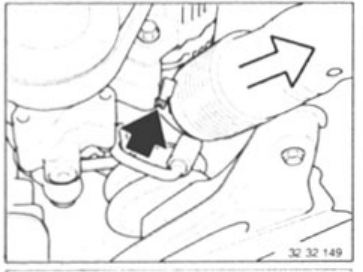
Release pulley on water pump.
Hold water pump pulley with drive belt and release screws.

11 23 031 Removing and installing or replacing hub for vibration damper

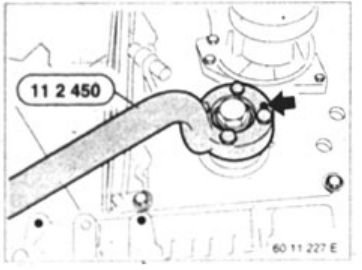
Remove vibration damper, refer to 11 23 010



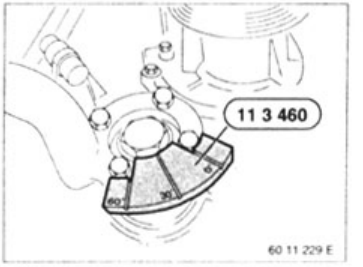
Remove protective plate at front.



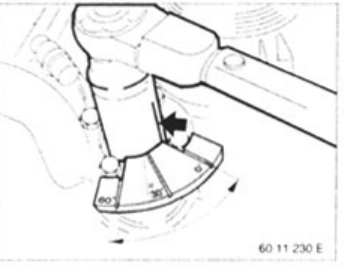
Remove cooling air duct for alternator at engine mount.



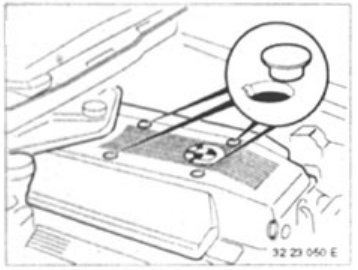
Observe fitted locating pin!
Secure special tool 11 2 450 to hub for vibration damper.
Release central bolt.



Installation note:
Fit special tool 11 3 460 on special tool 11 2 450. Special tool 11 3 460 is magnetic.

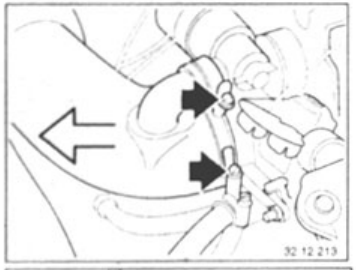


Select 0° position and mark on socket.
Firmly tighten central bolt with joint torque and torquing angle.
For tightening torque,
refer to Technical Data 11 23 2AZ

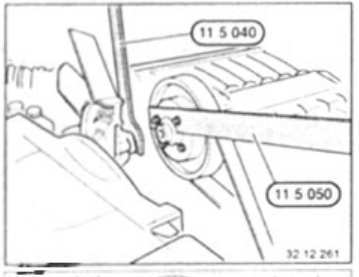


11 28 010 REPLACING DRIVE BELT FOR ALTERNATOR

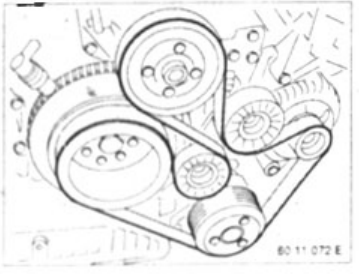
Remove caps from collector and clips.
Unscrew screws.



Disconnect intake hose between throttle valve assembly and mass air flow sensor.



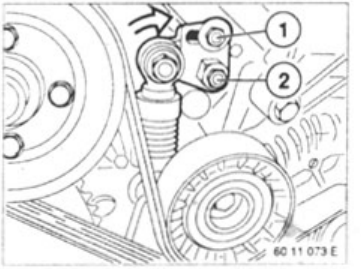
Unscrew fan using Special Tools 11 5 040 and 11 5 050.



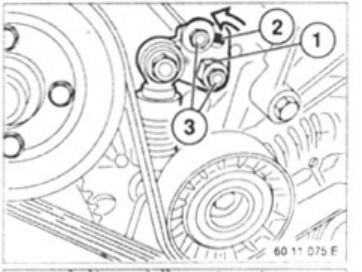
Remove ribbed drive belt.
Note arrangement of ribbed belt drive.

Installation:
Check ribbed drive belt for traces of coolant and oil, replacing it if necessary.

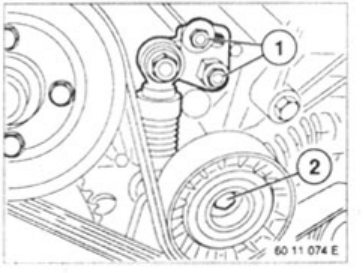
Important!
Always replace ribbed drive belt if it is dirtied with hydraulic oil.



Loosen nuts (1 and 2) to slacken the drive belt.



Installation:
Install ribbed drive belt and check for correct fit on the pulleys.
Preload the adjusting plate up to the end of slot (2) by turning hexagon (1).
Tighten nuts (3).



Unscrew nuts (1) and bolt (2).
Remove complete belt tensioner.

11 31 010 Adjusting camshaft timing

Refer to 11 31 010
Repair Manual 7 Series E38

11 31 011 Replacing left camshaft

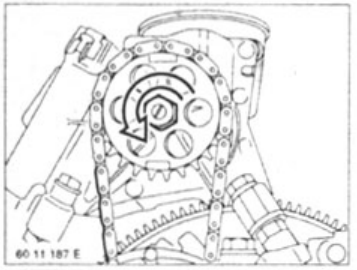
(intake or exhaust end as required)
(cylinder row 5-8)

Refer to 11 31 011
Repair Manual 7 Series E38

11 31 015 Replacing right camshaft

(intake or exhaust end as required)
(cylinder row 1-4)

Refer to 11 31 015
Repair Manual 7 Series E38

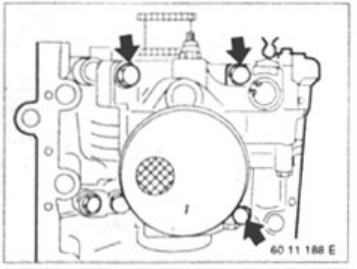


11 41 000 REMOVING AND INSTALLING OR REPLACING OIL PUMP

Remove complete oil pan lower section - refer to 11 13 020.
Unscrew sprocket bolts.

Installation:
Tightening torque*.

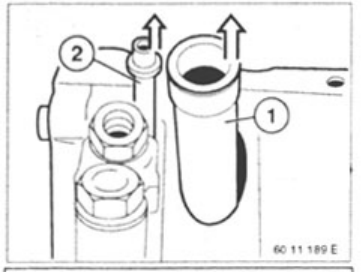
Remove sprocket together with chain.



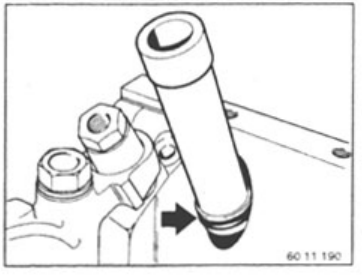
Unscrew oil pump bolts.

Installation:
Tightening torque*.

Remove oil pump.



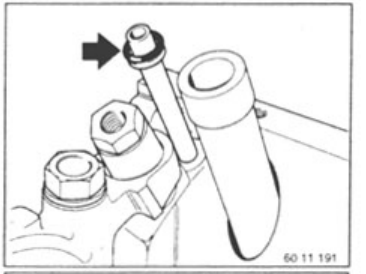
Pull
1 unfiltered oil pipe and
2 pure oil pipe
out of crankcase.



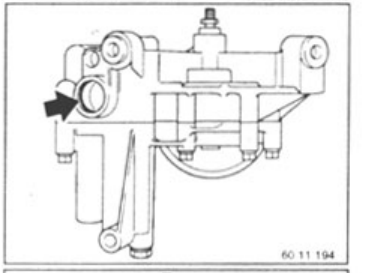
Installation:
Check seal, replacing it if necessary.
Lubricate seal lightly with oil.

Important!
Ensure that seal is not damaged on edge of case.

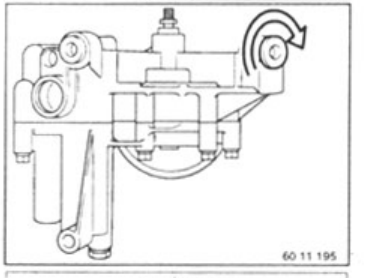
* Refer to Specifications



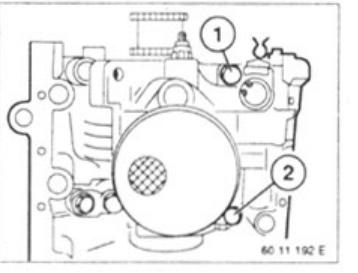
Installation:
Install pure oil pipe in crankcase.
Check seal, replacing it if necessary.



Installation:
Check seal in oil pump, replacing it if necessary.

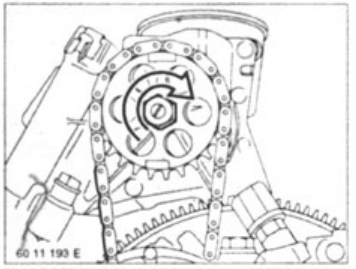


Installation:
Turn back hexagon adapter into oil pump as far as stop.

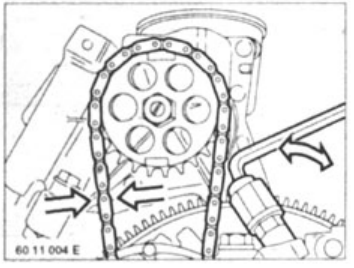


Installation:
Mount oil pump and tighten bolts (1 and 2).
Tightening torque*.

* Refer to Specifications

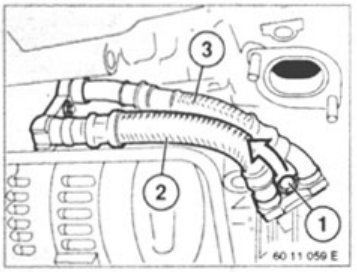


Installation:
Mount sprocket together with chain and tighten central nut.
Tightening torque*.



Installation:
Adjust chain sag (10 ± 2 mm) by turning hexagon adapter in oil pump.
Install and tighten bolt.
Tightening torque*.

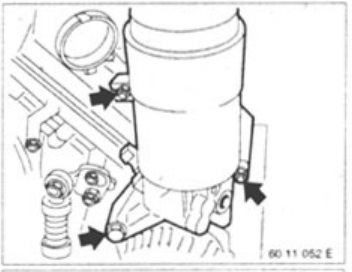
* Refer to Specifications



11 42 020 REMOVING AND INSTALLING, SEALING OR REPLACING FULL FLOW OIL FILTER

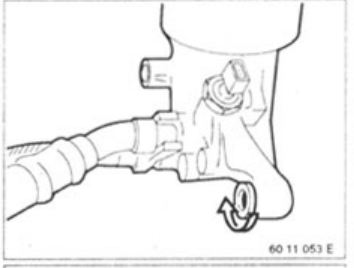
Remove alternator - refer to 12 31 020.
Disconnect oil hoses at carrier.
Unscrew bolt (1).
Lift out hoses upwards.

Installation:
Check seals, replacing them if necessary.
Check arrangement of oil hoses.
2 Used oil
3 Pure oil

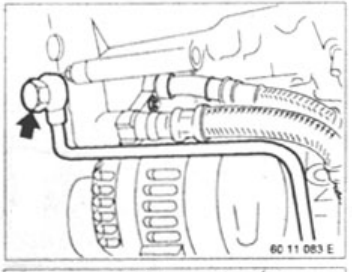


Unscrew bolt and nuts.
Remove oil filter.

Installation:
Tightening torque*.

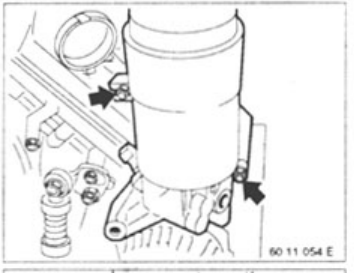


Installation:
Screw back adjusting hexagon into oil filter as far as possible using a hexagon socket key.

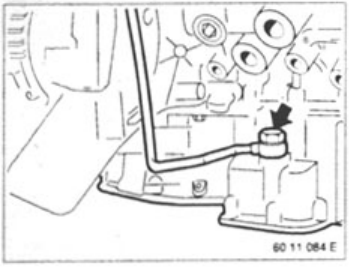


Unscrew oil drain pipe at oil filter.

Installation:
Check seal, replacing it if necessary.
Tightening torque*.

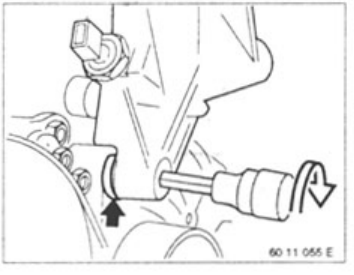


Installation:
Mount on upper timing case cover with both nuts.



Unscrew oil drain pipe at oil pan.

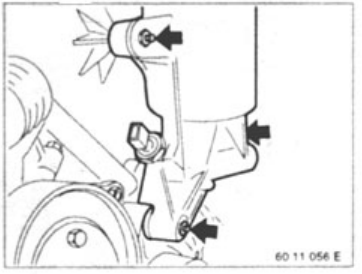
Installation:
Check seal, replacing it if necessary.
Tightening torque*.



Installation:
Turn adjusting hexagon with help of hexagon socket key until there is contact on the alternator free of play, but "do not preload".

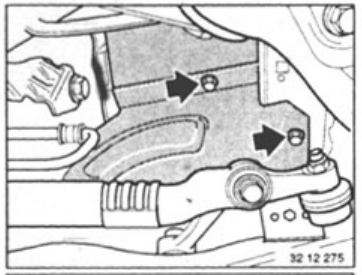
* Refer to Specifications

* Refer to Specifications



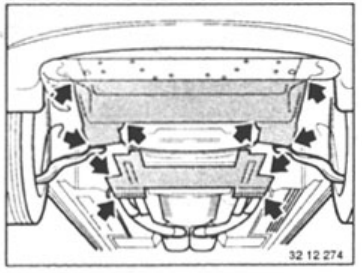
Installation:
Install bolts and tighten bolt and both nuts.
Tightening torque*.

* Refer to Specifications



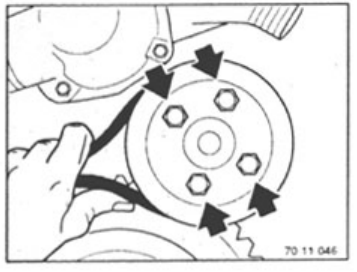
11 51 000 REMOVING AND INSTALLING OR REPLACING WATER PUMP

Unscrew heat shields at left and right hand sides of front axle carrier.



Unscrew front and rear engine splash guards.

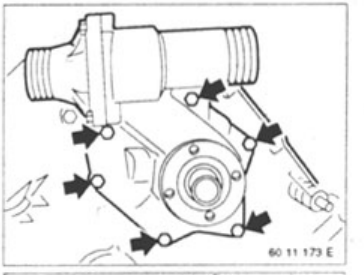
Drain coolant - refer to Group 17.
Remove vibration damper - refer to 11 23 010.
Disconnect coolant hose at cover of thermostat housing.
Remove thermostat housing cover together with thermostat.
Disconnect coolant hose at thermostat housing.



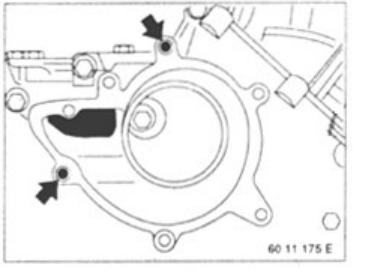
Hold water pump pulley tight with help of ribbed drive belt and unscrew bolts.

Installation:
Tightening torque*.

* Refer to Specifications



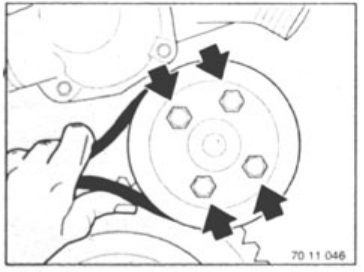
Unscrew bolts and remove water pump.



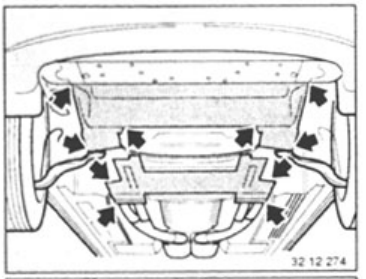
Installation:
Check for correct seating of dowel sleeves.
Clean sealing surfaces.
Replace gasket.

11 51 011 Replacing pulley on water pump

Remove drive belt for alternator, refer to 11 28 010

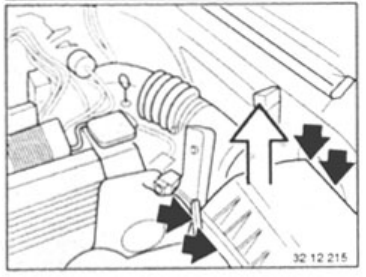


Hold water pump pulley with drive belt and release screws.



11 53 000 REMOVING AND INSTALLING OR REPLACING COOLANT THERMOSTAT

Remove front engine splash guard.



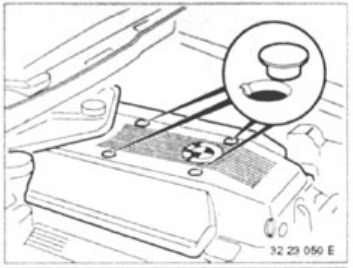
Remove air cleaner upper section together with mass air flow sensor.

Disconnect coolant hose at cover of thermostat housing.
Unscrew bolts of thermostat housing cover.
Remove thermostat housing together with bolts.

Installation:
Tightening torque*.

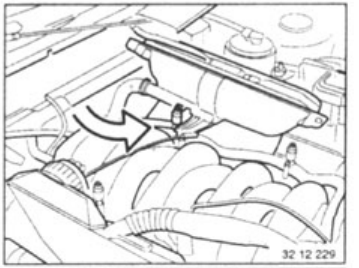
Replace gasket.
Fill cooling system - refer to Group 17.
Bleed and check cooling system for leaks - refer to Group 17.

* Refer to Specifications

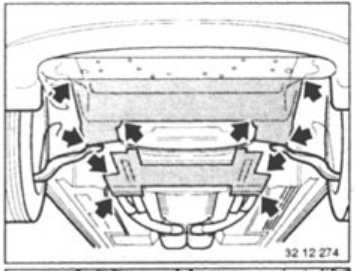


11 53 325 REMOVING AND INSTALLING OR REPLACING COOLANT COLLECTOR

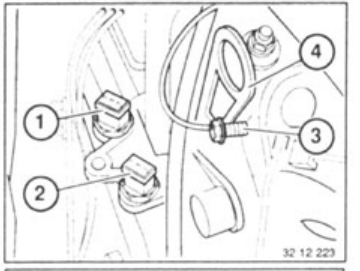
Remove caps from collector and clips.
Unscrew bolts.



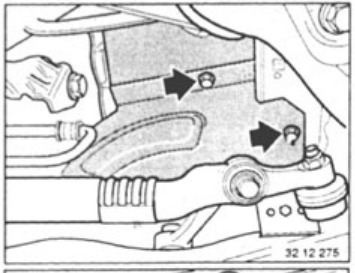
Place coolant expansion tank aside.



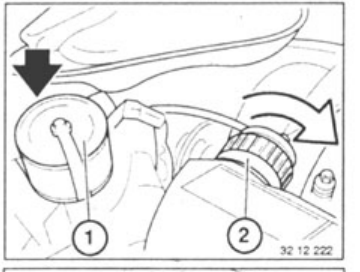
Remove front and, if applicable, rear engine splash guards.



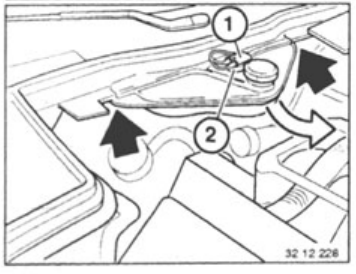
Disconnect plugs of wiring on back of right wiring duct.



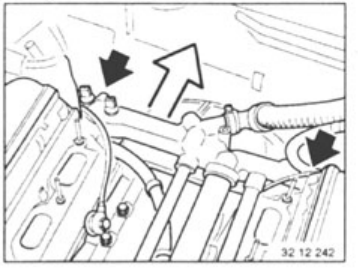
Unscrew heat shields at left and right hand sides of front engine carrier.



Unclip diagnosis socket (1) in holder.
Disconnect engine plug (2).



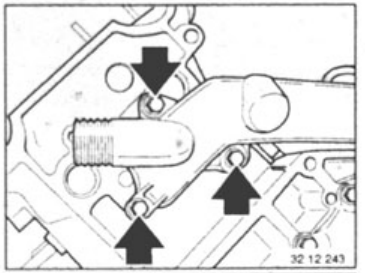
Drain coolant - refer to Group 17.
Remove complete coolant expansion tank.



Disconnect all coolant hoses at coolant collector.
Unscrew coolant collector screws on back of cylinder head at left and right hand sides.

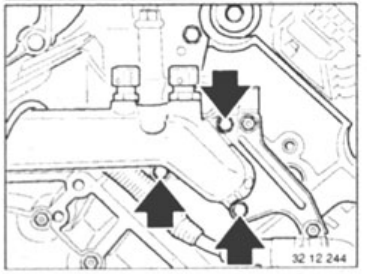
Installation:
Tightening torque*.

* Refer to Specifications



Unscrew coolant collector bolts.

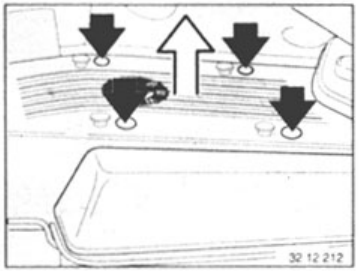
Installation:
Tightening torque*.



Unscrew coolant collector bolts.

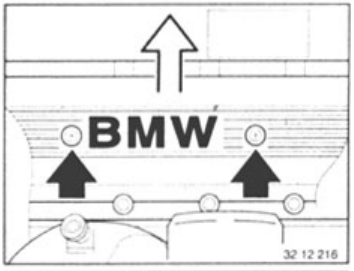
Installation:
Clean sealing surfaces.
Replace gaskets.
Tightening torque*.

* Refer to Specifications

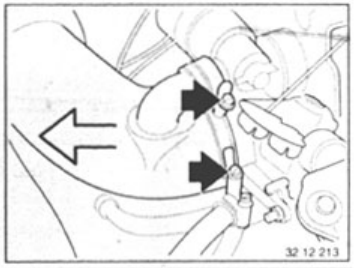


11 61 050 Removing and installing intake manifold

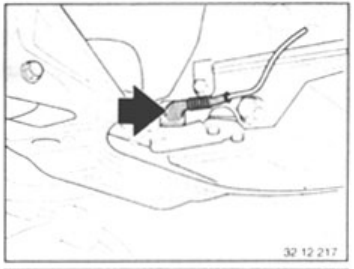
Check defect code memory.
Switch off ignition.
Unclip screw caps on covering for cylinder head cover.
Release screws.
Remove covering for cylinder head cover.



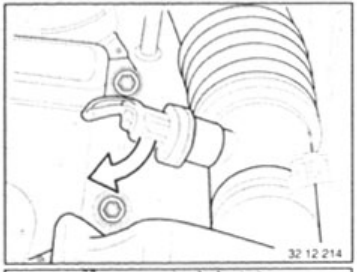
Unclip screw caps.
Release screws.
Remove covering for right cylinder head cover.



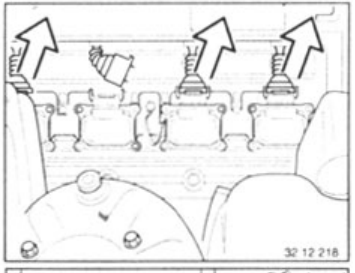
Remove hose clips at idle actuator and throttle body.



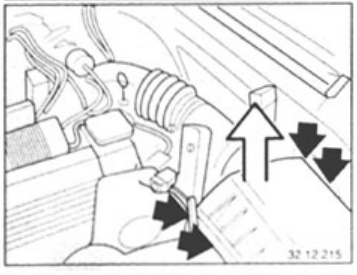
Jack up vehicle.
Disconnect plug-and-socket connection at oil level switch.



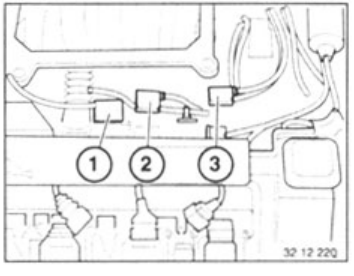
Release plug-and-socket connection on air mass meter.



Disconnect plug and socket connections at ignition coils.

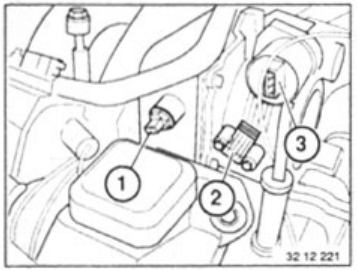


Release clips.
Remove upper section of air cleaner together with air mass meter.

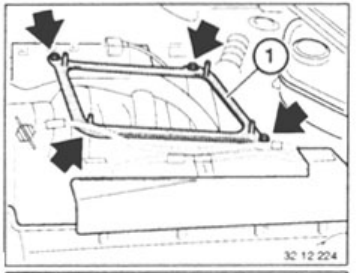


Disconnect plug-and-socket connections.
1 Knock sensor cylinders 3 and 4
2 Knock sensor cylinders 1 and 2
3 Pulse generator (on vibration damper)

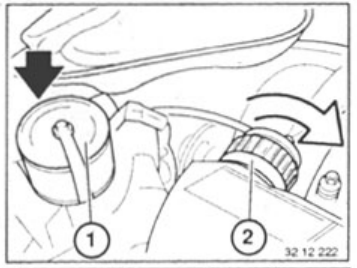
Caution!
Interchanging the plug-and-socket connections 1 and 2 causes engine damage!
Observe notes on knock sensors, refer to 12 14 610



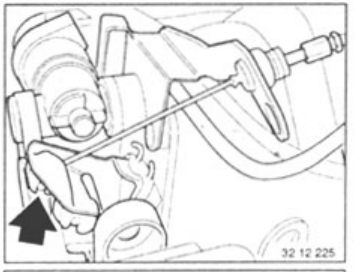
Disconnect plugs.
1 Intake air temperature sensor
2 Throttle valve potentiometer
3 Idle speed control



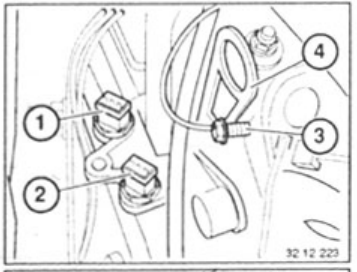
Unscrew screws of holder (1) for collector cover.



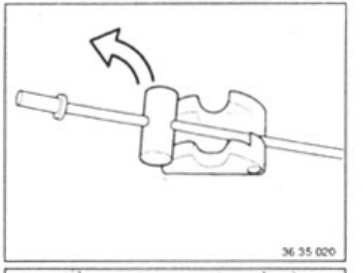
Disconnect plugs.
1 Diagnosis plug (unclip in holder)
2 Engine plug



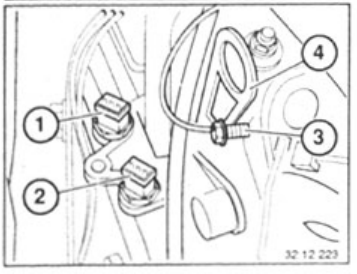
Disconnect throttle cable.
Compress nipple mounts on both retainers and press out of operating lever.



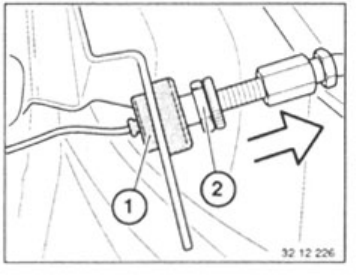
Unscrew mutual ground wire of ignition coils (3) close to rear engine suspension eye (4).



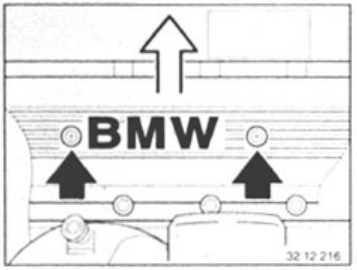
Press nipple out of nipple mounts.
Take cable out of nipple mounts.



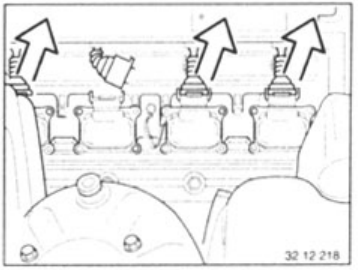
Disconnect plugs of temperature sensors.
1 Temperature sensor (black) for temperature gage
2 Temperature sensor (white) for digital engine electronics (DME)



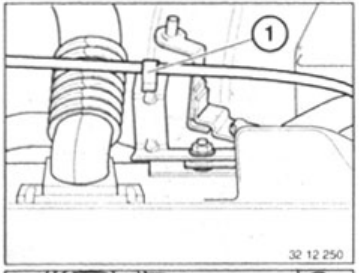
Take cable (2) out of rubber mount (1).
Take rubber mount (1) out of holder.
Remove throttle cable.



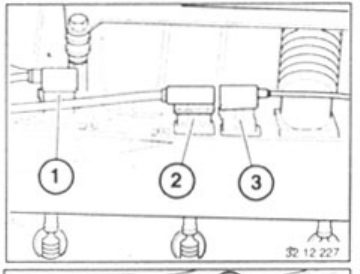
Remove covering for left cylinder head cover (cylinder row 5-8).



Disconnect plug-and-socket connections of ignition coils.

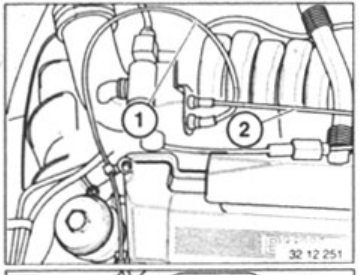


Remove throttle operating (Bowden) cable from holder (1).

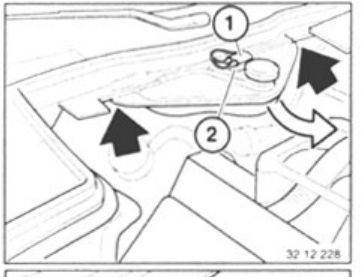


Disconnect plug-and-socket connections.
1 Camshaft sensor
2 Knock sensor cylinders 5 and 6
3 Knock sensor cylinders 7 and 8

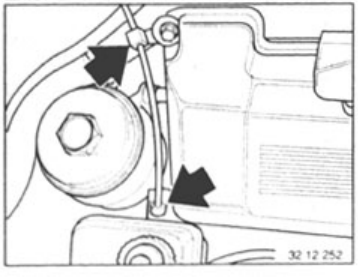
Caution!
Interchanging plug-and-socket connections 2 and 3 causes engine damage!
Observe notes on knock sensors, refer to 12 14 611



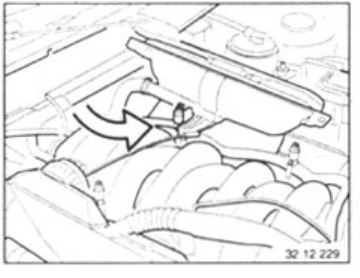
For cruise control (tempomat):
Run tempomat operating cable (1) under throttle operating cable (2).



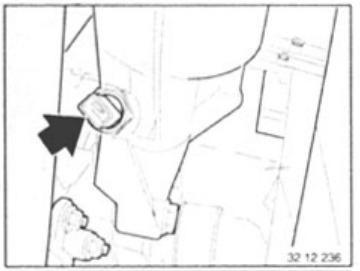
Disconnect plug-and-socket connection (1).
Disconnect overflow hose (2).
Release screws on left and right and place expansion tank to side.



Arrangement of tempomat operating cable on cylinder head cover.



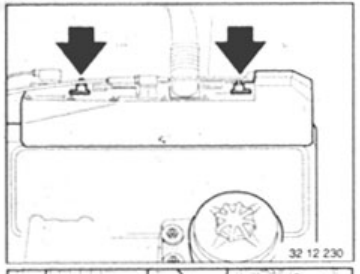
Coolant expansion tank



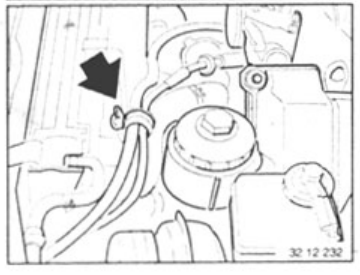
Disconnect plug-and-socket connection at oil pressure switch.



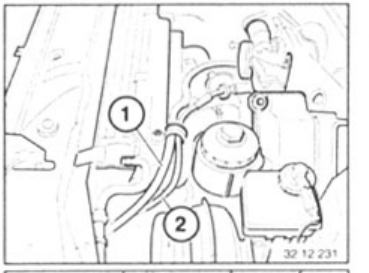
Disconnect wire of oil pressure switch.



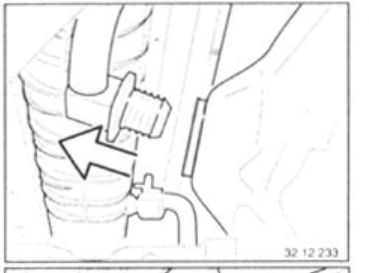
Release screw fittings of cable ducts on cylinder heads.



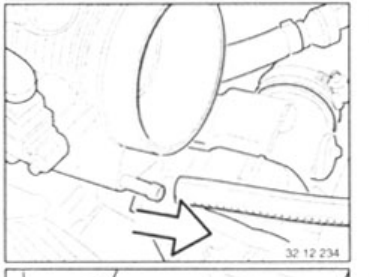
Remove vacuum lines at radiator.
Release hose clip.



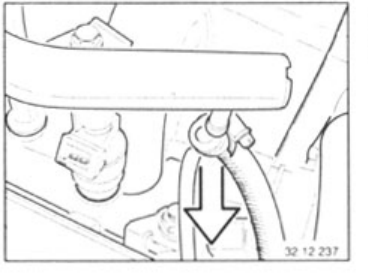
1 Tank ventilation
2 Vacuum supply for brake booster



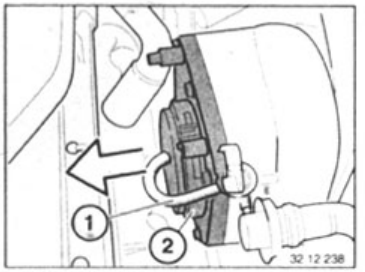
Disconnect vacuum hose at brake booster.



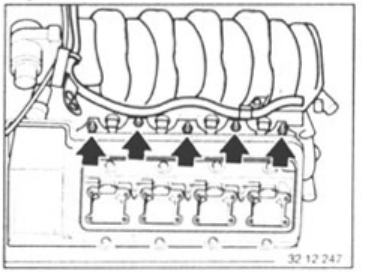
Disconnect tank ventilation hose at throttle body.



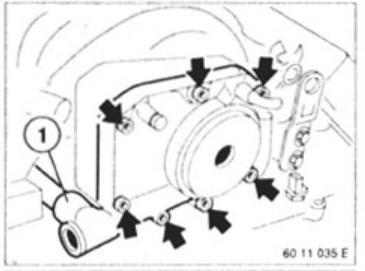
Remove fuel supply and return lines.
Installation note:
Replace plastic hoses.



Disconnect hose (1) from end cover (2) on rear of manifold.



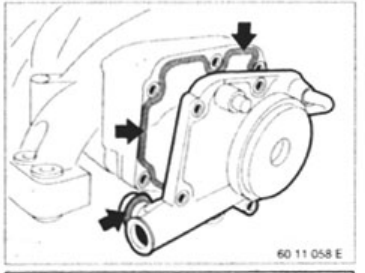
Release bolts on right and left.
Remove manifold by pulling upward.



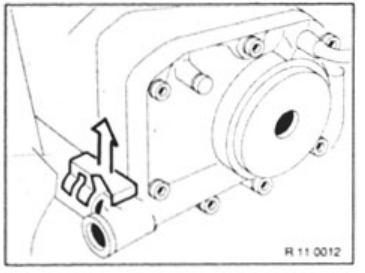
Note:
Version 1
Ventilation pipe fitted.
Release screws.

Caution!
Pull end cover for pressure control valve straight back to ensure ventilation pipe (1) is not damaged.

Read out defect code memory.
Check stored defect codes.
Repair defect, delete defect code memory.



Installation note:
Check sealing ring and gasket, replace if necessary.

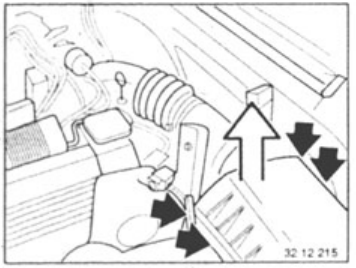


Note:
Version 2
Ventilation pipe and end cover connected with clip.
Remove clip and pull engine ventilation pipe forward.

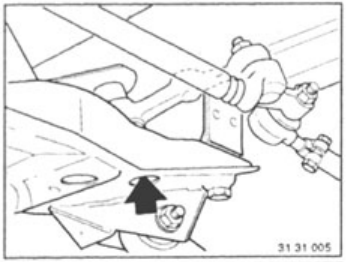
Installation note:
Check seal, replace if necessary.

11 62 142 REMOVING AND INSTALLING OR REPLACING BOTH LEFT EXHAUST MANIFOLDS

Remove exhaust assembly - refer to Gr. 18.
Remove alternator - refer to Group 12.
Remove left cylinder head cover - refer to 11 12 005.

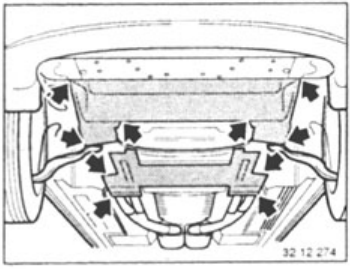


Remove complete air cleaner upper section together with mass air flow sensor.



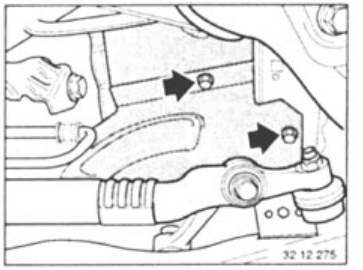
Unscrew bolts of left and right engine mounts at bottom.

Installation:
Tightening torque*.



If applicable, remove rear engine splash guard.

* Refer to Specifications

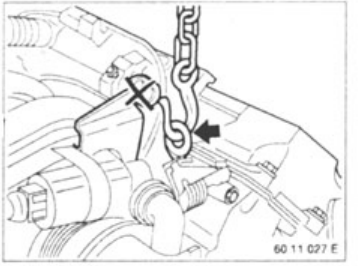


If applicable, unscrew bolts of center of gravity mount to front axle carrier.
Unscrew left heat shields on front axle carrier.

Unscrew manifold bolts.

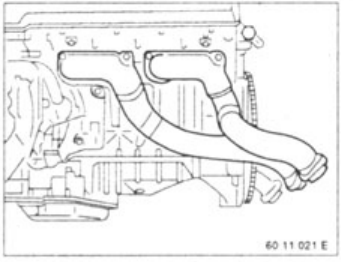
Installation:
Tightening torque*.

Remove manifolds downwards.



Installation:
Lift and lower engine using Special Tool 00 0 200 attached at front eye.

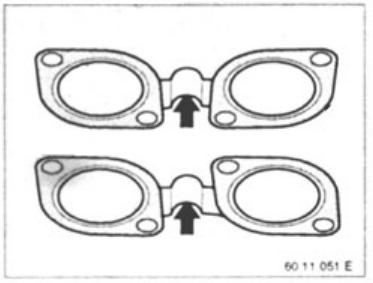
Important!
Ensure clearance between engine and firewall.



Check for correct installed position of manifolds.

* Refer to Specifications

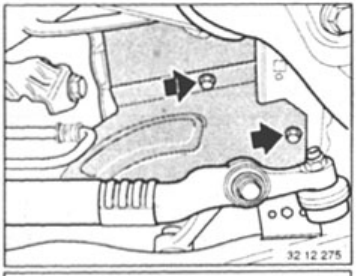
11-62/60.2



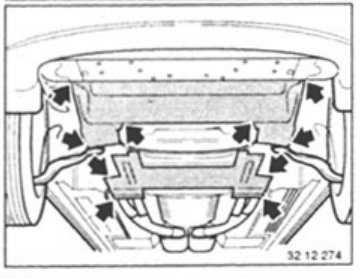
Installation:
Replace gaskets.
Gasket beads face exhaust manifolds!

11 62 142 REMOVING AND INSTALLING OR REPLACING BOTH RIGHT EXHAUST MANIFOLDS

Remove exhaust assembly - refer to Gr. 18.



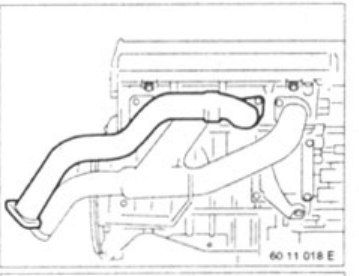
Remove right heat shields on front axle carrier at left and right hand sides.



If applicable, remove rear engine splash guard.

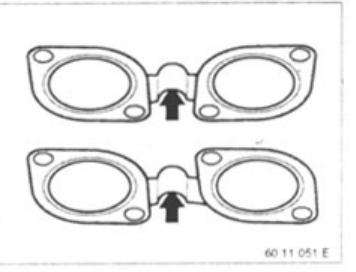
Remove washing fluid tank.
Unscrew manifold bolts.

Installation:
Tightening torque*.



Remove manifolds upwards.

Important!
Remove manifold for cylinders 2/4 first!



Installation:
Replace gaskets.
Gasket beads face exhaust manifolds!

* Refer to Specifications

12 Engine electrical system

	Notes on ignition system, DME (Digital Motor Electronics) and engine electrical equipment	12- 0/1
	Static high-tension distribution	12- 0/1
	Disconnecting battery	12- 0/1
	Notes on removal and installation of electronic control units	12- 0/1
	Component testing	12- 0/2
	Jumper start	12- 0/2
	Jumper start with cellular telephone	12- 0/2
12 11 091	Distributor cap – replace	12- 11/1
111	Distributor rotor – replace	12- 11/2
12 12 011	Spark plugs – replace	12- 12/1
072	Spark plug connector – replace one	12- 12/2
12 13 009	Ignition coil (M20, M30, M40) – check	12- 13/1
009	Ignition coil (M50, M60) – check	12- 13/1
. . .	Secondary voltage – check with aid of test adapters 12 7 040	12- 13/2
	Standard oscillograph	12- 13/4
	Oscillographs of ignition coils of different manufacturers	12- 13/5
	Ignition coil defect	12- 13/6
	Spark plug defect	12- 13/7
	Other defect patterns with evaluation	12- 13/8
	Defect in injection system	12- 13/9
	Further notes on troubleshooting	12- 13/9
	Secondary signal for static high-tension distribution (special tool 12 7 030) – check	12- 13/10
011	Ignition coil (M20, M30, M40) – replace	12- 13/11
011	Ignition coil (M50) – replace	12- 13/11
011	Ignition coil (S38 B38) – replace	12- 13/13
011	Ignition coil (M60) – replace	12- 13/13
12 14 150	Cylinder reference sensor (M20, M30, S38 B36) – replace	12- 14/1
150	Cylinder reference sensor (S38 B38) – replace	12- 14/2
150	Cylinder reference sensor (camshaft sensor M50) – replace	12- 14/2
150	Cylinder reference sensor (camshaft sensor M60) – replace	12- 14/4
155	Pulse generator (M20, M30, M40, S38 B36) – replace	12- 14/5
155	Pulse generator (S38 B38) – replace	12- 14/5
155	Pulse generator (M50) – replace	12- 14/6
155	Pulse generator (M60) – replace	12- 14/8
160	RPM sensor (M21) – replace and adjust	12- 14/10
550	Control unit (Digital Motor Electronics (DME)) – replace	12- 14/11
600	Knock sensor (M50) – replace	12- 14/12
610	Knock sensors, right (cylinders 1-4, M60) – replace	12- 14/14
611	Knock sensors, left (cylinder 5-8, M60) – replace	12- 14/19
	Relay assignments engine wiring harness (M20, M30, M40, M50)	12- 14/25
	Relay assignments engine wiring harness (M51)	12- 14/25
	Relay assignments engine wiring harness (M60)	12- 14/26
12 21 500	Relay for glow plugs – remove and install or replace	12- 21/1
12 23 000	Glow plugs, all – check	12- 23/1
505	Glow plugs, all – replace	12- 23/3
12 31 009	Alternator and voltage regulator – check	12- 31/1
020	Alternator (M20, M21, M30, M40, S38) – remove and install	12- 31/2
020	Alternator (M50) – remove and install	12- 31/3
020	Alternator (M51) – remove and install – replace	12- 31/4
020	Alternator (M60) – remove and install – replace	12- 31/6
299	Alternator drive belt (M20, M30, M40) – check/tension	12- 31/9
. . .	Alternator pulley – replace	12- 31/10
12 32 000	Voltage regulator – replace	12- 32/1
12 41 020	Starter (M20, M21, M30, S38) – remove and install	12- 41/1
020	Starter (M40) – remove and install or replace	12- 41/2
020	Starter (M50) – remove and install	12- 41/3
020	Starter (M51) – remove and install or replace	12- 41/4
020	Starter (M60) – remove and install or replace	12- 41/5
12 64 005	Fuel heater – replace	12- 64/1
12 70 500	Safety path of electronic engine power control (EML) – check	12- 70/1
12 72 520	Pedal position sensor – remove and install or replace	12- 72/1
. . .	Accelerator with electronic engine power control – adjust	12- 72/3
	On-board diagnosis	12- 73/0
	Defect code example: NZC water	12- 73/0
	Table: Defect codes	12- 73/1

For M43 engine refer to “Repair Manual 3 Series E36”.

INSTRUCTIONS FOR WORKING ON IGNITION SYSTEM, DME (DIGITAL MOTOR ELECTRONICS) AND ENGINE ELECTRICAL EQUIPMENT

Precautions!

- Always switch off ignition before working on ignition system.
  Never touch components under voltage while engine is running.
  Dangerous high voltage!
- Always remove DME master relay for the compression test to avoid ectivation of ignition coils by ignition final stages of the DME control unit.
  Dangerous high tension!
- Always switch off ignition before connecting / disconnecting Service Tester, other testers and adapters or replacing components!
- Secondary (high tension) side of ignition system must be loaded with at least 4 k-ohms.
- Never start engine after removing distributor cap or disconnecting wire (terminal 4) on ignition coil (terminal 4).
- Never connect a shielded capacitor or test lamp on ignition coil terminal 1.
- Never connect ignition coil terminal 1 wire to ground or B+.
  Consequently terminal 1 wire may not be used to interlock starting when service installing a burglar alarm system.

Direct Ignition System (Without Distributor):

- Engine must never be started after disconnection of the secondary circuit, i.e. disconnection of connectors on spark plugs and ground connection (terminal 4a).
- There is dangerous high tension in or on
  ignition leads,
  spark plug connectors,
  spark plugs,
  ignition coil terminal 4
  (*Caution!* approx. 40 kV high tension) and
  terminal 1 wire from ignition coil to DME control unit
  (*Caution!* approx. 350 V high tension at terminal 1).
- Battery as well as wires on alternator and starter may not be disconnected on a running engine.

Disconnecting Battery

Important!
Disconnecting the car battery will erase the fault memories of control units.
Consequently always interrogate fault memories and have faults printed with help of a BMW Service Tester before disconnecting the battery.
Investigate stored faults.
The radio can only be operated after disconnection of the battery by entering the radio code again, so that the customer should first be asked for his radio code card.
Note stored stations so that they can be stored again after connection of the battery.
The stored data of the on-board computer and clock will also be lost.
If car is fitted with an infrared locking system, all keys must be recoded.
Refer to Car Electric/Electronic Test Plan for additional information.

INSTRUCTIONS FOR REMOVING AND INSTALLING ELECTRONIC CONTROL UNITS

Ignition must always be switched off before disconnecting or connecting control unit plugs.
Removal and installation of components, relays, fuses, etc. could cause the storage of faults in fault memories of control units capable of self-diagnosis.
Consequently fault memories must always be interrogated after working on the electrical system.
Stored faults must be investigated and cancelled.

Note When Replacing DME (Digital Motor Electronics) Control Unit:

Each control unit is programed with certain basic values, which serve as mean values.
The control unit receives different input values, depending on engine condition, which are compared with the stored values.
The adaptive system compares the input values with the stored map values.
Appropriate correction commands are sent to the concerned drive elements.
If, for example, the DME control unit would be without current for a long time (more than one hour), its adaptive system would lose the stored values.
After re-operation of a cancelled or installation of a new control unit the input values of a pertinent engine must be read in and stored for the adaptive system.
This procedure could lead to erratic idling and disturbed overrunning of the engine after starting.
Depending on the engine it could require some time before all values are adapted to the engine condition.

Consequently there must be conformance with the following procedures before replacing a DME control unit or operating a control unit which had been disconnected.

Install control unit and drive car at least 5 minutes while changing the engine speed.
Interrogate fault memories and have faults printed with help of a BMW Service Tester.
Investigate stored faults.

CHECKING COMPONENTS

Note:
Refer to Construction Group Repair Manual.
Always conform with safety precautions and accident prevention regulations whenever carrying out tests or work on engine electric and electronic components.

Always disconnect plugs of control units or components before checking electric wires.

Testing Aids:
Concerned wiring diagrams and current flow diagrams can be found in the binders for "Car Electric/Electronic Test Plan – 3 Series E 36".

Only use appropriate test leads, adapter leads (refer to concerned repairing instructions), terminals and test clips.

Test values for checking components are contained in the Car Electric / Electronic Test Plan.
Also refer to the Technical Data microfiche for other specifications.

OUTSIDE STARTING AID

Do not start the engine with help of starting sprays.

Preparations:
Conform with the following when starting engine with starting cable.
Ensure that starting cable wires are of appropriate cross section size.
Only use fuse-protected starting cables.
Check whether the current supplying battery has 12 V voltage.
If engine is started from battery of another car, ensure that there is no contact between the bodies of both cars.

Caution!
Never touch ignition system components under current – dangerous high tension!

Procedures:
Always conform with the procedures to avoid injury to persons or damage to parts.
Select range P in cars with an automatic transmission and apply the parking brake.
Move the shift lever of cars with manual transmission into neutral and apply the parking brake.
Ensure that the starting cables cannot get caught in rotating parts, e.g. fan.
First connect both positive poles of the batteries with one starting cable (red).
Use the positive connection point in the engine compartment for cars with the battery in the trunk.
Then connect the second starting cable (black) between the negative pole of the current supplying battery and engine or body ground of the car to be started.

Caution!
Never connect the second starting cable (black) on the negative pole of the battery in the car to be started. Produced gas could be ignited by sparks – danger of explosion!

If the battery in the car supplying power is weak, start the engine of this car and let it run at idling speed.
After the engine of the car to be started has started up, first disconnect the starting cable on the negative pole / ground connection. Then remove the starting cable from the positive poles.

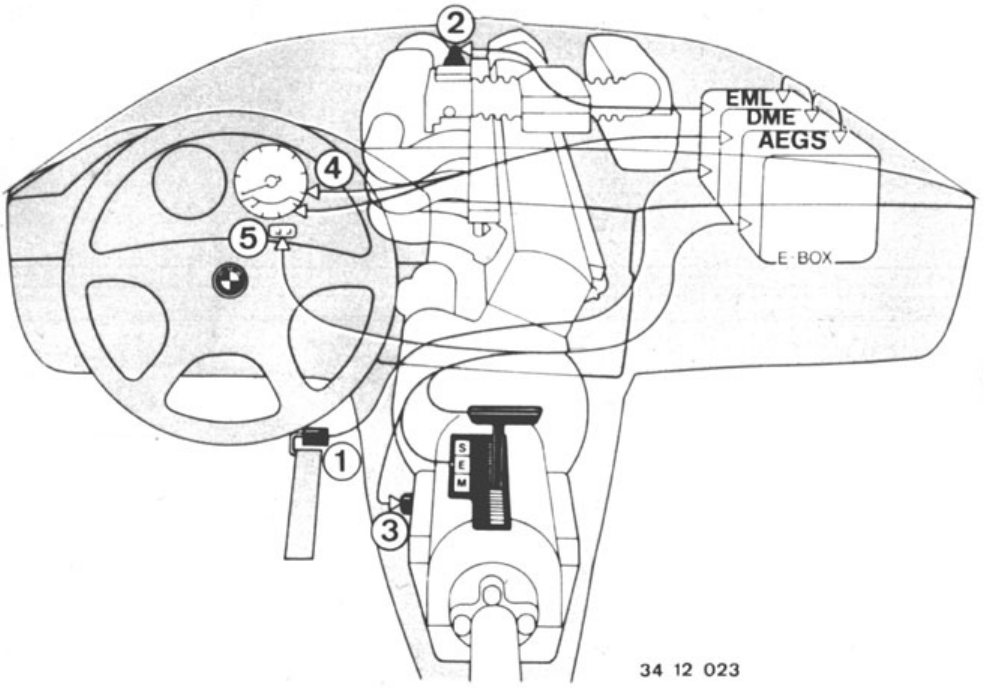
OUTSIDE STARTING AIR AND CAR TELEPHONE

Siemens C 2:
When starting the engine with help of the battery in a different vehicle ensure that the Siemens C 2 telephone is not damaged through overvoltage.
Disconnect the sender and receiver from the electrical system prior to starting the engine with outside help.

Siemens C 3 and Motorola C 451:
Senders and receivers of Siemens C 3 and Motorola C 451 car telephones have overvoltage protection, but calls may not be made while starting the engine with outside help.

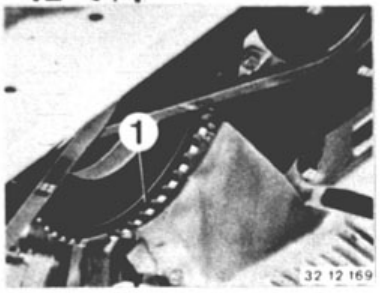
Always refer to the pertinent operating instructions of other type and other make car telephones.
If in doubt, disconnect the sender/receiver from the electrical system.

DME SURVEY



1 Pedal value sender
2 Throttle valve drive motor
3 Bayonet connector for transmission control
4 Speed signal/consumption display
5 Program display

EML = Electronic engine power control
DME = Digital motor electronics
AEGS = Independent electronic transmission control
S = Sport
E = Economy
M = Manual



Note:
Troubleshooting engine electric/ electronic system since introduction of M 1.1 – see electric/electronic test plan.

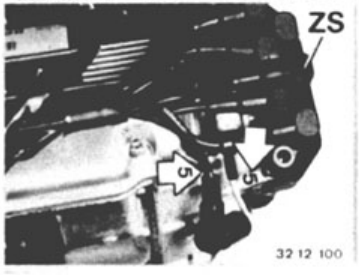
Can be recognized on the increment wheel (1) for sender-type Motronics.



12 11 091 REPLACING DISTRIBUTOR CAP

Take off cover.

Installation:
Engage cover in holder.



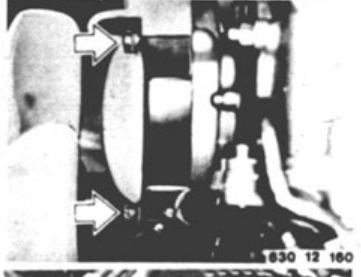
Pull off shielded plug connector.

Installation:
Numbering of electric leads and cap (e.g. 5) must be identical.
ZS = ignition coil
Applicable for M 20 and M 30 engines.

Note:
M 20 / M 30: 1 - 5 - 3 - 6 - 2 - 4

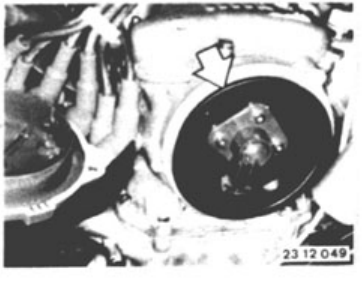


Unscrew fan – left-hand threads!
Use Special Tools 11 5 030 / 040.
Unscrew and push up fan cowl.

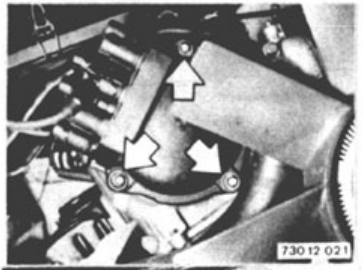


Unscrew bolts and take off distributor.

Caution!
Danger of cutting hands on radiator fins.



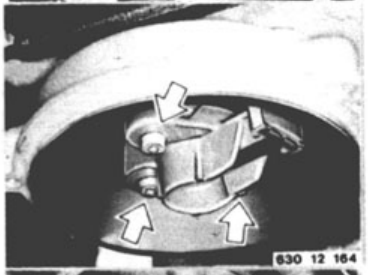
Installation:
Check seal, replacing if necessary.



12 11 111 REPLACING DISTRIBUTOR ROTOR

Remove distributor cap – see 12 11 091.

Caution!
Danger of cutting hands on radiator fins.



Unscrew screws with a 3 mm socket head key.

Installation:
Tightening torque*.



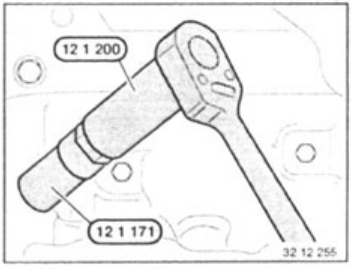
Testing:
Measure resistance*.
Inspect surface and cast compound for cracks and traces of burning.

* See Specifications

12 12 011 REPLACING SPARK PLUGS

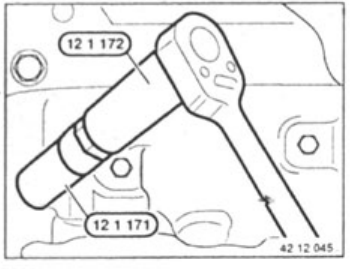
M20 / M30:
Remove spark plug connectors.
Unscrew spark plugs using standard plug wrench.

Installation:
Tighten spark plugs using plug wrench and Special Tool 12 1 200.
Refer to tightening torque* when working without Special Tool 12 1 200.



M40:
Remove spark plug connectors.
Unscrew spark plugs using Special Tool 12 1 171.

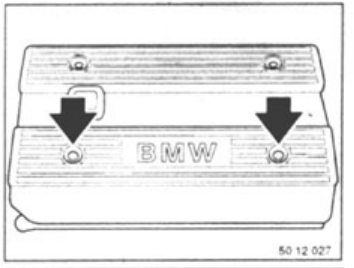
Installation:
Tighten spark plugs using Special Tools 12 1 171 and 12 1 200.
Refer to tightening torque* when working without Special Tool 12 1 200.



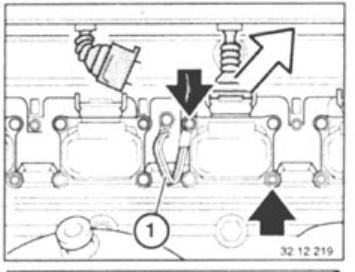
S38:
Remove spark plug connectors.
Unscrew spark plugs using Special Tool 12 1 171.

Installation:
Tighten spark plugs using Special Tools 12 1 171 and 12 1 172.
Refer to tightening torque* when working without Special Tool 12 1 172.

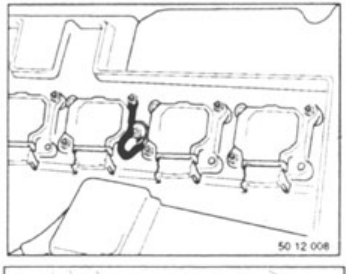
* Refer to Specifications



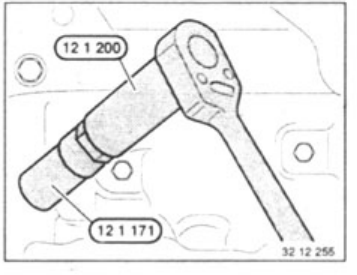
M50 / M60:
Unscrew cover on cylinder head cover.



Unscrew ignition coils.



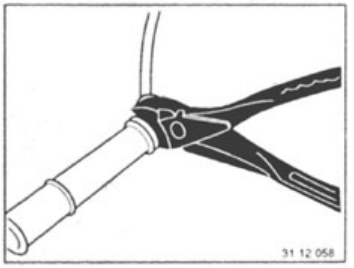
Installation:
Ground straps of cylinder head cover must be secured on ignition coils of cylinders 3 and 6.
Tightening torque*.



Unscrew spark plugs using Special Tool 12 1 171.

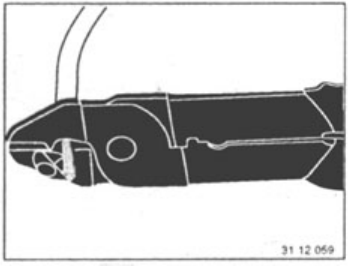
Installation:
Tighten spark plugs using Special Tools 12 1 171 and 12 1 200.
Refer to tightening torque* when working without Special Tool 12 1 200.

* Refer to Specifications

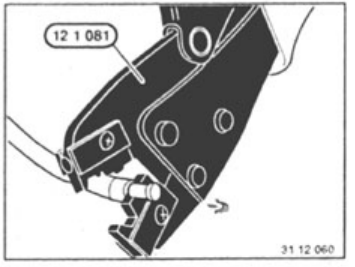


12 12 072 REPLACING ONE SPARK PLUG CONNECTOR

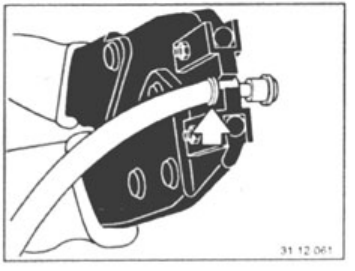
Cut off ignition lead close to the connector.



Strip ignition lead 6mm (1/4") with a stripping pliers* (1.5 mm / 0.059" lead cross section size).

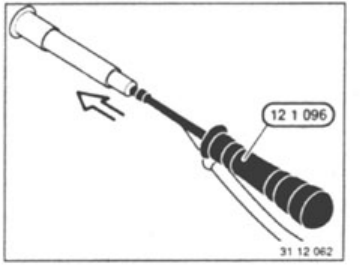


Place coupling on ignition lead and squeeze on wire end first with Special Tool 12 1 080/081.



Place connector flush with pliers and squeeze on.

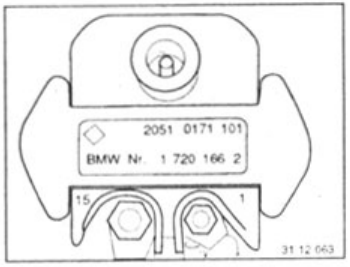
* Source of Supply: HWB



Place ignition lead in Special Tool 12 1 096 and slide into spark plug connector until the coupling is heard to engage.
If applicable, spray with lubricant (Special Tool 12 1 098).

12 13 009 CHECKING IGNITION COIL (M20, M30, M40)

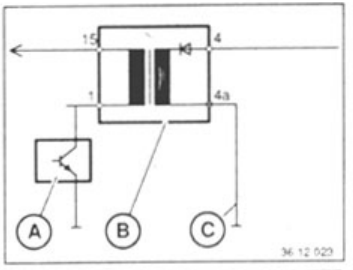
Multimeter Test (M 06):
Measure resistance of primary coil between terminals 1 and 15 = 0.5 kΩ ± 10 %
and resistance of secondary coil between terminals 15 and 4 = 6 kΩ ± 10 %.



Check the cast compound of the primary coil carrier for hairline cracks.
If gray material has run out at the edges of the coil carrier, this is indication for a faulty ignition final stage in the DME control unit.

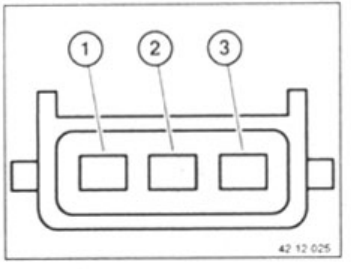
12 13 009 CHECKING IGNITION COIL (M50, M60)

Refer to precautions on page 12-0/1.



Wiring Diagram of Ignition Coil in Direct Ignition System:

- A Primary coil activation of ignition coils by DME
- B Ignition coil
- C Secondary coil ground connection



Ignition Coil Plug Pin Connections

1 Terminal 15
2 Terminal 4a
3 Terminal 1

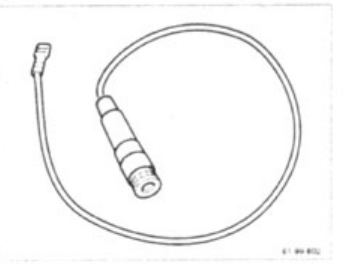
Resistance Test:
Primary coil specification = 0.4 ... 0.8 Ω.
Resistance of the secondary coil cannot be measured.

Check the cast compound of the primary coil carrier for hairline cracks.
If gray material has run out at the edges of the coil carrier, this is indication for a faulty ignition final stage in the DME control unit.



12 13 ... CHECKING SECONDARY VOLTAGE USING TEST ADAPTER KIT 12 7 040

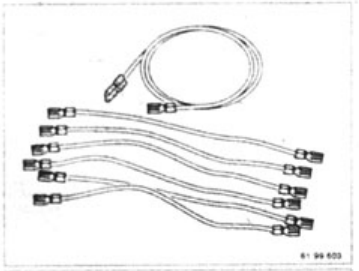
The following tests can be carried out with the adapter kit:
Secondary voltage test
Different make ignition coil comparison
Ignition coil faults
Spark plug faults
Injection system faults



Special Tool 12 7 042 for BMW Service Tester.
The high tension clip must be unscrewed from the service tester lead for connection to the Service Tester.

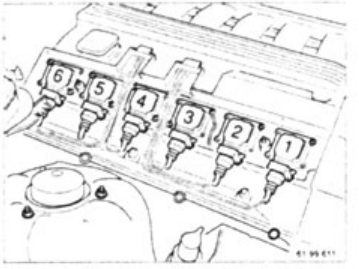
Caution!
Refer to precautions on page 12-0/1.

If a BMW Service Tester is not available, a common workshop oscilloscope with test leads may be used.
Special Tool 12 7 042 is then replaced by a test lead of the oscilloscope.
Triggering is then accomplished externally via the induction clip with primary voltage coming from cylinder no. 1.



Connect Special Tool 12 7 043 to Special Tools 12 7 041 and Special Tool 12 7 042 for the BMW Service Tester.

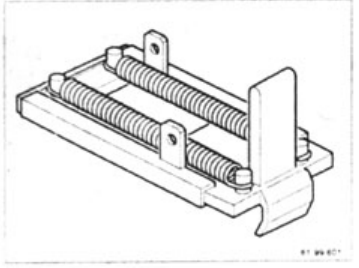
Connecting Lead 12 7 043



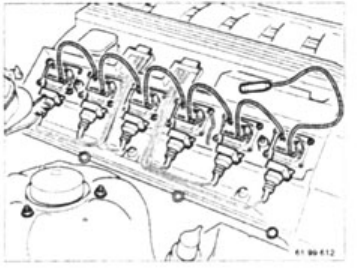
M 50:

Refer to precautions on page 12-0/1.
Switch off ignition.
Unscrew ignition coil cover.

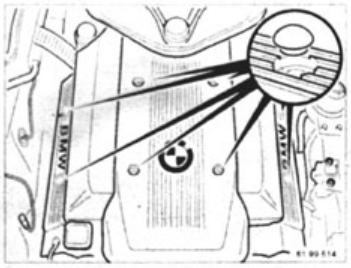
Firing order = 1-5-3-6-2-4.



Special Tool 12 7 041 for installation on the ignition coil.



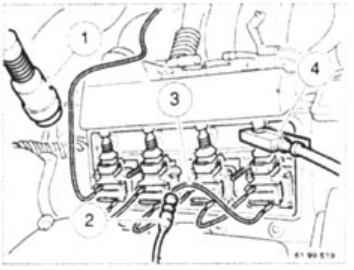
Mount Specials Tool 12 7 041 on ignition coils and connect using Special Tool 12 7 043.



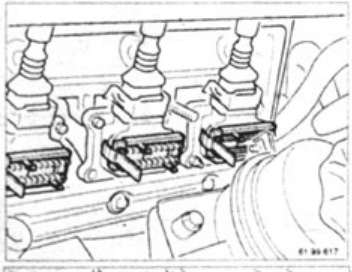
M 60:

Refer to precautions on page 12-0/1.
Switch off ignition.
Unscrew ignition coil cover.

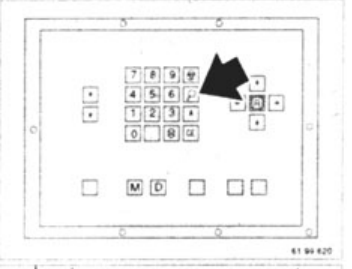
Firing order = 1-5-4-8-6-3-7-2.



Connect BMW Service Tester to diagnosis socket (1) in the car.
Connect Special Tool 12 7 042 (2) to high tension connecting lead (3) of the BMW Service Tester.
Connect trigger clip (4) of the BMW Service Tester to power supply lead of the ignition coil for cylinder no. 1.

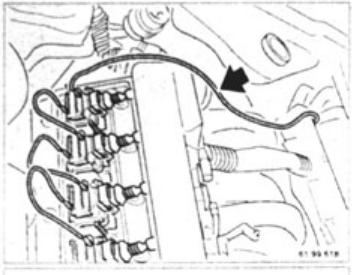


Mount Specials Tool 12 7 041 on ignition coils and connect using Special Tool 12 7 043.

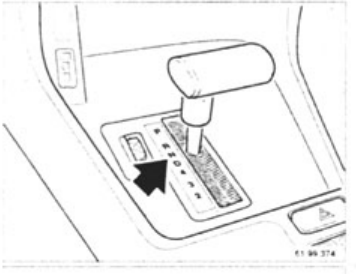


BMW Service Tester
Select Test Step 01 (engine) and afterwards select Test Step 10 (mixture, exhaust).

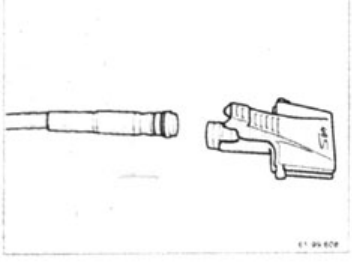
Enter the number of cylinders.



Note:
Use the long connecting lead of Special Tool 12 7 043 for connection of adapters between cylinder banks 1 - 4 and 5 - 8.

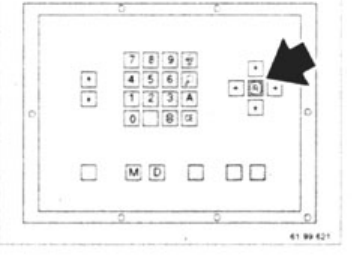


Apply the parking brake and move the manual transmission shift lever to neutral or the automatic transmission selector lever to "P".

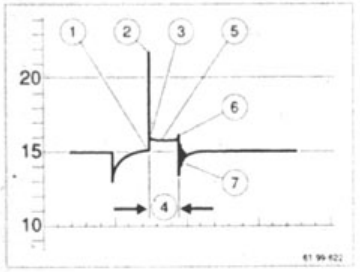


Connect BMW Service Tester as follows.

Unscrew high tension clip from the connecting lead of the BMW Service Tester.
Connect Special Tool 12 7 042 to the high tension connecting lead of the BMW Service Tester.

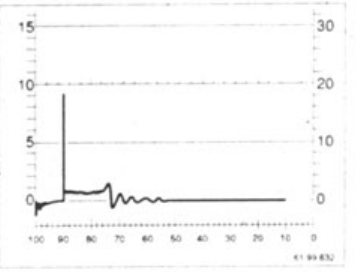


Select the type of display of secondary voltage on the oscilloscope with key "R".
Display of voltage (parallel, in series, superposed).



NORMAL OSCILLOGRAPH

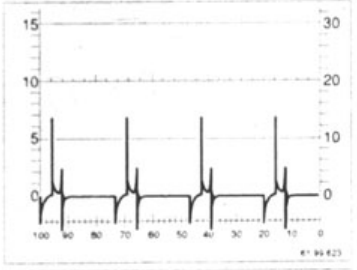
1 Beginning of ignition voltage peak
2 Ignition voltage peak
3 Sparking voltage peak
4 Sparking period
5 Sparking voltage line
6 Beginning of dying-out process
7 Dying-out



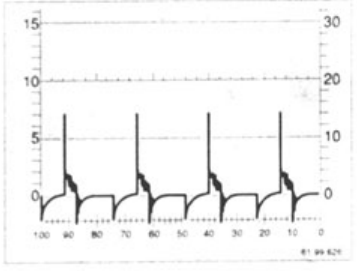
Series display.
Idling speed.

Greater differences can be recognized in the ignition voltage displays.
Allocation of a recognized fault to a pertinent cylinder must be made with help of the type of display (in series, parallel).

Parallel display.
Evaluation of sparking voltage line and dying-out process.
Idling speed.



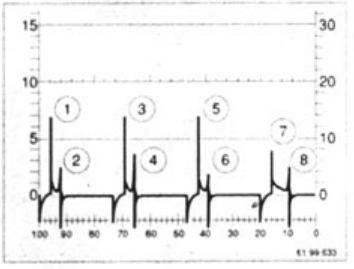
The display of ignition voltage peaks is about 20 to 25 % lower than the actual value.
The uniformity of all cylinders to each other is more important than the height of ignition voltage peaks.
Differences of 3000 to 4000 V are acceptable.
Refer to "fault displays" on the following pages in case of greater differences.



Display with speed increased to approx. 2000 rpm.
Evaluation of ignition voltage peaks.

OSCILLOGRAPHS FROM DIFFERENT MAKE IGNITION COILS

Evaluation of ignition voltage peaks and dying-out process at idling speed.



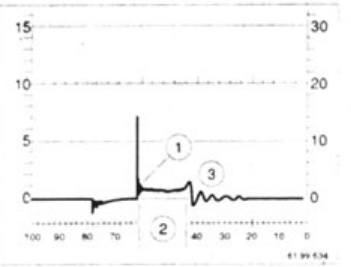
Make: Bremi
1 Normal ignition voltage peak (6000 to 9000 V)
2 Normal

Make: Beru
3 Normal ignition voltage peak
4 Higher beginning of dying-out process

Make: May & Christe
5 Normal ignition voltage peak
6 Lower beginning of dying-out process

Make: Bosch
7 Lower ignition voltage peak
8 Normal beginning of dying-out process

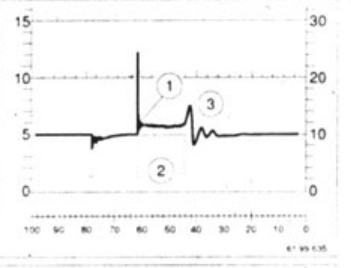
Note:
As compared with other makes of ignition coils the ignition voltage peaks will be shortened very strongly at higher speeds.



Evaulation of sparking voltage peaks at engine speed increased to approx. 2500 rpm.

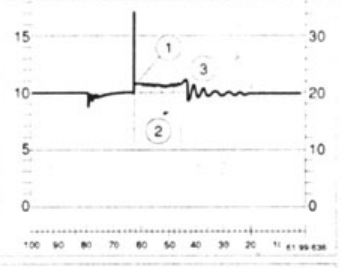
Make: Bremi

1 Normal building-up of sparking voltage line
2 Normal sparking period
3 3 to 4 dying-outs



Make: Beru

1 Normal building-up of sparking voltage line
2 Normal sparking period
3 At least 3 dying-outs



Make: May & Christe

1 No building-up of sparking voltage line
2 Normal sparking period
3 At least 5 dying-outs

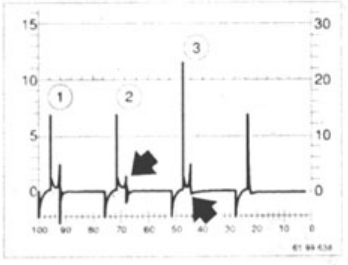


Make: Bosch

1 Normal building-up of sparking voltage line
2 Long sparking period
3 At least 3 dying-outs

IGNITION COIL FAULTS

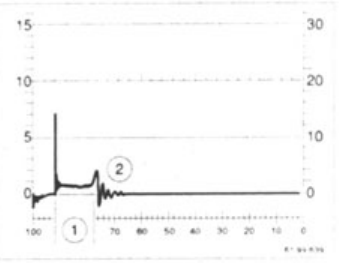
Evaluation of ignition voltage peaks and dying-out process at idling speed.



1 **Beginning of dying-out processes with normal peaks upwards and downwards**

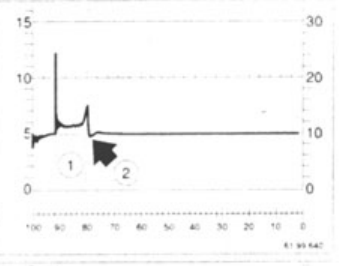
2 **Beginning of dying-out processes strongly shortened**
Ignition coil is defective!

3 **Beginning of dying-out processes downwards missing**
Ignition coil is defective!
Note:
Higher ignition voltage peak is not always available.

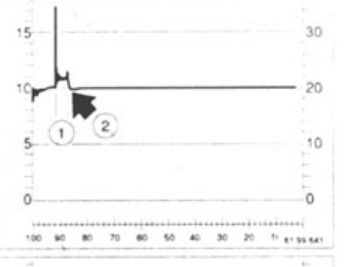


Evaluation of sparking voltage line at idling speed.

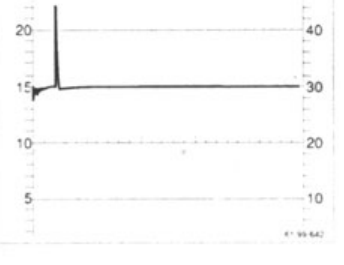
1 **Normal sparking period**
2 **Normal dying-outs to sparking voltage line**
Ignition coil is okay.



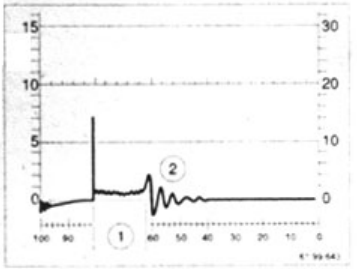
1 **Shorter sparking period**
2 **Dying-outs to sparking voltage line available only weakly**
Ignition coil is defective!



1 **Much shorter sparking period**
2 **Dying-outs to sparking voltage line missing**
Ignition coil is defective!

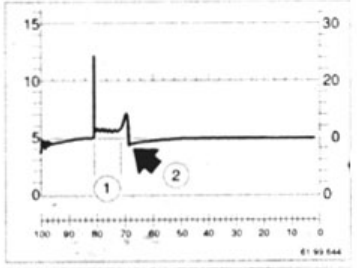


No sparking voltage line.
Ignition coil is defective!

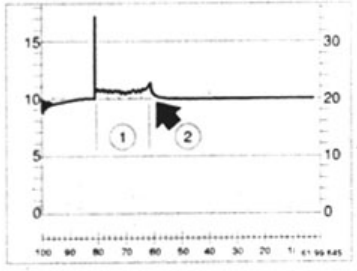


Evaluation of sparking voltage line at engine speed increased to approx. 1500 rpm.

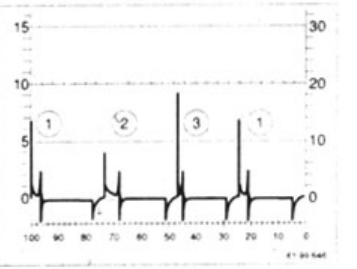
1 Normal sparking period
2 Normal dying-outs to sparking voltage line
Ignition coil is okay.



1 Shorter sparking period
2 Dying-outs to sparking voltage line available only weakly
Ignition coil is defective!

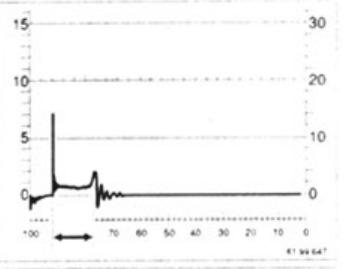


1 Normal sparking period
2 Dying-outs to sparking voltage line missing
Ignition coil is defective!



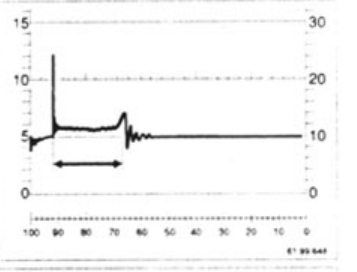
SPARK PLUG FAULTS

1 Normal ignition voltage peak
Spark plug is okay.
2 Low ignition voltage peak
Small electrode gap
3 High ignition voltage peak
Large electrode gap

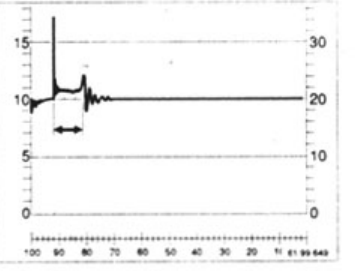


Evaluation of sparking period at idling speed.

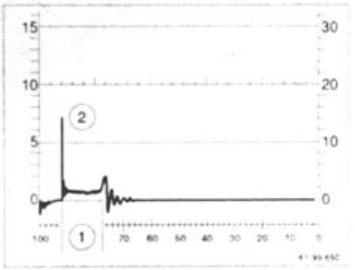
Normal sparking period.
Spark plug is okay.



Long sparking period.
Small electrode gap.



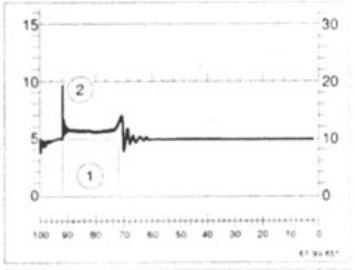
Short sparking period
Large electrode gap.



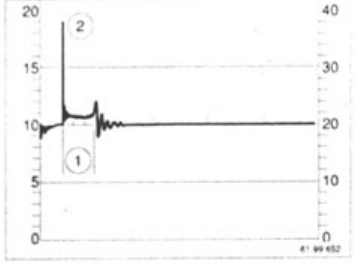
OTHER FAULT DISPLAYS WITH EVALUATION

Evaluation of sparking period and ignition voltage peaks at idling speed.

1 Normal sparking period
2 Normal ignition voltage peak
Ignition system is okay.



Long sparking period (1) with low ignition voltage peak (2).
Indicates low compression.
Fluctuating sparking period:
Indicates contamination on spark plug (shunt).



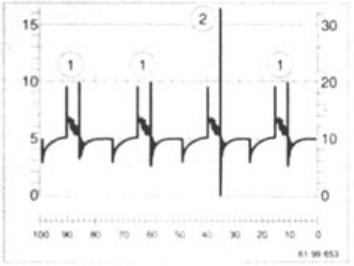
Short sparking period (1) with high ignition voltage peak (2).
Constant but short sparking period:
Indicates defective ignition lead.
Note:
The sparking voltage line could sometimes be missing completely and the ignition voltage peak could rise very high.

Ignition Voltage Too High:

Electrode gap	Large
Compression	High
Fuel/air mixture	Lean
Electrode temperature	Low
Electrode condition	Burnt
Ignition lead	Interrupted

Ignition Voltage Too Low:

Electrode gap	Small
Compression	Low
Fuel/air mixture	Correct
Electrode temperature	High
Electrode condition	New

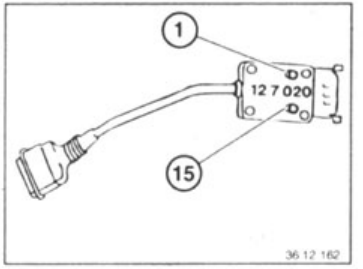


Fault in Injection System

Evaluation of ignition voltage peak in response to sudden accelerator loads

1 Beginning of dying-out process is not much higher than ignition voltage peak. Injection system is OK.

2 Beginning of dying-out process is considerably higher than ignition voltage peak. Fault in the injection system:
a) Lean mixture
b) Defective injection valve
c) Low compressions



Additional fault notes for troubleshooting

For troubleshooting on the primary side of a single ignition coil, use adapter for primary current measurement - special tool 12 7 020.

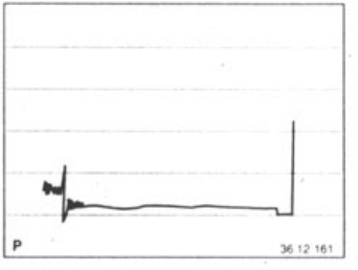
If terminal 1 signal is not present on pin 1 in the diagosis plug, the external trigger signal for the Service Tester can be prepared with the help of special tool 12 7 020.

Connect BMW Service Tester.
Select Engine Test Step 05.

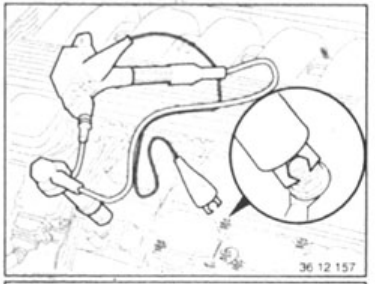
Enter number of cylinders (four).
Connect universal adapter to tester.
Connect brown clip to car's ground. Attach black terminal to terminal 1 of special tool 12 7 020.

If there is no trigger signal in the diagnosis box for a 6-cylinder engine, preselect a two-cylinder on the Service Tester.

The red inductive clip is not used as only one cylinder is being tested.
Consequently the engine speed display will be too low by factor 4.
Connect special tool 12 7 020 to the ignition coil being tested and the car's cable harness.



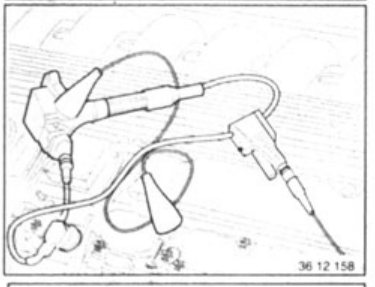
Produce a stationary signal on the oscilloscope by pressing key R.
Note:
The sparking voltage line on the oscilloscope will be very nervous, as the fuel/air mixture swirl of a 4-valve engine will be greater than that of a 2-valve engine.



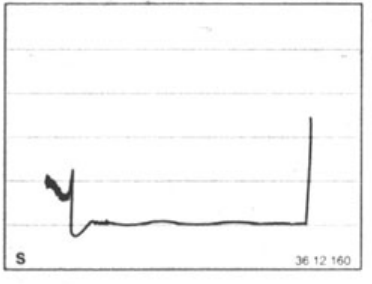
Examination of secondary signal for passive ignition distribution (special tool 12 7 030)

Engine Test Step 10

Remove ignition coil.
Clip special tool 12 7 030 on pertinent ignition coil to be tested.
Clip high tension clip around ignition lead.



Connect ground lead of adapter to vehicle ground and ignition coil. Connect up diagnosis plug.
If trigger signal is not present, (terminal 1), connect black terminal of universal adapter cable to Pin 1 of the primary adapter cable.



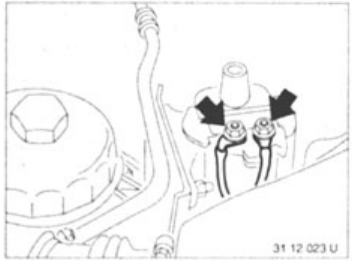
Produce a stationary signal by pressing key R on the tester.

Note:
Neighboring ignition leads could produce interference on the screen of the oscilloscope.

Refer to the fault memories of engine control units for additional troubleshooting.
Interrogate fault memory and its fault reports - refer to Electrical Troubleshooting Manual.

12 13 011 Replacing ignition coil (M 20, M 30, M 40)

Caution!
Only work on the ignition unit with the ignition switched off - dangerous high tension voltage.
Note working instructions for ignition unit - see Page 12 - 00.

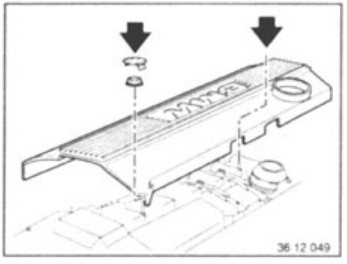


Remove protective cap and ignition lead (term. 4).
Unfasten connections (terminals 1 and 15).
Tightening torque 12 13 1AZ*
Unfasten bracket and remove ignition coil.

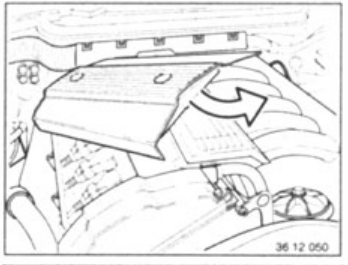
* Refer to Specifications

12 13 011 Replacing ignition coil (M 50)

Caution!
Always switch off ignition before working on ignition system - dangerous high tension voltage!
Note working instructions for ignition unit, see Page 12 - 0.

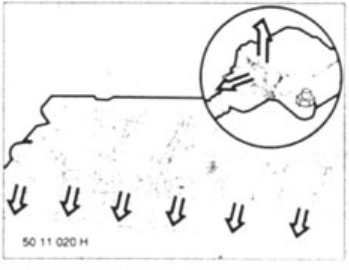


Remove oil filler cover.
Unclip cover on retaining screws.
Unscrew bolts.

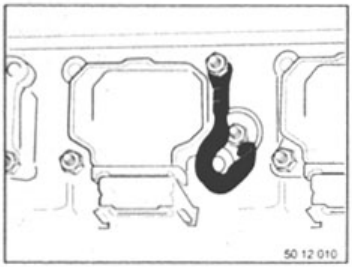


Remove cylinder head gasket.

Caution!
Ensure that no dirt falls into the open oil filler neck.
Close oil filler neck once cover has been removed.

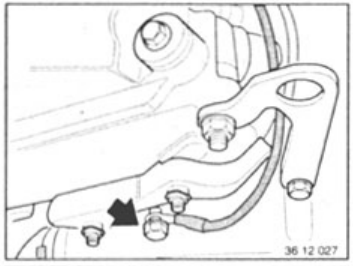


Unlock plug.
Pull off plugs.

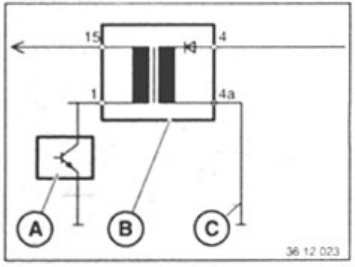


Unscrew bolts.
Pull out ignition coil.

Installation instruction:
Ground straps of the cylinder head cover must be secured on the ignition coils for cylinders 3 and 6.

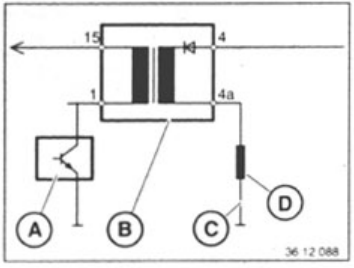


Caution!
Mutual ground connection of ignition coils (wire 4a) is screwed on front end of the cylinder head.



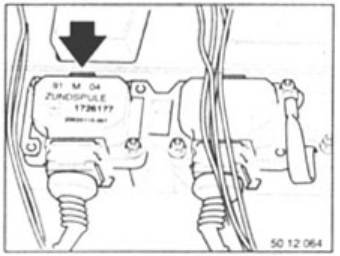
Bosch DME:

A Primary coil of ignition coil is controlled by the DME
B Ignition coil
C 4a = mutual ground connection on the secondary coils of the ignition coils

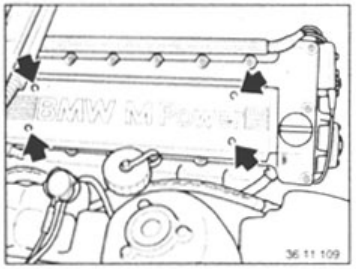


Siemens MS 40:

D Measuring resistance installed in the mutual ground connection for ignition coils. The measuring resistance is required for fault recognition in the secondary circuit of the ignition coils. The fault is stored in the engine control unit of the Siemens MS 40.

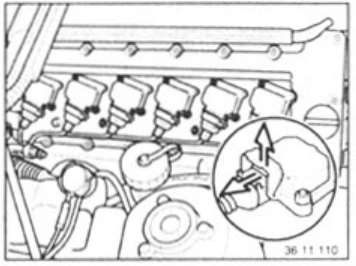


Caution!
To avoid destruction of the fault memory in a Siemens MS 40 engine control unit, only ignition coils from "May & Christe" may be used.

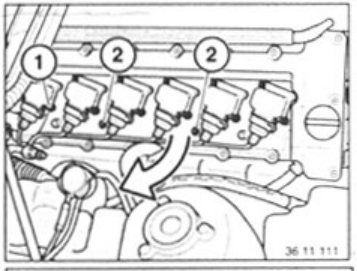


12 13 011 Replacing ignition coil (S38 B38)

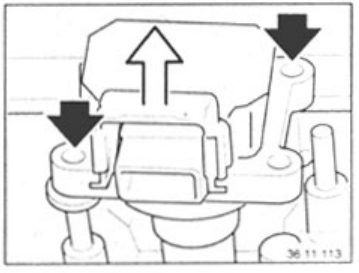
Unfasten screws.
Remove ignition coil cover.



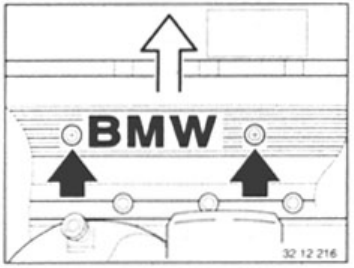
Disconnect plug from ignition coils.



Unfasten ground connection (1) on the ignition coil of the 6th cylinder.

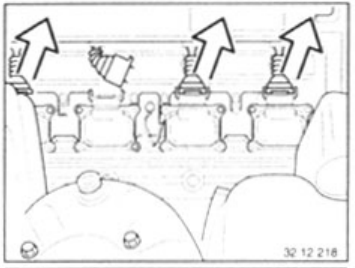


Unscrew nuts.
Remove ignition coils.

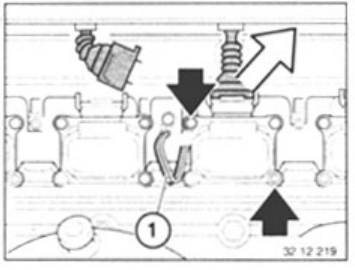


12 13 011 Replacing ignition coil (M 60)

Unclip and remove cover on screws in cylinder head cover.
Unscrew bolts.
Remove cover from cylinder head cover.

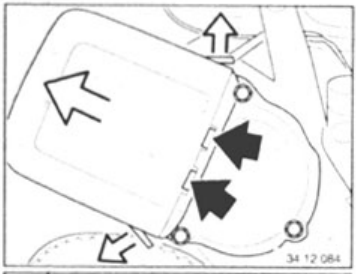


Unfasten plug connections on ignition coils.



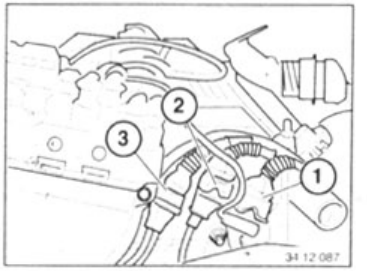
Unfasten screws on the ignition coils.

Installation instruction:
On the ignition coils for cylinders 2 and 6, the ground straps (1) for the cylinder head cover must be secured to the ignition coil screw connections.



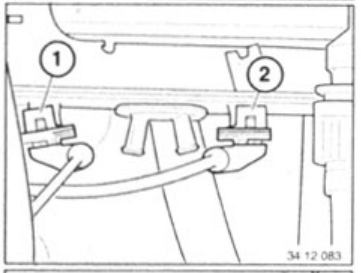
12 14 150 Replacing sensor for cylinder recognition (M 20, M 30, S38 B36)

Remove cover.
Sensor is fitted to ignition lead No. 6.
Disconnect suppressor plug from ignition lead.
Disconnect sensor from ignition lead.



S 38 B36
Unfasten plug (1).

TDC sensor on vibration damper (2).
Magnetic coupling on air pump (3).

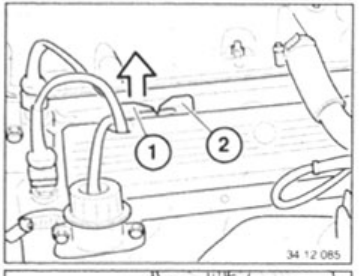


M 20
Disconnect plug connection (2) - remove cable. Fit new sensor.

1 = Inductive impulse sensor
2 = Cylinder recognition sensor

Removing fan and fan shroud including cover, see Gr. 17.

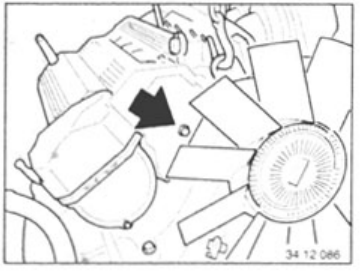
Note:
Unfasten water pipe.



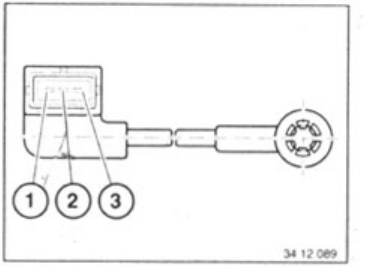
M 30
Disconnect plug connection - remove cable (2). Fit new sensor.



Installation instruction:
Fit suppressor plug.
See Construction Group, Pos. 12 12 072

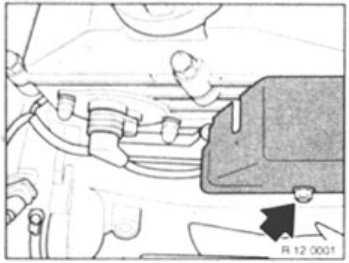


S 38 B36
Unfasten screw.
Remove cap.



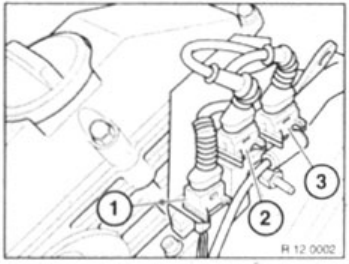
Check sensor:
Measure resistance* of coil between leads 1 and 2.

* Refer to Specifications



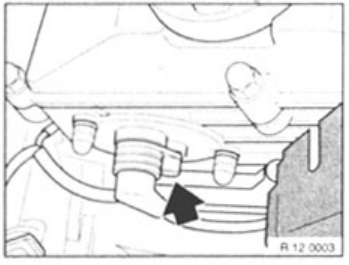
12 14 150 Replacing sensor for cylinder recognition (S38 B38)

Switch off ignition
Unfasten screw, remove cover.



Disconnect plug (3).

TDC sensor on vibration damper (2)
Magnetic coupling for vibration damper (1)



Remove screw.

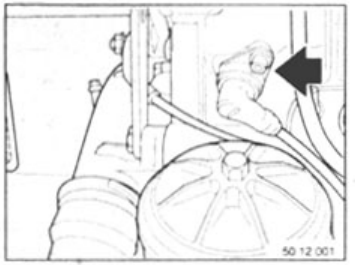
Installation instruction:
Replace O-ring.

Read fault memory.
Check stored faults.
Cancel fault memory.

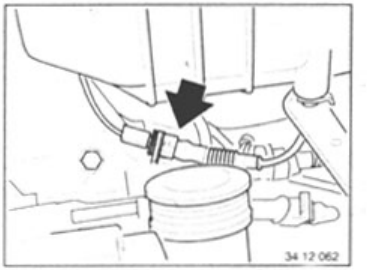
12 14 150 Replacing sensor for cylinder recognition (camshaft sensor M 50)

Function description, Bosch DME:
- Design: Inductive sensor:
- Only recognizes speed of camshaft.
- Different coding on sensor plug connection to prevent mistaken identity with the sensor on Siemens MS 40 engine control unit.
- Fault memory in DME control unit.
- Troubleshooting - refer to Electrical Troubleshooting Manual.

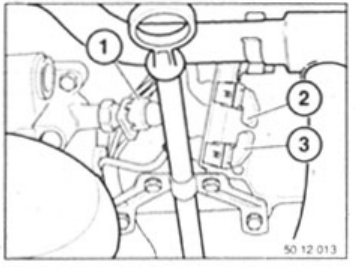
Description for Siemens MS 40 Control Unit:
- Design: Angle impulse sensor
- The speed and position of the camshaft is recognized.
- Position of camshaft is recognized even at speed 0.
- The sensor is supplied with high frequency by the control unit. Phase displacement is evaluated by the control unit.
- Fault memory in MS 40 control unit.
- Troubleshooting - see Electrical Troubleshooting Manual.



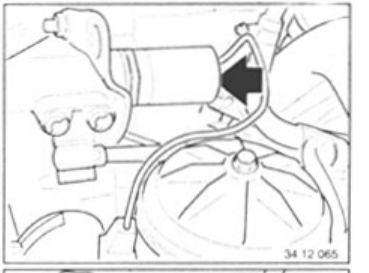
Remove screw.



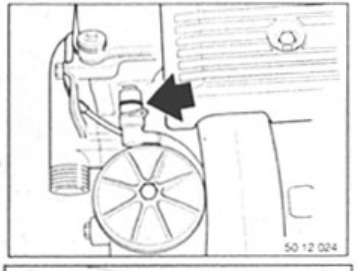
Unscrew solenoid.
Tightening torque*



Mark plug (2) on cable harness and disconnect it.



Check gasket, replacing if necessary.

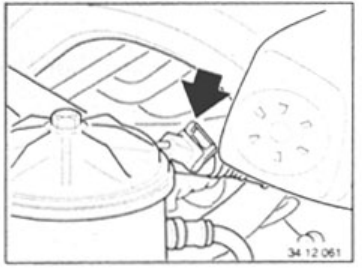


Remove sender.

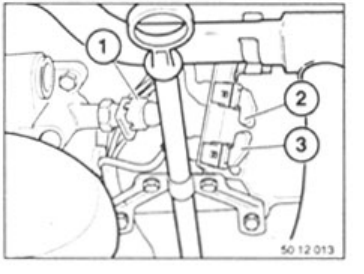
Installation instruction:
Check it is correctly seated on the rubber seal.



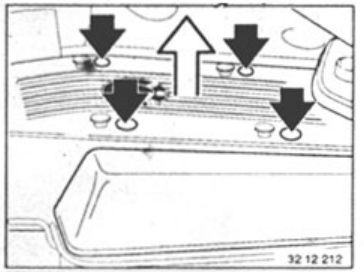
Remove screw.



M 50 TÜ (VANOS = Variable Camshaft Control):
Disconnect plug connection on VANOS adjustment unit.

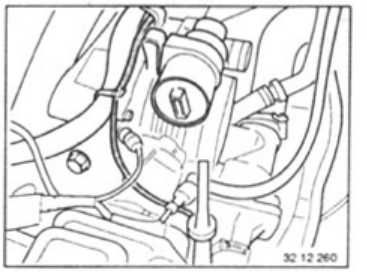


Mark plug (2) on cable harness and disconnect it.

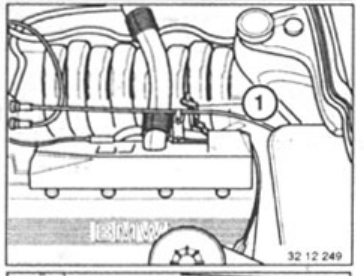


12 14 150 REPLACING CYLINDER IDENTIFYING SENDER (Camshaft Sender) (M60)

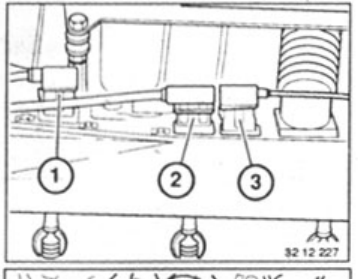
Interrogate fault memories.
Switch off ignition.
Unclip caps on screws of cover for cylinder head cover.
Unscrew screws.
Remove cover.



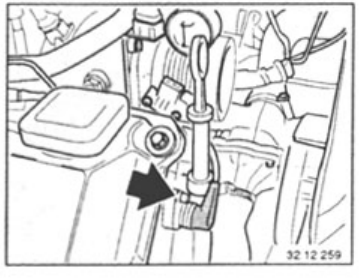
Note:
Routing of wiring on injection pipe.



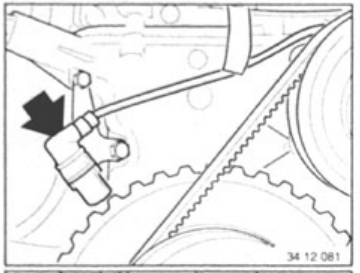
Disconnect plug (1).



Disconnect plug (1).

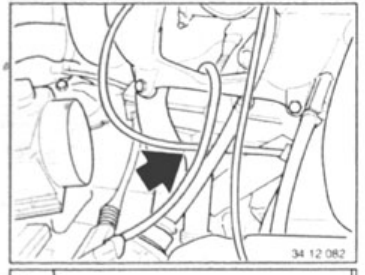


Unscrew screw.

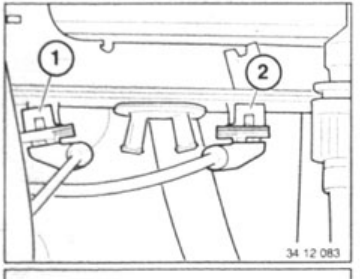


12 14 155 Replacing impulse sensor (M 20, M 30, M 40, S38 B36)

Check that impulse sensor is firmly seated and not damaged.

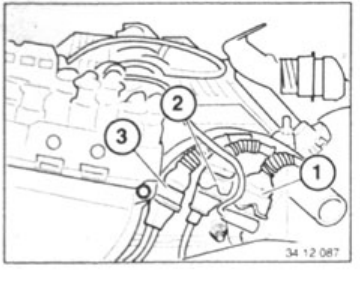


M 40
Disconnect plug connection.



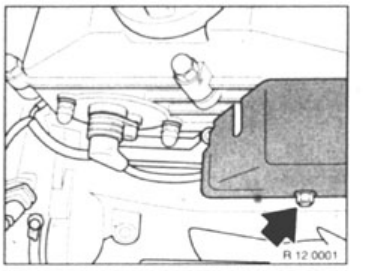
M 20, M 30
Disconnect plug connection (1).

Note:
Remove protective rail from side.



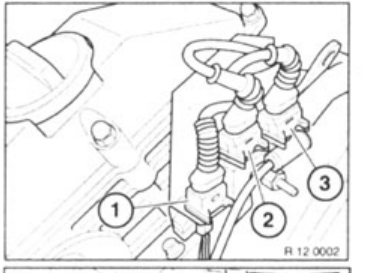
S38 B36

Disconnect plug (2).

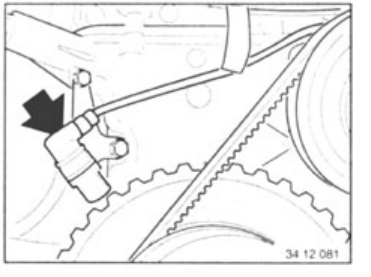


12 14 155 Replacing impulse sensor (S38 B38)

Switch off ignition,
Remove screw, remove cover.



Disconnect plug (2).

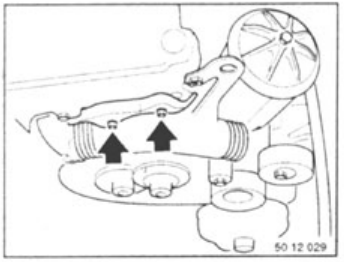


Remove screw.
Tightening torque 12 14 3AZ*
Interrogate fault memory.
Check faults stored in memory.
Cancel fault memory.

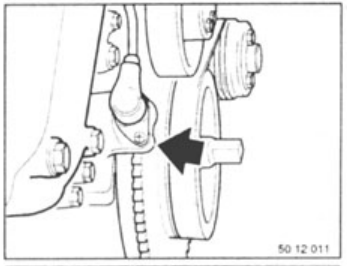
* Refer to Specifications

12 14 155 REPLACING PULSE SENDER (M50)

Description of Bosch DME:
- Design: inductive sender.
- Different coding of sender plug connection to avoid mixups with sender of Siemens MS 40 engine control.
- Fault memory in DME control unit.
- Troubleshooting - refer to Car Electric / Electronic Test Plan.



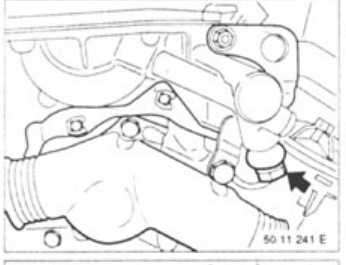
Unscrew screws.
Remove cover.



Unscrew screw.

Installation:
Ensure that the sender wire does not scrape on the increment gear after installation.

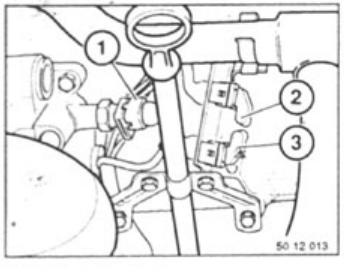
Description of Siemens MS 40:
- Design: angle pulse sender.
- Sender receives high frequency power from the control unit. Phase displacement between input and output signals is evaluated in the control unit.
- Fault memory in MS 40 control unit.
- Troubleshooting - refer to Car Electric / Electronic Test Plan.



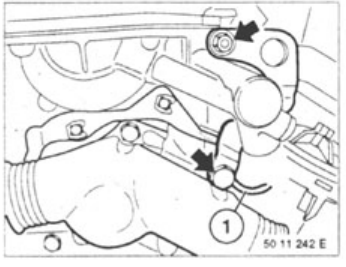
M 50 TÜ VANOS (= Variable Camshaft Control):

Unscrew oil pipe at VANOS control unit.

Installation:
Check seals, replacing them if necessary.
Tightening torque*.



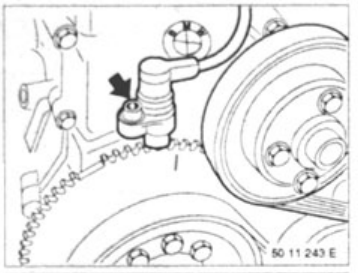
Disconnect plug (3).



Unscrew suspension eye bolts.

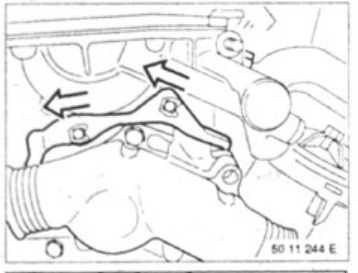
Installation:
Check connection of ground strap (1).

* Refer to Specifications

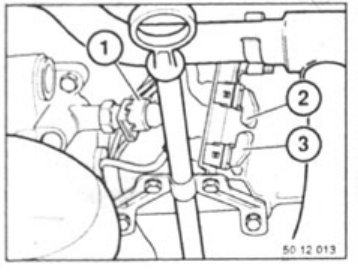


Unscrew pulse sender screw.

Installation:
Ensure that the sender wire does not scrape on the increment gear after installation.
Tightening torque*.

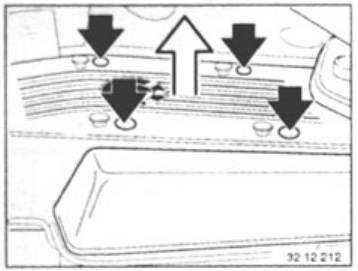


Remove wiring duct.



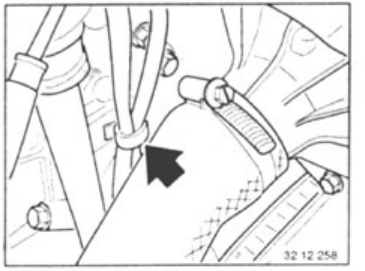
Mark location on wire harness and disconnect plug (3).

* Refer to Specifications

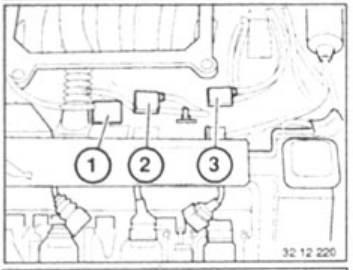


12 14 155 REPLACING PULSE SENDER (M60)

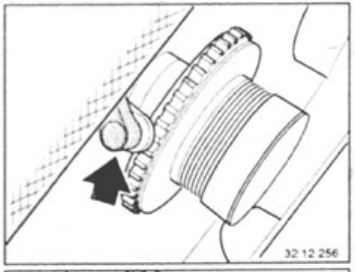
Interrogate fault memories.
Switch off ignition.
Unclip caps on screws of cover for cylinder head cover.
Unscrew screws.
Remove cover.



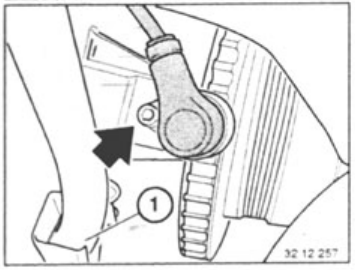
Note:
Check for correct routing of wiring at water pump.



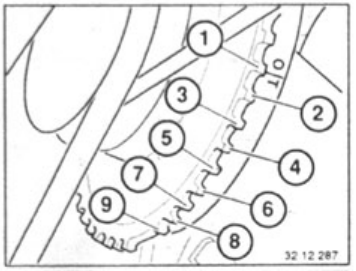
Disconnect plug (3).



Pulse sender is located close to increment gear.



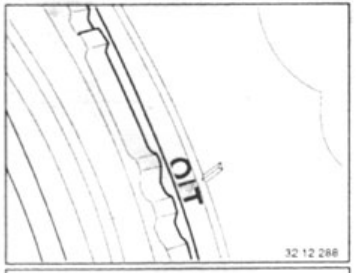
Unscrew screw (1).



Checking Increment Gear

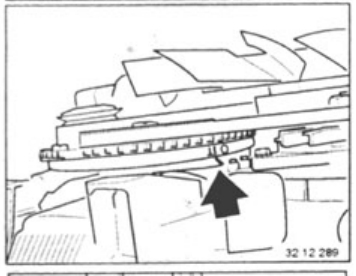
M 30
1. TDC mark must be found at middle of a tooth.
2. Gap must be found after 9 teeth from the TDC mark in the engine's direction of rotation.

If not, replace vibration damper.

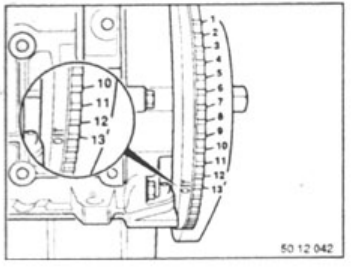


M 20
1. TDC mark must be found at middle of a tooth gap.
2. Large gap must be found after one tooth from the TDC mark in the engine's direction of rotation.

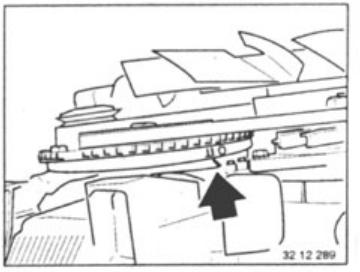
If not, replace vibration damper.



S 38
1. TDC mark must be found at beginning of the 12th tooth.
2. Large gap must be found after 11 teeth from the TDC mark in the engine's direction of rotation.



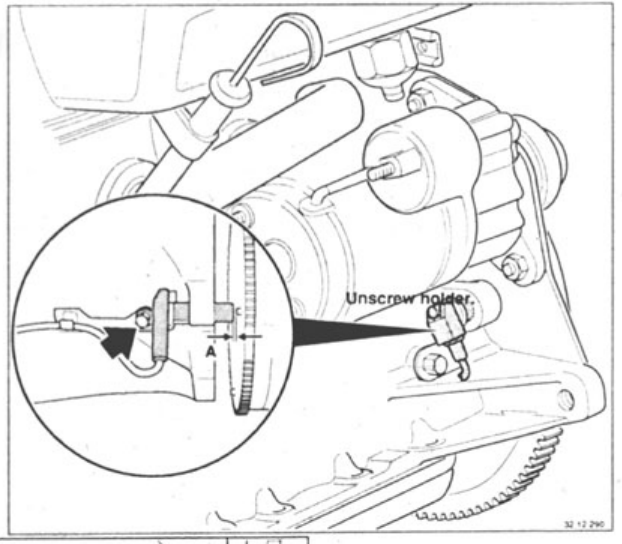
M 50
1. TDC mark must be found at middle of a tooth gap.
2. Large gap must be found after 13 teeth from the TDC mark in the engine's direction of rotation.

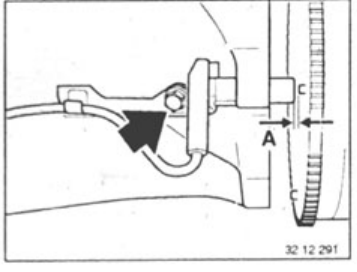


M 40
1. TDC mark must be found at middle of a tooth gap.
2. Bore for the dowel pin must be found after 11 teeth from the TDC mark in the engine's direction of rotation.

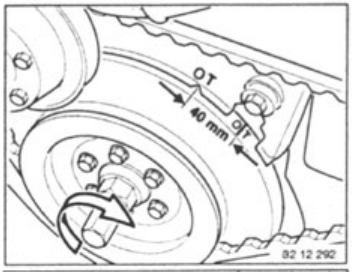
12 14 160 REPLACING AND ADJUSTING SPEED SEDER (M 21)

Disconnect plug; unscrew lead.

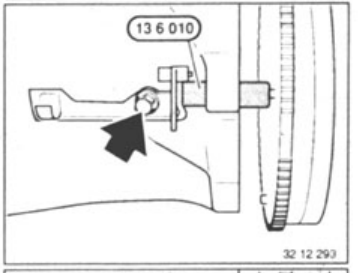




Adjusting:
Turn crankshaft 40 mm (1.575") further than the TDC mark.
Check whether dowel pin of the flywheel can be seen through take-up bore of the speed sender.

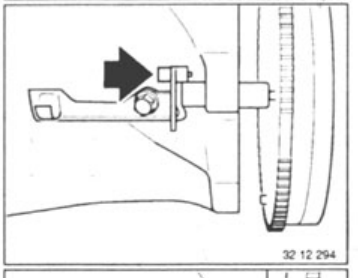


Mount Special Tool 13 6 010 on the holder. Mount holder on the crankcase and push forward against the stop. This automatically adjusts the distance (A) required between the pin on the flywheel and speed sender (Special Tool 13 6 010 is 1.3 mm / 0.051" longer than the speed sender).
Tighten the holder.

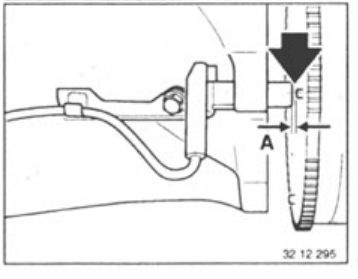


Unscrew Special Tool 13 6 010 on the holder and pull it out.

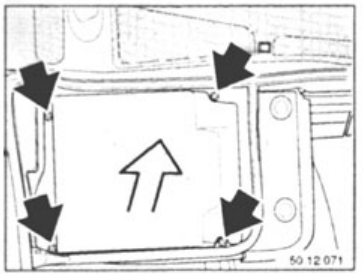
Important!
Holder must no longer be unscrewed on the engine block; only unscrew and pull out the special tool.

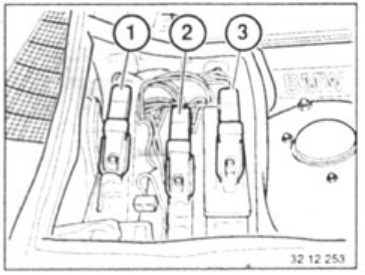


Slide speed sender into holder.
Screw speed sender.



Distance A: clearance between pin on the flywheel and speed sender.





12 14 550 REPLACING CONTROL UNIT FOR DIGITAL ENGINE ELECTRONICS (DME)

Interrogate fault memories.
Switch off ignition.
Unscrew screws of cover.
Remove cover.

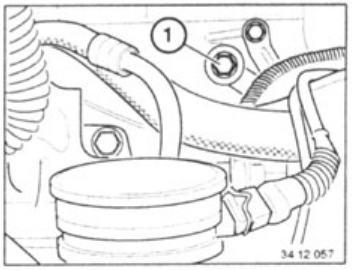
Remove control unit (1).

Note:
Location of control units could differ depending on version date of the model.
In case of doubt, remove concerned control unit and check the part number.

12 14 600 REPLACING KNOCK SENSORS (M50)

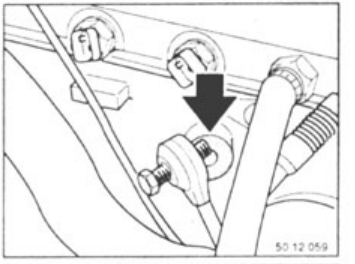
Interrogate fault memory of engine control unit.
Switch off ignition.
Remove complete collector - refer to Gr. 11.

Caution!
Mark plugs of knock sensors on the wire harness!
Mixing up plugs of knock sensors would lead to engine damage!

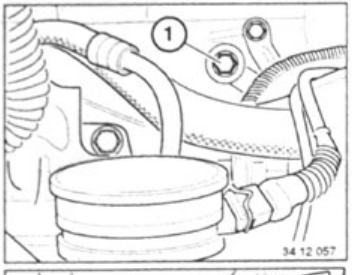


Unscrew bolt (1).

Installation:
Tightening torque*.

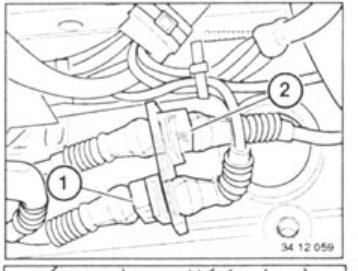


Installation:
Bearing surface of knock sensor on engine block must be clean.



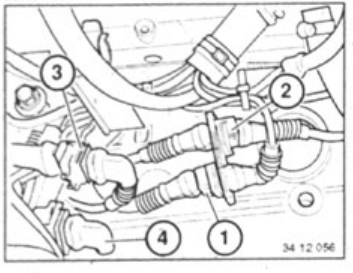
Knock Sensor (1) for Cylinders 1 to 3

Location:
Below temperature senders close to ventilating neck of alternator.

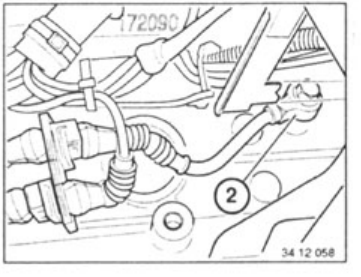


Knock Sensor (2) for Cylinders 4 to 6

Location:
Above starter.



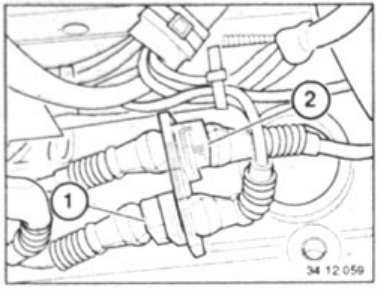
Plug is located below idle speed control (idle speed control not shown here).
Mark plugs of knock sensors on wire harness!
Disconnect plug (1).



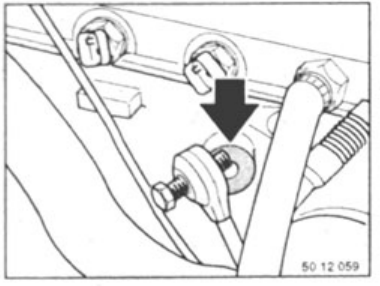
Unscrew screw (2).

Installation:
Tightening torque*.

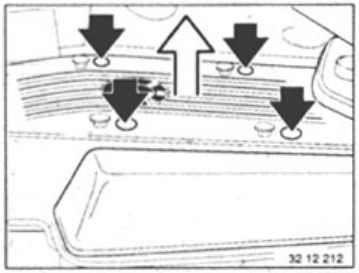
* Refer to Specifications



Plug is located below idle speed control (idle speed control not shown here).
Mark plugs of knock sensors on wire harness!
Disconnect plug (2).

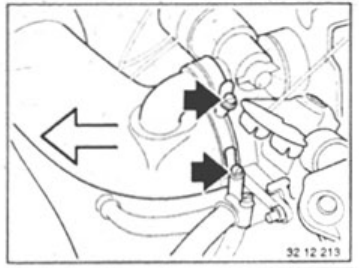


Installation:
Bearing surface of knock sensor on engine block must be clean.

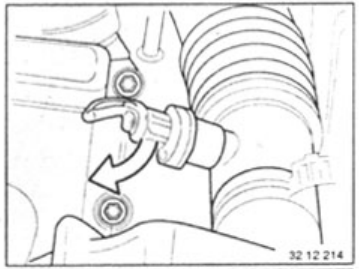


12 14 610 REPLACING KNOCK SENSORS ON RIGHT-HAND SIDE (Cylinders 1 - 4, M60)

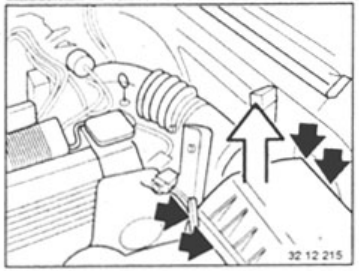
Interrogate fault memories.
Switch off ignition.
Unclip caps on screws for cover of cylinder head cover.
Unscrew screws.
Remove cover from cylinder head cover.



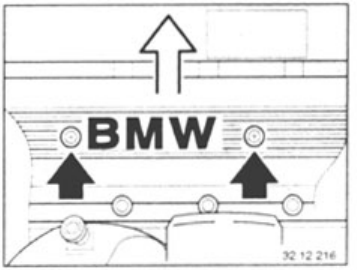
Loosen hose clamps on idle speed control and throttle valve assembly.



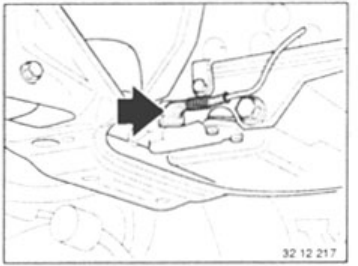
Disconnect plug on mass air flow sensor.



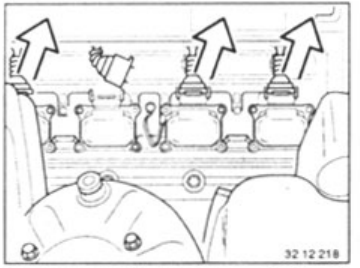
Unclip and remove air cleaner upper section together with mass air flow sensor.



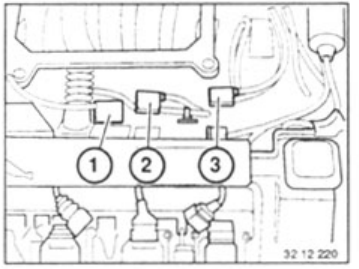
Unclip caps on screws.
Unscrew screws.
Remove cover from cylinder head cover at right-hand side.



Lift car.
Disconnect plug on oil level switch.

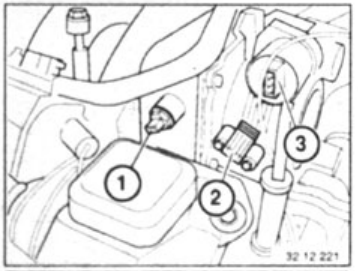


Disconnect plugs on ignition coils.

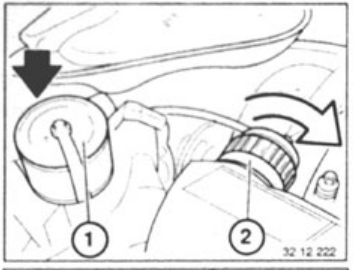


Disconnect plugs.
1 Knock sensor for cylinders 3 and 4
2 Knock sensor for cylinders 1 and 2
3 Pulse sender (on vibration damper)

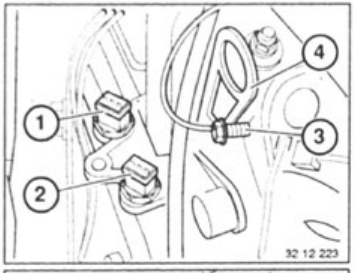
Caution!
Mixing up plugs of knock sensors would lead to engine damage!



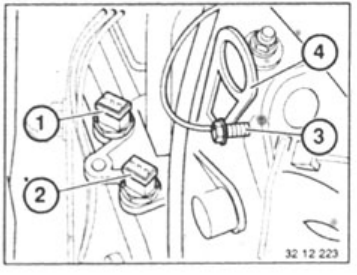
Disconnect plugs.
1 Intake air temperature sensor
2 Throttle valve potentiometer
3 Idle speed control



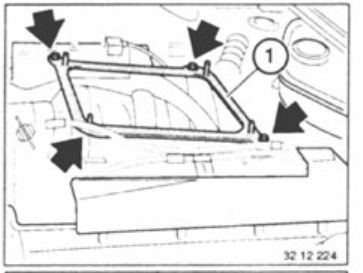
Disconnect plugs.
1 Diagnosis socket (unclip from holder)
2 Engine plug



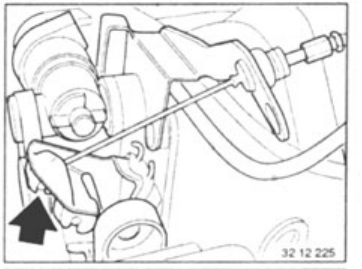
Unscrew mutual ground wire of ignition coils (3) close to rear engine suspension eye (4).



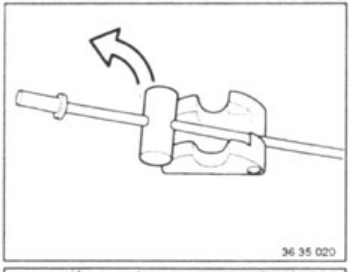
Disconnect plugs of temperature sensors.
1 Temperature sensor (black) for temperature gage
2 Temperature sensor (white) for digital engine electronics (DME)



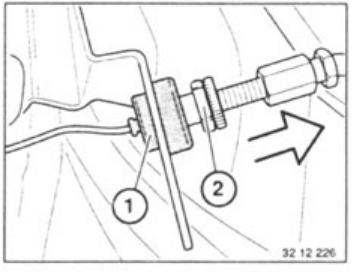
Remove holder (1) for cover of collector.
Unscrew screws.



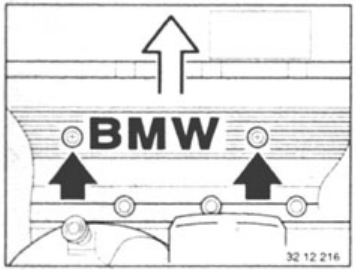
Disconnect throttle cable.
Compress nipple mounts at both retainers and press out of operating lever.



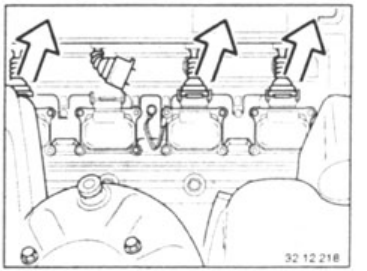
Press nipple out of nipple mounts.
Take cable out of nipple mounts.



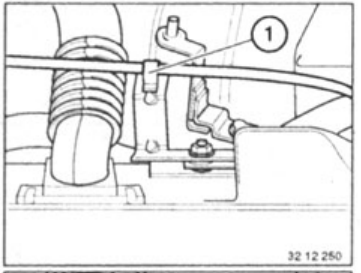
Take cable (2) out of rubber mount (1).
Take rubber mount (1) out of holder.
Remove throttle cable.



Unscrew cover of cylinder head cover at left-hand side (cylinder bank 5 - 8).

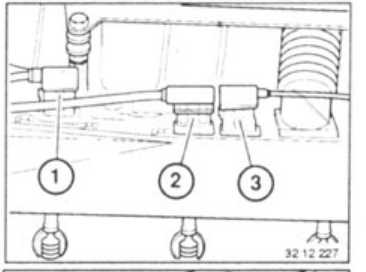


Disconnect plugs on ignition coils.



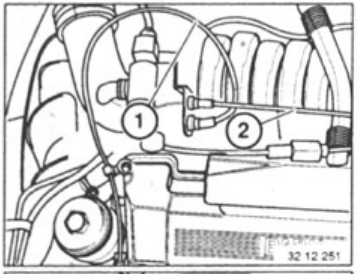
Routing of Throttle Cable

Take out of holder (1).



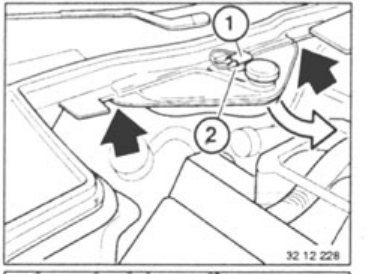
Disconnect plugs.
1 Camshaft sender
2 Knock sensor for cylinders 5 and 6
3 Knock sensor for cylinders 7 and 8

Caution!
Mixing up plugs of knock sensors would lead to engine damage!

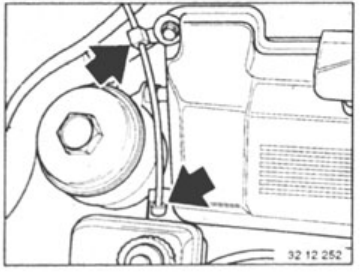


Cars with Cruise Control:

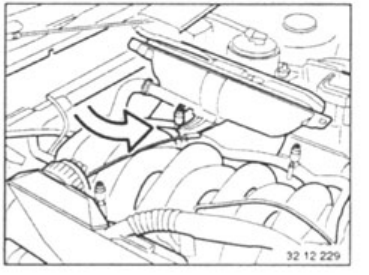
Route cruise control cable (1) underneath throttle cable (2).



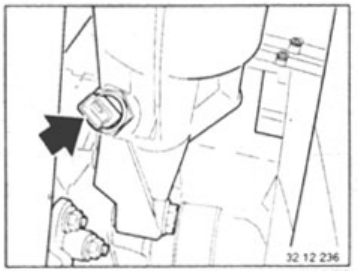
Disconnect plug (1).
Pull off spill hose (2).
Unscrew screws at left and right hand sides and place expansion tank aside.



Routing of Cruise Control Cable on Cylinder Head Cover



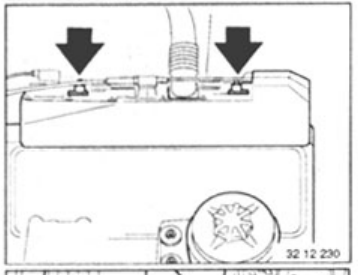
Coolant Expansion Tank



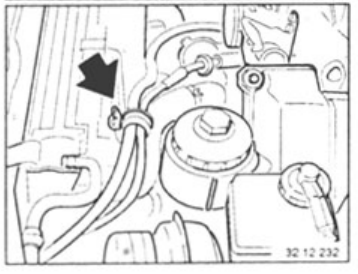
Disconnect plug on oil pressure switch.



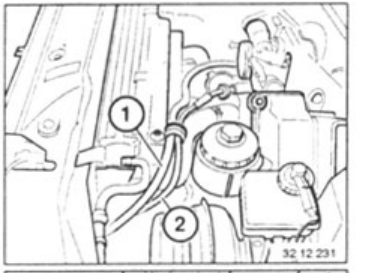
Remove pipe of oil pressure switch.



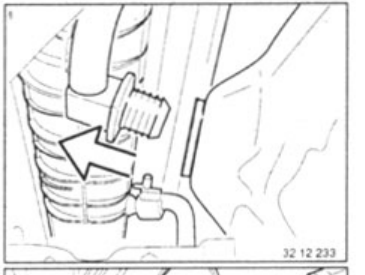
Unscrew screws of wiring ducts on cylinder heads.



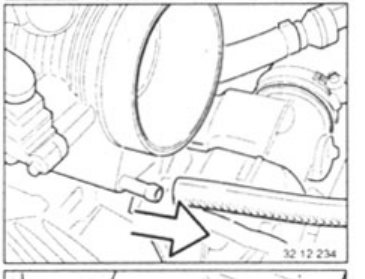
Disconnect vacuum hoses on radiator. Loosen hose clamp.



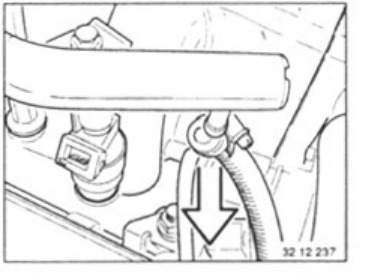
1 Tank vapor vent
2 Vacuum supply for brake booster



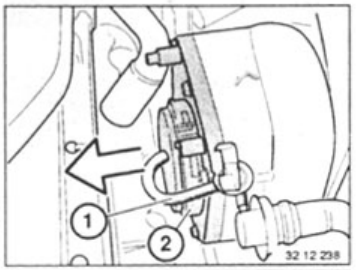
Disconnect vacuum hose at brake booster.



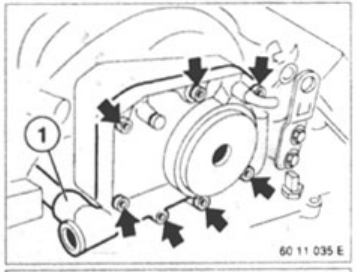
Disconnect tank vapor ventilation hose at throttle valve assembly.



Disconnect fuel feed and return pipes.



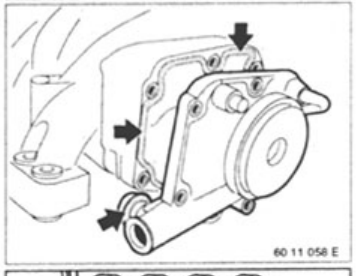
Pull hose (1) off of end cover (2) on back of manifold.



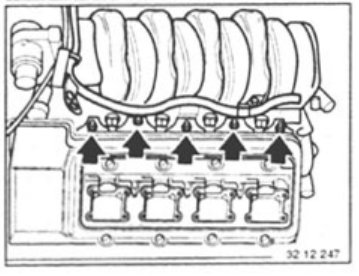
Unscrew bolts.

Installation:
Tightening torque*.

Important!
Pull off end cover together with pressure regulating valve straight back to avoid damaging vent pipe (1).



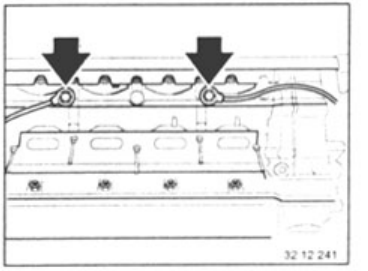
Installation:
Check seal and gasket, replacing them if necessary.



Unscrew bolts.
Remove manifold upwards.

Installation:
Tightening torque*.

* Refer to Specifications



Knock sensor 1 for cylinders 1 and 2
Knock sensor 2 for cylinders 3 and 4

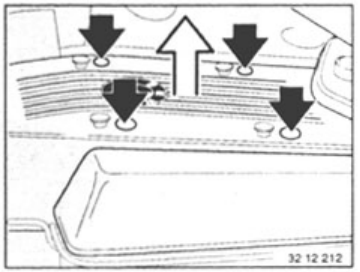
Unscrew screws.

Installation:
Tightening torque*.

Caution!
Mixing up plugs of knock sensors would lead to engine damage.
Routing of wires and connection of plugs must conform with original installation in car to avoid mixups.

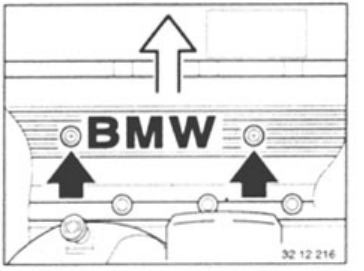
Interrogate fault memories.
Investigate stored faults.
Eliminate faults.
Erase fault memories.

* Refer to Specifications

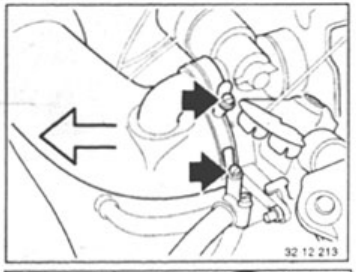


12 14 611 REPLACING KNOCK SENSORS ON LEFT-HAND SIDE (Cylinders 5 - 8, M60)

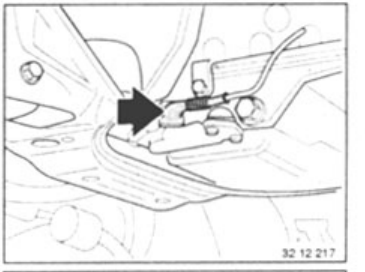
Interrogate fault memories.
Switch off ignition.
Unclip caps on screws for cover of cylinder head cover.
Unscrew screws.
Remove cover from cylinder head cover.



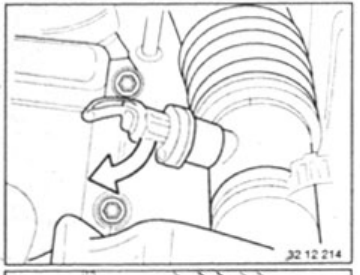
Unclip caps on screws.
Unscrew screws.
Remove cover from cylinder head cover at right-hand side.



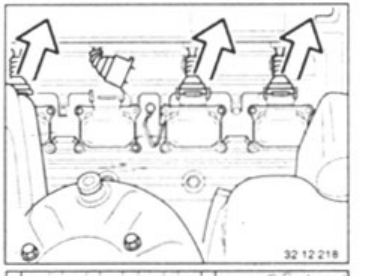
Loosen hose clamps on idle speed control and throttle valve assembly.



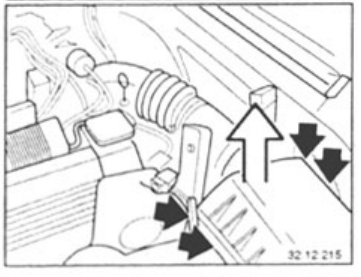
Lift car.
Disconnect plug on oil level switch.



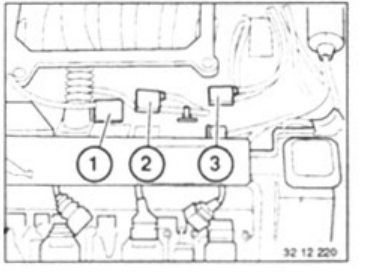
Disconnect plug on mass air flow sensor.



Disconnect plugs on ignition coils.

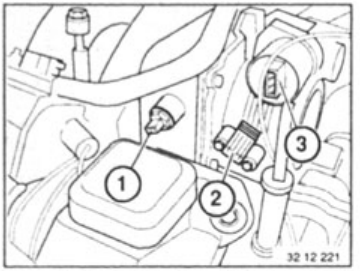


Unclip and remove air cleaner upper section together with mass air flow sensor.

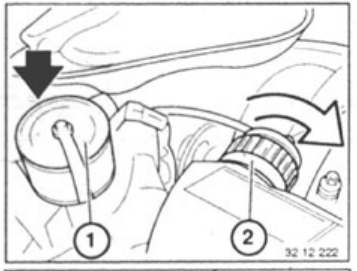


Disconnect plugs.
1 Knock sensor for cylinders 3 and 4
2 Knock sensor for cylinders 1 and 2
3 Pulse sender (on vibration damper)

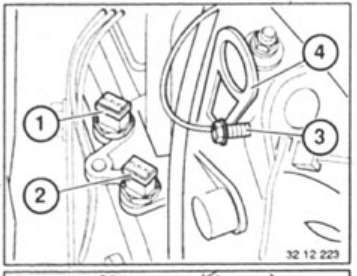
Caution!
Mixing up plugs of knock sensors would lead to engine damage!



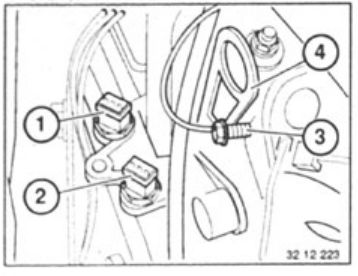
Disconnect plugs.
1 Intake air temperature sensor
2 Throttle valve potentiometer
3 Idle speed control



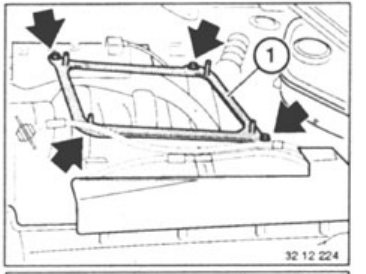
Disconnect plugs.
1 Diagnosis socket (unclip from holder)
2 Engine plug



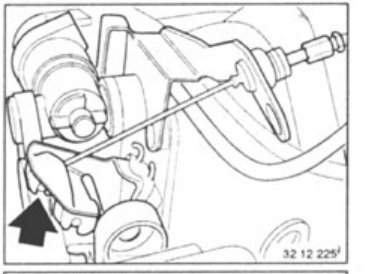
Unscrew mutual ground wire of ignition coils (3) close to rear engine suspension eye (4).



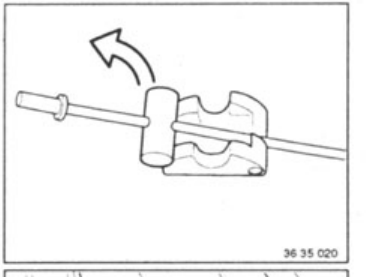
Disconnect plugs of temperature sensors.
1 Temperature sensor (black) for temperature gage
2 Temperature sensor (white) for digital engine electronics (DME)



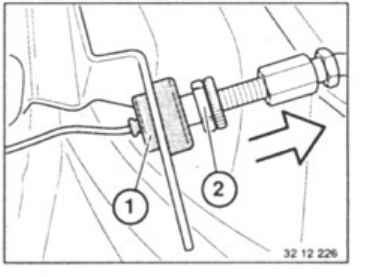
Remove holder (1) for cover of collector.
Unscrew screws.



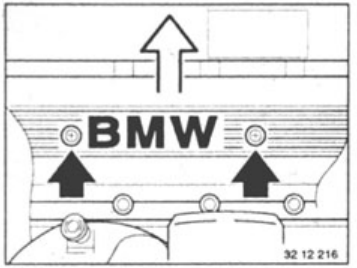
Disconnect throttle cable.
Compress nipple mounts at both retainers and press out of operating lever.



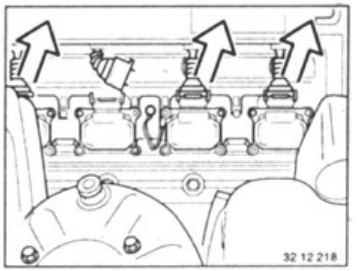
Press nipple out of nipple mounts.
Take cable out of nipple mounts.



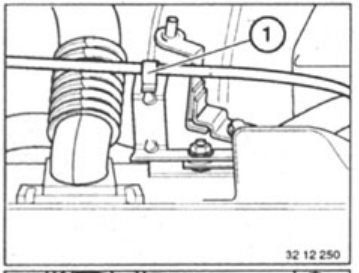
Take cable (2) out of rubber mount (1).
Take rubber mount (1) out of holder.
Remove throttle cable.



Unscrew cover of cylinder head cover at left-hand side (cylinder bank 5 - 8).

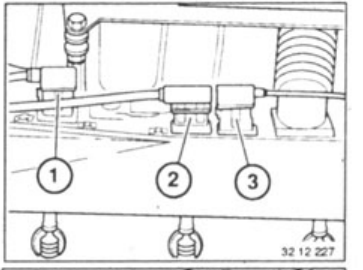


Disconnect plugs on ignition coils.



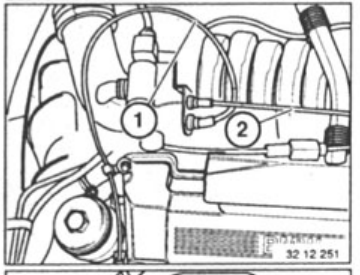
Routing of Throttle Cable

Take out of holder (1).



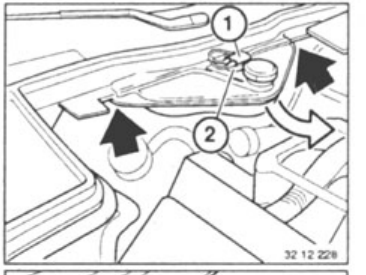
Disconnect plugs.
1 Camshaft sender
2 Knock sensor for cylinders 5 and 6
3 Knock sensor for cylinders 7 and 8

Caution!
Mixing up plugs of knock sensors would lead to engine damage!

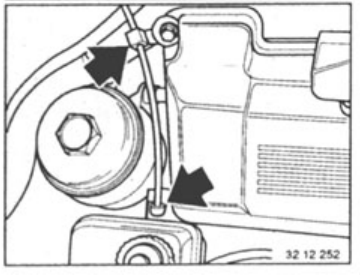


Cars with Cruise Control:

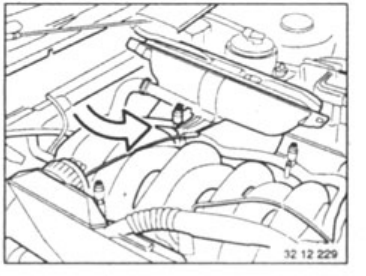
Route cruise control cable (1) underneath throttle cable (2).



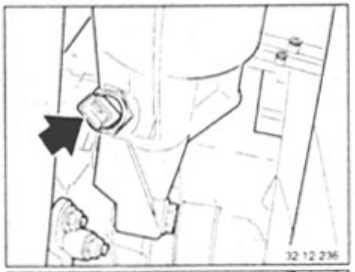
Disconnect plug (1).
Pull off spill hose (2).
Unscrew screws at left and right hand sides and place expansion tank aside.



Routing of Cruise Control Cable on Cylinder Head Cover



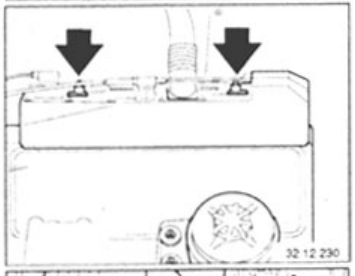
Coolant Expansion Tank



Disconnect plug on oil pressure switch.



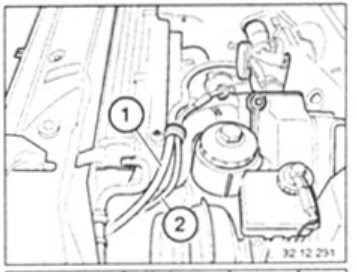
Remove pipe of oil pressure switch.



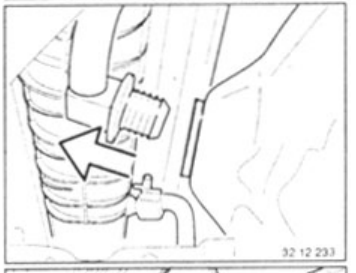
Unscrew screws of wiring ducts on cylinder heads.



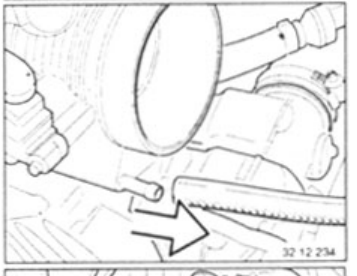
Disconnect vacuum hoses on radiator. Loosen hose clamp.



1 Tank vapor vent
2 Vacuum supply for brake booster



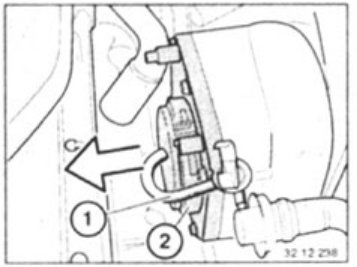
Disconnect vacuum hose at brake booster.



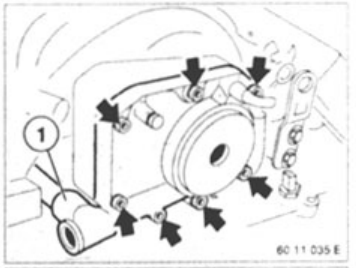
Disconnect tank vapor ventilation hose at throttle valve assembly.



Disconnect fuel feed and return pipes.



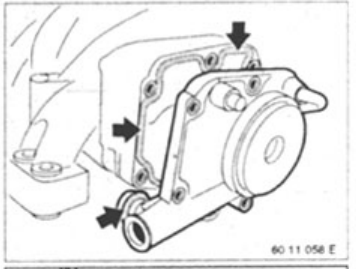
Pull hose (1) off of end cover (2) on back of manifold.



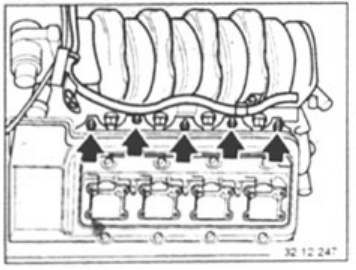
Unscrew bolts.

Installation:
Tightening torque*.

Important!
Pull off end cover together with pressure regulating valve straight back to avoid damaging vent pipe (1).



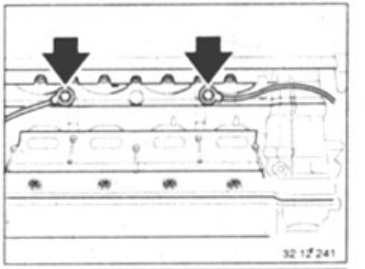
Installation:
Check seal and gasket, replacing them if necessary.



Unscrew bolts.
Remove manifold upwards.

Installation:
Tightening torque*.

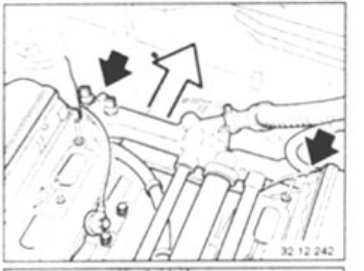
* Refer to Specifications



Knock sensor 1 for cylinders 1 and 2
Knock sensor 2 for cylinders 3 and 4

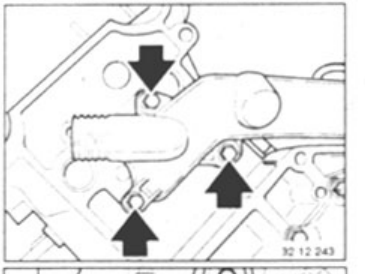
Unscrew screws.

Installation:
Tightening torque*.



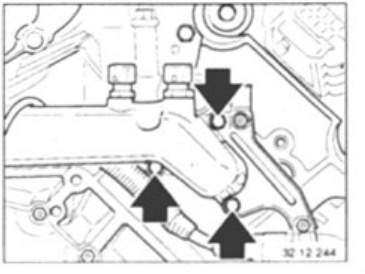
Knock Sensors for Cylinders 5 - 8

Drain coolant.

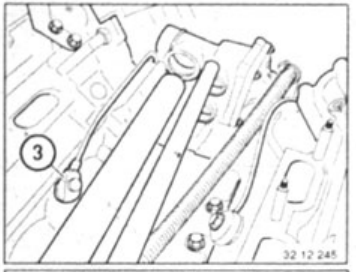


Remove water port on back of cylinder heads.
Unscrew bolts.

Installation:
Replace gaskets.
Tightening torque*
Refer to Group 1 for additional information!



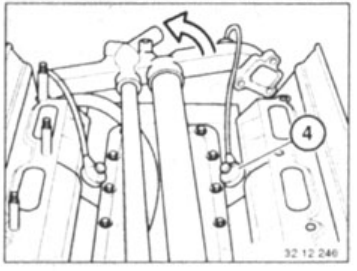
* Refer to Specifications



Knock Sensor 3

Unscrew screw.

Installation:
Tightening torque*.



Knock Sensor 4

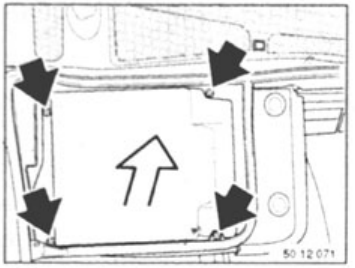
Unscrew screw.

Installation:
Tightening torque*.

Caution!
Mixing up plugs of knock sensors would lead to engine damage.
Routing of wires and connection of plugs must conform with original installation in car to avoid mixups.

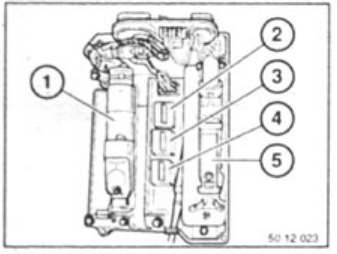
Interrogate fault memories.
Investigate stored faults.
Eliminate faults.
Erase fault memories.

* Refer to Specifications

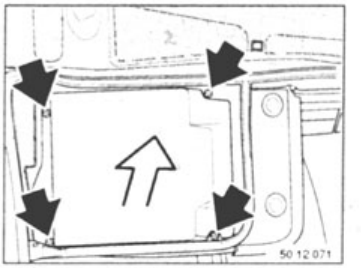


ENGINE WIRE HARNESS RELAYS
(M20, M30, M40, M50):

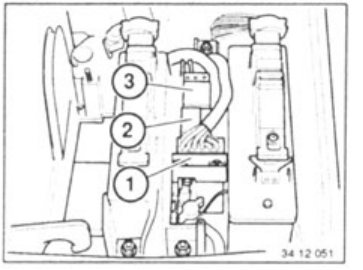
Unscrew screws.
Remove cover.



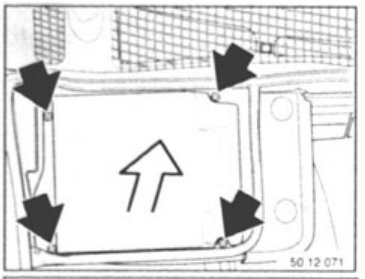
1 Engine control unit (Bosch DME or Siemens MS 40)
2 Engine control master relay
3 Electric fuel pump relay
4 Oxygen sensor heating relay (not installed with Siemens MS 40)
5 ABS control unit



ENGINE WIRE HARNESS RELAYS
(M51):

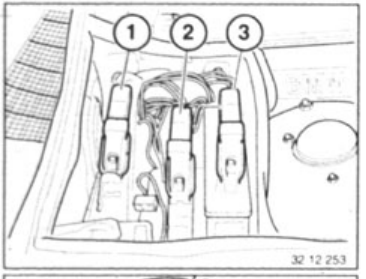


1 Preheating relay
2 Fuel transfer pump relay
3 DDE (Digital Diesel Electronics) master relay

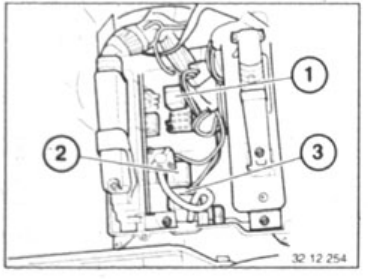


Relay allocation on engine cable harness (M 60)

Unfasten screws.
Remove cover.



1 Control unit for Digital Engine Control
2 Control unit for Automatic Transmission
3 Control unit for ABS

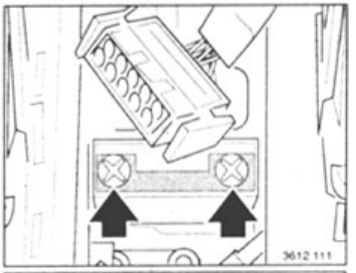


1 Main relay for engine control unit
2 Relay for electrical fuel pump
3 Relay for Lambda oxygen sensor heating

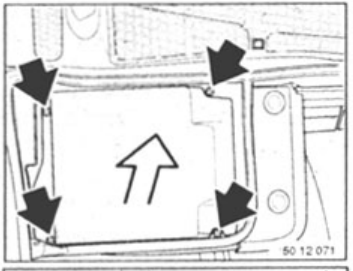
Note:
Depending on the model of the car, the installation location for the relays can differ. In cases of doubt, extract different relays to check whether the desired function interrupt has been achieved.

12 21 500 REMOVING AND INSTALLING OR REPLACING RELAY FOR GLOW PLUGS

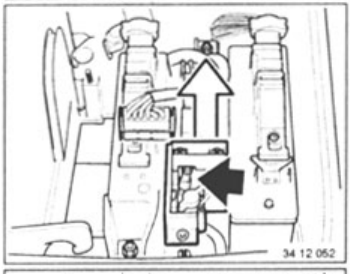
Interrogate fault memory.
Disconnect battery ground lead.
Remove insulation sheet.



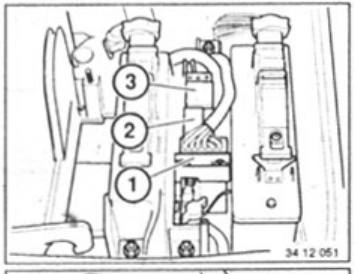
Check 80 ampere fuse.
Replace if defective.
Unscrew screws.
Tightening torque*.
If fuse has failed, always check for cause of fault.
Continue with checking glow plugs - refer to 12 23 000.



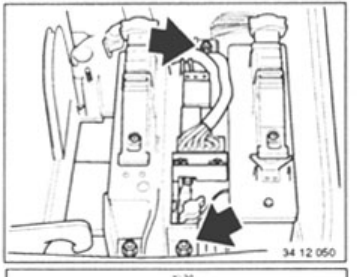
Unscrew bolts.
Remove cover.



Unscrew positive lead.
Tightening torque*.

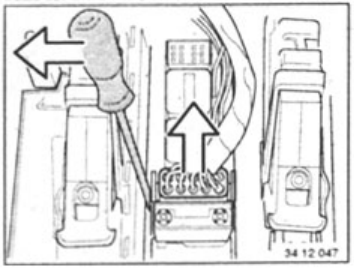


Remove control unit (1).

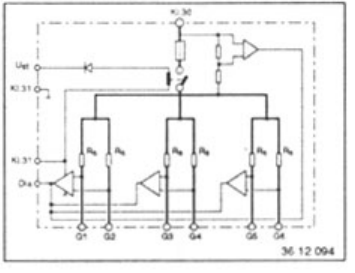


Removing the control unit will be easier, if the screws of the equipment carrier are loosened first.

Note:
Relay is activated directly from control unit of Digital Diesel Electronics.



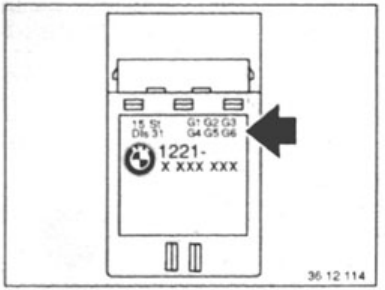
Press retaining hook back and pull control unit out.
Disconnect plug.



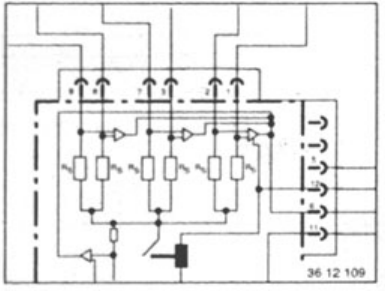
Wiring Diagram:

G1 ... G6:	Glow plugs 1 ... 6
Term. 15:	Positive switched in by ignition switch
Term. 30:	Battery positive
Term. 31:	Battery ground
U_{SI}:	Control voltage
Dia.:	Diagnosis interface

* Refer to Specifications

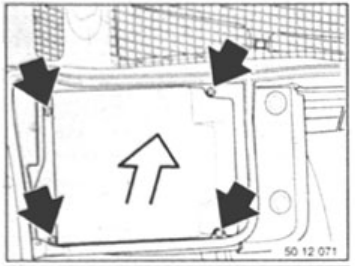


Plug Connections:
Printed on control unit.



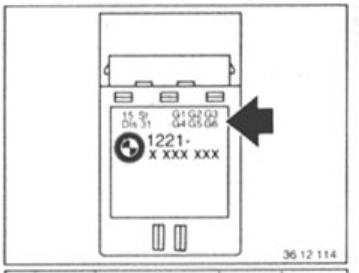
Pin No.:	Wire Color:	Glow Plug Cyl.:
9	black/green	1
8	black/violet	2
7	black/yellow	3
3	black/red	4
2	black/white	5
1	black/brown	6

Continue with troubleshooting - refer to the Car Electric/Electronic Test Plan for Digital Diesel Electronics (DDE 2).

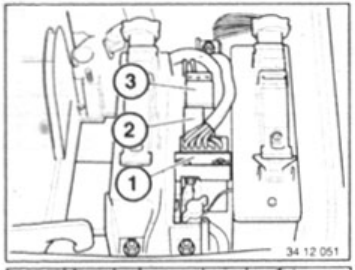


12 23 000 Checking all heater plugs

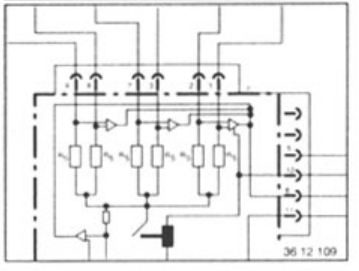
Battery voltage > 9 V.
Switch off ignition.
Remove cover on control units.



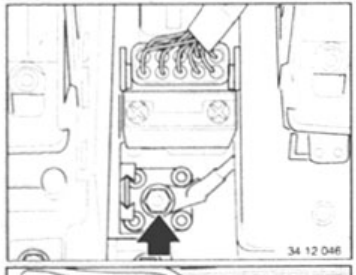
Plug Pin Connection:
Printed on control unit.



Disconnect plug connections from control unit (1).

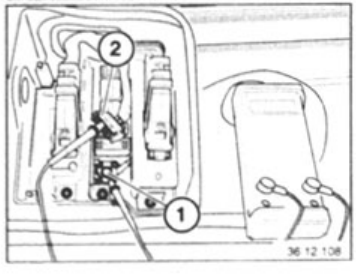


Pin No.:	Wire Colors:	Heater Plug, Cyl.
9	black-green	1
8	black-violet	2
7	black-yellow	3
3	black-red	4
2	black-white	5
1	black-brown	6



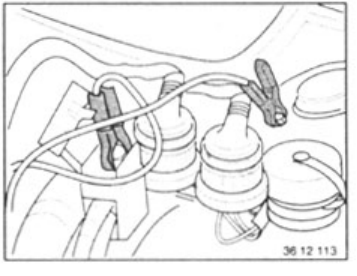
Remove cover from positive battery terminal.

Caution!
Never operate removed heater plugs - danger of injury and fire!



Connect measuring cable (special tool numbers 61 1 473 and 61 11 475) to ammeter. Connect up ammeter between plug connection on cable harness (2) between heater plugs and positive battery terminal (1) and read off current intake level*.

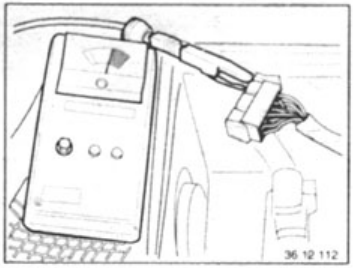
* Refer to Specifications



Check with Beru fast tester*

Disconnect plug on control unit.
Connect red lead (1) of tester on battery positive.
Connect blue lead (2) of tester on battery ground.

* Source of Supply: BMW Parts Service



Circuit diagram - see 12-23/1. Install measuring cable (special tool number 61 1 473) in plug connection of heater plug being inspected.
Connect black lead on test device to measuring cable.

Wait until red lamp lights up, equipment is ready for testing.
Press start button on tester - green lamp lights up.

Needle in green zone:
Heater plug in good working order

Needle in red zone:
Heater plug is faulty.
Time of test: approx. 12 seconds.

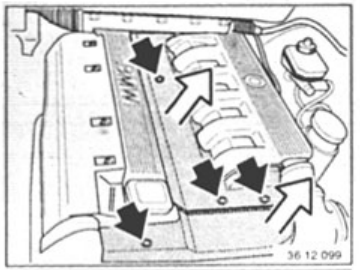
Test completed:
Red lamp lights up.
Continue with next heater plug.

Caution!
Additional troubleshooting :
If a faulty heater plug is found during the test, it is essential to also check the supply lead from the control unit to the heater plug.
Example: Tightness of screw on heater plug, continuity test of supply lead and tightness of screwed connector on supply lead.

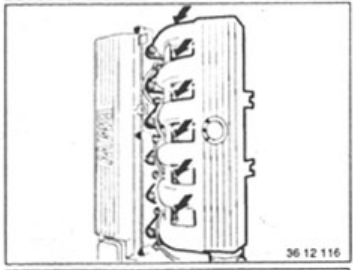
If other disturbances occur even though the heater plugs are okay, check the activation of the heater plug relay, the heater plug relay itself and the 80 amp fuse on the heater plug relay.
Also refer to the Electrical Troubleshooting Manual, Section 1360, Digital Diesel Electronics.

12 23 505 REPLACING ALL GLOW PLUGS

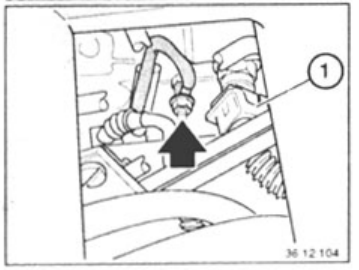
Interrogate fault memory.
Disconnect battery ground lead.



Remove covers.

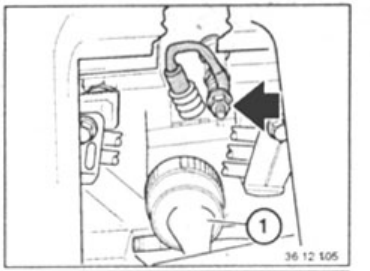


Location of glow plugs

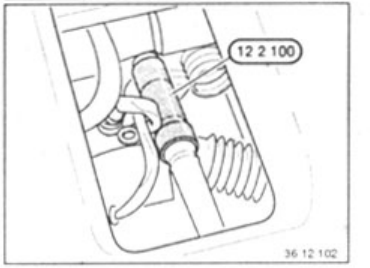


Unscrew lead screw.
Tightening torque*.

* Refer to Specifications



Unscrew lead screw.
Tightening torque*.



Unscrew glow plugs using Special Tool 12 2 100.
Tightening torque*.

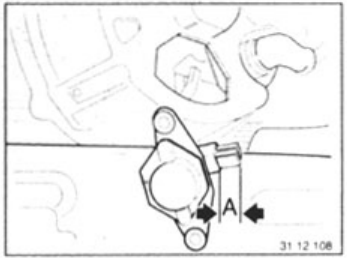
* Refer to Specifications



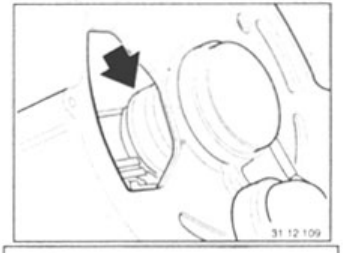
12 31 009 Checking 3-phase alternator and voltage regulator

Prerequisite for the inspection:

- Correct connections to charged battery
- Correct connections to alternator and starter motor
- Good ground connection between engine and body
- Taut Vee belt

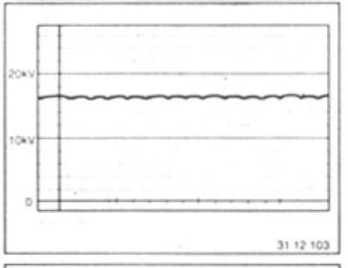


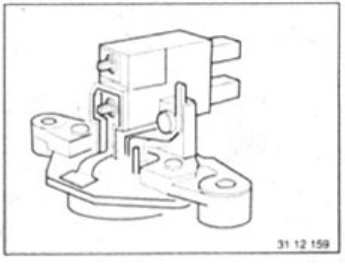
If the battery charge telltale lights continuously:
Remove voltage regulator and check carbon brushes, replacing if necessary 12 31 200.
Minimum length "A" 5 mm.



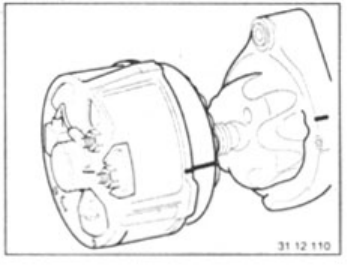
Caution !

Some alternators have normal regulators and some alternators have constant voltage regulators.
The regulators are coded mechanically and must not be confused!





Normal regulator



Constant voltage regulator
Can be identified by the mechanical coding.

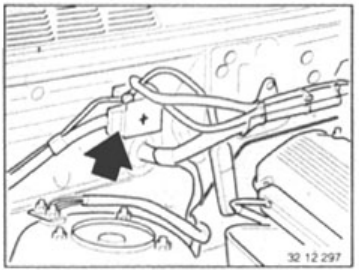
Under no circumstances may the constant voltage regulator be installed in vehicles with a battery in the engine compartment. This would result in damage to the battery.

Installation instruction:
Check scraper rings for signs of wear, precision-turning if necessary and polishing.
Connect up **BMW SERVICE TESTER.**
Start engine and compare readings with nominal values.

If the charge control light goes out while the engine is running and the control voltage* is not achieved, and if the oscillogram is okay (as per illustration), the voltage regulator must be replaced 12 32 000.
For additional oscillograms, see Electrical Troubleshooting Manual, 7 Series.

If the specified charge current is not achieved, remove and dismantle the alternator and inspect the components.
For additional troubleshooting and instructions or disassembly of the alternator, see Construction Group Repair Manual, Group 12.

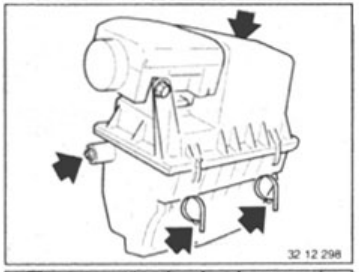
* Refer to Specifications



12 31 020 Removing and installing 3-phase alternator (M 20, M 21, M 30, M 40, S 38)

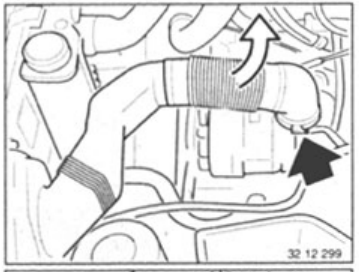
Disconnect negative terminal from battery. (Or pos. terminal on the firewall).

M 21 / M 30 battery under rear bench seat on right.



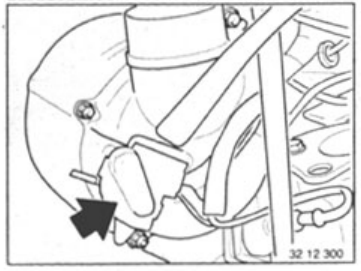
M 20 / Remove air filter with volume air flow sensor.
Remove plug, loosen hose clip, unfasten retaining screws, lift up air filter with volume air flow sensor, unfasten retaining screws from coolant hose and lift out air filter together with volume air flow sensor.

Note:
S 38 Removing fan and fan shroud, see Gr. 17
Removing suction filter housing, see Gr. 13.

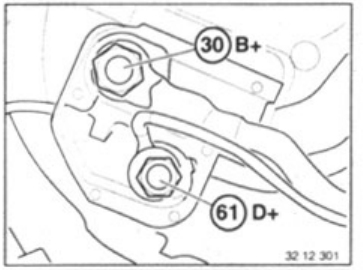


Remove coolant air hose.
Loosen hose clamps.

Note:
M 30 Remove coolant hose prior to disassembly.

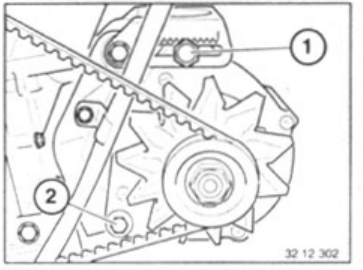


Alternator: remove protective cover.

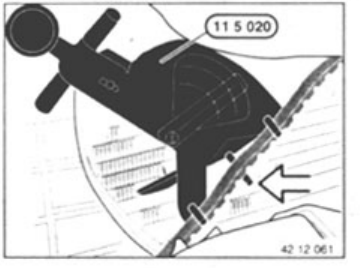


Alternator:
Unfasten leads on connection B+ (term. 30) and D+ (term. 61).

Tightening torque 12 31 1AZ*

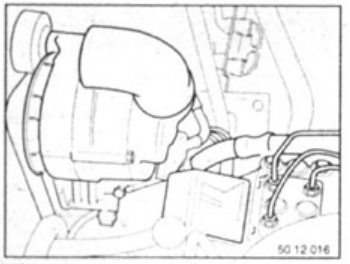


Loosen upper nut and remove screw together with tensioning wheel.
Loosen lower nut and remove screw (leads D+/B+ removed)



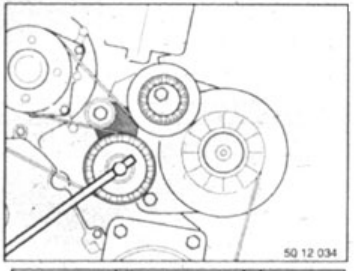
Installation instruction:
Tensioning V-belt* (SR version) see 12 31 299.

* Refer to Specifications

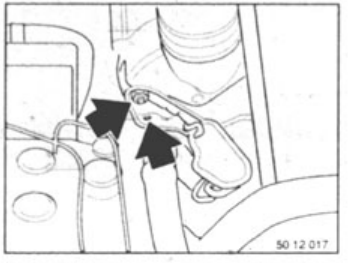


12 31 020 REMOVING AND INSTALLING ALTERNATOR (M50)

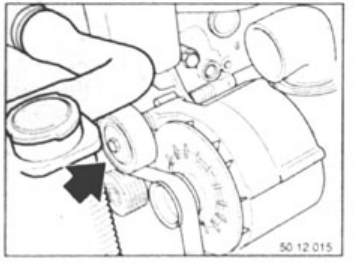
Disconnect battery ground lead.
Remove complete air cleaner.
Remove alternator vent hose.
Remove fan and fan cowl.



Slacken and remove the ribbed drive belt.

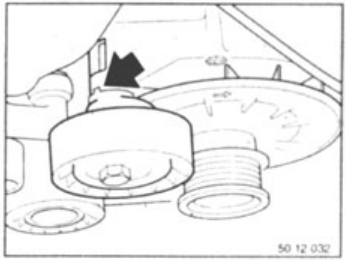


Remove cover from connections.
Unscrew wires.
Tightening torque*.



Unscrew screws.
Remove alternator.

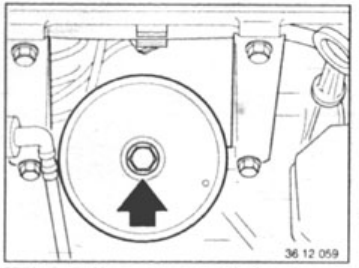
* Refer to Specification



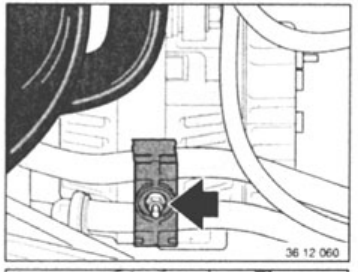
Installation:
Ensure that tab of the ribbed drive belt contacting roller engages in the opening.

12 31 020 REMOVING AND INSTALLING OR REPLACING ALTERNATOR (M51)

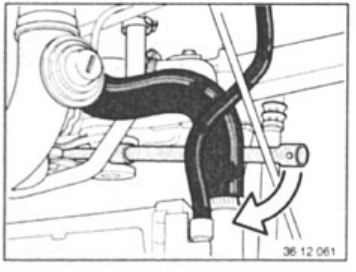
Refer to general information on page 12-00.
Interrogate fault memory.
Disconnect battery ground lead.



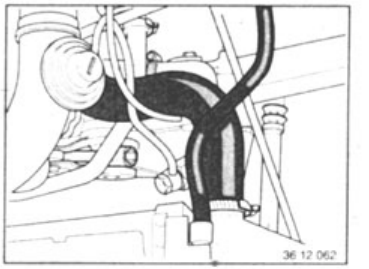
Unscrew cap on full flow oil filter and remove oil filter element.



Unscrew holder of engine oil pipes on alternator.

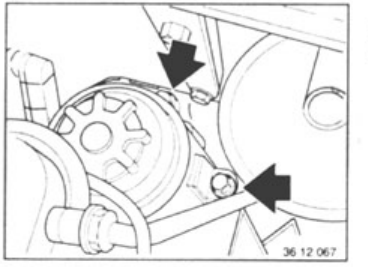


Slacken ribbed drive belt.
Slacken the automatic belt tensioner using a suitable lever (e.g. short and long ratchet extensions).
Apply short ratchet extension at front end.

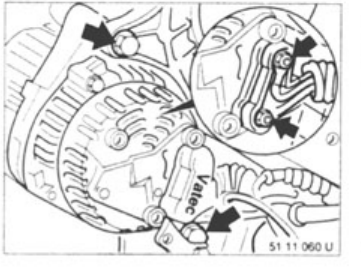


Leave short section of extension inserted between belt tensioner and coolant pipe / charge air pipe.
Belt tensioner remains preloaded.

Installation:
Pay attention to arrangement of belt.

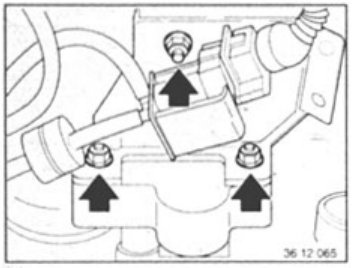


Unscrew power steering supply tank screws on engine carrier.

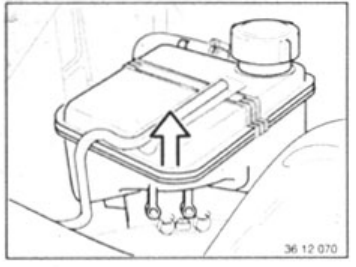


Pull cover off of wire harness connections on alternator.
Unscrew wires.
Tightening torque*

* Refer to Specifications

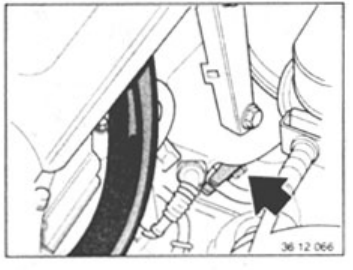


Unscrew bolts of charge air cooler and EGR valve.



Unclip coolant expansion tank and lay aside.

Important!
Always wrap rags around ends of pipes before disconnecting engine oil pipes on oil filter, so that escaping oil will not run into and collect in the engine guard. Complaints about "oil leakage" would be the result.

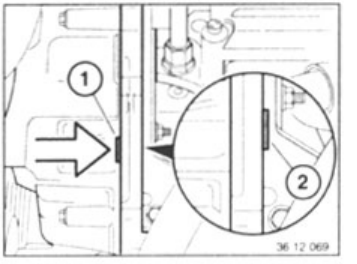


Unscrew engine oil pipe coupling on oil filter.
Remove engine guard.
Tightening torque*.

* Refer to Specifications

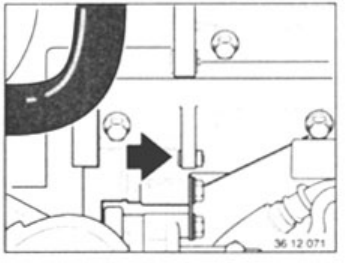


Unscrew alternator bolts.
Tightening torque*.



Installation:
Press bushings out on engine carrier before installing the alternator.
The alternator will then be easier to install.

1 = Locations of bushings after removal
2 = Installed position

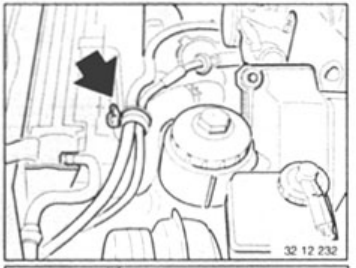


Lower bracket.

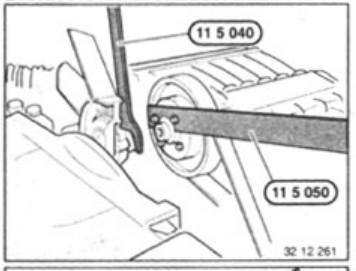
* Refer to Specifications

12 31 020 REMOVING AND INSTALLING OR REPLACING ALTERNATOR (M60)

Interrogate fault memories of control units as disconnecting the battery will erase fault memories.
Disconnect battery ground lead.
Refer to general information on page 12-0/1.



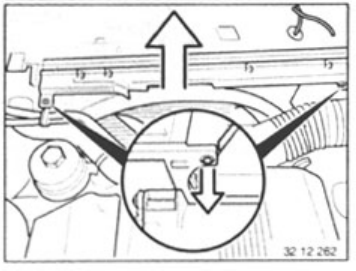
Remove holder of vacuum hoses on fan cowl.



Remove fan.
Unscrew fan bolt using Special Tools 11 5 040 and 11 5 050.

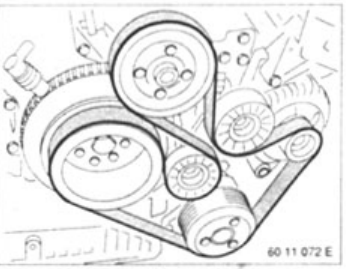
Important!
Left-hand threads.

Installation:
Tightening torque*.



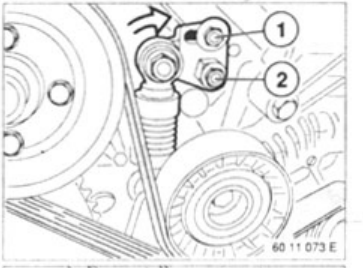
Remove fan cowl.
Remove clips at left and right hand sides and remove cowl upwards.

* Refer to Specifications

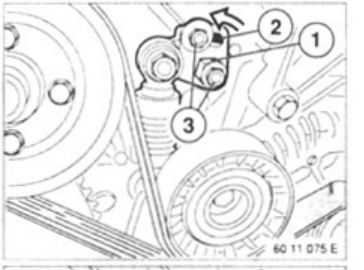


Arrangement of Ribbed Drive Belt

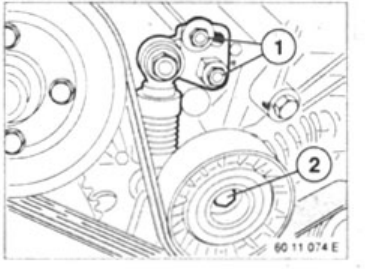
Installation:
Inspect ribbed drive belt for traces of coolant or oil, replacing it if necessary.



Loosen nuts (1 and 2) to loosen the ribbed drive belt.

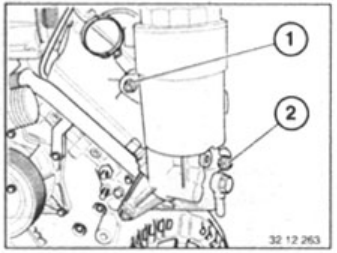


Installation:
Install ribbed drive belt and check for correct seating on pulleys.
Preload adjusting plate up to end of slot (2) by turning hexagon (1).
Tighten nuts (3).
Tightening torque*.

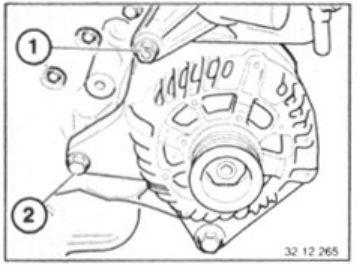


Unscrew nuts (1) and bolt (2).
Remove ribbed drive belt tensioner.

* Refer to Specifications

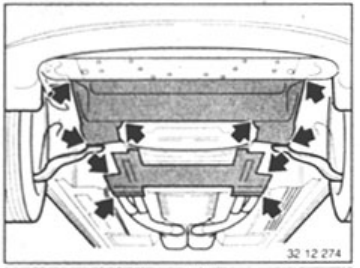


Loosen nuts (1 and 2) of oil filter so that oil filter can be pulled forward about 4 mm.

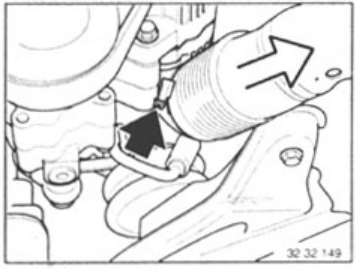


Unscrew alternator mounting bolts (1 and 2).

Installation:
Tightening torque*.

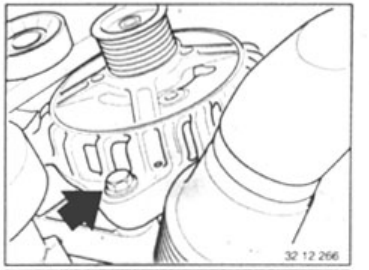


Lift car.
Unscrew engine splash guards.



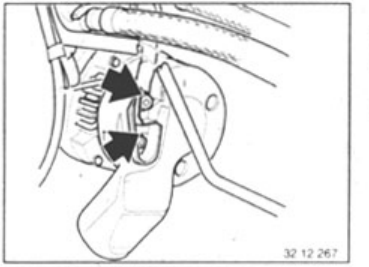
Disconnect vent hose of alternator at alternator.

* Refer to Specifications



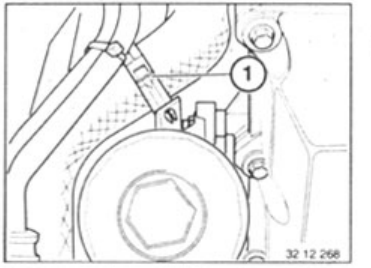
Unscrew lower alternator mounting bolt.

Installation:
Tightening torque*.

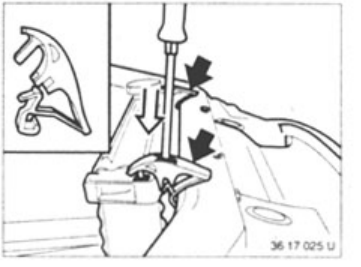


Pull alternator forward.
Unclip caps on connections.
Unscrew connections.

Installation:
Tightening torque*.

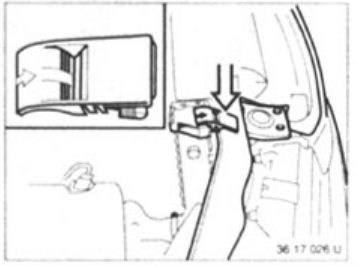


Lower car.
Take radiator hose out of clamp (1).

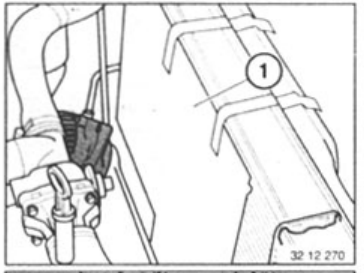


Unclip radiator at left and right hand sides by pressing in retainers with a screwdriver.

* Refer to Specifications

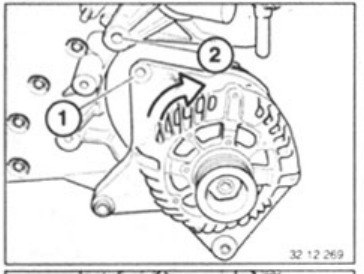


Installation:
Insert clips in radiator and compress until engagement is heard several times.

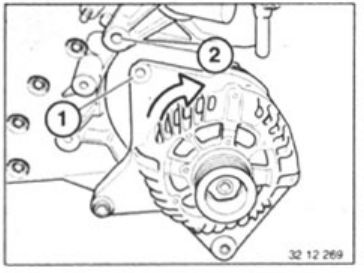


Protect radiator with sheet metal plate (1) to avoid damage while removing alternator.
Unscrew water pump pulley.

Installation:
Tightening torque*.

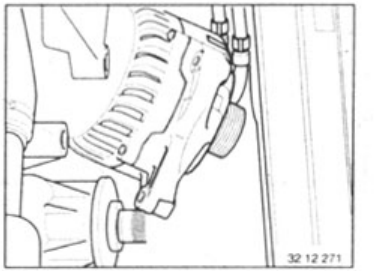


Pull oil filter forward slightly.
To remove the alternator, alternator mounting tab (1) must be turned clockwise underneath oil filter mounting tab (2).

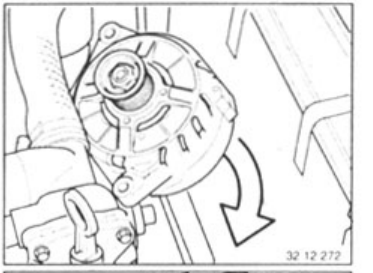


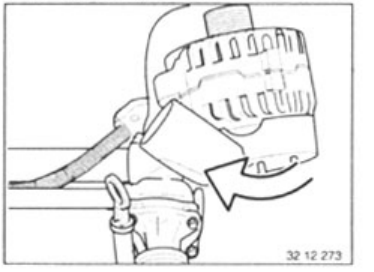
Pull alternator forward.

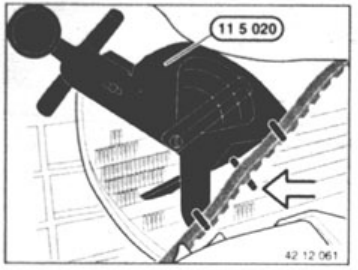
* Refer to Specifications



Remove alternator upwards.

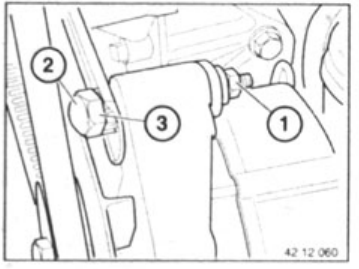






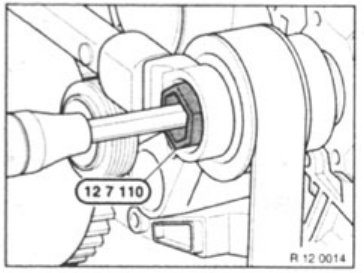
12 31 299 CHECKING AND TIGHTENING ALTERNATOR DRIVE BELT (M20, M30, M40)

Check and, if necessary, adjust tension of the drive belt using Special Tool 11 5 020. The pulling hook must bear in the middle of the splines.
The tester needle must be above the green or yellow zone of the scale.



Tightening Drive Belt:
Loosen nut (1) and turn tensioning wheel (3) with approximately 7 Nm torque.
Tighten nut (1).
Recheck drive belt tension with the special tool tester and correct if necessary.

Drive Belt Tension Tester:
With a "new scale" for SR drive belts.
SR = Service reduced.



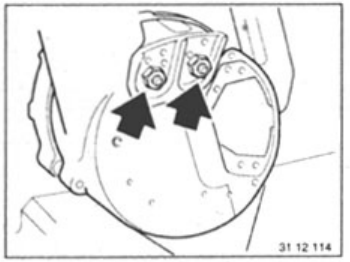
12 31 . . . Replacing alternator pulley

Unfasten nut with special tool 12 7 110.
Grip shaft of rotor with Allen key.
Tightening torque 12 31 3AZ*

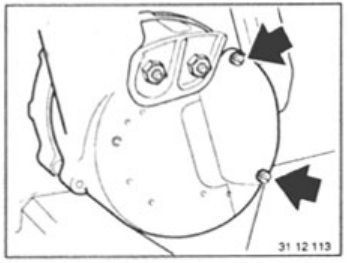
* Refer to Technical Data

12 32 000 REPLACING VOLTAGE REGULATOR

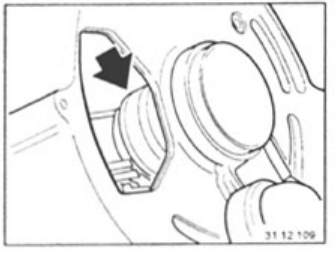
Disconnect ground leads from batteries.



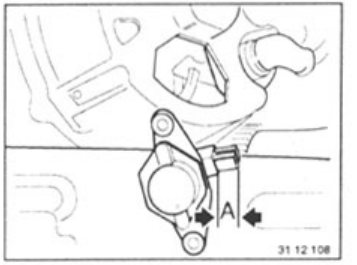
Remove alternator – refer to 12 31 020.
Unscrew cover.



Unscrew screws.
Remove voltage regulator.



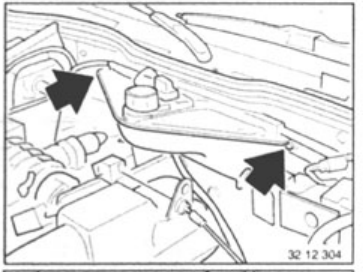
Check slip ring for wear and machine if necessary – refer to 12 31 200 in the Construction Group Repair Manual.



Installation:
Clean the contact surfaces and check tension of the spring contacts, bending to correct if necessary.
Distance A = at least 5 mm.

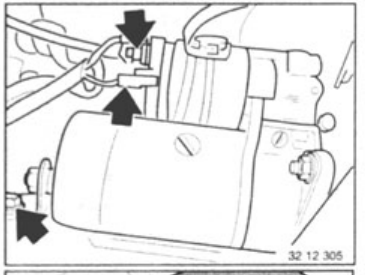
12 41 020 Removing and installing starter motor (M 20, M 21, M 30, S 38)

Read fault memory.
Disconnect negative battery terminal.

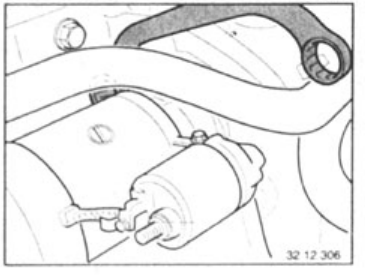


M 21/ M 30
Remove expansion tank - improves access to the screws.
On M 21, remove support for manifold.

S 38
Removing manifold for intake air, see Gr. 11.



Remove leads.



Remove retaining nuts.
Tightening torque*

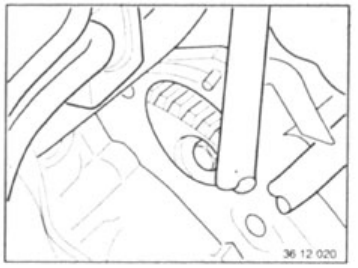
Installation instruction:
Fill with coolant** and bleed cooling system - see Pos. 17 0 039.

Notes on troubleshooting and disassembly of the starter motor, see
Construction Group Repair Manual Gr.12.

* Refer to Specifications
** Refer to Consumable Specifications

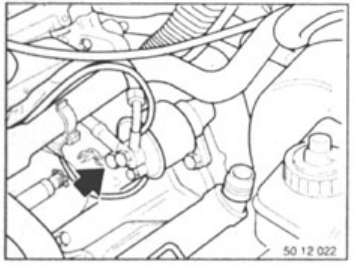
12 41 020 Starter - Remove, install / replace (M40)

See General Data, Gr. 12 00.
Interrogate fault memory.
Disconnect negative terminal on battery.

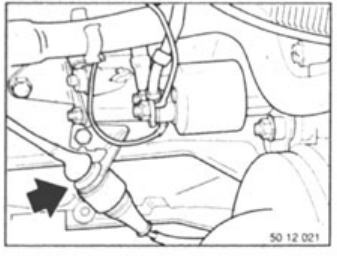


Installation instruction:
Check starter pinion for damage.
Check starter gear ring for damage prior to installation of starter.

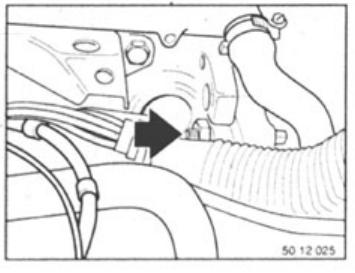
Notes on troubleshooting and disassembling the starter motor, see Construction Group Repair Manual Gr.12.



Remove leads on starter motor.
Tightening torque*



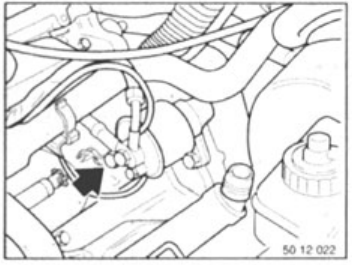
Unscrew screws and support.
Tightening torque*
Remove starter motor.



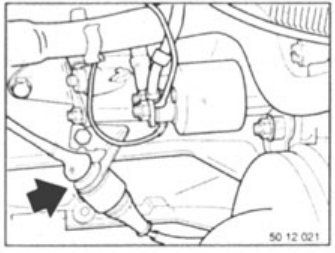
* Refer to Specifications

12 41 020 Removing and installing the starter motor (M 50)

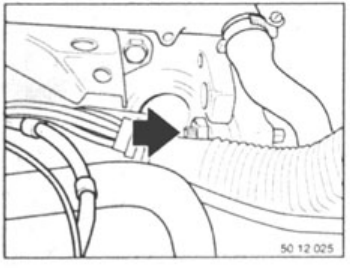
See General Data, Gr. 12 00.
Interrogate fault memory.
Disconnect negative battery terminal.
Remove vent hose on alternator.
Removing complete intake filter housing, removing complete air manifold, see Gr. 13.



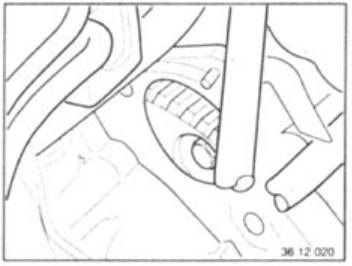
Remove leads from starter motor.
Tightening torque*



Unscrew screws and support.
Tightening torque*
Remove starter motor.



* Refer to Specifications

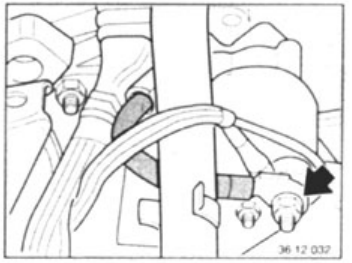


Installation instruction:
Check starter pinion for damage.
Check starter gear ring for damage prior to installation of starter.

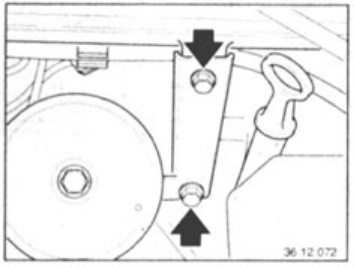
Notes on troubleshooting and disassembly of the starter motor, see Construction Group Repair Manual Gr.12.

12 41 020 Removing and installing the starter motor (M51)

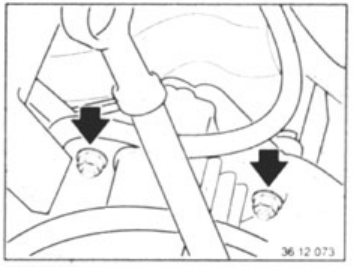
See General Data Gr. 12 00.
Interrogate fault memory.
Disconnect negative battery terminal.



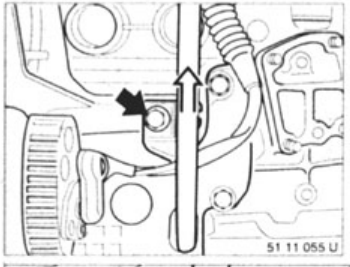
Unscrew wires on starter.
Tightening torque*



Unscrew screw of rear support for manifold.

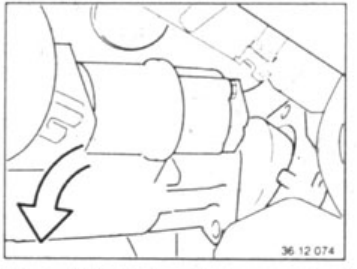


Unscrew bolts.
Tightening torque*
Unfasten support (if fitted).
Tightening torque*

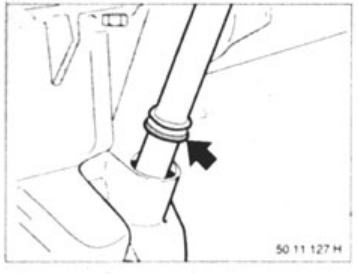


Unscrew oil dipstick screw.

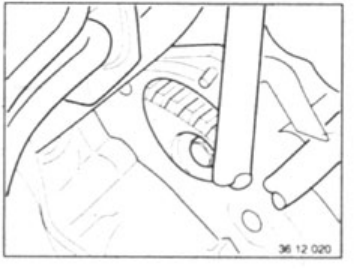
Caution!
When engine oil level is high, oil may run out of the dipstick bore.
Remove oil dipstick.



Unscrew starter below oil filter.



Installation instruction:
Check O-ring, replacing if necessary.

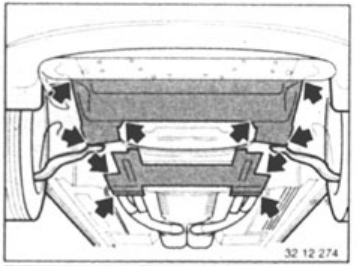


Installation instruction:
Check starter pinion for damage.
Check starter gear ring for damage prior to installation of starter.
Notes on troubleshooting and disassembly of the starter motor, see Construction Group Repair Manual Gr.12.

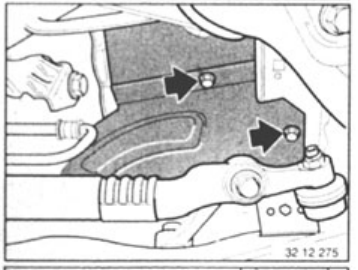
* Refer to Specifications

12 41 020 Removing and installing or replacing starter motor (M 60)

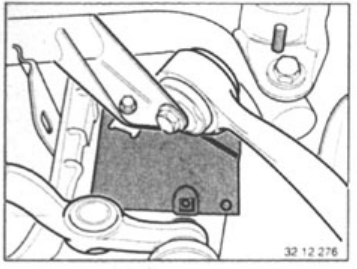
Note General Data Group 12-0.
Disconnect negative battery terminal.

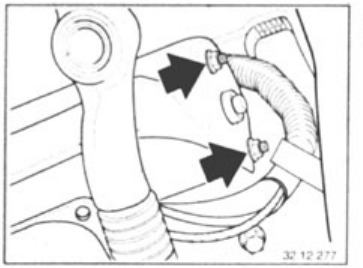


Remove splash guard.

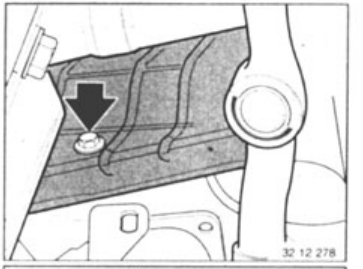


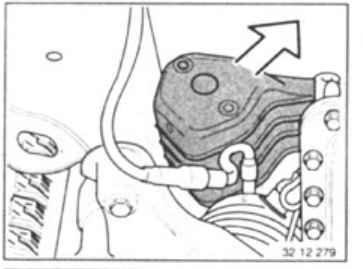
Remove heat baffle plates on right.
Unscrew bolts.



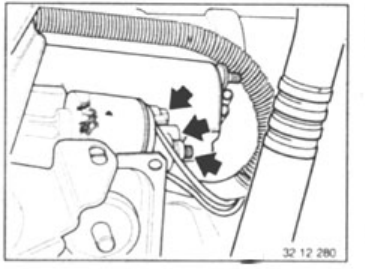


Remove heat baffle plate on starter motor.
Unscrew bolts.



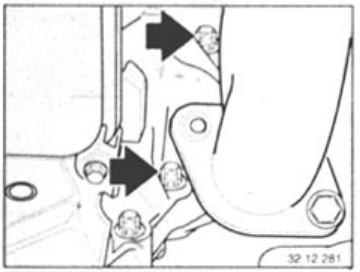


Remove heat baffle plate from front of front axle carrier.

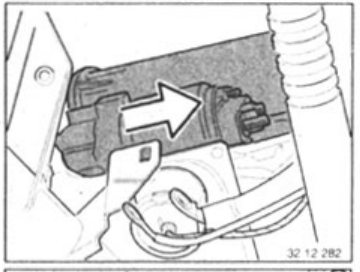


Unfasten screw connection on starter motor lead.
Tightening torque*

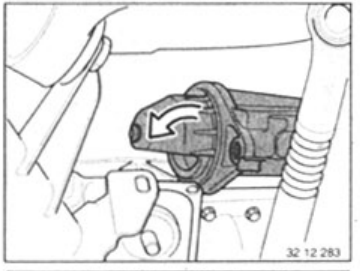
* Refer to Specifications



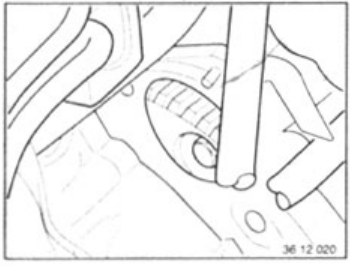
Unscrew bolts.
Tightening torque*



Remove starter motor by lifting out from back of ring gear.



Remove starter downwards.



Check pinion on starter motor and starter motor ring gear on flywheel for signs of damage.
Notes on troubleshooting and disassembly of the starter motor, see Construction Group Repair Manual Gr.12.

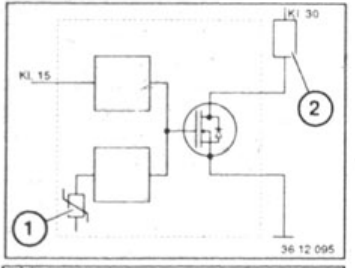
* Refer to Specifications

12 64 005 REPLACING FUEL HEATER

The electronics for diesel filter heating is integrated in upper section of filter.
The heating element and water level probe are integrated in upper section of filter and can be replaced only together with the complete fuel filter.

Caution!
Heating element could have temperature up to 130° C – danger of injury!

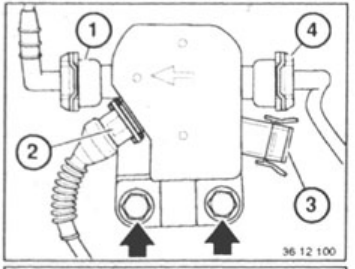
Description of Operation:
Heater switches on:
terminal 15 on and
fuel temperature less than + 2 ± 2° C.



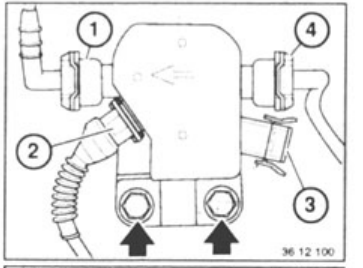
Wiring Diagram:

1	NTC sensor for temperature of supplied fuel
2	PTC heating element
Term. 15:	Battery positive switched in by ignition switch
Term. 30:	Battery positive
Term. 31:	Battery ground

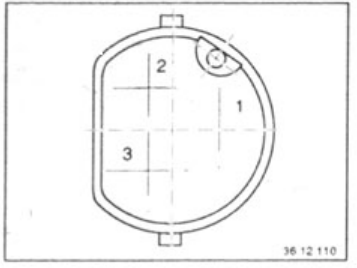
Heater switches off:
fuel temperature more than + 7 ± 2° C.
During engine starting if system voltage drops below 7.5 V.



3 = Fuel heater plug

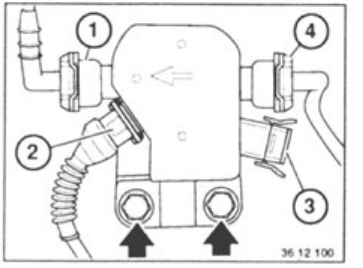


Disconnect plug (2) for water level probe and plug (3) for fuel heater.



Plug Connections:

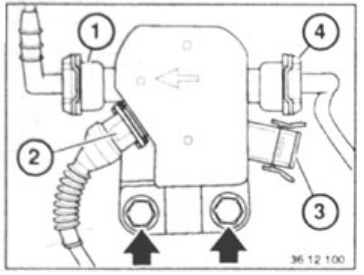
Pin 1: Terminal 30
Pin 2: Terminal 31
Pin 3: Terminal 15



Press retainers and pull pipes (1 and 4) off.

Caution!
Catch escaping fuel.

Installation:
Check seals and, if necessary, replace.
Coat seals with acid-free grease.

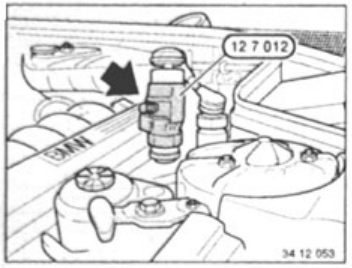


Unscrew bolts and remove filter.
Tightening torque*.

Empty filter into a suitable container.

Installation:
Bleed fuel system - refer to 13 51 320.

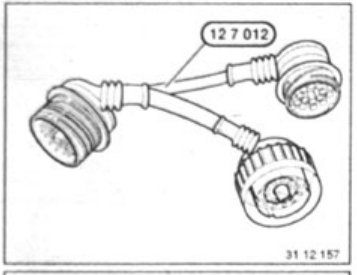
* Refer to Specifications



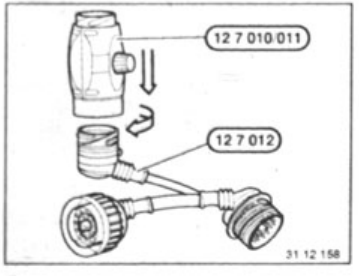
12 70 500 CHECKING SAFETY PATH OF ELECTRONIC ENGINE POWER CONTROL (EML)

Note:
Interrogate the fault memory of the EML control unit before installing the test adapter.

Switch ignition off.
Disconnect EML plug.



Cars with 20 Pin EML Plug:
Use test adapter, Special Tool 12 7 010/011.



Cars with 25 Pin EML Plug:
Special Tool 12 7 012 (adapter) must be used between the EML wire harness and Special Tool 12 7 010/011 (test adapter).

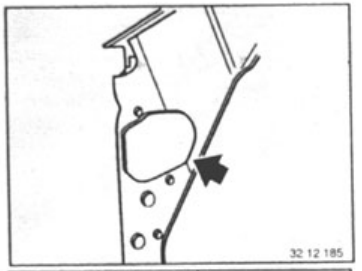
Connect the BMW Service Tester (to measure speed).

Testing Procedures:
Regulate test adapter 12 7 010/011 to middle position "–".
Take out gear (neutral).
Start engine.
Regulate idling speed with knurled wheel of the test adapter to at least 2500 rpm.
Now operate brake pedal immediately.
The engine speed must "immediately" drop to idling speed.
If yes, the safety path is OK.
Repeat this test with the clutch pedal in cars with a manual transmission.

Refer to the Car Electric/Electronic Test Plan for troubleshooting instructions.

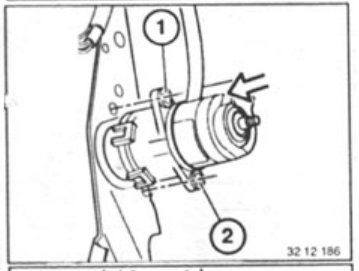
Switch ignition off.
Remove adapters.
Connect plug.

Note:
Interrogate the fault memory.
Investigate the stored faults and eliminate the faults.
Cancel the fault memory.

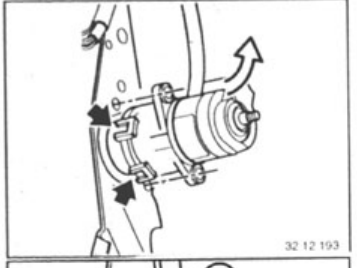


Installing Pedal Value Sender:

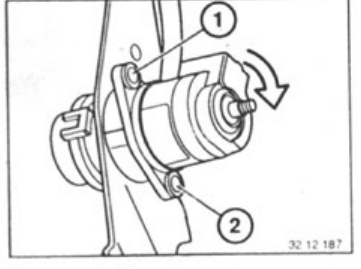
Picture shows the opening in the pedal console.



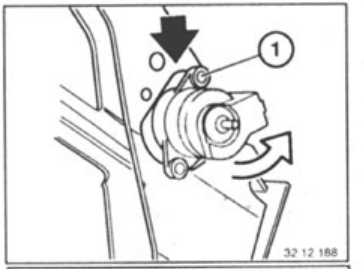
Turn pedal value sender until mounting tabs (1 and 2) are located above the mounting bores of the pedal console.



Then tilt the pedal value sender upwards at an angle until it can be put through the opening in the pedal console.



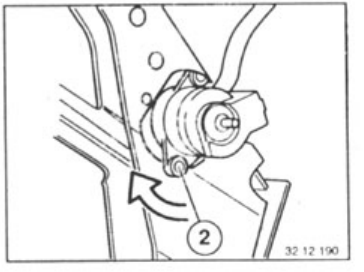
Insert pedal value sender fully.



Turn pedal value sender until eye (1) can be put through the oval opening of the pedal console.



Eye (1) mounted in pedal console.

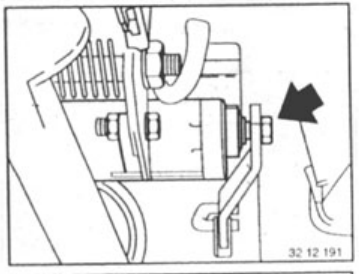


Turn pedal value sender until eye (2) can be put through the oval opening of the pedal console.
Screw on pedal value sender.

Mount plug.
Adjust pedal value sender and check function – see Adjusting Accelerator in 12 72 . . ..
Check safety path – see 12 70 500.

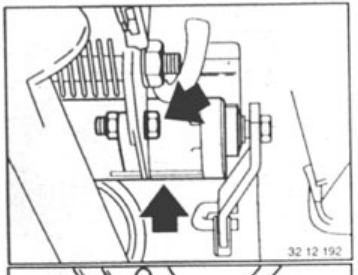
12 72 520 REMOVING AND INSTALLING OR REPLACING PEDAL VALUE SENDER

Turn ignition off.
Remove trim panel for the dashboard at bottom left – see 51 45 180.



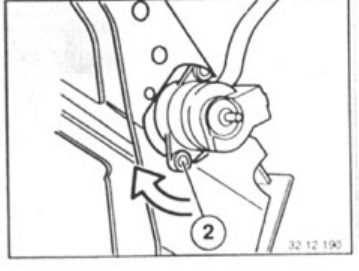
Unscrew nut and pull lever off of the pedal value sender.

Installation:
Adjust accelerator – see 12 72 . . ..



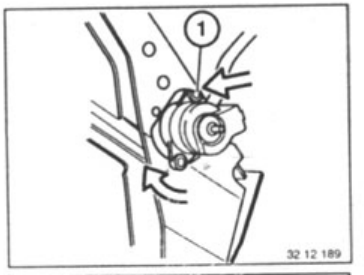
Unscrew both bolts.
Disconnect plug.

Installation:
Use spacers between the sender and pedal console.

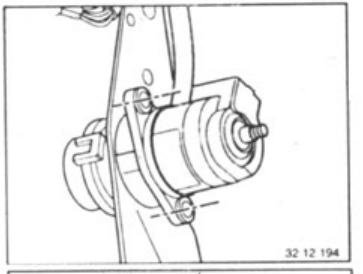


Removing Pedal Value Sender:

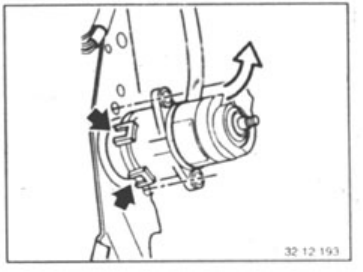
Turn pedal value sender until eye (2) can be taken out through the opening.



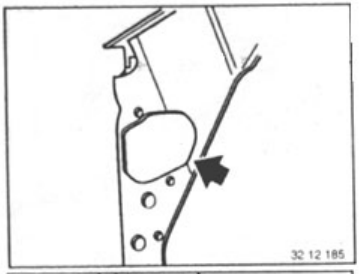
Turn pedal value sender until eye (1) can be taken out.



Tilt pedal value sender until the clips of the cover can be taken out of the opening first.
Remove pedal value sender.

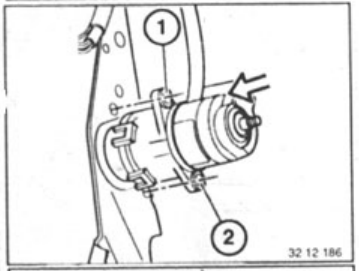


Turn pedal value sender until eyes are again aligned with the hole pattern of the holder.

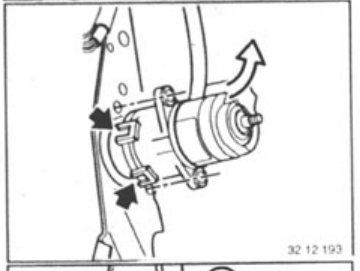


Installing Pedal Value Sender:

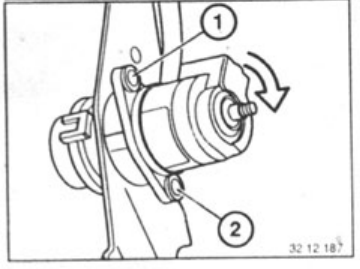
Picture shows the opening in the pedal console.



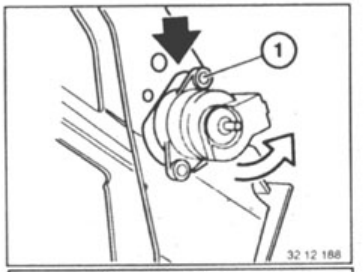
Turn pedal value sender until mounting tabs (1 and 2) are located above the mounting bores of the pedal console.



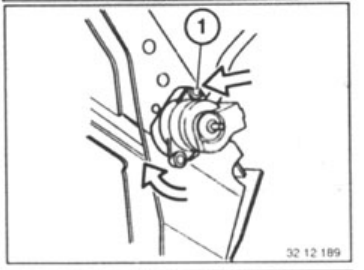
Then tilt the pedal value sender upwards at an angle until it can be put through the opening in the pedal console.



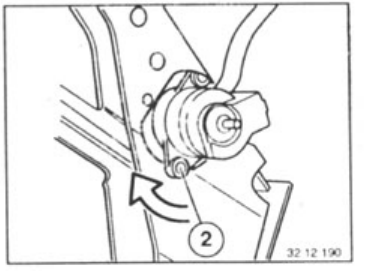
Insert pedal value sender fully.



Turn pedal value sender until eye (1) can be put through the oval opening of the pedal console.

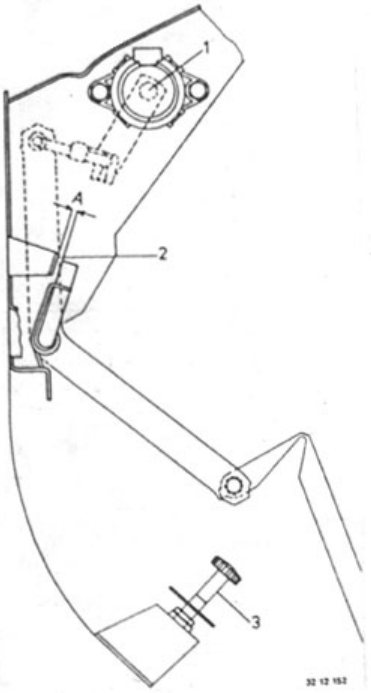


Eye (1) mounted in pedal console.



Turn pedal value sender until eye (2) can be put through the oval opening of the pedal console.
Screw on pedal value sender.

Mount plug.
Adjust pedal value sender and check function – see Adjusting Accelerator in 12 72 . . ..
Check safety path – see 12 70 500.



12 72 . . . ADJUSTING ACCELERATOR PEDAL WITH ELECTRONIC ENGINE POWER CONTROL

1. Idle Position

Loosen hexagon nut (1) on pedal value sender.
Produce a gap A of 3 mm (0.118") or 2 mm (0.079") for 524 td betw. the accelerator pedal shaft and idle stop (2).
Tighten hexagon nut (1) on pedal value sender to correct torque*.
Support lever on pedal value sender while tightening.

2. Full Load Position

a) Manual Transmission

Operate accelerator pedal to kickdown pressure point in the pedal value sender. Turn knurled head screw (3) to bear on the accelerator pedal in this position and lock.

b) Automatic Transmission

Operate accelerator pedal to kickdown pressure point in the pedal value sender. Adjust knurled head screw (3) in this position to have a distance of 6 mm (0.236") between the knurled head screw and accelerator pedal. Lock the knurled head screw.

Important!

Check pedal value sender with a diagnosis tester after adjusting. Connect tester, turn on ignition and press accelerator pedal to the full load stop. Compare actual voltage value displayed on the tester with the nominal value, correcting the adjustment if necessary.
Idle = min. 353 mV
Idle = max. 451 mV
Note:
No safety path test for 524 td.
Specifications:
a) Manuals = 3.15 ... 3.3 V
b) Automatics = 3.7 ... 3.8 V
Check safety path - see 12 70 500 in Construction Group Repair Manual.
Note:
Read EML fault memory before installation of the testing adapter.

* See Specifications

On-board Diagnosis

The DME control unit recognizes exhaust relevant faults and displays them by lighting up the "Check Engine" control lamp continuously. Check Engine control lamp – see Group 62. The fault lamp comes on after turning on the ignition and goes out when the engine runs. It is on continuously while the engine is running, if there is a fault.

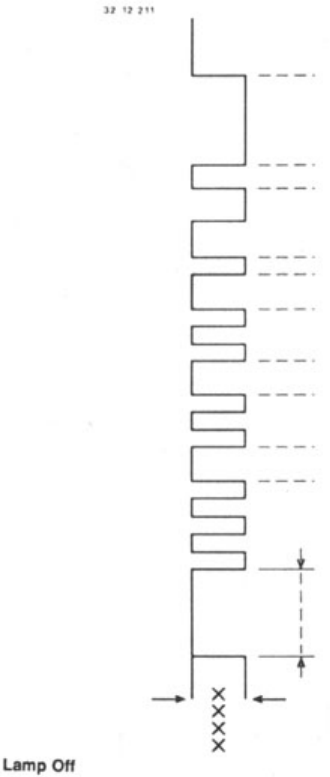
Flashing codes help in locating faults precisely and eliminating them.

Fault Output:
Activate flashing code output: ignition ON, operate full load contact 5 times within 5 seconds.
Fault output begins.
See sample fault: faulty NTC coolant – code 1223.

1 = Start of fault code

2 = End of fault code

Sample Fault Code: NTC Coolant Code 1223



Note:
Each additional call must be activated again.
Code X444 - fault no longer stored.
Code X000 (long dark phase) - after fault output = end of output.

* Two times for M 70 Left cylinder bank

FAULT CODE TABLE

Code	Faulty Component
x211	Control unit (self-test)
x215	Air flow sensor
x221	Oxygen sensor
x222	Oxygen sensor control stop
x223	NTC coolant (see sample fault)
x224	NTC air
x231	Battery voltage monitor
x232	Idle speed switch
x233	Full load switch
x251	Fuel injector final stage 1
x252	Fuel injector final stage 2
x261	Fuel pump relay final stage
x262	Idle control final stages
x263	Tank venting final stage
x264	Relay 3 final stage (oxygen sensor heating)

Table 1: CARB Flashing Code Scope

Remarks:
x = 2 for M 70 control unit of left engine half (cyl. 7 ... 12)
x = 1 for M 70 control unit of right engine half (cyl. 1 ... 6) and all other engines.

Fault memory empty: Code x444

Versions of Cancelling Fault Memories:

1. Disconnect DME control unit (permanent positive, pin 18) on power supply, e.g. by unplugging control unit.

2. With help of BMW SERVICE TESTER:
   Command: cancel fault memory (see car electric/electronic test plan).

3. Re-activation with ignition ON while flashing code output x000 is put out, close full load switch 10 seconds.

Remarks:
FL = Fault lamp
VL = Full load

13 Fuel system

518i (M40), 520i (M20, M50), 525i (M20, M50), 530i (M30), 535i (M30)....

M5 .....

524d (M21), 524td (M21) .....

525td (M51), 525tds (M51) .....

530i (M60), 540i (M60) .....

13 Fuel system

Models : 518i (M40), 520i (M20, M50), 525i (M20, M50), 530i (M30), 535i (M30)
Model: 518i (M43) refer to “Repair Manual 3 Series E36”

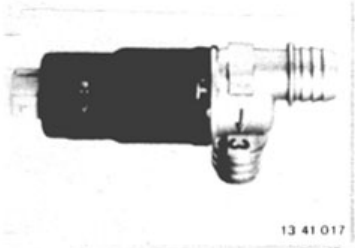
13 00 060	Engine idle speed and CO content (M20, M30) – check	13-00/1
. . .	Engine idle speed / CO content (M20, M30)	13-00/2
. . .	Basic setting of air flow meter adjusting screw M20, M30 – check	13-00/2
054	Engine idle speed and CO content (M50) – check and, if necessary, adjust	13-00/3
060	Engine idle speed and CO content (M50) – check	13-00/4
060	Engine idle speed and CO content (M40) – check	13-00/5
	Overview of fuel filters and lines	13-32/1
13 32 051	Fuel filter – replace	13-32/1
13 41 500	Idle speed control valve (M40) – replace	13-41/1
500	Idle speed control valve (M20, M30) – replace (check)	13-41/2
500	Idle speed control valve (M50) – replace	13-41/3
13 51 630	Fuel pressure regulator (M50) – replace	13-51/1
630	Fuel pressure regulator (M40) – replace	13-51/2
13 54 030	Throttle assembly (M50) – remove and install/seal	13-54/1
030	Throttle assembly (M40) – remove and install/seal	13-54/2
13 61 000	Control unit – remove and install or replace	13-61/1
13 62 000	Air flow meter (M40) – remove and install	13-62/1
000	Air flow meter (M20) – remove and install	13-62/2
000	Air flow meter (M30) – remove and install	13-62/3
560	Air mass meter (M50, M50 B20 TU) – remove and install	13-62/4
560	Hot film air mass meter (M50 B25 TU) – remove and install	13-62/5
511	Intake air temperature sensor (M50) – replace	13-62/6
531	Coolant temperature sensor – remove and install or check	13-62/7
531	Coolant temperature sensor (M50) – remove and install or replace	13-62/8
13 64 541	Fuel injector valves, all (M20) – replace	13-64/1
541	Fuel injector valves, all (M30) – replace	13-64/2
541	Fuel injector valves, all (M50) – remove and install	13-64/3
13 71 000	Air cleaner (M20) – remove and install	13-71/1
13 72 001	Air cleaner cartridge (M20) – replace	13-71/1
13 71 000	Air cleaner (M30) – remove and install	13-71/2
13 72 001	Air cleaner cartridge (M30) – replace	13-71/2
13 71 000	Air cleaner (M50) – remove and install	13-71/3
13 72 001	Air cleaner cartridge (M50) – replace	13-71/3
13 90 500	Tank ventilation valve (M20, M30) – replace	13-90/1

For further information on troubleshooting and jobs in assembly 13 refer to:
Microfiche Assembly Repair Manual and
Electrical Troubleshooting Manual 5 Series E34

For M43 engine refer to:
For other jobs refer to “Repair Manual 3 Series E36”

13 00 060 CHECKING ENGINE IDLING SPEED AND CO CONTENT (M20, M30) - Cars with Catalytic Converter -

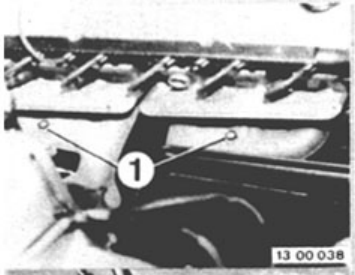
Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C.
Valve clearance correct.
Engine and ignition in perfect operating condition.
Connect BMW Service Tester to operating instructions.
Routine checking is not necessary.


13 41 017

1) Engine Idling Speed

Check engine idling speed**.
Refer to BMW Diagnosing System if nominal value is not reached.
Check intake system for leaks.

Note:
There is no adjusting screw for idling speed adjustments.



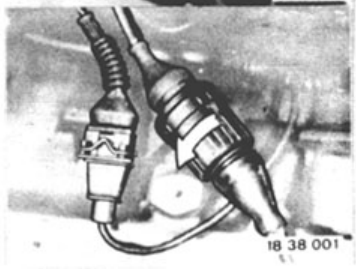
13 00 038

2) CO Content

Disconnect oxygen sensor plug (not in cars prepared for catalytic converter).
Unscrew screws (1).
Connect Special Tool 13 0 100 to exhaust manifold.
Check idling speed CO content**.
Switch exhaust extraction system off for time of test.

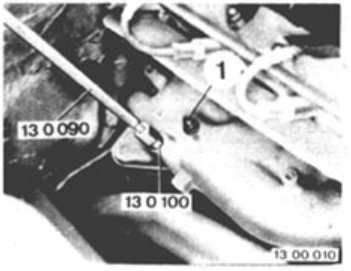
Nominal Value Not Reached and CO Content Too High:
Check
- fuel injectors,
- fuel pressure and
- coolant temperature sensor.

CO Content Too Low:
Check hoses and connections for engine idling speed control and detect air leaks.


18 38 001

** Refer to Specifications

Important!
Also valid for cars prepared for catalytic converter.
Adjustments may not be made on the air flow sensor adjusting screw, since this setting is the basis for oxygen sensor and idling speed control.

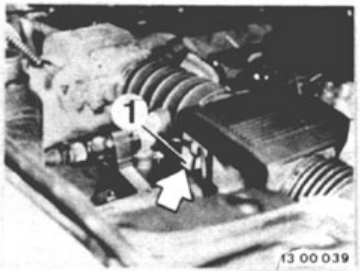


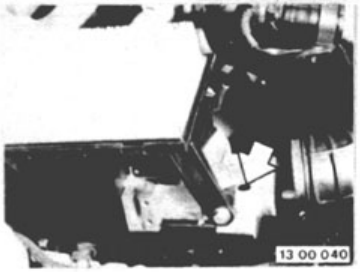
13 00 010

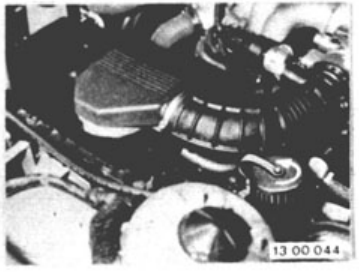
Checking Function of Oxygen Sensor (11 78 010):

Unscrew screw (1).
Connect Special Tools 13 0 100 to exhaust manifold.
Switch exhaust extraction system off for time of test.
Disconnect oxygen sensor plug.
Clamp vacuum hose leading to the fuel pressure regulator (not while engine is running).
Start engine – CO content rises.
Connect oxygen sensor – CO content should go back to the nominal value.
Remove clamp from vacuum hose.

For air flow or air volume measurements (M5) with the potentiometer the adjustment does not have influence on catalytic converter and idling speed regulation in catalytic converter operating mode.
The plug for the CO potentiometer, however, must be disconnected - refer to Gr. 12.





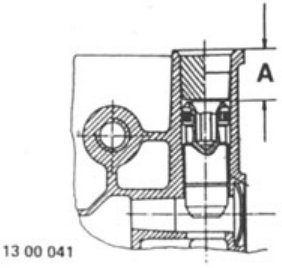


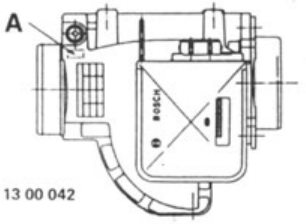
13 00 ... ENGINE RUNNING/CO CONTENT (M20, M30)

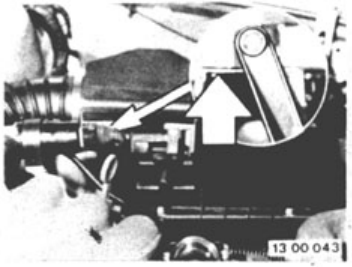
Only for cars prepared for catalytic converter operation.

If it is absolutely necessary to correct[1] the CO/engine running setting with the air volume sensor adjusting screw or if the adjusting screw had been turned unwantedly, the basic setting must be checked and/or restored when converting to a catalytic converter or working on the fuel/air mixture system.

[1] Corrections may never be carried out when there is a fault in the fuel/air mixture system:
Read the self-diagnosis, check for leaks in the intake and fuel systems, check fuel injectors, temperature sensor and fuel pressure - also refer to 13 00 060.







13 00 ... CHECKING BASIC SETTING OF AIR VOLUME SENSOR ADJUSTING SCREW (M20, M30)

Only for cars prepared for catalytic converter operation (anti-tamper lock in catalytic converter cars).

M 1.1 and M 1.3 Motronic:
Measure distance "A" at the adjusting screw with a depth gage and compare or adjust to the value dia-stamped in the air volume sensor.
Install an anti-tamper lock on the air volume sensor after converting the car to catalytic converter and checking the basic setting.

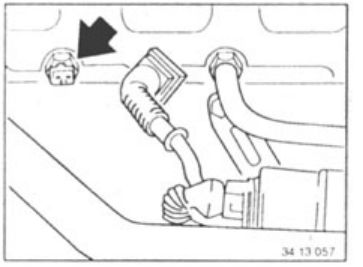
Cars with Potentiometer on Air Flow or Air Volume Sensor:

The setting of the adjusting screw can be read and/or corrected via the diagnosing system of a BMW Service Tester.

When converting to a catalytic converter, the CO potentiometer plug must be disconnected (refer to Group 12). The setting of the adjusting screw is then without influence.

13 00 054 CHECKING ENGINE IDLING SPEED AND CO CONTENT (M50)
- Cars Prepared for Cat. Conv. -

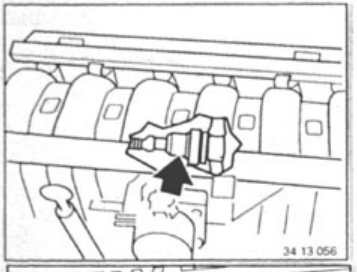
Engine with M 3.1 Motronic:
Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C.
Engine and ignition in perfect operating condition.
Enter number of cylinders (6) for engine idling speed test step no. 5.
Connect BMW Service Tester to operating instructions.
Routine checking is not necessary.



If the nominal value is not reached, first make sure that there are no faults in the engine, ignition or fuel injection before correcting the CO content setting.

CO Content Too High:
Check
- fuel injectors,
- fuel pressure and
- coolant temperature sensor.

CO Content Too Low:
Check hoses and connections for engine idling speed control and detect air leaks.
Also refer to BMW Diagnosing System.

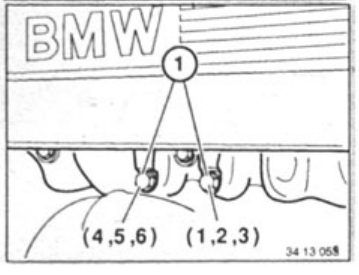


1) Engine Idling Speed

Check engine idling speed**.
Refer to BMW Diagnosing System if nominal value is not reached.
Check intake system for leaks.

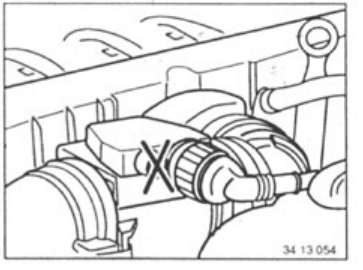
Note:
There is no adjusting screw for idling speed adjustments.
Clicking of the idling speed control valve must be heard and felt when switching the ignition on.

The CO content is corrected via the M 3.1 diagnosing program with MoDiC.



2) CO Content

Connect exhaust sensor in exhaust tailpipe.
Check idling speed CO content**.
Switch exhaust extraction system off for time of test.
If the nominal value is not reached, the CO content** of cyl. 1, 2 and 3 or cyl. 4, 5 and 6 can also be checked separately to troubleshoot.



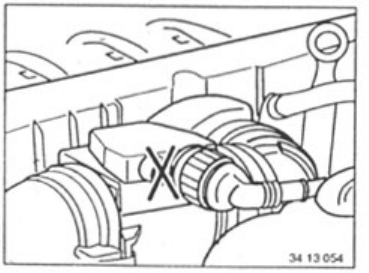
The setting of the adjusting no longer has any influence in all cars with the M50 engine.

Refer to the BMW Test Plan for further instructions.

** Refer to Specifications of Gr. 11 and 13

13 00 060 CHECKING ENGINE IDLING SPEED AND CO CONTENT (M50)
- Cars with Catalytic Converter -

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C.
Engine and ignition in perfect operating condition.
Connect BMW Service Tester to operating instructions.
Routine checking is not necessary.



If the nominal value is not reached, first make sure that there are no faults in the engine, ignition or fuel injection before correcting the CO content setting.

Also refer to BMW Diagnosing System.

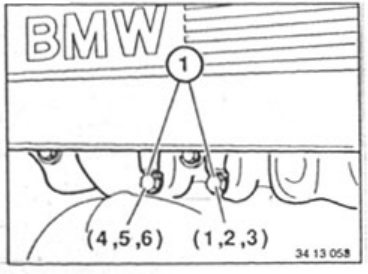
The setting of the adjusting no longer has any influence in all cars with the M50 engine.

Refer to the BMW Test Plan for further instructions.

1) Engine Idling Speed

Check engine idling speed**.
Refer to BMW Diagnosing System if nominal value is not reached.
Check intake system for leaks.

Note:
There is no adjusting screw for idling speed adjustments.

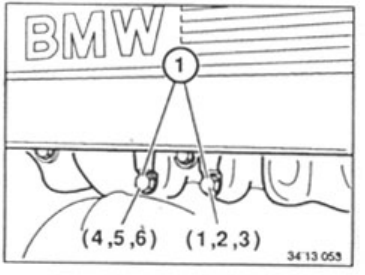


2) CO Content

Disconnect oxygen sensor plug (not in cars prepared for catalytic converter).
Unscrew screws (1).
Connect Special Tool 13 0 080 to exhaust manifold.
Check idling speed CO content**.
Switch exhaust extraction system off for time of test.

Nominal Value Not Reached and CO Content Too High:
Check
- fuel injectors,
- fuel pressure and
- coolant temperature sensor.

CO Content Too Low:
Check hoses and connections for engine idling speed control and detect air leaks.



Checking Function of Oxygen Sensor (11 78 010):

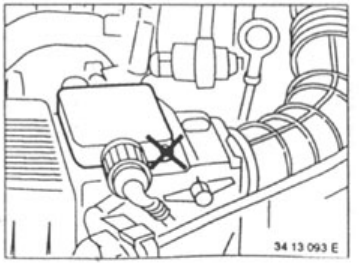
Unscrew screw (1).
Connect Special Tools 13 0 080 to exhaust manifold.
Switch exhaust extraction system off for time of test.
Disconnect oxygen sensor plug.
Clamp vacuum hose leading to the fuel pressure regulator (not while engine is running).
Start engine – CO content rises.
Connect oxygen sensor – CO content should go back to the nominal value.
Remove clamp from vacuum hose.

** Refer to Specifications

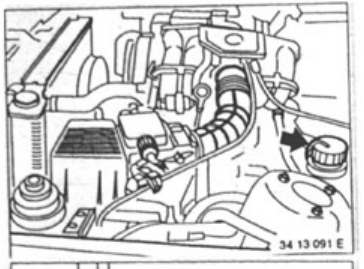
13 00 060 CHECKING ENGINE IDLING SPEED AND CO CONTENT (M40)
- Cars with Catalytic Converter -

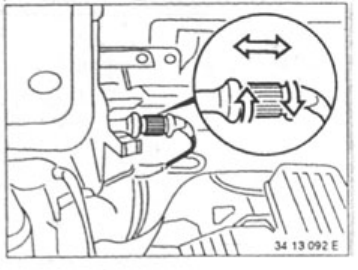
Engine with M 1.3 Motronic.

Requirements for All Adjustments:
Engine at operating temperature, i.e. oil temperature at least 60° C.
Engine and ignition in perfect operating condition.
Connect BMW Service Tester to operating instructions.
Routine checking is not necessary.
Enter number of cylinders (4) for engine idling speed test step no. 5.



Important!
Corrections cannot be carried out on the air volume sensor adjusting screw.
For air volume measurements with the potentiometer the adjustment does not have influence on catalytic converter and idling speed regulation in catalytic converter operating mode.
The plug for the CO potentiometer, however, must be disconnected - refer to Gr. 12.





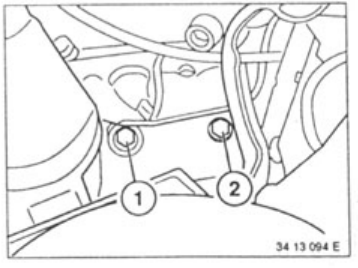
1) Engine Idling Speed
Check engine idling speed.**
Refer to BMW Diagnosing System if nominal value is not reached.
Check intake system for leaks.

Note:
There is no adjusting screw for idling speed adjustments.

2) CO Content
Disconnect oxygen sensor plug (not in cars prepared for catalytic converter). Unscrew screws (1). Connect Special Tool 13 0 100 to exhaust manifold. Check idling speed CO content. Switch exhaust extraction system off for time of test.**
Nominal Value Not Reached and CO Content Too High:
Check
- **fuel injectors,**
- **fuel pressure and**
- **coolant temperature sensor.**

CO Content Too Low:
Check hoses and connections for engine idling speed control and detect air leaks.

** Refer to Specifications of Gr. 11 and 13

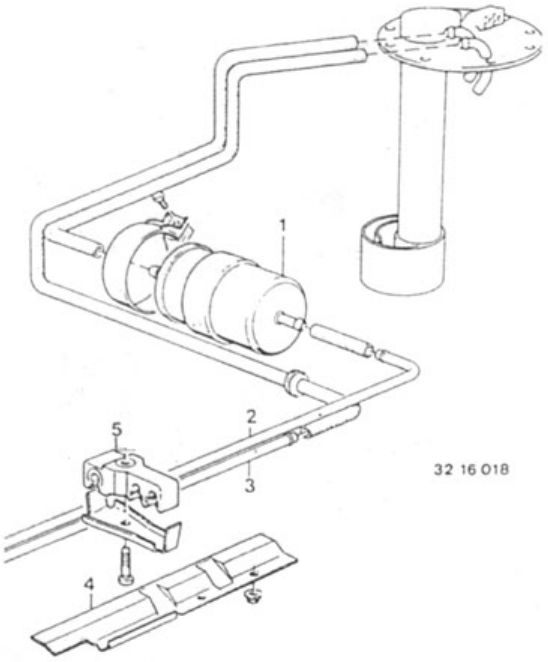


Checking Function of Oxygen Sensor (11 78 010):

Unscrew screws (1 and 2).
Connect Special Tools 13 0 100 to exhaust manifold.
Switch exhaust extraction system off for time of test.
Disconnect oxygen sensor plug.
Clamp vacuum hose (not while engine is running).
Start engine – CO content rises.
Connect oxygen sensor – CO content should go back to the nominal value.
Remove clamp from vacuum hose.

13 32 051 REMOVING AND INSTALLING FUEL FILTER

Survey of fuel filter and pipes.

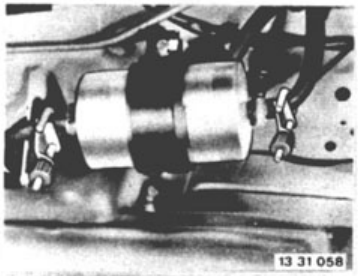


32 16 018

1 Fuel filter
2 Feed pipe
3 Return pipe
4 Trim panel
5 Holder on floor plate

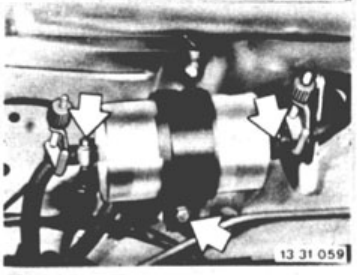
13 32 051 REPLACING FUEL FILTER

Disconnect pipes.



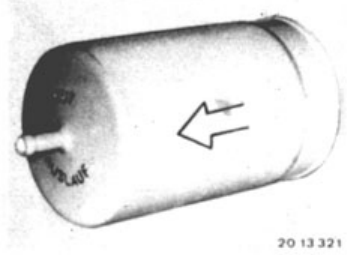
13 31 058

Unscrew bolts.
Pull off filter.

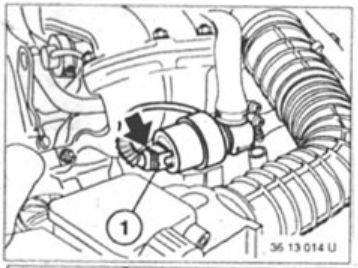


13 31 059

Installation:
Check direction of flow (arrow).



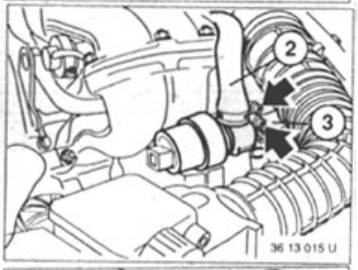
20 13 321



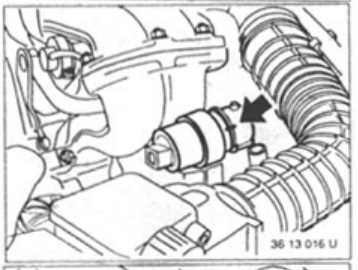
13 41 500 REPLACING IDLING SPEED CONTROL VALVE (M40)

After checking engine idling speed (13 00 054/060) or function of DME (13 00 002).

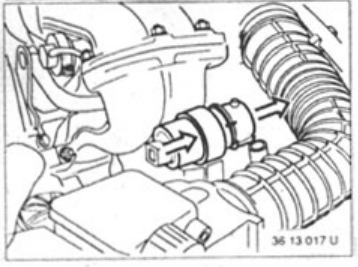
Squeeze clip and pull plug (1) off.



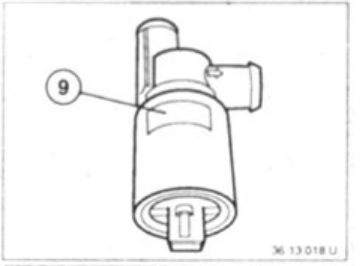
Loosen hose straps.
Disconnect hoses (2 and 3).



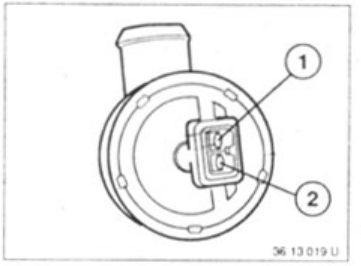
Cut wire straps off.



Push idling speed control valve through the retaining strap and remove.



Installation:
Check code (9).
Check idling speed*.



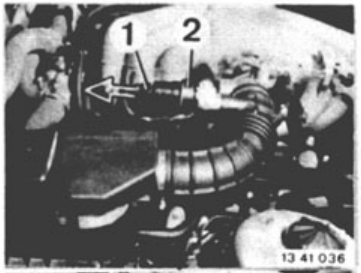
Component Test:

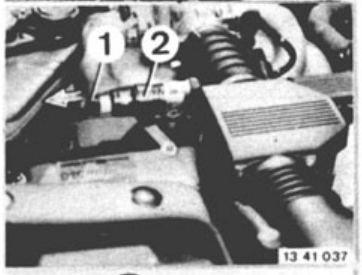
Refer to BMW Diagnosing System to troubleshoot and check electric connection.

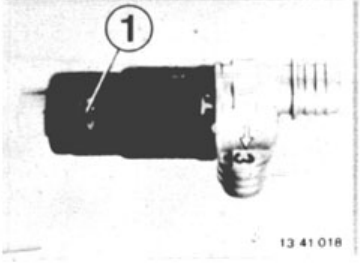
Electric Test:

Measure resistance between terminals (1 and 2).
Specification: 8 ± 2 Ω.

* Refer to Specifications





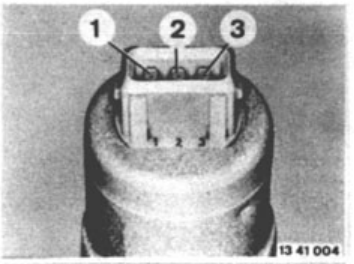


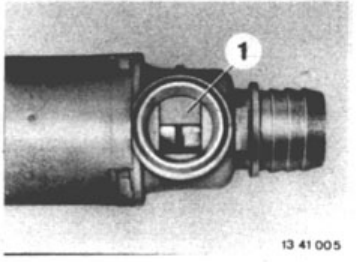
13 41 500 Replacing (checking) idle speed control valve (M20, M30)

Disconnect plug (1).
Detach (press together) retaining strap (2).
Pull idle speed control valve from hoses and remove.

Installation note:
Note identification No. (1) *).
Check idle speed *).

Note:
Operation of the idle speed control valve can be felt by touching with the hand (clocked voltage supply).

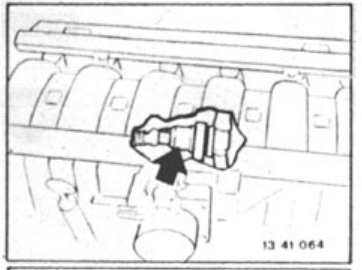




Electrical check
Measure resistance between terminal (1) and (3), setpoint approx. 40 W.
Measure resistance between terminal (2) and (1) or (2) and (3).
Setpoint approx. 20 W.

Dynamic check
Remove idle speed control valve (plug remains connected).
Completely open or close rotary piston (1) by turning valve abruptly.
Switch on ignition. Rotary piston must assume a position of approx. 50 % cross section opening and remain in this position.

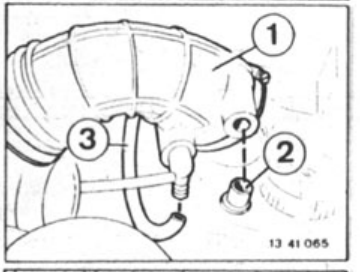
Test:
See BMW DIAGNOSTIC SYSTEM



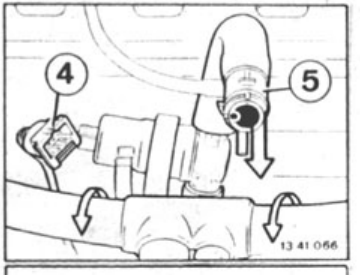
13 41 500 Replacing idle speed control valve (M50)

Note:
When installed, operation of the idle speed control valve can be detected by touching it with the hand (clocked voltage supply).

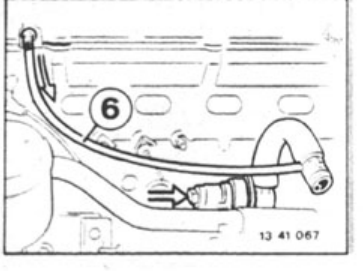
Test:
See BMW DIAGNOSTIC SYSTEM



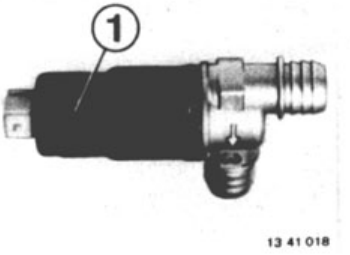
Release hose clip.
Remove gaiter (1).
Disconnect idle hose (2) and hose (3).



Disconnect hot water hose.
Disconnect plug (4).
Unclip hose (5) and remove.



Disconnect vacuum hose (6).
Slide idle speed control valve through retaining strap and remove.



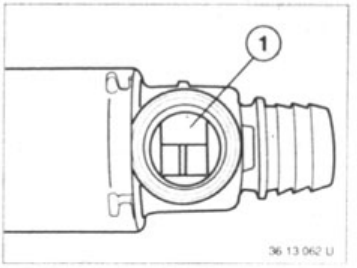
Installation note:
Note identification No. (1)*.
Check idle speed*.

* Refer to Technical Data

Component Test:

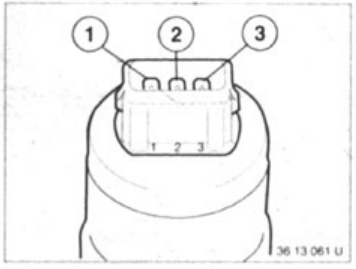
Bosch DME:
Double-coil rotary positioner
Three-pin plug

Clicking of the idling speed control valve must be heard and felt when switching the ignition on.
Refer to BMW Diagnosing System to troubleshoot and check electric connections.



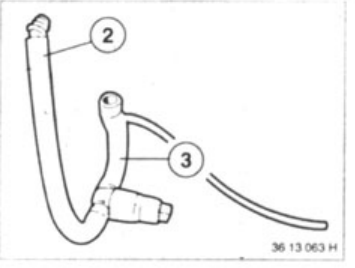
Dynamic Test:

Switch ignition off.
Remove idling speed control valve (plug remains connected).
Open or close rotary piston (1) completely.
Switch ignition on.
Rotary piston must move into and remain in a position of approx. 50 % of the cross section opening.

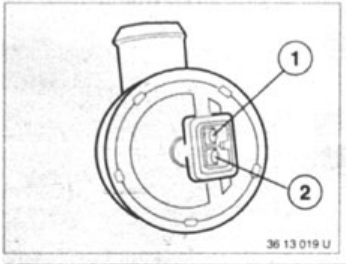


Electric Test:

Measure resistance between terminals (1 and 3).
Specification: 40 ± 5 Ω.
Measure resistance between terminals (2 and 1) or (2 and 3).
Specification: 20 ± 5 Ω each.

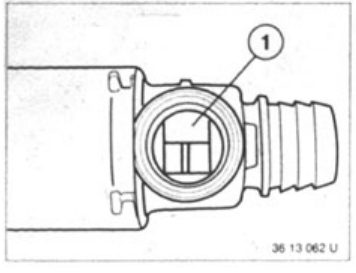


Disconnect hoses (2 and 3) to replace the valve.



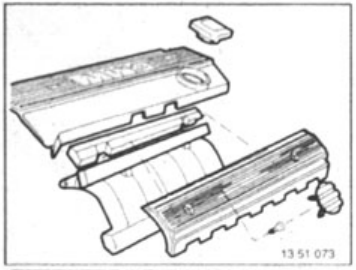
Siemens MS 40, MS 40.1:
Single-coil rotary positioner
Two-pin plug

Electric Test:
Measure resistance between terminals (1 and 2).
Specification: 20 ± 5 Ω.



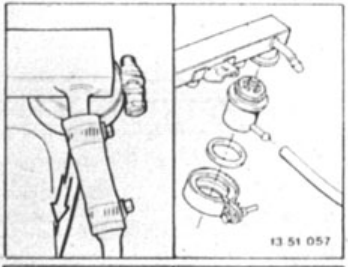
Mechanical Test:

It should be possible to turn rotary piston (1) in the idling speed control valve when the valve is rotated abruptly.

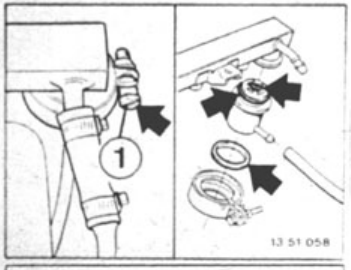


13 51 630 Replacing fuel pressure regulator (M50)

Remove covering.

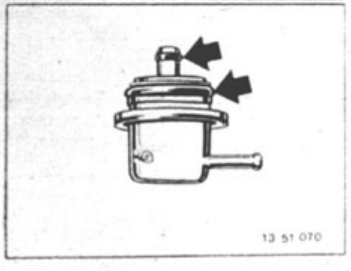


Disconnect vacuum hose.



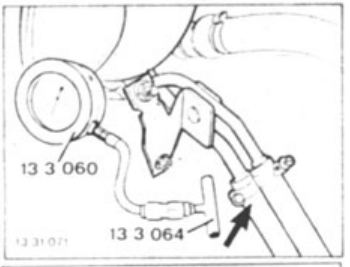
Release screw (1).
Press off fuel pressure regulator (stiff, sealing rings hold fast).

Caution!
Sealing ring drops out.

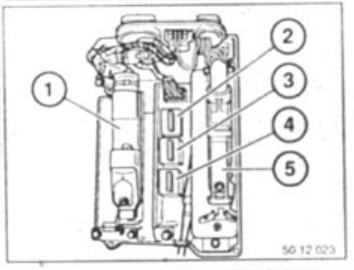


Installation note:
Check sealing rings and replace if necessary.
Note identification No. and nominal pressure*

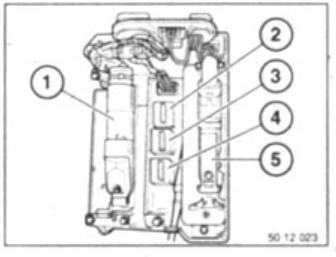
* Refer to Technical Data



Check:
Install pressure gage 13 3 060 with connection line and T-piece 13 3 064 in fuel supply line (bottom line).

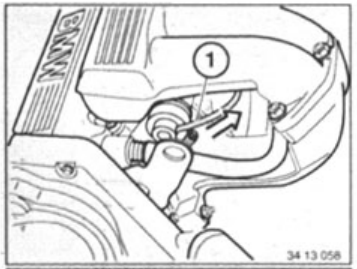


Unplug fuel pump relay (3).
Connect jumper between terminal 87 and terminal 30 with special tool 61 3 050.
Fuel injection pressure*.



If the fuel injection pressure* drops too fast, close off return line - upper line - with tool 13 3 010 and briefly operate tool 61 3 050 again.
The pressure regulator is defective if the injection pressure is now maintained.
If the injection pressure drops, there is a leak upstream of the pressure regulator.

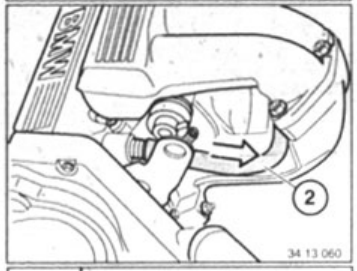
* Refer to Technical Data



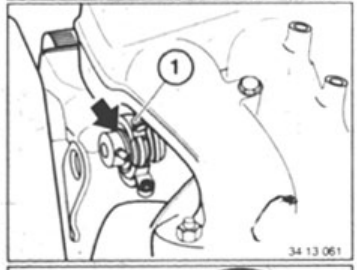
13 51 630 Replacing fuel pressure regulator (M40)

(After function test of digital motor electronics (DME) 13 00 002, or after testing delivery pressure of fuel pump 13 31 029)

Disconnect vacuum hose (1).

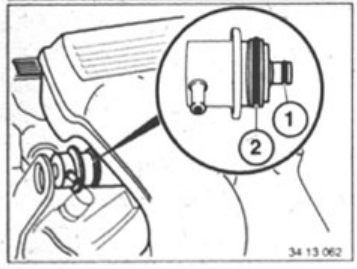


Disconnect hose (2).



Release screw (3). Remove retaining strap.

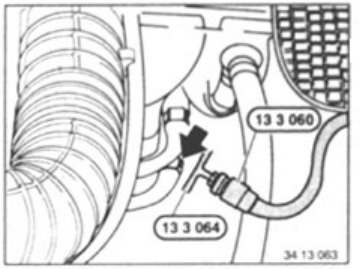
Caution!
Thrust washer drops out.



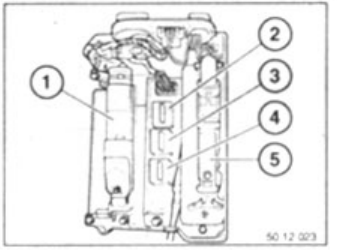
Turn regulator and pull out.

Installation note:
Replace sealing rings (1) and (2).
Note identification No. and nominal pressure*.

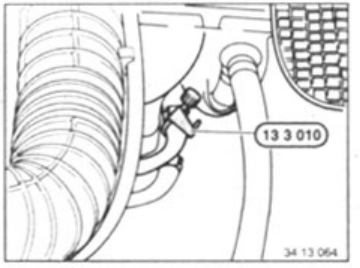
* Refer to Technical Data



Component testing:
Install BMW SERVICE TESTER or pressure gage 13 3 060 with connection line and T-piece 13 3 064 in fuel supply line - ahead of pressure regulator.

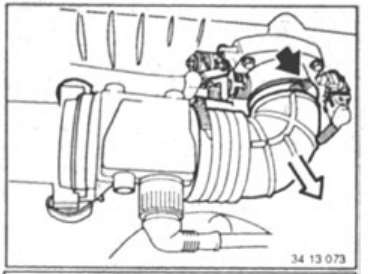


Unplug fuel pump relay (3). Connect jumper between terminal 87b and terminal 30 with special tool 61 3 050.
Read off fuel injection pressure*.



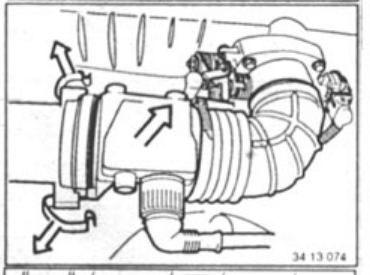
If the fuel injection pressure* drops at too fast a rate, close off return line - upper line - with tool 13 3 010 and once again briefly operate tool 61 3 050.
The pressure regulator is defective if the injection pressure is now maintained.
If the injection pressure drops, there is a leak upstream of the pressure regulator.

* Refer to Technical Data

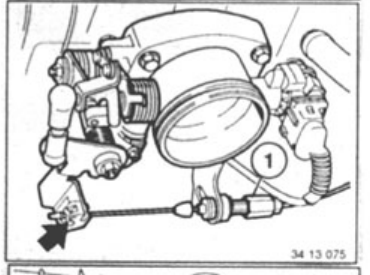


13 54 030 REMOVING AND INSTALLING THROTTLE VALVE ASSEMBLY (M50)

Loosen hose strap and pull bellows off.

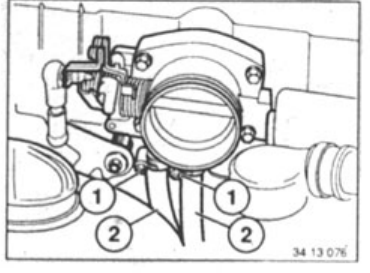


Loosen clamps and remove air volume sensor together with the bellows.

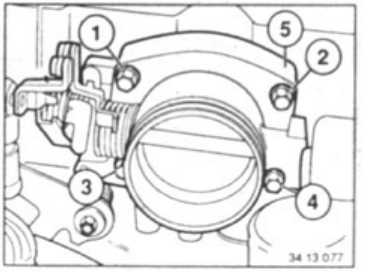


Disconnect cables (1 and if applicable 2).

Installation:
Adjust cables - refer to pertinent Group 35 or 65.



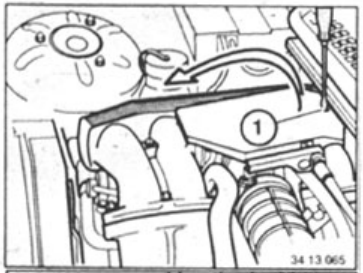
Loosen hose straps (1) **and push hoses** (2) **back.**
Pull plug (3) **off of the throttle valve switch.**



Unscrew screws (1 ... 4).
Remove throttle valve assembly.

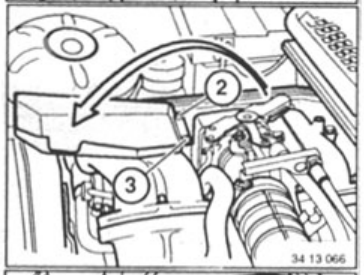
5 = Gasket

Installation:
Replace gasket (5).

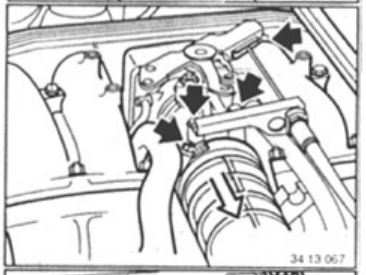


13 54 030 REMOVING AND INSTALLING THROTTLE VALVE ASSEMBLY (M40)

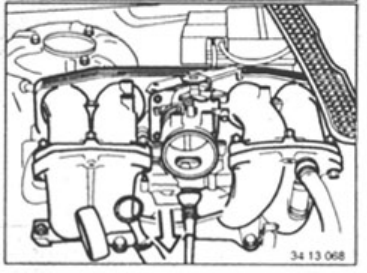
Unscrew screw (1) and fold plastic cap out of the way.



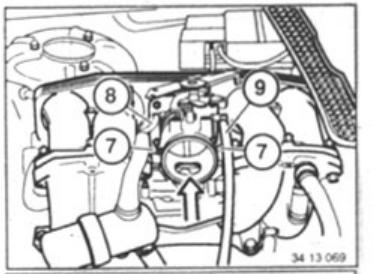
Unscrew screws (2 and 3).



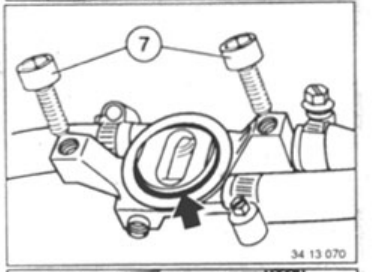
Unclip cable (or cables).
Unscrew screws and remove holders.
Loosen hose strap (4) and remove bellows (5).



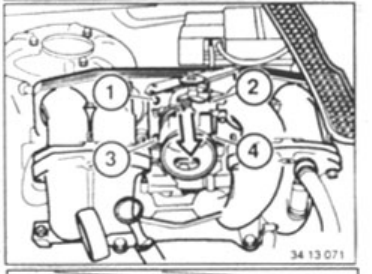
Pull plug off of the throttle valve switch.



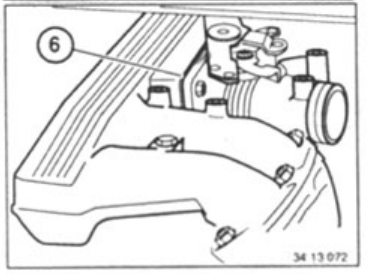
Unscrew screws (7) and remove preheater.
Disconnect hoses (8 and 9).



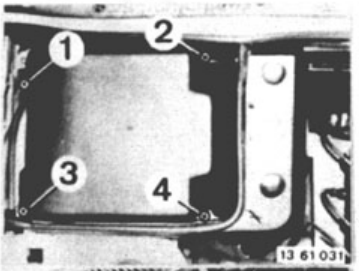
Installation:
Check for correct seating of the preheater.
Replace seal.



Unscrew screws (1 ... 4).
Remove throttle valve assembly.



Installation:
Replace gasket (6).



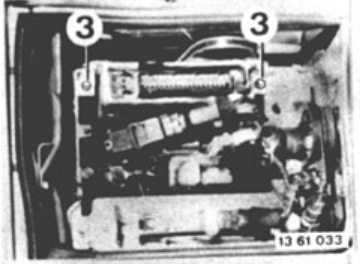
13 61 000 REMOVING AND INSTALLING OR REPLACING CONTROL UNIT

Unscrew screws (1 ... 4).
Remove cover.



Pull lock (1) up and disconnect plug (2).

Caution!
The plug may only be disconnected or connected with the ignition switched off.

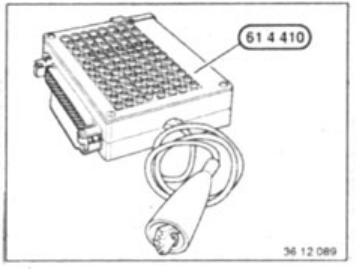


Unscrew mounting screws (3) or pull the control unit out of the spring retainers.
Remove control unit.



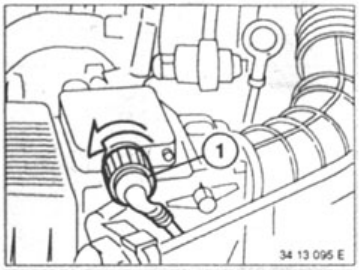
Installation:
Check code (1)* and production date (2)*.

* Refer to Specifications



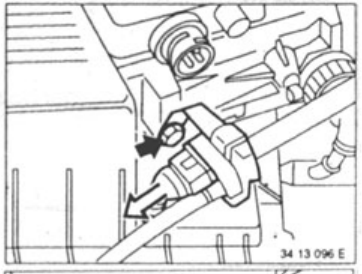
Important!
Bosch DME and Siemens MS 40 have different control units and they must not be interchanged.
Danger of short circuit!
Plugs are also coded differently.
Code and make information is provided on the data plate.
Refer to BMW Parts for a cross reference survey of types and models.

Important!
When using test adapters 61 4 410/411 there could be a mixup between Bosch DME and Siemens MS 40.
To avoid a mixup between control units and engine wire harnesses, first check whether the new control unit can be plugged on the engine wire harness.
Test adapters 61 4 410/411 have zero coding and fit both control units even with different coding of the plugs.
Non-conformance could lead to destruction of the DME control unit and wire harness.

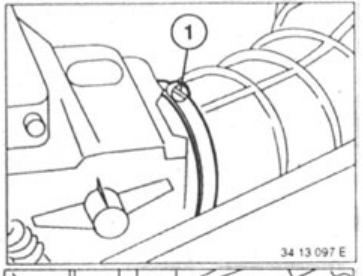


13 62 000 REMOVING AND INSTALLING AIR FLOW SENSOR (M40)

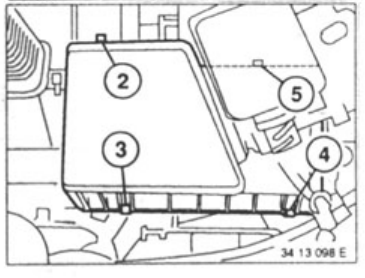
Twist and pull multiple-pin plug (1) off.



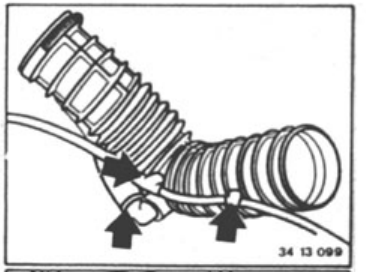
Squeeze the clip and pull the plug off of the cycling valve.
Unscrew screw on the mounting bar.



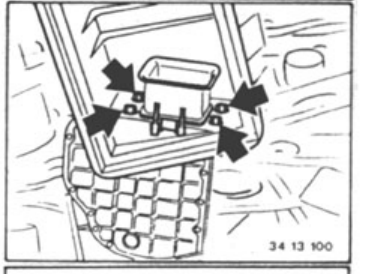
Loosen hose strap (1).
Pull bellows off.



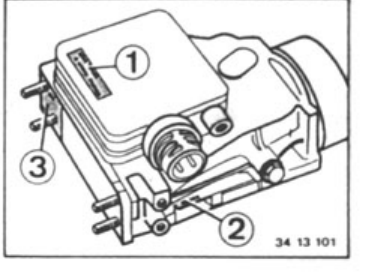
Unfasten clips (2 ... 5).
Remove upper section of the air cleaner together with the air flow sensor.



Installation:
Check securing of wires and hose connections.

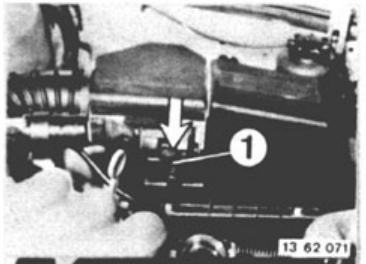


Unscrew nuts.



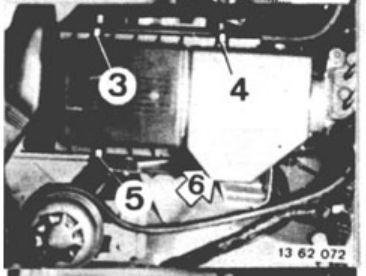
Installation:
Check code (1)*, production date (2)*, engine idling speed* and idling speed CO content*.
Replace gasket (3).

* Refer to Specifications

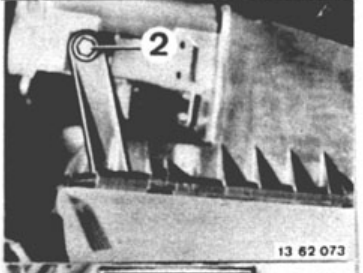


13 62 000 REMOVING AND INSTALLING AIR FLOW SENSOR (M20)

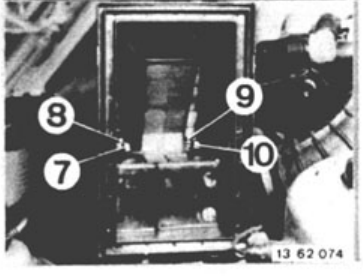
Pull multiple-pin plug (1) off.



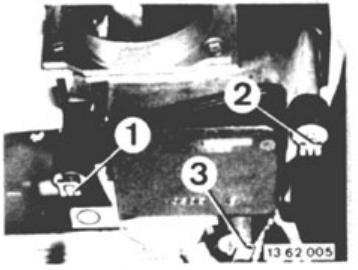
Unfasten clips (3 ... 6).
Pull upper section of air cleaner out together with the air flow sensor.



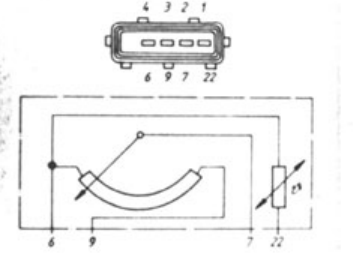
Unscrew screw (2).



Unscrew nuts (7 ... 10).
Remove air flow sensor.

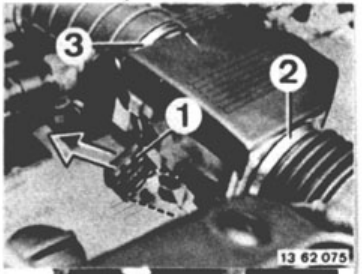


Installation:
Check code (1)*, production date (2)*, engine idling speed* and idling speed CO content*.
Check air flow sensor*.



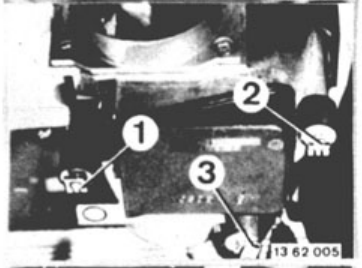
Wiring Diagram

* Refer to Specifications

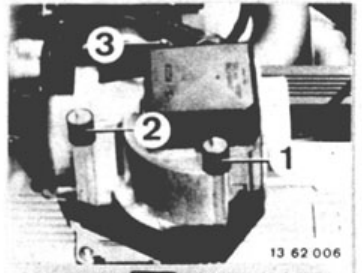


13 62 000 REMOVING AND INSTALLING AIR FLOW SENSOR (M30)

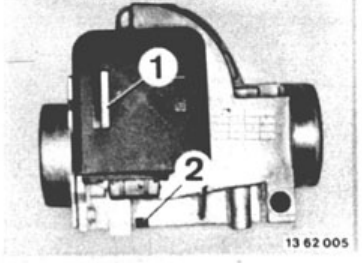
Pull multiple-pin plug (1) off.
Loosen hose straps (2 and 3).
Disconnect hose (4).



Press clips (1 ... 3) off.



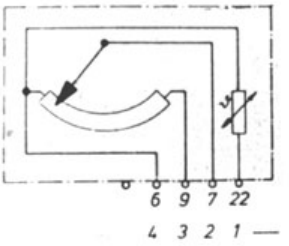
Check and, if necessary, replace silent blocks (1 ... 3).

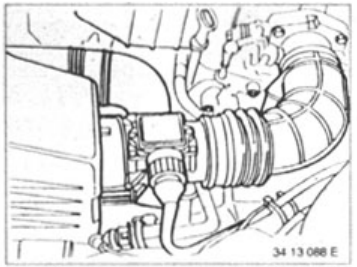


Installation:
Check code (1)*, production date (2)*, engine idling speed* and idling speed CO content*.
Check air flow sensor*.

* Refer to Specifications

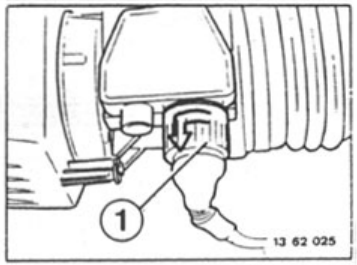
Wiring Diagram



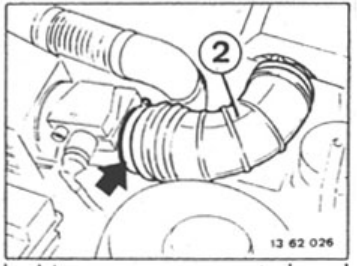


13 62 560 Removing and installing air mass meter (M50, M50 B20 TR)

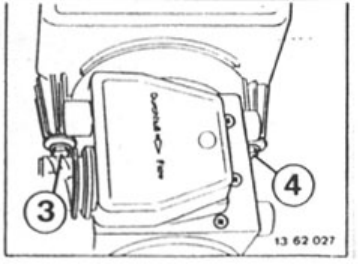
Caution!
As of 9.91 a new motor electronics system (MS40) is phased in on vehicles in Germany. identified by the hot film mass meter with small square plastic cover.
The components (e.g. control unit, sensor, sending unit etc.) must not be mixed. For further information, see BMW Diagnostic System.
Siemens MS40 hot film air mass meter



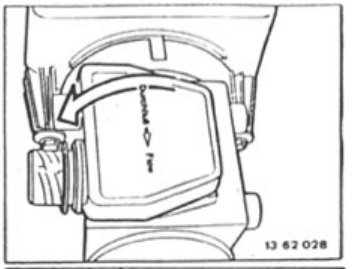
Bosch DME
Hot wire air mass meter
Turn multiplug (1) and disconnect.



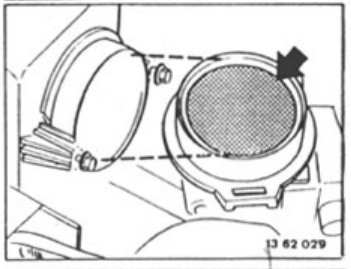
Release hose clip. Remove gaiter (2).



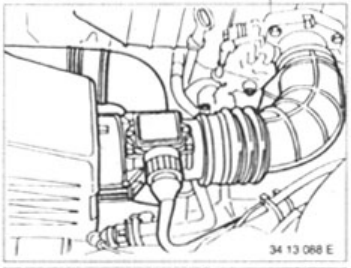
Release screws (3 and 4).



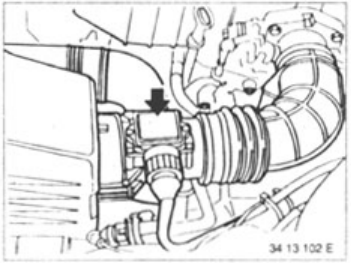
Turn air mass meter and remove.



Installation note:
Only re-install undamaged screen.

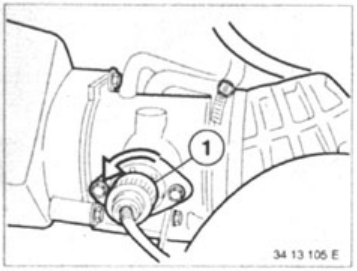


Caution!
The new motor electronics system (MS 40.1) is installed on vehicles with M50 TR 2.0 l engine. Identified by the hot film air mass meter with small square plastic cover.
The components (e.g. control unit, sensor, sending unit etc.) must not be mixed. For further information refer to BMW Diagnostic System
Siemens MS 40 hot film air mass meter



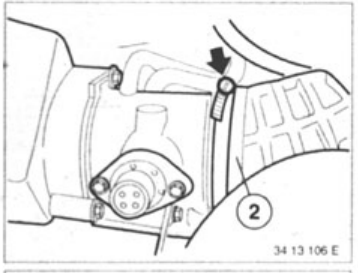
Note identification No.* when replacing air mass meter.
Check idle speed and CO content via BMW DIAGNOSTIC SYSTEM.

* Refer to Technical Data

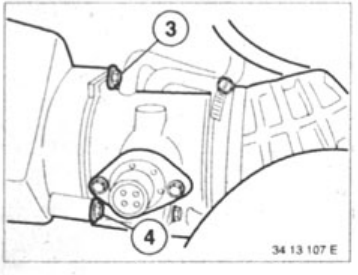


13 62 560 Removing and installing hot film air mass meter (M50 B25 TR)

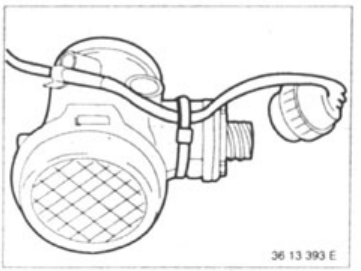
Turn multiplug (1) and disconnect.
Cut off cable ties.



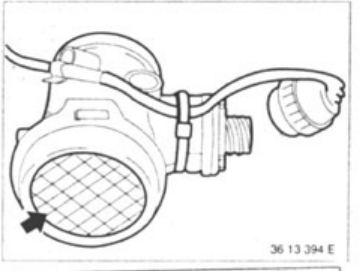
Release cable clip, remove gaiter (2).



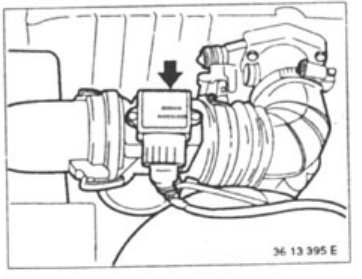
Release screws (3 and 4).
Remove air mass meter.



Installation note:
Secure cable with cable ties.

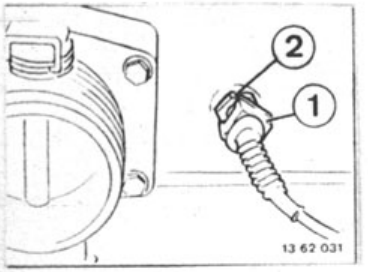


Installation note:
Only re-install undamaged screen.



Note identification No. when replacing air mass meter.
Check idle speed and CO content with BMW DIAGNOSTIC SYSTEM

* Refer to Technical Data



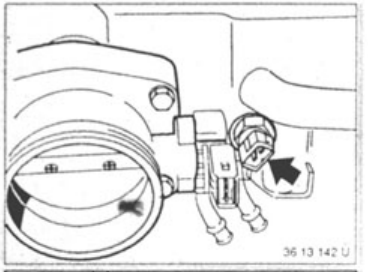
13 62 511 REPLACING INTAKE AIR TEMPERATURE SENSOR (M50)

(After checking function of digital engine electronics as in 13 00 002.)

Squeeze the retainer and pull off plug (1). Unscrew temperature sensor (2).

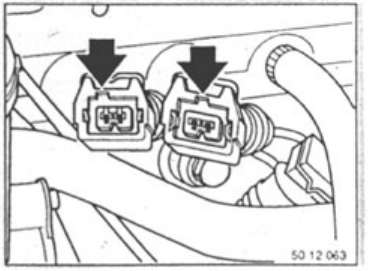
Checking:

Refer to BMW Diagnosing System.



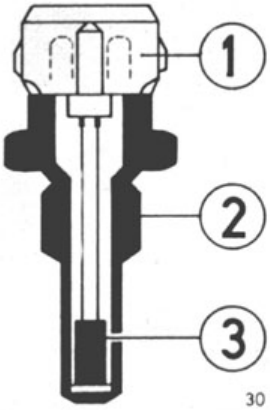
Component Test:

Check resistance value* on the temperature sensor.
Check wires from the control unit plug to the temperature sensor plug for breaks and shorts.



Important!
The coding of sender plugs is different for Bosch DME and Siemens MS 40.

* Refer to Specifications



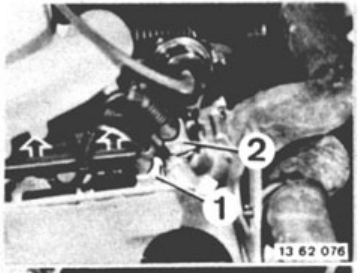
30 13 625

13 62 531 REMOVING AND INSTALLING / CHECKING COOLANT TEMPERATURE SENSOR

(After checking function of digital engine electronics as in 13 00 002.)

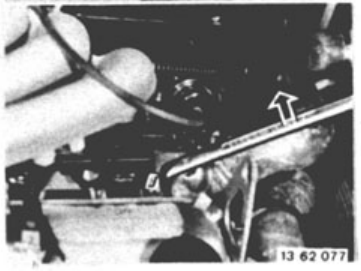
The temperature sensor measures the engine temperature and sends this information as a resistance value signal to the control unit.
The resistance value falls with rising temperature (NTC).

1 = Plug connection
2 = Housing
3 = NTC resistor

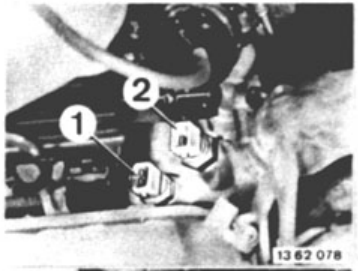


13 62 076

M20
Removing and installing:
Disconnect plugs (1 and 2).
If applicable, lift the fuel injector plug rail slightly.


13 62 077

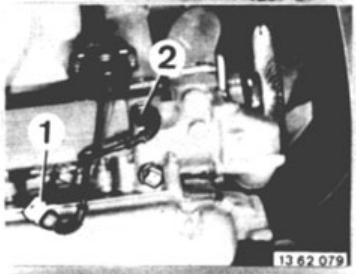
Unscrew temperature gage sender (2).
Unscrew DME temperature sensor (1).



13 62 078

Installation:
Tightening torque*.
Press the fuel injector plug rail onto each injector.

(1) Temperature sensor plug
= blue
(2) Temperature gage plug
= black

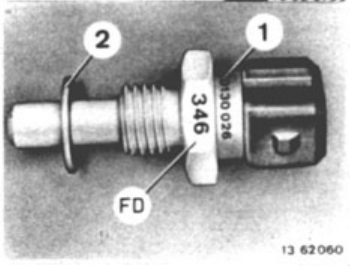


13 62 079

M30
Removing and installing:
Disconnect plug (1).
Unscrew temperature sensor.

Installation:
Tightening torque*.

(1) Temperature sensor plug
= blue
(2) Temperature gage plug
= black



13 62060

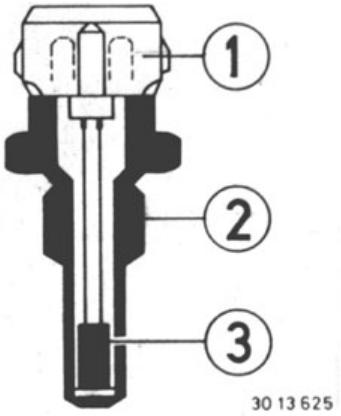
Installation:
Check code (1)*.
Replace seal (2).
FD = Production Date.
Fill and bleed cooling system – refer to Group 17.



13 62062

Testing:
Connect Jetronic test leads 61 1 440.
Check nominal value* with an ohmmeter.
To check the entire temperature range, remove and place the temperature sensor in a water bath, heat water to testing temperature and measure the resistance* with an ohmmeter.

* Refer to Specifications



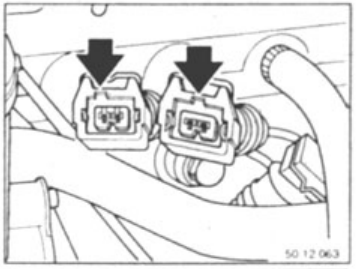
13 62 531 REMOVING AND INSTALLING / CHECKING COOLANT TEMPERATURE SENSOR (M50)

(After checking function of digital engine electronics as in 13 00 002.)

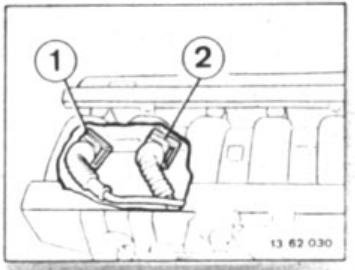
The temperature sensor measures the engine temperature and sends this information as a resistance value signal to the control unit.
The resistance value falls with rising temperature (NTC).

1 = Plug connection
2 = Housing
3 = NTC resistor

Refer to BMW Diagnosing System to check temperature sensor (coolant).

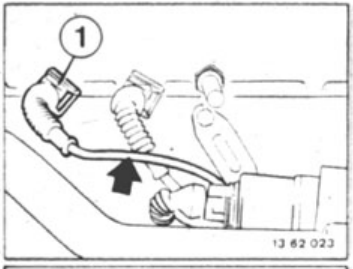


Important!
The coding of sender plugs is different for Bosch DME and Siemens MS 40.

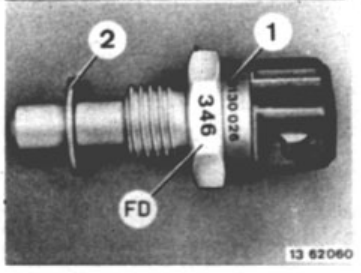


Installation:
Tightening torque*.

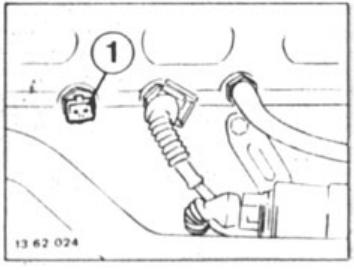
(1) Temperature sensor
(2) Temperature gage



Removing and installing:
Disconnect plug (1) with long wire.



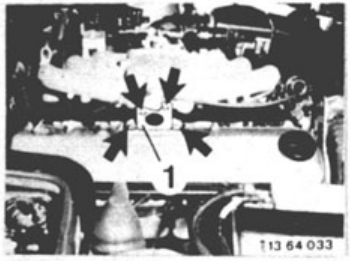
Installation:
Check code (1)*.
Replace seal (2).
FD = Production Date.
Fill and bleed cooling system – refer to Group 17.



Unscrew DME temperature sensor (1).

Testing:
Check nominal value* with an ohmmeter.
To check the entire temperature range, remove and place the temperature sensor in a water bath, heat water to testing temperature and measure the resistance* with an ohmmeter.

* Refer to Specifications

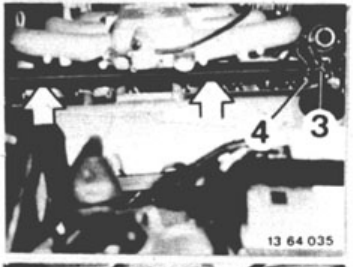


13 64 541 Replacing all fuel injector valves (M20)

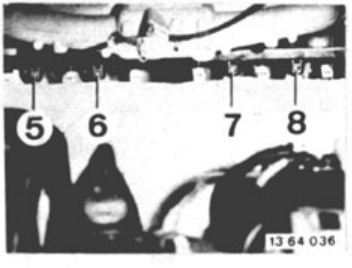
Remove retaining bracket (1).



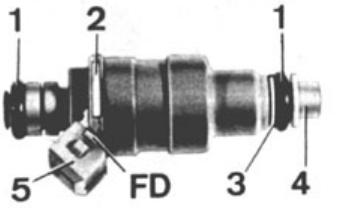
Disconnect plug-and-socket connection (2).



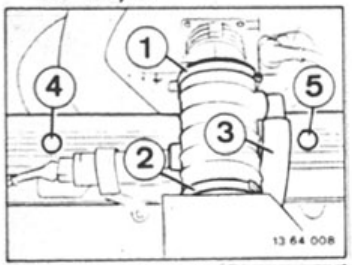
Disconnect plug (3) for water temperature sensor, plug (4) DME temperature sensor, pull up connector strip and remove.



Release retaining screws (5...8), push up injection tube until injector valves move out of guide of intake manifold.
Remove fuel injector valves individually.

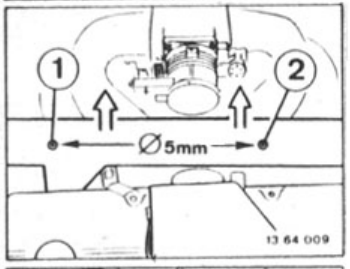


Installation note:
Check O-rings (1), replace if necessary.
Note identification No. (2)*.
Observe position of plastic washer (3).
Observe color* of plug housing (5) or of nozzle guard (4).
FD = Production date
Lightly coat O-rings with Vaseline before fitting.

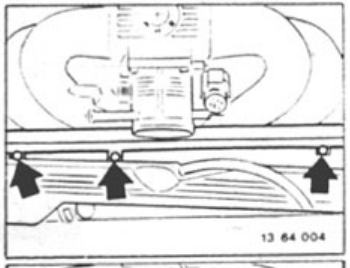


13 64 541 Replacing all fuel injector valves (M30)

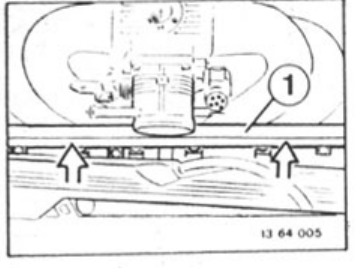
Release hose clips (1 and 2).
Remove hose (3).
Lift out plastic caps (4 and 5).



Release 5 mm Allen screws (1 and 2). Remove connector strip.



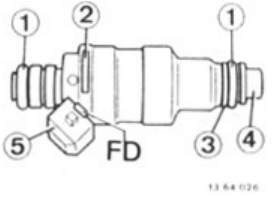
Release screws for injection tube (3 screws).



Push injection tube (1) upward until fuel injector valves are out of guide in intake manifold.

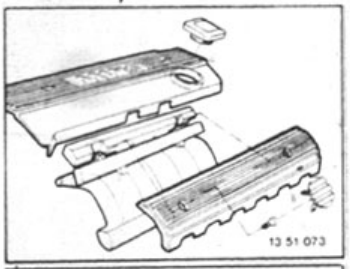


Disconnect plug (1).
Lift out retainer (2) and remove fuel injector valve.



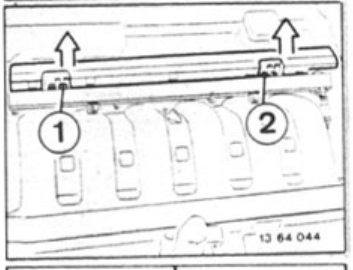
Installation note:
Check O-rings (1) and replace if necessary.
Note identification No. (2)*.
FD = Production date
Observe position of plastic washer (3).
Observe color* of plug housing (5) or of jet guard (4). Lightly coat O-rings with Vaseline or transmission oil SAE 90 before fitting.

* Refer to Technical Data

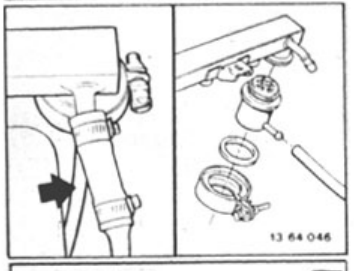


13 64 541 Removing and installing all fuel injector valves (M50)

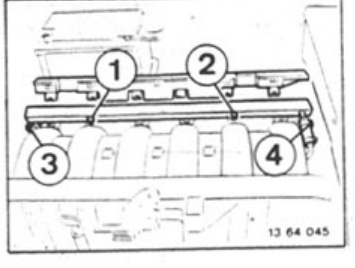
Remove covering.



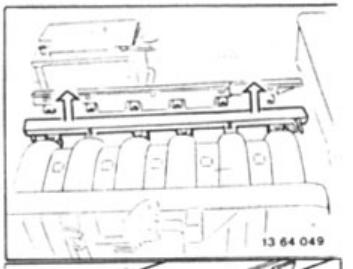
Release screws (1 and 2).
Remove connector strip.



Disconnect vacuum hose.

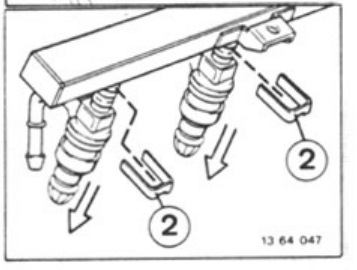


Release screws (1 and 2).
Remove supply line (3) and return line (4).

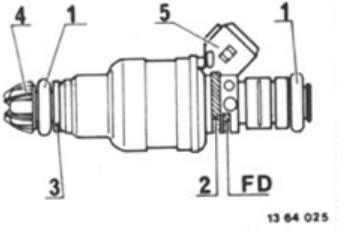


Pull injection tube with valves upward.

Installation note:
Check sealing rings and replace if necessary.
Check fuel line connections for leaks.



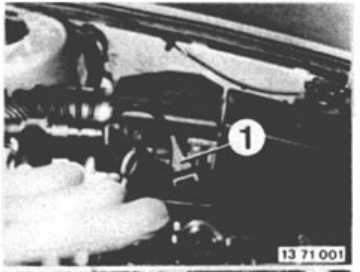
Lift out retainer (2) and remove fuel injector valve.



Installation note:
Check O-rings (1) and replace if necessary.
Note identification No. (2)*.
FD = Production date.
Observe position of plastic washer (3).
Observe color* of plug housing (5) or of jet guard (4). Lightly coat O-rings with Vaseline or transmission oil SAE 90 before fitting.

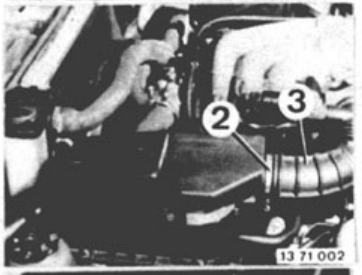
Clean fuel injector valves, refer to Service Information No. 2 1 87 (623).

* Refer to Technical Data

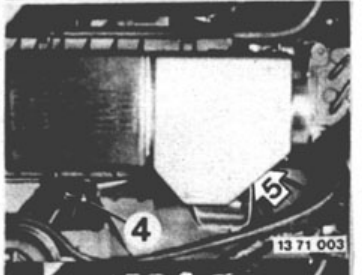


13 71 000 REMOVING AND INSTALLING AIR CLEANER

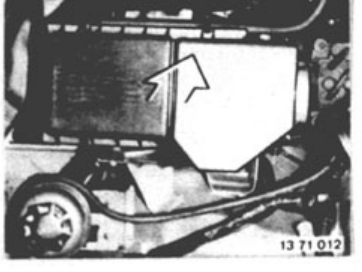
M 20
Pull off multiple-pin plug (1).



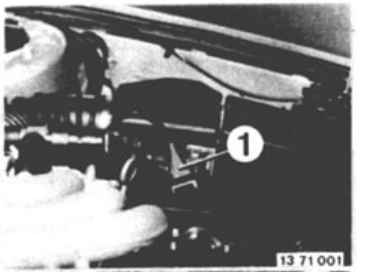
Loosen hose clamp (2).
Pull off hose (3).



Unscrew nuts (4 and 5).

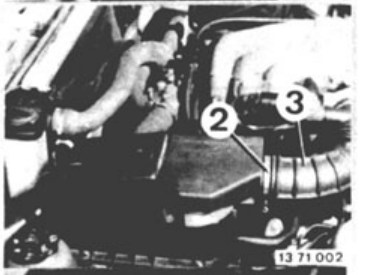


Pull up and remove air cleaner.

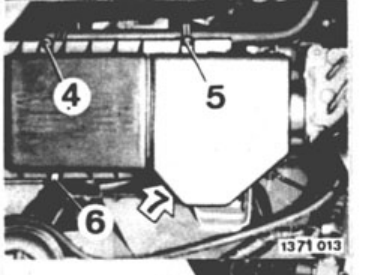


13 72 001 REPLACING AIR FILTER CARTRIDGE

M 20
Pull off multiple-pin plug (1).



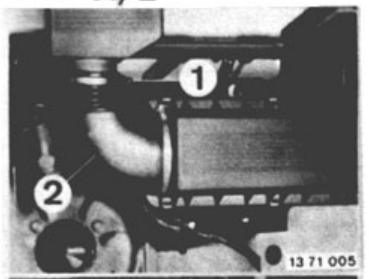
Loosen hose clamp (2).
Pull off hose (3).



Loosen fasteners (4 ... 7).
Pull up and turn upper air cleaner section with air flow sensor.

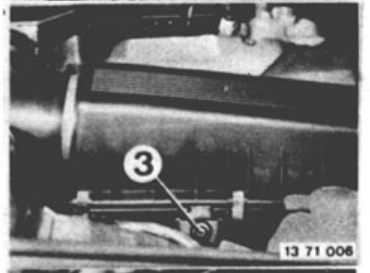


Pull out filter cartridge.



13 71 000 REMOVING AND INSTALLING AIR CLEANER

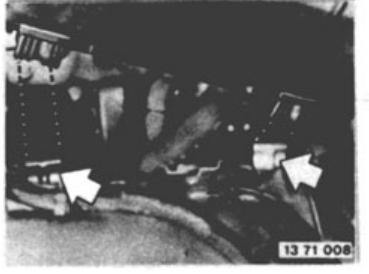
M 30
Loosen hose clamp (1).
Pull off hose (2).



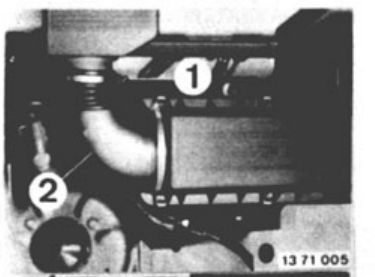
Unscrew nut (3).



Remove air cleaner by pulling back and up.

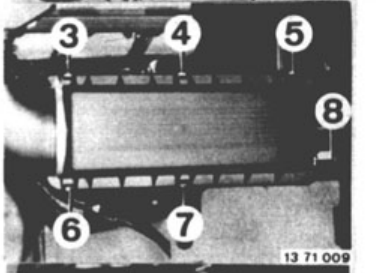


Installation:
Guide in intake neck.
Have rubber mounts engage in holders.

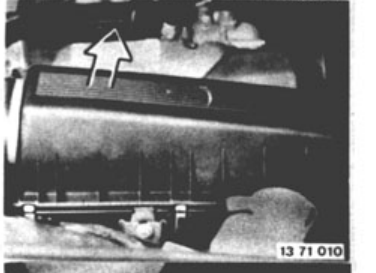


13 72 001 REPLACING AIR FILTER CARTRIDGE

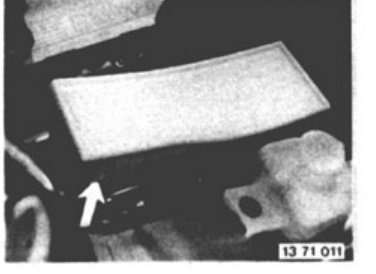
M 30
Loosen hose clamp (1).
Pull off hose (2).



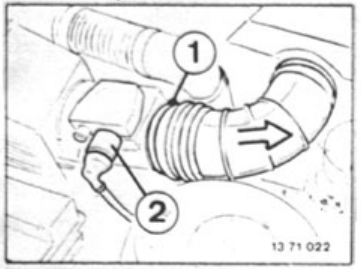
Loosen fasteners (3 ... 8).



Pull up upper air cleaner section.

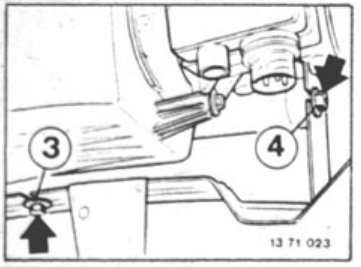


Pull out filter cartridge.

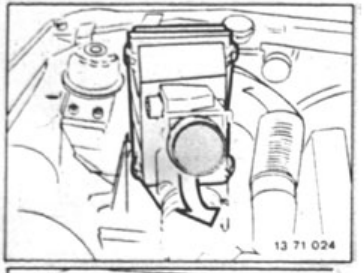


13 71 000 REMOVING AND INSTALLING AIR CLEANER (M 50)

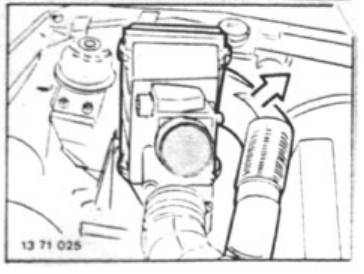
Loosen hose clamp (1).
Pull off dust cover.
Turn and pull off plug (2).



Unscrew nuts (3 and 4).

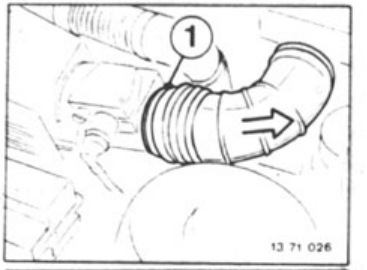


Pull out air cleaner with air mass sensor back from above.



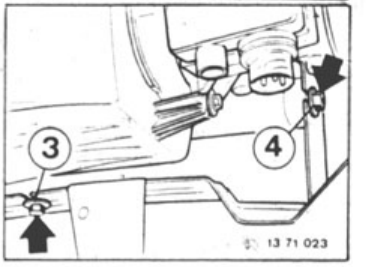
Disconnect cooling air hose.

Installation:
Guide in intake necks.
Have rubber mounts engage in holders.

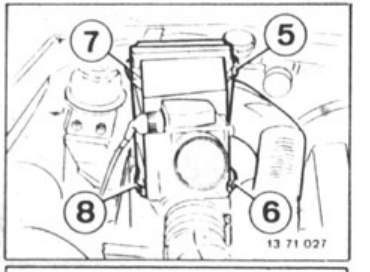


13 72 001 REPLACING AIR FILTER CARTRIDGE (M 50)

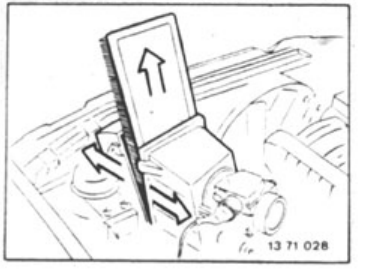
Loosen hose clamp (1).
Pull off dust cover.



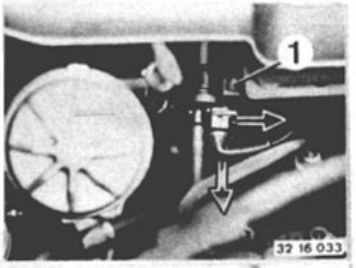
Unscrew nuts (3 and 4).
Pull up and push back air cleaner housing slightly.



Open fasteners (5 ... 8).



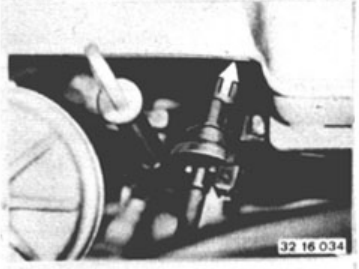
Pull air cleaner housing sections apart.
Pull out air filter cartridge.



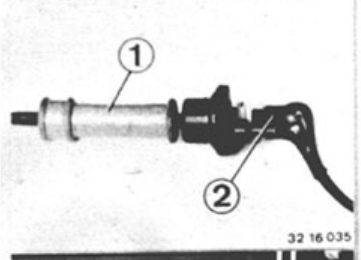
13 90 500 REPLACING TANK VAPOR VENTING VALVE (M20 / M30)

(After checking function of digital engine electronics as in 13 00 002.)

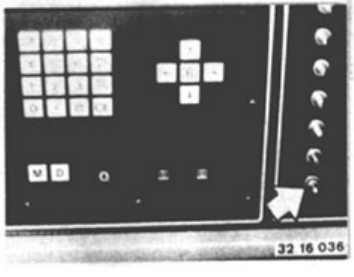
Lift out retainer.
Pull off plug.
Unscrew screw (1).



Pull off hoses.
Lift out tank vapor venting valve.



If Applicable, Checking:
Connect vacuum hose (1) to 8 mm dia. adapter.
Supply 12 V voltage to tank vapor venting valve using Special Tool 61 1 440 (2).



Select Multimeter Function 21 on BMW Service Tester.
Set vacuum to 600 ± 100 mbar.
Then switch off tester.

Vacuum must not drop by more than 50 mbar during the testing time of about 20 seconds.
Replace tank vapor venting valve if the vacuum drop is greater than 50 mbar.

13 Fuel system

M5

13 00 60	Engine idle speed and CO content (S38 B35/B36) – check	13- 0/11
	Exhaust gas synchronization (S38 B35/B36)	13- 0/12
13 00 60	Engine idle speed and CO content (S38 B38) – check	13- 0/13
	Exhaust gas synchronization (S38 B38)	13- 0/14
	Non-return valves in idle air rail (S38 B38) – check	13- 0/16
13 31 029	Delivery pressure of fuel pump – check	13- 31/11
. . .	Fuel delivery quantity – check	13- 31/11
. . .	Fuel pump – remove and install	13- 31/11
13 41 500	Idle speed control valve – remove and install or check	13- 41/11
13 51 630	Fuel pressure regulator – remove and install	13- 51/11
13 54 030	Throttle assembly – remove and install, seal	13- 54/11
	Basic throttle setting	13- 54/13
	Hose layout diagram (for mixture control) S38 B36	13- 54/16
	Resonance control – check	13- 54/17
13 62 560	Air mass meter – remove and install or replace	13- 62/11
531	Coolant temperature sensor – remove and install or check	13- 62/12
511	Air temperature sensor – remove and install	13- 62/12
13 63 544	Throttle switch – adjust	13- 63/11
511	Throttle switch – remove and install	13- 63/11
13 64 541	Fuel injector valves, all – remove and install or replace	13- 64/11
13 71 000	Air cleaner – remove and install	13- 71/11
13 72 001	Air cleaner cartridge – replace	13- 71/11

For further information on troubleshooting and jobs in assembly 13 refer to:
Microfiche Assembly Repair Manual and
Electrical Troubleshooting Manual 5 Series E34

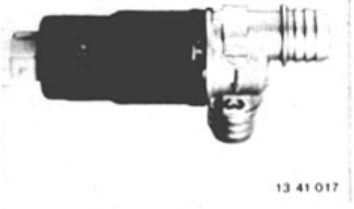
13 00 060 Checking engine idle speed and CO content S38 B35/B36

Preconditions for all setting work:
Engine is at operating temperature, i.e. min. oil temperature 60° C.
Valve clearance correct. Engine and ignition system in technically perfect condition.
Air conditioning system off.
Connect BMW SERVICE TESTER in accordance with operating instructions.
A routine check is not necessary.



Caution!
The setting of the air mass meter must not be changed with the adjusting screw.

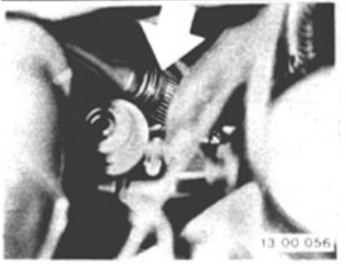
Note:
Check spark plugs after long idling period.



1) Engine idle speed

Check engine idle speed **.
Check intake system for leaks.
If the specified setpoint is not reached, see BMW Diagnostic System. Check function of idle speed control valve 13 41 500.

Note:
There is no adjusting screw for idle control.

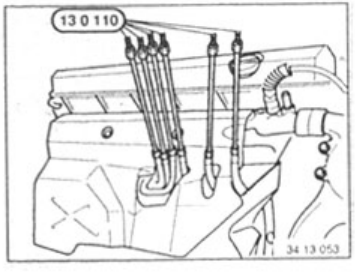


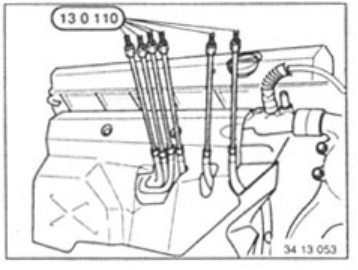
Check function of oxygen sensor (11 78 010):

Release screws.
Caution!
They are very hot.
Connect exhaust emission probes 13 0 110 to take-off pipe.
Switch off intake system for duration of exhaust emission measurement.
Disconnect plug from oxygen sensor.
Close off vacuum hose to fuel pressure regulator (not with engine running), start engine, CO value increases. Connect oxygen sensor. CO value must drop to specified setpoint**.
Remove clips.

2) Exhaust emission test

Disconnect plug-and-socket connection of oxygen sensor.
Release screws.
Caution! They are very hot.
Connect exhaust gas probes 13 0 110 to take-off pipes.
Check idle CO content**.
Switch off intake system for duration of measurement.
If the specified setpoint is not reached
If CO value too high:
Check injection nozzles
Fuel pressure
Water temperature sensor
If CO value too low:
Check hoses and connections for idle speed control and locate leakage air.
Exhaust emission synchronization must be carried out if the difference between the individual take-off points is greater than 0.2 vol.%.



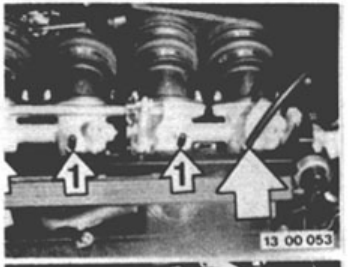


** Refer to Technical Data

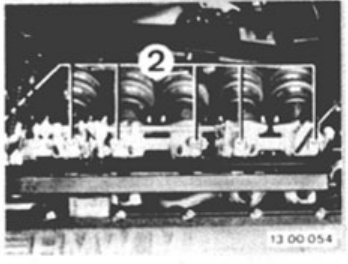
** Refer to Technical Data

Exhaust synchronization S38B35/B36

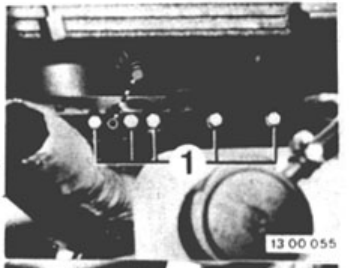
During routine service work, there is no need to conduct a vacuum test or exhaust synchronization test.
Synchronization is only required during repair work or if a complaint has been received (e.g. rough idle).



Engine without individual exhaust gas extraction points:
Prerequisite - pressure rod setting okay (see removing and installing throttle valve spigot 13 54 030).
Remove seal caps (1). Connect up vacuum measuring unit (BMW SERVICE TESTER M 21). Measure suction pipe vacuum at all 6 throttle valve spigots and note down results. Leave sealing caps (1) on the throttle valve spigots which are not to be measured.



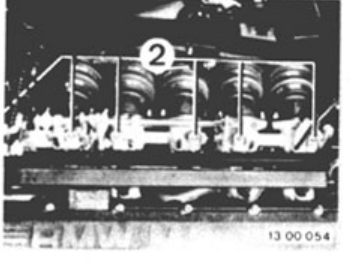
With screw (2/socket 7 mm WAF), set every throttle valve spigot to the same vacuum level = 300 ± 50 mbar at nominal idling speed*. Vacuum difference, max. ± 5 mbar.
Fit new tamper-proof device (2) once adjustment has been successfully completed.
Then check engine idle speed* and CO content*.



Engine with individual gas extraction points:
Prerequisite - pressure rod setting okay (see removing and installing throttle valve spigots 13 54 030).
Measure and compare CO values at the extraction points.

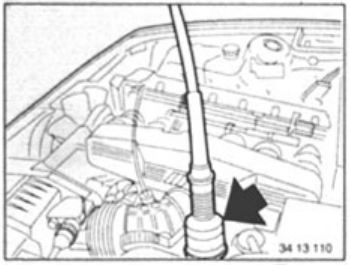


Disconnect oxygen sensor plug.



With screw (2/socket 7 mm WAF), check CO nominal value = 0.8 ± 0.4 Vol. %. Max. permitted deviation between the cylinders = ± 0.2 vol. %.
Connect up Lambda oxygen sensor plug.

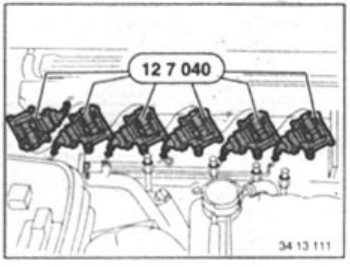
* Refer to Specifications



13 00 060 Check engine idle speed and exhaust contents S38B38

Requirements for all adjustments:
Engine is at operating temperature, i.e. oil temperature is min. 60°C.
Valve clearance is correct. Engine and ignition system in good working order.
Air conditioning system switched off.
Connect BMW Service Tester to operating instructions.

Routine checking is not necessary.



1) Engine idle speed

Check engine idle speed*.
Caution: If the TDC signal on the diagnosis plug (pin 1) is not allocated, use adapter set 12 7 040.
Refer to 12 13 ...

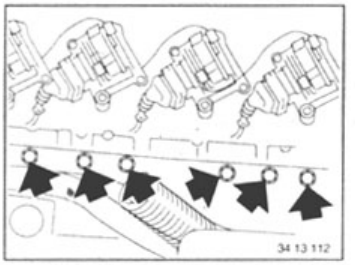
If engine idles unevenly, check air intake system for leaks.
If nominal value is not achieved, interrogate fault memory with BMW Diagnosis System, call up adaption values. Use diagnosis diskette from 11.0.

Perform function check on idle regulation valve 13 41 000.
Note:
There is no adjusting screw for idling speed regulation.

2) Exhaust test

Lambda oxygen sensor remains connected.
Unscrew bolts.
Caution: These get very hot.
Connect exhaust sensors 13 0 110 to extraction pipes.
Check the CO content* at idle speed.

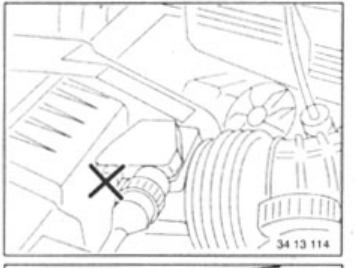
* Refer to Specifications



If nominal value is not achieved with excessive CO value, check:
injection nozzles
fuel pressure
water temperature sensor.

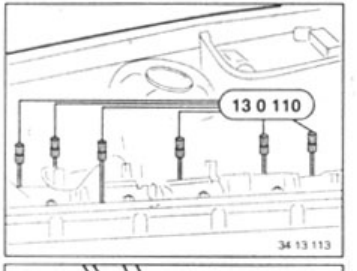
If CO value is too low:
Check hoses and connections for idle governing and pinpoint air leak.

If the difference between the individual extraction points exceeds ± 0.2 vol%, an exhaust synchronization test must be performed.



Caution:
Do not adjust the mass air flow sensor adjusting screw.

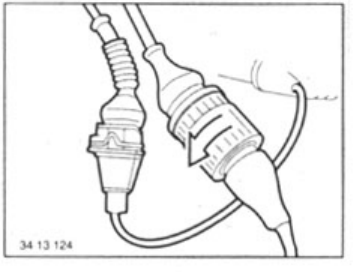
Note:
After extended period at idle speed, check spark plugs.



Perform function check on Lambda oxygen sensor (11 78 010):

Unscrew bolts.
Caution: These get very hot.
Connect exhaust sensors 13 0 110 to extraction pipes.

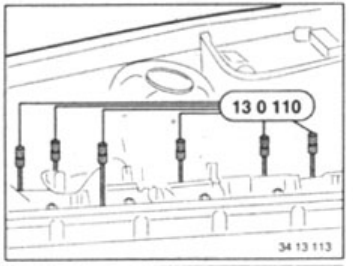
Disconnect oxygen sensor plug.
Clamp vacuum pipe to fuel pressure regulator (not while engine is running), start engine, CO value rises.
Connect oxygen sensor - CO value must return to nominal value*.
Remove clip



* Refer to Specifications

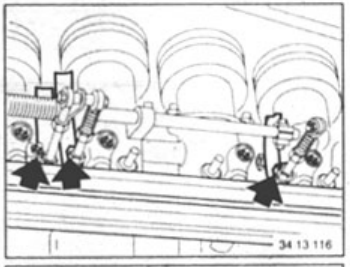
Exhaust synchronization test S38B38

During routine service work, there is no need to conduct a vacuum test or exhaust synchronization test.
Synchronization is only required during repair work or if a complaint has been received (e.g. rough idle).

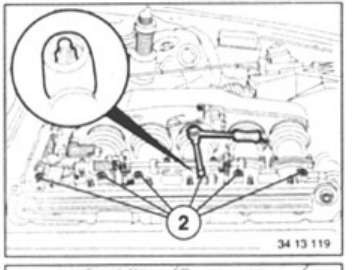


Unscrew bolts.
Caution! These get very hot.
Connect exhaust sensors 13 0 110 to extraction pipes.
Measure and compare CO values* at the extraction points.

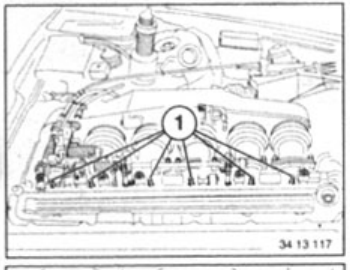
Caution:
Lambda oxygen sensor remains connected up.



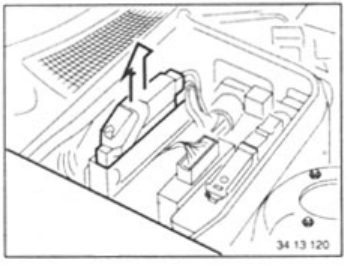
Inspection of throttle valve kinematics:
Trap paper strip between 3 detent screws and the kinematic detents. Pull on paper. If it is easy to remove the paper, perform a basic setting operation (see Removing and Installing Throttle Valve Spigot 13 54 030).



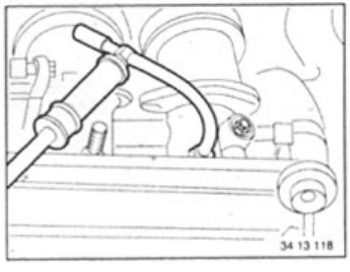
If the difference at the individual extraction points is greater than ± 0.2 vol. %: remove tamper protection. Adjust CO nominal value* with bypass screw (2/socket 7 mm WAFI)



If none of the paper strips can be extracted easily, perform vacuum test on throttle valves:
Remove seal caps (1). Connect up vacuum measuring unit (BMW SERVICE TESTER M 21).
Measure suction pipe vacuum at all 6 throttle valve spigots and note down results.
Note: Leave sealing caps (1) on the throttle valve spigots which are not to be measured.



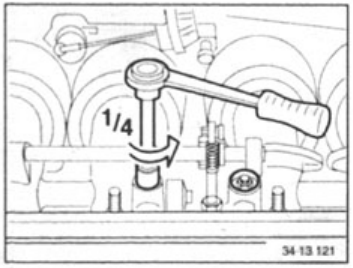
If there is a large deviation, screw all 6 bypass screws firmly home. Disconnect ignition system from DME control unit for 2 minutes. (Reset adaption values).



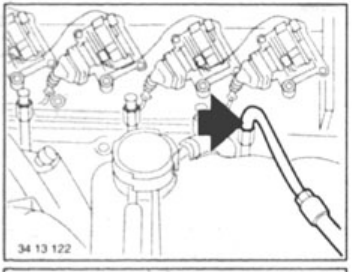
Suction pipe vacuum 300 ± 50 mbar.
If values deviate, perform a throttle valve basic setting operation (see Removing and Installing Throttle Valves 13 54 030).

Measure CO values from cylinders 1 ... 6 again and note down values. The bypass screw from cylinder with the lowest CO value does not change throughout the entire synchronization period. This value is raised when the other cylinders are adjusted.

* Refer to Specifications

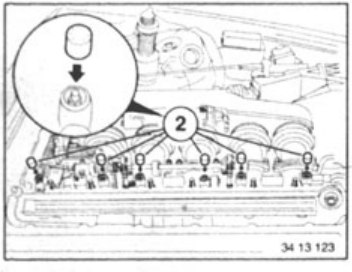


Gradually adapt the CO values of the other cylinders in small steps (max. 1/4 turns of the by-pass screw).



Caution! Keep repeating control check on other cylinders since all cylinders affect each other reciprocally.

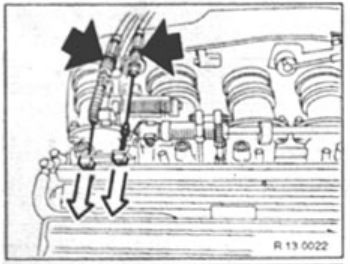
Note:
After extended period at idle speed, check spark plugs.



Fit new tamper protection (2) once adjustment process has been completed.

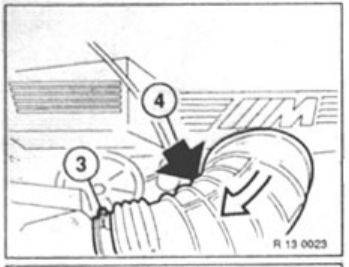
Finally, conduct trial run for 15 mins at part throttle and run engine at idle speed for 10 minutes.

Then: check adaption values and interrogate or clear fault memory. Refer to BMW diagnosis system.

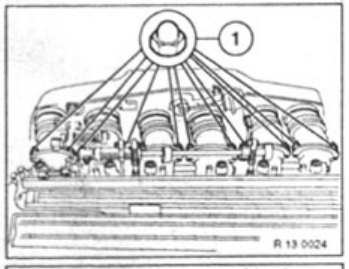


Check non-return valves in idle air strip S38B38.

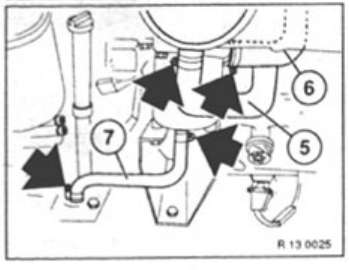
Disconnect accelerator cables.
Remove rubber mounts.



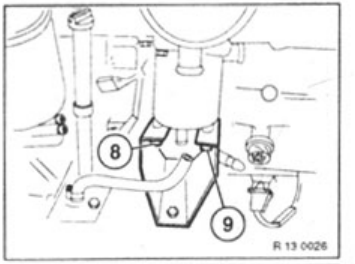
Loosen hose clamps (3 and 4).
Remove suction hose.



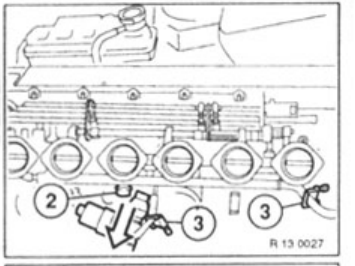
Unfasten nuts (1) from all 6 throttle valve spigots.



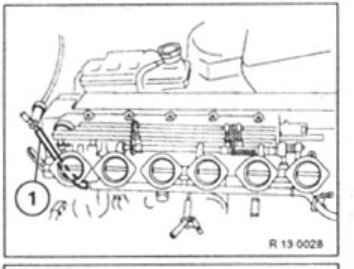
Loosen hose clamps.
Remove idle hose (5), vent hose (6) and oil return hose (7).



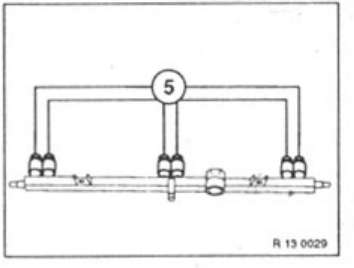
Unfasten nuts (8 and 9) from oil separator.
Remove air manifold.
Take care of vacuum hoses.



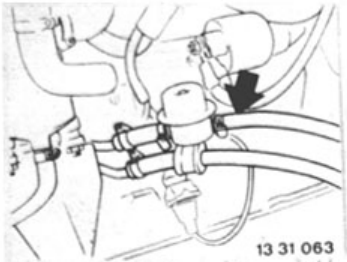
Remove idle speed control valve and close aperture (2). Disconnect hoses (3 and 4) or remove and seal apertures.



Remove vacuum hose (1) from fuel pressure regulator and connect up to BMW Service Test unit.

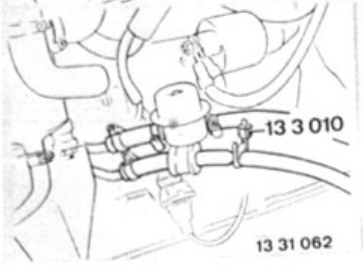


Measure vacuum with multimeter program (M21). Nominal value approx. 500 mbar.
If the measured value greatly exceeds this, or if it falls very rapidly when the pump is switched off, remove idle strip and fit new non-return valves (5).



13 31 029 Checking delivery pressure of fuel pump

Install pressure gage 13 3 060 with connection line and T-piece 13 3 064 in fuel supply line – upper line –.
Connect fuel line to tool 13 3 010 after the T-piece.

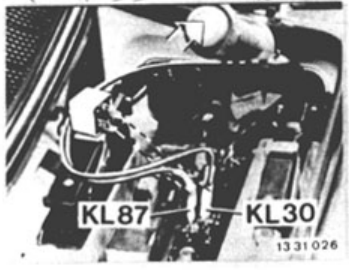


Remove lid of control unit box. Unplug fuel pump relay (1).
Connect jumper between terminal 87 and terminal 30 with tool 61 3 050.
Check delivery pressure*.

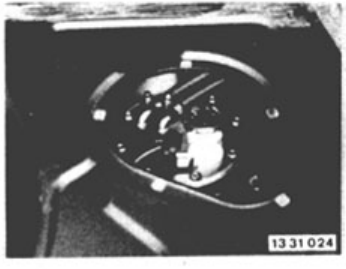


13 31 ... Checking fuel delivery rate

In order to also check the pressure build-up, measure the delivery rate after the pressure regulator.
Release fuel return line – bottom line – extend with plastic hose and place in measuring glass 13 3 020.



Remove lid from control unit box.
Unplug fuel pump relay.
Connect jumper between terminal 87 and terminal 30 with tool 61 3 050.
Check delivery quantity*.

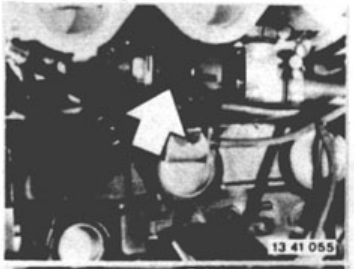


13 31 ... Removing and installing fuel pump

Remove and install fuel level sending unit and in-tank pump (M30)**, refer to 16 12 000.

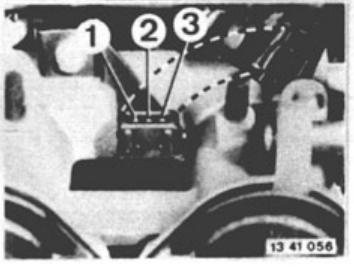
* Refer to Technical Data Group 16

* Refer to Technical Data Group 16
** Refer to Assembly 16



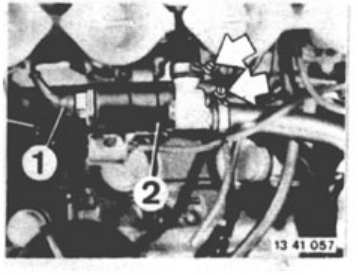
13 41 500 Removing and installing / checking idle speed control valve

Note:
When installed, operation of the idle speed control valve can be checked by touching with the hand (clocked voltage supply).

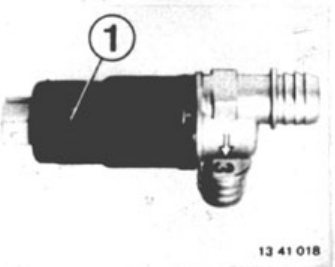


The electrical test can also be carried out at the intermediate connector with the valve installed.

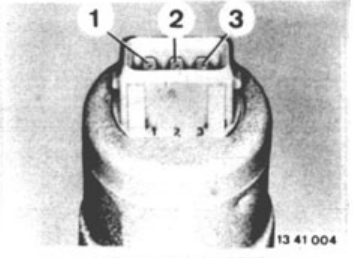
Remove idle speed control valve.
Remove manifold refer to:
Removing and installing throttle body 13 54 030.



Disconnect plug (1).
Detach (press together) retaining strap (2).
Release hose clips.
Pull idle speed control valve from hoses and remove.

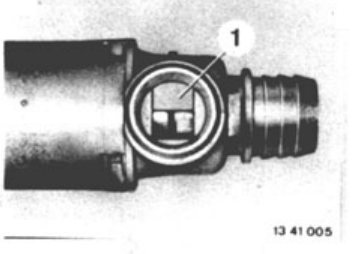


Installation note:
Note identification No. (1)*.
Check idle speed*.



Electrical check

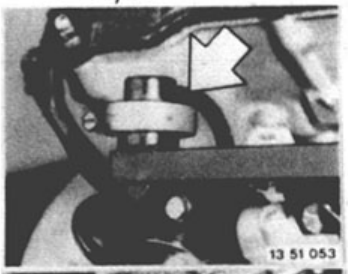
Measure resistance between terminal (1) and (3), set points approx. 40 Ohm.
Measure resistance between terminal (2) and (1) or (2) and (3).
Setpoints approx. 20 Ohm.



Dynamic check

Remove idle speed control valve for this purpose (plug remains connected).
Fully open or close rotary piston (1).
Switch on ignition.
Rotary piston must assume and maintain a setting of approx. 50 % cross section opening.

* Refer to Technical Data

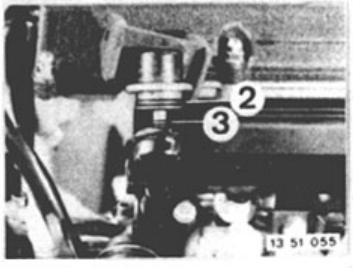


13 51 630 Removing and installing fuel pressure regulator

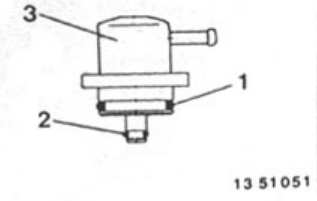
Disconnect vacuum hose.



Release screw (1).
Pull off fuel pressure regulator.
(Stiff, sealing rings hold fast.)

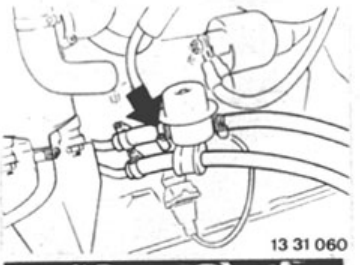


Installation note:
Check sealing rings (2 and 3) and replace if necessary.

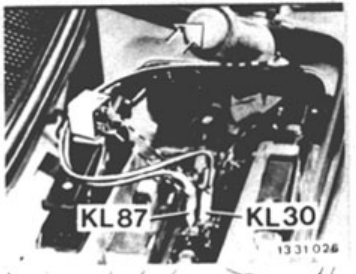


Installation note:
Note identification No. and nominal pressure*.

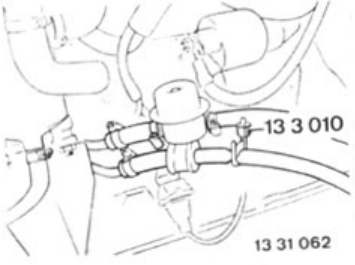
* Refer to Technical Data



Checking:
Install pressure gage 13 3 060 with connection line and T-piece 13 3 064 in fuel supply line (upper line) after damper.

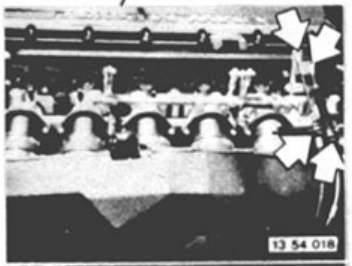


Unplug fuel pump relay.
Connect jumper between terminal 87 and terminal 30 with tool 61 3 050.
Check fuel injection pressure*.
Note:
If the injection pressure is too high, the pressure regulator is defective or the return line is blocked.



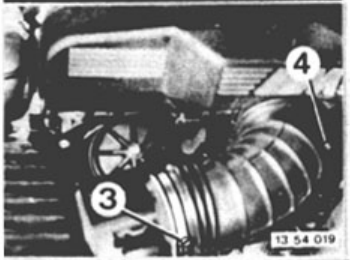
If the fuel injection pressure* drops at too fast a rate, close off return line – bottom line – with tool 13 3 010 and once again briefly operate tool 61 3 050.
The pressure regulator is defective if the injection pressure is now maintained.
If the injection pressure drops, there is a leak upstream of the pressure regulator.

* Refer to Technical Data

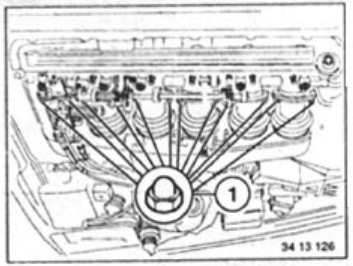


13 54 030 Removing and installing throttle valve spigot

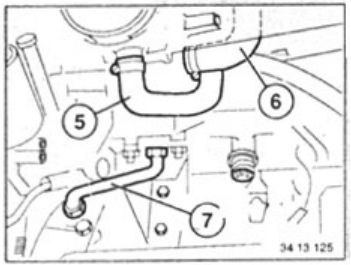
Disconnect accelerator cables.
Remove rubber mounts.



Unfasten hose clips (3 ... 4).
Remove suction hose.



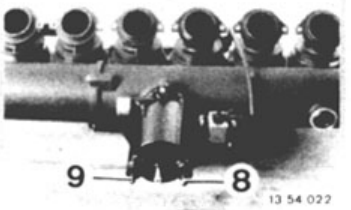
Unfasten nuts (1) from all 6 throttle valve spigots.



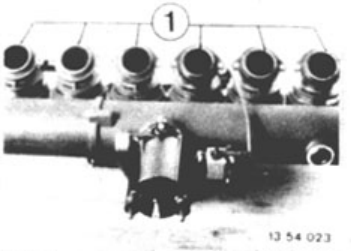
Loosen hose clamps.
Remove idle hose (5), vent hose (6) and oil return hose (7).



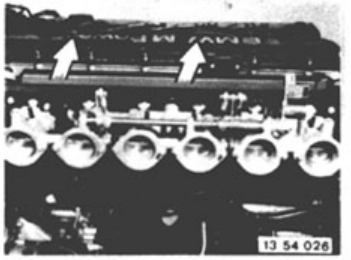
Unfasten nuts (8 and 9) from oil separator.
Remove air manifold.
Take care of vacuum hoses.



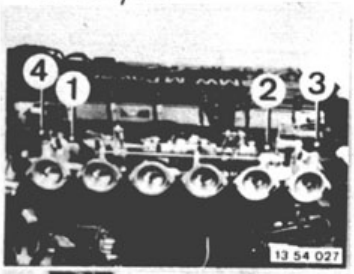
Installation instructions:
Before pressing on manifold, fit bolts (8 and 9) to the support.
Partially fit vacuum hoses.



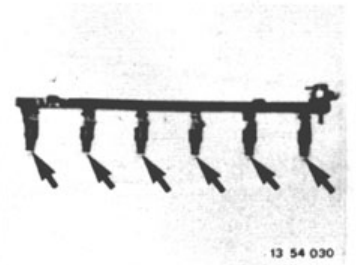
Installation instructions:
Check O-rings (1) and replace if necessary.
Check gaiters and hoses, replacing if necessary.
Replace hose clips if necessary.



Remove plug strip from the injection valves.

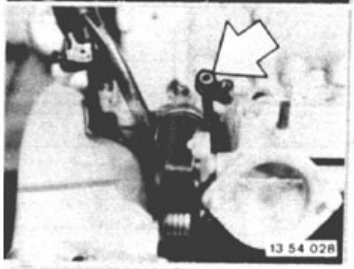


Unfasten injection pipe mounting (1 and 2).
Remove delivery lead (3) and return lead (4).

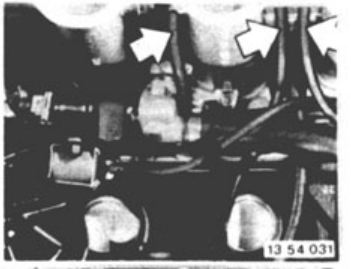


Remove injection tube together with injection valves.

Installation instructions:
Check / replace sealing rings.
Check that sealing rings are correctly seated.

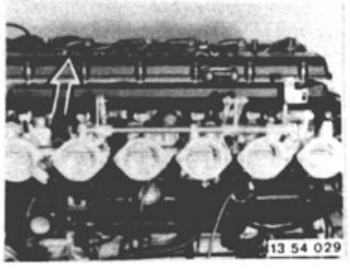


Installation instructions:
Check / replace sealing rings.
Check leads for leakage.

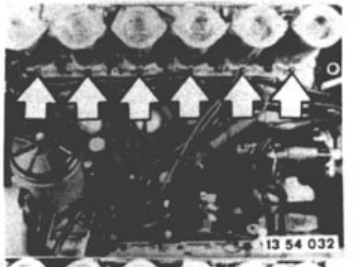


Pull off vacuum hoses.

Installation instruction:
S38B36 see hose circuit diagram.



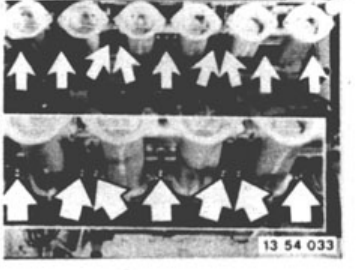
Remove intermediate plug for idling speed control valve.
Remove vacuum hoses and idling speed hoses.



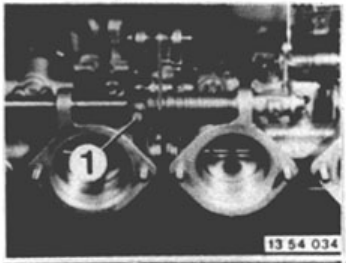
Unfasten 6 WAF 10 nuts.

S38B38: Disconnect nuts and remove idling air strip.

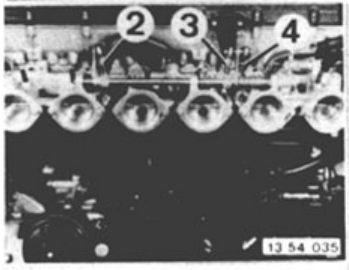
Note:
Check non-return valves, see 13 00 ...



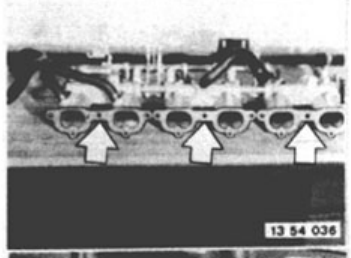
Unfasten 9 WAF 13 nuts.



Unfasten connecting screws (1).

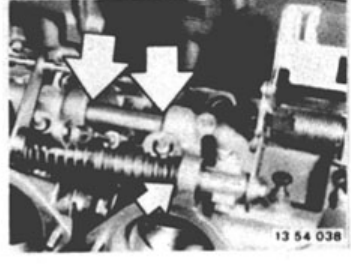


Remove throttle valve linkages (2 ... 4).



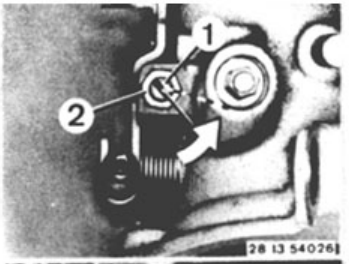
Remove throttle valve assembly.

Installation instruction:
Replace gasket.

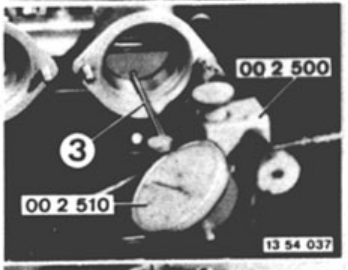


Remove connecting tubes.
Split throttle valve assembly.
Check / replace O-rings on connecting tubes.

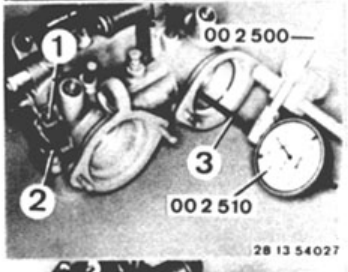
Note:
The shaft is guided on needle bearings.
Do not draw shaft through bearing while dirty.
Do not damage shaft with tool (pliers).
- This could damage the needle bearings.



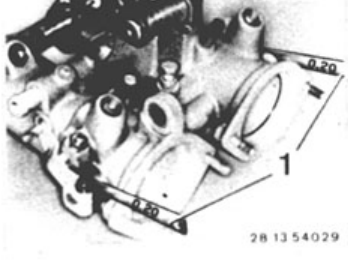
Basic setting of throttle valves.
Throttle valve linkages removed.
Adjust idle detent:
Loosen nut (2).
Rotate idle stop screw (1) in direction of arrow until the throttle valve is fully closed.
Retighten nut (2) gently.



Fit dial gage 00 2 510 (with extension 3) and bracket 00 2 500 to throttle valve assembly.
Gage tip rests under preload against lowest possible point of throttle valve.



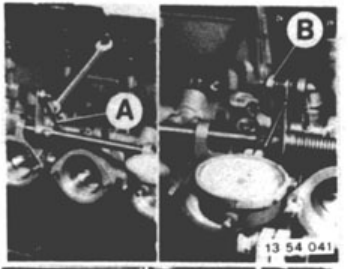
Loosen nut (2).
Screw in idle detent screw (1) until the throttle valve can just turn and no more. Adjust lower edge of throttle valve by (0.1 + 0.05 mm) (approx. 1/10 of a turn).
Fit lock nut to idle detent screw (1) and seal with paint.



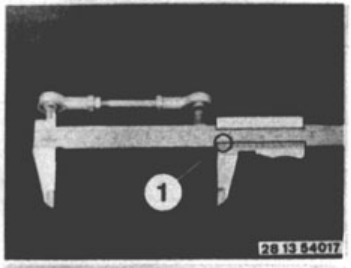
Check axial air gap:
With throttle valve closed and at room temperature (approx. + 20° C), it must be easy to insert a feeler gage (3) blade (0.2 mm) down the left and right sides between retaining ring / throttle lever and housing (both sides at the same time).
Check ease-of-movement of throttle valve at operating temperature.



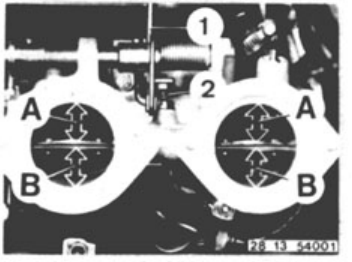
Adjust throttle valve lever position (M88):
Levers (1 and 2) must be flush with one another.
Correct by adjusting the clamping pieces (3).
Tighten screw and nut (4).



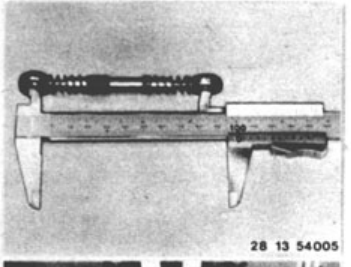
Secure dial gage (002 510) with mounting (002 500) to stud bolt.
Fit dial gage to lever (1) with preload.
Shorten each push rod (A and B) in turn until the dial gage needle starts to move.
In this position, all 3 throttle levers abut against the idle speed detents.



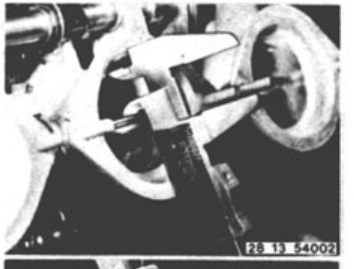
Loosen throttle valve switch.
Do not adjust throttle valve switch until the throttle valve lever position has been adjusted.
Adjust push rod.
Set push rod (cylinders 5 and 6) to
1 = 97, 5 ± 0.4 mm and install.



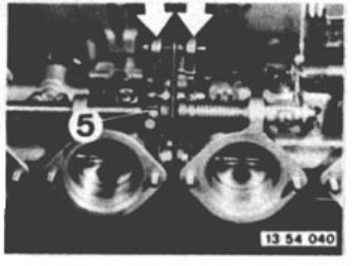
Set full throttle detent:
Move cable lever (1) to full throttle position.
Use a slide gage to check dimension (A) or (B) and note down result.
Calculate the mean value of the 6 throttle bodies and determine the deviation from the design dimension.
Using screw (2), adjust all 6 throttle valves simultaneously towards the design dimension.



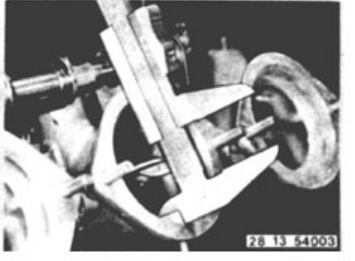
Set push rods on cylinders 1 and 2 / 3 and 4 respectively to a distance of approx. 98 mm.



Dimension A = 21.7 mm (design dimension).



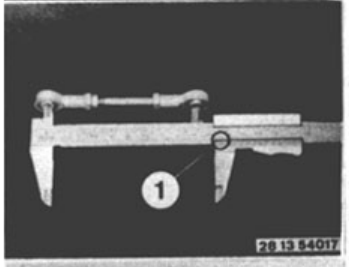
Fit clamping components (5) once the push rods have been connected.



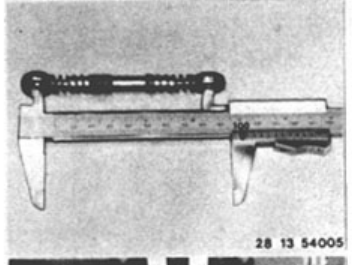
Dimension B = 22.7 mm (design dimension).



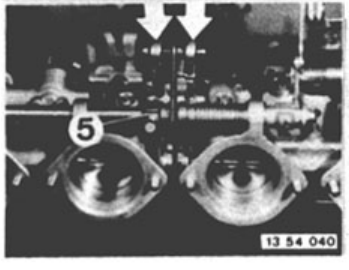
Adjust position of throttle valve lever (S38B38):
Levers (1 and 2) must be aligned and flush.
Correct by adjusting the clamping pieces (3).
Tighten screw and nut (4).



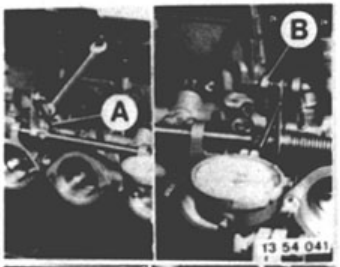
Adjust push rod.
Adjust push rod (cylinders 5 and 6) to 1 = 92, 5 ± 0.4 mm and install.



Adjust push rods on cylinders 1 and 2 / 3 and 4 respectively to a distance of 93 + 0.5 mm.



Fit clamping components (5) after the push rods have been installed.

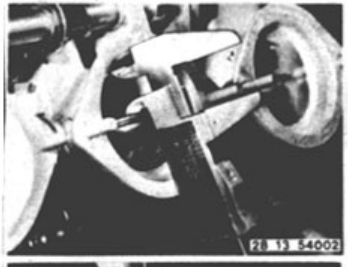


Install push rods and shorten consecutively until all 3 throttle levers contact the idle speed detent.

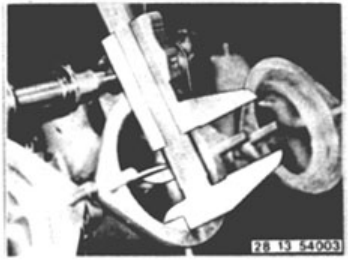
Inspection:
Insert paper strips between the 3 detent screws and the kinematic detent points.
When correctly adjusted, it should not be possible to remove any of the paper strips.



Set full throttle detent:
Move cable lever (1) to full throttle position.
Use a slide gage to check dimension (A) or (B) and note down result.
Calculate the mean value of the 6 throttle bodies and determine the deviation from the design dimension.
Use the screw (2) to adjust all 6 throttle valves simultaneously towards the design dimension.

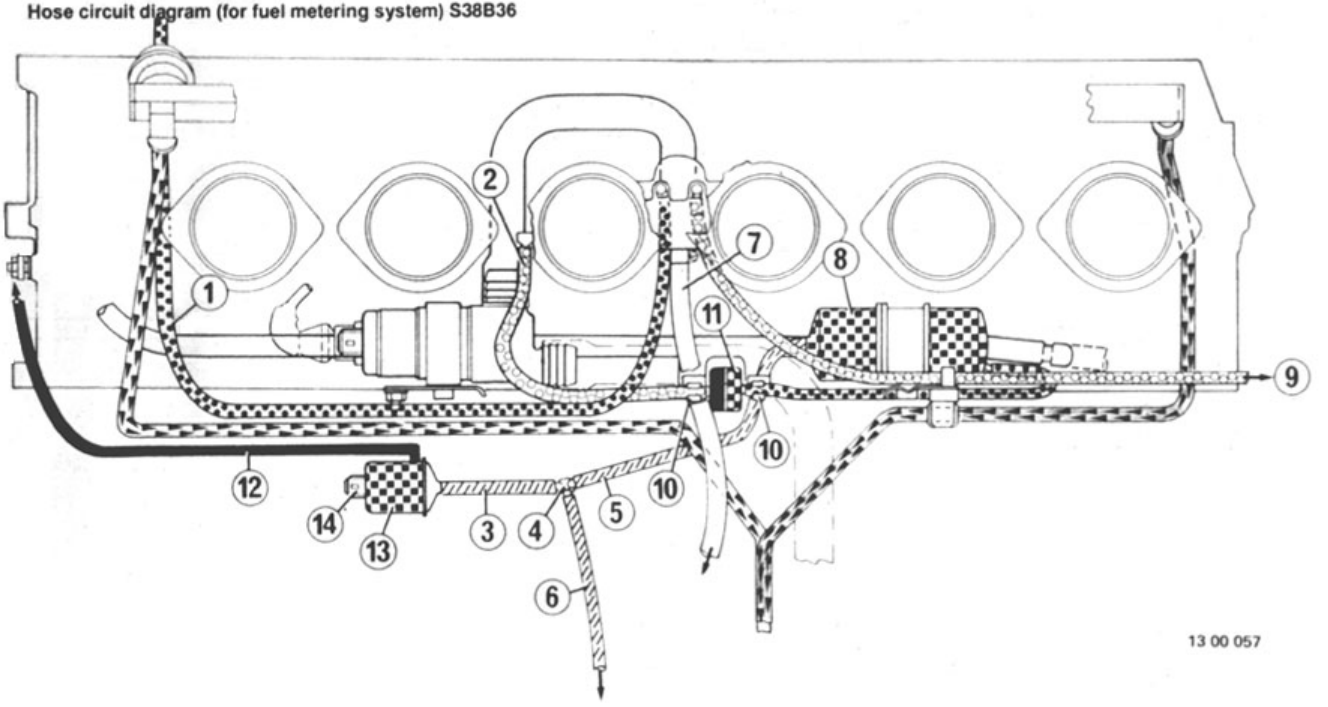


Dimension A = 23.75 mm (design dimension).



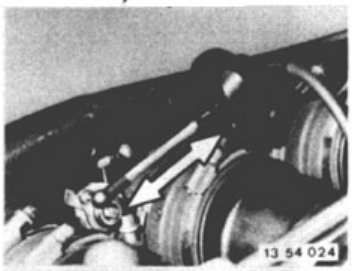
Dimension B = 24.75 mm (design dimension).

Hose circuit diagram (for fuel metering system) S38B36

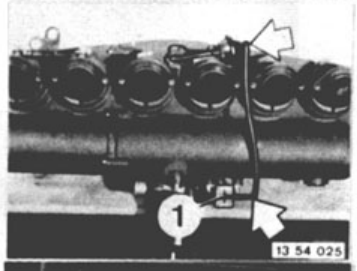


1 Vacuum hose to fuel pressure regulator
2 Vacuum hose to non-return valve
3 Vacuum hose to non-return valve (13)
4 T-piece
5 Vacuum hose to vacuum tank (8)
6 Vacuum hose from T-piece (4) to changeover valve for resonance control

7 Suction lead from cycle valve to intake spigot
8 Vacuum tank
9 Vacuum hose to heating regulator
10 Vacuum hose from vacuum tank (8) to non-return valve (11)
11 Non-return valve
12 Vacuum lead to shut-off valve for air intake
13 Changeover valve for air intake
14 Plug connection (2 pin) on changeover valve (to DME control unit)



Check resonance control unit:
After an engine start, the valve should close briefly, visible by the movement of the linkage. If necessary, check the vacuum hoses, vacuum unit or changeover valve.

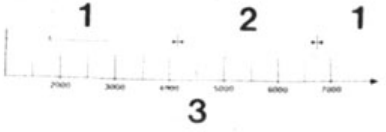


Check changeover valve:
After a cold start, the changeover valve (1) responds briefly.



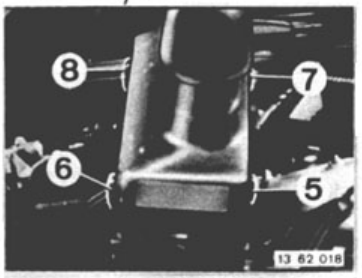
Check control unit for resonance control (in the control unit box):
After ignition ON, operating voltage + is supplied to changeover valve. After the engine switches on, the changeover valve receives a brief negative charge (-) from the control unit (2).

Suction system with resonance charging.



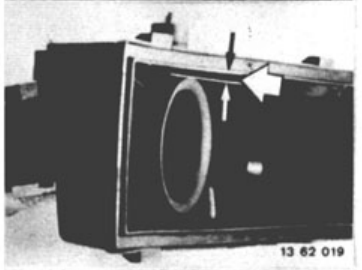
Resonance control unit with active full throttle switch.

1 = R-valve closed
2 = R-valve open
3 = Engine speed in rpm



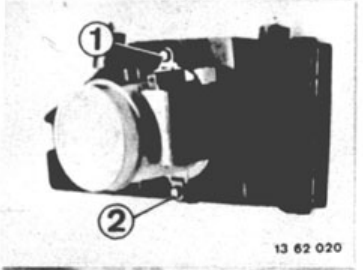
13 62 560 Removing and installing or replacing air mass meter

Remove air cleaner 13 71 000.
Open clips (5...8).

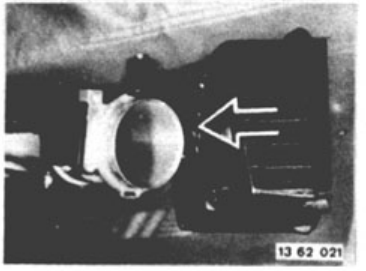


Disconnect filter housing.
Detach intake air duct.

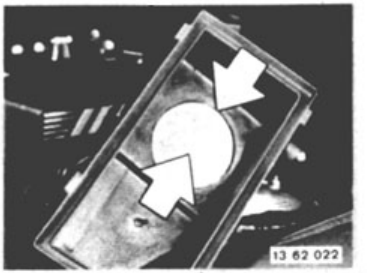
Installation note:
Fit inclined section of intake air duct such that the largest possible distance to the filter housing is maintained all round.
Completely press in intake air duct.



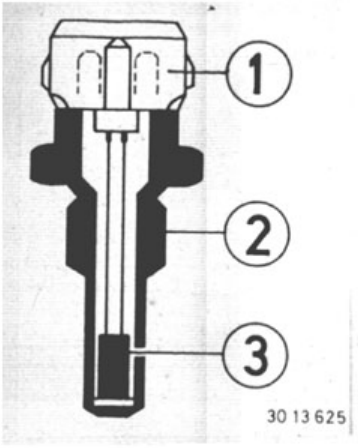
Release screws (1 and 2).



Remove air mass meter.



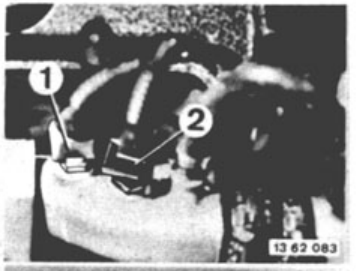
Installation note:
Only re-install undamaged screen.
Check that sealing ring is fitted correctly.



13 62 531 Removing and installing / checking coolant temperature sensor.

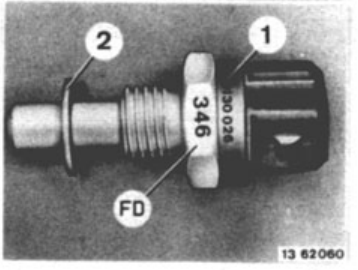
The temperature sensor measures engine temperature and communicates this to the control unit as a resistance value.
Resistance drops with rising temperature (NTC).
1 Plug connection
2 Housing
3 NTC resistance

Temperature sensor (water, air)
Test: see BMW diagnosis system

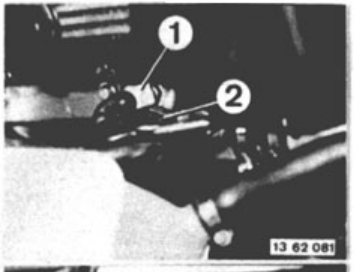


Installation instruction:
Note untightening torque*.

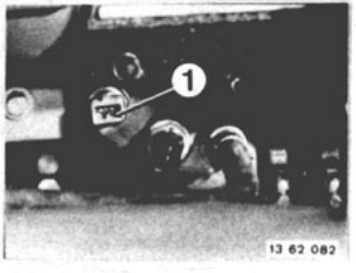
(1) Temperature sensor plug = blue
(2) Remote thermometer plug = black



Installation instructions:
Note Des. No. (1)*.
Replace seal (2).
FD = production date.
Fill and bleed cooling system (Gr. 17).

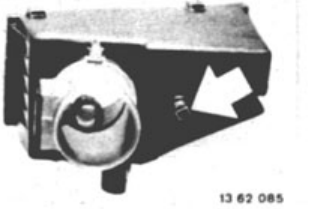


Removing and installing:
Remove plug (1 blue and 2 black).



Unscrew and remove DME temperature sensor (1).

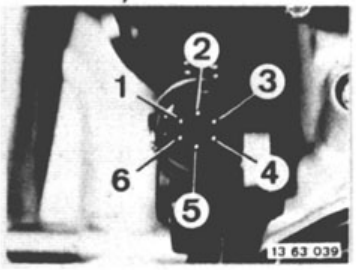
Check sensor:
Check nominal value with ohmmeter*.
To check the entire temperature range, remove temperature sensor, heat up to test temperature in water bath and check using ohmmeter*.



13 62 511 Removing and installing air temperature sensor

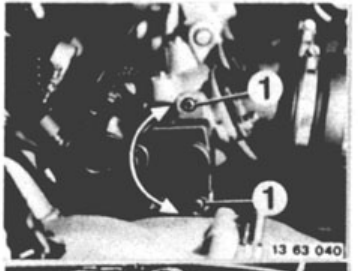
Removing and installing suction filter housing 13 71 000.
Unscrew temperature sensor (3).

* Refer to Specifications

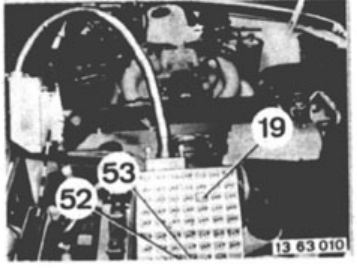


13 63 544 Adjusting throttle valve switch

Also refer to status queries in the BMW DIAGNOSIS SYSTEM.
Check throttle valve switch.
When the throttle valve is closed, value recorded between connections 6 and 4 should be virtually 0 ohms.
When the throttle valve is fully open, the value recorded between connections 5 and 4 should be virtually 0 ohms.



Adjustment:
When the throttle valve is closed, the value recorded between connections 6 and 4 should be virtually 0 ohms.
Adjust by loosening the screws (1) and twisting the throttle valve switch. After adjustment is completed, open throttle valve - resistance value should rise straight back to ∞ ohms.
When the throttle valve is released, the resistance value should drop back to virtually 0 ohms.



These values can also be measured using the control unit plug together with the universal adapter**.

LL (6)	= 52 on the adapter
VL (5)	= 53 on the adapter
Ground (4)	= 19 on the adapter

LL = idling speed
VL = full throttle

** Sourcing Reference HWB



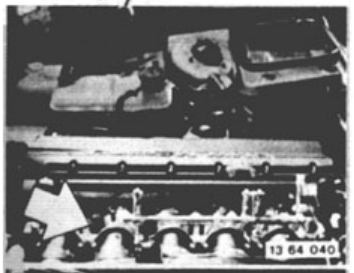
13 63 551 Removing and installing throttle valve switch

Remove multiple plug (3).
Unscrew bolts (1).
Remove throttle valve switch (2).



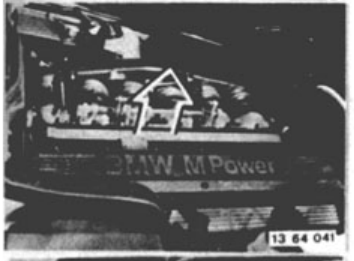
Installation instruction:
Check code (1)*.
Adjust throttle valve switch 13 63 544.

* Refer to Specifications



13 64 541 Removing and installing or replacing all fuel injector valves

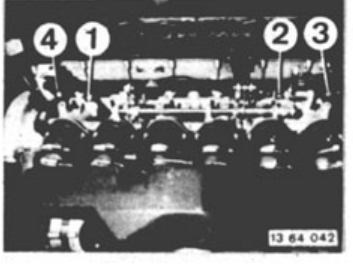
Disconnect plug connector for idle speed control valve.



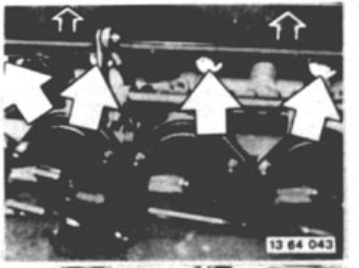
Remove connector strip.



Disconnect vacuum hose.

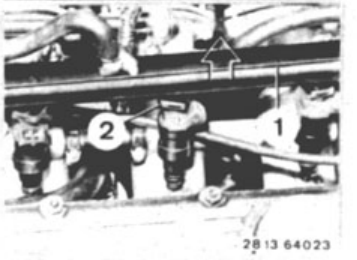


Release screws (1 and 2).
Remove supply line (3) and return line (4).

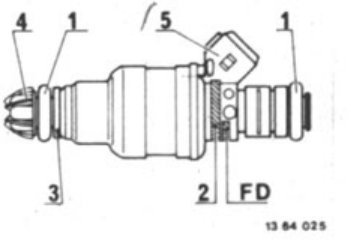


Remove ignition tube with valves by pulling upward.

Installation note:
Check sealing rings and replace if necessary.
Check fuel line connections for leaks.



Lift out retainer (2) and remove fuel injector valve.



Installation note:
Check O-rings (1) and replace if necessary.
Note identification No. (2)*.
FD = Production date
Observe position of plastic washer (3).
Observe color* of plug housing (5) or of jet guard (4). Coat O-rings with Vaseline or transmission oil SAE 90 before fitting.

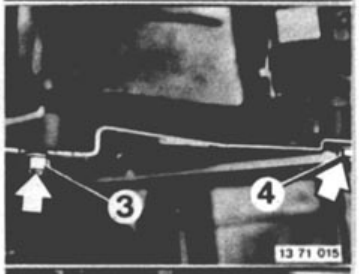
Clean fuel injector valves, refer to Service Information No. 2 1 78 (623).

* Refer to Technical Data



13 71 000 Removing and installing suction filter housing

Unfasten hose clip (1).
Pull off hose.
Pull off plug (2).



Unfasten screws (3 and 4).



Remove filter housing with air mass sensor at rear by lifting upwards.



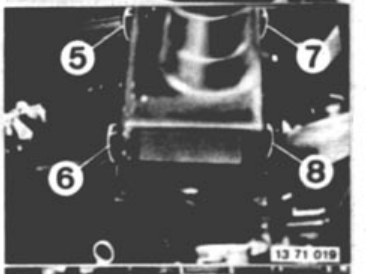
Remove plug (5).

Installation instructions:
Insert suction pipe.
Allow rubber mount to engage in bracket.



13 72 001 Replacing air cleaner filter element

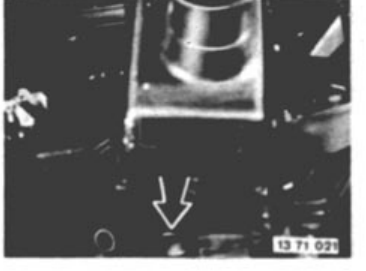
Unfasten screws (3 and 4).
Raise filter housing and slide slightly backwards.



Open clips (5 ... 8).



Dismantle air filter housing.



Pull out filter element.

13 Fuel system

524d (M21), 524td (M21)

	Notes	13- 00/21
13 00 050	Engine idle speed – check	13- 00/22
	Layout of electronically controlled injection pump for DDE	13- 00/23
13 32 . . .	Layout of fuel filters	13- 32/21
050	Water trap in fuel filter – drain	13- 32/21
051	Fuel filter – replace	13- 32/1
13 51 000	Injection pump – remove and install	13- 51/21
	Installation	13- 51/23
005	Injection pump – adjust statically	13- 51/25
290	Pressure valves – replace	13- 51/26
300	Electric fuel cutout – check	13- 51/27
301	Electric fuel cutout – replace	13- 51/28
320	Fuel system – bleed	13- 51/29
13 53 320	Fuel injector combination – remove and install	13- 53/21
13 61 000	Control units – remove and install	13- 61/21
13 71 000	Air cleaner – remove and install	13- 71/21
13 72 001	Air cleaner cartridge – replace	13- 71/21

For further information on troubleshooting and jobs in assembly 13 refer to:
Microfiche Assembly Repair Manual and
Electrical Troubleshooting Manual 5 Series E34

WORKING INSTRUCTIONS

in Reference to Cleanliness on Fuel Systems

- Clean area around point of repair thoroughly prior to disconnection of pipes/hoses, switches, etc..
- Always place removed parts on a clean surface and cover with plastic sheets – never use cloths losing lint!
- Cover or insert plugs in open ends of pipes or hoses and openings in components immediately – never work with compressed air.
- Only install cleaned parts.
  Take new parts out of their packaging only immediately before installation.
- Keep diesel fuel off of coolant hoses - if applicable, rinse off with water immediately.

EXPLANATION OF ABBREVIATIONS

DDE	Digital Diesel Electronics
MLG	Fuel Volume, Combustion Air, Road Speed
SB	Injection Begin Related
ME	Fuel Volume Related





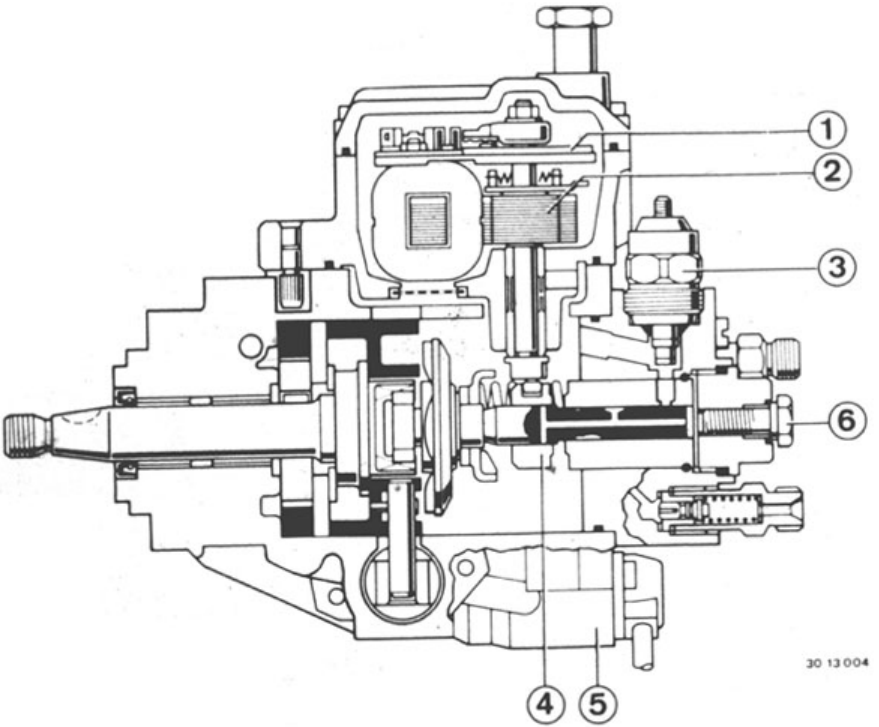
13 00 050 CHECKING ENGINE IDLE SPEED

Requirements:
- Engine at operating temperature, i.e. oil temperature at least 60° C (140° F).
  Valve clearance correct.
- All electric consumers switched off.

Read engine idle speed* from tachometer in the instrument cluster.
If value deviates from nominal value, read out fault memory of DDE self-diagnosis.
If applicable, check basic adjustment of pedal value sender.

* See Specifications

DRAWING OF ELECTRONIC FUEL INJECTION PUMP FOR DDE



1 Control valve travel sender
Potentiometer for feedback voltage

2 Drive for injection rate rotary magnet

3 Electric shutoff

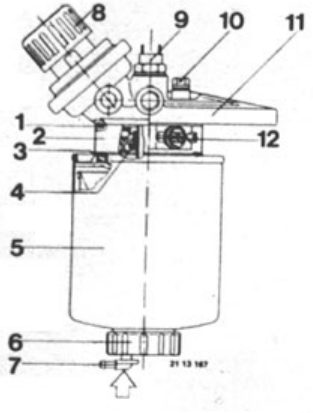
4 Control valve

5 Solenoid for injection begin

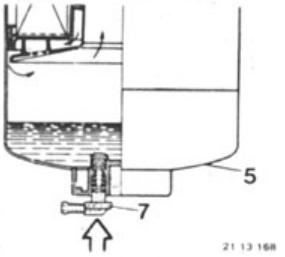
6 Plug for high pressure chamber
(for static adjustment with dial gage)

DDE
13 32 000 FUEL FILTER

Note:
Fuel filter heating is described in Group 12.



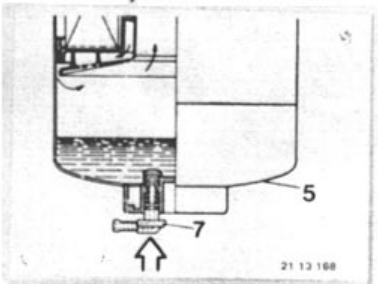
1 Seal
2 Heating element
3 Seal
4 Heating element mounting nut
5 Filter cartridge
6 Cap
7 Drain valve
8 Manual pump
9 Temperature switch 5.5° C (42° F)
10 Bleeder screw
11 Filter head
12 Electric connection for heating element



DDE
13 32 050 DRAINING WATER TRAP IN FUEL FILTER

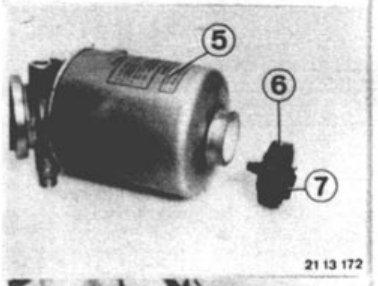
Unscrew bleeder screw (10).
Push up drain valve (7) and drain until pure diesel fuel runs out.

Unlock cap of manual pump (8) - turn 90° and pump so long, until diesel fuel runs out of bleeder screw (10).
Tighten bleeder screw (10).
Lock cap of manual pump (8).

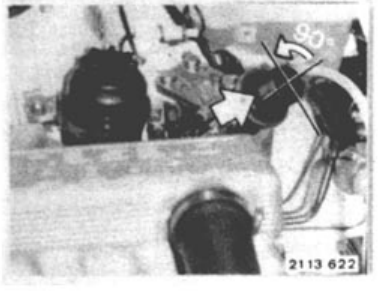


DDE
13 32 051 REPLACING FUEL FILTER

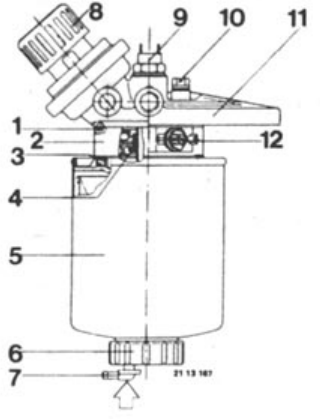
Unscrew bleeder screw (10) and drain a small amount of diesel fuel at drain valve (7).
Unscrew filter cartridge (5) – using a standard tool.



Mount cap (6) and drain valve (7) on new filter.



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 mounting 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 connection









13 51 000 REMOVING AND INSTALLING INJECTION PUMP

Removing:
Disconnect battery ground lead.

Important!
Interrogate fault memories of all systems first as disconnecting the battery will erase them.

Installation:
Fill with coolant* and bleed cooling system - refer to 17 00 039.

Disconnect coolant hoses.
Loosen and remove alternator drive belt.

Installation:
Adjust drive belt tension.

Turn crankshaft to TDC mark (ignition position in cylinder no. 1).

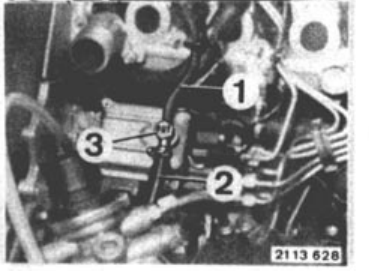
Unscrew toothed belt guard.



Loosen holder for wiring.



Unscrew oil pipe holder.



Pull off leak oil hose (1).
Unscrew return pipe (2).
Coupling (3) is matched with injection pump.

Installation:
Replace a removed leak oil hose.

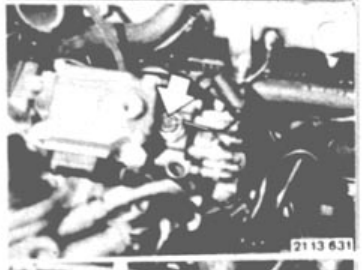
* Refer to Operating Fluids



Unscrew spacing holder of injection pipes.
Unscrew all coupling nuts on injection nozzles.
Plug openings in injection nozzles with caps.
Caution!
Apply tool carefully to avoid bending the injection pipes.



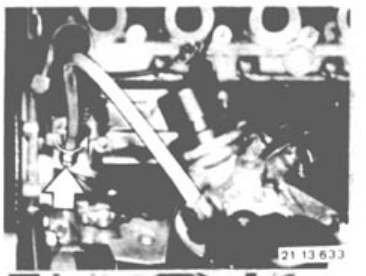
Unscrew coupling nuts on injection pump and pull back pipes.
Plug openings with caps.



Unscrew connection for fuel shutoff.



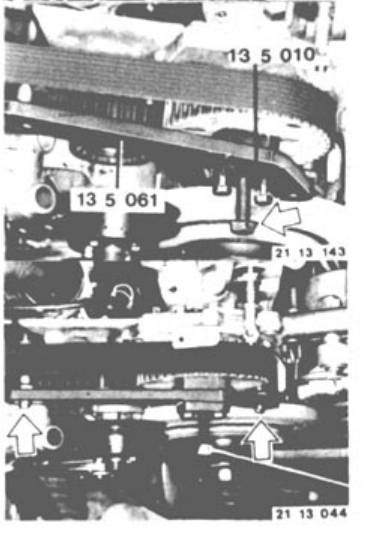
Disconnect wire harness.



Counterhold on adapter and unscrew pipe with Special Tool 13 5 020.
Plug opening with a cap.

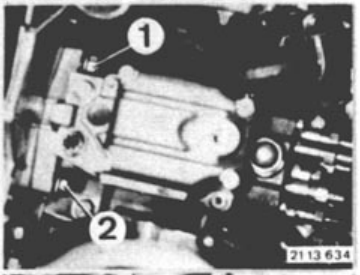


Unscrew nut on toothed belt sprocket.
Hold sprocket with Special Tool 13 5 340.

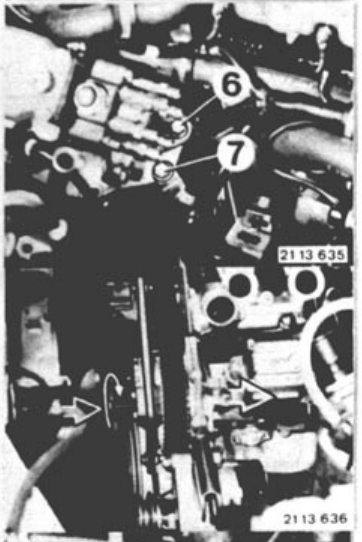


Bolt Special Tools 13 5 061 and 13 5 010 on toothed belt sprocket.
Loosen bolt (see arrow) completely.

Turn crankshaft further until special tool can be bolted.
Use M 6 x 20 mm bolts.

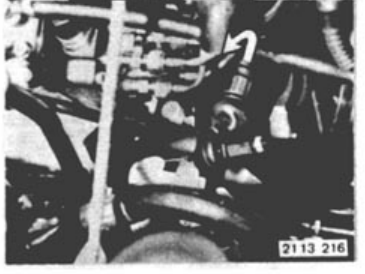


Unscrew nuts (1 and 2)

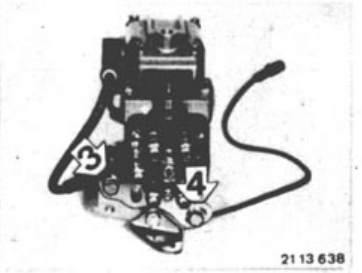


Remove bolts (6 ... 7)

Press out the injetion pump toward the rear with a pulling tool. Turn back the bolt again completely afterwards.



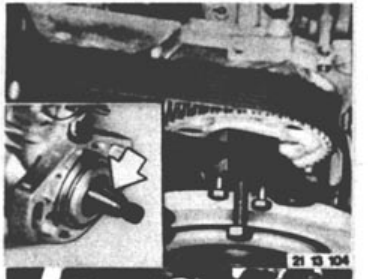
Pull wire connector out of holder. Remove injection pump. pump. Disconnect plug of Magnetic-Valve cable.



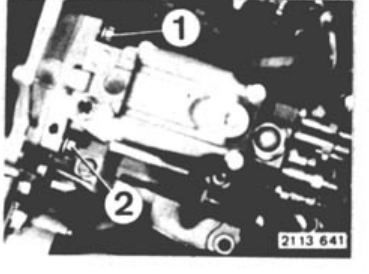
Installation:
Transfer attachments - see 13 51 001.
Loosen nuts (3 ... 4) prior to installation



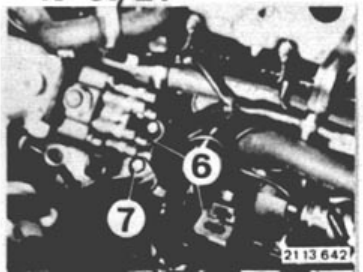
Move the injection pump shaft to installed position with special tool 13 5 062.
The turning lever must be vertical, before the cam.
(Perceptible resistance by turning the lever).



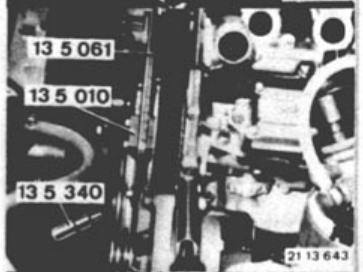
Insert injection pump - being careful that the woodruff key does not fall out.



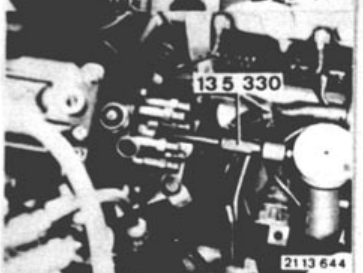
Tighten nuts (1 ... 2) only finger tight at this stage.



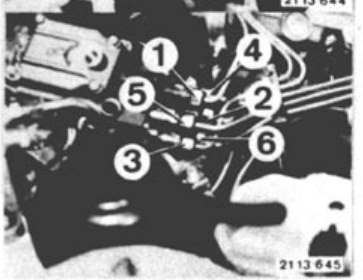
Tighten holder (6) and bolt (7).



Remove Special Tools 13 5 010 and 13 5 061.
Tighten toothed belt sprocket nut.
Counterhold with Special Tool 13 5 340.
Tightening torque*.



Adjust injection pump statically – see 13 51 005.



Mount injection pipes, beginning the tightening at connection (4).
After finishing installation, bleed fuel system – see 13 51 320 and check idle speed – see 13 00 050 in Construction Group Repair Manual.
Check pipes for cylinders 1, 5, 3, 6, 2, 4 to firing order.

* See Specifications

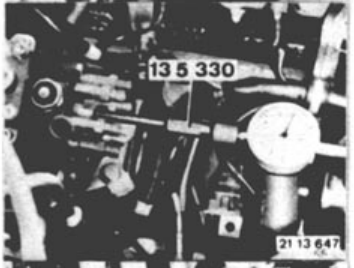


DDE
13 51 005 ADJUSTING INJECTION PUMP STATICALLY

Coolant temperature > 20° C.

Unscrew plug (1).

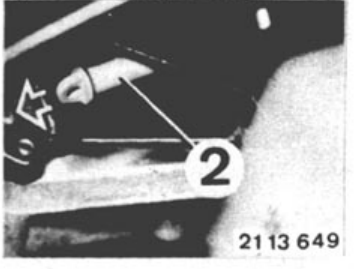
Installation:
Always replace seal.
Tightening torque*.



Screw in Special Tool 13 5 330.
Apply dial gage with preload.



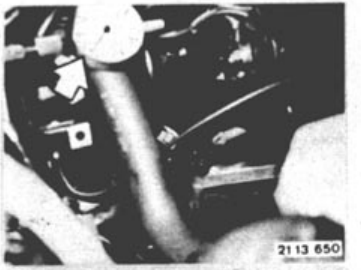
Turn crankshaft clockwise in direction of TDC in cylinder no. 1 (about 60 to 90° before beginning) until gage needle remains at deepest point for some time.
Set scale of dial gage to zero.



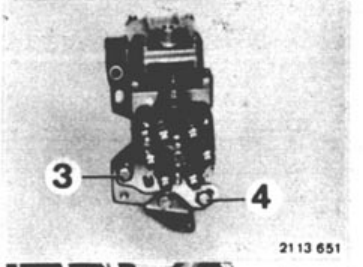
Pull out plug (2).
Turn crankshaft clockwise until Special Tool 11 2 300 engages in bore in flywheel at IT.

Important!
Do not turn opposite engine's direction of rotation - wrong test results.

* Refer to Specifications



Read travel of distributor plunger on dial gage.
Test value: 1.05 ± 0.02 mm.

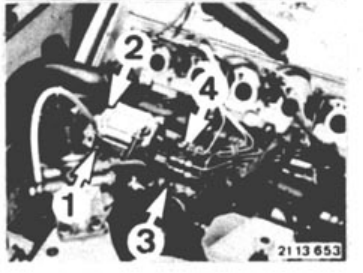


Adjusting:

Loosen screws (3 and 4).



Loosen nuts (1 and 2) — do not loosen too much to avoid tension from the toothed drive belt.



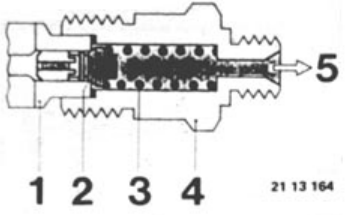
Turn injection pump until dial gage displays the correct value*.
Tighten nuts in sequence of 1 to 4.
Tightening torque*.
Recheck adjustment.

* Refer to Specifications

13 51 290 REPLACING PRESSURE VALVES

The pressure valve closes the injection pipe to the pump.
It has the task of taking pressure off of the injection pipe after completion of the delivery phase by way of removing a defined volume of the injection pressure.

1 Valve carrier
2 Valve plunger - valve seat
3 Valve spring
4 Pressure valve holder
5 Injection pipe connection





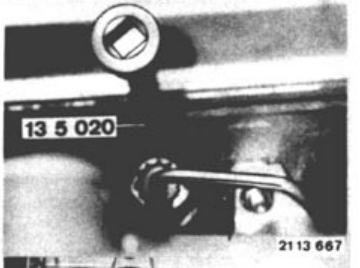
Disconnect battery ground lead.

Important!
Interrogate fault memories of all systems first as disconnecting the battery will erase them.

Disconnect hose.

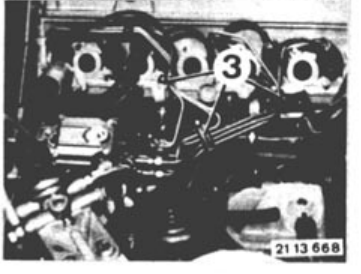


Unscrew oil trap (2).

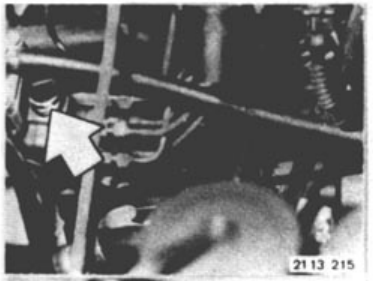


Remove injection pipes from injection nozzles using Special Tool 13 5 020.
Install protective caps.

Installation:
Tightening torque = 20 to 25 Nm.

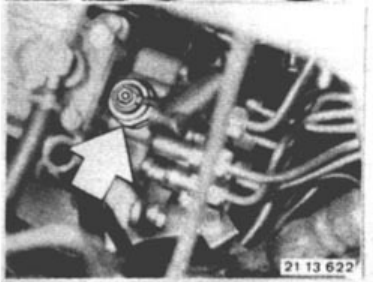


Unscrew spacing holders (3).

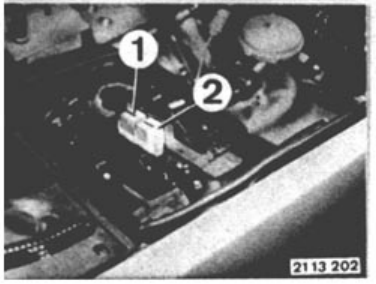


13 51 300 CHECKING ELECTRIC FUEL SHUTOFF

The shutoff receives power supply from the control unit from ignition key position DRIVE on. A loud click will be heard to indicate this.



Check power supply to the control unit, if a click is not heard.
See self-diagnosis for other tests.

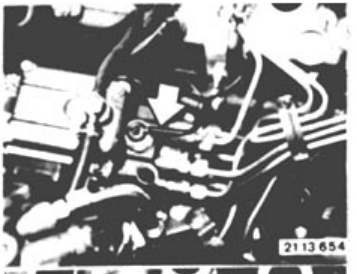


If applicable, check master relay.

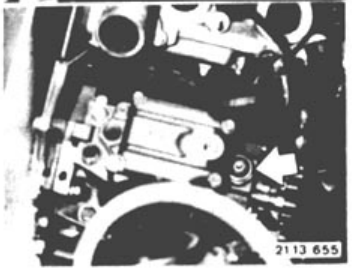
1 Master relay (red)
2 Fuel filter heating relay (orange)

13 51 301 REPLACING ELECTRIC FUEL SHUTOFF

The diesel engine is stopped by interrupting the supply of diesel fuel. The shutoff receives power supply from ignition key position DRIVE on.

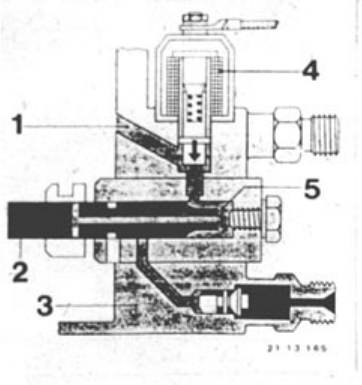


Installation:
Disconnect leads on fuel shutoff.



Unscrew fuel shutoff with a 24 mm open-end wrench.
Caution!
Watch out for piston and spring – they could fall out.

1 Feed bore
2 Distributor piston
3 Distributor head
4 Magnet
5 High pressure chamber





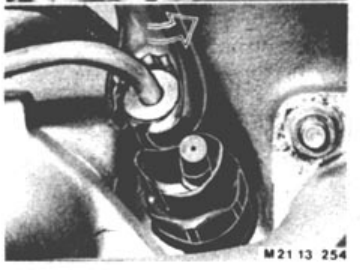
Piston is moved out by force of spring when without current – fuel feed is interrupted.
Installation:
Check O-ring for correct seating.
Tightening torque = 20 ± 5 Nm (14.5 ± 3.5 ft. lbs.).

DDE
13 51 320 BLEEDING FUEL SYSTEM

The fuel system (524 td) does not have to be bled, since the fuel transfer pump builds up pressure in the feed pipe in ignition key position "2".



Bleeding Injection Pump:
Loosen plug two turns.
Crank engine with the starter until diesel fuel runs out – then tighten plug again.
Tightening torque = 14 + 6 Nm (10 + 4 ft. lbs.).



Bleeding Injection Pipes:
Loosen all coupling nuts on injection nozzles with Special Tool 13 5 020.
Crank engine with the starter until diesel fuel runs out of the pipes – then tighten nuts again.
Tightening torque = 20 + 5 Nm (14.5 + 3.5 ft. lbs.).



13 53 320 REMOVING AND INSTALLING INJECTION NOZZLE ASSY.

Loosen hose clamps.
Disconnect intake air hose.

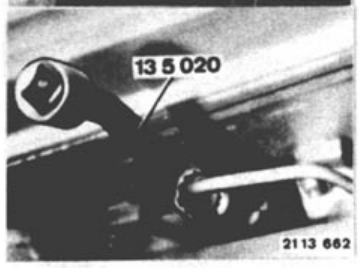


Unscrew oil trap.



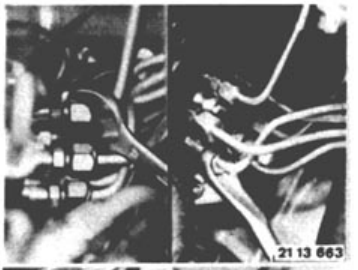
Loosen and remove pipe spacing holders.
Pull off leak oil hoses using a pliers.

Installation:
Replace leak oil hoses after removal.



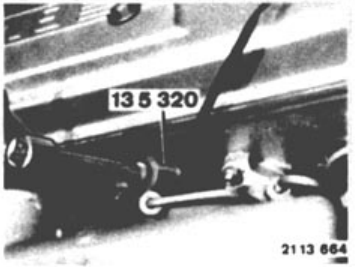
Unscrew couplings using Special Tool 13 5 020.

Note:
Reposition tool in good time to prevent bending pipes.
Plug openings with protective caps.



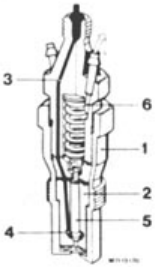
Unscrew coupling on injection pump.
If necessary, counterhold on pressure valve.

Installation:
Tightening torque*.



Unscrew injection nozzle using Special Tool 13 5 320.

Installation:
Bleed injection pipes - refer to 13 51 320.
Refer to Group 13 in Construction Group Repair Manual for additional information.

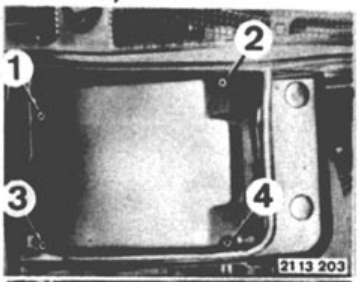


Components of Injection Nozzle Assembly:

1 Nozzle holder
2 Nozzle body
3 Feed bore
4 Pressure chamber
5 Nozzle pintle
6 Leak oil pipe

Important!
The injection nozzle with pintle movement sensor (wire) for cylinder no. 4 must never be disassembled.

* Refer to Specifications



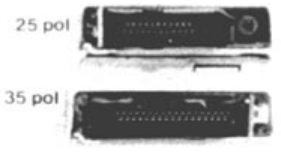
13 61 000 REMOVING AND INSTALLING CONTROL UNITS

Unscrew screws (1 ... 4).
Lift cover off of electric box.

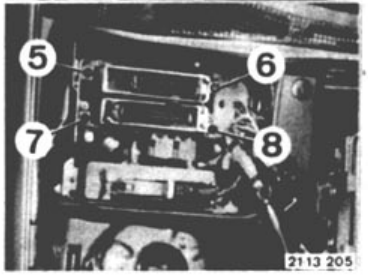
Note:
SB Control Unit (25-pin connection) responsible for:
– injection begin regulation,
– self-diagnosis and
– exhaust gas recirculation.



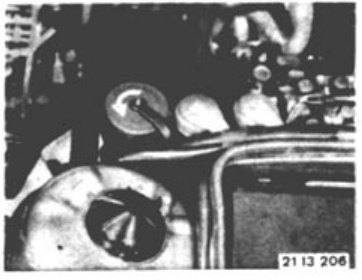
Caution!
Turn off ignition before disconnecting or connecting multiple pin plug.
Push back retainers and pull off multiple pin plug.



ME Control Unit (35 pin connection) responsible for:
– starting volume specification,
– volume control while driving,
– smoke limitation,
– fuel mass correction,
– idle speed control,
– road speed control,
– automatic transmission control,
– charge pressure control and
– hesitation suppression.



Unscrew nuts (5 ... 8).
(1) SB control unit
(2) ME control unit
Pull out control units (1 and 2).



Read out fault memories – see self-diagnosis.

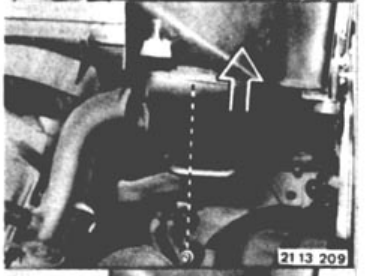


13 71 000 REMOVING AND INSTALLING AIR CLEANER

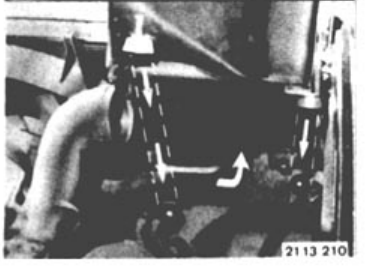
Loosen hose clamp.
Pull off hose (1).



Unscrew nut.



Tilt and pull out air cleaner.

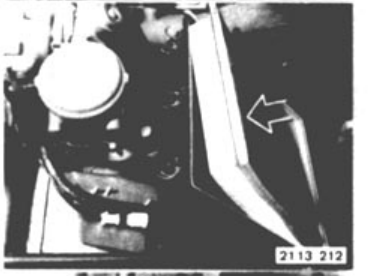


Installation:
Guide in intake neck.
Mount housing on rubber mounts.

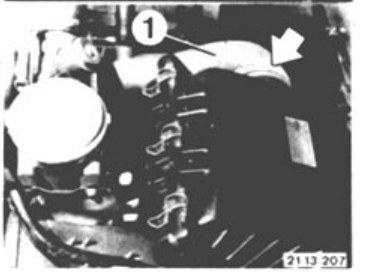


13 72 001 REPLACING AIR FILTER CARTRIDGE

Loosen hose clamp.
Open fasteners and pull up filter.



Insert filter cartridge.
Guide in intake neck.
Mount cover and tighten fasteners.



Mount hose (1).

13 Fuel system

525td (M51), 525tds (M51)

	Notes	13- 00/31
13 00 050	Engine idle speed – check	13- 00/32
	Layout of electronically controlled injection pump for DDE	13- 00/33
13 31 028	Fuel supply pressure – check	13- 31/31
13 32 000	Fuel filter DDE	13- 32/31
050	Water trap in fuel filter – drain	13- 32/31
051	Filter element – replace	13- 32/32
061	Fuel filter, complete, (with water level sensor and fuel heater) – remove and install or replace	13- 32/32
13 51 000	Injection pump – remove and install	13- 51/31
005	Fuel pump – adjust statically	13- 51/34
. . .	Fuel temperature sensor – replace	13- 51/36
300	Electric fuel cutout – check	13- 51/37
301	Electric fuel cutout – replace	13- 51/38
320	Fuel system – bleed	13- 51/39
13 62 520	Pedal position sensor – remove and install or replace	13- 62/31
600	RPM sensor (pulse generator) (M51) – replace	13- 62/31
13 71 000	Air cleaner (M51) – remove and install	13- 71/31
13 72 001	Air cleaner cartridge – replace	13- 72/31

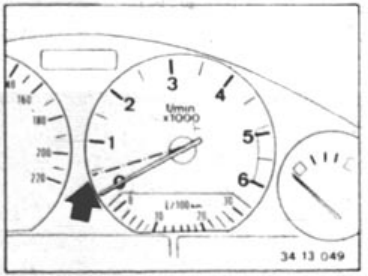
For further information on troubleshooting and jobs in assembly 13 refer to:
Electrical Troubleshooting Manual 5 Series E34

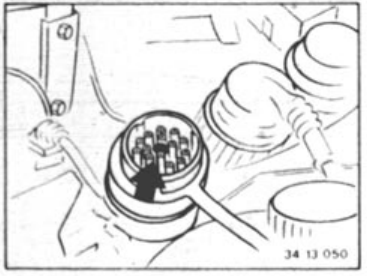
INFORMATION REGARDING CLEANLINESS WHEN WORKING ON FUEL SYSTEM

- Clean area around point of repair thoroughly, for example before disconnecting pipes/hoses, switches, etc.
- Place removed components only on clean surfaces and cover them with plastic sheet – never use fluffy cloths!
- Cover or insert plugs in opened pipes/hoses or components immediately – do not work with compressed air.
- Install only cleaned components.
  Take new replacement parts out of packaging only shortly before installation.
- Keep diesel fuel off of coolant hoses – if necessary wash off immediately with water.

EXPLANATION OF ABBREVIATIONS:

DDE	Digital Motor Electronics
AS	EGR injection begin control
MLG	Fuel rate, combustion air, road speed
SB	Injection begin relation
ME	Injection rate relation



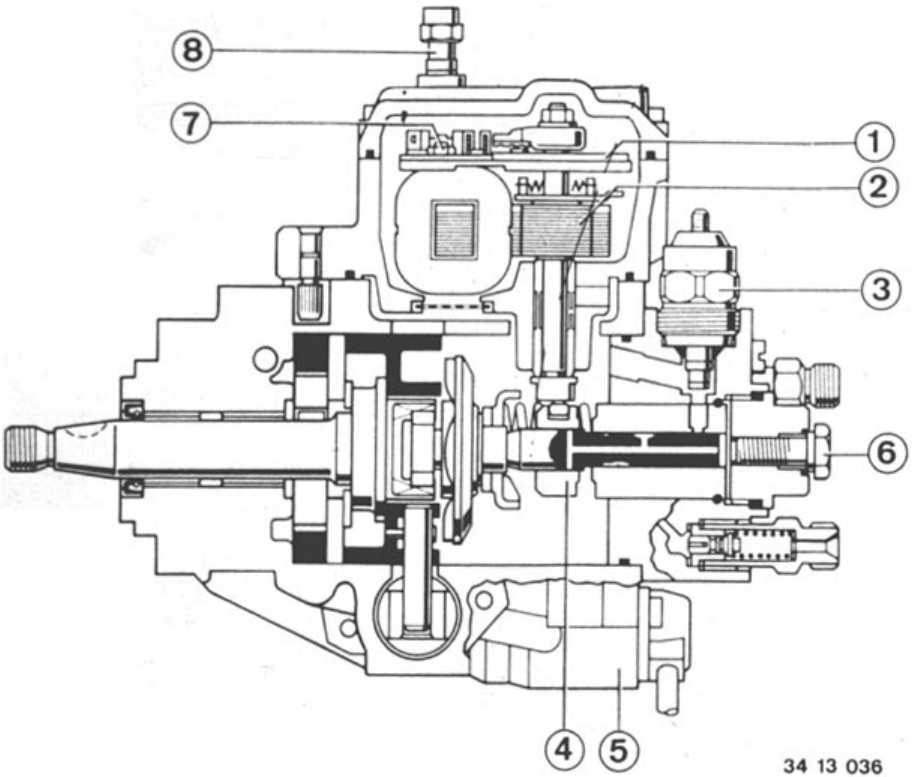


13 00 050 CHECKING ENGINE IDLING SPEED

Requirements:
- Engine at operating temperature (oil temperature > 60° C).
- Valve clearance OK.
- All electric consumers switched off.

Read idling speed* from tachometer in instrument cluster.
Or read engine speed via the diagnosing system.
The engine speed can also be read via the diagnostic socket:
Connect BMW Service Tester.
Select engine test step no. 5 (enter number of cylinders).
In case of deviation from specified value, interrogate fault memory of DDE (refer to DDE Test Plan).
If necessary, check basic setting of pedal value sender (refer to DDE Test Plan).

ELECTRONICALLY REGULATED INJECTION
PUMP FOR DDE



34 13 036

1 = Control valve motion sender
Potentiometer for feedback voltage

2 = Interlock for injection rate solenoid

3 = Electric fuel shut-off

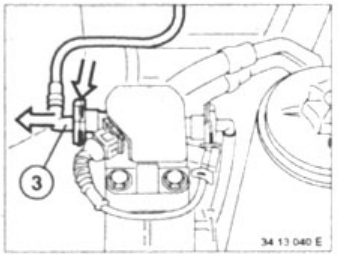
4 = Control valve

5 = Injection begin solenoid

6 = Plug for high pressure chamber
(for static adjustment with dial gage)

7 = Fuel temperature sensor

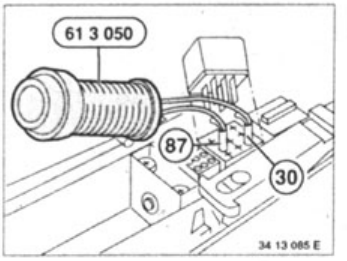
8 = Hollow union bolt or pressure valve



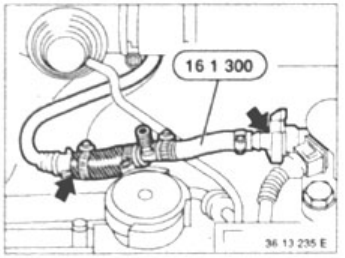
13 31 028 CHECKING FUEL FEED PRESSURE

Squeeze retainer (or pull out completely).
Remove fuel pipe (3) behind the filter.

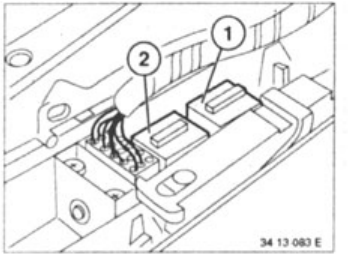
Caution!
Catch escaping fuel in a suitable container.



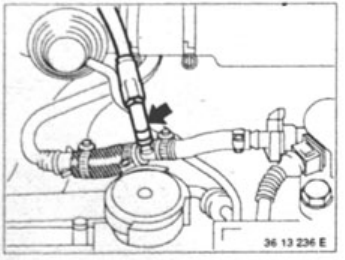
Switch ignition on.
Bridge terminals 30 and 87 on the relay carrier with Special Tool 61 3 050.
Operate special tool and read intank pump pressure* from tester.



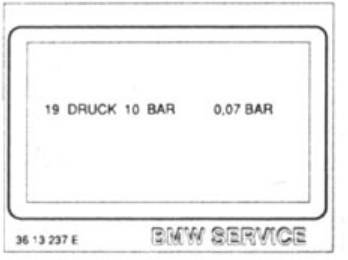
Install Special Tool 16 1 300 (adapter) between pipe (3) and filter housing.



Reinstall fuel pump relay (2).
Run engine at idling speed and read pressure* from tester.

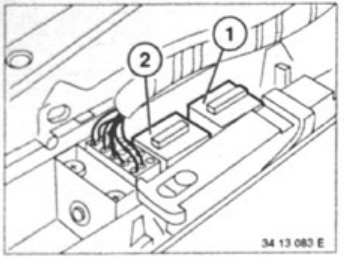


Screw 10 bar pressure connection of BMW Service Tester to Special Tool 16 1 300.
Select Mutlimeter Step 19 (refer to operating instructions of BMW Service Tester).

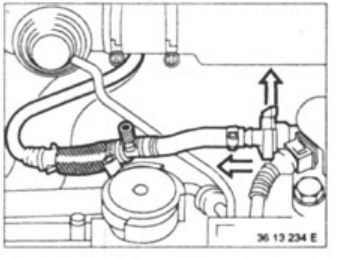


Increase engine speed to 4800 rpm and observe pressure* on the tester.

The suction effect of the injection pump should cause the feed pressure to drop considerably at high engine speed.



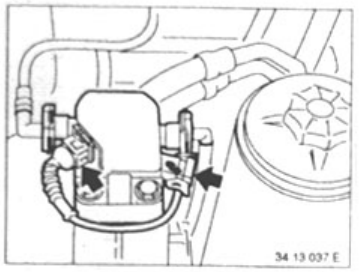
Remove relay box cover.
Remove fuel pump relay (2).



Caution!
Catch escaping fuel in a suitable container while removing Special Tool 16 1 300.

Installation:
Reconnect pipe only with seals which are in perfect condition and coat the seals with an acidless grease.
Ensure that the retainer engages correctly.

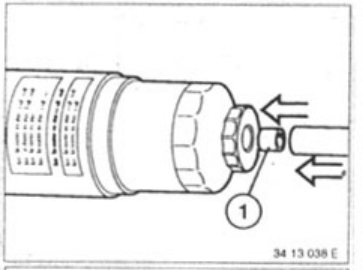
* Refer to Specifications



13 32 000 FUEL FILTER FOR DDE

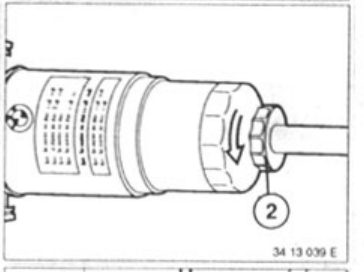
Note:
Fuel preheating is described in Group 12. The water level display is registered via the DDE control unit.
Refer to BMW Diagnosing System for information about troubleshooting.

The heating element and water level probe are integrated in the upper section of the filter and may only be replaced together with the complete fuel filter.

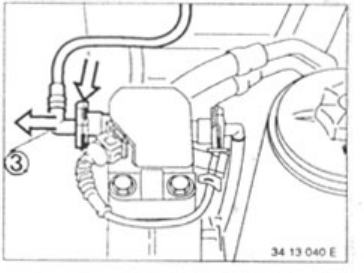


13 32 050 DRAINING WATER TRAP IN FUEL FILTER

Connect suitable hose to drain nipple (1), 8 mm dia., and insert other end into suitable container.



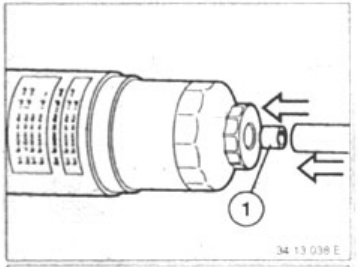
Open drain plug (2) by turning it and drain fluid until pure diesel fuel runs out.



To charge and discharge, press retainer and pull pipe (3) off.

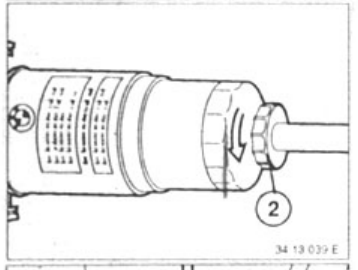
Important!
Catch escaping fuel.

Installation:
Check seals, replacing if necessary. Coat seals with acid-free grease.

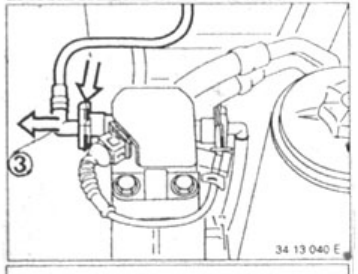


13 32 051 REPLACING FILTER ELEMENT

Connect suitable hose to drain nipple (1), 8 mm dia., and insert other end into suitable container.



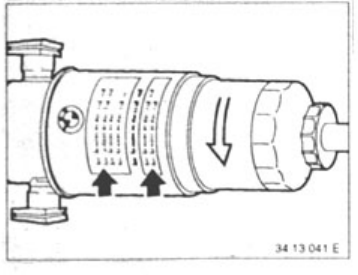
Open drain plug (2) by turning it and drain fuel.



To charge and discharge, press retainer (if necessary pull out completely) and pull pipe (3) off.

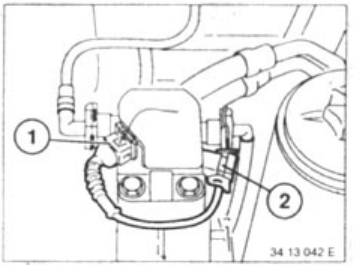
Important!
Catch escaping fuel.

Installation:
Check seals, replacing if necessary.
Coat seals with acid-free grease.



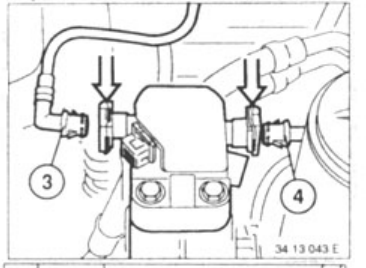
Twist and unscrew fuel filter element.

Installation:
Note instructions printed on the filter element.



13 32 061 REMOVING AND INSTALLING OR REPLACING COMPLETE FUEL FILTER (WITH WATER LEVEL PROBE AND FUEL HEATER)

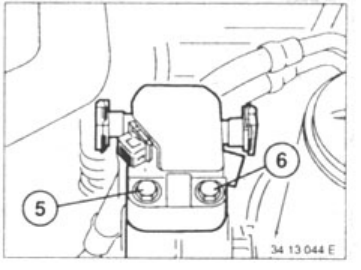
Disconnect plug (1) for water level probe and plug (2) for fuel heater.



Press retainers (if necessary pull out completely) and pull pipes (3 and 4) off.

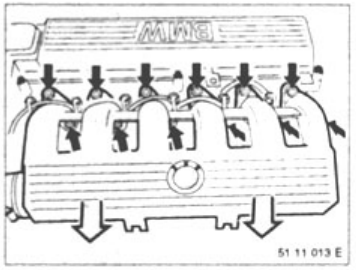
Important!
Catch escaping fuel.

Installation:
Check seals, replacing if necessary.
Coat seals with acid-free grease.



Unscrew bolts (5 and 6) and remove filter.

Empty fuel from filter into a suitable container.

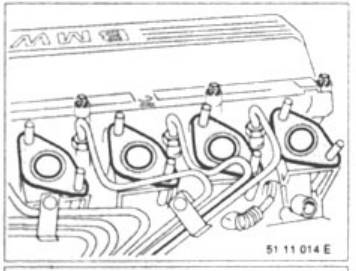


13 51 000 REMOVING AND INSTALLING INJECTION PUMP

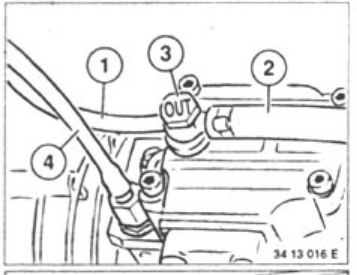
Disconnect battery ground lead.

Important!
Interrogate fault memories of all systems first as disconnecting the battery will erase them.

Remove engine splash guards, fan and fan cowl.
Remove intake manifold - refer to Gr. 11.

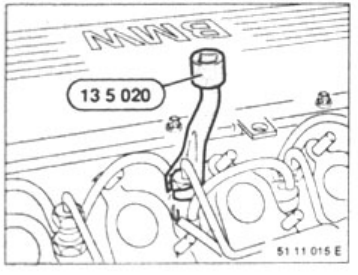


Installation:
Replace gaskets.
Replace leak oil hoses after removal.



Pull off leak oil hose (1).
Disconnect return pipe (2).
Coupling (3) is matched with injection pump.
Disconnect fuel pipe (4).

Installation:
Replace leak oil hose after removal.

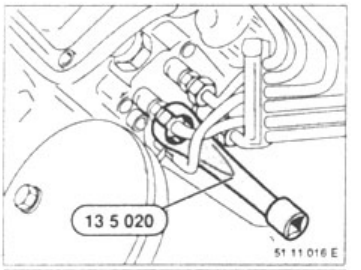


Loosen and remove injection pipes from injection nozzles using Special Tool 13 5 020.

Important!
Reposition tool in good time to avoid bending the pipes.
Plug openings of nozzles with caps.

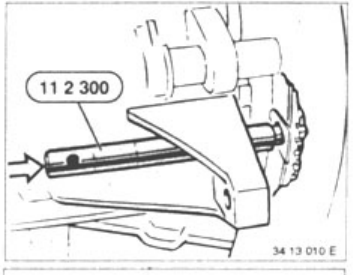
Installation:
Tightening torque*.

* Refer to Specifications

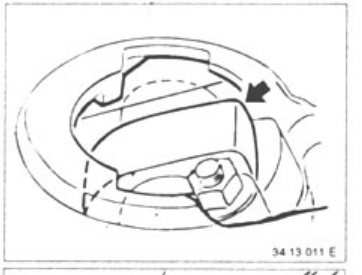


Loosen and remove couplings from injection pump using Special Tool 13 5 020.
Plug openings of injection pump with caps.

Installation:
Tightening torque*.

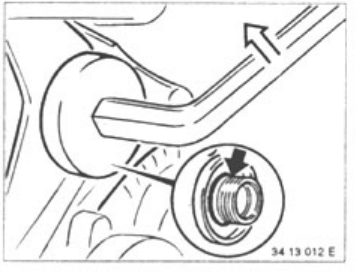


Hold engine in TDC of cylinder no. 1 (power stroke) using Special Tool 11 2 300.



Checking:

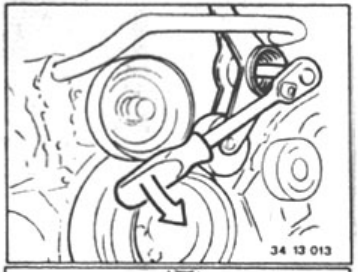
Unscrew oil filler cap.
The first cam of the camshaft must face up.



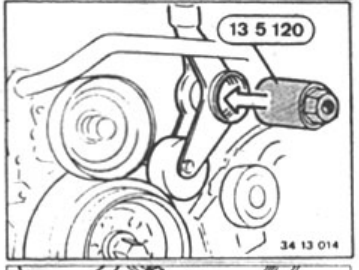
Unscrew toothed belt tensioner bolt.

Installation:
Check for O-ring.

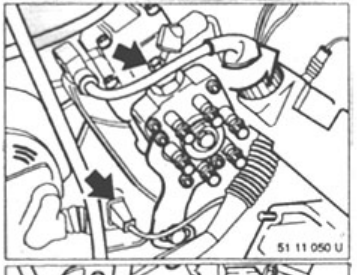
* Refer to Specifications



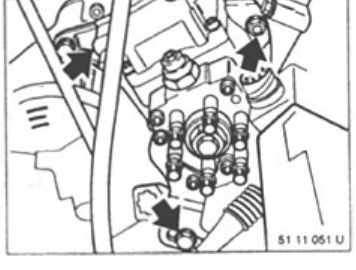
Unscrew central nut.



Screw Special Tool 13 5 120 in, without pressing-out bolt.

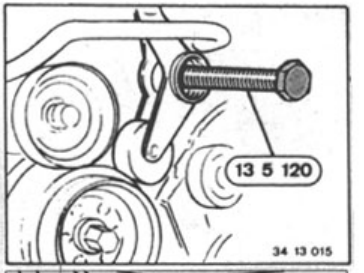


Disconnect plugs.

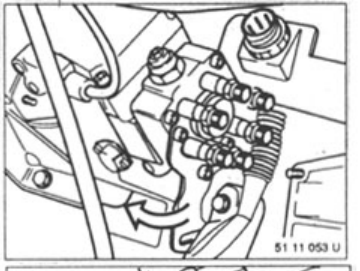


Unscrew pump mounting bolts.

Installation:
Pay attention to washers.

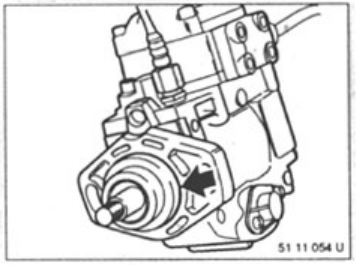


Press pump out by screwing pressing-out bolt into Special Tool 13 5 120.



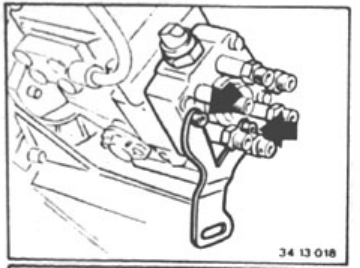
Remove pump.

Note:
Turn pump clockwise so that console can pass the engine mount console.

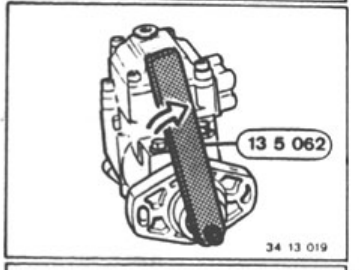


Installation:
Replace O-ring on pump flange.

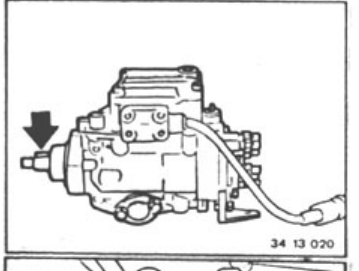
Important!
Leave special tool screwed until until pump is reinstalled as otherwsie the sprocket would fall down and the engine would have to be disassembled.
Unscrew pressing-out bolt of special tool completely before installing the injection pump.



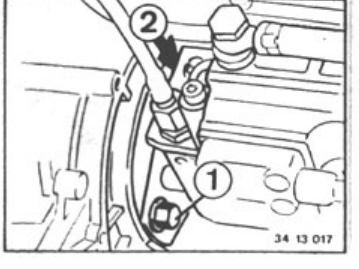
Installation:
When replacing pump, transfer the attachments and mounting parts.



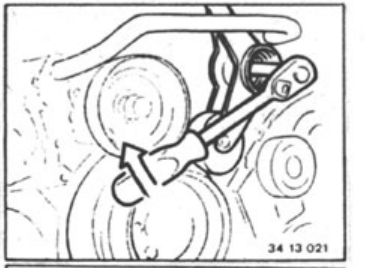
Bring injection pump shaft into installed position using Special Tool 13 5 062.
The cranking lever must be positioned vertically in front of the noticed cam.



Make sure that the woodruff key does not fall out while installing the injection pump.

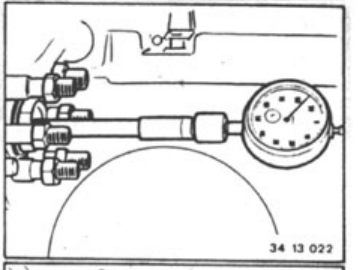


Tighten nuts (1 and 2) before unscrewing Special Tool 13 5 120.

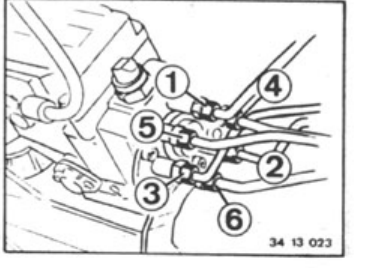


Remove Special Tool 13 5 120.
Screw central nut in and tighten.

Tightening torque*.



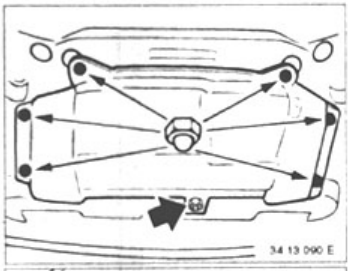
Adjust injection pump statically - refer to 13 51 005.



When connecting injection pipes, begin with connection no. 4.
Note that pipes for cylinders 1, 5, 3, 6, 2 and 4 are equal to the firing order.

Starting time is longer after assembling.
Bleed fuel system - refer to 13 51 320.
Check idling speed - refer to 13 00 050.

* Refer to Specifications



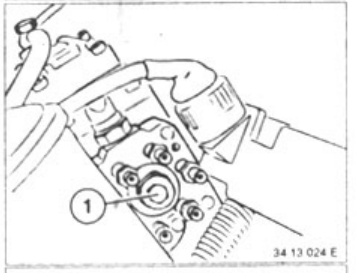
13 51 005 ADJUSTING INJECTION PUMP STATICALLY

DDE 2

Coolant temperature > 20° C.

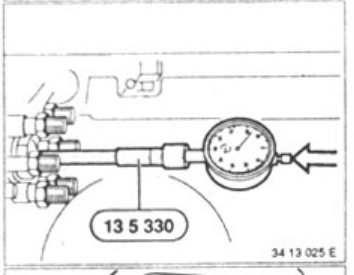
Disconnect battery ground lead.
Important!
This will erase the fault memories of all systems, so that they must first be interrogated.

Remove engine guard and fan cowl.

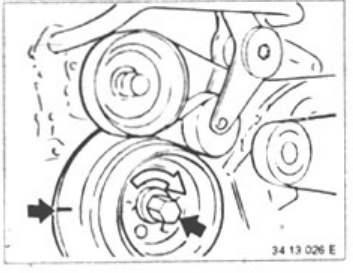


Unscrew plug (1).

Installation:
Replace seal if necessary.
Tightening torque*.

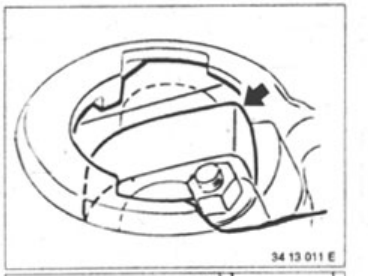


Screw in Special Tool 13 5 330.
Secure dial gage with preload.

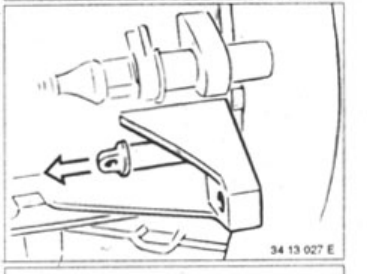


Turn crankshaft clockwise in direction of TDC in cylinder no. 1 (begin about 60 ... 90° in advance) until the needle remains at the deepest point for a short time.
Set scale of dial gage to zero.

* Refer to Specifications

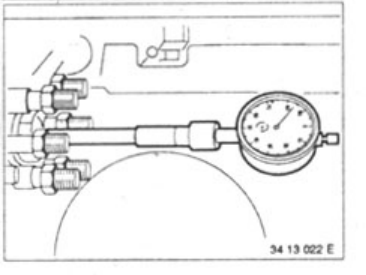


Checking TDC in cylinder no. 1 (power stroke):
Unscrew oil filler cap.
First cam of camshaft must point upwards.



Pull out plug (2).
Turn crankshaft clockwise until Special Tool 11 2 300 can be inserted into appropriate bore of flywheel.

Important!
Don't turn in opposite direction of engine rotation – wrong test results.

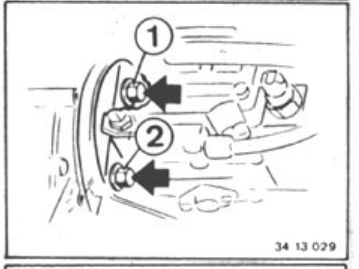


Read stroke of distributor plunger from dial gage.
Refer to adjustment value*.

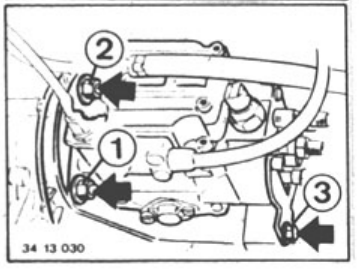
* Refer to Specifications



Adjusting:
Loosen bolt (1).

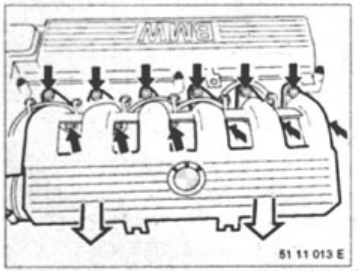


Loosen nuts (2 and 3), but do not loosen excessively in order to avoid tension from the chains.



Turn injection pump until dial gage shows the correct value*.
Tighten nuts and bolts in sequence of 1 through 3.
Tightening torque*.
Recheck the adjustment.

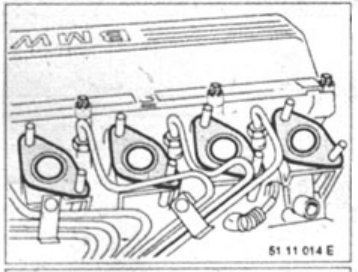
* Refer to Specifications



13 51 ... REPLACING FUEL TEMPERATURE SENSOR

Important!
Ensure absolute cleanliness when working on the injection pump.

Remove intake manifold - refer to Gr. 11.

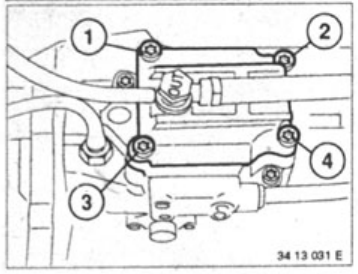


Installation:
Replace gaskets.
Replace leak oil hoses after removal.



Disconnect leak oil hose (1).
Disconnect return pipe (2).
Hollow union bolt (3) is matched with the injection pump.
Disconnect fuel pipe (4).

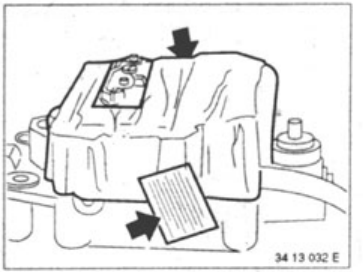
Installation:
Replace leak oil hose after removal.



Unscrew bolts (1 ... 4).
Remove injection rate control unit cover.

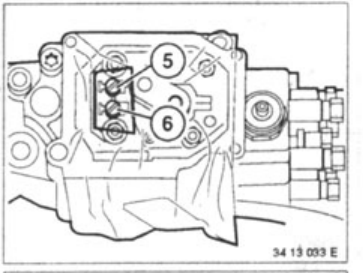
Important!
Catch escaping fuel.

Installation:
Tightening torque = 7 ... 10 Nm.



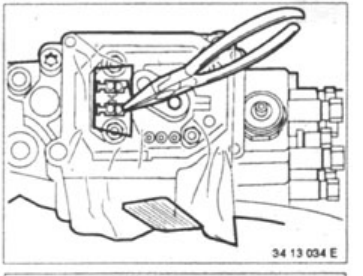
Cover injection rate control unit with clean plastic sheet.

Important!
Potentiometer and slider of motion sender must not be touched or cleaned.
Foreign particles must be kept out of the injection rate control unit.
They would lead to serious malfunction.

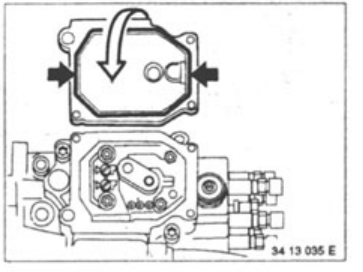


Loosen screws (5 and 6) on temperature sensor and remove screws.

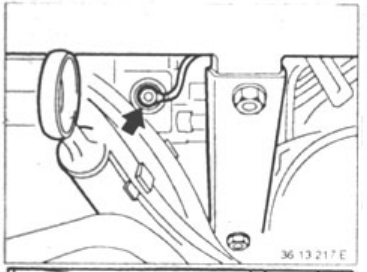
Installation:
Tightening torque = 0.5 ... 0.7 Nm.



Pull out temperature sensor using a pointed pliers applied on the connection lugs (not on connecting wires) and remove.
Don't touch the slider and potentiometer surfaces.

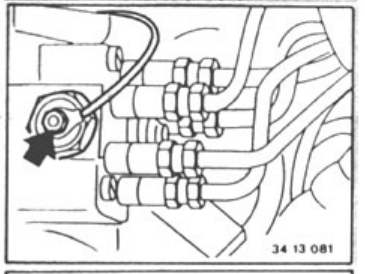


Installation:
Check for correct seating and good condition of gasket when mounting the injection rate control unit cover.

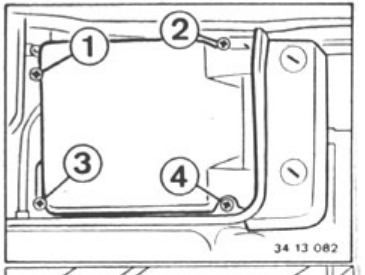


13 51 300 CHECKING ELECTRIC FUEL SHUT-OFF

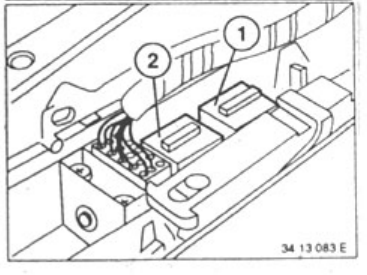
The shut-off receives voltage via the control unit as from ignition key position "2" on.
Switching-on will be heard by a loud click.



If a click is not heard, check power supply to the control unit.
Other tests – refer to BMW Diagnosing System.



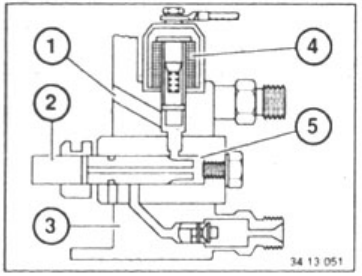
If necessary, check master relay after loosening screws (1 ... 4) and removing cover.



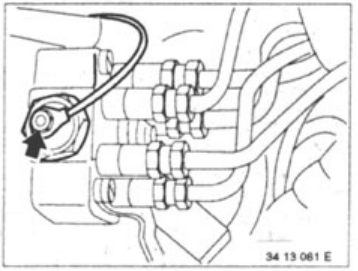
1 = Master relay (white)
2 = Fuel pump relay (orange)

13 51 301 REPLACING ELECTRIC FUEL SHUT-OFF

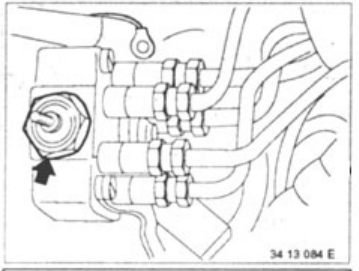
The diesel engine is stopped by interrupting the supply of fuel.
Check fuel shut-off - refer to 13 51 300.



1 = Feed bore
2 = Distributor plunger
3 = Distributor head
4 = Solenoid
5 = High pressure chamber

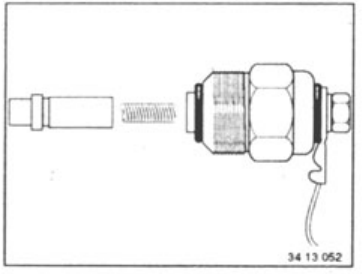


Disconnect lead on fuel shut-off.



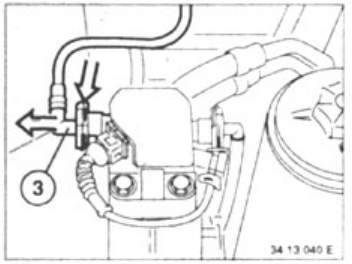
Unscrew fuel shut-off using a 24 mm fork wrench.

Caution!
Plunger and spring could fall out.



Without current the plunger will be run out by spring force and the fuel feed bore shut.

Check O-ring for correct seating.
Tightening torque = 20 ± 5 Nm.

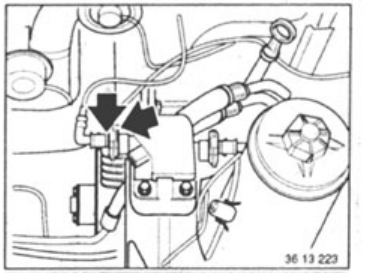


13 51 320 BLEEDING FUEL SYSTEM

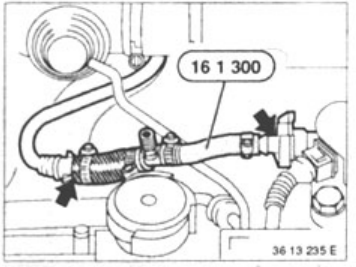
It is not necessary to bleed the fuel system, since the transfer pump builds up pressure* in the supply pipe with the ignition key turned to "2".

If the fuel system is drained completely or had been drained for a long time:
Press retainer (pull out completely if necessary) and disconnect fuel pipe (3) behind the filter.

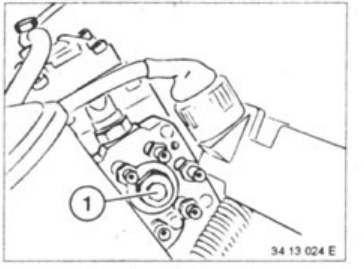
Important!
Catch fuel in a suitable container.



Installation:
Reconnect pipe only with seals which are in perfect condition.
Coat seals with acid-free grease.
Have retainer engage correctly.



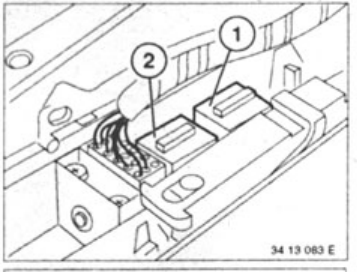
Install Special Tool 16 1 300 (adapter) between pipe (3) and filter housing.
Connect one fuel hose to the threaded nipple and stick other end of hose in a suitable container.



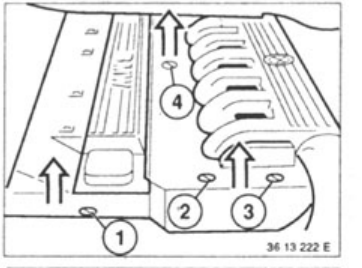
Bleeding Injection Pump:
Loosen plug (1) two turns.
Crank engine with starter until fuel runs out.

Important!
Catch fuel in a suitable container.

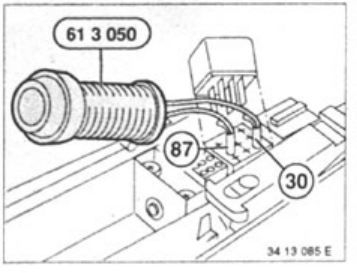
Retighten plug.
Tightening torque = 20 + 6 Nm.



Lift relay box cover off and remove fuel pump relay (2).

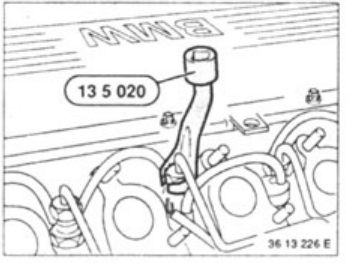


Bleeding Injection Pipes:
Unscrew screws (1 ... 4).
Remove engine cover.



Turn ignition on.
Bridge terminals 30 and 87 on relay carrier with Special Tool 61 3 050.
Operate tool until fuel runs out of filter.

Important!
Catch fuel in a suitable container.



Loosen all coupling nuts on injection nozzles using Special Tool 13 5 020.
Crank engine with starter until fuel runs out at pipes.
Retighten coupling nuts.
Tightening torque = 20 + 5 Nm.
Remove fuel from cylinder head with rags.

* Refer to Specifications

13 62 520 Removing and installing / replacing pedal position sensor

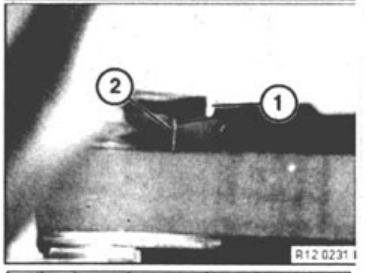
refer to 12 72 520

13 62 600 Replacing RPM sensor (pulse generator) (M51)

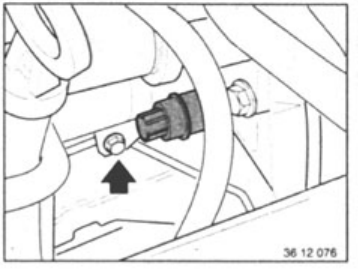
Switch off ignition.



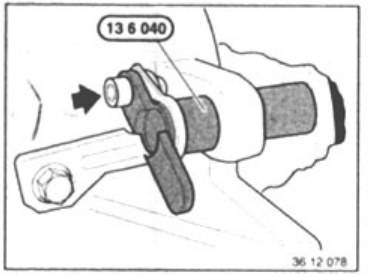
Press coolant hose to one side so that mark (1) can be seen on timing case cover.
Mark (1) on timing case cover must be aligned flush with mark (2) on vibration damper.



Viewed from above:
Mark (1) on timing case cover must be aligned flush with mark (2) on vibration damper.

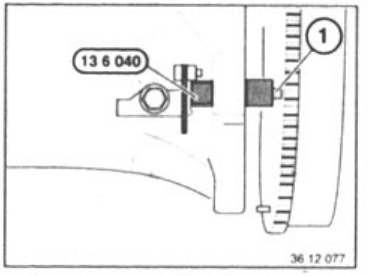


Location of RPM sensor:
Beneath starter.
Disconnect plug-and-socket connection.
Remove RPM sensor together with support bracket.



Installation note:
Fit special tool 13 6 040 to support bracket.
Mount support bracket with special tool on engine block and push till it comes up against the flywheel. This sets the minimum distance of the RPM sensor to the pins in the flywheel.

Firmly tighten support bracket.



Installation note:

Principle:
Special tool 13 6 040 rests on pin (1) of flywheel.
Unscrew special tool 13 6 040 at support bracket and remove.

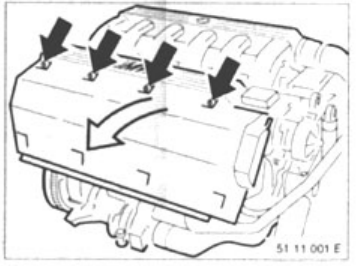
Caution!
The support bracket on the engine block must no longer be loosened, only release and remove the special tool!

Fit RPM sensor in support bracket.
Secure RPM sensor.
Reconnect plug-and-socket connection.
Check function, refer to DIS.

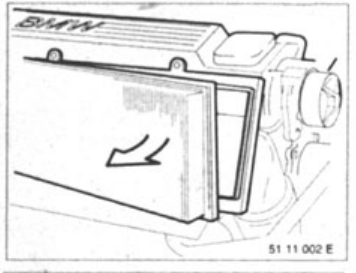
Read out defect code memory of DDE control unit, check stored fault messages, repair faults, delete defect code memory.

13 71 000 Removing and installing air cleaner (M51)

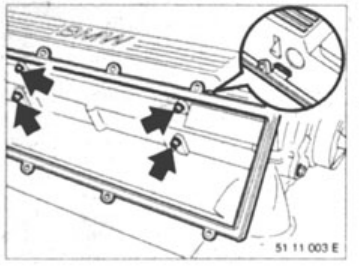
Remove coolant expansion tank.



Release screws. Remove upper section of air cleaner.

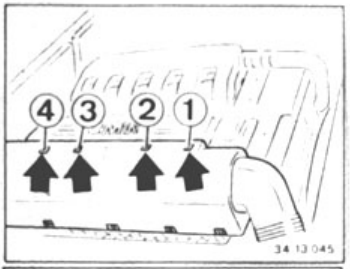


Remove air cleaner cartridge.



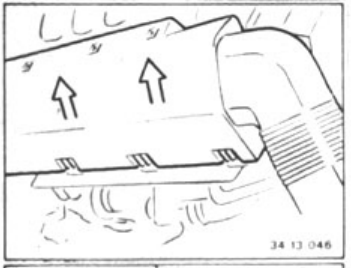
Unscrew air cleaner housing and lift off together with intake duct.

Installation note:
Check O-ring for crankcase ventilation, replace if necessary.
Fit screws with screw sealing compound, tightening torque 6 Nm.

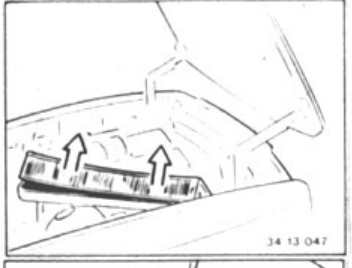


13 72 001 REPLACING AIR CLEANER FILTER ELEMENT

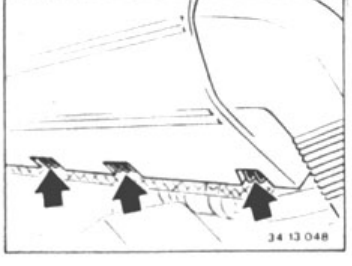
Unscrew screws (1 ... 4).



Pull housing cover up and tilt it out.



Pull filter element out.



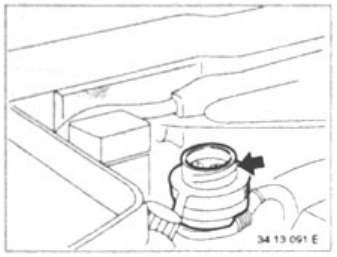
Installation:
First engage cover clips at bottom.

13 Fuel system

530i (M60), 540i (M60)

13 00 002	Functional check of digital motor electronics (DME)	13- 00/41
. . .	Component testing	13- 00/41
13 31 029	Delivery pressure of fuel pump – check	13- 31/41
	Overview of fuel filters and lines	13- 32/41
13 32 051	Fuel filter- replace	13- 32/41
13 41 500	Idle speed control valve – replace	13- 41/41
13 51 199	Fuel pressure regulator – check	13- 51/41
630	Fuel pressure regulator – replace	13- 51/42
13 54 030	Throttle assembly– remove and install/seal	13- 54/41
13 61 000	Control unit (for DME) – remove and install or replace	13- 61/41
13 62 511	Inlet air temperature sensor – replace	13- 62/41
531	Coolant temperature sensor – remove and install	13- 62/41
560	Air mass meter – remove and install or replace	13- 62/42
13 64 541	Fuel injector valves, all – remove and install or replace	13- 64/41
13 71 000	Air cleaner – remove and install	13- 71/41
13 72 001	Air cleaner cartridge – replace	13- 72/41
13 90 500	Tank ventilation valve – replace	13- 90/41

For further information on troubleshooting and jobs in assembly 13 refer to:
Microfiche Assembly Repair Manual and
Electrical Troubleshooting Manual 5 Series E34



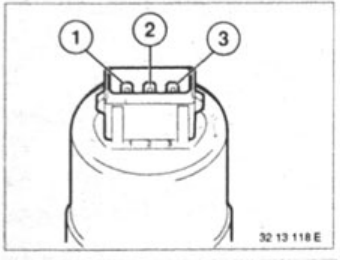
13 00 002 CHECKING FUNCTION OF DIGITAL ENGINE ELECTRONICS (DME)

Connect BMW Service Tester.
Carry out brief test.
Interrogate fault memories.
Interrogate status.
Refer to operating instructions of BMW Service Tester/BMW Diagnosing System.

Additional information on Troubleshooting: Car Electric/Electronic Test Plan and Wiring Diagram binders.

Check intake air temperature sensor.

Measure resistance* on temperature sensor. Check wiring from control unit plug to temperature sensor plug for breaks or shorts**.

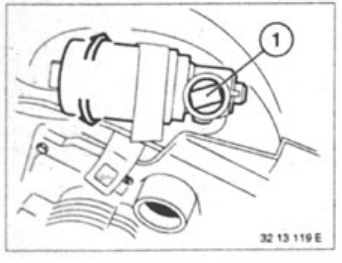


13 00 ... COMPONENT TEST

Check idling speed control valve.

Electric Test

Measure resistance between terminals (1 and 3).
Specification: approx. 23 Ω.
Measure resistance between terminals (2 and 1) or (2 and 3).
Specification: approx. 12 Ω each.

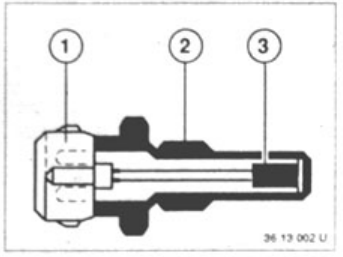


Dynamic Test

Remove idling speed control valve (plug remains connected).
Open or close rotary plunger (1) fully.
Switch on ignition.
Rotary plunger must move to and remain in a position of approx. 50 % cross section opening.

Refer to BMW Diagnosing System for other tests.

* Refer to Specifications of Gr. 12 and 13
** Refer to Wiring Diagrams

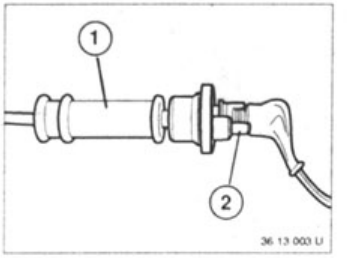


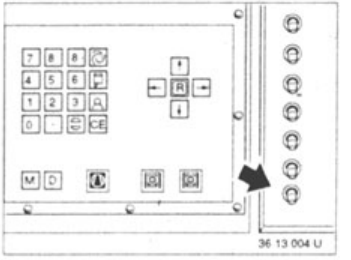
Check coolant temperature sensor.

Connect Jetronic test lead, Special Tool 61 1 440.
Measure resistance* with ohmmeter.
To check resistance in entire temperature range, remove and submerge sensor in a water bath as far as the hexagon and measure resistance* with ohmmeter.

The temperature sensor measures the engine temperature and sends this information to the control unit as a resistance signal.
Resistance drops with rising temperature (NTC).

1 = Plug connection
2 = Housing
3 = NTC resistor





Check tank vapor venting valve.

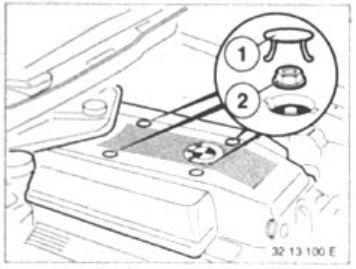
Connect vacuum hose (1) from BMW Service Tester on 8 mm dia. adapter.
Supply 12 V voltage to tank vapor venting valve using Special Tool 61 1 440 (2).

Select Multimeter Function 21 on BMW Service Tester.
Set vacuum to 600 ± 100 mbar.
Switch off vacuum pump.

Vacuum must not drop by more than 50 mbar during the testing time of about 20 seconds.
Replace tank vapor venting valve if vacuum drops by more than 50 mbar.

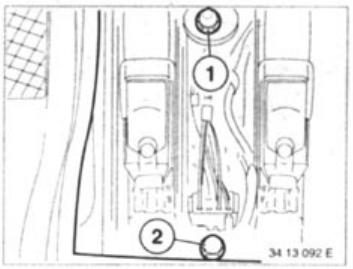
* Refer to Specifications of Gr. 12 and 13

* Refer to Specifications of Gr. 12 and 13
** Refer to Wiring Diagrams

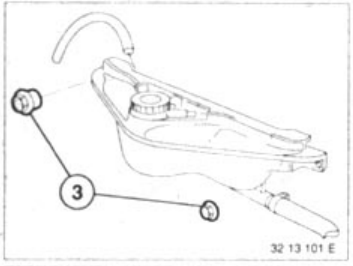


13 31 029 Checking delivery pressure of fuel pump

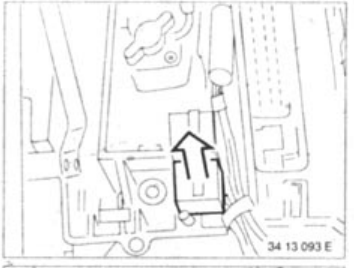
Remove caps (1), release nuts (2).
Remove manifold covering.



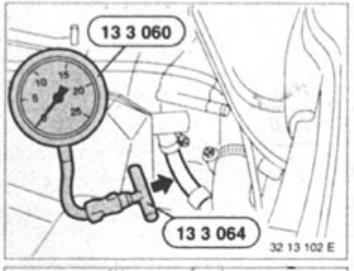
Release nuts (1 and 2) of holder and pull holder upward.
Lay plug connector and cables to one side.



If necessary release retaining nuts (3) of coolant expansion tank and push tank to one side.



Unplug fuel pump relay (orange).

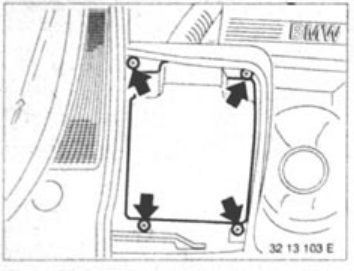


Install BMW SERVICE TESTER or special tool 13 3 060 with connection line and special tool 13 3 064 in fuel supply line upstream of pressure regulator.

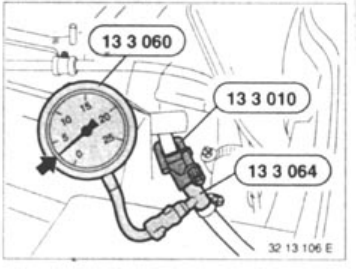


Connect special tool 61 3 050 to terminal 87 and terminal 30.
Press button and read off delivery pressure* at pressure gage.

If the specified delivery pressure is not reached, close off fuel return line after the T-piece with special tool 13 3 010. Switch on ignition. Operate special tool 61 3 050.



Release screws.
Remove lid for E-box.

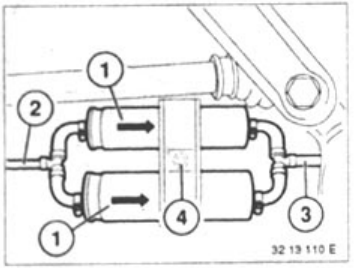


If delivery pressure* is reached:
Replace pressure regulator.

If delivery pressure* is not reached:
Check and clean plug-and-socket connection of fuel pump. Repeat test, if delivery pressure is still not reached: Replace fuel pump.

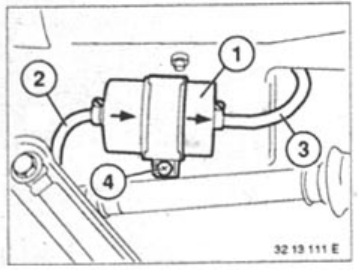
* Refer to Technical Data

SURVEY OF FUEL FILTER AND HOSES



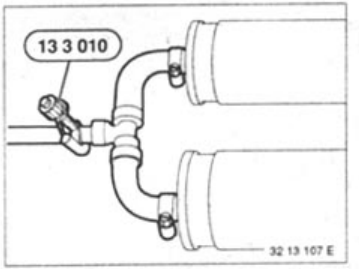
540i

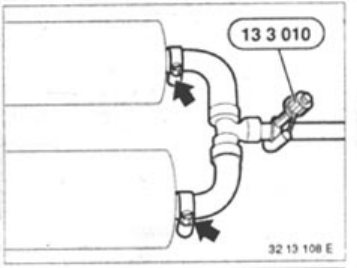
1 Fuel filter
2 Fuel hose from tank
3 Feed hose
4 Filter holder

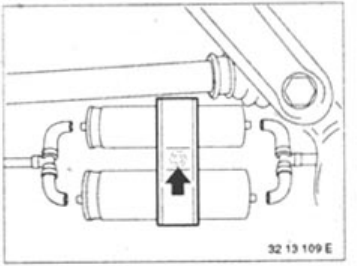


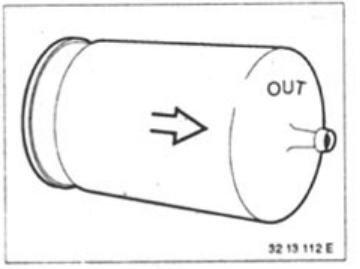
530i

1 Fuel filter
2 Fuel hose from tank
3 Feed hose
4 Filter holder









13 32 051 REPLACING FUEL FILTER

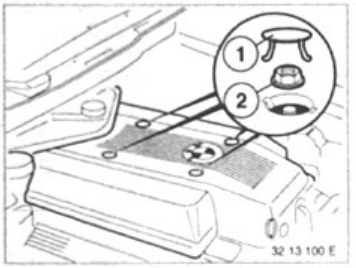
Loosen clamps of hoses on body as much as necessary.
Clamp all fuel hoses using Special Tool 13 3 010.

Disconnect hoses at fuel filter.

Important!
Catch and dispose escaping fuel.

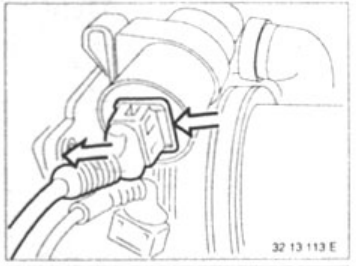
Unscrew nut and remove filter.

Installation:
Check direction of flow (arrow) or outlet (OUT).

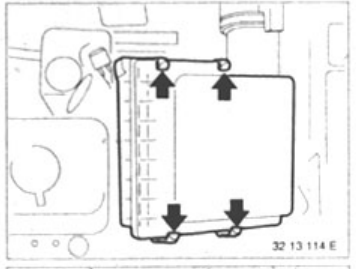


13 41 500 Replacing idle speed control valve

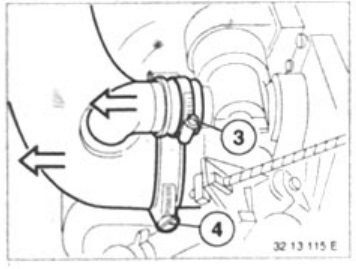
Remove caps (1), release nuts (2).
Remove manifold covering.



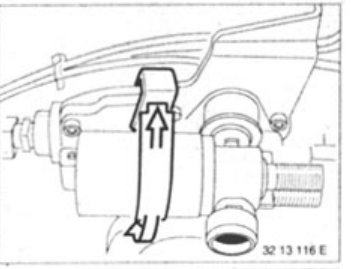
Press retaining spring and disconnect plug connector.



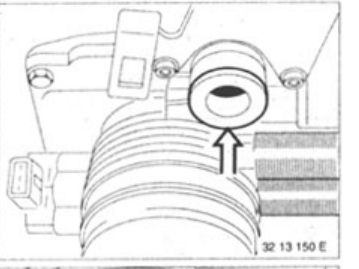
Open clips, lift off upper section of air cleaner.



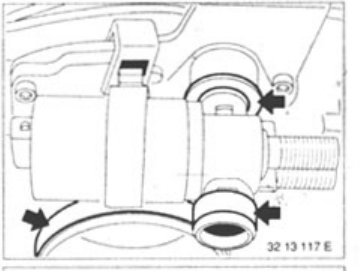
Release hose clips (3 and 4).
Remove intake hoses together with upper section of air cleaner.



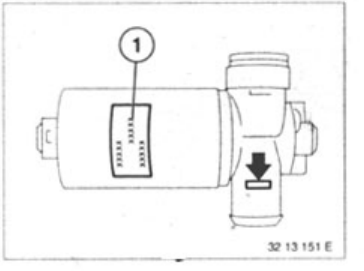
Press together mounting and detach.
Remove idle speed control valve.



Installation note:
First fit sealing ring in throttle flange.



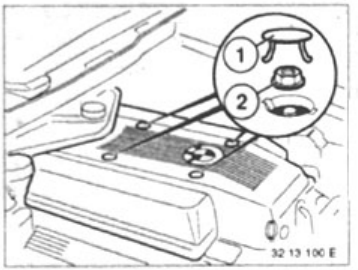
Installation note:
Ensure seals are fitted on throttle body and idle speed control valve.



Installation note:
Note identification No. (1)*.
Check idle speed.

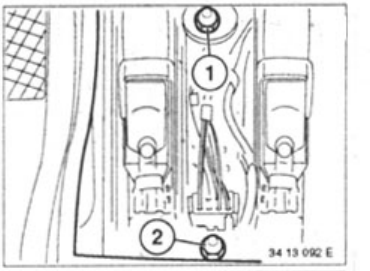
For component testing refer to 13 00 ...

* Refer to Technical Data

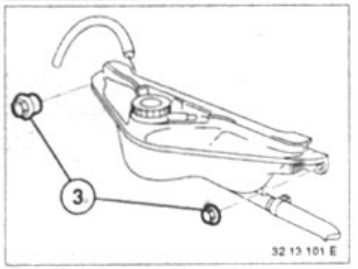


13 51 199 CHECKING FUEL PRESSURE REGULATOR

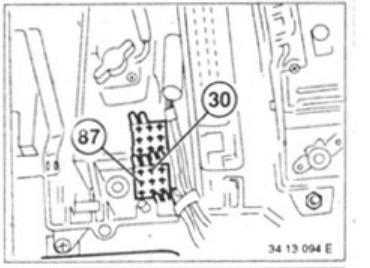
Press off caps (1).
Unscrew nuts (2).
Remove cover for collector.



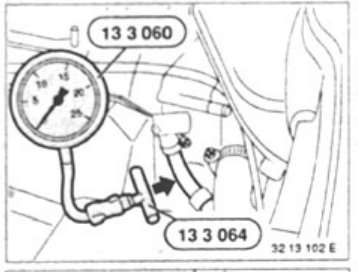
Unscrew plug rail nuts (1 and 2) and pull plug rail upwards.
Place plug and wiring aside.
Disconnect fuel pump relay (orange).



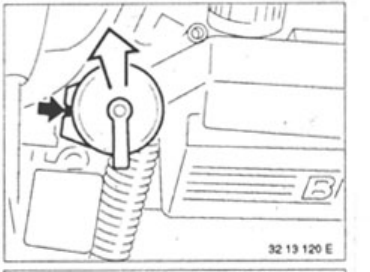
If applicable, unscrew coolant expansion tank mounting nuts (3) and push tank aside.



Bridge terminals 87 and 30 using Special Tools 61 3 050.
Switch on ignition.
Operate special tool.
Read and check system pressure*.

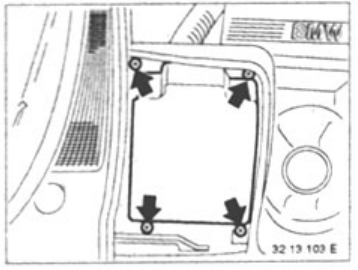


Install connector of BMW Service Tester or Special Tool 13 3 060 together with connecting pipe and Special Tool 13 3 064 in fuel feed hose.

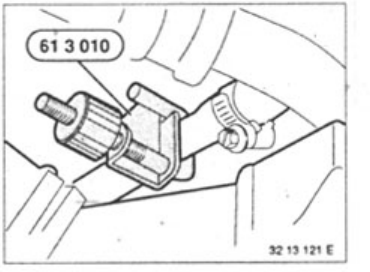


System Pressure Drops Too Fast:

Disconnect diagnosis socket and clamp return hose behind pressure regulator using Special Tool 13 3 010.
Operate Special Tool 61 3 050 again briefly.

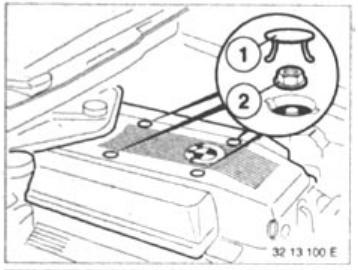


Unscrew screws.
Remove electronic box lid.



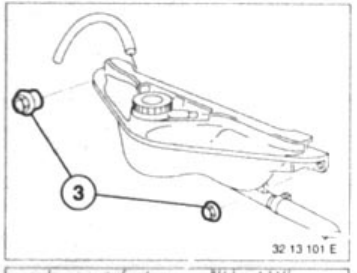
If system pressure is now maintained, the pressure regulator is faulty.
If the system pressure drops, there is a leak ahead of the pressure regulator (injection pipe, hose connections, fuel injectors, etc.).

* Refer to Specifications of Gr. 16

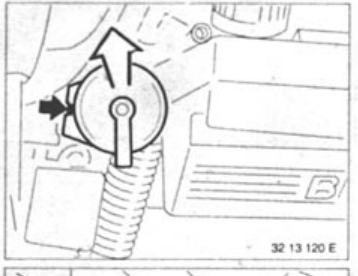


13 51 630 Replacing fuel pressure regulator

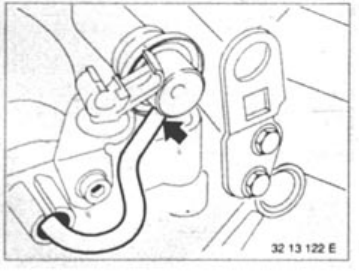
Remove end caps (1), release nuts (2).
Remove manifold covering.



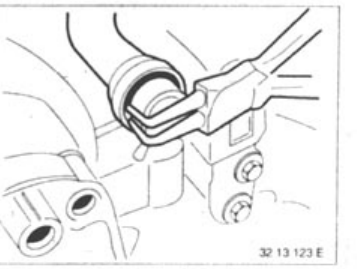
If necessary, release retaining nuts (3) from coolant expansion tank and push tank to one side.



Detach diagnostic socket.



Disconnect vacuum hose.

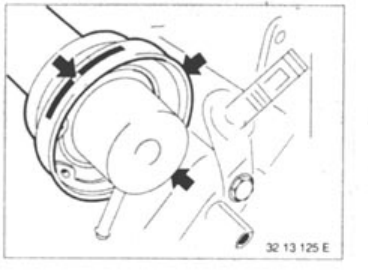


Lift out snap-ring.

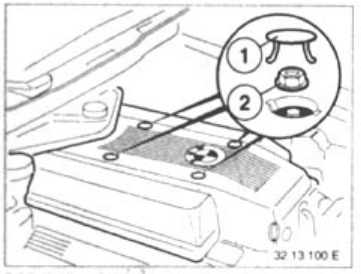


Note position of vacuum connection.
Turn pressure regulator and pull out.

Installation note:
Replace seals (1 and 2).

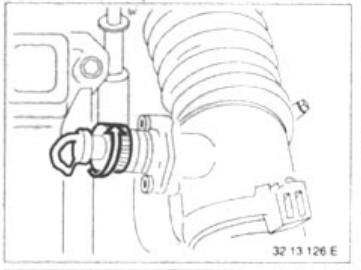


Installation note:
Ensure lugs of snap-ring engage in recesses.

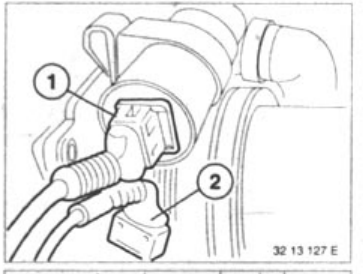


13 54 030 REMOVING AND INSTALLING / SEALING THROTTLE VALVE ASSEMBLY

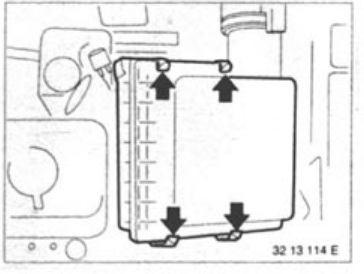
Press off caps (1).
Unscrew nuts (2).
Remove cover for collector.



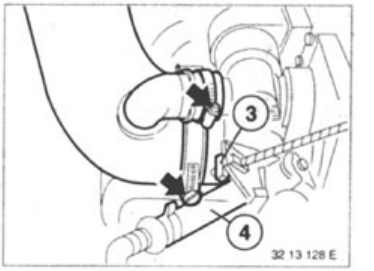
Twist and pull off mass air flow sensor plug.



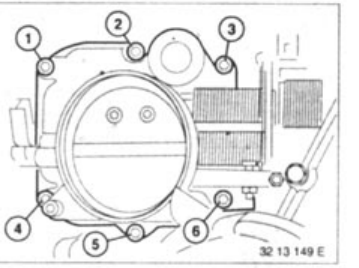
Pull plug (1) off of idling speed control valve and plug (2) off of throttle valve potentiometer.



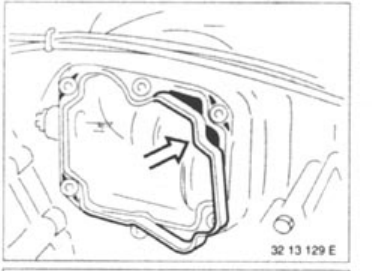
Unclip and pull up air cleaner upper section.



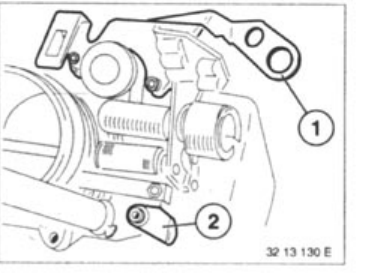
Loosen hose clamps and remove intake hoses together with air cleaner upper section.
Disconnect throttle cable (3).
Pull vacuum hose (4) off of throttle valve assembly.



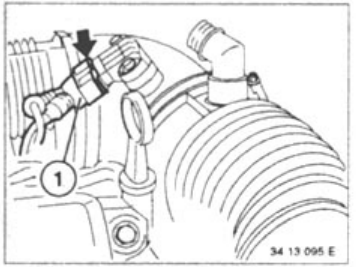
Unscrew screws (1 ... 6) and pull off throttle valve assembly.



Installation:
Replace gasket.

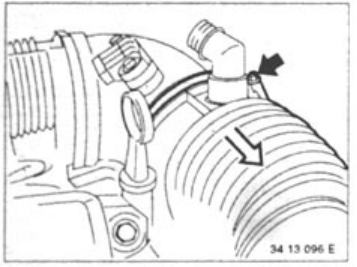


Installation:
Attach holders (1 and 2).

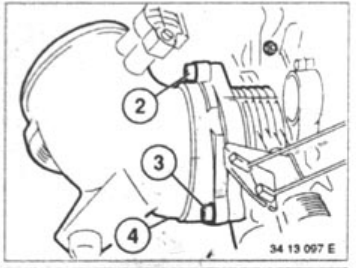


Models with Anti Slip Control (ASC):

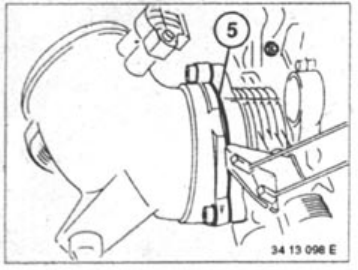
Pull off plug (1).



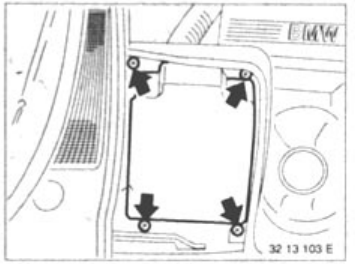
Loosen hose clamp and pull off bellows.



Unscrew screws (2 ... 4).
Take off and place throttle valve assembly aside.

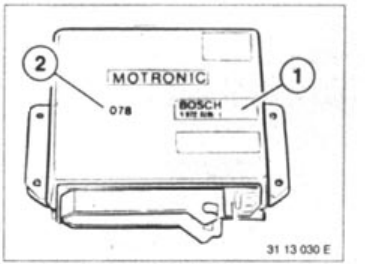


Installation:
Replace gasket (5).

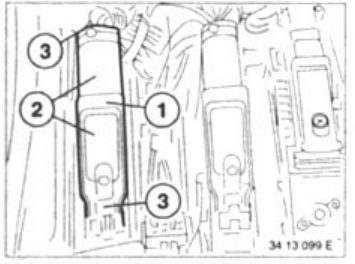


13 61 000 REMOVING AND INSTALLING OR REPLACING CONTROL UNIT (FOR DME)

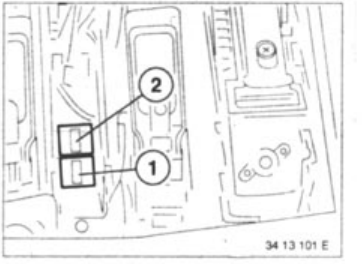
Unscrew electronic box lid screws.
Remove lid.



Installation:
Check code (1)* and production date (2)*.

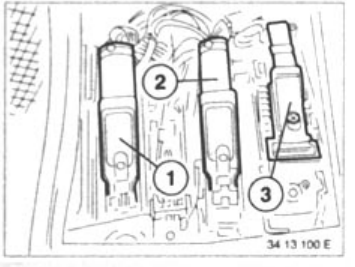


Pull up retainer (1) and pull off plug (2).
Unclip retainers (3) and remove control unit.



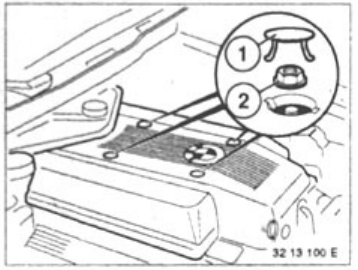
Relays in Control Unit Electronic Box:

1 = Fuel pump relay (orange)
2 = DME master relay (white)



1 = DME control unit
2 = EGS control unit
3 = ABS/ASC control unit

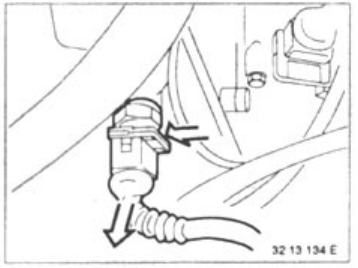
* Refer to Specifications



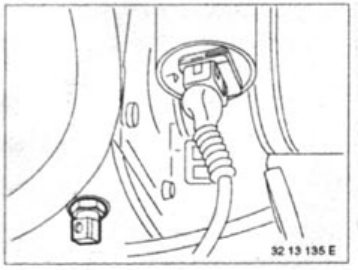
13 62 511 REPLACING INTAKE AIR TEMPERATURE SENSOR

(After checking function of digital engine electronics (DME) as in 13 00 002.)

Press off caps (1).
Unscrew nuts (2).
Remove cover for collector.



Press in retainer.
Pull off plug.



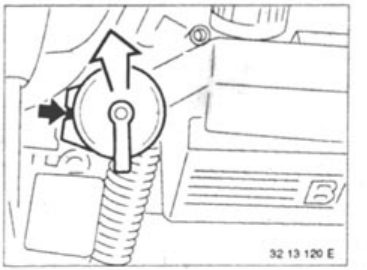
Unscrew temperature sensor.

Installation:
Tightening torque*.

Component Test:

Refer to 13 00 . . ..

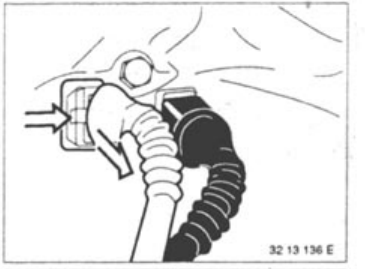
* Refer to Specifications



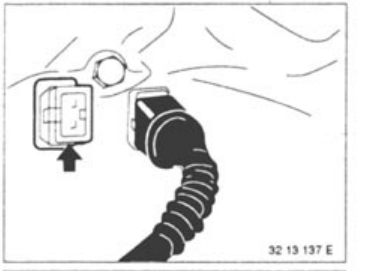
13 62 531 REMOVING AND INSTALLING COOLANT TEMPERATURE SENSORS

(After checking function of digital engine electronics (DME) as in 13 00 002.)

Detach and place diagnosis socket aside.

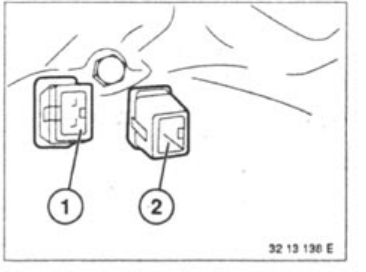


Press in retainer.
Pull off plug (white).



Unscrew temperature sensor.

Installation:
Tightening torque*.

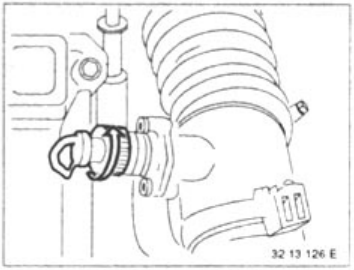


Arrangement:
1 Temperature sensor for DME (white)
2 Temperature sensor for temperature gage (black)

Component Test:

Refer to 13 00 . . ..

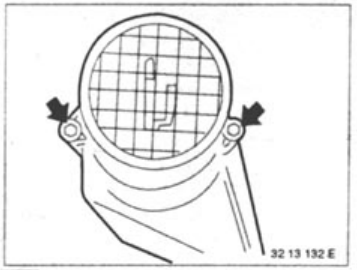
* Refer to Specifications



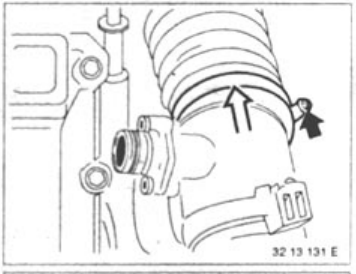
13 62 560 REMOVING AND INSTALLING OR REPLACING MASS AIR FLOW SENSOR

(After checking function of digital engine electronics (DME) as in 13 00 002.)

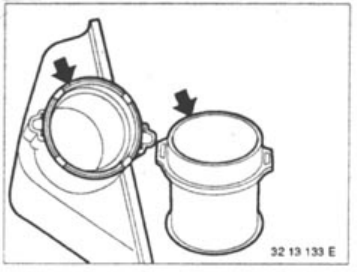
Twist and pull off mass air flow sensor plug.



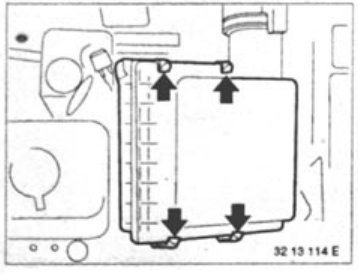
Unscrew screws.
Twist and pull off mass air flow sensor housing.



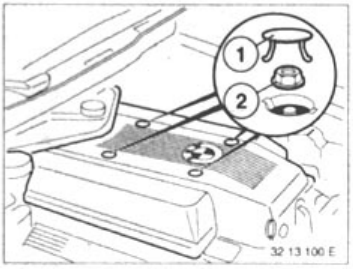
Loosen hose clamp and pull off intake hose.



Installation:
Replace seal.
Coat sealing lip surface on housing with a small amount of acidless grease.

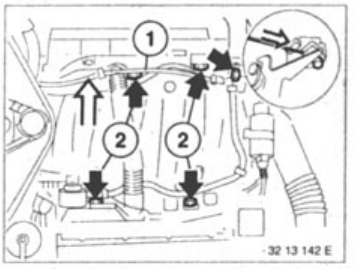


Unclip and pull off air cleaner upper section.

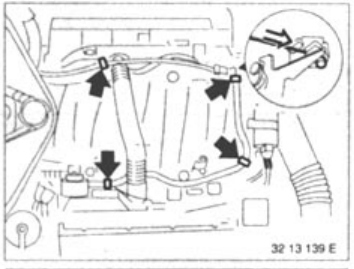


13 64 541 Removing and installing or replacing all fuel injector valves

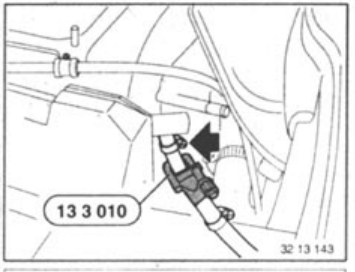
Remove end caps (1), release nuts (2).
Remove manifold covering.



Unclip throttle operating cable (1) and place to one side.
Remove cable ducts (2) and place to one side.
disconnect plug connectors from fuel injector valves.

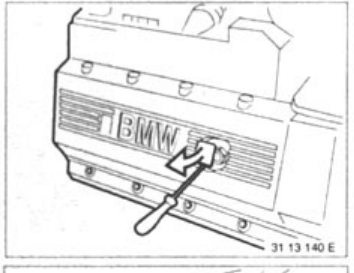


Remove retaining straps for mounting cable.
Detach throttle operating cable at throttle lever.

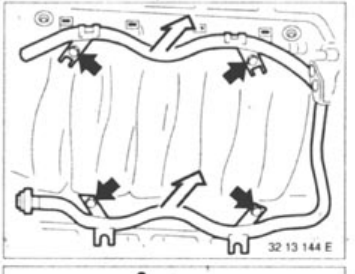


Close off fuel supply and return lines with special tool 13 3 010 and remove.

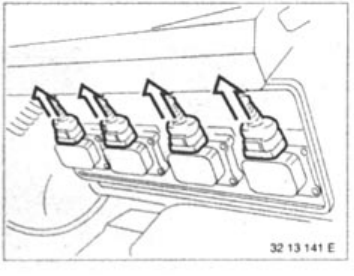
Caution!
Collect escaping fuel.



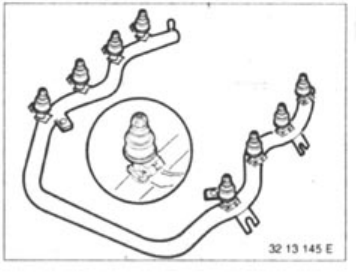
Remove covering for cylinder head covers on both sides.



Release injection tube retaining elements.
Remove injection tube together with fuel injector valves.

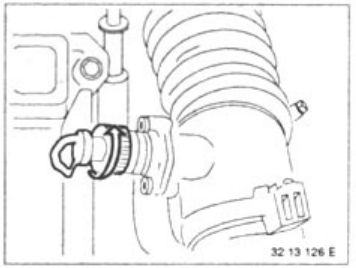


Disconnect cable connectors from ignition coils on both cylinder heads.



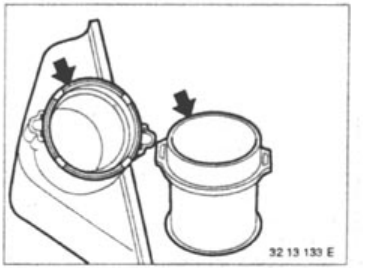
Press off clips. Remove fuel injector valves from injection tube.

Installation note:
Check seals and replace if necessary. Check fuel injector valves for leaks, refer to 13 64 582.
Before fitting, coat seals of fuel injector valves with acid-free grease.



13 71 000 REMOVING AND INSTALLING AIR CLEANER HOUSING

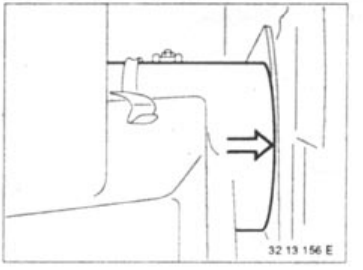
Twist and pull off mass air flow sensor plug.



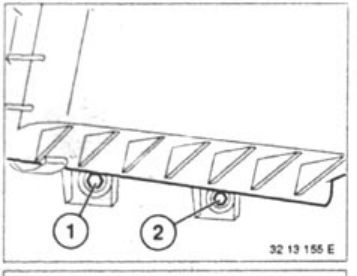
Installation:
Replace seal.
Coat housing at sealing lip surface with a small amount of acidless grease.



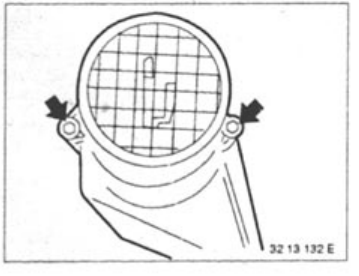
Loosen hose clamp.
Pull off intake hose.



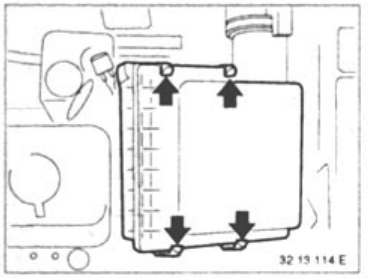
Installation:
Guide intake neck into opening.
Mount housing on rubber mounts.



Unscrew screws (1 and 2).
Tilt and pull out air cleaner housing.

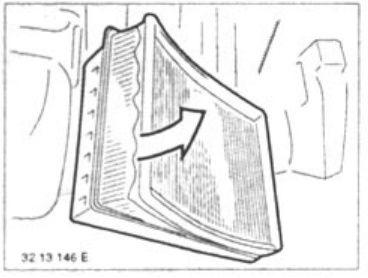


Unscrew screws.
Twist and pull off mass air flow sensor housing.

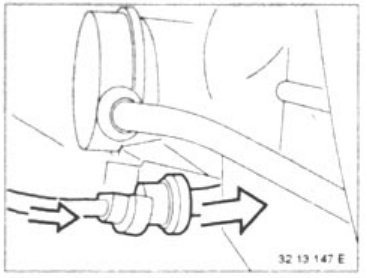


13 72 001 REPLACING AIR FILTER ELEMENT

Unclip.



Lift air cleaner upper section and pull out air filter element.

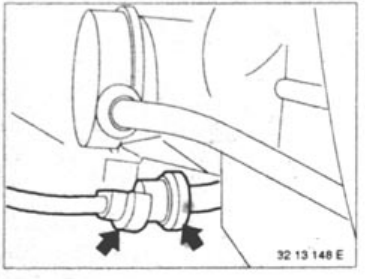


13 90 500 REPLACING TANK VAPOR VENTING VALVE

(After checking function of digital engine electronics (DME) as in 13 00 002.)

Tank vapor venting valve and carbon canister are located between bumper lower section and left front wheel house.

Push tank vapor venting valve out of rubber holder.
Press in retainer and pull off plug.



Disconnect fuel hoses.

Caution!
Catch escaping fuel.

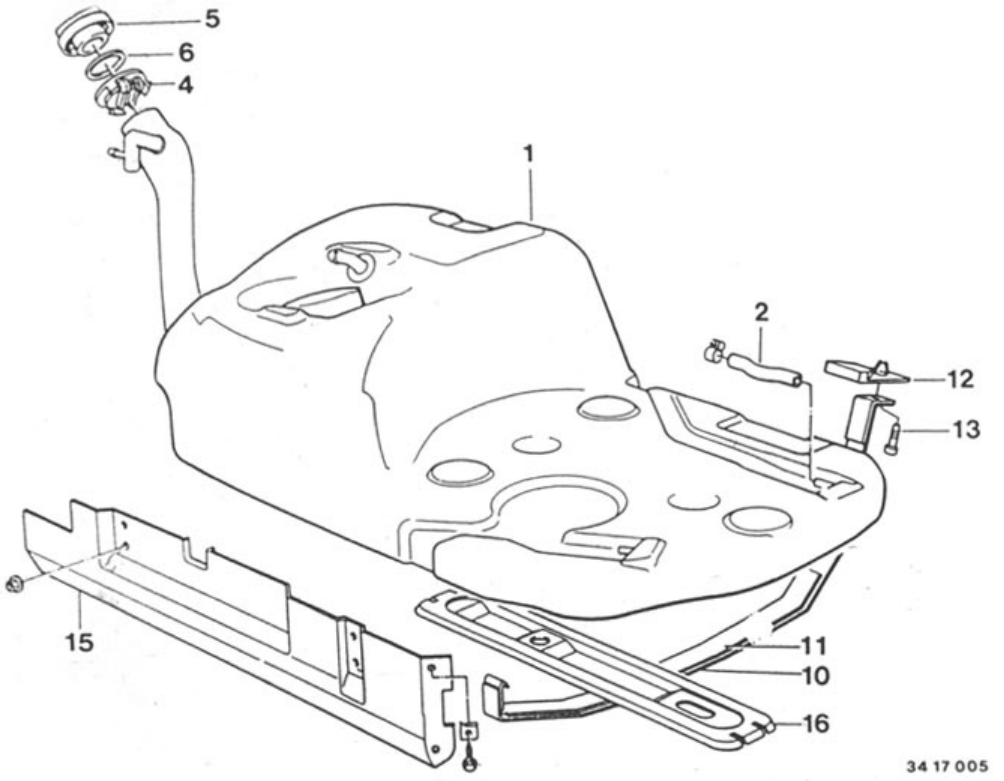
Component Test:

Refer to 13 00 . . ..

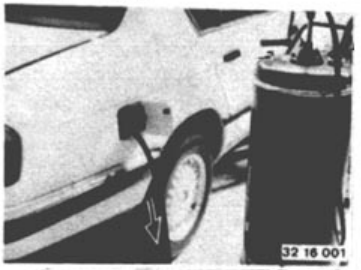
16 Fuel supply system

16 11	. . .	Overview fuel tank	16-11/1
	030	Fuel tank – remove and install	16-11/2
	. . .	Overview expansion tank with hose layout	16-11/4
	120	Expansion tank for tank venting – remove and install or replace	16-11/5
	. . .	Overview tank ventilation on catalytic converter vehicles	16-11/6
16 12	000	Fuel level sending unit and in-tank pump M30 – remove and disassemble	16-12/1
	. . .	Connector assignments in-tank pump fuel level sending unit	16-12/4

FUEL TANK SURVEY



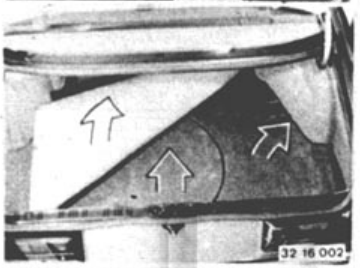
1 Fuel tank
2 Hose
4 Filler pipe insert
5 Tank cap
6 Seal
10 Retaining strap
11 Liner
12 Welded nut
13 Mounting screw
15 Heat shield
16 Adapter



16 11 030 Removing and installing fuel tank

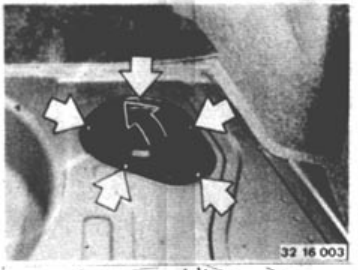
If necessary, partially drain fuel with suction pump**).

Caution!
Observe safety requirements and prevailing national legislation.

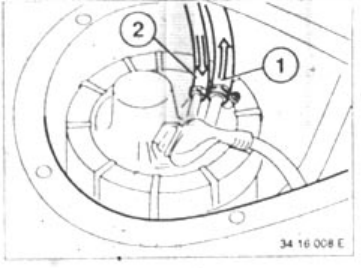


Installation instruction:
Only use new hose clips.
Check fuel hoses for condition and any leaks: replace if necessary.
Also see Service Information, Gr. 16.

Removing trunk trim panel.



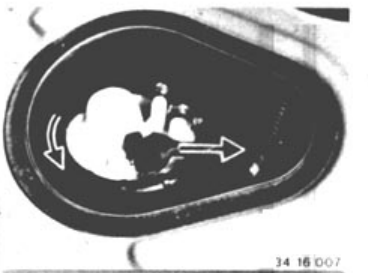
Unscrew bolts.
Remove cover.



Unscrew bolts.
Remove fuel hoses.

Note:
1 = inlet
2 = outlet

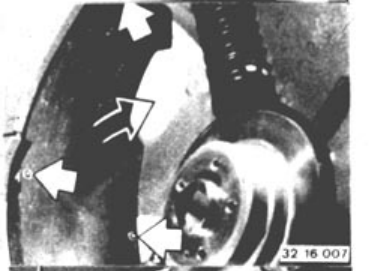
**) Sourcing Reference HWB



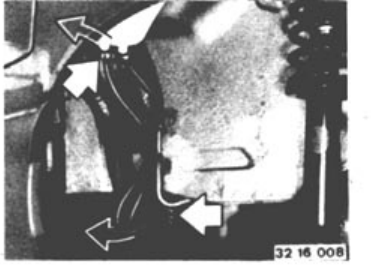
Move slide to one side.
Lift out plug.



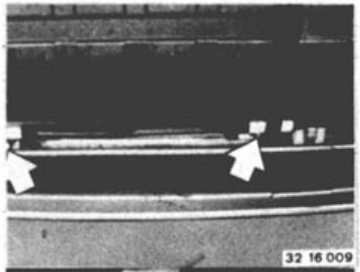
Lift out rubber gaiter.



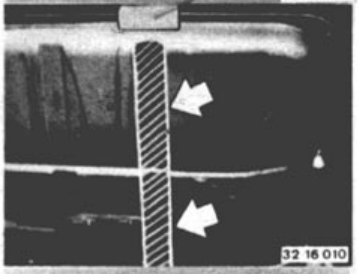
If necessary, remove wheel, see 36 10 300.
Unfasten screw.
Lift out trim panel.



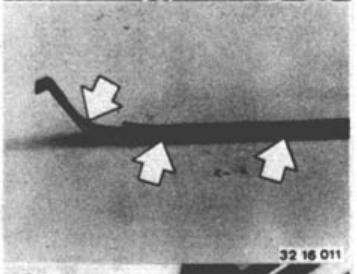
Unscrew bolts.
Remove vent hoses.



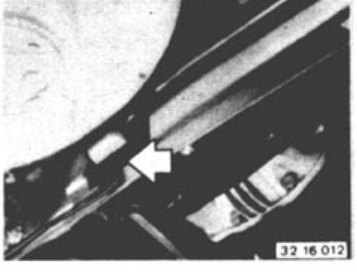
If necessary, support fuel tank from underneath.
Unscrew heat shield screws.
Lift out fuel tank.



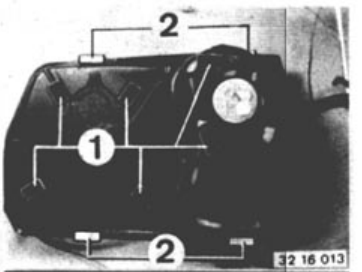
Installation:
Replace plastic sheet, if necessary.



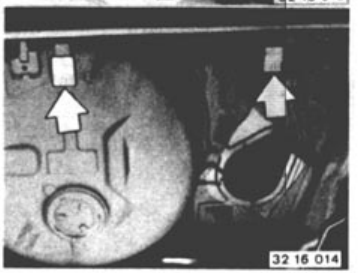
Installation:
Replace liners, if necessary.



Installation:
Check for correct seating of retaining straps.

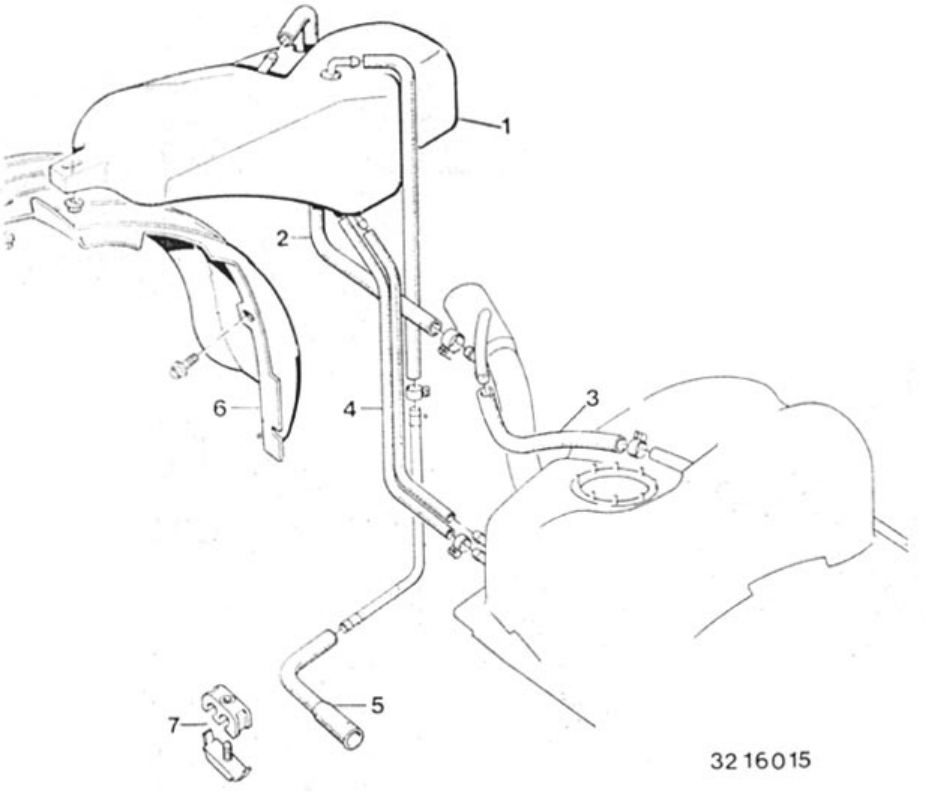


Installation:
Check liners (1), if installed, and edge guard (2), replacing if necessary.



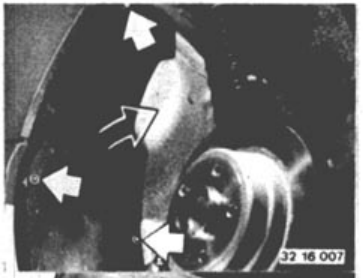
Installation:
Check stops, replacing if necessary.

EXPANSION TANK AND HOSE ROUTING SURVEY



1 Expansion tank
2 Vent hose (filler neck/expansion tank)
3 Vent hose (filler neck/fuel tank)
4 Vent pipe (fuel tank/expansion tank)
5 Spill pipe (expansion tank/next to differential)*
6 Trim panel
7 Fuel pipe holder on floor plate

* To carbon canister in cat. conv. cars

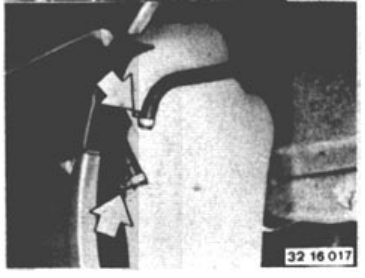


16 11 120 REMOVING AND INSTALLING OR REPLACING EXPANSION TANK FOR FUEL TANK VENT

Remove rear wheel – see 36 10 300.
Unscrew screws.
Lift out trim panel.

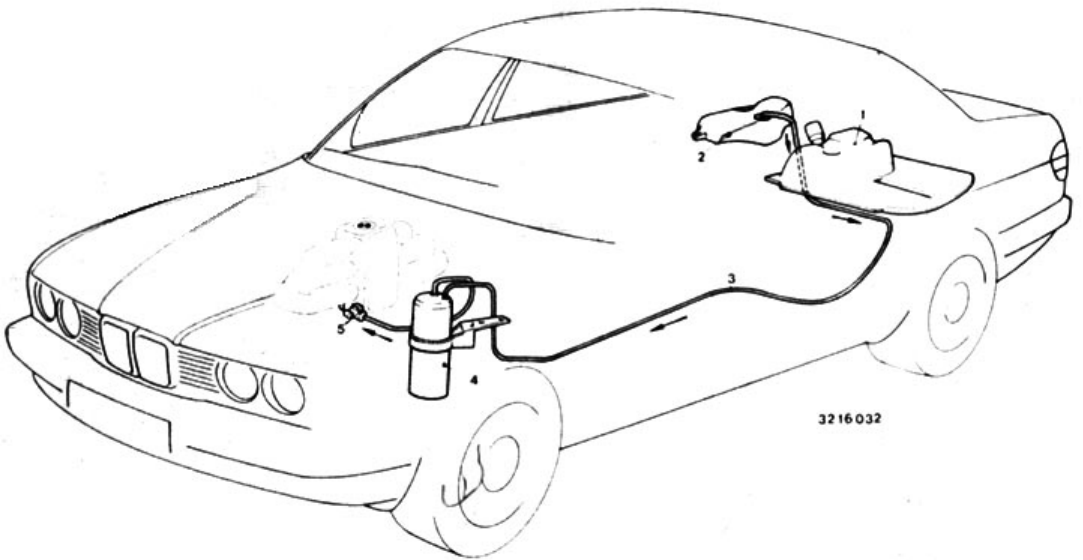


Unscrew screws.
Pull off vent hoses (see hose routing point no. 6).
Unscrew screw (1).



Unscrew screws.
Pull off vent hoses.
Pull off tank.

16 11 ... TANK VENTING SURVEY
(see "Note")



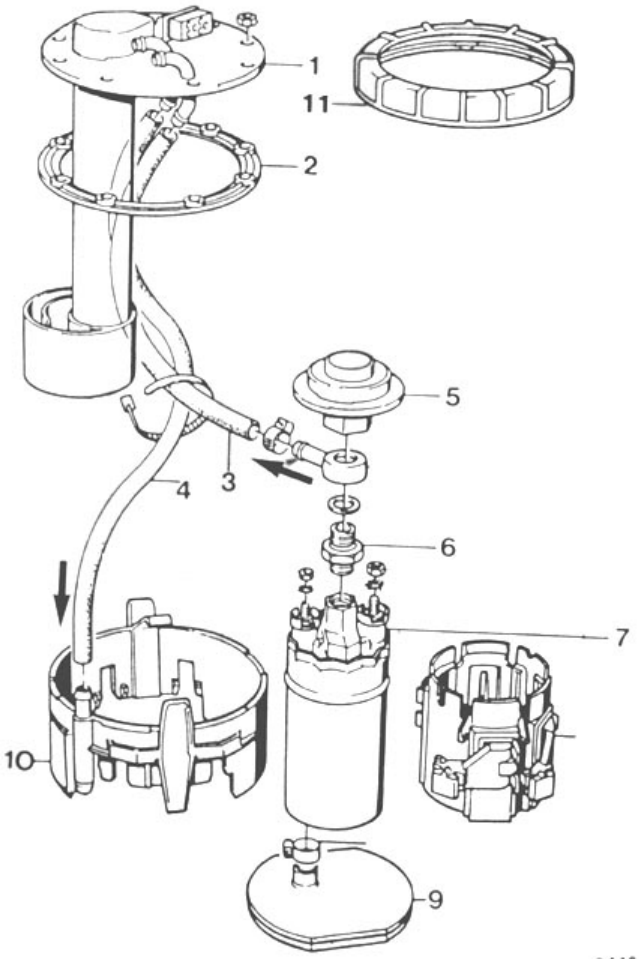
1 = Fuel tank
2 = Expansion tank
3 = Pipe
4 = Carbon canister
5 = Tank venting valve

Note:
Check tank venting valve – see 13 90 500.
Item 4 not used on M 21 engine and with provisions for catalytic converter. Vapors are discharged outdoors via the expansion tank.

16-12/1

16 12 000 Removing and disassembling immersed tube indicator and intank pump

Summary of immersed tube indicator and intank pump



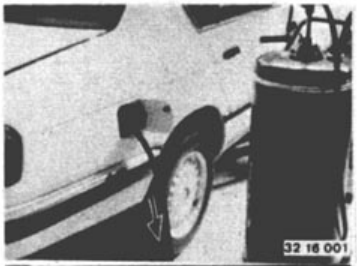
3416006

1 = Immersed tube indicator
2 = Gasket
3 = Inlet lead
4 = Return lead
5 = Pressure damper
6 = Non-return valve
7 = Fuel pump
8 = Pump carrier with damper rubber
9 = Fuel screen
10 = Pump bracket
11 = Union nut

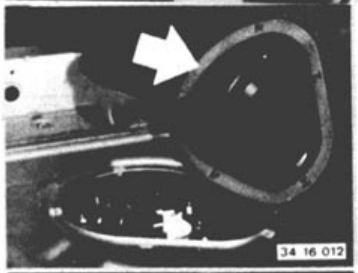
Check fuel pressure and delivery rate, see Gr. 13.

Check immersion tube indicator*), also refer to plug allocation on Page 16-12/4.

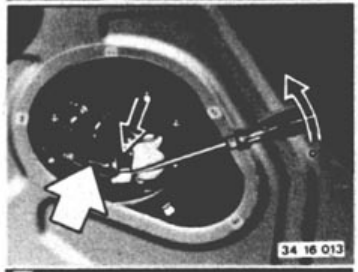
*) Refer to Specifications



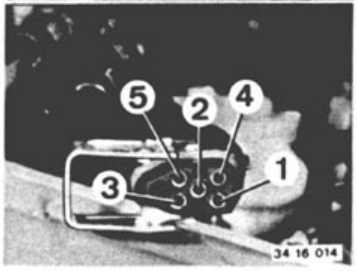
If necessary, partially remove fuel with suction pump**).



Lift out luggage compartment trim panels.
Unscrew bolts.
Remove lid.



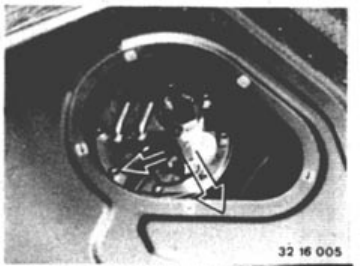
Move slide to one side.
Pull off plugs.



Plug allocation on intank pump and immersion tube indicator

1 = 31 = ground, immersion tube indicator
2 = Tank = warning lamp
3 = Tank = sensor
4 = 31 = ground, fuel pump
5 = EKP 1 = fuel pump 1

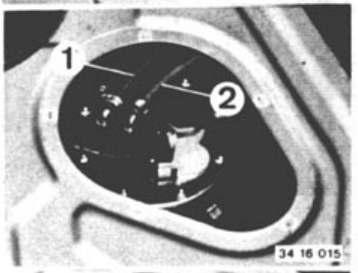
**) Sourcing Reference HWB



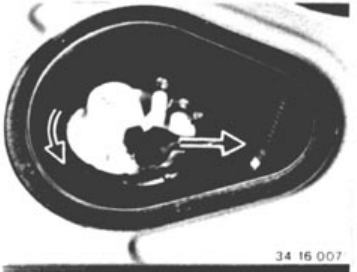
Unfasten hose clips.
Disconnect fuel hoses.

Note:
Mark fuel hoses.

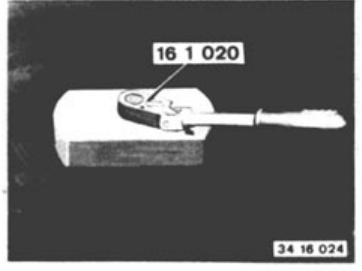
Installation instructions:
Only use new hose clips.
Check fuel hoses for condition and any leaks; replace if necessary.
Also see Service Information, Gr. 16.



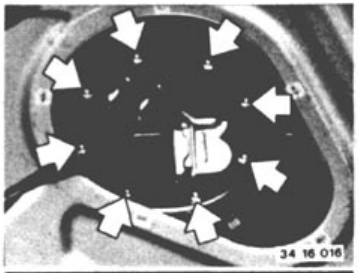
M5:
Remove inlet lead (1)
return lead (2).



Unfasten union nut with special tool No. 16 1 020.
Installation instruction:
Replace sealing ring and union nut.



Special tool No. 16 1 020



M 5:
Unscrew nuts.



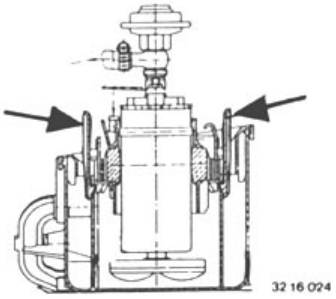
Pull out fuel level sender.



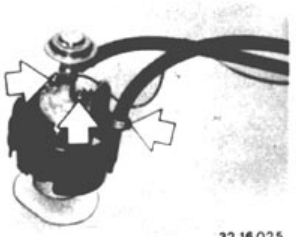
Installation:
Replace seal.



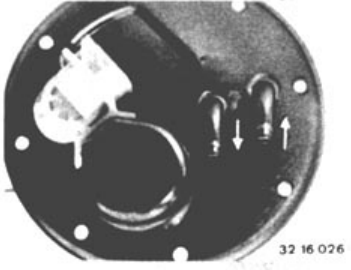
Drain gasoline or wear acid-proof gloves.
Compress retaining hooks and pull out fuel pump upward.



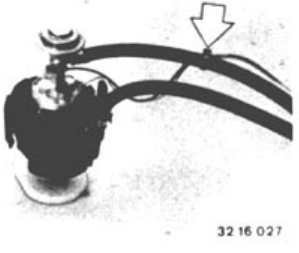
Installation:
Check for correct fit of retaining hooks.



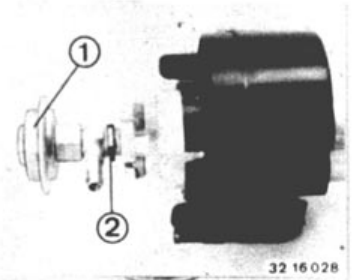
Unscrew screws.
Pull off hoses and electric leads.



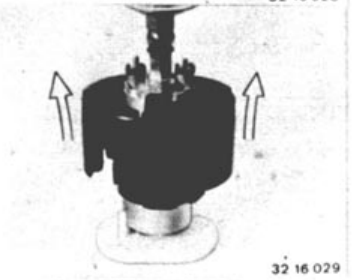
Installation:
Feed and return hoses are marked.



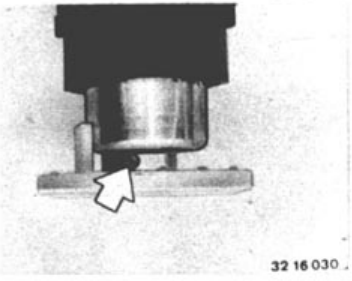
Installation:
Secure electric leads on a fuel hose with a strap at about the middle.



Unscrew screws.
Remove pressure damper (1) and check valve (2).



Pull off pump holder.



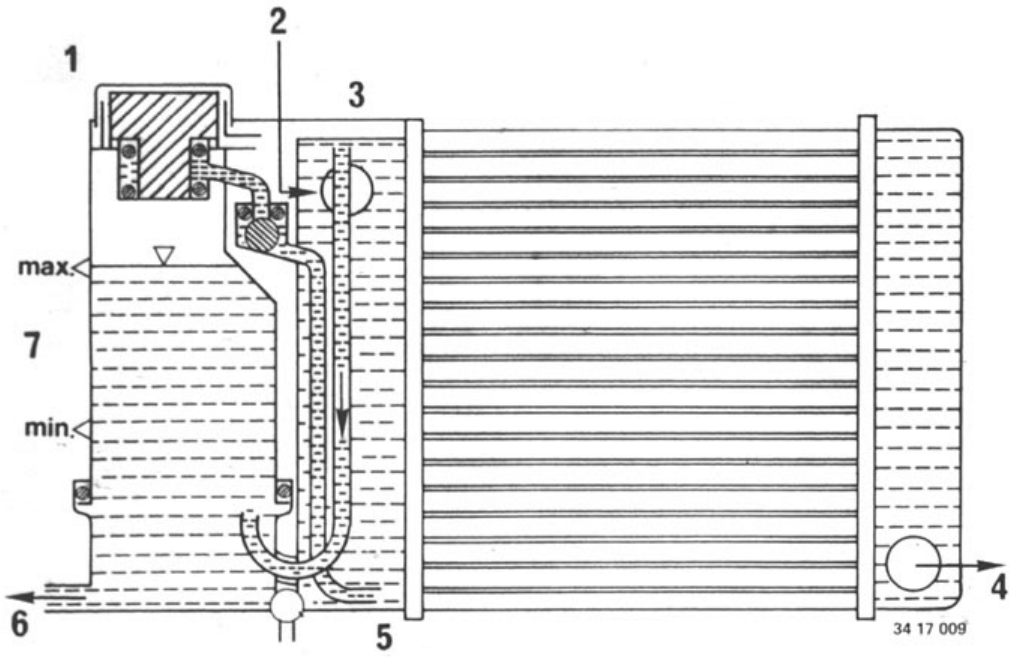
Unscrew screw.
Lift out fuel filter screen.

17 Cooling

	Partial flow cooling circuit M20 / M40 / M50	17- 00/1
	Coolant circuit M20 (with independent heating)	17- 00/2
	Coolant circuit 6-cylinder M30 / M21, M5	17- 00/3
	Coolant circuit M50 / M51	17- 00/4
17 00 005	Coolant – drain and fill	17- 00/4a
009	Cooling system – check for leaks	17- 00/5
010	Check for leaks between cooling system and combustion chamber	17- 00/5
039	Cooling system – bleed and check for leaks	17- 00/6
17 11 000	Radiator – remove and install	17- 11/1
100	Coolant expansion tank – remove and install	17- 11/3
100	Expansion tank M20 / M40 / M50 – remove and install	17- 11/4
100	Coolant expansion tank – remove and install	17- 11/5
509	Radiator – flush	17- 11/6
000	Radiator M51 – remove and install	17- 11/31
150	Oil cooler (for engine oil) – remove and install or replace	17- 11/33
	M51 with intercooler	17- 11/33
	M51 without intercooler	17- 11/33
17 21 000	Oil cooler (automatic transmission) – remove and install or replace	17- 21/1
17 30 000	Radiator shutters – remove and install or replace	17- 30/31
17 32 000	Vacuum box for radiator shutters – replace	17- 32/31
17 40 000	Auxiliary fan, complete – remove and install	17- 40/1
000	Auxiliary fan (M51), complete – remove and install	17- 40/31
17 51 000	Intercooler – remove and install or replace	17- 51/31

BYPASS COOLING CIRCUIT (M20/M40/M50)

1 Cap with pressure and vacuum valves
2 Front engine
3 Vent pipe
4 To thermostat
5 Control pipe
6 To water pump
7 Level mark



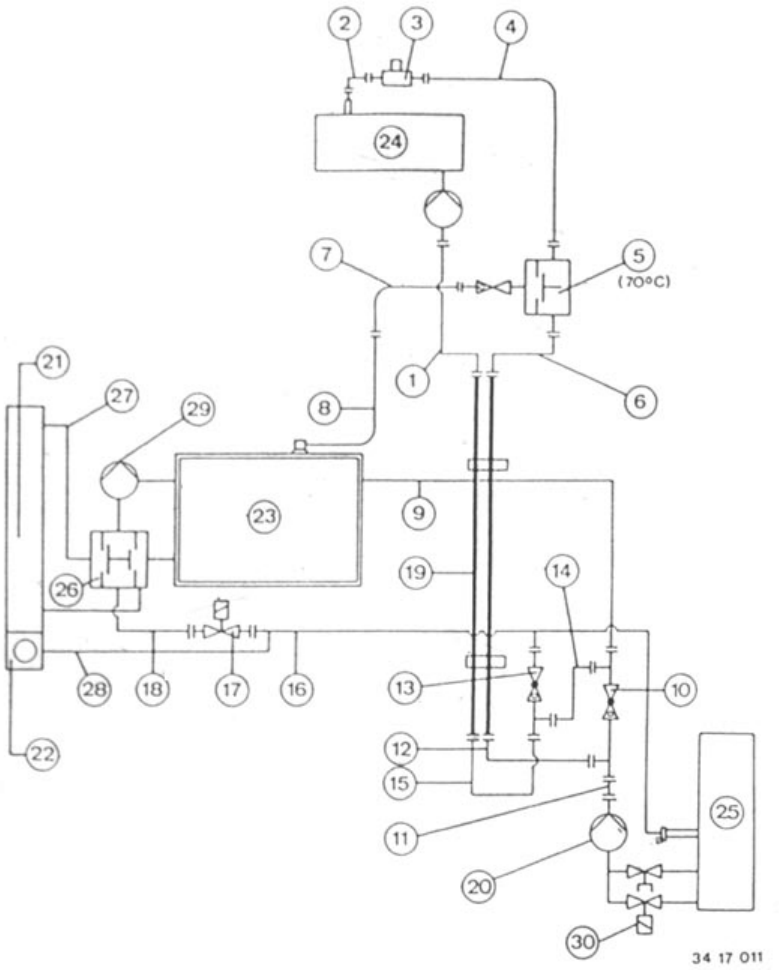
The bypass principle is applied in order to have good air exclusion in the cooling circuit. Use of a cross-flow radiator permits integration of the bypass expansion tank on the side of the radiator. The tank is designed two-piece in order to have sufficient tank volume. This version permits use of transparent plastic in the area of level marks.

The vent pipe 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 pipe by radiator feed pressure.

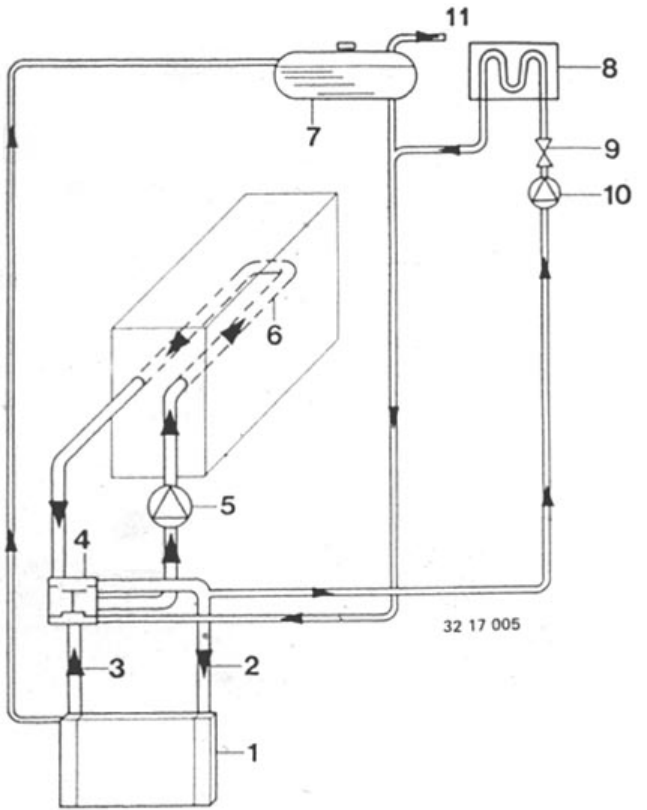
The cooling system is protected against excessive operating pressure by registering the radiator feed pressure. Pressure protection takes place at approximately the amount of the radiator operating pressure during the after-heating phase. This improves the operating safety of the cooling system and the boiling-over safety while after-heating.

COOLANT CIRCUIT – M 20
(with Additional Heater)



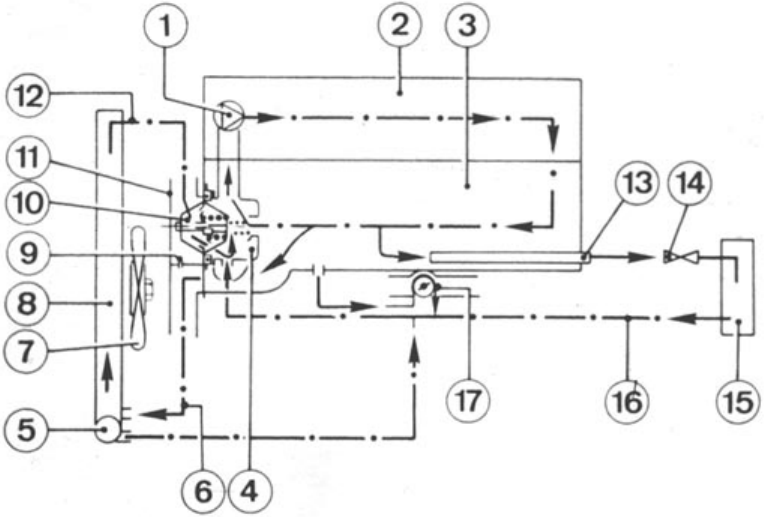
1 Molded hose 1
2 Molded hose 2
3 Bleeder
4 Molded hose 3
5 Thermostat with check valve
6 Molded hose 4
7 Coolant hose
8 Engine preheating pipe
9 Molded hose 7
10 Check valve
11 Molded hose 6
12 Molded hose 5
13 Check valve 5
14 Coolant hose
15 Molded hose 9
16 Connecting hose
17 Solenoid
18 Molded hose 8
19 Twin pipe
20 Only with air conditioner
21 Radiator
22 Expansion tank
23 Engine
24 Additional heater
25 Heat exchanger
26 Thermostat
27 Feed
28 Return
29 Water pump
30 Solenoids

COOLANT CIRCUIT FOR 6 CYLINDER M 30 / M 21 / M 5



1 Radiator
2 Return
3 Feed
4 Thermostat
5 Water pump
6 Engine block/cylinder head flow
7 Expansion tank
8 Heat exchanger
9 Solenoids/heater
10 Additional water pump
11 Spill pipe

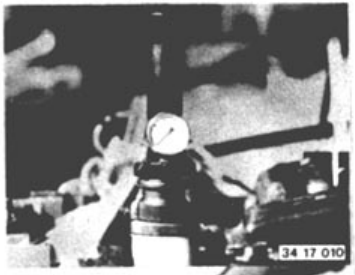
COOLANT CIRCUIT (M50 / M51)



1 Water pump
2 Crankcase
3 Cylinder head
4 Thermostat housing
5 Expansion tank
6 Radiator feed
7 Fan with visco coupling
8 Radiator
9 Vent bore
10 Thermostat
11 Thermostat cover
12 Radiator return
13 Heater feed
14 Heater valve
15 Heat exchanger
16 Heater return
17 Throttle valve heating

17 00 005 Drain off coolant and refill

Refer to Repair Manual, 3 Series E36



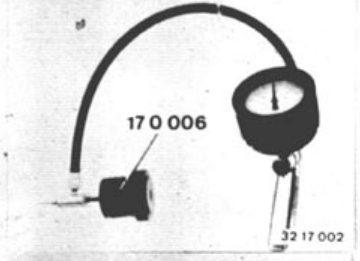
17 00 009 Checking cooling system for leaks

On the M 40/M 20/M 50, a check is carried out on the integrated expansion tank on the radiator using test device 17 0 002 in conjunction with adapter 17 0 005.



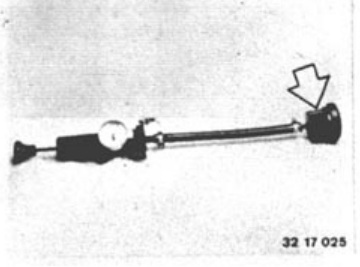
M 30/M 21/M 51

Fit test device 17 0 002 with adapter 17 0 005 on expansion tank and bring pressure up to 1 bar.
Cooling system does not leak if there is not a considerable pressure drop (max. 0.1 bar) after about 2 minutes.



Check cap.
A: Check pressure relief valve.

Screw cap (1) on special tool 17 0 006 and apply air pressure slowly. Pressure relief valve should open at about 2 bar.



Alternative:

Check connection for cooling system:

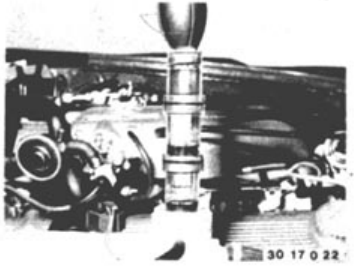
Use test device 17 0 002 in conjunction with adapter 17 0 006 and hose section 17 7 010 to check opening pressure * (pressure valve).

* Refer to Technical Data



Check vacuum valve:

Screw adapter onto test device 17 0 006 and slowly develop a vacuum using special tool 61 6 030 or the BMW SERVICE TESTER.
Vacuum valve opens at vacuum of approx. 0.1 bar.
Check gasket.
Gently raise vacuum valve, check that it is correctly seated and, if necessary, replace adapter.



17 00 010 Checking for leaks between cooling system and combustion chamber

"Tester for cylinder head" **.
Fill and perform test.
If there is a leak, the test fluid turns yellow due to the carbon monoxide (combustion gas) entering the combustion chamber (CO).

Note:
Follow manufacturer's operating instructions.

* Refer to Technical Data
** Source of Supply: BMW Parts service

17 00 039 Bleed cooling system and check for water leaks

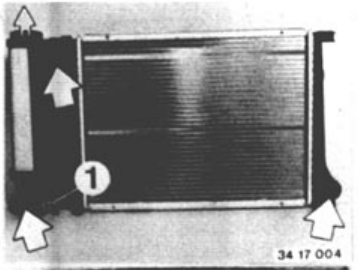
Refer to Repair Manual for 3 Series E36



17 11 000 REMOVING AND INSTALLING RADIATOR

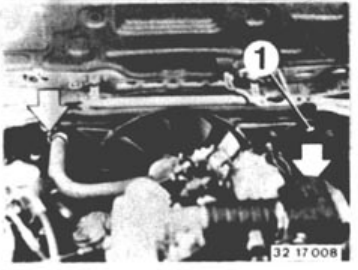
Unscrew cap on expansion tank.
Unscrew engine splash guard.
Loosen drain plug and drain, catch and dispose coolant*.

Installation:
Fill and bleed cooling system** – see 17 00 039.
Check cooling system for leaks – see 17 00 009.



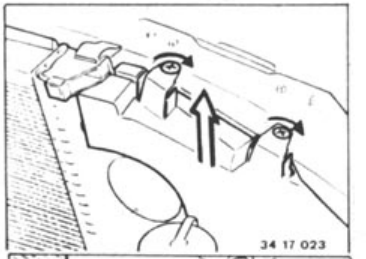
M 20 / M 50
Disconnect coolant hoses.
Tightening torque*.

1 = Drain plug

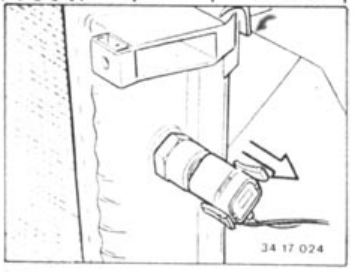


M 30 / M 21 / M 5
Disconnect spill pipe, upper and lower coolant hoses.
Tightening torque*.

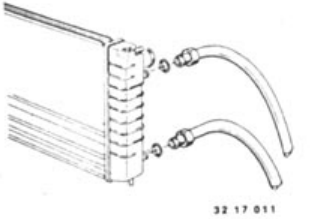
* See Specifications
** See Operating Fluids



Cars with Additional Fan:
Remove right headlight cover.



Pull off leads on temperature switch (1).

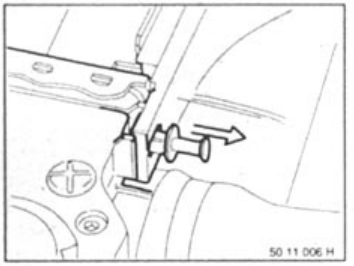


Cars with Automatic Transmission:
Unscrew transmission oil cooler pipes and plug with caps.

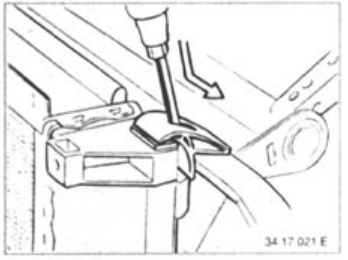
Installation:
Check ATF level, correcting if necessary.
Tightening torque*.

Important!
Catch oil.
Replace seals.

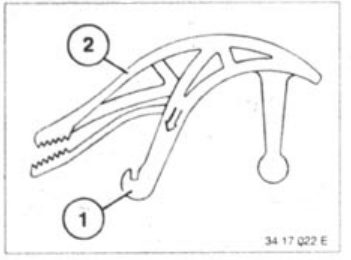
* See Specifications



Remove expanding rivets on left and right sides (pull backwards). Remove fan shroud from retaining tabs and slide backwards over the fan.



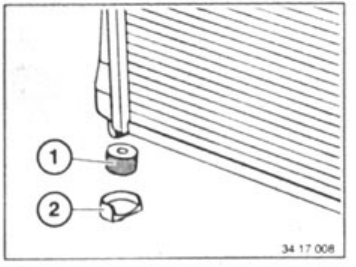
Remove top retaining clip from radiator. Press screwdriver downwards and swivel forwards, pulling radiator gently backwards at the same time.



Arrow = direction of pressure or pressure point with screwdriver

1 = Retaining hook

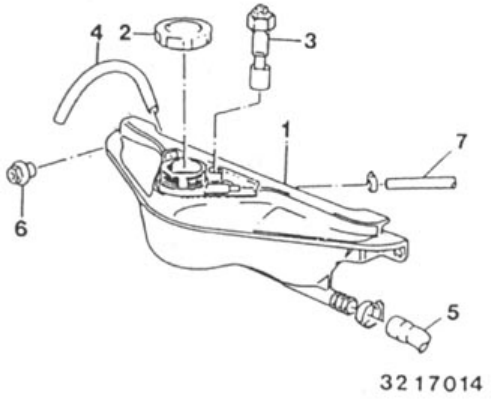
Installation:
Press down on top of clip (2), sliding radiator forwards at the same time.



Pull radiator upwards to remove.
Installation:
Place radiator on rubber mounts precisely.
Top up cooling system and bleed - 17 00 039.

1 = Rubber mount
2 = Bracket

17 11 100 Removing and Installing Coolant Expansion Tank



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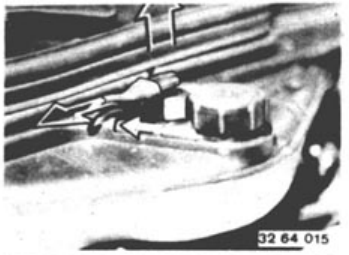
Important!
Unscrew expansion tank cap only when engine is cold. Catch coolant and dispose of correctly.
Remove and install/check level switch.

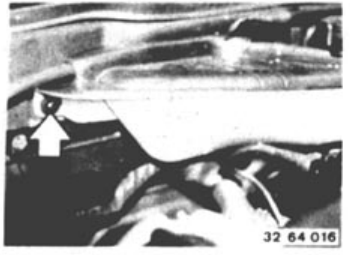
1 Expansion tank
2 Screw cap
3 Level switch
4 Vent line
5 Return line
6 Retaining nut
7 Inlet line

Installation:
Top up cooling system*, bleed and check for leaks, refer to 17 00 039.

* Refer to Technical Data



Remove plug and overflow hose.



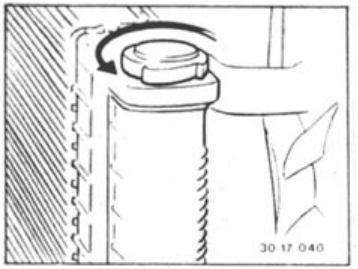
Remove inlet and return hoses.
Unfasten nuts on left and right sides of expansion tank and remove container.

Remove and install level switch (check with Diagnosis Tester).

Select Check.Control with 03.
200 Status List/Check Control status query/ coolant level
Electr. troubleshooting: refer to Gr. 62.
Tightening torque*.

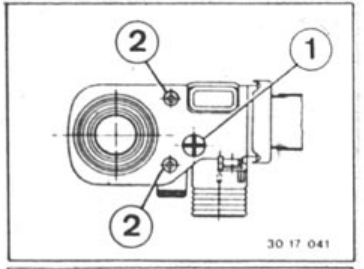
Level switch (manual check)
level switch removed, actuate float by hand, use multimeter to measure throughput.
Float at top => continuity => O.K.
Float at bottom => no continuity => O.K.

* Refer to Technical Data

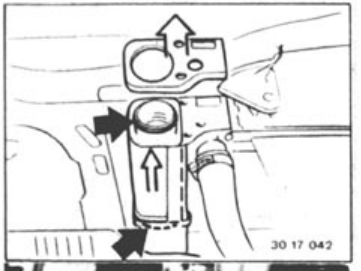


17 11 100 Removing and installing expansion tank M 20/M 40/M50.

Caution!
Unscrew expansion tank cap only when engine is cold. Drain, catch and dispose of coolant.



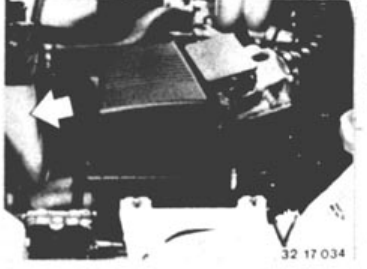
Loosen bleeder screw (1).
Remove mounting screws (2) and take off upper section.



Pull out expansion tank upwards.

Installation:
Replace seals.

Fill with specified coolant **, bleed (see 17 00 039).

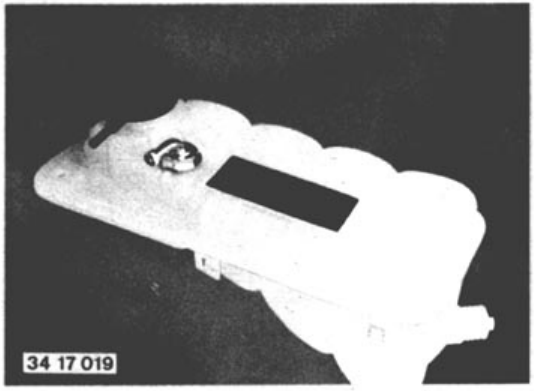


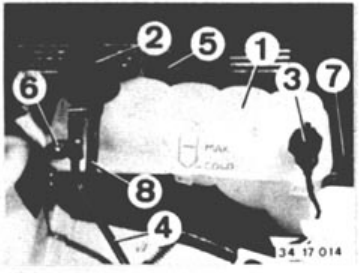
Container marks indicate fluid level at approx. 20° C.

Installation:
Top up cooling system*, bleed and check for leaks, refer to 17 00 039.

** Refer to Operating Fluids Specification

17 11 100 REMOVING AND INSTALLING COOLANT EXPANSION TANK (M 5)





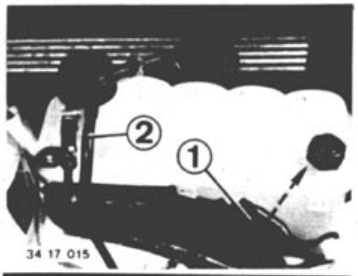
Caution!
Only unscrew cap when engine is cold.

Drain and dispose coolant.
Remove and check level switch.

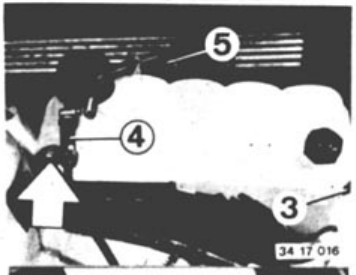
1 Expansion tank
2 Cap
3 Level switch
4 Bleeder hose
5 Return hose
6 Mounting screw
7 Feed hose
8 Spill hose

Installation:
Fill*, bleed and check cooling system for leaks – see 17-00/4.

* See Operating Fluids



Pull off plug (1) and spill hose (2).



Disconnect feed hose (3), bleeder hose (4) and return hose (5).
Unscrew screw on expansion tank and take out tank.



Remove and check (see BMW Diagnosing System) level switch.

Manual Test:
Remove level switch.
Operate float by hand and measure power flow with a multimeter.

Specifications:
Float up = power flow
Float down = no power flow

17 11 509 Flushing radiator

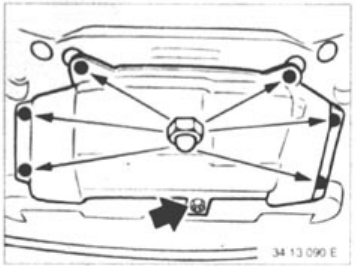
If oil has penetrated into the coolant circuit, the radiator and expansion tank will have to be flushed and cleaned with Solvethane**.

Procedures:

1. Remove radiator and expansion tank, refer to 17 11 000/100.
2. Fill with approx. 2 litres of Solvethane
3. Shake radiator and expansion tank thoroughly, then drain once the oil has separated.
4. Install cleaned cooler and expansion tank and connect to circuit.
5. Fill the entire circuit with hot water. Flush the circuit thoroughly by renewing the water as many times as required to ensure that any remaining cleaning residues are removed.
6. Check drained coolant for remaining oil. Repeat, if necessary.
   After the cleaning procedure, fill the coolant circuit with coolant * and bleed the system - 17 00 039.

Note:
Solvethane attacks rubber seals, hoses, etc. and consequently must not be permitted to enter or remain in the cooling system. Always conform with safety measures for the handling of Solvethane (printed on cans).

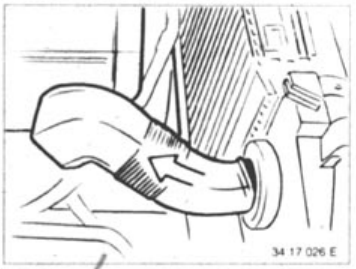
* Refer to Operating Fluids Specification, Gr. 17
** Source of Supply: BMW Parts service



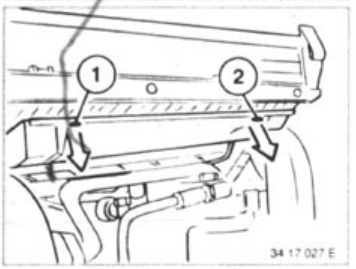
17 11 000 Removing and installing radiator M51

Unscrew cap from expansion tank.
Unscrew and remove splash guard.
Open drain screw and drain off coolant *, collect and dispose of correctly.

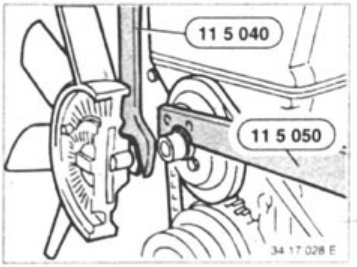
Installation:
Fill cooling system** and bleed, refer to 17 00 039.
Check cooling system for leaks, refer to 17 00 009.



Remove gaiter from suction filter.



Remove expanding rivets (1 and 2) by pulling backwards, pull fan shroud upwards and detach.



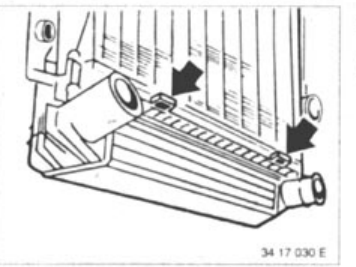
Remove fan, bracing with special tool 11 5 050 against pulley wheel.

Caution!
Left-hand threads. To loosen union nut from fan, turn clockwise (i.e. to right).

* Refer to Technical Data
** Refer to Operating Fluids Specification

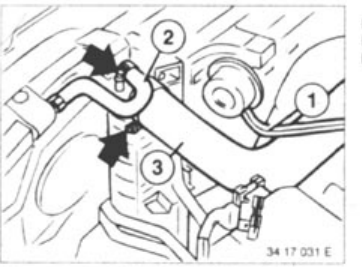


Installation:
Tighten fan with special tool 11 5 040.
40 Nm tightening torque is equal to 30 Nm on scale of torque wrench.

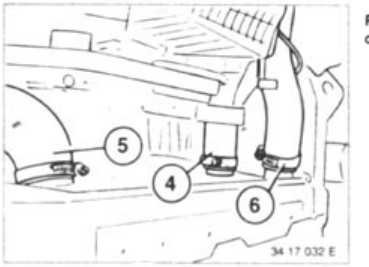


Remove fan together with fan shroud.

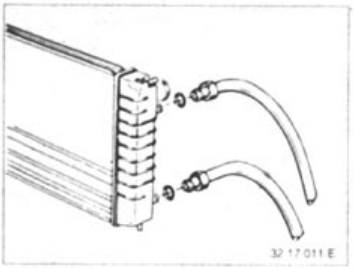
Installation:
Attach fan shroud correctly.



Remove vacuum hose.
Remove overflow hose (2) and upper coolant hose (3).



Remove lower coolant hose (4) and both intercooler hoses (5 and 6).



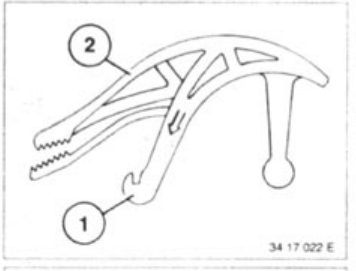
Models with Automatic Transmission:
Unscrew transmission oil cooler lines and seal with sealing plugs.

Installation:
Check transmission oil level and top up if necessary, tightening torque*

Caution!
Collect oil as it escapes.
Replace seals.



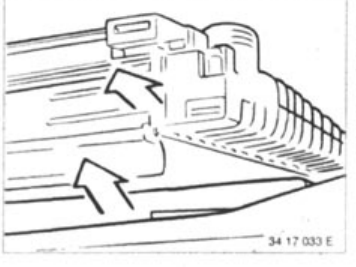
Remove retaining clip from top of radiator.
Press screwdriver downwards and push forwards, pulling radiator gently backwards when doing so.



Arrow = direction of pressure of pressure point with screwdriver

1 = Retaining hook

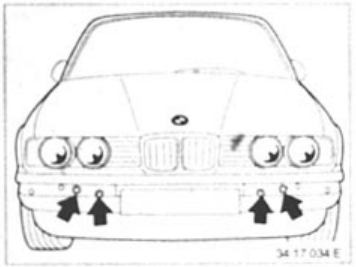
Installation:
Press down on top of clip (2), sliding radiator forwards while doing so.



Slightly raise radiator and remove intercooler by pulling backwards.
Remove radiator and intercooler by pulling upwards.

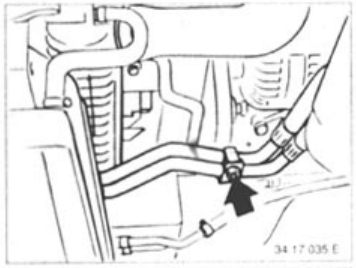
Installation:
Position radiator precisely on rubber mounts.
Top up cooling system and bleed - 17 00 039.

* Refer to Technical Data

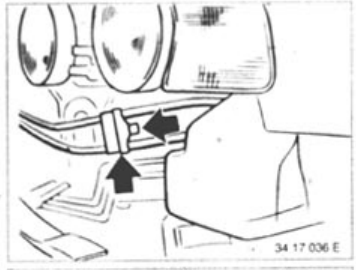


17 11 150 Removing and installing or replacing oil cooler (for engine oil)

M51 with intercooler
Remove front bumper and center radiator grill (BMW kidney grille), refer to Gr. 51.



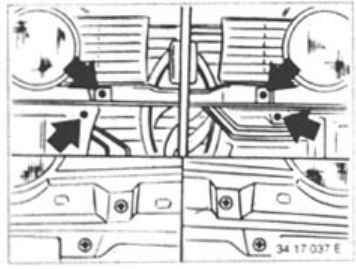
Unfasten bracket for engine oil lines on engine mount.



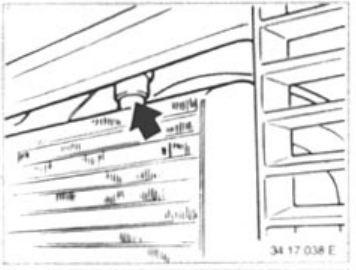
Disconnect link between oil cooler lines and engine.

Caution!
Catch escaping engine oil. Do not allow it to fall on the splash guard.

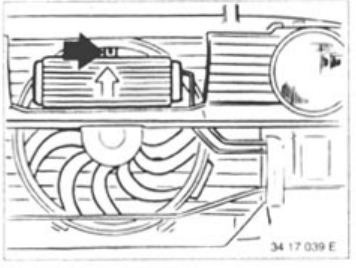
Installation:
Check and correct engine oil level.



Unfasten bracket for engine oil cooler.

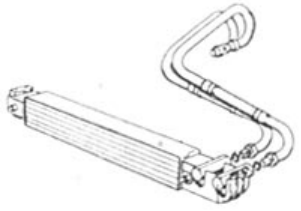


Unfasten retaining nut.

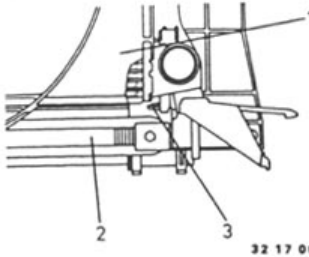


Lift engine oil cooler out of rubber mount and remove.

Caution!
Catch oil as it escapes.



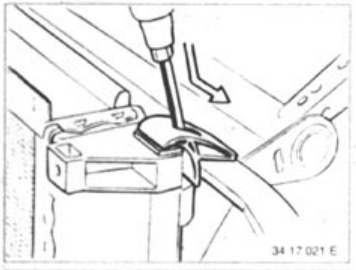
M51 without intercooler
Unscrew oil lines,
Note:
Catch oil.
Installation:
Replace gaskets.
Top up engine oil.



1 = Radiator
2 = Oil cooler
3 = Retaining clip
Open out clip 3 and lift out engine oil cooler on left side.

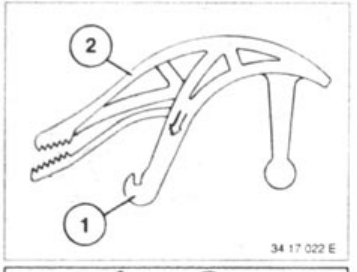
17 21 000 Removing and installing or replacing oil cooler (automatic transmission)

For vehicles with integrated transmission oil cooler in the water cooler, refer to 17 11 000.
On the M51 engine without intercooler, the transmission oil cooler is identical to the one in the M51 engine with intercooler.
Removal: refer to 17 11 150.



Vehicles with external transmission oil cooler:
Remove complete front bumper, refer to 51 11 000.

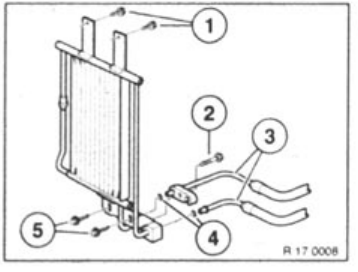
Remove retaining clip from top of radiator. Press screwdriver downwards and swivel forwards, pressing radiator slightly downwards at the same time.



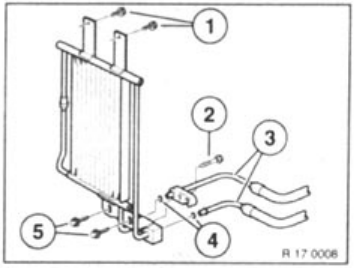
The arrow indicates the direction of pressure and the pressure point of the screwdriver.

1 Retaining hook

Installation:
Press top of bracket (2) down, sliding radiator forwards at the same time.

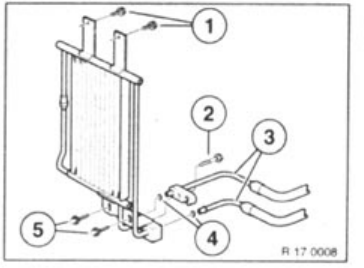


Push radiator towards engine and unfasten oil cooler screws (1).

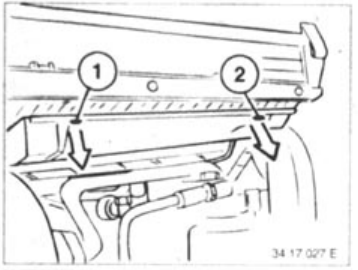


Unfasten screw (2) and remove oil lines (3). Catch oil and dispose of it correctly.

Installation:
Check O-rings (4) and replace if necessary. Measure and top up oil in automatic transmission.

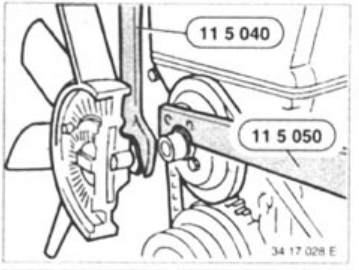


Unfasten screws (5) and lift oil cooler out from bottom.



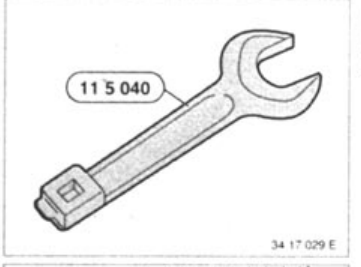
17 30 000 REMOVING AND INSTALLING OR REPLACING RADIATOR SHUTTERS

Pull expansion rivets (1 and 2) out towards rear.
Pull fan cowl upwards and disconnect.

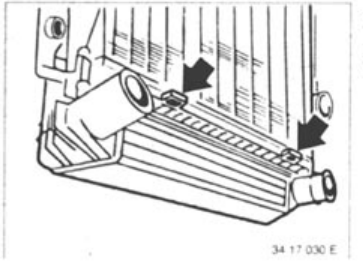


Remove fan, while counterholding on pulley with Special Tool 11 5 050.

Important!
Left-hand threads — turn coupling nut on fan clockwise to loosen.

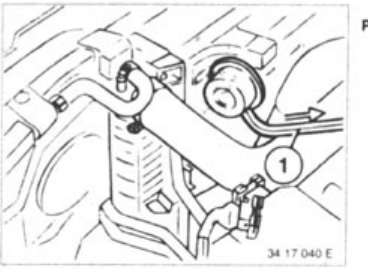


Installation:
Tighten fan using Special Tool 11 5 040.
40 Nm tightening torque is equal to 30 Nm on scale of torque wrench.

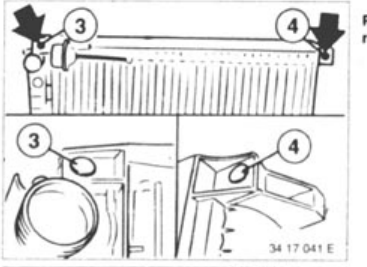


Remove fan together with fan cowl.

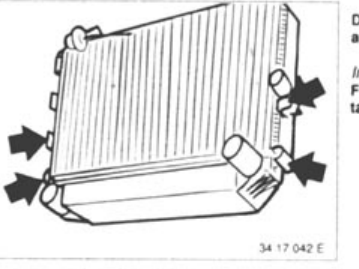
Installation:
Attach fan cowl correctly.



Pull vacuum hose (1) off.

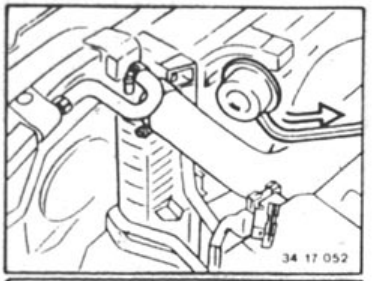


Pull expansion rivets (3 and 4) off of radiator shutters.



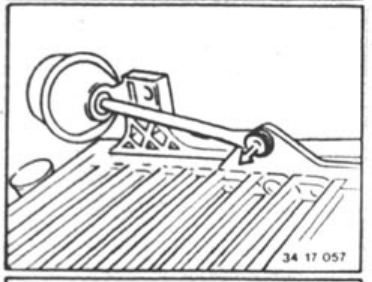
Disconnect radiator shutters by pulling up and remove.

Installation:
First attach radiator shutters at all four tabs.

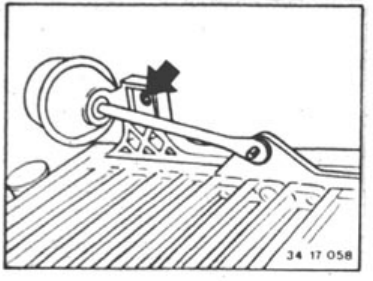


17 32 000 REPLACING VACUUM CONTROL BOX FOR RADIATOR SHUTTERS

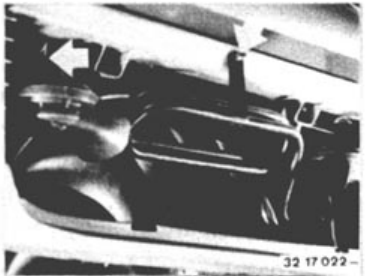
Pull vacuum hose off.



Press toothed retainer off.

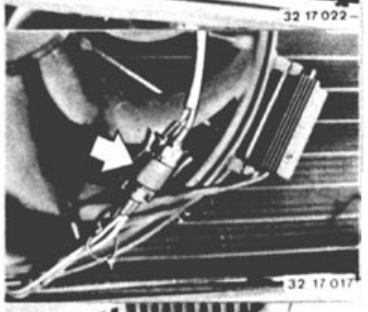


Pull expansion rivet out and remove vacuum control box.

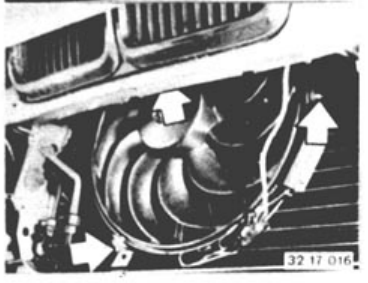


17 40 000 REMOVING AND INSTALLING ADDITIONAL FAN ASSY.

Remove front bumper and center radiator grill section (BMW kidney) – see Gr. 51.
Disconnect cooling coil and unscrew right two-tone horn.
Note:
Remove right headlight grill to improve the accessability.

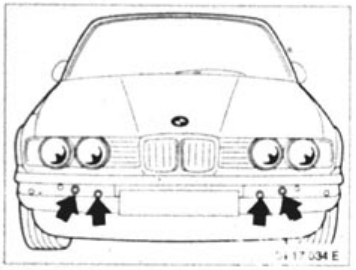


Disconnect plug.



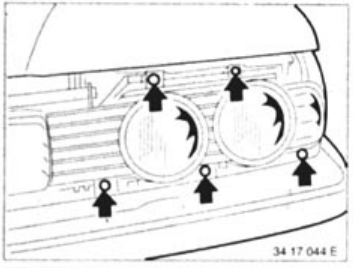
Unscrew fan console bolts.
Lift out additional fan downward.

Testing:
Check power consumption and speed – see Specifications of Group 17.

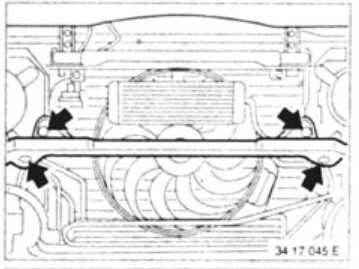


17 40 000 REMOVING AND INSTALLING COMPLETE ADDITIONAL FAN

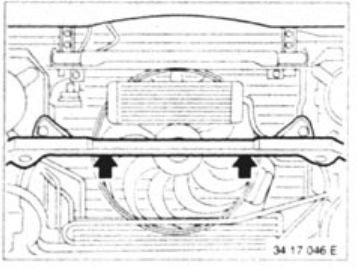
Remove front bumper and middle grill section (BMW kidney) - refer to Gr. 51.



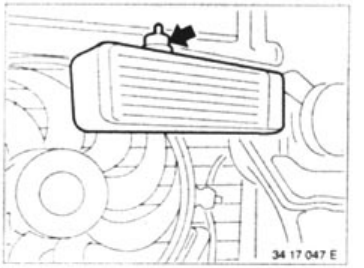
Unscrew and remove left and right headlight grills.



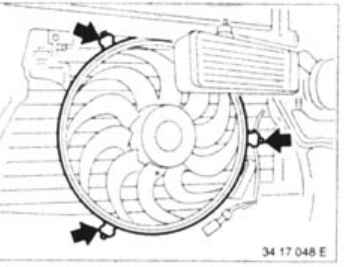
Unscrew oil cooler console at left and right sides.



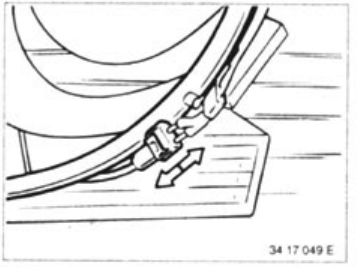
Loosen cable straps.



Unscrew engine oil cooler.

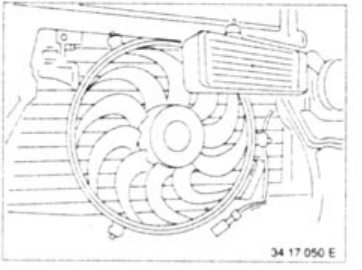


Unscrew fan console bolts.

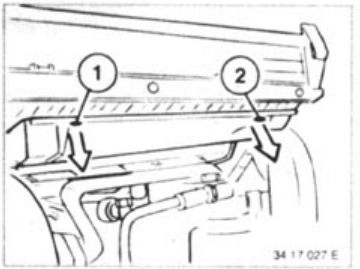


Disconnect plug

Note:
Unscrew ballast resistor when replacing fan.

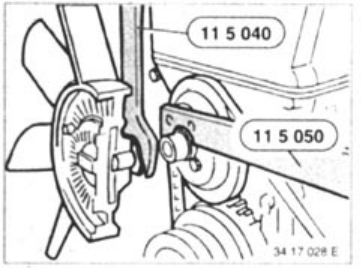


Lift fan console out together with fan.



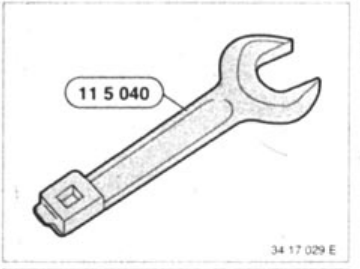
17 51 000 REMOVING AND INSTALLING OR REPLACING CHARGE AIR COOLER

Pull expansion rivets (1 and 2) out towards rear.
Pull fan cowl upwards and disconnect.

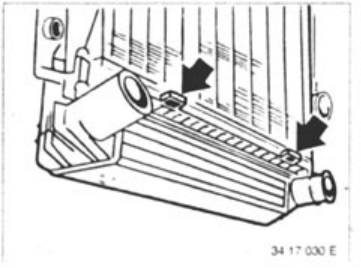


Remove fan, while counterholding on pulley with Special Tool 11 5 050.

Important!
Left-hand threads — turn coupling nut on fan clockwise to loosen.



Installation:
Tighten fan using Special Tool 11 5 040.
40 Nm tightening torque is equal to 30 Nm on scale of torque wrench.

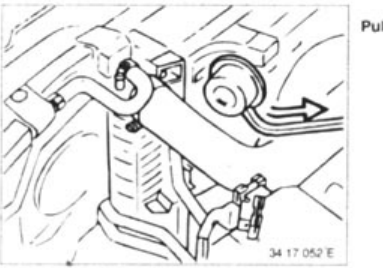


Remove fan together with fan cowl.

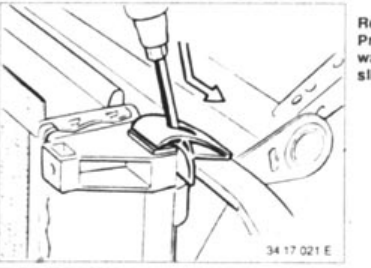
Installation:
Attach fan cowl correctly.



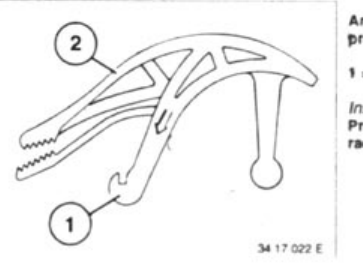
Unscrew engine splash guard at front.
Disconnect left and right charge air cooler hoses.



Pull vacuum hose off.



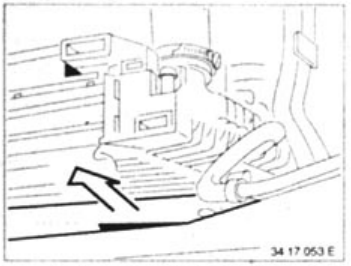
Remove clips from top of radiator.
Press screwdriver down and swing it forward, while pulling the radiator back slightly.



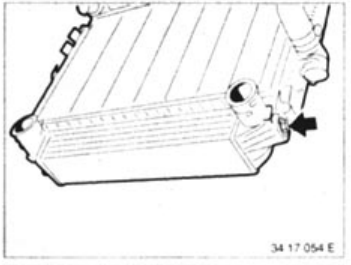
Arrow = direction of pressure or point of pressure with screwdriver.

1 = Securing hook

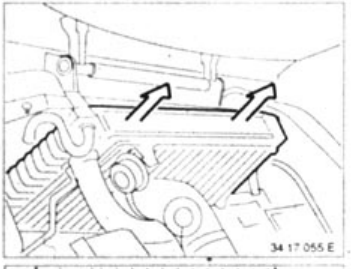
Installation:
Press on clip top (2), while pushing the radiator forward.



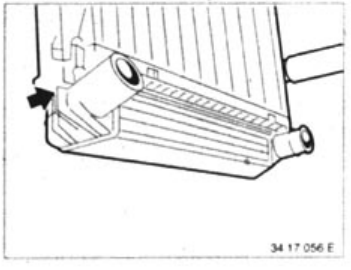
Pull radiator back at bottom.



Unscrew right bolt.



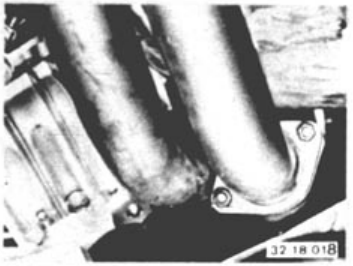
Lift radiator as far as possible (with connected coolant hoses).



Disconnect charge air cooler on left side and pull out underneath radiator.

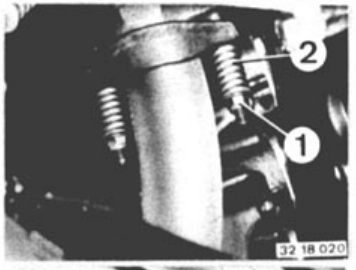
18 Exhaust system

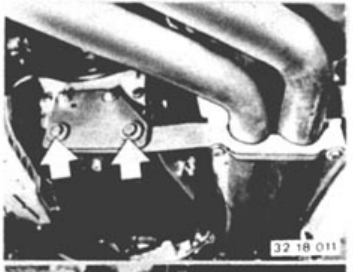
18 00 020	Complete exhaust system (M30) – remove and install	18-00/1
020	Complete exhaust system (M5) – remove and install	18-00/2
	Layout of exhaust system	18-00/4
	Version with catalytic converter (M51)	18-00/4
	Layout of exhaust system	18-00/5
	Arrangement without catalytic converter (M51)	18-00/5
020	Complete exhaust system (M51) – remove and install	18-00/6
020	Complete exhaust system (M40) – remove and install	18-00/8
18 12 012	Muffler assembly (intermediate and rear muffler) (M30) – replace	18-12/1
041	Front muffler (M30) – replace	18-12/1
. . .	Exhaust system (M51) – disassemble	18-12/2
031	Rear muffler (M51) – replace	18-12/3
040	Front muffler (M51) – replace	18-12/3
031	Rear muffler (M50) – replace	18-12/4
18 32 005	Catalytic converter (M30) – remove and install or replace	18-32/1
005	Catalytic converter (M5) – remove and install or replace	18-32/2



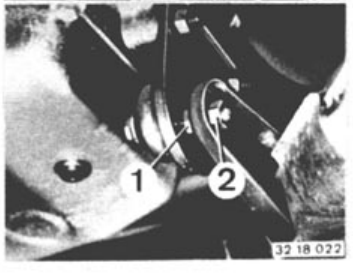
18 00 020 REMOVING AND INSTALLING EXHAUST ASSEMBLY

BMW 530 i and 535 i:
Unscrew both exhaust pipes on exhaust manifold.
Installation:
Replace self-locking nuts.
Lubricate taper of flange with copper paste CRC**.
Flatten springs (2) uniformly by tightening nuts (1) with a torque of 10 Nm (7 ft. lbs.).
Then loosen nuts (1) again by one and one half turns.
Flanges must be parallel to each other, or springs must not be pressed flat.
The pipe with compensator must be tightened last due to the danger of tension.



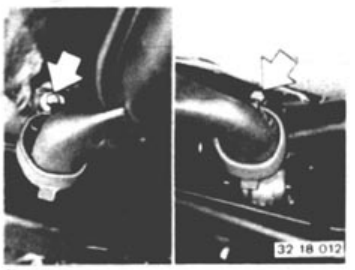


Unscrew exhaust carrier on transmission.
Installation:
Mount carrier without tension.
Tightening torque = 22 Nm (16 ft. lbs.).
Disconnect oxygen sensor plug in cars with catalytic converter – see 18 32 605.

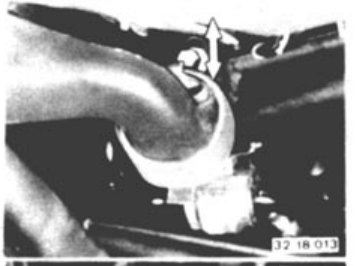


Cars with Automatic Transmission:
Unscrew nut (2).
Installation:
Mount exhaust carrier without tension by adjusting nut (1).

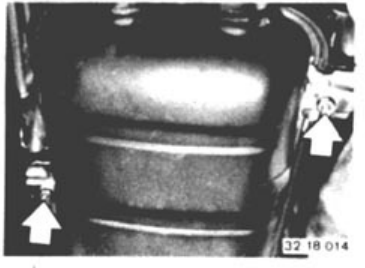
** Source of Supply: HWB



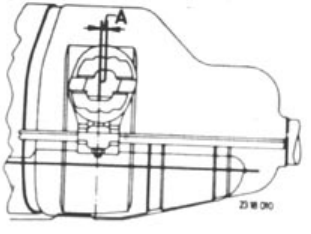
Unscrew holders for suspension on rear axle carrier.



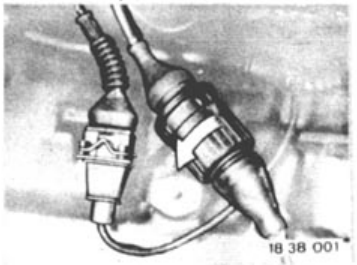
Installation:
Adjust and bolt down holders by moving the tabs on the exhaust only after complete installation of the exhaust assembly.
Tightening torque = 22 Nm (16 ft. lbs.).



Unscrew retainers.
Remove entire exhaust assembly.

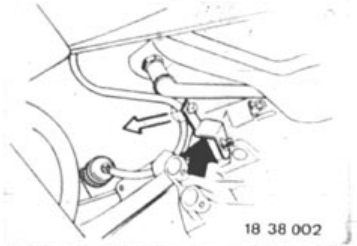


Installation:
Mount retainers in such a manner that rubber rings are pre-loaded.
Preload A = 7 mm (0.275").
Tightening torque = 22 Nm (16 ft. lbs.).

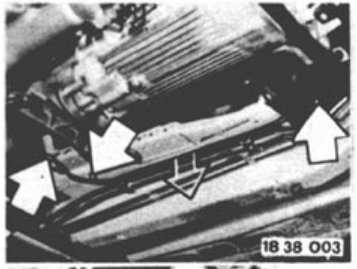


18 00 020 REMOVING AND INSTALLING EXHAUST ASSEMBLY (M 5)

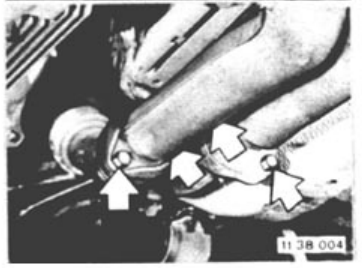
Disconnect plug for oxygen sensor (bayonet retainer).



Unclip electric leads in holder on the transmission.



Remove cover.
Disconnect electric leads.



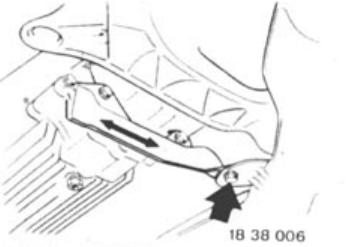
Unscrew both exhaust pipes on the exhaust manifolds.

Installation:
Tightening torque = 42 Nm (30 ft. lbs.).



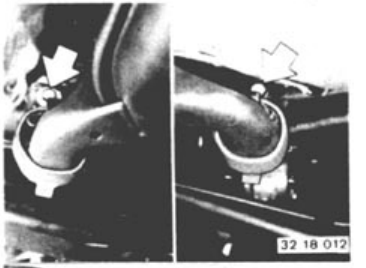
Installation:
Check gaskets, replacing if necessary.

Note:
New gaskets have a self-adhesive coat to make installation easier. Pull off plastic sheet. Install gasket with the adhesive surface facing the manifold.

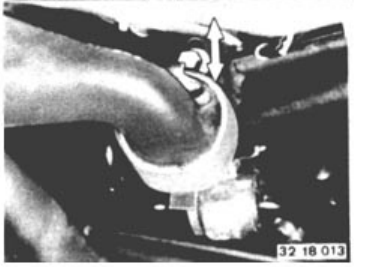


Unscrew exhaust support on the transmission.

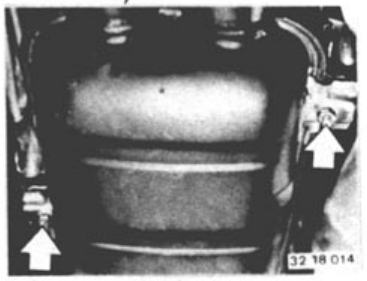
Installation:
Mount exhaust support without tension. Loosen bolts on the transmission if necessary.



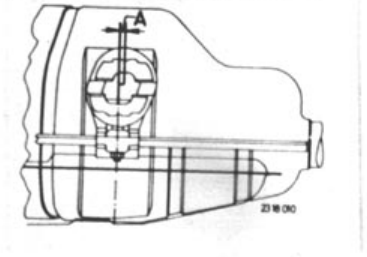
Unscrew holder for exhaust suspension on the rear axle carrier.



Installation:
Adjust holder after installation of the complete exhaust assembly by moving the tabs on the exhaust and then bolt down with a tightening torque of 22 Nm (16 ft. lbs.).



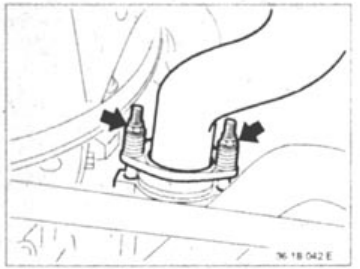
Unscrew retainers.
Remove complete exhaust assembly.



Installation:
Mount retainers in such a manner that the rubber rings are preloaded.
Preload distance A = 5 mm (0.197").
Tightening torque = 22 Nm (16 ft. lbs.).

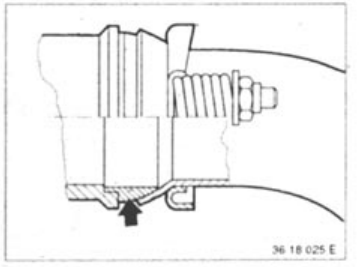
EXHAUST SYSTEM LAYOUT DRAWING (Version With Catalytic Converter)

EXHAUST SYSTEM LAYOUT DRAWING (Version Without Catalytic Converter)

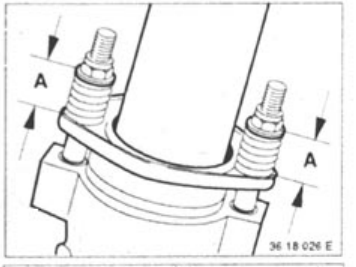


18 00 020 REMOVING AND INSTALLING EXHAUST ASSEMBLY
- Engine M51 -

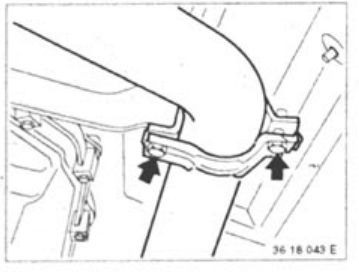
Unscrew exhaust pipe from turbocharger.



Installation:
Check seal, replacing if necessary.
Check installed position.

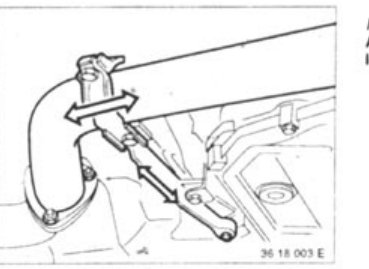


Installation:
Lubricate seal and threads with copper paste CRC**.
Replace self-locking nuts.
Tighten nuts until the coil springs are compressed to distance A = 27 ± 1 mm.
Flanges must be parallel to each other and springs must not be compressed flat.

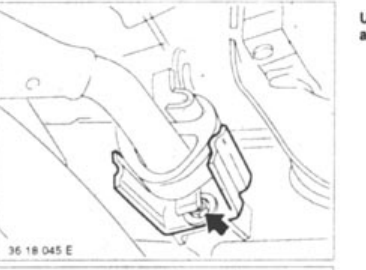


Unscrew exhaust pipe from transmission bracket.

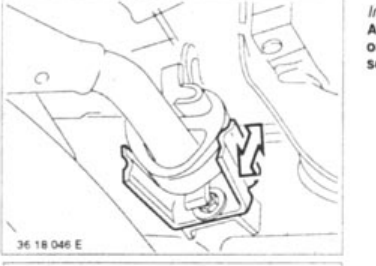
** Source of Supply: BMW Parts



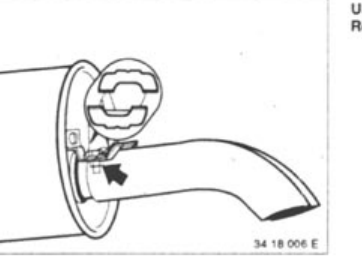
Installation:
Align support to be without tension after installation of the entire exhaust assembly.



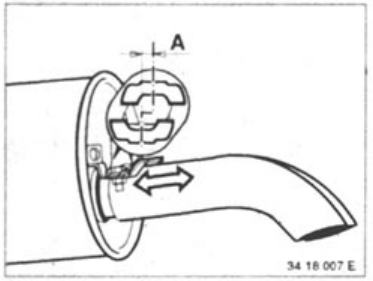
Unscrew bracket for suspension from rear axle carrier.



Installation:
Align (by moving) and tighten the bracket only after installation of the exhaust assembly has been completed.

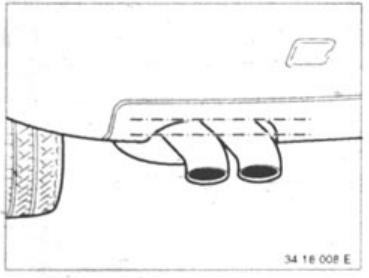


Unscrew bracket.
Remove exhaust assembly.



Installation:
Mount the bracket in such a manner that the rubber ring is preloaded in forward direction by distance A.

A = 12 mm.

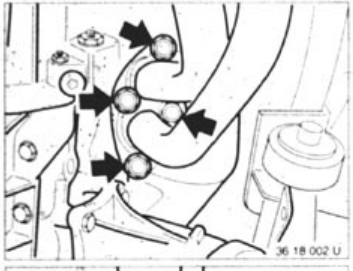


Installation:
Check position of tailpie in body opening. If necessary loosen flange connection and rubber suspension rings and align the exhaust assembly.

18 00 020 Removing and installing complete exhaust system (M40)

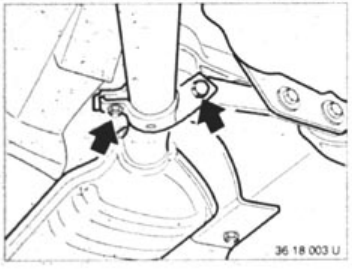


Disconnect plug for oxygen sensor.
Unclip wires in holder.



Unfasten baffle plate.
Unscrew exhaust pipes on manifold.

Installation:
Check gasket, replace if necessary.
Replace self-locking nuts.
Coat threads with copper paste CRC**.

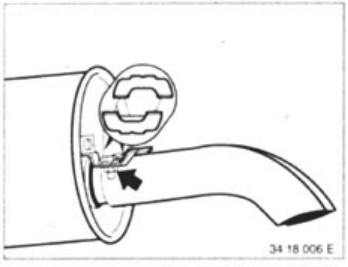


Unscrew exhaust pipe on transmission holder.

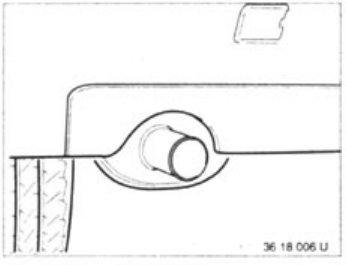
Installation:
Bolt holder free of tension after finishing installation of complete exhaust assembly.

* Source of Supply: BMW Parts service

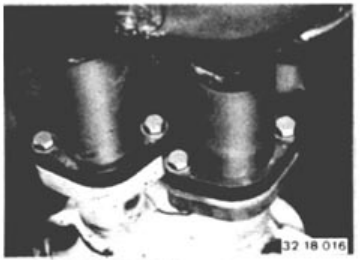
Disconnect rubber ring on rear axle carrier.
Unfasten rear suspension.
Remove exhaust assembly.



Installation:
Preload rubber mount in direction of travel up to end of long bore.

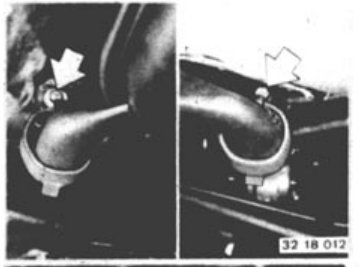


Installation:
Check position of tailpipe to body opening.
If necessary, loosen flange connection and rubber suspension rings and align exhaust assembly.

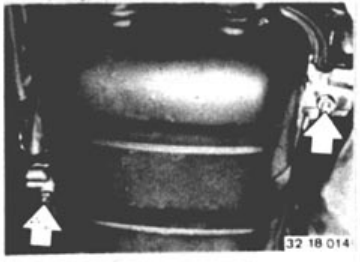


18 12 012 REPLACING MUFFLER ASSY. (INTERMEDIATE AND FINAL MUFFLERS)

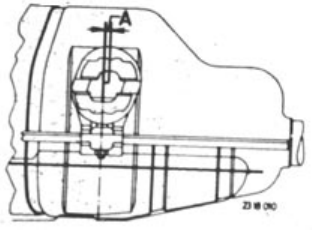
Unscrew muffler assembly on flanges.
Installation:
Check gaskets, replacing if necessary.
Replace self-locking nuts.
Tightening torque = 22 Nm (16 ft. lbs.).



Unscrew holders for suspension on rear axle carrier.
Installation:
Adjust holders on tabs of exhaust only after installation of the muffler assembly and bolt down.
Tightening torque = 22 Nm (16 ft. lbs.).



Unscrew retainers.
Remove muffler assembly towards rear.

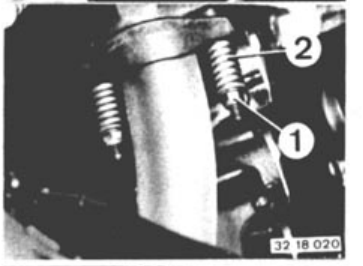


Installation:
Mount retainers in such a manner that the rubber rings are pre-loaded.
Preload A = 7 mm (0.275").
Tightening torque = 22 Nm (16 ft. lbs.).

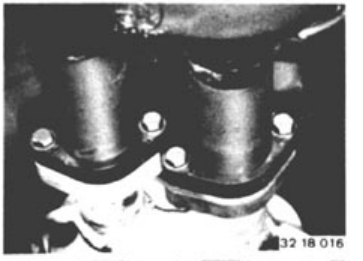


18 12 041 REPLACING PRIMARY MUFFLER

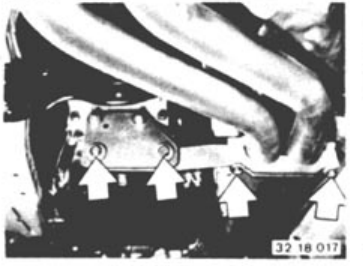
Unscrew exhaust pipe on exhaust manifold and exhaust pipe on flange.
Installation:
Replace self-locking nuts.



Installation:
Lubricate tapers on flanges with copper paste CRC**.
Flatten springs (2) uniformly by tightening nuts (1) with torque of 10 Nm (7 ft. lbs.).
Loosen nuts (1) again afterwards by one and one half turns.
Flanges must be parallel to each other or springs must not be pressed flat.
Tighten pipe with compensator last due to the danger of tensioning.

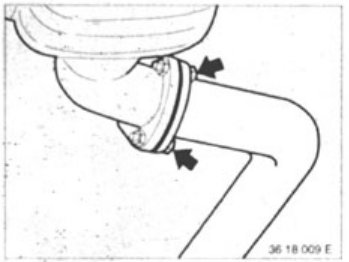


Unscrew primary muffler on flanges.
Installation:
Replace self-locking nuts.
Tightening torque = 22 Nm (16 ft. lbs.).



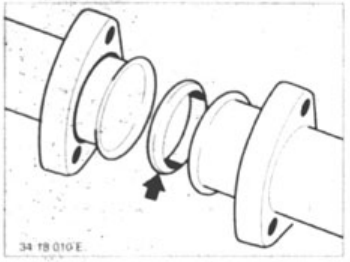
Unscrew exhaust carrier on transmission and exhaust assembly.
Installation:
Mount carrier without tension.
Tightening torque = 22 Nm (16 ft. lbs.).

** Source of Supply: HWB

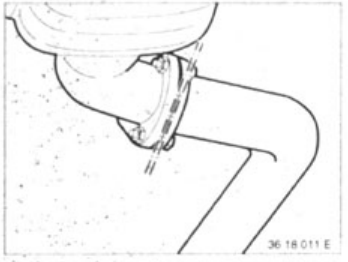


18 12 ... Disassembling exhaust system (M51)

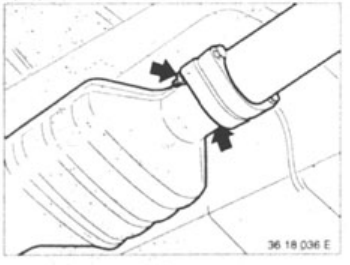
Release flange connection between front exhaust pipe and catalytic converter or front muffler.



Installation note:
Check sealing ring and replace if necessary.

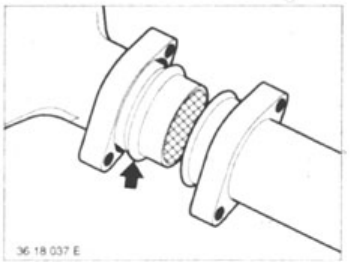


Installation note:
Turn flange such that the largest possible distance to neighbouring components is set.
Align flanges parallel.

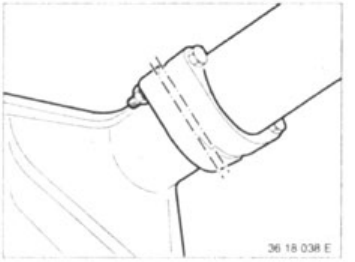


Catalytic converter version:

Release flange connection between catalytic converter and rear exhaust system.



Note:
The sealing cone is formed by the pipe connection.



Installation note:
Lightly grease connection with copper paste CRC**.

The flanges must be set parallel with respect to each other.
Turn flanges such that the largest possible ground clearance is obtained.

After complete installation, align exhaust system and firmly tighten all screw connections to the specified tightening torque*.

* Refer to Technical Data
** Source of Supply: BMW Parts Service

18 12 031 Replacing rear muffler (M51)

Remove complete muffler system.
Determine parting point (A) on new rear muffler (2).
Transfer determined size to installed rear muffler and mark.
Cut exhaust pipe with pipe cutter 00 2 200 and deburr.
Remove rear muffler.
Fit weld sleeve (3).
Align new rear muffler in installation position and connect with weld sleeve (3).

Note:
Ensure sufficient space to adjacent components.
Tack weld sleeve (3) with several weld dots.
Remove muffler system.
Completely weld sleeve (3) with inert gas welding set.

Installation note:
Coat stud bolts with copper paste -CRC-.

18 12 040 Replacing front muffler (M51)

Remove complete muffler system.
Determine parting point (B) on new rear muffler (1).
Transfer determined size to installed front muffler and mark.
Cut exhaust pipe with pipe cutter 00 2 200 and deburr.
Remove front muffler.
Fit weld sleeve (3).
Align new front muffler in installation position and connect with weld sleeve (3).

Note:
Ensure sufficient space to adjacent components.
Tack weld sleeve (3) with several weld dots.
Remove muffler system.
Completely weld sleeve (3) with inert gas welding set.

Installation note:
Coat stud bolts with copper paste -CRC-.

Location of weld connection

1 Front muffler

2 Rear muffler

3 Weld sleeve

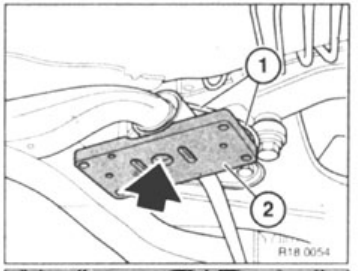
18 12 031 Replacing rear muffler (M50)

Remove center muffler together with rear muffler.

Installation note:
Coat stud bolts with copper paste -CRC-.

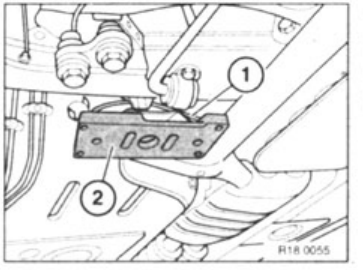
Remove rear muffler:

Determine parting point on new rear muffler.
Transfer and mark determined size on installed rear muffler.
Cut exhaust pipe with pipe cutter and deburr.
Remove rear muffler.
Fit weld sleeve
Install muffler system in vehicle.
Align new rear muffler in installation position and secure with weld sleeve. Remove muffler and completely weld welded sleeve.

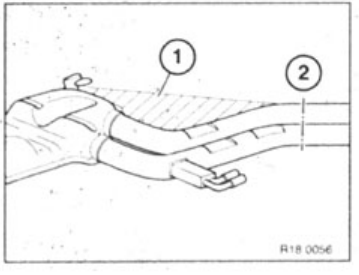


Install muffler.
Secure vibration absorber (2) on support bracket of rear muffler with screw.
Tightening torque: 24 Nm.

Pass arrester cable (1) around exhaust support bracket located on rear axle carrier and secure with screw to vibration absorber.
Tightening torque: 24 Nm



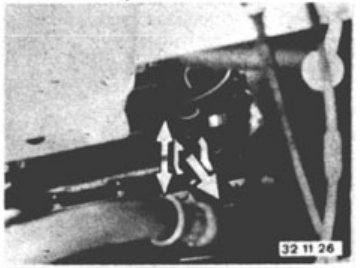
To avoid noises and paintwork damage, ensure sufficient space to adjacent components.
Ensure arrester cable (1) and vibration absorber (2) are fitted free moving and without tension.



Installation note:
Model 525iA:
A vibration absorber must be installed if the reinforcement plate (1) is not installed at the center muffler on this model. Refer to next page for procedure. Set parting point (2) behind reinforcement plate.

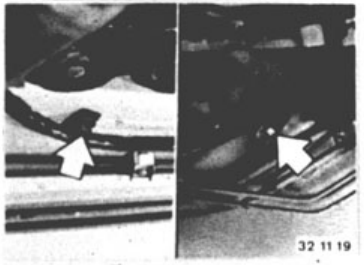
18 12 061 Replacing center muffler (M50)

This job is described in the job instructions "Replacing rear muffler", refer to 18 12 031 (M50)

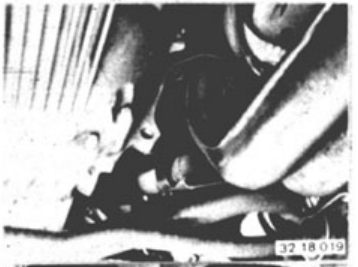


18 32 005 REMOVING AND INSTALLING OR REPLACING CATALYTIC CONVERTER

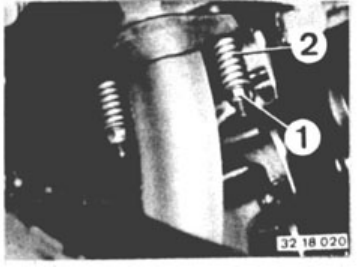
BMW 530 i and 535 i:
Disconnect plug for oxygen sensor.



Disconnect leads on body or lift them out of holders.

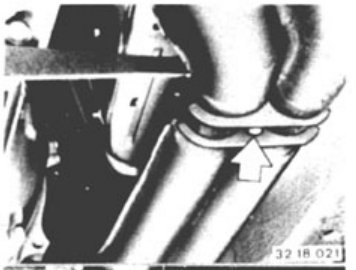


Unscrew exhaust pipes on exhaust manifold.
Note:
Replace self-locking nuts.

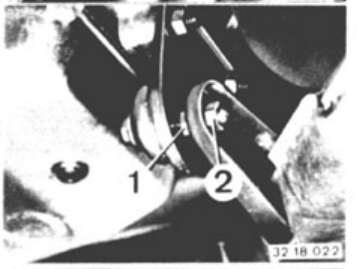


Installation:
Lubricate tapers of flanges with copper paste CRC**.
Flatten springs (2) uniformly by tightening nuts (1) with a torque of 10 Nm (7 ft. lbs.).
Loosen nuts (1) afterwards by one and one half turns.
Flanges must be parallel with each other or springs must not be pressed flat.
Tighten pipe with compensator last.

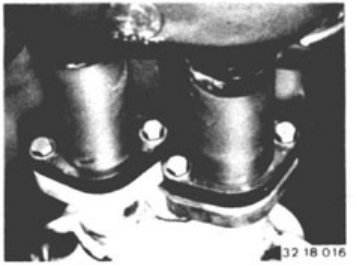
** Source of Supply: HWB



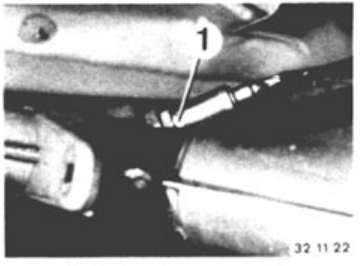
Unscrew exhaust carrier on transmission.
Installation:
Mount carrier without tension.
Tightening torque = 22 Nm (16 ft. lbs.).



Cars with Automatic Transmission:
Unscrew nut (2).
Installation:
Mount the exhaust carrier without tension by adjusting nut (1).
Tightening torque = 22 Nm (16 ft. lbs.).

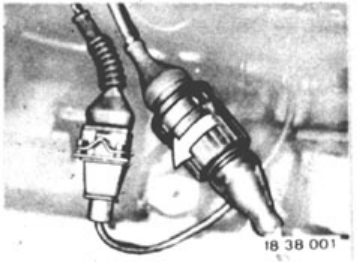


Unscrew flanges.
Installation:
Check gaskets, replacing if necessary.
Replace self-locking nuts.
Tightening torque = 22 Nm (16 ft. lbs.).



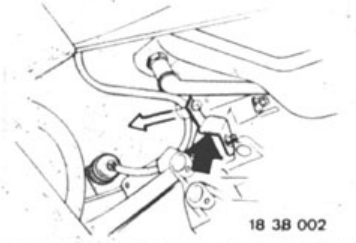
Unscrew oxygen sensor (1).
Scrapping Information:
Used catalytic converters can be returned for scrapping in the same manner as warranty parts***.

*** See Service Information



18 32 005 REMOVING AND INSTALLING OR REPLACING CATALYTIC CONVERTER (M 5)

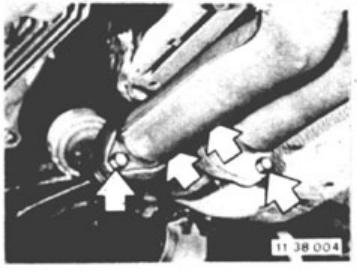
Disconnect plug for oxygen sensor (bayonet retainer).



Unclip electric leads in holder on the transmission.



Remove cover.
Disconnect electric leads.



Unscrew both exhaust pipes on the exhaust manifolds.

Installation:
Tightening torque = 42 Nm (30 ft. lbs.).



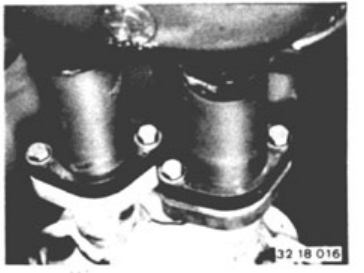
Installation:
Check gaskets, replacing if necessary.

Note:
New gaskets have a self-adhesive coat to make installation easier. Pull off the plastic sheet. Install gasket with the adhesive surface facing the manifold.



Unscrew exhaust support on the transmission.

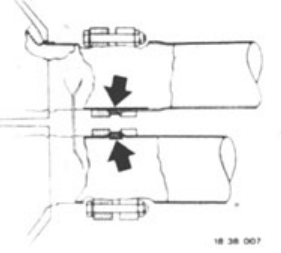
Installation:
Mount exhaust support without tension. Loosen bolt on the transmission if necessary.



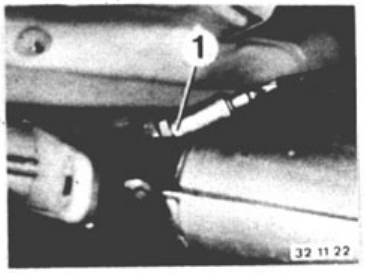
Unscrew muffler assembly on flanges.
Take off catalytic converter.

Installation:
Check gaskets, replacing if necessary.
Replace self-locking nuts.
Align flanges parallel.
Tightening torque = 22 Nm (16 ft. lbs.).

Important!
Gaskets are different. The wide gasket is located on the connection of the right pipe.



Arrangement of Primary and Final Muffler Connection



Unscrew oxygen sensor (1).

Installation:
Coat threads with Anti-Seize**.
Tighten oxygen sensor with torque of 55 ± 5 Nm (40 ± 3.5 ft. lbs.) with Special Tool 11 7 020.

Note:
Never clean an oxygen sensor and never coat it with a lubricant.
Protect the oxygen sensor while undercoating a car.

Scrapping Instructions:
Used catalytic converters may be returned in the same manner as warranty parts***.

** Source of Supply: HWB
*** See Service Information

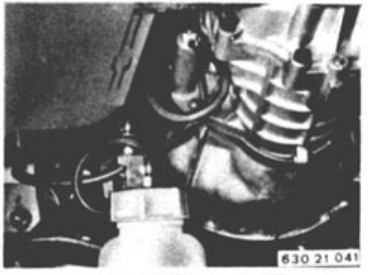
21 Clutch

21 00 006	Clutch – bleed	21- 00/1
010	Clutch disk – check for wear	21- 00/2
515	Clutch release travel – check	21- 00/3
21 21 500	Clutch – remove and install or replace	21- 21/1
21 51 500	Clutch release bearing/lever – remove and install or replace	21- 51/1
21 52 500	Clutch master cylinder – remove and install or replace	21- 52/1
510	Clutch slave cylinder – remove and install or replace	21- 52/2
502	Clutch master cylinder – overhaul	21- 52/3
512	Clutch slave cylinder – overhaul	21- 52/3
	Clutch – troubleshoot	21- 90/1

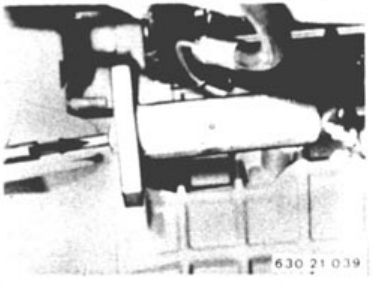


21 00 006 Bleeding clutch

Unscrew filler cap on reservoir.
Remove float (1).
Connect bleeding device.



Slowly open bleeder screw on clutch slave cylinder until air bubbles no longer escape.
Depress clutch pedal several times.



If air is still trapped in the hydraulic system after bleeding several times, the slave cylinder must be removed from the transmission.
Press push rod as far as it will go in slave cylinder and release slowly.
This forces any residual air still trapped into the reservoir and achieves the maximum clutch release range.
Do not press clutch pedal with slave cylinder removed.

21 00 010 Checking clutch disk for wear

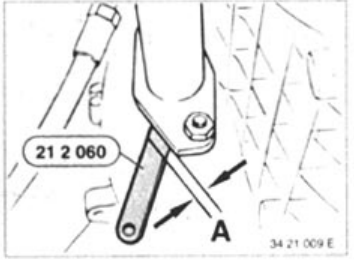
Transmission:
Getrag 240/5; 260/5; 260/6; 280/5

Transmission:
S5D 200G/250G; S5D 260Z/310Z;
S6S 420G/560G

Remove slave cylinder, line remains connected,
refer to 21 52 510.



Fit special tool 21 2 060, between transmission casing and slave cylinder, on piston rod of slave cylinder.

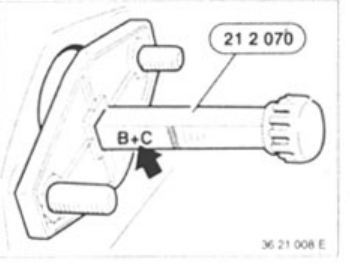


Clutch disk O.K.:

Shoulder of special tool 21 2 060 rests on housing of slave cylinder.

Clutch disk worn:

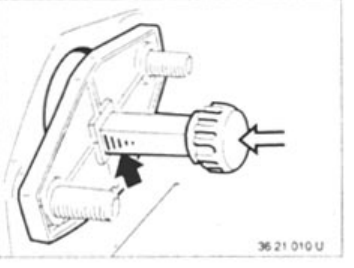
Special tool 21 2 060 cannot be pushed in so that the shoulder rests on the slave cylinder. A gap (A) of approx. 5 mm remains.



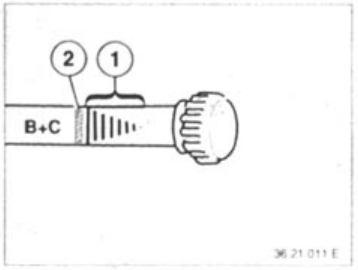
Fit special tool 21 2 070 such that the scale for the particular type of transmission can be seen from below.

Note:
Determine type of transmission,
refer to Technical Data Transmission Allocation HG 23.

B = S5D 200G
B = S5D 250G
C = S5D 260Z
C = S5D 310Z
D = S6S 420G
E = S6S 560G



Firmly press thrust pin by hand against the clutch release lever and read off wear value.



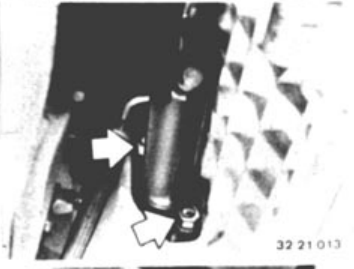
The clutch disk must be replaced if the red area (2) can be seen.

1 Clutch disk O.K.
2 Clutch disk worn

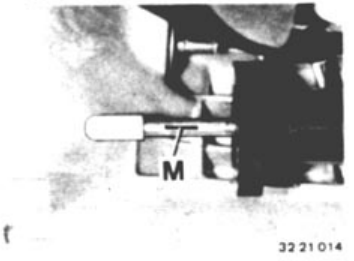


21 00 515 Determining clutch release travel

Fit test gage 21 2 060 in the recess and firmly press on piston rod of slave cylinder. Depress clutch pedal.



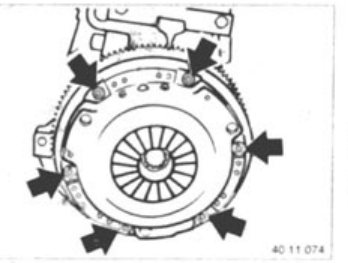
Remove slave cylinder from transmission - line remains connected.



Measure marking line (M) made by test gage. If the clutch release stroke (marking line) is less than 20 mm, either there may be air in the hydraulic system or a gaiter sleeve may be defective.

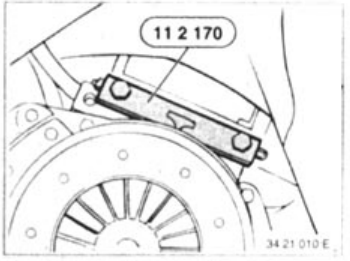
21 21 500 Removing and installing or replacing clutch

(Transmission removed)

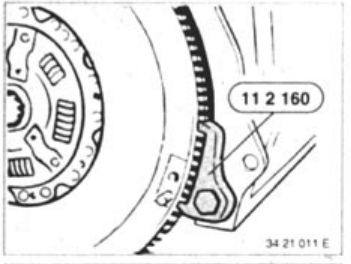


Loosen screws crosswise by one turn at a time until the clutch disk spring is released. Remove clutch and clutch disk.

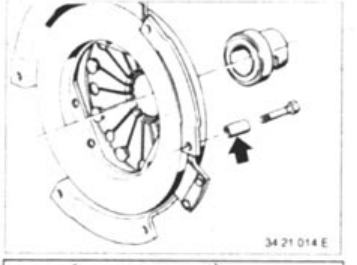
Installation note:
To avoid tension in the cover (can cause judder when starting off), fit screws by hand and then tighten crosswise by one turn at a time.
For tightening torque,
refer to Technical Data 21 21 1AZ.



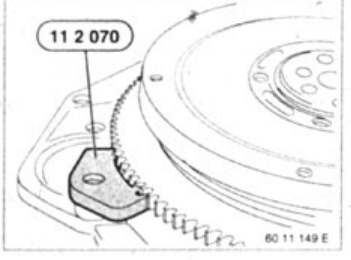
Engine M20 / M21 / M40 / M50 / M52:
Block flywheel with special tool 11 2 170.



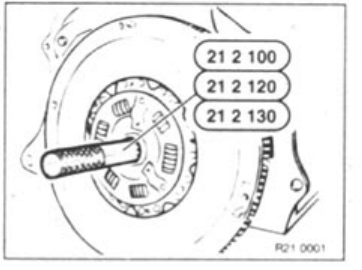
Engine M30 / S38:
Block flywheel with special tool 11 2 160



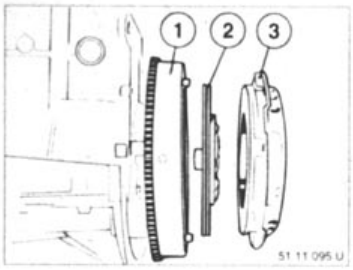
Installation note:
Engine S38:
Remove clamping sleeves and screws.



Engine M60:
Block flywheel with special tool 11 2 070.

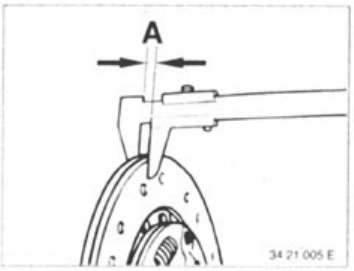


Installation note:
Centre clutch disk with special tool
21 2 100 / 120 / 130 (depending on diameter of transmission input shaft).



Installation note:
1 Flywheel/dual mass flywheel
2 Clutch disk
3 Clutch

Caution!
Handle clutch disk carefully, do not touch surfaces of friction pads. Install clutch disk (2) in correct position. Observe "engine side"/"transmission side" printed on disk.



Check clutch disk for wear and damage and replace if necessary.
Soiled clutch disks must always be replaced.
Press together clutch disk at test point (vice, screw clamp) and measure thickness (A).

Minimum thickness,
refer to Technical Data

Check that deep-groove ball bearing in crankshaft moves smoothly and also check for leaks, replace if necessary.

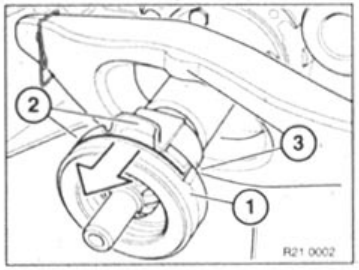
Check that flywheel retaining screws are oil-tight and replace if necessary.

Clean flywheel and clutch, check for wear and damage.
Replace flywheel/clutch if necessary.

Caution!
Before installing a new flywheel and a new clutch, the anti-corrosion agent on the friction pads must be removed completely.
Only use cleaning agents approved by BMW for this purpose.
Refer to BMW Parts Service.

21 51 500 Removing and installing or replacing clutch release bearing / lever

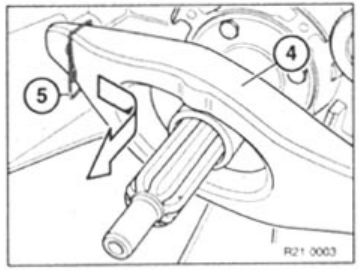
(Transmission removed)



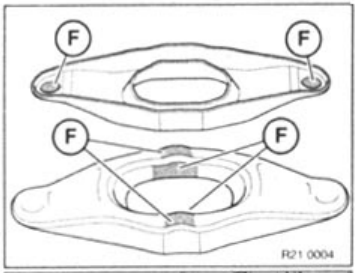
Remove release bearing (1).
Clean all sliding surfaces on release bearing.

Installation note:
Release bearing with plastic guide must not be greased on sliding surface for guide sleeve otherwise the release bearing can stick on the guide sleeve.

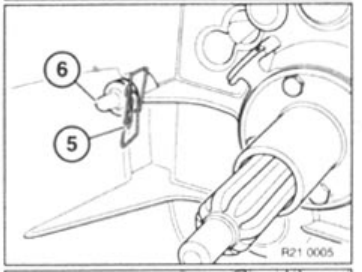
Sliding surfaces (2) of the release bearing must rest on the sliding surfaces (3) of the release lever.



Pull release lever (4) out of spring clip (5) and remove.

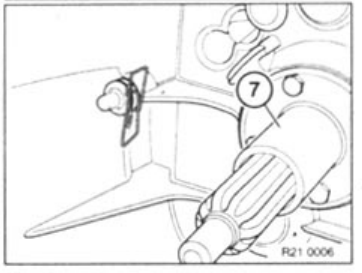


Installation note:
Clean release lever and thinly grease on sliding surfaces (F).
Grease,
refer to BMW Fluids and Lubricants Specifications.



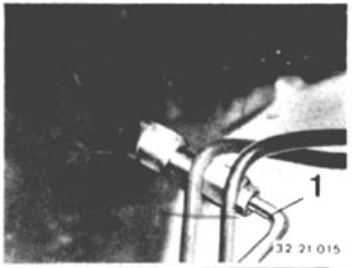
Check spring clip (5) and ball stud (6) for damage and replace if necessary.

Note:
The spring clip and ball stud must always be replaced on transmission S6S 420G.



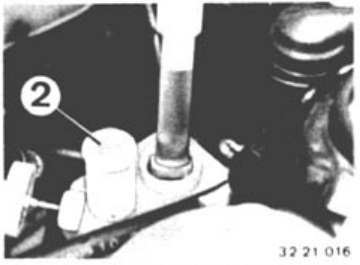
Clean guide sleeve (7).

Caution!
Do not grease guide sleeve.

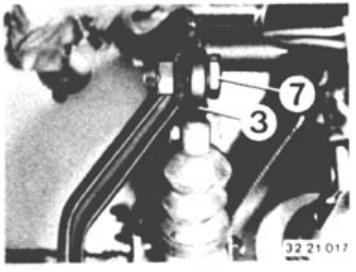


21 52 500 Removing and installing or replacing clutch master cylinder

Release line (1) to slave cylinder.

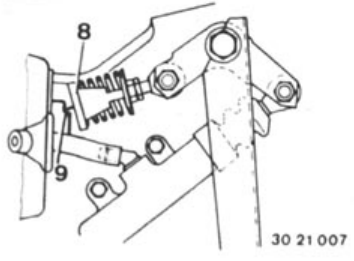


Unscrew filler cap on reservoir.
Remove float (2).
Drain off brake fluid in reservoir down to connection of top-up line.

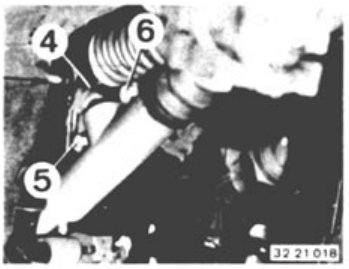


Remove bottom left trim panel for instrument panel 51 45 180.
Remove piston rod (3) from clutch pedal.

Installation note:
Adjust clutch pedal with eccentric screw (7) (refer to Group 35).

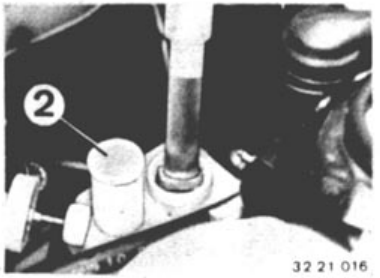


Caution!
Before installing piston rod (3), engage over-center helper spring (8) in guide lug (9) on pedal assembly.



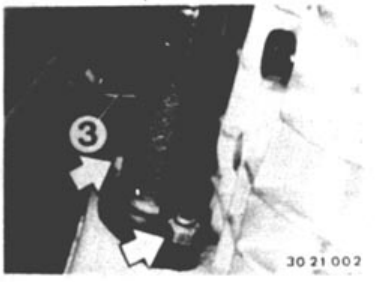
Remove top-up line (4). Release screws (5 and 6). Remove master cylinder.

Installation note:
Bleed clutch 21 00 006.



21 52 510 Removing and installing or replacing clutch slave cylinder

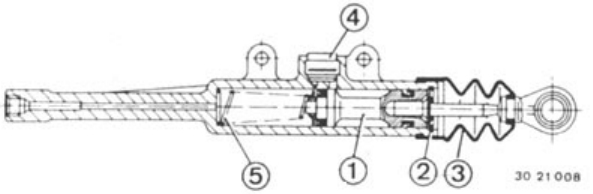
Unscrew filler cap on reservoir.
Remove float (2). Drain off brake fluid in reservoir down to connection of top-up line.



Detach slave cylinder from transmission.
Remove slave cylinder.
Release line (3).

Installation note:
Thinly grease push rod at contact surface to release lever.
Grease,
refer to BMW Fluids and Lubricants Specifications
Bleeder screw points downward.

Bleed clutch,
refer to 21 00 006.



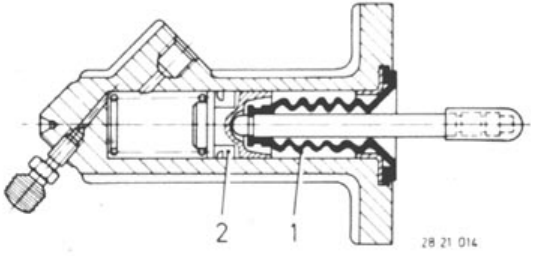
21 52 502 Overhauling clutch master cylinder

(Master cylinder removed)

Clean master cylinder and inner parts with spirits.
If cylinder barrel is scored or has corrosion points, replace complete master cylinder.
Install repair kit.

Note:
Only use repair kit of corresponding master cylinder manufacturer.

Consisting of
1 Piston assy.
2 Circlip
3 Dust cap
4 Sealing plug
5 Compression spring
Lightly coat cylinder barrel and grooved rings with brake cylinder paste - ATE**).



21 52 512 Overhauling clutch slave cylinder

(Slave cylinder removed)

Clean slave cylinder and inner parts with spirits.
If cylinder barrel is scored or has corrosion points, replace complete slave cylinder. Install repair kit.

Note:
Only use repair kit of corresponding slave cylinder manufacturer.

Consisting of:
1 Protective cap
2 Grooved ring cup
Retaining ring
Toothed ring
Lightly coat cylinder barrel and grooved ring cup with brake cylinder paste - ATE**)

**) Refer to BMW Parts Service

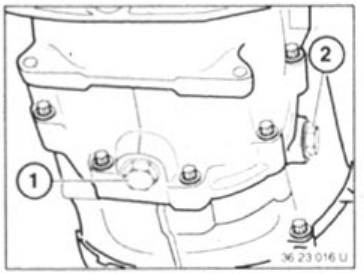
TROUBLESHOOTING CLUTCH

Condition	Cause	Correction
Clutch slips	a) Clutch contact pressure insufficient b) Clutch liner wear excessive c) Oil on liners – transmission or crankshaft seal faulty d) Clutch overheated e) Clutch not original BMW part	a) Replace clutch disc 21 21 . . . b) Replace drive plate 21 21 . . . c) Replace faulty seal and drive plate d) Replace clutch disc 21 21 . . . e) Install original BMW parts
Clutch grabs	a) Liners not specified type b) Oil on liners c) Release presses one-sidedly d) Pressure plate presses crooked e) Crankshaft not aligned with transmission input shaft f) Engine and transmission suspension defective g) Drive plate not original BMW part	a) Replace drive plate 21 21 . . . b) Replace drive plate 21 21 . . . c) Check release lever d) Replace pressure plate 21 21 . . . e) Check centering surfaces on engine and transmission f) Replace engine and transmission suspension g) Install original BMW part
Clutch will not separate	a) Drive plate quenched excessively or liner broken b) Drive plate lateral runout excessive c) Liner rusted on flywheel d) Drive plate seized on transmission input shaft e) Pilot bearing for transmission input shaft in crankshaft faulty f) Air in clutch hydraulic system g) Tangential leaf springs of clutch bent off	a) Replace drive plate 21 21 . . . b) Straighten or replace drive plate 21 21 565 c) Clean flywheel, roughen liner with emery cloth d) Service drive plate on transmission input shaft, replacing damaged parts if necessary e) Replace pilot bearing in crankshaft 11 21 571 f) Bleed clutch 21 00 006 g) Replace clutch disc 21 21 . . .
Clutch noise	a) Imbalance of clutch disc and drive plate excessive b) Torsion damper defective c) Clutch release defective d) Pilot bearing for transmission input shaft in crankshaft faulty e) Rivets of clutch loose	a) Replace clutch disc or drive plate 21 21 . . . b) Replace drive plate 21 21 000 c) Replace clutch release 21 51 001 d) Replace pilot bearing in crankshaft 11 21 571 e) Replace clutch 21 21 . . .

23 Manual transmission

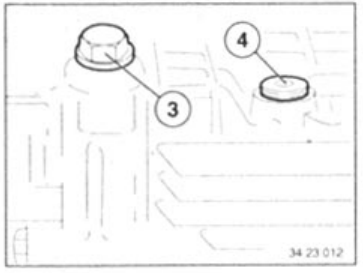
00 11 229	Oil change in transmission	23- 0/1
23 00 022	Transmission – remove and install	23- 0/2
023	Transmission – remove and install – 4-wheel drive	23- 0/5
032	Exchange transmission – install	23- 0/9
23 12 053	Radial seal for output flange – replace	23- 12/1
083	Radial seal for selector shaft – replace	23- 12/2
	Selector transmission – troubleshoot	23- 90/1

For further work, refer to Construction Group Repair Manual



00 11 229 Oil change in manual transmission

Oil should only be changed at operating temperature.
Unscrew drain plug (1) and filler plug (2).
Drain oil.



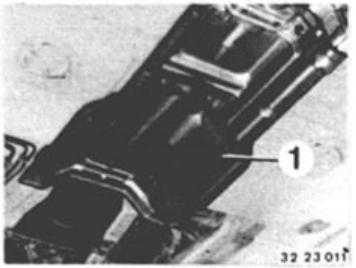
Caution!

On the M 5 model:
The filler plug (3) on transmission 280 is located in the adapter case.
The opening (4) in the front section of the case is sealed with a shear-off screw and must not be used.

Note:
Dispose of used lubricant properly!
Clean and screw in drain plug.
Tightening torque 23 00 4AZ*.

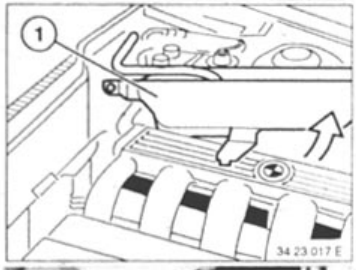
Fill new oil through filler aperture.
Refer to label or Consumables Specifications for grade of oil.
Volume*.
Oil must overflow through filler aperture.
Screw in filler plug (2).
Tightening torque 23 00 4AZ*.

* Refer to Specifications



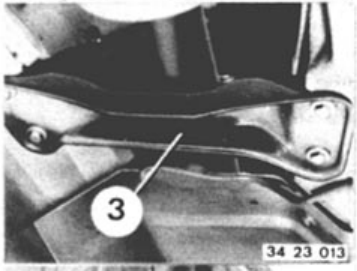
23 00 022 Removing and installing transmission

Disconnect negative lead from battery.
Caution!
First read fault memories with tester and print any faults as fault memories of control units will be cancelled by disconnecting the battery.
Remove underbody protection.
Remove complete exhaust unit 18 00 020.
Model 524 td, M5:
Remove silencer assembly, 18 12 012.
Remove heat baffle plate (1).

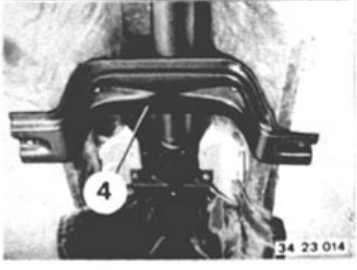


Model 525 tds-M 51:
Remove coolant expansion tank (1) from engine firewall.
Coolant hose remains connected.
Remove overflow hose from expansion tank.
Remove assembly underbody protection.

On vehicles with 4-wheel drive, remove transfer box 27 10 010

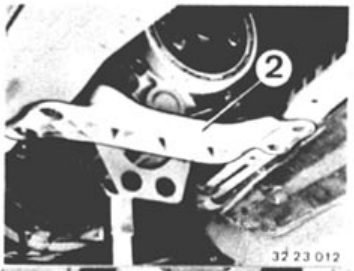


Version with support.
Remove support (3) on tunnel.
Installation instruction:
Tightening torque*



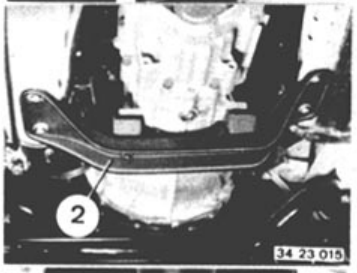
Version with bracket:
Remove bracket (4) from tunnel.
Installation instruction:
Tightening torque*

* Refer to Specifications



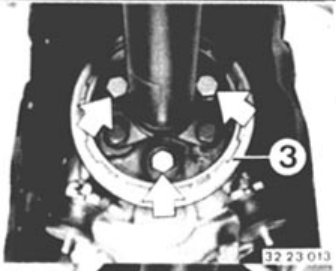
Remove cable from reverse gear switch.
Support transmission from underside.
Remove crossmember (2).

Installation instruction:
Center transmission (see Gr. 26).
Tightening torque*.



Version with M 50 engine
Remove crossmember (2).

Installation instruction:
Tightening torque*



Unscrew joint disk on transmission.

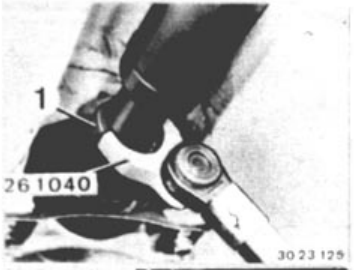
Note;
On version with vibration absorber:
Vibration absorber (3) is secured at same time.
Installation instruction:
M5 model has thicker flexible coupling:
note length of bolts.
Models 518 i ...535 i = 56 mm
M 5 = 60 mm



Installation instruction:
Tighten nuts with 19 mm insert (standard size) fitted to torque wrench.
Tightening torque*.

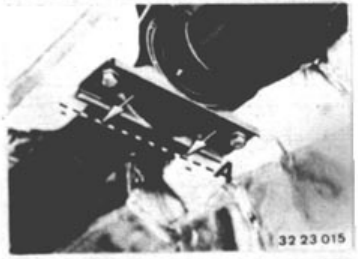
Caution!
To avoid torsion stress on flexible coupling, only tighten nuts on the flange side.

* Refer to Specifications

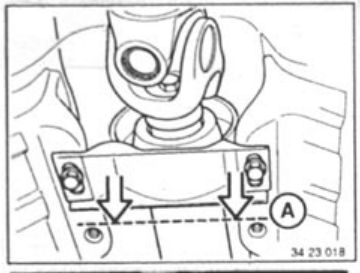


Version with sliding member:
Loosen ring nut (1) a few turns.

Installation instruction:
Tighten ring nut (1) with special tool 26 1 040 after finishing installation.
Tightening torque*.

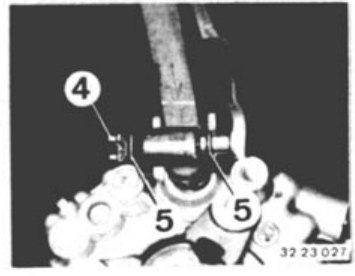


Unscrew center mount.
Installation instruction:
Preload center mount in direction of travel (A).
With sliding member on center mount
A = 4... 6 mm
Without sliding member on center mount
A = 2... 4 mm.
Tightening torque*.
Bend flexible coupling downwards and remove from centering spigot.
Caution!
Don't let the propeller shaft fall into the joints. Suspend propeller shaft from car on a piece of wire.



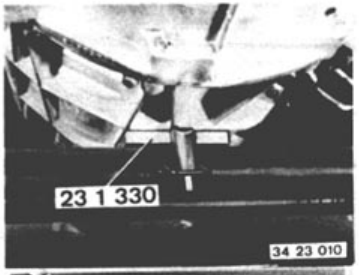
518 i model:
Three-section propshaft.
Remove second center mount from rear of body.

Installation:
Preload center mount in direction of travel
A=2...4 mm.
Tightening torque*.



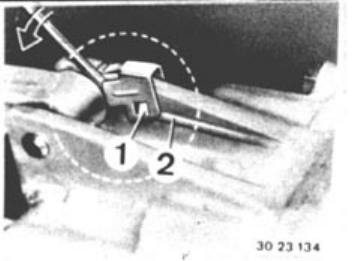
Lift out retaining disk (4) and remove washers (5).
Withdraw selector rod.

* Refer to Specifications



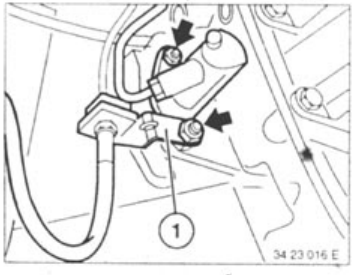
Lower transmission.

Caution! **Modell M 5:**
To avoid distortion of the engine firewall, before draining the transmission always insert spacer plate 23 1 330 between crossmember and oil pan.
On version with M 50 engine:
To prevent the transmission from contacting the stabilizer bar, insert space plate 23 1 330.



Lift spring (1) off of tab (2) on case using a screwdriver and swing upwards.
Pull out shaft.

Installation instruction:
Lubricate shaft lightly with Molykote Long term 2.



Remove clutch slave cylinder.
Pressure pipe remains connected.

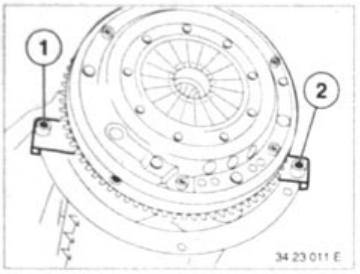
Installation instruction:
Also secure bracket (1) for pressure lead, if fitted.
Tightening torque*



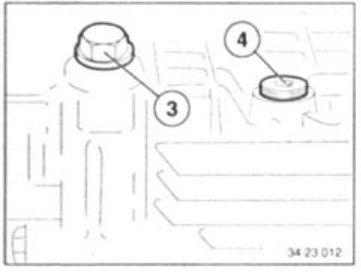
Unscrew transmission on engine.
Unscrew Torx bolts with a Torx socket.
Remove transmission toward rear.

Caution! Installation instructions:
Washers must be used on the version with Torx bolts to avoid increasing the breaking loose torque.
Tightening torque*.
518 i model:
Also secure bracket for heating connections.

* Refer to Specifications



Caution!
Check that dowel sleeves (1 and 2) are not missing prior to installation of the transmission.
Transfer guide sleeves from transmission or replace guide sleeves as applicable.
Coat splines and guide pins lightly with Microlube GL 261** prior to installation of the transmission.
Check oil level.



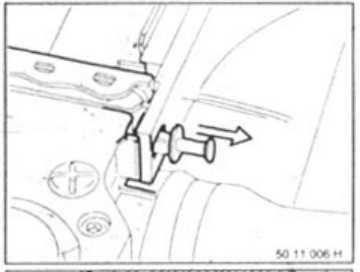
Caution!
On model with M 5 engine:
The filler screw (3) on transmission 280 is located in the adapter case.
The aperture (4) in the front section of the case is sealed with a shear-off bolt and must not be used.

* Source of Supply: BMW Parts Service

23 00 023 Removing and installing transmission - 4-wheel drive -

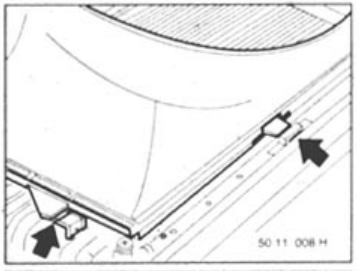
Unscrew negative lead from battery support point and remove.

Caution!
First read fault memories with tester and print any faults as fault memories of control units will be cancelled by disconnecting the battery.
Removing and installing exhaust unit 18 00 020



o Unfasten fan shroud:

Remove expanding rivets from fan shroud and lift fan shroud up slightly.



Installation instruction:
Connect up fan shroud on left and right and in center.



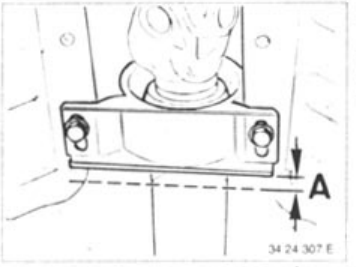
o Remove propshaft:

Remove heat baffle plate.



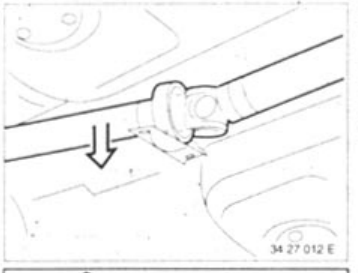
Unscrew propeller shaft on transmission.

Installation instruction:
Replace stop nuts.
Tightening torque 26 11 2AZ



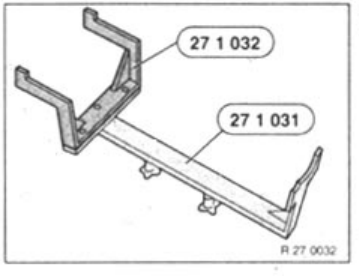
Unscrew center mount.

Installation instruction:
Preload center mount in direction of travel A = 2 ... 4 mm.
Tightening torque 26 11 6AZ



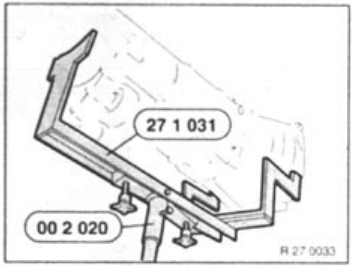
Fold propeller shaft downwards and withdraw from transmission.

Caution!
Do not allow the propeller shaft to drop into the joints.
Suspend propeller shaft from car on a piece of wire.

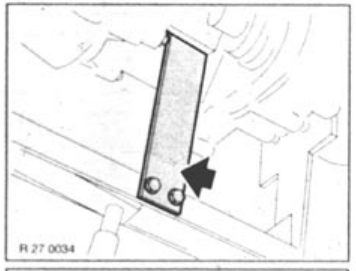


Pre-assemble special tools 27 1 031 and 27 1 032 to suit manual selector transmission.

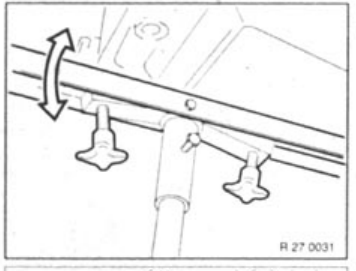
* Refer to Specifications



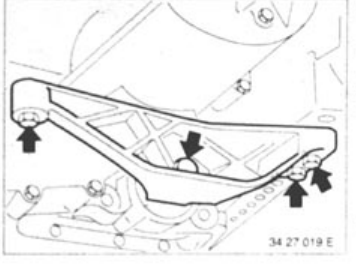
Support transmission on lifting fixture 00 2 030.



Screw additional bracket on to secure the transmission.



Set inclination by tightening the knurled-head bolts.

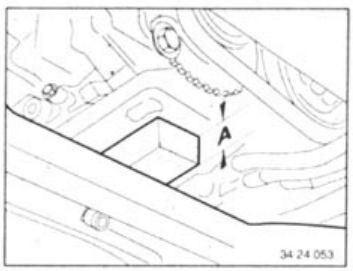


Unscrew cross-member from body and transfer box and remove.

Lower transmission.

Installation instruction:
Tightening torque 23 71 1AZ / 2AZ*

* Refer to Specifications

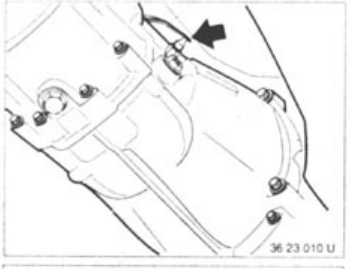


Jam a block (wooden or similar material) between front axle carrier and engine oil pan (A = 50 mm).

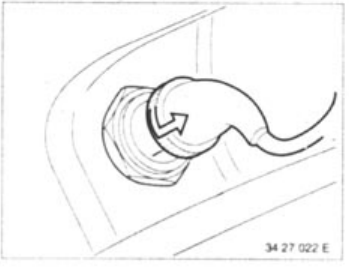
Note:
The block prevents the engine from tipping forwards when the transmission flange is unfastened.



Installation instruction:
When lowering the transmission, the coolant air guide for the alternator can slip out.
Check once the transmission has been installed.

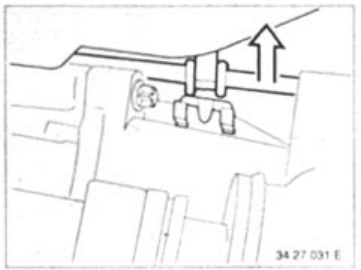


Remove cable from reversing light switch.

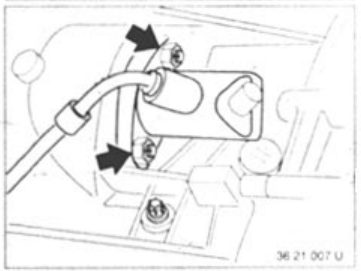


Turn bayonet connection for transfer box control counter-clockwise and remove.

Installation instruction:
Fit plug in such a way that the marking grooves are aligned with one another.



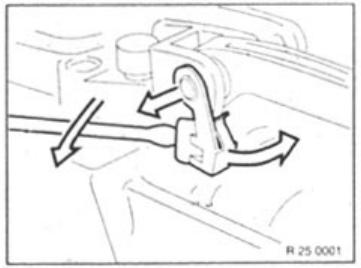
Remove bracket for cable on transmission control unit.



o Removing clutch slave cylinder.

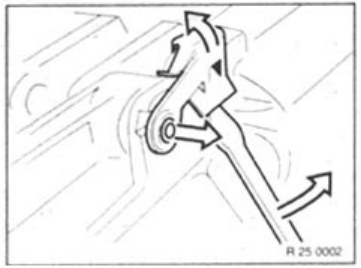
Unscrew clutch slave cylinder.
Pressure pipe remains connected.

Caution!
Do not actuate the clutch pedal.



o Remove selector arm

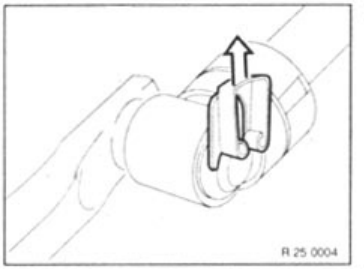
Left side:
Insert screwdriver between spring and transmission case.
Lift spring off lug on case and swivel upwards.
Remove bolt.



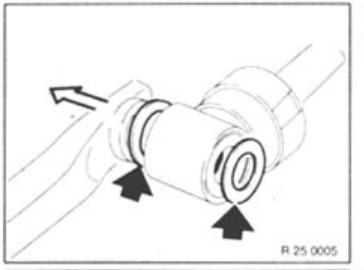
Right side:
Insert screwdriver between spring and transmission case.
Lift spring off lug on case and swivel upwards.
Remove bolt.



Installation instruction:
Check that selector arm is in correct position in rear rubber grommet.

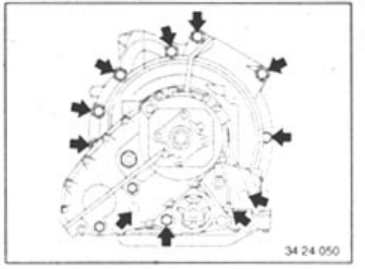


Pull off retainer.



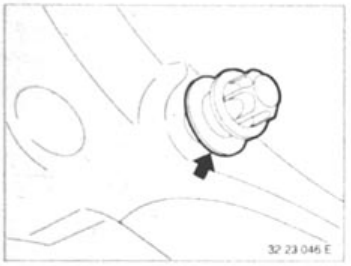
Withdraw selector rod.

Note:
Take care of washers.



o Remove transmission.

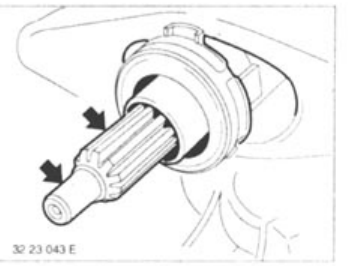
Disconnect transmission flange from engine.



Installation note:
Note washers on Torx screws.

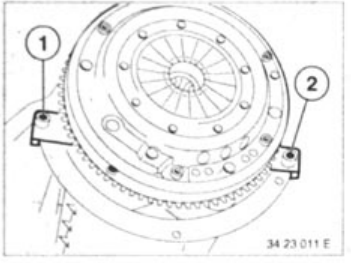
For tightening torque, refer to Technical Data 23 00 1AZ

Remove transmission by pulling to rear.



Installation note:
Clean spline of clutch disk.
Clean splines and guide pins of drive shaft and grease thinly.
The amount of grease necessary for this purpose corresponds to the size of a kernel of corn (maize).
Grease,
refer to BMW Fluids and Lubricants Specifications.

Installation note:
After installing the transmission, check oil level in manual transmission and transfer box.



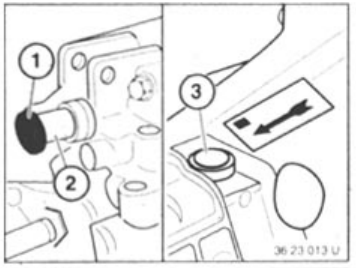
Installation note:
Note fitted bushes (1 ... 2).
If necessary, use fitted bushes from transmission or replace.
Ensure covering plate is fitted in correct position.

Installation note:
Remove release bearing and release lever, clean and grease at specified points, refer to 21 51 500.

* Refer to Technical Data

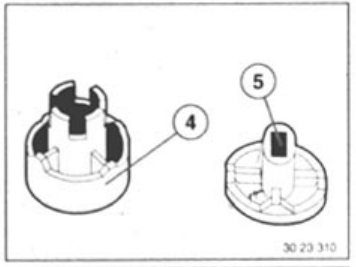
23 00 032 Installing exchange transmission

Removing and installing exchange transmission 23 00 022.
Transmission identification:
BMW code* bonded on front section of transmission.

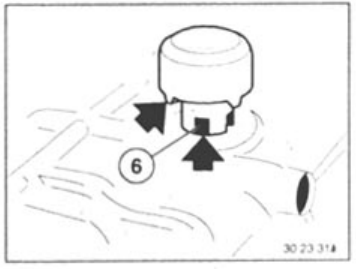


Transmission type ZF-S 5-16/S 5 D 310 Z:

Note:
Before installing transmission, fit breather (1) (see adhesive label).
Remove breather (1) and protective sleeve (2) from gearshift shaft.
Remove end cap (3) and install breather.

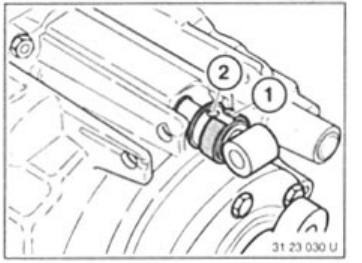


Caution!
New breather as of 8.88.
Differentiating features
New version (4)
Old version (5)



Breather version (4):
Ensure the breather is fitted correctly due to the increased height.
Centre breather with plastic-headed hammer and knock in with slot (6) positioned in longitudinal direction of the transmission.
Lug collides with casing wall.

* Refer to Technical Data



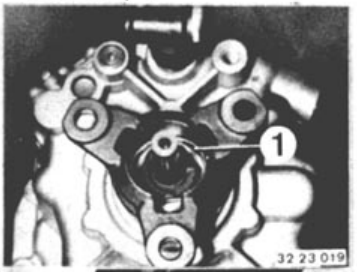
Convert shift rod joint.
Push back retaining sleeve (1).
Drive out parallel dowel pin (2).

Convert exhaust support bracket and backup light switch.

Caution!
Transmissions are supplied filled with oil.
Therefore only check the oil level after installing the transmission.

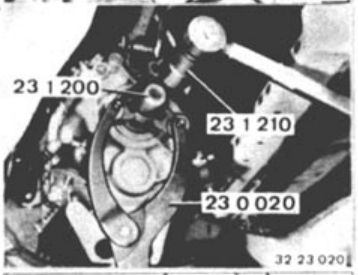
All:
Install release bearing and release lever in the new transmission,
refer to 21 51 500

23 12 053 Replacing radial oil seal for output flange



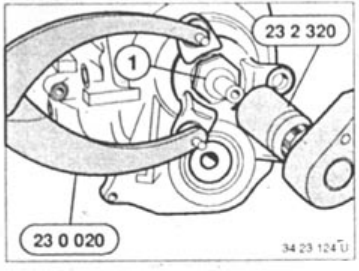
Front propeller shaft and center bearing
Removal, refer to 23 00 022.
Lift out tab washer (1).

Installation note:
Replace tab washer.



Fit special tool 23 1 200.
Hold output flange with special tool 23 0 020.
Release flanged nut with socket 23 1 210.

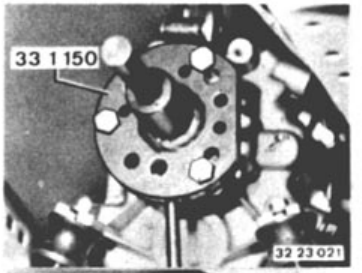
Installation note:
Fit flanged nut with screw locking compound**).
Tightening torque*



Transmission S5 D 310 Z:

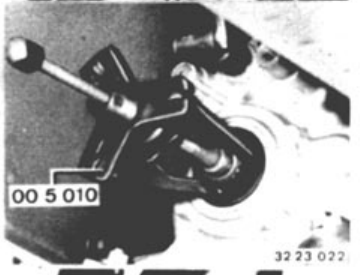
Hold output flange with special tool 23 0 020.
Release flanged nut (1) with socket 23 2 320.

Installation note:
Fit flanged nut (1) with screw locking compound**).
Tightening torque*



Remove output flange with special tool 33 1 150.

Installation note:
Transmission S5D 310Z
Heat output flange to approx. 80°C (hot air blower).
Slide output flange onto output shaft and, if necessary, drive on as far as it will go with special tool 23 1 160.

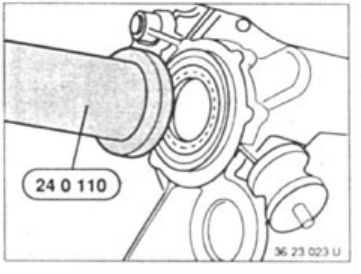


Remove radial oil seal with special tool 00 5 010.



Transmission 240, 260, 280:

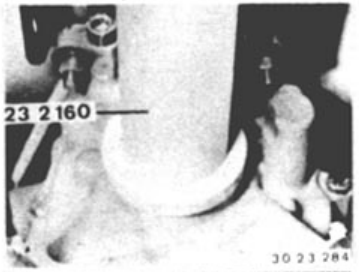
Oil sealing lip of radial oil seal.
Install radial oil seal flush with special tool 23 1 380 in conjunction with 00 5 500.



Transmission S 5 D 200 G:

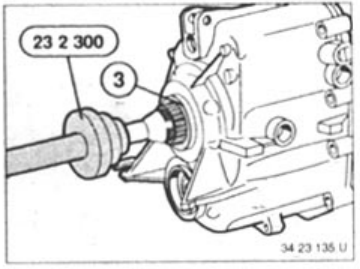
Oil sealing lip of radial oil seal.
Install radial oil seal flush with special tool 24 0 110.

*) Refer to Technical Data
**) Source of supply: BMW Parts Service



ZF-S 5-16 Transmissions:

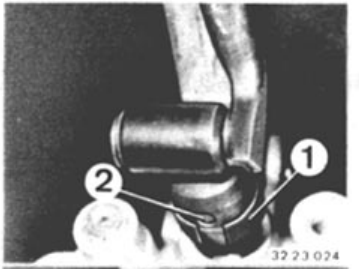
Lubricate sealing lip of the radial oil seal with oil.
Drive radial oil seal in flush using Special Tool 23 2 160.



S 5 D 310 Z Transmissions:

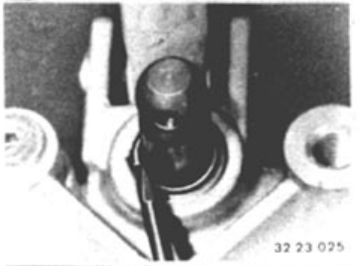
Lubricate sealing lip of the radial oil seal with oil.
Drive radial oil seal (3) in flush using Special Tool 23 2 300.

Important!
Use a plastic hammer to drive seals in.
Check oil level, correcting if necessary.

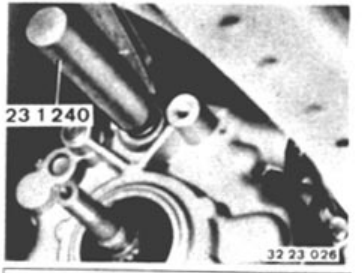


23 12 083 REPLACING RADIAL OIL SEAL FOR SHIFT SHAFT

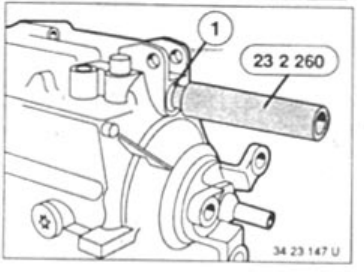
Unscrew propeller shaft - refer to 23 00 022.
Engage 5th gear.
Push locking sleeve (1) out of the way and drive cylindrical pin (2) out.



Lever radial oil seal out using a narrow screwdriver.



Lubricate sealing lip of the radial oil seal with oil.
Drive radial oil seal in using Special Tool 23 1 240.
Check oil level, correcting if necessary.



S 5 D 310 Z Transmissions:

Drive radial oil seal (1) in using Special Tool 23 2 260.

Replacing radial oil seal for input shaft - refer to 23 12 ... in the Construction Group Repair Manual.

TROUBLESHOOTING ON MANUAL TRANSMISSION

FAULT	CAUSE	CORRECTIVE MEASURES
Oil on clutch bell housing	a) Guide flange leaking	a) Seal guide flange
	b) Radial oil seal for drive shaft leaking	b Replace radial oil seal 23 12 ...
	c) Gasket on end cover (crankcase leaking)	c Replace gasket 11 14 611
	d) Radial oil seal for crankshaft leaking	d Replace radial oil seal 11 14 611
Oil on output flange	a) Radial oil seal for output flange leaking	a) Replace radial oil seal 23 12 053
	b) Radial oil seal for gearshift shaft leaking	b) Replace radial oil seal 23 12 083
Transmission leaking between front and rear section	a) Casing leaking	a) Seal casing
Oil on breather	a) Oil level too high	a) Correct oil level
	b) Wrong oil (excessive foaming)	b) Replace oil
Gear does not lock in - jumps out	a) Sliding sleeve worn, slide rail defective, springs broken	a) Replace defective parts 23 23 ...
	b) Sliding sleeves for 1st/2nd gear and 3rd/4th gear interchanged	b) Install sliding sleeve correctly 23 21 ...
	c) Gearshift arm mounting defective	c) Check gearshift arm mounting 25 11 211
	d) Shift fork worn	d) Replace shift fork 23 21 ...
	e) Output flange loose	e) Secure output flange

TROUBLESHOOTING MANUAL TRANSMISSION

Condition	Cause	Correction
Hard moving, hesitant shifts (scratching)	a) Clutch disengages insufficiently 1. Pedal travel insufficient 2. Drive plate worn 3. Liner seized on flywheel 4. Drive plate seized on transmission input shaft 5. Bearing in crankshaft for transmission input shaft faulty 6. Air in clutch hydraulic system	a) 1. Check/adjust pedal travel; remove excessively thick mats; floor clutch pedal for shifts 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 bearing in crankshaft 11 21 571 6. Bleed clutch 21 00 006
	b) Cold shifting force too high	b) Pour in HD engine oil SAE 20 ... 40
	c) Excessive play in selector lever bearings	c) Check selector lever bearings, replacing worn rubber mounts if necessary 25 11 211
	d) Selector forks worn	d) Replace selector forks 23 31 . . .
	e) Sliding sleeve worn	e) Replace sliding sleeve 23 23 . . .
Transmission scratches while shifting	a) Clutch disengages insufficiently – see a) above	a) See a) above
	b) Synchromesh rings worn/sliding sleeve scored	b) Check synchronization/replace damaged parts 23 23 . . .
	c) Reverse gear: shifting break of 3 seconds not held	c) Keep to specified break
Transmission loud	a) Oil level too low	a) Correct oil level
	b) Transmission shaft bearings defective	b) Replace all bearings 23 21 . . .
	c) Damaged parts (gears)	c) Replace pair or set of gears 23 21 . . .
	d) Needle bearing or output or input shaft faulty	d) Replace needle bearing 23 21 . . .
	e) Bearing in crankshaft for transmission input shaft faulty	e) Replace bearing in crankshaft 11 21 571

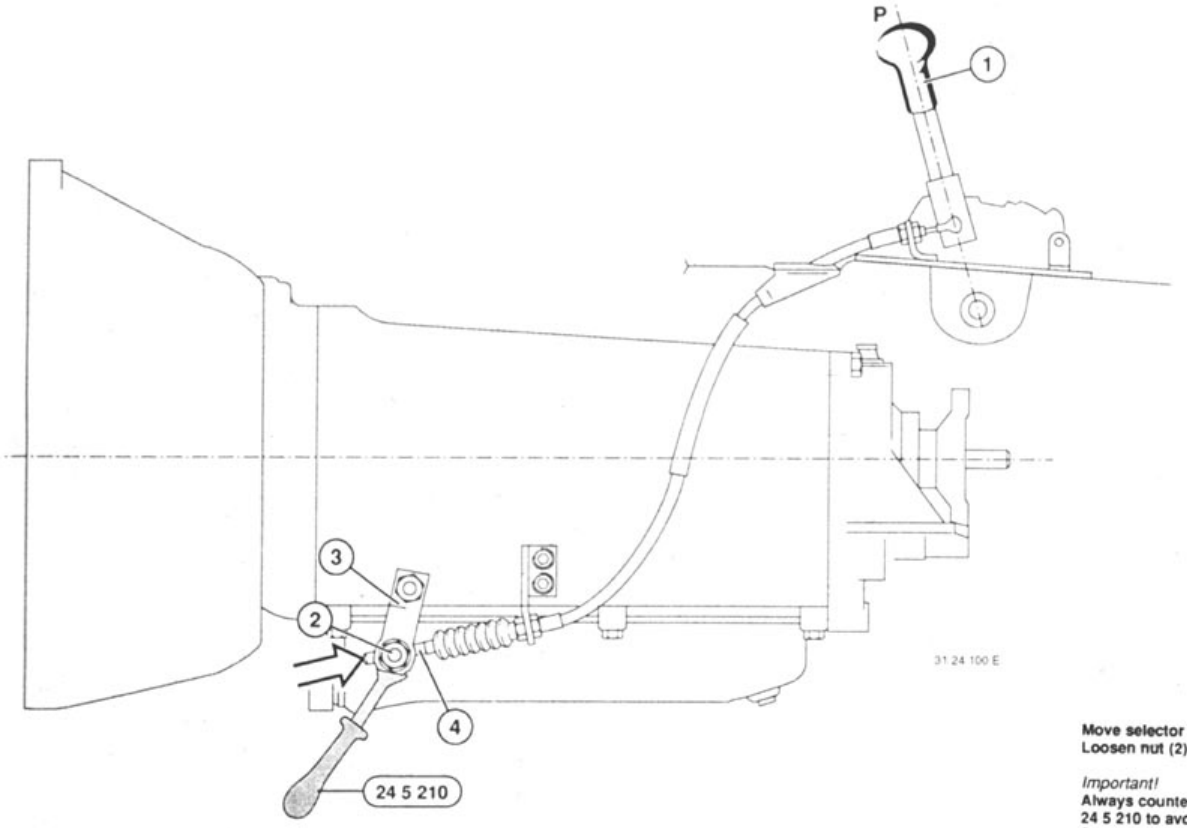
24 Automatic transmission

4 HP-22 / H + EH

24 00 006	Selector lever, throttle linkage and throttle cable – adjust	24- 00/1
011	Hydraulic pressure values – check	24- 00/4
022	Transmission – remove and install	24- 00/5
042	Transmission – exchange	24- 00/9
24 11 002	Oil sump – remove and install	24- 11/1
052	Transmission extension – remove and install/seal	24- 11/2
24 12 013	Radial oil seal for output flange – replace	24- 12/1
103	Radial oil seal for manual shift valve shaft – replace	24- 12/2
24 30 002	Valve body – remove and install	24- 30/1
24 31 152	Oil strainer on valve body – remove and install	24- 31/1
24 32 002	Centrifugal governor – remove and install	24- 32/1
505	Centrifugal governor – disassemble and assemble	24- 32/1
24 34 002	Parking lock pawl – remove and install	24- 34/1
102	Throttle cable – replace	24- 34/1
702	Throttle cable spring – replace	24- 34/2
851	Solenoids – replace	24- 34/3
. . .	Solenoids (for kickdown downshift lock) – replace	24- 34/3
860	Pressure regulator – replace	24- 34/4
870	Pulse sender – replace	24- 34/4
24 35 500	Wire harness for automatic transmission – replace	24- 35/1
502	Wire harness for kickdown downshift lock – replace	24- 35/1
24 61 500	Control unit (EH) – remove and install or replace	24- 61/1
514	Control unit for downshift lock – replace	24- 61/2
. . .	Control unit for kickdown downshift lock – replace	24- 61/2
	Automatic transmission – troubleshoot	24- 90/1

Refer to “Group 24 in Construction Group Repair Manual” for other jobs.

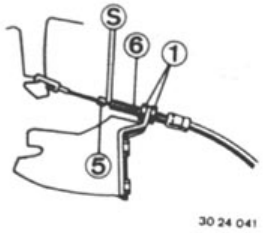
24 00 006 ADJUSTING SELECTOR LEVER, THROTTLE LINKAGE AND THROTTLE CABLE



Move selector lever (1) to "P".
Loosen nut (2).

Important!
Always counterhold bolt with Special Tool 24 5 210 to avoid deformation of the cable. Special Tool 24 5 210 can only be applied in position P.

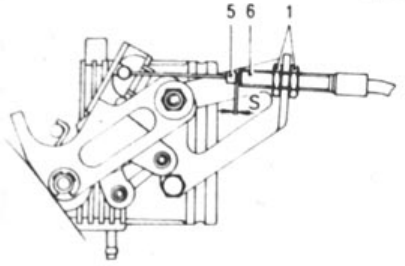
Press lever (3) forward (park position).
Press cable rod (4) opposite forward direction.
Clamp cable rod (4) by tightening nut (2) (counterhold with Special Tool 24 5 210). Tightening torque: 10 ... 12 Nm.

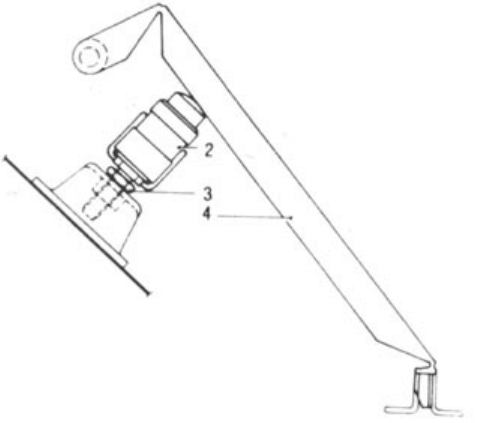


B) Adjusting Throttle Cable:
Requirement: correct full throttle adjustment – adjust if necessary – see 35 41 421.

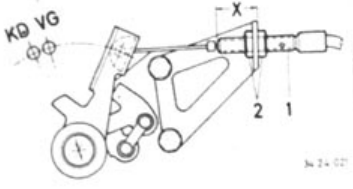
M 20 Engine:
Adjust play (S) to 0.50 ± 0.25 mm (0.020 ± 0.010") with nuts (1) in idle position.

M 30 Engine

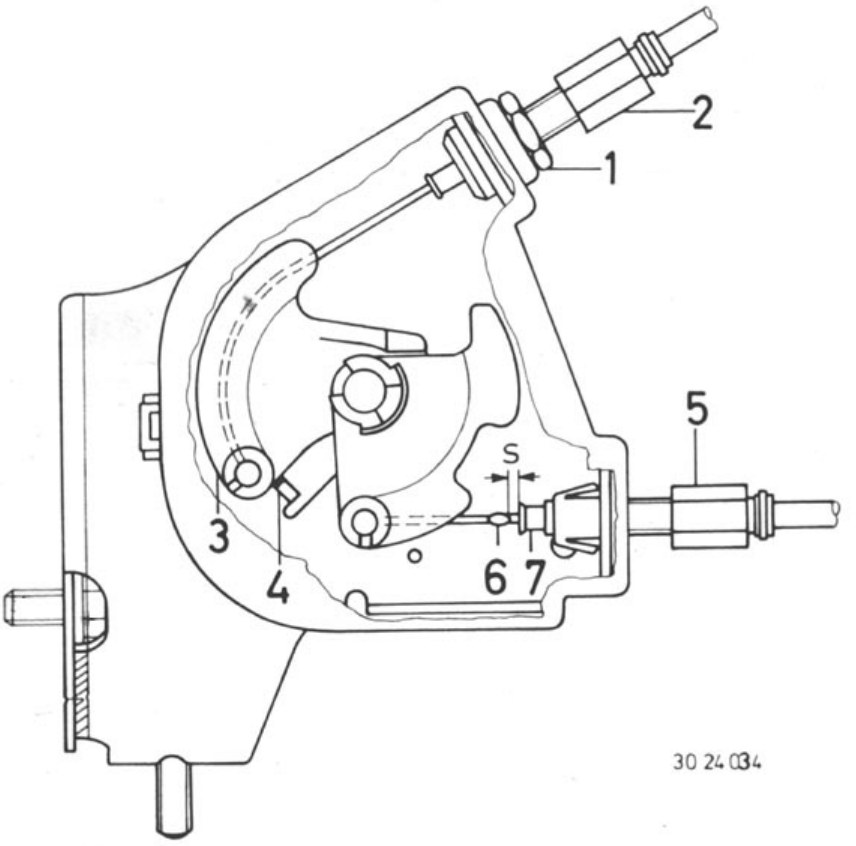




Check kickdown stop (2).
Loosen lock nut (3) and screw in kickdown stop (2).
Operate accelerator pedal (4) up to the transmission pressure point.
Unscrew the kickdown stop in this position, until the accelerator pedal bears.
Operate accelerator pedal (4) to kickdown (final position).
Now distance (S) from lead seal (5) to end of sleeve (6) must be at least 44 mm (1.732").



M 30 Engine with Passing Element in Throttle Valve Assembly:
Requirements: throttle cable in correct installed position and connected on the throttle valve lever.
Basic distance (X) = approx. 22.5 mm (0.886").
Move throttle valve to full load position.
Turn adjusting screw (1) to adjust the throttle cable without play in full load position or transmission kickdown pressure point.
Tighten lock nuts (2) in this position.
VG = Full load position
KD = Kickdown position



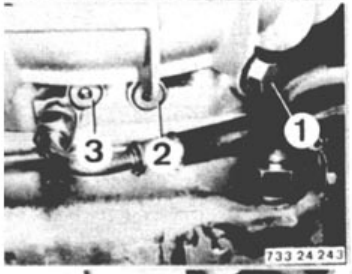
d) Adjusting Throttle Cable (BMW 524 td):

Version with pedal value sender.
Requirement: correct engine idle speed.
If not, adjust engine idle speed -- see 12 72 . . ..
Counterhold on nut (1).
Turn adjusting screw (2) until reversing lever (3) bears on stop (4).
Cable must not sag after this step.
Adjust play (S) between lead seal (6) and sleeve (7) to 0.50 ± 0.25 mm (0.020 + 0.010") by turning adjusting screw (5).
Check full throttle stop -- see 12 72 . . ..
Press accelerator pedal to final position (kickdown).
The distance from lead seal (6) to sleeve (7) must now be at least 44 mm (1.732").



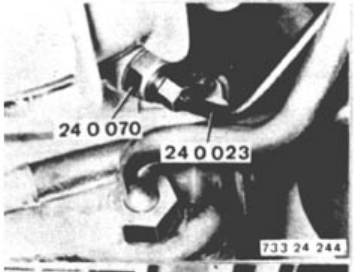
24 00 011 CHECKING HYDRAULIC PRESSURE VALUES

Connect Special Tools 24 0 021 and 13 3 061.

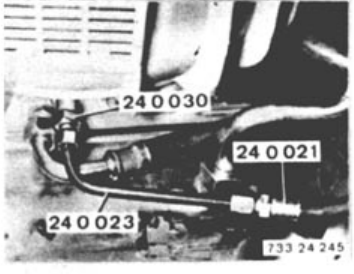


Remove pertinent plugs for testing.
1 Pump pressure
2 Clutch A
3 Converter pressure

Installation:
Tightening torque*.



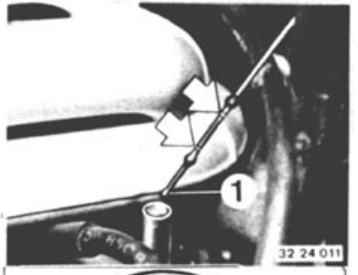
A) Pump Pressure:
Mount Special Tool 24 0 070 with a seal on the transmission.
Connect Special Tool 24 0 023 in conjunction with Special Tool 24 0 021.



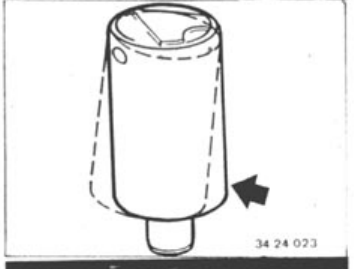
B) Converter Pressure:
Mount Special Tool 24 0 030 on the transmission.
Connect Special Tool 24 0 023 in conjunction with Special Tool 24 0 021.

* See Specifications

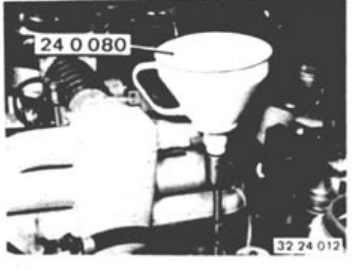
Test:	Pos.	Gear	Speed (rpm)	Pressure in bar (psi)
Pump pressure	D	1	700 ... 1000	6.0 ... 7.5 (85 ... 107)
		2, 3, 4	approx. 4000	4.6 ... 5.8 (65 ... 82)
	R	R	700 ... 1000	11 ... 13 (157 ... 185)
Converter pressure	D	4	Converter locked	max. 0.7 (10)



Check oil level with selector lever in P and engine running at idle speed, adding oil if necessary.
Car parked on level ground or floor.
Oil level should not be below ball (1) after a test drive and an oil temperature of approx. 40° C (105° F).
Oil level should be between min. and max. marks at an oil temperature of approx. 80° C (175° F).
Amount of oil between mic. and max. marks is approx. 0.3 ltr. (0.6 pint).
Never wipe off dipstick with a cloth losing lint.

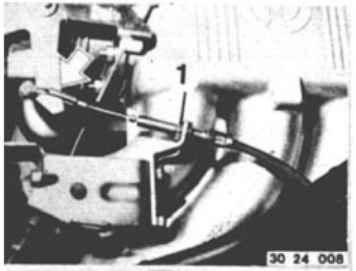


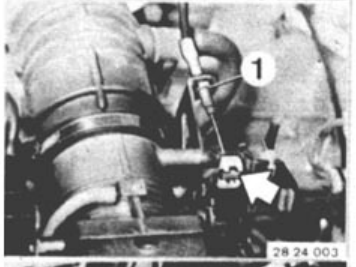
Important!
Oil Dipstick Version with Lock:
Oil dipstick can be pulled out only after tilting the grip.



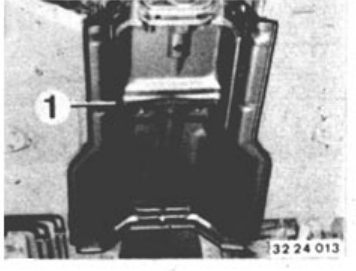
Important!
Oil Level Too High:
Strong foaming, splash loss, high temperature when driving fast, oil lost via vent.
Oil Level Too Low:
Valves rattling, foaming, engine slipping when driving in curves, general operating disturbances.

Only pour in ATF with Special Tool 24 0 080 (funnel).









24 00 022 REMOVING AND INSTALLING TRANSMISSION

Disconnect battery ground lead.

Important!
Disconnecting the battery will cancel fault memories of the control units. Consequently always first read fault memories with a tester and print any faults.

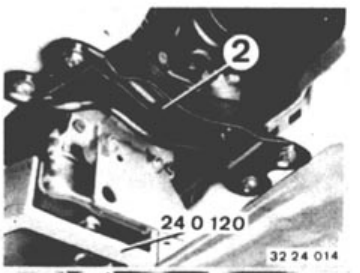
M 20 Engine:
Unscrew nut (1).
Disconnect throttle cable.

Installation:
Adjust throttle cable – see 24 00 006.

M 30 Engine:
Unscrew nut (1).
Disconnect throttle cable.

M 21 Engine:
Disconnect throttle cable.
Squeeze holders.
Pull out adjusting screw with throttle cable.

Remove exhaust assembly – see 18 00 020.
Remove heat shield (1).



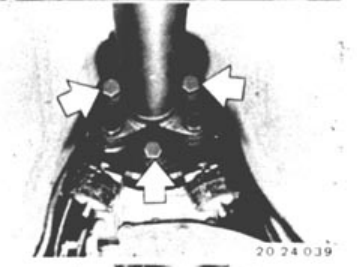
Support transmission from underneath with Special Tools 24 0 120 and 00 2 020.
Remove cross member (2).

Installation:
Center transmission – see Group 26.
Tightening torque*.

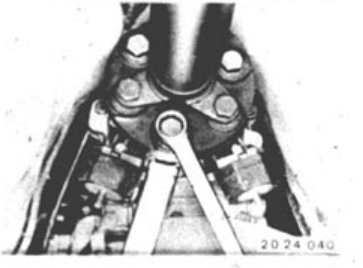


Version with Universal Joint:
Unscrew propeller shaft on transmission.

Installation:
Tighten nuts with specified tightening torque*.

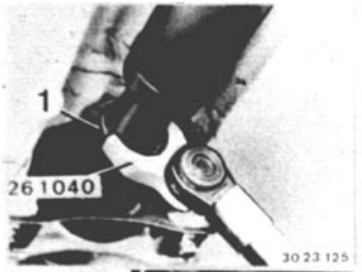


Version with Joint Disc:
Unscrew joint disc on transmission.



Installation:
Replace stop nuts.
Tighten nuts and bolts with a standard 17 mm wrench socket and a torque wrench.
Tightening torque*.

* See Specifications

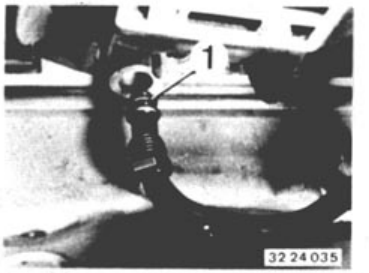


Version with Threaded Ring:
Loosen threaded ring (1) several turns.

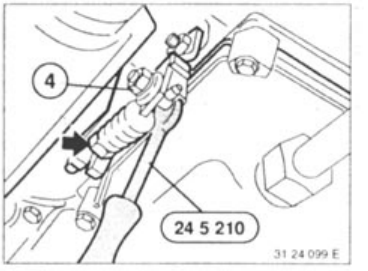
Installation:
Tighten threaded ring (1) after complete installation, using Special Tool 26 1 040.
Tightening torque*.



Unscrew center mount.
Installation:
Preload center mount in forward direction by distance (A).
With slide on center mount A = 4...6 mm
Without slide on center mount A = 2...4 mm
Bend propeller shaft down and pull it off of the transmission.
Important!
Prevent the propeller shaft from falling into the joints – suspend it from car on a piece of wire.
Tightening torque*.



Important! – Installation:
Check condition of O-rings (1), replacing them if necessary.



Unscrew nut (4) with selector lever in P.

Important!
Always counterhold on the bolt with Special Tool 24 5 210 to avoid deformation of the cable.
Note:
The special tool can only be applied with the selector lever in P.

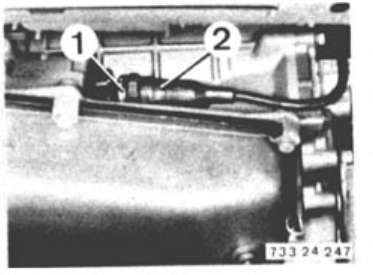
Unscrew cable from holder.
Pull cable out.

Installation:
Tightening torque*.
Adjust shift - refer to 24 00 006.



Drain ATF.
Important!
Never reuse drained ATF.
Installation:
If ATF has a burnt odor and is black, the transmission will have to be disassembled.
Important!
If transmission is faulty, clean oil cooler and pipes with compressed air and flush twice with ATF.
Remove oil filler pipe (1).
Unscrew oil cooler pipe at transmission.
Tightening torque*

* Refer to Specifications



Only for Version with EH Transmission or Kickdown Interlock:
Twist bayonet fastener (1) to the left.
Disconnect plug (2).
Pull wire harness out of the holder.

Installation:
Connect plug (2) that the marks are aligned.

* Refer to Specifications



M20 and M21 Engines:

Remove reinforcement.
Unscrew Torx bolts with a Torx wrench socket**.

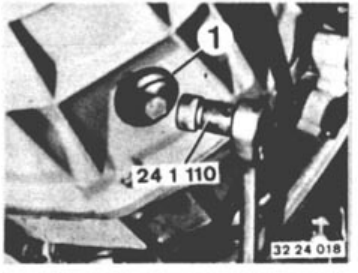
Important! – Installation:
Washers must be used with the Torx bolts to avoid increasing the breaking loose torque.
Tightening torque*.

Remove protective grid.



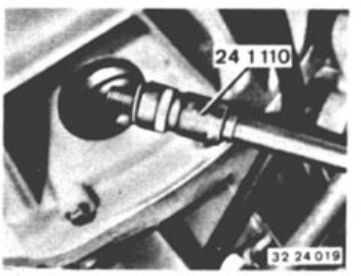
Unscrew torque converter from drive plate at three points, turning the flywheel for this purpose.

Important!
Only size M 10 x 16 mm bolts may be used together with spring washers.
Non-conformance would lead to destruction of the transmission.
Tightening torque*.



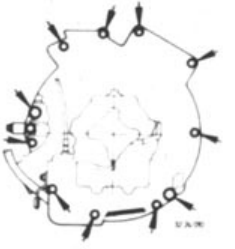
M30 Engines:

Remove cap from oil pan opening (1).
Unscrew torque converter from drive plate at three points, using Special Tool 24 1 110 and turning the flywheel for this purpose.



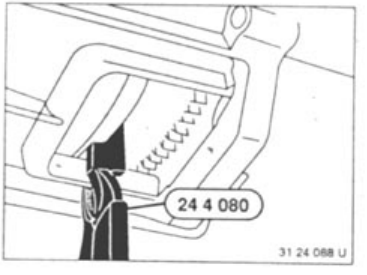
Installation:
Install and tighten bolts using Special Tool 24 1 110 and a torque wrench.
Tightening torque*.

!Important!
Only size M 10 x 16 mm bolts may be used together with spring washers.
Non-conformance would lead to destruction of the transmission.



Lower transmission as far as possible and unbolt it from the engine.
Unscrew Torx bolts with a Torx wrench socket.

Important! – Installation:
Washers must be used with the Torx bolts to avoid increasing the breaking loose torque.
Tightening torque*.

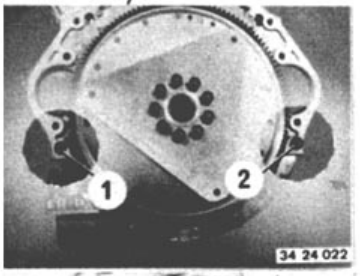


Apply and clamp Special Tool 24 4 080 on the transmission case to prevent the torque converter from sliding out.
Pull transmission off of the engine.

Important!
The special tool jack with mounted transmission may only be moved in completely lowered position.

* Refer to Specifications
** Source of Supply: BMW Parts

* Refer to Specifications

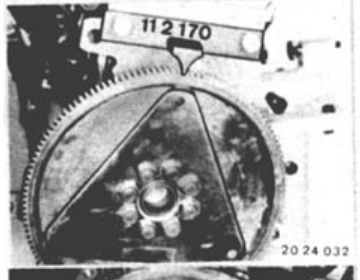


Important!
Ensure that dowel sleeves (1 and 2) are not missing prior to installation of the transmission.
If necessary, transfer the sleeves from the transmission or install new sleeves.



Important! – Installation:
Check installed position of the torque converter — the drive ring must be located below the case edge.

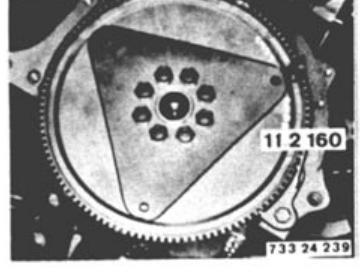
Note:
Ensure that the converter remains in the installed position while assembling, using Special Tool 24 4 080 to prevent it from sliding out if necessary.



Installation:
Check drive plate for breaks and cracks, replacing it if necessary.

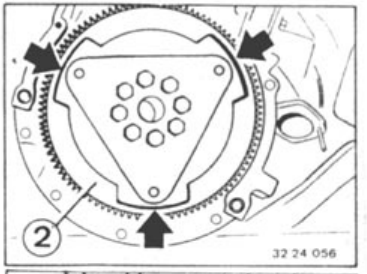
M20 and M21 Engines:
Hold flywheel using Special Tool 11 2 170.

Important!
Replace expansion bolts and install new bolts with a bolt cement**.
Only coat the threads.
Clean the tapped bores thoroughly.
Tightening torque*.



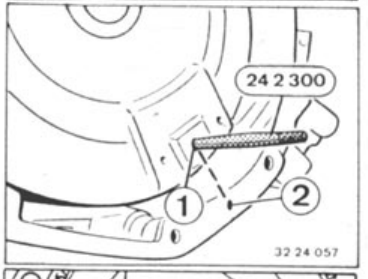
M30 Engines:
Hold flywheel using Special Tool 11 2 160.
Unscrew expansion bolts.

* Refer to Specifications
** Source of Supply: BMW Parts

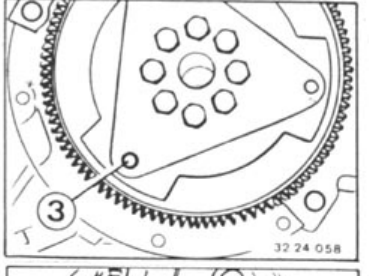


Version with Sheet Metal Flywheel (2):

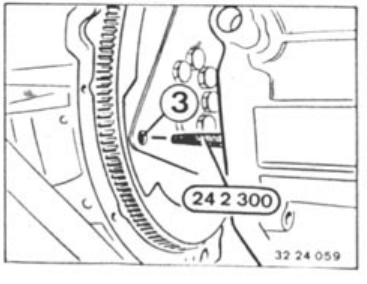
Important!
Keep to sequence of installation.
Sheet metal flywheel (2) has three indentations to take the mounting tabs of the torque converter.
The three mounting tabs of the torque converter must be aligned with the three indentations of the sheet metal flywheel while guiding the engine and transmission together.
Non-conformance will cause follow-up damage on the automatic transmission.
Cranking the torque converter or engine would no longer be possible after guiding together and leads to damage.



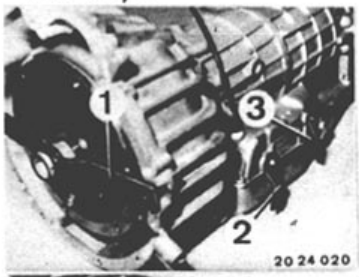
Turn the torque converter on the transmission to have hole (1) on the tab aligned with the 6 mm dia. bore (2) in the transmission case.
Screw Special Tool 24 2 300 into the tab.

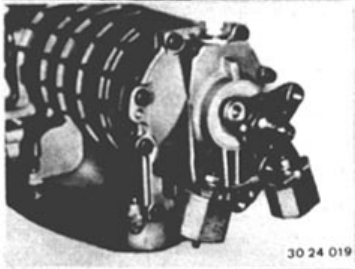


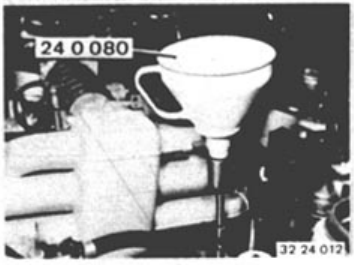
Bore (3) on the drive plate must point to the center of the oil pan opening.



Lift the automatic transmission until bore (3) in the drive plate is reached.
Guide the transmission into bore (3) of the drive plate carefully, using Special Tool 24 2 300.
Unbolt the transmission case from the engine.
Screw Special Tool 24 2 300 out of the tab towards the front.
Secure the torque converter.







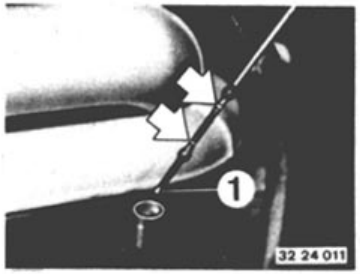
24 00 042 INSTALLING EXCHANGE TRANSMISSION

Remove transmission – see 24 00 022.

Important!
Always clean oil cooler and pipes with air pressure and flush twice with ATF before installing an exchange transmission.
Transmission identification* is on the data plate.
Transfer transporting holder (1), lever (2) and bracket (3).

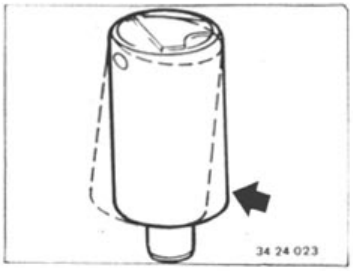
Transfer rubber mounts and exhaust holders.

Important! – Installation:
Automatic transmissions are supplied filled with oil.
Remove plug on oil sump prior to installation of the oil filler pipe.
Catch escaping ATF in a clean container.
Pour in ATF again with help of Special Tool 24 0 080 (funnel) after installation of the transmission.



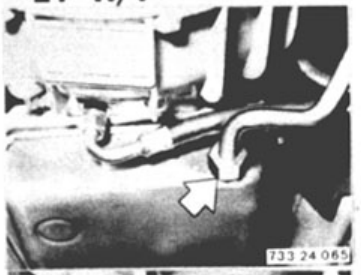
Check oil level with the selector lever in P, engine running at idle speed and car parked on level floor or ground, adding ATF if necessary.
Oil level should not be below ball (1) after a test drive and with a transmission oil temperature of approx. 40° C (105° F).
Oil level should be between the min. and max. marks with an oil temperature of approx. 80° C (175° F).
Amount of oil between the min. and max. marks is approx. 0.3 ltr. (0.6 pint).
Never wipe off the oil dipstick with a cloth losing lint.

Important!
Oil Level Too High:
Strong foaming, splash loss, high temperature when driving fast, oil lost via the vent.
Oil Level Too Low:
Valves rattling, foaming, engine slipping while driving in curves, general operating disturbances.

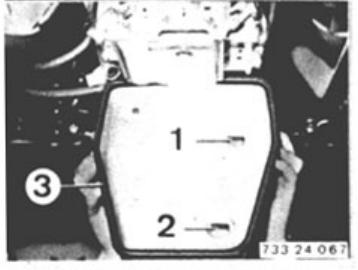


Important!
Oil Dipstick Version with Lock:
The oil dipstick can be pulled out only after tilting the grip.

* See Specifications







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 pitch black.

Unscrew oil filler pipe on the oil sump.
Unscrew oil sump.

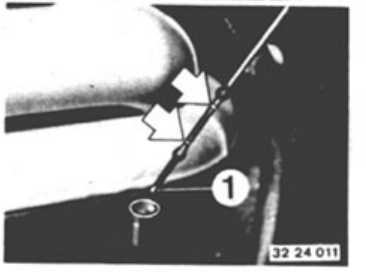
Installation:
Tightening torque*.

Installation:
Mount oil sump with the brackets in such a manner that the short leg presses on the oil sump.
Tightening torque*.
Important!
Both brackets with stright legs must be mounted on the sides.

Clean oil sump.

Important!
Place magnets (1 and 2) in the oil sump.
Install gasket (3).





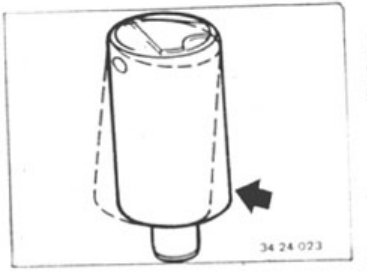
Pour in oil*.

Important!
Special Tool 24 0 080 (funnel) must always be used to pour in ATF.

Check oil level with the selector lever in P, engine running at idle speed and car parked on level floor or ground, adding ATF if necessary.
Oil level should not be below ball (1) after a test drive and with a transmission oil temperature of approx. 40° C (105° F).
Oil level should be between the min. and max. marks with an oil temperature of approx. 80° C (175° F).
Amount of oil between the min. and max. marks is approx. 0.3 ltr. (0.6 pint).
Never wipe off the oil dipstick with a cloth losing lint.

Oil Level Too High:
Strong foaming, splash loss, high temperature when driving fast, oil lost via the vent.

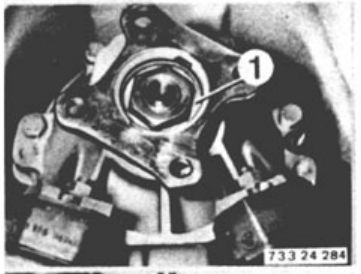
Oil Level Too Low:
Valves rattling, foaming, engine slipping and general operating disturbances.



Important!
Oil Dipstick Version with Lock:
The oil dipstick can be pulled out only after tilting the grip.

* See Specifications

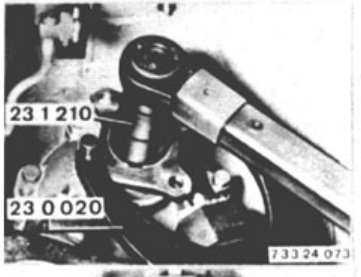
* See Specifications



24 11 052 REMOVING AND INSTALLING OR SEALING TRANSMISSION EXTENSION

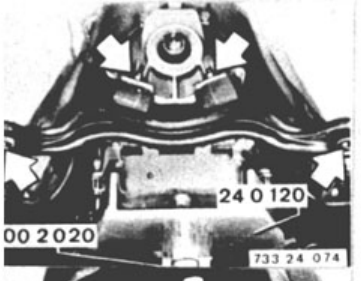
Unscrew propeller shaft - see 24 00 022.
Lift out lockplate (1).

Installation:
Replace lockplate.



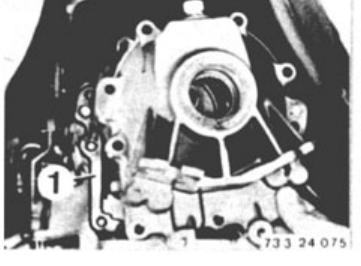
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.
Pull off output flange.

Installation:
Tightening torque*.



Support transmission with Special Tools 24 0 120 and 00 2 020.
Remove cross member with rubber mounts.
Lower the transmission.

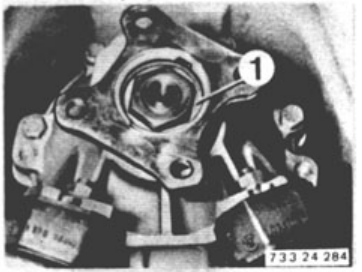
Installation:
Center transmission – see Group 26.
Tightening torque*.



Unscrew transmission extension.

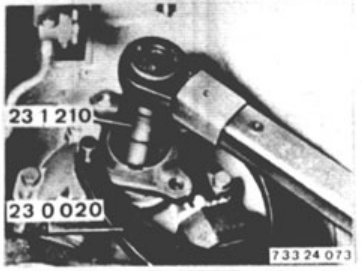
Installation:
Replace gasket (1).
Tightening torque*.

* See Specifications



24 12 013 REPLACING RADIAL OIL SEAL FOR OUTPUT FLANGE

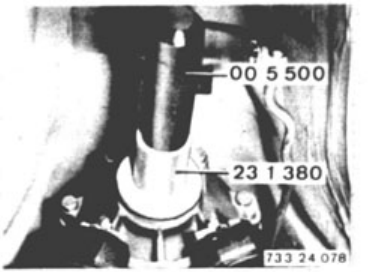
Unscrew propeller shaft – see 24 00 022.
Lift out lockplate (1).
Installation:
Replace lockplate.



Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.
Pull off output flange.
Installation:
Tightening torque*.



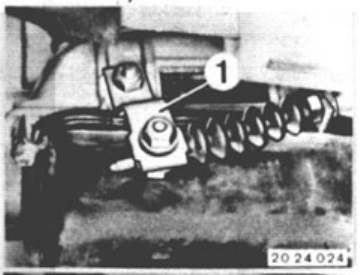
Pull out radial oil seal with Special Tool 00 5 010.



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 Construction Group Repair Manual.

* See Specifications



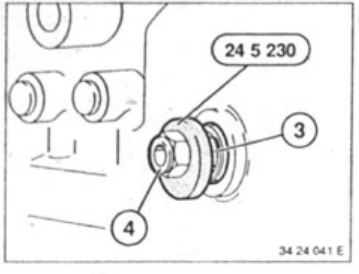
24 12 103 REPLACING RADIAL OIL SEAL FOR MANUAL SHIFT VALVE SHAFT

Unscrew selector lever (1) from the transmission.

Installation:
Tightening torque*.

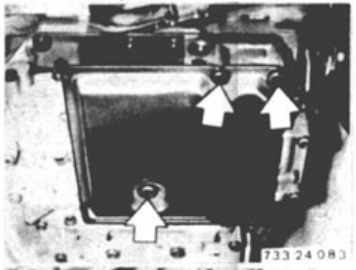


Lever radial oil seal (2) out using a narrow screwdriver.



Installation:
Lubricate the sealing lip of the radial oil seal with ATF.
Apply Special Tool 24 5 230 on the selector lever shaft.
Screw lever mounting nut (4) onto the shaft.
Press radial oil seal (3) in using Special Tool 24 5 230 and with help of the nut.

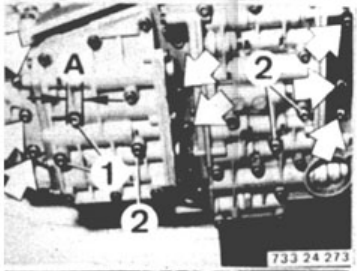
* Refer to Specifications



24 30 002 REMOVING AND INSTALLING VALVE BODY

Remove oil sump - see 24 11 002.
Remove oil filter screen.

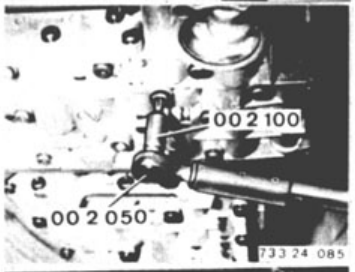
Installation:
Check length of bolts - 65 mm long.
Tightening torque*.



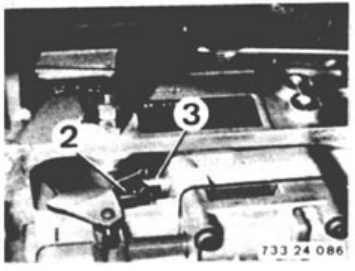
Remove valve body.
Unscrew Torx bolts with Special Tool 00 2 100.

Important!
Only unscrew bolts with bolt head size A = 12 mm.

Installation:
Bolts differ in length.
Bolts (1) = 65 mm long.
Bolts (2) = 60 mm long.

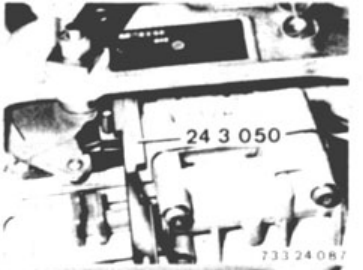


Installation:
Tighten Torx bolts with Special Tools 00 2 100 and 00 2 050.
Tightening torque*.

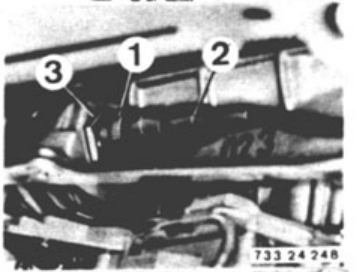


Installation:
Mount valve body that clamp on selector valve can be connected in operating finger of pawl.
This requires pulling the transmission cable slightly so that throttle cam (2) cannot clamp on throttle pressure valve (3).

* See Specifications



Install valve body and screw in bolts only finger tight.
Align valve body with Special Tool 24 3 050.
If this 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.



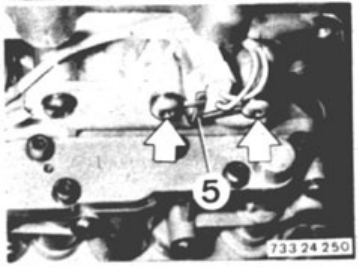
Only Version with EH Transmission or Kickdown Preventer:
Turn bayonet fastener (1) to the left.
Pull off plug (2).
Unscrew nut (3).

Installation:
Connect plug (2) in such a manner that the marking lines are aligned.



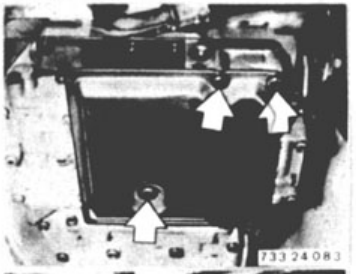
Pull out socket toward inside.

Installation:
Check O-ring (4), replacing if necessary.
Plug in socket with the flat side facing out.
Tightening torque*.



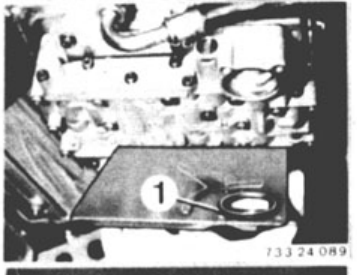
Note:
Also mount the pulse sender on the valve body.
Tabs on holder (5) must engage in the grooves of plug.

* See Specifications

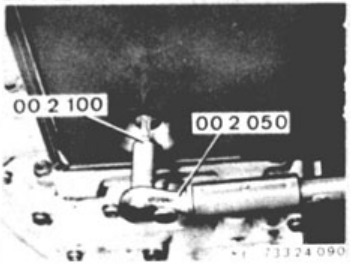


24 31 152 REMOVING AND INSTALLING OIL FILTER SCREEN ON VALVE BODY

Remove oil sump – see 24 11 002.
Remove oil filter screen.
Installation:
Clean oil filter screen.
Replace an oil filter screen when it starts to gum up with a burnt brown residue.
Check length of bolts – 65 mm (2.559").
Tightening torque*.

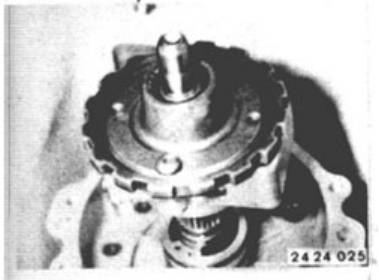


Check rubber ring (1), replacing if necessary.



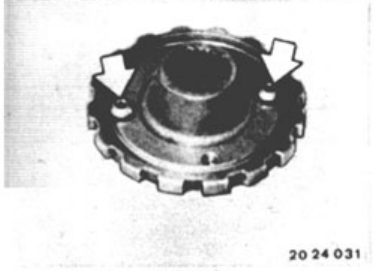
Installation:
Tighten Torx bolts with Special Tools 00 2 100 and 00 2 050.
Tightening torque*.

* See Specifications



24 32 002 REMOVING AND INSTALLING CENTRIFUGAL GOVERNOR

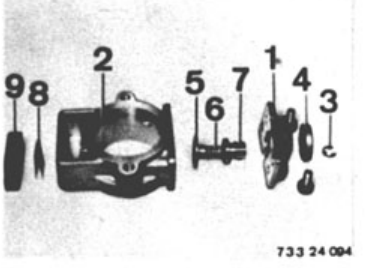
Remove transmission extension – see 24 11 052.
Pull off parking lock gear with centrifugal governor.



24 32 505 DISASSEMBLING AND ASSEMBLING CENTRIFUGAL GOVERNOR

–Centrifugal Governor Removed

Unscrew parking lock gear on centrifugal governor.
Installation:
Tightening torque*.



Unscrew cover (1) on case (2).
Lift out circlip (3) and remove washer (4).
Remove governor piston (5), spring (6) and governor bushing (7).
Installation:
Governor piston must slide easily in governor bushing.
Remove spring clip (8) and balance weight (9).

* See Specifications

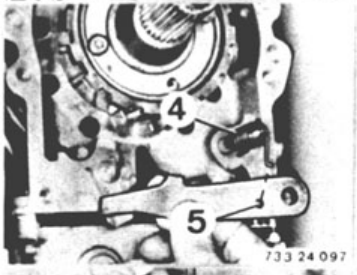


24 34 002 REMOVING AND INSTALLING PARKING LOCK PAWL

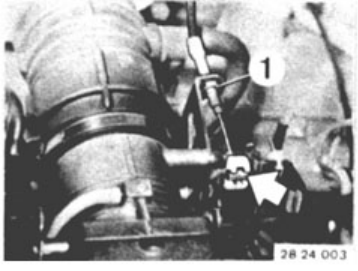
Remove transmission extension – see 24 11 052.
Loosen bolt (1).
Swing down holder (2).



Pull off pawl (3).
Caution!
Spring force.

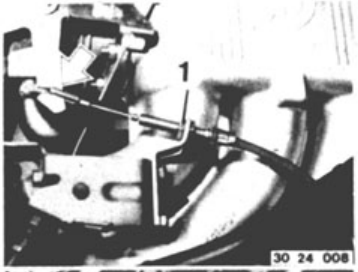


Installation:
Check installed position of spring (4).
It must be possible to connect end of spring (4) in bore (5) of pawl.



24 34 102 REPLACING THROTTLE CABLE

Engine M 30:
Unscrew nut (1) and disconnect throttle cable.



Engine M 20:
Unscrew nut (1) and disconnect throttle cable.



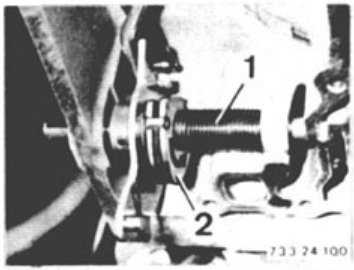
Engine M 21:
Disconnect throttle cable.
Compress retainers.
Pull out adjusting screw with throttle cable.



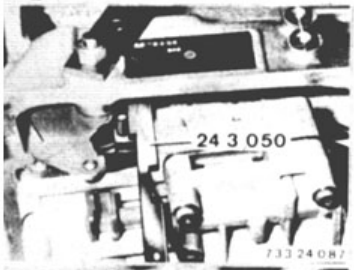
Remove valve body – see 24 30 002.
Disconnect throttle cable.



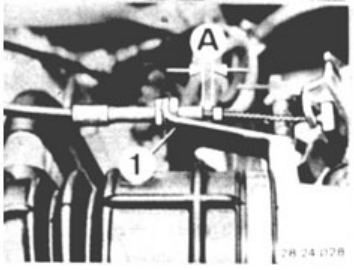
Press throttle cable out of case upwards.
Press new throttle cable into case until retainers engage.



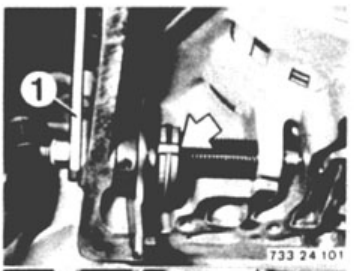
Preload spring (1) by one turn clockwise with throttle cam (2).
Connect nipple on throttle cam.



Install valve body.
Insert Special Tool 24 3 050 between valve body case and throttle pressure valve.
Push throttle cam against throttle pressure valve.

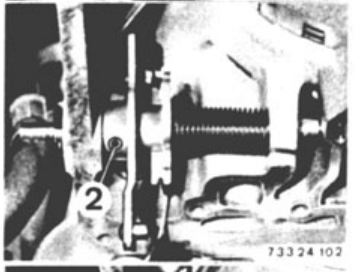


Connect throttle cable in suspension on transmission and holder (1).
Tighten cable.
Squeeze loose lead seal on cable at distance (A) = 0.25 to 0.50 mm (0.010 to 0.020").
Adjust throttle cable – see 24 00 006.
Distance (A) of the lead seal is the same for all other models.

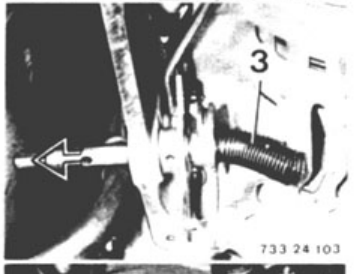


24 34 702 REPLACING SPRING FOR THROTTLE CABLE

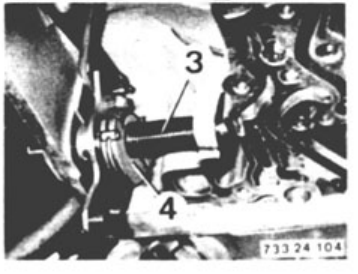
Remove valve body – see 24 30 002.
Disconnect selector lever (1) on transmission.
Disconnect throttle cable.



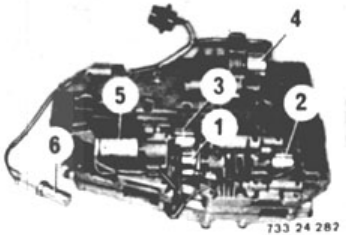
Drive out pin (2) in position N.



Pull out selector shaft far enough that spring (3) can be removed.

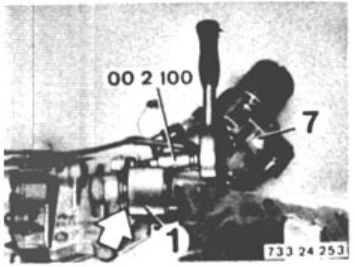


Installation:
Install selector shaft.
Preload spring (3) by one turn anticlockwise with throttle cam (4).
Connect nipple on throttle cam.

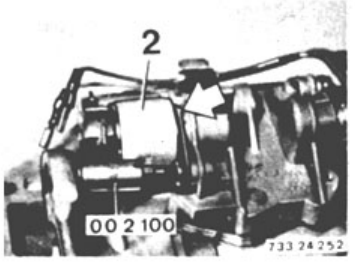


24 34 851 REPLACING ALL SOLENOID VALVES (EH)
– Valve Body Removed –

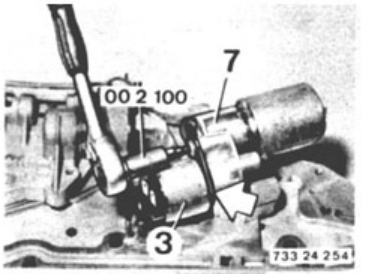
Testing – see BMW test plan in Group 24.
Arrangement:
1 Solenoid - 1st/2nd and 3rd/4th gears
2 Solenoid - 2nd/3rd gears
3 Solenoid - converter lockup clutch
4 Solenoid - reverse gear lock
5 Pressure regulator
6 Pulse sender



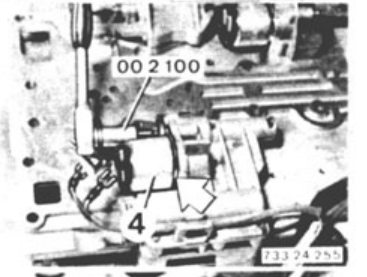
a) Solenoid (1) - 1st/2nd and 3rd/4th Gears:
Unscrew governor housing (7).
Pull off wire plug.
Unscrew Torx bolt with Special Tool 00 2 100.
Take off holder.
Pull out solenoid.
Installation:
Install holder with tabs facing collar on solenoid.
Arrow on housing must be between plug jacks.
Tightening torque*.



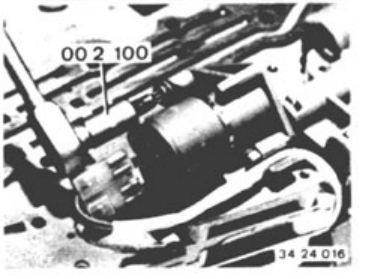
b) Solenoid (2) - 2nd/3rd Gears:
Pull off wire plug.
Unscrew Torx bolt with Special Tool 00 2 100.
Take off holder.
Pull out solenoid.
Installation:
Install holder with tabs facing collar on solenoid.
Arrow on housing must be between plug jacks.
Tightening torque*.



c) Solenoid (3) - Converter 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.
Arrow on housing must be between plug jacks.
Tightening torque*.



d) Solenoid (4) - Reverse Gear Lock:
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.
Arrow on housing must be between plug jacks.
Tightening torque*.

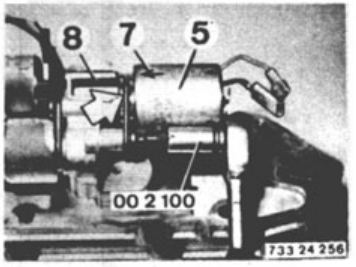


24 34 . . . REPLACING SOLENOID FOR KICKDOWN DOWNSHIFT PREVENTER
– Valve Body Removed –

Testing – see BMW test plan in Group 24.
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*.

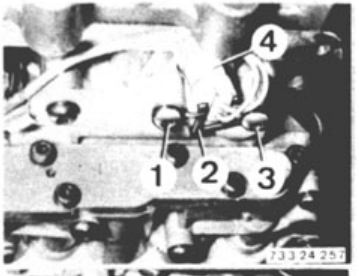
* See Specifications

* See Specifications



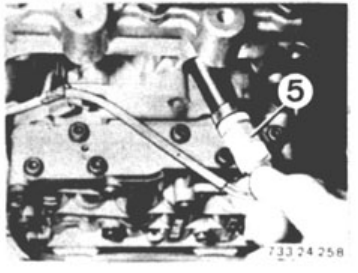
24 34 860 REPLACING PRESSURE REGULATOR
– Valve Body Removed –

Testing – see BMW test plan in Group 24.
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.
Tightening torque*.



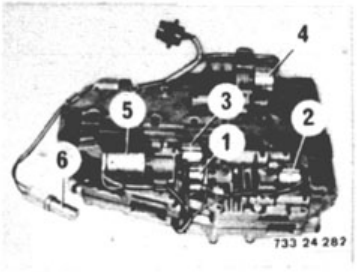
24 34 870 REPLACING PULSE SENDER
– Oil Sump Removed –

Testing – see BMW test plan in Group 24.
Unscrew Torx bolts (1 and 3) with Special Tool 00 2 100.
Take off holder (2).
Installation:
Engage tabs on holder (2) in grooves of plug (4).



Pull out pulse sender.
Pull off plug (5).
Installation:
Tightening torque*.

* See Specifications



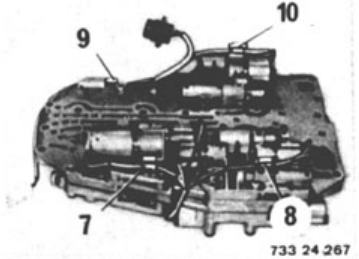
24 35 500 REPLACING WIRE HARNESS FOR EH AUTOMATIC TRANSMISSION

– Valve Body Removed –

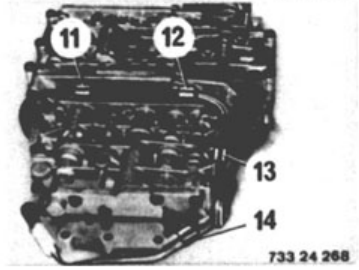
Pull off wire harness plugs on solenoids (1 ... 4), pressure regulator (5) and pulse sender (6).
Lift wire harness out of holders.

Installation:

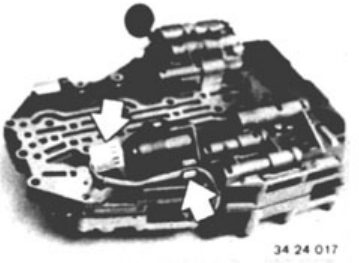
Check colors of wires.
Solenoid (1) – gray/violet
Solenoid (2) – green/violet
Solenoid (3) – red/violet
Solenoid (4) – orange/violet
Pressure regulator (5) – blue/violet
Pulse sender (6) – brown/brown
Push on plugs against the step and check for tight fit.



Route wire harness and clamp in holders (7 ... 10).



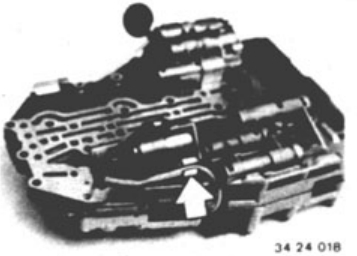
Turn valve body around.
Route wire harness and clamp in holders (11 ... 14).



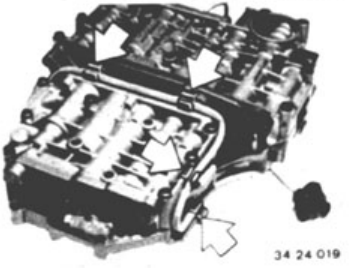
24 35 502 REPLACING WIRE HARNESS FOR KICKDOWN DOWNSHIFT PREVENTER

– Valve Body Removed –

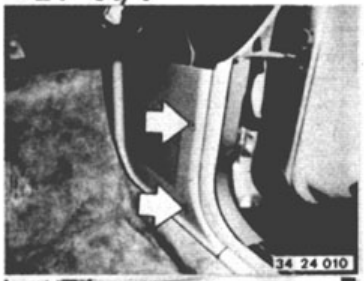
Pull off plug on solenoid.
Lift wire harness out of holders.



Route wire harness and clamp in holders.



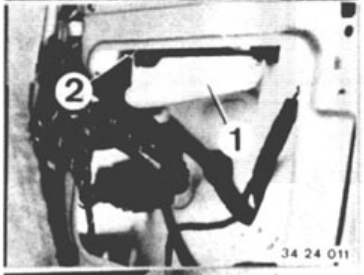
Turn valve body around.
Route wire harness and clamp in holders.



24 61 500 REMOVING AND INSTALLING OR REPLACING CONTROL UNIT (EH)

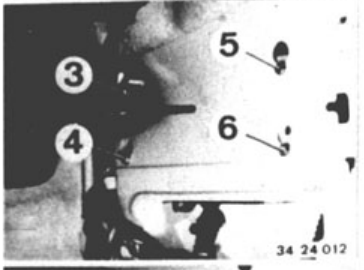
Control unit for the EH transmission is located in the right A-pillar.

Remove glove box – see 51 16 360.
Unscrew cover for radio speaker.
Pull off electric leads for radio speaker.

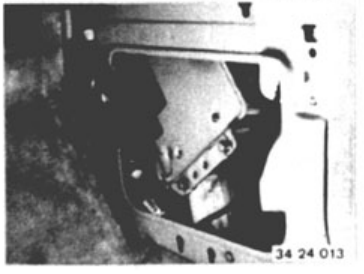


Pull off plug (1) on control unit, turning back spring retainer (2) for this purpose.

Important!
The ignition must always be turned off first prior to disconnection or connection of the plug.



Unscrew holder for insulation sheet.
Only loosen screws (3 ... 6).

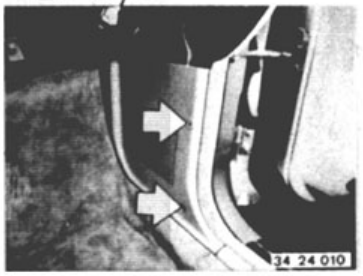


Lift and take out control unit toward the rear.



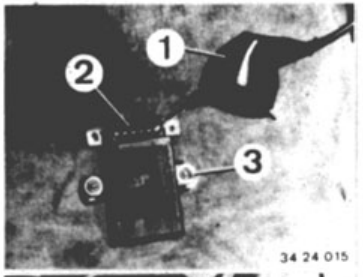
735 24 016

Check code letter on the data plate.
Refer to the Parts Catalog for a cross reference of types and models.

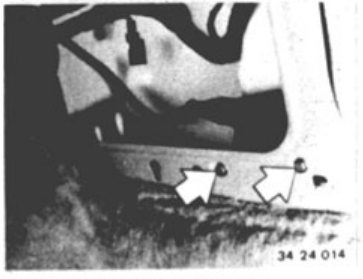


24 61 012 REPLACING CONTROL UNIT
24 61 014 FOR DOWNSHIFT PREVENTION (EH)

Testing – see BMW Test Plan in Gr. 24.
The downshift prevention control unit prevents racing of the engine when operating the kickdown with the selector lever in D and at top speed.
Downshift from 4th to 3rd gear is prevented by a solenoid in the transmission depending on the speedometer signal.
Downshifting is possible only after reduction of the road speed.
When accelerating there is automatic upshifting from 3rd to 4th gear prior to the governed speed of the engine.
Location: right A-pillar below the AEGS control unit.
The downshift prevention control unit is not installed since 8.88.
The DME control unit is used to activate the solenoid.



Unscrew cover for radio speaker.
Pull off electric leads for radio speaker.



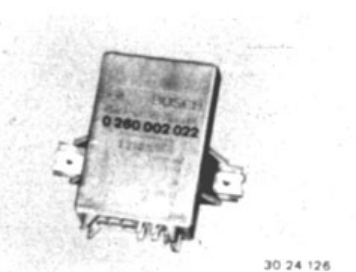
Unscrew control unit on body.



Pull off protective cap (1) and plug (2).
Unscrew holder (3).

Downshift Prevention Control Unit Identification:

Model/ Transm. Version H	Bosch Number
520 iA, 524 tdA	0 260 002 051
525 iA	0 260 002 032
530 iA	0 260 002 020



Downshift Prevention Control Unit Identification:

Model/ Transm. Version EH	Bosch Number
520 iA	0 260 002
525 iA	
530 iA	
535 iA	

Replace kickdown switch – see 35 41 480.
Replace program switch – see 61 31 265.

Note:
See self-diagnosis or test plan for troubleshooting and testing electronic components.

TROUBLESHOOTING AUTOMATIC TRANSMISSION – 4 HP 22 / H + EH

Condition	Cause	Correction
Position P		
Park will not engage	Selector linkage between selector lever and transmission maladjusted	Adjust – see 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 – see 24 00 006
Engine cannot be started in N or P, or can be started in all positions	Selector linkage between selector lever and transmission maladjusted	Adjust – see 24 00 006
	Transmission switch faulty	Replace transmission switch 25 16 080
	Starter interlocking relay or supply lead faulty	Repair/replace relay or supply lead
Position R		
No reverse gear	Selector linkage between selector lever and transmission maladjusted	Adjust – see 24 00 006
	Oil filter screen dirty	Replace oil filter screen; replace transmission in case of liner remainders 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 position 1, 1st gear	Disassemble clutches 24 23 022
	Clutch E destroyed, in this case also no engine braking in 2nd and 3rd gears as well as in position 1, 1st gear	Disassemble clutches 24 23 022
	Reverse gear arrest does not cancel	Check transmission electronics. Replace control unit 24 30 002
Slipping or shaking when moving off	Clutch B or E or brake D damaged	Disassemble clutches 24 23 022

TROUBLESHOOTING AUTOMATIC TRANSMISSION – 4 HP 22 / H + EH

Condition	Cause	Correction
Hard engaging jolt P–R or N–R or definite double knock for P–R or N–R shift (engine speed < 1500 rpm)	Damper B defective. In this case shift 2–3 also not correct	Replace control unit 24 30 002. Check transmission electronics
Backup lights do not come on (electrical system okay)	Transmission switch faulty	Replace transmission switch 25 16 080
Car moves or creeps	Selector linkage between selector lever and transmission maladjusted	Adjust – see 24 00 006
	Clutch A faulty (bonded)	Replace clutch A – see 24 23 022
Position D		
No power flow	Oil filter screen dirty	Replace oil filter screen 24 31 152; exchange transmission in case of liner remainders in oil sump
	Clutch A defective	Replace clutch A – see 24 23 022
	1st gear one-way clutch slips	Disassemble transmission 24 00 082
	Selector linkage between selector lever and transmission maladjusted	Adjust selector lever 24 00 006
Slipping or shaking when moving off	Clutch A damaged	Replace clutch A – see 24 23 022
Hard engaging jolt N–D (engine speed < 1500 rpm)	Clutch A damaged	Replace clutch A – see 24 23 022
	Damper A faulty	Replace valve body 24 30 002
No shift (warm or cold state)	Kickdown switch faulty (only kickdown shifts)	Replace kickdown switch 35 41 480
– Shift 1–2 / 2–1	Transmission electronics faulty	Check transmission electronics
	Solenoid valve (1) faulty	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
	Governor dirty	Clean or replace governor 24 32 002
– Shift 1–2	Brakes C' and/or C faulty	Disassemble clutches 24 23 022

Condition	Cause	Correction
– Shift 2–3 / 3–2	Solenoid valve (2) faulty	Replace solenoid valve 24 34 851
	Shift valve 2–3 seized	Replace valve body 24 30 002
– Shift 2–3	Clutch B faulty	Replace clutch B – 24 23 022
– Shift 3–4 / 4–3	Solenoid valve (1) faulty	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
	Governor dirty	Clean or replace governor 24 32 002
No shift (warm or cold state)	Brake F faulty	Disassemble clutches 24 23 022
– Shift 3–4	Program switch faulty	Replace program switch 61 31 265
– Shift 1–2 Engine speed does not exceed stall speed in drive and full load	Pulse transmitter faulty	Replace pulse transmitter 24 34 870
Car moves off in 2nd gear	Transmission electronics faulty	Check transmission electronics
	Solenoid valve (1) faulty	Replace solenoid valve 24 34 851
	Shift valve 1–2 seized	Replace valve body 24 30 002
	Governor bushing seized	Clean or replace governor 24 32 002
Car moves off in 3rd gear	Transmission electronics faulty	Check transmission electronics
	Solenoid valve (1 or 2) faulty	Replace solenoid valve 24 34 851
	Shift valve 1–2 and 2–3 seized	Exchange valve body
	Governor bushing seized	Clean or replace governor 24 32 002
Car shifts 1–3	Shift valve 2–3 seized	Replace valve body 24 30 002
	Transmission electronics faulty	Check transmission electronics
	Solenoid valve (2) faulty	Replace solenoid valve 24 34 851

Condition	Cause	Correction
Shift Points		
Zero load shift not okay	Control unit faulty	Replace control unit 24 61 000
Full load shift points not okay	Full load signal missing	Check throttle valve switch 13 63 544
	Throttle cable not okay	Check or adjust throttle cable 24 00 006
No kickdown shift	Kickdown shift faulty	Replace switch 35 41 480
	Throttle cable kickdown adjustment not correct	Adjust throttle cable kickdown 24 00 006
Only zero load shifts	Zero load switch on engine faulty	Check or replace zero load switch 13 66 554
Only kickdown shifts	Kickdown switch faulty	Replace switch 35 41 480
Shift Transitions		
Zero load shifts too hard	Control unit faulty	Replace control unit 24 61 000
	Damper faulty	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 faulty	Replace control unit 24 61 000
	Damper faulty	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 not correct	Replace valve body 24 30 002
	Damper faulty	Replace valve body 24 30 002
	Control unit faulty	Replace control unit 24 61 000

Condition	Cause	Correction
Position 3, 3rd Gear		
No engine braking	Clutch E damaged	Disassemble clutches 24 23 022
Position 2		
Manual downshift 3–2 not okay	Locking valve 2 sticks	Replace valve body 24 30 002
	Governor sticks	Replace governor 24 32 002
	Transmission electronics faulty	Check transmission electronics
	Solenoid valve (2) faulty	Replace solenoid valve 24 34 851
No engine braking	Brake C' or clutch E damaged	Disassemble clutches 24 23 022
Position 1		
Manual downshift 2–1 not okay	Locking valve 1 sticks	Replace valve body 24 30 002
	Governor sticks	Replace governor 24 32 002
	Transmission electronics faulty	Check transmission electronics
	Solenoid valve (1) faulty	Replace solenoid valve 24 34 851
No engine braking	Brake D or clutch E damaged	Disassemble clutches 24 23 022
Torque Converter Lockup Clutch		
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 okay	Replace governor 24 32 002
	Control unit faulty	Replace control unit 24 61 000
Shift transition too hard	Converter damper faulty	Replace control unit 24 30 002
	Converter not okay (converter lockup clutch)	Replace converter 24 40 003

Condition	Cause	Correction
No shift	Valve body not okay	Replace valve body 24 30 002
	Converter faulty	Replace converter 24 40 003
	No 4th gear	Replace valve body 24 30 002
	Transmission electronics faulty	Check transmission electronics
	Solenoid valve (3) faulty	Replace solenoid valve 24 34 851
	Converter faulty	Replace converter 24 40 003
Converter lockup clutch always closed (engine dies in driving position)	Transmission electronics faulty	Check transmission electronics
	Solenoid valve (3) faulty	Replace solenoid valve 24 34 851
General Information		
Shifts only as position	Transmission electronics faulty	Check transmission electronics
	Program switch faulty	Replace program switch 61 31 265
Fault indicator lighted	Transmission electronics faulty	Check transmission electronics
	Solenoid valve (2) faulty	Replace solenoid valve 24 34 851
Fault indicator lights up while driving	Transmission electronics faulty	Check transmission electronics
	Plug on transmission has poor contact	Check plug connection
Noise and then power flow interruption after long drive	Oil filter screen on valve body dirty	Only replace oil filter screen when there are no burnt clutch liners in oil sump; otherwise exchange transmission
No power flow in 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		
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

Condition	Cause	Correction
Loud, screeching noise depending on speed in all positions, especially with warm oil, occurring after a long drive and sometimes accompanied by power flow interruptions	Oil filter screen dirty	Only replace oil filter screen when there are no clutch liners in oil sump; otherwise exchange transmission
Loud noise when converter lockup clutch closes	Torsion damper faulty	Replace converter 24 40 003
Leakage		
Oil dripping out of converter bell housing	Seal in pump housing damaged	Replace seal 24 31 002
	Pump housing leaks	Replace pump assembly 24 31 002
	Converter leaking at welded seam	Replace converter 24 40 003
	Radial oil seal for torque 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*
	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*
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 lost through or on vent	Oil level too high	Correct oil level
	Wrong oil (strong foaming)	Replace oil, if necessary remove transmission and drain complete oil including the torque converter oil
	Vent cap missing	Install cap or replace vent
	O-ring on vent damaged	Unscrew transmission extension – replace O-ring
	Preload of circlip insufficient	Replace circlip

* See Specifications for tightening torque

Condition	Cause	Correction
Oil lost on cooler pipes	Connections loose	Tighten bolts*
	Cooler pipe damaged	Replace cooler pipe
	Cooler leaks	Replace cooler 17 11 000
Oil lost on transfer plate	Plug on transfer plate leaks	Tighten plug*
		Replace seal
Leak between transmission case and transmission extension	Mounting bolts loose	Tighten bolts*
	Gasket damaged	Replace gasket 24 11 052

* See Specifications for tightening torque

TROUBLESHOOTING VALVE BODY FOR 4 HP 22 / EH

Note:
Also refer to self-diagnosis or test plan for troubleshooting and testing electronic components.

Condition	Cause	Correction
Position R		
No reverse gear	Solenoid (4) faulty	Replace solenoid valve 24 34 851
	Wire to solenoid (4) grounded out	Replace wire harness 24 35 500
	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 sender faulty	Replace pulse sender 24 34 870
	Wire to pulse sender grounded out	Replace wire harness 24 35 500
No shift function 1–2 / 2–1	Solenoid (1) faulty	Replace solenoid valve 24 34 851
	Wire to solenoid (1) grounded out	Replace wire harness 24 35 500
	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) faulty	Replace solenoid valve 24 34 851
	Wire to solenoid (2) grounded out	Replace wire harness 24 35 500
	Shift valve 2–3 seized	Replace valve body 24 30 002
No shift function 3–4 / 4–3	Solenoid (1) faulty	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 faulty	Replace pressure regulator 24 34 860
	Wire to pressure regulator grounded out	Replace wire harness 24 35 500
	Damper faulty	Replace valve body 24 30 002
	Modulation valve, pressure reducing valves 1 and 2 stick	Replace valve body 24 30 002
Upshifts 1–2 / 2–3 / 3–4 too hard	Pressure regulator faulty	Replace pressure regulator 24 34 860
	Modulation valve sticks	Replace valve body 24 30 002
	Damper faulty	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' faulty	Replace valve body 24 30 002

Condition	Cause	Correction
Position 1		
Manual downshift 2-1 not okay	Pressure regulator faulty	Replace pressure regulator 24 34 860
	Damper D faulty	Replace valve body 24 30 002
	Modulation valve sticks	Replace valve body 24 30 002
Converter Lockup Clutch		
No converter clutch locking	Solenoid (3) faulty	Replace solenoid valve 24 34 851
	Converter clutch damper faulty	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) faulty	Replace solenoid valve 24 34 851
	Wire to solenoid (3) grounded out	Replace wire harness 24 35 500
Main pressure too high in all positions	Pressure regulator faulty	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

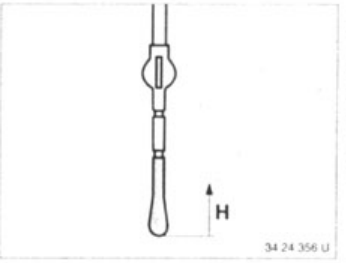
24 Automatic transmission

A4S 270 R / 310 R

00 11 239	Oil change in automatic transmission	24- 0/21
24 00 005	Shift lever – adjust	24- 0/23
015	Hydraulic pressure values – check	24- 0/24
025	Automatic transmission – remove and install	24- 0/25
045	Exchange transmission – install	24- 0/28
600	Converter bell housing and spring in selector unit – replace intermediate case – seal	24- 0/29
601	Converter bell housing – replace intermediate case – seal	24- 0/29
24 11 007	Transmission oil sumps, both – remove and install/seal or replace	24- 11/21
055	Transmission extension – remove and install/seal	24- 11/23
575	Converter bell housing – remove and install/seal	24- 11/24
24 12 015	Radial oil seal for output flange – replace	24- 12/21
105	Radial oil seal for manual shift valve shaft – replace	24- 12/21
505	Radial oil seal for torque converter (transmission removed) – replace	24- 12/24
24 31 155	Transmission oil strainer – remove and install or replace	24- 31/21
24 34 856	Solenoid valves, all – replace	24- 34/21
865	Pressure regulator for selector unit – replace	24- 34/23
875	Pulse generator (for output speed) – replace	24- 34/23
24 35 505	Wiring harness in automatic transmission – replace	24- 35/21
24 40 005	Torque converter – remove and install or replace	24- 40/21
24 61 500	Control unit – remove and install or replace	24- 61/21
	Automatic transmission THM-R1 – troubleshoot	24- 90/21

00 11 239 Oil change in automatic transmission

Ensure that transmission is at full operating temperature before changing fluid.



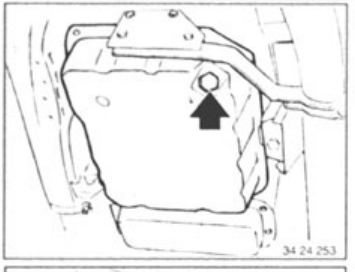
Run engine at idle speed in selector lever setting "P" or "N".
Car must be unladen and standing on a level surface.
Interrogate ATF temperature with Service Tester or Modic (see Troubleshooting Manual).
Pull oil dipstick out and measure fluid level.
Compare measured level with value in the following table.
Wipe dipstick clean with a lint-free cloth.



Version with oil filler pipe:

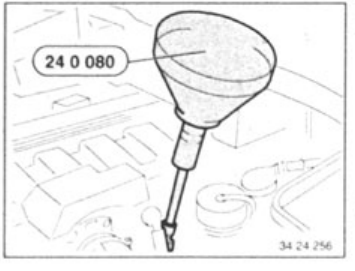
Extract dipstick.

Caution!
Locking dipsticks:
Tilt the handle to unlock dipstick for removal.



Remove drain plug (1).
Drain off fluid.

Installation instruction:
Replace seal.
Tightening torque 24 11 6AZ*



Top up ATF fluid** using special tool 24 0 080.
Volume of ATF*.

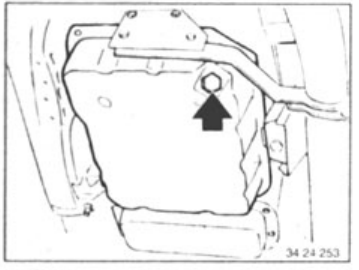
* See Technical Data
** For grade of ATF fluid, see Consumables Specifications

Oil temperature + °C	Fluid level = H mm Min.	Max.
20	3	15
25	5	17
30	8	20
35	11	22
40	13	25
45	14	26
50	16	27
55	17	28
60	19	29
65	21	32
70	22	34
75	24	36
80	26	38
85	29	41
90	31	43

* Refer to Specifications

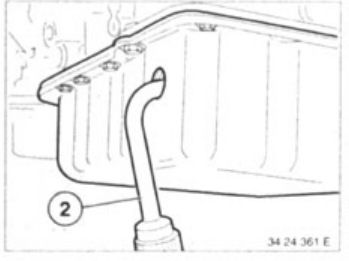
Version without oil filler pipe:

With effect from 2.91 the oil filler pipe was discontinued.
Use the filler opening on the lower side of the oil pan to replenish ATF.



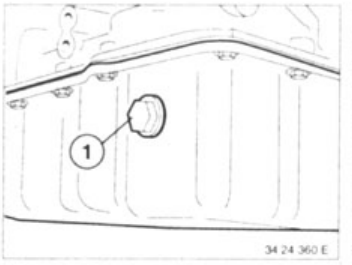
Remove drain plug (1).
Drain off fluid.

Installation instruction:
Replace seal.
Tightening torque 24 11 6AZ*



To fill, attach filler neck (2)** to filler aperture.
Add ATF until it overflows.
Screw in filler plug.
Tightening torque 24 11 7AZ*.

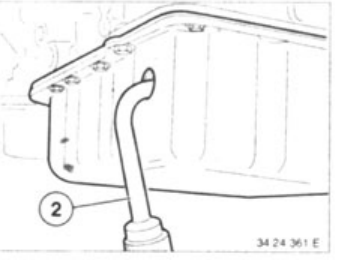
* Refer to Specifications
* Source of Supply: BMW Parts Service



Check ATF level, correcting if necessary.

Car must be unladen and standing on a level surface.
Only check fluid level when transmission fluid temperature lies between 30...55° C.
Interrogate ATF temperature with Service Tester or MoDiC (refer to Troubleshooting Manual).
Run engine at idle speed with selector lever in setting "P" or "N".
Unscrew filler plug (1).

Installation instruction:
Check seal, replacing if necessary.



Drain excessive ATF or add ATF if insufficient.
To top up ATF, attach filler neck (2)** to filler aperture.
Add ATF until it overflows.
Screw in filler plug.Tightening torque 24 11 7AZ*.

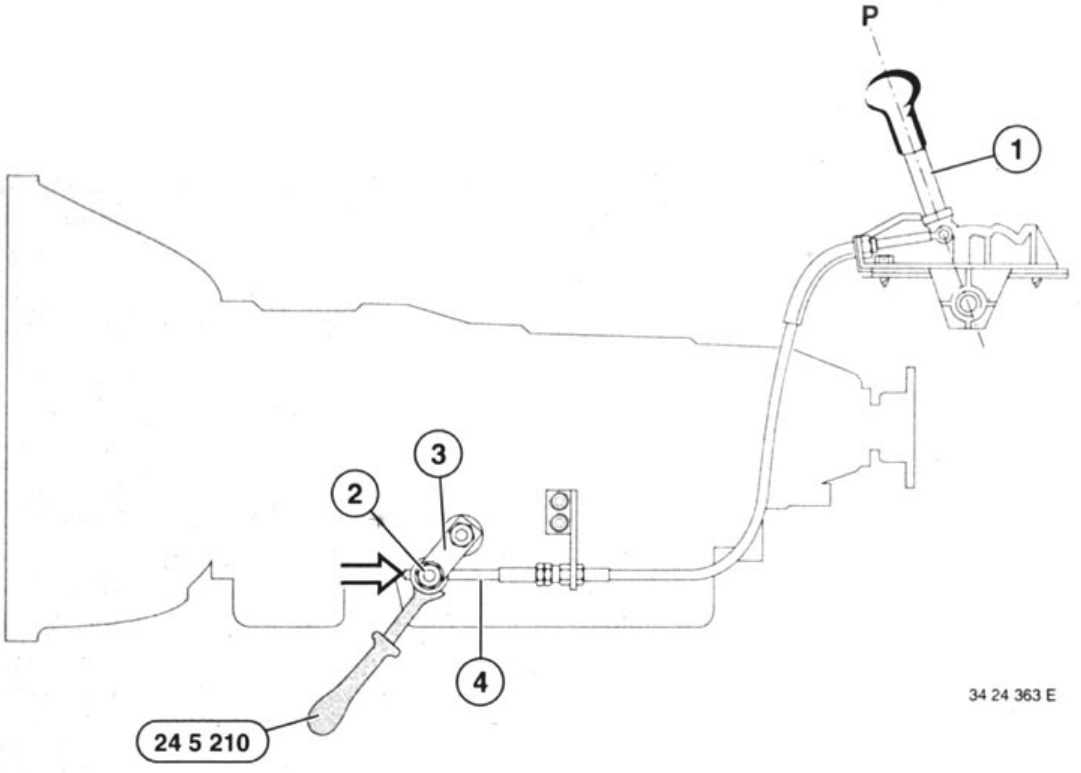
ATF level too high:
Strong foaming, loss through splashing, high temperature when driving fast.
Fluid loss through vent.

ATF level too low:
Valve rattle, foaming, transmission slip.
Generai operating disturbances.

* Refer to Specifications

24 00 005 Adjusting gearshift lever

Getriebe A4S 310 R



Set gearshift lever (1) to "P".
Release nut (2).

Caution!
In order to avoid deforming the operating cable, the clamping screw must be held with the special tool 24 5 210.

Note:
The special tool 24 5 210 can only be fitted in position "P".

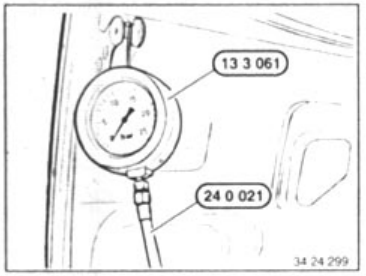
Press forward lever (3) (park position).

Press operating cable rod (4) opposite forward direction and release again.

Firmly secure operating cable rod (4) with nut (2) (held with special tool 24 5 210).

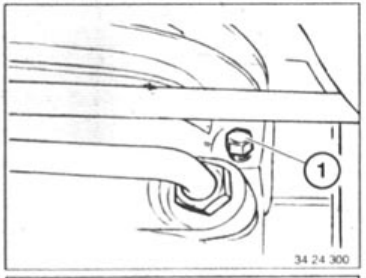
For tightening torque 24 51 1AZ *.

* Refer to Technical Data



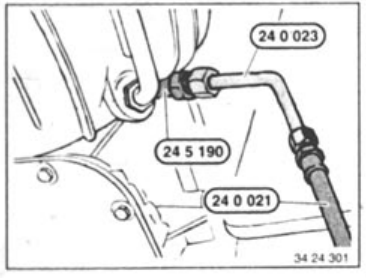
24 00 015 Checking hydraulic pressure values

Connect hose 24 0 021 to pressure gage 13 3 061.



Unscrew and remove plug (1) from the converter bell housing to check the main pressure.

Caution!
Inch threads.



Screw in and tighten special tool 24 5 190 (adapter).
Secure pipe manifold 24 0 023 to adapter and connect to hose 24 0 021.

Start engine.
Selector lever setting "P" or "N".
Engine speed > 1500 rpm.
Read off main pressure on pressure gage.
Main pressure specification: 9.6 ...10.5 bar.

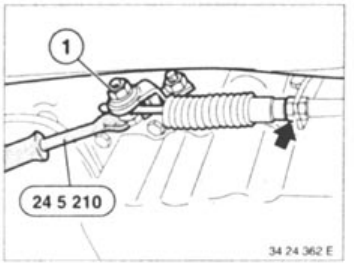
24 00 025 Removing and installing transmission

Disconnect negative lead.

Caution!
First read fault memories with tester and print any faults as disconnecting the negative lead will cancel the fault memories in the control units.
Use tester to read out fault memories and print out data on any errors prior to disconnecting battery.

Remove propshaft from transmission and center mount and fasten to one side.
Refer to 26 11 000

Note:
On version with two center mounts, only disconnect front center mount.



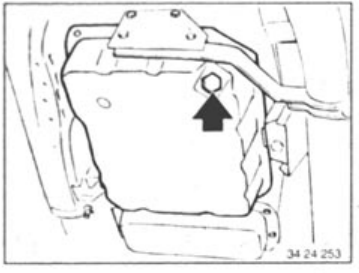
o Remove selector lever

Move selector lever into setting "P".
Unscrew nut (1).

Caution!
Always counterhold bolt with special tool 24 5 210 to avoid deformation of the cable.

Note!
The special tool can only be fitted in setting "P".
Unscrew cable from holder.
Pull out cable.
Tightening torque 25 16 2AZ*.

Installation instruction:
Adjust selector lever - see 24 00 006.

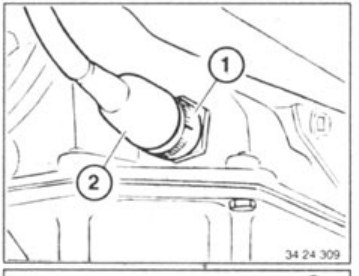


Drain oil.
Never reuse drained ATF.

Note:
Replace the transmission if the ATF smells burnt and is black.

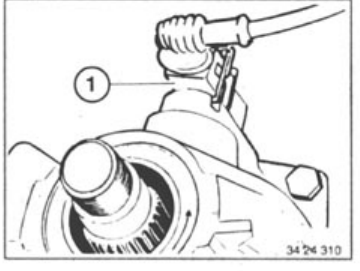
Caution!
Clean oil cooler and pipes with compressed air and flush twice with ATF if the transmission is faulty.

Installation instruction:
Replenishing ATF, see 00 11 239



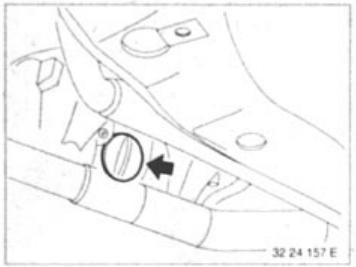
Turn bayonet lock (1) counter-clockwise.
Pull off plug (2).
Lift cable harness out of holder.

Installation instruction:
Fit plug (2) in such a way that marking lines are aligned with one another.



Pull plug (1) off of speed sender.

* Refer to Specifications



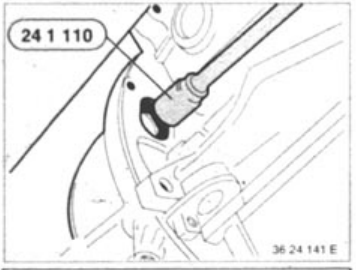
o Unfasten torque converter screw connection

Lift cover off aperture for torque converter screw connection.

Note:
This aperture, depending upon model variant, is usually located under the engine oil sump.



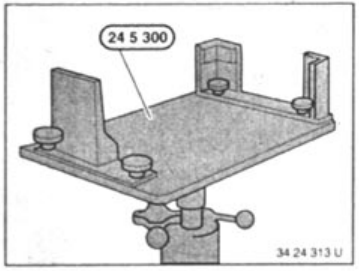
Or in the side cover plate under the exhaust manifold.



Unfasten the screw connections on the torque converter using special tool 24 1 110.
To do this, keep rotating engine as far as next screw by turning the central screw on the crankshaft.

Caution!
Only use original bolts.

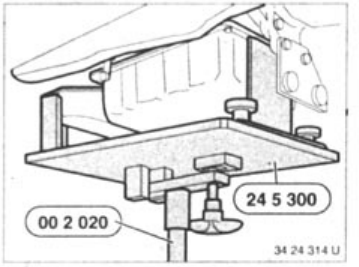
Installation instruction:
Tightening torque 24 40 1AZ*



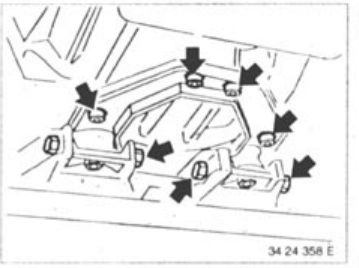
o Lower transmission

Preassemble fixture 24 5 300 to suit THM-R1 transmission as marked.

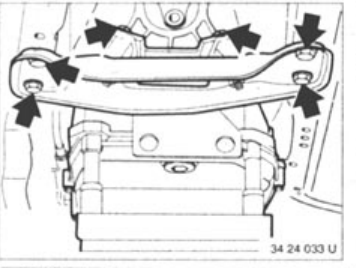
* Refer to Specifications



Support transmission from underneath with special tools 24 5 300 and 00 2 020.

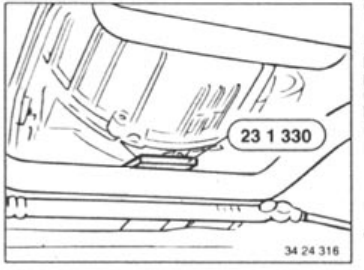


If applicable, remove center of gravity suspension.



Unscrew cross member.

Installation instruction:
Centering transmission (refer to Group 26).
Tightening torque 24 71 1AZ*.

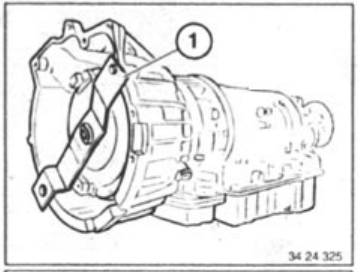


6-cylinder engine:

Before lowering transmission, insert spacer plate 23 1 330 between cross-member and oil pan.

Lower transmission.

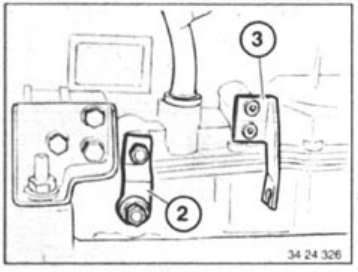
* Refer to Specifications



24 00 045 Installing exchange transmission

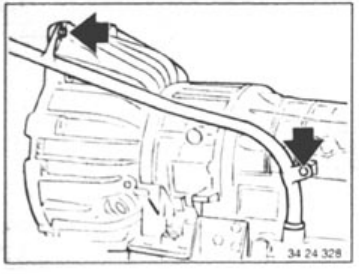
Removing transmission 24 00 025.

Caution!
Always clean oil cooler and pipes with compressed air and flush twice with ATF before installing an exchange transmission.
Transmission identification** on data plate.
Transfer transport holder (1).



Transfer lever (2) and bracket (3).
Tightening torque 24 51 1AZ*.

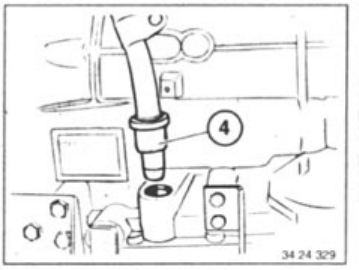
Transfer rubber mounts and exhaust bracket.



Version with oil filler pipe:

Transfer oil filler pipe.
Unscrew bolts.

* Refer to Specifications
** Refer to Parts Catalog



Pull oil filler pipe out of case.

Installation instruction:
Check sealing plug (4), replacing if necessary.

Caution!
Automatic transmission is supplied with a factory fill of ATF.

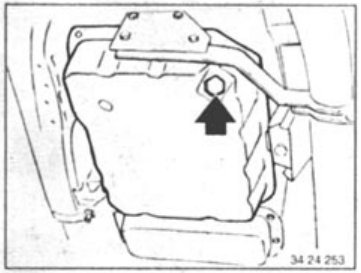
For this reason, a fluid level check is not required until after the transmission has been installed (refer to 00 11 239).

24 00 600 Replacing converter bell housing and spring in selector unit, sealing intermediate case (A4S 270R/310R)

Refer to Repair Manual 3 Series E36

24 00 601 Replacing converter bell housing, sealing intermediate case (A4S 270R/310R)

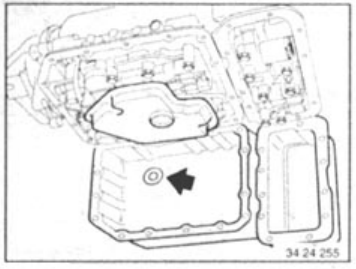
Refer to Repair Manual 3 Series E36



24 11 007 Removing and installing / sealing or replacing both transmission oil sumps

Drain oil.
Remove oil sumps.

Remove magnet from the large oil sump and clean.
Remove gaskets and remove remaining pieces of gaskets.

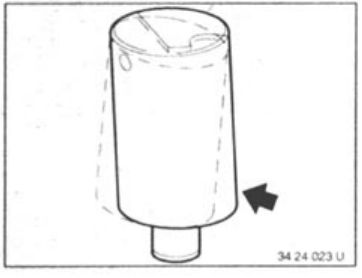


Note:
The screws are micro-encapsulated and must be replaced after every disassembly. Only use screws with M-thread.

Fit gaskets for oil sumps.
Fit magnet in large oil sump. Fit oil sumps in position and screw in all screws as fat as it will go.

Caution!
Do not tighten screws crosswise and do not retighten screws.

Firmly tighten screws once one after the other to specified tightening torque*.

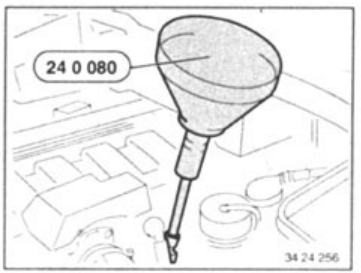


Version with oil filler tube:

Remove oil dipstick.

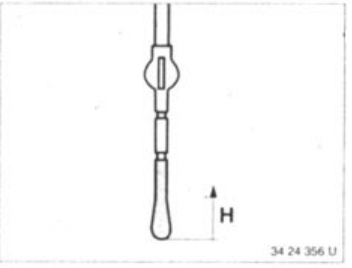
Caution!
Oil dipstick with lock:
Dipstick can only be removed by tilting handle.

* Refer to Technical Data



Fill with oil*.

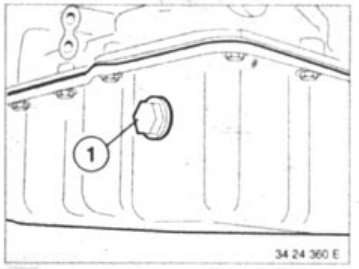
Caution!
Gear oil must only be filled using funnel 24 0 080.



Run engine at idle speed in selector lever position P or N.
Vehicle must be unladen and parked on even surface.
Check transmission oil temperature with Service Tester or MoDiC (refer to Test Manual).
Remove dipstick and measure oil level and compare in following table.
Only clean dipstick with lint-free cloth.

Oil temperature +°C	Oil level = H mm	
	Min.	Max.
20	3	15
25	5	17
20	8	20
35	11	22
40	13	25
45	14	26
50	16	27
55	17	28
60	19	29
65	21	32
70	22	34
75	24	36
80	26	38
85	29	41
90	31	43

* Refer to Technical Data

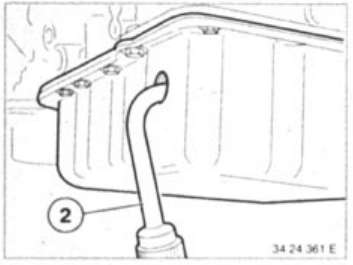


Version without oil filler tube:

The oil filler tube was discontinued after 2/91.
Use the filler opening on the lower side of the oil pan to replenish ATF.

Unscrew filler plug (1).

Installation:
Check seal, replacing if necessary.



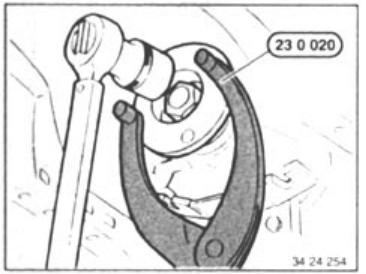
Hang filler (2)** in filler opening.
Add ATF until it overflows.
Run engine at idle speed in selector lever setting "P" or "N".
Car must be unladen and standing on a level surface.
Add ATF until it overflows.
Increase oil temperature to 30...55° C.
Interrogate ATF temperature with Service Tester or MoDiC (refer to Troubleshooting Manual).
Recheck ATF level, correcting if necessary.

Screw in and tighten filler plug (1).
Tightening torque*.

ATF level too high:
Strong foaming, loss through splashing, high temperature when driving fast.
Fluid loss through vent.

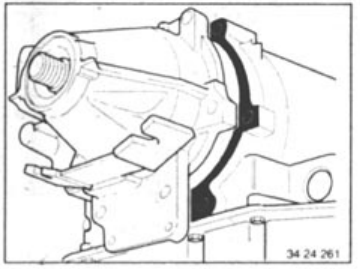
ATF level too low:
Valve rattle, foaming, transmission slip.
General operating disturbances.

* Refer to Specifications
** Source of Supply: BMW Parts Service

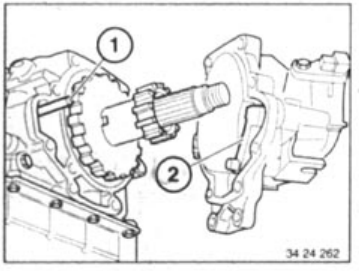


24 11 055 Removing and installing / sealing transmission extension

Remove propshaft, see 24 00 025.
Remove output flange.
Hold output flange with special tool 23 0 020.
Unscrew collar nut with a wrench socket.
Pull off output flange.



Pull plug off of speed sender.
Remove transmission extension.
Unscrew bolts with special tool 24 5 180.
Caution!
Bolts have inch threads.
Remove transmission extension and gasket.



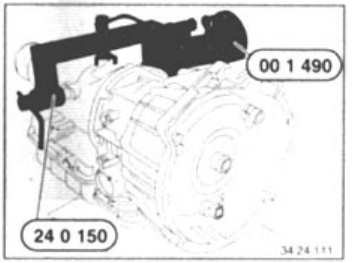
Install gasket with grease (Vaseline).
Mount transmission extension.
Use special tool 24 5 180.
Guide operating rod (1) for parking lock into pawl (2).

Caution!
Only use bolts with inch threads.
Tightening torque*
Mount and bolt output flange.
Tightening torque*

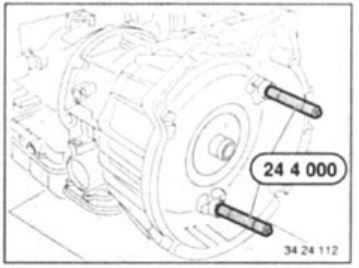
* Refer to Specifications

24 11 575 Removing and installing/sealing converter bell housing

Remove automatic transmission, refer to 24 00 025



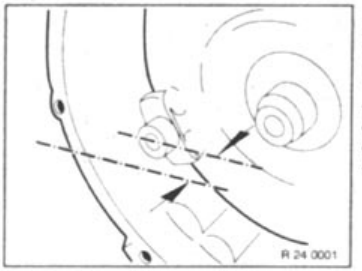
Secure transmission to assembly frame 00 1 490 with mounting bracket 24 0 150.



Pull torque converter out of oil pump carefully using special tool 24 4 000.

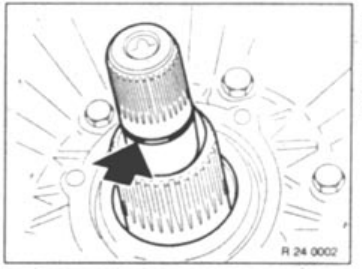
Caution!
Escaping ATF.

Installation:
Carefully guide openings on converter into primary pump by turning slightly.



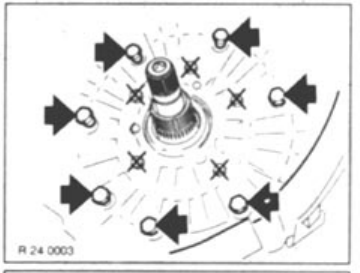
Caution!
Do not damage converter mounting and sealing ring.
Insert torque converter as far as stop.

The torque converter has engaged correctly when the distance between case and torque converter screw connection reaches approx. 31 mm.



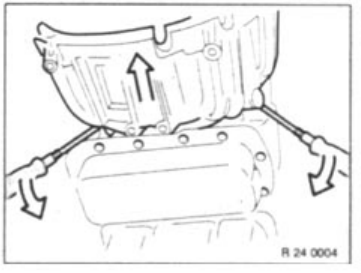
Set transmission upright.
Lift out O-ring.

Note:
A slight quantity of oil will escape through the breather.



Unscrew the seven outer screws in the torque converter bell housing.

Caution!
Do not unscrew the five inner screws.

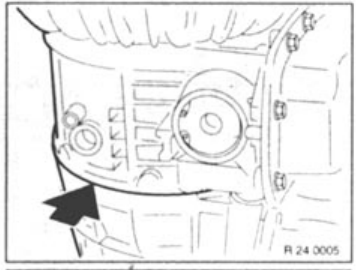


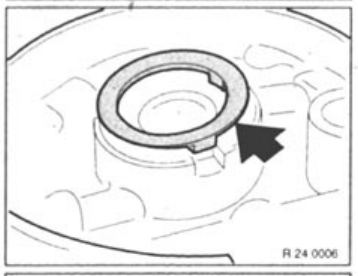
Detach the converter bell housing from the adapter case with two levers (screwdriver).

Carefully lift off converter bell housing.



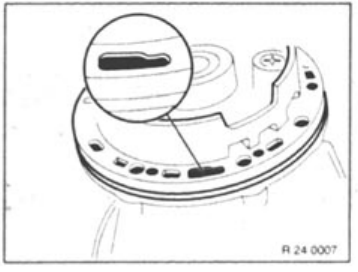
Once the screw connection has been unfastened, also loosen the connection between adapter case and transmission case.
Do not unfasten this screw connection when removing the converter bell housing from the adapter housing because the gasket cannot be replaced.





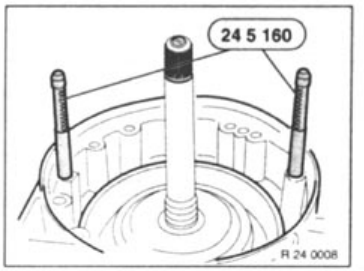
Note:
A spacer disk is fitted to the oil pump.
Refit the same spacer disk (i.e. one of the same color).

Attach spacer disk to oil pump with Vaseline.

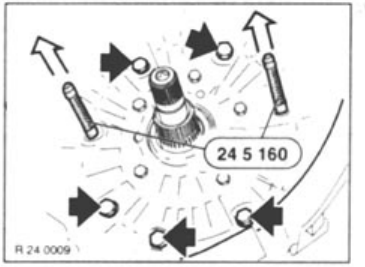


Clean sealing faces and remove any oil which may have emerged from the threaded bores.
Replace the sealing ring and gasket.

Installation instruction:
Attach gasket with Vaseline.
Ensure that recesses in paper gasket are located correctly.

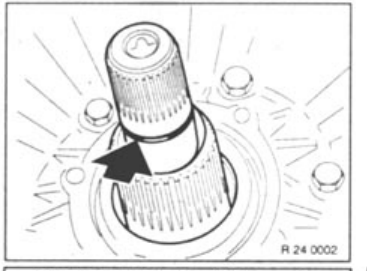


Insert special tool 24 5 160 in two opposing threaded bores.

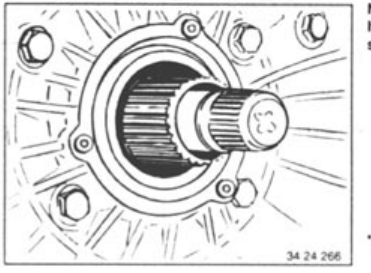


Fit converter bell housing and secure with five screws.
Remove special tool 24 5 160.
Tighten down the remaining screws.

Tightening torque 24 11 3AZ*

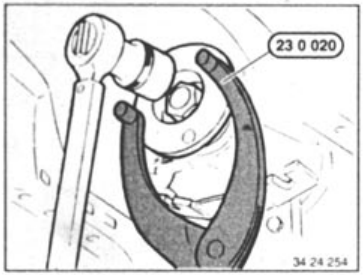


Fit new O-ring to the torque converter shaft.



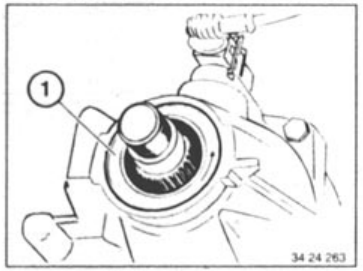
Note:
If applicable, fit radial seal in torque converter: see 24 12 505

* Refer to Specifications

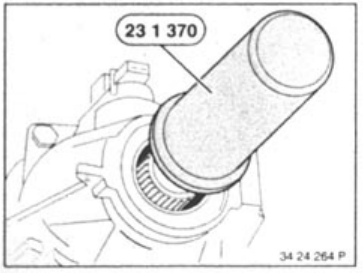


24 12 015 Replacing radial oil seal for output flange

Unscrew propeller shaft - see 24 00 025.
Remove output flange:
Hold output flange with special tool 23 0 020.
Unscrew collar nut with a wrench socket.
Pull off output flange.

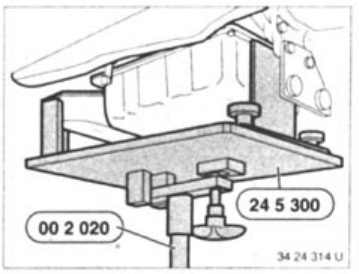


Lift out radial oil seal (1).



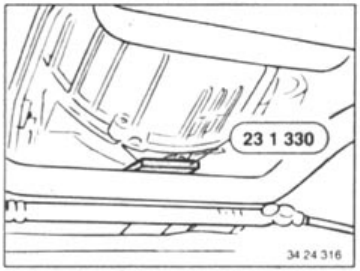
Lubricate sealing lip with ATF.
Drive in radial oil seal with special tool 23 1 370.
Mount and bolt output flange.
Tightening torque 24 21 1AZ*
Check oil level and top up if necessary.

* Refer to Technical Data

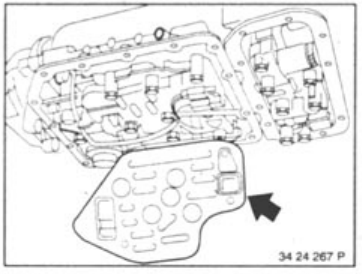


24 12 105 Replacing radial oil seal for manual shift valve shaft

Remove propeller shaft, transmission plug and engine speed sensor plug. (refer to 24 00 025).
Support transmission from underneath with special tools 24 5 300 and 00 2 020.
Unfasten crossmember from body.



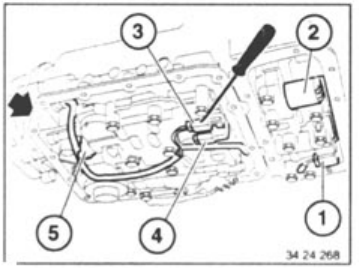
Before lowering transmission, insert spacer plate 23 1 330 between crossmember and oil pan.
Drain transmission as far as possible.



Remove shift control unit from main case

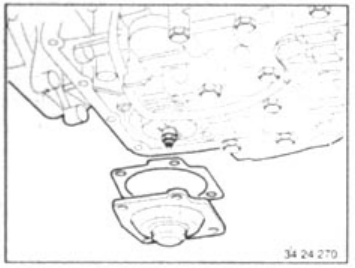
Remove oil pan, refer to 24 11 007
Remove oil screen.
Unscrew bolts with special tool 24 5 180.
Caution!
Bolts have imperial threads.

Installation:
Check gasket between strainer and valve body.



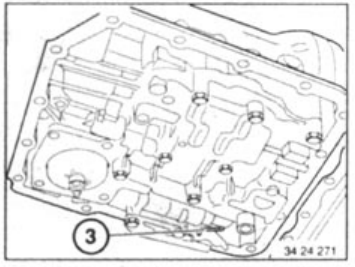
Remove plugs (1 ... 5) on solenoid valves.

Caution!
Pry off plug with a screwdriver.
Do not pull off plug on wires.
Pull out plug through hole in transfer case.
Unscrew nut on plug connection.
Pull out wiring harness.

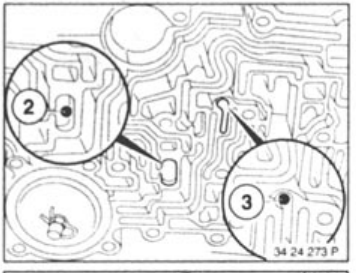


Unscrew cover for servo piston.
Unfasten screws with special tool 24 5 180.

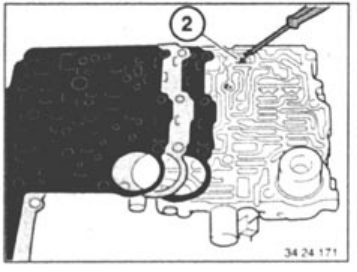
Caution!
Bolts have imperial threads.
Take off cover and gasket.



Unscrew valve body on main case.
Unfasten screws with special tool 24 5 180.
Watch out for lockplate.
Lift off valve body with gasket, pulling the overrun valve connecting lever (3) off the pawl.
Overrun valve should remain in the valve body.

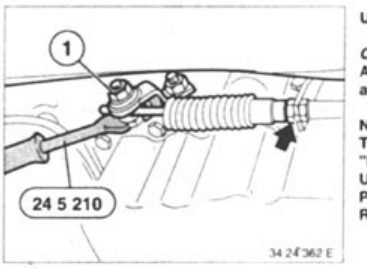


Watch out for valve balls (2 and 3) in main case.



Unscrew transfer plate on valve body.
Remove gasket.
Replace gasket.

Caution!
Watch out for valve ball (2).

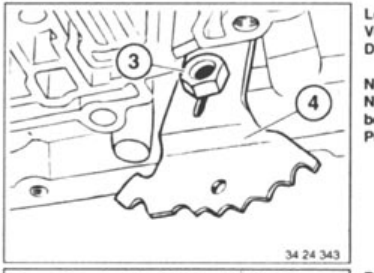


Unfasten nut (1) in setting "P"

Caution!
Always brace bolt with special tool 24 5 210 to avoid distortion of the cable.

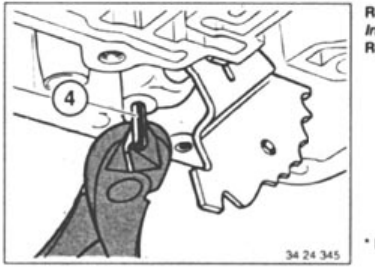
Note:
The special tool can only be fitted in setting "P".
Unscrew cable from holder.
Pull out cable.
Remove lever from transmission.

Installation:
Adjust shift unit 24 00 006.
Tightening torque 24 51 1AZ*



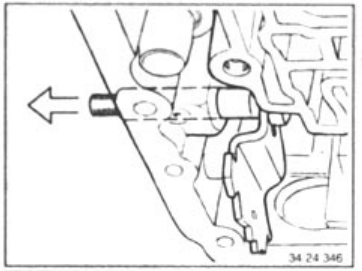
Loosen nut (3)
Version with pin:
Drive out pin.

Note:
Nut (3) cannot be removed until shaft has been pressed out.
Pull shift element (4) off shaft.



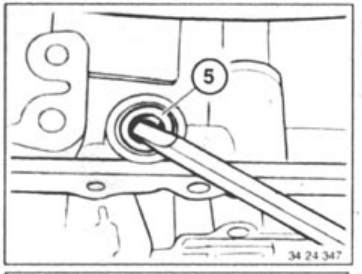
Remove clamping pin (4) (side cutter)
Installation:
Replace pin.

* Refer to Technical Data

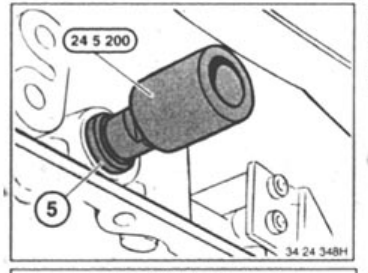


Pull or press out shift valve shaft.

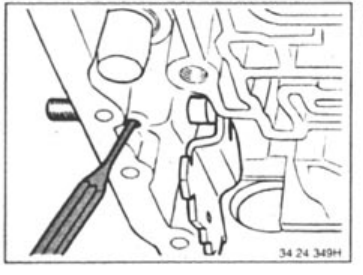
Installation:
If necessary, remove burr from shaft.



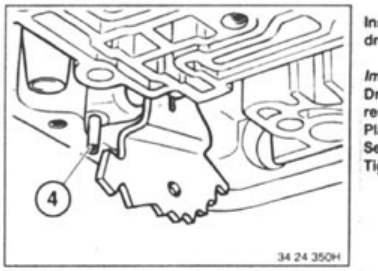
Lever out radial oil seal (5) with a screwdriver.



Lubricate shift valve shaft with oil and insert in case.
Fit radial seal (5) to case and drive firmly home with special tool 24 5 200.
Place shift element on shaft and screw on nut.

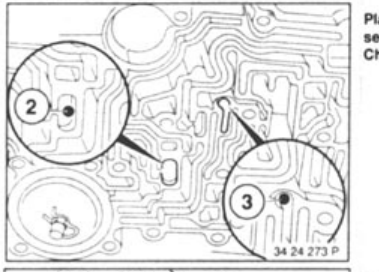


Hold groove of shaft tight with a suitable mandrel inserted through the bore.

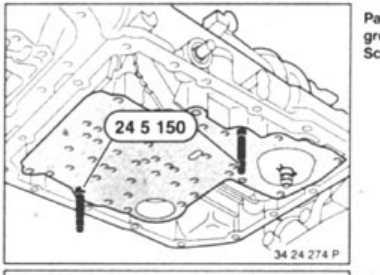


Install pin (4) with the open end facing in and drive in.

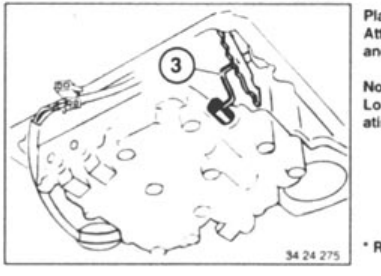
Important!
Drive in pin only far enough that it can be removed again by pulling it out.
Place shift element on shaft.
Secure shift element with a nut or pin.
Tightening torque 24 52 1AZ*



Place two valve balls in main case (use vaseline).
Check installed positions (2 and 3).



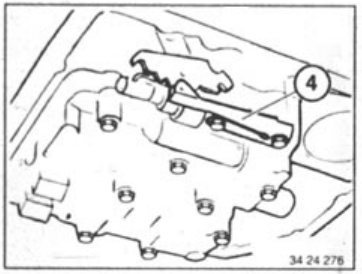
Paste gasket on case with a light coat of grease (vaseline).
Screw in special tools 24 5 150.



Place valve body on main case.
Attach connecting lever (3) on overrun valve and operating lever.

Note:
Long arm for overrun valve, short arm for operating lever.

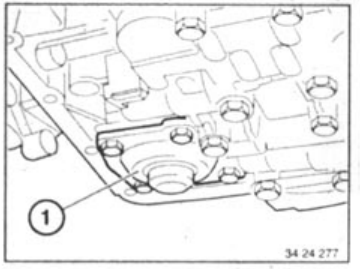
* Refer to Technical Data



Screw in bolts.
Remove centering pin 24 1 150.
Tighten valve body bolts crosswise.
Special tool 24 5 180

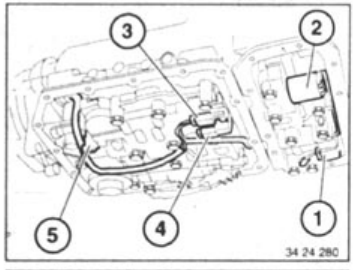
Note:
Also secure lockplate (4).

Caution!
Only use screws with imperial thread
Tightening torque 24 30 1AZ*



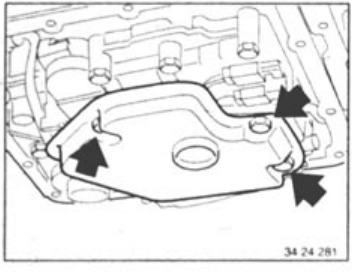
Screw on cover (1) for servo piston.
Socket nut 24 5 180.

Caution!
Only use bolts with imperial threads.
Tightening torque: 25 Nm.



Connect wire harness to solenoid valves (1 ... 5).

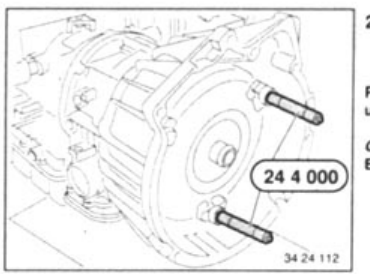
Note:
Plugs are coded.



Mount and bolt strainer.
Special tool 24 31 2AZ*

Caution!
Only use bolts with imperial threads.
Tightening torque 18 ... 21 Nm.

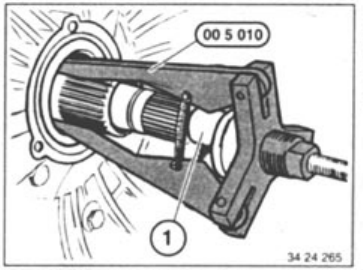
* Refer to Technical Data



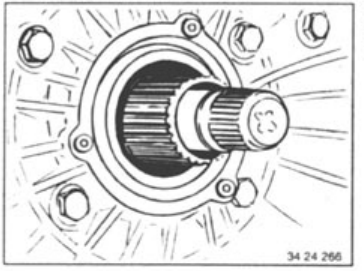
24 12 505 Replace radial seal for torque converter
(transmission removed)

Pull torque converter out of oil pump carefully using assembly handles 24 4 000.

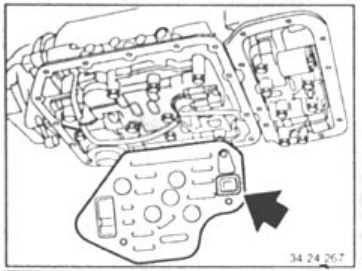
Caution!
Escaping ATF.



Unscrew Torx bolts with a Torx socket.
Pull out radial oil seal with extractor tool 00 5 010.
Place a suitable pressure piece (1) on the input shaft on which the pressure bolt can bear.



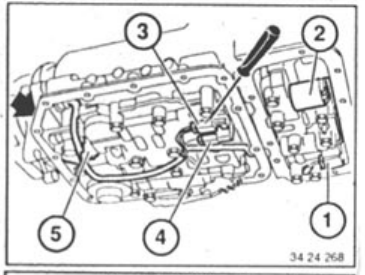
Lubricate sealing lip with ATF.
Install radial oil seal.
Tightening torque: 3 Nm.



24 30 ... REMOVING AND INSTALLING BOTH VALVE BODIES

Remove both oil sumps – 24 11 007.
Unscrew oil filter screen.
Unscrew bolts with Special Tool 24 5 180.
Important!
Bolts have inch threads.

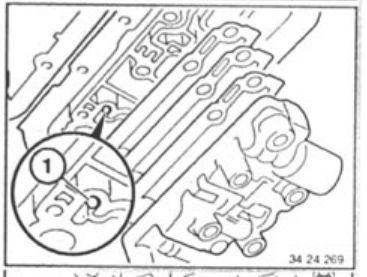
Installation:
Check gasket between oil filter screen and valve body.



Pull off plugs (1 ... 5) on solenoids.

Important!
Pry off plugs with a screwdriver — don't pull off on electric leads.

Pull out plugs through bore in transfer case.
Unscrew nut on plug connector.
Pull out wire harness.

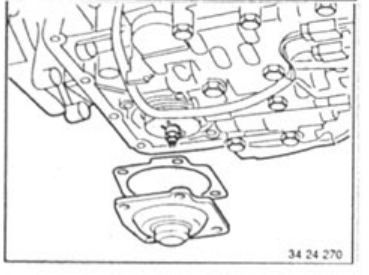


Unscrew valve body on transfer case.
Unscrew bolts with Special Tool 24 5 180.

Important!
Bolts have inch threads.

Take off valve body.

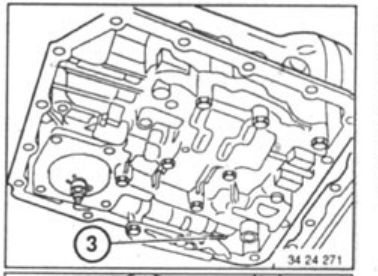
Important!
Check installed position of gasket, transfer plate and gasket.
Check ball valve (1) in transfer case.



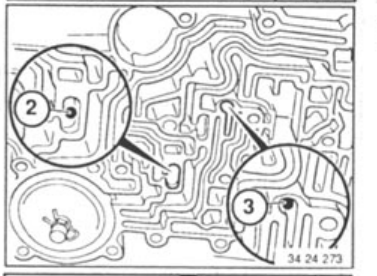
Unscrew cover for servo piston.
Unscrew bolts with Special Tool 24 5 180.

Important!
Bolts have inch threads.

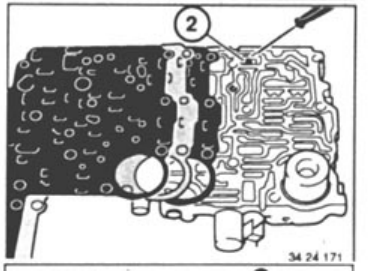
Take off cover and gasket.



Unscrew valve body on main case.
Unscrew bolts with Special Tool 24 5 180.
Check plate for the lock.
Lift off valve body with gasket, pulling the connecting lever (3) for the coasting valve off of the locking pawl at the same time.
Coasting valve should remain in the valve body.

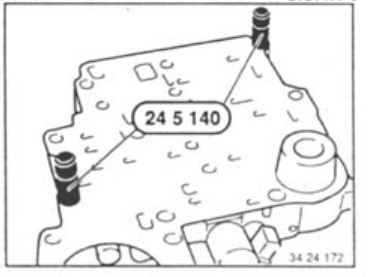


Check ball valves (2 and 3) in main case.



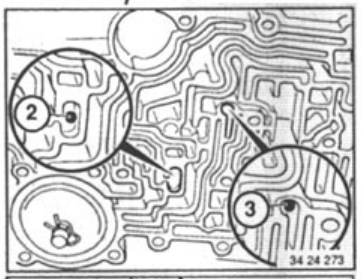
Unscrew transfer plate on valve body.
Take off gasket.
Replace gasket.

Important!
Check ball valve (2).

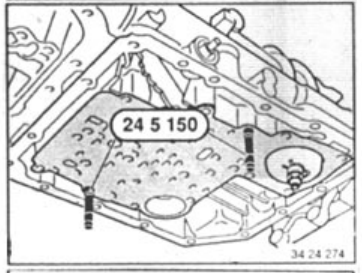


Mount gasket and transfer plate, and center with Special Tools 24 5 140.
Screw in and tighten bolts.

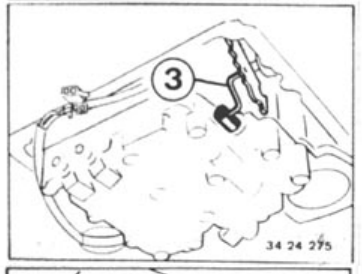
Important!
Only use bolts with inch threads.
Tightening torque = 13 Nm (9 ft. lbs.).
Removing special tool centering pins.



Place two ball valves in main case (with vaseline).
Check locations (2 and 3).

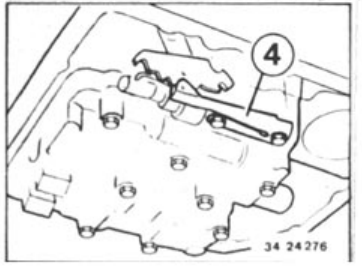


Mount gasket on case with a light coat of grease (vaseline).
Screw in Special Tools 24 5 150.



Place valve body on main case.
Attach connecting lever (3) on coasting valve and operating lever.

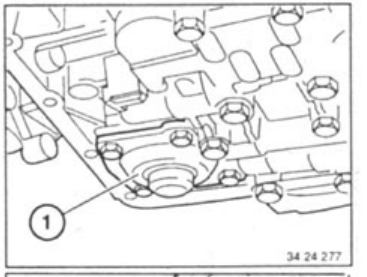
Note:
Long arm faces the coasting valve; short arm faces the operating lever.



Screw in bolts.
Remove Special Tools 24 1 150.
Tighten bolts of valve body crosswise.
Use Special Tool 24 5 180.

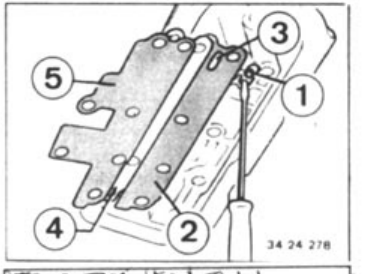
Note:
Also bolt down lockplate (4).

Important!
Only use bolts with inch threads.
Tightening torque = 20 Nm (14 ft. lbs.).



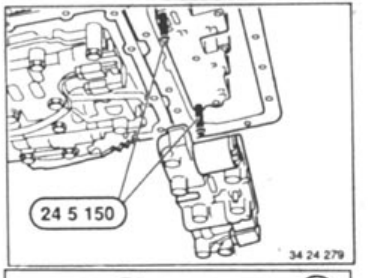
Mount cover (1) for the servo piston.
Use Special Tool 24 5 180.

Important!
Only use bolts with inch threads.
Tightening torque = 25 Nm (18 ft. lbs.).



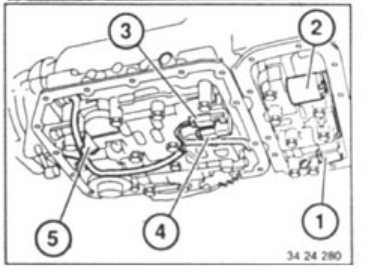
Place ball valves in transfer case (with vaseline).
Check location (1).

Important!
Install gasket (2) with oval opening (3) facing the ball valve.
Install transfer plate (4) and second gasket (5).

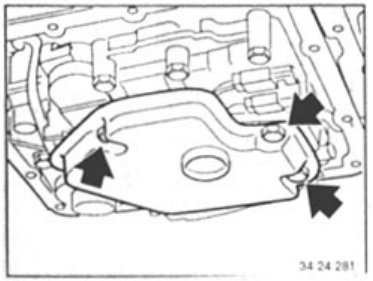


Screw in Special Tools 24 5 150.
Place valve body on transfer case.
Screw in bolts.
Remove Special Tools 24 5 150.
Tighten bolts of valve body crosswise.
Use Special Tool 24 5 180.

Important!
Only use bolts with inch threads.
Tightening torque = 20 Nm (14 ft. lbs.).



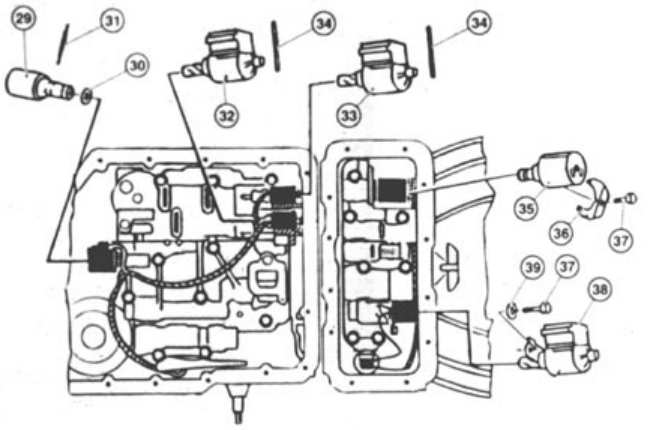
Connect wire harness on solenoids (1 ... 5).
Plugs are coded.



Install and screw on oil filter screen.
Use Special Tool 24 5 180.

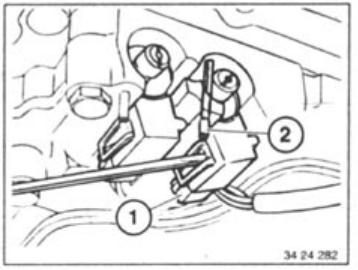
Important!
Only use bolts with inch threads.
Tightening torque = 18 ... 21 Nm
(13 ... 15 ft. lbs.).

24 34 856 Replacing all solenoid valves
(oil pans removed)



Arrangement of solenoid valve

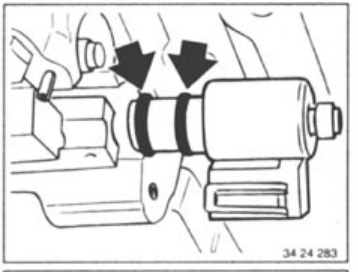
29 Solenoid brake band
30 Corrugated disc
31 Pint
32 Solenoid switch stage 2/3
33 Solenoid switch stage 1/2 and 3/4
34 Spring pin
35 Pressure regulator
36 Retaining bracket
37 Screw, 1/4 inch
38 Solenoid valve, torque converter clutch
39 Disc



a) Solenoid valve (32) 2nd/3rd gear

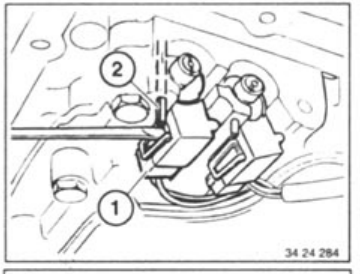
Press off plug (1) with screwdriver.
Do not pull on wires.
Pull out pin (2) (use side cutters).

Installation:
Replace pin (2).
Pin must protrude about 5 mm.



Pull or press (use screwdriver) out solenoid valve.

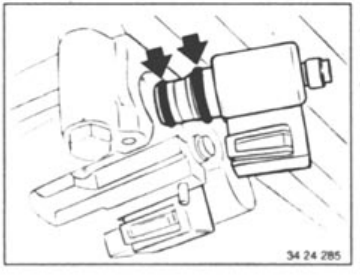
Installation:
Coat seals with grease (vaseline).
Press in solenoid valve as far as stop.



b) Solenoid valve (33) 1st/2nd and 3rd/4th gear

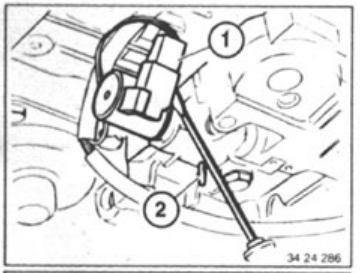
Press off plug (1) with screwdriver.
Do not pull on wires.
Pull out pin (2) (use side cutters).

Installation:
Replace clamping pin (2).
Pin must protrude about 5 mm.



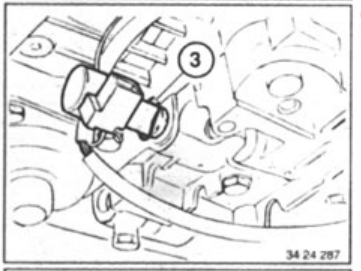
Pull or press (use screwdriver) out solenoid valve.

Installation:
Coat seals with grease (vaseline).
Press in solenoid valve as far as stop.



c) Solenoid valve (29) brake band

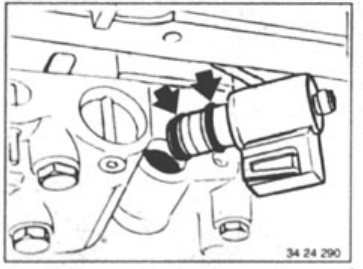
Remove oil screen 24 31 155.
Press off plug (1) with screwdriver.
Do not pull on wires.
Press in solenoid valve - light spring pressure - and pull out pin (2) by hand or with a pliers if necessary.



Pull out solenoid valve.
Avoid damage to corrugated washer (3).



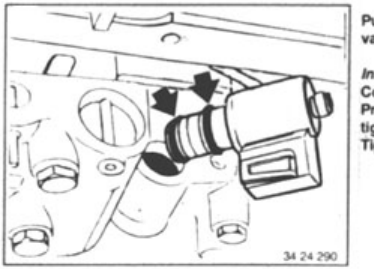
Installation:
Coat seals with grease (vaseline).
Install solenoid valve that groove (4) is aligned with bore (5).
Press in solenoid valve that pin (2) can be inserted.



d) Solenoid valve (38), torque converter clutch

Press off plug (1) with screwdriver.
Do not pull on wires.
Remove screw (2).

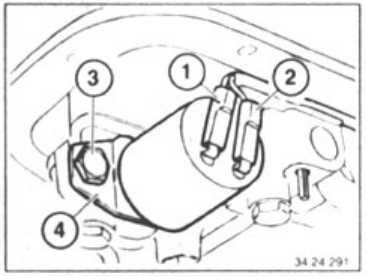
Important!
Imperial threads.



Pull or press (use screwdriver) out solenoid valve.

Installation:
Coat seals with grease (vaseline).
Press in solenoid valve as far as stop and tighten screw.
Tightening torque 24 34 2AZ *

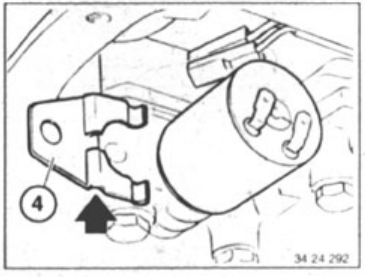
* Refer to Technical Data



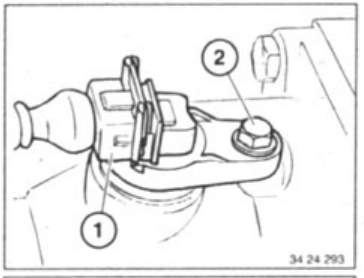
24 34 865 Replacing pressure regulator for selecting unit
(Oil sump removed)

Disconnect cables (1 and 2).
Remove screw (3).

Caution!
Inch thread
Remove support bracket (4).
Pull out pressure regulator

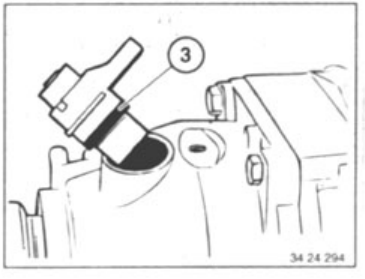


Installation note:
Fit pressure regulator in position.
Support bracket (4) must be fitted and secured with curved section facing outward.
For tightening torque 24 34 2AZ*.



24 34 875 Replacing pulse generator
(for output speed)

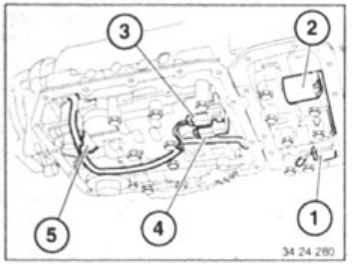
Disconnect plug (1).
Remove screw (2).



Pull out or press out pulse generator.

Installation note:
Coat O-ring (3) with grease (Vaseline).

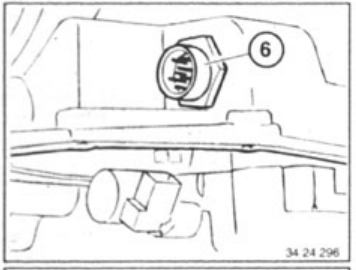
* Refer to Technical Data



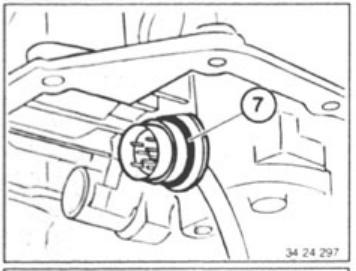
24 35 505 Replacing wiring harness in automatic transmission

Remove oil screen 24 31 155.
Remove plugs (1 ... 5) from the solenoid valves.

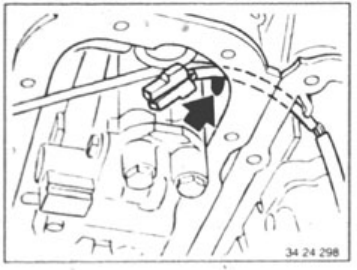
Caution!
Pry off plug with a screwdriver.
Do not pull on wires.



Unscrew nut (6) from plug.
Withdraw plug from inside.

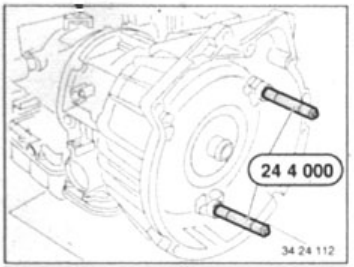


Installation:
Check seal (7).
Place flattened side of plug facing upwards.
Tightening torque 24 35 112*



Pull out wire harness through bore in transfer case.

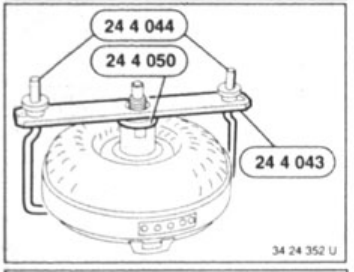
* Refer to Technical Data



24 40 005 Removing and installing or removing torque converter

Remove transmission, refer to 24 00 025.
Pull torque converter out of primary pump carefully using assembly handles 24 4 000.

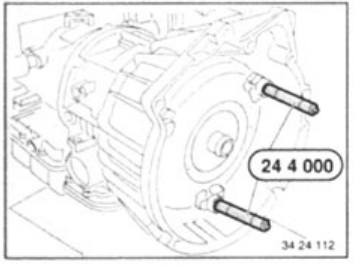
Caution!
Escaping ATF.



Installation:
Check torque converter for leaks using fixture 24 4 050, retaining bracket 24 4 043 and retaining screws 24 4 044.
Test pressure: 0.5 bar.

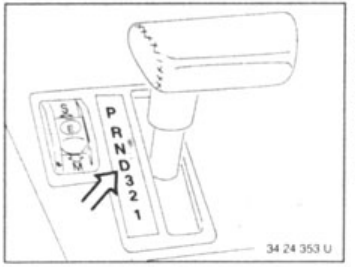
Caution!
Danger of injury - always use special tool 24 4 043.

Torque converter must be replaced if the bearing surface on the converter shaft is damaged.



Carefully guide openings on converter into primary pump by turning slightly and using assembly handle 24 4 000.

Caution!
Make sure converter bearings and seal are not damaged while guiding in.
Insert torque converter as far as stop.

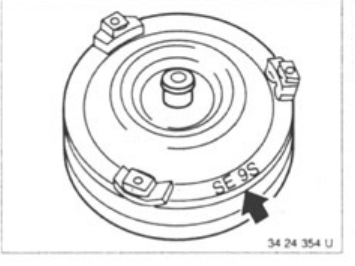


Checking installed torque converter:
Engine and transmission oil must be at operating temperature.
Engine must develop full power.
Start engine.
Pull up parking brake lever and press down on brake pedal firmly.
Move selector lever to D.
Press accelerator pedal to kickdown.
Read stall speed * off tachometer.

Caution!
Never test stall speed longer than ten seconds to avoid overheating. Stall speed much higher than specified value *.
a) Torque converter not sufficiently filled
- top up the oil level
b) Slip in the clutches
- check the clutches.

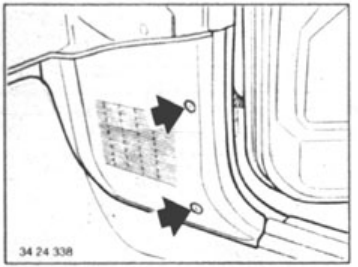
Stall speed much lower than specified value *.
a) Engine not developing sufficient power.
Check engine.

b) Torque converter or pump defective.
Replace torque converter or check pump.



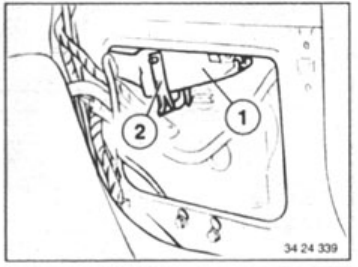
Torque converters cannot be cleaned with standard workshop equipment and must be replaced in case of transmission damage or torn oil strainer.
Converter identification*

* Refer to Technical Data



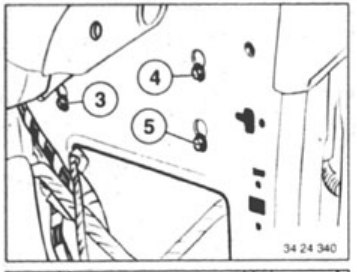
24 61 500 Removing and installing or replacing control unit

The control unit for EH transmissions is located in the A-pillar on the right side.
Removing and installing glovebox 51 16 360.
Lift off cover for loudspeaker.
Disconnect wires for loudspeaker.

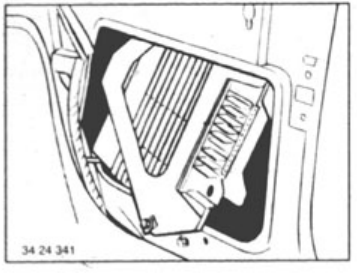


Pull plug (1) off of control unit, swinging spring retainer (2) down for this purpose.

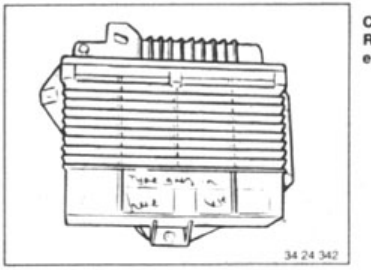
Caution!
Always switch ignition off first before disconnecting or connecting plug.



Partially remove insulating mat.
Only loosen screws (3 ... 5).



Lift out control unit and remove from underside.



Code is on identification plate.
Refer to BMW Parts catalog for cross reference of types and models.

TROUBLESHOOTING AUTOMATIC TRANSMISSION THM-R1

Note:
See self-disgnosis or test plan for troubleshooting and testing electronic components.

Condition	Cause	Correction
Engine cannot be started in N or P or in all positions	Selector lever not in N or P	Move selector lever to N or P
	Maladjustment between selector lever and transmission	Adjust selector lever – see 24 00 007
	Transmission switch faulty	Replace transmission switch – see 25 16 080
Position P Park does not engage	Maladjustment between selector lever and transmission	Adjust selector lever – see 24 00 007
	Excessive friction in parking lock mechanism	Replace parking lock parts (connecting rod, pawl)
Park does not hold (slips out)	Maladjustment between selector lever and transmission	Adjust selector lever – see 24 00 007
Delayed shift from N to D	Oil level in transmission too low	Correct oil level
	Oil pressure too low	Check oil pressure – see 24 00 015
Slip or shake in 1st gear	Oil pressure too low	Check oil pressure – see 24 00 015
	Torque converter faulty	Replace converter – see 24 40 005
	Brake band maladjusted	Adjust brake band
	Oil loss in oil circuit for the brake band	Check brake band piston and cover for leaks/seal
	4th gear one-way clutch or panet gear set one-way clutch faulty	Replace one-way clutches

TROUBLESHOOTING AUTOMATIC TRANSMISSION THM-R1

Condition	Cause	Correction
Position R No reverse gear	Maladjustment between selector lever and transmission Reverse gear clutch faulty Oil filter screen dirty	Adjust selector lever – see 24 00 007 Repair reverse gear clutch Replace oil filter screen
Car moves or creeps in N	Maladjustment between selector lever and transmission Brake band adjusted too tight	Adjust selector lever – see 24 00 007 Adjust brake band
Hard engaging jolt from N to D	Brake band locked or faulty	Check/replace brake band
Poor acceleration	Emergency running program activated Torque converter faulty	Check self-diagnosis Replace converter – 24 40 005
No upshift 1–2	Maladjustment between selector lever and transmission Oil loss in 2nd gear clutch Solenoid/electric lead faulty	Adjust selector lever – see 24 00 007 Seal piston of 2nd gear clutch Check lead/replace solenoid – see 24 34 856
Problems with 1–2 shift	Wrong oil pressure for 2nd gear clutch Oil loss in 2nd gear clutch Pressure reservoir valve for 1/2 gear clutch seized or leaks	 Seal piston of 2nd gear clutch Replace valve body
No upshift 2–3	Maladjustment between selector lever and transmission Solenoid/electric lead faulty Shift valve in valve body faulty	Adjust selector lever – see 24 00 007 Check lead/replace solenoid – see 24 34 856 Replace valve body
Problems with 2–3 shift	Brake band maladjusted Brake band valve faulty/seized Oil loss in 3rd gear clutch Oil loss in return pipe of pressure reservoir for brake band Wrong oil pressure	Adjust brake band Seal piston of 3rd gear clutch

TROUBLESHOOTING AUTOMATIC TRANSMISSION THM-R1

Condition	Cause	Correction
No upshift 3–4	Maladjustment between selector lever and transmission	Adjust selector lever – see 24 00 007
	Oil loss in 3rd gear clutch	Seal piston of 3rd gear clutch
	Solenoid/electric lead faulty	Check lead/replace solenoid – see 24 34 856
Problems with 3–4 shift	Oil loss in 4th gear clutch	Seal piston of 4th gear clutch
	Wrong oil pressure	
	4th gear overdrive clutch does not disengage	Repair overdrive clutch
No bearing of converter clutch	Solenoid/electric lead faulty	Check lead/replace solenoid – see 24 34 856
	Oil loss in oil circuit	
Rattling from converter clutch	Converter faulty	Replace converter – see 24 40 005
	Insufficient oil pressure	Check oil pressure – see 24 00 015
Converter clutch does not disengage	Solenoid/electric lead faulty	Check lead/replace solenoid – see 24 34 856
	Return pipe clogged	
No "S" program	Program switch faulty	Replace program switch – see 61 31 265
	Break in electric lead	Check / repair electric lead
No "M" program	Program switch faulty	Replace program switch – see 61 31 265
	Break in electric lead	Check / repair electric lead
No kickdown	Kickdown switch faulty	Replace kickdown switch – see 35 41 480
	Break in electric lead	Check / repair electric lead

TROUBLESHOOTING AUTOMATIC TRANSMISSION THM-R1

Condition	Cause	Correction
No downshift	1/2 and 3/3 solenoids or electric lead faulty	Check electric lead/replace solenoids – see 24 34 856
	Shift valves in valve body faulty	Replace valve body
No engine braking effect Selector lever in D (3rd gear) M program / selector lever in 3, 2, 1	4th gear overdrive clutch faulty	Repair overdrive clutch
	Oil loss in oil circuit	
ATF temperature too high Oil escapes through vent	Oil level too high	Correct oil level
	No function of converter clutch	Replace solenoid for converter lockup clutch / check electric lead
	Extreme load in emergency running program or M program	

TROUBLESHOOTING AUTOMATIC TRANSMISSION THM-R1

Condition	Cause	Correction
Leakage Oil drips out of converter bell housing	O-ring of input shaft faulty Pump housing leaks Converter leaks on welded seam Radial oil seal for converter leaks	Replace O-ring Replace complete pump – see 24 31 ... Replace converter – see 24 40 005 Replace radial oil seal – see 24 12 505
Leak between transmission case and oil sump	Oil sump mounting bolts not tightened correctly Oil sump gasket damaged	Tighten bolts to correct torque* Replace gasket – see 24 11 007
Leak on transfer case	Converter bell housing mounting bolts loose Case gaskets faulty	Tighten bolts to correct torque* Seal case
Oil loss on transmission plug	O-ring faulty Transmission plug not tight	Replace O-ring – see 24 30 ... Tighten transmission plug
Oil loss on output	Radial oil seal on output damaged	Replace radial oil seal – see 24 12 015
Oil loss through or on vent	Oil level too high Wrong oil (strong contamination) Vent cover missing O-ring on vent damaged	Correct oil level Replace oil, if necessary remove transmission and drain completely including torque converter Mount cover or replace vent Replace O-ring
Oil loss on filler pipe	Plug on filler pipe faulty	Replace plug
Leak between transmission case and extension	Mounting bolts loose Gasket damaged	Tighten bolts to correct torque* Replace gasket – see 24 11 055
Oil loss on oil cooler pipe	Connection loose Oil cooler pipe damaged Cooler leaks	Tighten to correct torque* Replace oil cooler pipe Replace cooler – see 17 11 000

* See Specifications

24 Automatic transmission

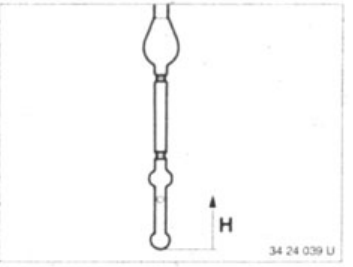
A5S 310 Z

00 11 239	Oil change in automatic transmission	24- 0/300
24 00 007	Selector lever – adjust	24- 0/302
016	Hydraulic pressure value – check	24- 0/303
026	Transmission – remove and install – engine M50 /M51 transmission A5S 310 Z	24- 0/304
026	Transmission – remove and install – engine M60 transmission A5S 310 Z	24- 0/310
026	Transmission with transfer box – remove and install – 4-wheel drive	24- 0/321
046	Exchange transmission – install	24- 0/326
24 11 008	Transmission oil pan – remove and install/seal	24- 11/31
24 12 016	Radial seal for output flange – replace	24- 12/31
106	Radial seal for manual selector valve shaft – replace	24- 12/33
24 13 156	Output flange – replace	24- 13/31
706	Bearing on transmission extension – replace	24- 13/31
24 30 006	Shift unit – remove and install/replace	24- 30/31
24 31 020	Oil pump housing – remove and install/seal	24- 31/31
156	Transmission oil strainer – remove and install/replace	24- 31/32
24 34 006	Parking interlock (pawl / leg spring) – remove and install/replace	24- 34/31
853	All solenoid valves – replace	24- 34/32
861	Shift unit pressure regulator – replace	24- 34/33
871	Impulse sensor for output speed – replace	24- 34/33
872	Impulse sensor for turbine speed – replace	24- 34/33
24 35 501	Wiring harness in automatic transmission – replace	24- 35/31
24 40 006	Torque converter – remove and install/replace	24- 40/31
24 61 500	Control unit – remove and install/replace	24- 61/31
	Automatic transmission – troubleshoot	24- 93/31
	Shift unit – troubleshoot	24- 93/36
	Peripherals – troubleshoot	24- 93/12

00 11 239 CHANGING OIL IN AUTOMATIC TRANSMISSION

Version with Oil Filler Pipe:

Important!
The oil change should only be carried out at operating temperature.



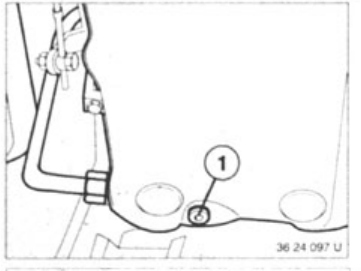
Check / correct ATF level with selector lever in P or N and engine running at idling speed.
Car must be on a level surface.
Wipe off oil dipstick with a rag which does not lose lint.
ATF temperature is sensed by a temperature dependent resistor which is integrated in the transmission wire harness.
Read ATF temperature with MoDiC or a Service Tester (refer to Test Plan).
Pull out oil dipstick and measure oil level and compare with value in this table.



Pull out oil dipstick.

Note:
The oil dipstick with arrest can only be pulled out after tilting the grip.

Oil Temperature	ATF Level = H in mm	
+ °C	Min.	Max.
30	3	16
40	8	23
50	12	31
60	16	39
70	21	46
80	26	53
90	31	59



Unscrew drain plug (1).
Drain ATF.

Installation:
Replace seal.
Tightening torque*.

ATF Level Too High:
Strong foaming, splash loss, high temperature when driving fast.
Oil lost via the vent.

ATF Level Too Low:
Valves rattle, foaming, engine spins.
General disturbances.

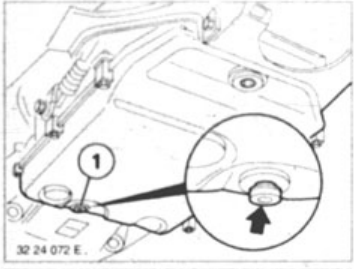


Pour in ATF only with help of Special Tool 24 0 080.
Volume of ATF*.

* Refer to Specifications

Version without Oil Filler Pipe:

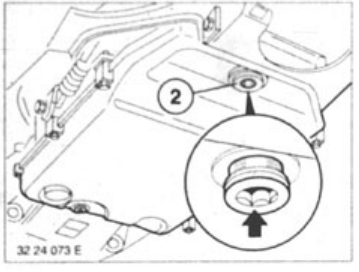
The oil filler pipe has been omitted since 1.91.
ATF is poured in and ATF level is checked through a filler bore underneath the oil sump.
The oil change should only be carried out at operating temperature.



Unscrew drain plug (1).
Drain ATF.

Note:
Dispose old ATF properly.

Installation:
Replace seal.
Tightening torque*.

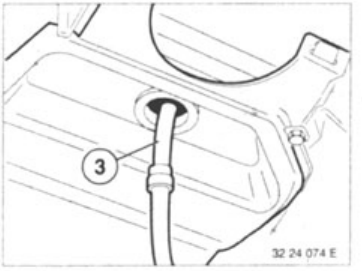


Fill transmission with ATF.

ATF*** is poured in through the filler bore underneath the oil sump.
Unscrew filler plug (2).

Installation:
Check seal, replacing it if necessary.

* Refer to Specifications
*** Refer to Operating Fluids



Car must be on level surface.
With the engine stopped, pour in ATF using filler adapter (3)** until it runs out of the spill bore.
Don't plug the bore.
Start engine and move the selector lever in and out of all ranges while operating the brake pedal.

ATF temperature must be 30 to 55° C.

Interrogate ATF temperature with MoDiC or a Service Tester (refer to Test Plan).
Run engine at idling speed with selector lever in "P" or "N".
Recheck ATF level.
Screw in filler plug.
Tightening torque*.

* Refer to Specifications
** Source of Supply: BMW Parts

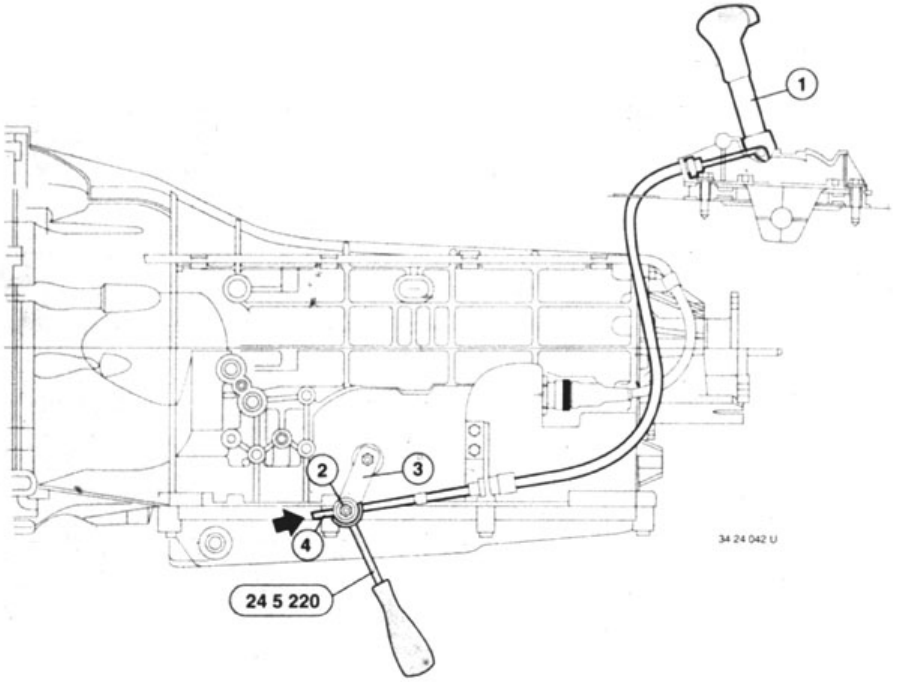
24-0/302

24 00 007 Adjusting gearshift lever

Transmission A5S 310 Z

Set gearshift lever (1) to "P".
Release nut (2).

Caution!
In order to avoid deforming the operating cable, the clamping screw must be held with the special tool 24 5 220.



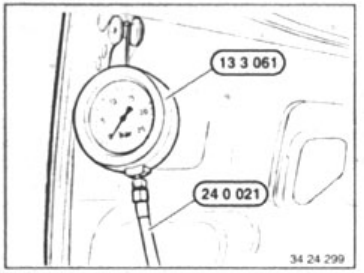
Note:
The special tool 24 5 220 can only be fitted in position "P".

Press forward lever (3) (park position).

Press operating cable rod (4) opposite forward direction and release again.

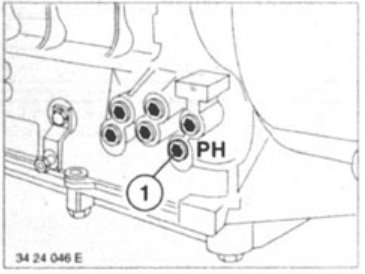
Firmly secure operating cable rod (4) with nut (2) (held with special tool 24 5 220).

Observe tightening torque 10 ... 12 Nm



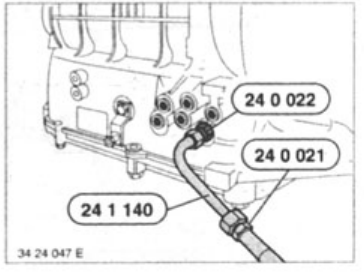
24 00 016 CHECKING HYDRAULIC PRESSURE VALUES

Connect Special Tools 24 0 021 and 13 3 061.



Unscrew and remove plug (1) from the right-hand side of the transmission case to check the main pressure.
Identification on case: PH.

Important!
Check seal, replacing it if necessary.
Tightening torque*.



Screw in Special Tool 24 0 022 with feeling until resistance is noticed (adapter threads are tapered).
Mount Special Tool 24 1 140 (elbow pipe) on Special Tool 24 0 022 (adapter) and connect with Special Tool 24 0 021 (hose).

Selector lever in P or N.
Start and run engine at idling speed*.
Read main pressure on pressure gage.
Main pressure specification: 5.4 ... 6.4 bar.

* Refer to Specifications



24 00 026 Removing and installing transmission

- Engine M50 / M51 transmission A5S 310 Z

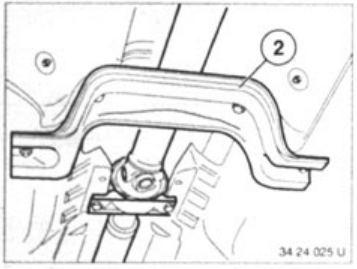
Disconnect negative lead.

Caution!

First read fault memories with tester and print any faults since disconnecting the negative lead will cancel the fault memories in the control units.

Remove the complete exhaust unit 18 00 020.

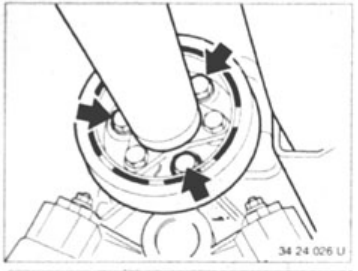
Remove heat baffle plate (1).



Remove bracket (2).

Installation instruction:

Tightening torque*.

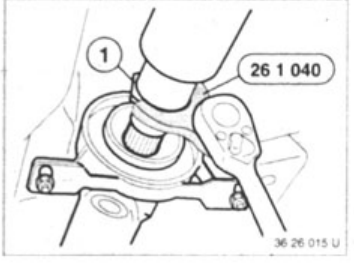


Unscrew propeller shaft on transmission.

Installation instruction:

Replace stop nuts.

Tighten nuts with specified tightening torque*.



Version with screwed-on ring:

Loosen screwed-on ring (1) several turns.

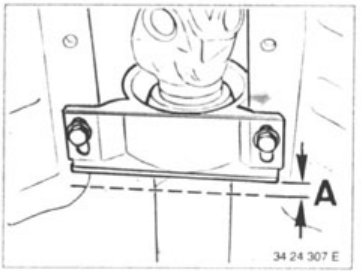
Installation instruction:

Tighten screwed-on ring (1) with special tool 26 1 040 after finishing installation.

Tightening torque*.

Press joint disk away from transmission.

* Refer to Specifications



Unscrew center mount.

Installation instruction:

Preload center mount in direction of travel (A).

With sliding member on center mount

A = 4 ... 6 mm.

Without sliding member on center mount

A = 2 ... 4 mm

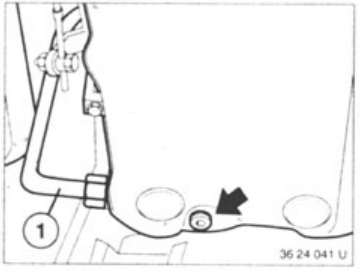
Fold propshaft downwards and withdraw from transmission.

Caution!

Do not allow the propeller shaft to drop into the joints.

Suspend propeller shaft from car on a piece of wire.

Tightening torque*.



Drain ATF.

Caution!

Never reuse drained ATF.

Installation instruction:

Transmission must be replaced if ATF smells burnt and is black.

Caution!

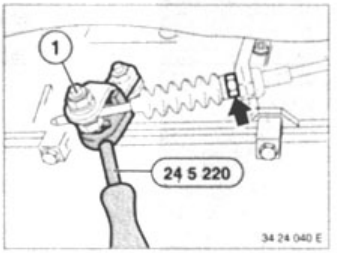
Clean oil cooler and pipes with compressed air and flush twice with ATF if the transmission is faulty.

Remove oil filler pipe (1).

Installation note:

Tightening torque*.

* Refer to Specifications



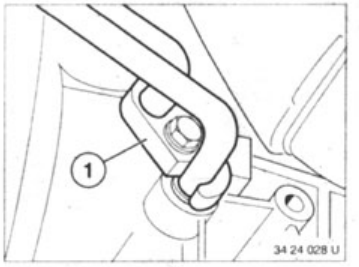
Unscrew nut (1).

Important!
Always counterhold bolt with Special Tool 24 5 220 to prevent deformation of the cable.

Note:
Special Tool 24 5 210 can be applied only in position P.

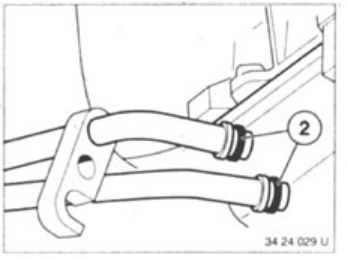
Unscrew cable at holder.
Pull out cable.

Installation:
Adjust selector lever – see 24 00 008.
Tightening torque*.



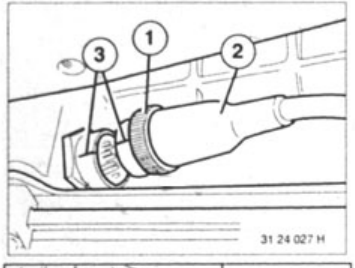
Unscrew holder (1) for oil cooler pipe.

Installation:
Tightening torque*.



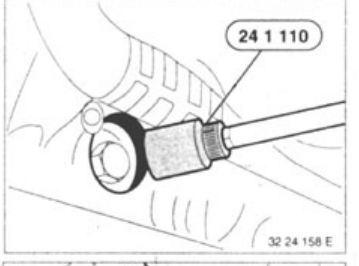
Pull oil cooler pipe out of transmission.

Installation:
Check O-rings (2), replacing them if necessary.
Tightening torque*.

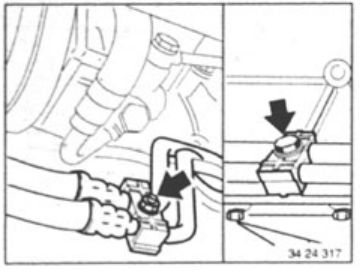


Turn bayonet lock (1) counterclockwise.
Pull off plug (2).
Lift wire harness out of holder.

Installation:
Connect plug (2) that marks (3) are aligned.



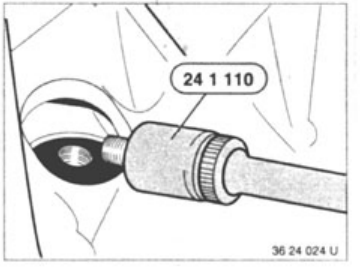
Lift cap off opening (1) in oil sump.
Unscrew torque converter from drive plate at three points using Special Tool 24 1 110.
Turn flywheel for this purpose.



Unscrew oil cooler pipe clamps on crankcase and oil sump.

Installation:
Tightening torque*.

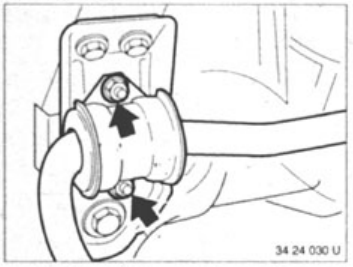
* Refer to Specifications



Installation:
Insert bolt with Special Tool 24 1 110 and tighten with a torque wrench.
Tightening torque*.

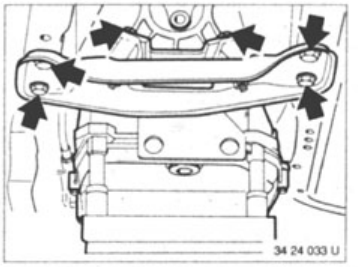
Important!
Only use size M 10 x 16 mm bolts together with spring washers.
Non-conformance leads to destruction of the transmission.

* Refer to Specifications



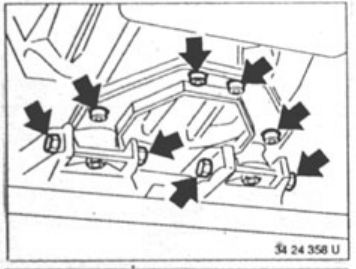
Unscrew stabilizer on engine carrier at left and right hand sides.

Installation:
Tightening torque*.



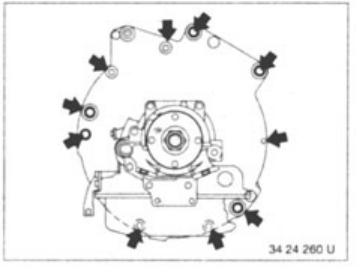
Unscrew cross member.
Lower transmission as far as connecting pipe.

Installation:
Center transmission – see Group 26.
Tightening torque*.



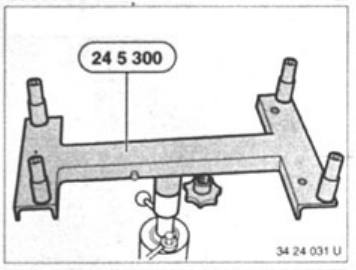
Remove gravity center mount.

Installation:
Rubber mounts must be adapted by moving after installation of the rear cross member.
Tightening torque*.

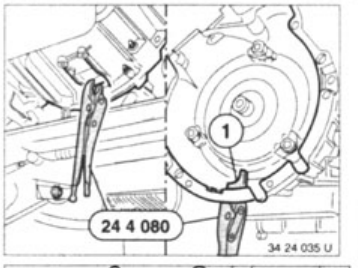


Unscrew transmission on engine.
Unscrew Torx bolts with a Torx socket.

Important!
Washers must be used to avoid increasing the breaking loose torque.
Tightening torque*.

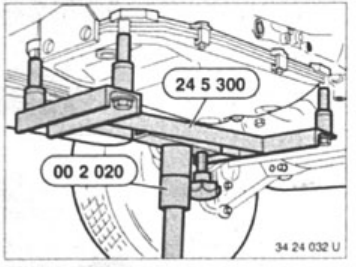


Assemble Special Tool 24 5 300 to suit a 5 HP-18 transmission as marked.

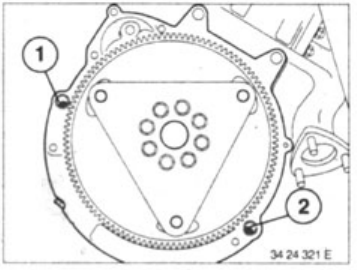


Prevent converter from sliding out by applying and clamping Special Tool 24 4 080 on transmission case with flat side of retainer (1) facing the converter.
Pull transmission off of engine.

Important!
The lifting fixture with mounted transmission may be moved only in completely lowered state.



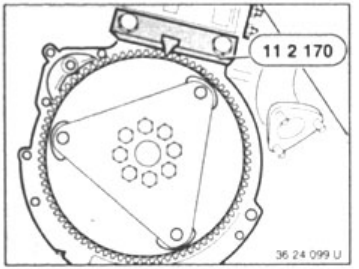
Support transmission from underneath with Special Tools 24 5 300 and 00 2 020.



Important!
Check that dowel sleeves (1 and 2) are not missing before installing transmission.
If applicable, transfer dowel sleeves from transmission or use new dowel sleeves.

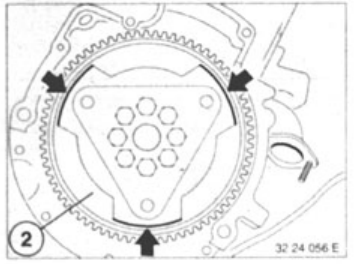
* Refer to Specifications

* Refer to Specifications



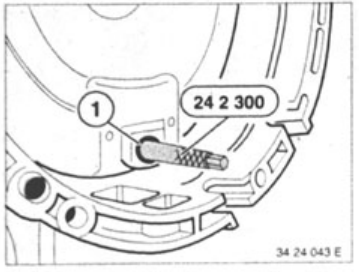
Installation:
Check drive plate for breaks and cracks, replacing it if necessary.
Hold flywheel using Special Tool 11 2 170.

Important!
Replace expansion bolts and install new bolts with bolt cement**.
Only coat threads.
Clean tapped bores thoroughly.
Tightening torque*.



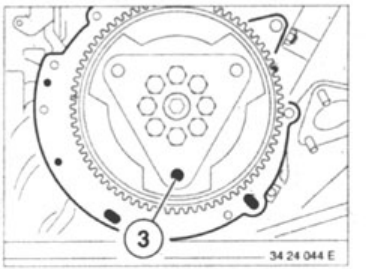
Version with Sheet Metal Flywheel (2):

Important!
Keep to sequence of installation.
Sheet metal flywheel (2) has three indentations for the torque converter mounting tabs.
When guiding the engine and transmission together the three mounting tabs on the torque converter must be aligned with the three indentations in the sheet metal flywheel.
Non-conformance will lead to follow-up damage on the automatic transmission.
Turning of the torque converter, or engine, is no longer possible after guiding the engine and transmission together and would lead to damage.

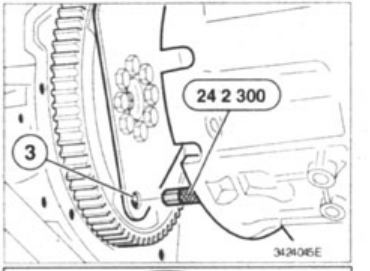


Turn torque converter on the transmission that bore (1) in the tab points down perpendicularly.
Screw Special Tool 24 2 300 into the tab.

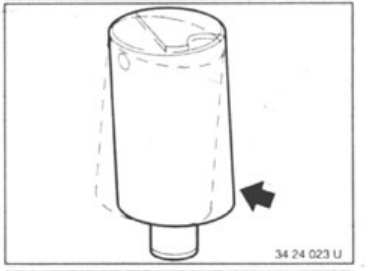
* Refer to Specifications
** Source of Supply: BMW Parts



Bore (3) on drive plate must point perpendicularly to center of opening in oil sump.



Lift automatic transmission until bore (3) in drive plate is reached.
Carefully guide transmission into bore (3) of drive plate using Special Tool 24 2 300.
Bolt transmission case to engine.
Unscrew Special Tool 24 2 300 from tab forwards.
Mount torque converter.
Tightening torque*.



Pour in ATF.

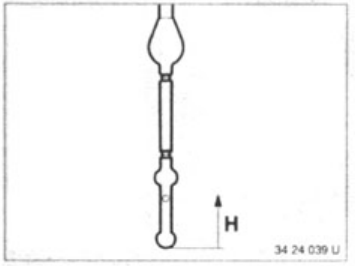
Version with Oil Filler Pipe:
Pull oil dipstick out.

Important!
Oil dipstick is locked and can only be pulled out after tilting it on the grip.



Pour in ATF only with use of Special Tool 24 0 080.
Volume: approx. 3.0 liters.

* Refer to Specifications



Check / correct oil level with selector lever in P or N and engine running at idling speed.
Car must be on a level surface.
Wipe off oil dipstick with a rag which does not lose lint.
ATF temperature is sensed by a temperature dependent resistor which is integrated in the transmission wire harness.
Read ATF temperature with MoDIC or a Service Tester (refer to Test Plan).
Pull out oil dipstick and measure oil level and compare with value in this table.

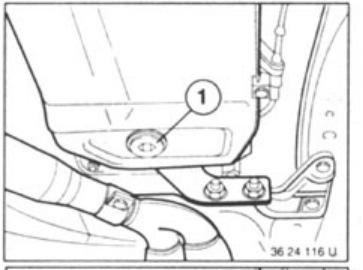
Oil Temperature	Oil Level = H in mm	
+ °C	Min.	Max.
30	3	16
40	8	23
50	12	31
60	16	39
70	21	46
80	26	53
90	31	59

Oil Level Too High:
Strong foaming, loss through splashing, high temperature when driving fast, oil lost via vent.

Oil Level Too Low:
Valves rattling, foaming, engine spinning, general operation disturbances.

Version without Oil Filler Pipe:

The oil filler pipe has been omitted since 1.91.
Check ATF level after installation of the transmission.
ATF is poured in and ATF level is checked through a filler bore underneath the oil sump.

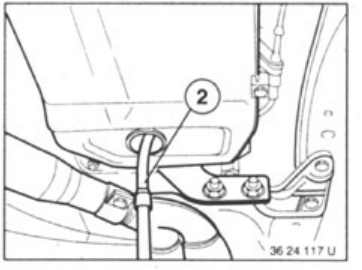


Car must be on level surface.

ATF temperature must be 30 to 55° C to check ATF level.

Interrogate ATF temperature with MoDIC or a Service Tester (refer to Test Plan).
Run engine at idling speed with selector lever in "P" or "N".
Unscrew filler plug (1).

Installation:
Check seal, replacing it if necessary.
Check or correct ATF level.



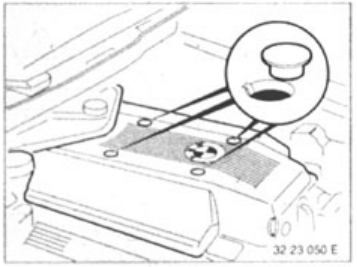
Pour in ATF with help of filler neck (2) so long until it runs out of the overflow hole.
Screw in and tighten filler plug.
Tightening torque*.

* Refer to Specifications
** Source of Supply: BMW Parts

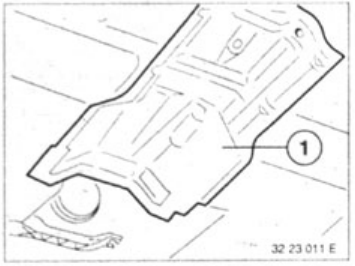
24 00 026 Removing and installing transmission

- Engine M60 / Transmission A5S 310 Z -

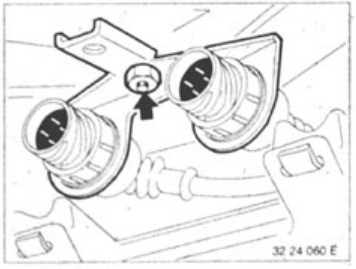
Disconnect negative lead from battery.
Caution!
Disconnecting the negative lead cancels the fault memories in the control units.
For this reason, first interrogate the fault memories with the Service Tester and print out any faults recorded.
Remove complete underbody protection.
Remove complete exhaust assembly 18 00 020.



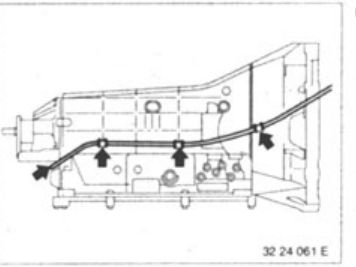
Remove end cover.



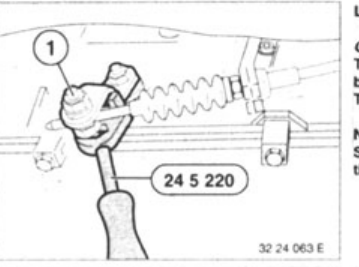
Unscrew heat shield (1).



Remove bracket for Lambda oxygen sensor plug.



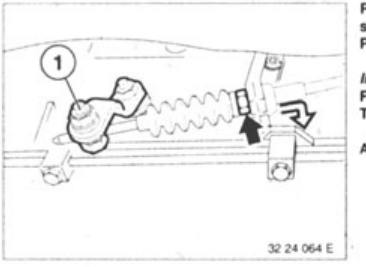
Unclip cable bracket on transmission.



Loosen nut (1).

Caution!
To prevent deformation of the cable, always brace the screw with special tool 24 5 220.
Tightening torque*

Note:
Special tool 24 5 220 can only be fitted in setting "P".

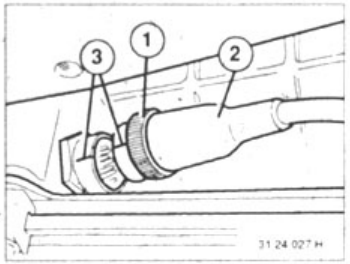


Remove Bowden cable sleeve from counter support.
Pull out cable.

Installation instruction:
Fit rubber gaiter.
Tightening torque*

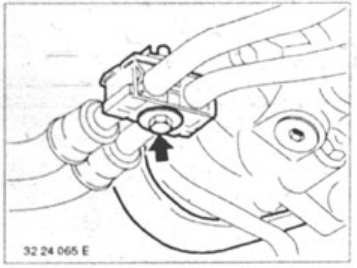
Adjust selector lever, see 24 00 007

* Refer to Specifications



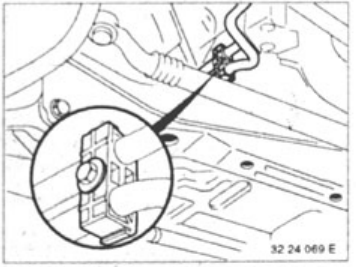
Turn bayonet lock (1) counterclockwise.
Pull off plug (2).
Lift wire harness out of holder.

Installation:
Connect plug (2) that marks (3) are aligned.



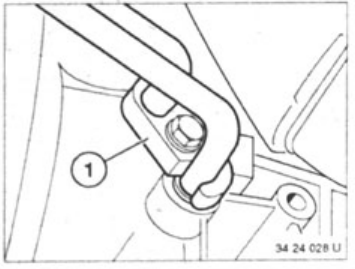
Unscrew oil cooler pipe clamps on power steering pump.

Installation:
Tightening torque*.



Unscrew oil cooler pipe clamps on oil sump.

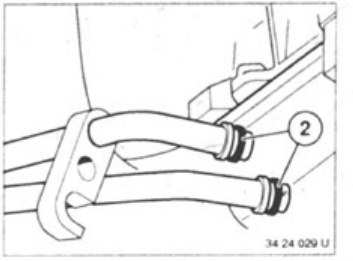
Installation:
Tightening torque*.



Unscrew oil cooler pipe clamp (1).

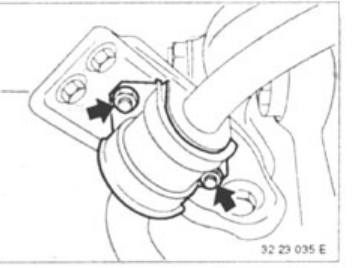
Installation:
Tightening torque*.

* Refer to Specifications

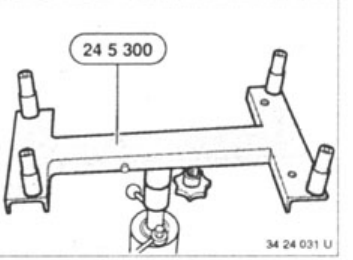


Pull oil cooler pipes out of transmission.

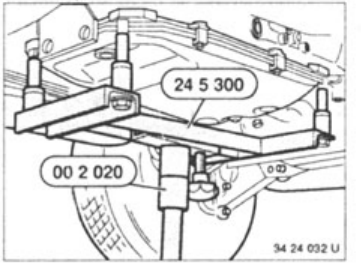
Installation:
Check O-rings (2), replacing them if necessary.



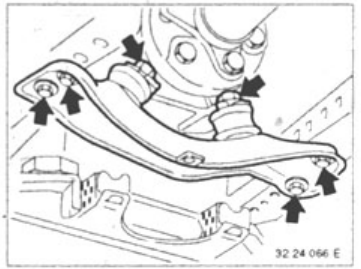
Unscrew stabilizer at left and right hand ends and let it hang down.



Assemble Special Tool 24 5 300 to suit a 5 HP-18 transmission.

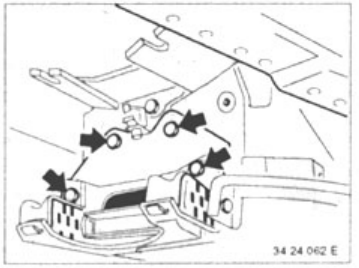


Support transmission from underneath using Special Tools 24 5 300 and 00 2 020.

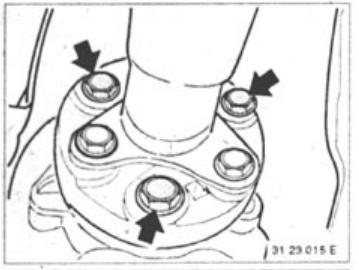


Unscrew cross member.

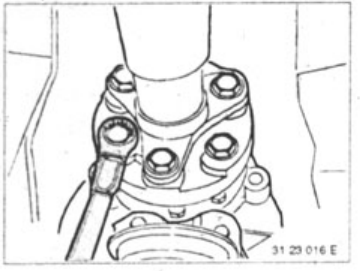
Installation:
Center transmission - refer to Group 26.
Tightening torque*.



Unscrew exhaust suspension at transmission.



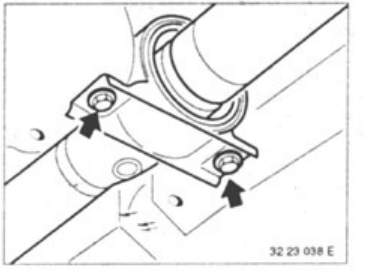
Unscrew joint disc at transmission.



Installation:
Replace stop nuts.
Tighten bolts to specified tightening torque*.

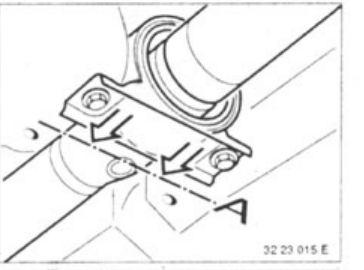
Important!
Only turn nuts on flange end whenever possible by design to avoid tension in the joint disc.

* Refer to Specifications



Unscrew center mount.
Bend propeller shaft down and pull off of centering pins on transmission.

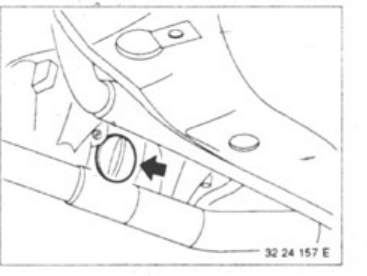
Important!
Do not let propeller shaft fall into joints.
Suspend it from car on piece of wire.



Installation:
Preload center mount in forward direction by distance (A) = 2 ... 4 mm.
Tightening torque*.



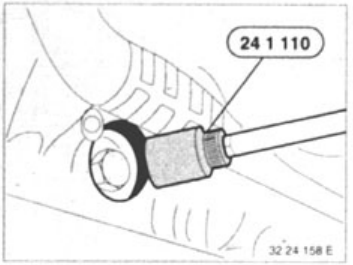
Unscrew heat shields at left and right hand sides and push forward.



Turn steering wheel fully against left or right lock.

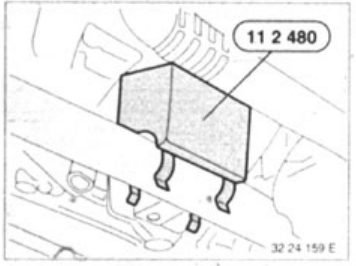
Lift cap out of opening in oil sump.

* Refer to Specifications

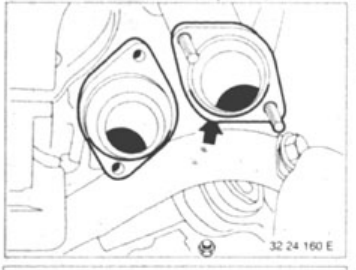


Unfasten torque converter from drive plate with special tool 24 1 110.
(3 or 4 screws).
To do this, turn flywheel round one screw at a time.

Note:
The torque converter screw connection has been changed from 3 to 4 screws.

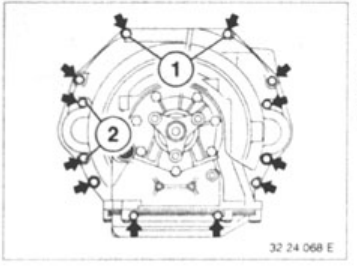


Fit special tool 11 2 480 between connecting tube and engine oil sump.



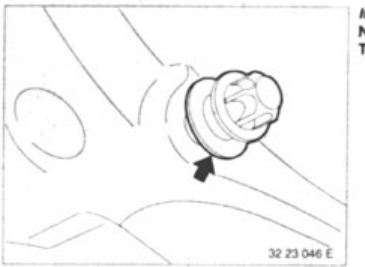
Lower transmission.

Caution!
The exhaust manifold must not contact the traction strut mounts.

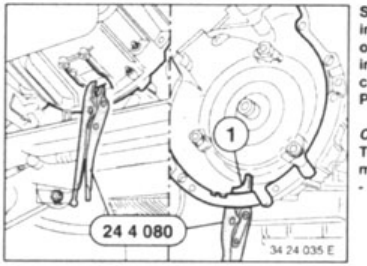


Unscrew transmission on engine.
(Torx screws).

Note:
Screws (1) Torx E 10
all others Torx E 12
The screws opposite the starter motor (2) have nuts on the front.

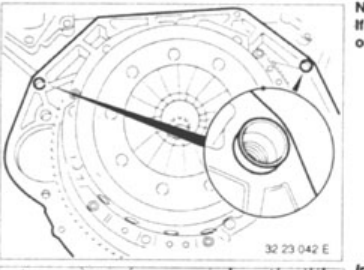


Installation instruction:
Note that Torx screws are fitted with washers.
Tightening torque* –

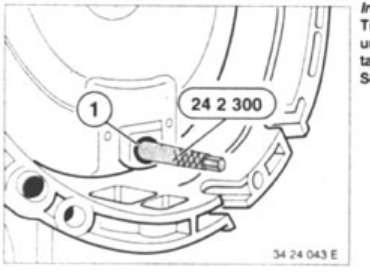


Secure torque converter to prevent it from falling out. To do this, place special tool 24 4 080 on transmission case with flat side of retaining tongue (1) against torque converter and secure.
Pull transmission off of engine.

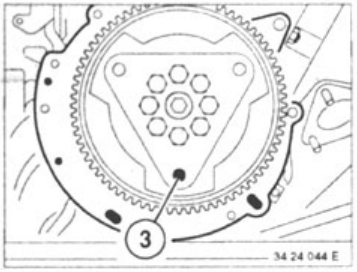
Caution!
To transport the transmission, lower transmission fully onto lifting fixture.
- Risk of accident -



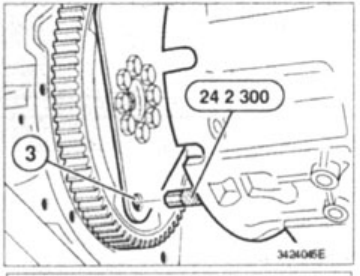
Note dowel sleeves.
If necessary, transfer / replace dowel sleeves on transmission.



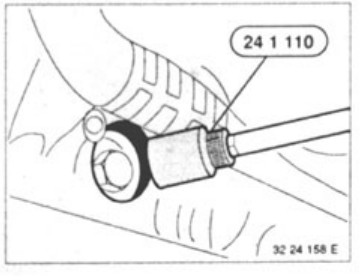
Installation instruction:
Turn the torque converter on the transmission until bore (1) faces down perpendicular to the tab.
Screw special tool 24 2 300 into the tab.



Installation:
Bore (3) on drive plate must point perpendicularly to center of opening in oil sump.



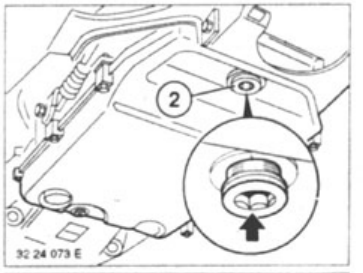
Installation:
Lift automatic transmission until bore (3) in drive plate is reached.
Carefully guide transmission into bore (3) of drive plate using Special Tool 24 2 300.
Bolt transmission case to engine.
Unscrew Special Tool 24 2 300 from tab forwards.
Mount torque converter to flywheel.
Tightening torque*.



Installation:
Install bolt using Special Tool 24 1 110 and tighten using a torque wrench.
Tightening torque*.

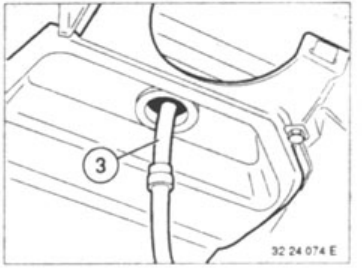
Important!
Only use original bolts** together with spring washers.
Non-conformance will lead to destruction of the transmission.

* Refer to Specifications
** Source of Supply: BMW Parts



Installation:
Fill transmission with ATF.

ATF is poured in through filler opening underneath the oil sump.
Unscrew filler plug (2).
(Check seal, replacing it if necessary.)



Car must be on level surface.
With engine stopped, pour in ATF with help of filler neck (3)** so long until it runs out of the overflow hole.
Do not plug hole.
Start engine and shift in and out of all gears several times while operating the brake pedal.

ATF temperature must be 30 to 55° C.

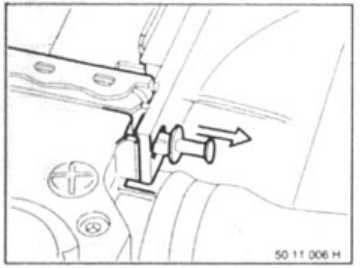
Interrogate ATF temperature with MoDiC or a Service Tester (refer to Test Plan).
Run engine at idling speed with selector lever in "P" or "N".
Recheck ATF level.
Screw in filler plug.
Tightening torque*.

* Refer to Specifications
** Source of Supply: BMW Parts

24 00 026 Removing and installing transmission with transfer case

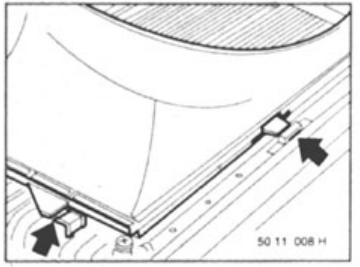
- 4-wheel drive

Disconnect negative lead.
Caution!
First read fault memories with tester and print any faults since disconnecting the negative lead will cancel the fault memories in the control units. Removing and installing exhaust assembly 18 00 020



o Remove fan shroud:

Remove expanding rivets from fan shroud and lift fan shroud up slightly.

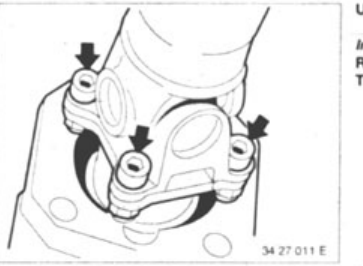


Installation instruction:
Connect up fan shroud on left and right and in center.



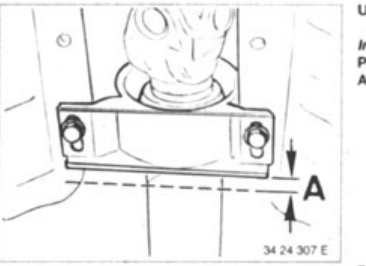
o Remove propshaft:

Remove heat baffle plate (1).



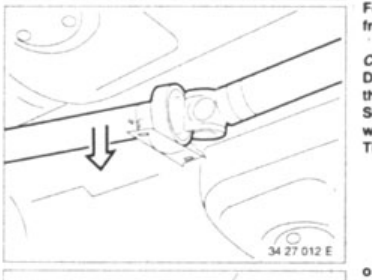
Unscrew propeller shaft on transmission.

Installation instruction:
Replace stop nuts.
Tightening torque 26 11 2AZ*



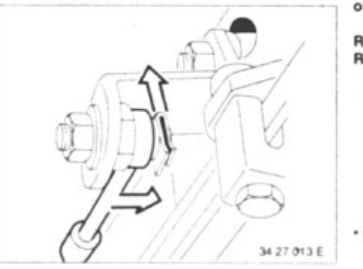
Unscrew center mount.

Installation instruction:
Preload center mount in direction of travel A = 2 ... 4 mm.



Fold propeller shaft downwards and withdraw from transmission.

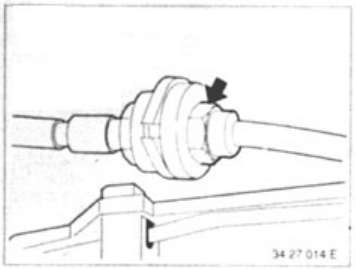
Caution!
Do not allow the propeller shaft to drop into the joints.
Suspend propeller shaft from car on a piece of wire.
Tightening torque 26 11 6AZ*.



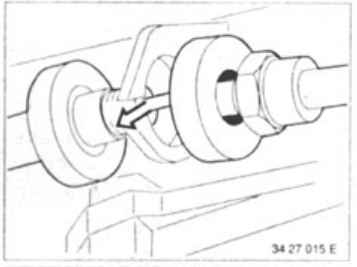
o Working on the automatic transmission:

Remove bracket.
Remove Bowden cable.

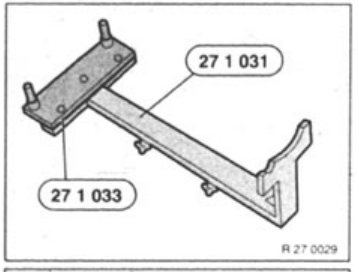
* Refer to Specifications



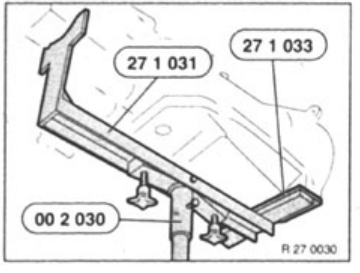
Unscrew nut for Bowden cable sleeve.



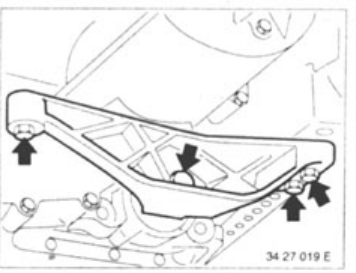
Detach Bowden cable sleeve from bracket.



Preassemble special tools 27 1 031 and 27 1 033 to suit automatic transmission.



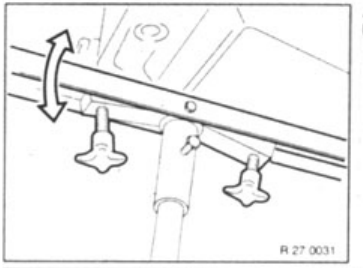
Support transmission on lifting fixture 00 2 030.



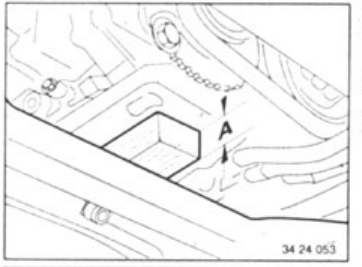
Unscrew cross-member from body and transfer box and remove.

Lower transmission.

Installation instruction:
Tightening torque 24 71 1AZ*

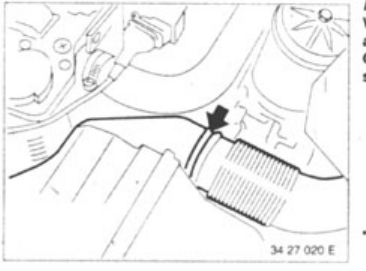


Adjust inclination by turning the knurled-head bolts with special tool 27 1 031.



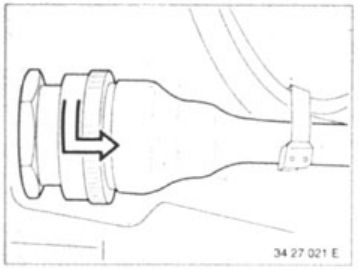
Jam a block (wooden or similar material) between front axle carrier and engine oil pan (A = 50 mm).

Note:
The block prevents the engine from tipping forwards when the transmission flange is unfastened.

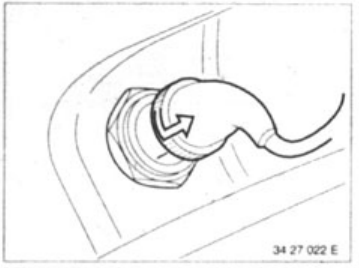


Installation instruction:
When lowering the transmission, the coolant air guide for the alternator can slip out. Check once the transmission has been installed.

* Refer to Specifications



Disconnect plug connection for transmission control unit (bayonet connection).

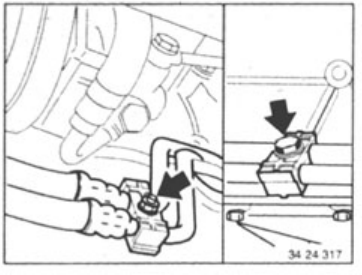


Turn bayonet connection for transfer box control counter-clockwise and remove.

Installation instruction:
Fit plug in such a way that marking grooves are aligned with one another.



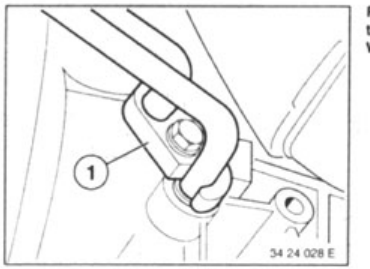
Remove bracket for cable on transmission control unit.



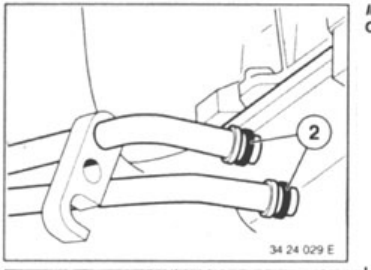
Loosen oil cooler pipe clamps on crankcase and oil pan.

Installation instruction:
Tightening torque 17 22 3AZ*.

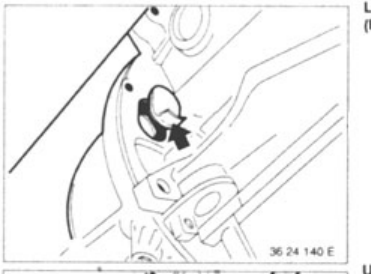
* Refer to Specifications



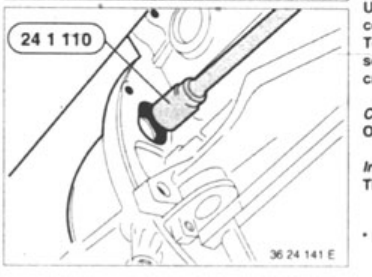
Remove retaining tab (1) for oil cooler lead on transmission.
Withdraw oil cooler lead.



Installation instruction:
Check O-rings (2), replacing if necessary.



Lift rubber stops out of aperture in cover plate. (Below exhaust manifold).

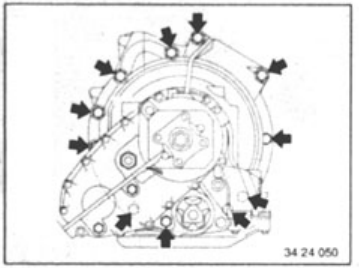


Unfasten the screw connections on the torque converter using special tool 24 1 110.
To do this, keep rotating engine as far as next screw by turning the central screw on the crankshaft.

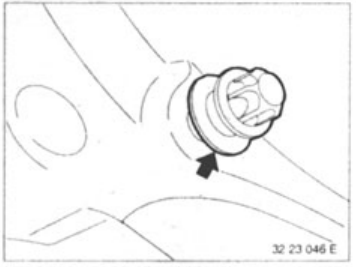
Caution!
Only use original bolts.

Installation instruction:
Tightening torque 24 40 1AZ*

* Refer to Specifications

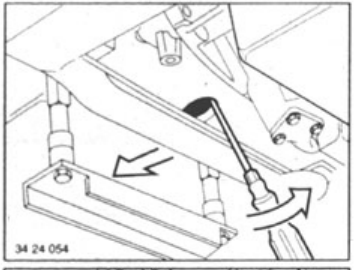


Disconnect transmission flange from engine. (Torx screws).



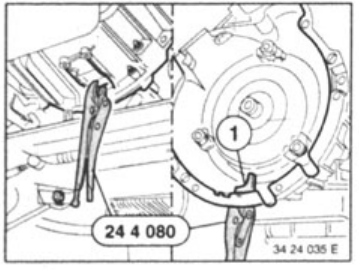
Installation instruction:
Note that Torx screws are fitted with washers.

Tightening torque 24 00 1AZ*



Carefully remove transmission.

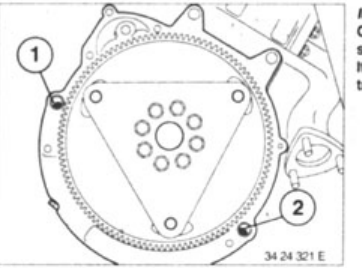
Caution!
Prevent torque converter from sliding out.
To do this, press down with screwdriver pointing towards transmission while removing the transmission unit.



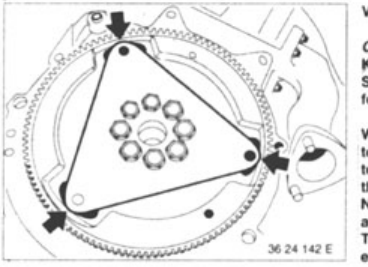
As soon as possible, fit and secure special tool 24 4 080 on transmission case with flat side of retaining tongue (1) facing the torque converter.

Caution!
A lifting fixture with mounted transmission may be moved only in completely lowered position. The lifting fixture is not suitable for transporting the transmission.
- Danger of accident! -

* Refer to Specifications



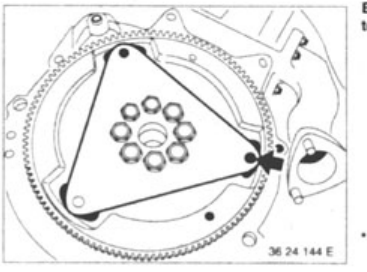
Installation instruction:
Check that dowel sleeves (1 and 2) are not missing.
If applicable, transfer dowel sleeves from transmission or use new dowel sleeves.



Version with sheet metal flywheel:

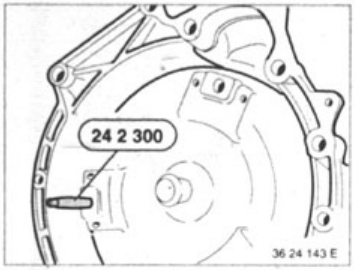
Caution!
Keep to sequence of installation.
Sheet metal flywheel (2) has three indentations for the torque converter mounting tabs.

When guiding the engine and transmission together the three mounting tabs on the torque converter must be aligned with the three indentations in the sheet metal flywheel. Non-conformance will lead to secondary damage on the automatic transmission. Turning the torque converter, or cranking the engine, is no longer possible after guiding the engine and transmission together and would lead to damage.



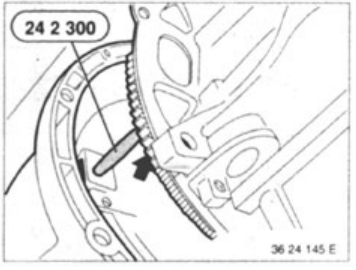
Bore on drive plate must point perpendicularly to center of opening in guard.

* Refer to Specifications

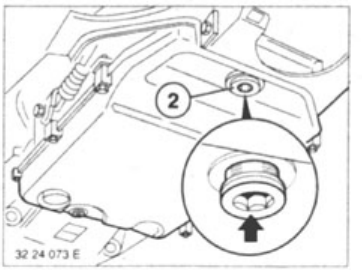


Turn torque converter on the transmission that bores in the tabs point to the center of bores in the flywheel.

Screw special tool 24 2 300 into the tab.



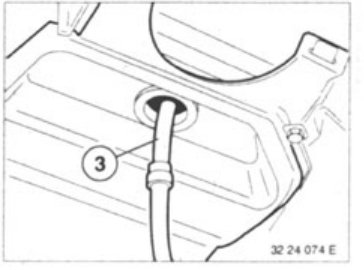
Lift automatic transmission until bore in drive plate is reached.
Guide transmission in carefully with special tool 24 2 300 in bore (3) on the drive plate.
Bolt transmission case to engine.
Unscrew special tool 24 2 300 from the tab towards the front.
Mount torque converter.
Tightening torque 24 40 1AZ*



o Check transmission fluid level.

The ATF fluid*** is filled through the lower filler aperture in the oil pan.
Remove filler plug (2).

Installation instruction:
Check seal, replacing if necessary.



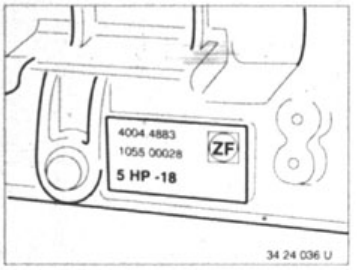
Car must be standing on a level surface.
When the engine is stationary, top up with ATF fluid with filler neck (3)**, until fluid overflows around the filler screw.
Don't plug the bore.
Start engine. Depress brake and shift the selector lever through all positions several times.

Oil temperature must be between 30...55°C.

- Interrogate with Modic or Service Tester (see Troubleshooting Manual) -
Allow engine to idle in selector lever setting "P" or "N".
Recheck ATF level.
Screw in filler plug.
Tightening torque*

* Refer to Specifications

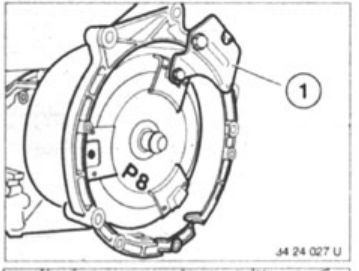
* Refer to Specifications
** Source of Supply: BMW Parts Service
*** Refer to Consumables Specifications



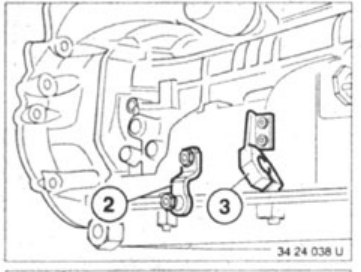
24 00 046 Installing exchange transmission

Removing transmission 24 00 026.

Caution!
Always clean oil cooler and pipes with compressed air and flush twice with ATF before installing an exchange transmission.
Transmission identification/coding* on type plate or label.



Transfer transport holder (1).



Transfer lever (2) and retaining bracket (3) and cable bracket for Lambda oxygen sensors.

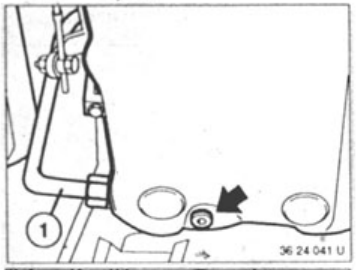
Installation instruction:
Tightening torque 24 51 1AZ*



Caution!
Automatic transmissions are supplied filled with ATF.
Version with oil filler pipe:
Remove plug from oil sump before installing the oil filler pipe.
Catch escaping ATF in a clean container.
Pour in ATF using special tool 24 0 080 after installing transmission.

* Refer to Specifications

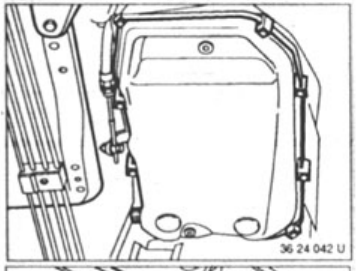
Perform an oil level check.
(Refer to 00 11 239).



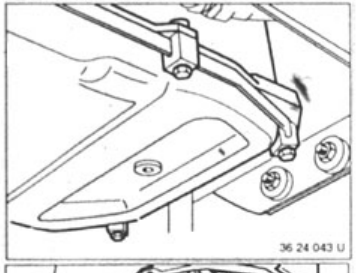
24 11 008 REMOVING AND INSTALLING / SEALING TRANSMISSION OIL SUMP

Drain oil.

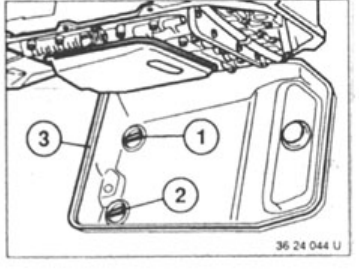
Version with Oil Filler Pipe:
Unscrew filler pipe (1).



Unscrew oil sump.
Take off oil sump with gasket.



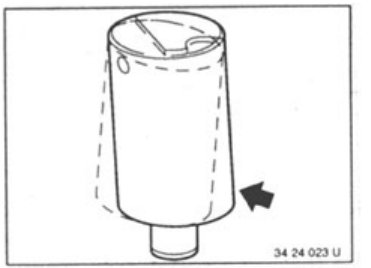
Installation:
Mount holder with straight arm on side and curved holders at front and rear.
Tightening torque*.



Clean oil sump.

Important!
Place magnets (1 and 2) in oil sump.
Check gasket (3), replacing if necessary.

* Refer to Specifications



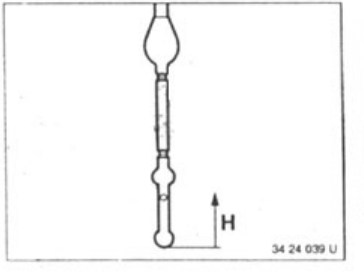
Version with Oil Filler Pipe:
Pull out oil dipstick.

Important!
Oil dipstick is locked and can be pulled out only after tilting the handle.
Pour in ATF.

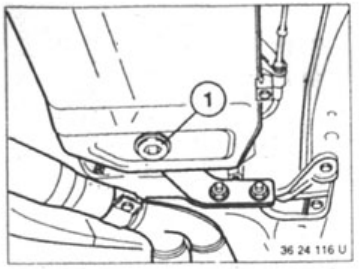


Pour in ATF using Special Tool 24 0 080.
Volume of ATF: approx. 3.0 liters.

Check / correct oil level with selector lever in P or N and engine running at idling speed.
Car must be on a level surface.
Wipe off oil dipstick with a rag which does not lose lint.
ATF temperature is sensed by a temperature dependent resistor which is integrated in the transmission wire harness.
Read ATF temperature with MoDiC or a Service Tester (refer to Test Plan).
Pull out oil dipstick and measure oil level and compare with value in this table.

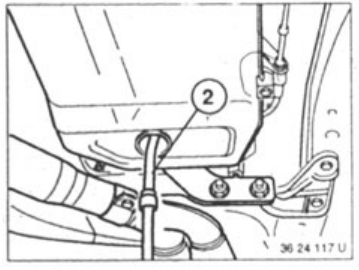


Oil Temperature	Oil Level = H in mm	
+ °C	Min.	Max.
30	3	16
40	8	23
50	12	31
60	16	39
70	21	46
80	26	53
90	31	59



Version without Oil Filler Pipe:
Oil filler pipe is omitted as of 1.91.
Automatic transmissions are filled with ATF through filler opening from below on the oil sump.
Unscrew filler plug (1).

Installation:
Check seal, replacing if necessary.



Car must be on a level surface.
With the engine stopped, pour in ATF using filler (2)** so long until ATF runs out of overflow hole.
Do not plug the hole.
Start engine and move selector lever in and out of all positions, while operating the brake pedal.
ATF temperature must be 30 ... 55° C.
Interrogate ATF temperature with MoDiC or Service Tetser (refer to Test Plan).
Run engine at idling speed with selector lever in P or N.
Recheck ATF level.
Screw in and tighten filler bolt.
Tightening torque*.

* Refer to Specifications
** Source of Supply: BMW Parts

24 12 016 Replacing radial oil seal for output flange

Remove propshaft (refer to 24 00 026).
The output flange can no longer be dismantled from outside.
Transmission extension has to be removed for removal of output flange.



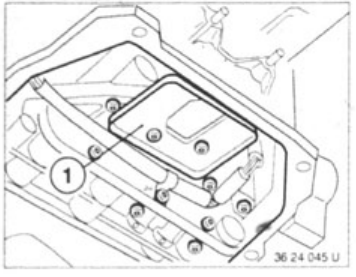
Caution!
Until this design modification is introduced, the oil pan must be removed before removal of the transmission extension and special tool 24 1 210 must be used, otherwise the clutch disks will slip out.

Because of this it is necessary to dismantle the transmission.



Special tool need no longer be used for removal of the oil pan with effect from

Transmission number: 112300

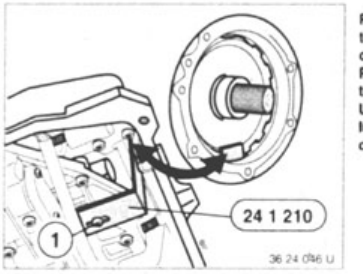


For installation of special tool 24 1 210:

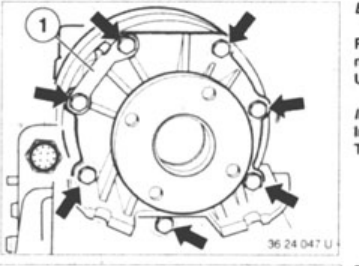
To remove oil pan, refer to 24 11 008.
Remove cover plate (1) from shift unit.

Installation instruction:
Tightening torque 24 11 2AZ*

* Refer to Specifications



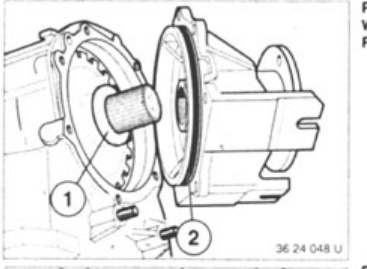
Prevent axial movement by installing special tool 24 1 210 between parking lock gear and case.
Plates could slide out during removal of the transmission extension.
Unscrew bolt on valve body.
Install special tool 24 1 210 for parking pawl detent and case and secure with screw (1).



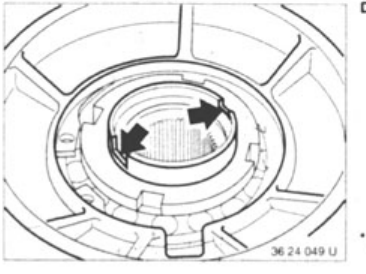
Both versions:

Remove cross member from body and transmission extension.
Unscrew bolts.

Installation instruction:
Install guide (1) for cable holder.
Tightening torque 24 11 1AZ*.



Pull off transmission extension.
Watch out for spacer (1).
Replace O-ring (2).

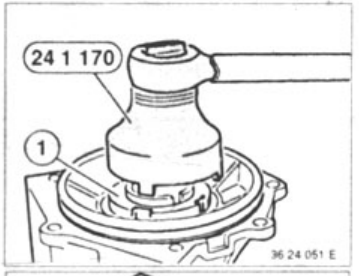


Drive back retaining tab on grooved nut.

* Refer to Specifications

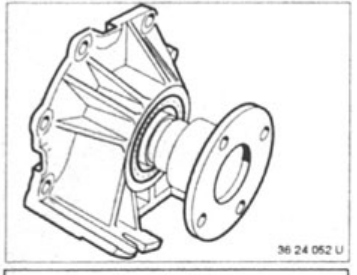


Clamp Special Tool 24 1 220 in a vise.
Place transmission extension with output flange in Special Tool 24 1 220.

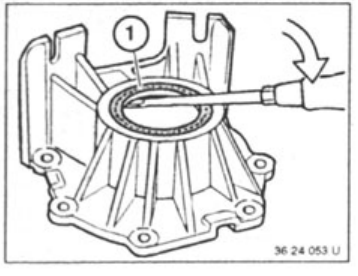


Unscrew slotted nut (1) using Special Tool 24 1 170.

Installation:
Tightening torque*.

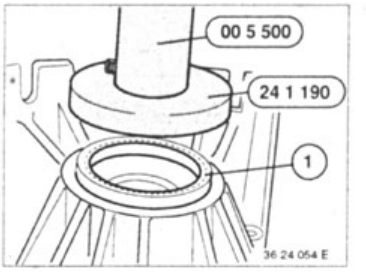


Take transmission extension off of Special Tool 24 1 220.
Pull output flange out of bearings.

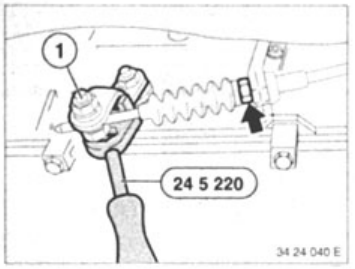


Lift out radial oil seal (1).

* Refer to Specifications



Installation:
Drive in new radial oil seal (1) flush using Special Tools 23 1 119 and 00 5 500.



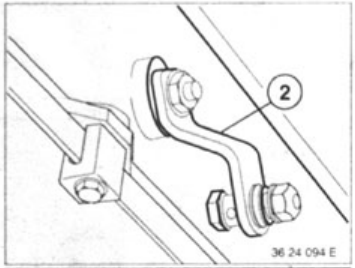
24 12 106 Replacing radial oil seal for manual shift valve shaft

Loosen nut (1).

Caution!
In order to avoid deforming the operating cable, clamping screw must be held with special tool 24 5 220.

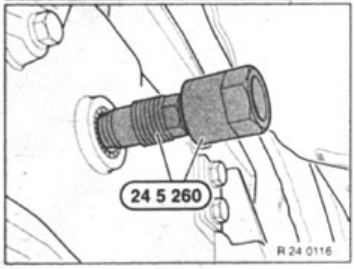
Note!
Special tool 24 5 220 can only be fitted in position "P".
Detach operating cable from support bracket.
Pull out operating (Bowden) cable.

Installation note:
Adjust gearshift,
refer to 24 00 007.



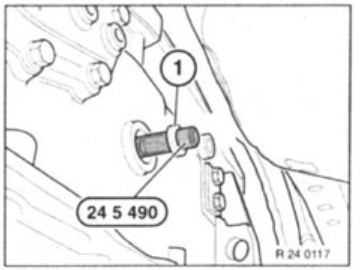
Remove lever (2).

Installation note:
For tightening torque 24 51 1AZ*.

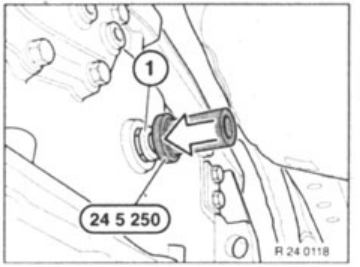


Remove radial oil seal from transmission casing with special tool 24 5 260.

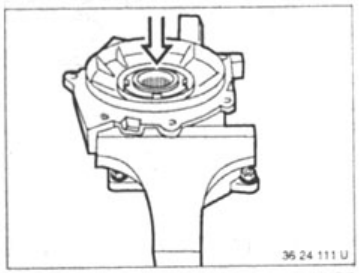
* Refer to Technical Data



Installation note:
Fit special tool 24 5 490 on manual shift valve shaft.
Oil sealing lip of new radial oil seal (1) with automatic transmission oil.
Slide on radial oil seal (1) up to casing.



Installation note:
Press radial oil seal into transmission casing with special tool 24 5 250.
Remove special tool 24 5 490 from manual shift valve shaft.

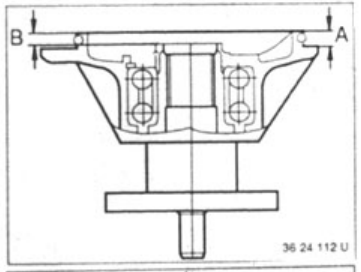


24 13 156 REPLACING OUTPUT FLANGE

Remove output flange – refer to 24 12 016.

Important!
Aaxial play must be checked and, if necessary, adjusted.

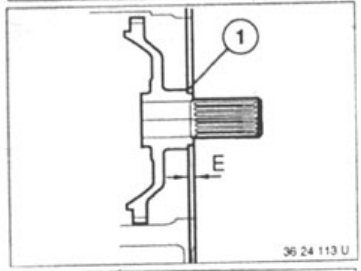
Clamp transmission extension in a vise.
Output flange must not bear.
Press output flange in direction of output.



Measure distance (A) from shoulder to sealing surface and distance (B) from shoulder to end of output flange.

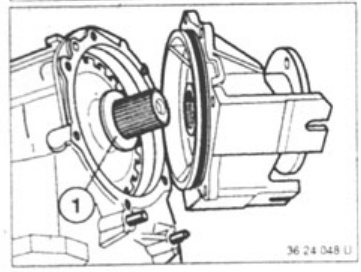
Example:

	A =	**10.0 mm**
–	**B** =	**7.4 mm**
	C =	**2.6 mm**



Measure distance (E) from sealing surface to shoulder (1) on parking lock gear.
Press in parking lock gear for this purpose.

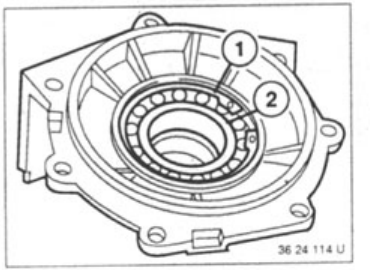
Example:
E = 4.0 mm



Example:

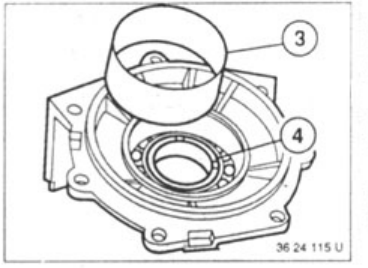
	E =	**4.0 mm**
–	**C** =	**2.6 mm**
		2.4 mm
–		**0.15 ... 0.35 mm axial play**

Install spacer (1) of correct thickness.
Spacers are available from Parts in thicknesses of 0.8 to 2.8 mm.



24 13 706 REPLACING BEARING OF TRANSMISSION EXTENSION – Output Flange Removed –

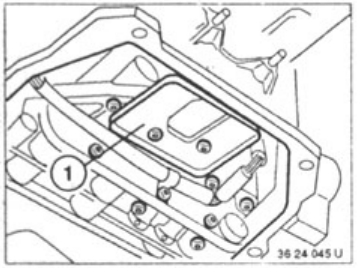
Lift out circlip (1).
Remove ball ring (2).



Heat transmission extension in area of bearing race to about 80° C with a hot air blower.
Remove bearing race (3).

Installation:
First insert ball ring (4) before installing bearing race.

Important!
Axial play must be checked and, if necessary, adjusted – see 24 13 156.



24 30 006 REMOVING AND INSTALLING OR REPLACING VALVE BODY

Remove oil sump – see 24 11 008.
Remove oil strainer – see 24 31 156.
Unscrew cover (1) from valve body.

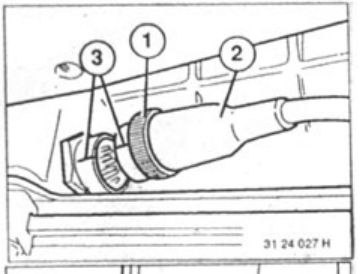
Installation:
Tightening torque*.



Unscrew valve body on case.

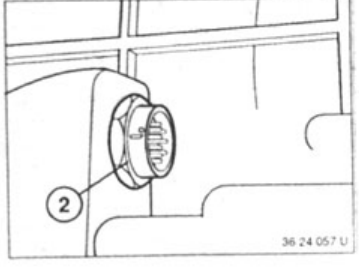
Important!
Only unscrew bolts with head size (A) of 12 mm.

Installation:
Tightening torque*.



Turn bayonet lock (1) counterclockwise.
Pull off plug (2).

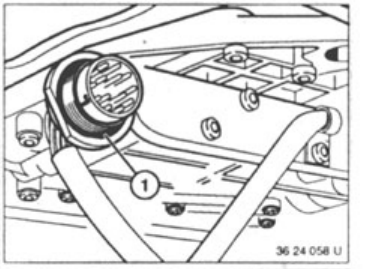
Installation:
Connect plug (2) that marks (3) are aligned.



Unscrew nut (2).

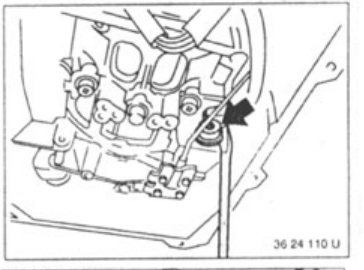
Installation:
Tightening torque*.

* **Refer to Specifications**

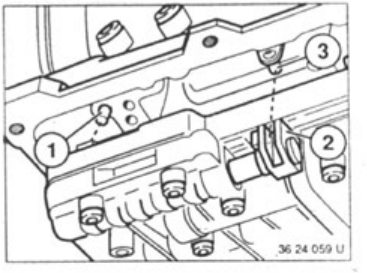


Pull out plug.

Installation:
Check O-ring (1), replacing if necessary.
Install that flat side on plug faces case.

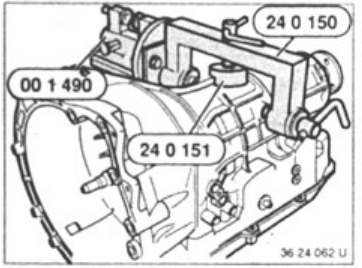


Installation:
Hold plug receptacle on the flat side with a screwdriver to prevent turning.



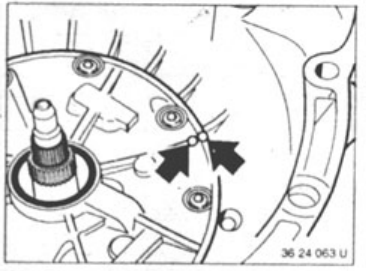
Remove valve body with wire harness.

Installation:
Attach valve body to centering pin (1) and overrun valve (2) in selector lever shaft (3).

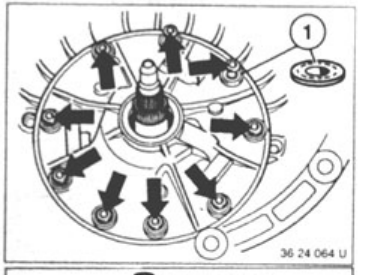


24 31 020 REMOVING AND INSTALLING / SEALING OIL PUMP HOUSING

Remove torque converter – see 24 40 006.
Mount transmission on Special Tool 24 0 150 in conjunction with Special Tool 00 1 490.
Mount transmission in horizontal position with help of Special Tool 24 0 151.



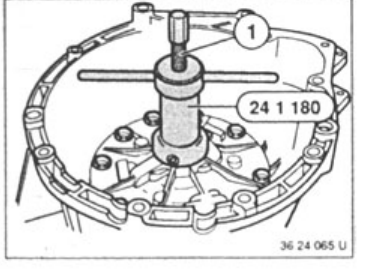
Set transmission upright.
Mark installed position of oil pump housing to make reinstallation easier.



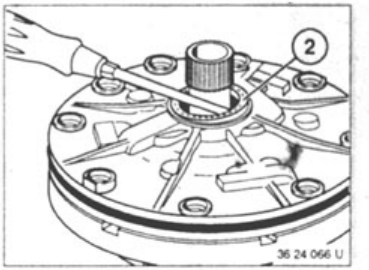
Unscrew bolts.

Important!
Watch out for seals (1).

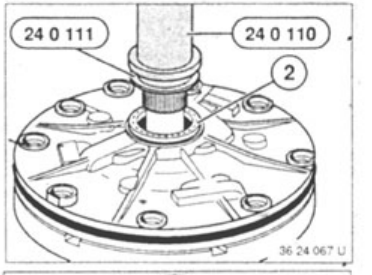
Installation:
Replace seals (1).



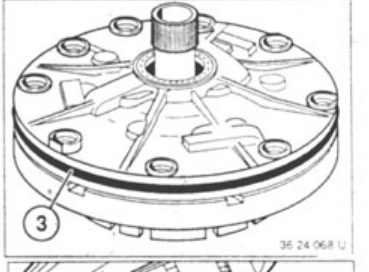
Apply Special Tool 24 1 180 and clamp tight on converter support shaft.
The oil pump housing is pressed out by turning spindle (1) in.
Lift out oil pump housing.
Remove Special Tool 24 1 180.



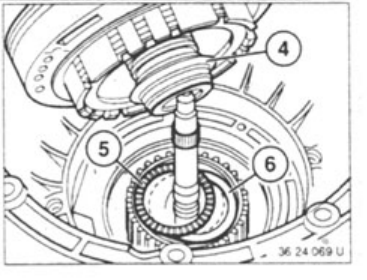
Lift out radial oil seal (2).



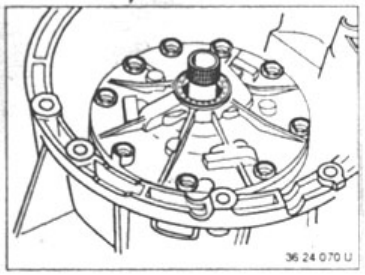
Lubricate sealing lip of radial oil seal with ATF.
Drive in radial oil seal (2) to fit tight using Special Tools 24 0 110 and 24 0 111.
Installed depth = 1 mm.



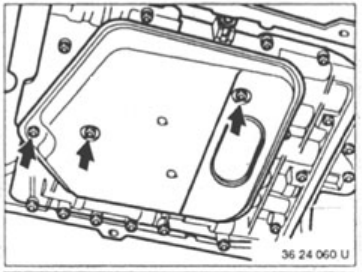
Replace round seal (3).

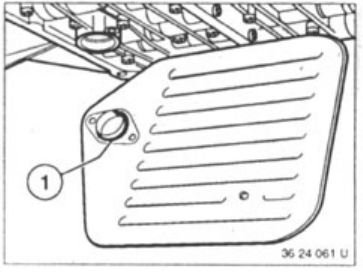


Check for correct installed position of thrust washer (4), needle bearing (5) and thrust washer (6) before installing the oil pump housing.
Lubricate round seal (3) with ATF.



Mount oil pump housing.
Check self-made marks.
Install bolts with new seals.
Bolt oil pump housing to transmission case by tightening the bolts uniformly.
Tightening torque = 10 Nm.



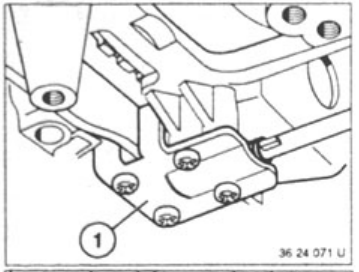


24 31 156 REMOVING AND INSTALLING OR REPLACING TRANSMISSION OIL STRAINER

Remove oil sump – see 24 11 008.
Unscrew oil strainer on valve body.

Take off oil strainer.
Watch out for O-ring (1).

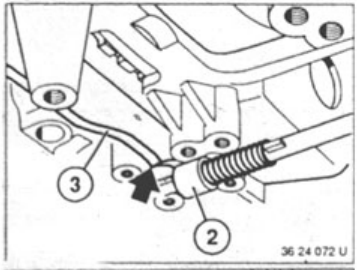
Installation:
Tightening torque = 5 Nm.



24 34 006 REMOVING AND INSTALLING OR REPLACING PARKING LOCK (PAWL / SPRING)

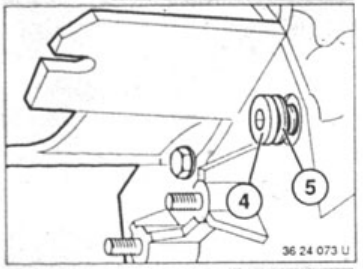
Remove valve body – see 24 30 006.
Unscrew holder (1) on case.

Installation:
Tightening torque*.



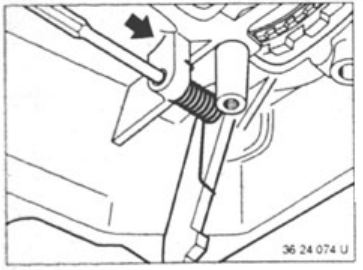
Take off holder.

Installation:
Connecting rod (2) must engage in groove of locking lever (3).

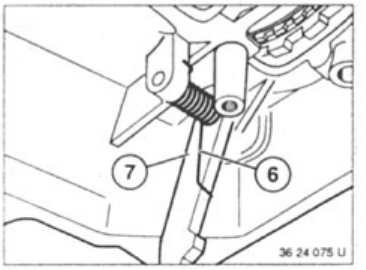


Unscrew plug (4).

Installation:
Check seal (5), replacing if necessary.
Tightening torque*.



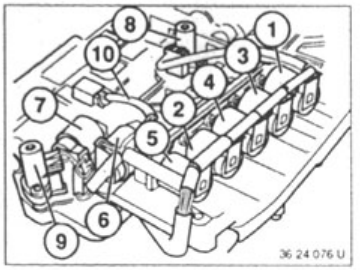
Drive out shaft pin from inside to outside.



Remove spring (6) and parking lock lever (7).

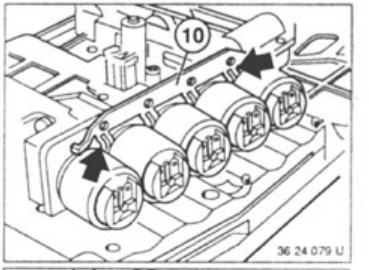
Installation:
Install spring (6) that long arm faces locking lever (7).

* **See Specifications**

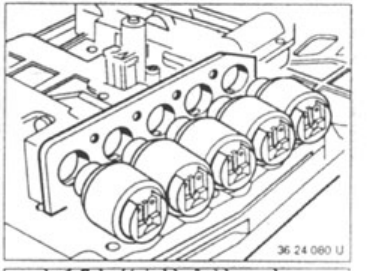


Arrangement of Solenoid Valves

1 Solenoid valve
2 Solenoid valve
3 Solenoid valve
4 Solenoid valve
5 Solenoid valve
6 Solenoid valve for conv. lockup clutch
7 Pressure regulator
8 Pulse sender for mean turbine speed
9 Pulse sender for output speed
10 Temperature sensor

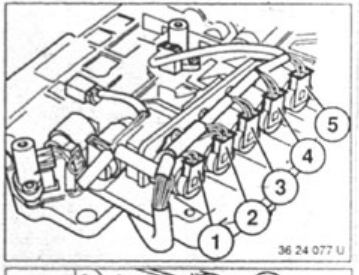


Installation:
Install holder (10) with curved side facing solenoid valves.
Tightening torque*.



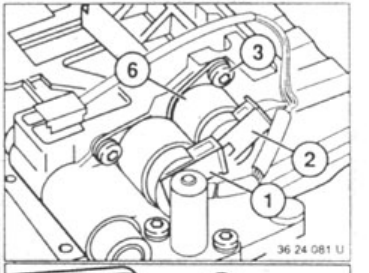
Pull out solenoid valves.

Installation:
Solenoid valves are identical.

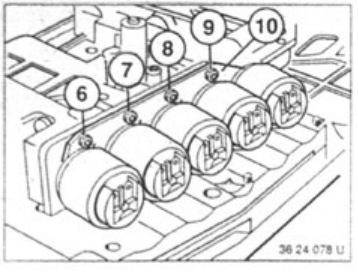


24 34 853 REPLACING ALL SOLENOID VALVES

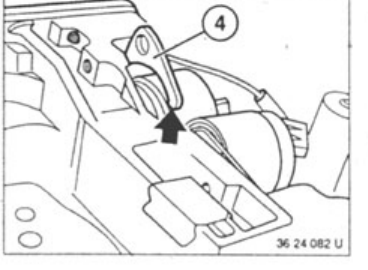
Remove valve body – 24 30 006.
Pull plugs (1 ... 5) off of solenoid valves.
Do not pull on wires.



Remove solenoid valve (6).
Pull off plugs (1 and 2) and unscrew screw (3).



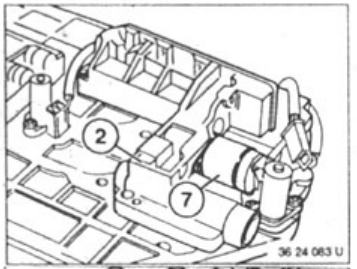
Unscrew screws (6 ... 9).
Take off holder (10).



Take off holder (4).
Pull out solenoid valve.

Installation:
Install holder (4) with lightly curved side facing valve housing.
Identification: solenoid valve (6) has a white plug receptacle.
Tightening torque*.

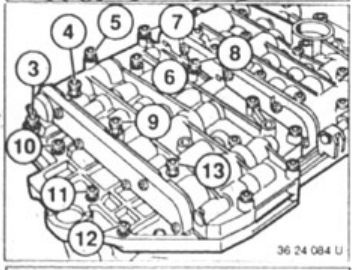
* **Refer to Specifications**



24 34 861 REPLACING PRESSURE REGULATOR FOR VALVE BODY

Remove valve body – see 24 30 006.
Pressure regulator (7) cannot be replaced separately, since the modulation pressure has to be adjusted.
Modulation pressure can only be adjusted by the manufacturers.

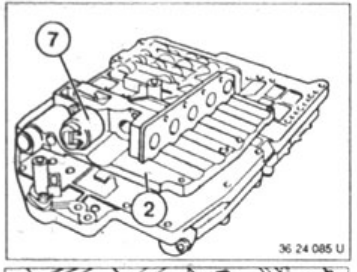
Replace pressure regulator (7) only in conjunction with valve housing (2).



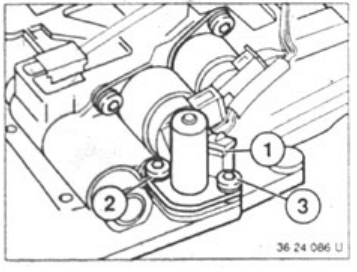
Remove solenoid valves (1 ... 6) – see 24 34 853.
Unscrew valve housing on valve body by loosening screws (3 ... 13).

Important!
Check length of screws.

Installation:
Tightening torque*.



Take valve housing (2) with pressure regulator (7) off of valve body.

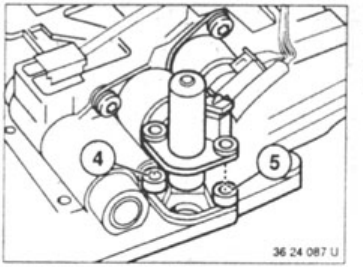


24 34 871 REPLACING PULSE SENDER FOR OUTPUT SPEED

Remove valve body – see 24 30 006.
Pull off plug (1).
Unscrew screws (2 and 3).

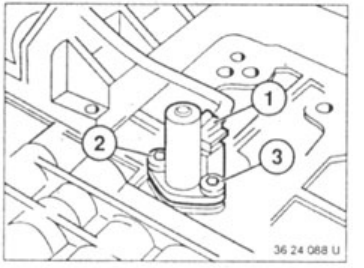
Installation:
Tightening torque*.

* **See Specifications**



Lift off pulse sender.

Important!
Watch out for spacers (4 and 5).

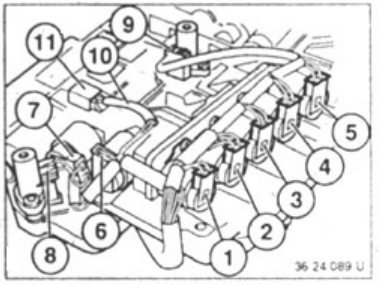


24 34 872 REPLACING PULSE SENDER FOR TURBINE SPEED

Remove valve body – see 24 30 006.
Pull off plug (1).
Unscrew screws (2 and 3).
Lift off pulse sender.

Installation:
Tightening torque*.

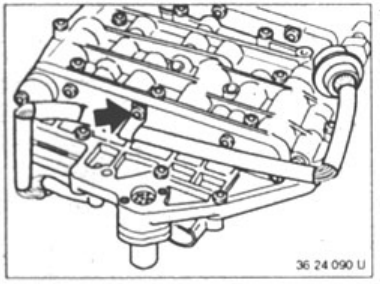
* **See Specifications**



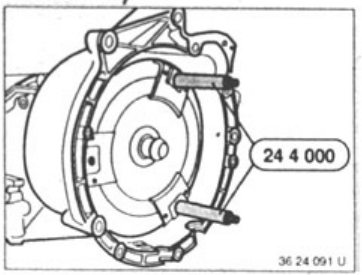
24 35 501 REPLACING WIRE HARNESS IN AUTOMATIC TRANSMISSION

Remove valve body – see 24 30 006.
Pull plugs off of solenoids (1 ... 6) and pressure regulator (7).
Pull plugs (8 and 9) off of pulse senders.

Note:
Temperature sensor (10) is integrated in the wire harness and must be inserted into holder (11).



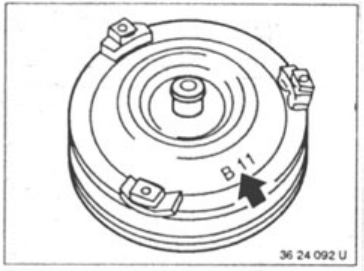
Unscrew holder on valve body.
Take off wire harness.



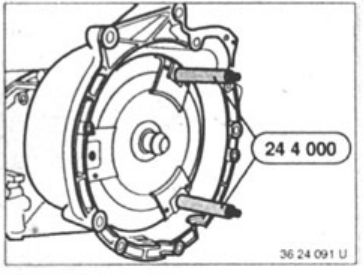
24 40 006 REMOVING AND INSTALLING OR REPLACING TORQUE CONVERTER

Remove transmission – see 24 00 026.
Pull torque converter out of primary pump carefully using Special Tools 24 4 000.

Caution!
Escaping ATF.



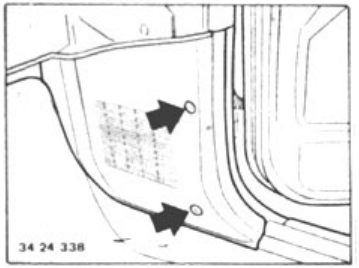
Torque converters cannot be cleaned with common workshop equipment and must be replaced when damaged.
Torque converter identification*.



Carefully guide openings on converter into primary pump by turning slightly and using Special Tool 24 4 000.

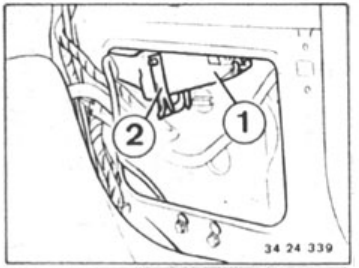
Important!
Make sure that converter bearing and seal are not damaged while guiding in.
Install torque converter as far as stop.

* See Specifications



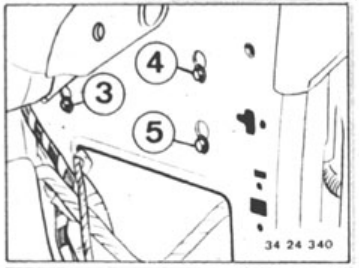
24 61 500 REMOVING AND INSTALLING / REPLACING CONTROL UNIT

The control unit for EH transmissions is located in the right A-pillar.
Read and print fault memories prior to removal.
Remove glovebox - refer to 51 16 360.
Unscrew loudspeaker cover.
Disconnect loudspeaker wires.
Remove protective hood.

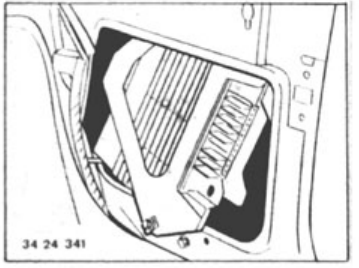


Pull plug (1) off of the control unit after swinging spring retainer (2) downwards.

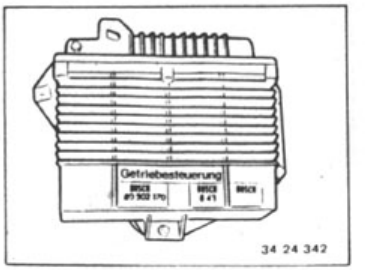
Caution!
Always switch the ignition off before disconnecting or connecting the plug.



Pull soundproofing sheet off partially.
Only loosen screws (3 ... 5).



Lift control unit out and remove downwards.



Code is provided on the data plate.
Refer to BMW Parts Catalog for cross reference of types and models.

TROUBLESHOOTING AUTOMATIC TRANSMISSION A 5 S 310 Z

Condition	Cause	Correction
Position P Park position does not engage	a) Shift linkage between selector lever and transmission maladjusted	a) Adjust shift - see 24 00 008
	b) Excessive friction in parking lock mechanism	b) Replace parking lock parts (connecting rod, pawl) - see 24 34 006.
Park position does not hold (slips)	a) Shift linkage between selector lever and transmission maladjusted	a) Adjust shift - see 24 00 008
Engine cannot be started in N or P, or can be started in all positions	a) Shift linkage between selector lever and transmission maladjusted	a) Adjust shift - see 24 00 008
	b) Transmission switch faulty Starter interlocking relay or wire faulty	b) Replace transmission switch - see 25 16 080 Repair/replace relay or wire
Position R No reverse gear	a) Shift linkage between selector lever and transmission maladjusted	a) Adjust shift - see 24 00 008
	b) Clutch B destroyed	b) Exchange transmission - see 24 00 046
	c) Brake D destroyed. In this case also no engine braking effect in position 2, 1st gear	c) Exchange transmission - see 24 00 046
	d) Brake G destroyed	d) Exchange transmission - see 24 00 046
	e) Refer to "Troubleshooting Valve Body"	
Hard engaging jolt P-R or N-R	a) Idling speed too high	a) Refer to "Test Plan"
	b) Refer to "Troubleshooting Valve Body"	
Backup lights do not light up (electrics OK)	a) Transmission switch faulty	a) Replace transmission switch - see 25 16 080
	b) Shift linkage between selector lever and transmission maladjusted	a) Adjust shift - see 24 00 008
Car moves or creeps	a) Shift linkage between selector lever and transmission maladjusted	a) Adjust shift - see 24 00 008
	b) Clutch A defective (bonded)	b) Exchange transmission - see 24 00 046

Condition	Cause	Correction
Position D No power flow	a) Clutch A destroyed	a) Exchange transmission - see 24 00 046
	b) 1st gear one-way clutch faulty	b) Exchange transmission - see 24 00 046
	c) Shift linkage between selector lever and transmission maladjusted	a) Adjust shift - see 24 00 008
Hard engaging jolt N - D (engine speed > 1500 rpm)	a) Idling speed too high	a) Refer to "Test Plan"
	b) Also refer to "Troubleshooting Valve Body"	
No shift (warm or cold)	a) Refer to "Troubleshooting Valve Body"	
No shift Shift 1-2	a) Brakes C1 and 2 faulty	a) Exchange transmission - see 24 00 046
	b) Insufficient oil supply to brakes C1 and C2	b) Exchange transmission - see 24 00 046
Shift 2-1	a) Refer to "Troubleshooting Valve Body"	
Shift 2-3	a) Clutch F faulty	a) Exchange transmission - see 24 00 046
	b) Insufficient oil supply to clutch F	b) Exchange transmission - see 24 00 046
Shift 3-2	a) Refer to "Troubleshooting Valve Body"	
Shift 3-4	a) Clutch E faulty	a) Exchange transmission - see 24 00 046
	b) Insufficient oil supply to clutch E	b) Exchange transmission - see 24 00 046
No braking effect Shift 4-3	a) Brake band C2 faulty; in this case shift 1-2 not OK	a) Exchange transmission - see 24 00 046
	b) Insufficient oil supply to brake C2	b) Exchange transmission - see 24 00 046
	c) Brake band C2 not preloaded, spring broken; in this case shift 1-2 not OK	c) Adjust brake band

Condition	Cause	Correction
No shift Shift 4-5	a) Refer to "Troubleshooting Valve Body"	
Shift 5-4	a) Clutch A faulty, in this case no 1st ... 4th gears	a) Exchange transmission - see 24 00 046
Shift from full load to kickdown too long	a) Plates broken b) Also refer to "Troubleshooting Valve Body"	a) Exchange transmission - see 24 00 046
Engine spins in shift 2-1	a) Poor friction torque at plates b) 1st gear one-way clutch not OK	a) Exchange transmission - see 24 00 046 b) Exchange transmission - see 24 00 046
Engine spins in shift 2-3/3-2	a) Poor friction torque at plates b) Also refer to "Troubleshooting Valve Body"	a) Exchange transmission - see 24 00 046
Engine spins in shift 4-3	a) Poor friction torque at plates b) 3rd gear one-way clutch not OK	a) Exchange transmission - see 24 00 046 b) Exchange transmission - see 24 00 046
Engine spins in shift 4-5/5-4	a) Poor friction torque at plates b) Also refer to "Troubleshooting Valve Body"	a) Exchange transmission - see 24 00 046
No engine braking effect, no manual downshift 5-4	a) Clutch A damaged b) Also refer to "Troubleshooting Valve Body"	a) Exchange transmission - see 24 00 046
4-3 / 3-2	a) Refer to "Troubleshooting Valve Body"	a) Exchange transmission - see 24 00 046
No 1st gear, no braking effect	a) Brake D faulty b) Also refer to "Troubleshooting Valve Body"	a) Exchange transmission - see 24 00 046

Condition	Cause	Correction
Shift transition too hard	a) Torque converter faulty b) Also refer to "Troubleshooting Valve Body"	a) Replace converter - see 24 40 006
No converter lockup clutch	a) Torque converter faulty b) Also refer to "Troubleshooting Valve Body"	a) Replace converter - see 24 40 006
Engine dies when moving off in Drive (converter lockup clutch always engaged)	a) Torque converter faulty b) Also refer to "Troubleshooting Valve Body"	a) Replace converter - see 24 40 006
Noise Noise in all positions	a) ATF level too low b) Valve body leaks c) Oil strainer dirty d) Round seal on oil filter missing / faulty	a) Correct ATF level - see 24 00 026 b) Exchange valve body - see 24 30 006 c) Replace oil strainer - see 24 31 156 d) Replace seal - see 24 31 156
Leaks Oil dripping from converter bell housing	a) Seals on oil pump body leak b) Round seal on oil pump body leaks c) Radial oil seal for torque converter faulty	a) Replace seals - see 24 31 020 b) Replace round seal - see 24 31 020 c) Replace radial oil seal - see 24 31 020
Leak between transmission case and oil sump	a) Mounting bolts loose b) Gasket faulty	a) Tighten bolts* b) Replace gasket - see 24 11 008

* Refer to Specifications for tightening torque

Condition	Cause	Correction
Leaks	a) Radial oil seal for output flange leaks	a) Replace radial oil seal - see 24 12 016
Output leaks	b) O-ring for transmission extension leaks	b) Replace O-ring - see 24 12 016
Manual shift valve shaft leaks	a) Radial oil seal leaks	a) Replace radial oil seal - see 24 12 106
Transmission plug leaks	a) Nut loose	a) Tighten nut*
	b) O-ring faulty	b) Replace O-ring
Plugs on transmission case leak	a) Plugs loose	a) Tighten plugs*
	b) Seals faulty	b) Replace seals
Oil cooler pipes leak	a) Oil cooler pipes loose	a) Tighten oil cooler pipes*
	b) O-rings faulty	b) Replace O-rings

* Refer to Specifications for tightening torque

TROUBLESHOOTING VALVE BODY A 5 S 310 Z

Condition	Cause	Correction
Position R	a) Signal wire to solenoid 3 grounded	a) Repair/replace wire harness - see 24 35 501
No power flow in reverse	b) Valve piston for reverse gear lock not in parked position	b) Exchange valve body - see 24 30 006
Hard engaging jolt in position R	a) Damper of brake D malfunctions	a) Exchange valve body - see 24 30 006
	b) Modulation pressure too high	b) Replace pressure regulator - see 24 34 861
	c) Wire to pressure regulator faulty	c) Repair/replace wire harness - see 24 35 501
	d) Pressure regulator faulty	d) Replace pressure regulator - see 24 34 861
Position D	a) Damper A blocked	a) Exchange valve body - see 24 30 006
No power flow in forward	b) Signal wire to solenoid 5 grounded	b) Repair/replace wire harness - see 24 35 501
Hard engaging jolt in position D	a) Damper of clutch A malfunctions	a) Exchange valve body - see 24 30 006
	b) Wire to pressure regulator faulty	b) Repair/replace wire harness - see 24 35 501
	c) Pressure regulator faulty	c) Replace pressure regulator - see 24 34 861
	d) Modulation valve malfunctions	d) Exchange valve body - see 24 30 006
Hard shift jolts in general	a) Modulation valve malfunctions	a) Exchange valve body - see 24 30 006
	b) Wire to pressure regulator faulty	b) Repair/replace wire harness - see 24 34 501
	c) Pressure regulator faulty	c) Replace pressure regulator - see 24 34 861

Condition	Cause	Correction
Position D	a) Wire to output speed sensor faulty	a) Repair/replace wire harness - see 24 35 501
No shift 1-2	b) Output speed sensor faulty	b) Replace speed sensor - see 24 34 871
	c) Signal wire to solenoid 1 grounded	c) Repair/replace wire harness - see 24 35 501
	d) Shift valve 1 seized in parked position	d) Exchange valve body - see 24 30 006
	e) Damper C2 or clutch valve C1 seized	e) Exchange valve body - see 24 30 006
	f) Shift valve 3 seized in parked position	f) Exchange valve body - see 24 30 006
No shift 2-1	a) Signal or positive wire to solenoid 1 faulty	a) Repair/replace wire harness - see 24 35 501
	b) Solenoid 1 faulty	b) Replace solenoid 1 - see 24 34 853
	c) Shift valve seized in pushed position	c) Exchange valve body - see 24 30 006
No shift 2-3	a) Signal wire to solenoid 2 faulty	a) Repair/replace wire harness - see 24 35 501
	b) Solenoid 2 faulty	b) Replace solenoid 2 - see 23 34 853
	c) Shift valve 2 seized in pushed position	c) Exchange valve body - see 24 30 006
	d) Pulling valve 2-3 seized in parked position	d) Exchange valve body - see 24 30 006
No shift 3-2	a) Signal or positive wire to solenoid 2 faulty	a) Repair/replace wire harness - see 24 35 501
	b) Shift valve seized in parked position	b) Exchange valve body - see 24 30 006
	c) Pulling valve 2-3 seized in pushed position	c) Exchange valve body - see 24 30 006

Condition	Cause	Correction
Position D	a) Signal wire to solenoid 3 grounded	a) Repair/replace wire harness - see 24 35 501
No shift 3-4	b) Solenoid 3 faulty	b) Replace solenoid 3 - see 24 34 853
	c) Shift valve seized in pushed position	c) Exchange valve body - see 24 30 006
	d) Damper E seized	d) Exchange valve body - see 24 30 006
No shift 4-3	a) Signal or positive wire to solenoid 3 faulty	a) Repair/replace wire harness - see 24 35 501
	b) Shift valve 3 seized in parked position	b) Exchange valve body - see 24 30 006
No shift 4-5	a) Signal or positive wire to solenoid 1 faulty	a) Repair/replace wire harness - see 24 35 501
	b) Shift valve 4 seized in parked position	b) Exchange valve body - see 24 30 006
	c) Damper C2 seized	c) Exchange valve body - see 24 30 006
No shift 5-4	a) Signal wire to solenoid 1 grounded	a) Repair/replace wire harness - see 24 35 501
	b) Solenoid 1 faulty	b) Replace solenoid 1 - see 24 34 853
	c) Shift valve 4 seized in pushed position	c) Exchange valve body - see 24 30 006

Condition	Cause	Correction
Car moves off in 2nd gear	a) Signal or positive wire to solenoid 1 faulty; in this case no 5th gear	a) Repair/replace wire harness - see 24 35 501
	b) Shift valve 1 seized in parked position	b) Exchange valve body - see 24 30 006
Car moves off in 3rd gear	a) Signal or positive wire to solenoids 1 and 2 faulty	a) Repair/replace wire harness - see 24 35 501
	b) Shift valves 1 and 2 seized in parked position	b) Exchange valve body - see 24 30 006
Car moves off in 4th gear	a) General positive wire faulty (transmission without current)	a) Repair/replace wire harness - see 24 35 501
	b) Shift valves 1, 2 and 3 seized in parked position	b) Exchange valve body - see 24 30 006
Shift transitions in zero load positions Full load shifts too hard	a) Modulation valve malfunctions	a) Exchange valve body - see 24 30 006
	b) Wire to pressure regulator faulty	b) Repair/replace wire harness - see 24 35 501
	c) Pressure regulator faulty	c) Replace pressure regulator - see 24 34 861
	d) Damper malfunctions	d) Exchange valve body - see 24 30 006
Shift transitions of full load and kickdown shifts too long	a) Pressure reducing valve 1 or 2 malfunctions	a) Exchange valve body - see 24 30 006
	b) Modulation valve malfunctions	b) Exchange valve body - see 24 30 006
	c) Pressure regulator faulty	c) Replace pressure regulator - see 24 34 861

Condition	Cause	Correction
Engine dies from shift 2-3 / 3-2 (overlapped control)	a) Signal or positive wire to solenoid 4 faulty	a) Repair/replace wire harness - see 24 35 501
	b) Solenoid 4 faulty	b) Replace solenoid 4 - see 24 34 853
	c) Pull/push valve 1 moves too hard	c) Exchange valve body - see 24 30 006
	d) Aperture for damper G clogged	d) Exchange valve body - see 24 30 006
	e) Damper F moves too hard	e) Exchange valve body - see 24 30 006
	f) Pull valve 2-3/3-2 moves too hard	f) Exchange valve body - see 24 30 006
Engine dies from shift 4-5 / 5-4 (overlapped control)	a) Signal or positive wire to solenoid 5 faulty	a) Repair/replace wire harness - see 24 35 501
	b) Solenoid 5 faulty	b) Replace solenoid 4 - see 24 34 853
	c) Pull/push valve 2 moves too hard	c) Exchange valve body - see 24 30 006
	d) Damper C2 malfunctions	d) Exchange valve body - see 24 30 006
	e) Pull valve 4-5/5-4 moves too hard	e) Exchange valve body - see 24 30 006
	f) Damper A moves too hard	f) Exchange valve body - see 24 30 006
Converter lockup clutch Shift transition too hard	a) Converter lockup clutch valve malfunctions	a) Exchange valve body - see 24 30 006
No converter lockup clutch	a) Signal or positive wire to solenoid 6 faulty	a) Repair/replace wire harness - see 24 35 501
	b) Solenoid 6 faulty	b) Replace solenoid 6 - see 24 34 853

Condition	Cause	Correction
Engine dies when stopping car in drive position (converter lockup clutch always engaged)	a) Signal wire to solenoid 6 grounded	a) Repair/replace wire harness - see 24 35 501
	b) Converter lockup clutch valve seized in pushed position	b) Exchange valve body - see 24 30 006
	c) Solenoid 6 faulty	c) Replace solenoid 6 - see 24 34 853
Shift speed and shift comfort in general not OK	a) Temperature sensor not OK	a) Replace wire harness - see 24 35 501.

TROUBLESHOOTING PERIPHERAL EQUIPMENT

Condition	Cause	Correction
Idling speed control (throttle valve, electronic engine power control)		
Wrong shift points, oscillating shifts	a) Engine idling speed too high or too low	a) Refer to "Test Plan"
	b) Idling speed control valve faulty	b) Replace idling speed control valve - see 13 41 501
Kickdown switch	a) Wire harness faulty	a) Repair wire harness
No kickdown shifts; only partial load/full load shifts	b) Kickdown switch faulty	b) Replace kickdown switch - see 35 41 480
	c) Kickdown switch maladjusted	c) Check adjustment - see 35 41 480
Program switch		
No S program or only S program	a) Signal wire to program switch faulty	a) Repair wire harness
	b) Program switch faulty	b) Replace program switch - see 61 31 265
No W program or only W program	a) Signal wire to program switch faulty	a) Repair wire harness
	b) Program switch faulty	b) Replace program switch - see 61 31 265
Position switch (selector lever)	a) No positive supply / fuse faulty	a) Replace fuse
No shifts Car remains in shifted gear	b) Signal wire faulty	b) Repair wire harness
	c) Switch faulty	c) Replace switch - see 25 16 080

24 Automatic transmission

A5S 300 J

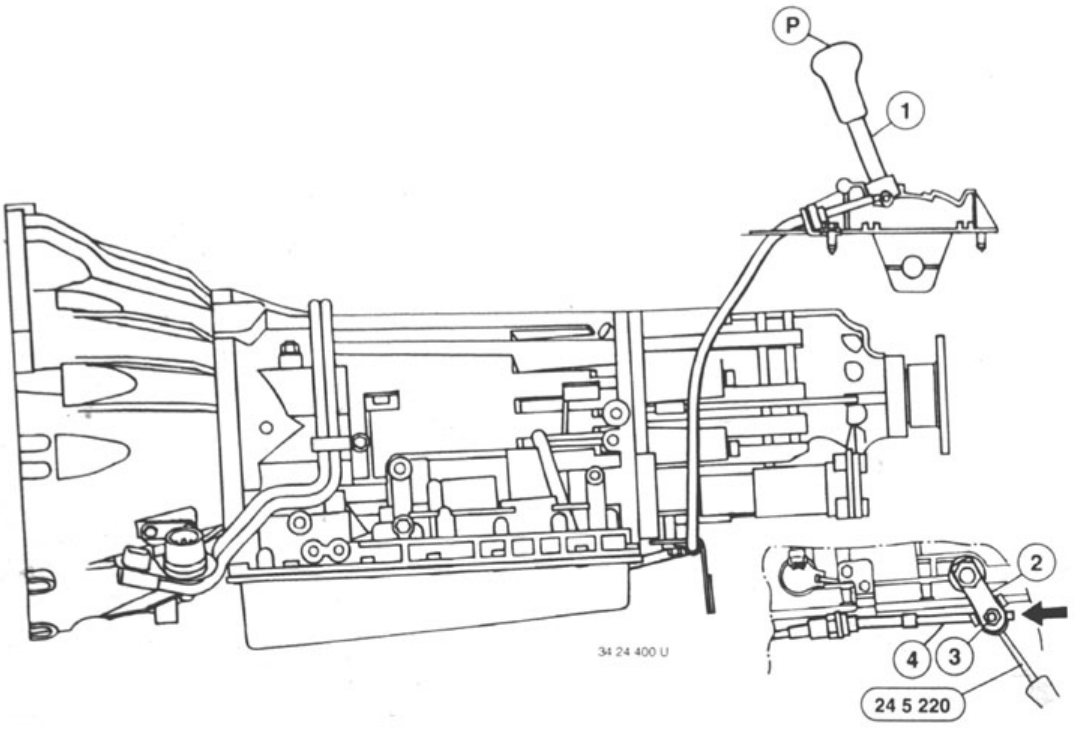
24 00 003	Shift lever – adjust	24- 00/41
027	Automatic transmission – remove and install	24- 00/42
047	Automatic transmission – install	24- 00/46
24 11 009	Transmission oil sump – remove and install, seal or replace	24- 11/41
24 12 107	Radial oil seal for manual shift valve shaft – replace	24- 12/41
506	Radial oil seal for torque converter – replace	24- 12/42
24 20 001	O-ring for output flange – replace	24- 20/41
24 30 008	Selector unit – remove and install/replace	24- 30/41
24 31 158	Gear oil strainer – remove and install/replace	24- 31/41
24 34 140	Damper cover – remove and install/seal	24- 34/41
872	RPM sensor – replace	24- 34/42
844	Solenoid valves for pressure regulator/torque converter – replace	24- 34/43
845	Solenoid valves for reverse gear inhibit – replace	24- 34/43
846	Solenoid valve block A B C – replace	24- 34/43
24 35 506	Wiring harness for automatic transmission – replace	24- 35/41
24 40 007	Torque converter – remove and install or replace	24- 40/41
24 52 500	Notched disk – replace	24- 52/41
24 61 501	Control unit – remove and install or replace	24- 61/41
525	Resistor for control unit – replace	24- 61/42

A5S 560Z

00 11 239	Oil change in automatic transmission	24- 00/51
24 00 007	Shift lever – adjust	24- 00/53
026	Automatic transmission – remove and install	24- 00/55
046	Replacement transmission – install	24- 00/60
585	Automatic transmission – disassemble and assemble	24- 06/61
24 11 008	Transmission oil sump – remove and install, seal	24- 11/50
24 12 016	Radial oil seal for output flange – replace	24- 12/50
106	Radial oil seal for manual shift valve shaft – replace	24- 12/53
506	Radial oil seal for torque converter – replace	24- 12/54
24 13 156	Output flange – replace	24- 13/50
706	Bearing for transmission extension – replace	24- 13/51
24 30 006	Selector unit – remove and install or replace	24- 30/50
24 31 156	Transmission oil strainer – remove and install, replace	24- 31/50
24 34 006	Parking lock (pawl/leg spring) – remove and install or replace	24- 34/50
857	Solenoid valves and/or pressure regulator – replace	24- 34/51
873	Pulse generator (turbine speed) – replace (oil pan removed)	24- 34/52
874	Pulse generator (output speed) – replace (oil pan removed)	24- 34/53
24 35 501	Wiring harness in automatic transmission – replace (selector unit removed)	24- 35/50
24 40 006	Torque converter – remove and install or replace	24- 40/50
24 61 501	(EGS) control unit – remove and install or replace	24- 61/50

24 00 003 Adjusting gearshift lever

Transmission Jatco



Set gearshift lever (1) to "P".
Release nut (3).

Caution!
In order to avoid deforming the operating cable, the clamping screw must be held with the special tool 24 5 220.

Note:
The special tool 24 5 220 can only be fitted in position "P".

Press forward lever (2) (park position).

Press operating cable rod (4) opposite forward direction and release again.

Firmly secure operating cable rod (4) with nut (2) (held with special tool 24 5 220).

For tightening torque 24 51 1AZ*.

* Refer to Technical Data

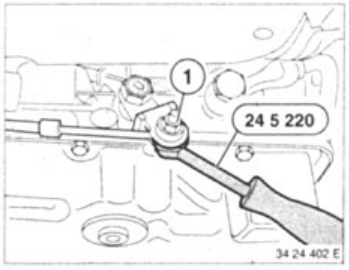


24 00 027 Removing and installing automatic transmission

Disconnect ground lead from battery.

Caution!
Disconnecting the negative lead will cancel the fault memories in the control units.
For this reason, first read fault memories with tester and print any faults prior to disconnecting battery.

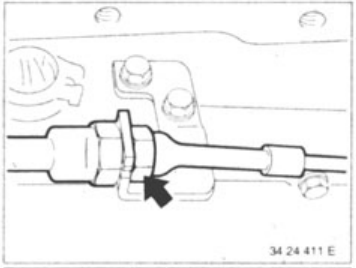
Remove exhaust assembly - refer to 18 00 020.
Remove heat shield (1).



Unfasten nut (1) in transmission setting "P".

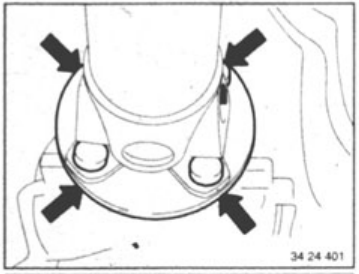
Caution!
Always brace clamping screw with special tool 24 5 220 to avoid distortion of the cable.

Note:
Special tool 24 5 220 can only be fitted in setting "P".



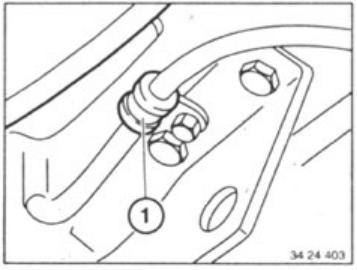
Unscrew cable from counter holder.
Pull out cable.

Installation:
Adjust shift mechanism, refer to 24 00 007.

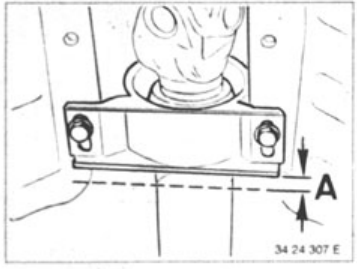


Unscrew propeller shaft on transmission.

Installation:
Replace stop nuts.



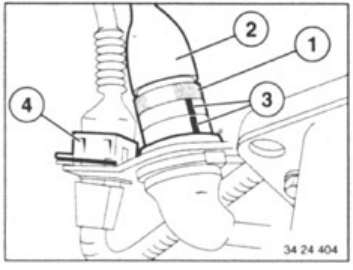
Remove cable holder (2) from transmission.



Unscrew center mount.

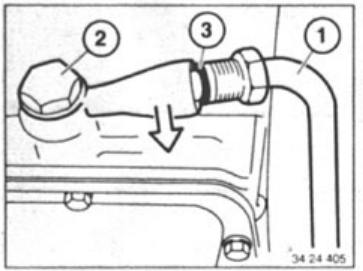
Installation:
Preload center mount in direction of travel (A) with 2...4 mm.
Fold propeller shaft downwards and withdraw from transmission.

Caution!
Do not allow the propeller shaft to drop into the joints.
Suspend propeller shaft from car on a piece of wire.



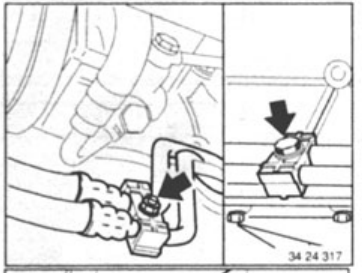
Turn bayonet lock (1) counterclockwise.
Pull off plug (2).

Installation:
Fit plug (2) in such a way that the marking lines (3) are aligned with one another.
Disconnect plug (4).

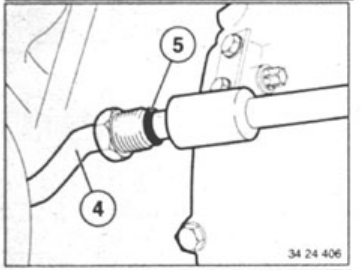


Unscrew oil cooler feed pipe (1).
Loosen coupling bolt (2) and swing connector downwards.
Pull oil cooler pipe out in this position.

Installation:
Check O-ring (3), replacing if necessary.
Tightening torque 24 31 4AZ *

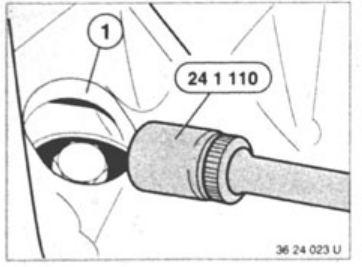


Unscrew oil cooler pipe at crankcase and oil sump.



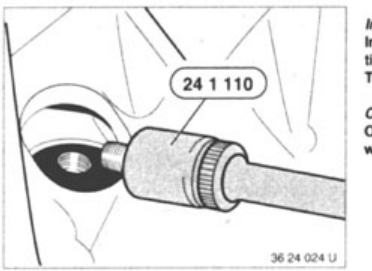
Unscrew oil cooler return line (4).

Installation:
Check O-ring (5), replacing if necessary.
Tightening torque 24 31 4AZ *



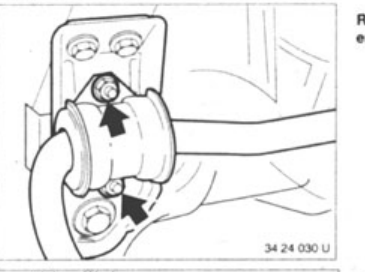
Lift cover off aperture (1) in oil pan.
Unscrew torque converter from drive plate at three points with special tool 24 1 110.
Turn flywheel for this step.

* Refer to Technical Data

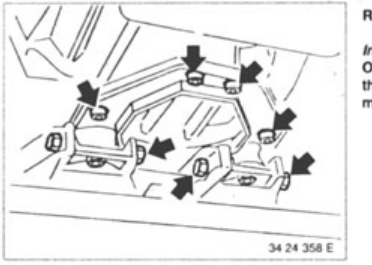


Installation:
Install bolt using special tool 24 1 110 and tighten using a torque wrench.
Tightening torque 24 40 1AZ *

Caution!
Only use M 10 x16 mm screws in conjunction with spring washer.

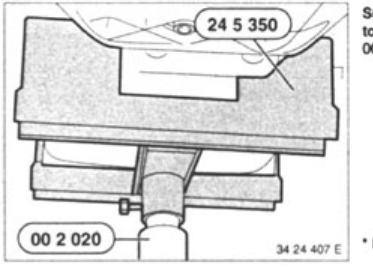


Remove stabilizer from left and right sides of engine mount.



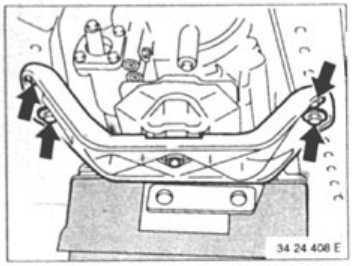
Remove center of gravity loading.

Installation:
Once the rear crossmember has been fitted, the rubber mounts must be adapted to suit by moving them slightly.



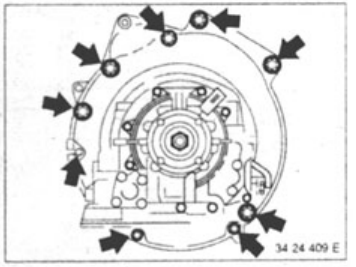
Support transmission from below with special tool 24 5 350 in conjunction with lifting fixture 00 2 020.

* Refer to Technical Data



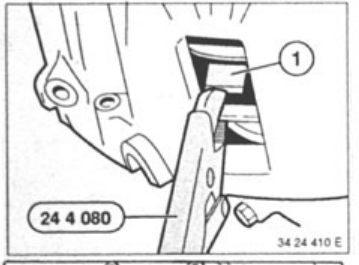
Unscrew the cross member from the body.
Lower the transmission

Installation:
Center the transmission - refer to Gr. 26.
Tightening torque*.



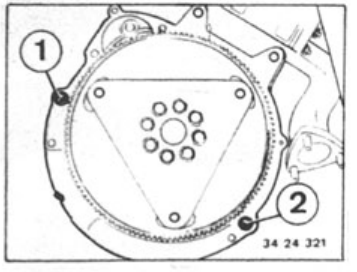
Unbolt the transmission from the engine.
Unscrew Torx bolts with a Torx wrench socket.

Important!
Washers must be used to avoid increasing the breaking loose torque.
Tightening torque*.



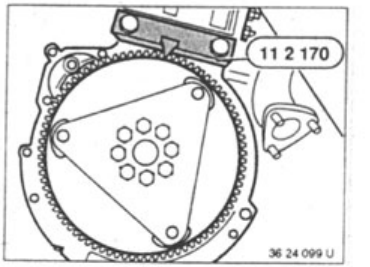
Apply and clamp Special Tool 24 4 080 on the transmission case with flat side (1) of the retainer facing the torque converter, to prevent the converter from sliding out.
Pull the transmission off of the engine.

Important!
The special tool jack with mounted transmission may only be moved in completely lowered position.



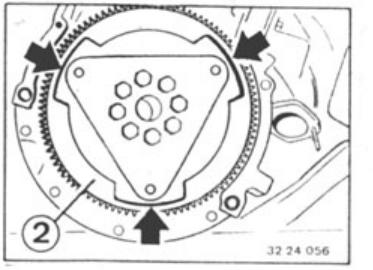
Important!
Ensure that dowel sleeves (1 and 2) are not missing prior to installation of the transmission.
If necessary, transfer dowel sleeves from the transmission.

* Refer to Specifications



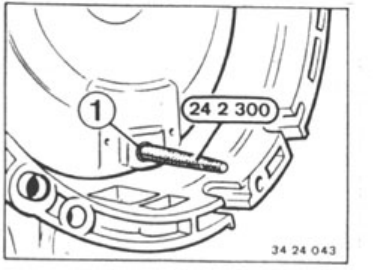
Installation:
Inspect the drive plate for breaks and cracks, replacing it if necessary.
Hold flywheel with Special Tool 11 2 170.

Important!
Replace expansion bolts and install the new bolts with a bolt cement**.
Only coat the threads.
First clean the tapped bores in the crankshaft thoroughly.
Tightening torque*.



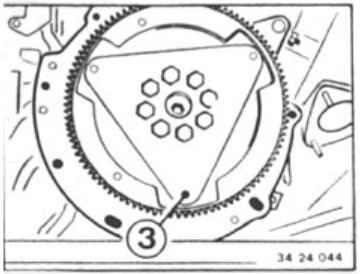
Version with Sheet Metal Flywheel (2):

Important!
Keep to the sequence of installation.
Sheet metal flywheel (2) has three indentations to take the mounting tabs of the torque converter.
When guiding the engine and transmission together, the three mounting tabs on the torque converter must be aligned with the three indentations on the sheet metal flywheel.
Non-conformance will cause follow-up damage to the automatic transmission.
Turning the torque converter or engine is no longer possible after guiding together and an attempt to turn would lead to damage.

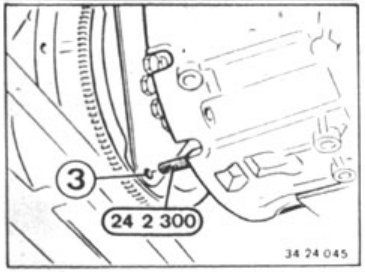


Turn the torque converter on the transmission that bore (1) of the tab points down at right angles.
Screw Special Tool 24 2 300 into the tab.

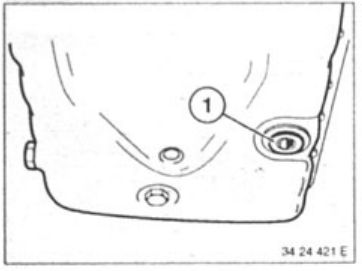
* Refer to Specifications
** Source of Supply: BMW Parts



Bore (3) of the drive plate must point at right angles to the center of the oil pan opening.

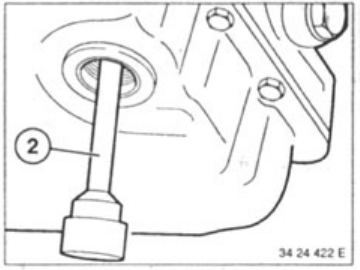


Lift the automatic transmission until bore (3) of the drive plate is reached.
Guide the transmission into bore (3) of the drive plate carefully, using Special Tool 24 2 300.
Bolt the transmission case on the engine.
Unscrew Special Tool 24 2 300 out of the tab towards the front.
Secure the torque converter.



Check the ATF level after installation of the transmission.
Car must stand on a level surface.
Check the ATF level only when the ATF temperature is between 30 and 55° C.
Interrogate the ATF temperature with Modic or a Service Tester (refer to Test Plan).
Run the engine at idling speed with the selector lever in P or N.
Unscrew filler plug (1).

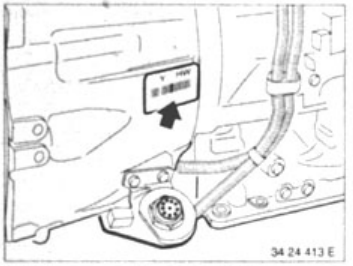
Installation:
Check the seal, replacing it if necessary.



Check and, if necessary, correct the ATF level.
Pour in ATF through filler (2)** until it runs out of the spill bore.

Important!
Only ATF approved for Jatco transmissions may be used.
Install and tighten the filler plug.
Tightening torque*.

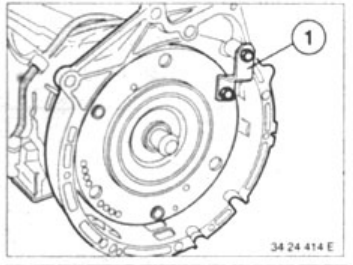
* Refer to Specifications
** Source of Supply: BMW Parts



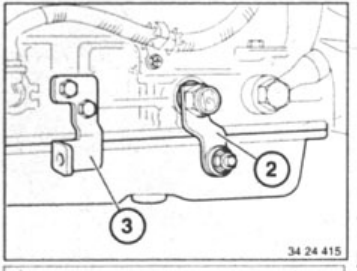
24 00 047 Installing exchange transmission.

Remove transmission, refer to 24 00 027.

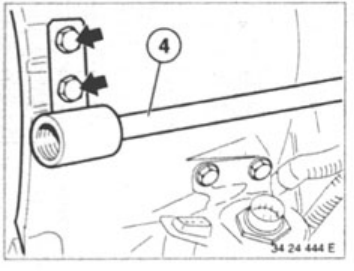
Caution!
Always blow oil cooler and lines clean with blast of compressed air and rinse twice with transmission oil before installing an exchange transmission.
Use special oil.
Transmission identification and code** on label.



Transfer transport holder (1).

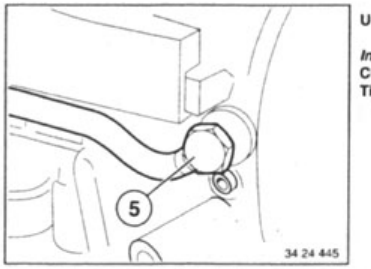


Transfer lever (2) and bracket (3).
Tightening torque 24 51 1AZ *



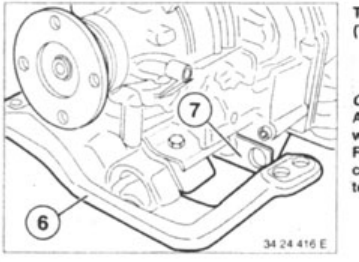
Transfer oil cooler return pipe (4).
Unscrew bolts from holder.

* Refer to Technical Data
** Source of Supply: BMW Parts service



Unscrew banjo bolt (5).

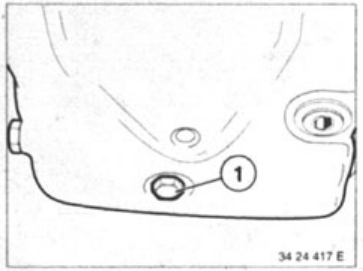
Installation:
Check seals, replace if necessary.
Tightening torque 17 22 6AZ*



Transfer cross member (6) and exhaust carrier (7).

Caution!
Automatic transmissions are supplied filled with ATF.
For this reason, simply perform an oil level check after installing the transmission (refer to 24 00 027).

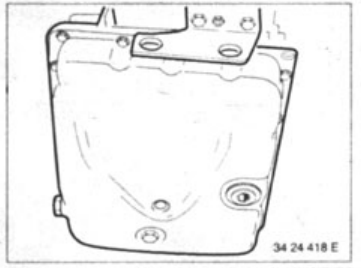
* Refer to Technical Data



24 11 009 Removing and installing/sealing or replacing transmission oil pan.

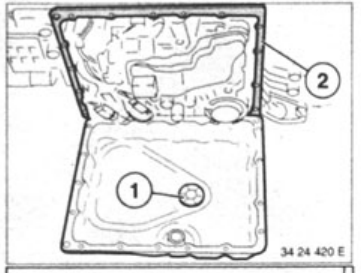
Remove drain plug (1).
Drain oil.

Installation:
Replace seal.
Tightening torque 24 11 6AZ *



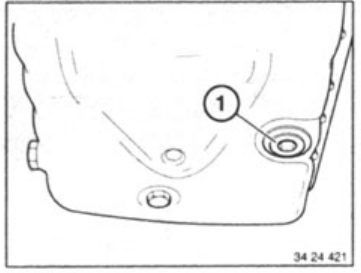
Unscrew oil sump.
Take off oil sump with gasket.

Installation:
Replace seal.



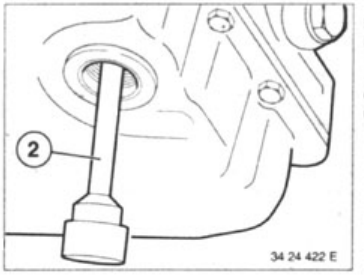
Clean oil sump.

Caution!
Place magnet disc (1) in oil sump.
Replace gasket (2).



Unscrew filler plug (1).

* Refer to Technical Data

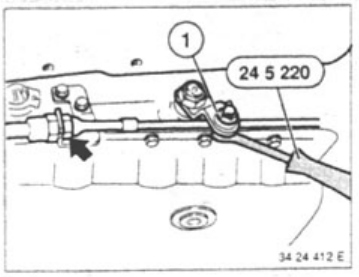


Hang filler (2)** in filler opening.
Pour in ATF until it overflows.

Caution!
Only oil grade approved for Jatco transmissions may be used.

Run engine in selector lever setting "P" or "N".
Select all settings in transmission.
Increase transmission oil temperature to approx. 30 ... 55° C
Interrogate ATF temperature with MoDiC or Service Tester (refer to Electrical Troubleshooting Manual).
Recheck ATF level.
Drain excessive ATF or pour in additional ATF.
Screw in filler plug.
Tightening torque 24 11 7AZ *

* Refer to Technical Data
** Source of Supply: BMW Parts service



24 12 107 REPLACING RADIAL OIL SEAL FOR MANUAL SHIFT VALVE SHAFT

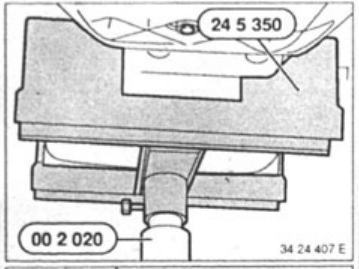
Remove exhaust assembly - refer to 18 00 020.
Unscrew nut (1) in position P.

Important!
Always counterhold on bolt using Special Tool 24 5 220 to avoid deformation of the cable.

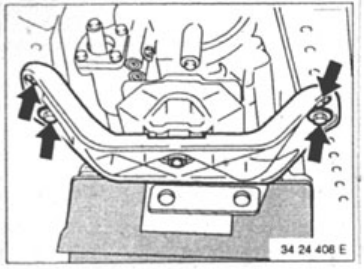
Note:
Special Tool 24 5 220 can only be applied in position P.

Unscrew cable from holder.
Pull cable out.

Installation:
Adjust shift - refer to 24 00 007.
Tightening torque*.



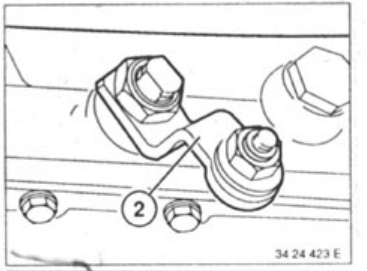
Support the transmission from underneath using Special Tools 24 5 350 and 00 2 020.



Unscrew cross member from the body.
Lower the transmission as far as possible.

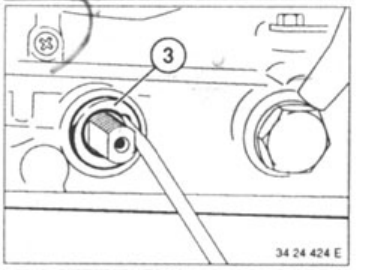
Installation:
Center the transmission - refer to Gr. 26.
Tightening torque*.

* Refer to Specifications

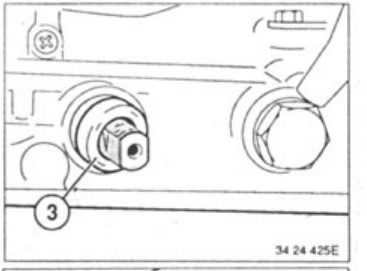


Unscrew lever (2).

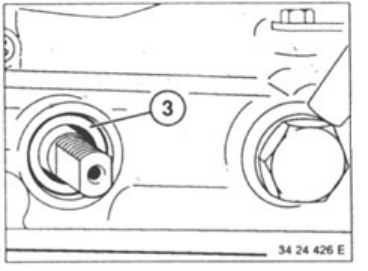
Installation:
Tightening torque*.



Lever radial oil seal (3) out using a narrow screwdriver.



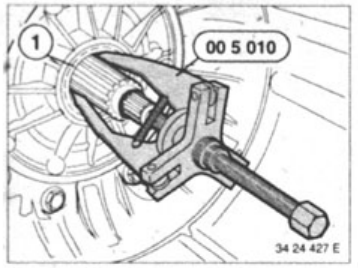
Protect threads and edges of manual shift valve shaft with adhesive tape.
Lubricate sealing lip of radial oil seal with oil.
Push radial oil seal (3) over the adhesive tape up to the case.



Drive radial oil seal (3) in using a suitable sleeve.
The radial oil seal must be flush with the bevel.

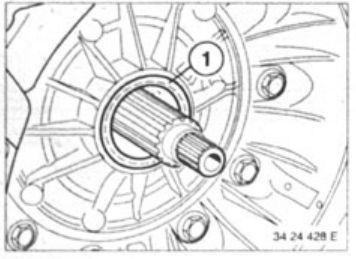
Note:
Check ATF level - refer to 24 00 027.

* Refer to Specifications

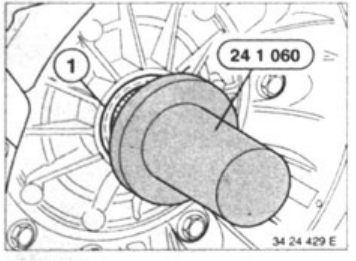


24 12 506 Replace radial seal for torque converter
(transmission removed)

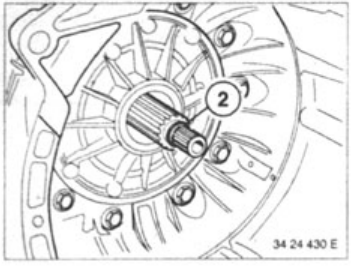
Remove torque converter 24 40 007.
Remove radial seal (1) with special tool 00 5 010.



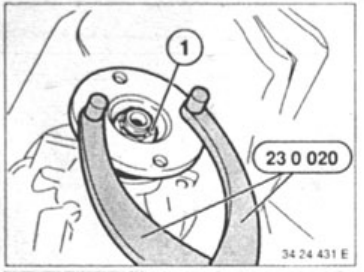
Lubricate sealing lip with oil.
Apply radial oil seal (1) on case.

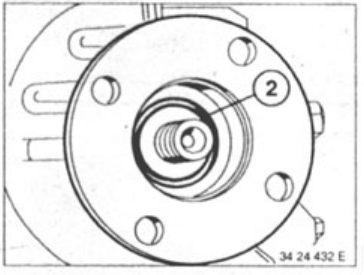


Drive radial oil seal (1) in flush using special tool 24 1 060.



Check O-ring (2) on input shaft, replace if necessary.





24 20 001 REPLACING O-RING FOR OUTPUT FLANGE

Remove exhaust assembly - refer to 18 00 020.
Unscrew propeller shaft at transmission and center mount - refer to 24 00 027.
Block output flange using Special Tool 23 0 020.
Unscrew stop nut (1).

Installation:
Replace stop nut.
Tightening torque*.

Lever O-ring (2) out using a scribe.

Installation:
Lubricate O-ring (2) lightly with oil and install it in the groove.

Note:
Check ATF level - refer to 24 00 027.

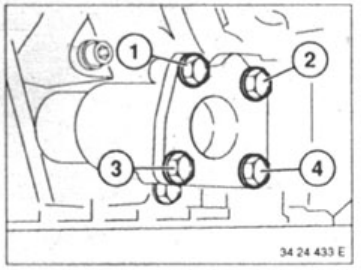
* **Refer to Specifications**

24 30 008 Removing and installing or replacing selector unit

Refer to Repair Manual 3 Series E36.

24 31 158 Removing and installing or replacing transmission oil strainer

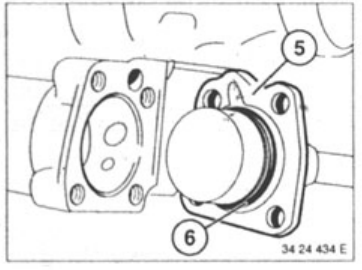
Refer to Repair Manual 3 Series E36.



24 34 140 Removing and installing / sealing damper cover

Remove bolts (1 ... 4).

Installation note:
Bolts are coated and must be replaced every time they are assembled.
Clean thread in transmission casing before fitting bolts.
For tightening torque*.

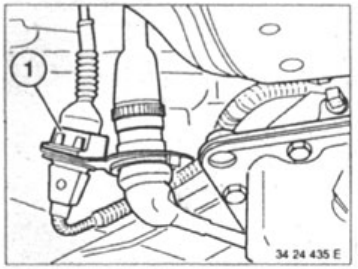


Remove damper cover.
Replace gasket (5) and O-ring (6).
Lightly oil O-ring with automatic transmission oil**.

Note!
Check oil level, refer to 24 00 027.

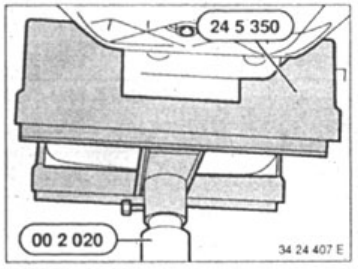
* Refer to Technical Data.
** Refer to BMW Fluids and Lubricants Specifications

24 34 872 Replacing RPM sensor

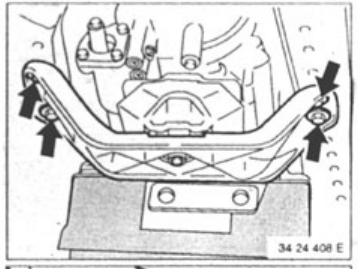


Remove complete exhaust system 18 00 020.
Detach propeller shaft at transmission and center bearing from body (refer to 24 00 027).

Disconnect plug-and-socket connection (1).

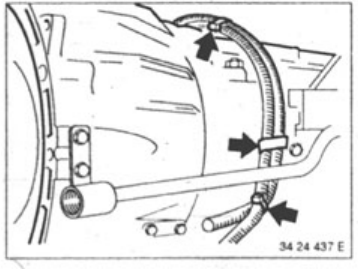


Support transmission with special tool 24 5 350 in conjunction with lifting fixture 00 2 020.



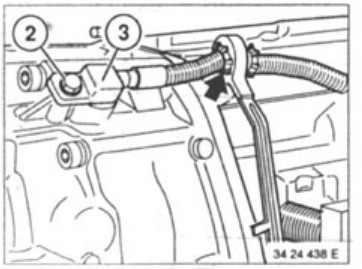
Release cross member from body.
Lower transmission as far as possible.

Installation note:
Align transmission in center (refer to HG 26).
For tightening torque*.



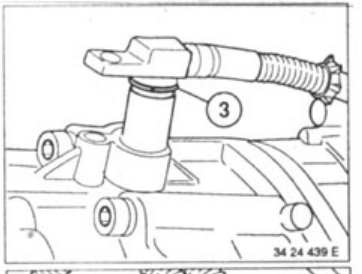
Cut open cable ties.
Detach wiring harness from holder.

* Refer to Technical Data

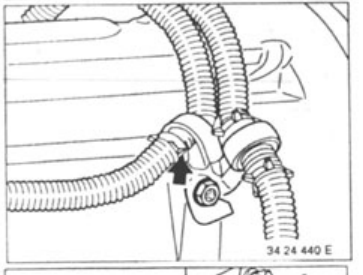


Remove screw (2).
Pull out RPM sensor (3).
Detach wiring harness from holder.

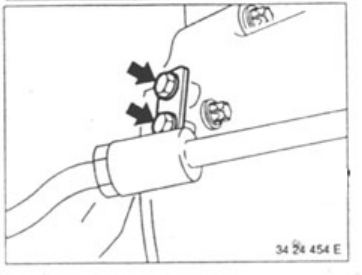
Installation note:
For tightening torque.



Installation note:
Lightly grease O-ring (3).



Detach wiring harness from front holder.



Release oil cooler return line from transmission.
Push oil cooler return line away from transmission until plug connection of wiring harness can be disconnected.
Remove RPM sensor together with wiring harness.

Installation note:
Lay and secure wiring harness in same position as before removal.

* Refer to Technical Data

24 34 844 Replacing solenoid valves for pressure regulator / torque converter

Refer to Repair Manual 3 Series E36

24 34 845 Replacing solenoid valve for reverse gear inhibit

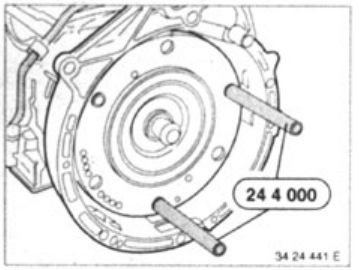
Refer to Repair Manual 3 Series E36

24 34 846 Replacing solenoid valve block A B C

Refer to Repair Manual 3 Series E36

24 35 506 Replacing wiring harness in automatic transmission

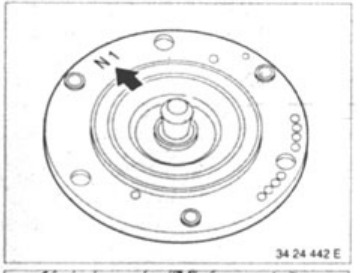
Refer to Repair Manual 3 Series E36



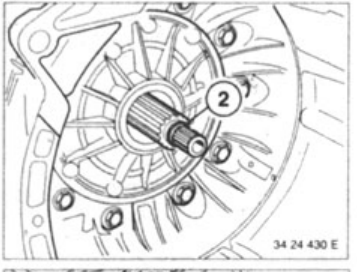
24 40 007 Removing and installing or replacing torque converter

Remove transmission - refer to 24 00 027.
Pull torque converter out of primary pump carefully using assembly handles 24 4 000.

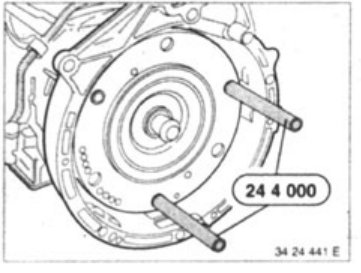
Caution!
Escaping ATF.



Torque converters cannot be cleaned with standard workshop equipment and must be replaced when damaged.



Installation:
Check O-ring (2) on input shaft, replacing if necessary.



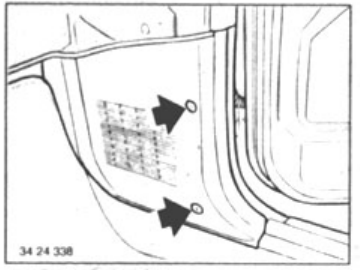
Carefully guide openings on converter into primary pump by turning slightly and using assembly handle 24 4 000.

Caution!
Make sure converter bearings and seal are not damaged while guiding in.
Insert torque converter as far as stop.

* Refer to Technical Data

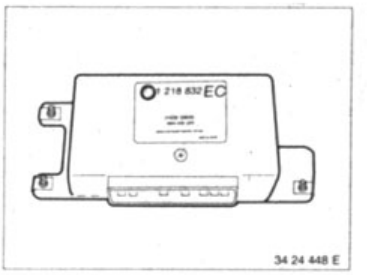
24 52 500 Replacing notched disk

Refer to Repair Manual 3 Series E36

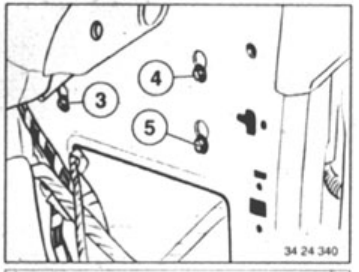


24 61 501 Removing and installing or replacing control unit

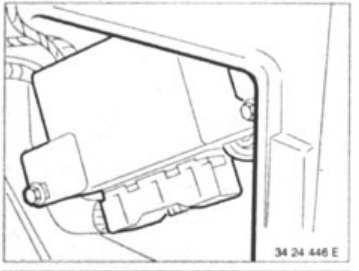
The control unit for EH transmission is located in the right-hand A-pillar.
Removing and installing glovebox, refer to 51 16 360.
Remove speaker covering.
Disconnect wire for speaker.
Remove protective hood.



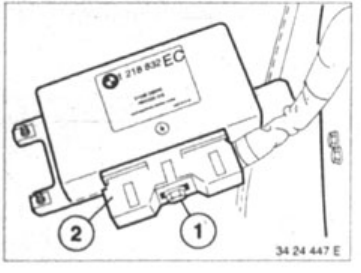
Identification letter on type identification plate. For type and model allocation, refer to BMW Parts Catalogue.



Partly remove soundproofing mat.
Only slacken off screws (3 ... 5).



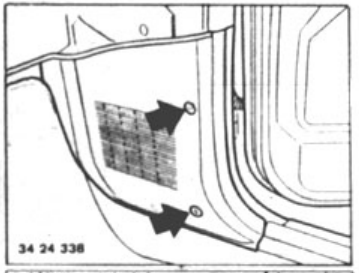
Lift out control unit and remove by pulling downward.



Release screw (1).
Disconnect plug connector (2).

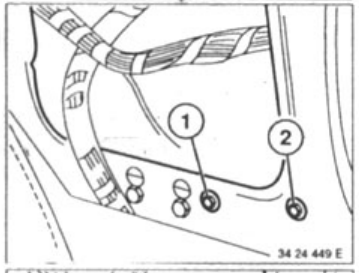
Caution!
The plug connector must only be disconnected and reconnected with the ignition switched off.

Installation note:
Tightening torque 5 Nm.



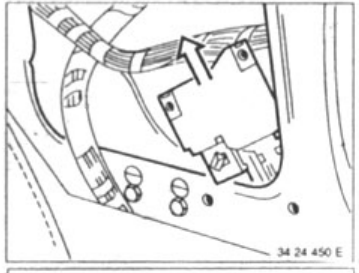
24 61 525 REPLACING RESISTOR FOR CONTROL UNIT

The resistor for the control unit is located in the right A-pillar.
Remove glovebox - refer to 51 16 360.
Unscrew loudspeaker cover.
Disconnect loudspeaker wires.
Remove the protective hood.

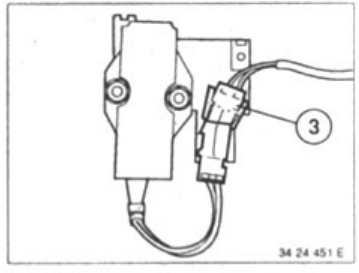


Unscrew screws (1 and 2).

Installation:
Tightening torque*.



Remove the resistor together with the holder upwards.



Disconnect plug (3).

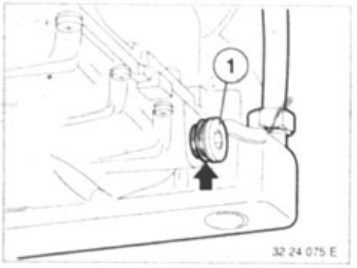
* **Refer to Specifications**

00 11 239 Oil change in automatic transmission

(M60 engine, A5S 560 Z transmission)

Note:
The transmission has lifetime lubrication.
Oil changes are therefore only required under exceptional circumstances.

Caution!
Special oil - refer to Lubricant Specifications

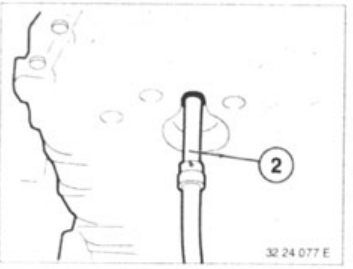


Ensure that transmission is at full operating temperature before changing fluid.

Remove drain plug (1).
Drain oil.

Note:
Dispose of old oil correctly.

Installation instruction:
Replace seal.
Tightening torque 24 11 6AZ*



o Top up transmission oil level:

ATF*** is poured in through the filler bore underneath the oil sump.
Unscrew filler plug (1).

Installation instruction:
Check seal, replacing if necessary.

With engine stationary, fill with oil until it overflows.

Screw in oil filler plug and start engine. Selector lever position " P ".

Open oil filler plug and, with engine running, top up with oil until it overflows.

Caution!
If suction noises occur during the filling process, air is being drawn in. This causes the transmission oil to foam, thereby increasing its volume.
This results in an excessively low oil level.
If this happens, repeat the oil level check a few hours later.

* Refer to Specifications
*** Refer to Consumables Specifications

* Refer to Specifications
*** Refer to Consumables Specifications

o Check oil level / adjust:

Perform the oil level check rapidly.
When the check is complete, the transmission temperature must not exceed 50° C.
It is always preferable to check the oil level at lower temperatures.
The inspection should therefore be completed at 30° C if possible.
The transmission then holds about 0.6 liters more oil than when the oil level is checked at 50° C.

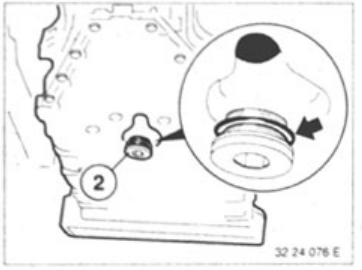
At the start of the oil level check, the transmission temperature must be between 20° und 30° C.

Read off temperature with MoDic or Service Tester.

Park car on level ground.

Run engine at idle speed.
With M60 engines, switch on lights to increase engine speed.

With the engine running (idle speed; apply brake), slowly shift up and down all gears in *program (winter program).



Move selector lever into position " P ", then unscrew and remove oil filler plug with engine running.
Pour in ATF until it overflows.

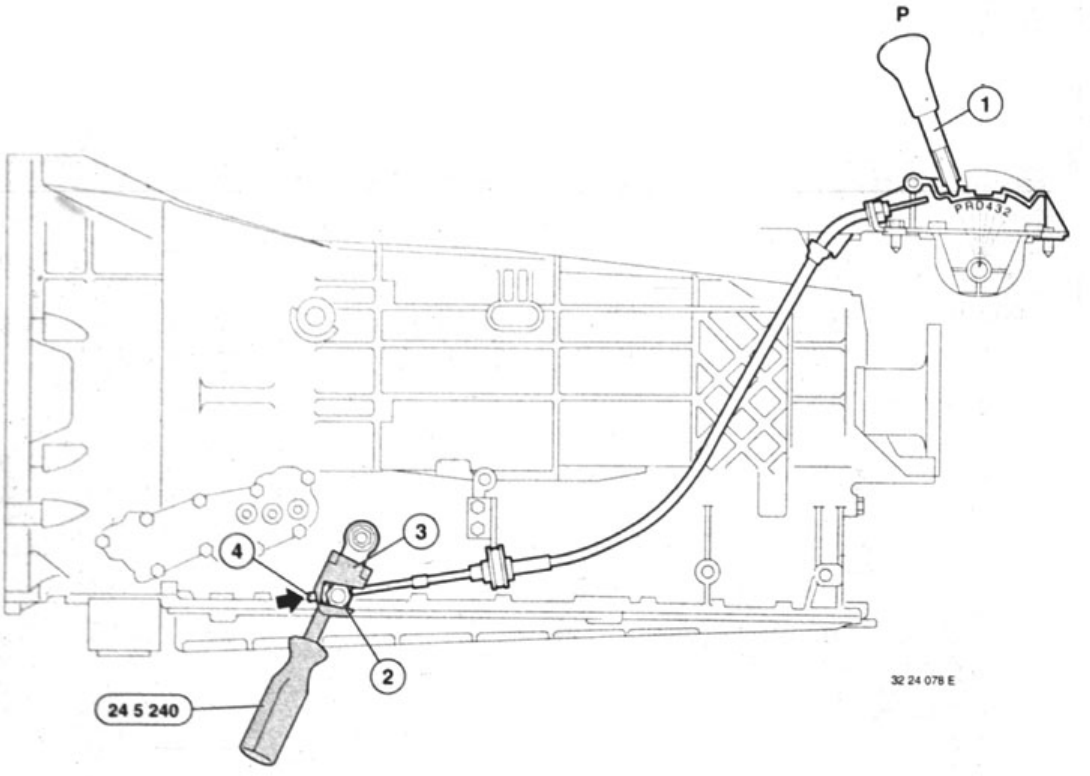
With engine running, screw oil filler plug back in.

Installation instruction:
Replace seal.
Tightening torque 24 11 7AZ*

* Refer to Specifications
** Source of Supply: BMW Parts Service

24 00 007 Adjusting gearshift lever

Transmission A5S 560 Z



Set gearshift lever (1) to "P".
Release nut (2).

Caution!
In order to avoid deforming the operating cable, the clamping screw must be held with the special tool 24 5 240.

Note:
The special tool 24 5 240 can only be fitted in position "P".

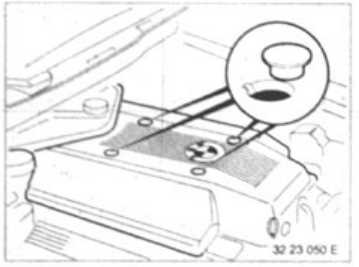
Press forward lever (3) (park position).
Press operating cable rod (4) opposite forward direction and release again.
Firmly secure operating cable rod (4) with nut (2) (held with special tool 24 5 240).
For tightening torque 24 16 2AZ*.

* Refer to Technical Data

24 00 026 Removing and installing transmission

- Engine M60 transmission
A5S 560 Z -

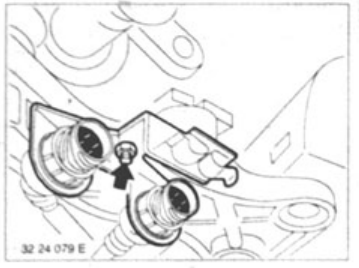
Disconnect negative lead from the battery.
Caution!
First read fault memories with tester and print any faults as fault memories of control units will be cancelled by disconnecting the battery.
Remove complete exhaust system 18 00 020.
Remove underbody protection from engine.



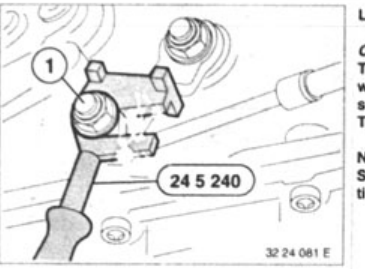
Remove protective cover.



Unscrew heat shield (1).



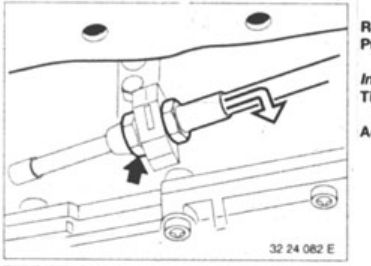
Remove bracket for Lambda oxygen sensor plug.



Loosen nut (1).

Caution!
To avoid distortion of the cable, always brace with special tool 24 5 240 on the clamping screw.
Tightening torque*

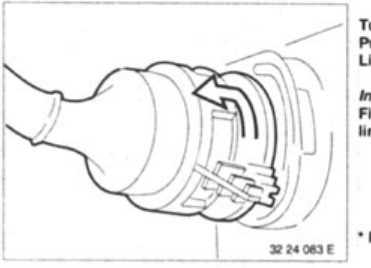
Note:
Special tool 24 5 240 can only be fitted in setting "P".



Remove cable sleeve from counter support.
Pull out cable.

Installation instruction:
Tightening torque*

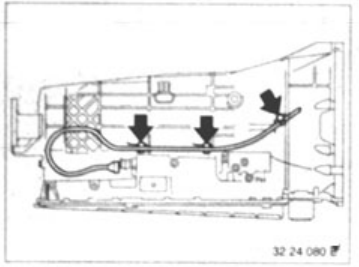
Adjust shift mechanism 24 00 007.



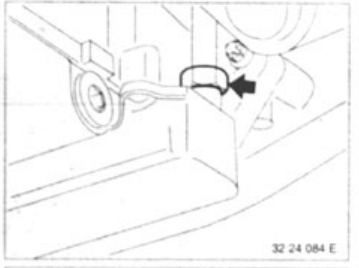
Turn bayonet connection counter-clockwise.
Pull off plugs.
Lift cable harness out of holder.

Installation instruction:
Fit plug, taking care to ensure that the marker lines are aligned.

* Refer to Specifications



Unclip cable holders on transmission.



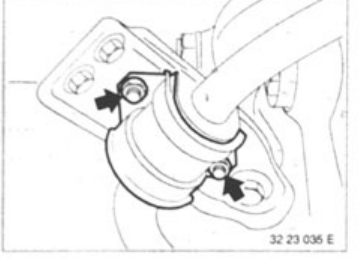
Unscrew coolant pipes on left and right hand sides of transmission oil cooler.

Note:
Approximately 1 liter of coolant will run out when unscrewing the pipes.

Fill cooling system - refer to 17 00 005.

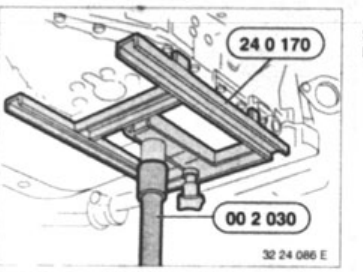


Installation:
Replace O-rings.
Tightening torque*.

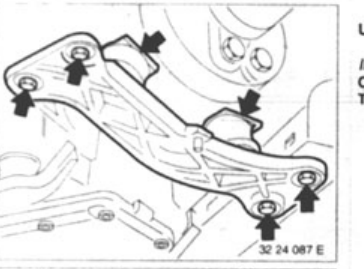


Unscrew stabilizer at left and right hand ends and let it hang down.

* Refer to Specifications

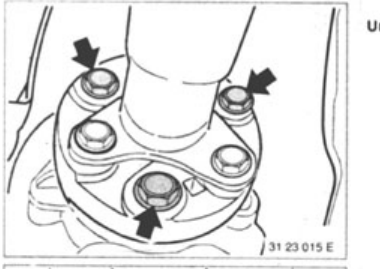


Support transmission from underneath using Special Tools 24 0 170 and 00 2 030.

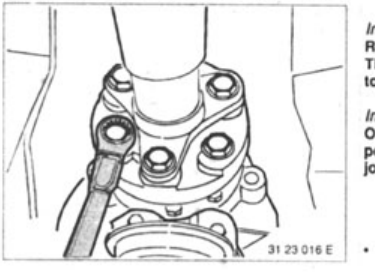


Unscrew cross member.

Installation:
Center transmission - refer to Group 26.
Tightening torque*.



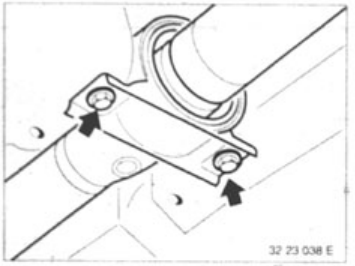
Unscrew joint disc at transmission.



Installation:
Replace stop nuts.
Tighten bolts to specified tightening torque*.

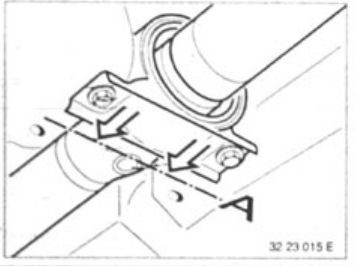
Important!
Only turn nuts on flange end whenever possible by design to avoid tension in the joint disc.

* Refer to Specifications



Unscrew center mount.
Bend propeller shaft down and pull off of centering pins on transmission.

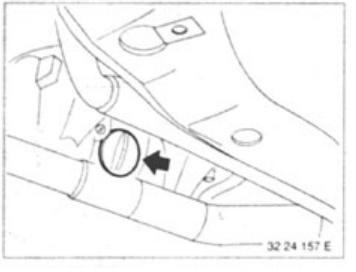
Important!
Do not let propeller shaft fall into joints. Suspend it from car on piece of wire.



Installation:
Preload center mount in forward direction by distance (A) = 2 ... 4 mm.
Tightening torque*.



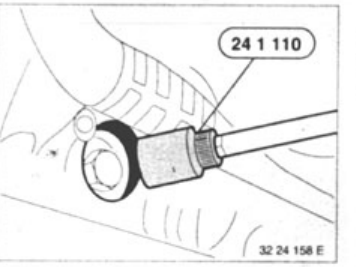
Unscrew heat shields at left and right hand sides and push forward.



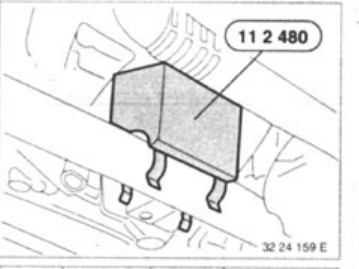
Turn steering wheel fully against left or right lock.

Lift cap out of opening in oil sump.

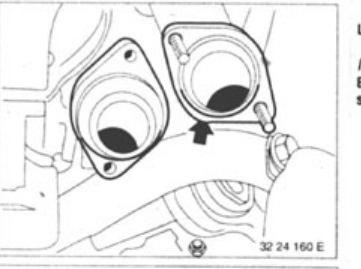
* Refer to Specifications



Unscrew three torque converter to drive plate mounting bolts using Special Tool 24 1 110 and turning flywheel 1/3 turn for each bolt.

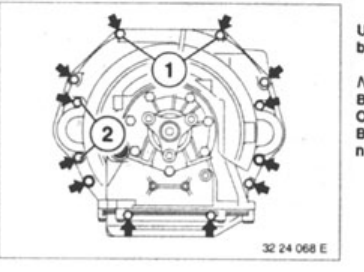


Apply Special Tool 11 2 480 between connecting pipe and engine oil pan.



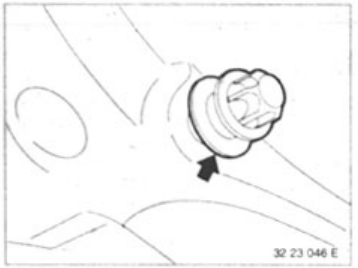
Lower transmission.

Important!
Exhaust manifolds must not bear on thrust strut mounts.



Unbolt transmission from engine (Torx bolts).

Note:
Bolts (1) = Torx E 10
Other bolts = Torx E 12
Bolts (2) opposite the starter are fitted with nuts at front.



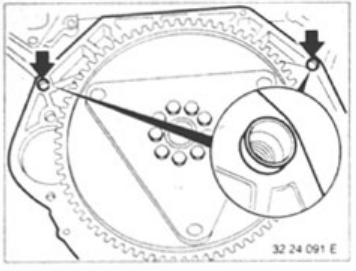
Installation instruction:
Note that Torx screws are fitted with washers.
Tightening torque 24 00 1AZ*



Prevent torque converter from slipping out by fitting and securing special tool 24 4 120 to transmission case with flat side of retaining tab facing torque converter.
Pull transmission off engine.

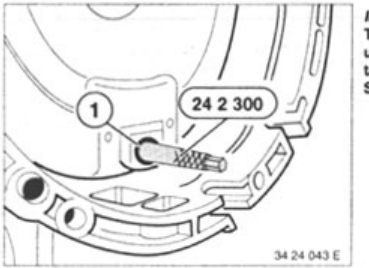
Caution!
To transport the transmission, lower transmission fully onto lifting fixture.
- Risk of accident -
Transmission weight approx. 120 Kp

Caution!
When putting down transmission without support, do not place on oil cooler.

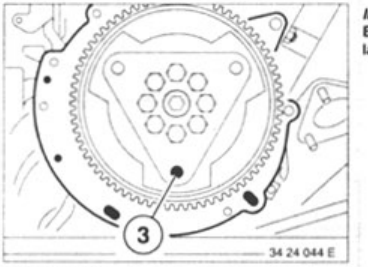


Note dowel sleeves.
If necessary, transfer / replace dowel sleeves on transmission.

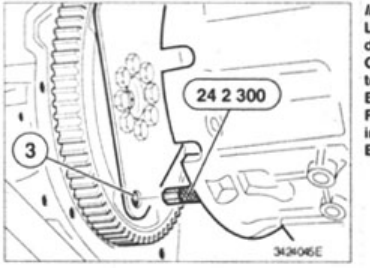
* Refer to Specifications



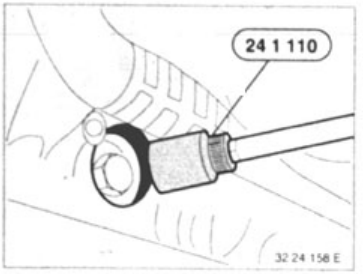
Installation instruction:
Turn the torque converter on the transmission until bore (1) faces down perpendicular to the tab.
Screw special tool 24 2 300 into the tab.



Installation instruction:
Bore (3) on drive plate must point perpendicularly to center of opening in oil sump.

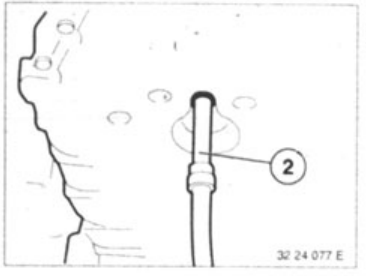


Installation instruction:
Lift automatic transmission until bore (3) in drive plate is reached.
Guide transmission in carefully with special tool 24 2 300 in bore (3) on the drive plate.
Bolt transmission case to engine.
Remove special tool 24 2 300 from tab by rotating and pulling forwards.
Bolt torque converter to flywheel.



Installation instruction:
Install bolt using special tool 24 1 110 and tighten using a torque wrench.
Tightening torque 24 40 1AZ*

Caution!
Only use original screws**.



Installation instruction:
If necessary top up/adjust transmission fluid level, refer to 00 11 239.

* Refer to Specifications
** Source of Supply: BMW Parts Service



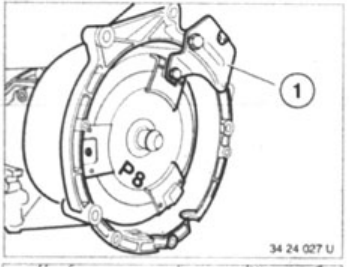
24 00 046 Installing exchange transmission

- Engine M 60 transmission
A5S 560 Z -

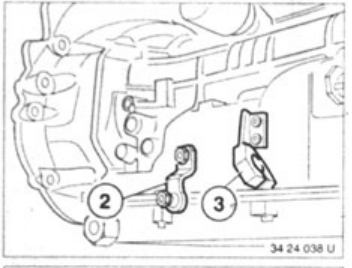
Removing transmission 24 00 026.

Note:
Check transmission designation/coding* on type plate or label.

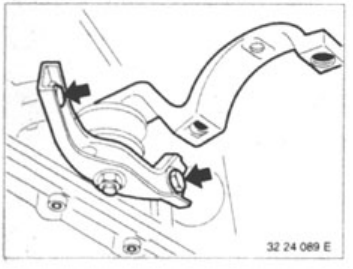
Check that correct electronic transmission control unit (EGS) is fitted to transmission.



Fit transport container (1).



Fit lever (2), retaining angle (3) and cable clip for Lambda oxygen sensor.



Fit left and right exhaust brackets.

Caution!
Automatic transmission is supplied with an oil fill.
After installation, simply check the transmission fluid level.

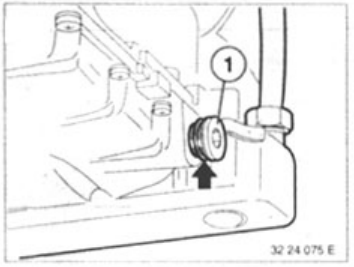
Check/top up oil level, see 00 11 239

Whenever a transmission is replaced, cancel the EGS adaption memory using the Service Tester and perform a new adaption procedure.

Perform all upshifts (1-2, 2-3, 3-4, 4-5) several times in E program and setting "D" at a range of different accelerator positions (low, medium, high part throttle, full throttle). Perform several repeats of shifts which have been the subject of complaint.

24 00 585 Disassembling and assembling automatic transmission
(A5S 560Z)

Refer to Repair Manual 7 Series E38



24 11 008 REMOVING AND INSTALLING / SEALING TRANSMISSION OIL SUMP

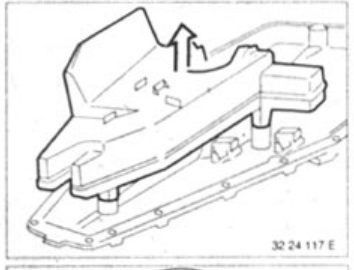
Unscrew drain plug (1).
Drain oil.

Note:
Dispose old oil properly.

Installation:
Fill transmission with oil – refer to "Oil Change in Automatic Transmission" in 00 11 239 of Group 24.



Unscrew oil sump bolts.
Remove oil sump and gasket.



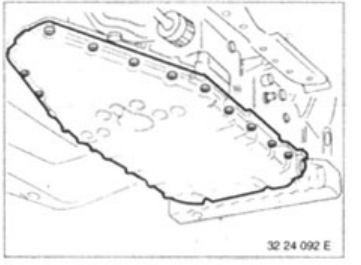
Lift expansion tank off of oil sump.



If applicable, lift off retainers, remove and clean magnets.



Installation:
Clean oil sump.
Install magnets.
Hold new gasket on oil sump by using glycerine grease.



Installation:
Tighten bolts uniformly in several steps.
Tightening torque*.

* Refer to Specifications

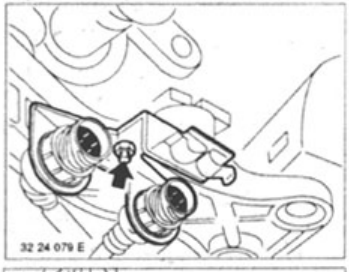
24 12 016 REPLACING RADIAL OIL SEAL FOR OUTPUT FLANGE

Note:
The output flange can no longer be removed from the outside.
The transmission extension must be taken off for removal of the output flange.

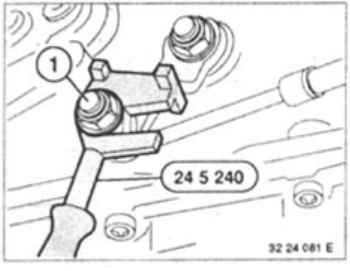
Remove exhaust assembly - refer to 18 00 020.



Remove heat shield (1).



Unscrew holder for oxygen sensor plugs.

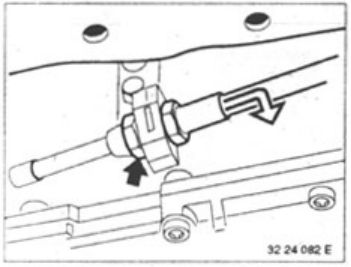


Loosen nut (1).

Important!
Always counterhold on bolt using Special Tool 24 5 240 to avoid deformation of the cable.
Tightening torque*.

Note:
Special Tool 24 5 240 can only be applied in position "P".

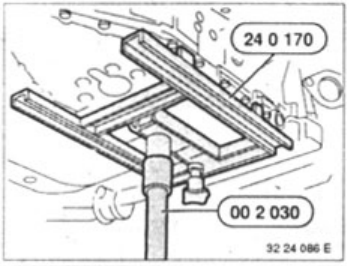
* Refer to Specifications



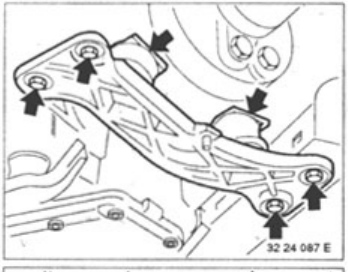
Unscrew cable sleeve at counterholder.
Pull out cable.

Installation:
Tightening torque*.

Adjust selector lever - refer to 24 00 007.

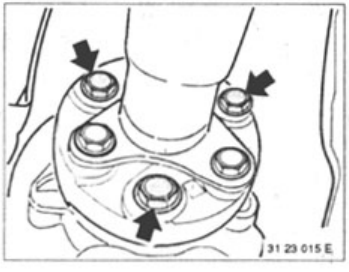


Support transmission from underneath using Special Tools 24 0 170 and 00 2 030.



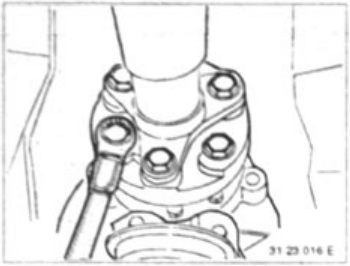
Unscrew cross member.

Installation:
Center transmission - refer to Group 26.
Tightening torque*.



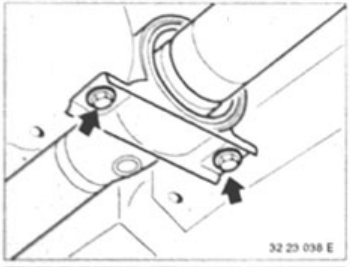
Unscrew joint disc at transmission.

* Refer to Specifications



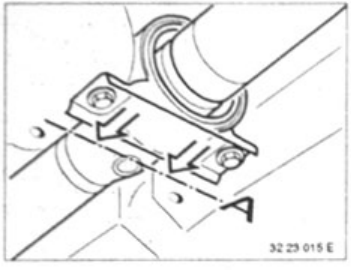
Installation:
Replace stop nuts.
Tighten bolts to specified tightening torque*.

Important!
Only turn nuts on flange end whenever possible by design to avoid tension in the joint disc.



Unscrew center mount.
Bend propeller shaft down and pull off of centering pins on transmission.

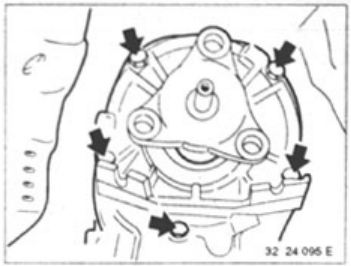
Important!
Do not let propeller shaft fall into joints. Suspend it from car on piece of wire.



Installation:
Preload center mount in forward direction by distance (A) = 2 ... 4 mm.
Tightening torque*.

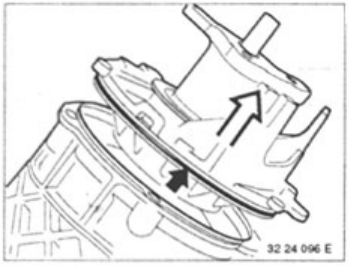
Lower transmission as far as possible.

* Refer to Specifications



Unscrew transmission extension.

Installation:
Tightening torque*.

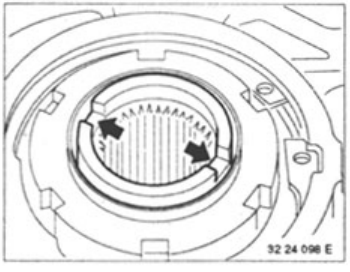


Pull off transmission extension.

Installation:
Replace O-ring.

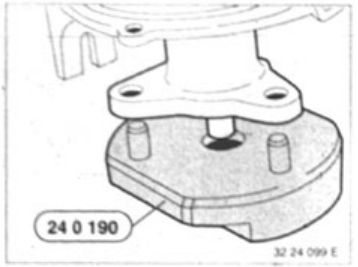


Installation:
Check for shim.
Install same shim (same thickness) again.

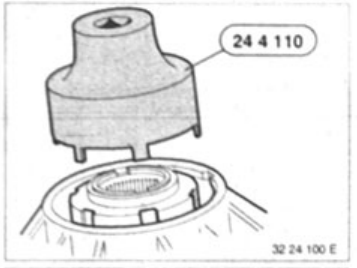


Knock back lock of slotted nut.

* Refer to Specifications

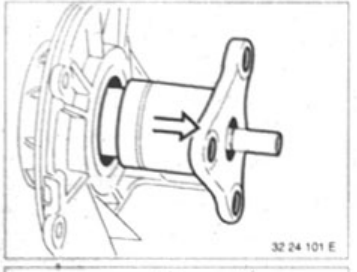


Clamp special tool 24 0 190 in vice.
Fit transmission extension with output flange in the special tool.

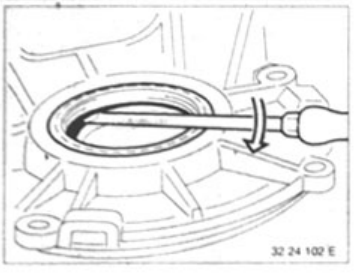


Release slotted nut with special tool 24 4 110.

Installation note:
For tightening torque*.

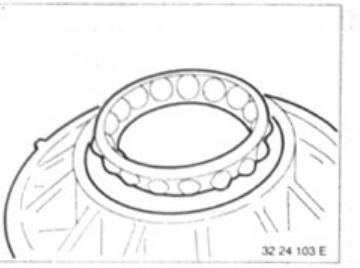


Remove transmission extension from special tool.
Pull output flange out of mounting.

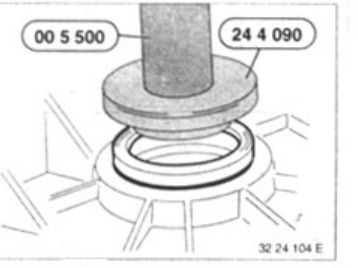


Lift out radial oil seal.

* Refer to Technical Data.



Caution!
Bearing inner race and balls with cage can drop out.
Observe installation direction.



Fit new radial oil seal flush with special tool 24 4 090 in conjunction with handle 00 5 500.

24 12 106 Replacing radial oil seal for manual shift valve shaft

Note:
On completion of work, check transmission oil level and correct as required, refer to 00 11 239.

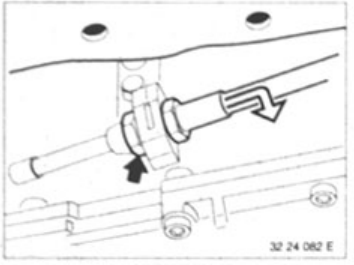
Set selector lever to position "P".



Fit special tool 24 5 240 on gearshift lever.
Note:
Special tool can only be fitted in position "P".

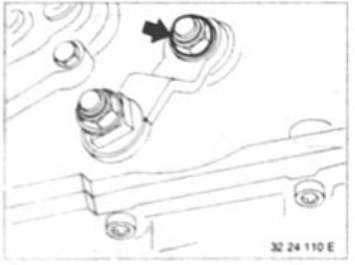
Release nut (1).

Installation note:
Adjust gearshift lever, refer to 24 00 007.



Remove operating cable sleeve from support bracket and pull out.

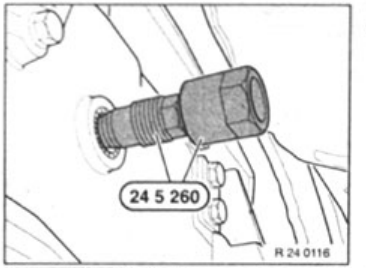
Installation note:
For tightening torque 25 16 1AZ*.



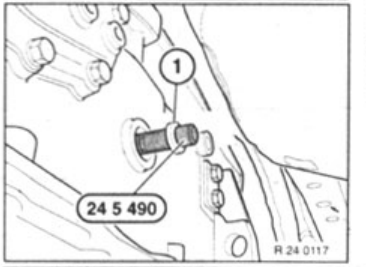
Release nut.
Detach gearshift lever.

Installation note:
For tightening torque 24 51 1AZ*.

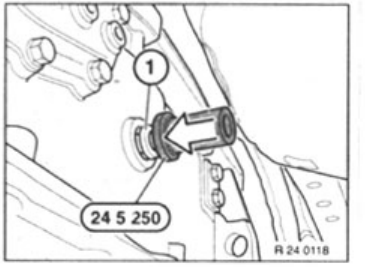
* Refer to Technical Data



Remove radial oil seal from transmission casing with special tool 24 5 260.

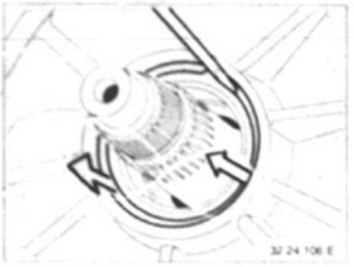


Installation note:
Fit special tool 24 5 490 on manual shift valve shaft.
Oil sealing lip of radial oil seal (1) with automatic transmission oil.
Slide gear on radial oil seal (1) up to casing.



Installation note:
Press radial oil seal into transmission casing with special tool 24 5 250.
Remove special tool 24 5 490 from manual shift valve shaft.

Note:
The radial oil seal on the right-hand side of the transmission is replaced in the same way.



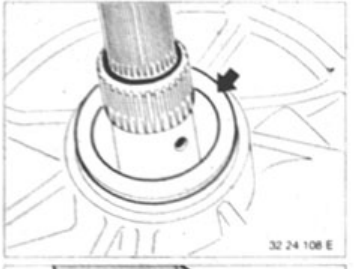
24 12 506 Replacing radial oil seal for torque converter

Remove torque converter 24 40 006.

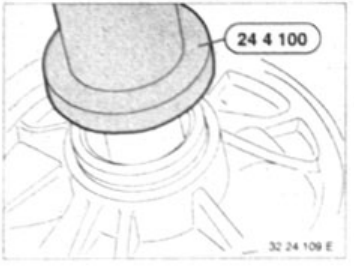
Lever out snap-ring with small screwdriver.



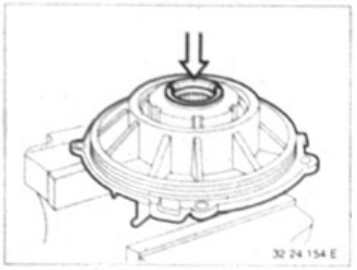
Lift out radial oil seal with open-ended wrench (WAF 13).



Installation note:
Note washer under radial oil seal.



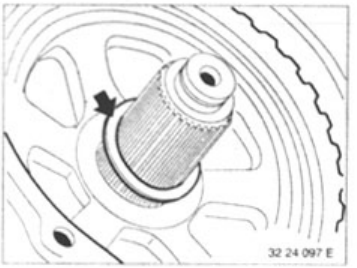
Oil new radial oil seal and install with special tool 24 4 100.



24 13 156 Replacing output flange

Remove output flange
(refer to 24 12 016).

Caution!
Axial clearance must be checked and adjusted if necessary.
Clamp transmission extension in vice.
Output flange must not rest on vice.
Press output flange in output direction.



Calculation example:

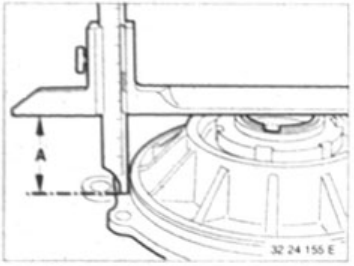
B = 45.1 mm
minus A = 42.7 mm
Distance = 2.4 mm

minimum 0.25 ... 0.45 mm axial clearance

Calculated thickness of spacer ring = 2.15 ... 1.95 mm

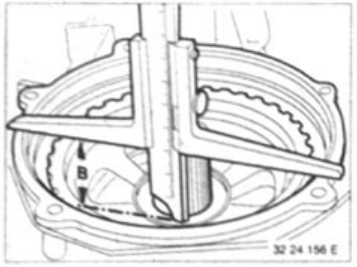
Spacer rings are available from parts service from 1.0 ... 3.2 mm in steps of 0.2 mm.

Install required spacer ring (2.0 mm).



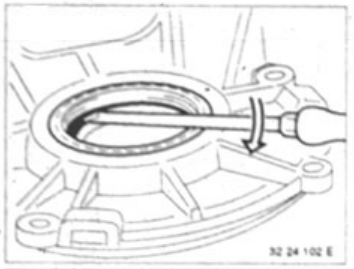
Determine dimension (A) from support shoulder to sealing surface.
Press down output flange for this purpose

Example:
A = 42.7 mm



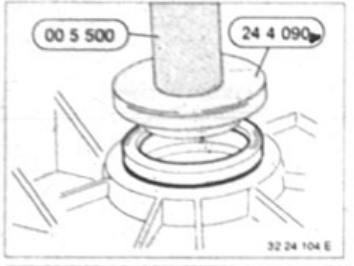
Determine dimension (B) from sealing surface of transmission casing to shoulder on sprag wheel.

Example:
B = 45 .1 mm

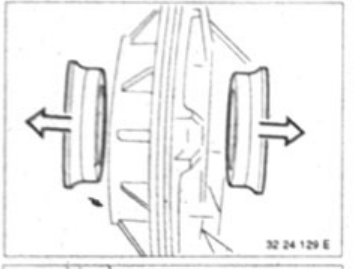


24 13 706 REPLACING BEARING OF TRANSMISSION EXTENSION
– Output Flange Removed –

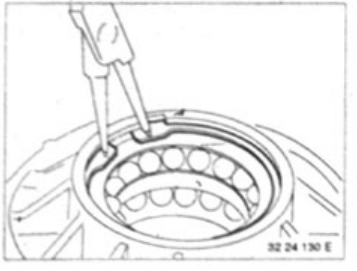
Pry out radial oil seal.



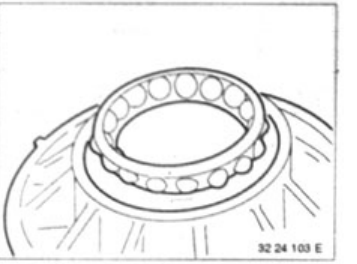
Installation:
Drive in new radial oil seal flush using Special Tools 24 4 090 and 00 5 500.



Remove both inner races.

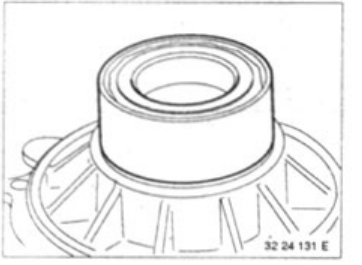


Remove circlip.



Remove ball cage.

Installation:
Check installed direction.



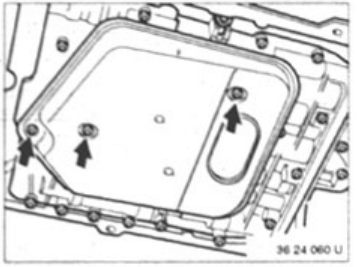
Heat transmission extension in area of bearing race to about 80° C using a hot air blower.
Remove bearing race.

Installation:
Heat case again.
Install first ball cage.

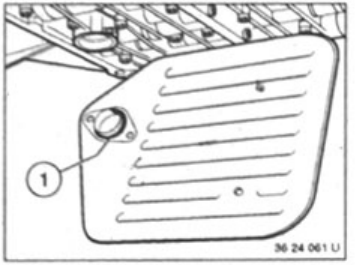
Important!
Axial play must be checked / adjusted if necessary - refer to 24 13 156.

24 30 006 REMOVING AND INSTALLING / REPLACING VALVE BODY

Remove oil sump - refer to 24 11 008.

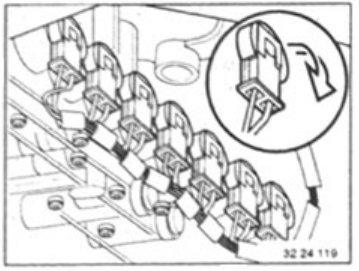


Unscrew oil strainer on valve body.



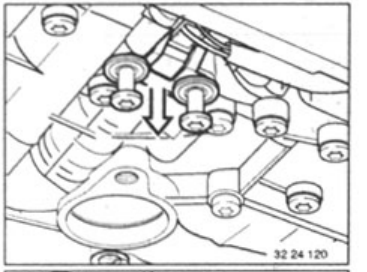
Remove oil strainer.
Check for O-ring (1).

Installation:
Tightening torque*.

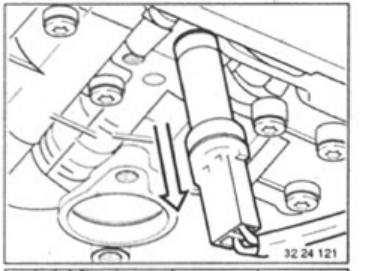


Pull plugs off of solenoids.

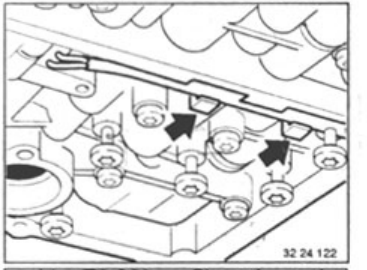
* Refer to Specifications



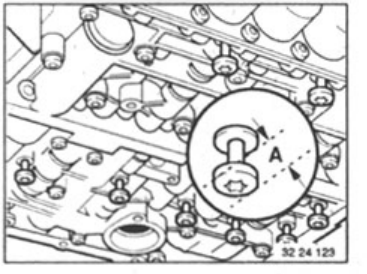
Unscrew holder.



Pull out pulse sender.
Unclip wires.



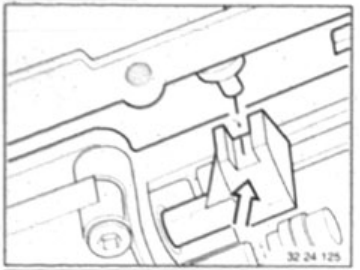
Installation:
Check routing of wires.



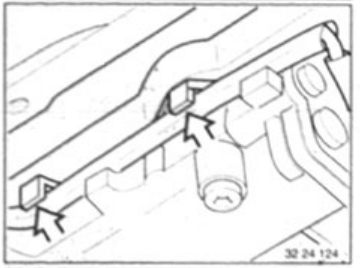
Unscrew all bolts with large bolt heads (A = 12 mm).
Remove valve body.

Installation:
Tighten all bolts in several steps.
Tightening torque*.

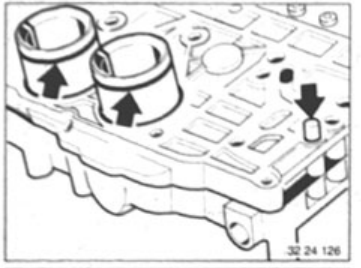
* Refer to Specifications



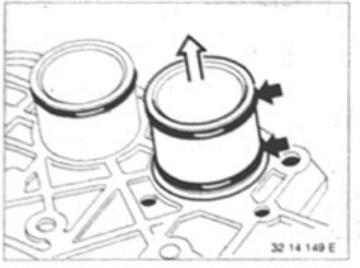
Installation note:
During assembly, fit slide valve on pin of notched disk.



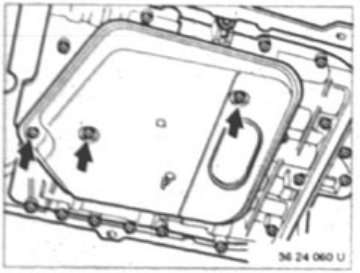
Detach wiring harness from retaining lugs.



Installation note:
Replace O-rings.
Note centring pin.

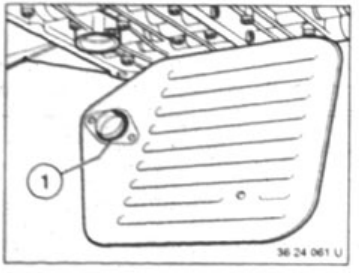


If necessary convert bushes.
Replace O-rings.



24 31 156 REMOVING AND INSTALLING / REPLACING TRANSMISSION OIL STRAINER

Remove oil sump - refer to 24 11 008.
Unscrew oil strainer on valve body.



Remove oil strainer.
Check O-ring (1).

Installation:
Tightening torque*.

* Refer to Specifications

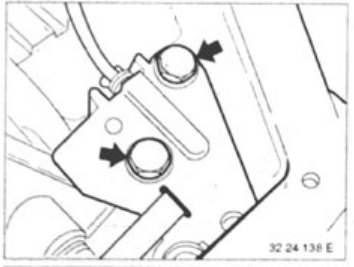
24 34 006 REMOVING AND INSTALLING OR REPLACING PARKING LOCK (PAWL / SPRING)

Remove oil sump - refer to 24 11 008.
Remove transmission extension - refer to 24 12 016.



Unscrew retainer for pulse sender.
Pull out pulse sender.

Installation:
Tightening torque*.



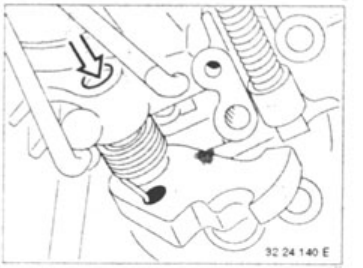
Unscrew guide plate.

Installation:
Tightening torque*.



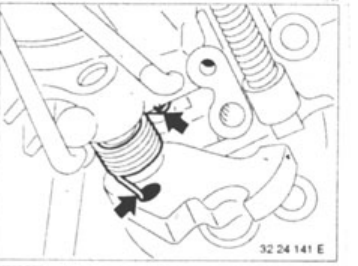
Installation:
Check arrangement of lockpin.

* Refer to Specifications



Drive out bearing shaft from inside to outside using a suitable 6.0 mm dia. plastic punch.

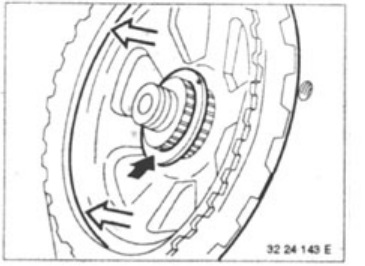
Remove parking lock lever and spring.



Installation:
Attach spring in bore and retainer.



Installation:
Replace seal on bearing shaft.

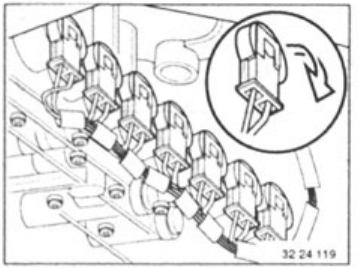


Lift off shim and parking lock gear.

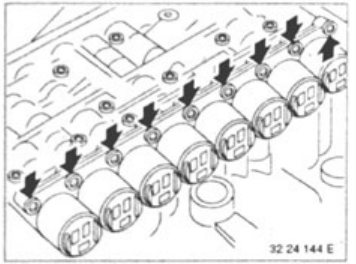
Important!
If the parking lock gear is replaced, the thickness of the shim must be recalculated - refer to 24 13 156.

24 34 857 REPLACING SOLENOIDS AND / OR PRESSURE REGULATOR

Remove oil sump - refer to 24 11 008.

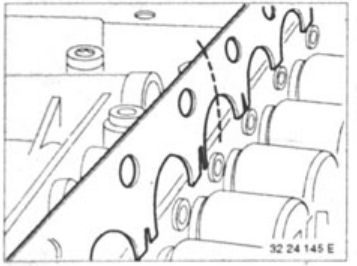


Pull concerned plugs off of solenoids.



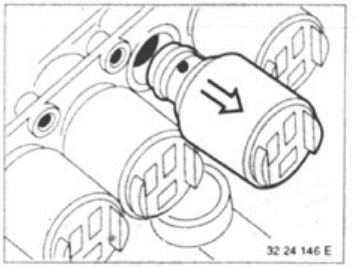
Unscrew retaining rail.

Installation:
Tightening torque*.

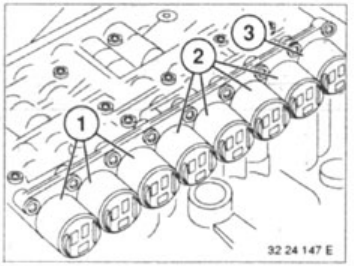


Installation:
The retaining rail is curved in direction of the valve body.

* Refer to Specifications



Pull out solenoid or pressure regulator.



Note:
Solenoids cannot be mixed up.

1 = Solenoid
2 = Pressure regulator - 13 mm dia. pin
3 = Pressure regulator - 17 mm dia. pin



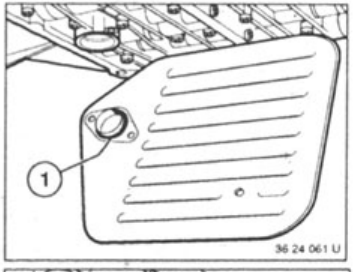
Installation:
Check for O-ring.
Turn solenoids in such a manner that pins face in direction of the oil sump.

24 34 873 REPLACING PULSE SENDER (TURBINE SPEED)
– Oil Sump Removed –

Remove oil sump - refer to 24 11 008.

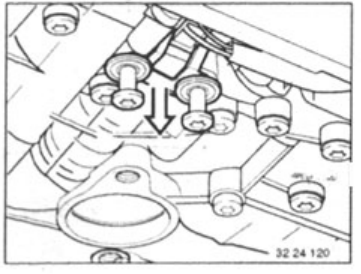


Unscrew oil strainer on valve body.



Remove oil strainer.
Check for O-ring (1).

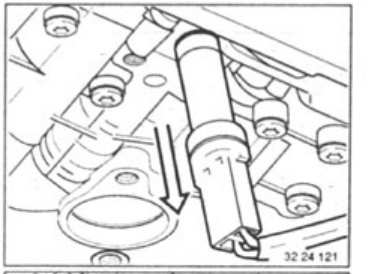
Installation:
Tightening torque*.



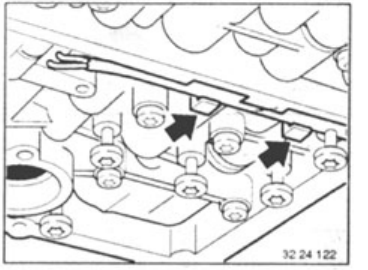
Unscrew holder.

Installation:
Tightening torque*.

* Refer to Specifications



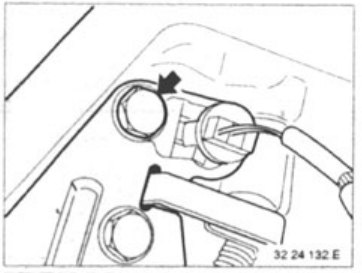
Pull out pulse sender.
Take wiring out of retainers.
Disconnect plug.



Installation:
Check routing of wiring.

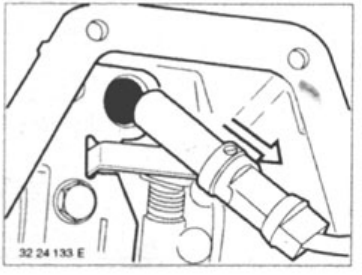
24 34 874 REPLACING PULSE SENDER (OUTPUT SPEED)
– Oil Sump Removed –

Remove oil sump - refer to 24 11 008.



Unscrew retainer.

Installation:
Tightening torque*.



Pull out pulse sender.
Disconnect plug.

* **Refer to Specifications**

24 35 501 REPLACING WIRE HARNESS IN AUTOMATIC TRANSMISSION
– Valve Body Removed –

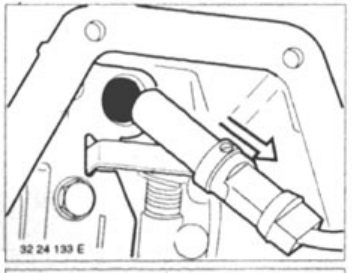
Remove valve body - refer to 24 11 008.

Note:
Removal is necessary to be able to attach the wire harness in retainers on the valve body.

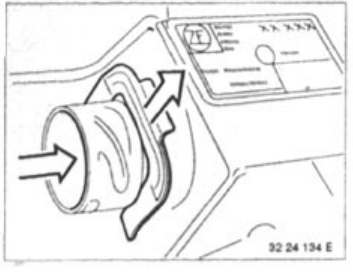


Unscrew retainer.

Installation:
Tightening torque*.

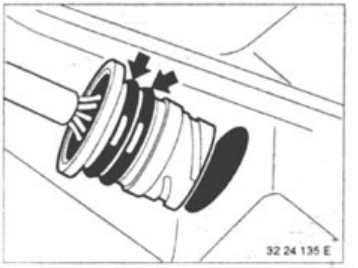


Pull out pulse sender.
Disconnect plug.

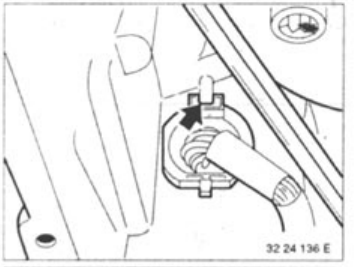


Remove retainer.
Pull out plug towards inside.

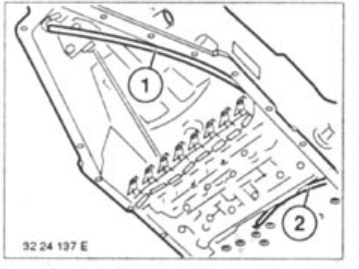
* Refer to Specifications



Installation:
Check O-rings, replacing them if necessary.

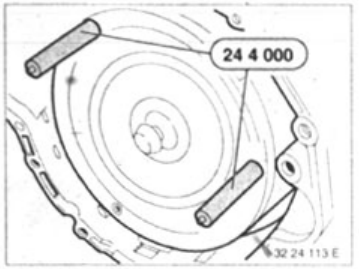


Installation:
Lock plug with retainer on body to prevent turning.



Installation:
Check routing and colors of wires.

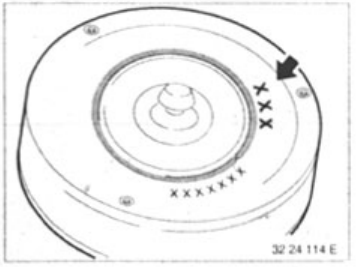
1 = brown
2 = yellow



24 40 006 Removing and installing / replacing torque converter

Remove transmission, refer to 24 00 026.
Using assemble handles 24 4 000, carefully pull torque converter out of primary pump.

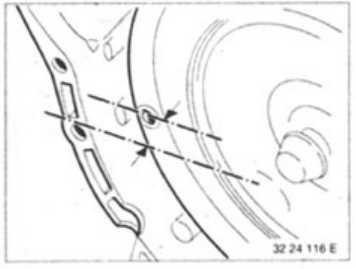
Caution!
Transmission oil flows out.



The torque converter cannot be cleaned with standard workshop equipment and must be replaced if damaged.
Converter identification*

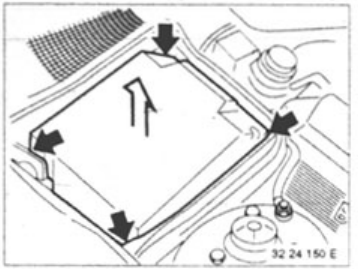
Installation note:
While turning slightly, carefully fit the recesses on the torque converter in the primary pump. Use assembly handles 24 4 000 for this purpose.

Caution!
Do not damage converter bearing mount and seal when fitting. Fit torque converter as far as it will go against stop.



Note:
The torque converter is engaged correctly in position when the distance between the casing and threaded connection on the converter is approx. 25 mm

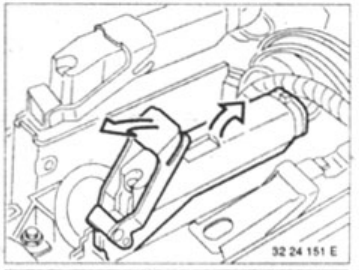
* Refer to Technical Data



24 61 501 REMOVING AND INSTALLING / REPLACING CONTROL UNIT (EGS)

Unscrew electronic box lid (right-hand side looking forward in car).

Installation:
Check for seals on wire harnesses.



Pull plug off of control unit.



Pull out retainers.



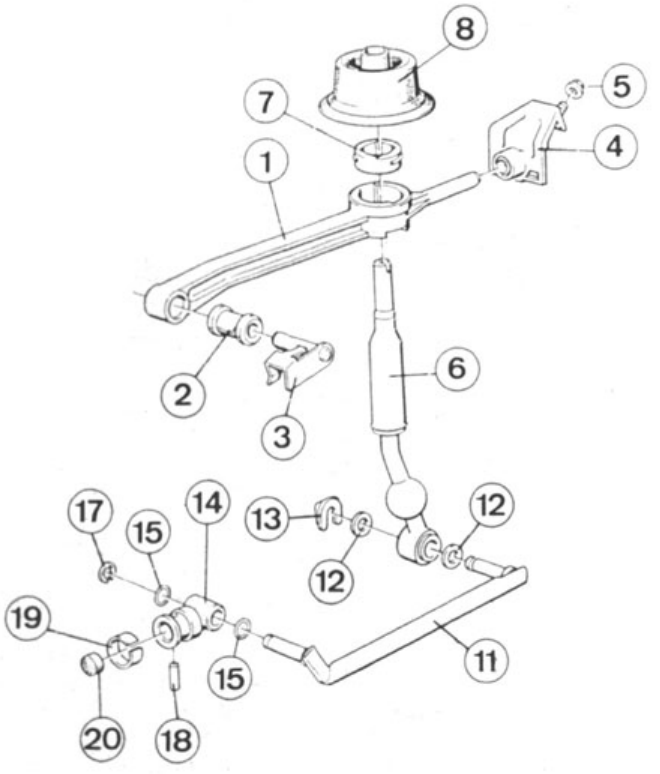
Pull out control unit.

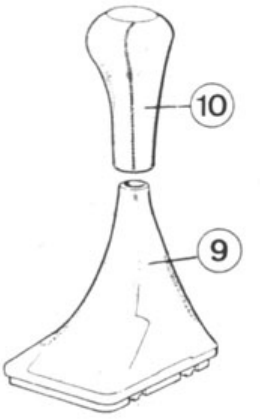
Installation:
Attach control unit with openings on case in retainers at securing points.

Code is on data plate.
Refer to Parts Catalog for cross reference of versions and models.

25 Gear shift mechanism

	Layout of gear shift mechanism	25- 11/0
25 11 000	Shift lever – remove and install	25- 11/1
041	Spherical shell for shift lever – replace	25- 11/3
081	Imitation leather dust cover for shift lever – replace	25- 11/4
111	Shift rod joint – replace	25- 11/5
211	Selector arm for shift lever mounting – replace	25- 11/6
245	Support bearing for selector arm – replace	25- 11/7
	Layout of gear shift mechanism for automatic transmission	25- 16/0
25 16 050	Shift lever complete with shift lever bracket – remove and install	25- 16/1
061	Knob for shift lever – replace	25- 16/2
076	Pull rod in shift lever – replace	25- 16/2
	Interlock function – check	25- 16/3
	Shift lock function – check	25- 16/3
. . .	Shift lever complete with shift lever bracket – remove and install	25- 16/4
080	Shift lever – remove and install or replace	25- 16/7
202	Operating cable for gear selector lever – replace	25- 16/9

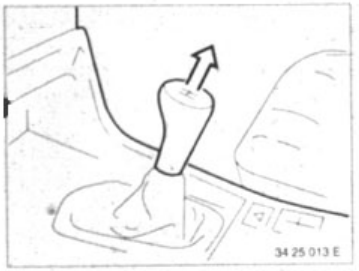




32 25 058

SHIFT LAYOUT DRAWING
- Manual Transmission -

1 Shift console
2 Bearing sleeve
3 Bearing shaft
4 Bearing bracket
5 Nut
6 Shift lever
7 Mount
8 Rubber cover
9 Leather cover
10 Shift lever knob
11 Shift rod
12 Washers
13 Retainer
14 Shift rod joint
15 Spacers
17 Retainer
18 Cylindrical pin
19 Spring sleeve
20 Lubricating felt



25 11 000 REMOVING AND INSTALLING SHIFT LEVER

Pull knob off of shift lever.

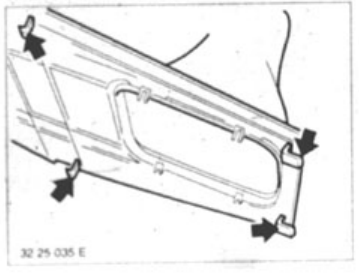
Note:
Pulling off requires a force of about 40 kp (90 lbs.).



M 5:
The shift lever knob is illuminated.
Watch out for electric leads while pulling off.



Lift front end of cover out of the retainers.
Lift off cover with dust cover.



Installation:
Engage retainers at rear and clip in at front.

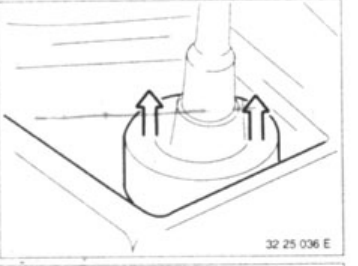


Remove insulation sheet.

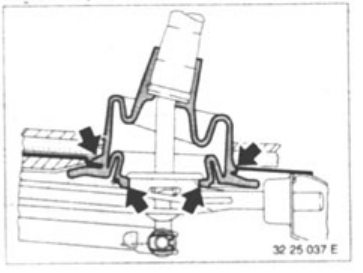
Installation:
Rubber mat is located between carpet and center console.



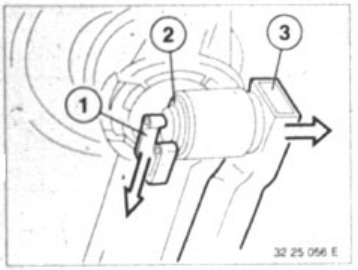
M 5:
Disconnect plug (1).
The shift lever knob can only be replaced together with the electric leads.
This requires pulling the plug out through the dust cover.



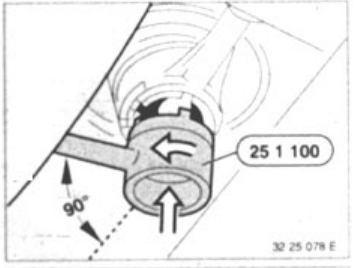
Unbutton dust cover on body and shift console.



Installation:
Button inner dust cover over selector arm and outer dust cover in body opening.



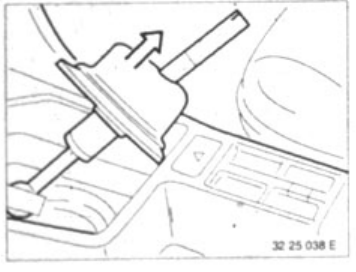
Lift out retainer (1).
Take off washer (2).
Pull out selector rod (3).



Apply Special Tool 25 1 100.
Turn counterclockwise 90°.
Press up spherical plate.



Installation:
Mount spherical plate in such a manner that tabs on spherical plate are aligned with openings in selector arm. Press in shift lever until retainers are hears to engage on the left and right sides.



Take out shift lever from above and unbutton in dust cover.



25 11 041 Replacing spherical shell for gearshift lever

Remove gearshift lever 25 11 00.
Remove spherical shell by pressing down.

Installation note:
Grease spherical shell and ball with Klüber Polylub GLY 801*.

* Source of supply: BMW Parts Service

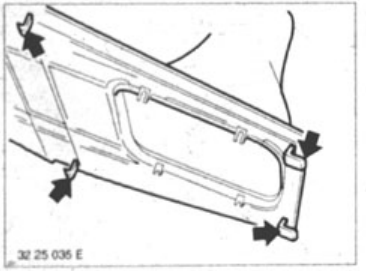


25 11 081 REPLACING DUST COVER FOR SHIFT LEVER

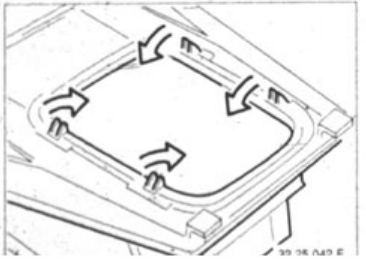
Pull off shift lever knob.
Note:
Force required for pulling off:
approx. 40 kp (88 lbs.).



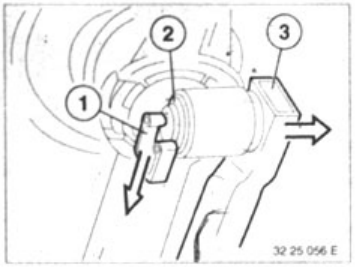
Lift front of cover out of retainers.
Lift off cover with dust cover.



Installation:
Engage retainers at rear and clip in at front.

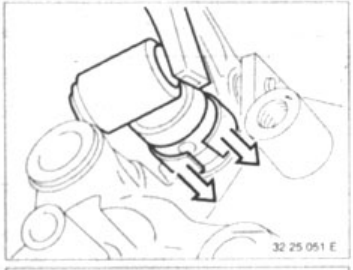


Unbutton dust cover on cover.

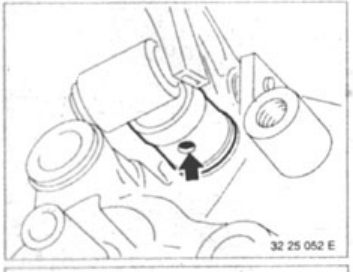


25 11 111 Replacing shift rod joint

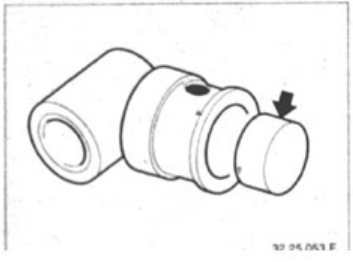
Remove propeller shaft at transmission, refer to 26 11 000.
Engage reverse gear.
Remove retainer (1).
Remove washer (2)
Pull out shift rod (3).



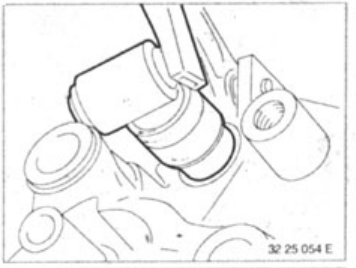
Lift retaining sleeve out of groove and slide forward.



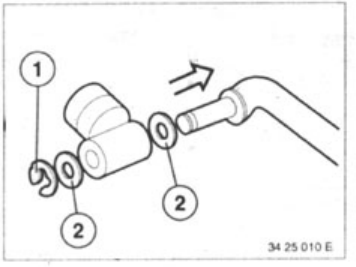
Drive out pin.
Pull out shift rod with joint.



Installation note:
Check damping disk in joint and replace if necessary.



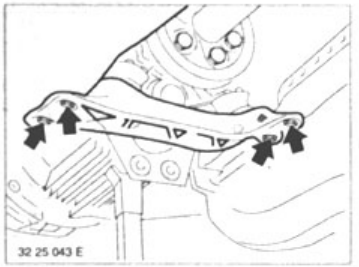
Installation note:
Shift bearing bush to left side.



Lever out retaining ring (1).
Remove washers (2).
Pull out shift rod.

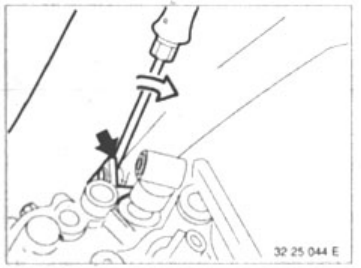
Installation note:
Install washers (2) such that the chamfer faces away from the shift rod joint.
Grease bearing points with Klüber Polylub GLY 801*.

* Source of supply: BMW Parts Service

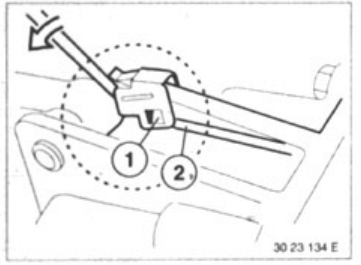


25 11 211 Replacing selector arm for gearshift lever mounting

Remove propeller shaft at manual transmission,
refer to 26 11 000.
Remove gearshift lever 25 11 000.
Support transmission.
Unscrew cross member.
Lower transmission down to front axle carrier.

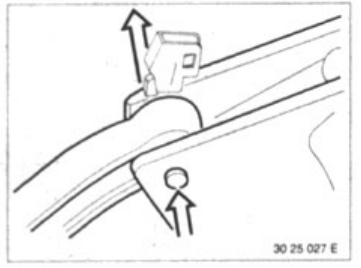


Fit screwdriver between spring and housing.



Detach spring (1) from lug (2) on housing and swivel up.
Remove pivot pin.

Installation note:
Grease pivot pin with Klüber Polylub GLY 801*.



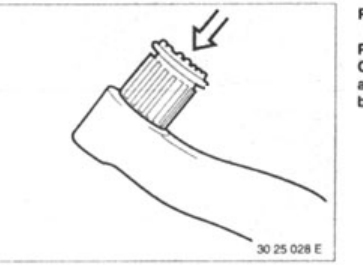
Swivel back clip.
Remove pivot pin.
Detach selector arm.

* Source of supply: BMW Parts Service



Remove selector arm from rear mounting.

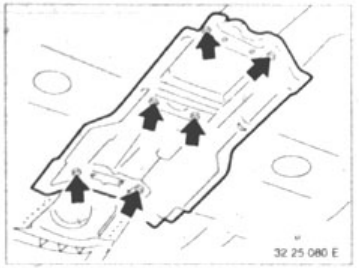
Installation note:
Check support ring and grease with Klüber Polylub GLY 801*.



Replace bearing bush(es):

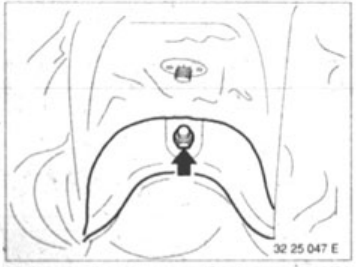
Press out old bearing bush(es).
Coat new bearing bush(es) with Circolight* and press into selector arm hole until side beading of bush(es) project evenly.

* Source of supply: BMW Parts Service



25 11 245 Replacing support bearing for selector arm

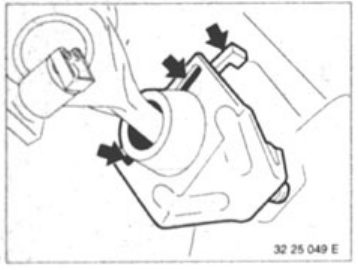
Remove exhaust system 18 00 020.
Remove heat shield.



Release bolt.

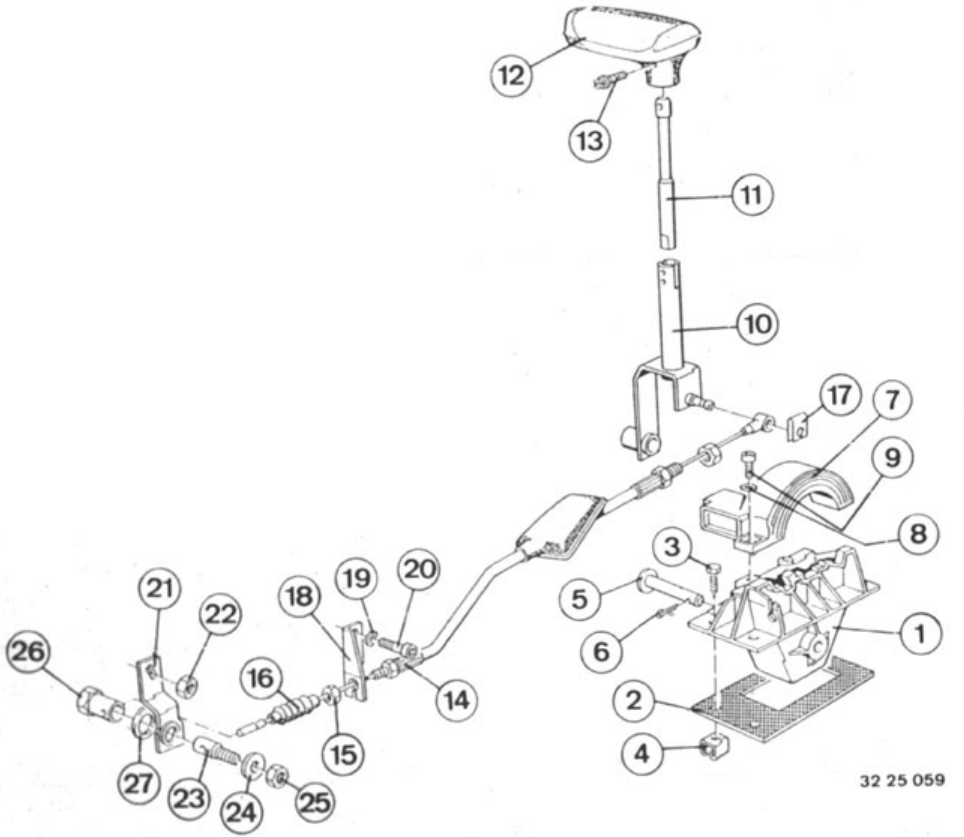


Slide bearing bracket forward, turn, press down selector arm and remove support bracket.



Installation note:
Grease support bracket with Klüber Polylub GLY 801*.
Attach bracket in retaining lugs.

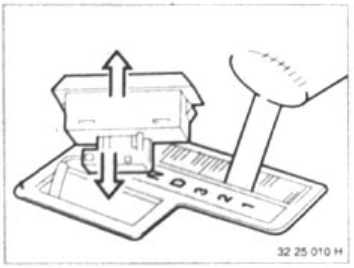
* Source of supply: BMW Parts Service



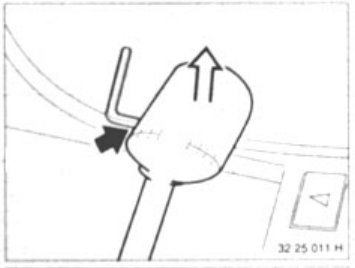
SHIFT LAYOUT DRAWING
- Automatic Transmission -

1 Console
2 Insulator
3 Self-tapping screw
4 Self-tapping nut
5 Bearing shaft
6 Cotter pin
7 Switch
8 Washer
9 Screw
10 Selector lever
11 Pull rod
12 Handle
13 Fillister head bolt
14 Cable
15 Nut
16 Cover
18 Holder
19 Washer
20 Fillister hed bolt
21 Lever
22 Nut
23 Clamping bolt
24 Washer
25 Nut
26 Sleeve
27 Washer

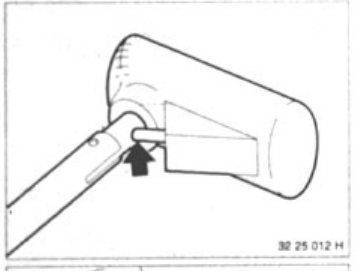
25 16 050 Removing and installing selector lever with console



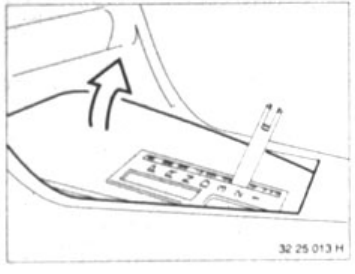
Pull off EGS switch, remove plug.



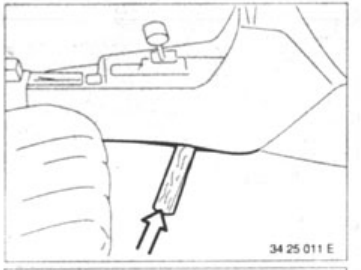
Unscrew fillister head screw (3 mm hexagon socket).
Pull off handle.



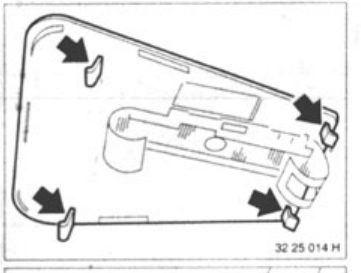
Installation instruction:
Engage pin of button in bore of pull rod.



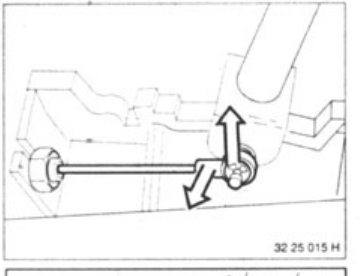
Remove front cover from retaining lugs.
Remove cover.



Note:
To lift out the trim, push up between transmission tunnel and console with a flat object (e.g. wooden ruler).

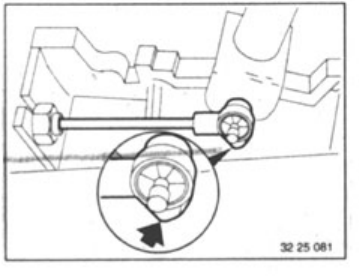


Installation instruction:
Attach retaining lugs from back, clip in at front.

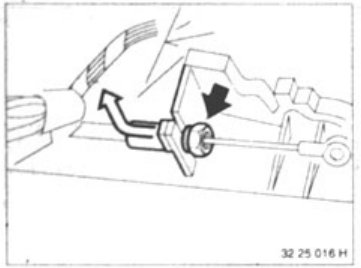


Pry out retainer.
Unfasten lug from bolts.

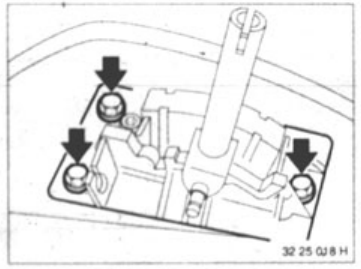
Caution!
Do not bend steel wire.



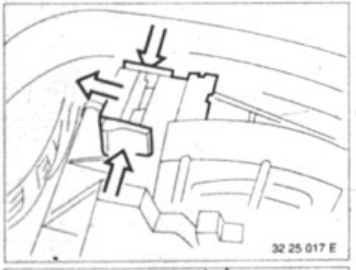
Installation instruction:
Lug on the eye points upwards.



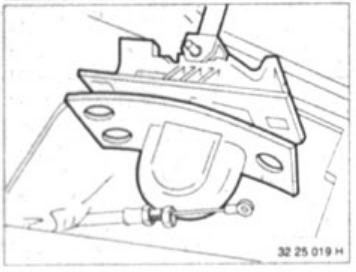
Unscrew nut.
Disconnect Bowden cable sleeve from retaining bracket.



Unscrew bolts.

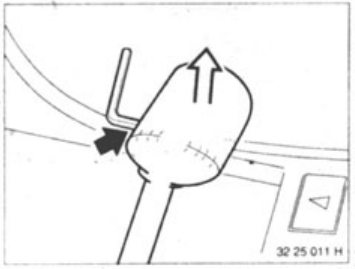


Press together the retaining clips.
Disconnect plug.



Removing selector console and protective cover.

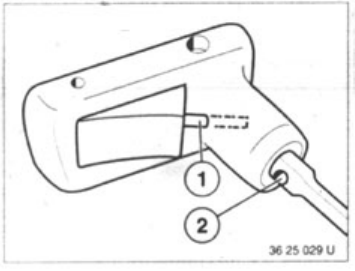
Installation instruction:
Examine / replace protective gaiter.
Adjust selector mechanism, see main group 24.



25 16 061 Replacing handle for selector lever

Unscrew fillister head screw (3 mm hexagon socket).
Pull off handle with pull rod.

Installation instruction:
Tightening torque*.



Disconnect pull rod (button not pressed).
Engage pin (1) of button in bore (2) of pull rod.

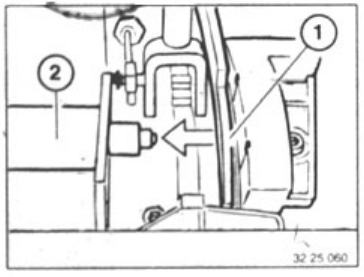
25 16 076 Replacing pull rod in selector lever

Description given in Replacing Handle For Selector Lever, see 25 16 061.

* Refer to Specifications

CHECKING INTERLOCK

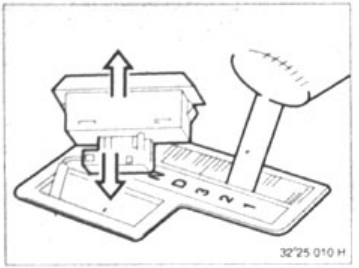
Turn ignition key to center position (radio).
It must be possible to move the selector lever in and out of all positions.
It should only be possible to turn the ignition key back to "Zero" position and remove the key with the selector lever in P.
It must not be possible to move the selector lever out of P with the ignition key in "Zero" position or removed.



1 Interlock
2 Shiftlock

CHECKING SHIFTLOCK

With the engine running and car stopped the selector lever must be in P or N.
With the brake pedal operated and an engine speed of less than 2500 rpm the selector lever must be unlocked.
With the brake pedal operated and an engine speed of more than 2500 rpm the selector lever must be locked in P or N.
When moving the selector lever quickly from R to D and from D to R the selector lever lock must not be activated in position N.
If the selector lever is left in position N for longer than about 5 seconds the lock must be activated.
Except for positions P and N, the selector lever must never be locked regardless of the operating condition.
The selector lever lock must not be activated at a road speed of more than 5 km/h.

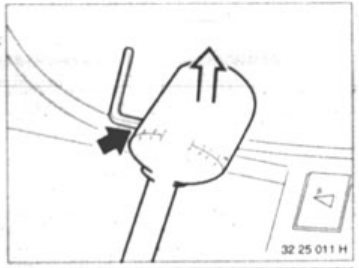


32 25 010 H

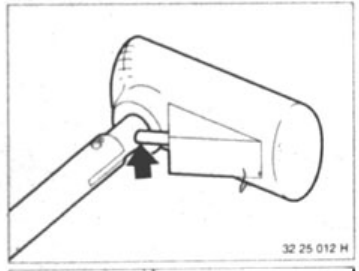
25 16 . . . Removing and installing selector lever and console

Version with Interlock/Shift-Lock:

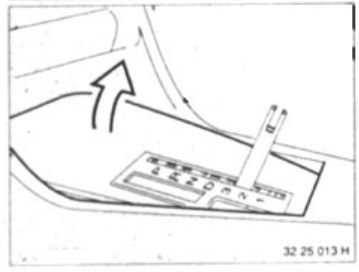
Lift out switch for EGS control unit, remove plug.


32 25 011 H

Unscrew fillister head screw (3 mm hexagon socket).
Remove handle.

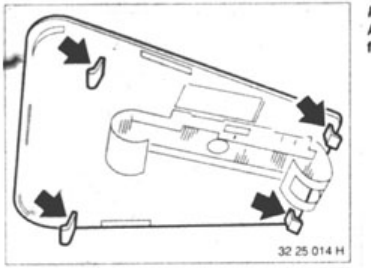

32 25 012 H

Installation instruction:
Insert pin on button in bore of pull rod.

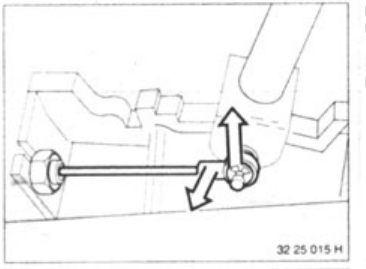


32 25 013 H

Lift out front cover from retaining lugs.
Remove cover.

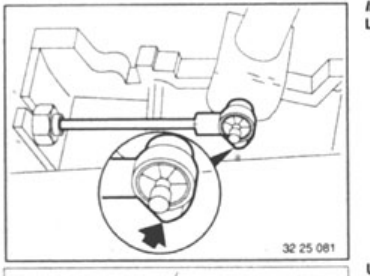

32 25 014 H

Installation instruction:
Attach retaining lugs at back and clip in at front.

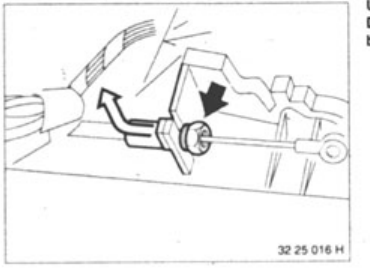

32 25 015 H

Lift out clamping spring.
Unfasten eye on bolt.

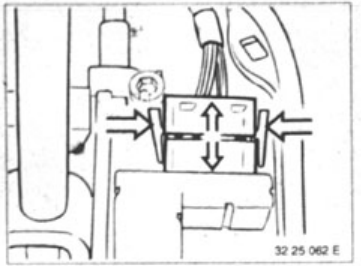
Caution!
Do not bend steel wire.


32 25 081

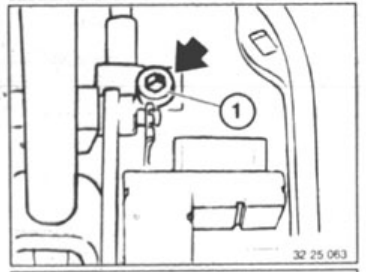
Installation instruction:
Lug on the eye points downwards.


32 25 016 H

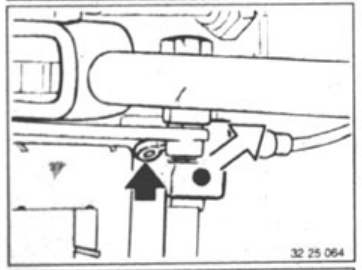
Unscrew and remove nut.
Detach Bowden cable sleeve from retaining bracket.



Press together retaining clips.
Disconnect plug.

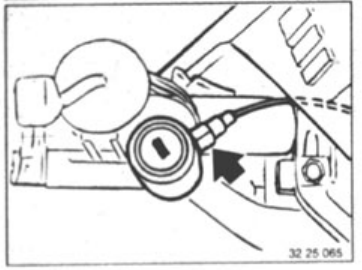


Unfasten screw (1)

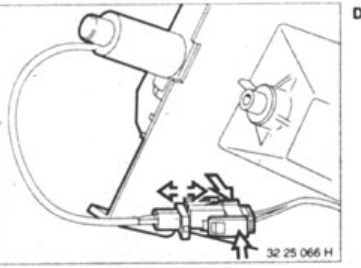


Unscrew holder.
Disconnect interlock cable.

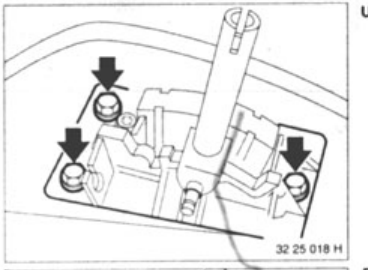
Installation instruction:
Adjust interlock cable.



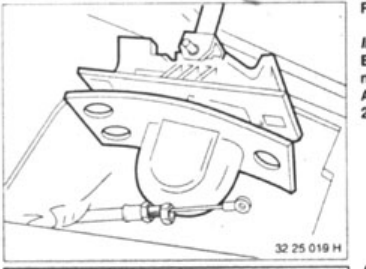
Fit new interlock cable, see Replacing Steering Lock, main group 32.



Detach plug connection for Shiftlock.

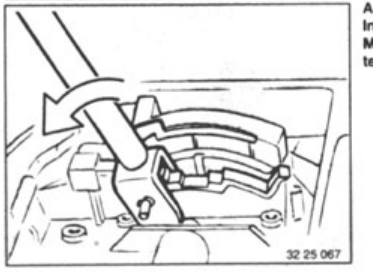


Unscrew bolts.

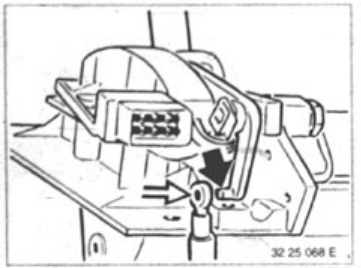


Remove console and protective cover.

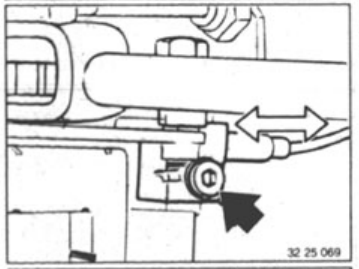
Installation instruction:
Examine protective gaiter and replace if necessary.
Adjust gearshift mechanism, see main group 24.



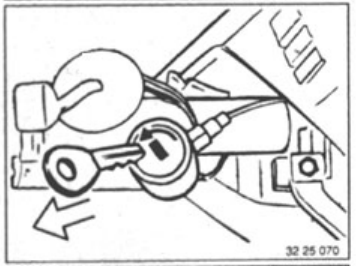
Assembly and adjustment.
Interlock cable.
Move selector lever into setting "P" (front detent on bearing pot).



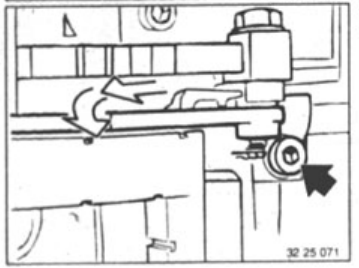
Connect cable eyelet on pin of lever.



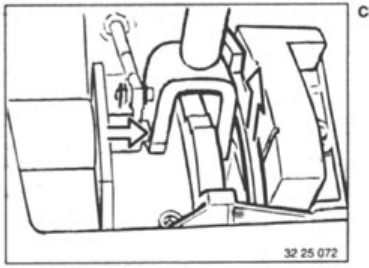
Fit cable with bracket and screw on bearing pot (cable tube must initially retain axial movement in the bracket).



Move ignition key into zero setting (remove ignition key).

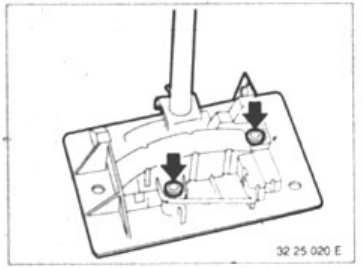


Press detent lever down and tighten screw for retaining cable to torque of 8 Nm.

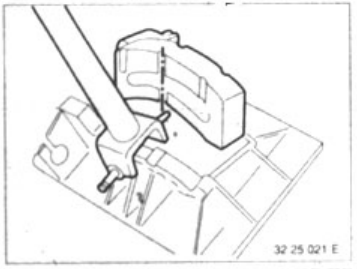


Check function of interlock and shiftlock.

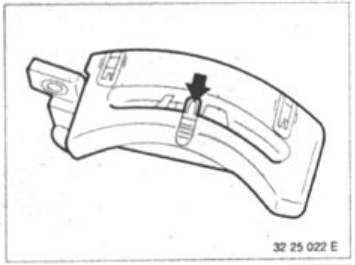
25 16 080 Removing, installing and replacing selector lever



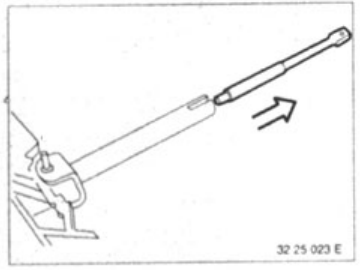
Remove transmission switch:
Remove screws.



Move selector lever into central position.
Lift off switch.



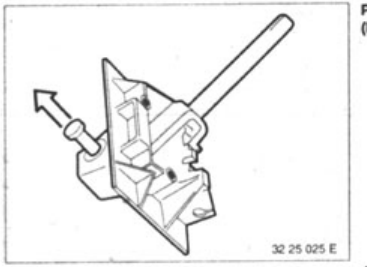
Installation instruction:
Align slot in housing and guide groove in slide with one another (i.e. align them).
Check that the driver spigot is correctly located.



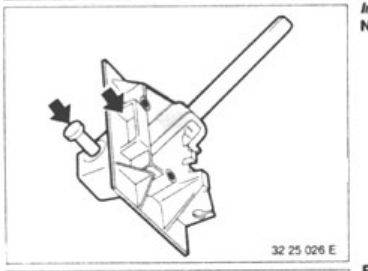
Remove selector lever:
Remove pull rod.



Unfasten cotter pin.

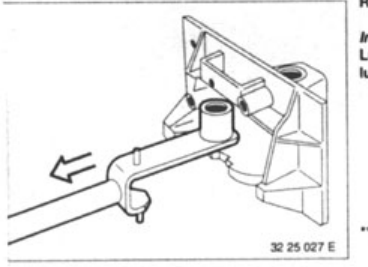


Press out bolt.
(Press fit).



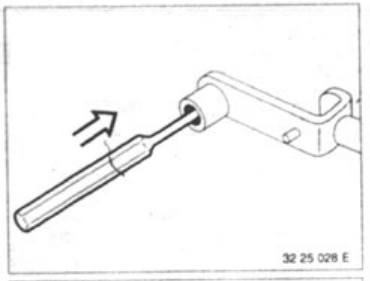
Installation instruction:
Note installation direction of bolt.

Remove selector lever from housing.



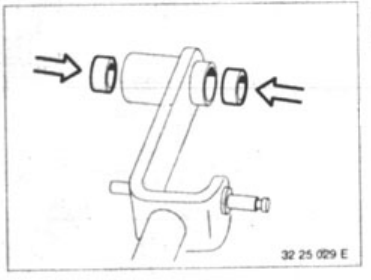
Installation instruction:
Lubricate bearing surfaces with Klüber Polylup GLY801** grease.

** Source of Supply: BMW Parts Service

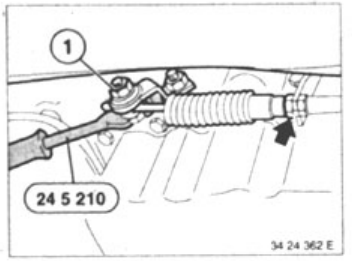


Replacing Bearing Sleeves:

Drive both bearing sleeves out.



Installation:
Press new bearing sleeves in flush.

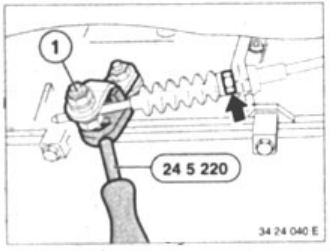


25 16 202 Replace cable for gear selector lever

Unfasten nut (1) in setting "P".

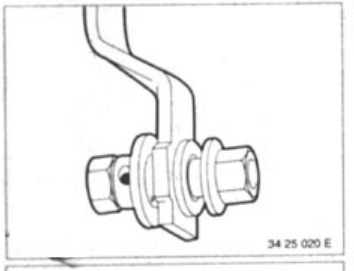
Caution!
To prevent any distortion of the cable, brace with special tool 24 5 210 or 24 5 220 on the clamping screw.

Transmission A 4 S 310 R.
Special tool 24 5 210.

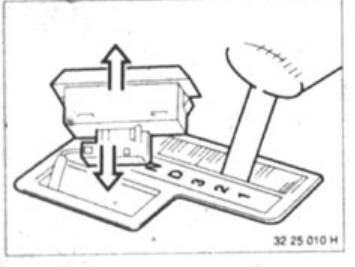


Transmission A 5 S 310 Z and A 5 S 300 J.
Special tool 24 5 220.

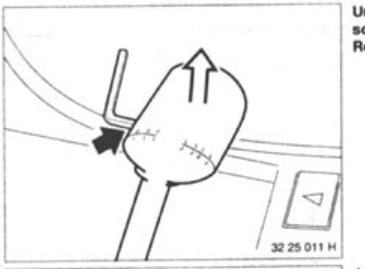
Note:
The special tool can only be fitted in setting "P".
Unscrew cable from holder.
Remove cable.



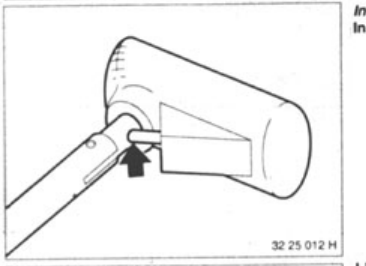
Installation instruction:
Note the arrangement of washers.
Check / replace rubber mount.



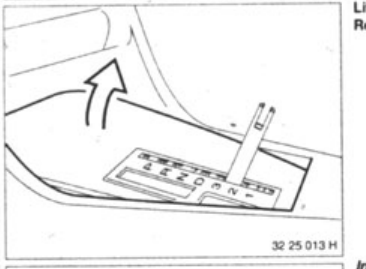
Lift out switch for EH control unit, remove plug.



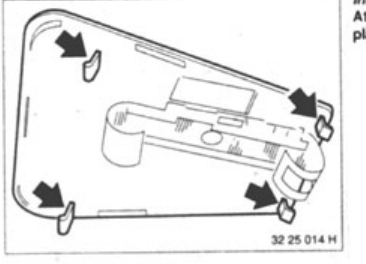
Unfasten clamping screw (3 mm hexagon socket).
Remove handle.



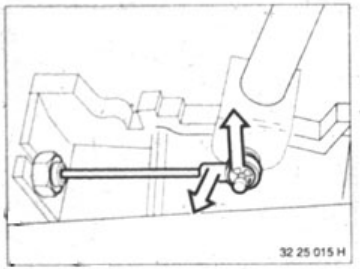
Installation instruction:
Insert pin of button in pull rod bore.



Lift cover out from front of retaining lugs.
Remove cover.

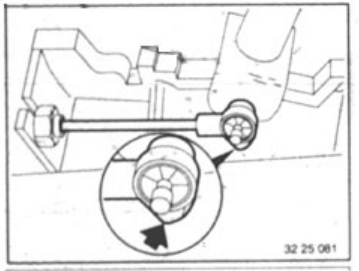


Installation instruction:
Attach retaining lugs at rear and clip into place at front.

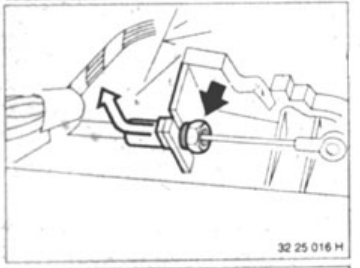


Lift out clamping spring.
Unfasten eyelet from bolt.

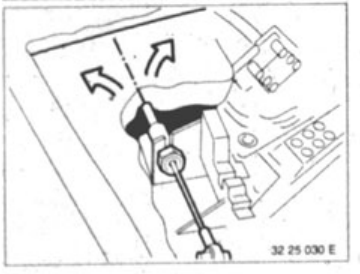
Caution!
Do not bend steel wire.



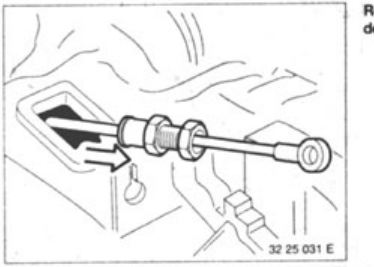
Installation instruction:
Lug on the eyelet points downwards.



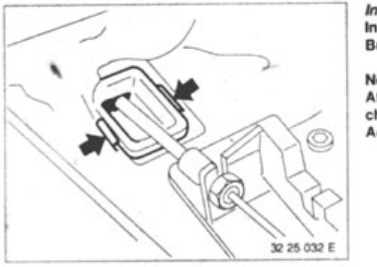
Unscrew and remove nut.
Detach Bowden cable sleeve from retaining bracket.



Cut open carpet and hammer into place.



Remove rubber grommet together with Bowden cable.

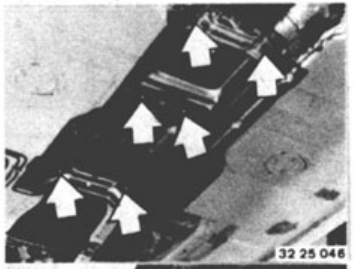


Installation instruction:
Insert Bowden cable from top.
Button up rubber grommet.

Note:
After complete assembly of the Bowden cable, check location of rubber grommet once again. Adjust shift mechanism, see main group 24.

26 Propeller shaft

26 11 000	Propeller shaft – remove and install	26- 11/1
030	Propeller shaft – balance (center and adjust deflection angle)	26- 11/4
051	Flexible coupling for front propeller shaft – replace	26- 11/6
160	Constant velocity joint for propeller shaft – replace – version with press-fitted knurled bolts	26- 11/8
160	Constant velocity joint for propeller shaft – replace – version with screwed stud bolt	26-11/10
501	Centering for propeller shaft at front – replace	26-11/12
26 12 001	Propeller shaft center mount – complete unit – replace – propeller shaft with sliding member on center mount	26- 12/1
001	Propeller shaft center mount – complete unit – replace – propeller shaft without sliding member on center mount	26- 12/2
002	Both propeller shaft center mounts – complete units – replace	26- 12/3
011	Grooved ball bearing in propeller shaft center mount – replace	26- 12/5
500	Propeller shaft center mount – preload and check	26- 12/5
26 20 000	Input shaft – 4-wheel drive – remove and install	26- 20/1
051	Flexible coupling for input shaft – 4-wheel drive – remove and install	26- 20/2
	Propeller shaft – troubleshoot	26- 90/1

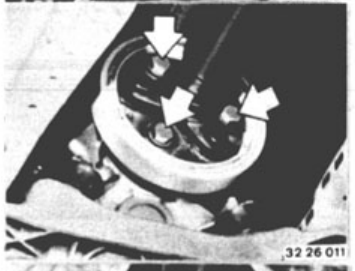


26 11 000 REMOVING AND INSTALLING PROPELLER SHAFT

Remove exhaust assembly - refer to 18 00 020.

Note:
The propeller shaft is adapted to pertinent requirements in reference to the transmission version, power flow and vibration behavior, so that removal and installation will differ and depend on the version.

Remove the heat shield if applicable.



Version with Front Joint Disc:

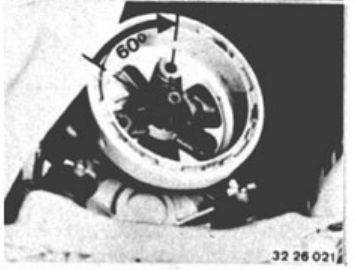
Unscrew the joint disc at the transmission.

Installation:
Note the length of bolts due to the thicker joint disc for the M5.
518i ... 535i = 56 mm
M5 = 60 mm



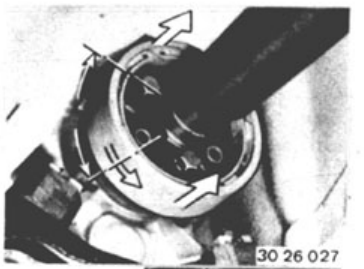
Installation:
Replace the stop nuts.
Tightening torque*.

Important!
Only tighten the nuts or bolts on the flange end whenever possible to avoid tension in the joint disc.

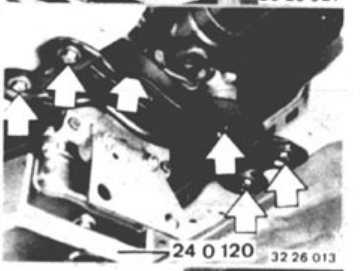


Note:
The vibration damper is mounted on the transmission end of the output flange.
By turning 60° the vibration damper can be pushed over the output flange.

* Refer to Specifications



Turn the vibration damper 60° and lay it on the rubber coupling.
The vibration damper is removed together with the propeller shaft.



Version with Front Universal Joint:

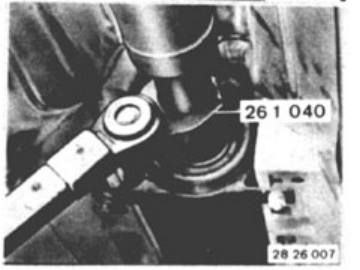
Support the transmission from underneath.
Unscrew the transmission suspension.

Installation:
Center the transmission - refer to Gr. 26.
Tightening torque*.



Unscrew the universal joint from the transmission.

Installation:
Replace the stop nuts.
Tightening torque*.

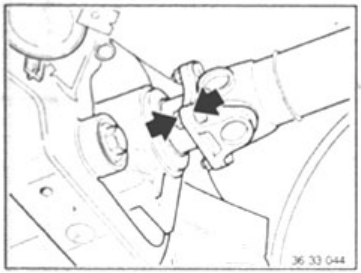


Version with Slide:

Loosen the threaded bush several turns, using Special Tool 26 1 040.

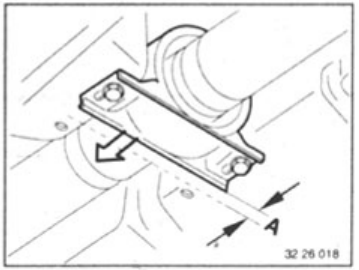
Installation:
Tighten the threaded bush after complete installation, using Special Tool 26 1 040.
Tightening torque*.

* Refer to Specifications



Removing propeller shaft from rear axle differential.

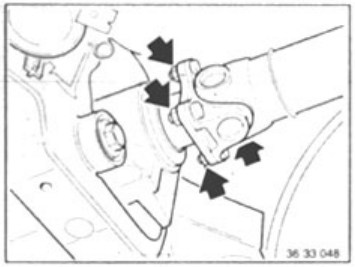
Caution!
Draw relative positions of flanges.



Remove center mount from body.

Installation instruction:
Preload center mount in forward direction.
Tightening torque 26 11 6AZ*

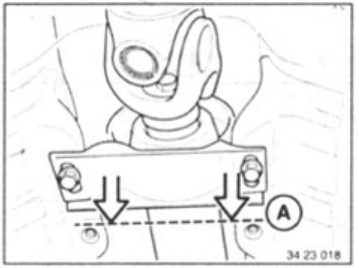
Preload on propeller shafts with sliding member on center mount A = 4 ... 6 mm.
Propshafts without sliding member on center mount A = 2 ... 4 mm.



Version with universal joint:

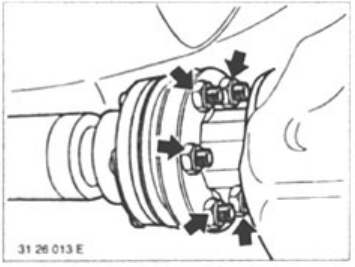
Unscrew universal joint on transmission.

Installation instruction:
Replace stop nuts.
Note tightening torque 26 11 4AZ*.



Model 518i:
Three-section propeller shaft.
In addition, remove second center mount from back of body.

Installation instruction:
Preload center mount in forward direction in parallel fashion. A = 2 ... 4 mm.

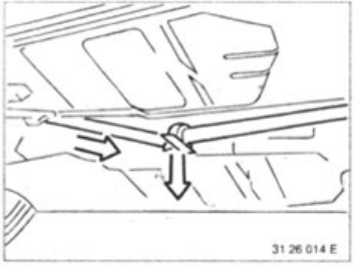


Version with constant velocity joint:

Unscrew universal joint on rear axle differential.

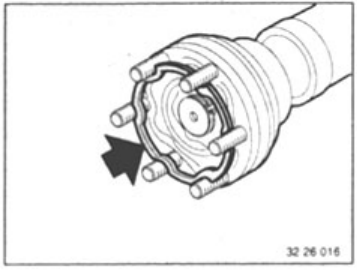
Installation instruction:
Replace stop nuts.

Caution!
The tightening torque 26 11 4AZ* for M 8 bolt connections can differ depending upon the version of nuts used.



Bend down propeller shaft at center mount and withdraw from centering spigot on transmission.

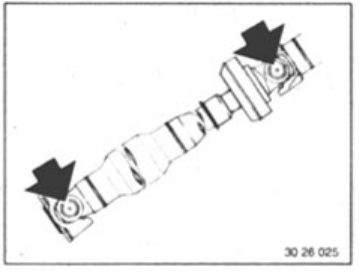
Remove propeller shaft.
The propeller shaft is balanced in the driveline and may only be replaced as a complete unit.



Installation instruction:
Check / replace gasket.

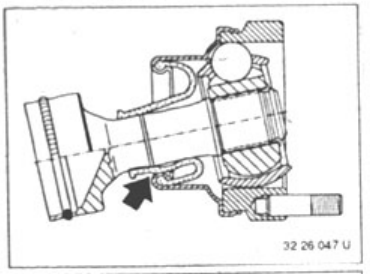
Caution!
The constant velocity joint is not micro-encapsulated.
Protect joint from dirt with transport cap or similar item.
Check grease fill*.

* Refer to Specifications

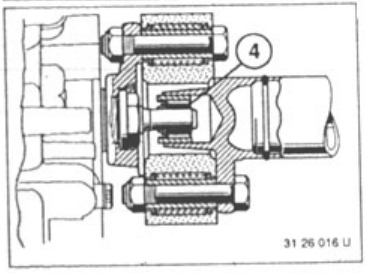


Do not separate propeller shaft on sliding member.
Propeller shaft sections are mounted in such a manner that the universal joints are in one plane.
If the sliding member was mistakenly dismantled without marking, the only mistake possible is incorrect assembly (offset at 180°) due to the balancing operation.

* Refer to Specifications



Important!
Do not let the propeller shaft fall into the joints. The rubber cover of the constant velocity joint in particular would be damaged.



Installation:
Check center (4).
Replace a damged center.
Lubricate the center with Molykote Longterm 2 prior to installation.**

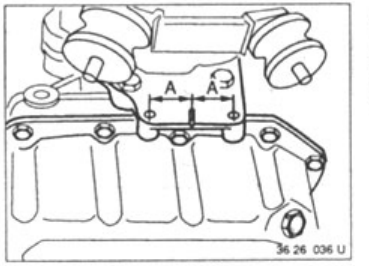
** Source of Supply: BMW Parts

26 11 030 BALANCING PROPELLER SHAFT (CHECKING AND ADJUSTING DEFLECTION ANGLES)

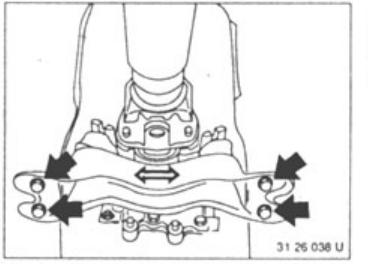
Vibration or Noise:

Requirements:
Propeller shaft in perfect optical condition.
Balance the propeller shaft, if balance plates are missing or there is suspicion of propeller shaft imbalance (refer to the operating instructions supplied with the balancing machine).

Important!
Test run a jacked-up car only with supported wheel suspension on the driven wheels (deflection angle of output shaft).
Never exceed the top speed specified for a car in jacked-up state or on a dynamometer test stand.
Conform with safety precautions!



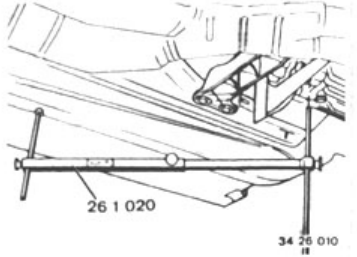
THM R1 Automatic Transmission:
Determine the measuring point.
Measure dustance A from the center of the bore to the inside.
A = 31.0 mm.
Punch mark the measuring point.

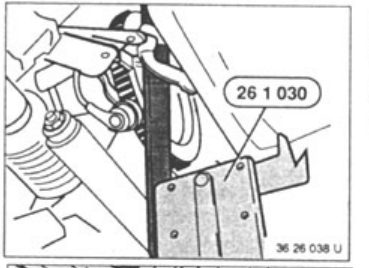


Move the transmission sideways until the special tool gage shows the same distance on the left and right sides.
Mount the cross member.
Tightening torque*.

Centering Propeller Shaft:

Loosen the exhaust assembly, engine rubber mounts and transmission cross member.
Apply Special Tool 26 1 020.



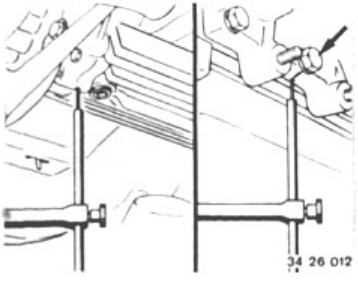


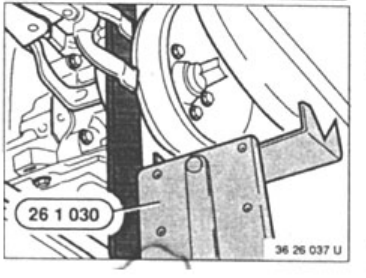
Checking Deflection Angle of Propeller Shaft:

M40 Engines:
Clamp rail (steel ruler) on the pulley in vertical position (use a clamp).
Place Special Tool 26 1 030 on the rail.

Measuring Points:
Bore in engine carrier at rear.
Manual transmission - center cast rib.

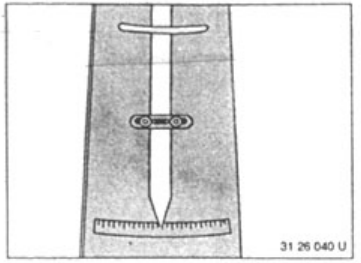
4 HP-22/5 HP-18 Automatic Transmissions:
Center bolt of transmission extension (punch mark the measuring point).





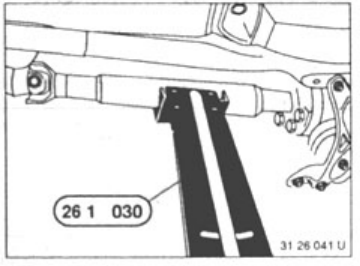
M20/M50 Engines:
Clamp rail (steel ruler) on the vibration damper in vertical position (use a clamp).
Place Special Tool 26 1 030 on the rail.

* Refer to Specifications



Set the indicator perpendicular with help of the water scale.

Note:
Always apply the special tool with the scale in the same direction (e.g. scale right).
One graduation = 5'.
The position of the car is not important, as only separate angles are compared.

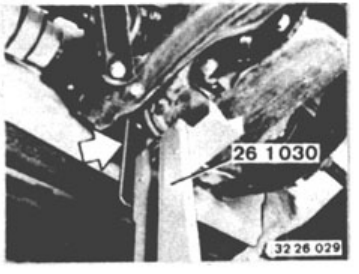


Place the special tool on the front section of the propeller shaft and measure the angle.
Determine the deflection angle* of the joint disc and, if necessary, correct it by installing max. 3 mm thick shims on the transmission suspension or center mount.

Example:

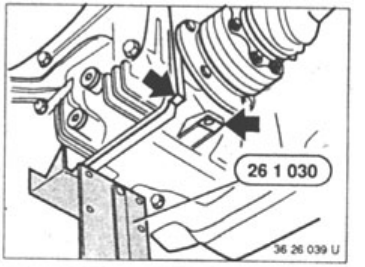
Engine angle	2° 16'
Propeller shaft angle	– 2° 06'
Joint disc deflection angle	+ 0° 10'

Note:
When correcting deflection angles by installing shims, remember that this will change the deflection angle of the neighboring joints.
In general a small as possible deflection angle on joints would be ideal.

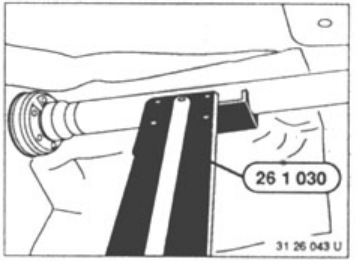


Place Special Tool 26 030 on the rear axle final driver together with a rail (steel ruler). Measure the deflection angle*.

* Refer to Specifications

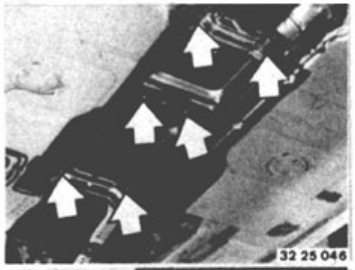


If a machined surface is accessible on the rear axle final drive, Special Tool 26 1 030 may by applied on the machined surface. Measure the deflection angle*.



Place Special Tool 26 1 030 on the rear section of the propeller shaft and measure the angle.
Determine the deflection angle* of the center mount and, if necessary, correct it by installing shims of up to max. 3 mm thickness on the transmission suspension or center mount.

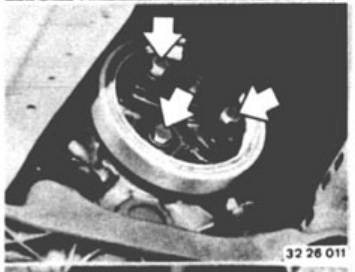
* Refer to Specifications



26 11 051 REPLACING FRONT JOINT DISC FOR PROPELLER SHAFT

Remove exhaust assembly - refer to 18 00 020.
Remove the heat shield if applicable.

Note:
The propeller shaft is adapted to pertinent requirements in reference to the transmission version, power flow and vibration behavior, so that removal and installation will differ and depend on the version.



Unscrew the joint disc at the transmission.

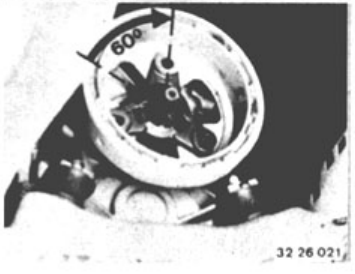
Installation:
Note the length of bolts due to the thicker joint disc for the M5.

518i ... 535i	=	56 mm
M5	=	60 mm



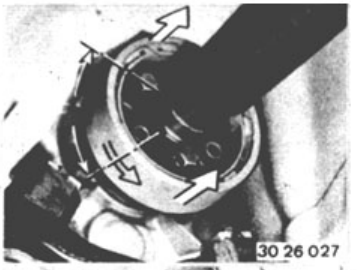
Installation:
Replace the stop nuts.
Tightening torque*.

Important!
Only tighten the nuts or bolts on the flange end whenever possible to avoid tension in the joint disc.



Note:
The vibration damper is mounted on the transmission end of the output flange.
By turning 60° the vibration damper can be pushed over the output flange.

* Refer to Specifications



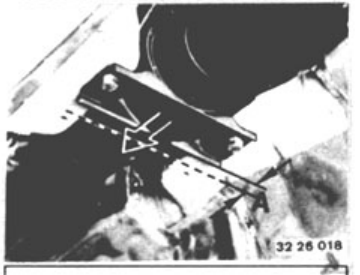
Turn the vibration damper 60° and lay it on the rubber coupling.
The vibration damper is removed together with the propeller shaft.



Version with Slide:

Loosen the threaded bush several turns, using Special Tool 26 1 040.

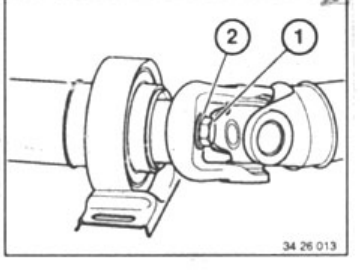
Installation:
Tighten the threaded bush after complete installation, using Special Tool 26 1 040.
Tightening torque*.



Unscrew the center mount from the body.

Installation:
Preload the center mount parallel in forward direction.
Tightening torque*.

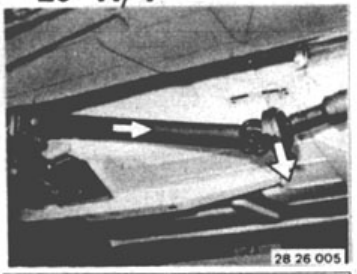
Preload the center mount by distance A = 4 to 6 mm for propeller shafts <u>with</u> a slide or by distance A = 2 to 4 mm for propeller shafts <u>without</u> a slide.



BMW 518i:
Three-piece propeller shaft.
Unscrew the second center mount at rear from the body.

Installation:
Preload the center mount parallel in forward direction by distance A = 2 to 4 mm.

* Refer to Specifications

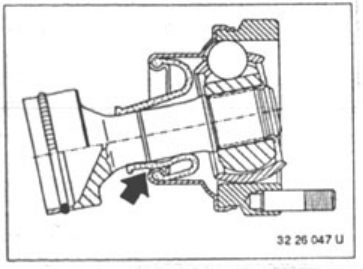


Bend the propeller shaft down and pull it out of the centering pin on the transmission.

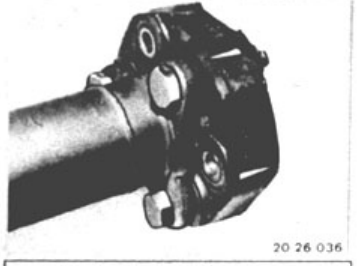
Important!
Do not disconnect the propeller shaft at the slide.

The propeller shaft was balanced in an assembled state and may only be replaced as a complete assembly.

Suspend the propeller shaft from the car on a piece of wire.

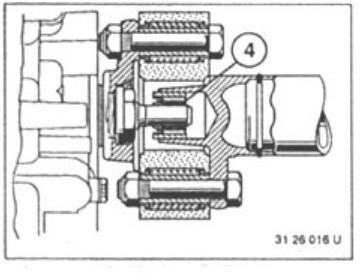


Important!
Do not let the propeller shaft fall into the joints. The rubber cover of the constant velocity joint in particular would be damaged.



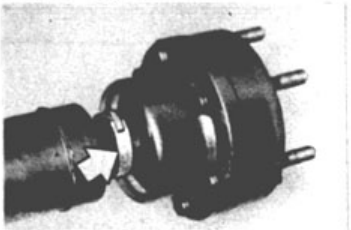
Unscrew the joint disc from the propeller shaft.

Important!
The joint disc must be installed that the arrows point to the flange arms.
Replace the self-locking nuts.
Tightening torque*.
Only tighten the nuts or bolts on the flange end to avoid tension in the joint disc.



Installation:
Check center (4).
Replace a damged center.
Lubricate the center with Molykote Longterm 2** prior to installation.

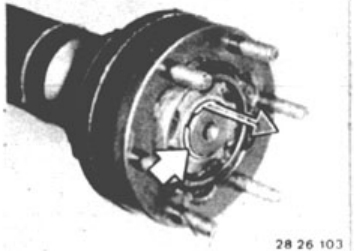
* Refer to Specifications
** Source of Supply: BMW Parts



28 26 102

26 11 160 **REPLACING CONSTANT VELOCITY JOINT FOR PROPELLER SHAFT**
- Version with Press-fit Knurled Head Bolts -

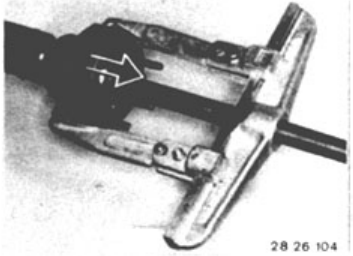
Remove complete propeller shaft - refer to 26 11 000.
Remove hose strap.



28 26 103

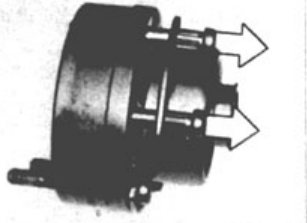
Lift circlip out.

Installation:
Replace the circlip.



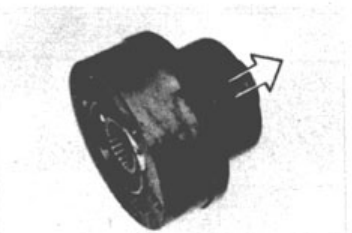
28 26 104

Pull constant velocity joint off together with the dust cover.



28 26 105

Press knurled head bolts and washers out of the constant velocity joint.



28 26 106

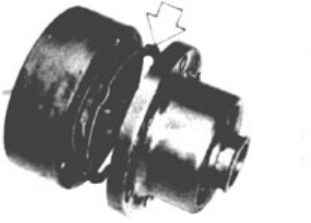
Press dust cover off.



28 26 107

Fill new constant velocity joint with 60 grams of grease*

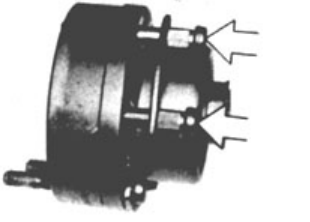
Note:
Don't cant the inner race with cage as the balls would fall out.



28 26 108

Place the gasket on the shoulder provided for this purpose.
Press dust cover on.

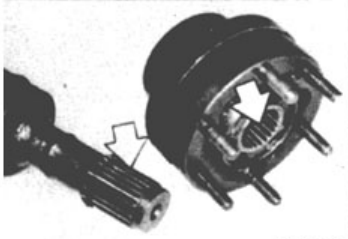
Installation:
Check for correct positioning of the bores.



28 26 109

Press knurled head bolts in together with washers.

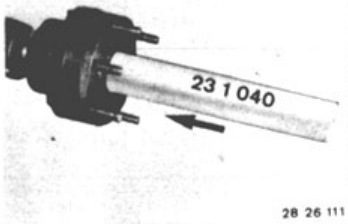
* Source of Supply: BMW Parts



28 26 110.

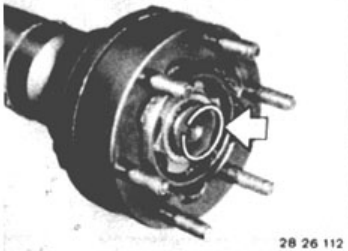
Clean the splines to remove grease and coat with a bolt cement**.

Important!
Keep the bolt cement out of the ball paths.



28 26 111

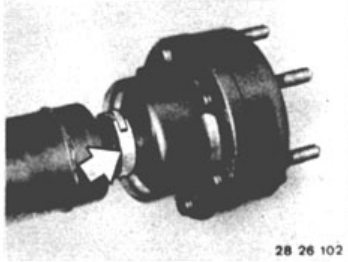
Drive the constant velocity joint onto the propeller shaft using Special Tool 23 1 040.



28 26 112

Install the circlip.

Note:
Check for correct and tight fit.

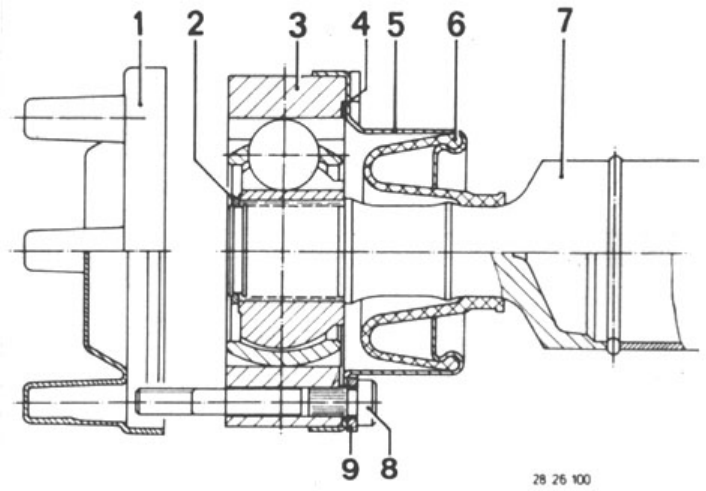


28 26 102

Install hose clamp on the dust cover.

** Source of Supply: BMW Parts

CONSTANT VELOCITY JOINT DRAWING



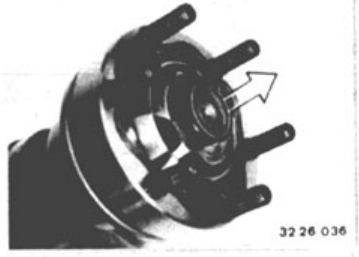
28 26 100

1 Transporting cap
2 Circlip
3 Constant velocity joint
4 Gasket
5 End cover
6 Dust cover
7 Propeller shaft
8 Bolt
9 Washer



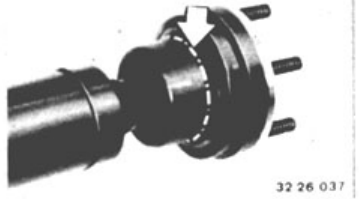
26 11 160 REPLACING CONSTANT VELOCITY JOINT FOR PROPELLER SHAFT
-Version with Screwed-in Studs-

Remove complete propeller shaft - refer to 26 11 000.
Remove hose strap.

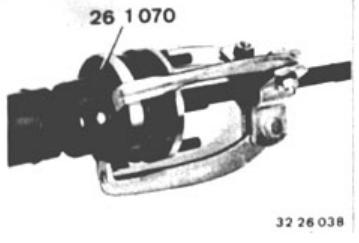


Lift circlip out.

Installation:
Replace the circlip.



Saw through the sheet metal sleeve along the line all around.

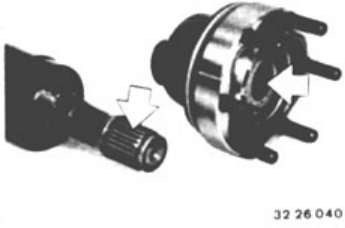


Push the sleeve back.
Apply Special Tool 26 1 070.
Pull the constant velocity joint off using a standard puller.



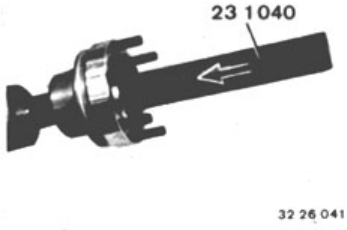
Fill new constant velocity joint with 80 grams of grease*

Note:
Don't cant the inner race with cage as the balls would fall out.



Clean the splines to remove grease and coat with a bolt cement**.

Important!
Keep the bolt cement out of the ball paths.



Drive the constant velocity joint onto the propeller shaft using Special Tool 23 1 040.

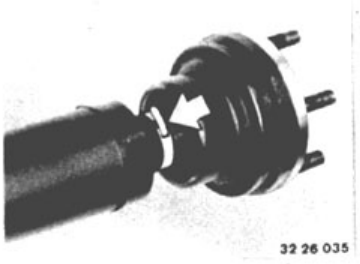


Install the circlip.

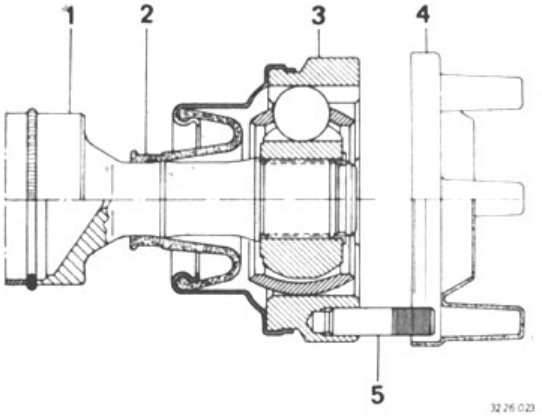
Note:
Check for correct and tight fit.

** Source of Supply: BMW Parts

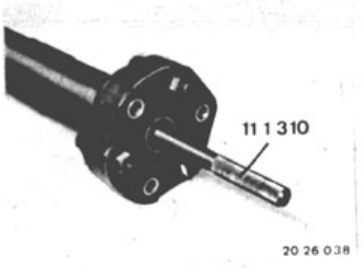
Install hose clamp on the dust cover.



CONSTANT VELOCITY JOINT DRAWING

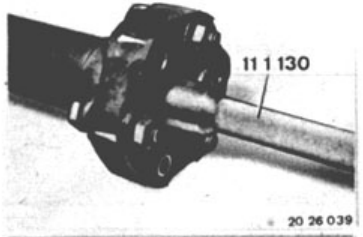


1 Propeller shaft
2 Dust cover
3 Constant velocity joint
4 Transporting cap
5 Stud

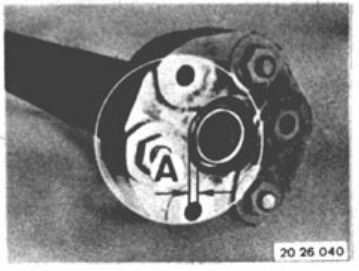


26 11 501 REPLACING CENTER FOR FRONT END OF PROPELLER SHAFT
- Propeller Shaft Removed -

Fill the center with viscous grease and drive it out using Special Tool 11 1 130. Pressure on the grease filling drives the center bearing out.

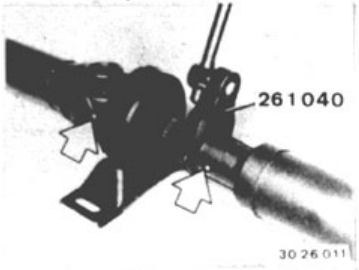


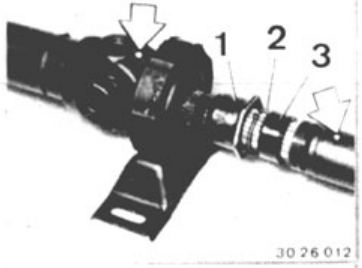
Lubricate the center with Molykote Long-term 2** and drive it in using Special Tool 11 1 130.
The sealing lip faces down.

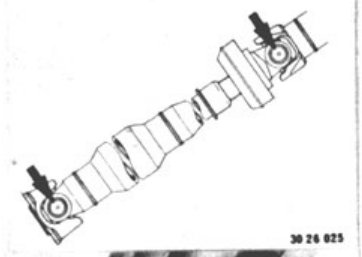


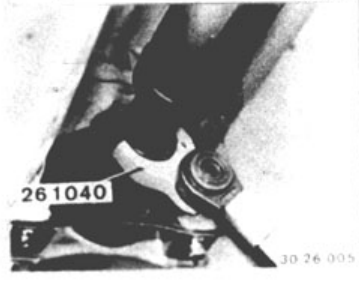
Protrusion A = 4 to 6 mm.

** Source of Supply: BMW Parts









26 12 001 **REPLACING PROPELLER SHAFT CENTER MOUNT**
- Propeller Shaft with Slide on Center Mount -

Remove propeller shaft - refer to 26 11 000.
Unscrew threaded bush using Special Tool 26 1 040.
Pull off front section of the propeller shaft.

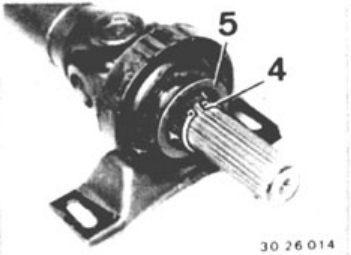
Important!
The propeller shaft was balanced in an assembled state and may not be turned in the slide.
Note the paint marks.
Mark an unmarked propeller shaft.

Installation:
Lubricate the slide with Molykote Longterm 2**.
Install threaded bush (1), washer (2) and rubber ring (3).
Assemble the propeller shaft that the paint marks are aligned.

Note:
The propeller shaft sections are mounted in such a manner that the universal joints are in one plane.
If the slide had been erroneously disassembled without marking, wrong installation of only 180° is possible due to the balancing.

Installation:
Tighten the threaded bush after completed installation using Special Tool 26 1 040.
Tightening torque*.

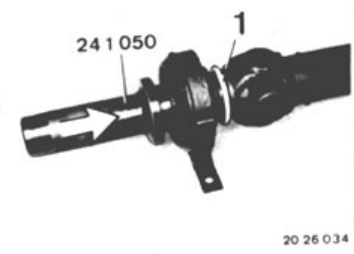
* Refer to Specifications
** Source of Supply: BMW Parts



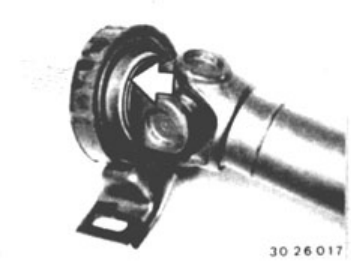
Lift circlip (4) out and remove dust guard (5).



Pull the center mount off together with the grooved ball bearing.
Use a standard puller.

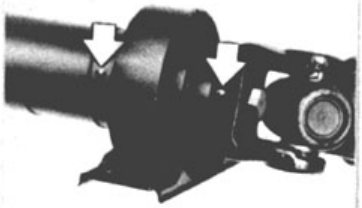


Install dust guard (1).
Drive the center mount on to fit tight using Special Tool 24 1 050.



Installation:
Check the installed position of the dust guard — it must be flush with the center mount.

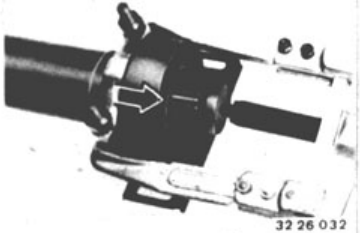
Important!
Check movement of the center mount.



32 26 030



32 26 031



32 26 032



32 26 033

26 12 001 REPLACING PROPELLER SHAFT CENTER MOUNT
- Propeller Shaft without Slide on Center Mount -

Remove propeller shaft - refer to 26 11 000.

Important!
The propeller shaft was balanced in an assembled state and the propeller shaft sections may not be turned when assembled.
Note the paint marks.
Mark an unmarked propeller shaft.

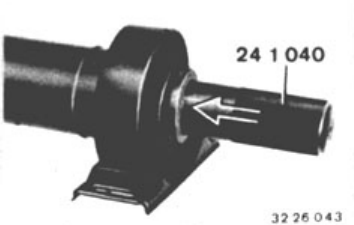
Unscrew the bolt.
Pull off front section of the propeller shaft.

Installation:
Assemble the propeller shaft that the paint marks are aligned.
Install the bolt with a bolt cement**.
Tightening torque*.

Pull the center mount off together with the grooved ball bearing.
Use a standard puller.

Installation:
Check the installed position of the dust guard.

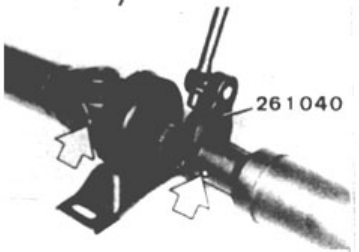
* Refer to Specifications
** Source of Supply: BMW Parts



32 26 043

Drive the center mount on to fit tight using Special Tool 24 1 040.

Important!
Check movement of the center mount.

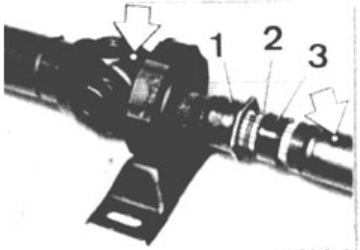


30 26 011

26 12 001 REPLACING BOTH PROPELLER SHAFT CENTER MOUNTS - Three Piece Propeller Shaft -

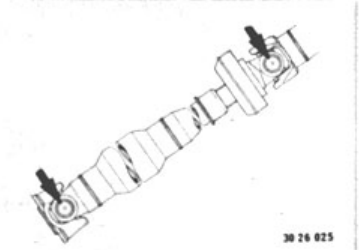
Remove propeller shaft - refer to 26 11 000.
Unscrew threaded bush using Special Tool 26 1 040.
Pull off front section of the propeller shaft.

Important!
The propeller shaft was balanced in an assembled state and may not be turned in the slide.
Note the paint marks.
Mark unmarked propeller shaft sections.

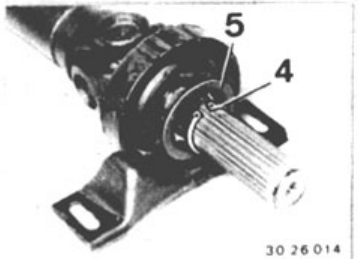


30 26 012

Installation:
Lubricate the slide with Molykote Longterm 2**.
Install threaded bush (1), washer (2) and rubber ring (3).
Assemble the propeller shaft that the paint marks are aligned.

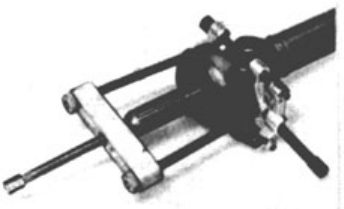

30 26 025

Note:
The propeller shaft sections are mounted in such a manner that the universal joints are in one plane.
If the slide had been erroneously disassembled without marking, wrong installation of only 90° is possible due to the balancing.

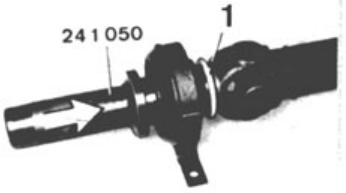


30 26 014

Lift circlip (4) out and remove dust guard (5).

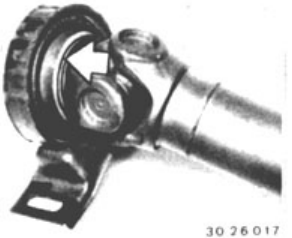

20 26 032

Pull the center mount off together with the grooved ball bearing.
Use a standard puller.



20 26 034

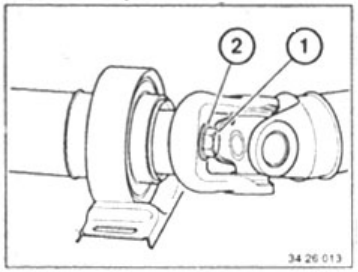
Install dust guard (1).
Drive the center mount on to fit tight using Special Tool 24 1 050.


30 26 017

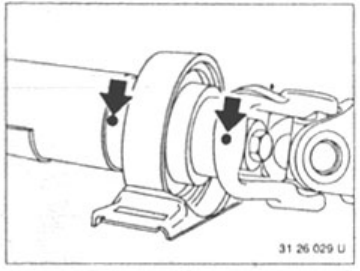
Installation:
Check the installed position of the dust guard — it must be flush with the center mount.

Important!
Check movement of the center mount.

* Refer to Specifications
** Source of Supply: BMW Parts



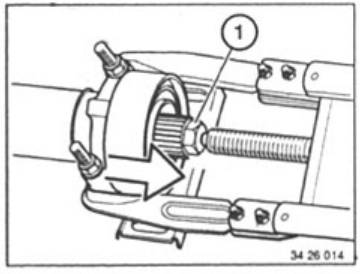
Unscrew bolt (1).
Press the universal joint off while unscrewing the bolt.
Remove washer (2).



Important!
The propeller shaft was balanced in an assembled state and may not be turned in the slide.
Note the paint marks.
Mark unmarked propeller shaft sections.

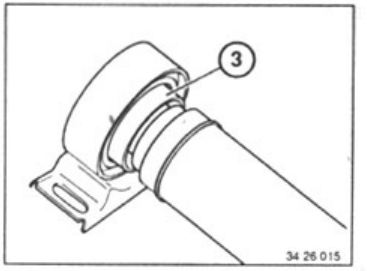
Pull off rear sections of the propeller shaft.

Installation:
Assemble the propeller shaft that the paint marks are aligned.
Install the bolt with a bolt cement**.
Tightening torque*.

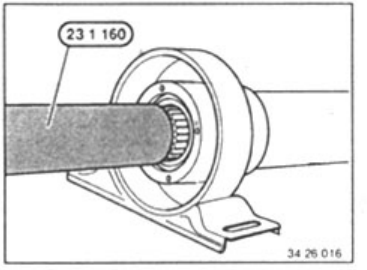


Remove the dust guard.
Screw the universal joint mounting bolt (1) in again without the washer.
Pull the second center mount off together with the grooved ball bearing.
Use a standard puller.

* Refer to Specifications
** Source of Supply: BMW Parts

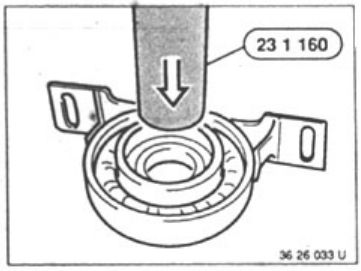


Install the center mount with a long collar (3) for the propeller shaft sections.



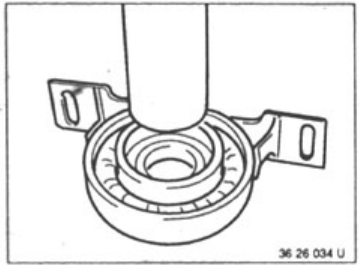
Drive the center mount on to fit tight using Special Tool 23 1 160.

Important!
Check movement of the center mount.



26 12 011 REPLACING GROOVED BALL BEARING IN PROPELLER SHAFT CENTER MOUNT

Remove center mount - refer to 26 12 001 / 002.
Press the grooved ball bearing out using Special Tool 23 1 160.



Always coat the center mount in the area of the ball bearing with Circolight**.
Press the ball bearing in as far as the stop using a suitable sleeve.

26 12 500 PRELOADING AND CHECKING PROPELLER SHAFT CENTER MOUNT

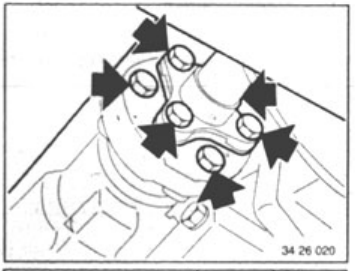
Refer to "Removing Propeller Shaft" in 26 11 000 for the procedures.

** Source of Supply: BMW Parts

26 20 000 Removing and installing input shaft

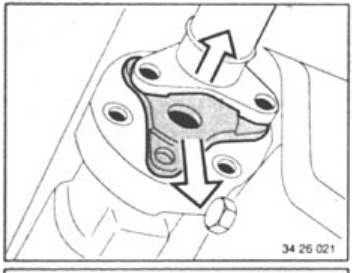
- 4-wheel drive -

Caution!
Do not use engine to move vehicle once input shaft has been removed.

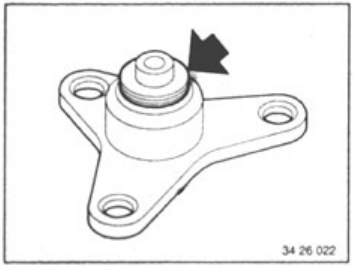


Remove all six screws.

Installation instruction:
Replace stop nuts.
To prevent torsion stress on the flexible coupling, only turn the nuts or bolts on the flange side - if possible.
Tightening torque 26 11 1AZ*

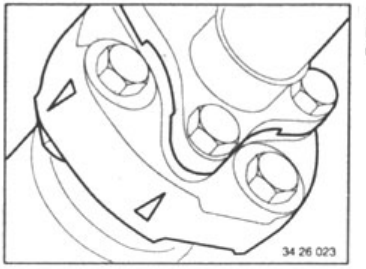


Slide back input shaft.
Remove joint disk with centering flange.

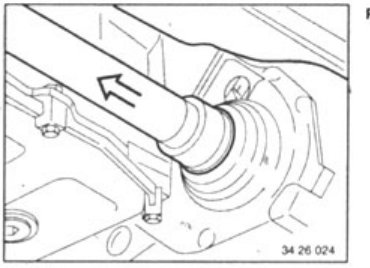


Installation instruction:
Check seal, replace if necessary.
Coat centering spigot with Molykote Longterm 2** grease.

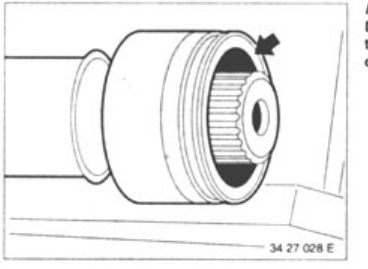
* Refer to Specifications
** Source of Supply: BMW Parts Service



Installation instruction:
Flexible coupling must be installed that arrows point to flange arms.



Remove input shaft from transfer box.

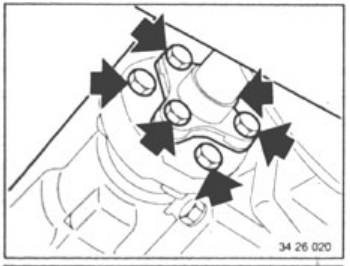


Installation instruction:
During installation, ensure that sealing ring on the input shaft is located accurately in the dust cover.

26 20 051 Removing and installing flexible coupling for input shaft.

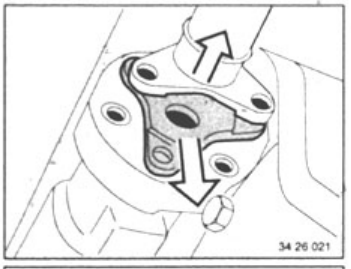
- 4-wheel drive -

Caution!
Do not use engine to move vehicle once the joint disk has been removed.

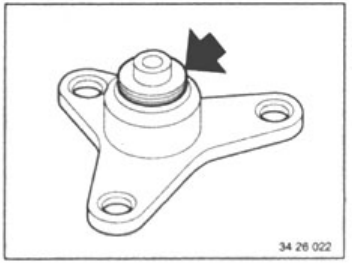


Remove all six screws.

Installation instruction:
Replace stop nuts.
To prevent torsion stress on the joint disk, only tighten the nuts or screws on the flange side - if possible.
Tightening torque 26 11 1AZ*

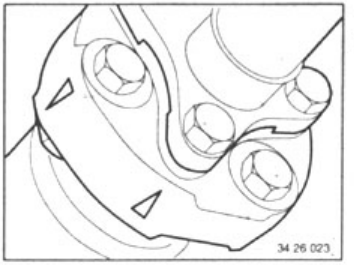


Slide back input shaft.
Remove joint disk with centering flange.

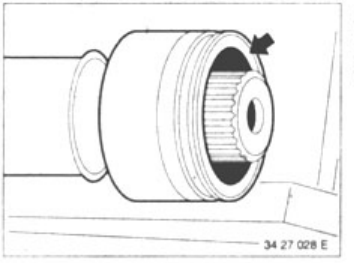


Installation instruction:
Check seal, replace if necessary.
Coat centering spigot with Molykote Longterm 2** grease.

* Refer to Specifications
** Source of Supply: BMW Parts Service



Installation instruction:
Joint disk must be installed that arrows point to flange arms.



Installation instruction:
Coat sealing ring with grease.
During installation, ensure that the sealing ring on the front input shaft does not slide into the dust cover.

TROUBLESHOOTING PROPELLER SHAFT

Condition	Cause	Correction
Drumming noise in stationary car	a) Propeller shaft without influence	a) Check engine tuning; take tension out of exhaust assembly.
Shaking while moving off forward/reverse (center mount knocking)	a) Propeller shaft not aligned precisely b) Runout on centering pin, transmission or final drive flanges c) Center mount rubber torn. Propeller shaft axial compensator of propeller shaft with slide seized. d) Universal joints worn excessively or seized e) Engine/transmission suspension not okay f) Joint disc rubber torn	a) Align propeller shaft. b) Check centering pin and flanges for runout with a dial gage – see Specifications. Align or replace final drive/transmission flange. c) Replace center mount – see 26 12 001. Align propeller shaft. Check movement of axial compensator, lubricating slide with Molykote Longterm 2 if necessary and tightening the screwed on sleeve with correct torque*. d) Check whether there is play or difficult movement, replacing propeller shaft if necessary – see 26 11 000. e) Check mounts, aligning or replacing if necessary. f) Replace joint disc – see 26 11 051.
Shaking at 40 to 50 km/h (25 to 30 mph)	a) Propeller shaft not aligned precisely b) Runout on centering pin, transmission or final drive flanges c) Center mount rubber torn. Propeller shaft axial compensator of propeller shaft with slide seized. d) Universal joints worn excessively or seized e) Joint disc rubber torn	a) Align propeller shaft. b) Check centering pin and flanges for runout with a dial gage – see Specifications. Align or replace final drive/transmission flange. c) Replace center mount – see 26 12 001. Align propeller shaft. Check movement of axial compensator, lubricating slide with Molykote Longterm 2 if necessary and tightening screwed-on sleeve with correct torque*. d) Check whether there is play or difficult movement, replacing propeller shaft if necessary – see 26 11 000. e) Replace joint disc – see 26 11 051.

* See Specifications

TROUBLESHOOTING PROPELLER SHAFT

Condition	Cause	Correction
Drumming noise from 60 km/h (37 mph) on	a) Propeller shaft not aligned precisely or installed with tension / axial compensator of propeller shaft with slide seized	a) Align propeller shaft. Check movement of axial compensator, lubricating the slide with Molykote Longterm 2 if necessary and tightening screwed-on sleeve with correct torque*.
	b) Centering pin damaged.	b) Replace centering pin – see 26 11 501.*
	c) Runout on centering pin, transmission or final drive flanges	c) Check centering pin and flanges for runout with a dial gage – see Specifications. Align or replace final drive/transmission flange.
	d) Erroneous centering due to excessively worn flange bores (loose mounting bolts).	d) Replace transmission or final drive flange.
	e) Excessive propeller shaft imbalance, balance plate missing	e) Balance or replace propeller shaft.
	f) Universal joints worn excessively or seized	f) Check whether there is play or difficult movement, replacing propeller shaft if necessary.
Loud center mount noise while driving	a) Center mount not perpendicular to propeller shaft; not or insufficiently preloaded	a) Preload center mount in forward direction and perpendicular to propeller shaft. 4 to 6 mm (0.157 to 0.236") preload for propeller shaft <u>with</u> slide on center mount; <u>without</u> slide: 2 to 4 mm (0.079 to 0.157").
	b) Center mount grooved ball bearing not okay	b) Replace grooved ball bearing – see 26 12 001.

* See Specifications

27 Transfer box

27 10 001	EM interlock – function check	27- 10/1
010	Transfer box – remove and install – manual transmission	27- 10/2
010	Transfer box – remove and install – automatic transmission	27- 10/5
27 21 020	Radial seal for output flange – replace	27- 21/1
030	Radial seal for output shaft on front axle – replace	27- 21/2
510	Radial seal for input shaft – replace – manual transmission	27- 21/4
510	Radial seals for input shaft – replace – automatic transmission	27- 21/5
27 70 000	Rubber mount for transmission mounting – replace	27- 70/1

27-10/1

27 10 001 Check funtion of EM interlock

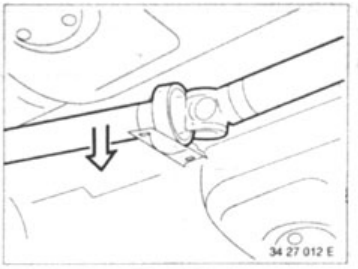
The following test can be performed to obtain a "yes / no" status message on the function of the EM interlock in the transfer box:

1. Place car on vehicle lift. All wheels clear of ground.
2. Apply handbrake.
3. Start engine and select 1st gear or Drive setting.
4. Depress accelerator - front wheels should turn.
5. Depress accelerator further until the rear wheels start to rotate, despite the applied handbrake.
   Caution!
   Only perform test for a brief period. (Wear on brake linings).
6. If the EM interlock is not functioning, the rear wheels do not rotate, even when engine speed is increased.

27 10 010 Removing and installing transfer box

- Manual transmission -

Removing and installing exhaust system
18 00 020



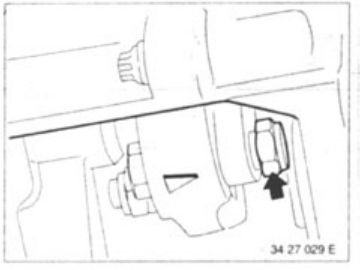
Fold propeller shaft downwards and withdraw from transmission.

Caution!
Don't let the propeller shaft fall into the joints. Suspend propeller shaft from car on a piece of wire.
Tightening torque*.



o Removing propshaft:

Remove heat baffle plate (1).

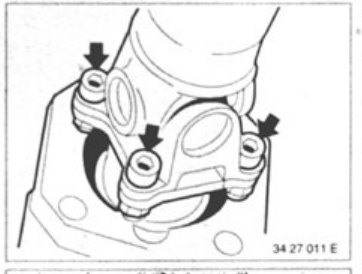


o Removing transfer box.

Unscrew flexible coupling between manual transmission and transfer box from output flange on manual transmission.

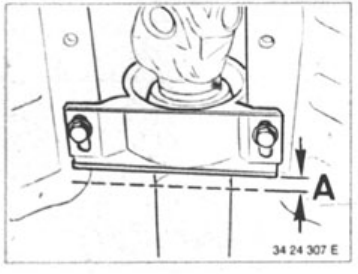
Installation instruction:
Replace stop nuts.
Tightening torque*

Note:
To avoid torsion stress on the flexible coupling, only - if the design makes this possible - tighten nuts or screws on the flange side.



Unscrew propeller shaft on transmission.

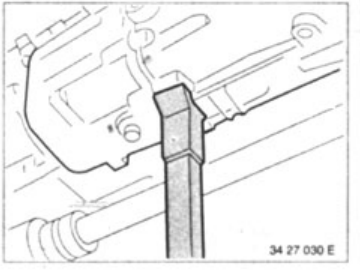
Installation instruction:
Replace stop nuts.
Tighten screws with specified torque*.



Unscrew center mount.

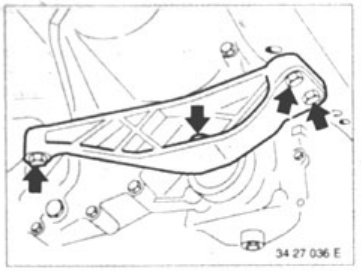
Installation instruction:
Center mount in forward direction A = 4 ... 6 mm.
Preload in forward direction.

* Refer to Specifications



Support transmission from underside.

* Refer to Specifications

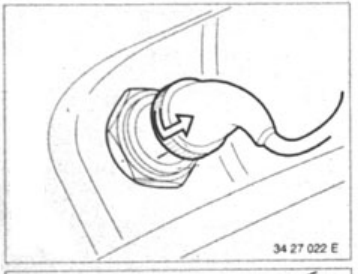


Unscrew cross-member from body and transfer box and remove.
Lower transmission.

Installation instruction:
Tightening torque*.

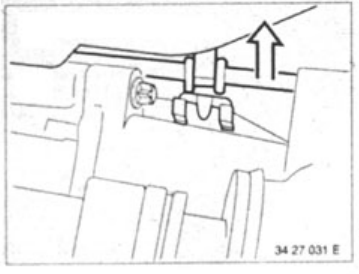


Installation instruction:
When lowering the transmission, the coolant air guide for the alternator can slip out.
Check once the transmission has been installed.



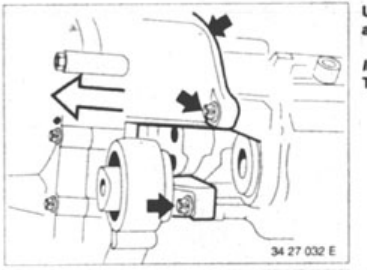
Turn bayonet connection for transfer box control counter-clockwise and remove.

Installation instruction:
Fit plug in such a way that marking grooves are aligned with one another.



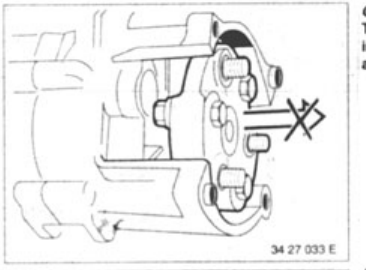
Remove bracket for cable on transmission control unit.

* Refer to Specifications

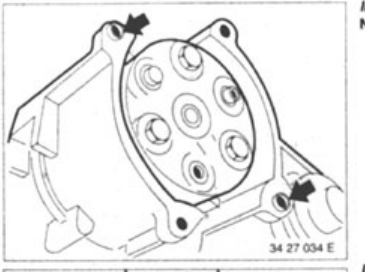


Unbolt transfer box
and remove by drawing backwards.

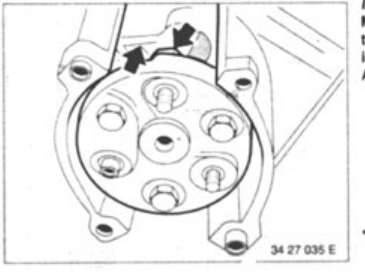
Installation instruction:
Tightening torque*



Caution!
The input shaft must not slip down when lifting out the transfer box since this would damage the shaft seal.

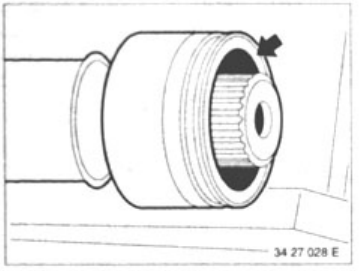


Installation instruction:
Note dowel sleeves.

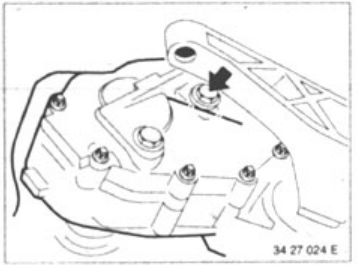


Installation instruction:
Move rubber coupling into a position where the top screw is unable to slip into the housing bead.
Align manual transmission flange accordingly.

* Refer to Specifications



Installation instruction:
During installation, ensure that the sealing ring on the front propeller shaft does not slip into the dust cap.



o Checking oil level in the transfer box.

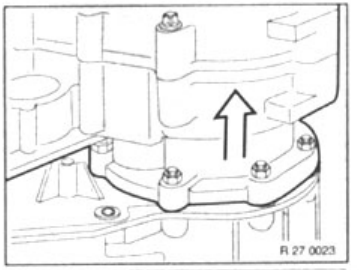
Check the oil level on the filler screw.
If necessary, top up with oil to the lower edge of the filler aperture.

Installation instruction:
Tightening torque*

* Refer to Specifications
** For oil grade refer to Consumables Specifications

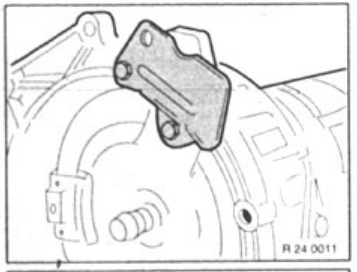
27 10 010 Removing and installing transfer box
- Automatic transmission -

Remove automatic transmission complete with transfer box 24 00 028



Position transmission vertically.
- Transfer box at top -

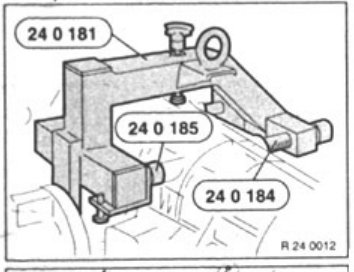
Unscrew transfer box and lift off.



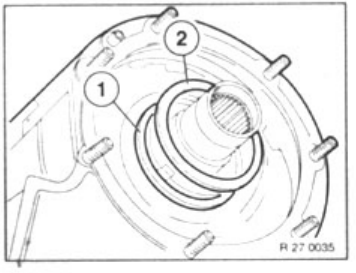
Secure torque converter to prevent dropping out.



Caution!
Do not swivel automatic transmission after removing transfer box.
The clutch disks can slip out making it necessary to disassemble the entire transmission.
If necessary fit holder, refer to 24 12 016

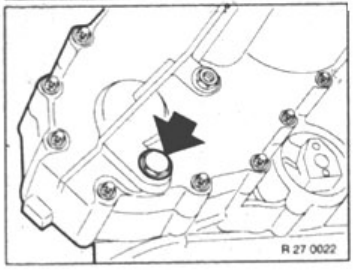


Secure transmission with special tool 24 0 181 in conjunction with adapters 24 0 183 and 24 0 184 and mount on assembly rig 00 1 490.



The spacer ring must be determined anew if the automatic transmission of transfer box is to be replaced or other jobs are to be carried out which influence the thickness of the spacer ring.

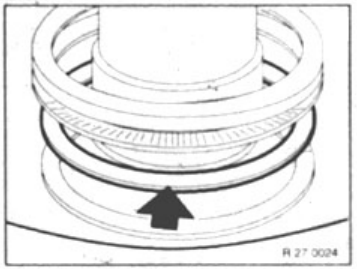
1) Spacer ring
2) Needle thrust bearing



Drain oil from transfer box.

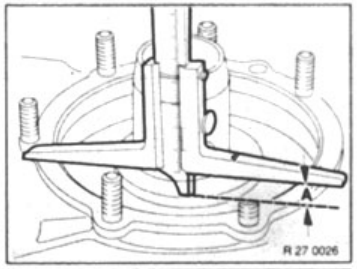
Installation note:
For tightening torque 27 00 7AZ*.

* Refer to Technical Data



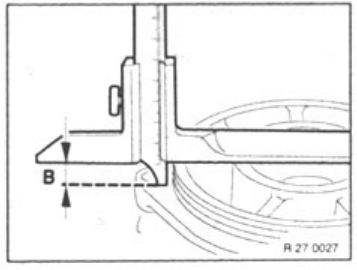
o Determining thickness of shim:

Place existing shim with pressure bearing in automatic transmission.



Determine dimension (A) on automatic transmission between contact face and pressure bearing.

Example: Dimension A = 12.3



Place transfer box upright.

Determine dimension (B) on transfer box between contact face to support face for pressure bearing.

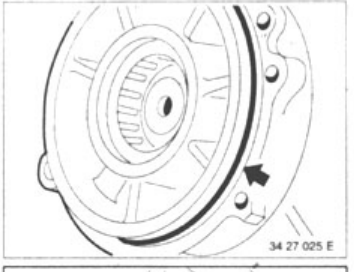
Example: Dimension B = 12.0

Example:

	A =	12.3 mm
minus	B =	12.0 mm
End float	=	0.3 mm

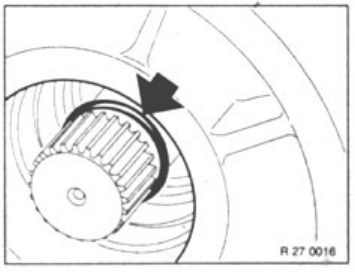
Required end float = 0.1 ... 0.6 mm.
Install correspondingly thicker or thinner shim.

Note:
Selection: dimension A smaller than dimension B = thinner disk,
Dimension A larger than dimension B = thicker disk



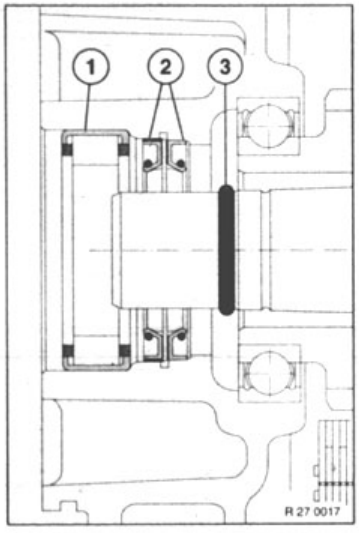
o Fitting transfer box:

Replace O-ring on transfer box and coat with Vaseline.



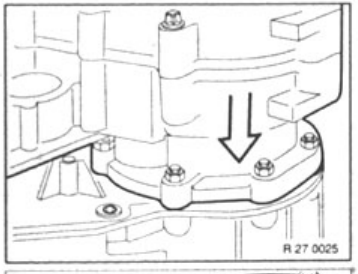
Caution!
An O-ring is located on the transmission shaft.

Check / replace O-ring and coat with Vaseline.



Arrangement:

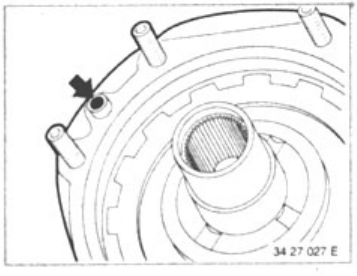
1 Bearing
2 Radial seal
3 O-ring



Attach shim and axial bearing with Vaseline.

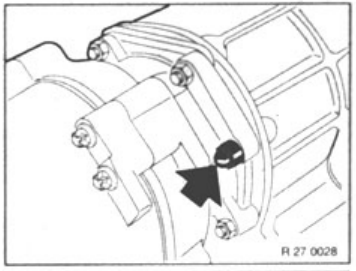
Carefully fit transfer box and tighten down.

Tightening torque 27 00 2AZ*

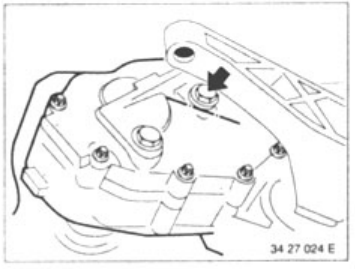


Caution!
Note dowel sleeve.

* Refer to Specifications



Place plastic cap on the nut shown in the illustration.
(Protection for Bowden cable).



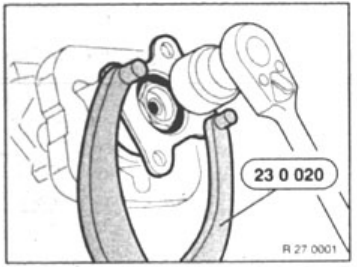
After installation in the vehicle, top up oil** in the transfer box.

Correct oil level in automatic transmission.

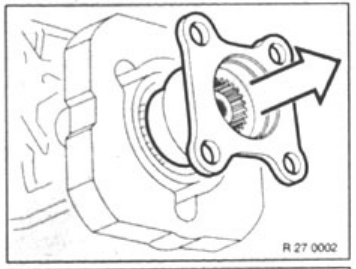
** Oil grade: refer to Consumables Specifications

27 21 020 Replacing radial seal on output flange

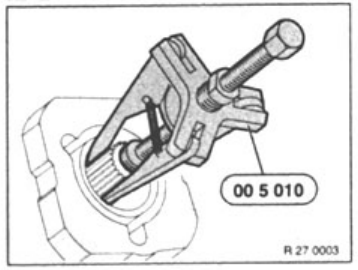
Remove propeller shaft from transfer box, see 26 11 000



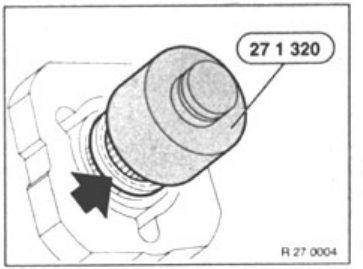
Attach special tool 23 1 200.
Hold output flange with special tool 23 0 020.
Unfasten collar nut with special tool 23 1 210.



Pull off output flange.

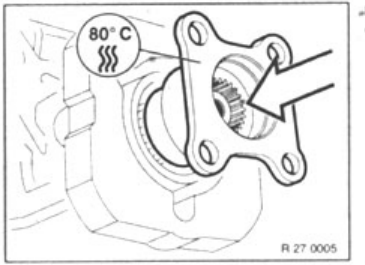


Remove radial seal with special tool 00 5 010.

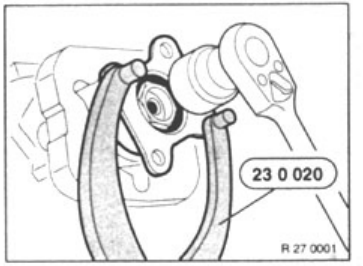


Coat new radial seal with oil and insert with special tool 27 1 320.

Note:
Sealing lip faces housing.

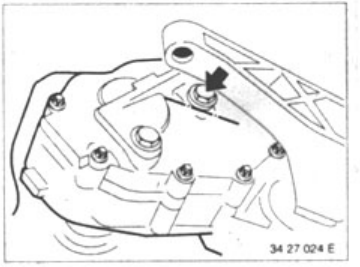


Heat output flange to 80 °C and slide spline onto output shaft.



Fit screw-locking device** to thread and collar of collar nut.

Screw on collar nut.
Tightening torque 27 00 6AZ*



o Check oil level in transfer box:

Check oil level on filler screw.
If necessary, fill with oil*** to lower edge of filler aperture.

Installation instruction:
Tightening torque 27 00 7AZ*

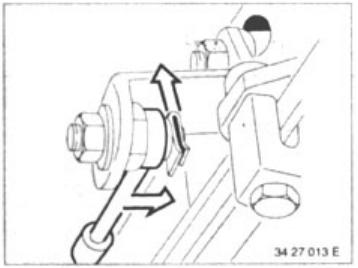
* Refer to Specifications
** Source of Supply: BMW Parts Service
*** Oil grade: refer to Consumables Specifications

27 21 030 Replacing radial seal for output shaft on front axle

Removing and installing exhaust system, see 18 00 020.

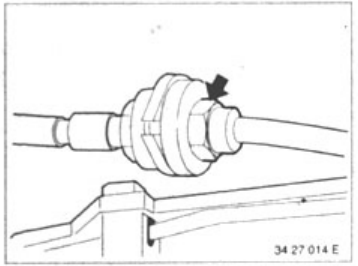
Remove propeller shaft from back of transfer box, see 26 11 000.

Removing and installing propeller shaft from front, see 26 20 000.

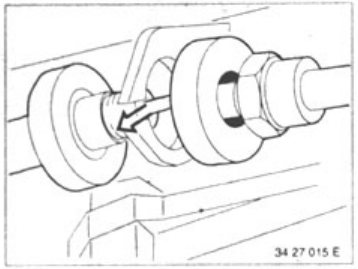


o Work on the automatic transmission:

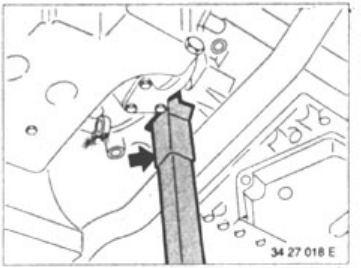
Lift out clips.
Remove Bowden cable.



Unscrew nut for Bowden cable sleeve.

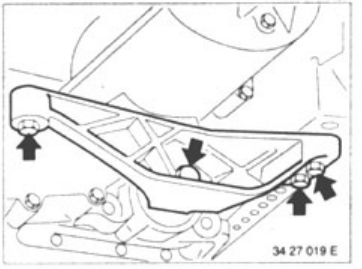


Detach Bowden cable sleeve from bracket.



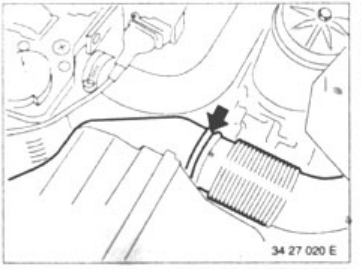
o Lowering transfer box:

Support transmission on the converter bell housing.

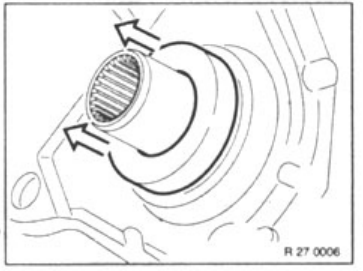


Unscrew cross-member from body and transfer box and remove.
Lower transmission.

Installation instruction:
Tightening torque 27 00 8AZ*

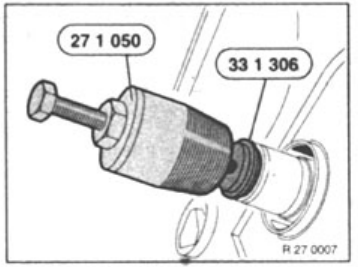


Installation instruction:
When lowering the transmission, the coolant air guide for the alternator can slip out.
Check once the transmission has been installed.

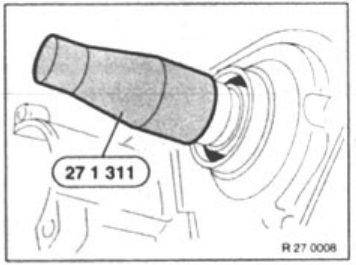


Press off protective cap.

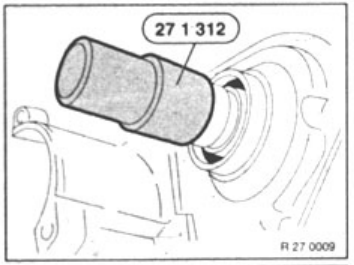
* Refer to Specifications



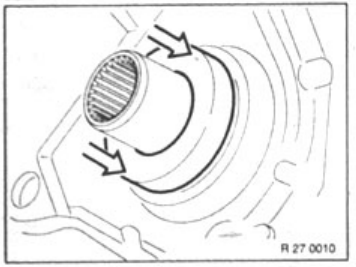
Lift out radial seal with special tool 27 1 050 in conjunction with 33 1 306.



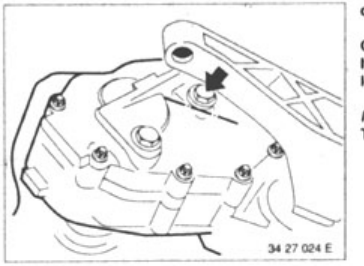
Fit special tool 27 1 311.



Coat radial seal with grease and drive in with special tool 27 1 312.



Press on protective cap.



o Check oil level in transfer box:

Check oil level on the filler screw.
If necessary, fill with oil*** to lower edge of filler aperture.

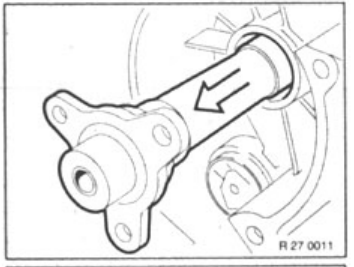
Installation instruction:
Tightening torque 27 00 7AZ*

* Refer to Specifications
*** Oil grade: refer to Consumables Specifications

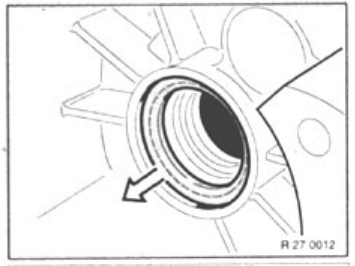
27 21 510 Replacing radial seal for input shaft

- Manual transmission -

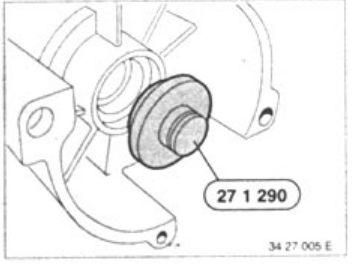
Remove transfer box 27 10 010



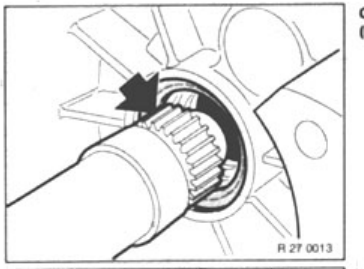
Remove input shaft.



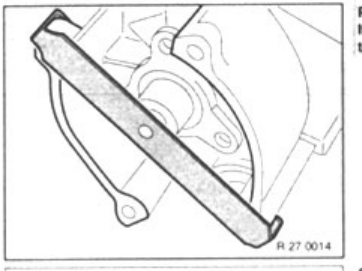
Lift out radial seal.



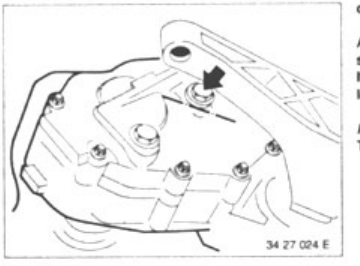
Coat new radial seal with grease and drive into place with sealing lip facing inwards, using special tool 27 1 290.



Carefully insert input shaft.
(Damage to radial seal).



Prevent input shaft from falling out.
If necessary, use bracket from replacement transmission.



o Checking oil level in transfer box:

After installation, check oil level on filler screw.
If necessary, fill with oil*** to lower edge of filler aperture.

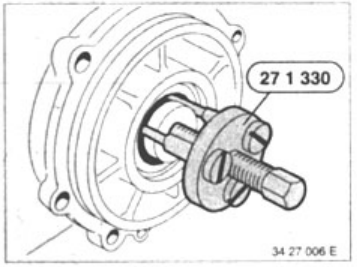
Installation instruction:
Tightening torque 27 00 7AZ*

* Refer to Specifications
*** Oil grade: refer to Consumables Specifications

27 21 510 Replacing radial seals for input shaft
- Automatic transmission -

Remove transfer box 27 10 010

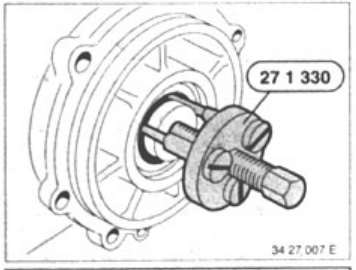
Note:
The radial seals are located behind the roller bearing.



o Removing roller bearing:

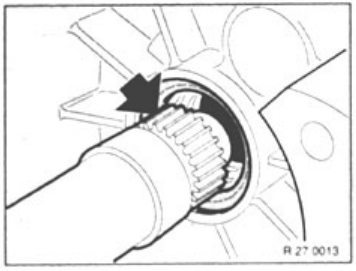
Turn back spindle from special tool 27 1 330 as far as possible.

Rotate slots in circular direction.
Insert special tool.



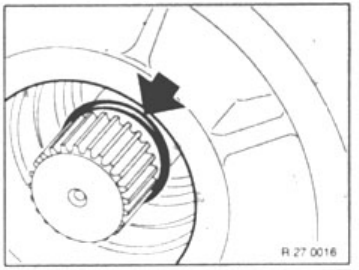
Turn slots until aligned with marking.
(Jaws now grip behind the bearing).

Remove roller bearing.



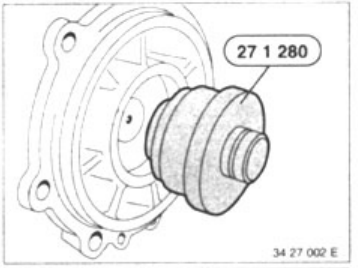
o Replacing radial seals:

Lift out radial seals (2 off) with special tool 00 5 010.



Note:
An O-ring is located on the transmission shaft

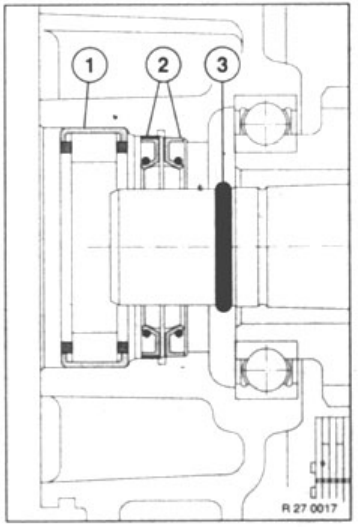
Check O-ring, replacing if necessary, and coat with Vaseline.



Coat smaller radial seal with oil and install with sealing lip facing inwards.

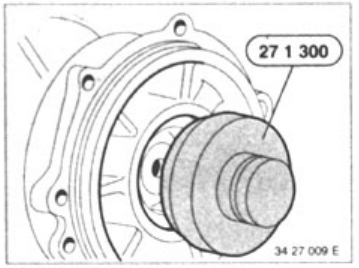
Coat larger radial seal with oil and install with sealing lip facing outwards.

Drive in both radial seals with special tool 27 1 280.

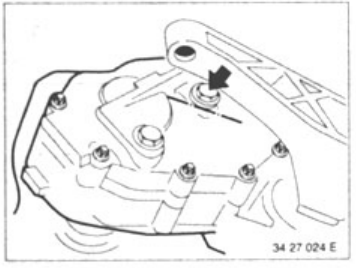


Arrangement:

1 Bearing
2 Radial seals
3 O-ring



Drive in new roller bearing with special tool 27 1 300.



o Checking oil level in transfer box:

After installation, check oil level on the filler screw.
If necessary, fill with oil*** to lower edge of the filler aperture.

Installation instruction:
Tightening torque 27 00 7AZ*

* Refer to Specifications
*** Oil grade: refer to Consumables Specifications

27 70 000 Replacing rubber mount for transmission mount

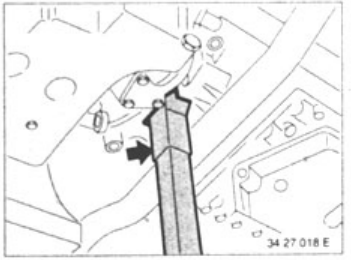
Manual transmission:
Removing and installing exhaust system, see 18 00 020

Automatic transmission :

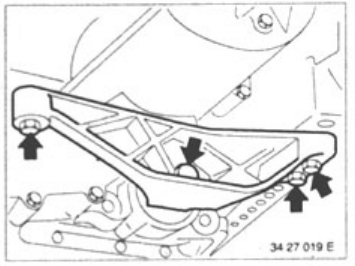
Remove transfer box 27 10 010



Remove heat baffle plate.



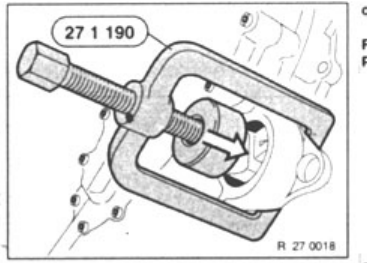
Support transmission on the converter bell housing.



Unscrew cross-member from body and transfer box and remove.
Lower transmission.

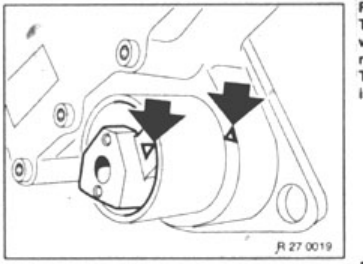
Installation instruction:
Tightening torque 27 00 8AŽ*

* Refer to Specifications

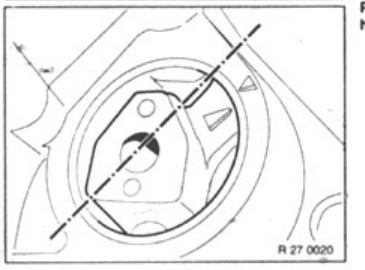


o Replacing rubber mount.

Fit special tool 27 1 190.
Press rubber mount out forwards.



Fit new rubber mount.
The arrow on the housing must be aligned with the marking (arrow) on the rubber mount.
The protruding side of the internal bush points in reverse direction of travel (i.e. backwards).



Press rubber mount flush with transmission housing with special tool 27 1 190.

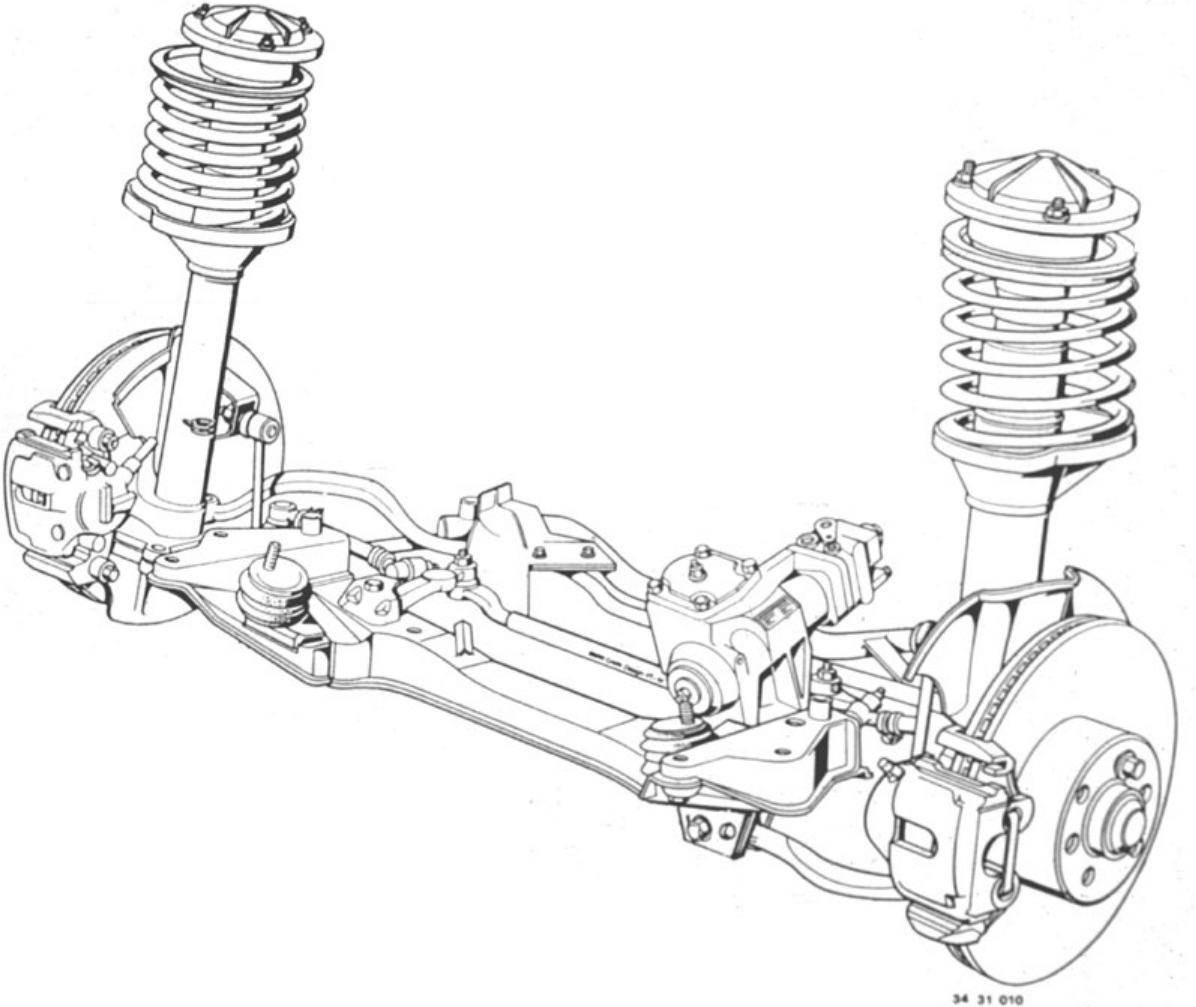
31 Front axle

	Front wheel suspension – layout drawing	31- 0/1
	Struts and arms – layout drawing	31- 0/2
31 10 000	Front axle assembly – remove and install	31- 10/1
31 11 001	Front axle carrier – replace	31- 11/1
31 12 000	Control arm, left or right – remove and install	31- 12/1
090	Thrust strut, left or right – remove and install or replace	31- 12/2
130	Rubber mount in left or right control arm – replace	31- 12/3
. . .	Thrust strut mounts – check	31- 12/4
147	Rubber mount in left or right thrust strut – replace	31- 12/5
31 21 180	Bearings (wheel hub) for front wheel – replace	31- 21/1
31 31 000	Front spring strut, left or right – remove and install	31- 31/1
031	Front spring strut, left or right – replace	31- 31/2
	Shock absorber with mount and coil spring – layout drawing	31- 32/1
31 32 001	Shock absorber for left or right front spring strut – replace	31- 32/3
31 33 001	Mount for left or right front spring strut – replace	31- 33/1
100	Coil spring for left or right front spring strut – remove and install or replace	31- 33/1
. . .	Car ride level height – measure and correct (before 1992 models)	31- 33/2
. . .	Car ride level height – measure and correct (since 1992 models)	31- 33/5
31 35 000	Front stabilizer – remove and install or replace	31- 35/1
	Front axle – troubleshoot	31- 90/1
	Shock absorbers – troubleshoot	31- 90/3

Four wheel drive

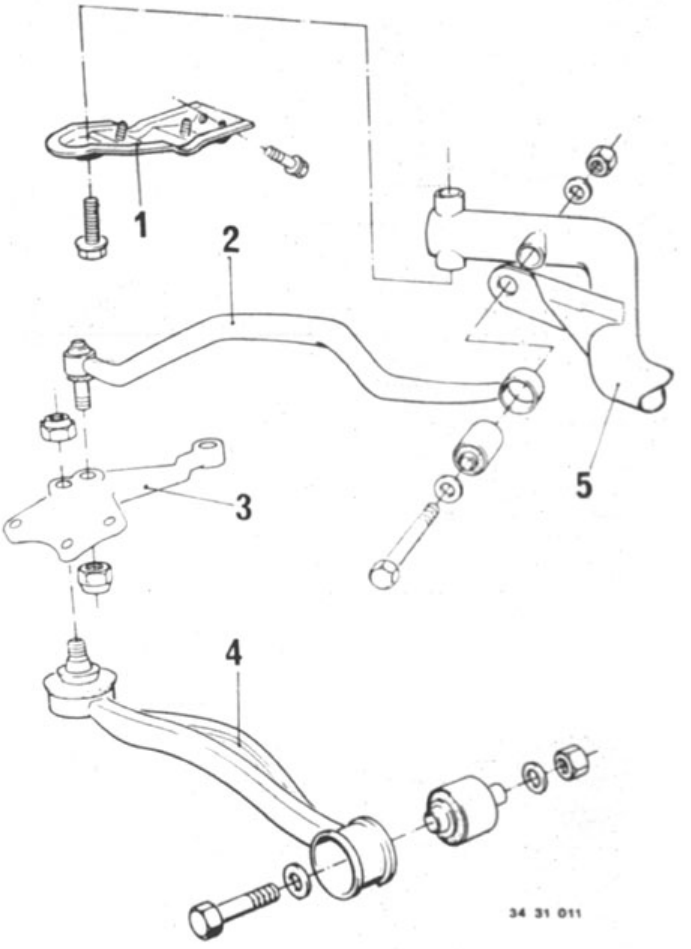
	Front wheel suspension layout drawing	31- 0/10
31 10 000	Front axle assembly – remove and install	31- 10/10
31 11 001	Front axle carrier – replace	31- 11/10
31 12 000	Control arm, left or right – remove and install	31- 12/10
046	Control arm bracket – replace	31- 12/11
130	Control arm rubber mount – replace	31- 12/13
31 21 090	Pivot bearing, left or right – replace	31- 21/10
121	Wheel hub (drive flange), left or right – replace	31- 21/11
151	Bearings of wheel hub (drive flange), left or right – replace	31- 21/12
	Spring strut assembly layout drawing	31- 31/10
31 31 031	Front spring strut shock absorber, left or right – replace	31- 31/11
31 33 001	Front spring strut mount, left or right – replace	31- 33/10
100	Front spring strut coil spring, left or right – replace	31- 33/10
. . .	Car ride level height – measure and correct	31- 33/11
31 35 000	Front stabilizer – remove and install	31- 35/10
31 50 000	Front axle differential – remove and install or replace	31- 50/10
31 51 015	Shaft seal for left output shaft – replace	31- 51/10
020	Shaft seal for right output shaft – replace	31- 51/10
060	O-ring for right front axle differential – replace	31- 51/11
065	O-ring for right mounting block – replace	31- 51/11
31 53 050	Bearing (in bearing block) for right output shaft – replace	31- 53/10
31 60 000	Output shaft, left or right – remove and install or replace	31- 60/10
	Front axle – troubleshoot	31- 90/10
	Shock absorber – troubleshoot	31- 90/12

FRONT AXLE LAYOUT DRAWING



LAYOUT DRAWING OF STRUTS AND ARMS

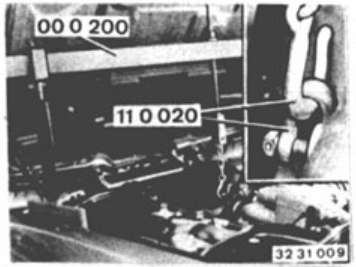
1 Support
2 Thrust strut
3 Tie rod arm
4 Control arm
5 Connecting pipe



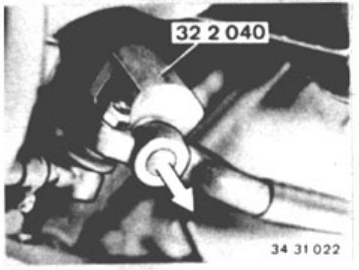
31 10 000 Removing and installing complete front axle assembly

Remove brake calliper (lines remain connected), refer to Group 34
Remove ABS pulse generator, refer to Group 34
Observe EDC notes, Group 37.

Note:
Align front axle after mounting, refer to Group 32



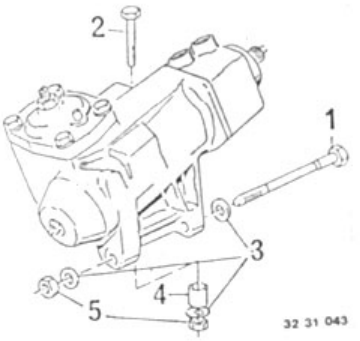
Attach engine to tool 00 0 200.
Use chain and shackle of tool 11 0 020.
Depending on engine, also refer to Removing Engine 11 00 050.



Release nut.
Using tool 32 0 040, press tie rod from pitman arm.

Installation note:
Replace self-locking nut.
For tightening torque*.

* Refer to Technical Data

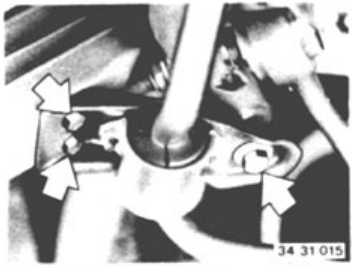


Release steering gear retaining bolts (1 and 2).
Tie back steering gear - lines remain connected.

Installation note:

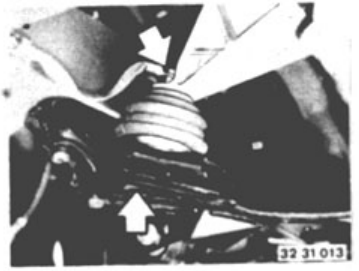
1 Bolt
2 Bolt, only install strength class 10.9
3 Washer
4 Bush
5 Replace nuts

For tightening torque*.



Release bolts on left and right

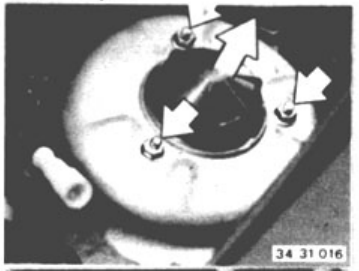
Installation note:
For tightening torque, refer to Technical Data.



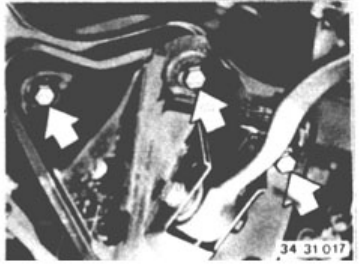
Release engine mount on left and right of front axle carrier.
Also release right-hand engine mount at top.

Installation note:
For tightening torque*.

* Refer to Technical Data



Lift off cap.
Unscrew nuts on left and right sides.
Installation:
Replace self-locking nuts.
Tightening torque*.

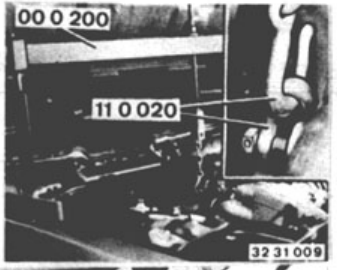


Place workshop jack underneath the front axle carrier.
Unscrew bolts on left and right sides and lower the front axle slowly.
Important!
Spring struts must not fall out or down – this would damage the ball joints.
Installation:
Tightening torque*.

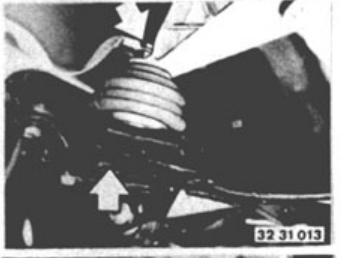
* See Specifications

31 11 001 Replacing front axle carrier

Note:
The pitman arm must be adjusted after installing a new front axle carrier, refer to Group 31 21 510.
Align front axle after assembly, refer to Group 32

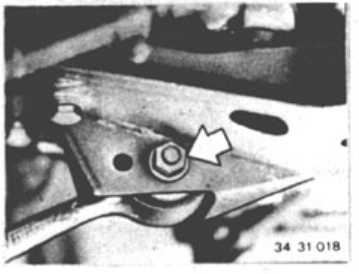


Attach engine to special tool 00 0 200.
Use chain and shackle from tool 11 0 020.
Depending on type of engine, also refer Removing Engine 11 00 050.



Release engine mount on left and right of front axle carrier.
Also release right-hand engine mount at top.

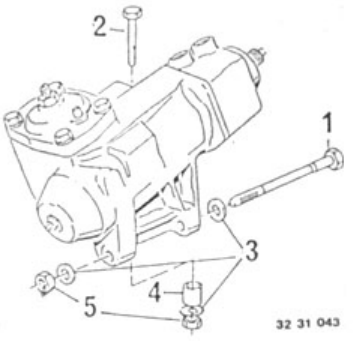
Installation note:
For tightening torque*.



Remove left and right control arms.

Installation note:
Replace self-locking nuts.
Washer on both sides.
For tightening torque*, in normal position*

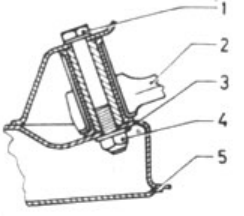
* Refer to Technical Data



Release steering gear retaining bolts (1 and 2). Tie back steering gear - lines remain connected.

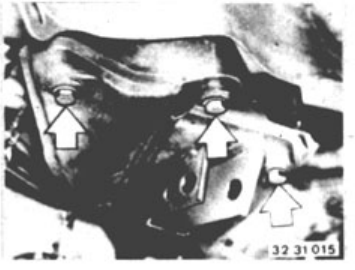
Installation note:
1 Bolt
2 Bolt, only fit strength class 10.9
3 Washer
4 Bush
5 Replace nuts

For tightening torque*.



Remove idler arm.

Installation note:
Replace self-locking nut.
For tightening torque*
1 Bolt
2 Idler arm
3 Washer
4 Self-locking nut
5 Front axle carrier



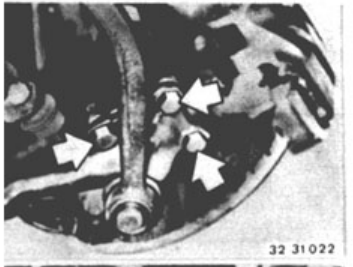
Release bolts on left and right and remove front axle carrier.

Installation note:
For tightening torque*.

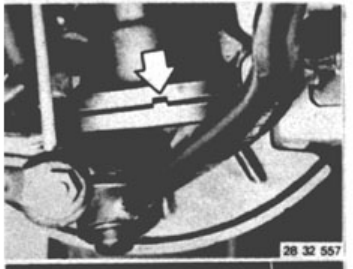
* Refer to Technical Data

31 12 000 REMOVING AND INSTALLING LEFT OR RIGHT CONTROL ARM

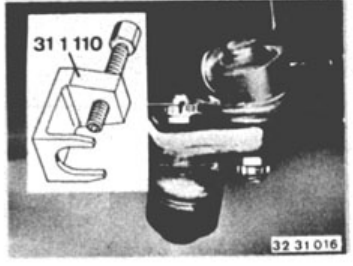
Remove front wheel – see Group 36.



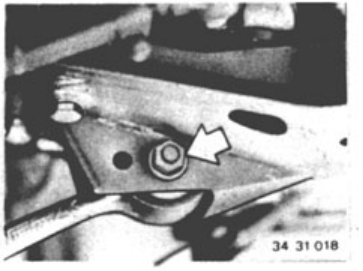
Unscrew bolts.
Installation:
Clean threads of bores and bolts.
Install bolts with a bolt cement**.
Tightening torque*.



Check for correct installed position.



Unscrew nut.
Press off ball joint with Special Tool 31 1 110.
Installation:
Remove grease on ball pin and in bore.
Replace self-locking nut.
Tightening torque*.



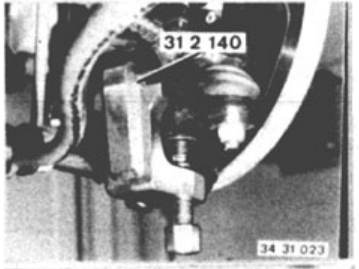
Unscrew bolt.
Installation:
Replace self-locking nut.
Use washers on both sides.
Tightening torque* for car loaded down to normal position*.

* See Specifications
** Source of Supply: HWB

* See Specifications

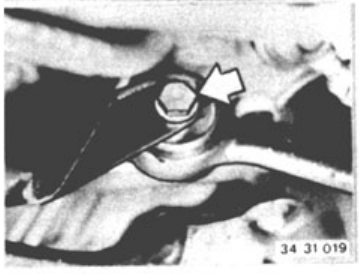
31 12 090 REMOVING AND INSTALLING OR REPLACING LEFT OR RIGHT THRUST STRUT

Remove front wheel – see Group 36.



Unscrew nut.
Pry off ball joint with Special Tool 31 2 140.

Installation:
Keep grease off of ball journal and bore.
Replace self-locking nut.
Tightening torque*.

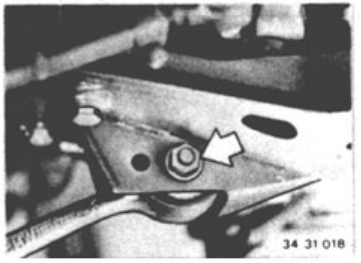


Unscrew thrust strut (counterhold with open-ended wrench), grinding off if necessary.

Installation:
Replace self-locking nut.
Use washers on both sides.
Tightening torque* for car loaded down to normal position*.

Important!
Thrust strut mounts must always be installed or replaced in pairs.

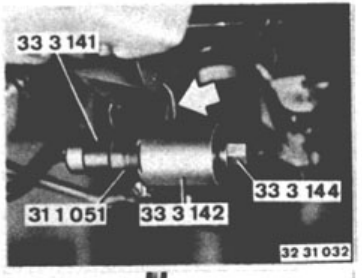
* See Specifications



31 12 130 REPLACING RUBBER MOUNT IN LEFT OR RIGHT CONTROL ARM

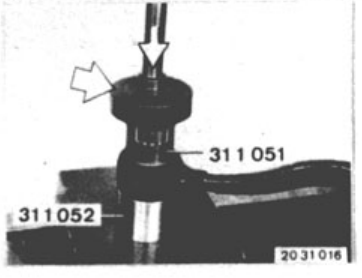
Unscrew control arm.
Aluminum control arms must always be replaced.

Installation:
Replace self-locking nut.
Use washers on both sides.
Tightening torque* for car loaded down to normal position*.



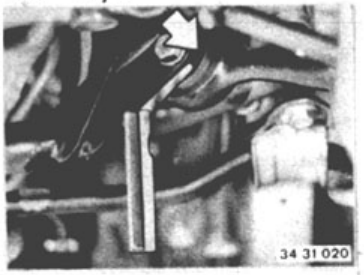
Suspend control arm from car on a piece of wire (prevents damaging the ball joint).
Pull out rubber mount with Special Tools 31 1 051 and 33 3 141/142/144.

Installation:
Remove grease from rubber mount and control arm bores.
Pull in rubber mount from the bevelled side of the control arm.
Same tools as above.



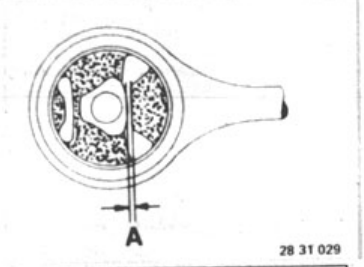
Removed Control Arm:
Press rubber mount out and in on a press and with Special Tools 31 1 051 / 052 as well as a pressure pad.

* See Specifications



31 12 ... CHECKING THRUST STRUT MOUNTS

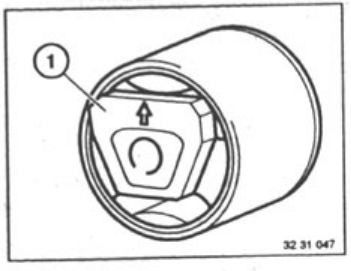
Load the car down to normal position*.
Measure distance (A) between the rubber part and centering sleeve, using a feeler gage blade.



Specification:
A = 1.0 to 2.0 mm

If there is deviation from the specification, the mount must be replaced - refer to 31 12 147.

Important!
Thrust strut mounts must always be installed or replaced in pairs.



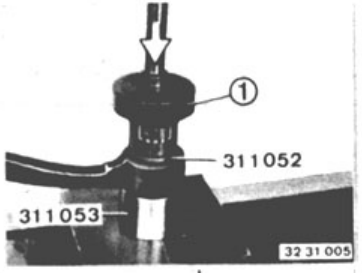
Note:
The hydraulic pressure strut mounts, which can be recognized on the plastic clip (1), cannot be checked.
Both mounts must be replaced, if fluid is running out of a hydraulic mount.

* Refer to Specifications

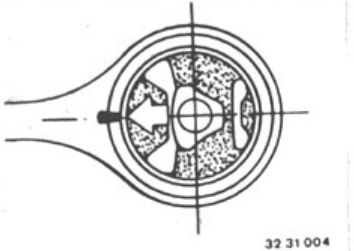
31 12 147 REPLACIUNG RUBBER MOUNTS IN LEFT OR RIGHT THRUST STRUT

Remove thrust strut - refer to 31 12 090.

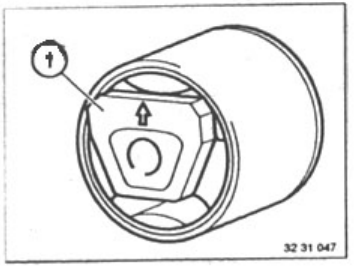
Important!
Thrust strut mounts must always be installed or replaced in pairs.



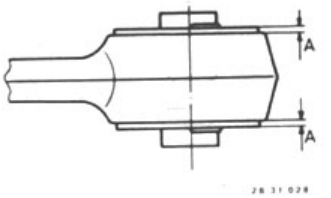
Press the rubber mount out in a press using Special Tools 31 1 052 / 053 and thrust piece (1).



Installation:
Rubber mount and thrust strut bore must be free of grease.
The arrow on the rubber mount points to the mark on the thrust strut.



Hydraulic Mounts:
The arrow on plastic clip /1) points to the mark on the thrust strut.
The special tool must bear on the outer sleeve of the mount while pressing the mount in.

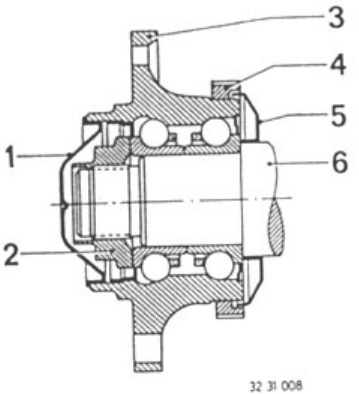


Installation:-
Ensure equal amount of protrusion (A) on both sides.

31 21 180 REPLACING BEARINGS (WHEEL HUB) FOR FRONT WHEEL

Important!
Do not reuse the bearing unit after removal.
Unscrew brake disc – line remains connected (see Group 34).

Wheel Bearings:

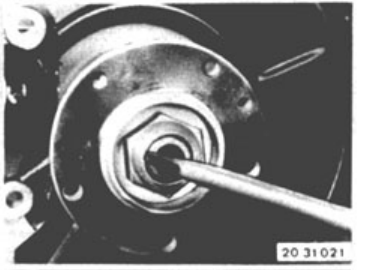


1 Grease cap
2 Collar nut
3 Bearing unit

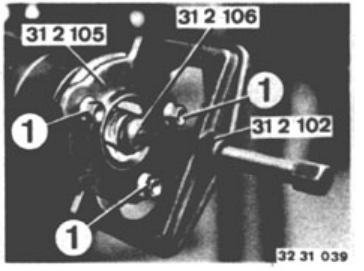
4 Pulse gear
5 Dust cover
6 Stub axle



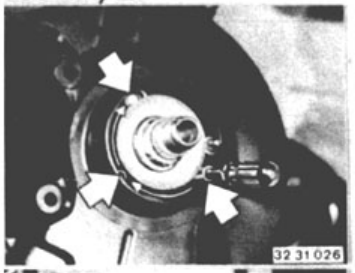
Pry off grease cap with a screwdriver.
Do not reuse the cap!



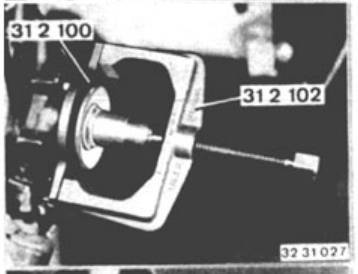
Chisel off lock of collar nut.
Unscrew nut with Special Tool 31 2 080.
Do not reuse the nut!



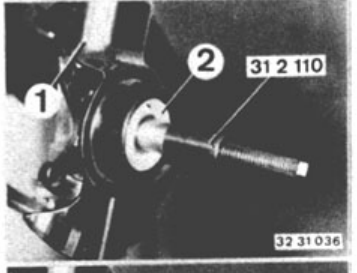
Pull off bearing unit with Special Tools 31 2 102/105/106 and wheel bolts (1).
Do not reuse the bearing unit!



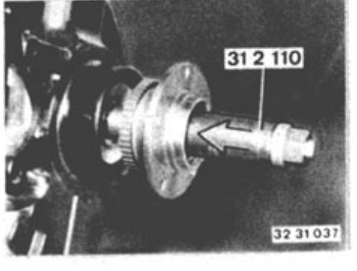
When Bearing Inner Race Remains on Stub Axle:
Insert socket wrench key and unscrew guard.



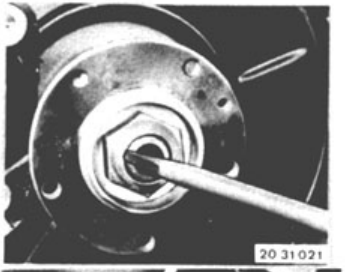
Pull off bearing inner race and dust cover with Special Tools 31 2 100/102.



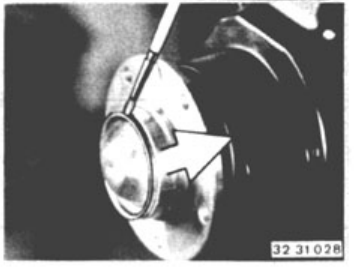
Screw on guard (1).
Install new dust cover (2).
Screw on Special Tool 31 2 110 whole length of threads.



Slide and pull on new bearing unit with Special Tool 31 2 110.



Screw on new collar nut with correct tightening torque* and lock by punching.

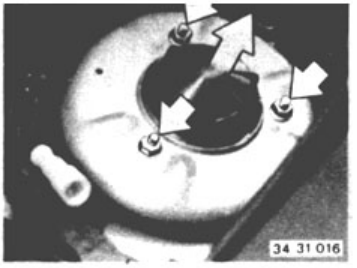


Install new cap with a sealing compound**.

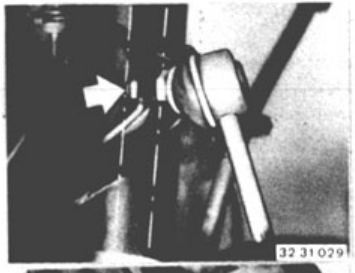
* See Specifications
** Source of Supply: HWB

31 31 000 REMOVING AND INSTALLING LEFT OR RIGHT FRONT SPRING STRUT ASSEMBLY

Unscrew brake caliper (line remains connected) – see Group 34.
Remove ABS pulse sender – see Group 34.
Refer to EDC information in Group 37.



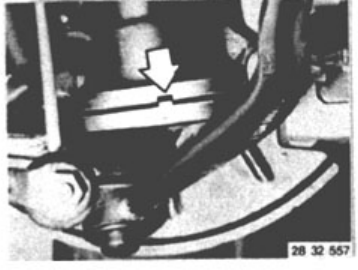
Lift off cap.
Support spring strut.
Unscrew spring strut mount on wheel house.
Installation:
Replace self-locking nuts.
Tightening torque*.



Unscrew stabilizer push rod, counterholding with an open-ended wrench.
Installation:
Wrench surface on ball pin parallel to the sbsorber axle.
Replace self-locking nut.
Tightening torque*.



Unscrew bolts.
Installation:
Clean threads of bores and bolts.
Install bolts with a bolt cement**.
Tightening torque*.

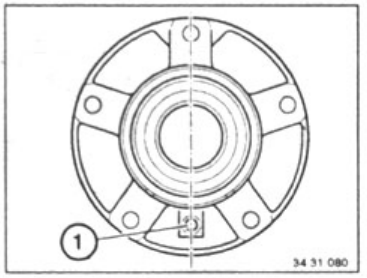


Check for correct installed position.

* See Specifications
** Source of Supply: HWB

Important!
Always store shock absorbers standing upright. If shock absorbers are stored laying down with piston rods run in, they could cause a rattling noise when used again.
Correction:
Store shock absorbers standing upright with piston rods run out at room temperature for 24 hours.

* See Specifications



31 31 031 REPLACING LEFT OR RIGHT FRONT SPRING STRUT

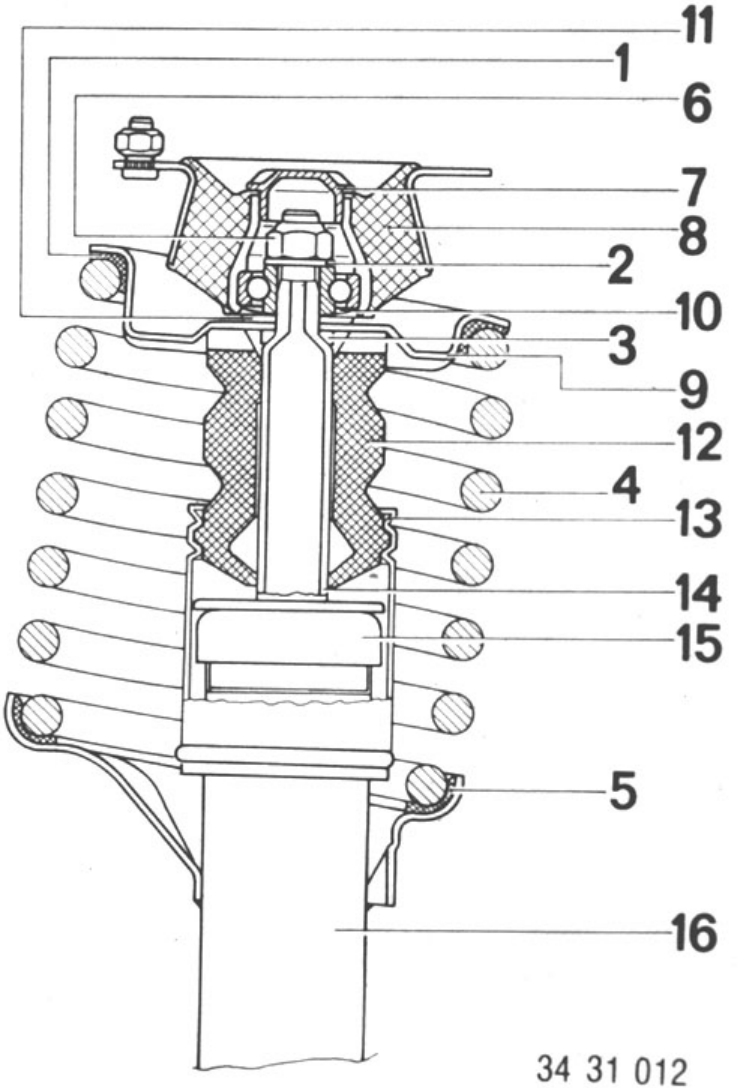
Remove spring strut - refer to 31 31 000.
Remove shock absorber for spring strut - refer to 31 32 001.
Replace wheel bearings - refer to 31 12 147.

Important!
On cars which had been produced prior to introduction of the standard wheel bearing, parts as shown on the parts microfiche must be replaced in addition to the spring strut.

The standard wheel bearing can be recognized on bore (1) provided in the middle for brake disk installation.

Spring Strut Assembly Drawing – 520 i:

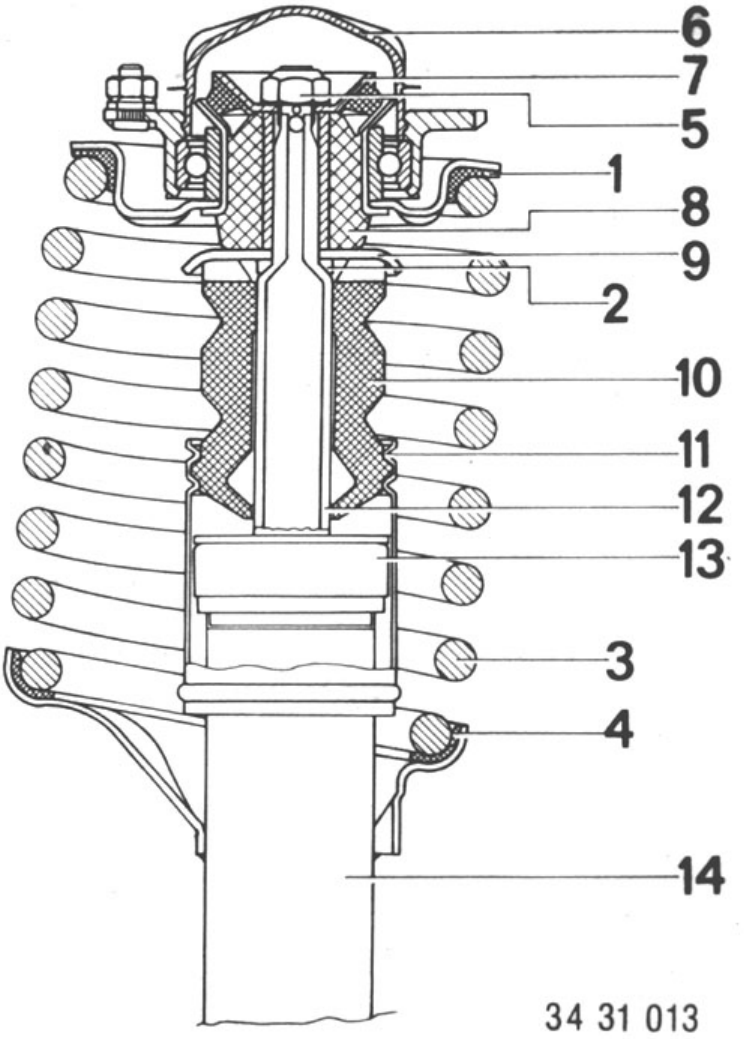
1 Spring retainer, upper
2 Washer
3 Ring for hollow piston rod
4 Coil spring
5 Spring retainer, lower
6 Nut
7 Cap
8 Mount
9 Spring retainer, upper
10 Seal
11 Washer
12 Rubber damper
13 Protective pipe
14 Shock absorber
15 Screw-on ring
16 Spring strut



LAYOUT DRAWING OF SHOCK ABSORBER WITH MOUNT FOR SEPARATE SUSPENSION AND COIL SPRING

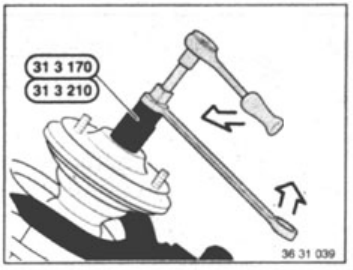
Models 524td ... M5 (After Conversion of Standard Spring Strut)

1 Upper spring ring
2 Ring for hollow piston rod
3 Coil spring
4 Lower spring ring
5 Nut
6 Cap
7 Stop washer
8 Mount
9 Support
10 Rubber mount
11 Protective pipe
12 Shock absorber
13 Screw-on ring
14 Spring strut



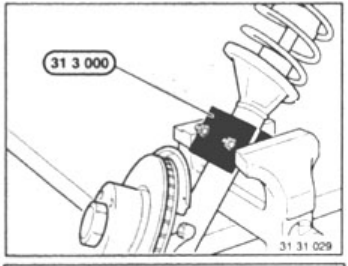
31 32 001 Replacing shock absorber for front left or right spring strut

To know whether a spring strut shock absorber has to be replaced, it must either be checked installed with a Shock Tester or removed and checked in a shock absorber testing machine.
Also refer to Service Information 37 01 92 (562).

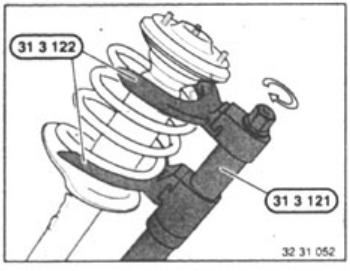


Unscrew self-locking nut with tool 31 3 170/210 (replace socket), brace piston rod.

Installation:
Replace self-locking nut.
Tightening torque*.

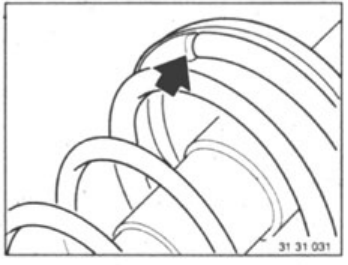


Remove complete spring strut - 31 31 000 - and clamp in vise with tool 31 3 000.



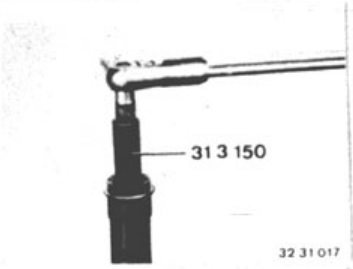
Press together coil spring using spring tensioner 31 3 121/122.

Caution!
The tool must grip 5 spring coils.



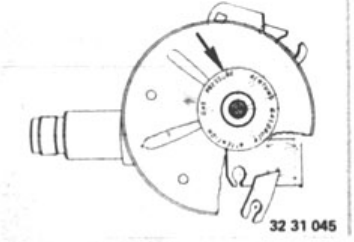
Installation:
Installation sequence, refer to "arrangement of shock absorber".
Check top and bottom base spring mount and replace if necessary.
The ends of the coil springs must locate in the recesses in the top and bottom spring plate.

* Refer to Technical Data

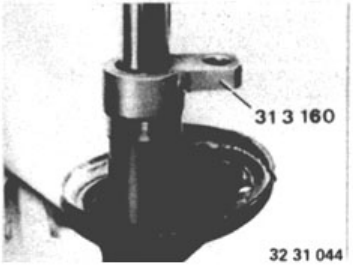


Unscrew screw-on ring with Special Tool 31 3 150.

Installation:
Tightening torque*.

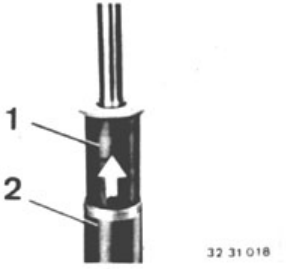


Important!
The M 5 is delivered ex factory with "wet spring struts". If they are still installed, it is always necessary to replace both shock absorbers.
Take off rubber cover.
Pull off lettered stop shell – don't reuse it.



Unscrew screw-on ring slowly with Special Tool 31 3 160 (to let pressure escape in the absorber).

Installation:
Replace screw-on ring.
Tightening torque*.



Pull out shock absorber (1).

Installation:
Remove old oil from spring strut pipe (2).
Fill with engine oil** prior to installation of new shock absorber.
Engine oil is required to carry off heat from the shock absorber to the spring strut pipe.

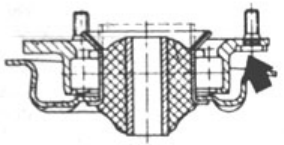
Important!
Single-pipe gas pressure front axle cartridges, recognized on piston rod diameter = at least 33 mm (1.299"), may not be installed with oil - see Service Information of Group 37.
Only store shock absorbers standing upright. If shock absorbers are stored laying down with their piston rods run in, this could cause a rattling noise when used in car again.
Correction:
Store shock absorbers standing upright with piston rods run out at room temperature for 24 hours.

* See Specifications

** See Operating Fluids

31 33 001 REPLACING MOUNT FOR LEFT OR RIGHT FRONT SPRING STRUT

Procedures are identical with those for replacing shock absorber -- see 31 32 001.



32 31 019

Important!
If the installed mount is marked with "+" or "–", a mount with the same mark must be installed.
Also refer to correcting chamber in Group 32.

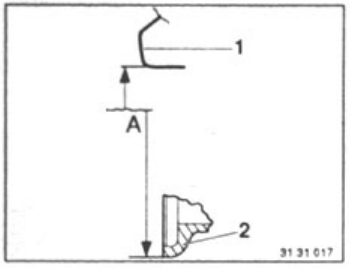
31 33 100 REMOVING AND INSTALLING OR REPLACING COIL SPRING FOR LEFT OR RIGHT FRONT SPRING STRUT

Procedures are identical with those for replacing shock absorber -- see 31 32 001.



34 31 014

Important!
Only install pairs of springs on one axle with the same BMW number (1) (located on end of spring).
Refer to parts microfiche for cross reference of springs to vehicle type and, if applicable, special equipment (e.g. air conditioner, sport suspension, etc.) as well as dates of introduction.
The BMW number on the spring can be used to determine the part number and therefore the correct spring for a pertinent vehicle type according to the parts microfiche.



31 33 ... MEASURING / CORRECTING RIDE LEVEL HEIGHT BEFORE 1992 MODELS

Load down car to normal position*.

Measure actual height (A) from wheel house lower edge (1) to rim flange (2) at center of wheel 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 ride level height value*.

Identify the installed springs - refer to 31 33 100.

Find correction spring in the table. The numbers are ride level height deviation (nominal values in mm) between the pertinent springs.

Example:

The car is supplied with coil springs having BMW No. 1 133 333 and is, for example, 8 mm too deep due to so many optional extra equipment items.
The nominal ride level height* is reached again by installing springs having BMW No. 1 133 334 (refer to 31 33 100 for information on determining part numbers).

Note:
Additional ride level height correction by installing spring rings in different thickness is not possible.

Table for Standard Suspension - 520i:

A = Equipment after correction
B = Equipment of delivered car
a = Adjusted higher
b = Adjusted lower

B \ A	1 136 046	1 135 462	1 135 463	1 135 464
1 136 046		+6	+13	+20
1 135 462	+6		+7	+14
1 135 463	-13	-6		+7
1 135 464		-14	-7	

* Refer to Specifications

Table for EDC Models:

Refer to page 31-33/2 for explanations.

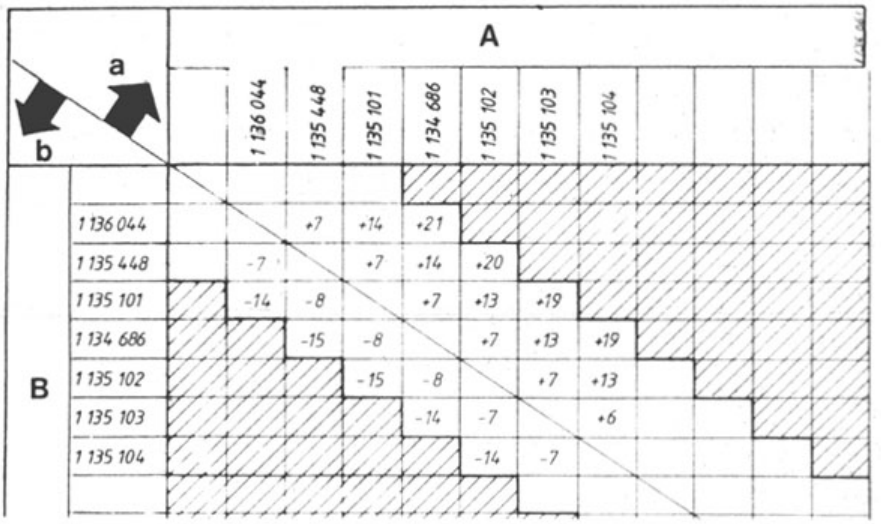


Table for Standard Suspension - 524td, 525td, 525i, 530i, 535i:

Refer to page 31-33/2 for explanations.

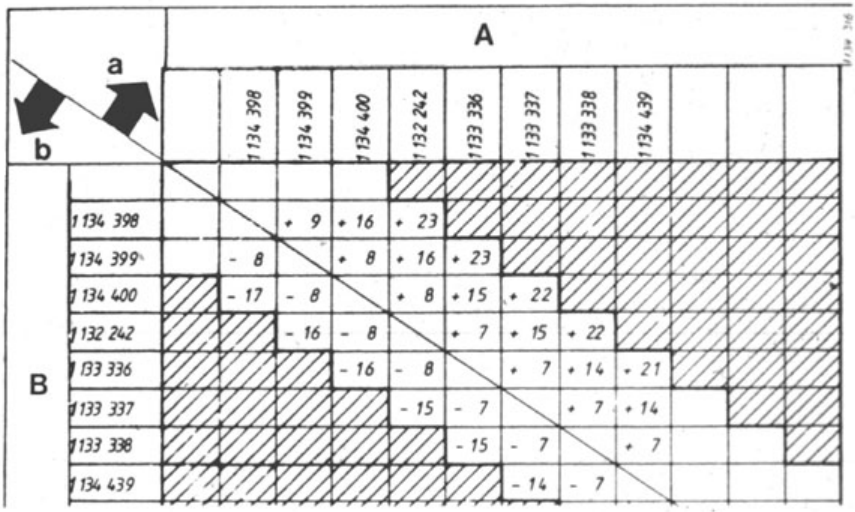
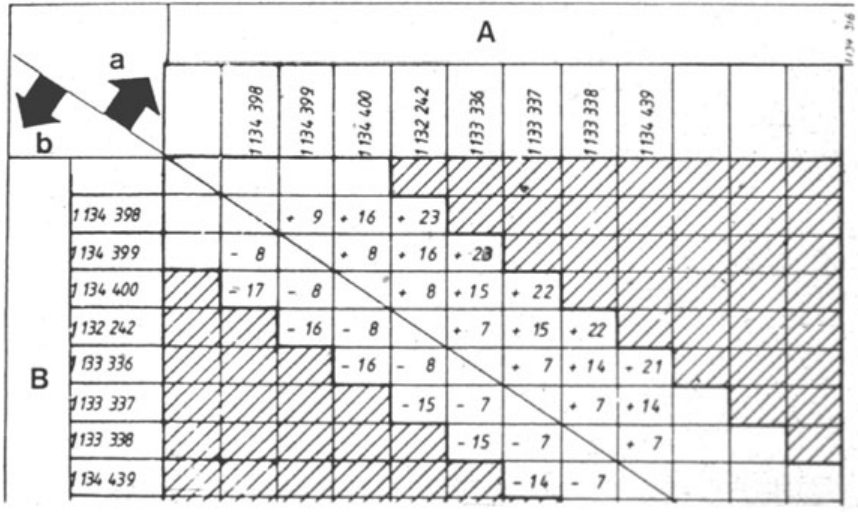
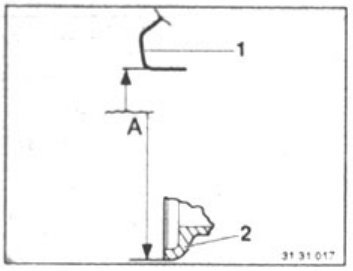


Table for Sport Suspension - 520i:

Refer to page 31-33/2 for explanations.





31 33 ... MEASURING / CORRECTING RIDE LEVEL HEIGHT SINCE 1992 MODELS

Load down car to normal position*.

Measure actual height (A) from wheel house lower edge (1) to rim flange (2) at center of wheel height. Determine the mean value of each wheel after lifting and lowering the car body, and then the mean value of the axle.

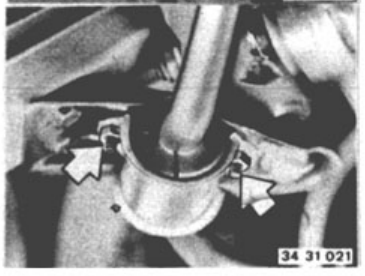
In case of deviation from the nominal value*, install new coil springs - refer to parts microfiche for information on determining correct coil springs.

* Refer to Specifications



31 35 000 REMOVING AND INSTALLING OR REPLACING FRONT STABILIZER

Unscrew push rod on left and right sides.
Installation:
Wrench surface on ball pin is parallel to the absorber axis.
Replace self-locking nut.
Tightening torque*.



Unscrew nuts on left and right sides.
Take off the stabilizer.

* See Specifications

TROUBLESHOOTING FRONT AXLE

Condition	Cause	Correction
Grinding noise (louder in curves)	a) Wheel bearings defective	a) Replace wheel bearings
Vibration	a) Imbalance of wheels	a) Balance wheels
	b) Rim lateral and radial runout	b) Replace rims, if necessary
	c) Tire radial runout	c) Match or replace tires
Steering wheel shake	a) Rim lateral and radial runout	a) Replace rims, if necessary
	b) Imbalance of wheels	b) Balance wheels
	c) Shock absorber effect insufficient	c) Replace shock absorbers
	d) Thrust strut mounts defective	d) Replace thrust strut mounts
	e) Wrong thrust strut mounts installed	e) Replace thrust strut mounts
	f) Steering gear play excessive	f) Adjust pressure point
Rattling noise	a) Shock absorber cartridge in spring strut loose	a) Tighten screw-on ring (check threads)
	b) Ball joint on control arm worn	b) Replace control arm
	c) Ball joint on thrust strut worn	c) Replace thrust strut
	d) Stabilizer rubber mounts worn	d) Replace rubber mounts
	e) Ball joints of push rod worn	e) Replace push rod
	f) Front axle carrier mounted loose on body	f) Tighten (check threads)

TROUBLESHOOTING FRONT AXLE

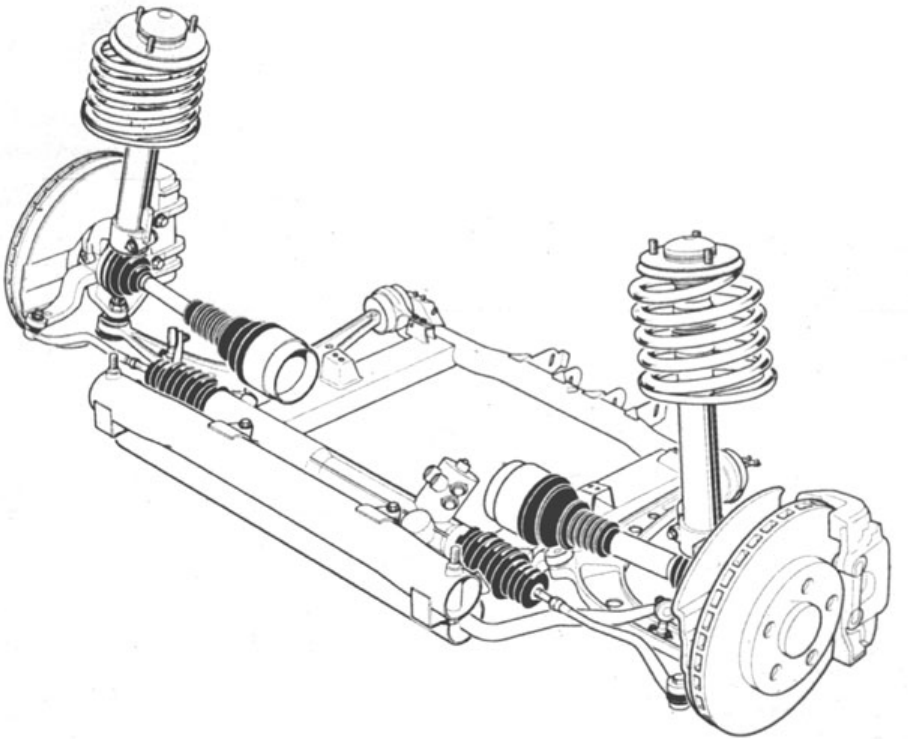
Condition	Cause	Correction
Body swing long time after driving over rough road	Weak shock absorbers – see page 31 - 90/3	Replace shock absorbers
Body wip when driving over successive rough road surfaces		
Body rise while accelerating		
Wheel jump even on normal road surfaces		
Car breaking out while braking		
Breaking out (skidding) in curves due to poor track holding		

TROUBLESHOOTING SHOCK ABSORBERS

The condition of shock absorbers can only be checked with a shock absorber tester in car or with a shock absorber testing machine after removal.
Cars with EDC (Electronic Absorber Control) – See Group 37.

Condition	Cause	Correction
Shock absorbers knocking (bottoming)	a) Rubber damper defective	a) Check or replace rubber damper
	b) Weak shock absorbers	b) Replace shock absorbers
Shock absorber noise	a) Shock absorber cartridge loose	a) Tighten screw-on ring – inspect threads
	b) Installed shock absorber had been stored laying down with piston rod run in	b) Store shock absorber standing upright with piston rod run out and at room temperature for 24 hours
	c) Shock absorbers defective	c) Replace shock absorbers
Poor handling	a) Weak shock absorbers	a) Replace shock absorbers
Flat spots on tire treads	a) Shock absorbers defective	a) Replace shock absorbers

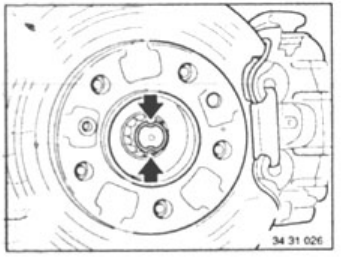
FRONT AXLE LAYOUT DRAWING



34 31 025

31 10 000 REMOVING AND INSTALLING COMPLETE FRONT AXLE

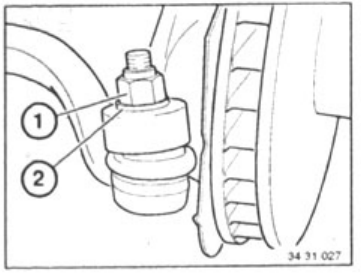
Important!
Check the wheel alignment after installation - refer to Group 32.



Unscrew covers of front wheels.
Unscrew left and right collar nuts.

Installation:
Replace the collar nuts.
Tightening torque*.
Lock the collars of the nuts in both grooves of the shaft with a punch.

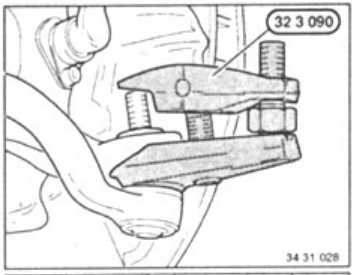
Remove the front wheels - refer to Gr. 36.
Unscrew left and right brake calipers and suspend them from the body on pieces of wire - refer to Group 34.
Disconnect the ABS wire plug.
Loosen wires secured to the spring strut.
Remove the stabilizer - refer to 31 35 000.



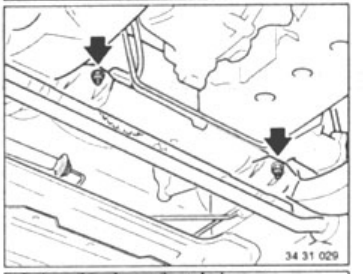
Unscrew nut (1) on left and right sides.

Installation:
Replace the self-locking nut.
Install washer (2).
Tightening torque*.

* Refer to Specifications

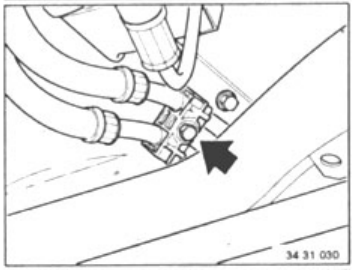


Press the tie rod off using Special Tool 32 3 090.

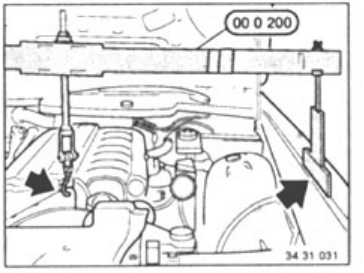


Unscrew the nuts and pull the bolts out.

Installation:
Tightening torque*.

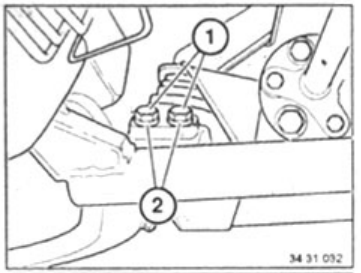


If applicable, unscrew the holder for oil pipes.



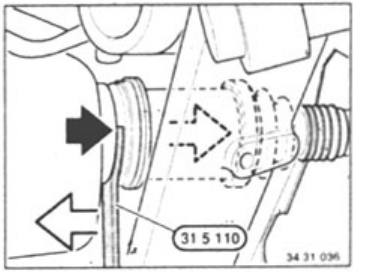
Attach Special Tool 00 0 200 to the engine. The supports bear on the side panel bolts.

* Refer to Specifications



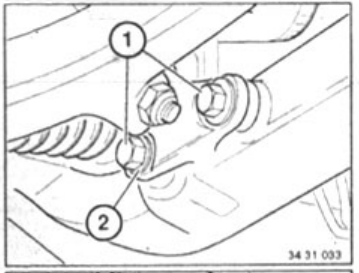
Unscrew bolts (1) on left and right hand sides.

Installation:
Use washers (2).
Tightening torque*.



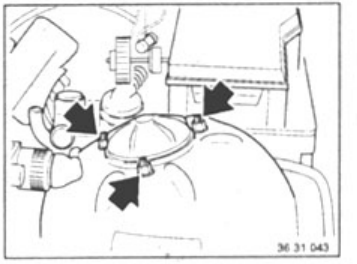
Slide Special Tool 31 5 110 into gap between case and output shaft.
Pry out left and right output shafts with a jerk and remove them.

Installation:
Replace circlips of output shafts.
Circlips of output shafts must be heard to engage in the front axle final drive.



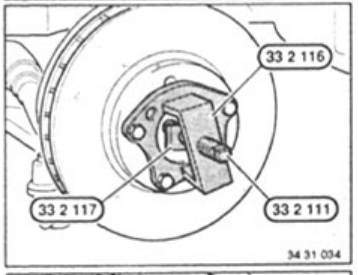
Unscrew bolts (1) on left and right hand sides.
Pull control arms aside and secure them on spring strut with a piece of wire so that the ball joint on the spring strut cannot be damaged.

Installation:
Use washer (2) on the forward bolt.
Tightening torque*.

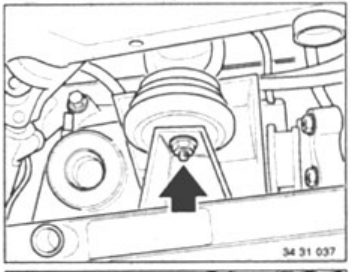


Support spring struts on left and right hand sides, unscrew nuts and remove spring struts.

Installation:
Tightening torque*.

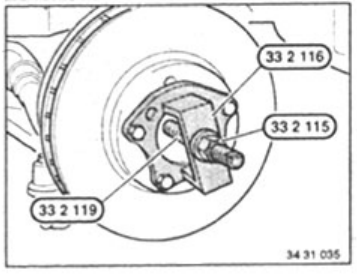


Bolt on Special Tools 33 2 111 , 33 2 116 and 33 2 117 with three wheel bolts.
Press output shaft out of drive flange on left and right hand sides.



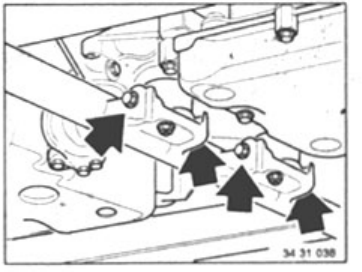
Unscrew nut on left and right hand sides.

Installation:
Tightening torque*.



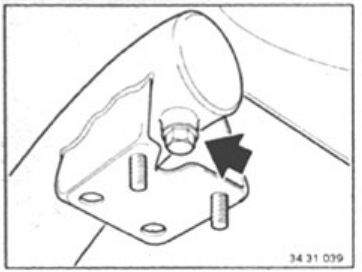
Installation:
Bolt on Special Tools 33 2 115, 33 2 116 and 33 2 119 with three wheel bolts.
Pull output shaft into drive flange.

* Refer to Specifications



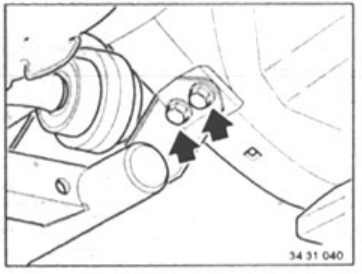
Unscrew bolts.

* Refer to Specifications



Support the front axle carrier.
Unscrew the bolt on left and right sides.

Installation:
Tightening torque*.



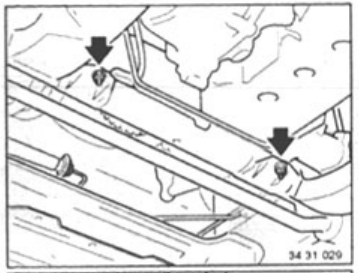
Unscrew bolts.
Remove the front axle carrier towards the front.

Installation:
Tightening torque*.
Remove and install heat shield.

31 11 001 REPLACING FRONT AXLE CARRIER

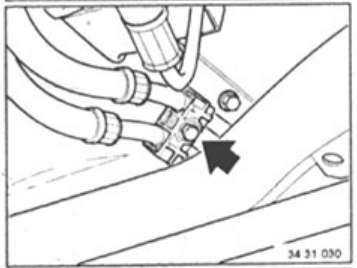
Important!
After installation:
Check output shafts for correct engagement in front axle final drives.
Check wheel alignment - refer to Gr. 32.

Remove stabilizer - refer to 31 35 000.

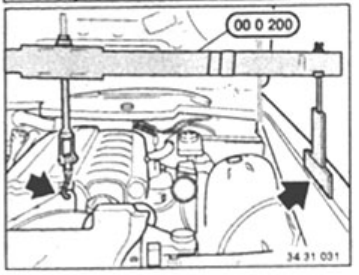


Unscrew nuts and pull out bolts.

Installation:
Tightening torque*.

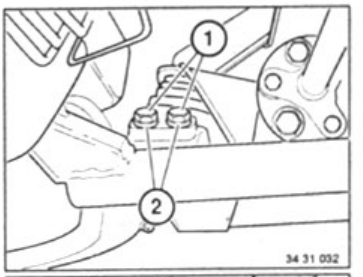


If applicable, unscrew holder for oil pipes.



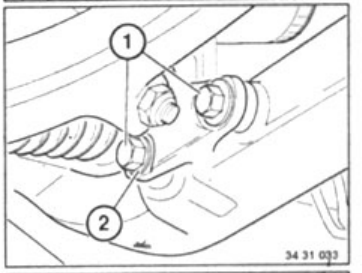
Attach Special Tool 00 0 200 on engine.
Supports bear on side panel screws.

* **Refer to Specifications**



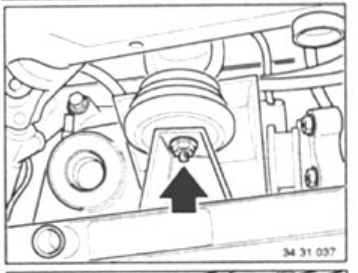
Unscrew bolts (1) on left and right hand sides.

Installation:
Use washers (2).
Tightening torque*.



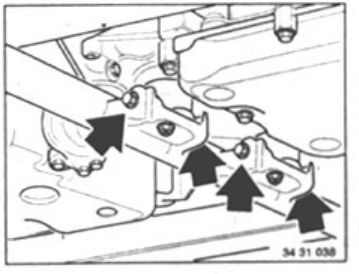
Unscrew bolts (1) on left and right hand sides.
Pull control arms aside and secure them on spring strut with a piece of wire so that the ball joint on the spring strut cannot be damaged.

Installation:
Use washer (2) on the forward bolt.
Tightening torque*.



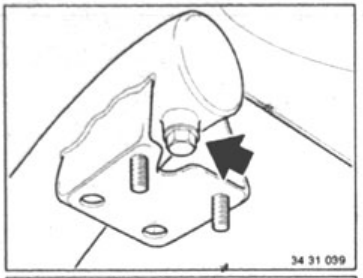
Unscrew nut on left and right hand sides.

Installation:
Tightening torque*.



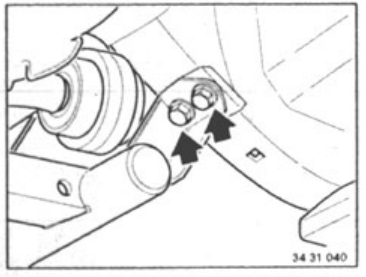
Unscrew bolts.

* **Refer to Specifications**



Support the front axle carrier.
Unscrew the bolt on left and right sides.

Installation:
Tightening torque*.

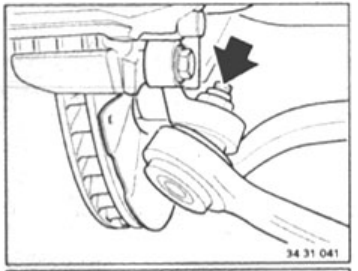


Unscrew bolts.
Remove the front axle carrier towards the front.

Installation:
Tightening torque*.
Remove and install heat shield.

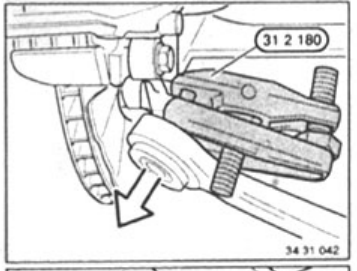
31 12 000 REMOVING AND INSTALLING LEFT OR RIGHT CONTROL ARM

Remove output shaft - refer to 31 60 000.

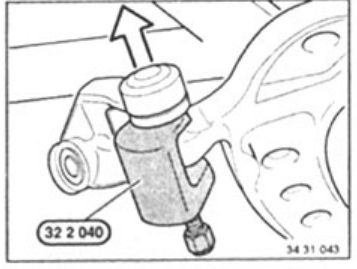


Unscrew nut.

Installation:
Replace the self-locking nut.
Tightening torque*.



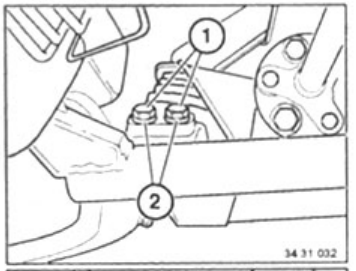
Press the control arm off using Special Tool 31 2 180.



If applicable, unscrew the nut.
Press the ball joint off of the control arm using Special Tool 32 2 040.

Installation:
Replace the self-locking nut.
Tightening torque*.

* **Refer to Specifications**

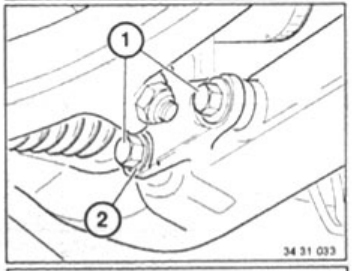


31 12 046 REPLACING HOLDER FOR CONTROL ARM

Important!
After installation:
Check output shafts for correct engagement in front axle final drives.

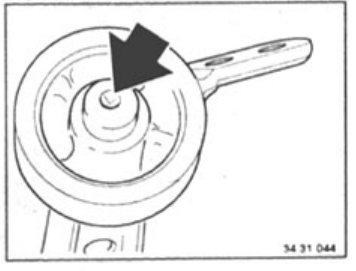
Unscrew bolts (1).

Installation:
Use washers (2).
Tightening torque*.

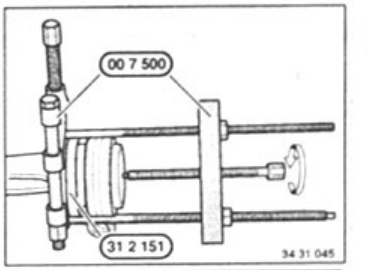


Unscrew bolts (1).
Pull control arm aside and secure it on spring strut with a piece of wire so that the ball joint on the spring strut cannot be damaged.

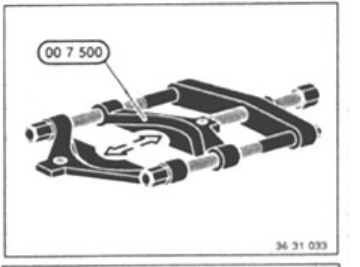
Installation:
Use washer (2) on the forward bolt.
Tightening torque*.



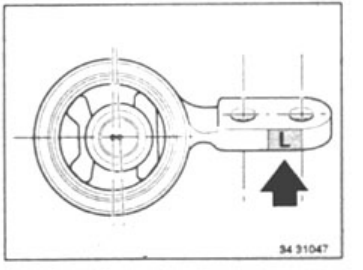
Punch mark center of control arm.



Pull holder off of control arm using Special Tools 31 2 151 and 00 7 500.



Important!
A rubber mount pulled off of control arm must never be reused, as the rubberized interior sleeve will be destroyed by pulling off dry.
Replace rubber mount - refer to 31 12 130.
Always replace left and right rubber mounts and use rubber mounts of same make (appears on mount).

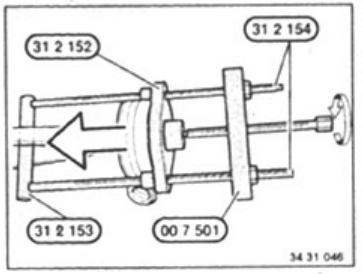


Coat control arm journal with approved lubricant.**

Installation:
Holders are marked with
L for left holder or
R for right hider.
Centering bores (larger diameter) face down.

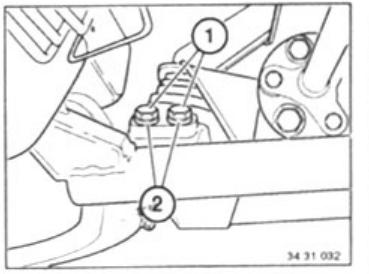
* Refer to Specifications

* Refer to Specifications
** Source of Supply: BMW Parts

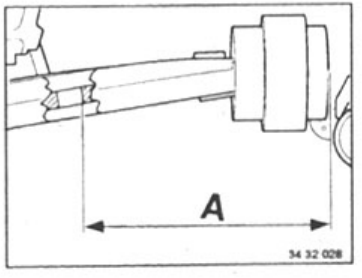


Attach Special Tool 31 2 153 in the bore of the control arm.
Pull the bracket/mount onto the control arm using Special Tools 31 2 152 / 154 and 00 7 501.

Note:
If the threaded rods are too short, the mount must be pulled on with the help of two nuts.
After the mount has been pulled on approx. 10 mm, Special Tool 00 7 501 can be used again.



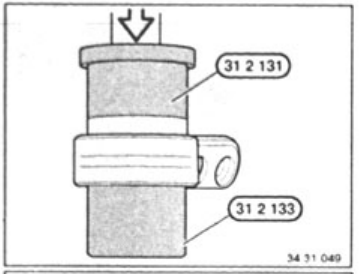
Important!
Bolt the bracket to the front axle carrier immediately.
Tightening torque*.
Load the car down to normal position* immediately.
Leave the car in normal position at least 30 minutes and avoid bottoming of the suspension.
The lubricant will have evaporated after about 30 minutes and the control arm will fit tight and be correctly positioned in the rubber mount.
Non-conformance with these procedures will lead to serious impairment of handling behavior.



Pull the bracket/mount on up to distance (A).
The mount must be free of tension when measuring the distance – loosen the special tool.
Measure distance A at the bottom of the control arm from a perpendicular line of the mount eye to the edge of the machined bore in the control arm.

A = 170.3 ± 0.3 mm

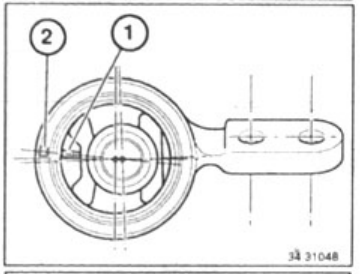
* Refer to Specifications



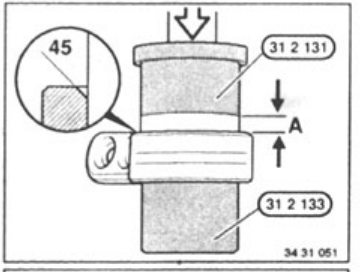
31 12 130 REPLACING RUBBER MOUNTS FOR CONTROL ARM

Important!
Always replace the left and right rubber mounts and use rubber mounts of the same make (identification on mounts).

Remove bracket for control arm - refer to 31 12 046.
Press rubber mount out of the bracket using Special Tools 31 2 131 / 133.

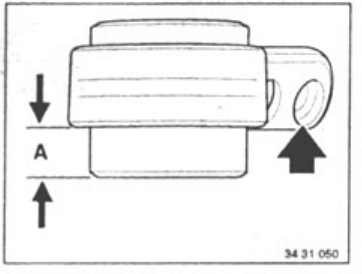


Installation:
Check the installed position!
Mark (1) on the rubber mount must be aligned with mark (2) on the bracket.
The bracket and rubber mount must be free of grease.



Apply the rubber mount at the bevelled side of the bracket and press it in to distance (A) using Special Tools 31 2 131 / 133.

A = 18 ± 0.3 mm



Important!
Larger protrusion (A) of the rubber mount must be on the side of the bracket with the larger diameter centering bores.

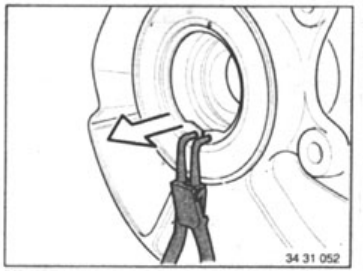
A = 18 ± 0.3 mm

* **Refer to Specifications**

31 21 090 Replacing left or right swivel bearing

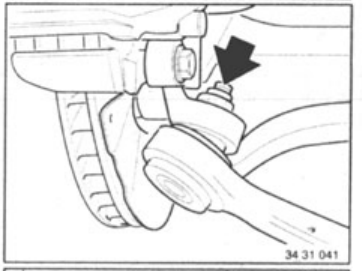
Caution!
After assembly:
Check that output shafts are correctly located in front axle differential.

Remove wheel hub (driver flange) 31 21 121.
Remove ABS impulse sensor.



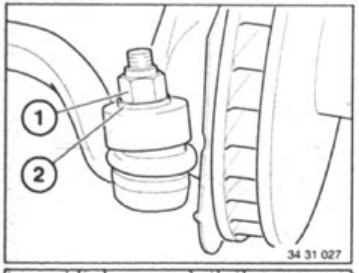
Remove circlip.
Do not remove the bearing because a new bearing has to be installed.

Installation instruction:
Install bearing in wheel hub 31 21 151.



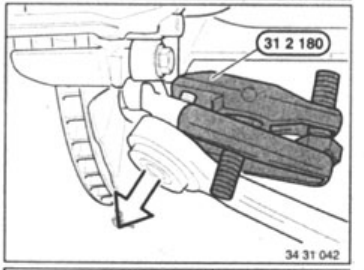
Unfasten nut.

Installation instruction:
Replace self-locking nut.
Tightening torque 31 12 5AZ*.

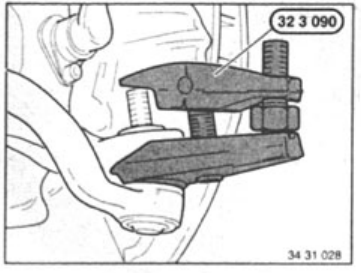


Unscrew nuts (1).

Installation instruction:
Replace self-locking nut.
Install washer (2).
Tightening torque 32 21 3AZ*.

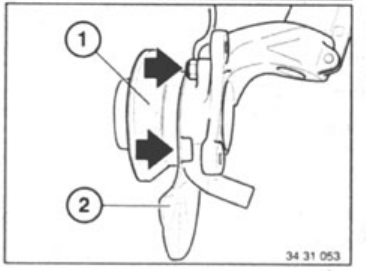


Press control arm off swivel bearing with special tool 31 2 180 .



Press off track rod with special tool 32 3 090.

Installation instruction:
Remove grease from pin and bore.

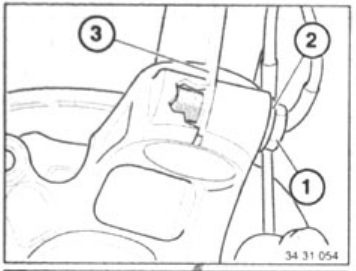


Knock dust cover sleeve (1) off swivel bearing.
Remove protective plate (2).

Installation instruction:
If necessary, replace dust cover sleeve (1).

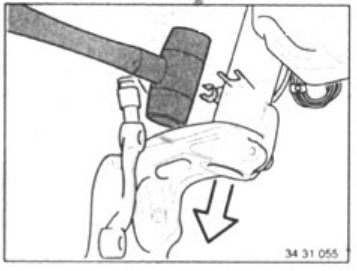
* Refer to Specifications

* Refer to Specifications



Unfasten and remove screw (1).

Installation instruction:
Install washer (2).
Screw (1) must make positive contact with the retaining web (3).
Tightening torque 31 31 3AZ*.



Use hammer to knock swivel bearing off spring strut.

31 21 121 Replacing left or right wheel hub (driver flange)

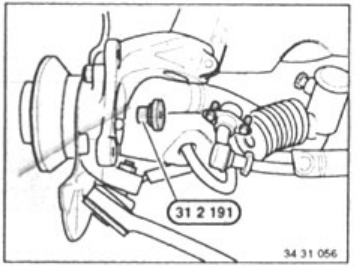
The work is identical to Replacing Bearing on Wheel Hub 31 21 151.

Caution!
When the driver flange is removed, the wheel bearing is destroyed, it is always necessary to fit a new one.

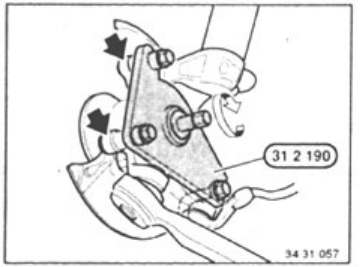
* Refer to Specifications

31 21 151 REPLACING BEARING OF LEFT OR RIGHT WHEEL HUB (DRIVE FLANGE)

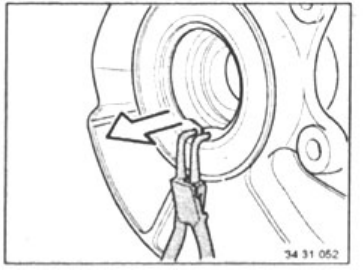
Remove output shaft - refer to 31 60 000.
Remove brake disk - refer to Group 34.



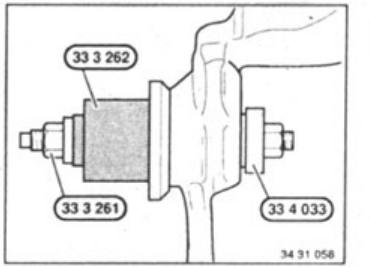
Secure the control arm to the front axle carrier with one bolt.
Apply Special Tool 31 2 191.



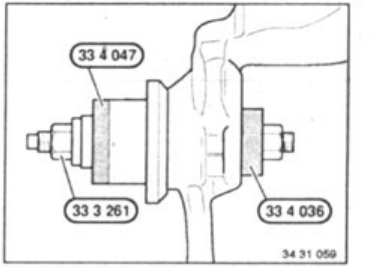
Attach Special Tool 31 2 190 on the tie rod arm and bolt it at the brake caliper mounting points.
Press the drive flange out.
Remove the special tool.



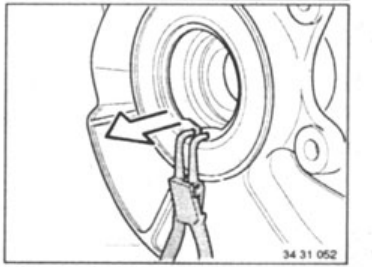
Remove the circlip.



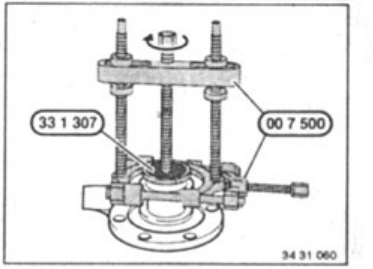
Pull the bearing out using Special Tools 33 3 261 / 262 and 33 4 033.



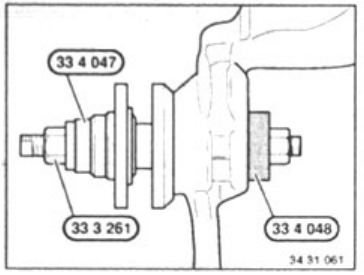
Pull a new bearing in using Special Tools 33 3 261 and 33 4 036 / 047.



Install the circlip.

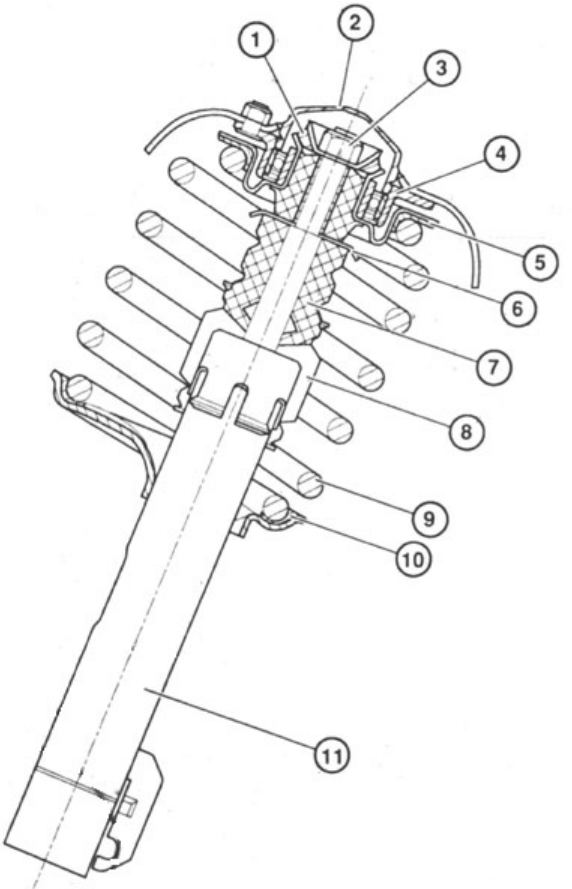


Pull the bearing inner race off of the drive flange using Special Tools 00 7 500 and 33 1 307.



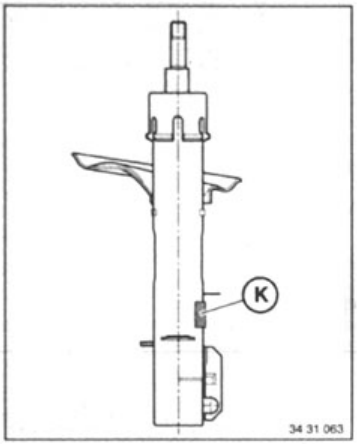
Pull the drive flange in using Special Tools 33 3 261 and 33 4 047 / 048.
Install the output shaft and brake disk.

SPRING STRUT ASSEMBLY DRAWING



1 Stop washer
2 Cap
3 Nut
4 Mount
5 Spring retainer, upper
6 Washer
7 Rubber mount
8 Bellows
9 Coil spring
10 Spring retainer, lower
11 Spring strut shock absorber

34 31 062



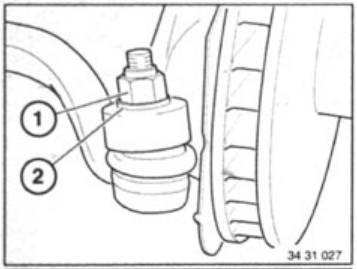
31 31 031 Replacing left or right front spring strut shock absorber

To know whether a spring strut shock absorber has to be replaced, it must either be checked installed with a Shock Tester or removed and checked in a shock absorber testing machine.
Also refer to Service Information 37 01 92 (562).

When replacing a spring strut shock absorber, always ensure that the replacement unit is marked with the same code (K) as the old shock absorber.

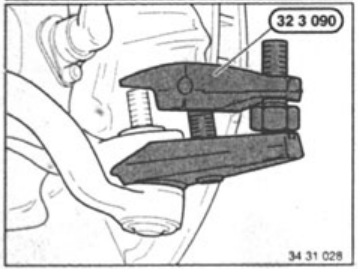
Remove front wheel, see 36 10 300.
Remove stabilizer bar, see 31 35 000.
Remove brake caliper and tie up, (do not sever brake line), refer to 34 11 519.

Caution!
After assembly:
Check that output shafts are correctly located in front axle differential.



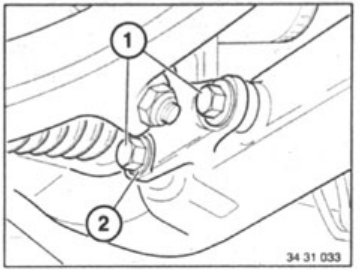
Unscrew nuts (1).

Installation:
Replace self-locking nut.
Install washer (2).
Tightening torque 32 21 3AZ*.



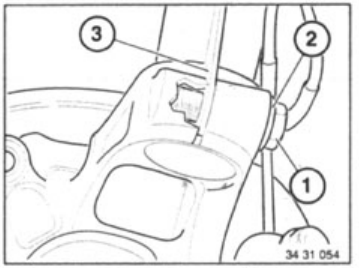
Press off track rod with special tool 32 3 090.

* Refer to Technical Data



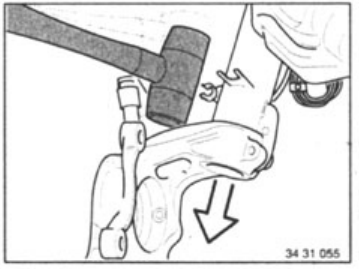
Unscrew bolts (1).

Installation:
Fit washer (2) to the front screw.
Tightening torque 31 12 8AZ*.

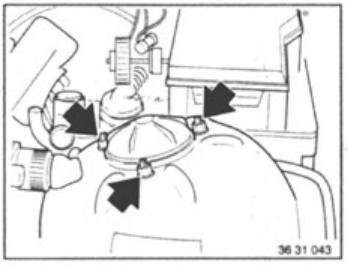


Unfasten and remove screw (1).

Installation:
Install washer (2).
Screw (1) must locate in bore of retaining web (3).
Tightening torque 31 31 3AZ*.



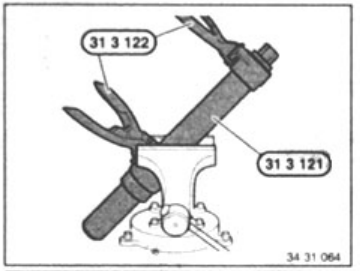
Support swivel bearing.
Use a plastic hammer to knock the swivel bearing off the spring strut.
To prevent damage to the propeller shaft, lower the swivel bearing until the spring strut is freely accessible.



Unscrew nuts and remove spring strut.

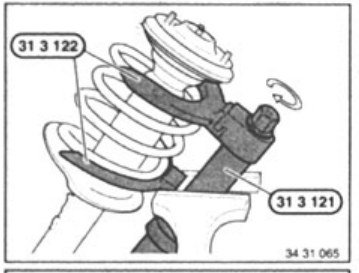
Installation:
Tightening torque 31 1 1AZ*.

* Refer to Technical Data

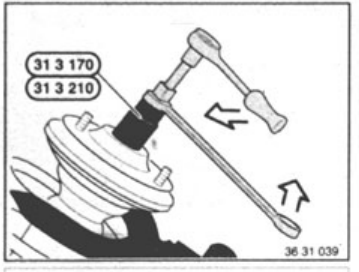


Clamp special tool 31 3 121/ 122 on the jaw support in the vise.

Caution!
Do not squeeze together guide bore.



Take up spring strut shock absorber in the special tool and compress the coil spring.



Unscrew nut with special tool 31 3 170 / 210 (exchanging wrench socket if necessary) and take off spring strut shock absorber.

Installation instruction:
Replace self-locking nut.
Tightening torque 31 31 2AZ*.



Installation instruction:
Check rubber damper with protective tube and spring rings, replacing if necessary.
Note installation sequence, see arrangement of spring strut shock absorber.
Ends of springs must locate in the recesses in the plate spring.

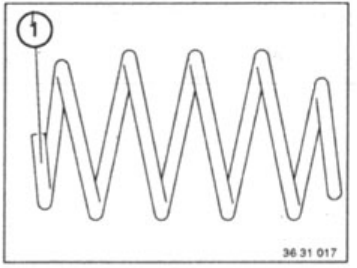
* Refer to Specifications

31 33 001 REPLACING LEFT OR RIGHT SPRING STRUT MOUNT

The procedures are identical with those for "Replacing Spring Strut Shock Absorber" in 31 31 031.

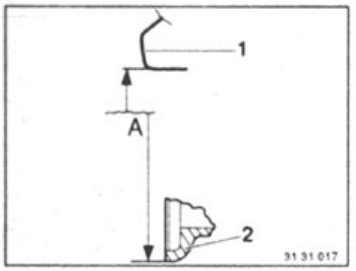
31 33 100 REPLACING COIL SPRING FOR LEFT OR RIGHT FRONT SPRING STRUT

The procedures are identical with those for "Replacing Spring Strut Shock Absorber" in 31 31 031.



Important!
Only install pairs of springs on one axle with the same BMW part number (1) (found on end of the spring).

Refer to the Parts Microfiche for a survey of springs according to vehicle types and, if applicable, special equipment such as air conditioner, sport suspension, etc. as well as introduction dates.



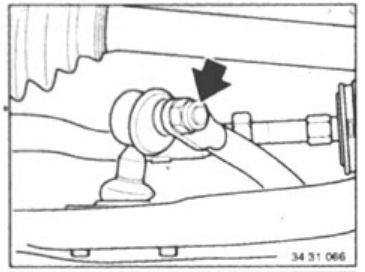
31 33 ... MEASURING / CORRECTING RIDE LEVEL HEIGHT

Load down car to normal position*.

Measure actual height (A) from wheel house lower edge (1) to rim flange (2) at center of wheel height. Determine the mean value of each wheel after lifting and lowering the car body, and then the mean value of the axle.

In case of deviation from the nominal value*, install new coil springs - refer to parts microfiche for information on determining correct coil springs.

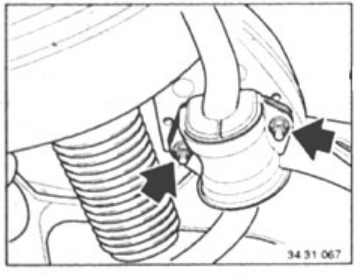
* Refer to Specifications



31 35 000 REMOVING AND INSTALLING FRONT STABILIZER

Unscrew left and right nuts.

Installation:
Tightening torque*.



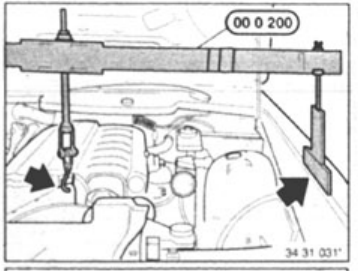
Unscrew left and right nuts.
Remove the stabilizer.

Installation:
Tightening torque*.

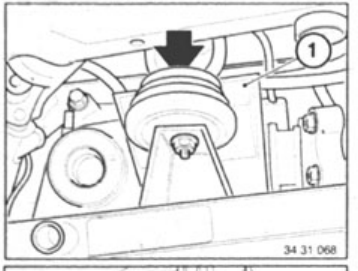
* Refer to Specifications

31 50 000 Removing and installing or replacing the front axle differential

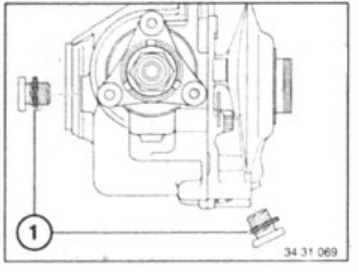
Removing input shaft from front axle differential, see 26 20 000.
Removing left and right output shafts, see 31 60 000.



Attach engine to special tool 00 0 200. The supports locate against the screw connection of the side wall.



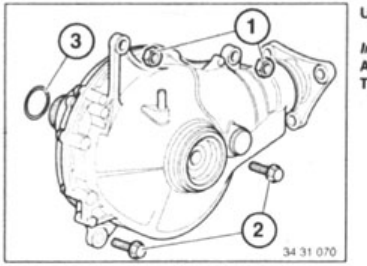
Unscrew nut.
Lift engine using special tool 00 0 200 and turn detent (1) outwards.



Unfasten screw and drain off transmission oil.

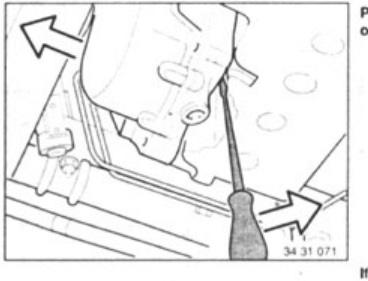
Installation instruction:
Replace sealing rings (1). Fill with transmission oil.**
Tightening torque 31 50 2AZ / 3AZ*.

* Refer to Specifications
** Refer to Consumables Specifications



Unfasten nuts (1) and screws (2).

Installation instruction:
Always replace sealing ring (3).
Tightening torque 31 50 6AZ*.



Press front axle differential away from engine oil sump and remove by lowering downwards.

If necessary, replace sealing ring, see 31 51 015.

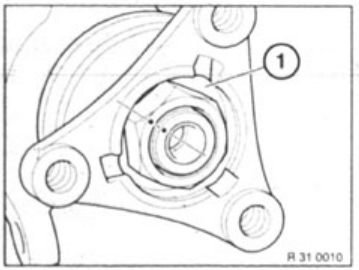
Running-in note for exchange or repairs to the front axle differential:

The running-in rules and the oil change interval for new vehicles apply.
Up to 1000 km: max. permitted roadspeed = 2/3 of top speed.
A label or tag should be provided to remind the driver.

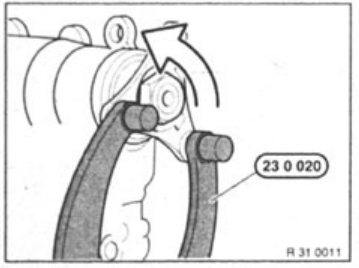
* Refer to Specifications

31 51 010 Replacing shaft seal for input flange on front axle differential

Removing input shaft from front axle differential, see Gr. 26.

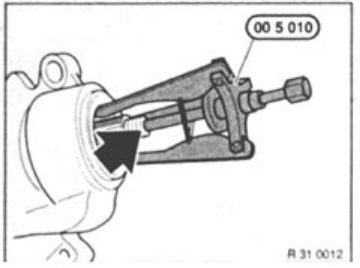


Lever out retaining plate (1).
Mark the position of the nut on the shaft with punch marks.



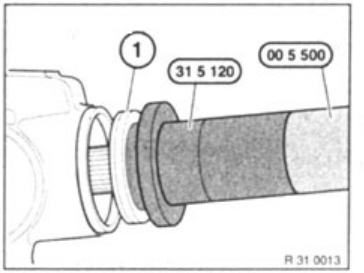
Use special tool 23 0 020 to brace the input shaft and unfasten nut.
Remove input flange.

Caution!
If an input flange is badly worn, it must be replaced, see 31 51 512.

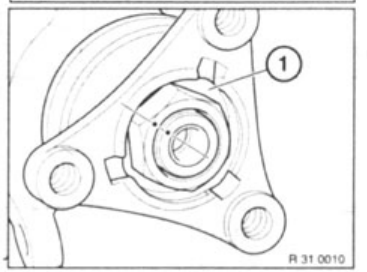


Shaft seal with special tool 00 5 010 abziehen.

Caution!
Do not damage the bush in the shaft.



Dip the shaft seal (1) in oil* and drive firmly home with special tool 31 5 120 / 00 5 500.



Clean and fit input flange.
Tighten nut until punch marks on nut and shaft are aligned with each other.

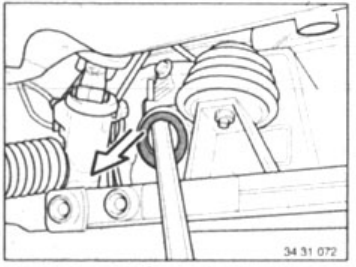
Caution!
Under no circumstances tighten the nut beyond the punch marks since it is otherwise necessary to replace the clamping sleeve: see 31 51 512 Replacing Input Flange. For this, the punch marks should be aligned before starting work.

Replace retaining plate (1).
Top up oil* in front axle differential.

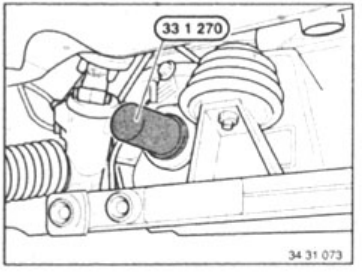
* Refer to Consumables Specifications

31 51 015 REPLACING SHAFT SEAL FOR LEFT OUTPUT SHAFT

Remove output shaft - refer to 31 60 000.



Lever the shaft seal out with help of a tire iron.



Dip the shaft seal in gear lube and drive it in as far as the stop using Special Tool 33 1 270.

31 51 020 REPLACING SHAFT SEAL FOR RIGHT OUTPUT SHAFT

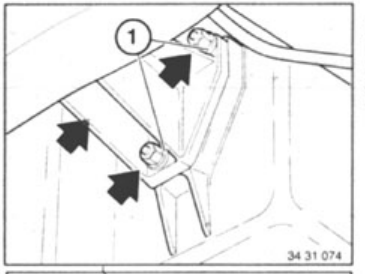
The procedures are the same as those for "Replacing Shaft Seal for Left Output Shaft" in 31 51 015.

31 51 060 REPLACING RIGHT FRONT AXLE FINAL DRIVE O-RING

The procedures are identical with those for "Removing Front Axle Final Drive" in 31 50 000.

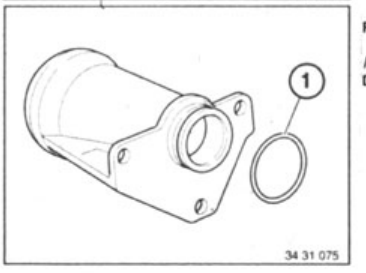
31 51 065 REPLACING RIGHT CONSOLE O-RING

Remove right output shaft - refer to 31 60 000.



Unscrew the bolts and remove the console.

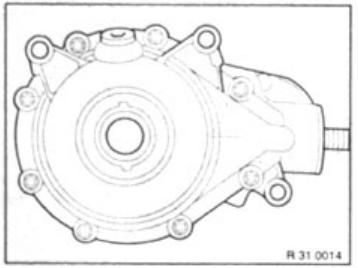
Installation:
Remove washer (1).
Tightening torque*.



Replace O-ring (1).

Installation:
Dip the O-ring in gear lube.

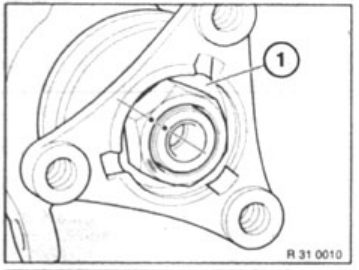
* Refer to Specifications



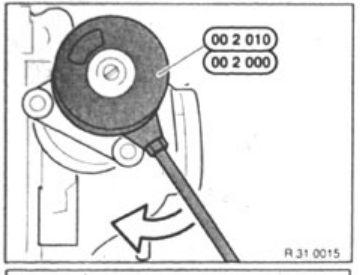
31 51 512 Replacing input flange

- Front axle differential removed -

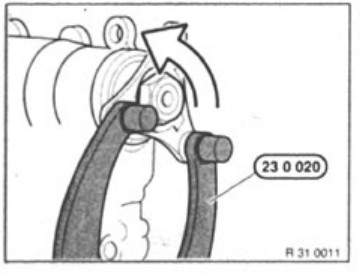
Unscrew bolts.
Remove cover and shim.



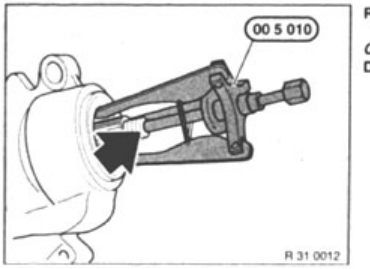
Lever out retaining plate (1).



Use special tool 00 2 010 or 00 2 000 to determine the friction torque of the drive pinion bearing and note down result.

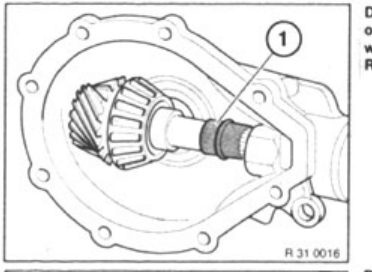


Use special tool 23 0 020 to brace the input flange and unfasten the nut.
Remove input flange.

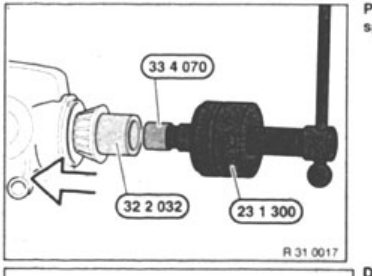


Remove shaft seal with special tool 00 5 010

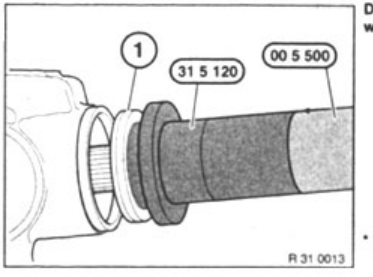
Caution!
Do not damage the bush in the shaft.



Drive drive pinion off inner bearing race of outer bearing with plastic hammer or force off with press if necessary.
Replace clamping sleeve (1).



Pull drive pinion onto inner bearing race with special tools 32 2 032 / 33 4 070 and 23 1 300.

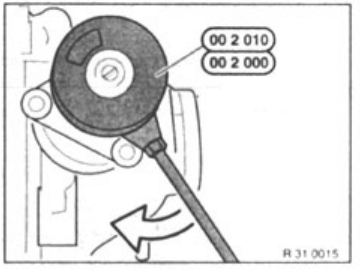


Dip shaft seal (1) in oil* and drive firmly home with special tool 31 5 120 / 00 5 500.

* Refer to Consumables Specifications



Clean new input flange, attach and tighten the new nut with special tool 23 0 020 to a tightening torque of 31 52 1AZ*.



Use special tool 00 2 010 or 00 2 000 to measure the friction moment. Gradually tighten the nut until the friction moment reaches the specified value + 20 Ncm for the new shaft seal.

Caution!
If the nut was tightened too far, replace the clamping sleeve. Loosening the nut to adjust the friction value is not permitted.

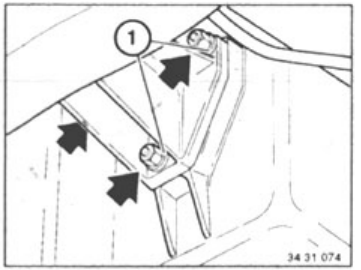
Replace tab washer
Install differential housing.
Clean sealing face of housing and cover and coat with sealing compound***.
Screw down cover to tightening torque 31 50 6AZ*.

Top up oil** in front axle differential.

* Refer to Specifications
** Refer to Consumables Specifications
*** Source of Supply: BMW Parts Service

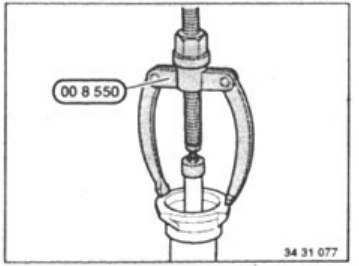
31 53 050 REPLACING RIGHT OUTPUT SHAFT BEARING (IN CONSOLE)

Remove right output shaft - refer to 31 60 000.

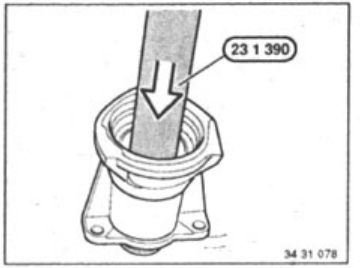


Unscrew the bolts and remove the console.

Installation:
Use washers (1).
Tightening torque*.

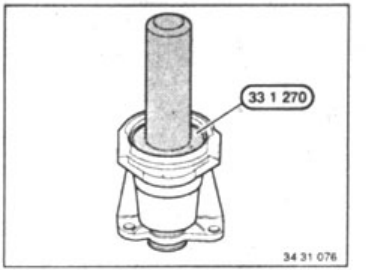


Pull the bearing out together with the shaft seal using Special Tool 00 8 550.

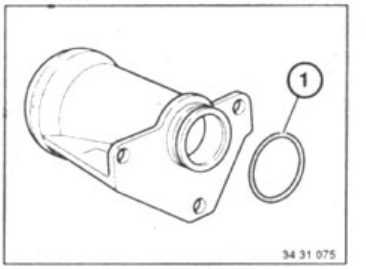


Press a new bearing in using Special Tool 23 1 390.

* Refer to Specifications



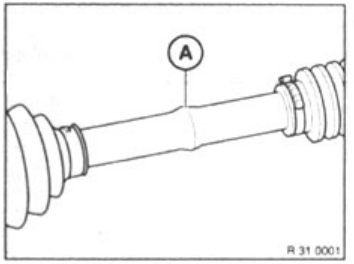
Dip the new shaft seal in gear lube and drive it in as far as the stop using Special Tool 33 1 270.



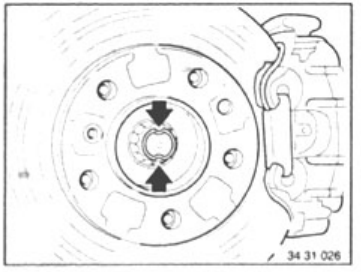
Dip new O-ring (1) in gear lube and pull it on.

31 60 000 Removing and installing or replacing left or right output shaft

After assembly:
Check that output shafts are correctly located in front axle differential.
Check oil level.



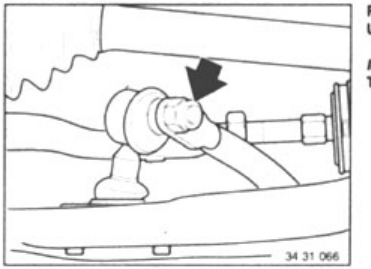
Caution!
If an output shaft without web is replaced with an output shaft with web (A), a new detent must be installed on the engine mounts - in accordance with Parts film - on the appropriate side.



Remove cover on front wheel.
Unfasten collar nut.

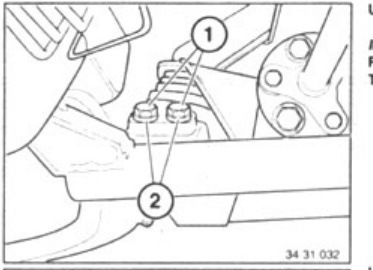
Installation instruction:
Replace collar nut.
Tightening torque*.
Peen (secure) the collar on the nut with a punch in both grooves of the shaft.

* Refer to Specifications



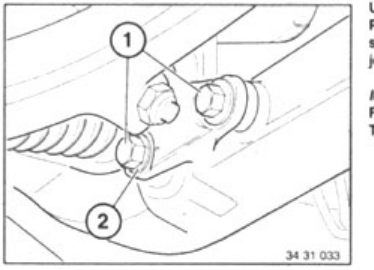
Remove front wheel, see Gr. 36.
Unfasten screw.

Installation instruction:
Tightening torque*.



Unscrew bolts (1).

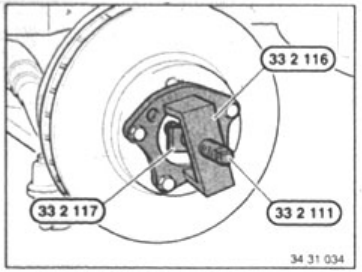
Installation instruction:
Fit disks (2).
Tightening torque*.



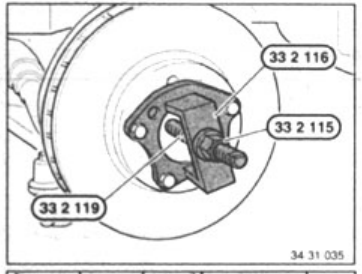
Unscrew bolts (1).
Pull control arm to one side and secure to spring strut with wire to ensure that the ball joint on the spring strut is not damage.

Installation instruction:
Fit washer to the front screw (2).
Tightening torque*.

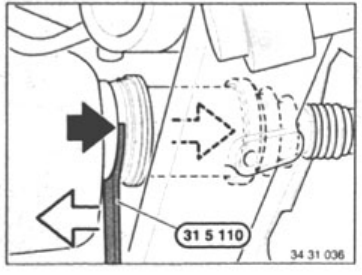
* Refer to Specifications



Screw on special tool 33 2 111/116/117 with 3 wheel studs.
Press output shaft out of left and right sides of driver flange.

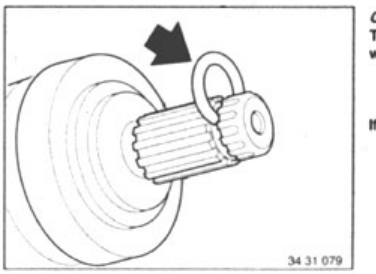


Installation instruction:
Screw on special tool 33 2 115/116/119 with 3 wheel studs.
Pull output shaft into the driver flange.



Slide special tool 31 5 110 into the gap between housing and output shaft. Lever out left and right sides of output shaft with a jolt and remove.

Installation instruction:
The snap ring on the output shaft must audibly locate in the front axle differential.

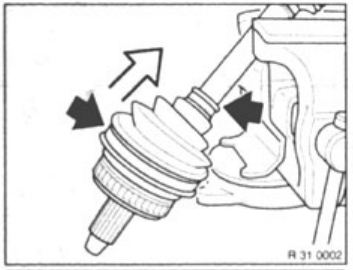


Caution!
The retaining ring on the output shaft must always be replaced.

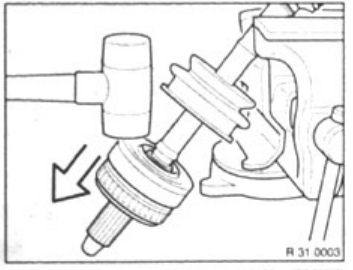
If necessary, replace shaft seal, see 31 51 015.

31 60 020 Replacing one constant velocity joint (outer) on the output shaft

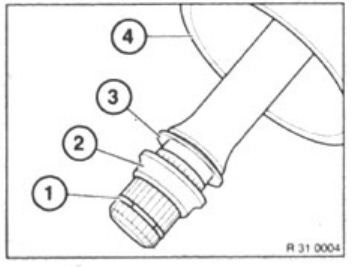
Remove output shaft 31 60 000.



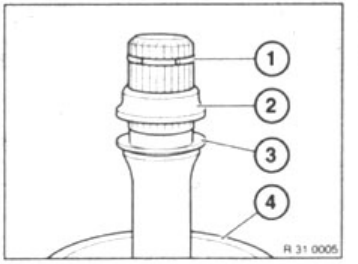
Clamp output shaft in vise with aluminum jaws.
Unfasten both clips and remove gaiter.



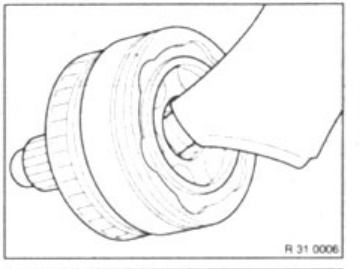
Use a plastic hammer to drive the constant velocity joint off the spline shaft.



Remove retaining ring (1), adapter ring (2), plate spring (3) and gaiter (4).
Clean spline shaft.

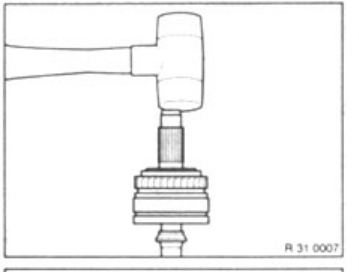


Slide on new gaiter (4).
Fit new plate spring (3) and new adapter ring (2) - note installation position.
Insert new retaining ring (1) in the groove.

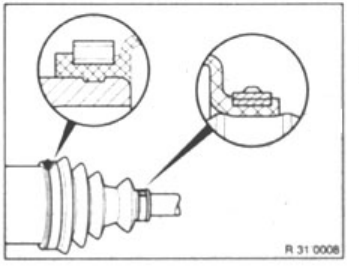


Apply approx. 2/3 of volume of grease from the b l u e tube in the new constant velocity joint.
Distribute the remaining grease in the gaiter.

Caution!
Only use grease from the blue tube.



Use a plastic hammer to drive the constant velocity joint on to the spline shaft until the retaining ring engages in its functional position.

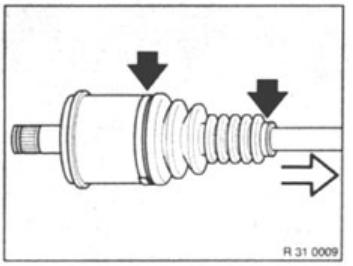


Fit gaiter to constant velocity joint and move spline shaft in to installation position.
Insert screwdriver between gaiter and spline shaft and vent constant velocity joint.
Secure gaiter with new clips.

31 60 030 Replacing one gaiter on the output shaft (outer)

Work is identical to 31 60 020 - Replacing Constant Velocity Joint (outer).

Caution!
Clean the constant velocity joint thoroughly.



31 60 035 Replacing both gaiters on the output shaft

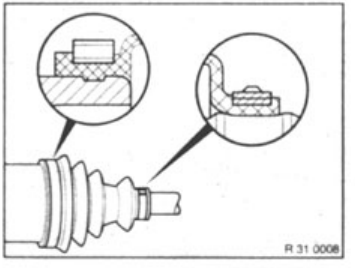
Remove constant velocity joint (outer), 31 60 020

Unfasten both clips on inner joint and remove gaiter.

Do not dismantle the joint!

Clean the joint thoroughly.
Insert approx. 2/3 of the volume of grease in the two w h i t e tubes into the joint.
Distribute the remaining grease in the new gaiter.

Caution!
Only use grease from the white tubes.



Move gaiter on joint and on spline shaft into installation position.
Insert screwdriver between gaiter and spline shaft and vent joint.
Secure gaiter with new clips.

TROUBLESHOOTING FRONT AXLE

Condition	Cause	Correction
Grinding noise (louder in curves)	a) Wheel bearings faulty	a) Replace wheel bearings
Vibration	a) Imbalance of wheels b) Rim lateral and radial runout c) Tire radial runout d) Output shaft faulty	a) Balance wheels b) Replace rims if necessary c) Replace output shaft d) Replace output shaft
Steering wheel shake	a) Imbalance of wheels b) Rim lateral and radial runout c) Shock absorber effect insufficient d) Control arm mounts faulty e) Wrong control arm mounts installed f) Excessive steering gear play g) Output shaft faulty	a) Balance wheels b) Replace rims if necessary c) Replace shock absorbers d) Replace control arm mounts e) Exchange control arm mounts f) Adjust pressure point g) Replace output shaft
Rattling noise	a) Control arm ball joint worn b) Stabilizer rubber mounts worn c) Thrust strut ball joints worn d) Front axle carrier mounted loose at body	a) Replace control arm b) Replace rubber mounts c) Replace thrust strut d) Tighten (check threads)
Load change knock	a) Excessive backlash b) Output shaft faulty	a) Adjust backlash b) Replace output shaft
Acceleration or overrun noise	a) Backlash excessive or insufficient	a) Adjust backlash
Oil loss	a) Radial oil seal leaks b) Vent plugged c) Wrong oil grade	a) Replace radial oil seal b) Clean vent c) Replace front axle final drive oil*

* Refer to Operating Fluids

TROUBLESHOOTING FRONT AXLE

Condition	Cause	Correction
Body swing long time after driving car over rough road	Weak shock absorbers - refer to troubleshooting shock absorbers on page 31-90/3.	Replace shock absorbers.
Body wip when driving car over successive rough road surfaces		
Body rise while accelerating		
Wheel jump even on normal road surfaces		
Car breaking out while breaking		
Breaking out (skidding) in curves due to poor track holding		

The condition of shock absorbers can be checked with a shock absorber tester or in a shock absorber testing machine.

TROUBLESHOOTING SHOCK ABSORBERS

Condition	Cause	Correction
Shock absorbers knocking (bottoming)	a) Rubber dampers faulty	a) Check or replace rubber dampers
	b) Weak shock absorbers	b) Replace shock absorbers
Shock absorber noise	a) Newly installed shock absorbers had been stored laying down with piston rod run in	a) Store shock absorbers standing upright with piston rod run out and at room temperature for 24 hours
	b) Shock absorbers faulty	b) Replace shock absorbers
Poor handling properties	Weak shock absorbers	Replace shock absorbers
Flat spots on tire treads	Shock absorbers faulty	Replace shock absorbers

32 Steering and wheel alignment

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GENERAL INFORMATION

Steering Gear:
The steering gear could be damaged from impact forces if a car is involved in an accident or operated under conditions similar to an accident. There must always be conformance with factory specifications in the interest of safety – refer to Service Information 32 01 88 (828).

Tie Rod Joint:
Refer to Service Information 32 03 87 (733) for an evaluation of wear on ball joints.

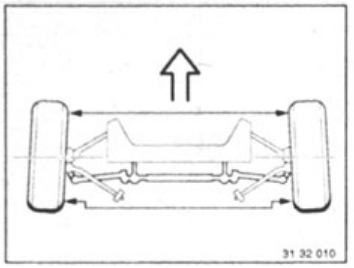
Servotronic:
Troubleshoot with BMW DIAGNOSING SYSTEM - refer to Car Electric/Electronic Test Plan.

Airbag:
Troubleshoot with BMW DIAGNOSING SYSTEM - refer to Car Electric/Electronic Test Plan.

M5:
The rear wheel toe can be adjusted.

Electric Steering Wheel Adjustment:
Troubleshoot with BMW DIAGNOSING SYSTEM - refer to Car Electric/Electronic Test Plan.

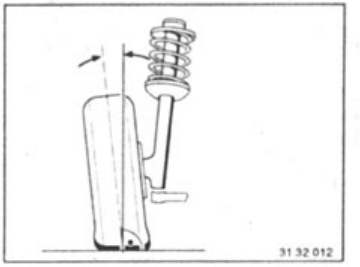
Car with Interlock System:
The function must be checked if a component of the interlock system had been removed and installed or the installed position of the interlock cable was changed - refer to 33 32 170.



GENERAL INFORMATION AND DEFINITIONS

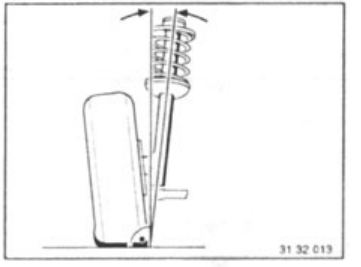
Toe

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".



Camber

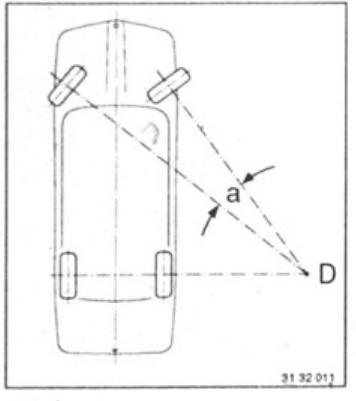
Is the inclination of the wheel from the perpendicular.



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 so strong influence on the steering.

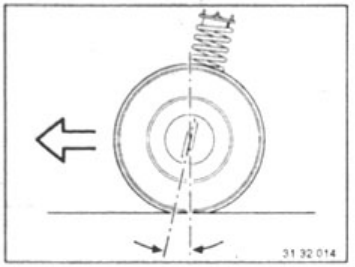


Toe difference angle

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 factory tolerances.

a = Toe difference angle
D = Turning circle center point

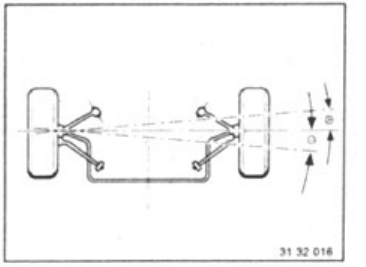
* The "king pin" is equal to a line through the center point of the spring strut mount and control arm ball joint.



Caster

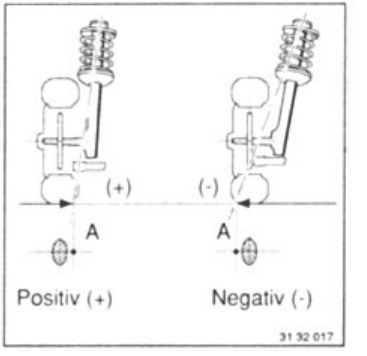
is the inclination of the king pin* in forward direction as seen from the side.

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.



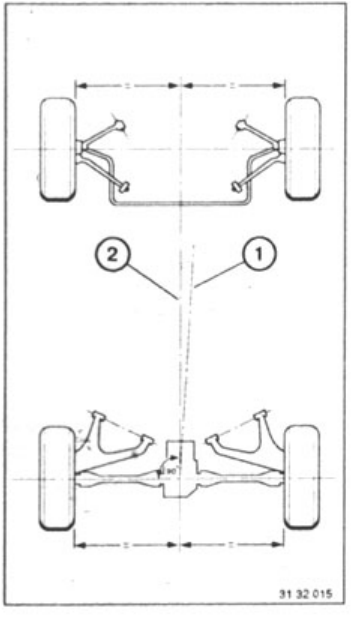
Wheel offset

is the angle, by which one front wheel is displaced more toward front or rear than the other front wheel.



King pin offset / scrub radius

is the distance from the center of the point of contact between the wheel and road to the point of intersection of an extended king pin* axis.
Scrub radius is influenced by camber, king pin inclination and rim offset.



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.

* **The "king pin" is equal to a line through the center point of the spring strut mount and control arm ball joint.**

* **The "king pin" is equal to a line through the center point of the spring strut mount and control arm ball joint.**

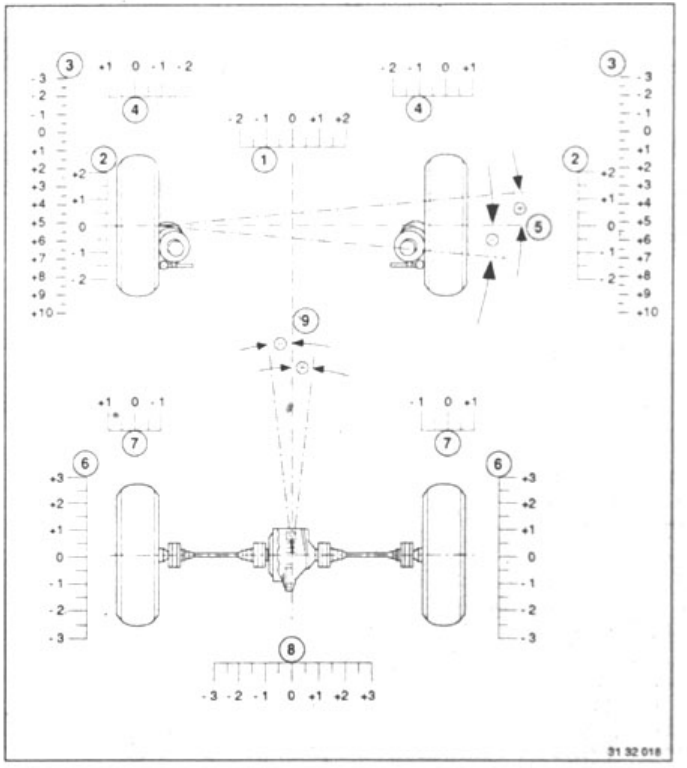
32 00 150 CHECKING WHEEL ALIGNMENT WITH ELECTRONIC TESTER (with KDS)

Requirements to be fulfilled prior to checking wheel alignment:

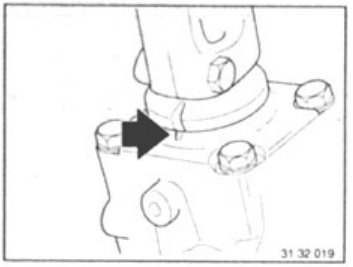
1. Good, uniform tire treads.
2. Specified tire pressure**.
3. Wheel rims in perfect condition*.
4. Specified wheel bearing play*.
5. Car loaded down to normal position*.
6. Specified ride level height*.

Always check wheel alignment only with a recommended electronic tester (see Workshop Equipment) and also use/turntables on the rear wheels.

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

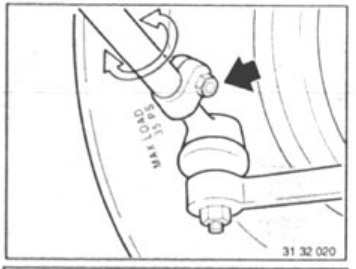


* Refer to Specifications of Gr. 31/32/33/36
** Refer to Service Information of Gr. 36



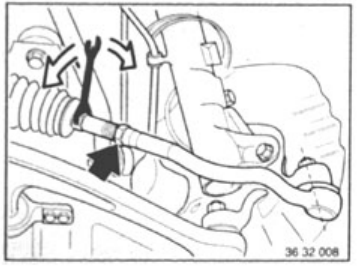
32 00 610 Adjusting front axle (with KDS)

Adjust toe-in and toe-out angles.
Set steering gear in straight ahead position (marks on casing and steering shaft must agree).



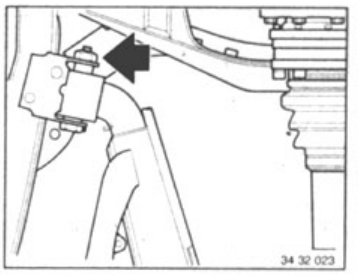
Loosen both clamping screws of tie rod.
Adjust toe-in of left and right wheel by turning the threaded sleeve to the specified setpoint*.

Installation note:
Make sure the ball joint is not twisted.
For tightening torque*.



Four-wheel drive:
Loosen nut.
Adjust toe-in of left and right wheel by turning the tie rod to the specified setpoint*.

Installation note:
Make sure the ball joint is not twisted.
For tightening torque*.



32 00 620 Adjusting rear axle (with KDS)

M5:
Loosen nut.
Adjust toe-in on left and right wheel by turning the eccentric screw to the specified setpoint*.

Installation note:
Firmly tighten screw on right-hand semi-trailing arm with special tool 33 3 060 to tightening torque*.

* Refer to Technical Data

* Refer to Technical Data

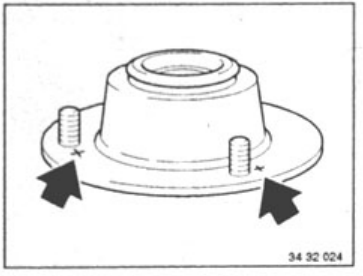
32 00 ... CORRECTING CAMBER

Eccentric mounts can be installed to correct the front axle camber by ∞ 30', when deviation is caused by the summary of unfavorable tolerances.

Important!
This measure must never be applied to eliminate changes in the axle geometry caused in an accident.

Example:

Nominal camber value	+ 7' ... – 43'
Actual camber value	– 60'
Correction added	+ 30'
New actual value	– 30'



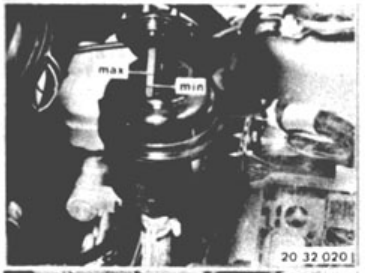
Correction mounts are marked with "+" or "–" next to the stud.
Replace spring strut mounts - refer to 31 33 001.

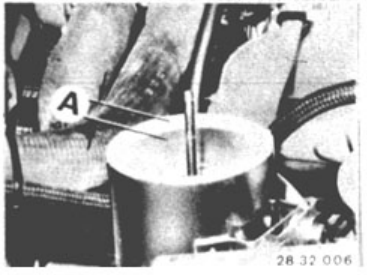
TROUBLESHOOTING FRONT WHEEL ALIGNMENT

Condition	Cause	Correction
1 Toe deviation	a) Car not in normal position b) Tie rod(s) bent c) Track arm on spring strut bent d) Tie rod ball joints worn e) Rubber mount in control arm faulty	a) Ride level height, see Specifications of Group 31 b) Replace tie rod(s) c) Replace track arm d) Replace tie rod(s) or ball joints e) Replace rubber mount
2 Camber deviation Camber is given by design and cannot be adjusted.	a) Rubber mount in control arm faulty b) Control arm deformed c) Spring strut deformed d) Guide joint worn e) Spring force insufficient f) Front axle carrier deformed g) 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) Replace coil springs Ride level height, see Specifications of Group 31 f) Replace front axle carrier g) Repair front end h) Repair body i) Install eccentric mounts
3 Caster deviation Caster is given by design and cannot be adjusted.	a) Rubber mount for thrust strut faulty b) Thrust strut deformed c) Control arm deformed d) Spring strut deformed e) Wheel house deformed (spring strut mount) f) Distortion in floor assembly (engine carrier)	a) Replace rubber mount b) Replace thrust strut c) Replace control arm d) Replace spring strut e) Repair front end f) 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 track arm
5 Wheel offset deviation	Assuming front wheels have equal single toe to geometrical axis: a) Front axle carrier deformed b) Engine carrier deformed c) Control arm deformed d) Thrust strut deformed	a) Replace front axle carrier b) Repair body c) Replace control arm d) Replace thrust strut

TROUBLESHOOTING REAR WHEEL ALIGNMENT

Condition	Cause	Correction
6 Camber deviation	a) Car not in normal position Spring force insufficient b) Rubber mounts on rear axle carrier faulty c) Rubber mounts on final drive faulty d) Silent blocks in trailing arm faulty e) Rear axle carrier deformed f) Trailing arm deformed g) Distortion in floor assembly	a) Ride level height, see Specifications of Group 33 b) Replace rubber mounts c) Replace rubber mounts d) Replace silent blocks e) Check or replace rear axle carrier f) Check or replace trailing arm g) Repair body
7 Rear wheel position deviation	a) Rear axle carrier displaced laterally b) Distortion in floor assembly	a) Check / replace rubber mounts on rear axle carrier b) Repair body
8 Toe deviation	a) Car not in normal position or spring force insufficient b) Rubber mounts in rear axle carrier faulty c) Rubber mounts on final drive faulty d) Silent blocks in trailing arm faulty e) Rear axle carrier deformed f) Trailing arm deformed g) Unfavorable summary of tolerances	a) Ride level height, see Specifications of Group 33 b) Replace rubber mounts c) Replace rubber mounts d) Replace silent blocks e) Check or replace rear axle carrier f) Check or replace trailing arm g) Install eccentric silent blocks - see 33 32 561
9 Deviation of geometrical axis from symmetrical axis	Assuming single wheel toe cannot be adjusted: a) Distortion in floor assembly	a) Repair body





32 13 006 Filling and bleeding power steering

1. Fill with engine stationary
   Fill oil container to dipstick mark "MAX" or to A = approx. 25 mm below the edge with hydraulic fluid*)

2. Bleeding
   Start engine.
   Turn steering wheel to left and right locks twice each way.

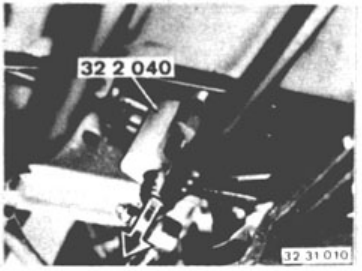
3. Oil level check with engine stationary

a) Without level regulation:
   fill up to "MAX" mark.
b) With level regulation:
   Lift rear axle until wheels are suspended. After 2 minutes, the oil level should be max. 5 mm over the base of the screen.

   Correct oil level as required with engine stationary.

On ASC + T vehicles, see 34 00 040.

* Refer to Specifications

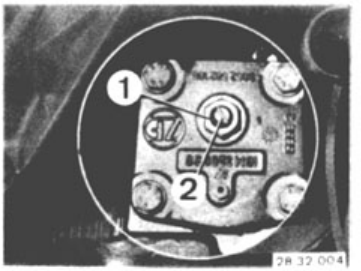


32 13 014 ADJUSTING PRESSURE POINT IN POWER STEERING GEAR

Requirements:
Steering gear and mounts/joints of steering column in perfect condition.

Unscrew the nut.
Press the tie rod off of the steering drop arm using Special Tool 32 2 040.

Installation:
Replace the self-locking nut.
Tightening torque*.

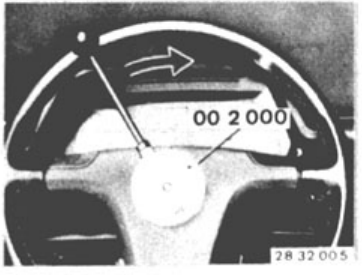


Adjusting:
Turn the steering wheel counterclockwise about 1 turn from straight ahead position.
Loosen nut (1) on the steering gear and turn adjusting screw (2) until the specified friction torque* is reached while passing the pressure point.

Installation:
Tightening torque* for nut.
Recheck the pressure point.

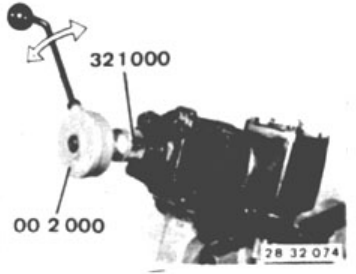


Set the steering gear ti straight ahead position (marks on spindle and case).



Lift the BMW emblem out or remove the airbag unit - refer to 32 34 020.
Turn the steering wheel counterclockwise about one turn.
Mount Special Tool 00 2 000, turn the steering wheel clockwise past the pressure point and read the friction torque*.

* Refer to Specifications



Steering Gear Removed:
Mount Special Tool 32 1 000 on the spindle and apply Special Tool 00 2 000.
Adjust as described above.

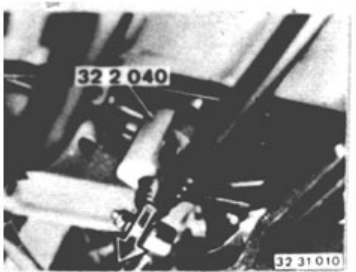
* Refer to Specifications

32 13 060 REMOVING AND INSTALLING POWER STEERING GEAR

Suck the hydraulic fluid out of the tank — don't reuse it.

Installation:
Fill and bleed the hydraulic system - refer to 32 16 006.

Cars with Airbag:
Remove the steering wheel - refer to 32 33 000.



Ball-and-nut Power Steering:
Unscrew nut.
Press the tie rod off of the steering drop arm using Special Tool 32 3 040.

Installation:
Replace the self-locking nut.
Tightening torque*.



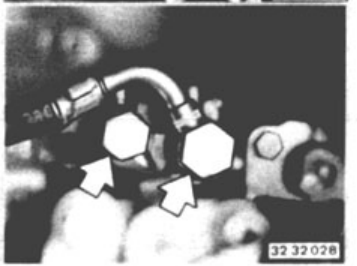
Unscrew bolt.
Push the universal joint off of the steering gear.

Installation:
The bolt must be in the locking groove of the steering stub.
Tightening torque*.

* Refer to Specifications

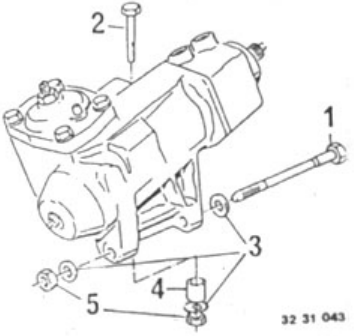


Installation:
Check the straight ahead position of the steering wheel and steering gear.
Turn the steering wheel counterclockwise or clockwise as far as lock and then back about 1.7 turns until the marks are aligned.



Unscrew the hydraulic pipes.
Plug the bores with dust caps.
If applicable, pull the plug off of the converter for Servotronic.

Installation:
Replace seals.
Tightening torque*.

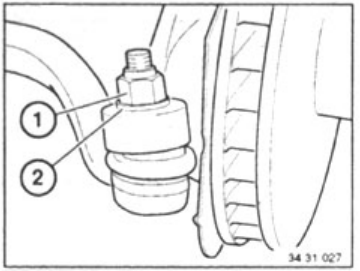


Unscrew bolts (1 and 2).
Remove the steering gear.

Installation:
Tightening torque*,

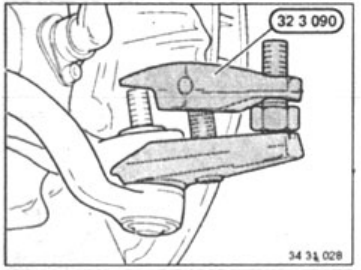
1 Bolt
2 Bolt (only use grade 10.9)
3 Washer
4 Bushing
5 Nut (replace)

* Refer to Specifications

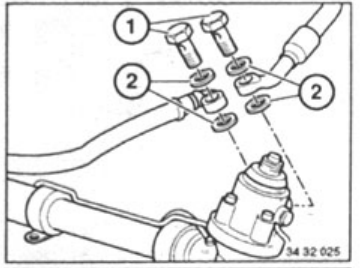


Rack-and-pinion Power Steering:
Remove the front wheels - refer to Gr. 36.
Unscrew left and right nuts (1).

Installation:
Replace the self-locking nuts.
Install washers (2).
Tightening torque*.

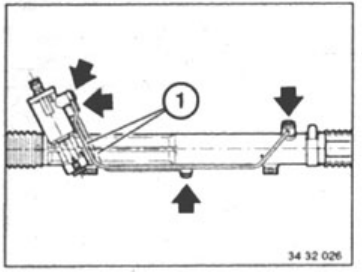


Press the left and right track rods off using Special Tool 32 3 090.



Unscrew steering gear bolts (1).

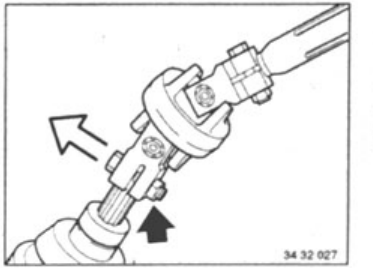
Installation:
Replace seals (2).
Tightening torque*.



Unscrew return pipes (1) from the steering gear.

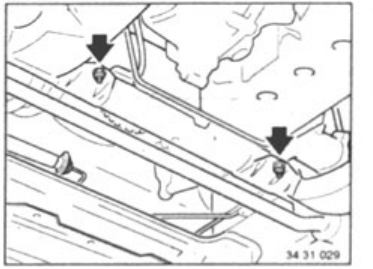
Installation:
Replace the seals.
Tightening torque*.

* Refer to Specifications



Remove the bolt and disconnect the joint from the steering gear.

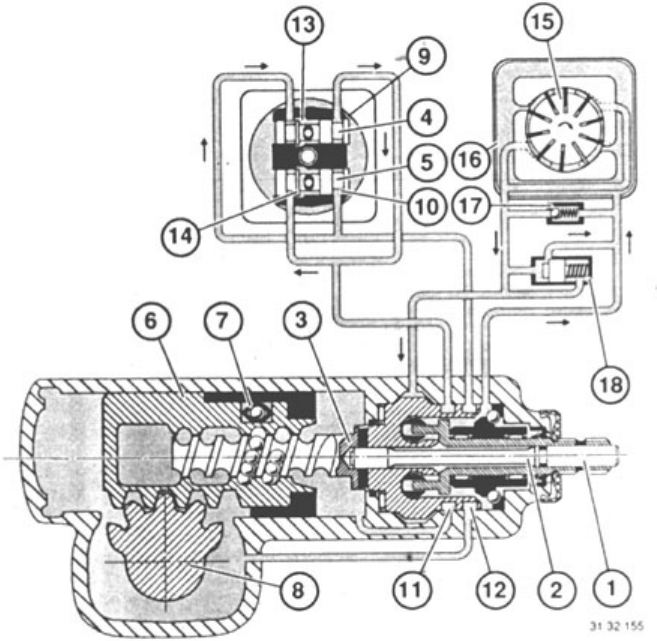
Installation:
The bolt must be located in the groove of the steering gear spindle.
Replace the nut.
Tightening torque*.



Unscrew left and right nuts.
Remove the steering gear from the side.

Installation:
Tightening torque*.

* Refer to Specifications



DESIGN AND DESCRIPTION OF BALL AND NUT POWER STEERING

The housing contains a complete mechanical steering gear, the control valve and operating cylinder. Steering spindle (1) is connected elastically with worm (3) via torsion bar (2) and with valve pistons (4 and 5) without play. The valve pistons are installed transversely in the worm head. The connection between piston (6) and worm (3) is accomplished with an infinite line of balls. When turning the worm the balls are taken up at one end by circulating tube (7) and put out again at the other end of the balls. Piston (6) and sector shaft (8) are meshed. The special shape of teeth on the sector shaft permits zero-play adjustment with an adjusting screw.

In neutral position of valves (4 and 5) the oil flow delivered by the pump passes through the steering and can flow through the opened feed and return control edges to the cylinder chamber and return flow. Hydraulic support cuts in when force is transmitted from the steering wheel or from the steering drop arm via the sector shaft and pistons to the worm. Torsion bar (2) then serves as a link. It deforms itself in the elastic range and returns the valve pistons to neutral position after releasing the steering wheel. Moving valves (4 and 5) will let the oil flow into only one of the operating cylinder chambers and in this manner support the rotating motion of the steering spindle and/or counteract the jolt from rough roads.

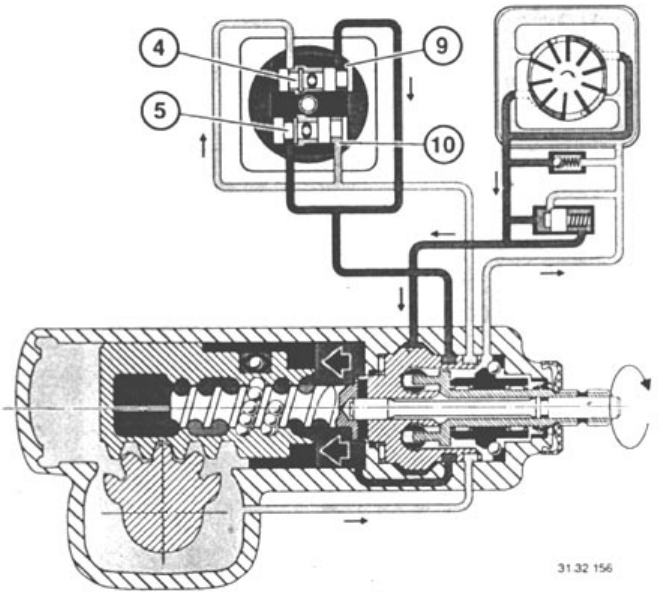
Steering Wheel in Neutral Position:

Oil flows from the impeller pump into the worm head, through feed grooves (9 and 10) to radial grooves (11 and 12). From here via connecting bores to the right and left cylinder chambers and via opened return flow grooves (13 and 14) back to the oil tank. The valve is also illustrated in cross section.

15 = Pump
16 = Oil tank
17 = Pressure relief valve
18 = Control valve

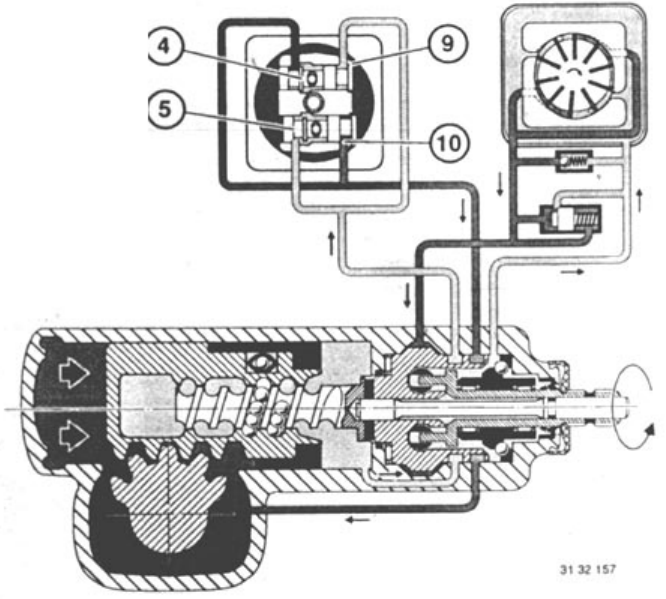
Steering Wheel Turned Clockwise:

Valve piston (4) is displaced to the right and feed groove (9) opened. Valve piston (5) is displaced to the left and feed groove (10) closed. This lets the oil flow into the right cylinder chamber. Oil in the left cylinder chamber is forced out and flows back into the oil tank.



Steering Wheel Turned Counterclockwise:

Valve piston (5) is displaced to the right and feed groove (10) opened. Valve piston (4) is displaced to the left and feed groove (9) closed. This lets the oil flow into the left cylinder chamber. Oil in the right cylinder chamber is forced out and flows back into the oil tank.



SERVOTRONIC

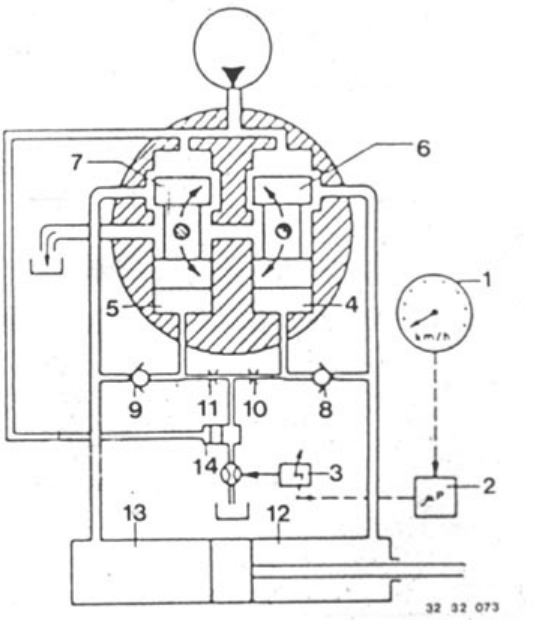
Components:
Electronic speedometer
Control unit (installed in A pillar)
Electric/hydraulic converter (bolted on steering gear)

Design:
The speed signal from the speedometer is evaluated in the control unit and put out to the converter in form of electric pulses. The converter regulates the flow of oil out of the reaction chambers into return flow.

Description:
Turning the steering wheel clockwise causes the right valve piston (6) to move. This lets the oil flow into the right cylinder chamber (12) as well as via the right check valve (8) into the right reaction chamber (4).
When the car is in "parking" state (there are no speed signals from the speedometer), converter valve (3) remains closed and the oil continues to flow via both orifices (10 and 11) to the left reaction chamber (5). The closed left check valve (9) prevents the oil from flowing into the pressureless left cylinder chamber (13) which is connected with return flow. Since there is equal pressure in both reaction chambers (4 and 5), there is no counterforce (no reaction) on the steering wheel. The steering wheel is easy to turn.
When driving fast on "highways", the converter valve is wide open and the oil flows from the pressurized right cylinder chamber (12) via the right check valve (8), right orifice (10) and converter (3) to return flow. The right reaction chamber (4) then has full pressure, while the left reaction chamber (5) is without pressure. This produces a left-turning torque, which tries to force the valve pistons back into neutral position (maximum reaction). The steering wheel is hard to turn.
When driving at medium speed, converter valve (3) is opened only partially. The reduced ram pressure is transmitted to the left reaction chamber (5), while the right reaction chamber (4) has maximum pressure. The counterforce acting on valve pistons (6 and 7) is lower accordingly.

Cross Section Drawing of Valve in Worm Head (also refer to page 32 - 3/5):

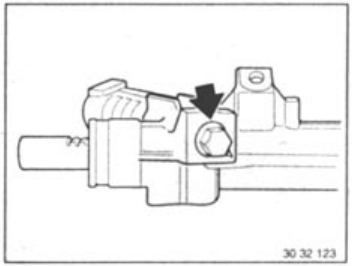
1 Speedometer
2 Control unit
3 Electric/hydraulic converter
4 Reaction chamber, right
5 Reaction chamber, left
6 Valve piston, right
7 Valve piston, left
8 Check valve, right
9 Check valve, left
10 Orifice, right
11 Orifice, left
12 Cylinder chamber, right
13 Cylinder chamber, left
14 Reaction limit valve



32 13 503 Disassembling and assembling power steering gear

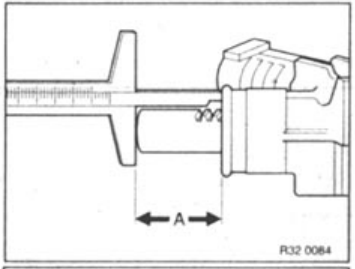
- Power steering gear removed -

Remove tie rods, refer to 32 21 231.

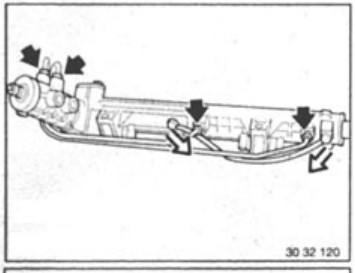


Unscrew end cap.

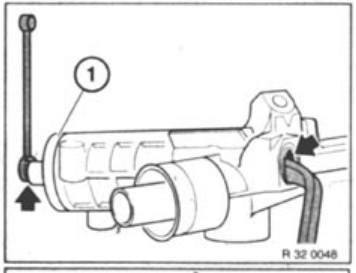
Caution!
Take the utmost care and ensure absolute cleanliness when working on the steering gear. Do not use any force whatsoever during disassembly and assembly work. The use of force can cause damage which can lead to failure of the steering system.



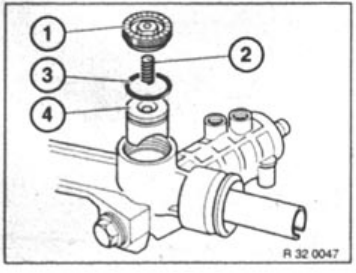
Set steering gear in mid-position (by halving total number of turns). In this position, the marks on the steering spindle, cap and housing agree. Make marks if necessary. Determine dimension (A) with a depth gage and note down. This dimension is required as a check during assembly.

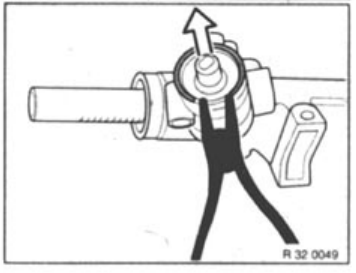


Disconnect leakage line.
Detach delivery lines and remove O-rings.
1. Mark position of adjusting screw (1) with respect to housing with center punch dots.
2. Determine installation depth of adjusting screw (1) in housing with a depth gage and note down.
3. Release adjusting screw (1).
4. Remove spring (2), O-ring (3) and spacer (4).

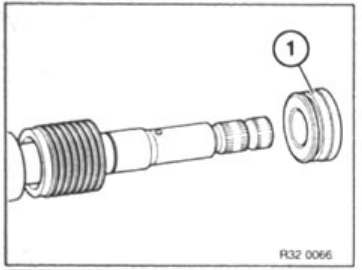


Remove protective cap (1) from steering shaft.
Release nut - held on flat of steering shaft -

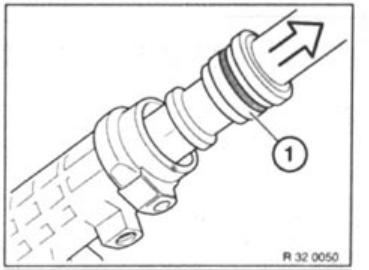




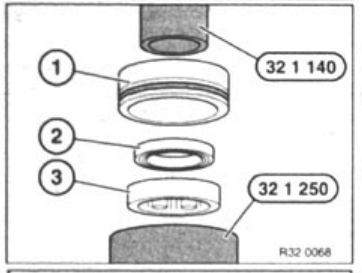
Lever out snap-ring.
Pull steering shaft out of housing.



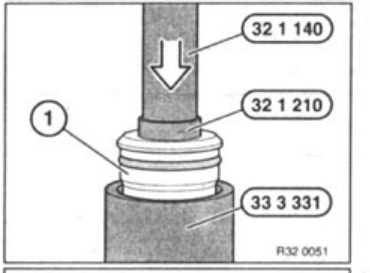
Remove bearing bush (1).



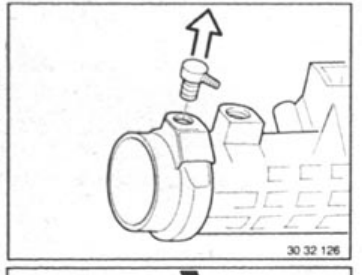
Pull gear rack with bearing bush (1) out of tube.



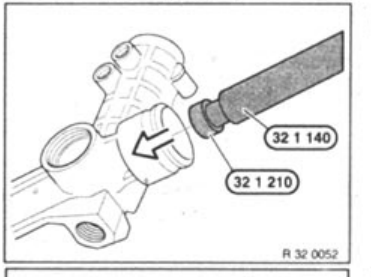
Using special tool 32 1 140/250, remove radial oil seal (2) together with bearing (3) out of bearing bush (1).



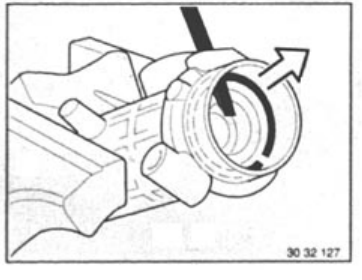
Remove radial oil seal from bearing bush (1) with special tool 32 1 140/210 and 33 3 331.



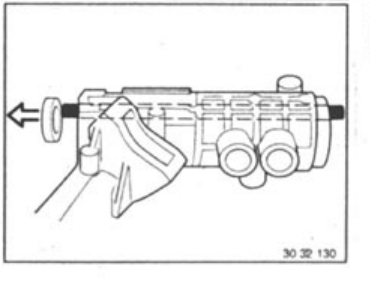
Disconnect connection for leakage oil line.



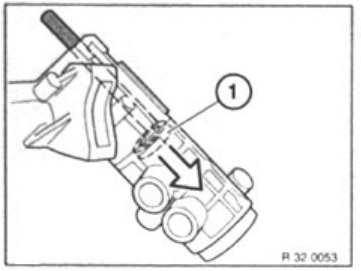
Remove radial oil seal out of tube with special tool 32 1 140/210.



Lever out snap-ring through hole for leakage oil line and pull out of housing.

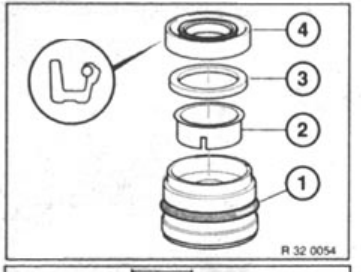


Using a drift punch, carefully drive bearing out of steering shaft housing. This improves access to the radial oil seal.

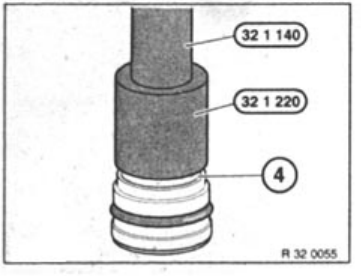


Caution!
Do not damage polished cylinder bore.
With the aid of a drift punch, carefully drive radial oil seal (1) out of steering shaft housing.

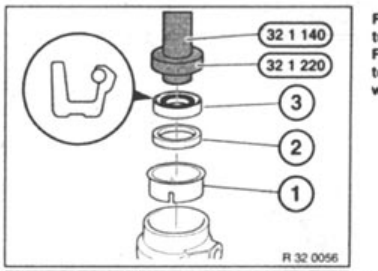
Thoroughly clean all parts.
Coat new sealing rings with hydraulic fluid and pack radial shaft seal between dust cap and sealing lip with grease, refer to BMW Fluids and Lubricants Specifications.



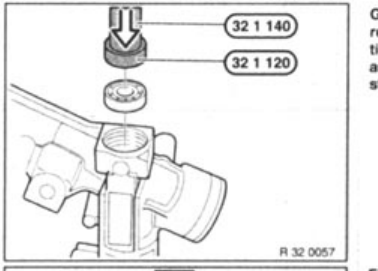
Replace O-ring (1).
Fit new plastic bush (2) and support ring (3) in bearing bush.
Radial oil seal (4).



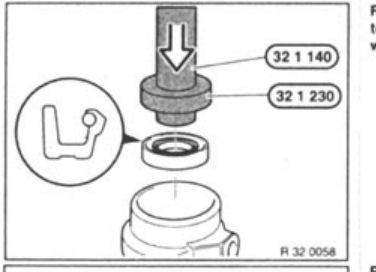
Fit new radial shaft seal (4) - with open side facing towards special tool 32 1 140/220 - as far as it will go in the bearing bush.



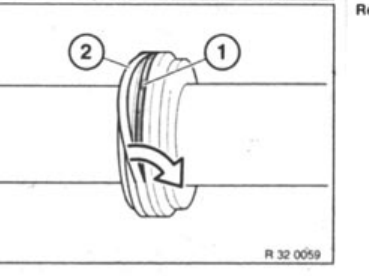
Fit plastic bush (1) and support ring (2) in the tube.
Fit new radial oil seal (3) - open side facing towards special tool 31 1 140/220 - as far as it will go in the tube.



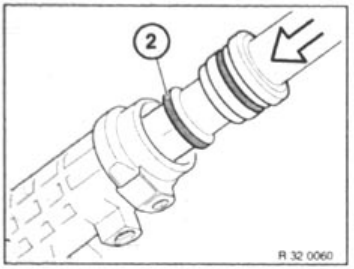
Grease bearing,
refer to BMW Fluids and Lubricants Specifications
and, using special tool 32 1 140/120 fit in steering shaft housing as far as it will go.



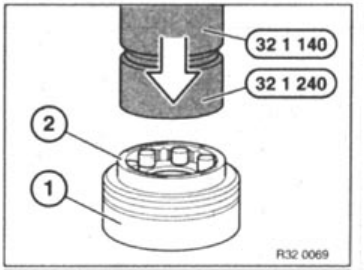
Fit new radial oil seal - open side facing towards special tool 31 1 140/230 - as far as it will go in the steering shaft housing.



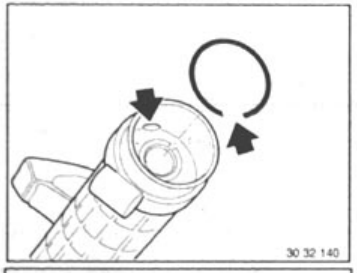
Replace O-ring (1) and piston ring (2).



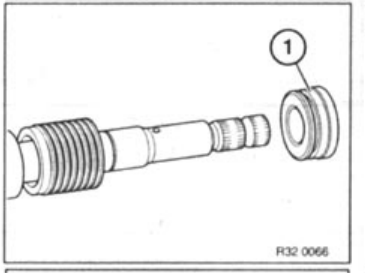
Carefully insert gear rack in the tube, making sure:
1. The inner radial oil seal is not damaged by the gear teeth and
2. the piston ring (2) is not damaged.
Fit bearing bush on gear rack and fit in tube.



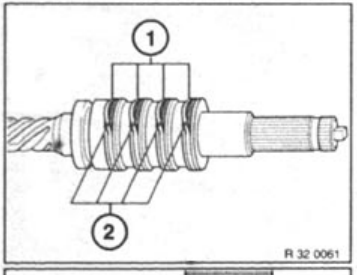
Fit bearing (2) - labelling facing upwards - as far as it will go in bearing bush (1) with special tool 31 1 140/240/250.



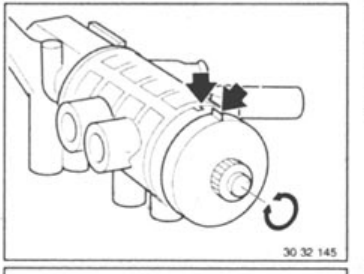
Fit new snap-ring with the open side located opposite the leakage oil hole.



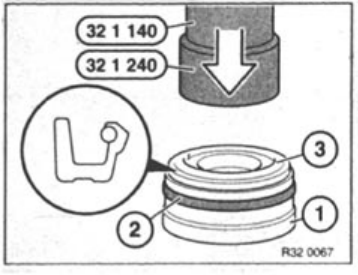
Fit bearing bush (1) - radial oil seal facing upwards - on steering shaft.



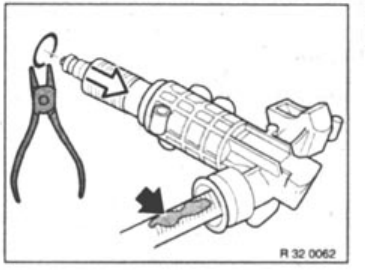
Replace piston rings (1) and O-rings (2) below them.



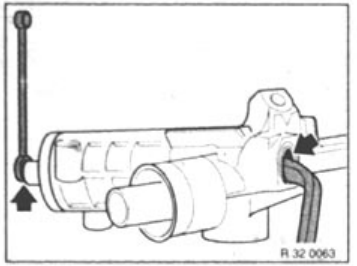
Grease rack and pinion,
refer to BMW Fluids and Lubricants Specifications.
Pull out rack by dimension (A) noted down.
Carefully insert steering shaft in housing and fit snap-ring.
Check marks.



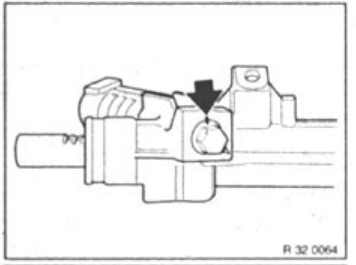
Fit new radial oil seal (3) - open side facing upward - as far as it will go in bearing bush (1) with special tool 32 1 140/240/250.
Replace O-ring (2).



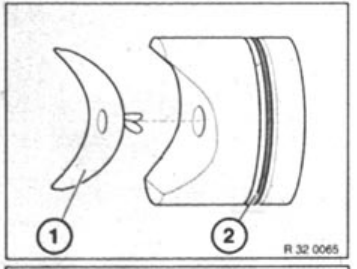
Fit new protective cap in this position where marks on housing, steering shaft and protective cap must agree.



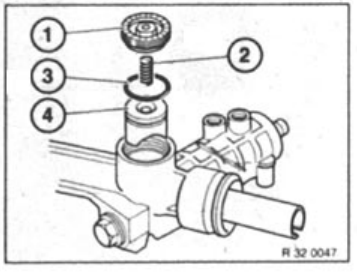
Replace self-locking nut and tighten to tightening torque = 17 Nm.



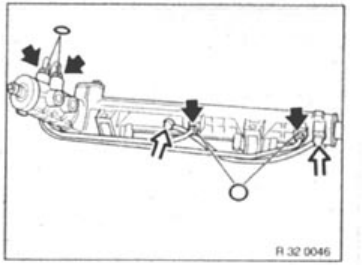
Tighten end cap to tightening torque = 32 Nm and fix in position by caulking.



Replace film inlay (1) and O-ring (2).



Grease thrust piece (4), spring (2) and O-ring (3) and fit in position.
Screw in adjusting screw (1) to the determined installation depth and align marks.
Secure adjusting screw in position by caulking.
Caution!
It must be possible to move the rack smoothly over its entire range.



Fit leakage oil line connections.
Connect leakage oil line and install delivery lines with new O-rings.
Tightening torque = 20 Nm.

TROUBLESHOOTING BALL AND NUT POWER STEERING

Condition	Cause	Correction
Steering hard to turn left or right from center	Pressure point adjusted too tight	Adjust pressure point
Steering runs automatically to final position onesidedly	Valve setting for hydraulic center incorrect	Replace steering gear (adjusting only possible in the factory)
Steering wheel has excessive play	a) Steering gear loose on front axle carrier b) Universal joints have excessive play c) Joint disk loose d) Tie rod ends worn e) Play between worm and piston f) Worm has axial play g) Insufficient oil in system	a) Tighten steering gear b) Replace universal joints c) Tighten joint disk d) Replace tie rod ends e) Replace steering gear f) Replace steering gear g) Add oil* and bleed power steering - see 32 13 006
Steering wheel shakes	a) Wheels have imbalance or radial runout b) Toe, camber, caster or king pin inclination incorrect c) Thrust strut bent d) Rubber mount for thrust strut defective e) Control arm bent f) Weak shock absorbers g) Bearing sleeve in steering guide arm defective	a) Balance wheels; replace rim or tire in case of radial runout b) Check/adjust front wheel alignment with optical tester c) Replace thrust strut d) Replace rubber mount e) Replace control arm f) Replace shock absorbers g) Replace bearing sleeve
Steering is hard to turn against left or right lock	a) No pressure built up in lower pressure chamber b) No pressure built up in upper pressure chamber c) Insufficient oil in system d) Control valve in power pump seized e) Filter clogged f) Valve piston seized or leaks g) Piston seal damaged h) Teflon rings in worm head leak i) Teflon ring in intermediate cover leaks k) System filled with strong foaming, unsuitable oil	a) Replace steering gear b) Replace steering gear c) Add oil* and bleed power steering - see 32 13 006 d) Replace power pump e) Replace filter, clean lines f) Replace steering gear g) Replace steering gear h) Replace steering gear i) Replace steering gear k) Fill system with specified oil*

* Refer to Specifications

TROUBLESHOOTING BALL AND NUT POWER STEERING

Condition	Cause	Correction
Loss of hydraulic fluid	a) Hose connections leak b) Oil tank seal leaks c) Radial oil seal for sector shaft defective d) Radial oil seal for steering spindle defective e) O-ring in cover leaks f) O-rings in intermediate cover leak	a) Tighten hose connections or replace hoses b) Replace seal c) Seal steering gear d) Seal steering gear e) Seal steering gear f) Seal steering gear
No straight ahead	Height of steering drop arm not correct	Adjust steering drop arm - see 32 21 520

TROUBLESHOOTING RACK AND PINION POWER STEERING

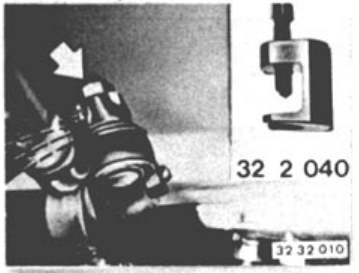
Condition	Cause	Correction
Steering hard to turn left or right from center	Pressure point not adjusted correctly.	Replace steering gear
Steering runs automatically to final position onesidedly	Valve setting for hydraulic center incorrect	Replace steering gear (adjusting only possible in the factory)
Steering wheel has excessive play	a) Steering gear loose on front axle carrier b) Universal joints have excessive play c) Joint disk loose d) Tie rods worn e) Worm has axial play f) Insufficient oil in system	a) Tighten steering gear b) Replace universal joints c) Tighten joint disk d) Replace tie rods e) Replace steering gear f) Add oil* and bleed power steering - see 32 13 006
Steering wheel shakes	a) Wheels have imbalance or radial runout b) Toe, camber, caster or king pin inclination incorrect c) Control arm bent d) Weak shock absorbers	a) Balance wheels; replace rim or tire in case of radial runout b) Check/adjust front wheel alignment with optical tester c) Replace control arm d) Replace shock absorbers
Steering hard to turn against left or right lock	a) Insufficient oil in system b) Drive belt too loose c) Filter clogged d) Control valve in pump seized e) Valve piston leaks or seized f) System filled with strong foaming, unsuitable oil	a) Add oil* and bleed power steering - see 32 13 006 b) Tighten or replace drive belt c) Clean filter d) Replace pump e) Replace steering gear f) Fill systen with specified oil*
Steering runs only difficultly to left or right lock	No pressure built up in left or right cylinder chamber	Replace steering gear

* Refer to Specifications

TROUBLESHOOTING RACK AND PINION POWER STEERING

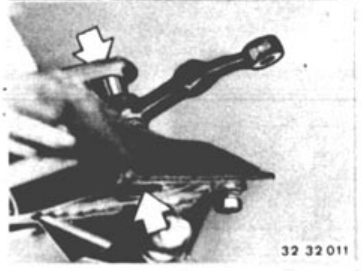
Condition	Cause	Correction
Loss of hydraulic fluid	a) Hose connections leak b) Oil tank seal leaks c) Radial oil seal for steering spindle defective d) O-ring in cover leaks	a) Tighten hose connections or replace hoses b) Replace seal c) Seal steering gear d) Seal steering gear
No straight ahead	a) Insufficient oil in system b) Tie rods worn	a) Add oil and bleed power steering - see 32 13 006 b) Replace tie rods
Steering runs difficultly when turn to lock quickly	a) Drive belt loose b) Pump delivery rate insufficient	a) Tighten or replace drive belt b) Check or replace pump
Strong knocks felt on steering wheel while steering	a) Insufficient oil in system b) Air in system in spite of sufficient oil c) Excessive play between rack and pinion d) Valve body has excessive play	a) Add oil* and bleed power steering - see 32 13 006 b) Check where air is being sucked in on intake side c) Replace steering gear d) Replace steering gear
Hesitant return of steering wheel	Mount, ball joint, tie rod joints or hard moving steering spindle in steering column	Check/repair or replace mount, ball joint, tie rod joints and steering spindle in steering column

Refer to Specifications

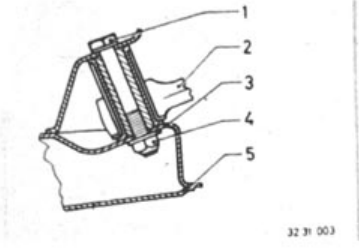


32 21 080 REMOVING AND INSTALLING STEERING GUIDE ARM

Unscrew nut.
Press off ball joint with Special Tool 32 2 040.
Installation:
Replace self-locking nut.
Tightening torque*.

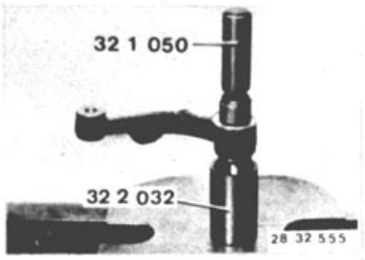


Unscrew steering guide arm.



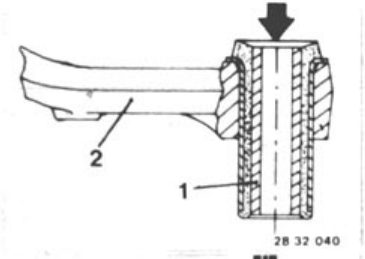
Installation:
Replace self-locking nut.
Tightening torque*.
1 Bolt
2 Steering guide arm
3 Washer
4 Self-locking nut
5 Front axle carrier
Important!
If the steering guide arm is replaced, adjust the steering drop arm – see 32 21 510.

* See Specifications

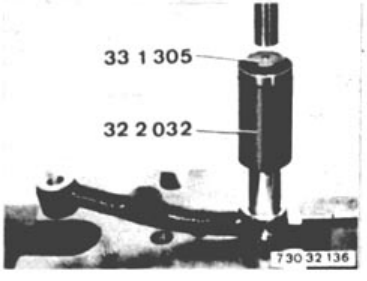


32 21 091 REPLACING DAMPER FOR STEERING GUIDE ARM

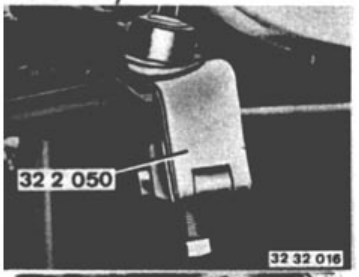
Remove steering guide arm – see 32 21 080.
Press out damper with Special Tools 32 1 050 and 32 2 032.



Note pressing-in direction.
1 = Damper
2 = Steering guide arm



Press in new damper against the stop with Special Tools 33 1 305 and 32 2 032.
Important!
Adjust steering drop arm after installation – see 32 21 510.



32 21 101 REPLACING LEFT OR RIGHT TIE ROD ARM

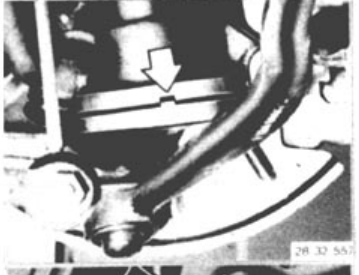
Remove front wheel - refer to Group 36.
Unscrew nut.
Press ball joint off of tie rod arm using Special Tool 32 2 050.

Installation:
Replace self-locking nut.
Tightening torque*.
Check front wheel alignment - refer to 32 00 . . ..

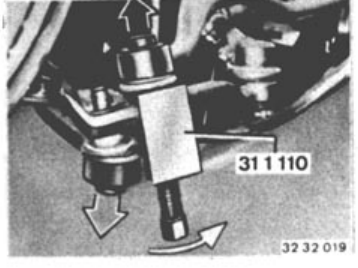


Unscrew bolts.

Installation:
Clean threads of tapped bores and bolts.
Install bolts with bolt cement**.
Tightening torque*.



Check for correct installed position.



Unscrew nut on control arm and thrust strut.
Press off ball joints using Special Tool 31 1 110.

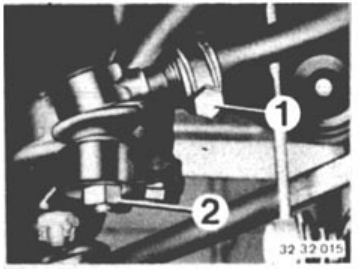
Installation:
Replace self-locking nut.
Tightening torque*.

* Refer to Specifications
** Source of Supply: BMW Parts

32 21 151 REPLACING LEFT OR RIGHT TIE ROD END

Remove the front wheel - refer to Gr. 36.

Check wheel alignment after installation.

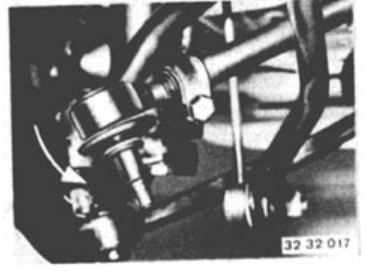


Loosen bolt (1).
Unscrew nut (2).

Installation:
Replace self-locking nut (2).
Tightening torque*.



Press the toe rod off using Special Tool 32 2 050.

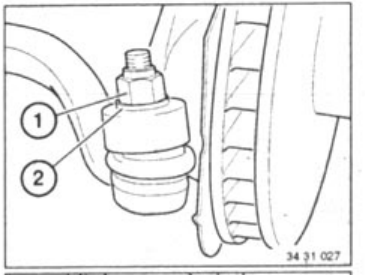


Unscrew the tie rod end.

* Refer to Specifications

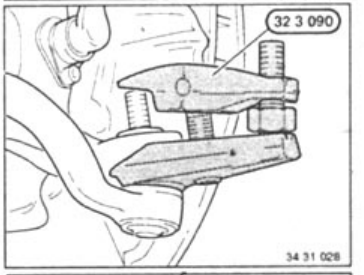
Four Wheel Drive:
Remove the front wheel - refer to Gr. 36.

Check wheel alignment after installation.

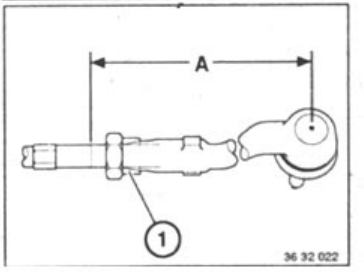


Unscrew nut (1).

Installation:
Replace self-locking nut (1).
Use washer (2).
Tightening torque*.



Press the toe rod off using Special Tool 32 3 090.



Measure distance (A) before unscrewing the tie rods – makes wheel alignment easier.
Unscrew nut.
Unscrew tie rod end.

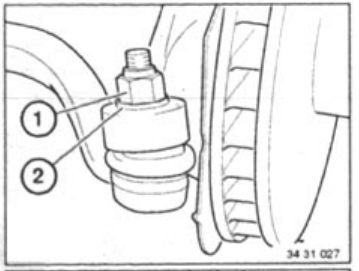
Installation:
Install clamping ring (1).
Screw tie rod end in up to distance (A).
Tightening torque*.

* Refer to Specifications

32 21 231 REPLACING LEFT OR RIGHT TIE ROD

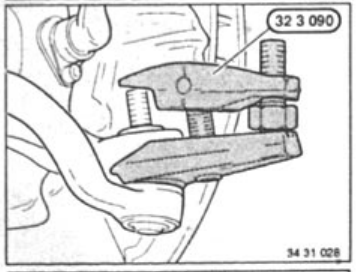
Important!
Adjust front wheel alignment after installation - refer to 32 00 600.

Remove the front wheel - refer to Gr. 36.

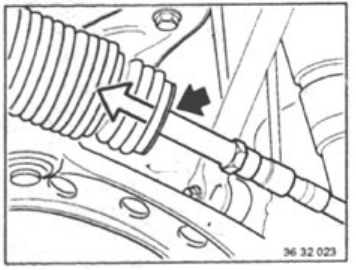


Unscrew nut (1).

Installation:
Replace self-locking nut (1).
Use washer (2).
Tightening torque*.



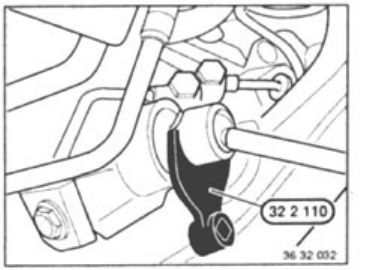
Press the toe rod off using Special Tool 32 3 090.



Loosen the clamp and push the boot back.

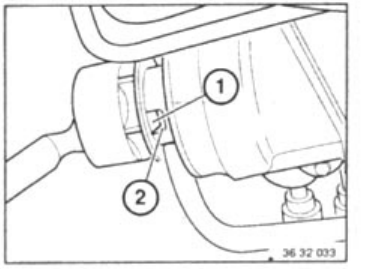
Installation:
Check / replace the boot.

* **Refer to Specifications**



Unbend the lockplate.
Remove the tie rod using Special Tool 32 2 110.

Important!
Unbend the lockplate with a suitable pliers (never with a hammer) to avoid damaging the rack and suspension.



Installation:
Replace the lockplate.
Turning lock (1) must be positioned in groove (2) of the rack.
Tightening torque*.
Bend the lockplate with a pliers.

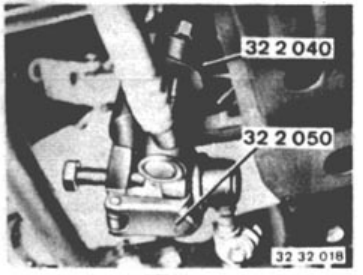
* **Refer to Specifications**



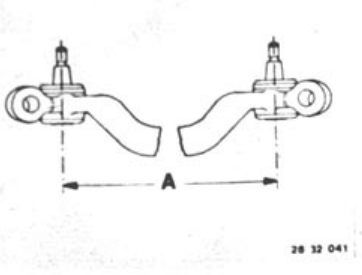
32 21 281 REPLACING CENTER TIE ROD

Unscrew nuts on left and right sides.

Installation:
Replace self-locking nuts.
Tightening torque*.
Adjust steering drop arm - refer to 32 21 510.
Check front wheel alignment - refer to 32 00 . . ..



Press off side tie rods using Special Tool 32 2 050 and center tie rod using Special Tool 32 2 040.

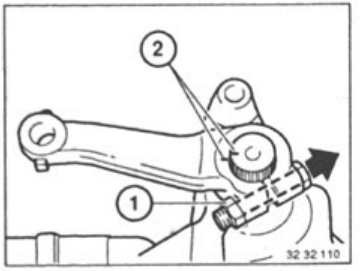


Control distance A = 534 ± 1 mm.

* Refer to Specifications

32 21 500 REMOVING AND INSTALLING STEERING DROP ARM
– Steering Gear Removed –

Mark position of sliding steering drop arm on the sector shaft prior to unscrewing bolt (1). If necessary, adjust steering drop arm – see 32 21 510.

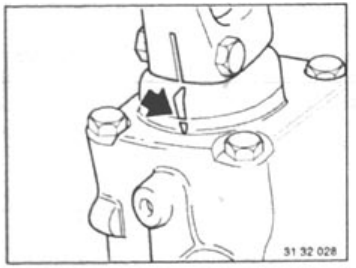


Installation:
Slide on steering drop arm up to the mark, whereby marks (2) must also be aligned.
Replace self-locking nut.
Tightening torque*.

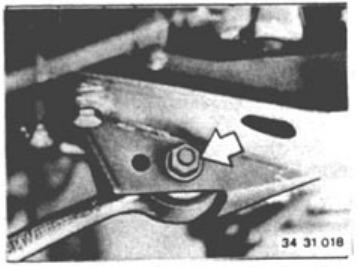
* See Specifications

32 21 510 ADJUSTING STEERING DROP ARM

Adjusting the steering drop arm moves the left and right tie rods to the same height. This guarantees the same amount of toe on left and right wheels when the car's suspension is bottomed.
It also optimizes directional stability on rough road surfaces.

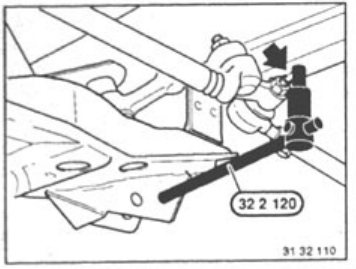


Set steering gear to straight ahead position (marks on spindle and case aligned).



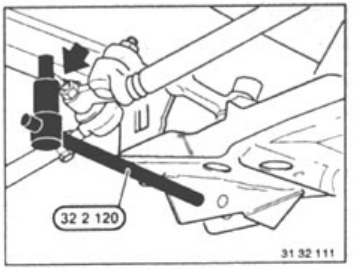
Unscrew left and right control arms on front axle carrier.

Installation:
Replace self-locking nuts.
Tightening torque*.

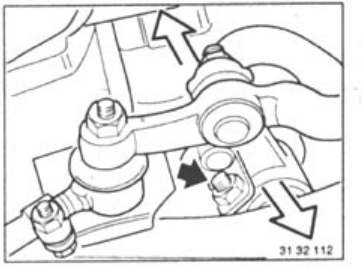


Mount Special Tool 32 2 120 on control arm mount at the steering guide arm side.
Align the master mandrel with the centering bore in the pivot pin and clamp.

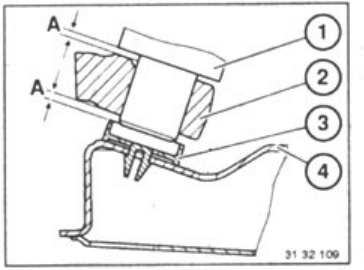
* Refer to Specifications



Mount the special tool on the other side — without changing the master mandrel.



Loosen bolt.
Move steering drop arm until centering bore is aligned with master mandrel as precisely as possible.
Max. permissible deviation = ± 1.5 mm.
Tighten nut.
Tightening torque*.
Recheck adjustment if necessary.



Important!
Turn steering gear from stop to stop — steering drop arm must move easily.

Distance A = 0.5 mm.

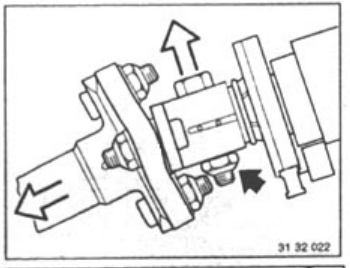
1 Steering gear
2 Steering drop arm
3 Spacer
4 Front axle carrier

* Refer to Specifications

32 31 062 REMOVING AND INSTALLING OR REPLACING STEERING ANGLE SENSOR

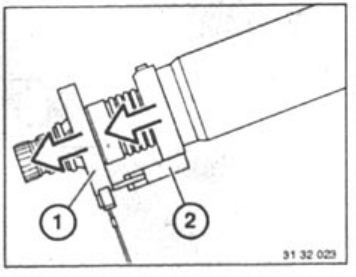
Disconnect battery - refer to Group 61.
Remove dashboard trim panel at bottom - refer to Group 51.
Models with Airbag:
Remove steering wheel - refer to 32 33 000.

Important!
After installation, offset steering angle for electronic shock absorber control - refer to Car Electric/Electronic Test Plan in Gr. 37.



Remove bolt.
Press down on steering spindle.

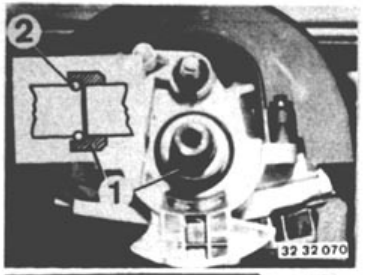
Installation:
Bolt must be located in locking groove of the steering spindle.
Replace self-locking nut.
Tightening torque*.



Pull steering angle sensor (1) off of steering spindle.

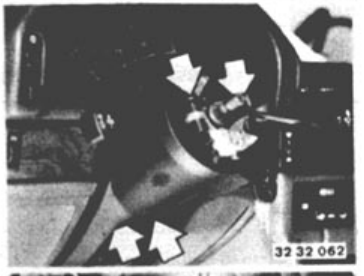
Installation:
Pin of steering angle sensor (1) must seat in turning lock (2).

* Refer to Specifications



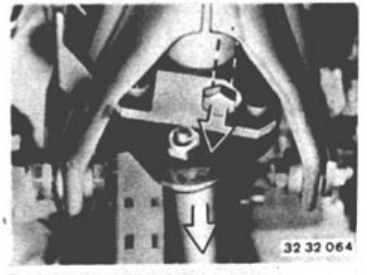
32 31 090 REMOVING AND INSTALLING STEERING COLUMN ASSY.

Disconnect battery ground lead.
Remove steering wheel - refer to 32 33 000.
Remove dashboard trim panel at bottom - refer to Group 51.
Check position of collar ring (1) to snap ring (2).



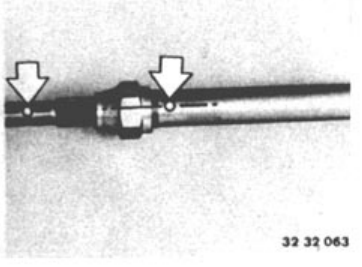
Unscrew steering column casing.

If applicable, unscrew interlock cable at steering lock.



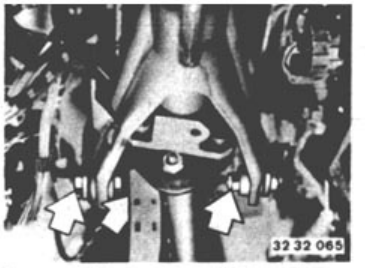
Remove bolt.
Press down on steering spindle.

Installation:
Bolt must be located in locking groove of the steering spindle.
Replace self-locking nut.
Tightening torque*.



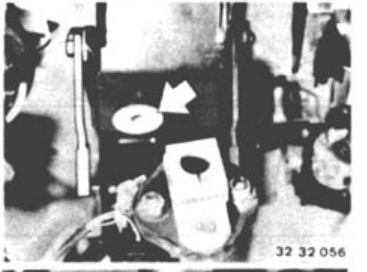
Note:
Mark meshing point of splines with a dot of paint.
Screw on adjusting nut far enough that the sliding force is 40 ± 25 N.

* Refer to Specifications

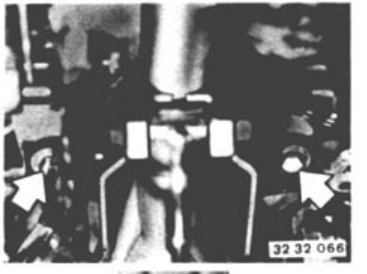


Unscrew bolts.
Chisel off shear-off screw.

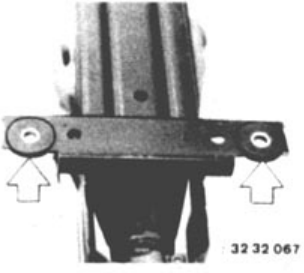
Installation:
Replace self-locking nuts.
Tightening torque*.
Tighten new shear-off screw until it shears off.



Installation:
Install spacer.



Unscrew bolts.
Loosen both mounting nuts on bracket.
Press down and remove steering column.



Installation:
Install spacer.
Tightening torque*.

* Refer to Specifications

32 32 090 REMOVING AND INSTALLING STEERING COLUMN ASSY. (AIRBAG)

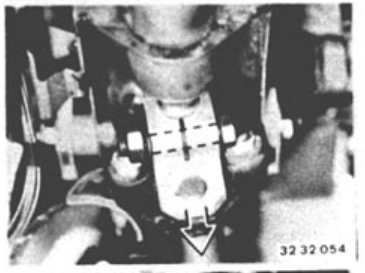
Caution!
Conform with safety precautions. Improper handling could ignite the airbag and cause injuries.

Remove dashboard trim panel at bottom - refer to 51 45 180.
Remove steering wheel - refer to 32 33 000.
Disconnect plugs of wires leading to the steering column.



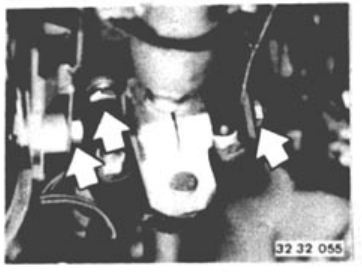
Remove collar ring (1).

Installation:
Recess in collar ring (1) locks snap ring (2).



Remove bolt.
Press down on steering spindle.

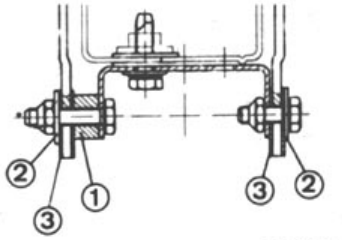
Installation:
Bolt must be located in locking groove of the steering spindle.
Replace self-locking nut.
Tightening torque*.



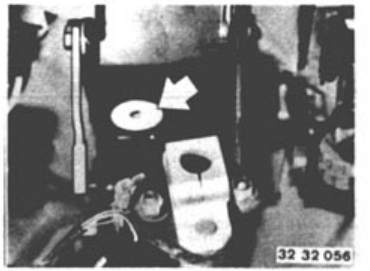
Unscrew bolts.

Installation:
Replace self-locking nut.
Tightening torque*.

* Refer to Specifications



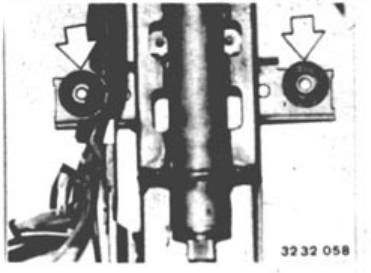
Installation:
1 Spacer
2 Washer
3 Sliding liner



Installation:
Install spacer.



Unscrew bolt.
Loosen both mounting nuts on bracket.
Press down and remove steering column.

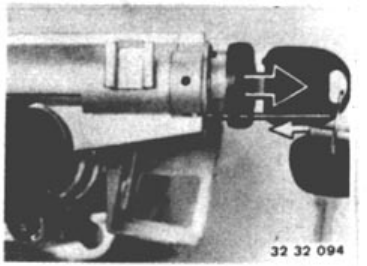


Installation:
Install spacer.
Tightening torque*.

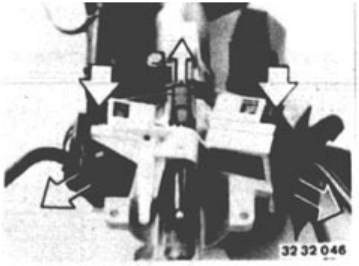
* Refer to Specifications

32 31 ... DISASSEMBLING AND ASSEMBLING STEERING COLUMN ASSEMBLY

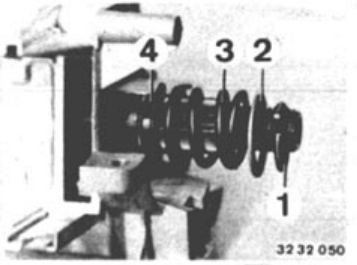
Remove steering column - refer to 32 31 090.



Turn ignition key to "R".
Press Special Tool 32 3 110 or piece of 1.2 mm dia. wire into bore and pull out lock cylinder.

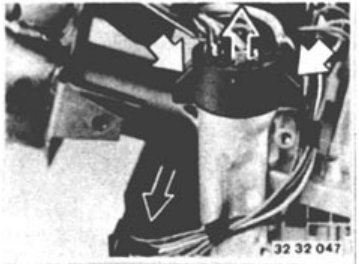


Pull off plug.
Compress retainers and pull off switch.

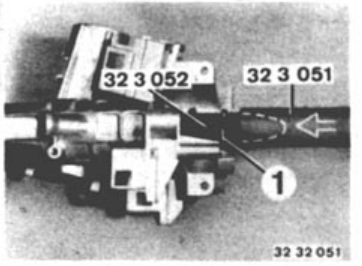


Lift out snap ring (1).
Remove washer (2), spring (3) and support ring (4).

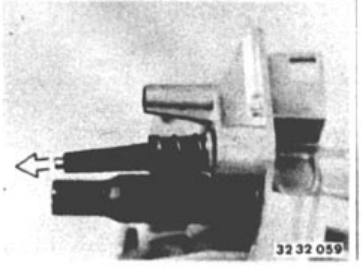
Installation:
Stem of support ring (4) faces bearing.



Press retainers down using a screwdriver and remove starter switch.
Remove wire harness holder and relay socket.

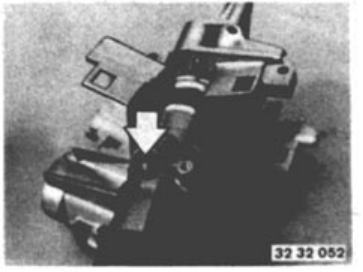


Installation:
Place snap ring (1) on Special Tool 32 3 052 and mount using Special Tool 32 3 051 (knock from hammer).
Counterhold on steering spindle.

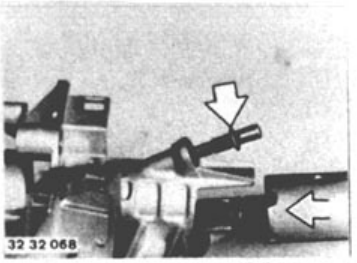


Compress and pull out horn contact.

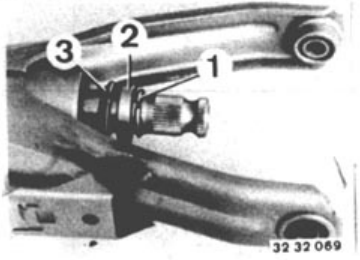
Installation:
Lubricate lightly with grease in area of the spring.



Chisel off shear-off screw.
Pull off steering lock.
If necessary, knock out bearing.



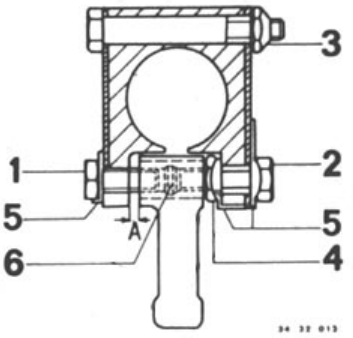
Installation:
Slide steering lock on to outer pipe.
Tighten Torx screws until they shear off.



Lower Steering Spindle Bearing:

Lift out snap ring (1) and remove collar ring (2) together with support ring (3).
If necessary, knock out bearing.

Installation:
Stem of support ring (3) faces bearing.
Mount snap ring using Special Tools 32 3 051 and 32 3 052.



Unbend lockplates (5).
Unscrew bolts (1 ... 3).

Bolt (1) = left-hand threads.

Assembling Procedures (Conform with Sequence):

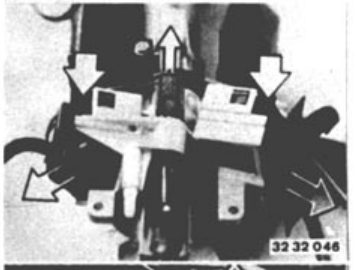
1. Screw in M 8 x 22 left-hand thread bolt (1) together with lockplate (5).
   Tightening torque = 14 Nm.
   Check for distance A = 1.75 + 1.25 mm between lever and clamp.
2. Screw in M 8 x 28 bolt (2) together with lockplate (5) and nut (4).
   Tightening torque = 9 Nm.
3. Tighten nut (4).
   Tightening torque = 14 Nm.
4. Tighten hexagon nut (3) with lever (6) in "CLOSED" position.
   Tightening torque = 12 Nm.
5. Bend lockplate (5) to lock it.

32 31 ... DISASSEMBLING AND ASSEMBLING STEERING COLUMN ASSEMBLY (AIRBAG)

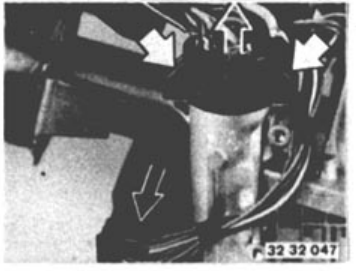
Remove steering column - refer to 32 31 090.



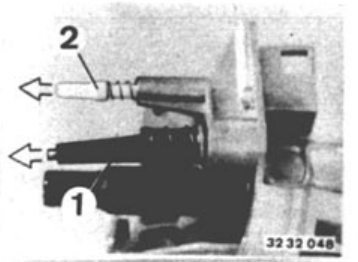
Drive out expansion rivets with help of a punch.
Remove upper section.



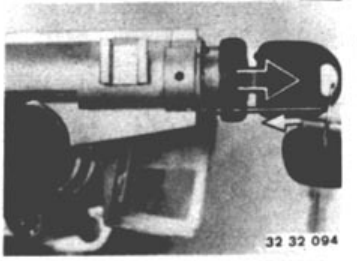
Pull off plug.
Compress retainers and pull off switch.



Press retainers down using a screwdriver and remove starter switch.
Remove wire harness holder and relay socket.



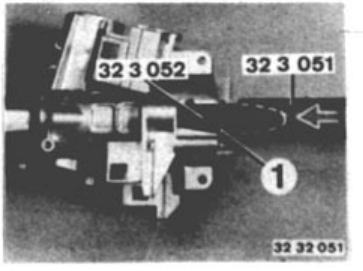
Compress and pull out horn contact (1) and lockpin (2).



Turn ignition key to "R".
Press Special Tool 32 3 110 or piece of 1.2 mm dia. wire into bore and pull out lock cylinder.

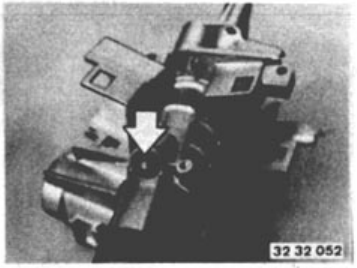


Lift out snap ring (1).
Remove washer (2), spring (3) and support ring (4).



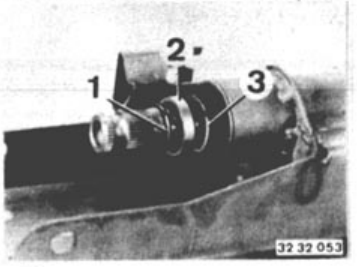
Installation:
Stem of support ring (4) faces bearing.

Installation:
Place snap ring (1) on Special Tool 32 3 052 and mount using Special Tool 32 3 051 (knock from hammer).
Counterhold on steering spindle.



Chisel off shear-off screw.
Pull off steering lock.
If necessary, knock out bearing.

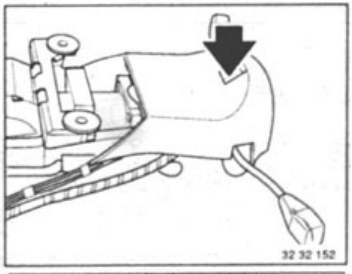
Installation:
Use new shear-off screw.



Lower Steering Spindle Bearing:

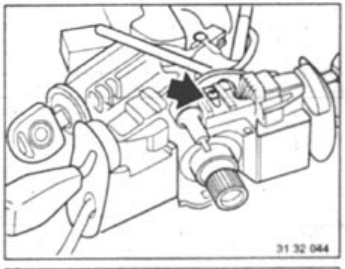
Lift out snap ring (1) and remove collar ring (2) together with support ring (3).
If necessary, knock out bearing.

Installation:
Stem of support ring (3) faces bearing.
Mount snap ring using Special Tools 32 3 051 and 32 3 052.

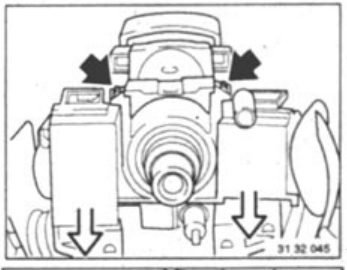


Manually Adjusted Steering Column:

Unscrew screw and remove casing.

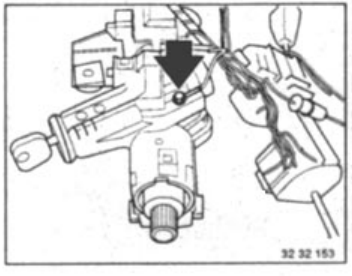


Unscrew screw.

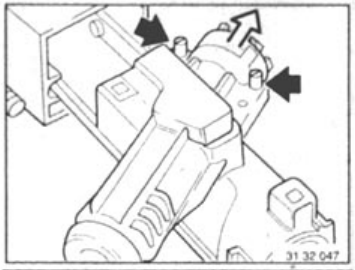


Press switch housing out of steering column with pressure from both thumbs on the retainers.

Important!
Retainers will break off easily.

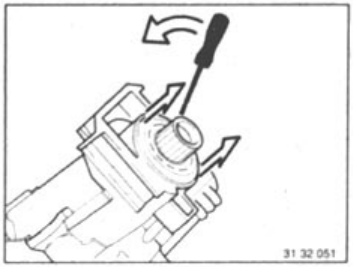


Unscrew ground lead.

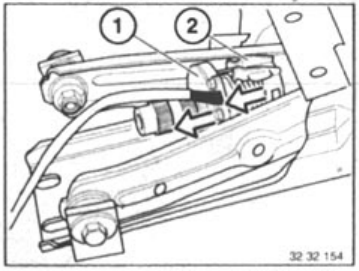


Release both grub screws.

Installation note:
Secure grub screws with paint.

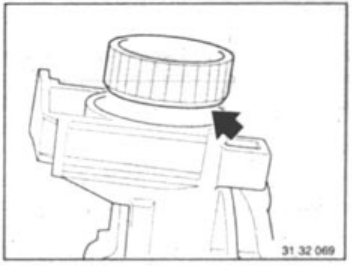


Lever out steering shaft bearing and remove inner sleeve of bearing.

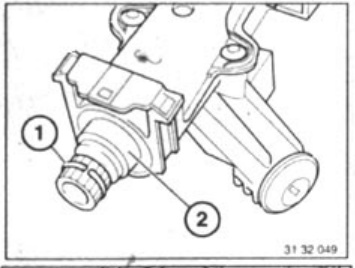


Remove steering angle sensor (1) with arrester (2).

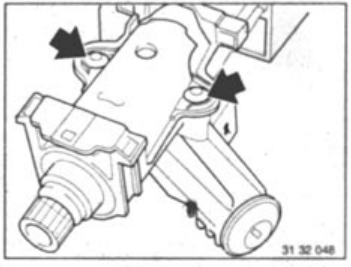
Installation note:
The pin of steering angle sensor (1) must be fitted in the arrester (2).



Installation note:
Fit inner sleeve of bearing with chamfered side facing towards the steering lock.

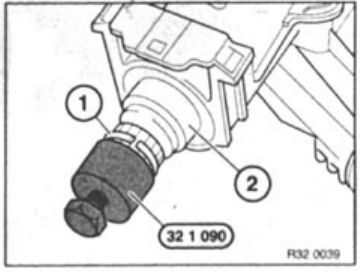


Lever out snap ring (1) and remove together with support ring (2).

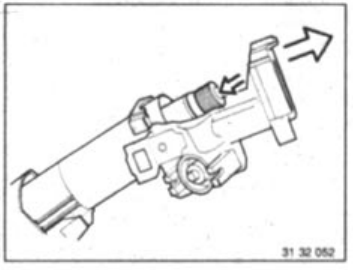


Release shear-off screws.

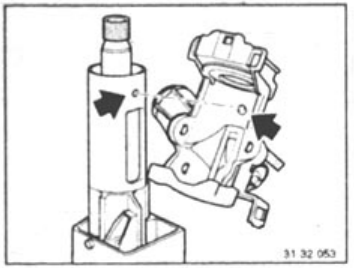
Installation note:
Tighten shear-off screws until they shear.



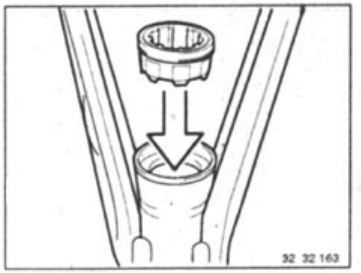
Installation note:
Fit support ring (2).
Pull snap ring (1) with special tool 32 1 090 and steering wheel retaining screw until it engages in groove of steering shaft.
Snap ring (1) can also be fitted with special tool 32 3 070.



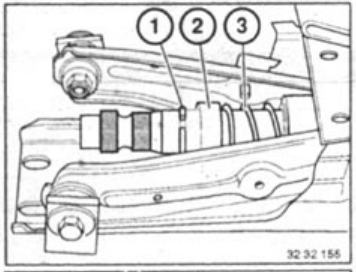
Turn steering lock in position "R".
Press down steering shaft and remove steering lock.



Installation:
Dowel pin must fit in bore.

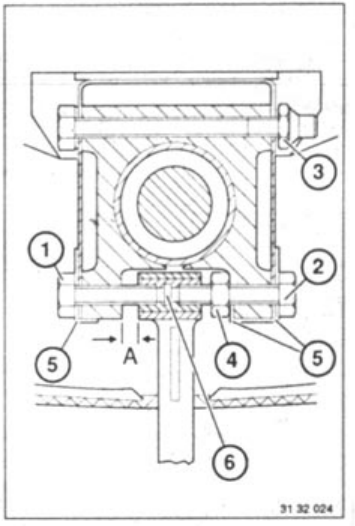


Coat metal lugs of contact ring with grease* and press contact ring into bearing.



Upper Steering Spindle Bearing:

Lift out snap ring (1) and remove support ring (2) together with spring (3).
Remove steering spindle.
Pull outer pipe out of console.



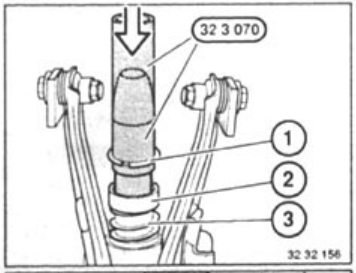
Unscrew screw, press retainers towards outside and remove potentiometer.

Clamp Adjustment:
Unbend lockplates (5).
Unscrew bolts (1 ... 3).

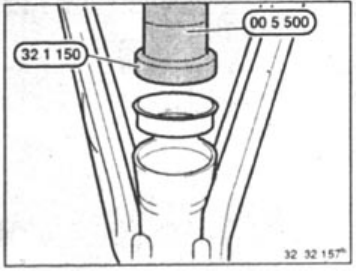
Bolt (1) = left-hand threads.

Assembling Procedures (Conform with Sequence):

1. **Screw in M 8 x 32 left-hand thread bolt (1) together with lockplate (5).**
   Tightening torque = 15 Nm.
   Check for distance A = 6.5 ± 1 mm between lever and clamp.
2. **Screw in M 8 x 40 bolt (2) together with lockplate (5) and nut (4).**
   Tightening torque = 7 Nm.
3. **Tighten nut (4).**
   Tightening torque = 15 Nm.
4. **Tighten hexagon nut (3) with lever (6) in "CLOSED" position.**
   Tightening torque = 15 Nm.
5. **Bend lockplate (5) to lock it.**



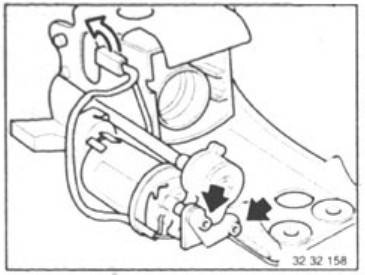
Installation:
Install spring (3) and support ring (2).
Recess in support ring (2) must face snap ring (1).
Install snap ring (1) using Special Tool 32 3 070.



Knock steering spindle bearing out of outer pipe.

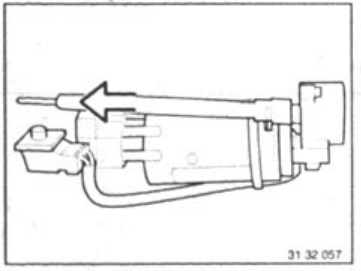
Installation:
Press contact ring out of bearing.
Knock in bearing using Special Tools 32 1 150 and 00 5 500.

* **Refer to Operating Fluids**

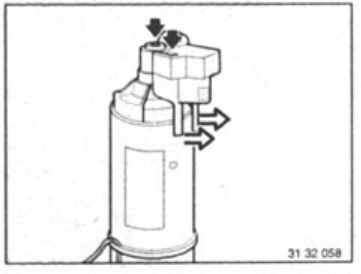


Electrically adjustable steering column:
Work is identical to mechanically adjustable steering column.

Unscrew bolts.
Twist plug out of bracket.
Remove transmission motor.



Remove shaft.



Unscrew bolts.
Remove transmission.

32 32 001 REPLKACING COMPLETE STEERING LOCK

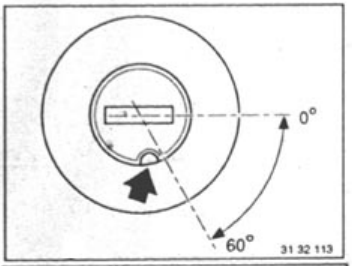
Procedures are identical with those for "Removing and Disassembling Steering Column" in 32 32 090/... .

32 32 170 REPLACING INTERLOCK CABLE

Procedures are contained in 32 32 001 (Replacing Steering Lock) and 25 16 ... (Removing and Installing Selector Lever - Interlock Version).

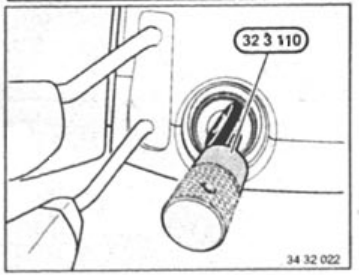
Check the function after installation as follows.

1. Move selector lever of automatic transmission into "P".
2. Remove the ignition key.
3. Press the selector lever button.
4. If the selector lever can be moved out of P, the interlock cable must be adjusted – refer to Group 25.
5. Switch the ignition on.
6. Press the selector lever button.
7. If the selector lever cannot be moved out of P, the interlock cable must be adjusted – refer to Group 25.

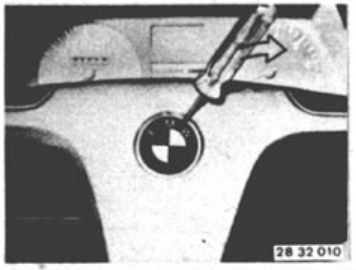


32 32 050 REMOVING AND INSTALLING / REPLACING STEERING LOCK CYLINDER

Turn the lock cylinder 60° to position "R" with the ignition key.

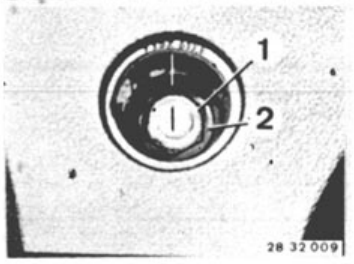


Press Special Tool 32 3 110 or a piece of 1.2 mm dia. wire into the bore of the lock cylinder and pull the lock cylinder out.



32 33 000 REMOVING AND INSTALLING STEERING WHEEL
– Without Airbag –

Lift out BMW emblem.

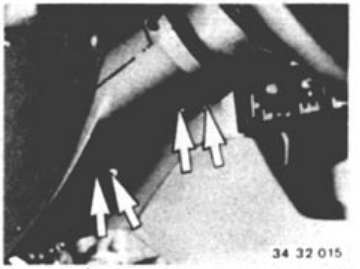


Unscrew and remove nut (1) together with washer (2).
Mark position of steering wheel to steering spindle.
Pull off steering wheel - only possible after unlocking steering lock.

Installation:
Replace self-locking nut.
Tightening torque*.

Important!
Do not damage turn signal self-cancelling cam.
Lubricate slip ring for horn with grease**.

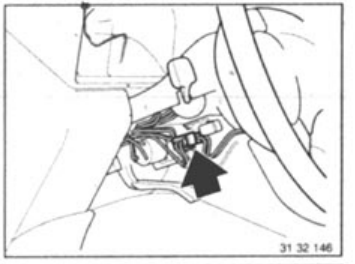
* Refer to Specifications
** Refer to Operating Fluids



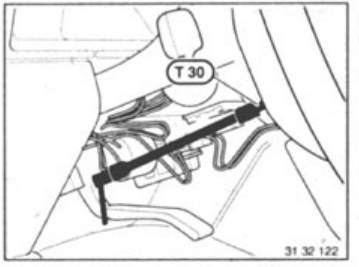
– With Airbag –

Caution!
Conform with safety precautions. Improper handling could ignite the airbag and cause injuries.

Disconnect battery and cover negative pole or terminal.
Unscrew casing lower section.

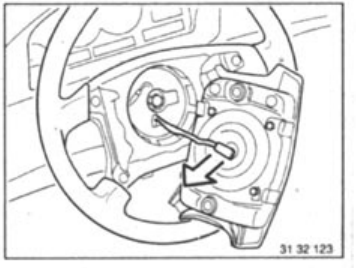


Pull plug (orange) out of holder and disconnect it.



Unscrew screws (Torx T 30 socket).

Installation:
First tighten screw at right hand side as seen looking in forward driving direction.
Tightening torque*.

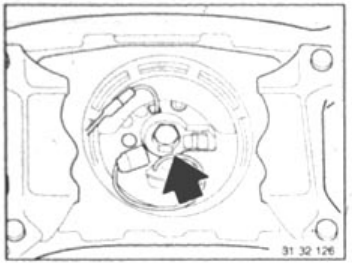


Pull off plug and remove airbag unit.

Caution!
Airbag unit may only be laid aside with pad facing up (in trunk).

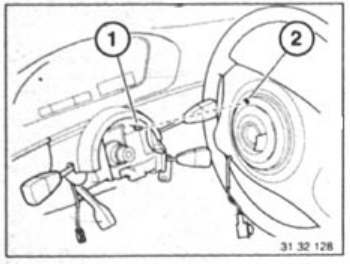
Installation:
Do not pinch wiring.

* Refer to Specifications

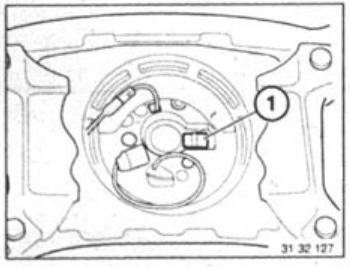


Set steering wheel in straight ahead position (marks on steering gear and on steering shaft). Release nut/bolt and remove with washer.
Mark steering wheel with respect to steering shaft.

Caution!
If the steering wheel is secured by a nut, it can only be removed with the steering lock unlocked.



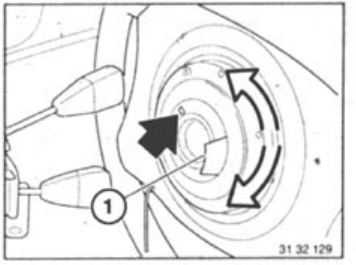
Installation note:
Lock pin (1) must engage in recess (2).
Replace self-locking nut. Tightening torque* for nut or bolt.



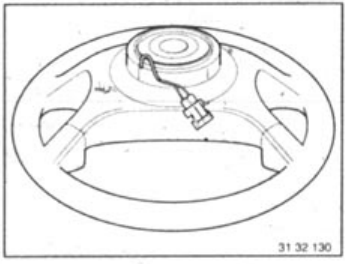
Note:
The retaining spring (1) which holds the contact ring in center position exerts a force by loosening the nut/bolt.

On no account must the steering wheel be moved without the nut/bolt being tightened. The contact ring will be damaged!

* Refer to Technical Data



Adjust contact ring if necessary:
Press down spring (1) - turn contact ring to left or right as far as it will go, turn back by approx. 3 turns, until marking arrows for center position agree, release spring (1).



Installation note:
Tilt slip ring with grease**.

- with airbag II

Remove steering wheel, refer to Repair Manual 3 Series E36.

** Refer to Fluids and Lubricants Specifications

32-34/1

Airbag System

Components of Airbag:

a) Steering wheel with impact absorber and impact absorber cover, in which airbag, gas generator and squib are integrated

b) Contact ring - provides secure power source to squib.

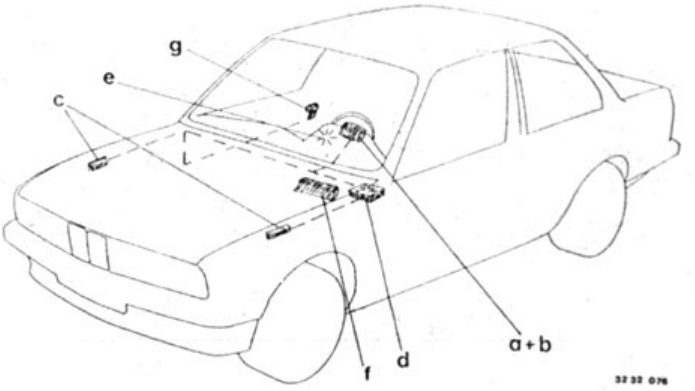
c) 2 Crash sensors (left and right, front of wheel arch) and safety switch on left side.

d) Diagnosis electronics under instrument panel trim with integrated Safing Sensor (prevents accidental deployment)

e) Airbag telltale in the instrument cluster

f) Knee protection (US model)

g) Belt tensioner with gas generator and ignition squib (integrated in inertia reel of seatbelt).



Components Airbag II and basic / central airbag unit:

refer to Repair Manual, 3 Series E36.

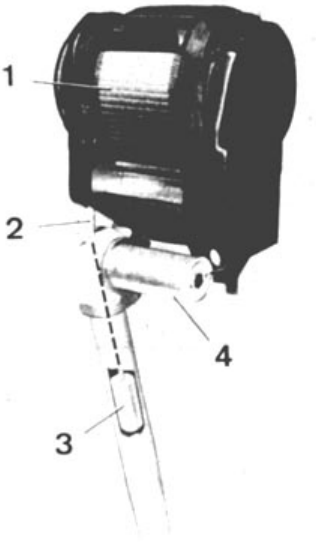
Function

The system is triggered by sensors which must detect vehicle retardation equivalent to a direct head-on collision at no less than 18 km/h with a stationary and rigid object (i.e. one which does not move on impact).
The electric circuit is made and gas generators ignited. At this point, through the instantaneous combustion of the solid fuel mixture, non-toxic gases are released which:

a) fully inflate the folded airbags in the steering wheel and the instrument panel within approx. 30 ms. (fully inflated, the airbag reduces the extent of injuries to head and upper torso in head-on collisions.
The bags are deflated by two holes in the side of the airbag opposite the driver).

b) push down the piston (3) in the cylinder and tensions the safety belt by tightening a wire cable (2). The passenger is securely held against the backrest.

Monitoring:
The airbag system is monitored continuously by a diagnosis unit from ignition lock position "1" on. The telltale lights up and goes out again after about 6 seconds, Airbag II approx. 4 seconds, indicating operational readiness of the system.
Constant flashing or continuous lighting of the telltale indicate the presence of a defect in the airbag system.
Self-diagnosis - fault-memory interrogation with BMW DIAGNOSIS SYSTEM.
Airbag II troubleshooting, refer to Repair Manual, 3 Series E36.



32 32 075

Belt tensioner:

1 Safety belt, inertia reel unit
2 Wire cable
3 Piston in cylinder
4 Gas generator

SAFETY RULES FOR HANDLING AIRBAG/BELT TENSIONER GAS GENERATORS

Non-conformance with these instructions could lead to unwanted activation of the system and injury.

Gas generators are pyrotechnical items. Handling, transporting and storing are subject to "legislation concerning explosive materials".

The specifications listed below are in reference to Germany. There must always be conformance with pertinent legislation in other countries.

1. Transporting:

1.1 Gas generators must never be transported in passenger compartments!

1.2 Company level transportation must always be in the trunk or cargo room of a vehicle in packed state — the quantity of units is limited to 50.

2. Storing:

2.1 Max. permitted quantity of gas generators in one workroom is 20.

2.2 Storage of up to 200 units is permitted in a suitable and lockable room.

2.3 Gas generators must be stored in packaging suitable for transportation.

3. Installing and Removing:

3.1 "Airbag" components and plugs can be recognized immediately on the orange color.

3.2 Tests and installation/removal may only be performed by personnel with qualified training in BMW service.

3.3 Working on the "airbag system" always requires the battery to be disconnected, the negative pole or terminal to be covered and the "airbag" plug (steering column) to be disconnected.

3.4 If work on the system has to be interrupted, a gas generator must not be left unattended.

3.5 Components of the airbag system may not be repaired, but instead they must always be replaced.

3.6 Never treat "airbag" components with cleaning solutions or grease.

3.7 Never subject gas generators to temperatures above 100° C.

3.8 Gas generators, crash sensors and electronic diagnosing units, which have fallen down from a height of 0.5 meters or more, cannot be installed in cars again.

3.9 The "airbag system" may only be checked electrically installed in the car and only with a BMW Service Tester.

3.10 The airbag gas generator may only be laid aside with the padded side facing up, since if the generator were ignited with the airbag facing down, the generator would be catapulted up and could cause injury!

3.11 The ignition pill of a gas generator must never be aimed at persons regardless of the circumstances.

Procedures for Repairing and After Accidents:

Always disconnect the battery (first interrogate fault memories as disconnecting the battery erases them), cover the negative pole or terminal and disconnect both plugs for crash sensors in the engine compartment and plugs for the gas generators, to be sure that power supply to the gas generators is interrupted, prior to working on the body or welding with an electric welder.
Also refer to other instructions in the 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

Airbag inflater assemblies which have not been triggered pose a danger (also for the environment)!

In accordance with relevant accident prevention regulations, "airbag" inflater assemblies must be dismantled and made inoperable before scrapping. This is necessary since pyrotechnic components can cause injuries if activated incorrectly (e.g. scrapping with cutting torch). "Airbag" inflater assemblies in the vehicle to be scrapped must be fired with the doors closed from the outside. The ignition device with corresponding cables developed by BMW should be used for this purpose.

Caution!
The burning solid fuel causes the airbag unit to heat up - risk of burn injuries!
Wash hands after touching ignited inflater assemblies"

1. Driver's airbag up to model year '94

1.1 Remove bottom section of steering column shroud and disconnect plug connection (orange) to airbag unit.
1.2 Connect ignition device 62 1 270 to plug connector, use cable 62 1 280 or 62 1 233 if necessary.
1.3 Connect ignition device to a 12 V battery (10 m distance from vehicle).
1.4 Keep distance from vehicle corresponding to length of ignition cable - location always in front of vehicle (this also applies to all other persons).
1.5 Press switch of ignition device - airbag inflates.

2. Driver's airbag with indicator lamp integrated in steering wheel

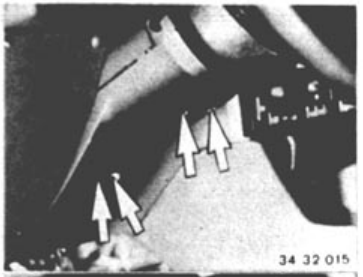
2.1 Remove airbag unit from steering wheel.
2.2 Disconnect plug connector from airbag unit, connect cable 62 1 240 and connect to ignition device 62 1 270.
2.3 Reinstall airbag unit.
2.4 Connect ignition device to a 12 V battery (10 m distance from vehicle).
2.5 Maintain distance from vehicle corresponding to length of ignition cable - location always in front of vehicle (this also applies to all other persons).
2.6 Press switch on ignition device - airbag inflates.
2.7 Remove airbag unit - caution: Airbag unit is hot! Danger of burn injury! Disconnect cable.

3. Belt tensioner up to model year '93

3.1 Insert plug-in bracket in belt buckle. if this is no longer possible, the plug-in bracket must be pushed as far as the outlet opening in the B-pillar.
3.2 Mark seat belt strap with a chalk line at the outlet opening of the B-pillar, in this way it is possible to check the belt tension after ignition.
3.3 Disconnect plug connection to belt tensioner at airbag control unit.
Installation location of airbag control unit: LH side under instrument panel trim.
3.4 Connect ignition device 62 1 270 together with cable 62 1 280 to the plug connector.
3.5 Connect ignition device to a 12 V battery (10 m distance from vehicle).
3.6 Maintain distance from vehicle corresponding to length of ignition cable - location always in front of vehicle (this also applies to all other persons).
3.7 Press switch on ignition device - belt tensioner ignites.

4. Vehicles as of model year '94 (driver's, front passenger's airbag and belt tensioner if applicable)

4.1 Disconnect plug connector from airbag control unit.
Installation location of airbag control unit: Under rear seat
4.2 Connect ignition device 62 1 270 together with cable 62 1 210 to the plug connector.
4.3 Connect ignition device to a 12 V battery (10 m distance from vehicle).
4.4 Maintain distance from vehicle corresponding to length of ignition cable - location always in front of vehicle (this also applies to all other persons).
4.5 Press switch on ignition device - all inflater assemblies ignite.



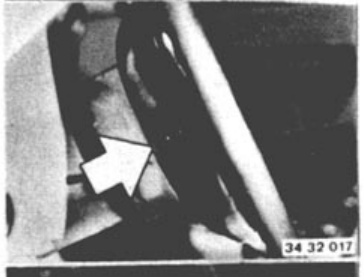
32 34 020 REMOVING AND INSTALLING OR REPLACING AIRBAG UNIT

Caution!
Conform with safety regulations. Improper handling could cause activation of the airbag and lead to injuries. Disconnect battery and cover the negative pole or terminal.

Unscrew casing lower section.



Pull (orange) plug out of the holder and disconnect.



Unscrew screws with Special Tool 00 2 110.

Installation:
First tighten bolt on right-hand side as seen looking forward in car.
Tightening torque*.



Pull off plug and remove the airbag unit.

Caution!
Place airbag unit aside (in trunk) with the padded side facing up.

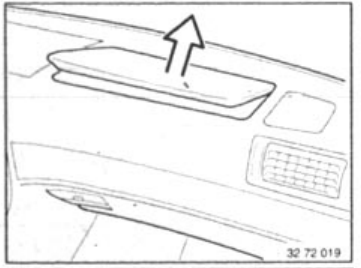
Installation:
Don't pinch the electric leads.

* See Specifications

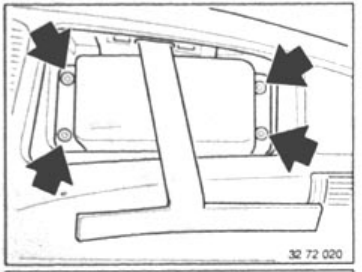
32 34 500 Additional work with front passenger's airbag

- Steering wheel removed -

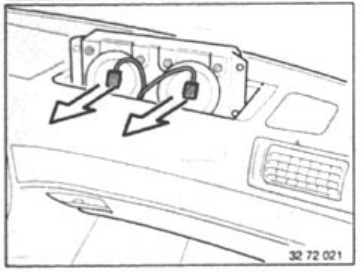
Caution!
Observe safety instructions!
Incorrect handling can result in the airbag triggering thus causing injuries.



Lift out covering.



Release screws.



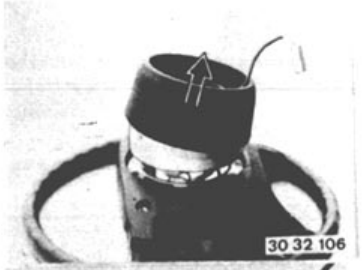
Disconnect plug connectors and remove front passenger's airbag.

Caution!
Place front passenger's airbag with padded cushion facing upward (luggage compartment).

Installation note:
Do not trap cable.

32 34 510 REPLACING CONTACT RING (AIRBAG)

Caution!
Conform with safety regulations.
Improper handling could lead to activation of the airbag and lead to injuries.
Remove steering wheel – see 32 33 000.



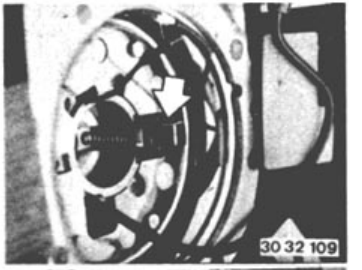
Pull off casing.
Installation:
Lubricate slip ring for horn with grease.



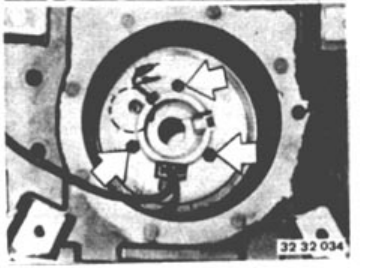
Mark position of circlip to hub.
Unscrew three studs.
Press down, turn and remove the circlip.



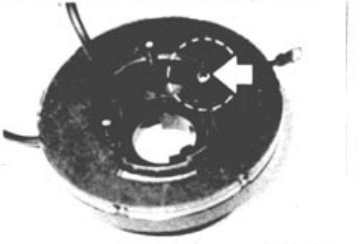
Installation:
Insert, turn and pull up circlip in hub.
Studs must be in openings of the circlip.



Lift out the lock with a screwdriver.
Installation:
Place spring on the lock and insert in bore.
Press down on lock until it engages.



Disconnect plug.
Unscrew nuts and take off the contact ring.



32 32 020

Important!
A new contact ring is held in center position by a screw.
This screw must be removed after bolting the contact ring on the steering wheel.



65 77 010 Removing and installing or removing airbag diagnosis unit

Caution!
Observe safety regulations!
Incorrect handling can activate the airbag and lead to injuries.
Disconnect battery and cover ground pole or terminal.
Remove lower section of trim. Remove plug connection (orange) from bracket and disconnect.



Press plug connection off bracket. Unscrew holder.



Unscrew bolts.
Disconnect plug connections (orange).
Remove diagnosis unit.

Installation:
Arrow on unit shows direction of travel.

65 77 012 Removing and installing or replacing control unit for Airbag II

Refer to Repair Manual for 3 Series E36.

65 77 015 Replacing capacitor in airbag diagnosis unit

Diagnosis unit 65 77 010.

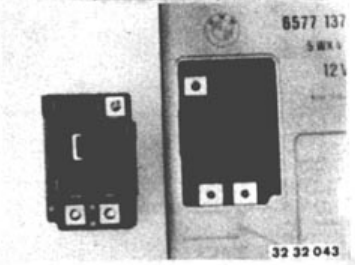


Open cover with feeler gage (0.20 mm) or a small screwdriver.

Installation note:
Install new cover.



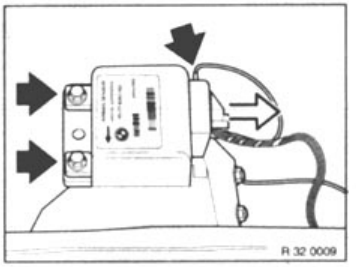
Release screws and remove capacitor.



Installation note:
Clean contact surfaces.

65 77 016 Removing and installing basic/central airbag unit

Caution!
Observe safety instructions!
Incorrect handling can cause the airbag to trigger thus causing injuries.
Disconnect battery and cover negative terminal.



Remove rear seat, refer to 52 20 010.
Release screws, disconnect cable plug connector and remove basic/central airbag unit.

Installation note:
Arrow on unit points in forward direction

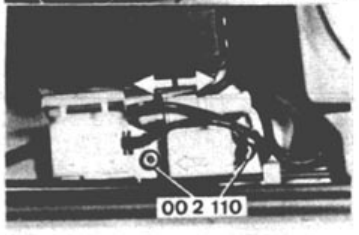
65 77 018 Replacing basic/central airbag unit

Removing and installing basic/central airbag unit, refer to 65 77 016.

Encode new unit with MoDiC.



34 32 016



32 32 031

65 77 020 REMOVING AND INSTALLING OR REPLACING ONE AIRBAG FRONT SENSOR

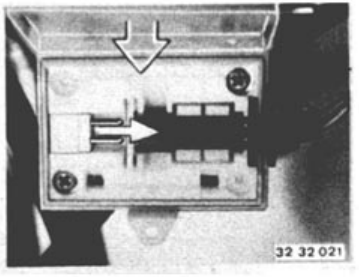
Caution!
Conform with safety regulations.
Improper handling could cause activation of the airbag and lead to injuries.
Disconnect battery and cover negative pole or terminal.
Unscrew casing lower section.
Pull (orange) plug out of holder and disconnect.

Disconnect plug and unscrew screws with Special Tool 00 2 110.
Installation:
Arrow on sensor faces forward.
Tightening torque*.

* See Specifications

65 77 040 REPLACING AIRBAG SAFETY SWITCH

Caution!
Conform with safety regulations.
Improper handling could cause activation of the airbag and lead to injuries.
Disconnect battery and cover negative pole or terminal.
Open the cover, remove plug and unscrew screws.
Note:
Opening the cover destroys the safety switch, which must then be replaced.

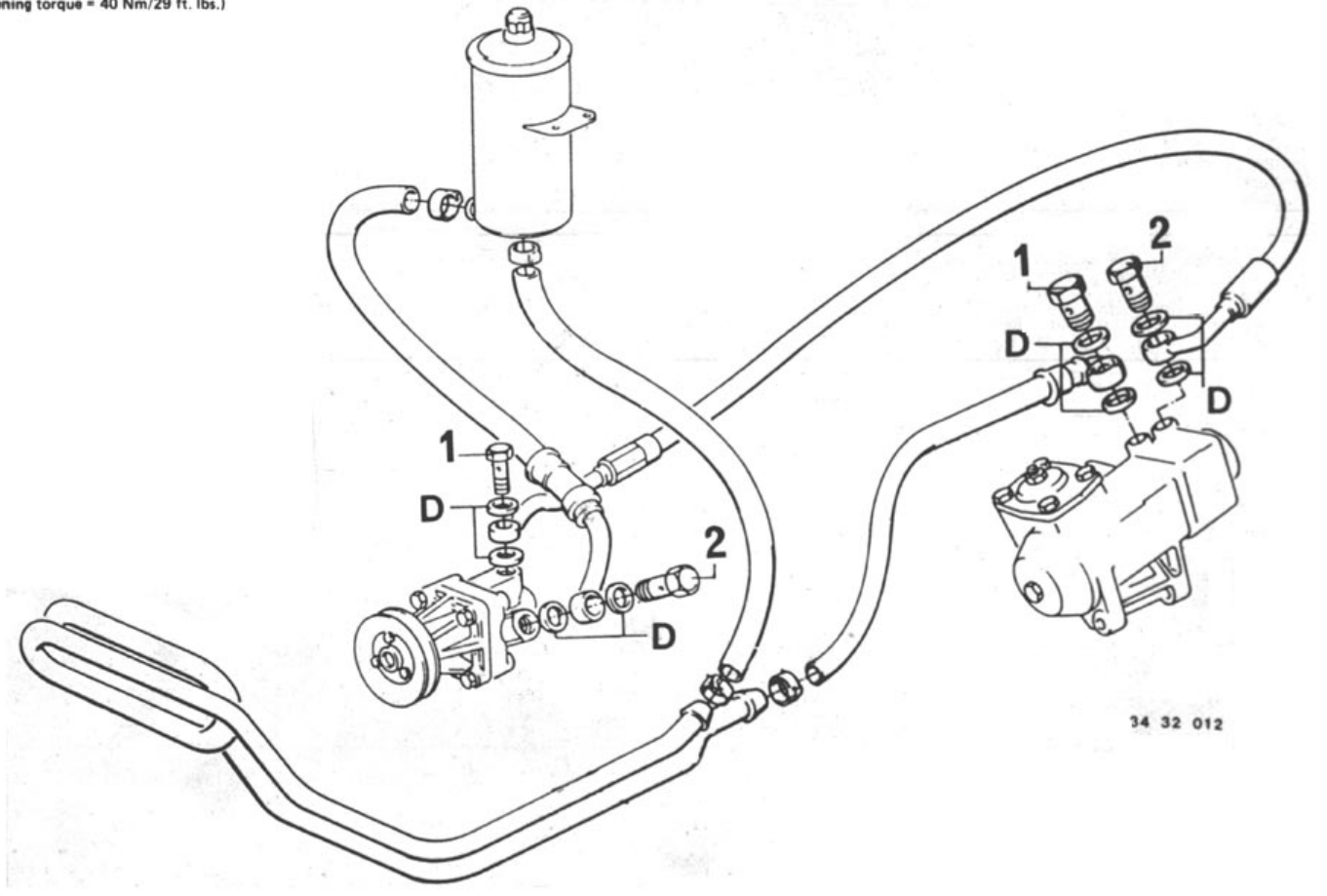


Screw on safety switch.
Install plug.
Slide contact sleeve on plug.
Close cover.

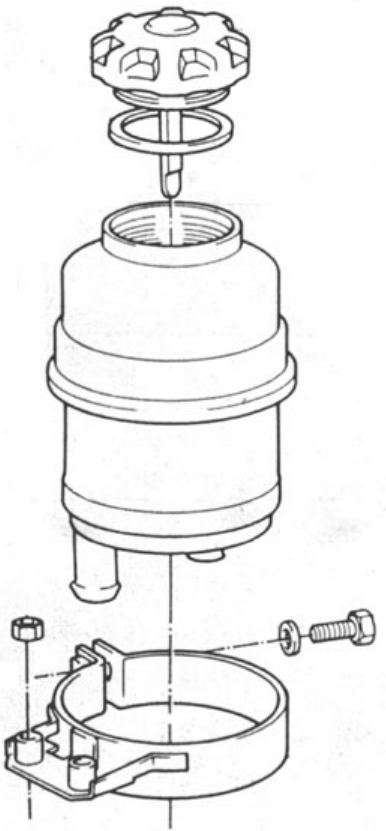
32-41/1

Power Steering Layout Drawing

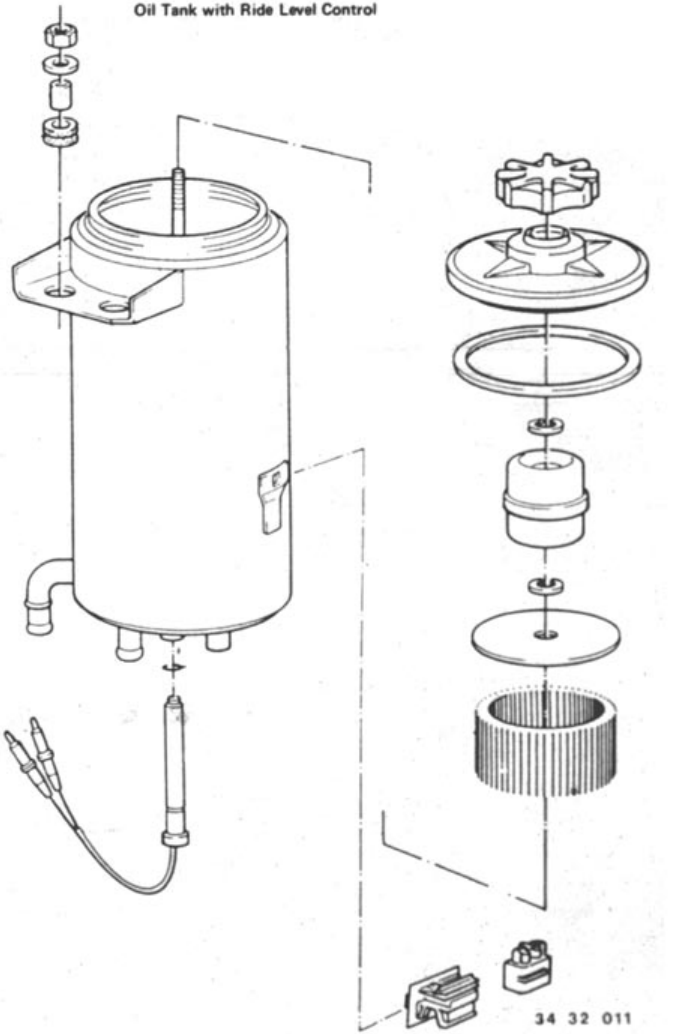
D = Gasket
1 = M 14 hollow coupling bolt
(tightening torque = 35 Nm/25 ft. lbs.)
2 = M 16 hollow coupling bolt
(tightening torque = 40 Nm/29 ft. lbs.)



Oil Tank Layout Drawing

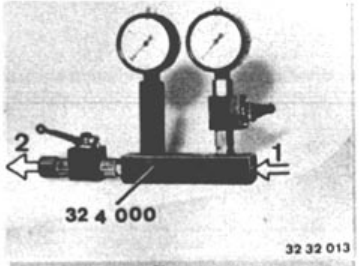


Oil Tank with Ride Level Control



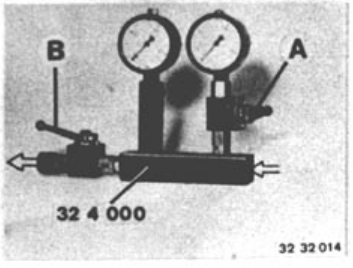
32 41 009 CHECKING FUNCTION OF POWER STEERING PUMP

Check all hose connections, pump and steering gear for leaks before testing.
1. Checking Power Steering Pump:
Connect pressure tester between pump and steering gear.



1 = Pump connection
2 = Steering gear connection

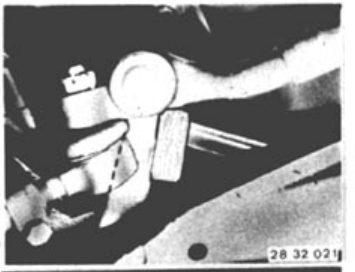
A = Shutoff valve (low pressure)
0 to 15 bar (0 to 213 psi)
B = Shutoff valve (high pressure)
0 to 150 bar (0 to 2133 psi)



Shut valve (A).
Open valve (B).
Start engine.
Correct hydraulic fluid level** in tank.

Shut valve (B) max. 10 seconds and read pressure.
The rated pump pressure* must be reached within ± 10 %.
If the rated pressure* is exceeded, replace power steering pump – see 32 41 061.
If the rated pressure* is not reached, check drive belt tightness – see 32 41 109.
Repeat test.
If the rated pressure* is still not reached, replace power steering pump – see 32 41 061.

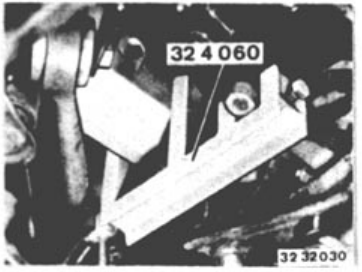
* See Specifications
** See Operating Fluid Specifications



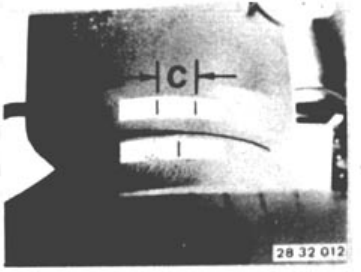
2. Checking Power Steering:
Pressure tester connected between pump and steering gear; system bled, valve (B) opened; valve (A) shut; engine not started.
Lift car.
Stop steering from reaching final left lock by 1/2 to 3/4 steering wheel turn with a piece of wood or something similar.



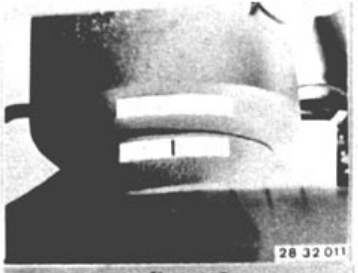
Start engine.
Pull steering wheel against final left lock with a force of 100 N (22 lbs.) (force meter) about 5 seconds and read pressure.
Limit final right lock and repeat test on right lock.
If pressure values are lower than pump pressure determined in point 2, replace steering gear – see 32 13 060.



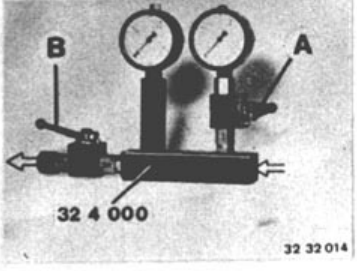
3. Checking Mechanical Play of Steering:
– Pressure point adjusted – see 32 13 014.
– No play in steering column.
Pressure tester between pump and steering gear.
System bled.
Open valve (B).
Shut valve (A).
Engine not started.
Hold steering drop arm in straight ahead position with Special Tool 32 4 060.



Turn steering wheel counterclockwise until pressure tester shows 1 bar (14 psi) more pressure than the flow pressure value.
Mark position of steering wheel hub.
Repeat this in clockwise direction.
If max. permissible travel (C) = 7 mm (0.276") is exceeded, replace the steering gear — see 32 13 060.
Remove special tool holder and pressure tester.
Bleed hydraulic system and, if necessary, add hydraulic fluid**.

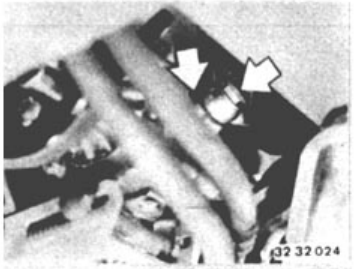


Paste strips of paper on the steering wheel hub and casing upper section.
Make mark (center) on steering wheel hub.



Start engine.
Open valve (A).
Read flow pressure.

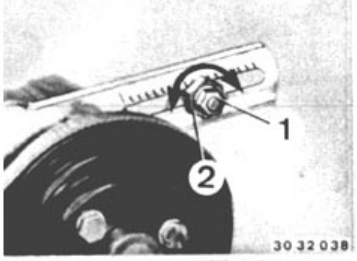
** See Operating Fluid Specifications



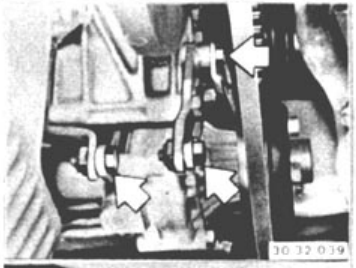
32 41 060 REMOVING AND INSTALLING POWER STEERING PUMP

Suck hydraulic fluid out of tank — never reuse it.
Unscrew pipes.

Installation:
Replace gaskets.
Tightening torque*.
Bleed hydraulic system - refer to 32 13 006.

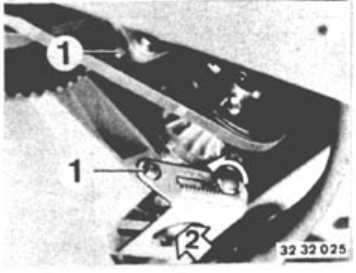


M20, M21:
Loosen nut (1) and slacken drive belt by turning toothed element (2).



Unscrew bolts and remove power steering pump.

Installation:
Adjust drive belt tension prior to tightening the bolts.

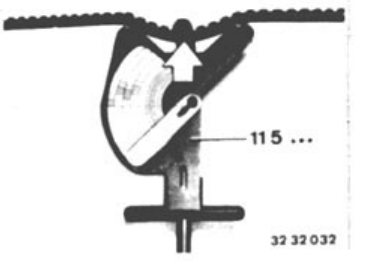


M30:
Loosen bolts (1).
Loosen nut (2) and turn tensioning pinion.
Remove bolts (1).

* Refer to Specifications



Installation:
Adjust drive belt tension prior to tightening the bolts.
Torque tensioning pinion to approx. 8 Nm and tighten nut.



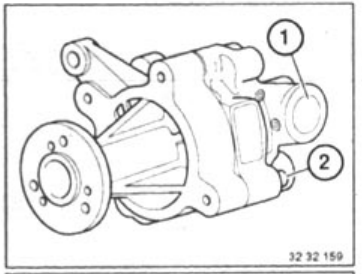
Check drive belt tension using Special Tool 11 5 ...
Hook bears on tip of tooth.

Important!
Ensure sufficient clearance between hoses and body parts, making corrections on hose connections if necessary.

M50, M51:
Remove ribbed drive belt - refer to Groups 11 and 12.
Unscrew pump at oil pan.

M60:
If applicable, remove splash guard.
Remove ribbed drive belt - refer to Gr. 11.

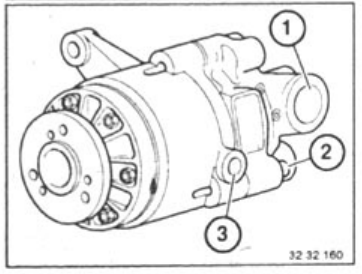
Unscrew pipes.



Power Steering Pump:

Installation:
Replace gaskets.
Tightening torque*.
Bleed hydraulic system - refer to 32 13 006.

1 To steering
2 To tank

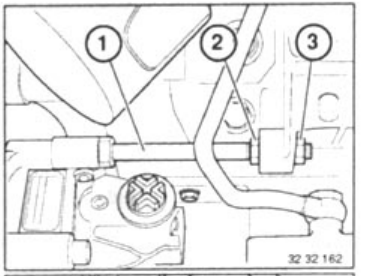


Tandem Pump:

Installation:
Replace gaskets.
Tightening torque*.
Bleed hydraulic system - refer to 32 13 006.

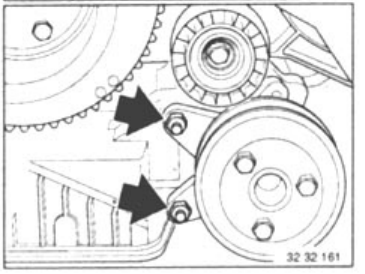
1 To steering
2 To tank
3 To ride level height control

* Refer to Specifications



Unscrew nut (3).

Installation:
Mount support (1) on pump to specified tightening torque*.
Screw nut (2) against engine carrier hand tight.
Tighten nut (3) to specified torque*.



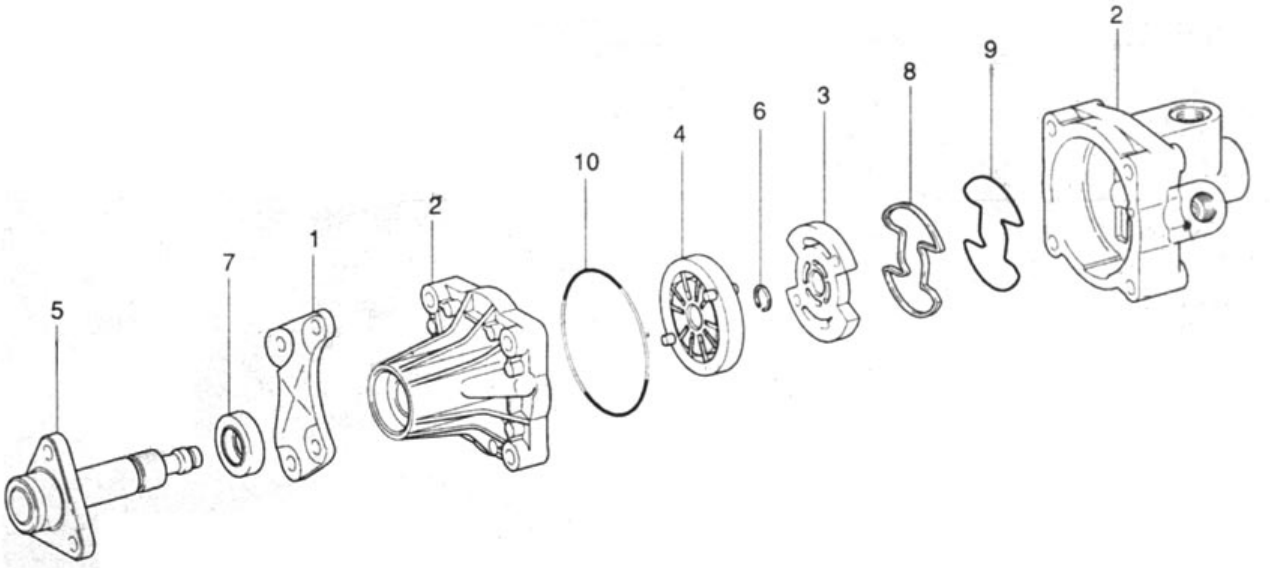
Unscrew oil pump to oil pan bolts and remove pump.

Installation:
Tightening torque*.

* Refer to Specifications

POWER STEREING PUMP

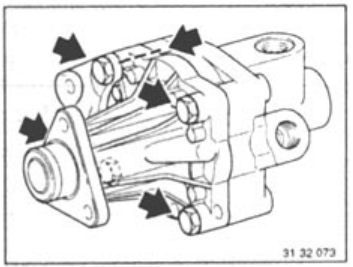
1 Holder
2 Body
3 Face plate
4 Rotor
5 Shaft
6 Snap ring
7 Radial oil seal
8 Seal
9 Guide
10 O-ring



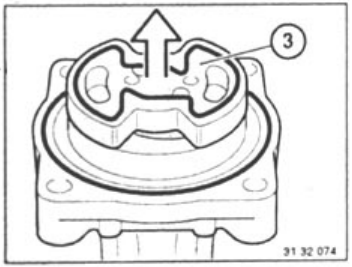
31 32 072

32 41 553 DISASSEMBLING AND ASSEMBLING POWER STEERING PUMP
– Pump Removed –

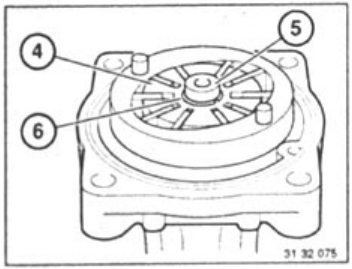
Absolute cleanliness is essential when working on pumps.



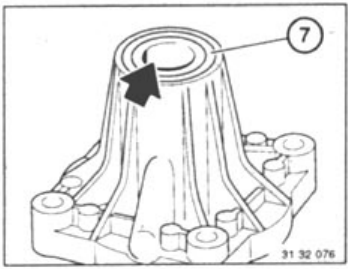
Mark position of holder (1) to pump body (2). Unscrew bolts and separate the body.



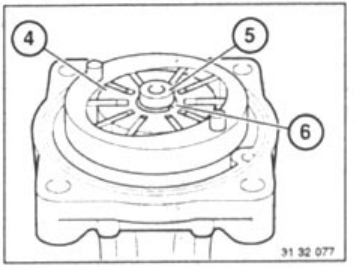
Take off face plate (3).



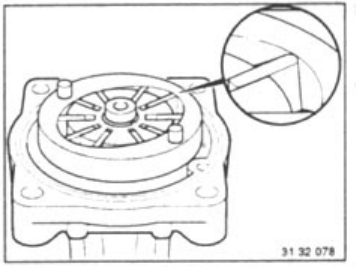
Press down rotor (4) on shaft (5).
Remove circlip (6) and pull shaft our of body.
Remove rotor (4) with the impellers.



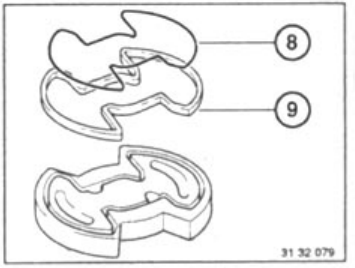
Assembling:
Clean and lubricate all parts with hydraulic fluid.
Replace radial oil seal (7) – sealing lip faces in – and pack space between sealing and dust lips with grease.



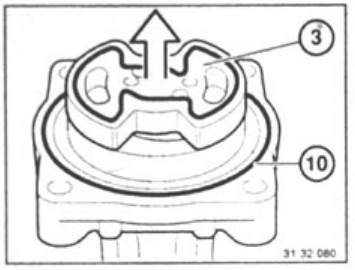
Insert shaft (5) in body.
Mount rotor (4) with recess for snap ring facing up and install snap ring (6) in radial groove of the shaft.



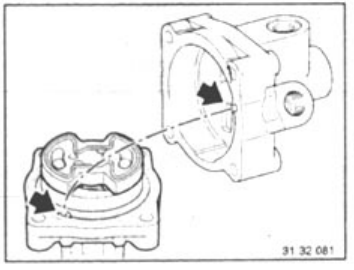
Install the impeller with the polished, rounded outside surfaces facing the cam ring. Check that impeller moves easily.



Install seal (8) with wide end facing down and guide (9) in face plate (3).



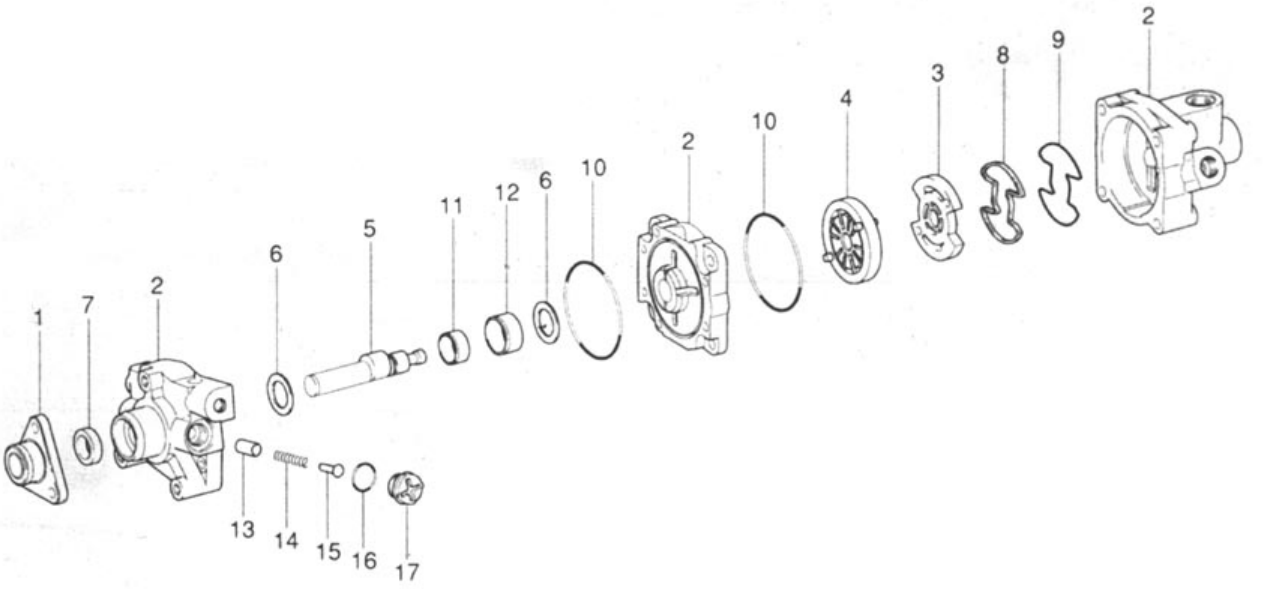
Install face plate (3) on dowel pins.
Replace O-ring (10).



Mount body (checking the bores are aligned) and bolt down with the holder.
Tightening torque = 16 to 19 Nm (12 to 14 ft. lbs.).

Check function after installation of the power steering pump.

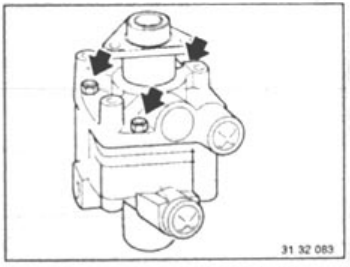
TANDEM PUMP LAYOUT DRAWING



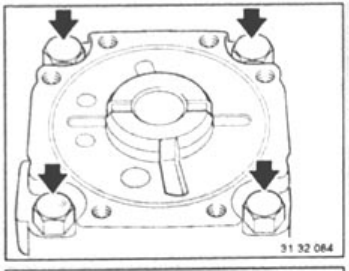
1	Flange	7	Radial oil seal	13	Piston
2	Body	8	Seal	14	Spring
3	Face plate	9	Guide	15	Shaft
4	Rotor	10	O-ring	16	O-ring
5	Shaft	11	Sleeve	17	Plug
6	Axial washer	12	Slide		

32 41 . . . DISASSEMBLING AND ASSEMBLING TANDEM PUMP – Pump Removed –

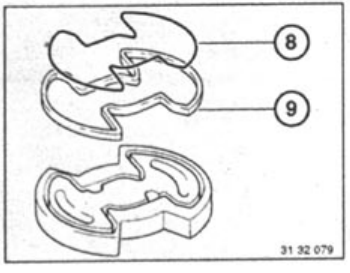
Absolute cleanliness is required when assembling the pump.
Lubricate all parts with hydraulic fluid.



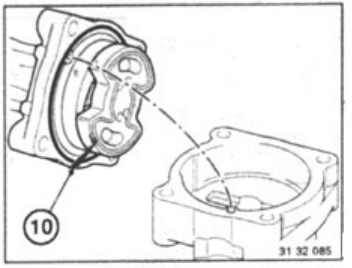
Mark position of flange to shaft and body sections to each other.
Unscrew bolts.
Take off body.



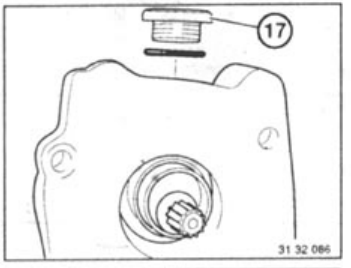
Unscrew bolts.
Take off body (4).



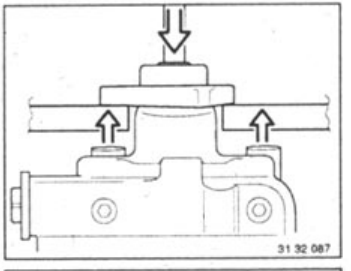
Replace seal (8) – wide end facing plate – and guide (9).



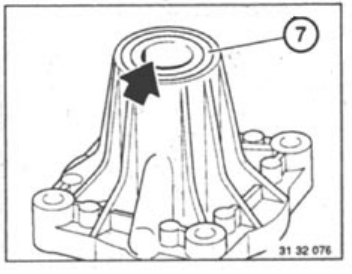
Replace O-ring (10).
Bolt body – bore to bore.
Tightening torque = 14 + 5 Nm (10 + 4 ft.lbs.).



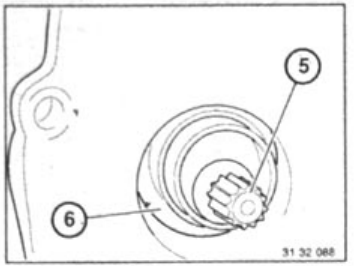
Unscrew both plugs (17).
Take off piston and sliding ring with sleeve.



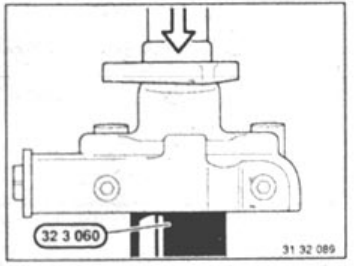
Press triangular flange off of the shaft with a press, while supporting on the flange.



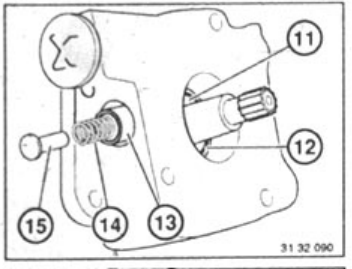
Replace radial oil seal (7) – sealing lip facing in and filled with grease.



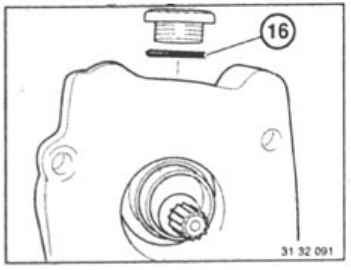
Install axial washer (6) and run in shaft (5).



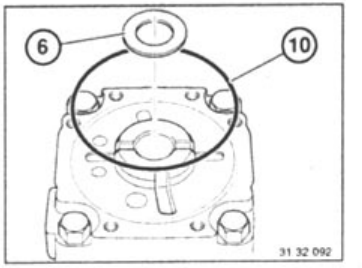
Press on flange with Special Tool 32 3 060.
Shaft protrusion = approx. 1 mm (0.039").
Check marks.



Insert sleeve (11) and sliding ring (12).
Slide in both pistons (13), spring (14) and shaft (15).



Replace O-ring (16).
Tighten plugs (17) with a torque of 50 Nm (36 ft. lbs.).



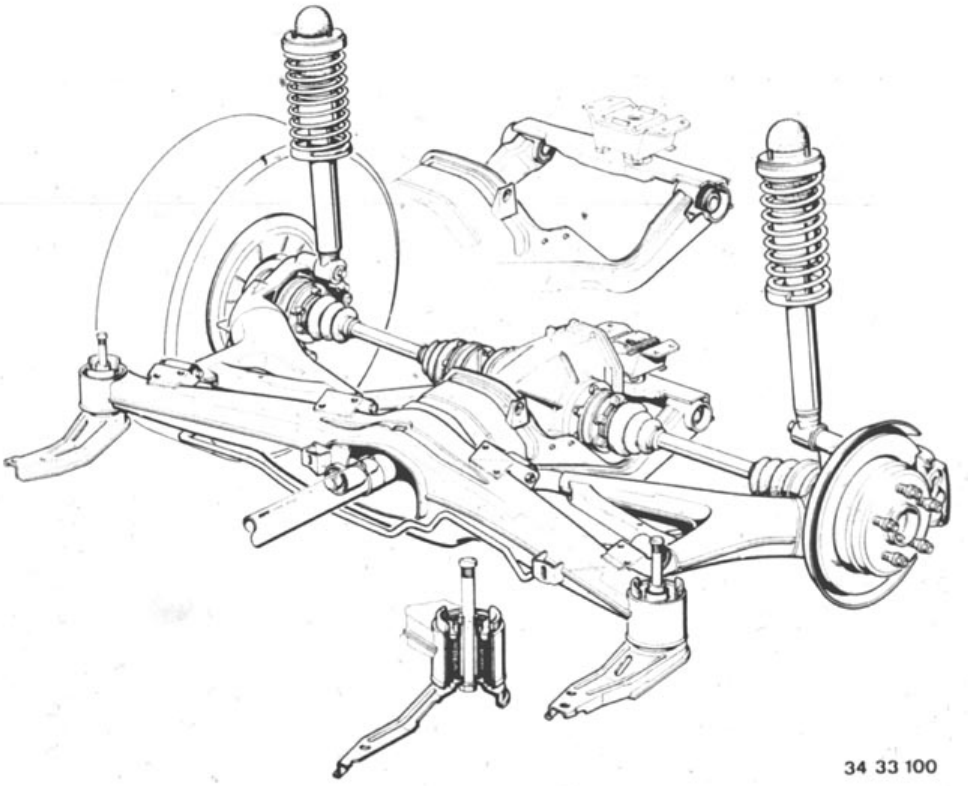
Replace O-ring (10).
Insert axial washer (6).
Mount and bolt body.
Tightening torque = 8 Nm (6 ft. lbs.).

Other jobs – see 32 41 553.

33 Rear axle

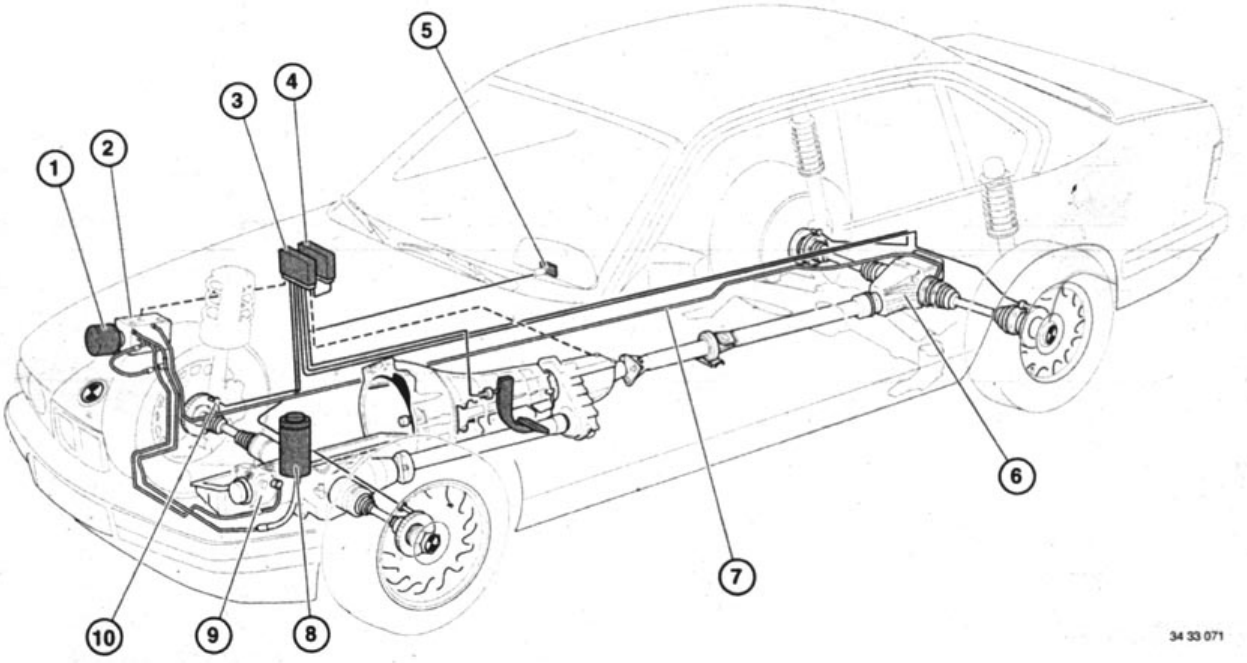
	Rear axle – layout drawing E34 (excluding 520i, 524td)	33- 0/1
	Rear axle – layout drawing (four wheel drive)	33- 0/2
	Breaking-in procedures after replacing/repairing final drive	33- 10/1
33 10 010	Rear axle final drive – remove and install (525i ... M5/Four wheel drive)	33- 10/2
010	Rear axle final drive – remove and install (520i, 524td)	33- 10/3
33 11 151	Shaft seal for drive flange – replace	33- 11/1
151	Shaft seal for drive flange – replace (E34 Four wheel drive)	33- 11/2
33 17 001	Rubber mounts for final drive (rear axle carrier) – replace	33- 17/1
006	Rubber mounts for final drive (front and rear) – replace	33- 17/2
33 19 000	EH limited slip differential – check function	33- 19/1
010	EH limited slip differential – bleed	33- 19/2
. . .	Hydraulic system leak test	33- 19/2
050	GSA control unit – remove and install or replace	33- 19/3
100	EH limited slip differential hydraulic control unit – remove and install or replace	33- 19/4
. . .	Pressure reservoirs – check pressure	33- 19/5
. . .	Pressure reservoirs – remove and install or replace	33- 19/7
33 21 000	Output shaft – remove and install	33- 21/1
031	Boot – replace	33- 21/1
33 31 000	Rear axle carrier, complete – remove and install	33- 31/1
	Arrangement of control arm 13° - axis	33- 32/1
33 32 000	Control arm, complete – remove and install	33- 32/2
021	Control arm – replace	33- 32/3
561	Both rubber thrust mounts – replace	33- 32/3
	Toe-in modification on left wheel	33- 32/5
	Toe-in modification on right wheel	33- 32/6
33 33 071	Rubber mount for rear axle carrier – replace	33- 33/1
001	Thrust rod – replace	33- 33/3
33 41 151	Wheel bearing and shaft seals – replace	33- 41/1
33 52 100	Spring strut shock absorbers – rear left or right, complete – remove and install	33- 52/1
131	Spring strut shock absorber, rear left or right – replace	33- 52/2
	Arrangement of spring strut at rear	33- 52/3
33 53 000	Coil spring, rear left or right – install	33- 53/1
	Rear axle – troubleshoot	33- 90/1

REAR AXLE LAYOUT DRAWING – E 34 (Excluding 520 i, 524 td)



34 33 100

FOUR WHEEL DRIVE LAYOUT DRAWING



1 Pressure reservoir
2 Hydraulic control unit
3 ABS control unit
4 GSA control unit
5 Fault/control lamp
6 Rear axle final drive with EH lock
7 Hydraulic pipe to rear axle final drive
8 Hydraulic fluid tank
9 Hydraulic fluid pump
10 ABS sensor

BREAKING IN PROCEDURES AFTER REPLACING / REPAIRING REAR AXLE FINAL DRIVE

Strict conformance with these breaking in procedures is required for preloading the tapered roller bearing.

During the first 1,000 kilometers the car must be driven at different engine speeds and road speeds, but never faster than 2/3rds of the max. permissible speed.

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 continuous noise, overheating and oil leakage.

Install a tag or label to remind the driver of the next oil change.



33 10 010 REMOVING AND INSTALLING REAR AXLE FINAL DRIVE
-525i ... M5 / Four Wheel Drive-

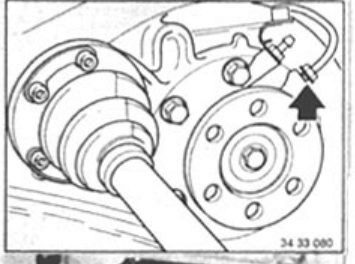
Unscrew the propeller shaft at the rear axle - refer to Group 26.

Installation:
Replace the self-locking nuts.
Tightening torque*.



Unscrew and suspend the output shafts from the car on pieces of wire.

Installation:
Use washers.
Tightening torque*.



Rear Axle Final Drive with EH Lock:

Unscrew the hydraulic pipe and plug the opening with a suitable cap.

Installation:
Tightening torque*.
Bleed the EH limited slip differential - refer to 33 19 010.



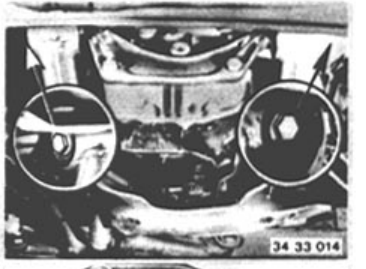
Unscrew the rear axle final drive bolt at the front end of the rear axle carrier.

Installation:
First secure the rear axle final drive on the rear axle carrier with the front bolts.
Tightening torque*.

* Refer to Specifications

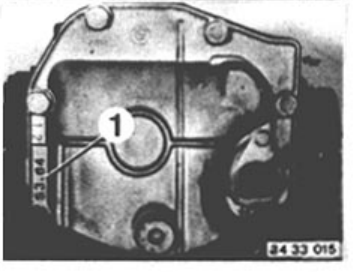


Pull the electric wire plug off of the speedometer pulse sender after squeezing both retainers.
Pull the transmission end plug out of the holder.



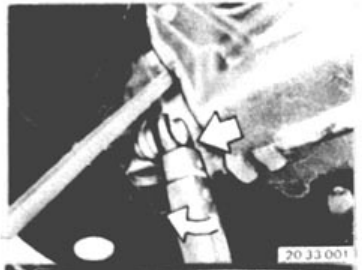
Support the rear axle final drive from underneath using a garage jack and Special Tool 33 4 390.
Unscrew the left and right rubber mount bolts and lower the rear axle final drive.

Installation:
Tightening torque*.
Check the oil level and, if necessary, add rear axle final drive gear lube**.



Note:
When replacing the final drive, note the final drive ratio and version.
Ratio and version are die-stamped in data plate (1).

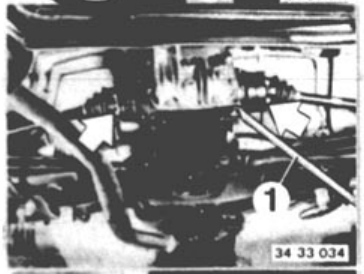
* Refer to Specifications
** Refer to Operating Fluids



33 10 010 REMOVING AND INSTALLING REAR AXLE FINAL DRIVE - 520i and 524td -

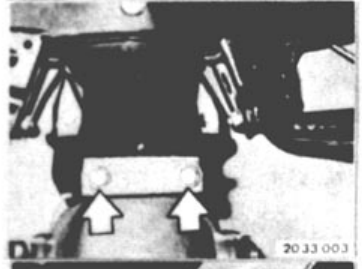
Unscrew the propeller shaft at the rear axle - refer to Group 26.

Installation:
Replace the self-locking nuts.
Tightening torque*.



Unscrew and suspend the output shafts from the car on pieces of wire.
Unscrew reinforcement strut (1).

Installation:
Use washers.
Tightening torque*.



Unscrew the bolts at the top of the rear axle carrier.

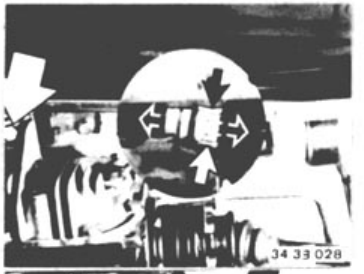
Installation:
Tightening torque*.



Support the rear axle final drive from underneath using a garage jack and Special Tool 33 4 390.
Unscrew the front bolts.

Installation:
Tightening torque*.

* Refer to Specifications



Pull the electric wire plug off of the speedometer pulse sender after squeezing both retainers.
Unscrew the rubber mount bolt and lower the rear axle final drive.

Installation:
Tightening torque*.
Check the oil level and, if necessary, add rear axle final drive gear lube**.



Note:
When replacing the final drive, note the final drive ratio and version.
Ratio and version are die-stamped in data plate.

* Refer to Specifications
** Refer to Operating Fluids

33 11 011 Replacing shaft seal and output flange of rear axle differential (type K/M/G)

Refer to Repair Manual 7 Series E38

33 11 021 Replacing shaft seal for output flange of rear axle differential

Refer to Repair Manual 7 Series E38 for differential Type G and M

Refer to Repair Manual 7 Series E38 for differential Type M and K



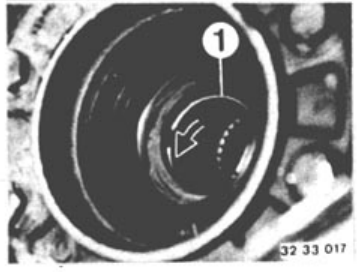
33 11 151 Replacing shaft seal for drive flange

Unflange output shaft from drive flange and tie back.

Installation note:
Install shims.
For tightening torque*.

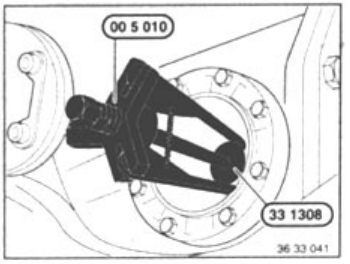


Press out drive flange with crowbar.



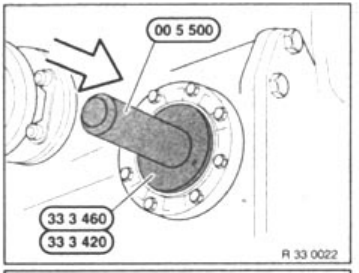
Installation note:
Replace stretched round wire snap rings.
Before mounting the drive flange, fit the round wire snap ring (1) in the groove of the differential casing such that both ends of the round wire snap ring are sunk in the groove.
This prevents the ring being bent to the side.
Press on drive flange by hand and by turning slightly until the round wire snap ring can be heard to engage.

* Refer to Technical Data

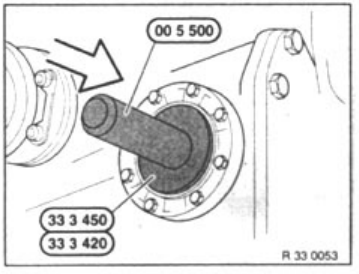


Remove shaft seal with special tool 00 5 010 and suitable thrust piece.

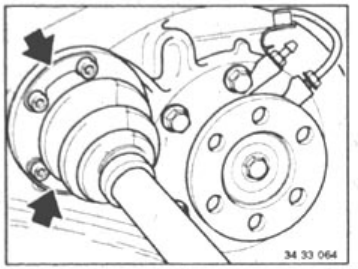
Installation note:
Coat casing flange and sealing lips of shaft seal with differential gear oil.



Installation note:
Drive in shaft seal as far as it will go with special tool 00 5 500/33 3 460 (cover with 4 bolts) or 33 3 420 (cover with 6 bolts).



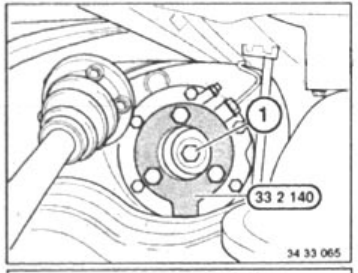
Installation note:
Drive in shaft seal as far as it will go with special tool 00 5 500/33 3 450 (cover with 8 bolts) or 33 3 420 (cover with 6 bolts).



33 11 151 REPLACING SHAFT SEAL FOR DRIVE FLANGE
- E34 Four Wheel Drive -

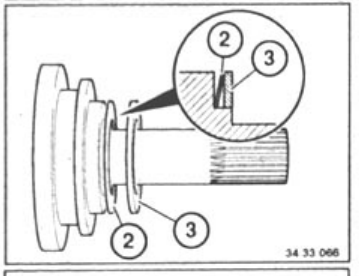
Unscrew the output shaft at the rear axle final drive and suspend it from the car on a piece of wire.

Installation:
Use washers.
Tightening torque*.

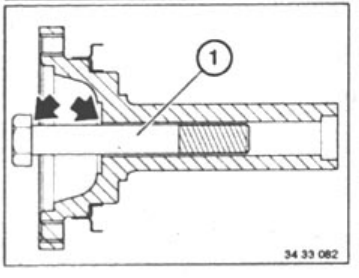


Left Flange:

Mount Special Tool 33 2 140 on the drive flange with three bolts and unscrew bolt (1). Pull the drive flange out and ensure that the bearing thrust washers and needle bearing do not fall out.

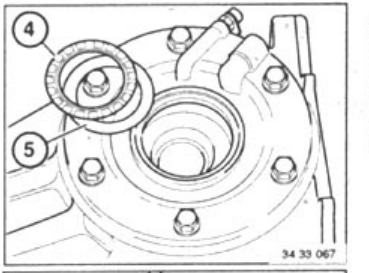


Installation:
Install diaphragm spring (2) and bearing thrust washer (3) on the flange prior to installation of the drive flange.
Press the drive flange in by hand and with slight turning.



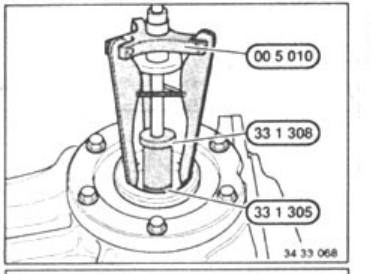
Installation:
Replace bolt (1).
Clean the bearing surfaces between the bolt head and drive flange (sealing surface) thoroughly.
Tighten the bolt using Special Tool 00 9 120.
Tightening torque*.

* Refer to Specifications

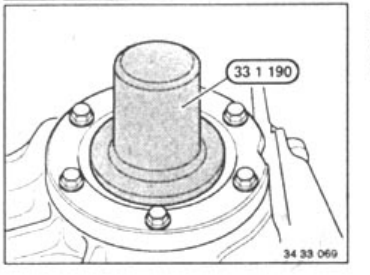


Take needle bearing (4) and thrust washer (5) out of the bearing cap.

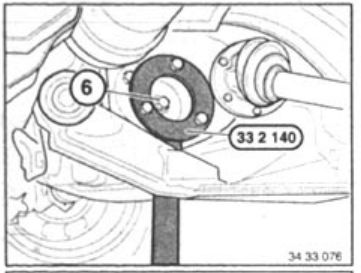
Installation:
Dip the needle bearing and thrust washer in rear axle final drive gear lube prior to installation.
Ensure absolute cleanliness.



Apply Special Tools 33 1 305 and 33 1 308, and pull the shaft seal out using Special Tool 00 5 010.

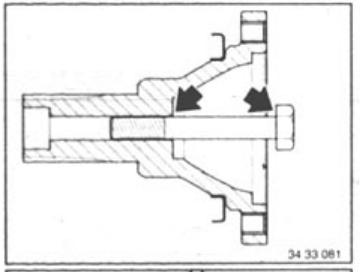


Dip the new shaft seal in rear axle final drive gear lube.
Knock the shaft seal in as far as the stop using Special Tool 33 1 190.

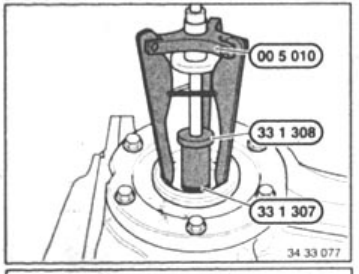


Right-hand flange

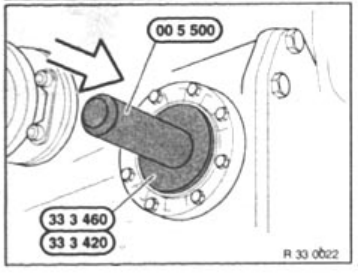
Secure special tool 33 2 140 with three bolts to drive flange and release bolt (6).
Pull out drive flange



Installation note:
Press in drive flange by hand while turning slightly.
Thoroughly clean contact surfaces between bolt head and drive flange (sealing surface).
For tightening torque*.



Fit thrust pieces 33 1 307 and 33 1 308 and remove shaft seal with Special Tool 00 5 010.



Installation note:
Coat casing flange and seal lips of shaft seal with differential gear oil.
Installation note:
Drive in shaft seal as far as it will go with special tool 00 5 500/33 3 460 (cover with 4 bolts) or 33 3 420 (cover with 6 bolts).

* Refer to Technical Data

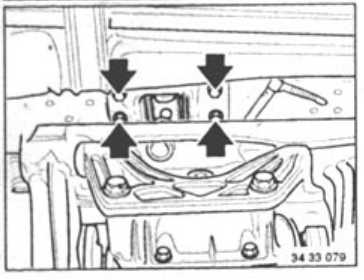
33 17 001 REPLACING RUBBER MOUNT FOR REAR AXLE FINAL DRIVE (REAR AXLE CARRIER)

Pull the electric wire plug off of the speedometer pulse sender.
Support the rear axle final drive from underneath with a garage jack.



Unscrew the bolts and lower the rear axle final drive.

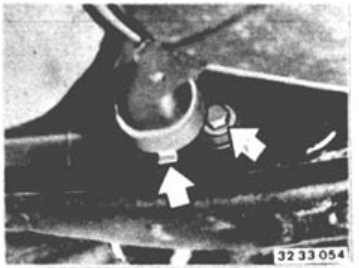
Installation:
Tightening torque*.



Unscrew the bolts and remove the rubber mount.

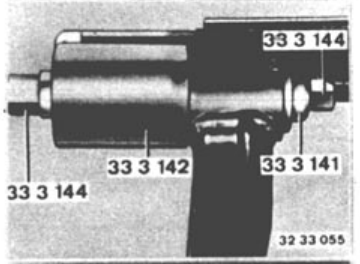
Installation:
Clean the threads and install the bolts with Loctite.
Tightening torque*.

* Refer to Specifications

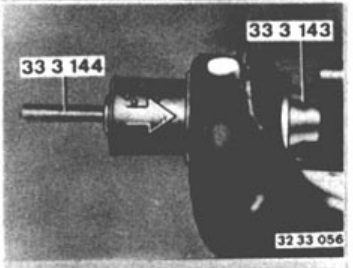


33 17 006 REPLACING ALL RUBBER MOUNTS FOR REAR AXLE FINAL DRIVE (FRONT AND REAR)

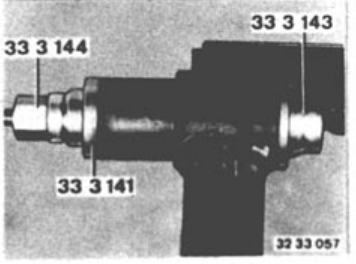
Remove exhaust assembly - refer to 18 00 020.
Remove the heat shield.
Remove rear axle final drive - refer to 33 10 010.
Unscrew the propeller shaft at the center mount and lower.



Pull the rear rubber mounts out using Special Tools 33 3 142, 33 3 141 and 33 3 144.

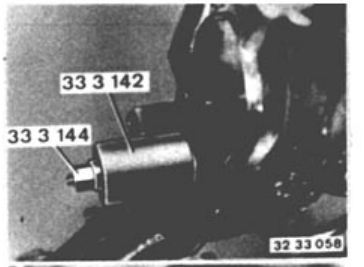


Coat new rubber mounts with Circolight* and install using Special Tools 33 3 143 and 33 3 144.

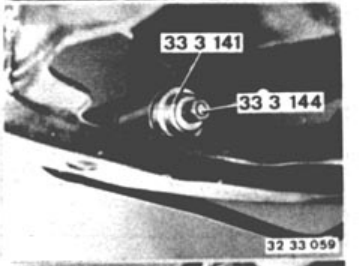


Pull the rubber mounts in flush using Special Tools 33 3 141 and 33 3 144.

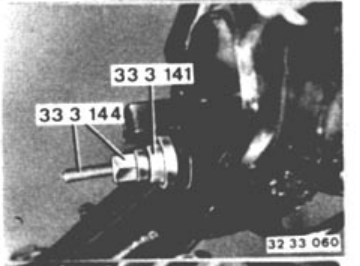
* Source of Supply: BMW Parts



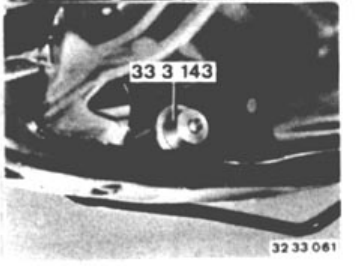
Unscrew the exhaust suspension holder. Pull the front rubber mount out using Special Tools 33 3 142 and 33 3 144.



Use Special Tool 33 3 141 for pulling out.



Coat the new rubber mount with Circolight* and install from outside using Special Tools 33 3 141 and 33 3 144.



Counterhold on inside with Special Tool 33 3 143 for pulling in.

* Source of Supply: BMW Parts

33 19 000 CHECKING FUNCTION OF EH LIMITED SLIP DIFFERENTIAL

Note:
This test is provided only for the sake of checking the entire electric/hydraulic (EH) locking system with simple means.
First ensure that the electric/mechanical (EM) lock functions before checking the EH lock.
EM lock function test - refer to Group 27.

Drive the car onto a lifting platform and raise the platform until all four wheels have cleared ground.

1. Checking Free Movement of Limited Slip Differential:

Switch the ignition off.
Release the parking brake lever.
Engage first gear or move the selector lever into P.
Turn the left rear wheel by hand, whereby the right rear wheel must turn in opposite direction.

Note:
When the rear wheels can only be turned in opposite directions very difficultly or not at all, this is indication that the lock does not open.

Possible Faults:
1. Mechanical fault in the limited slip differential.
2. Pressure is not discharged in the hydraulic pipe to the limited slip differential.
Troubleshooting – refer to diagnosis.

2. Checking Locking Effect:

Requirement:
Parking brake adjusted correctly.

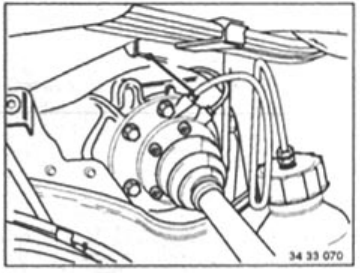
Remove the dust cover from the parking brake lever.
Pull the parking brake lever up 5 or 6 teeth.
Slacken the parking brake cable of the right rear wheel, until the wheel can be turned easily.
Engage first gear or range D.
Both front wheels and the right rear wheel must turn in forward direction.
The left rear wheel remains braked by the parking brake.

Caution!
Do not carry out the following test longer than 5 seconds as otherwise the parking brake would be subjected to excessive loads.

Increase the engine speed to 1500 ... 2000 rpm and observe the left rear wheel.
The EH lock is okay, if the left rear wheel is turned in forward direction against the braking effect.

33 19 010 BLEEDING EH LIMITED SLIP DIFFERENTIAL

Note:
Carry out the bleeding procedures via diagnosis.



Set up the bleeder hose with bottle on the bleeder screw of the rear axle final drive.
Start the engine.
Loosen the bleeder screw slightly and begin with the bleeding procedures.

Flush the hydraulic system until bubbleless hydraulic fluid runs out (flushing volume: approx. 250 cm^3).

Tighten the bleeder screw.
Tightening torque*.

Note:
Remove any escaped Pentosin from the surface of the rear axle final drive after bleeding.

Check for leaks - refer to 33 19 . . ..

Check and, if necessary, correct the hydraulic fluid level in the supply tank - refer to Group 32.

* Refer to Specifications

33 19 . . . CHECKING HYDRAULIC SYSTEM FOR LEAKS

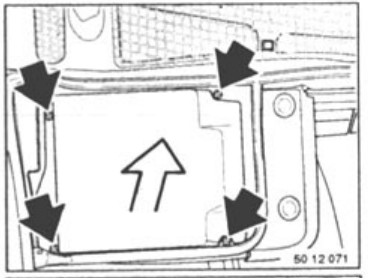
Carry out the leak test via diagnosis.

Leak Test:

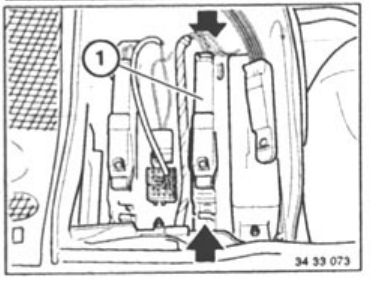
- Begin the bleeding procedures with the engine running.
- Check connections of the hydraulic system for leaks, especially the hydraulic pipe between the hydraulic control unit and EH limited slip differential.

33 19 050 REMOVING AND INSTALLING / REPLACING GSA CONTROL UNIT

Caution!
Always switch the ignition off before removing or installing the control unit.



Unscrew the screws.
Remove the cover.

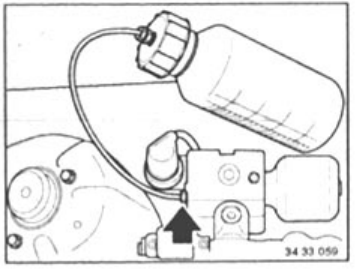


Unlock and pull plug (1) off of the control unit.
Pull the retainers out and remove the control unit.

33 19 100 REMOVING AND INSTALLING / REPLACING HYDRAULIC CONTROL UNIT FOR EH LIMITED SLIP DIFFERENTIAL

Note:
Bleed the hydraulic system - refer to 33 19 010.

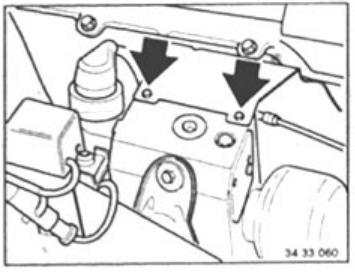
Switch the ignition off.



Discharge the pressure reservoir on the hydraulic control unit by connecting a bleeder bottle to the pressure discharging screw and loosening the screw carefully.

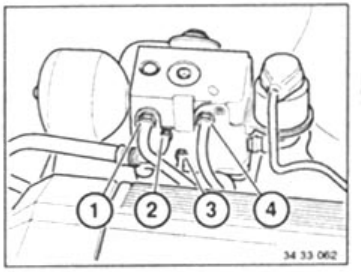
Caution!
If the pressure discharging screw is unscrewed too fast, the bleeder hose could pop off due to the high oil pressure (180 bar).
Wear protective goggles.

Installation:
Tightening torque*.



Unscrew the screws and remove the heat shield.

* Refer to Specifications

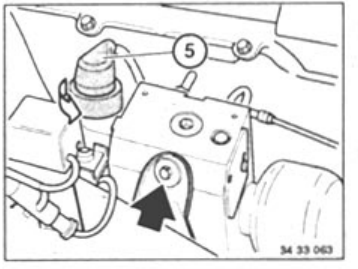


Unscrew hydraulic pipes (1 ... 4) and insert suitable caps into the openings.

Important!
Don't mix up the hydraulic pipes.
1 (T) return pipe to supply tank
2 (A) circulating connection (supply tank/ ride level height control)
3 (P) feed pipe from hydraulic fluid pump
4 (EH) feed pipe to rear axle final drive

Don't start the engine as the pipe to the pump is disconnected.

Installation:
Tightening torque*.



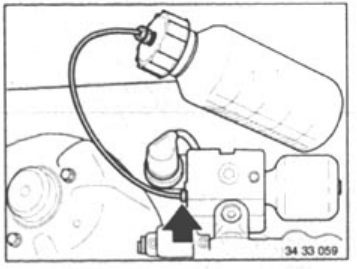
Unlock and pull plug (5) off.
Unscrew the screw and remove the hydraulic control unit.

Note:
Don't start the engine when the hydraulic control unit is disconnected, as the fault memory would be activated.

* Refer to Specifications

33 19 ... CHECKING GAS CHARGE PRESSURE IN PRESSURE RESERVOIR

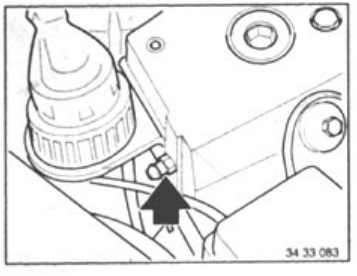
Switch off ignition



Discharge the pressure reservoir on the hydraulic control unit by connecting a bleeder bottle to the pressure discharging screw and loosening the screw carefully.

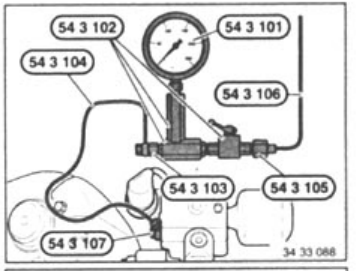
Caution!
If the pressure discharging screw is unscrewed too fast, the bleeder hose could pop off due to the high oil pressure (180 bar).
Wear protective goggles.

Installation:
Tightening torque*.

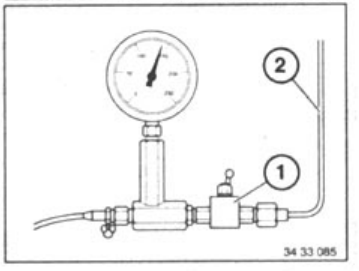


Unscrew the pressure discharging screw.

* Refer to Specifications



Connect a pressure tester to the hydraulic control unit.
Special Tools 54 3 101/102/103/104/105/106 and 107.



Shut valve (1).
Start the engine and wait until 140 to 160 bar pressure is built up.
Stop the engine.
Connect pipe (2) to a bleeder bottle or place it in the supply tank.
Open valve (1) far enough that the pressure drops slowly, while observing the pressure tester gage.
The pressure, at which the needle instantaneously drops to 0 bar, is the gas charge pressure of the pressure reservoir.

Note:
Repeat the test to double-check.
If the measured pressure is less than the minimum gas charge pressure*, the pressure reservoir must be replaced.

Remove the pressure tester.
Install the pressure discharging screw.
Tightening torque*.

* Refer to Specifications

Flushing Hydraulic Control Unit:

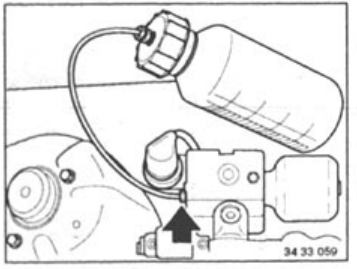
Start the engine and wait (approx. 20 sec.) until pressure is built up.
Stop the engine.
Activate the pressure build-up valve so often (2 or three times) via diagnosis (component activation) until flow noise from the hydraulic control unit is no longer heard.

Important!
There must only be activation one time per minute.

Check and, if necessary, correct the oil level after finishing the work - refer to Group 32.

33 19 ... REMOVING AND INSTALLING / REPLACING PRESSURE RESERVOIR

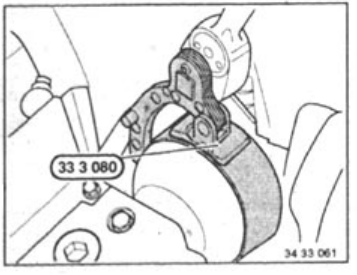
Switch the ignition off.



Discharge the pressure reservoir on the hydraulic control unit by connecting a bleeder bottle to the pressure discharging screw and loosening the screw carefully.

Caution!
If the pressure discharging screw is unscrewed too fast, the bleeder hose could pop off due to the high oil pressure (180 bar).
Wear protective goggles.

Installation:
Tightening torque*.



Loosen the pressure reservoir using Special Tool 33 3 080 and unscrew it.

Installation:
Screw a new pressure reservoir in.
Tightening torque*.

* Refer to Specifications

Flushing Hydraulic Control Unit:

Start the engine and wait (approx. 20 sec.) until pressure is built up.
Stop the engine.
Activate the pressure build-up valve so often (2 or three times) via diagnosis (component activation) until flow noise from the hydraulic control unit is no longer heard.

Important!
There must only be activation one time per minute.

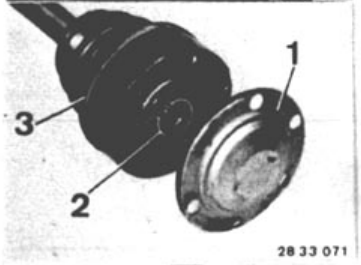
Check and, if necessary, correct the oil level after finishing the work - refer to Group 32.



33 21 000 REMOVING AND INSTALLING OUTPUT SHAFT

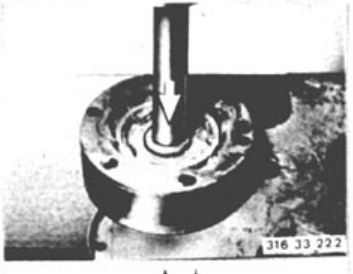
Unscrew output shaft on final drive and rear axle shaft.

Installation:
Install washers on transmission and rear axle ends.
Tightening torque*.

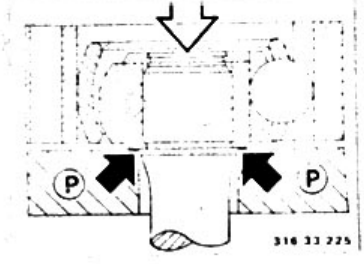


33 21 031 REPLACING DUST COVER

Remove output shaft - see 33 21 000.
Press off sealing cover (1).
Remove circlip (2).
Loosen strap on dust cover.
Press off cover (3).
Peel off the dust cover.



Press output shaft out of constant velocity joint.



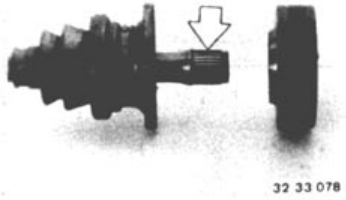
Important!
Bearing inner race must bear on counterpressure plate (P).
Don' disassemble the joint.
Check joint for dirt or damage.

* See Specifications



Mount dust cover with inside cover on the output shaft.
The joint must be positioned with the inner race collar facing the output shaft.

Important!
Use a repair kit.
Dust cover is mounted on the cover.



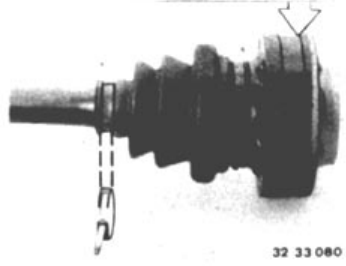
Remove grease from splines of joint.
Coat splines with Loctite No. 270.

Important!
Keep Loctite out of ball grooves.



Press on joint with cap and install circlip.

Installation:
If only one end is disassembled, the sealing cover on the other end must be removed to press on the joint.



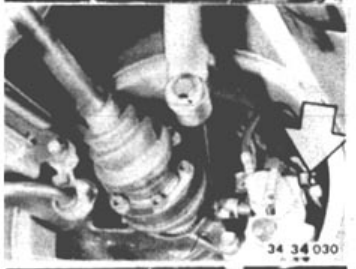
Fill joint and dust cover with grease*.
Remove grease from sealing surface for the dust cover.
Mount dust cover with a new strap.
Seal the sealing cover with Curil K2** and install.

* See Specifications
** Source of Supply: HWB



33 31 000 REMOVING AND INSTALLING REAR AXLE CARRIER ASSY.

Remove exhaust assembly - see 18.00 020.
Remove propeller shaft - see 26 11 000.
Disconnect brake cables on parking brake lever - see 34 41 000.
Draw off brake fluid in tank with a syringe reserved exclusively for use with brake fluid.
Remove the float housing for this purpose.



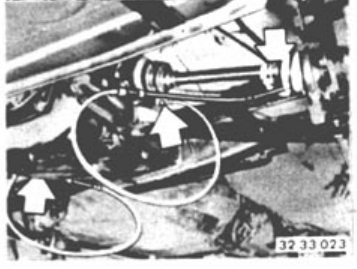
Installation:
Fill with brake fluid** and bleed brakes.

Unplug right brake pad wear indicator.
Disconnect ground lead and lift lead out of clamps.



Pull down connecting plug for both pulse senders and disconnect.

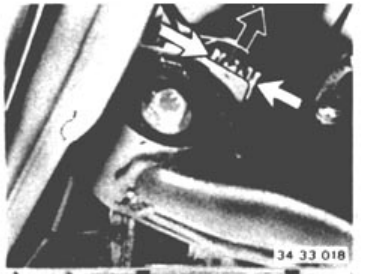
Important!
Don't destroy the rubber grommet.



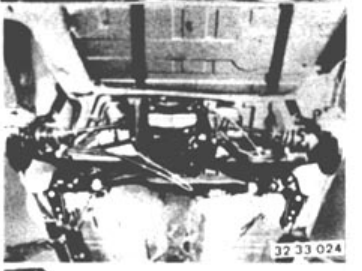
Pull brake cables out of guides.
Unscrew left and right brake lines.

Installation:
Tightening torque*.

* See Specifications
** See Gr. 34 of Operating Fluids

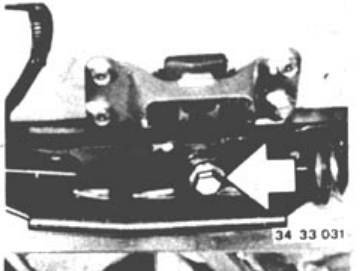


Disconnect plug on speedometer pulse sender, squeezing both tabs together for this purpose.
Remove holder.



Support final drive with a workshop jack.
Unscrew left and right thrust struts on the floor plate.

Installation:
Replace self-locking nuts.
Tightening torque*.



Unscrew rear mounting bolt.

Installation:
Tightening torque*.



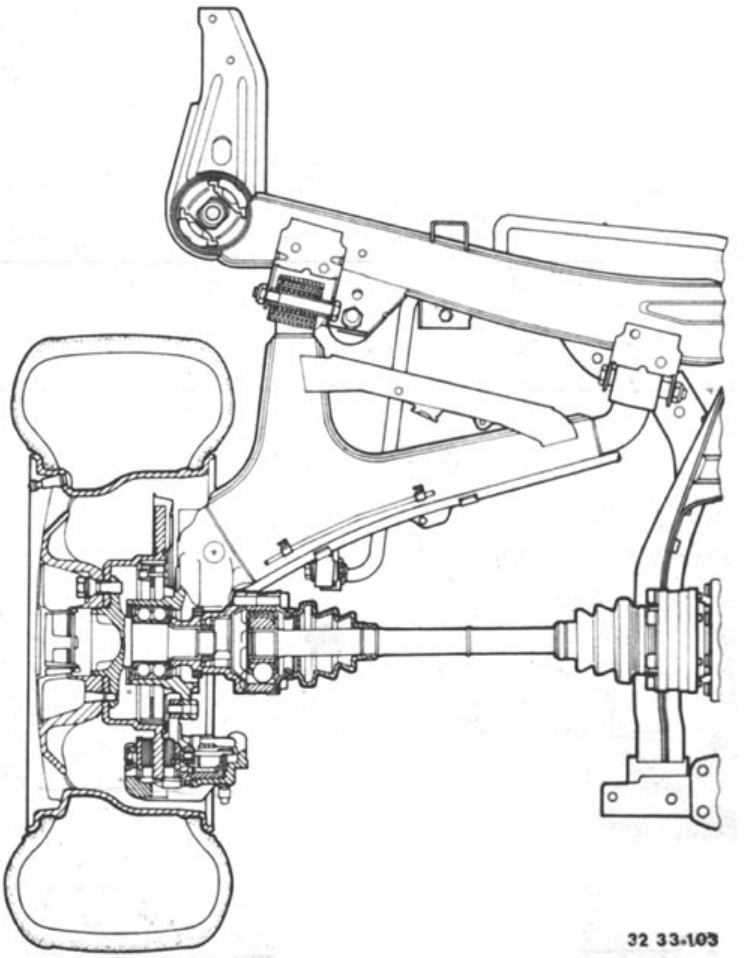
Unscrew left and right shock absorbers on trailing arms.
Lower the rear axle carrier.

Installation:
Tighten mounting bolts with the car in normal position**.
Tightening torque*.

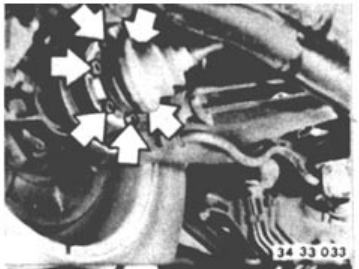
Lift car and pull out complete rear axle carrier.

* See Specifications
** See Specifications of Gr. 32

TRAILING ARM LAYOUT DRAWING
13° Trail Axle



32 33-103



33 32 000 REMOVING AND INSTALLING TRAILING ARM ASSEMBLY

Remove rear wheel - see 36 10 300.
Pull up parking brake lever and unscrew output shaft on the drive flange, suspending it from the car on a piece of wire.

Installation:
Tightening torque*.

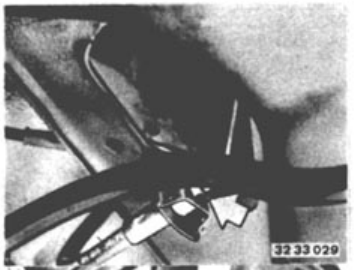


Remove brake cable on parking brake lever - see 34 41 000.
Draw off brake fluid in tank with a syringe reserved exclusively for use with brake fluid.
Remove float housing for this purpose.

Installation:
Pour in brake fluid** and bleed brakes - see 34 00 046.

Pull down and disconnect plug for pulse sender.

Important!
Don't destroy the rubber grommet.



Pull parking brake cable out of guide.
Disconnect brake line.

Installation:
Tightening torque*.



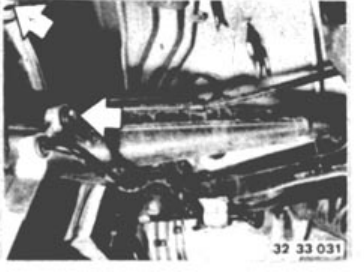
Support trailing arm from underneath.
Unscrew trailing arm on rear axle carrier.

Installation:
First insert bolt on the inner console.

Important!
Tighten mounting bolts with the car in normal position**.
Tightening torque*.



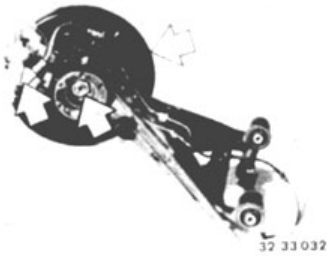
M 5:
Installation:
Tighten bolt with Special Tool 33 3 060 in conjunction with a torque wrench set to 55 Nm (40 ft. lbs.).



Unscrew stabilizer.
Unscrew shock absorber and take off the trailing arm.
Important! - Installation:
Tighten mounting bolts with the car in normal position**.
Tightening torque*.
Check ride level height of car with ride control - see 37 12 010, adjusting if necessary.

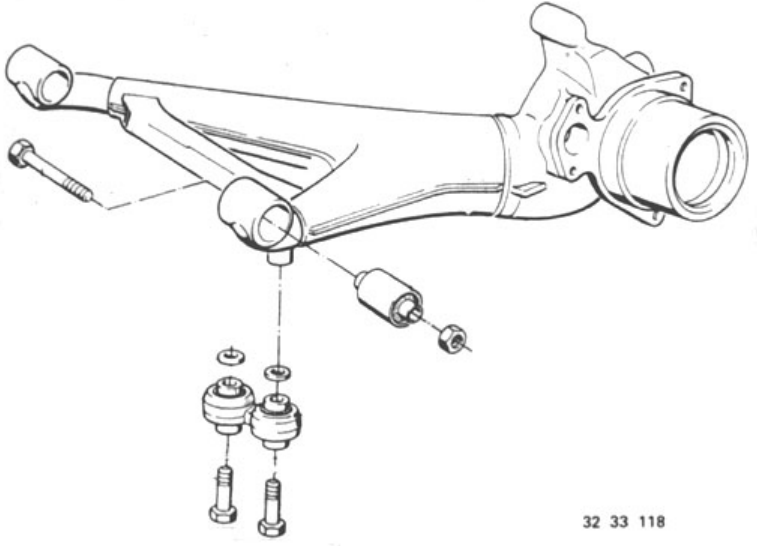
* See Specifications
** See Operating Fluids

* See Specifications
** See Specifications of Gr. 32


32 33 032

33 32 021 REPLACING TRAILING ARM

Remove trailing arm - see 33 32 000.
Replace wheel bearings and shaft seal - see 33 32 151.
Transfer guard.
Rubber mounts are already installed in a new trailing arm.


32 33 118



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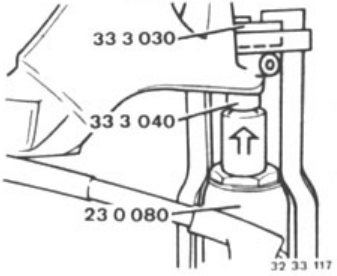
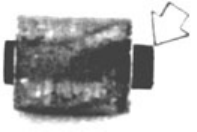
33 32 561 REPLACING BOTH THRUST RUBBER MOUNTS - Trailing Arm Removed -

Press out rubber mounts in a press with Special Tool 33 3 040.



32 33 117

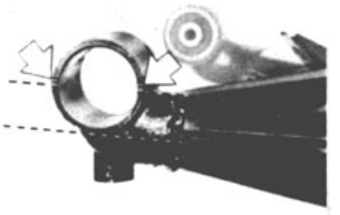
If a suitable press is not available, press out (and in) rubber mounts with Special Tools 23 0 080 and 33 3 030 / 040.
Screw in pad of the pulling tool in such a manner, that the threaded section faces up.


28 33 057

Installation:
Longer section of each inner bushing faces the center of the car.

Eccentric thrust rubber mounts could be installed to correct rear axle toe deviation caused by the unfavorable summary of tolerances.

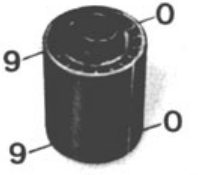
Important!
This measure may never be applied for the "elimination" of changes in axle geometry caused in an accident.



28 33 061

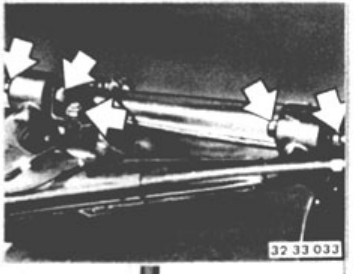
Mark the trailing arm ir horizontal position on the trailing arm eye.

Check the rear wheel alignment - refer to Group 32.

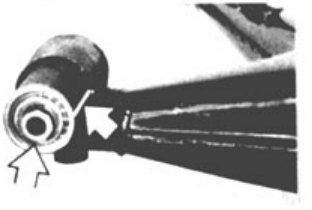


28 33 062

Take the corresponding angle displacement from the following diagram.
Connect the numbers for toe correction on both ends of the rubber mount with lines.



Remove complete trailing arm - refer to 33 32 000.



28 33 063

Coat the rubber mount with Circolight® and apply it on the trailing arm that the line is aligned with the mark on the trailing arm.
Press the rubber mount in.
Mount the trailing arm and check the rear wheel alignment.

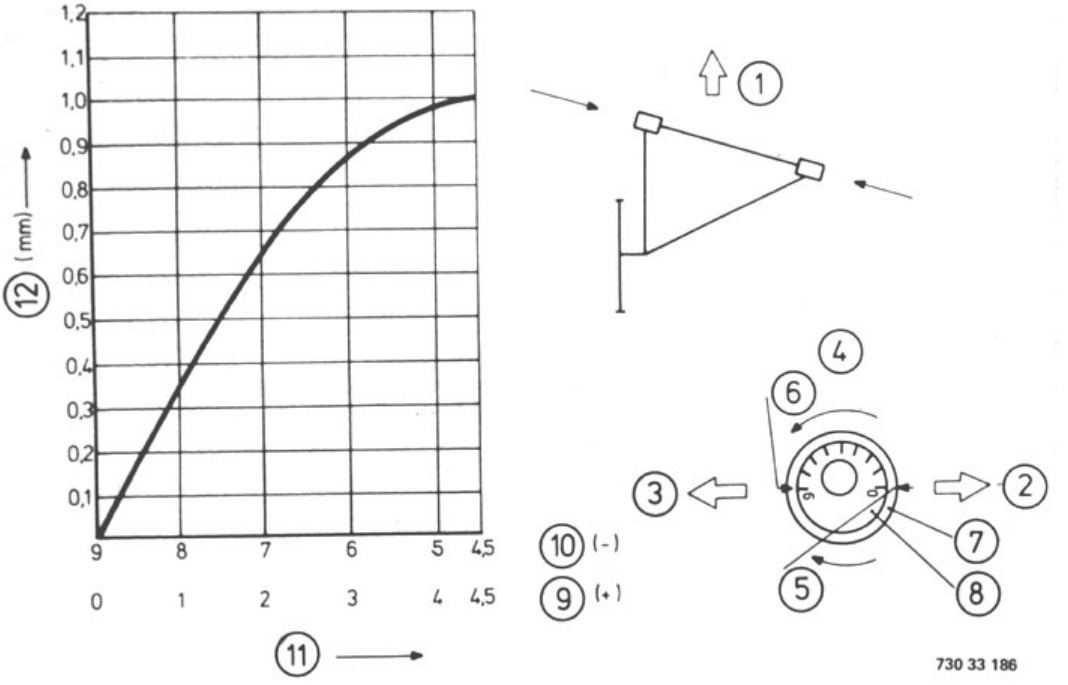


Press the rubber mount out - refer to 33 32 561.

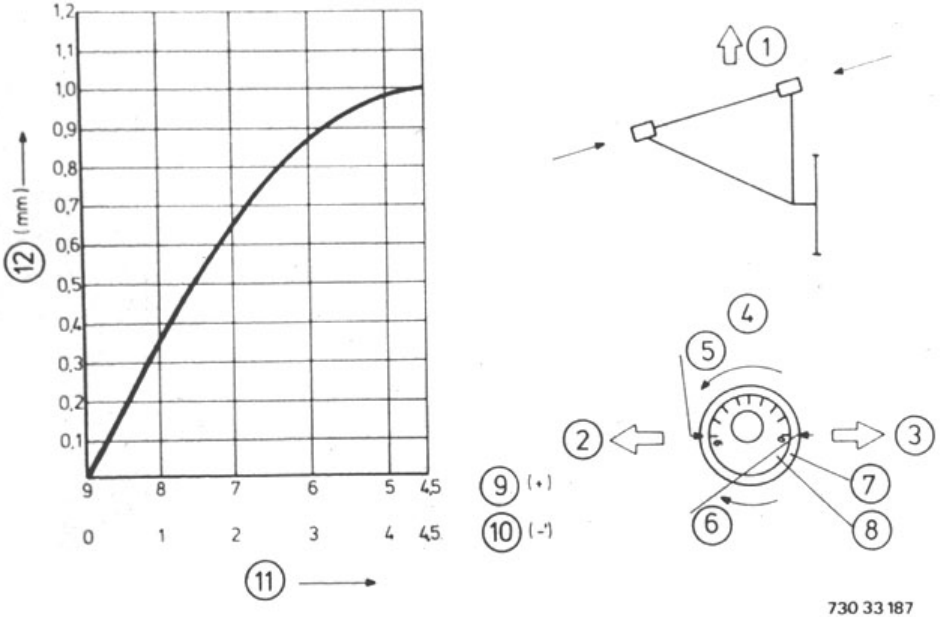
If correction on the outer rubber mount is not sufficient, an eccentric rubber mount may also be used on the inside.

1 Forward direction
2 Forward direction - inner rubber mount
3 Forward direction - outer rubber mount
4 Pressing-in note
5 Reading point - toe increase
6 Reading point - toe decrease
7 Trailing arm eye
8 Thrust rubber mount
9 Toe increase
10 Toe decrease
11 Displacement angle
12 Toe change

TOE CHANGE ON LEFT REAR WHEEL

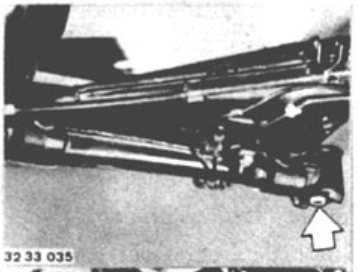


TOE CHANGE ON RIGHT REAR WHEEL



730 33 187

1 Forward direction
2 Forward direction - inner rubber mount
3 Forward direction - outer rubber mount
4 Pressing-in note
5 Reading point - toe increase
6 Reading point - toe decrease
7 Trailing arm eye
8 Thrust rubber mount
9 Toe increase
10 Toe decrease
11 Displacement angle
12 Toe change



33 33 071 REPLACING RUBBER MOUNTS FOR REAR AXLE CARRIER

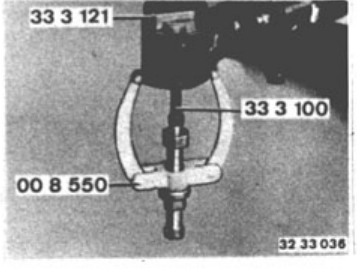
Remove the rear seat.
Support the trailing arms from underneath.
Unscrew the thrust strut.

Installation:
Replace the self-locking nuts.
Tightening torque*.

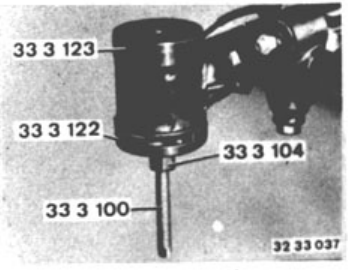


Knock the studs out upwards.

Important!
Don't damage the threads.
If applicable, cut off protruding rubber at the openings.



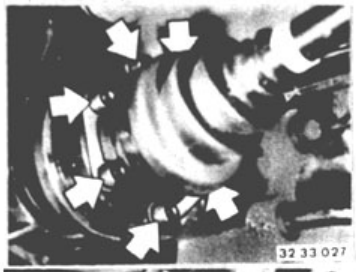
Place Special Tool 33 3 121 on the rubber mount between the body and rear axle carrier, and screw in Special Tool 33 3 107.
Apply Special Tool 00 8 550 with its claws in the openings, secure with Special Tool 33 3 107 and pull the rubber mount out.
Heat the rear axle carrier at the rubber mount take-up with an industrial hot air blower to make this step easier.



Place Special Tool 33 3 123 on the edge of the take-up sleeve between the body and rear axle carrier, and screw in Special Tool 33 3 103.
Coat the rubber mount with Circolight** and apply it on the rear axle carrier.
Pull it in using Special Tools 33 3 122 and 33 3 104.

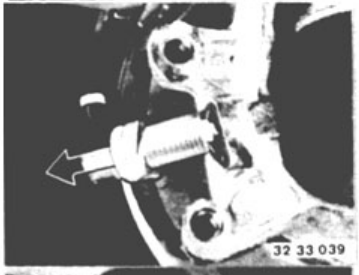
* Refer to Specifications.

* Refer to Specifications
** Source of Supply: BMW Parts

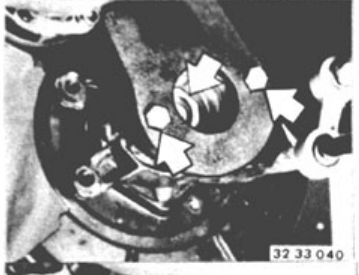


33 41 151 REPLACING SHAFT SEALS AND WHEEL BEARINGS

Unscrew output shaft on drive flange and suspend from car on a piece of wire.
Remove rear brake disc – see 34 21 320.
Installation:
Tightening torque*.



Lift out lockplate.
Remove ABS speed sensor.



Mount Special Tool 33 4 000 with two M 10 x 30 bolts.
Unscrew collar nut.

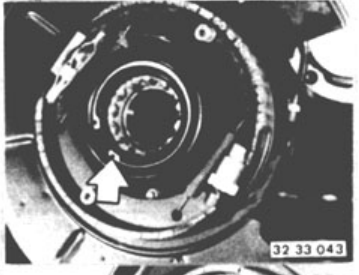


Pull off drive flange with Special Tool 00 7 501 and two M 10 x 30 bolts.

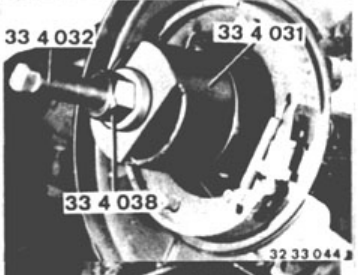
* See Specifications



Screw on collar nut flush with end of shaft and drive out with a nylon hammer.
Installation:
Check splines.
Check drive flange, replacing flange if necessary.



Lift out circlip.



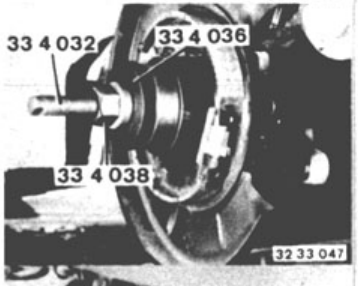
Pull out wheel bearings with Special Tools 33 4 031, 33 4 032 and 33 4 038.



Use Special Tool 33 4 033.



Pull inner bearing shell off of the rear axle shaft with Special Tool 00 7 500.



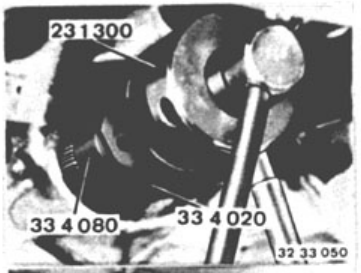
Pull in complete wheel bearing with Special Tools 33 4 036, 33 4 032 and 33 4 030.



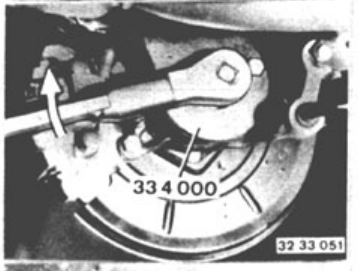
Use Special Tool 33 4 037.



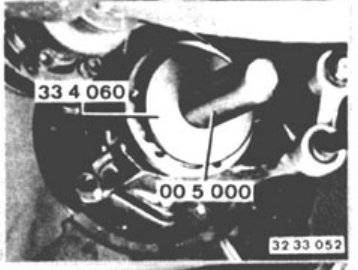
Install circlip.



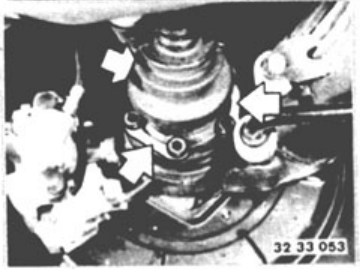
Pull in rear axle shaft with Special Tools 23 1 300, 33 4 080 and 33 4 020.



Important!
Give bearing surface on collar nut a light coat of oil.
Apply Special Tool 33 4 000.
Tighten collar nut.
Tightening torque*.



Drive in lockplate with Special Tools 33 4 060 and 00 5 000.



Install output shaft.
Use washer.
Tightening torque*.

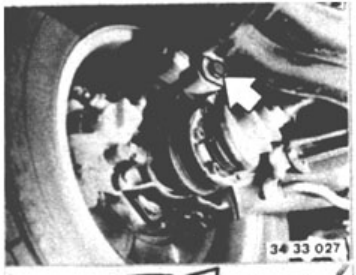
* See Specifications

33 52 100 Removing and installing complete left or right rear spring strut shock absorber

Level control, refer to 37 12 100.

Sedan:
Remove backrest, refer to 52 20 000.
Touring:
Remove wheel arch trim,
refer to 51 47 151.

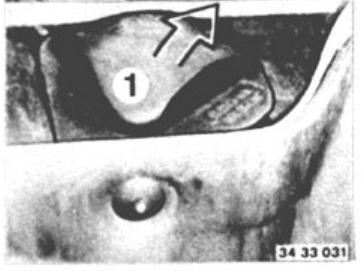
Jack up vehicle and support semi-trailing arm.



Caution!
The spring strut shock absorber performs the function of an arrester band.

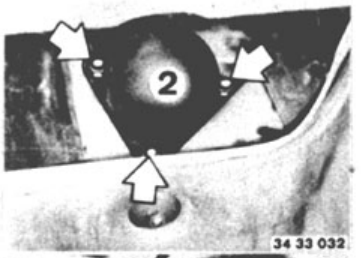
Unfasten screw and remove spring strut shock absorber from semi-trailing arm.

Installation:
Tightening torque 33 52 1AZ*

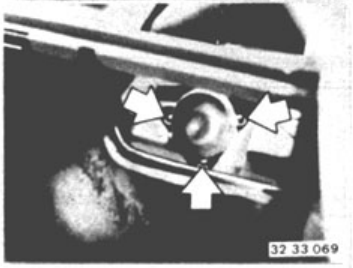


Lift up trim (1).

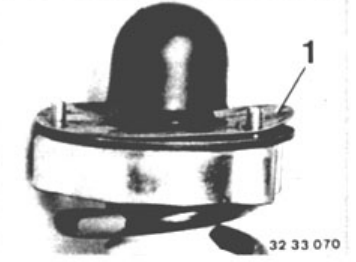
* Refer to Technical Data



Remove cap (2).



Brace spring strut shock absorber, unfasten screws and remove spring strut shock absorber.



Installation:
Replace sealing disc (1).
Replace self-locking nuts.
Tightening torque 33 52 5AZ*

Note:
Only store shock absorbers in upright position.
If shock absorbers are stored for extended periods with the piston rod retracted, this can give rise to hammering noises when driving.
Remedy:
Remove piston rod and store shock absorber upright at room temperature for 24 hours.

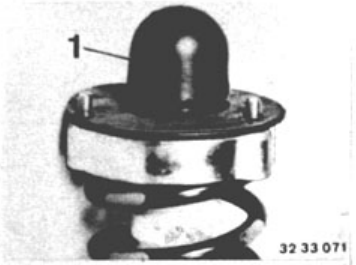
* Refer to Technical Data

33 52 131 Replacing rear left or right spring strut shock absorber

Whether a shock absorber needs to be replaced can only be determined by testing it when installed with a shock tester or when removed with a shock absorber testing machine.
Refer to SI 37 01 92 (562).

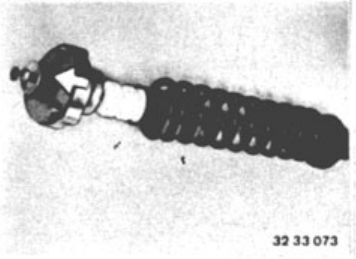
When replacing, a spring strut shock absorber with the same identification designation must always be installed.

Remove spring strut shock absorber, refer to 33 52 100.



32 33 071

Remove cap (1).

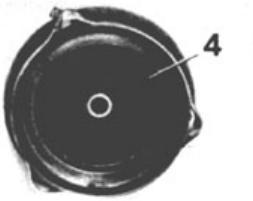

32 33 073

Release nut.
Remove support bearing and coil spring.

Installation note:
Refer to spring strut layout for installation sequence.
For tightening torque 33 52 3AZ*.

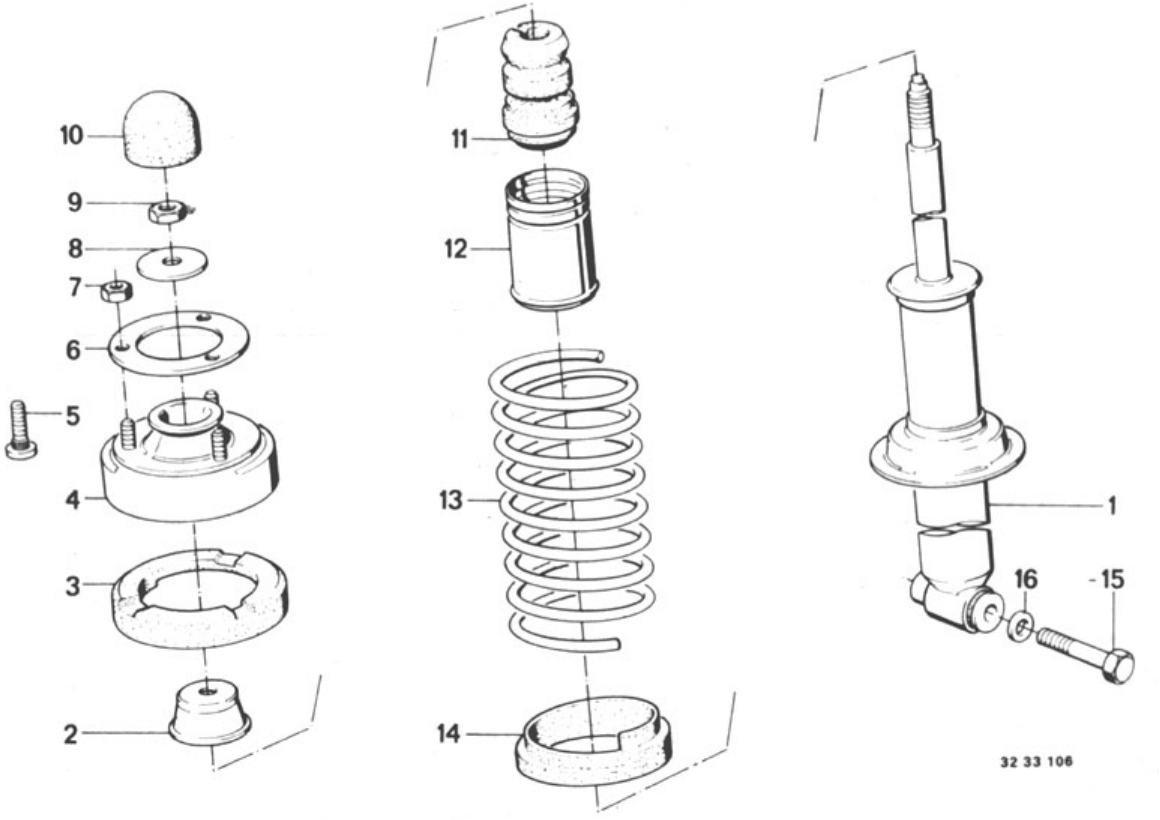
* Refer to Technical Data

Check support bearing (4) for damage.



32 33 074

REAR SPRING STRUT LAYOUT DRAWING



1 Shock absorber
2 Support
3 Upper spring ring
4 Mount
5 Bolt
6 Insulator
7 Collar nut M 8
8 Disc
9 Nut M 10 x 1 - 8 ZN
10 Cap
11 Rubber damper
12 Protective tube
13 Coil spring
14 Lower spring ring
15 Bolt M 14 x 1.5 x 85
16 Washer

33 53 000 Removing and installing rear left or right coil spring

The procedure is identical as that for replacing spring strut shock absorber, refer to 33 52 131.

TROUBLESHOOTING REAR AXLE

Condition	Cause	Correction
Load change knock	Backlash excessive Output shaft defective Play in propeller shaft slide	Adjust backlash – see 33 12 551 Replace output shaft – see 33 21 000 Install slide with Loctite No. 75 for joints
Traction or compression noise	Backlash excessive or insufficient	Adjust backlash – see 33 12 551
Drumming	Propeller shaft Rubber mounts on rear axle carrier defective	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 Group 33 Replace final drive oil
Vibration	Imbalance of wheels Output shaft defective Propeller shaft	Balance wheels, replacing rims if necessary Replace output shaft – see 33 21 000 See "Troubleshooting Propeller Shaft"
Rattling or grinding noise	Shock absorbers loose Upper shock absorber rubber mount defective Lower shock absorber rubber mount defective Rubber mounts on rear axle carrier defective	Tighten shock absorbers Replace rubber mount Replace shock absorber – see 33 52 100 Replace rubber mounts – see 33 33 071
Grinding noise only when driving in curves	Wheel bearings defective	Replace wheel bearings – see 33 41 151

* See Specifications

34 Brakes

34 00 . . .	General information	34-	0/1
34 00 . . .	Notes on brake fluid	34-	0/1
34 00 . . .	Notes on brakes	34-	0/1
34 00 . . .	Notes on brake lines	34-	0/1
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34 00 009	Brake test on test rig	34-	0/2
519	Foot brakes (high pressure, low pressure check) – check	34-	0/3
017	Brake booster – check function	34-	0/4
046	Brake system – bleed	34-	0/5
047	Brake system with ABS – bleed	34-	0/5
	Function description ASC+T	34-	0/6
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34 10 014	Handbrake – adjust	34-	10/1
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220	Front brake disc – remove and install	34-	11/4
599	Front brake disk – check for runout and thickness deviation	34-	11/5
667	Front brake disc – grind	34-	11/5
34 21 200	Rear brake pads – remove and install	34-	21/1
745	Rear brake calipers – remove and install	34-	21/1
292	Rear brake calipers – overhaul	34-	21/2
320	Rear brake disks – remove and install	34-	21/3
879	Rear brake disks – check for runout and thickness deviation	34-	21/4
947	Precision turning rear brake disks	34-	21/4
34 31 000	Master brake cylinder – remove and install	34-	31/1
500	Master brake cylinder – remove and install (M60)	34-	31/2
34 32 361	All brake lines – replace	34-	32/1
381	Brake hose, front – replace	34-	32/1
451	Brake hose, rear – replace	34-	32/1
34 33 505	Brake unit (brake booster) – remove and install or replace	34-	33/1
505	Brake unit (brake booster) – remove and install or replace	34-	33/2
051	Non-return valve for brake unit – replace	34-	33/3
071	Vacuum hose for brake units – replace	34-	33/3
34 41 000	Hand brake lever – remove and install	34-	41/1
	Arrangement, handbrake lever	34-	41/2
100	Handbrake Bowden cable – remove and install	34-	41/3
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34 50 000	Anti-lock braking system – function check	34-	50/3
34 51 520	Hydraulic unit (for ABS), complete unit – remove and install or replace	34-	51/1
520	Hydraulic unit (for ABS), complete unit – remove and install or replace (M60)	34-	51/2
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525	Hydraulic unit (ASC+T) – remove and install or replace (M60)	34-	51/5
525	Hydraulic unit (ASC+T) – remove and install or replace	34-	51/7
34 51 540	ASC+T filter – remove and install or replace	34-	51/8
34 52 510	Control unit (for ABS) – replace	34-	52/1
61 12 510	One impulse sensor (for ABS) at front – replace	34-	52/2
522	One impulse sensor (for ABS) at rear – replace	34-	52/2
61 31 570	Relay on hydraulic unit (for ABS) – replace	34-	52/3
62 99 080	Telltale for ABS – replace	34-	52/3
	Brake system – troubleshoot	34-	90/1

34 00 ... General information

Ensure absolute cleanliness and only use lint-free cleaning rags.
No oil or grease must enter the brake system as this could cause the brake system to fail.
On no account must brake cleaner enter the brake system when cleaning brake components (with brake cleaner, refer to BMW Parts Service).
Even small traces of brake cleaner must be avoided. Only use approved assembly pastes when carrying out repairs on brake callipers, refer to BMW Parts Service.
Wash off brake dust or remove with vacuum cleaner, do not blow off with compressed air. The dust is hazardous to health!

34 00 ... Notes on brake fluid

Refer to BMW Fluids and Lubricants Specifications.
Should brake fluid get into the eyes, immediately flush with ample clean water and visit ophthalmologist.
Avoid skin contact, if necessary, clean with soap and water.
Replace brake fluid every two years at the latest.
On no account re-use drained brake fluid.
Dispose off brake fluid only in approved facilities, refer to Workshop Equipment Planning documentation.
Ensure no brake fluid comes in contact with the vehicle paintwork since it is aggressive and destroys paint.

34 00 ... Notes on brakes

Brake disks, brake drums, brake pads:
Brake disks, brake drums and brake pads should only be replaced in axle sets.
Brake disks, brake drums must show no signs of scoring or cracks.
Minimum disk thickness (MIN TH), disk runout, parallel alignment and peak-to-valley height of friction surfaces must not exceed or drop below the permissible limits, refer to Technical Data.
Brake pads must not wear down to below the specified minimum pad thickness, refer to Technical Data.
Remove preserving agent on new components before installing.

34 00 ... Notes on brake lines

Release and tighten brake line screw fittings only with a special brake line wrench (this avoid damaging brake lines).
Close off open connections of brake lines and individual components to ensure no dirt can enter the brake system.
The brake system must be bled after brake lines have been released.
Check all connecting parts for leaks.
Brake lines and brake hoses must be laid correctly and must not rest or chafe on the body or fixed components.
Firmly tighten brake hoses at the front wheels only with the wheels in the straight ahead position.

General instructions for ABS/ASC+T

The ABS requires no maintenance at all but you must observe the following when ABS is fitted:

Plug must be pulled off the electronic control unit when welding with an electric welder (ignition switched off).

During painting work, the electronic control unit can be exposed for up to 2 hours to max. 95° C and, over longer periods, to max. 85° C.

Do not incorrectly connect up the brake lines on the hydraulic unit: if necessary, mark them prior to disassembly.

The ABS system must be checked in accordance with the Electrical Troubleshooting Manual if one of the following ABS components is removed or replaced:

- Hydraulic unit
- ABS control unit
- Wheel speed sensor
- ABS wiring harness
- Valve control relay
- Electric motor relay

525i with ASC+T up to model year 94:
The ABS/ASC control unit must be reconfigured in accordance with the BMW Diagnosis unit if one of the following components is removed or replaced:

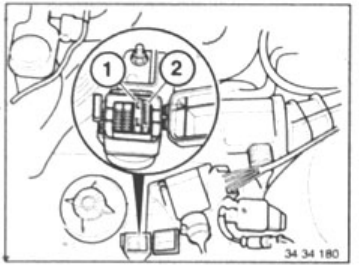
- ABS control unit
- Throttle valve assembly
- Throttle valve potentiometer

34 00 009 Checking Brakes on Test Stand

Requirements:

- Switch off ASC+T
- On four-wheel drive vehicles, switch off GSA system (Governed Locking 4WD)
- Tire profile O.K.
- Tire fill pressure O.K.
- Brake at operating temperature and dry (if necessary, heat up by applying brakes several times).

Observe the operating specifications of the relevant test bench manufacturer.

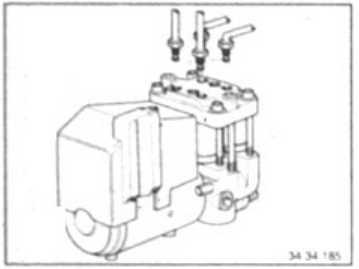


Disable GSA system:

In a separate fuse box, in the front left side of the engine compartment, there are two fuses for the GSA system.
To disable the system without activating the error memory, only remove fuse (2).

Fuse:

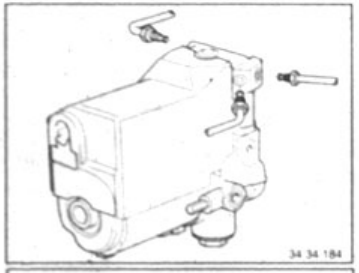
1	25 A
2	5 A



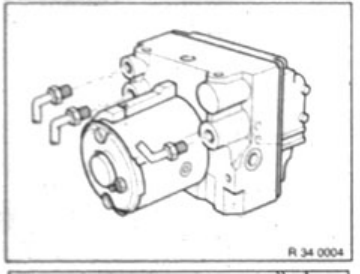
34 00 519 Check footbrake (high pressure, low pressure check)

Brake circuit distribution:
Without ABS/with 4 channel ABS

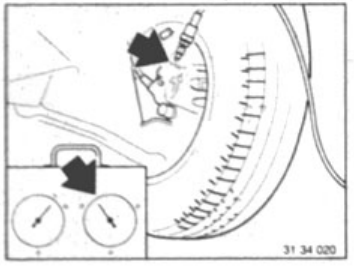
1st brake circuit, front right and rear left.
2nd brake circuit, front left and rear right.



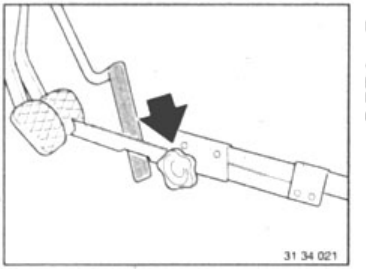
Brake force distribution:
With 3 channel ABS/ASC+T
1st brake circuit, front axle.
2nd brake circuit, rear axle.



Brake force distribution:
ABS, ABS/ASC+T from model year 94
1st brake circuit, front axle
2nd brake circuit, rear axle

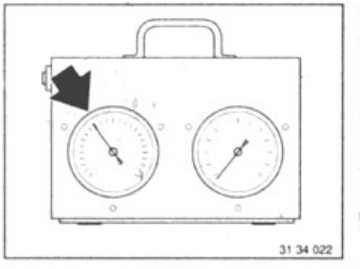


Unscrew one breather valve on a wheel brake in the 1st brake circuit.
Connect up pressure tester and bleed the system.



High Pressure Leak Test:

Apply force* to brake pedal and block brake pedal with pedal support.
Pressure may drop by max. 8 % after two minutes.



Low Pressure Leak Test:

Release pedal support until test pressure in brake system falls to between 2 ... 5 bar.
Vehicle and display unit must be at rest because vibrations falsify the results.
Over a test period of 5 minutes, the pressure must not drop at all.
If pressure drops sharply, check all rubber parts.
After the leak check, bleed the brake system, refer to 34 00 046/047.

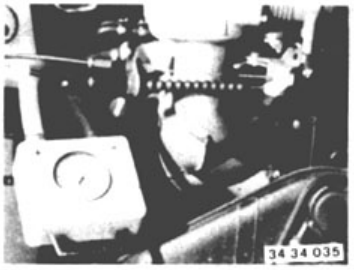
Follow similar procedure for high and low pressure leak test of the 2nd brake circuit.

* Refer to Technical Data

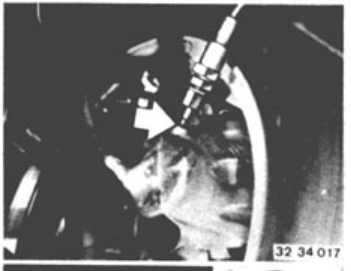
34 00 017 CHECKING FUNCTION OF BRAKE BOOSTER

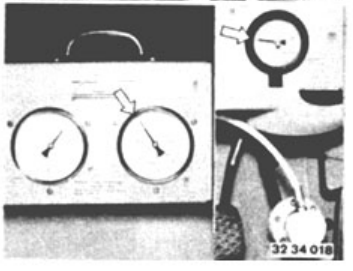
1. Operation Test
Operate the brake pedal with the engine stopped so often until it is hard to operate.
Operate the brake pedal and start the engine.
The brake booster is okay if the brake pedal gives.
If not, refer to the troubleshooting chart.

2. Leak Test
Run engine at about 3,500 rpm to operating temperature and release the accelerator (repeating 2 or 3 times) to build up vacuum in the brake booster.
Stop the engine and operate the brake pedal with a force which is equal to normal braking of the car.
The brake pedal operation should be spongy at least 1 or 2 times, whereby the suction noies of the brake booster will be heard.
In this case there is no leak and the system is okay.
If not, refer to the troubleshooting chart.



3. Engine Vacuum Test
Disconnect the vacuum hose from the brake booster.
Install Special Tool 34 3 100 between the brake booster and non-return valve.
Run engine at about 3,500 rpm to operating temperature and release the accelerator (repeating 2 or 3 times) to build up vacuum in the brake booster.
Specification: approx. – 0.7 bar.
Stop the engine and discharge the vacuum by operating the brake pedal several times.
Repeat this test two times.
If not okay, refer to Group 11.



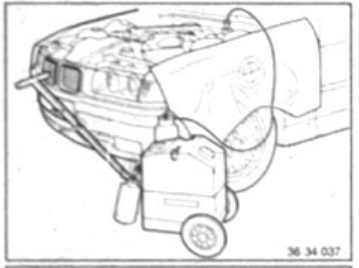


4. Brake Booster Test
Unscrew the bleeder screw from the left front brake caliper.
Connect the pressure tester and bleed.
Mount a pedal force meter on the brake pedal.
Run engine at about 3,500 rpm to operating temperature and release the accelerator (repeating 2 or 3 times) to build up vacuum in the brake booster.
Apply force* to the brake pedal.
This must cause the line pressure of the brakes to reach the nominal value*.
If this value is not reached in a brake system in perfect condition, replace the brake booster.

* Refer to Specifications

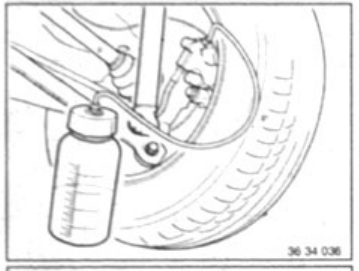
34 00 046 BLEEDING BRAKES

Note:
Only use approved brake fluid*.
Conform with the brake fluid change intervals*.
Keep brake fluid off of painted surfaces on the car as brake fluid would destroy the paint finish.

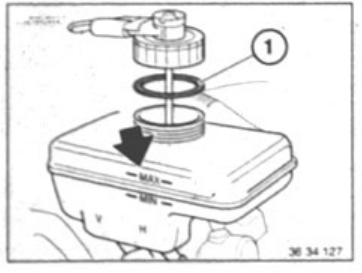


Connect a bleeder to the brake fluid tank.

Note:
Conform with the operating instructions supplied with a pertinent bleeder.
The charging pressure must not exceed two bar.



Connect the bleeder hose with bottle to the bleeder screw of the right rear brake caliper.
Loosen the bleeder screw.
Tighten the bleeder screw when bubbleless brake fluid runs out.
Repeat these bleeding procedures at left rear, right front and left front.



After Finsihing Work:

Check the brake fluid level.
Check rubber gasket (1).

* Refer to Operating Fluids

34 00 047 BLEEDING BRAKES WITH ABS

Connect a bleeder to the brake fluid tank.
Conform with the operating instructions supplied with a pertinent bleeder.

Important!
Don't use air flushing.

Operate and hold the brake pedal down.

Connect the bleeder hose with bottle to the bleeder screw and open the bleeder valve on the wheel brake, beginning at right rear.
Release the brake pedal and then operate it as far as the stop twelve times.

Hold the brake pedal in down position.
Shut the bleeder valve.
Release the brake pedal.
Repeat these procedures at left rear, right front and left front.

DESCRIPTION OF AUTOMATIC STABILITY AND TRACTION CONTROL (ASC+T)

Tasks of ASC+T:
- Taking the load off of the driver during car operation.
- Guarantee of directional stability and steering.
- Improvement of traction (+T).
- Information for the driver.

Description of Operation:
The system has the task of regulating the slip of the driven wheels to an optimal value in reference to directional stability and vehicle propulsion regardless of the driving situation.

For regulation the engine torque is reduced by influencing the ignition (ignition timing control or injection/ignition blendout via DME) and reducing the throttle valve gap (ADS: ASC throttle valve positioner). If these measures are not sufficient, the driven wheel rotating too fast is slowed down by the wheel brake.

The system is switched on automatically after starting the engine and can be switched off manually. The ASC lamp is off with the system switched on.

When regulation is activated, this is reported to the driver by a flashing ASC lamp in the instrument cluster.
If the ASC lamp lights up continuously, the system has been switched off automatically due to an occurred fault or had been switched off by hand.

Note:
Troubleshooting – refer to Car Electric / Electronic Test Plan.

Important!
The mineral oil circuit must be bled if repairs had been carried out on mineral oil equipment and pipes between the tank and up to and including the ASC+T hydraulic control unit.

Switch the ASC+T off for tests on the brake dynamometer or performance test stand!

OPENED BRAKE SYSTEM FUNCTION TEST WITHOUT TESTER

Car on lifting platform — wheels have cleared ground.

Procedures:
- Left rear wheel can be turned easily.

- Move shift lever into neutral or selector lever into "N".

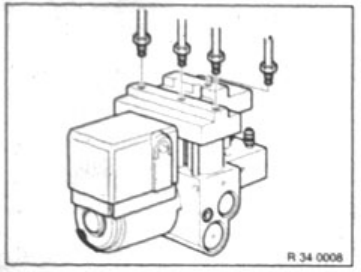
- Start the engine.

- Regulate the engine speed to 2000 ± 100 rpm with help of the accelerator pedal.

- Spin the left rear wheel quickly by hand in forward direction (if applicable, hold the right rear wheel tight during test).

Reaction:
- Left rear wheel is braked noticeably.

Procedures:
- Repeat the test on the right rear wheel.

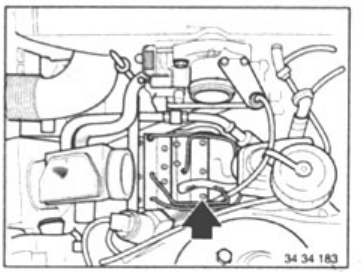


34 00 048 Venting brake system with ABS/ASC+T

(ABS/ASC+T 525i M50 up to model year 94)

Note:
Conform with the filling and bleeding procedures when replacing or repairing the
- tandem master brake cylinder
- hydraulic unit ABS/ASC+T
- and components installed between these assemblies.

For other work on the brake system (e.g. replacing the brake calipers), conform to specification "Bleeding brake system with ABS", refer to 34 00 047.



1. Bleed suction line

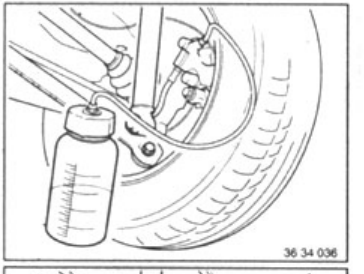
Fit hose of bleeder bottle to the bleed screw on the hydraulic unit.
Open bleeder screw and flush suction line until brake fluid emerges without air bubbles.
Close bleeder screw.

Note:
For greater ease of access to bleeder screw, special tool 34 3 110 can be used.

Caution!
Always ensure that there is no hydraulic fluid in special tool 34 3 110. If necessary, clean before use.

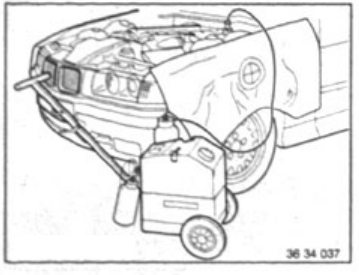
Installation:
Tightening torque 34 00 1AZ*

Connect BMW Service Tester / MoDIC to diagnosis plug.
Call up diagnosis program (ABS/ASC/ABD).



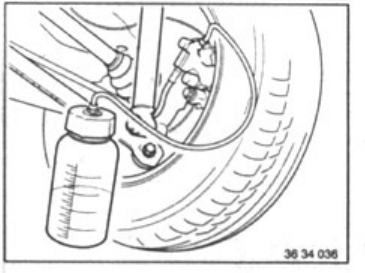
2. Perform preliminary bleeding operation on brake system.

On each wheel brake, open vent screw in specified sequence and flush until brake fluid emerges without air bubbles.
Sequence:
- rear right
- rear left
- front right
- front left



Connect bleeding device to expansion tank and switch on.

Note:
Conform with manufacturer's operating instructions.
Charging pressure should not exceed 2 bar.



3. Bleed secondary circuit in hydraulic unit

On rear right wheel brake, connect bleeding bottle.
Loosen bleeder screw.
Perform bleeding operation using BMW Diagnosis System.
Close bleeding screw.

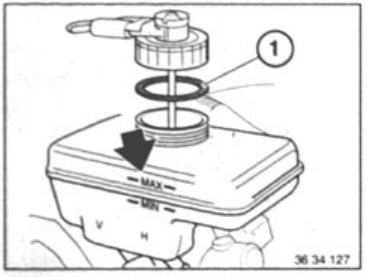
*** Refer to Technical Data**

4. Bleed brake system (draining operation)

On each wheel brake, in the specified sequence, drain off approx. 50 cm^3 of brake fluid.
Sequence:
rear right
rear left
front right
front left

Then perform following procedure on each wheel brake:
- Open bleeder screw
- Depress brake pedal hard 5 times
- Drain away brake fluid until it emerges without air bubbles for about 100 cm^3

Sequence:
rear right
rear left
front right
front left



Switch off bleeding unit and remove from expansion tank.
Check brake fluid level.
Pay attention to rubber seal (1).

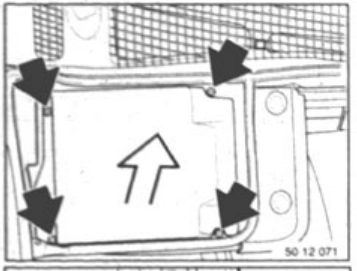
Remove BMW Service Tester / MoDIC and connect up diagnosis plug.

34 00 040 BLEEDING ASC + T MINERAL OIL CIRCUIT

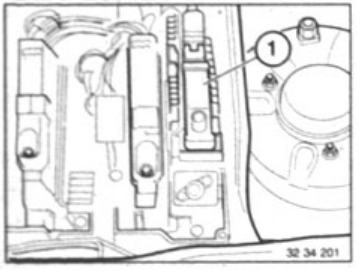
1. Filling Mineral Oil Circuit

Important!
Ensure that brake system is filled with brake fluid before filling the mineral oil circuit with hydraulic fluid*.

Fill brake system - refer to point 1 in 34 00 048.

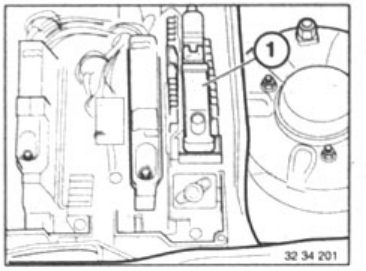


Switch off ignition.
Unscrew screws and take lid off of electronic box.



Unlock and pull plug (1) off of ABS/ASC+T control unit.

Fill circuit with hydraulic fluid - refer to Group 32.

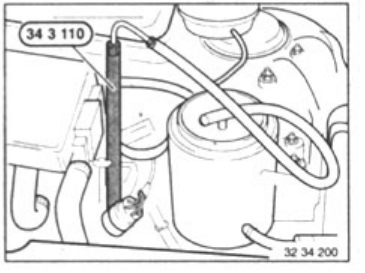


2. Bleeding Mineral Oil Circuit

Note:
The plunger-type hydraulic control unit is bled by running the engine.

Switch off ignition.
Connect plug (1) on ABS/ASC+T control unit.

Start and run engine at idling speed at least 60 seconds (automatic charging of ASC+T plunger-type reservoir).



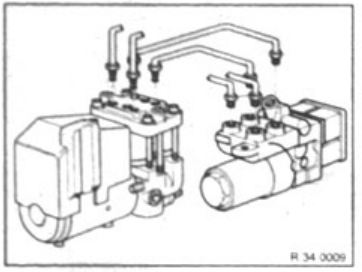
Apply Special Tool 34 3 110 on bleeder screw of plunger-type hydraulic control unit and place end of hose in supply tank. Loosen bleeder screw and flush plunger-type hydraulic control unit until bubbleless hydraulic fluid runs out (at least 15 sec.). Tighten bleeder screw.

Note:
Tightening torque*.

Check and, if necessary, correct hydraulic fluid level - refer to Group 32.

* Refer to Operating Fluids

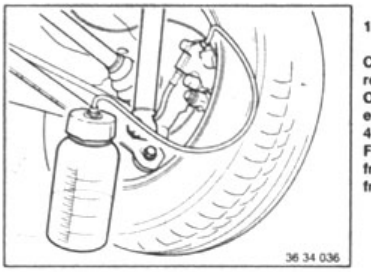
* Refer to Specifications



34 00 048 Bleed brake system with ABS/ASC+T

ABS/ASC+T with plunger hydraulic unit

Note:
Use the specified filling and bleeding specification when replacing or repairing components in the tandem master brake cylinder and ASC+T - plunger hydraulic unit (both included in each case).
For all other work on the brake system (e.g. replacing the brake calipers), continue to use the relevant specification "Bleeding brake system with ABS" (refer to 34 00 047). This can also be used on vehicles fitted with ASC+T.



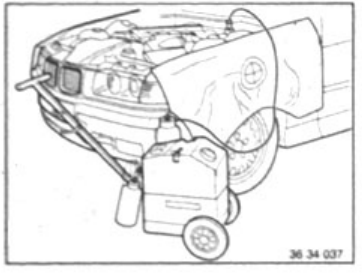
1. Fill brake system with brake fluid *

Connect bleeder hose and fluid receptacle to rear right brake caliper.
Open bleeder valve and bleed until brake fluid emerges without air bubbles, for at least 4 minutes, then close the bleeder valve.
Fill wheel brakes at rear left, front right and front left in a similar manner (bleed time per front wheel brake at least 1 minute)

2. Bleed brake system

Caution!
Before performing the bleeding operation, always ensure that the oil side of the ASC+T plunger hydraulic unit has been vented. This applies especially when replacing or repairing mineral oil assemblies and lines between the expansion tank and the plunger hydraulic unit. If necessary, before bleeding the brake system, first bleed the ASC+T mineral oil circuit, refer to 34 00 040.

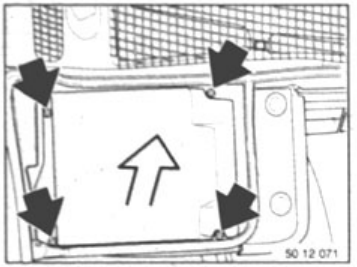
It is only possible to vent the ASC+T hydraulic unit correctly in conjunction with ABS/ASC test equipment 34 5 110.



Connect bleeder unit to expansion tank.

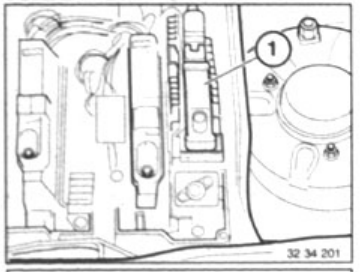
Note:
Conform with operating instructions supplied with bleeder.
The fill pressure must not exceed 2.5 bar.

* see BMW Operating Fluids Specification

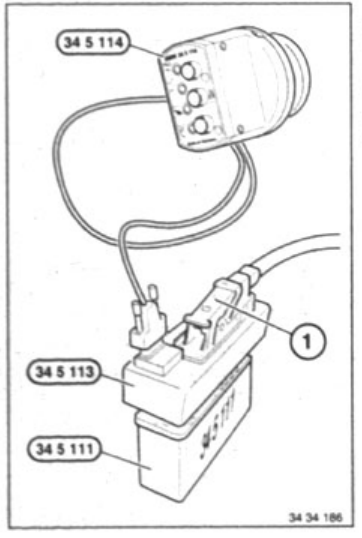


2.1 Bleed rear axle brake circuit:

Switch off ignition.
Unfasten screws and remove cover from the electronics box.



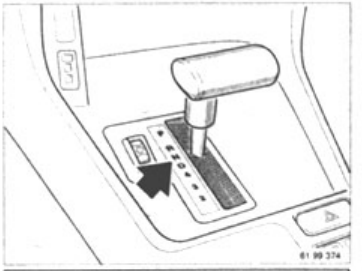
Unlock control unit plug (1) and remove from control unit of ABS/ASC+T.



Attach test adapter 34 5 113 to test control unit 34 5 111.

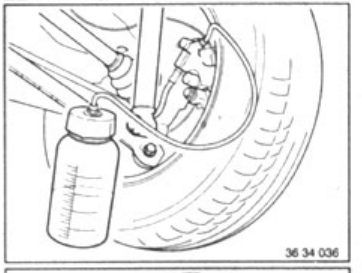
Attach diagnosis connection cable 34 5 114 to test adapter 34 5 113.

Attach control unit plug (1) to test adapter 34 5 113.



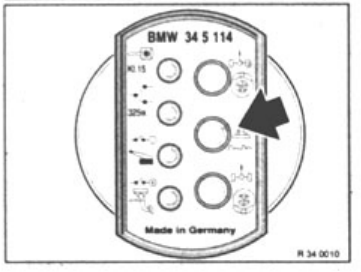
Move shift lever (manual) into neutral or move selector lever (automatic) into "P" or "N".

Start engine.



Connect the bleeder hose with bottle to the right rear brake caliper.
Open bleed valve and fully depress brake pedal at least 20 times (brake fluid must emerge without air bubbles).

Release brake pedal



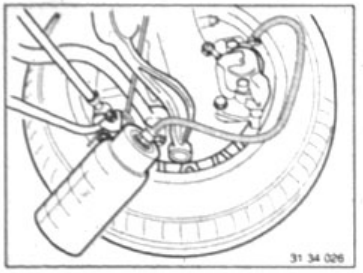
Actuate red button to start bleeding routine (duration approx. 60 seconds)

Caution!
Brake fluid should emerge without bubbles: if necessary, repeat the bleeding procedure.

Close the bleeder valve.

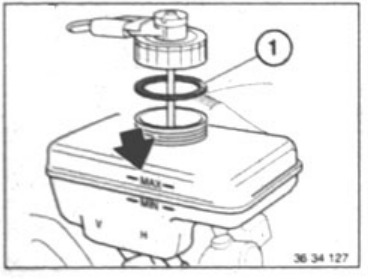
Bleed rear left wheel brake in similar manner.

Switch off engine.



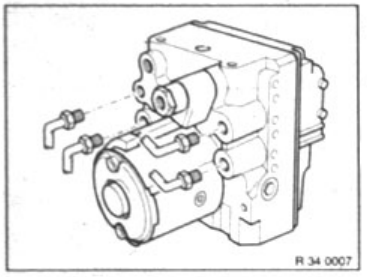
2.2 Bleed front axle brake circuit:

Connect bleeder hose and bottle to front right brake caliper.
Open bleed valve and fully depress brake pedal at least 12 times (brake fluid must emerge without air bubbles).
Keep the brake pedal depressed, close the bleeder valve and release the brake pedal.
Bleed the front left wheel brake in a similar manner.



Switch off bleeder unit and remove from expansion tank.
Check brake fluid level.
Screw cap on the brake fluid tank (ensure that rubber seal (1) is installed in cap).

Switch off ignition.
Disconnect control unit plug from adapter and connect up to ABS/ASC+T control unit.
Install cover on electronics box.



34 00 048 Bleeding brake system with ABS/ASC+T

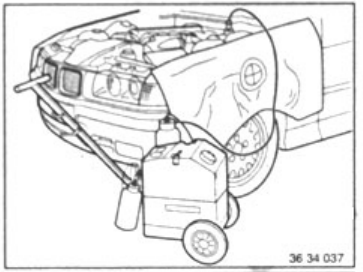
ABS/ASC+T from model year '94

Note:
Conform with the filling and bleeding procedures when replacing or repairing the
Tandem master brake cylinder
Hydraulic unit, ABS/ASC+T
and components installed between these two assemblies.

For other work on the brake system (e.g. replacement of brake calipers), conform to specification "Bleeding the ABS brake system", refer to 34 00 047.

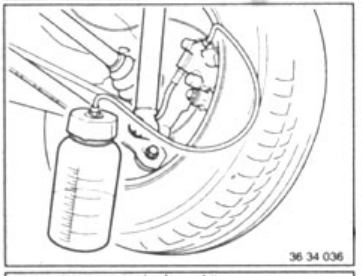
Caution!
Refer to "General Data".

Connect up BMW Service Tester / MoDIC to diagnosis plug.
Call up diagnosis program (ABS/ASC/ABD).

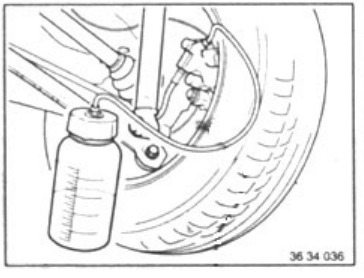


Connect bleeder unit to expansion tank and switch on.

Note:
Conform with operating instructions supplied with bleeder unit.
Charging pressure should not exceed 2 bar.

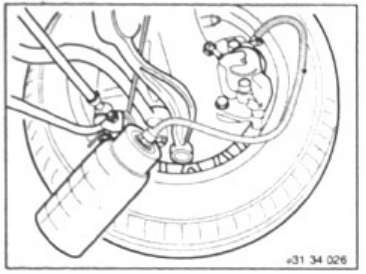


Fit bleeder hose and bottle to bleeder valve on rear right brake caliper.
Open bleeder valve and bleed until clear, bubble-free brake fluid emerges.
Close the bleeder valve.
Follow similar procedure on rear left, front right and front left wheel brake.



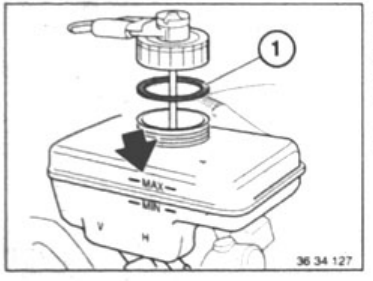
Bleeding rear axle brake circuit:

Attach bleeder hose and bottle to vent valve on rear right brake caliper.
Open up vent valve.
Perform bleeding routine with BMW diagnosis system.
Close the bleeder valve.
Follow similar procedure on rear left wheel brake.



Bleed front axle brake circuit:

Fit bleeder hose and bottle to bleeder valve on front right brake caliper.
Open up bleeder valve.
Fully depress brake pedal at least 12 times.
Brake fluid must emerge clear and without air bubbles.
Hold down brake pedal in fully depressed position.
Close the bleeder valve.
Release brake pedal.
Follow similar procedure on front left wheel brake.



Switch off bleeder unit and remove from expansion tank.
Check brake fluid level.
Seal expansion tank (note rubber gasket (1) in cover).

Remove BMW Service Tester / MoDIC and close diagnosis plug.

34 10 014 ADJUSTING PARKING BRAKE

Test Specifications

- There should not be braking effect when parking brake lever is pulled up one tooth.
- The wheel peripheral force may deviate from the larger value by max. 30 % in comparison with the opposite wheel (measured on dynamometer).
  Adjustment is necessary in case of greater brake force difference.
- It should be possible to hold the car with the parking brake.
- The parking brake must be adjusted if the parking brake lever travel is greater than ten teeth.

Note:
The parking brake can only be adjusted correctly if the parking brake cables and all moving parts of the parking brake move easily and function correctly.

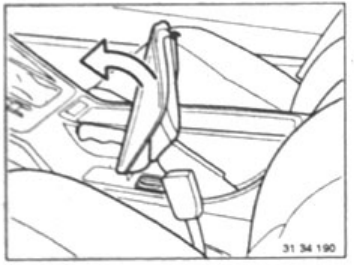
Basic parking brake adjustment is necessary:
- After replacing brake shoes
- After replacing brake drums
- After resetting slack control device
- In case of excessive parking brake lever travel (ten teeth).

1. Basic Adjustment

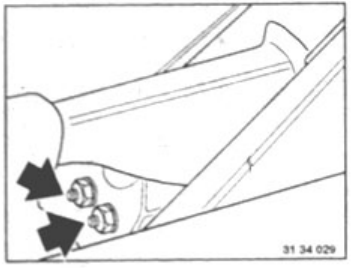
1.1 Drum Brakes

Note:
If applicable, mount the wheels (brake drums must be blocked).
Tightening torque*.

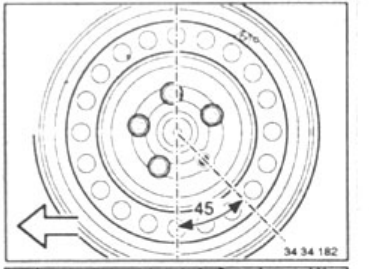
Operate the brake pedal so long until the slack control sound (soft click) is no longer heard.
(The slack control operation can also be observed through a wheel bolt bore.)



Lift dust cover off.



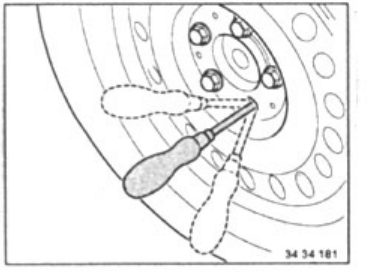
Unscrew the adjusting nuts and loosen the cable completely.



1.2 Disc Brakes
(Duo-Servo Parking Brake)

Unscrew and remove one wheel bolt from each rear wheel.
Turn wheel until the tapped bore is positioned approx. 65° behind a vertical line at top (as seen in forward driving direction).

Installation:
Install and tighten wheel bolt.
Tightening torque*.



Turn adjusting screw using a screwdriver until the wheel or brake disc can no longer be turned.
Loosen the adjusting screw 8 catches afterwards.

* Refer to Specifications

2. Adjusting Cables

2.1 By Hand

Pull parking brake lever up four teeth and turn the adjusting nuts until it is just possible to still turn the rear wheels.

Release the parking brake lever; it must be possible to turn the wheels easily.

Switch ignition on; the control lamp must not be on with a released parking brake lever.

1 tooth: No braking effect.
Control lamp could be on.

2 teeth: Control lamp must be on; if necessary, adjust the switch contact on the parking brake lever – refer to Group 61.

2.2 On Dynamometer

Caution!
Stop operation of the EM lock in four wheel drive cars - refer to 34 00 009.

0 teeth: (parking brake lever released) wheel peripheral force at idling speed in cars
a) without limited slip differential < 150 N
b) with limited slip differential < 200 N

1 tooth: No braking effect.
Control lamp could be on.

2 teeth: Control lamp must be on; if necessary, adjust the switch contact on the parking brake lever – refer to Group 61.

Checking of braking force difference with
duo-servo parking brake in 3rd tooth
drum brakes in 5th tooth

The left/right brake force display must be 600 + 50 N.

3. Breaking In Specifications for Duo-Servo Parking Brake

The following breaking in procedures are applicable in case of insufficient braking effect or after replacing brake discs and/or brake shoes.

With car moving approx. 40 km/h pull up the parking brake lever until braking of the car is noticed.
Then pull up the parking brake lever into the next catch and drive approx. 400 meters in this position.
(A basic requirement is that the parking brake is adjusted uniformly.)

Note:
The parking brake is completely independent of the service brake and consequently is only subjected to limited wear.
Quite often dirt and corrosion will cause the braking effect of the parking brake to give in the course of time.

34 11 000 Removing and installing or replacing brake pads of both disk brakes

Note:
After finishing work, test brake pedals several times to ensure the brake pads rest on the brake disks.
Remove front wheels, refer to 36 10 300.



Remove caps (1).
Left: Disconnect cable connector from brake pad sensor



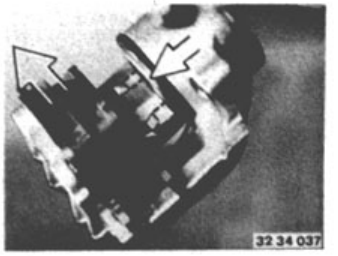
Release guide screws (2).

Installation note:
Only clean guide screws, do not grease.
Check thread. Replace guide screws if not satisfactory.
For tightening torque 34 11 3AZ*.



Lift out retaining spring (3) and push brake calliper forward and remove.

* Refer to Technical Data



Remove brake pads from brake calliper.
Check dust cover for wear and replace if necessary.

Installation note:
Check pad thickness*.

Caution!
New brake pads* should only be installed if the brake disk thickness is greater than or equal to the minimum thickness* (MIN TH).



Lightly coat brake pad back plates at the contact points with anti-squeak paste.
For anti-squeak paste, refer to BMW Fluids and Lubricants Specifications



Installation note:
Completely push back piston with special tool 34 1 050.
Clean brake pad guides on brake calliper and brake back plate with a brush** and thinly coat with anti-squeak paste.
For anti-squeak paste, refer to BMW Fluids and Lubricants Specifications

* Refer to Technical Data
** Source of supply: BMW Parts Service

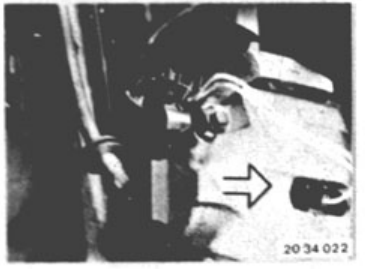


34 11 020 REMOVING AND INSTALLING FRONT BRAKE CALIPER

Remove front wheel – see 36 10 300.
Draw off brake fluid with a syringe, which is reserved exclusively for brake fluid.
Disconnect brake pipe.

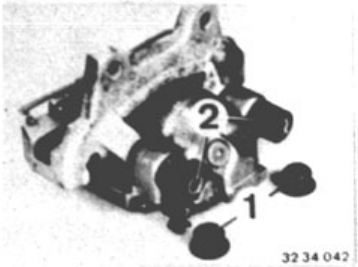


Unscrew brake caliper bolt (1).
Installation:
Tightening torque*.



Disconnect brake pad wear indicator plug.
Pull off brake caliper forward.
Installation: – Important!
Check that brake pad wear indicator wire is held in correct position by tab of dust cap.
Rubbing of the wire on the wheel rim must always be avoided.

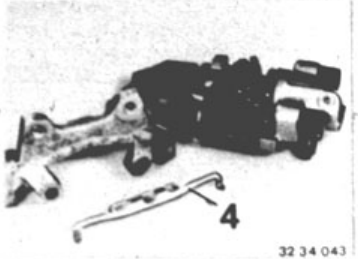
* See Specifications



32 34 042

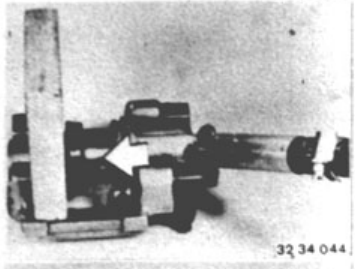
34 11 092 OVERHAULING FRONT CALIPER
– Use Repair Kit –

Remove front caliper – see 34 11 020.
Press off plastic caps (1).
Unscrew guide bolts (2).
Installation:
Only clean guide bolts – don't lubricate them.
Check guide bolts, replacing if necessary.
Tightening torque*.



32 34 043

Disassemble caliper and take out brake pads.
Installation:
Press out brake pads completely before inserting spring (4).


32 34 044

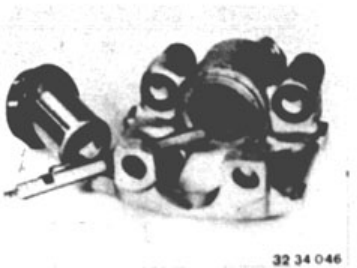
Press off rubber cap and clamping ring.
Place a liner (piece of hard wood, hard felt or something similar) in caliper recess to protect the piston.
Press out piston with compressed air applied through the connection bore.
Caution!
Air pressure of 10 bar (142 psi) produces a force of about 1250 N (275 lbs.).



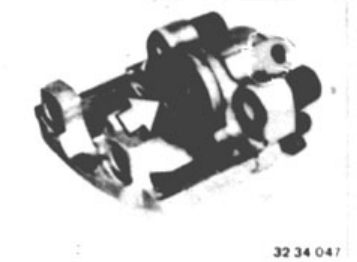
32 34 045

Check guide sleeves (5), installing guide sleeves from the repair kit if necessary.

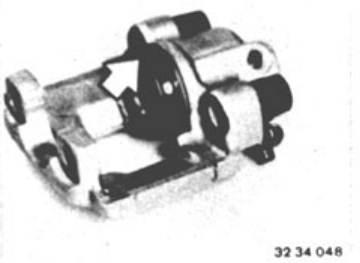
* See Specifications


32 34 046

Remove seal carefully with a plastic needle.
Clean cylinder bores and parts with alcohol and dry with compressed air.
Check cylinder bore, piston and flange surfaces thoroughly for damage.
Machining of cylinders and piston is not approved.
Installation:
Give all parts a light coat of ATE brake cylinder paste and install.


32 34 047

First pull rubber cap on to the piston.
Press in piston with a piece of hard wood. being careful not to cant the piston.


32 34 048

Pull rubber cap over edge of cylinder bore and secure with the clamping ring.
Assemble the caliper.

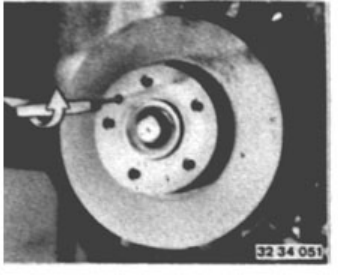


34 11 220 REMOVING AND INSTALLING FRONT BRAKE DISC

Remove front wheel – see 36 10 300.
Pull rubber grommet (1) out of bracket.

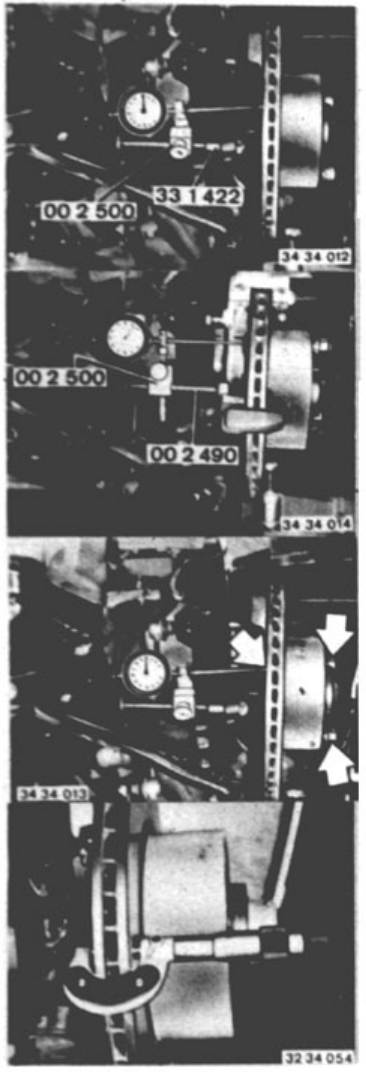


Unscrew caliper and suspend from car on a piece of wire.
Important!
The brake pipe remains connected.
Installation:
Tightening torque*.



Unscrew bolt and take off the brake disc.
Installation:
Tightening torque*.
Important!
Always replace both brake discs of one axle together.

* See Specifications



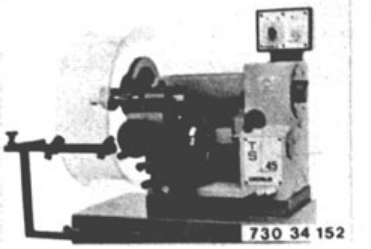
34 11 599 CHECKING FRONT BRAKE DISC FOR RUNOUT AND DEVIATION IN THICKNESS
– Front Wheel Removed –

Requirement: wheel bearings okay.
Procedures on Removed Brake Caliper:
Mount Special Tools 00 2 500 and 33 1 422 on brake caliper.
Secure brake disc with two M 12 x 1.5 bolts additionally.
Check lateral runout* of brake disc with a dial gage.

If the brake caliper is disassembled (for replacement of brake pads), Special Tools 00 2 500 and 00 2 490 can be mounted direct in the caliper tapped bores (for guide bolts).

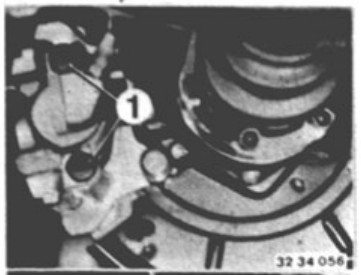
Measure deviation in thickness* of braking surface at about 8 points with a micrometer.

*** See Specifications**



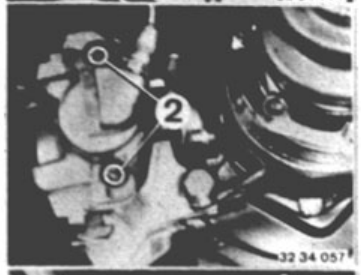
34 11 667 FINISH GRINDING FRONT BRAKE DISC
– Brake Discs Removed –

Important!
Always grind both sides of both brake discs on one axle.
Check minimum thickness*.
After machining to final size*, one more brake pad set may be installed and used until worn (see wear limit*).
Installation:
If it is necessary to replace a brake disc, always replace both brake discs of one axle.

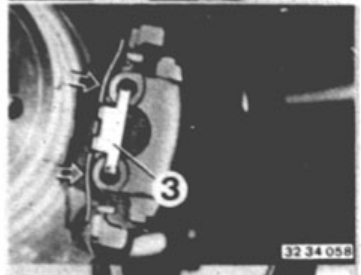


34 21 200 REMOVING AND INSTALLING REAR BRAKE PADS

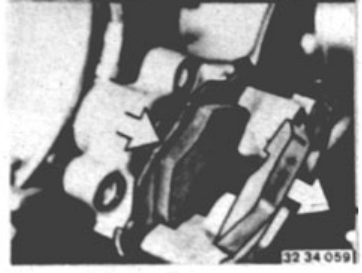
Remove rear wheels.
Press off plastic caps (1).
Right:
Pull off plug for brake pad wear indicator.



Unscrew guide bolts (2).
Installation:
Only clean guide bolts – don't lubricate them.
Replace guide bolts not in perfect condition.
Tightening torque*.

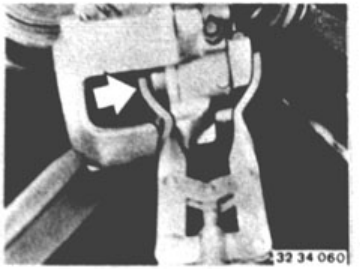


Press out clamp (3).
Pull off caliper toward rear.

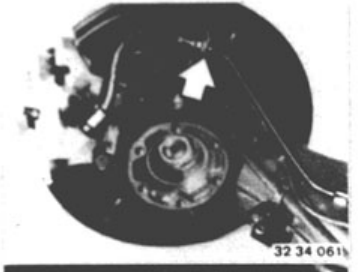


Take off outer brake pad.
Inner brake pad is located in the piston together with a spring.
Important!
Always replace all brake pads of both brake calipers on one axle.
Check make*.
Lubricate backs of brake pads lightly with Plastilube** at the brake piston contact points.

* See Specifications
** Source of Supply: HWB

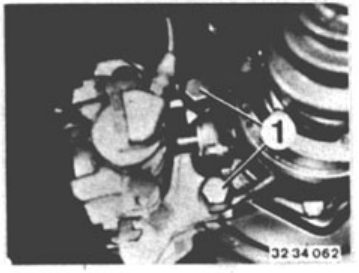


Installation:
Push back piston completely.
Clean brake pad guides and recesses with a brush**.
Caution!
Extract pad dust – never remove by blowing.
Check dust cover for damage.
Lubricate guides lightly with Plastilube**.



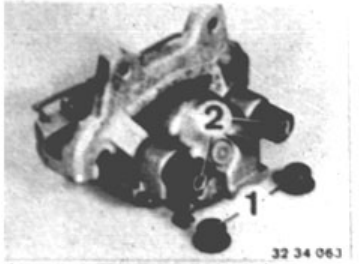
34 21 745 REMOVING AND INSTALLING REAR CALIPER

Remove rear wheel.
Draw off brake fluid with a syringe reserved exclusively for use with brake fluid.
Disconnect brake pipe.



Unscrew bolts (1).
Unplug the brake pad wear indicator.
Pull off caliper toward the rear.
Installation:
Tightening torque*.
Bleed brakes – see 34 00 047.

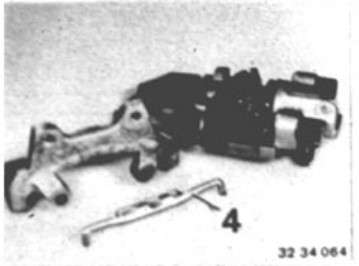
* See Specifications
** Source of Supply: HWB



32 34 063

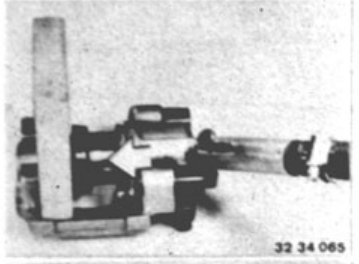
34 21 292 OVERHAULING REAR CALIPER
– Use Repair Kit –

Remove rear caliper – see 34 21 220.
Press off plastic caps (1).
Unscrew guide bolts (2).
Installation:
Only clean guide bolts – don't lubricate them.
Check guide bolts, replacing if necessary.
Tightening torque*.

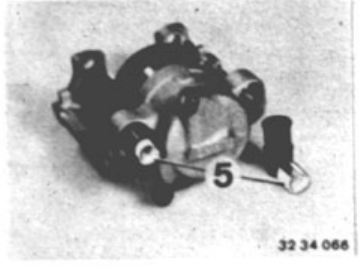


32 34 064

Disassemble caliper and take out brake pads.
Installation:
Press out brake pads completely before inserting spring (4).


32 34 065

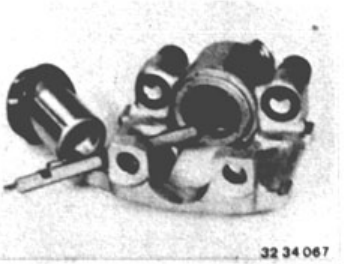
Press off rubber cap and clamping ring.
Place liner (piece of hard wood, hard felt or something similar) in the caliper recess tp protect the piston.
Press out piston with compressed air applied through the connection bore.
Caution!
Air pressure of 10 bar (142 psi) produces a force of about 1250 N (275 lbs.).



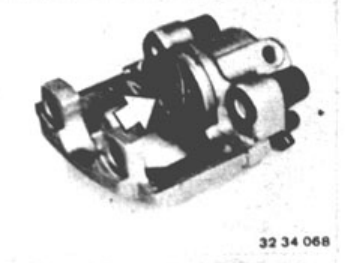
32 34 066

Check guide sleeves (5), installing guide sleeves from the repair kit if necessary.

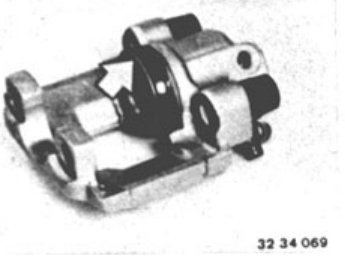
* See Specifications


32 34 067

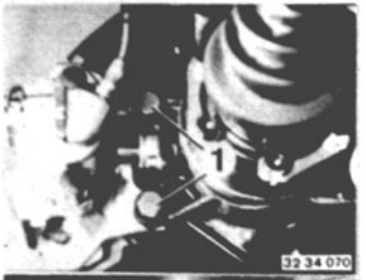
Remove seal carefully with a plastic needle.
Clean cylinder bores and parts with alcohol and dry with compressed air.
Inspect cylinder bore, piston and flange surfaces thoroughly for damage.
Machining of cylinders and pistons is not approved.
Installation:
Give all parts a light coat of ATE brake cylinder paste and install.


32 34 068

First pull rubber cap on to the piston.
Press in piston with a piece of hard wood, being careful not to cant the piston.

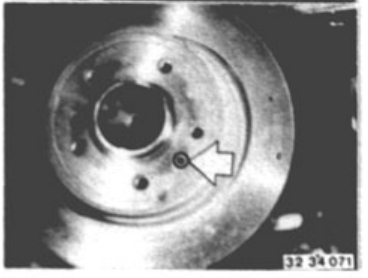

32 34 069

Pull rubber cap over edge of cylinder bore and secure with a clamping ring.
Assemble the caliper.



34 21 320 REMOVING AND INSTALLING REAR BRAKE DISC

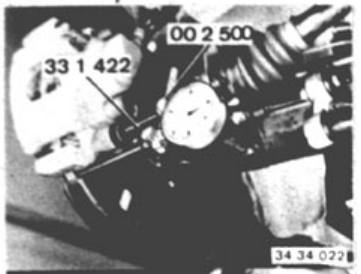
Remove rear wheel.
Unscrew bolts (1).



Pull off caliper toward rear and suspend from car on a piece of wire.
Brake pipe remains connected.
Unscrew bolt and take off brake disc.

Important!
When replacement is necessary, always replace both brake discs of one axle.
Adjust parking brake – see 34 10 014.
Breaking in Parking Brake After Replacing Brake Discs:
Car must be broken in in three phases.

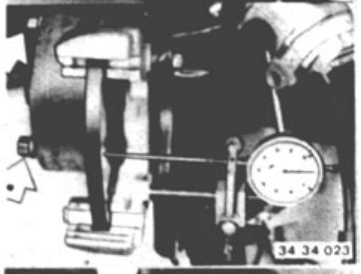
Phase 1: 5 x full stop braking from 50 km/h (30 mph).
Phase 2: Brakes allowed to cool off.
Phase 3: 5 x full stop braking from 50 km/h (30 mph).



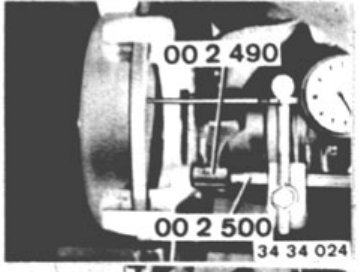
34 21 879 CHECKING REAR BRAKE DISC FOR RUNOUT AND DEVIATION IN THICKNESS

– Rear Wheel Removed –

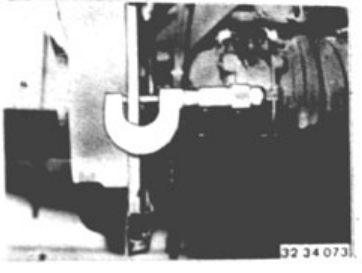
Procedures On Removed Brake Caliper:
Mount Special Tools 00 2 500 and 33 1 422 direct in caliper tapped bore after removing the lower brake caliper mounting bolt.



Secure brake disc additionally with two M 12 x 1.5 bolts.
Check lateral runout* of brake disc with a dial gage.

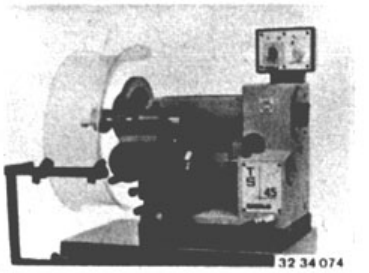


If the brake caliper is disassembled (for replacement of brake pads), mount Special Tools 00 2 500 and 00 2 490 direct in a brake caliper tapped bore (for guide bolt).



Measure deviation in thickness* of braking surface at about 8 points with a micrometer.

* See Specifications

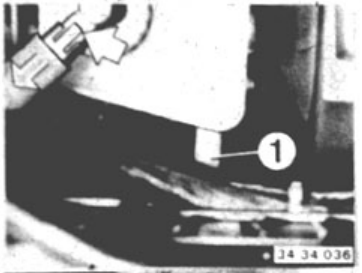


34 21 947 FINISH GRINDING REAR BRAKE DISCS

– Brake Discs Removed –

Important!
Always finish grind both sides of both brake discs on one axle.
Check minimum thickness*.
Installation:
If a brake disc has to be replaced, always replace both brake discs of one axle.

* See Specifications

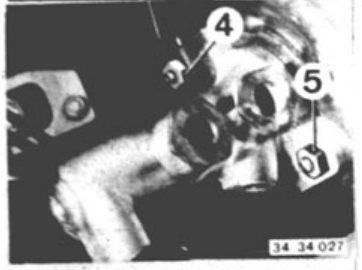


34 31 000 REMOVING AND INSTALLING BRAKE MASTER CYLINDER

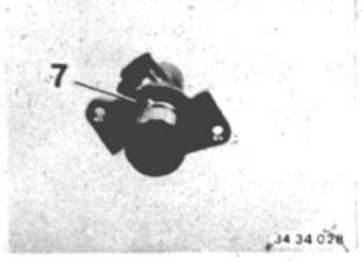
Draw off brake fluid in tank with a syringe, which is reserved exclusively for brake fluid.
Pull off plug.
If applicable, pull off hose (1) for clutch.



Pull off brake fluid tank.
Disconnect brake pipes (2 and 3).
Brake Pipe 2:
front right
rear left = brake circuit 1
Brake Pipe 3:
front left
rear right = brake circuit 2



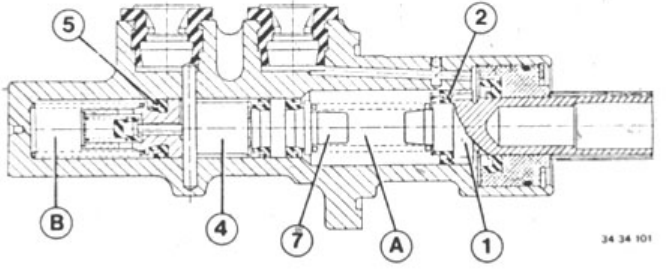
Unscrew mounting bolts (4 and 5).
Installation:
Check rubber seal and connections.
Replace self-locking nuts.



Installation:
Check rubber ring (7).
The building up of vacuum will be prevented when the sealing is not perfect.

Tandem Brake Master Cylinder – Description:
Operating the brake pedal moves pistons (1 and 4) forward.
Primary cups (2 and 5) pass over the compensating bores.
There is now balanced pressure in chambers A and B.

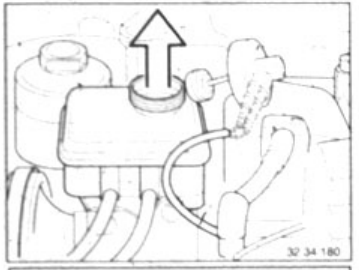
Diagonal Dual Circuit System:
Chamber A acts on front right and rear left.
Chamber B acts on front left and rear right.
Brake pedal travel will be considerably longer when a brake circuit fails.
If the second brake circuit fails, piston (1) will use the pressure building up in chamber A to push piston (4) in pressureless chamber B against tandem master cylinder housing and the first brake circuit functions.
If the first brake circuit fails, piston (1) in pressureless chamber A will be pushed against spring-loaded cap (7) and the second brake circuit will have full action via chamber B.



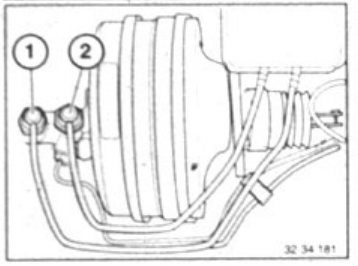
34 31 500 Removing and installing master brake cylinder (M60)

Note:
When work is completed, bleed the brake system, refer to 34 00 047 for ABS and 34 00 048 for ABS ASC+T.

Remove left headlight, refer to Gr. 63.

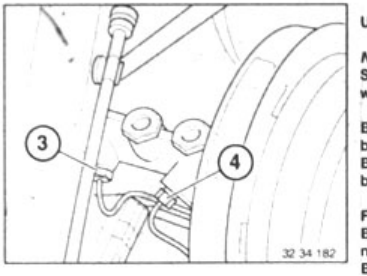


Draw brake fluid out of tank with a suction bottle reserved for exclusive use with brake fluid.



Lift supply line (1 and 2) off master brake cylinder.

*** Refer to Technical Data**



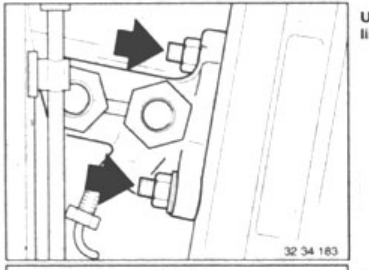
Unfasten brake line (3 and 4).

Note:
Seal master brake cylinder and brake lines with suitable caps.

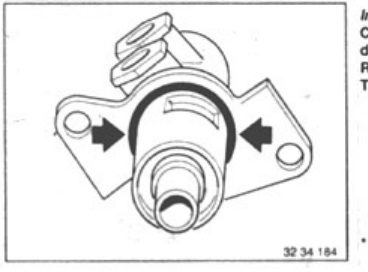
Brake line (3) leads to ABS hydraulic unit, 1st brake circuit (front right/rear left).
Brake line (4) leads to ABS hydraulic unit, 2nd brake circuit (front left/rear right).

From model year 94:
Brake line (3) leads to ABS hydraulic unit, connection R (rear axle).
Brake line (4) leads to ABS hydraulic unit, connection F (front axle).

Installation:
Tightening torque *



Unfasten screws and remove master brake cylinder.

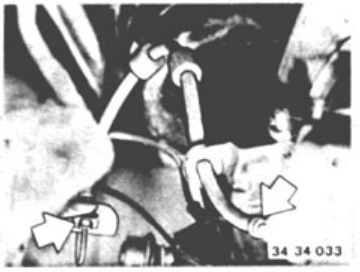


Installation:
Check rubber ring between master brake cylinder and brake unit, replacing if necessary.
Replace self-locking nuts.
Tightening torque*

*** Refer to Technical Data**

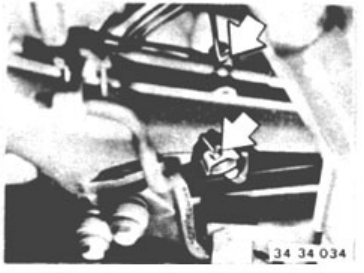
34 32 361 REPLACING ALL BRAKE PIPES

Brake pipes are now only supplied in straight version and correct length with connecting nipples.
Use the removed pipe as a template for bending.
Use bending tool**.
Don't damage surface of pipe.
Don't bend pipes sharply or attempt to bend back an incorrectly bent pipe.
Also refer to Service Information of Gr. 34.



34 32 381 REPLACING FRONT BRAKE HOSE

Draw off brake fluid.
Disconnect brake hose.
Installation:
Never twist brake hose while installing.
Bleed brakes – see 34 00 046.
Tightening torque*.
See Group 34 of Operating Fluid Specifications for approved brake fluids.



34 32 451 REPLACING REAR BRAKE HOSE

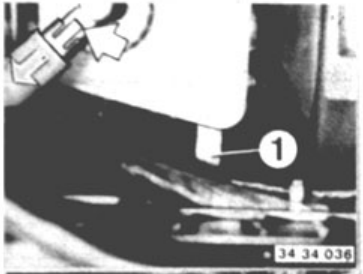
Draw off brake fluid.
Disconnect brake hose.
Installation:
Never twist brake hose while installing.
Bleed brakes – see 34 00 046.
Tightening torque*.
See Group 34 of Operating Fluid Specifications for approved brake fluids.

**Source of Supply: HWB

* See Specifications

34 33 505 REMOVING AND INSTALLING OR REPLACING BRAKE BOOSTER

Suck the brake fluid out of the brake fluid tank using a siphon used exclusively with brake fluids.

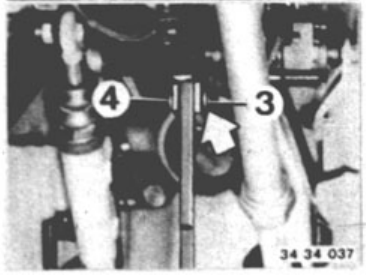


Disconnect the plug.
Pull off tank.
Disconnect clutch hydraulic hose (1).

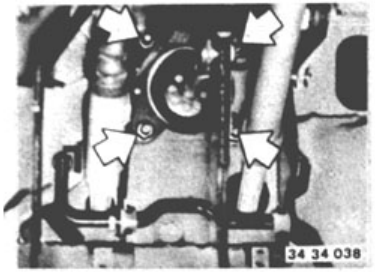


Unscrew brake pipes (2 and 3).

Important!
Don't mix up brake pipes.
Tightening torque*.



Remove dashboard trim panel at bottom left - refer to 51 45 180.
Press off clip (3) and pull out pin (4).



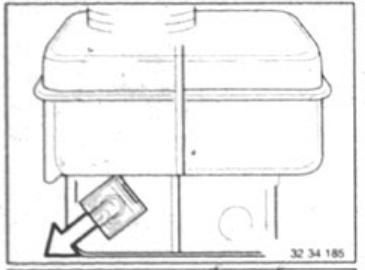
Unscrew brake bosster at pedal console.
Remove brake booster together with brake master cylinder forwards.

Installation:
Tightening torque*.
Adjust brake pedal - refer to Group 35.
Adjust brake light switch - refer to Gr. 61.

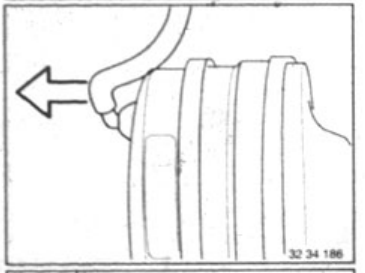
* Refer to Specifications

34 33 505 REMOVING AND INSTALLING OR REPLACING BRAKE BOOSTER (M60)

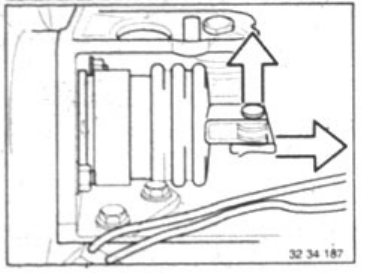
Remove brake master cylinder - refer to 34 31 500.



Lift out retainer and remove brake fluid tank.

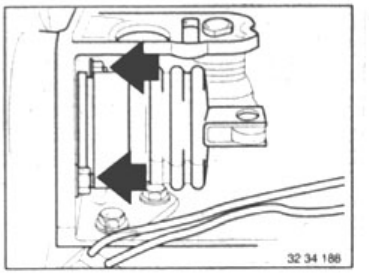


Disconnect vacuum hose at brake booster.



Lift out retainer and pull out retaining pin.

Important!
Ensure the retainer engages correctly when installing.



Unscrew nuts and remove brake booster forwards.

Installation:
Replace self-locking nuts.
Tightening torque*.

* Refer to Specifications



34 33 051 REPLACING NON-RETURN VALVE FOR BRAKE BOOSTER

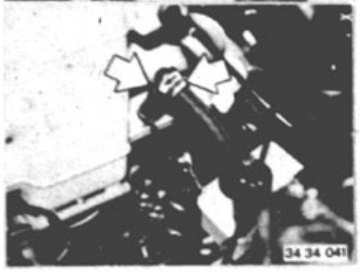
Disconnect the vacuum hose at non-return valve (1).

Installation:
Replace the clamps.



Loosen the clamps and remove the non-return valve.

Installation:
The arrow on the non-return valve must point in direction of the intake manifold.
Replace the clamps.





34 33 071 REPLACING VACUUM HOSE FOR BRAKE BOOSTER

Unscrew the vacuum hose at the brake booster.

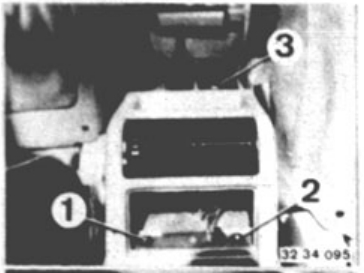
Installation:
Replace the clamps.



Unscrew the vacuum hose at non-return valve (1).

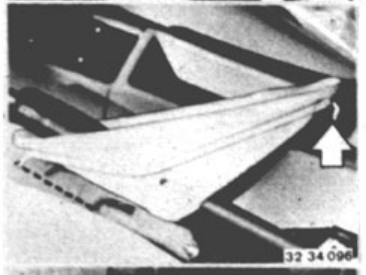
Installation:
Replace the clamps.



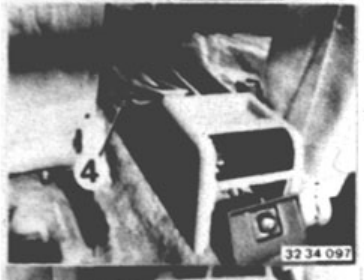


34 41 000 REMOVING AND INSTALLING PARKING BRAKE LEVER

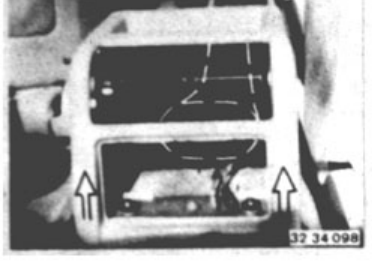
Lift out air extraction mask.
Unscrew nuts (1 and 2).
Press off cap.
Unscrew bolt (3).



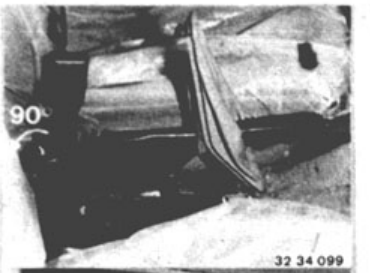
Lift out cover.



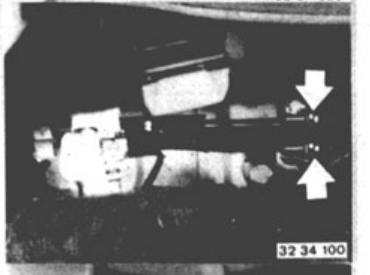
Unscrew bolt (4).
If applicable, pull off plugs for power windows, etc..



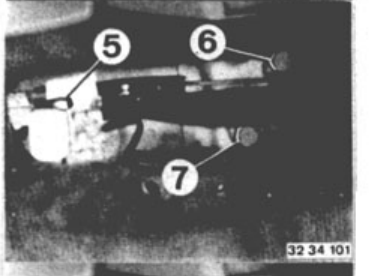
Lift the center console and remove the heating ducts.



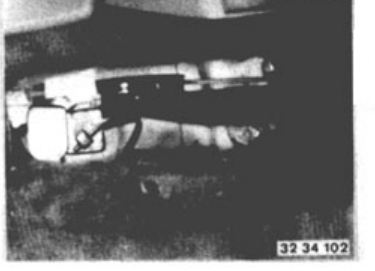
Turn retainer 90° and peel down the rubber cover.



Unscrew adjusting nuts on parking brake cables.

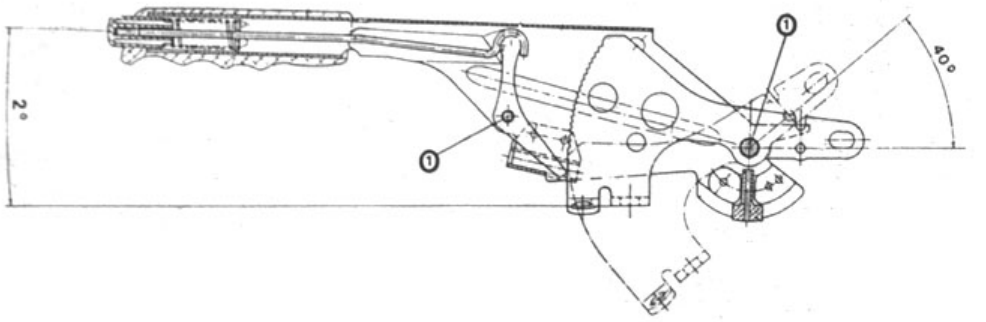


Unscrew bolts (5 ... 7).
Remove parking brake lever.



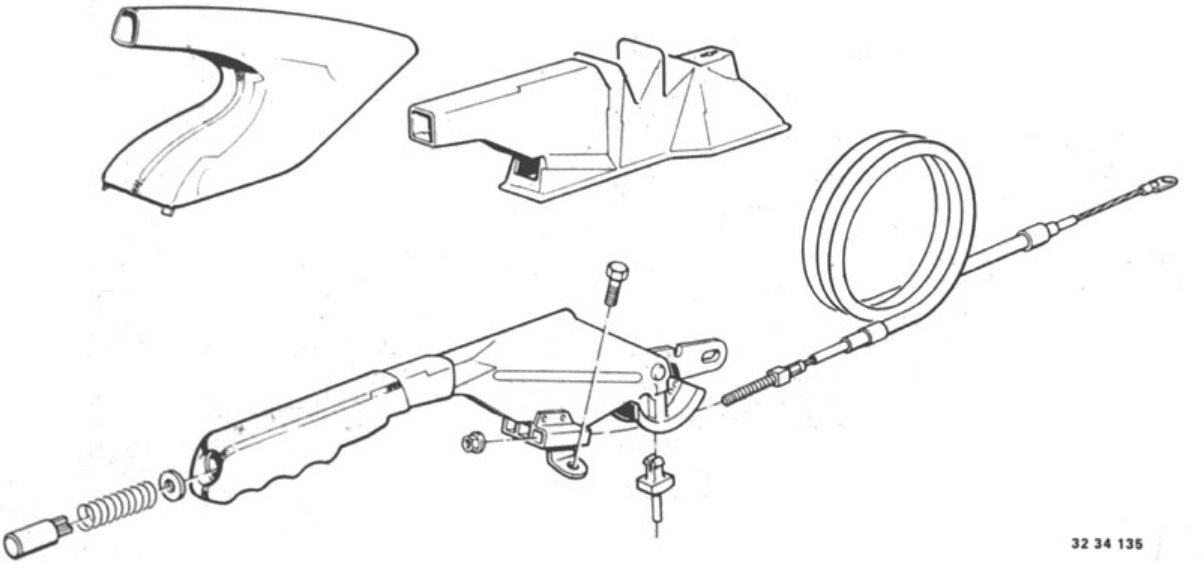
Be careful not to damage the warning switch while removing and installing.
Check adjustment.
Installation:
Adjust parking brake – see 34 10 014.

PARKING BRAKE LEVER LAYOUT DRAWING

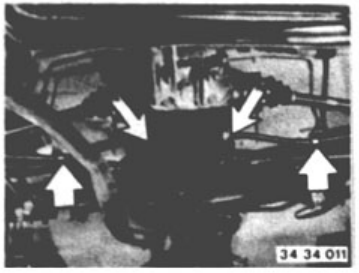


(1) = Riveted

32 34 104

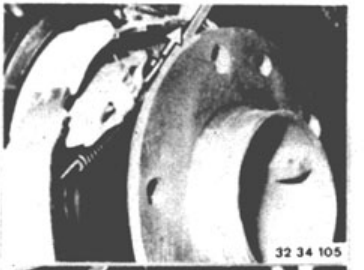


32 34 135



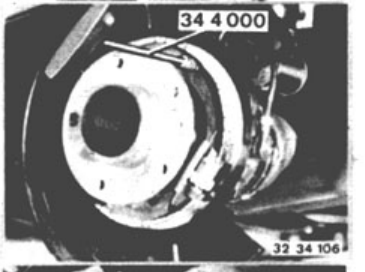
34 41 100 REMOVING AND INSTALLING PARKING BRAKE CABLE

Remove expander lock with parking brake shoes – see 34 41 220.
Remove parking brake lever – see 34 41 000.
Unscrew parking brake cable on trailing arm and pull out.
Installation:
Adjust parking brake – see 34 10 014.

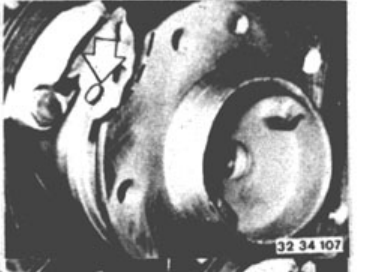


34 41 220 REMOVING AND INSTALLING PARKING BRAKE SHOES

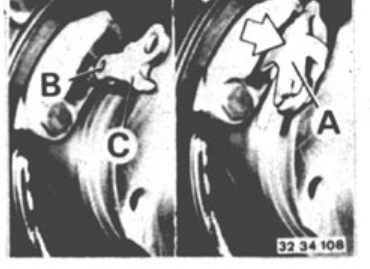
Remove rear brake disc – see 34 21 320.
Disconnect upper return spring with a brake spring pliers.



Turn retaining springs 90° with Special Tool 34 4 000 and disconnect.

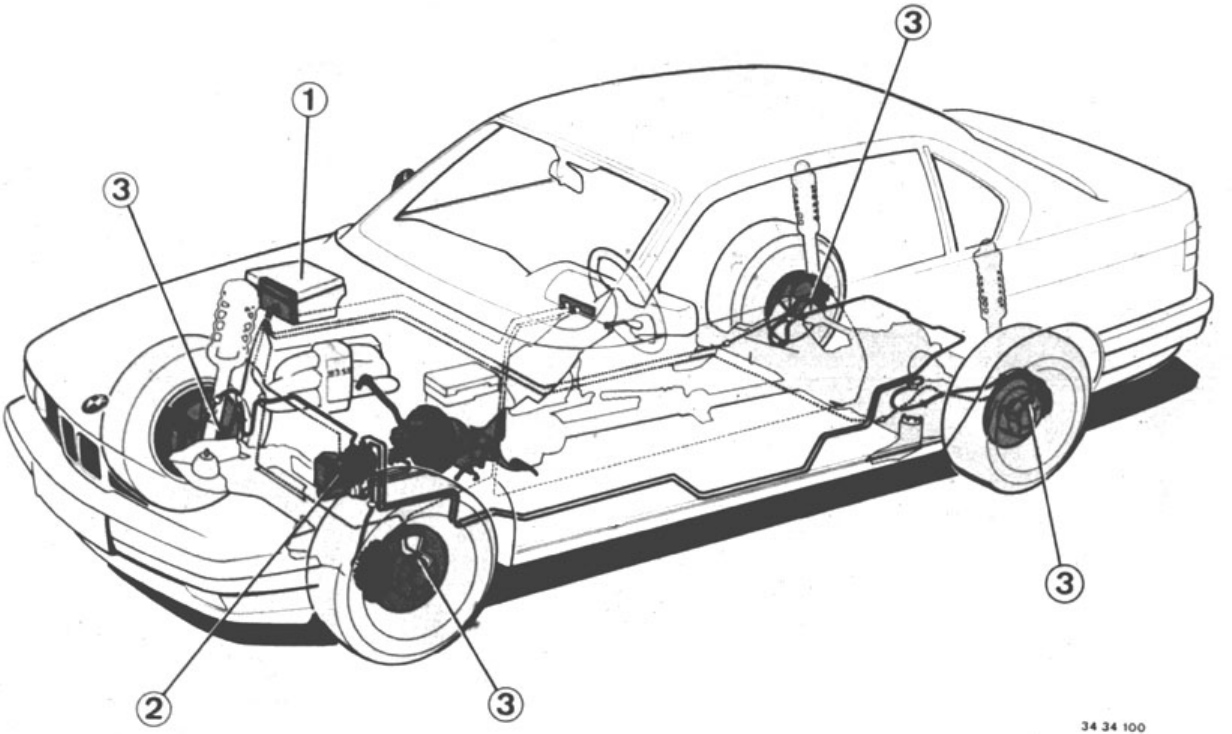


Pull brake shoes apart at top and remove from below.
Important!
Pin of expander lock could fall out.
Replacing Liners:
Break in as for replacement of brake discs – see 34 21 320.



Check expander lock.
Pull part A forward.
Press out pin B.
Pull out part C.
Caution!
Extract liner dust – never remove by blowing.
Installation:
Apply a thin coat of Molykote Paste G on sliding surfaces and pins.
Adjust parking brake – see 34 10 014.

ABS LAYOUT DRAWING



34 34 100

1 = Electronic control unit
2 = Hydraulic control unit
3 = Pulse senders



DESCRIPTION OF FUNCTION AND CHECKING ABS CONTROL LAMP

The ABS control lamp lights up after switching the ignition on.
The control lamp must go out after starting the engine if ABS is okay.

The procedure is repeated each time the ignition is switched off and on.

The causes for faulty display — control lamp does not light up, does not go out or lights up while driving (even sporadically — can be determined with help of a BMW Service Tester and brake test stand.

The control unit automatically switches to "conventional brakes" in case of an electric or electronic fault in ABS.
This means that the car can still be braked, but without regulation (the wheels could lock!).
The ABS control lamp in the dashboard lights up continuously to indicate a faulty system.



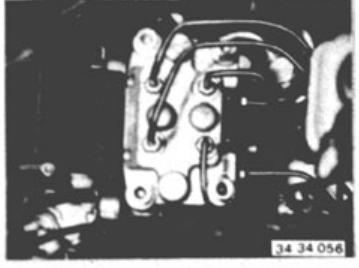
34 50 000 CHECKING FUNCTION OF ABS

An electronic circuit in the control unit monitors ABS constantly.
The function 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.



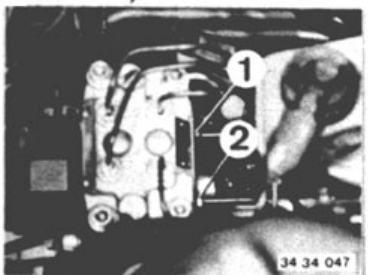
The function is checked with a BMW Service Tester.
Connect tester on wire harness and control unit with a suitable plug.
Refer to ABS nominal value microfiche.
Caution!
Control unit plug may only be disconnected and connected after turning off ignition.
See wiring diagram in ABS nominal value microfiche for connections.





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.

ABS Function and Troubleshooting:
See car electric/electronic test plan.

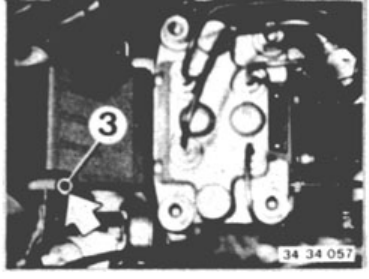


34 51 520 REMOVING AND INSTALLING OR REPLACING COMPLETE HYDRAULIC CONTROL UNIT (FOR ABS)

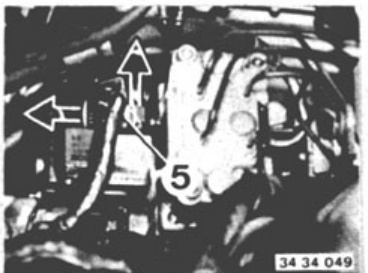
Unscrew brake pipes (1 and 2).
Installation:
Pipe (1) to brake master cylinder, rear.
Pipe (2) to brake master cylinder, front.
Caution!
Catch escaping brake fluid and don't let it get on clothes or paint finish.



Unscrew brake pipes (VL / VR / HL / HR).
Installation:
Don't mix up pipes (mark).
VL to left front brake caliper.
VR to right front brake caliper.
HL to left rear brake caliper.
HR to right rear brake caliper.
Important!
Keep open pipes and connections clean (insert plugs).



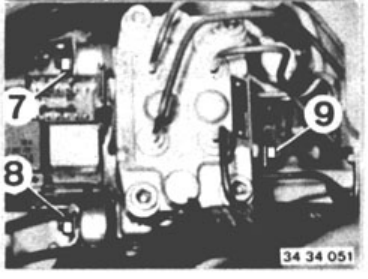
Unscrew bolt (3), Torx T 15, and lift off cover.



Pull out plug (4).
Pull off multiple-pin plug (5) and insulate.



Unscrew ground lead (6).

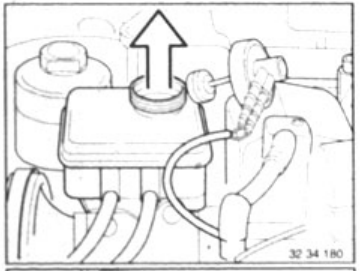


Loosen nuts (7 ... 9).
Pull up and remove hydraulic control unit.
Installation:
Bleed brakes see 34 00 046.
Check function of ABS with a BMW Service Tester – see 34 50 000.

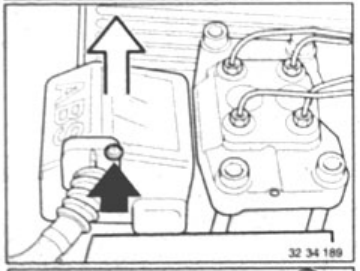
34 51 520 REMOVING AND INSTALLING OR REPLACING HYDRAULIC CONTROL UNIT FOR ABS (M60)

After finishing work, bleed brake system - refer to 34 00 047 for ABS or 34 00 048 for ABS/ASC+T.

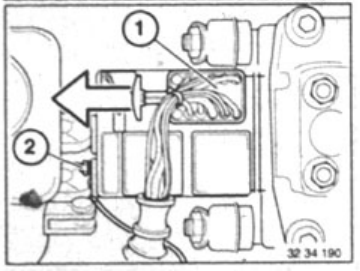
Disconnect battery ground lead.
Refer to General Information in Group 61.



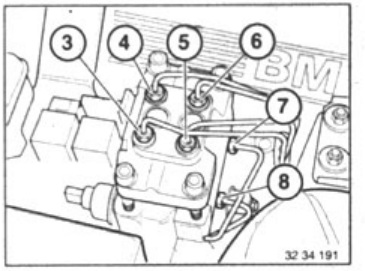
Suck the brake fluid out of the brake fluid tank using a siphon used exclusively with brake fluids.



Unscrew screw and remove cover.



Unlock and pull off plug (1).
Unscrew nut (2) and remove ground wire.



Unscrew brake pipes (3 ... 8).

Important!
Don't mix up brake pipes – mark them before disconnecting if necessary.

Note:
Plug brake pipes and ABS control unit with suitable plugs.

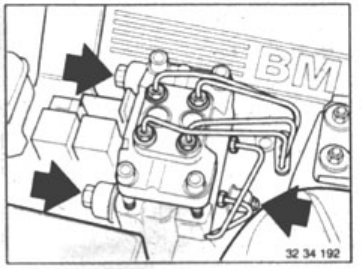
Installation:
Tightening torque*.

Brake Pipes:

3 (VL)	to left front brake caliper
4 (VR)	to right front brake caliper
5 (HR)	to right rear brake caliper
6 (HL)	to left rear brake caliper
7	from master cyl. conn. (V)
8	from master cyl. conn. (H)

Brake Pipes of Models with ASC+T:

5 (HR)	to plunger inlet (HR ABS)
6 (HL)	to plunger inlet (HL ABS)



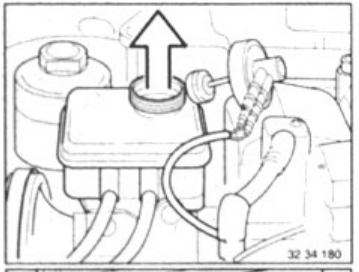
Loosen mounting nuts and remove ABS hydraulic control unit.

* Refer to Specifications

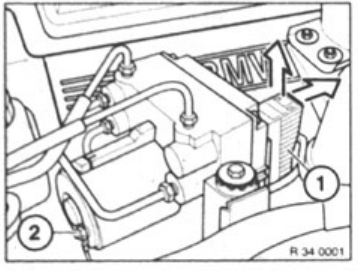
34 51 520 Removing and installing or replacing complete hydraulic unit (for ABS) (M 60)
(from model year '94)

When work is complete, bleed the brake system, refer to 34 00 047.

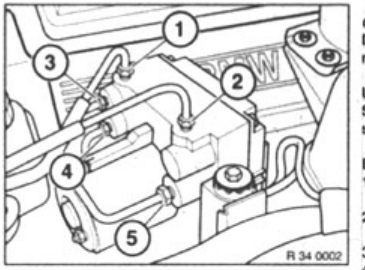
Disconnect negative lead from battery.
Note general instructions in Gr. 61!



Draw brake fluid out of tank with a suction bottle reserved for exclusive use with brake fluid.



Unlock plug (1) and remove.
Unfasten screw (2) and remove ground cable.



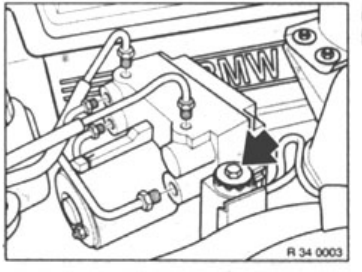
Caution!
Do not confuse position of brake lines: if necessary, mark before disconnecting.

Unfasten brake leads (1 ... 5).
Seal brake lines and ABS hydraulic unit with suitable plugs.

Brake line:

1 (V)	from master brake cylinder, connection (V)
2 (H)	from master brake cylinder, connection (H)
3 (VR)	to front right brake caliper
4 (VL)	to front left brake caliper
5 (HA)	to rear right and rear right brake caliper

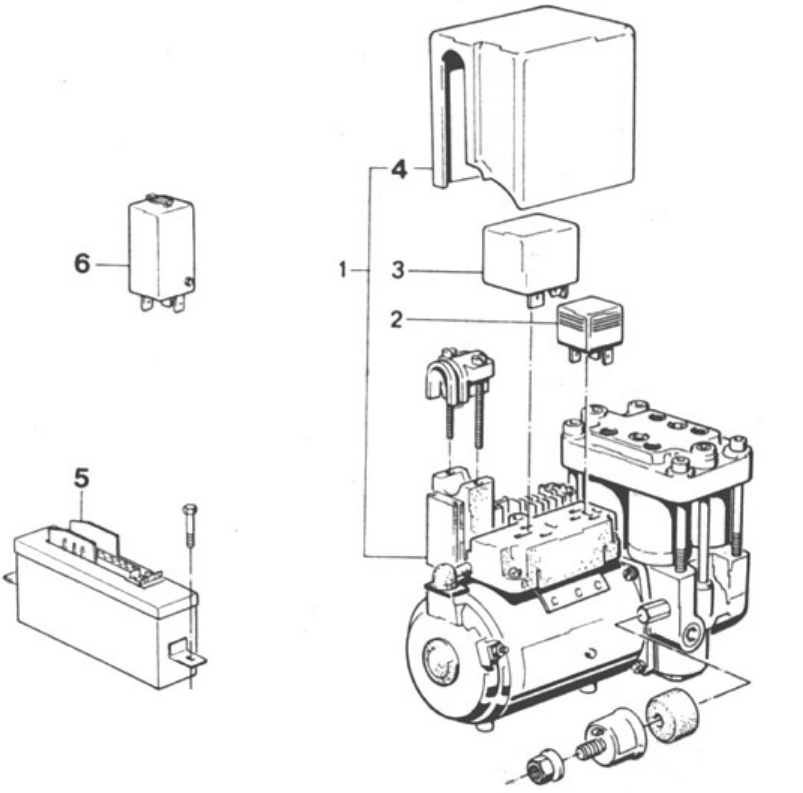
Installation:
Tightening torque *



Unfasten screw and remove ABS hydraulic unit.

* Refer to Technical Data

ABS COMPONENTS



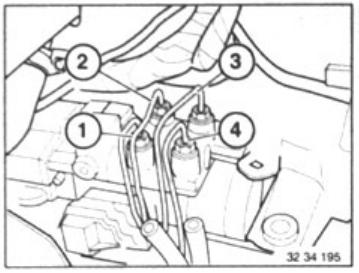
1 Hydraulic control unit
2 Valve relay
3 Motor relay
4 Cap
5 ABS electronic control unit
6 ABS electronic relay

34 51 525 REMOVING AND INSTALLING OR REPLACING HYDRAULIC CONTROL UNIT FOR ASC+T (M60)

After finishing work, bleed brake system - refer to 34 00 048.

Disconnect battery ground lead.
Refer to General Information in Group 61.

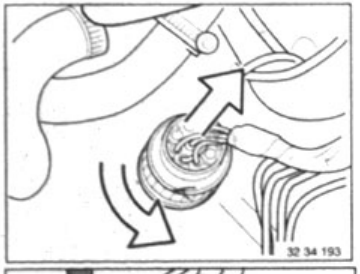
Remove hydraulic fluid supply tank - refer to Group 32.
Remove rear pedal assembly console - refer to Group 35.



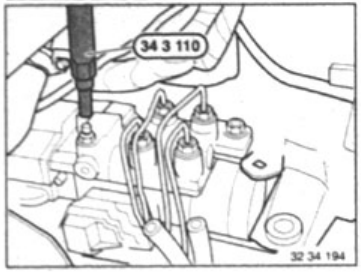
Unscrew brake pipes (1 ... 4) on plunger-type hydraulic control unit.
Unscrew and remove brake pipes (1 and 2) on ABS hydraulic control unit.

Installation:
Tightening torque*.

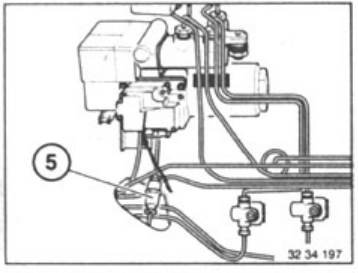
Brake Pipes:
1 Plunger inlet (HR ABS)
2 Plunger inlet (HL ABS)
3 Plunger outlet (HL RZ)
4 Plunger outlet (HR RZ)



Unlock and disconnect plug.



Apply Special Tool 34 3 110 on bleeder screw.
Loosen bleeder screw to discharge pressure in reservoir.



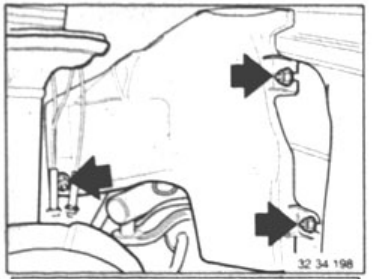
Unscrew hydraulic pipe (5) at adapter.

Note:
A second hydraulic pipe must be unscrewed at this position in models with ride level height control.

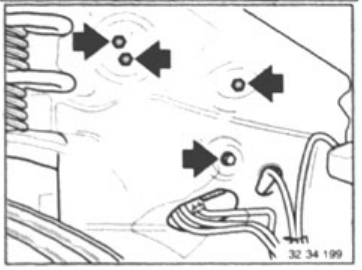
Important!
Don't mix up hydraulic pipes; mark before disconnecting if necessary.

Installation:
Tightening torque*.

* Refer to Specifications



Unfasten nuts and remove interior wheel arch trim.

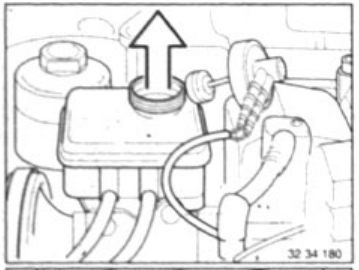


Unfasten retaining screws in wheel arch and remove plunger hydraulic unit.

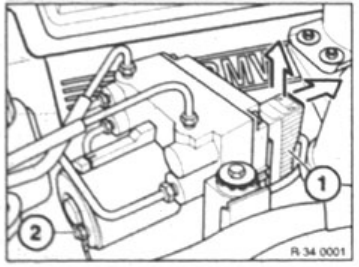
34 51 525 Removing and installing or replacing hydraulic unit (ASC+T)
(from model year '94)

When work is complete, bleed the brake system, refer to 34 00 048.

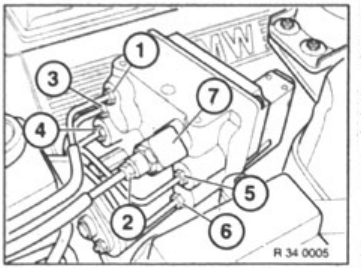
Disconnect negative lead of battery.
Observe general instructions in Gr. 61!



Draw brake fluid out of tank with a suction bottle reserved for exclusive use with brake fluid.



Unlock and remove plug (1).
Unfasten nut (2) and remove ground cable.



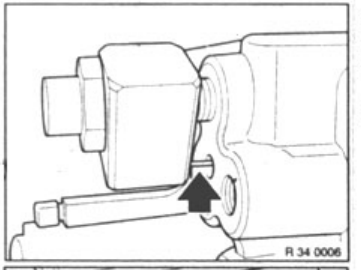
Caution!
Do not confuse brake lines: if necessary, mark them before removal.

Unfasten brake lines (1 ... 6).
Seal brake lines and hydraulic unit with suitable plugs.

Brake line:

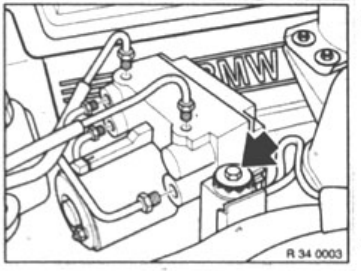
1 (V)	from master brake cylinder, connection (V)
2 (H)	from master brake cylinder connection (H)
3 (VR)	to front right brake caliper
4 (VL)	to front left brake caliper
5 (HR)	to rear right brake caliper
6 (HL)	to rear left brake caliper
7	Diaphragm flow damper

Installation:
Tightening torque 34 32 1AZ*



Note:
Note installation position of the diaphragm flow damper.
The pin must be in bore.

Installation:
Tightening torque 34 50 2AZ*



Unfasten screw and remove hydraulic unit.

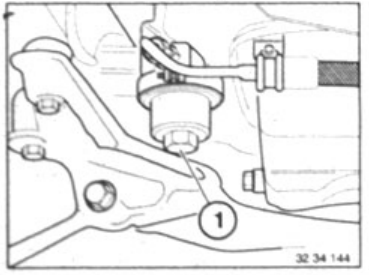
* Refer to Technical Data

34 51 540 Removing and installing or replacing ASC +T filter

Filter replacement intervals, refer to Gr. 00.

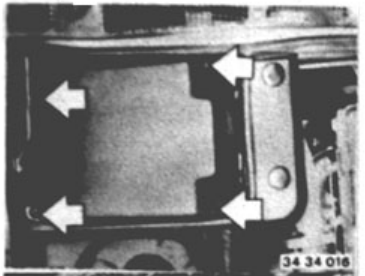
When work is complete, bleed mineral oil circuit, refer to 34 00 040.

If necessary, remove engine splash guard



Unfasten filter bell housing (1).
Replace filter element and O-ring.

Installation:
Tightening torque *

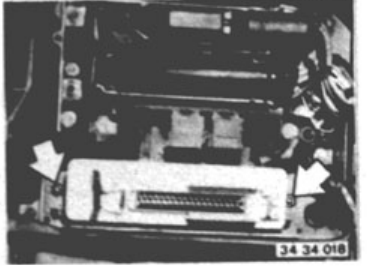


34 52 510 REPLACING CONTROL UNIT (FOR ABS)

Unscrew cover in engine compartment on right side.
Caution!
Only remove or install control unit after turning off the ignition.



Push back clamp (1) and pull off right side and disengage left side of multiple pin plug.
Unscrew control unit on body.



Check for correct connections when replacing the control unit.
The multiple pin plug has a tab on the left side, for which the control unit must have an opening.
Installation:
First engage the left side of the plug and then press the right side into the clamp.
Check function of ABS with a BMW Service Tester – see 34 50 000.
Check the control unit number*.
Also refer to Service Information of Gr. 34.

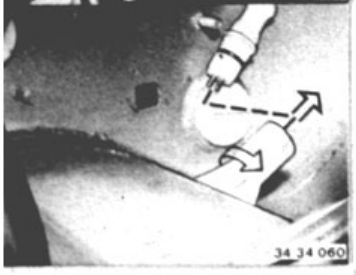
Electric wires for ABS are completely integrated in the main wire harness.

* See Specifications

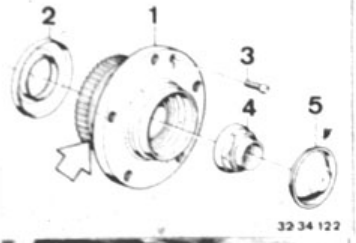


61 12 510 REMOVING AND INSTALLING OR REPLACING ONE FRONT PULSE (SPEED) SENSOR (FOR ABS)

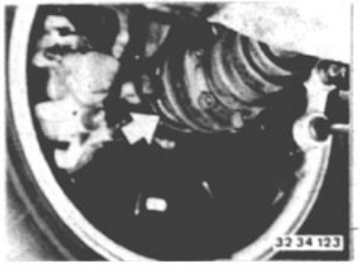
Turn off ignition.
Unscrew socket head screw.
Lift wire out of holder.
Pull out pulse sensor.
Installation:
Check seal, replacing if necessary.
Lubricate pulse sensor and housing with Molykote Longterm 2 prior to installation.



Disconnect plug in engine compartment when replacing the pulse sensor; turn and push down plug.
Installation:
The spacing distance for front pulse sensors is given by the take-up bore.
Check function of ABS with a BMW Service Tester – see 34 50 000.



Removing and Installing/Replacing Front Pulse Wheel for ABS:
Teeth of the pulse wheel are integrated in the front wheel hub.
See replacing wheel hub in 31 21 561.

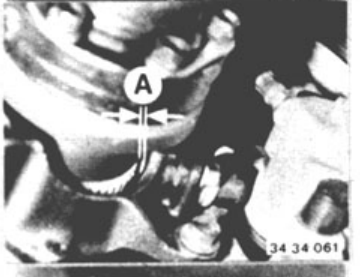


Removing and Installing/Replacing Rear Pulse Wheel for ABS:
The rear pulse wheel is integrated in the drive flange.
See replacing rear wheel bearings in 33 41 151.



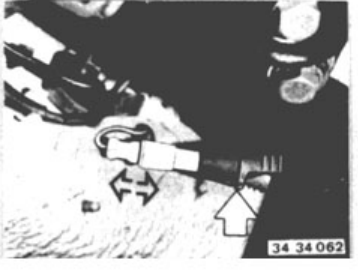
61 12 522 REMOVING AND INSTALLING OR REPLACING REAR PULSE (SPEED) SENSOR (FOR ABS)

Turn off ignition.
Remove rear wheel – see 36 10 300.
Remove rear caliper – see 34 21 220.
Installation:
The distance* between pulse sensor and pulse wheel (A) is given by design and cannot be adjusted.
However, the pulse wheel must be visually inspected for dirt or damage.



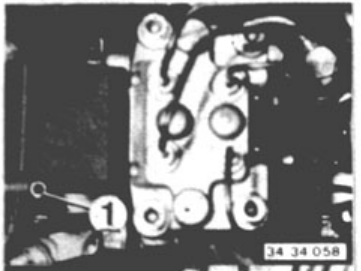


Unscrew socket head screw.
Lift wires out of holders.
Pull out pulse sensor.
Installation:
Check seal, replacing if necessary.
Lubricate pulse sensor and housing with Molykote Longterm 2 prior to installation.



Replacing Rear Pulse Sensor:
Take wires out of clamps.
Pull out wires and rubber grommet.
Disconnect plug.
Take off pulse sensor.
Important!
Don't damage the rubber grommet.

* See Specifications

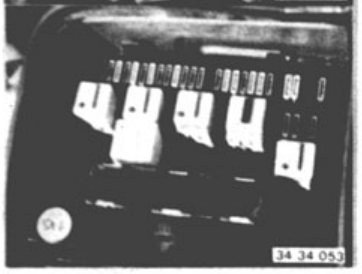


61 31 570 REPLACING RELAYS ON HYDRAULIC UNIT (FOR ABS)

Unscrew screw (1) (Torx T 15).
Pull off cover.



Pull out engine relay (2) or valve relay (3).

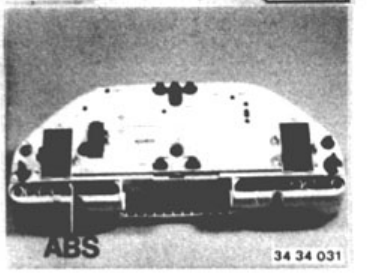


Replacing Electronic Relay for ABS:
Open cover on relay carrier in engine compartment on left-hand side.
Pull out ABS electronic relay (Bosch) with Special Tool 61 1 250 and replace.

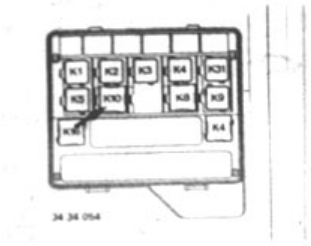


62 99 080 REPLACING INDICATOR LAMP (FOR ABS)

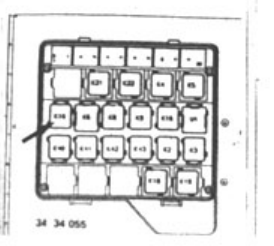
Remove instrument cluster – see 62 11 000.



Pull out indicator lamp socket.
Replace indicator lamp.



High Version Power Distributor
K 10 = ABS relay



Low Version Power Distributor
K 10 = ABS relay

TROUBLESHOOTING BRAKES

Condition	Cause	Correction
Brakes pull to one side	a) Tire inflation pressure incorrect b) Uneven tire tread wear c) Oil an pads/liners d) Pad/liner type not as specified e) Caliper recesses dirty f) Rear wheel alignment maladjusted g) Corrosion in calipers h) Shock absorbers without action i) Pad of one caliper worn k) 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) Check/adjust wheel alignment g) Remove and install, repair or replace calipers h) Check or replace shock absorbers i) Replace brake pads; check calipers k) Replace brake pads; 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) 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) Check parking brake and parking brake cables, repairing if necessary
Braking effect insufficient inspite of great force on pedal Brake pedal travel – normal	a) Brake pads coated with oil or burnt; wrong type of brake pads	a) Replace brake pads
short	b) Brake booster malfunctions	b) Check seal on brake master cylinder, replacing if necessary Check brake booster
long	c) One brake circuit failed due leaks or damage	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 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 d) Rubber ring for piston control swollen	a) Replace brake pads b) Remove and install, repair or replace calipers 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 d) Brake disc wear angular e) Pads worn less than minimum thickness	a) Replace wheel bearings b) Check caliper installation c) Remove and install, repair or replace calipers d) Grind or replace brake discs e) Replace brake pads

TROUBLESHOOTING BRAKES

Condition	Cause	Correction
Seized brake pads, pads stuck on brake disc	a) Caliper recesses dirty, caps damaged b) Corrosion in calipers c) Compensation bore in master cylinder clogged	a) Remove and install, repair or replace calipers b) See a) c) Overhaul or replace master cylinder
Brakes squeal or knock	a) Wrong type of brake pads b) Caliper recesses dirty c) Brake disc not aligned with caliper d) Brake disc runout e) Excessive thickness deviation within braking surface f) Rust on edges of brake discs g) Pads loose h) Wheel bearing play excessive	a) Replace brake pads b) Remove and install, repair or replace calipers c) Check caliper installation d) Check brake disc runout, replacing discs if necessary e) Measure brake disc thickness and grind or replace f) Grind or replace brake discs g) Replace brake pads h) 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 deviation within braking surface e) Brake system has a leak f) Air in brake system g) Wrong type of brake pads	a) Replace wheel bearings b) Check caliper installation c) Check brake discs for runout, replacing if necessary d) Measure brake thickness deviation and grind or replace discs e) Check brake system for leaks f) Bleed brakes g) Replace brake pads

TROUBLESHOOTING BRAKES

Condition	Cause	Correction
Seized pistons in calipers	a) Caliper recesses dirty, caps damaged b) Brake disc not aligned with caliper c) Corrosion of pistons in calipers	a) Remove and install, repair or replace calipers b) Check caliper installation c) See a)
Pulsating effect on brake pedal	a) Wheel bearing play excessive b) Brake disc not aligned with caliper c) Brake disc runout d) Excessive thickness deviation within braking surface	a) Replace wheel bearings b) Check caliper installation c) Check brake discs for runout, replacing if necessary d) Measure disc thickness and grind or replace
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 expander locks; check cables, replacing if necessary

35 Pedals

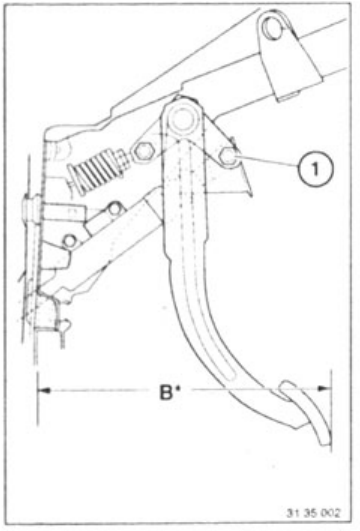
	Notes	35-	0/1
	Arrangement of pedals	35-	0/2
	Control dimensions for spacing between pedals	35-	0/3
35 11 000	Console for pedals, complete unit – remove and install	35-	11/1
001	Console for pedals – replace	35-	11/2
35 21 . . .	Pull rod for brake actuation – adjust	35-	21/1
. . .	Brake pedal – adjust	35-	21/1
000	Brake pedal – remove and install	35-	21/2
051	Console for brake system – remove and install or replace	35-	21/3
055	Console for pivot lever – remove and install or replace	35-	21/7
35 31 000	Clutch pedal – remove and install	35-	31/1
35 41 000	Accelerator pedal – replace	35-	41/1
010	Accelerator pedal shaft – remove and install/replace	35-	41/1
421	Bowden cable for throttle valve actuation – replace	35-	41/2
. . .	Bowden cable for throttle valve actuation – adjust	35-	41/4
. . .	Bowden cable for throttle valve actuator – adjust (on ASC+T)	35-	41/4
480	Kick-down switch – replace (EH transmission)	35	41/5

GENERAL INFORMATION

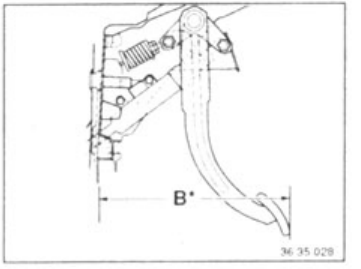
Cars with Interlock System:
The following function test must be carried out if a component of the interlock system had been removed and installed or the position of the interlock cable changed.

1. Move selector lever of automatic transmission into "P".
2. Remove ignition key.
3. Press lock button on selector lever.
4. If the selector lever can be moved out of "P", the interlock cable must be adjusted – refer to Group 25.
5. Switch on ignition.
6. Press lock button on selector lever.
7. If the selector lever cannot be moved out of "P", the interlock cable must be adjusted – refer to Group 25.

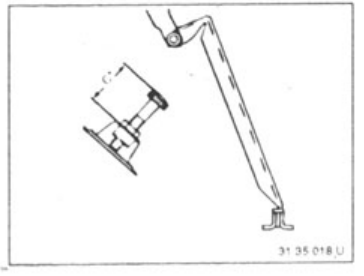
PEDAL ASSEMBLY LAYOUT DRAWINGS



Brake Pedal



Clutch Pedal

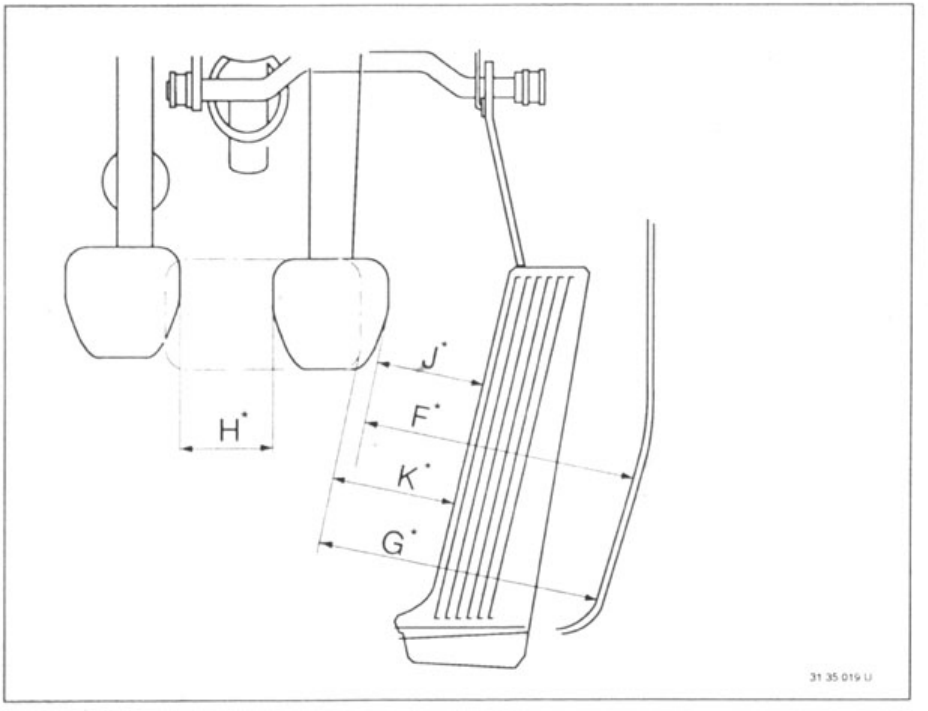


Accelerator Pedal

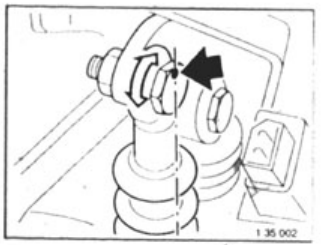
* Refer to Specifications

* Refer to Specifications

DIMENSIONS TO CHECK SPACING BETWEEN PEDALS



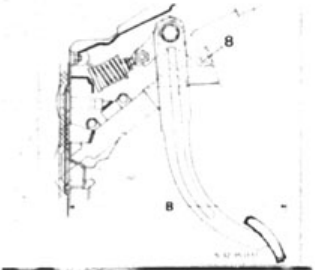
* Refer to Specifications



35 11 000 REMOVING AND INSTALLING COMPLETE PEDAL CONSOLE

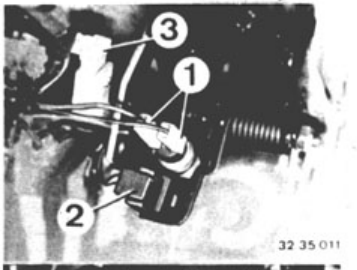
Remove accelerator pedal shaft - refer to 35 41 010.
Remove complete steering column - refer to 32 31 090.
Remove clutch master cylinder - refer to 21 52 000.

Adjusting Clutch Pedal Eccentric Bolt:
Turn eccentric bolt until dot on bolt is opposite the clutch master cylinder.



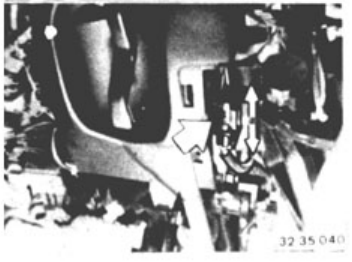
Installation:
Distance (B)* must be reached.
If distance (B)* is not reached in the above mentioned adjustment, turn eccentric bolt 180°.

Important!
Intermediate positions of the eccentric bolt are not acceptacble.



Pull off plugs (1 and 2).

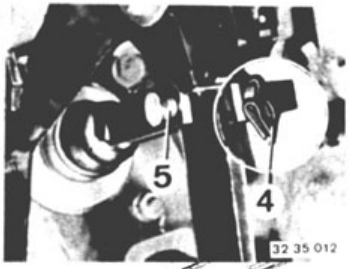
Version with Automatic Cruise Control:
Disconnect plug (3).



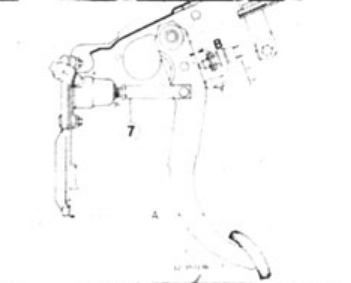
Version with Electronic Pedal Value Sender:

Disconnect plug.

* Refer to Specifications



Lift out retainer (4) and pull out shaft (5).



Installation:
Adjust brake pedal at brake master cylinder push rod (7) to distance (A)*.
Adjust brake light switch - refer to Gr. 61.

Important!
Movement must be limited in the brake master cylinder and not, for example, by the brake light switch (distance "B").

Check function of brake lights!



Unscrew nuts on engine compartment wall.

Installation:
Replace self-locking nuts.
Tightening torque*.



Unscrew bolts at top.
Remove pedals.

Installation:
Tightening torque*.
Lubricate all sliding surfaces lightly with grease**.

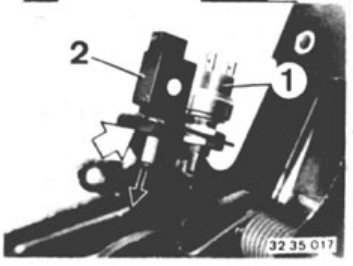
* Refer to Specifications
** Refer to Operating Fluids



35 11 001 REPLACING PEDAL CONSOLE

Remove pedal console - refer to 35 11 000.

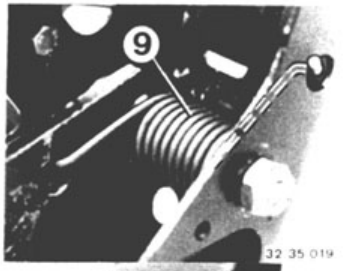
Refer to Group 12 for information on removal, installation and adjustment of the pedal value sender.



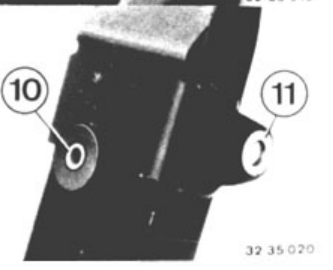
Transfer brake light test switch (1) and brake light switch (2).

Note:
Plunger and sleeve must be pressed out to remove brake light switch (2).
Compress retainers and pull out switch.

Installation:
Mount switch with protruding strip inserted into opening in holder.

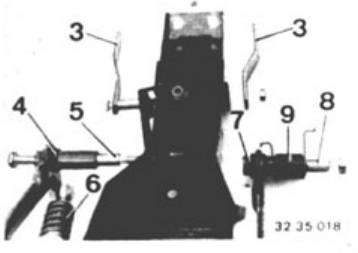


Installation:
Check for correct installed position of spring (9).



Transfer spacer (10) and bearing sleeves (11).
Check bearing sleeves, replacing them if necessary.

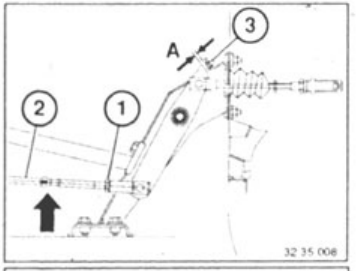
General Note:
All sliding surfaces must be given a light coat of grease**.



Transfer steering column lever (3), clutch pedal (4) together with spacer (5) and overcenter spring (6) as well as brake pedal (7) together with spacer (8) and spring (9).

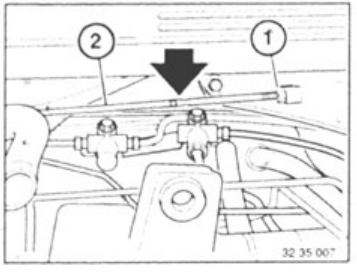
** Refer to Operating Fluids

35 21 ... ADJUSTING BRAKE OPERATING PULL ROD



Loosen nut (1) using Special Tool 13 5 020.
Turn pull rod (2) until distance (A)* is reached.

Note:
Check for correct seating of rubber stop (3).



Counterhold on pull rod (2) and tighten nut (1) using Special Tool 13 5 020.
Tightening torque*.

Check distance (A)*, repeating the adjusting procedures if necessary.

Note:
Support was removed for better illustration.

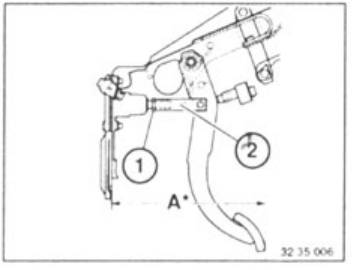
Check brake pedal adjustment - refer to 35 21 ...

* Refer to Specifications

35 21 ... ADJUSTING BRAKE PEDAL

Requirement:
Correct adjustment of brake operating pull rod - refer to 35 21 ...

Remove dashboard trim panel at bottom left - refer to Group 51.

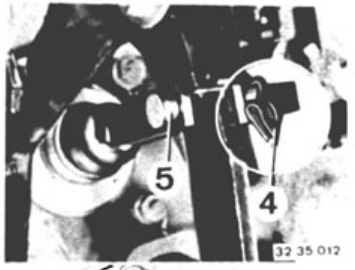


Loosen nut (1).
Turn push rod (2) until distance (A)* is reached.

Counterhold on push rod (2) and tighten nut (1).
Tightening torque*.

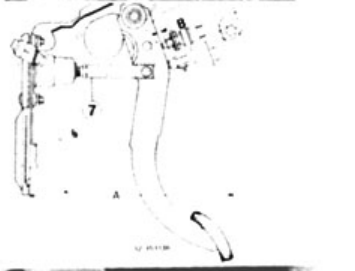
Check function of brake lights and adjustment of brake light switch, adjusting it if necessary - refer to Group 61.

* Refer to Specifications



35 21 000 REMOVING AND INSTALLING BRAKE PEDAL

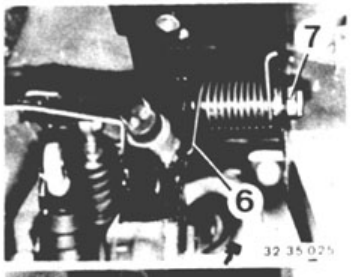
Remove dashboard trim panel at bottom left - refer to 51 45 180.
Lift out retainer (4) and pull out shaft (5).



Installation:
Adjust brake pedal at brake master cylinder push rod (7) to distance (A)*.
Adjust brake light switch - refer to Gr. 61.

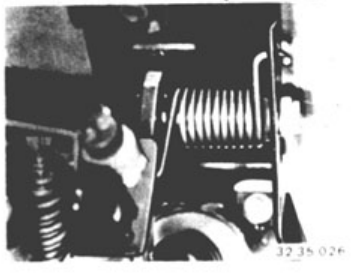
Important!
Movement must be limited in the brake master cylinder and not, for example, by the brake light switch (distance "B").

Check function of brake lights!



Detach spring (6).
Unscrew nut (7) and pull out shaft bolt as far as clutch pedal.
Remove brake pedal together with spacers and spring.

Installation:
Tightening torque*.



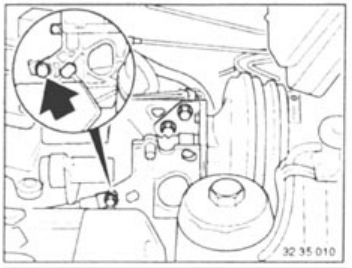
Check installed position of spring (6).

Installation:
Lubricate all sliding surfaces with grease**.

* Refer to Specifications
** Refer to Operating Fluids

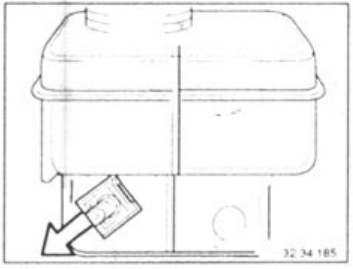
32 21 051 REMOVING AND INSTALLING OR REPLACING CONSOLE FOR BRAKE BOOSTER

Remove left headlight - refer to Group 63.



Unscrew screw.
Remove support.

Note:
View from front passenger's side.

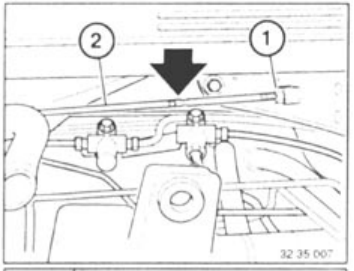


Lift out retainer and remove brake fluid tank.
Suspend tank from car on piece of wire.

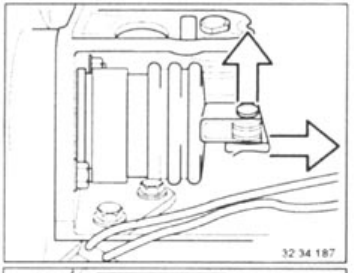
Caution!
Don't bend supply pipes to the brake master cylinder.

Don't lift supply pipes to brake master cylinder out of seat in brake master cylinder.

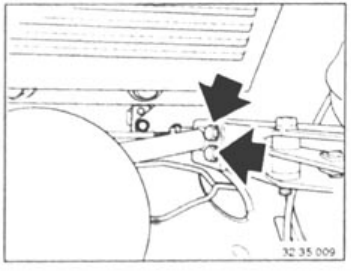
Keep brake fluid off of painted surfaces on car as it would destroy the paint finish.



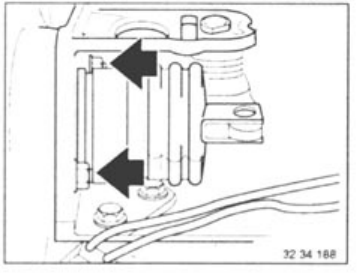
Loosen nut (1) of pull rod (2) using Special Tool 13 5 020.
Screw pull rod out of swivel heads and remove.



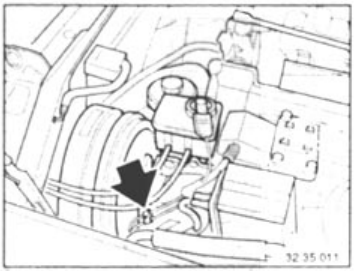
Lift out retainer and pull out shaft.



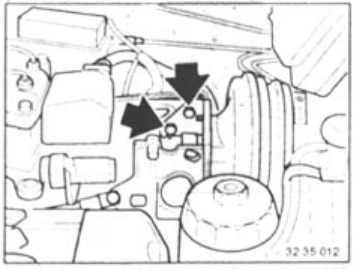
Unlock retainer for pipe to oil supply tank.
Unscrew screws.



Unscrew brake booster mounting nuts.

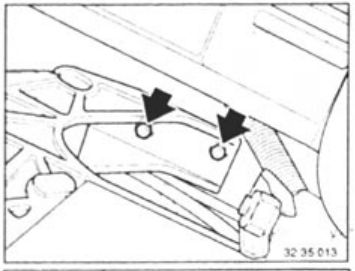


Remove holder for brake pipes.

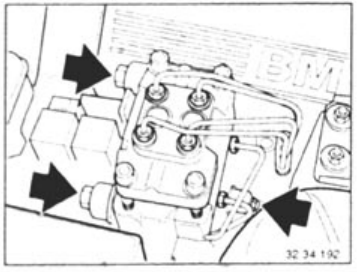


Unscrew screws.

Note:
View from front passenger's side.

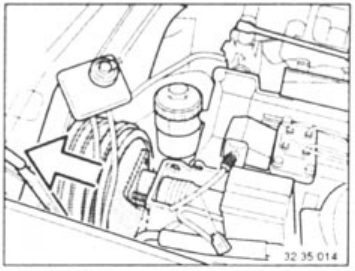


Unscrew nuts.



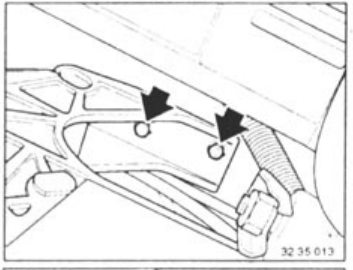
Loosen ABS hydraulic control unit mounting nuts and lift ABS hydraulic control unit out of holder.

Caution!
Don't damage the brake pipes!



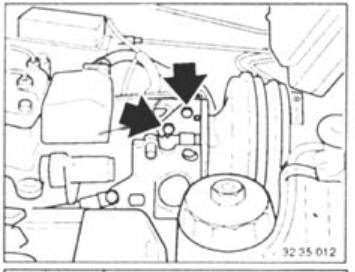
Push brake booster towards front wall and remove console.

Caution!
Don't damage the brake pipes!



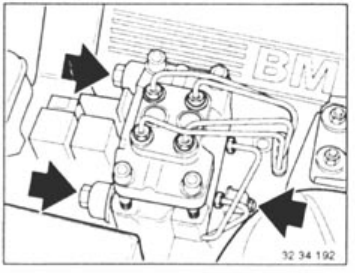
Install console.

Screw on nuts, but do not tighten!
Replace self-locking nuts!



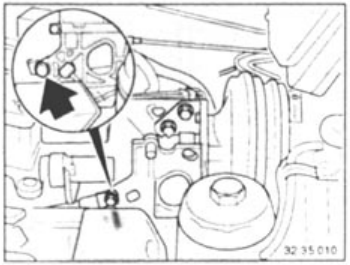
Screw in screws, but do not tighten.

Note:
View from front passenger's side.



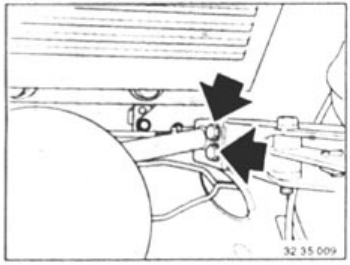
Place ABS hydraulic control unit in holder and tighten nuts and screws.
Tightening torque*.

* Refer to Specifications

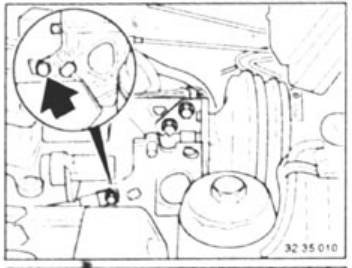


Install support.
Screw in screw, but do not tighten!

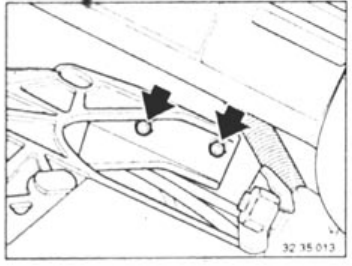
Note:
View from front passenger's side.



Screw in and tighten screws.
Tightening torque*.

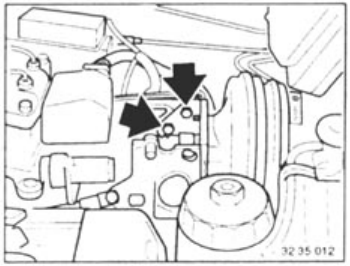


Tighten screw.
Tightening torque*.



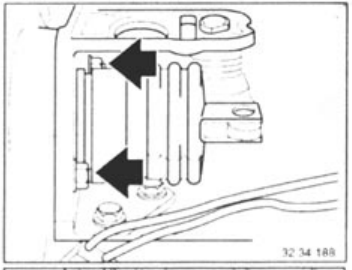
Tighten nuts.
Tightening torque*.

* Refer to Specifications

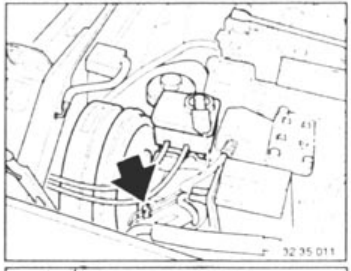


Tighten screws.
Tightening torque*.

Lock retainer for pipe to oil supply tank.

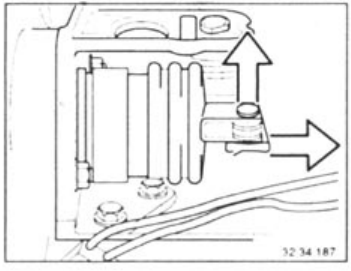


Place brake booster in console and tighten nuts.
Replace self-locking nuts.
Tightening torque*.



Secure holder for brake pipes.

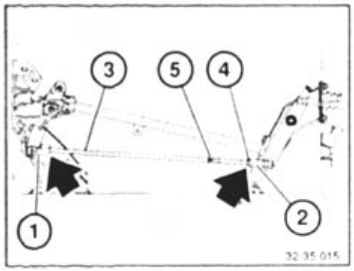
Important!
Check for correct routing of brake pipes.
Brake pipes must not rub!



Insert shaft and install retainer.

Important!
Check for correct seating of retainer.
Replace a damaged retainer.

* Refer to Specifications



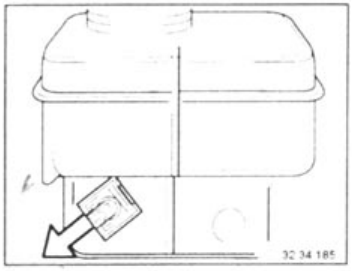
Insert pull rod (3) and screw uniformly into both swivel heads (1 and 2).

4 = Nut

Installation:
Pull rod and swivel heads have left-hand and right-hand threads!

Important!
Check installed position of pull rod (3). Surfaces (5) for counterholding pull rod (3) are located at the reversing lever console end!

Ensure sufficient and uniform screwed-in depth of the pull rod in the swivel heads!

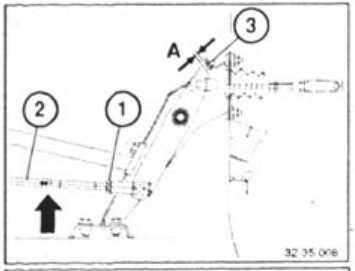


Install brake fluid tank and insert retainer.

Important!
Check for correct seating of retainer. Replace a damaged retainer.

Check for correct routing of brake pipes. Brake pipes must not rub.

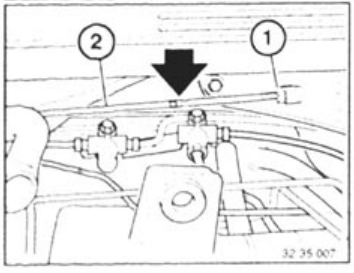
Check for correct seating of supply pipes in brake master cylinder and on brake fluid tank.
If necessary, reconnect brake pipes and then bleed the brake system - refer to Group 34.



Turn pull rod (2) until distance (A)* is reached.

1 = Nut

Note:
Check for correct seating of rubber stop (3).



Counterhold on pull rod (2) and tighten nut (1) using Special Tool 13 5 020.
Tightening torque*.

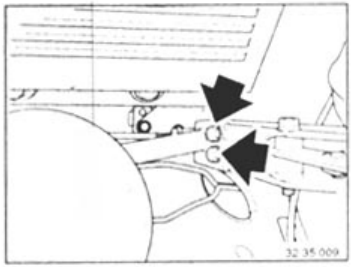
Check distance (A)*, repeating the adjustment if necessary.

* Refer to Specifications

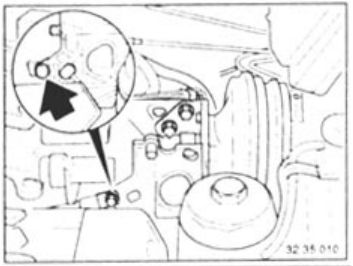
Check function of brake lights and adjustment of brake light switch, correcting it if necessary - refer to Group 61.

35 21 055 REMOVING AND INSTALLING OR REPLACING CONSOLE FOR REVERSING LEVER

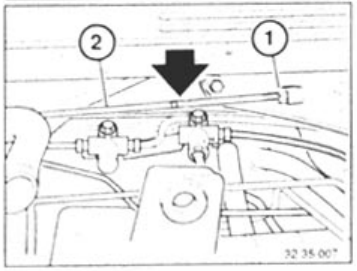
Remove dashboard trim panel at bottom left - refer to Group 51.



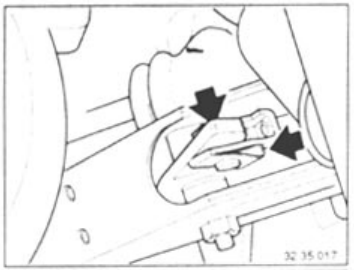
Unlock retainer for pipe to oil supply tank.
Unscrew screws.



Unscrew screw.
Remove support.



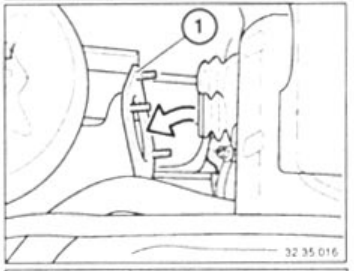
Loosen nut (1) of pull rod (2) using Special Tool 13 5 020.
Unscrew and remove pull rod in swivel heads.



Lift out retainer and pull out shaft.



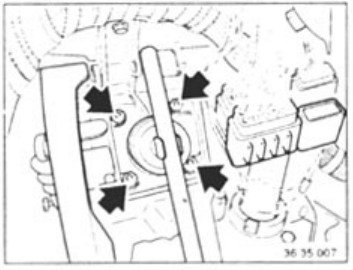
Unscrew nuts on engine compartment wall.
Take off bellows and remove console.



Check gasket (1) for console on firewall, replacing it if necessary.

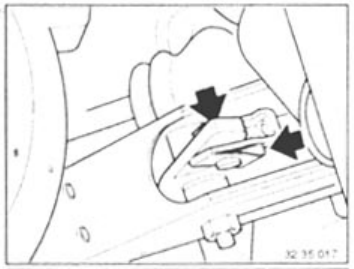
Insert console and mount bellows.

Installation:
Check for correct seating of bellows.



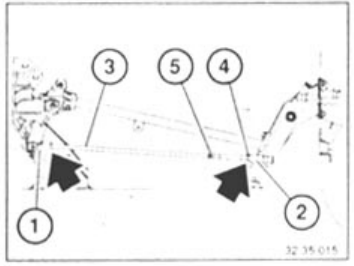
Replace and tighten self-locking nuts on engine compartment wall.
Tightening torque*.

* Refer to Specifications



Insert shaft and install retainer.

Important!
Check for correct seating of retainer.
Replace a damaged retainer.



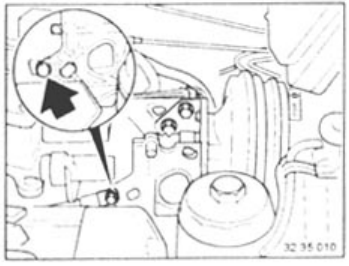
Insert pull rod (3) and screw uniformly into both swivel heads (1 and 2).

4 = Nut

Installation:
Pull rod and swivel heads have left-hand and right-hand threads!

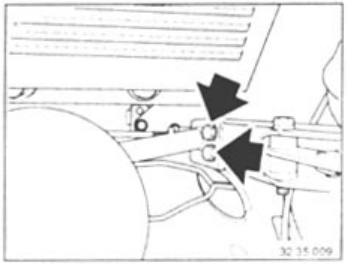
Important!
Check installed position of pull rod (3).
Surfaces (5) for counterholding pull rod (3) are located at the reversing lever console end!

Ensure sufficient and uniform screwed-in depth of the pull rod in the swivel heads!



Install support.
Screw in screw, but do not tighten!

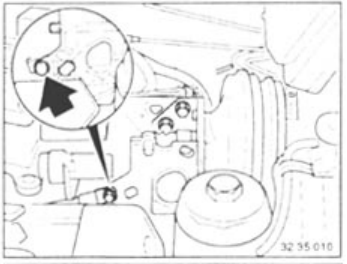
Note:
View from front passenger's side.



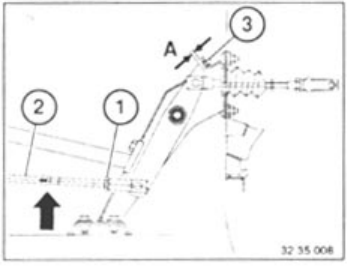
Screw in and tighten screws.
Tightening torque*.

Lock retainer for pipe to oil supply tank.

Important!
Support must not be installed with tension, if necessary correct the centering of the brake booster console.



Tighten screw.
Tightening torque*.

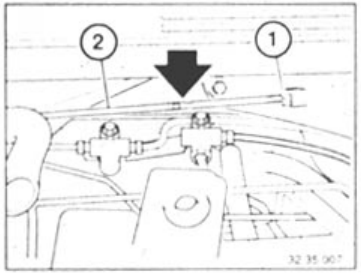


Turn pull rod (2) until distance (A)* is reached.

1 = Nut

Note:
Check for correct seating of rubber stop (3).

* Refer to Specifications



Counterhold on pull rod (2) and tighten nut (1) using Special Tool 13 5 020.
Tightening torque*.

Check distance (A)*, repeating the adjustment if necessary.

Check adjustment of brake pedal, correcting it if necessary - refer to 35 21 . . .
Check function of brake lights and adjustment of brake light switch, correcting it if necessary - refer to Group 61.

* Refer to Specifications

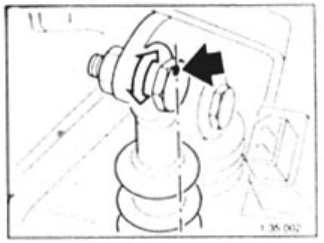


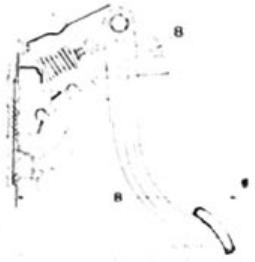
35 31 000 REMOVING AND INSTALLING CLUTCH PEDAL

Remove dashboard trim panel at bottom left - refer to 51 45 180.
Remove eccentric bolt (1).

Models with Automatic Cruise Control:
Unscrew holder for clutch switch.
Testing and adjusting - refer to Group 65.

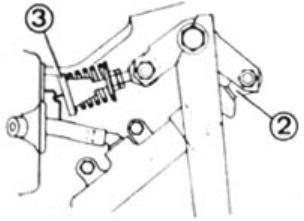
Installation:
Tightening torque*.
Lubricate eccentric bolt lightly before installation.
Adjusting Clutch Pedal Eccentric Bolt:
Turn eccentric bolt until dot on bolt is opposite the clutch master cylinder.





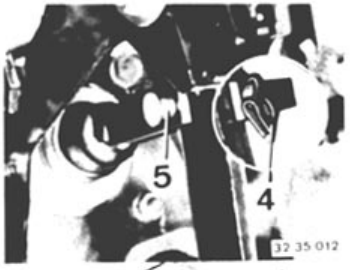
Installation:
Distance (B)* must be reached.
If distance (B)* is not reached in the above mentioned adjustment, turn eccentric bolt 180°.

Important!
Intermediate positions of the eccentric bolt are not acceptacble.



Installation:
Engage over-center spring (3) in guide on pedal assembly before installing piston rod (2).

* Refer to Specifications



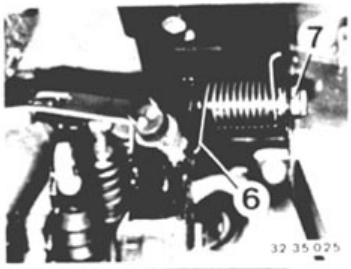
Lift out retainer (4) and pull out shaft (5).



Installation:
Adjust brake pedal at brake master cylinder push rod (7) to distance (A)*.
Adjust brake light switch - refer to Gr. 61.

Important!
Movement must be limited in the brake master cylinder and not, for example, by the brake light switch (distance "B").

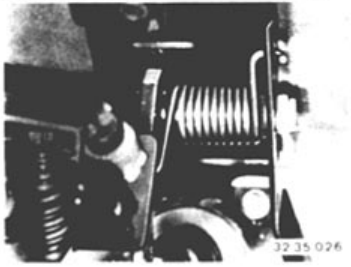
Check function of brake lights!



Detach spring (6).
Unscrew nut (7) and pull out shaft bolt.

Installation:
Tightening torque*.

Remove clutch and brake pedals together with spacers, over-center spring and spring



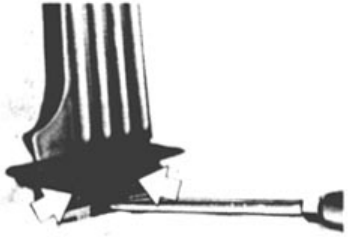
Check installed position of spring (6).

Installation:
All sliding surfaces must be lubricated lightly with grease**.

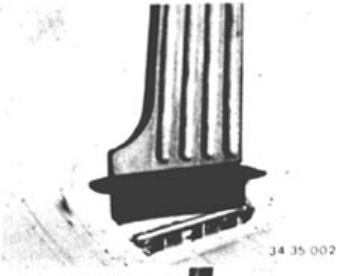
* Refer to Specifications
** Refer to Operating Fluids

35 41 000 REPLACING ACCELERATOR PEDAL

Installation:
Always replace a removed accelerator pedal.
Retainers of the old part could be damaged and let the accelerator pedal slide out of the connector.
Danger of accidents!

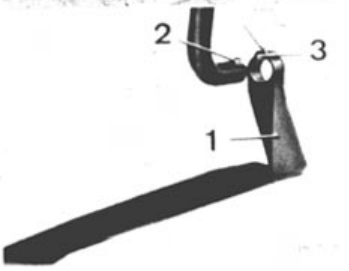

34 35 003

Push down on carpet.
Unbend retainers and remove accelerator pedal by prying up.


34 35 002

Installation:
Install accelerator pedal with pocket over the connector on the floor plate and ensure engagement of the retainers.

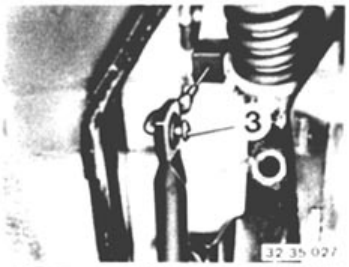
Important!
Always recheck for correct engagement of the retainers.



Turn accelerator pedal (1) far enough that linkage tab (2) of the accelerator shaft engages in opening (3).
Pull accelerator pedal off of accelerator shaft.

Installation:
Lubricate sliding surface on accelerator shaft lightly with grease**.

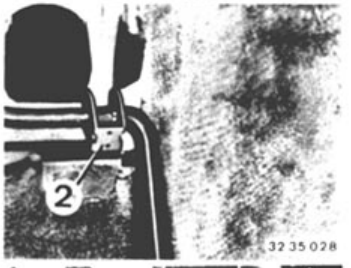
** Refer to Operating Fluids



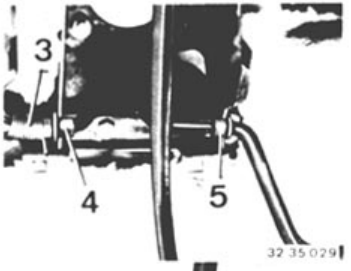
35 41 010 REMOVING AND INSTALLING OR REPLACING ACCELERATOR PEDAL SHAFT

Remove dashboard trim panel at bottom left - refer to 51 45 180.
Disconnect throttle cable (3).

Installation:
Check rubber grommet, replacing it if necessary.

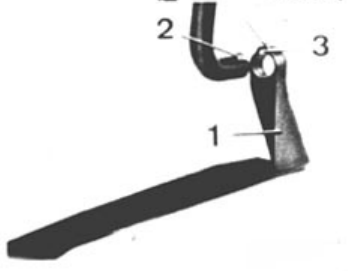


Lift out retainer (2).



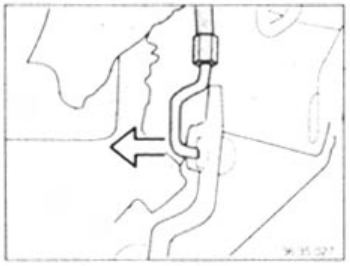
Detach spring (3).
Move bearing sleeves (4 and 5) to the side.
Lift out accelerator pedal shaft.

Installation:
Check bearing sleeves, replacing them if necessary.
All sliding surfaces must be lubricated lightly with grease**.



Turn accelerator pedal shaft and guide tab (2) through opening (3) in accelerator pedal (1).

** Refer to Operating Fluids

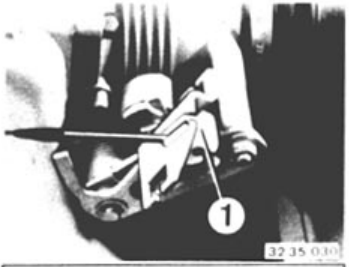


35 41 421 Replacing bowden cable for throttle valve actuation

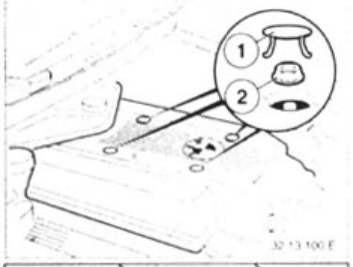
Remove lower left trim from instrument panel, refer to Group 51.

M 40:
Refer to Repair Manual, 3 Series E36.

Remove Bowden cable from pedal shaft.



M 20, M 30:
Lift locating nipple (1) off throttle valve lever.

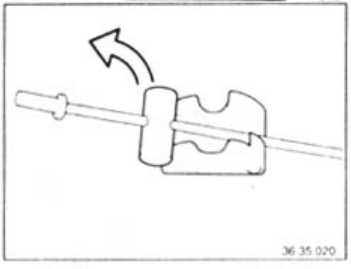


M 60:
Lift off covers (1).
Unfasten nuts (2).

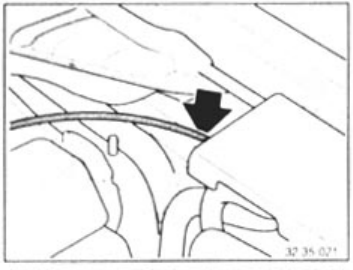
Installation:
Tightening torque*

If necessary, remove grommet from Tempomat Bowden cable.

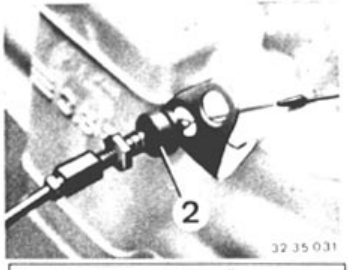
Remove manifold cover.



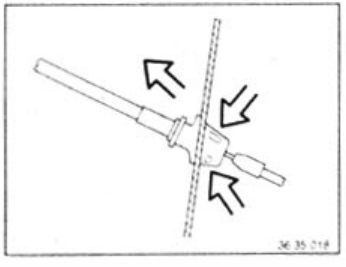
Press nipple out of nipple mounts.
Remove Bowden cable out of nipple mounts.



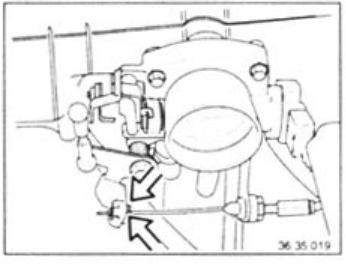
M 60:
Detach Bowden cable from bracket on firewall.



Lift rubber grommet (2) out of counter support.
Remove Bowden cable from bore.



Press together retaining lugs and withdraw Bowden cable from engine firewall in direction of engine compartment.

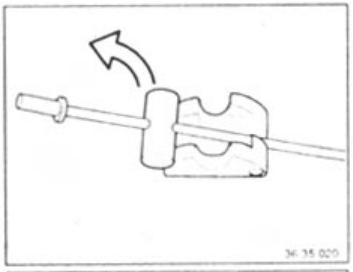


M 50:
Compress nipple mounts on both tabs and press out of operating lever.

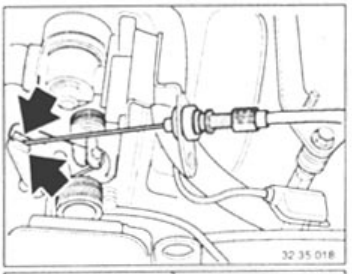
Note:

Intake pipe was removed for picture to improve demonstration.

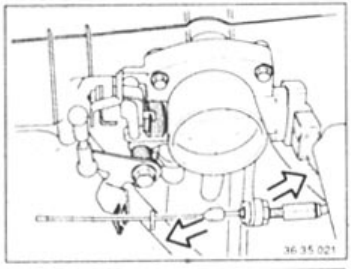
* Refer to Technical Data



Press nipple out of nipple holders.
Take cable out of nipple holders.

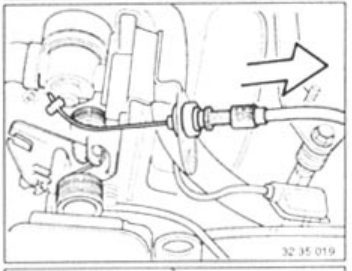


Compress nipple holder on both retainers and press out of operating lever.



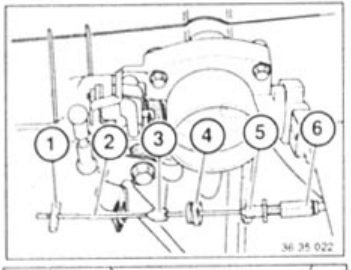
Pry out cap using a screwdriver.
Pull out cable towards rear.
Take rubber pad out of holder.

Installation:
Guide in cable completely as far as stop.



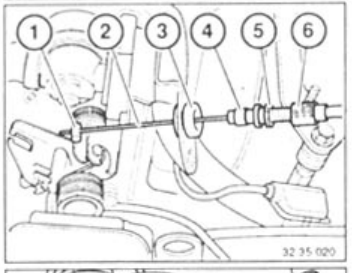
Pull out cable towards rear.
Take rubber pad out of holder.

Installation:
Guide in cable completely as far as stop.



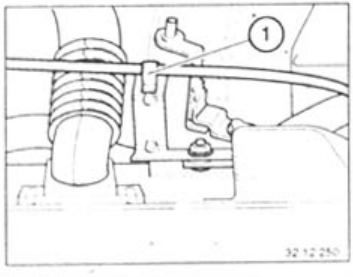
Survey of Throttle Cable to Throttle Valve:

1 Nipple
2 Throttle cable
3 Cap
4 Rubber pad
5 Sleeve
6 Setscrew

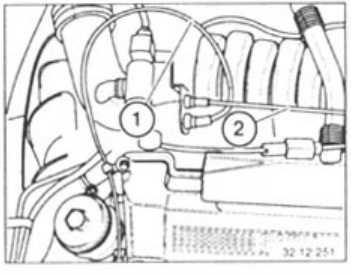


Survey of Throttle Cable to Throttle Valve:

1 Nipple
2 Throttle cable
3 Rubber pad
4 Sleeve
5 Locknut
6 Setscrew



M60:
Take cable out of holder for collector cover (1).



Models with Cruise Control:
Route cruise control cable (1) underneath throttle cable (2).

35 41 ... Adjusting bowden cable for throttle valve actuation

Throttle cable adjusting procedures:

Manual transmission:

1. Fully depress accelerator pedal
2. Move throttle valve into idle setting
3. Adjust Bowden cable with no tension.
4. Set adjusting screw on full throttle detent, adjust pedal so that 0.5 mm of clearance is still present at full throttle detent of throttle valve when accelerator pedal is fully depressed. (unscrew adjusting screw 1.5 turns - equivalent to 0.5 mm clearance).
   Lock full throttle stop with nut.

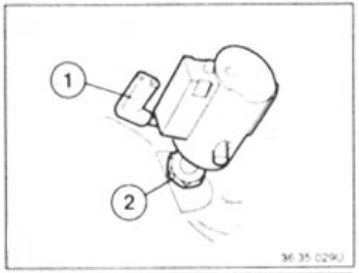
Automatic transmission:

1. - 3. as for manual transmission
4. Check inspection dimension C*.
5. Adjust full throttle detent in such a way that, in kick-down setting (full throttle detent) there is still clearance of 0.5 mm at the throttle valve (unscrewing full throttle detent 1.5 turns is equivalent to clearance of 0.5 mm.
   Lock nut on kick-down detent.
6. Depress accelerator pedal until transmission pressure point and adjust guide sleeve of full throttle detent in such a way that the transmission pressure point matches the full throttle detent.

* Refer to Technical Data

35 41 ... Adjusting bowden cable for throttle valve actuator (on ASC+T)

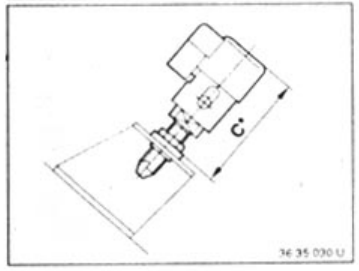
Bowden cable must be set with no clearance or tension.
Perform adjustment using adjusting screw.



35 41 480 REPLACING KICKDOWN SWITCH (EH Transmission)

Testing – refer to BMW Test Plan for Group 24.

Pull off flat male plug (1).
Unscrew nut (2).
Unscrew switch.

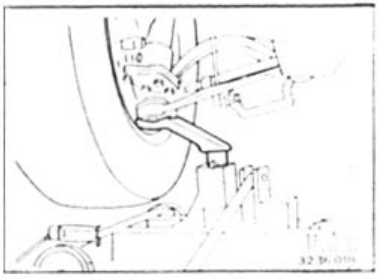


Installation:
Adjust nut to control distance C*.
Make final adjustment after installation.
Tightening torque*.

* Refer to Specifications

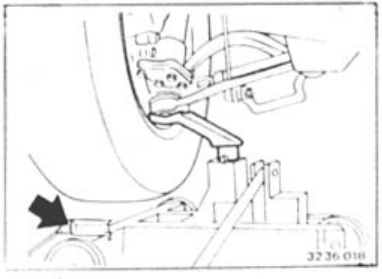
36 Wheels and tires

36 10 008	Front wheel, left or right – balance electronically	36-	10/1
058	Rear wheel, left or right – balance electronically	36-	10/2
209	Wheel – check lateral and radial runout	36-	10/3
300	Wheel, front or rear – remove and install	36-	10/4
508	Wheel – balance dynamically	36-	10/5
713	Wheel, front or rear – check for lateral and radial runout	36-	10/6
715	Wheel rim – check for lateral and radial runout	36-	10/7
36 12 01	Tire for front, rear or spare wheel – replace	36-	12/1
081	Tires for all wheels – replace	36-	12/4
36 13 . . .	Wheel bolt lock – service install	36-	13/1
551	Wheel rim blades – remove and install or replace	36-	13/2



36 10 008 BALANCING LEFT OR RIGHT FRONT WHEEL ELECTRONICALLY (Finish Balancer)

Always first balance wheels stationary prior to electronic balancing - see 36 10 508.
Set up gage for balancing on the control arm end.
Use a suitable take-up fork or additional fork (see Service Information or Workshop Equipment files).
Set up gage on control arm as close as possible to the control arm end.



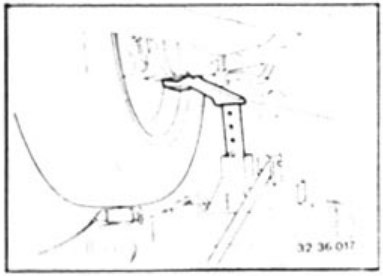
Connect leads for tester.

Important!
Balance wheel to the instructions supplied with the balancing machine. Balancing must be carried out on a solid base (concrete floor without a basement or sublevel underneath). Also refer to Service Information of Group 36.

If more than 15 grams of imbalance are displayed during finish balancing, the possible causes (e.g. insufficient stationary balancing, centering pin, etc.), also refer to Service Information 36 0 483 (196), must be eliminated prior to finish balancing and the finish balanced wheel rechecked.



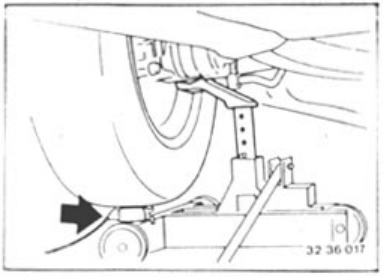
Make a chalk mark on the side of the tire, opposite the valve.



36 10 058 BALANCING LEFT OR RIGHT REAR WHEEL ELECTRONICALLY (Finish Balancer)

Always first balance wheels stationary (see 36 10 508) prior to electronic balancing.

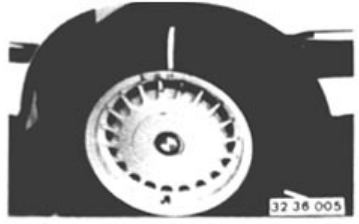
Unscrew and suspend output shaft from car on a piece of wire.
Set up gage for balancing on trailing arm as close as possible to the wheel.



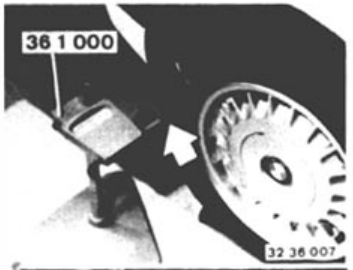
Connect leads for tester.

Important!
Balance wheel according to the instructions supplied with the balancing machine.
Balancing must be performed on a solid foundation (concrete floor without cellar).
Also refer to Service Information of Group 36.

If more than 15 grams of imbalance are displayed for one wheel during finish balancing, the possible causes (e.g. inaccurate stationary balancing, centering, etc.), also refer to Service Information 36 0 483 (196), must be eliminated before finish balancing and a previously finish balanced wheel must be rechecked.

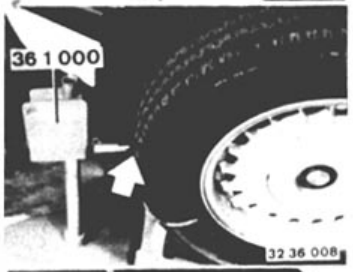


Make a chalk mark on the side of the tire, opposite the valve.

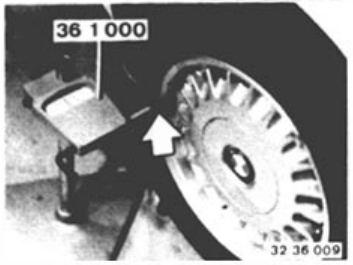


36 10 209 CHECKING WHEEL FOR LATERAL AND RADIAL RUNOUT

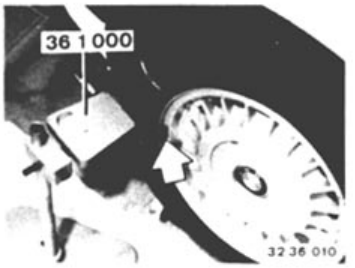
Wheel bearings must be in perfect condition.
Lift car.
Check wheel for lateral runout* with Special Tool 36 1 000.



Check wheel for radial runout* with Special Tool 36 1 000.



If necessary, remove balance weights.
Pry off the ornamental ring, if applicable.
Check lateral runout* of rim with Special Tool 36 1 000.



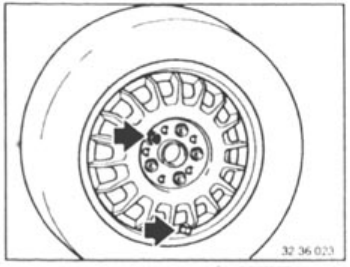
Check radial runout* of rim with Special Tool 36 1 000.

* See Specifications

* See Specifications

36 10 300 REMOVING AND INSTALLING FRONT OR REAR WHEEL

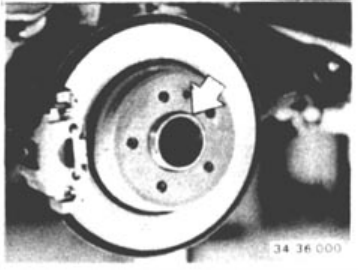
Important!
Wheel was balanced electronically.
Use the following procedures to avoid transforming errors and imbalance.



- Loosen wheel bolts.
- Position wheel with valve at bottom and install in same position.
- If several wheels are removed at the same time, mark installed location of wheels on tires with chalk.
- Mark position of wheel to wheel hub (to avoid transforming errors).
- Mark position of wheel lock to wheel (to avoid imbalance).
- Unscrew wheel bolts.



M5 Wheel:
Press the BMW emblem in against the spring force.
Grab hold of the hub cap with fingers inserted through the visible openings and pull the cap off towards the outside.



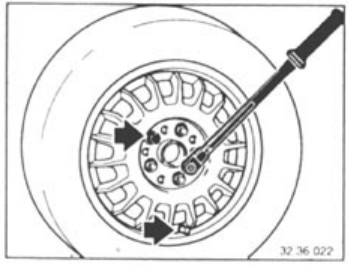
Installation:
Remove dirt and oil grease from the wheel centering shoulder and rim bearing surfaces and coat wheel center with Plastilube** before installing a wheel.
Inspect wheel bolt threads and tapers for wear, replacing wheel bolts if necessary.
Lubricate wheel bolt threads lightly with grease, but keep grease off of the tapers.

* Refer to Operating Fluids

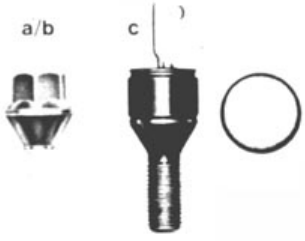


M5 Wheel Installation:
The wheels must run in a certain direction due to the blade wheels.
Identification of the wheel running direction is provided on the surface of the blade wheel shown by the arrow.

L = Left
R = Right



Tighten wheel bolts crosswise.
Tightening torque*.
If new wheel rims are mounted for the first time, the tightening torque* must be checked after 1,000 km.
Place a pertinent information label or tag in car where the driver can see it.



a) Wheel bolt - galvanized
b) Wheel bolt - black chrome plated
c) Wheel bolt - black chrome plated and lockable (special equipment)

Note for Wheel Bolt Locks:
If the adapter is missing, use a suitable adapter from the wheel bolt adapter set, Special Tool 36 1 300, to unscrew the locked wheel bolts.

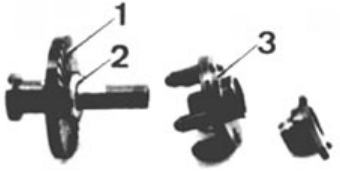
** Refer to Specifications



30 36 049

36 10 508 BALANCING WHEEL DYNAMICALLY (Wheel Removed)

Remove old balance weights, stones in treads and large pieces of dirt.
Check inflation pressure and tires for damage or flat spots (caused by parking a car with hot tires for a long time).
If necessary, check wheel and tire for radial and lateral runout – see 36 10 209.



32 36 014

Use a suitable center of pertinent balancing machine supplier.

1 = Basic flange
2 = Center
3 = Type flange

Also refer to Workshop Equipment and Planning.

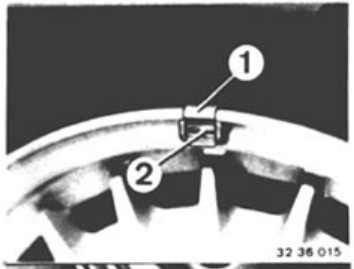
Important!
It is necessary to mount the wheel on the balancing machine in the same manner as it will be mounted on the car afterwards (e.g. valve facing down), in order to avoid clamping-over errors.
Balance wheel according to the instructions supplied with the pertinent balancing machine.



30 36 062

Pry the tire wall away from the rim flange slightly with a tire pliers** at a suitable point and insert a retainer in the case of light alloy rims.
Remove the tire pliers and slide a balance weight underneath the retainer and let it engage.

** See Workshop Equipment and Planning



32 36 015

Arrangement of Balance Weights for Cast Light Alloy Wheel Rims:

1 = Spring clip
2 = Balance weight

Max. imbalance per wheel and side*.

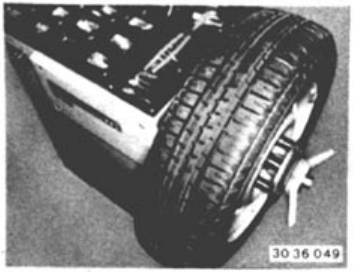


34 36 001

Arrangement of Balance Weights for Steel Wheel Rims:

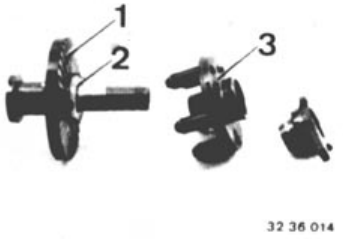
Max. imbalance per wheel and side*.

* See Specifications



36 10 713 CHECKING FRONT OR REAR WHEEL FOR RADIAL OR LATERAL RUNOUT (Wheel Removed)

Remove wheel – see 36 10 300.
Mount wheel on the balancing machine in the same manner as it will be mounted on the car afterwards (e.g. valve facing down), in order to avoid clamping-over errors.



Use a suitable center of the pertinent balancing machine supplier.

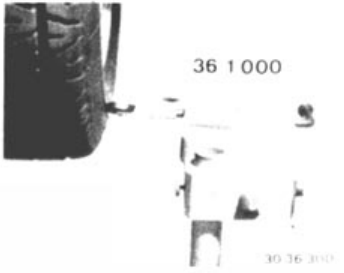
1 = Basic flange
2 = Center
3 = Type flange

Also refer to Workshop Equipment and Planning.



Apply Special Tool 36 1 000 on tread surface of the tire.
Turn the wheel by hand and measure the max. tire radial runout*.

Note:
Special tool must be perpendicular to the tread surface of the tire.



Apply Special Tool 36 1 000 on side wall of the tire.
Turn the wheel by hand and measure the max. tire lateral runout*.

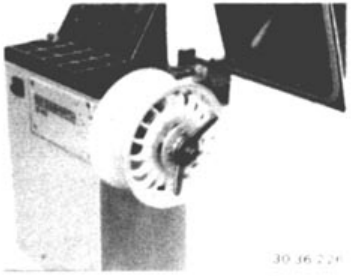
Note:
Special tool must be perpendicular to the tire's side wall.
Don't measure on the printed surface!

If necessary, check radial and lateral runout of the wheel rim – see 36 10 715.

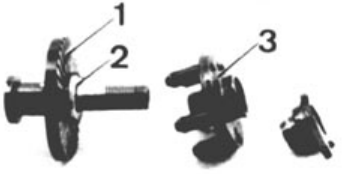
* See Specifications

36 10 715 CHECKING WHEEL RIM FOR RADIAL AND LATERAL RUNOUT

Remove wheel - see 36 10 300.
Pull tire off of wheel rim.
Remove old balance weights.
Remove dirt on rim well and rim flange.



Mount wheel rim on balancing machine.

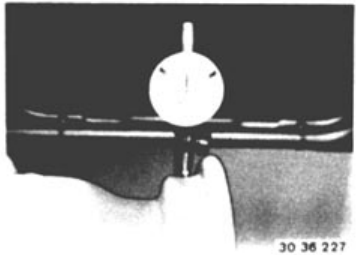


32 36 014

Use a suitable center for pertinent balancing machine.

1 Basic flange
2 Center
3 Type flange

Also refer to Workshop Equipment files.



30 36 227

Apply dial gage on rim well.
Turn wheel rim by hand and measure maximum radial runout*.
Measure runout on both sides of the rim well.

Note:
Dial gage must be perpendicular to the rim well.

* See Specifications

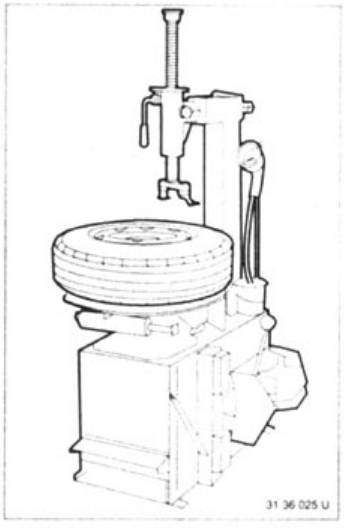


Apply tester on rim flange.
Turn wheel rim by hand and measure maximum lateral runout*.
Perform test on both rim flanges.

Note:
Dial gage must be perpendicular to the rim flange.

Important!
Avoid errors in rechucking during installation afterwards.
Also refer to 36 10 508.

* See Specifications



36 12 001 Replacing tires for front wheels, rear wheels or spare wheel

Note Service Information Group 36!
Asymmetric rims, refer to 36 12 081.

Refer to the Operating Manual for the relevant tire-fitting device for instructions on how to fit tires correctly. Also make sure that the machine is in perfect condition and that the wheel rim and tire are not damaged.

General tire removing/fitting instructions

Removing:

To remove a tire, first remove the valve.
After the tire has been forced off the rim flange, remove balancing weights, press tire bulges into well and apply good coat of tire mounting paste*.
Clean wheel rim thoroughly and inspect rim for damage before mounting the tire.
The valve and valve insert must be replaced each time a tubeless tire is removed and installed.

Caution!
It will be necessary to loosen the bead at several points on the bead periphery from the inside and outside with the pressing-off blade on the rim flange before pressing off the tire.
If it is very difficult to press off the tire, loosen tire from rim flange as well as possible with the pressing-off horn and then apply a coat of tire-mounting paste between the tire and rim flange.
Repeat this procedure around the entire circumference of the tire.
Then press off tire completely.

TD tires require higher levels of force for removal because their rim flanges are slightly higher.

Caution!
TD rim lips can suddenly jump into the Denloc groove, causing the forcing-off blade to deflect inwards!

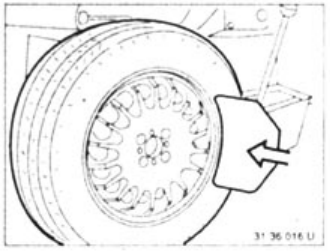
Assembly:

Coat the tire rims 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 minimum possible rim distortion because otherwise there is a risk of damaging the tire - or the rim lips in the case of TD tires.
On TD tires, start assembly on the side opposite the valve.
Allow the tire bead - coming from the well - to first clear the hump of the rim shoulder.
Build up pressure gradually, maintaining constant watch.
Maximum "jumping pressure": 3.3 bar.
If the tire is not seated on the rim correctly in the first place, tire seating will not be improved by simply increasing the inflation pressure!
Instead it will be necessary to press off both tire beads, apply another coat of mounting paste and reinflate the tire.
Only when the tire beads are securely located on the rim shoulders, slowly increase inflation pressure to enable the tire to "seat down".
Maximum "seating pressure": 4.0 bar.
After pumping up the tire, perform visual inspection of tire seating, assessed on the basis of bead characteristics.
For approved tires, tire sizes and special equipment, refer to Service Information, Group 36.

Caution!
TD tires may only be mounted on TD rims!
If incorrectly mounted TD tires or rims for other tire concepts (including TR) are used, damage can be caused to tires which may cause them to fail in service.
Tires of this kind must not be reused, not even on a TD rim!

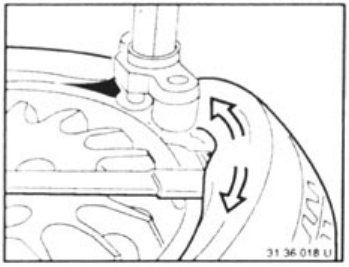
* Source of Supply: BMW Parts service

* Source of Supply: BMW Parts service

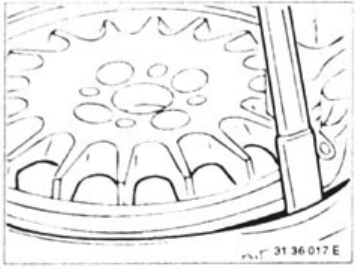


Mounting Tires with a Mounting Machine:

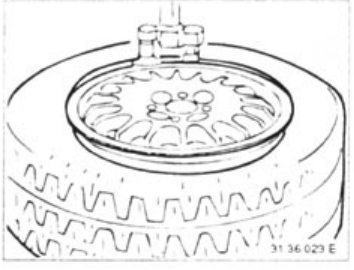
Unscrew valve and deflate tire.
Press off bead from rim flange all around on outside and inside using pressing-off horn of machine.
If tire beads fit too tight, first only loosen tire from flange at several points with the pressing-off horn prior to the actual pressing-off.
Push both tire beads into 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.



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 is run back slightly, if the bead clamps.

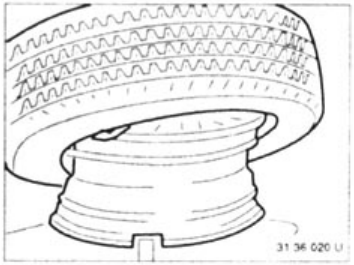


Swing mounting pillar into position or fold and let it engage.
Adjust mounting head, whereby it must be pressed on the rim edge fully and turn down the lever for the clamp; normally the distance of the mounting head will set in automatically.
Valve should be about 10 cm to the right of the mounting head.
Lift tire bead over mounting finger using tire irons.
It is recommended to use coated or shrink-fit hose covered tire irons for light alloy rims.

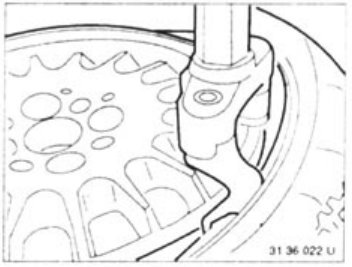


If the upper bead is pulled off of the rim, now also lift the bottom bead over the mounting finger with the tire iron.
Let machine run back a short distance again and then forward (clockwise) briefly, until there is complete separation of the tire from the rim.

** Source of Supply: BMW Parts



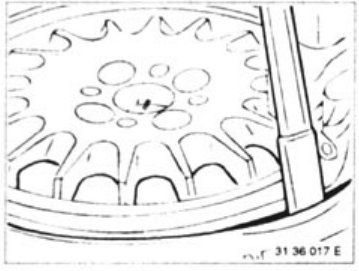
Release lock and tilt back or swing away the mounting pillar.
Unclamp and clean the rim.
Replace the valve.
Coat the rim flange and tire beads with mounting paste.
Clamp the rim on the mounting machine.
Slide on the tire with the lower bead over the rim flange partially.
Valve is 10 cm to the right of the mounting head.



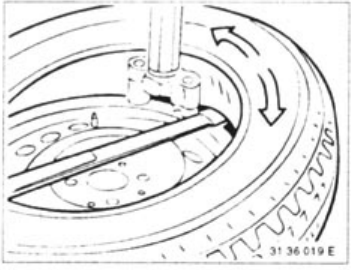
Press the upper tire bead underneath the mounting finger.
Tire bead should seat in rollers next to the mounting finger.

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.



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 roll next to the mounting finger.
Let the mounting machine run forward (clockwise) a short distance.
The lower tire bead will drop into the well.



After mounting, first release the clamps and then inflate the tire (without valve).
Increase pressure up to 3.3 bar in steps (jumping 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 rim flange with mount- ing paste again and inflate again up to 3.3 bar.
If the beads bear perfectly on the rim shoulders, increase the pressure to maximum 4.0 bar to "seat" the tire.
Screw in the valve and correct the tire pressure.

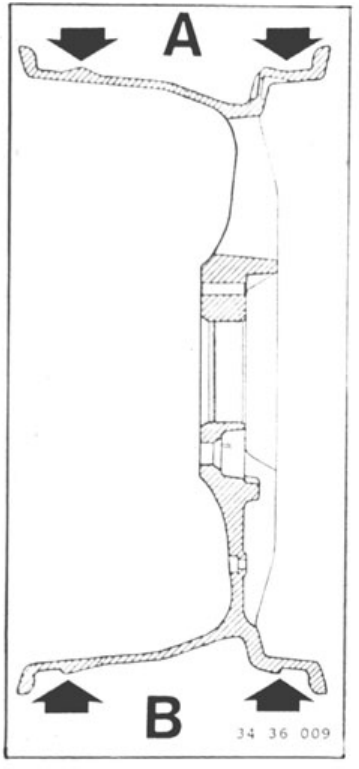
** Source of Supply: BMW Parts

** Source of Supply: BMW Parts

36 12 081 REPLACING TIRES OF ALL WHEELS

Valid for "asymmetric hump rims".

Recognition of Asymmetric Hump Rims:
There withh be "AH" or AH 2" after the rim size data in the wheel disk.
Example:
8 J x 17 AH 2.



Feature of Asymmetric Hump Rims:
The profile of the hump changes around the periphery of the rim.
This provides sections where removal of the tire is easier.

A Rim profile in area of valve with flat hump profile

B Rim profile offset 180° from valve with steep hump profile

Removing Tire:

The removal of tires from asymmetric hump rims is different.
The pressing off of the tire from the inner and outer rim flanges must always be begun at the valve seat.
The springing over of the tire bead is easier due to the flat hump profile.

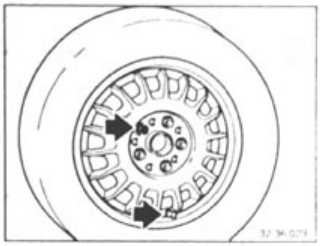
Otherwise the procedures are the same as for tires on symmetric hump rims.

Installing Tire:

The installation of tires on asymmetric hump rims is different.
A bead compressor* should be used to make installation easier.
Maximum "jumping pressure": 3.5 bar.
Release the pressure if the tire beads have not jumped over the hump with 3.5 bar pressure.
Coat tire beads with tire mounting paste* again, reposition the tire and inflate the tire again.

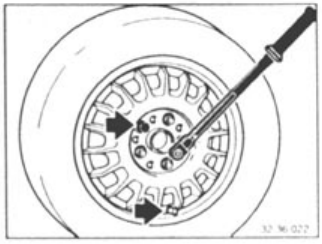
Otherwise the procedures are the same as for tires on symmetric hump rims.

* Source of Supply: BMW Parts



36 13 ... SERVICE INSTALLING WHEEL BOLT LOCK

Loosen wheel bolts.
Lift car until wheel can be turned.
Loosen wheel bolts until wheel can be moved easily on the wheel hub.
Have valve of wheel face down.
Remove top wheel bolt and install the wheel bolt lock.



Imbalance could be produced by play in the wheel center and actual weight of the wheel.
This imbalance is kept at a minimum by installing the slightly heavier wheel bolt lock in the position of the top wheel bolt.

Tighten the wheel bolts hand tight crosswise in this position (wheel bolt lock at top and valve at bottom).
Lower car and tighten wheel bolts crosswise.
Tightening torque*.

Wheels will have to be finish balanced if a customer complains about wheel imbalance after installation of wheel bolt locks.

* See Specifications

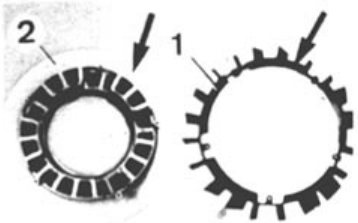


34 36 002

36 13 551 REMOVING AND INSTALLING OR REPLACING BLADES ON WHEEL RIM
(Wheel Removed)

Unscrew bolts.
Take off inner and outer blades.

Installation:
Tightening torque*.



34 36 004

Installation:
Only install blades with identical identification (see arrow)

L = Left
R = Right

on one wheel.

1 = Inner blades
2 = Outer blades



34 36 005

Important!
Install outer blades without identification in such a manner that the blades face forward at an angle in the turning direction of the wheel and are parallel to the inside blades.

* See Specifications

37 Integrated suspension systems

	General information	37- 0/1
	Ride level control with LAD / circulating system – layout drawing	37- 0/2
37 12 010	Car ride level height – adjust	37- 12/1
100	Rear spring strut / shock absorber assembly, left or right – remove and install	37- 12/3
210	Ride level height control valve – remove and install or replace	37- 12/4
37 14 005	Wheel camber warning switch –check (with BWM Service Tester)	37- 14/1
510	Wheel camber warning switch – replace	37- 14/2
37 21 005	Ride level control pump – check	37- 21/1
030	Pressure reservoir, left or right – replace	37- 21/2
500	Charge pressure in left or right pressure reservoir – check	37- 21/3
	Ride level control with LAD – troubleshoot	37- 90/1

GENERAL INFORMATION

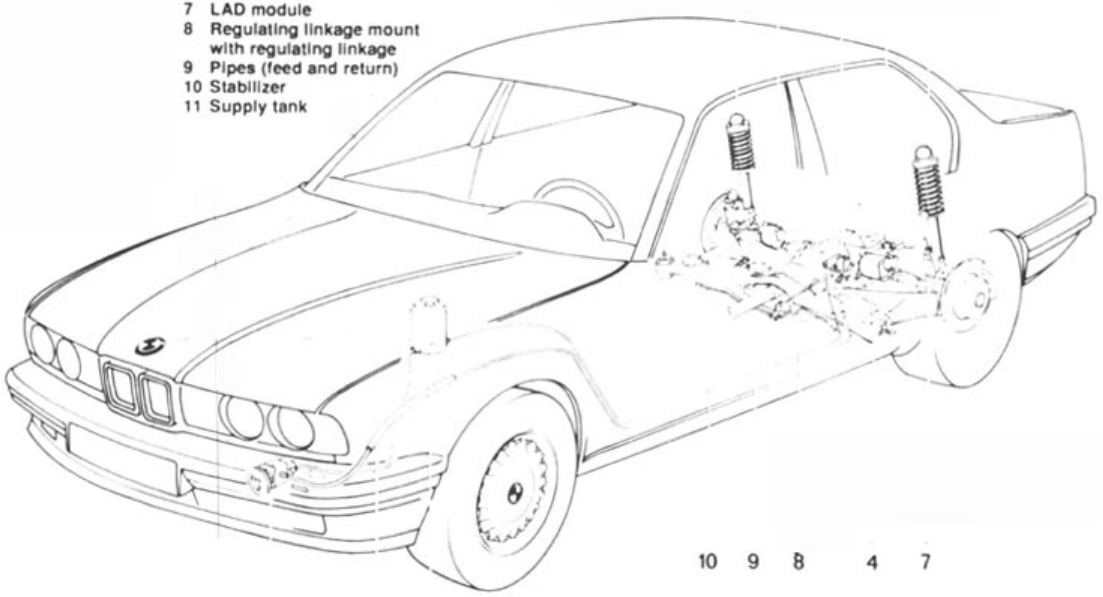
Ride level height control has the task of keeping the tail end of the car at a certain specified height regardless of the payload (up to maximum axle load), through which optimal handling is guaranteed.

Refer to BMW Technic 37 02 87 (1176) for a precise description of ride level height control operation.

Filling and bleeding hydraulic system are described in Group 32.

LAYOUT DRAWING OF RIDE LEVEL CONTROL WITH LAD / CIRCULATING SYSTEM

1 Pump
2 Expansion hose
3 Spring strut shock absorber
4 Pressure reservoir
5 Regulating valve
6 Branch
7 LAD module
8 Regulating linkage mount with regulating linkage
9 Pipes (feed and return)
10 Stabilizer
11 Supply tank



34 37 001

37 12 010 ADJUSTING CAR RIDE LEVEL HEIGHT

Drive car on to a four-pillar lifting platform (or over a pit), whereby the rear wheels must bear on rotating disks or moving plates.

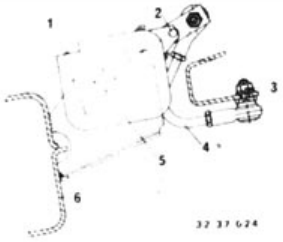
Block the front wheels to prevent the car from rolling away.

Move shift lever to neutral or selector lever to "N".

Release the parking brake lever.

Load down car by placing weights* in trunk at middle (close to wall to passenger compartment).

Start engine.



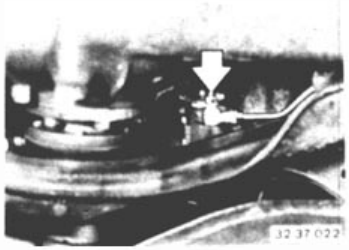
If applicable, adjust wheel camber warning switch.

Note:
Located on rear axle carrier at right-hand side.

1 Mounting screw
2 Four mm dia. bore
3 Linkage mounted to trailing arm
4 Transitting linkage
5 Wheel camber warning switch
6 Rear axle carrier.

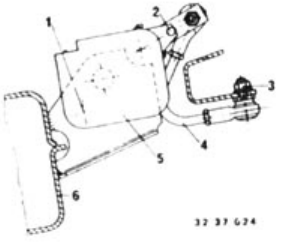
Adjust car to ride level height* for warning switch by operating lever on regulating valve (measuring ride level height - refer to Group 32).

Note:
Lever moved forward - Car is lifted
Lever at center - No height change
Lever moved back - Car is lowered



Disconnect push rod from lever on regulating valve.

Important!
The lever on the regulating valve must not be disconnected.



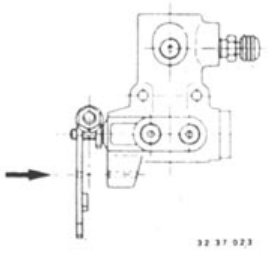
Loosen screw (1).
Hold control lever on warning switch in position with a 4 mm dia. pin (drill bit); turn switch housing slightly if necessary.
Tighten warning switch screw and remove holding pin.

Adjust car ride level height.

Lower car by operating lever on regulating valve towards rear.

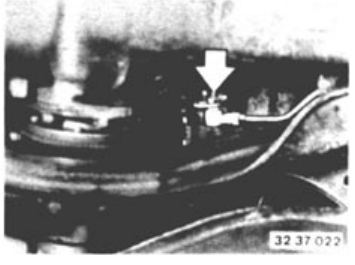
* Refer to Specifications

* Refer to Specifications



Lift car to ride level height* by operating lever on regulating valve forwards (refer to Group 32 for information on measuring ride level height).
After correct ride level height has been reached, move lever to center position and hold in this position with a shortened 3 or 4 mm dia. pin (drill bit).

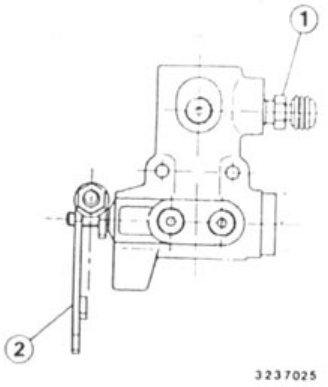
Important!
Lever must not be operated beyond the center position in lowering direction. If this happens, repeat the adjusting procedures.



Bolt push rod on lever.
Remove holding pin.

Remove load from car and let it regulate down.
Load down car again, let it regulate up and check the ride level height.
If necessary, repeat the adjusting procedures.

* Refer to Specifications



37 12 100 REMOVING AND INSTALLING LEFT OR RIGHT REAR SPRING STRUT ASSEMBLY

Remove rear seat cushion and backrest - see Group 52.
Remove wheel - see Group 36.

Installation:
Conform with filling and bleeding procedures on page 37 - 00/3) and check pipe connections for leaks.

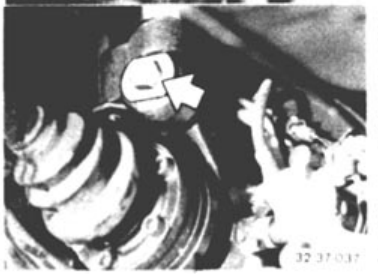
Unscrew pressure discharging plug (1) on the regulating valve and discharge the pressure.

Note:
Place a pan underneath.
Clamping screw on lever (2) must not be loosened!



Remove dirt around the coupling nut (absolute cleanliness).
Unscrew coupling nut on pipe.

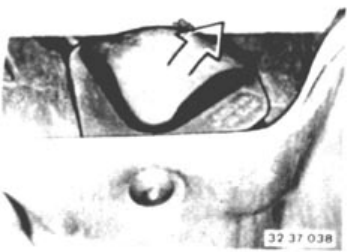
Installation:
Tightening torque*.



Support the trailing arm.
Unscrew mounting bolt.

Installation:
Tighten bolt with car in normal position**.
Tightening torque***.

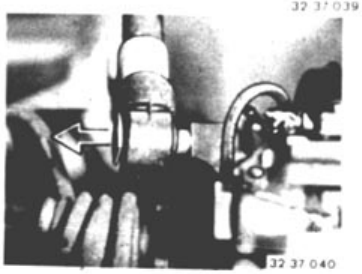
* See Specifications
** See Specifications of Gr. 32
*** See Specifications of Gr. 33



Remove rubber cover.



Unscrew mounting bolts on spring strut.
Tightening torque*.



Lift out shock absorber from the side.

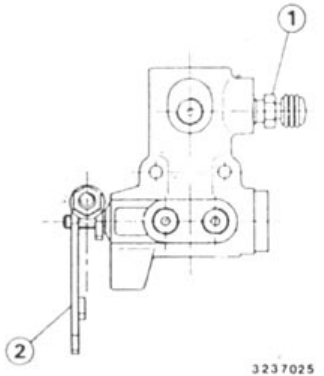
Installation:
First screw nuts on the spring strut top for installation.
Lift the trailing arm and slide in the shock absorber from the side.

Keep dirt out of the connecting bore on the LAD module.

* See Specifications

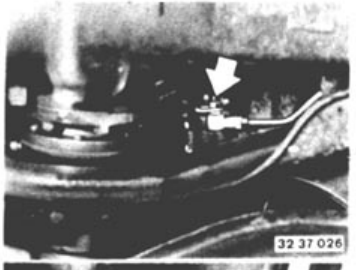
37 12 210 REMOVING AND INSTALLING OR REPLACING RIDE LEVEL REGULATING VALVE

Remove intermediate and final mufflers - see Group 18.



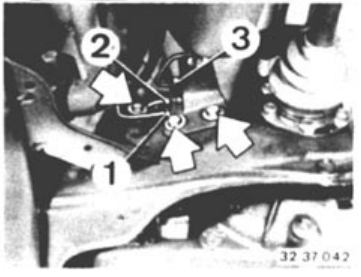
Unscrew pressure discharging plug (1) on the regulating valve and discharge pressure.
Note:
Place a pan underneath.
Never loosen the clamping screw on lever (2).

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 the valve lever.

Installation:
Tightening torque*.



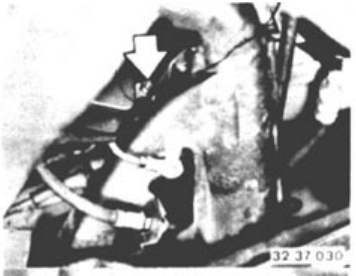
Unscrew pipes (1 ... 3).
Unscrew mounting bolts and take off the ride level regulating valve.

Installation:
Tightening torque*.

* See Specifications

37 14 005 CHECKING FUNCTION OF WHEEL CAMBER WARNING SWITCH
(with BMW Service Tester)

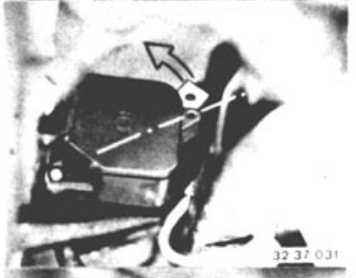
Connect BMW Service Tester.
Select instrument cluster check control (03).
Select status lists of check control (200) and continue to page: wheel camber warning switch.
Turn ignition on.



Note:
Refer to operating manual.

Unscrew nut on transmitting linkage.

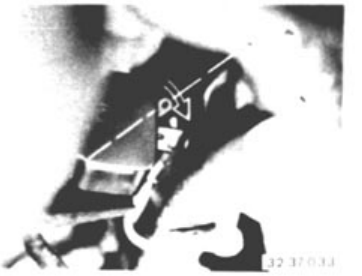
Installation:
Tightening torque*.



Move lever up.
Display of Tester:
Wheel camber incorrect.



Move lever into middle position.
Display of Tester:
Wheel camber correct.

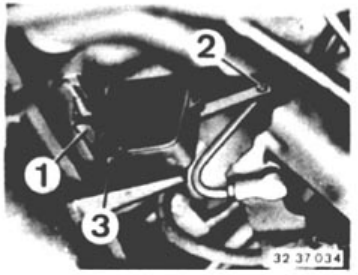


Move lever down.
Display of Tester:
Wheel camber incorrect.

The wheel camber warning switch is okay, if the tester display is as specified above while moving the lever.

Note:
Refer to test plan in case of disturbances.

* See Specifications



37 14 510 REPLACING WHEEL CAMBER WARNING SWITCH

Pull off plug (1).
Unscrew nut (2) on transmitting linkage.

Installation:
Tightening torque*.

Unscrew mounting screw (3).

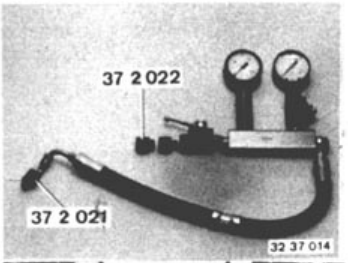
Installation:
Tightening torque*.

Take off wheel camber warning switch.

Installation:
Engage new warning switch in console of rear axle carrier and screw in the mounting screw.

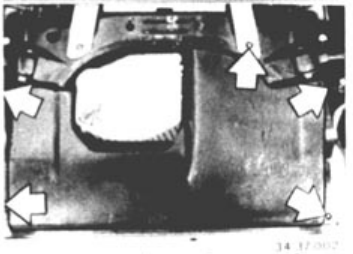
Adjust car ride level height – see 37 12 010.

* See Specifications

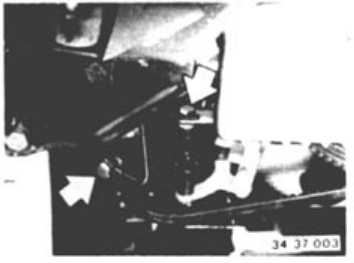


37 21 005 CHECKING FUNCTION OF RIDE LEVEL CONTROL PUMP

Assemble Special Tool 32 4 000.
Connect adapters on tester.

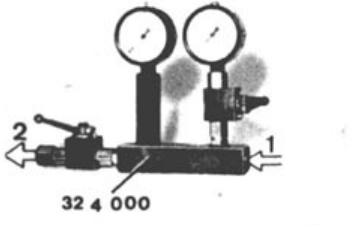


Unscrew screws and take off the splash guard.



Unscrew bolts.

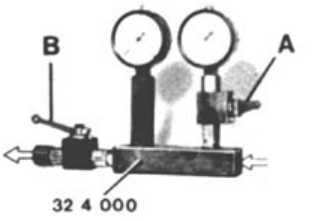
Installation:
Replace seals.
Tightening torque*.
Conform with filling and bleeding procedues on page 37 - 00/3.
Check pipe connections for leaks.



Connect tester.

1 Pump connection
2 Connection for pipe to regulating valve

* See Specifications



A Shutoff valve (low pressure / 0 to 15 bar or 0 to 213 psi)

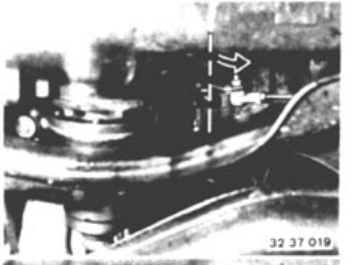
Important!
Shutoff valve (A) must be closed for high pressure tests - pressure tester would be damaged.

B Shutoff valve (high pressure / 0 to 150 bar or 0 to 2133 psi)

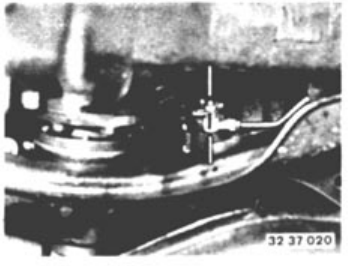
Open valve B.
Close valve A.



Unscrew nut and disconnect regulating linkage on the stabilizer.
Start engine.

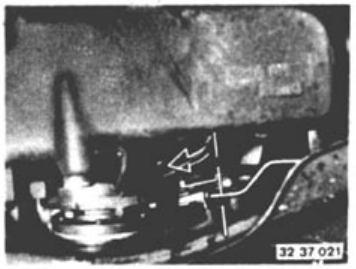


Regulating up position = lever moved forward.
Maximum pressure*.
(Rear end of car lifted.)

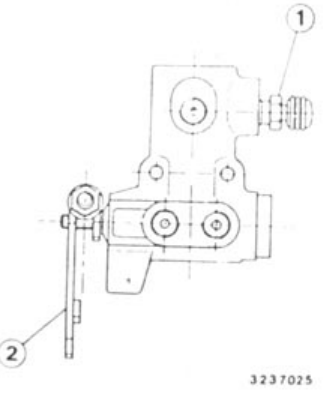


Normal position = lever in middle position.
Circulating pressure*.

* See Specifications



Regulating down position = lever moved back.
Circulating pressure*.
(Rear end of car lowered.)

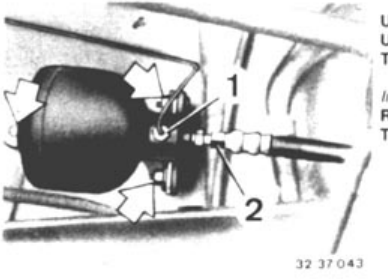


37 21 030REPLACING LEFT OR RIGHT PRESSURE RESERVOIR

Unscrew pressure discharging plug (1) on the regulating valve and discharge the pressure.

Note:
Place a pan underneath.
Never loosen the clamping screw on lever (2)!

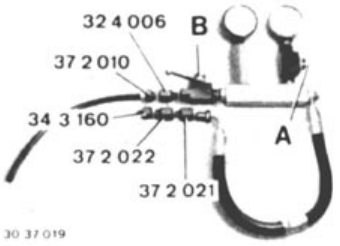
Installation:
Conform with filling and bleeding procedures on page 37 - 00/3.
Check pipe connections for leaks.



Unscrew pipes (1 and 2).
Unscrew mounting bolts.
Take off pressure reservoir.

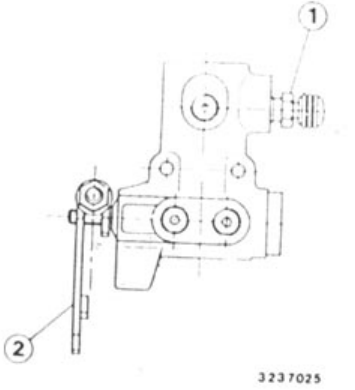
Installation:
Replace rubber mounts if necessary.
Tightening torque*.

* See Specifications



37 21 500/ CHECKING PRESSURE IN
37 21 501 LEFT/RIGHT PRESSURE RESERVOIR

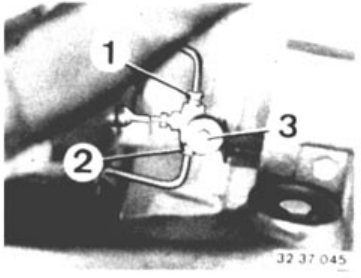
Assemble tester 32 4 000.
Connect adapters on tester.
Close valves (A and B).



Unscrew pressure discharging plug (1) on the regulating valve and discharge the pressure.

Note:
Place a pan underneath.

Installation:
Conform with filling and bleeding procedures on page 37 - 00/3.
Check pipe connections for leaks.

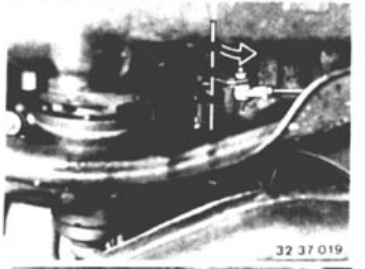


Unscrew pipe (2) and connect tester to check the left pressure reservoir.

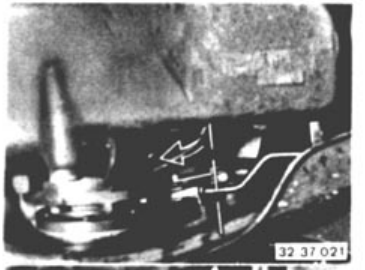


Unscrew nut and disconnect regulating rod on the stabilizer.

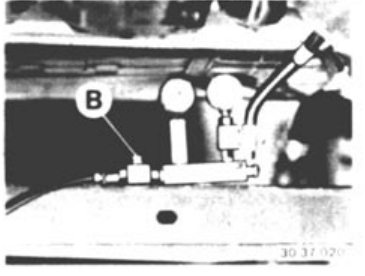
Installation:
Tightening torque*.



Start engine and regulate the system upward (lever on regulating valve moved forward).
Max. pressure* (ride level regulating valve).
Stop engine.



Regulate the system downward (lever on regulating valve moved back).
Min. pressure* (ride level regulating valve).

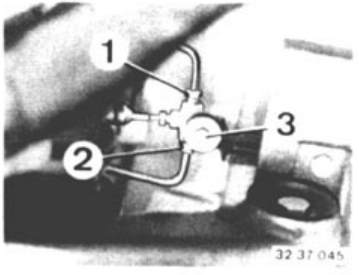


Open shutoff valve (B) slowly and let hydraulic oil run into the pan.
The pressure, at which the pressure gage needle drops suddenly to 0, is the gas charging pressure of the pressure reservoir (nominal value*).
Repeat test.

* See Specifications

Remove tester.
Connect pipe (2).

Installation:
Tightening torque*.



Checking Right Pressure Reservoir:
If applicable, discharge pressure.
Unscrew pipe (1) and connect tester by unscrewing bolt (3) and pushing the branch aside.
Now perform the test in the same manner as for the left pressure reservoir.

Installation:
Tightening torque*.

* See Specifications

TROUBLESHOOTING RIDE LEVEL HEIGHT CONTROL WITH LAD (Load Dependent Absorption)

Condition	Cause	Correction
Measured car ride level height too high or too low	a) Ride level height maladjusted	a) Adjust ride level height - refer to 37 12 010
	b) Regulating rod not mounted correctly	b) Check regulating rod installation, repairing if necessary, and adjust ride level height - refer to 37 12 010
Tail end of car drops below nominal ride level height with payload and engine running	a) Car overloaded	a) Check payload, reducing weight to maximum permissible axle load if necessary
	b) Hydraulic oil level too low	b) Check / correct hydraulic oil level
	c) Regulating rod not mounted correctly	c) Check regulating rod installation, repairing if necessary, and adjust ride level height - refer to 37 12 010
	d) Feed pipe damaged	d) Check feed pipe, repairing or replacing as necessary
	e) Pump pressure too low	e) Check pump - refer to 37 21 005, repairing or replacing as necessary - refer to Group 32
	f) Ride level regulating valve defective	f) Check ride level regulating valve - refer to 37 21 500/501 (Checking Pressure of Pressure Reservoirs), replacing if necessary - refer to 37 12 210
	g) Spring strut shock absorbers defective	g) Check spring strut shock absorbers (shock absorber test), replacing if necessary - refer to 37 12 100

TROUBLESHOOTING RIDE LEVEL HEIGHT CONTROL WITH LAD (Load Dependent Absorption)

Condition	Cause	Correction
Rear end of car does not rise/drop to nominal ride level height when unloaded	a) Regulating rod not mounted correctly	a) Check regulating rod installation, repairing if necessary, and adjust ride level height - refer to 37 12 010
	b) Feed/return pipes damaged	b) Check feed/return pipes, repairing or replacing as necessary
	c) Ride level regulating valve defective	c) Check ride level regulating valve - refer to 37 21 500/501 (Checking Pressure of Pressure Reservoirs), replacing if necessary - refer to 37 12 210
	d) Spring strut shock absorbers defective	d) Check spring strut shock absorbers (shock absorber test), replacing if necessary - refer to 37 12 100
	e) Pump pressure too low	e) Check pump - refer to 37 21 005, repairing or replacing as necessary - refer to Group 32
Pipes between pressure reservoirs and LAD module damaged	a) Ride level regulating valve defective	a) Check ride level regulating valve - refer to 37 21 500/501 (Checking Pressure of Pressure Reservoirs), replacing if necessary - refer to 37 12 210
	b) Gas charging pressure valve in pressure reservoir	b) Check pressure reservoir - refer to 37 21 500/501, replacing if necessary - refer to 37 21 030
Car suspension harder than normal	a) LAD module defective	a) Check LAD module (shock absorber tester), replacing shock absorbers if necessary
	b) Gas charging pressure loss in pressure reservoir	b) Check pressure reservoir - refer to 37 21 500/501, replacing if necessary - refer to 37 21 030
Weak shock absorbers, knock from rear axle	a) Spring strut shock absorbers defective	a) Check spring strut shock absorbers (shock absorber test), replacing if necessary - refer to 37 12 100

TROUBLESHOOTING RIDE LEVEL HEIGHT CONTROL WITH LAD (Load Dependent Absorption)

Condition	Cause	Correction
Permanent display of wheel camber warning switch Instrument cluster display: ride level height control	a) Car overloaded	a) Check payload, reducing weight to maximum permissible axle load if necessary
	b) Hydraulic oil level too low	b) Check / correct hydraulic oil level
	c) Regulating rod not mounted correctly	c) Check regulating rod installation, repairing if necessary, and adjust ride level height - refer to 37 12 010
	d) Feed pipe damaged	d) Check feed pipe, repairing or replacing as necessary
	e) Pump pressure too low	e) Check pump - refer to 37 21 005, repairing or replacing as necessary - refer to Group 32
	f) Ride level regulating valve defective	f) Check ride level regulating valve - refer to 37 21 500/501 (Checking Pressure of Pressure Reservoirs), replacing if necessary - refer to 37 12 210
	g) Adjustment installation of wheel camber warning switch incorrect	g) Check adjustment, adjust wheel camber warning switch if necessary - refer to 37 12 010 (adjusting ride level height)
	h) Fuse no. 29 blown	h) Check circuit (troubleshoot electrical systems), replace fuse
	i) Wheel camber warning switch defective	i) Check wheel camber warning switch - refer to 37 14 005, replacing if necessary - refer to 37 14 010

41 Body

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41 11 043	Engine carrier front section, left or right (without wheel house) – replace	41- 11/1
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250	Cover for left or right front side member (partial replacement A and B pillars) – replace	41- 11/3
300	Cover for left or right side member with door pillar (partial replacement A and B pillars) – replace	41- 11/5
. . .	Cross member, front – replace	41- 11/7
41 14 151	Wheel house outer section and side panel, rear, left – replace	41- 14/1
. . .	Wheel house inner section, rear, right – replace (side panel and outer wheel house section removed)	41- 14/50
503	Wheel house outer section, rear, right – replace (side panel removed)	41- 14/53
41 31 001	Roof panel – replace (version without double sunroof)	41- 31/50
011	Roof panel – replace (version with double sunroof)	41- 31/53
41 33 001	Front panel complete with front wall – replace	41- 33/1
41 34 041	Tail panel – replace	41- 34/1
041	Tail panel – replace	41- 34/50
41 35 000	Side panel, front, left or right	41- 35/1
105/115	Side panel, rear, left or right – replace (partial replacement C-pillar)	41- 35/1.1
337/338	Side panel, rear, left or right – replace (partial replacement up to wheel house)	41- 35/2
115	Side panel, rear, right – replace (partial replacement C-pillar)	41- 35/50
41 51 . . .	Bearing sleeves for door hinges – replace	41- 51/1
080	Front door, left or right – remove and install	41- 51/2
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41 61 000	Engine hood – remove and install	41- 61/1
014	Engine hood – adjust	41- 61/2
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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 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 all welding seams, which had been sealed originally with a body sealing compound, correctly and immediately after repairing. 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.

Source of supply for workshop equipment and materials: HWB (a Business Division of BMW AG).

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.

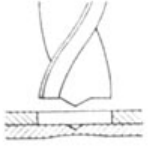
Grind off welded seams with a disc grinder carefully. Heat brazed connections with an autogen gas torch (don't heat excessively!). Lift off scrap metal. Remove residual brazing solder with a steel brush. Straighten and grind all connection points thoroughly.

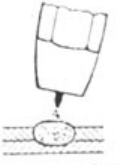
2. Installing New Parts:

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, correctly and immediately after repairing. 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 WORKING ON BODY OF CARS WITH AIRBAG

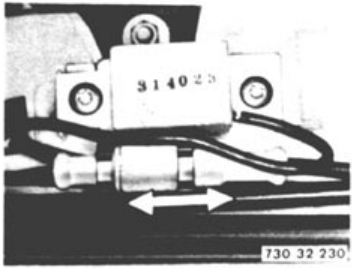
Disconnect both poles of car's battery before working with an electric welder.
Cover battery poles.

Parts of the airbag system must not be subjected to heat greater than 100° C (210° 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.

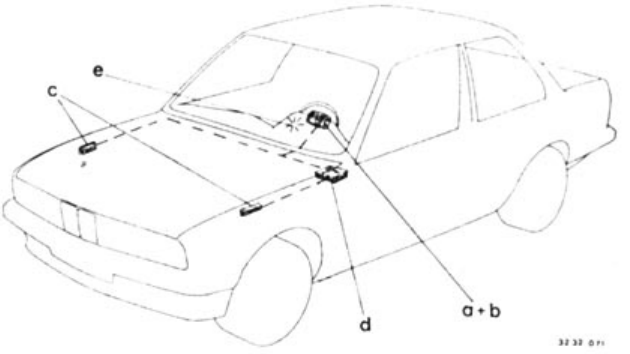
Also refer to the repairing and safety regulations concerning the airbag system in Group 32.



Disconnect plugs of both front sensors (C).



Unscrew lower casing section.
Pull (orange) plug out of holder and disconnect.



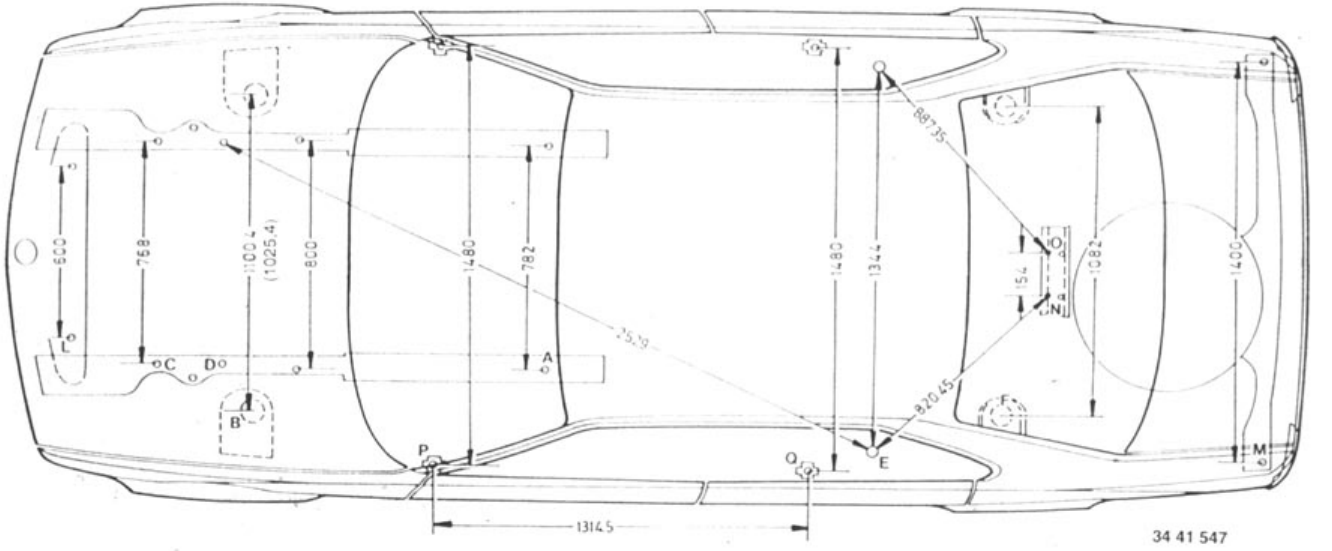
Components:

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 the 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.

Frame alignment control dimensions, BMW 5 Series E34 Sedan

- Sheet 1 -
Dimensions in mm, tolerance: ± 2.0 mm.
Differing dimensions for 4WD in brackets.

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.



34 41 547

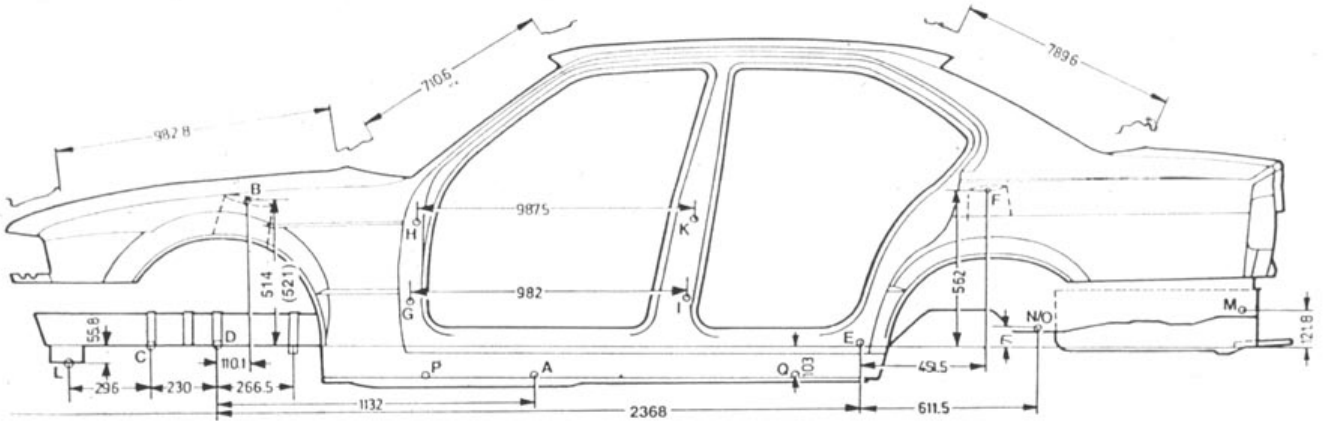
A = Bore in rear engine carrier
B = Front spring mount
C = Front axle take-up
D = Front axle support
E = Rear axle take-up at side
F = Spring mount, rear
G = Hinge axis front lower
H = Hinge axis front upper
I = Hinge axis rear lower
K = Hinge axis rear upper
L = Bore, front crossmember
M = Bore, crossmember rear
N/O = Rear axle support, center
P = Front car jack take-up
Q = Rear car jack take-up

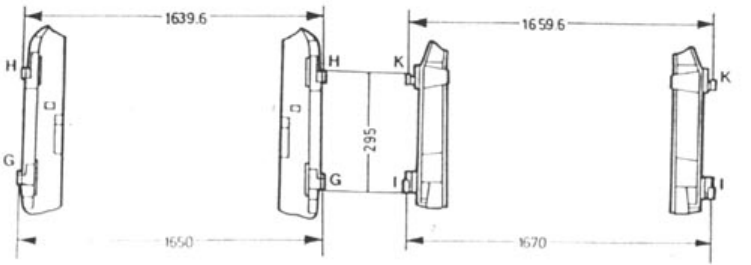
Frame alignment control dimensions, BMW 5 Series E34 Sedan

- Sheet 2 -
Dimensions in mm, tolerance ± 2.0 mm.
Differing dimensions for 4WD in brackets.

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.



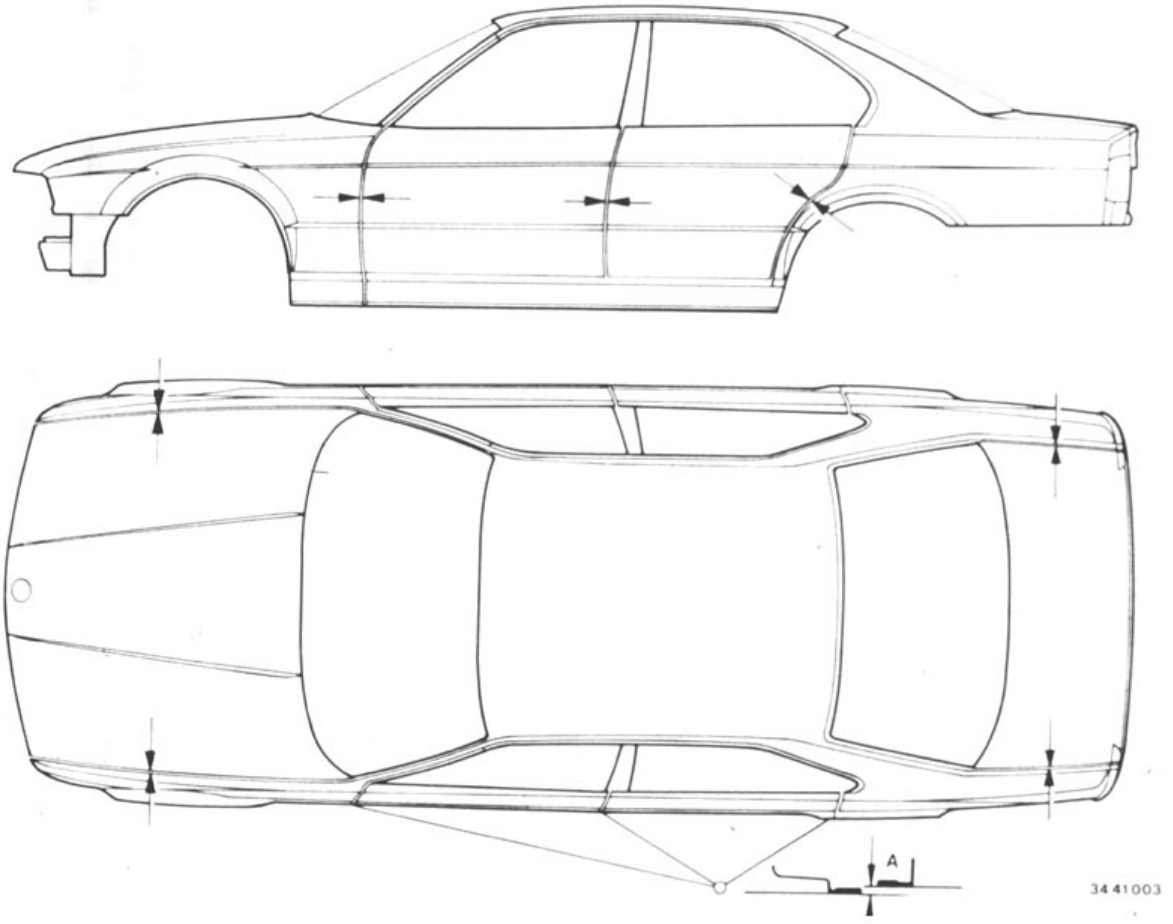


34 41 546

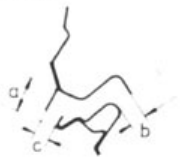
41-0/7

GAPS OF DOORS / ENGINE HOOD / TRUNK LID

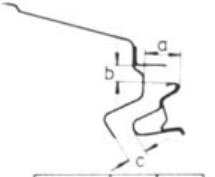
Door and hood/lid gaps: 5.5 + 0.5/- 1.0 mm (0.216 + 0.020/- 0.040").
Permissible deviation in parallel: 1 mm (0.040").
Plane displacement A for each body part adjacent to the rear = max. 1 mm (0.040") toward inside.



WINDOW AND DOOR GAPS OF FRONT AND REAR DOORS
All dimensions in mm



Schnitt	B-B
a	21.2 ± 1
b	111 ±
c	8.6 ±



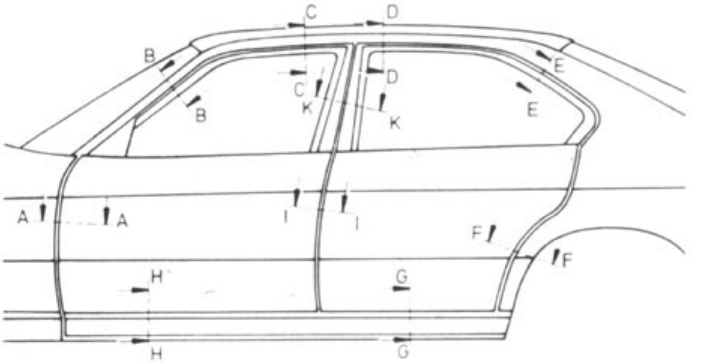
Schnitt	C-C	D-D
a	21.2 ± 1	
b	9.5 ±	
c	111 ±	

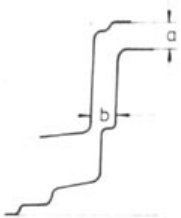


Schnitt	K-K
a	121 ±
b	121 ±

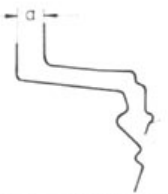


Schnitt	E-E
a	121 ±
b	21 ± 1
c	116 ±

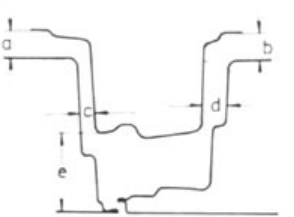




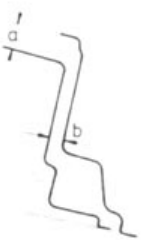
Schnitt	A-A
a	201 ±
b	181 ±



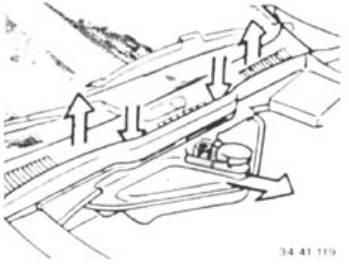
Schnitt	H-H	G-G
a	201 ±	



Schnitt	I-I
a	201 ±
b	20.3 ±
c	101 ±
d	177 ±
e	515 ±



Schnitt	F-F
a	201 ±
b	101 ±

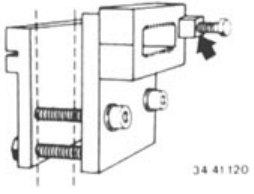


DIE STAMPING VEHICLE IDENTIFICATION NUMBER

The chassis number must be die stamped again, if it had been removed during body repairs.

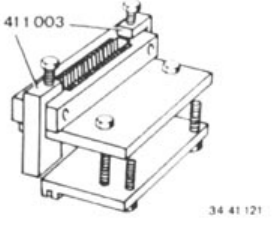
Note:

The chassis number can also be die stapmed in a completely assembled car, but then the coolant reservoir, cover on separating wall, windshield wiper arms and air inlet grills must be removed.

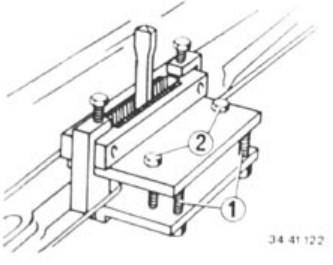


Assemble Special Tool 41 1 001 in such a manner, that smooth side of the baseplate faces the stamp guide.

Screw in bolts only far enough, that the spacing in brackets can be installed later.



Install and clamp Special Tool 41 1 003 on left and right sides.

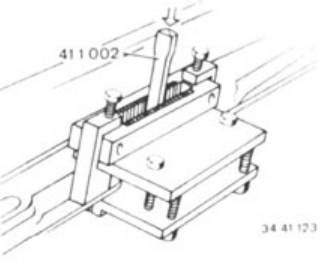


Have special tool fixture bear on concerned surface.

Align baseplate to be parallel with the stamp guide with bolts (1).

Align special tool fixture.

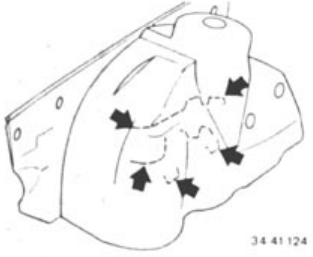
Tighten bolts (2).



Place impact numbers 41 1 002 in special tool separately and die stamp the chassis number. Die stamp "+" in front of the chassis number instead of the BMW emblem to indicate replacement of parts or body in a workshop.

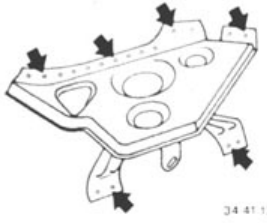
COMPLETING REPLACEMENT PART ENGINE CARRIER MEMBER WITH WHEEL HOUSE OR FRONT WHEEL HOUSE

To make storing easier, wheel houses are supplied without the brackets differing according to vehicle type.
Brackets can be used from the cut out part or ordered new separately.



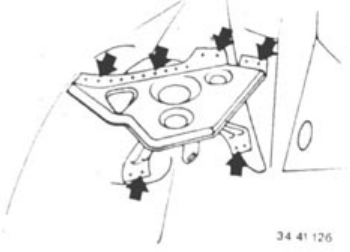
34 41 124

Positions of brackets are marked on the wheel house.



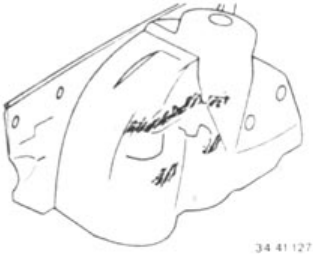
34 41 125

Drill holes for plug spot welding when using new brackets.



34 41 126

Hold brackets on pertinent marks.
Draw holes.



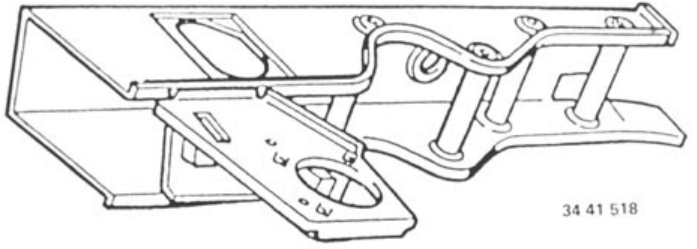
34 41 127

Grind down wheel house only on points used for plug spot welding, so that marks required to position the bracket are not removed.

41 11 043/ REPLACING LEFT OR RIGHT ENGINE CARRIER FRONT SECTION
41 11 044 (Without Wheel House)

Procedures are described for the left side of the car.
Procedures are analogous for the right side of the car.

Refer to "Introduction" on page 41 - 0/1.



34 41 518

Remove or disconnect/detach the following parts.

Left Side of Car:

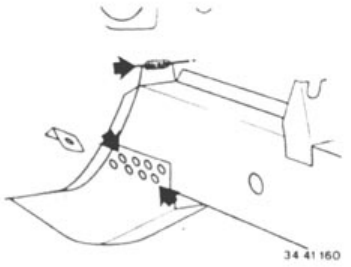
- Ground connection on ground pole of battery or body ground point
- Front axle with engine and transmission, fuel and brake pipes/hoses as required
- Hydraulic control unit
- Brake booster with hoses
- Cooling coil for power steering
- Cover for radiator
- Carbon canister
- Heater valve and positive pole connection point
- All electric leads in front panel
- Wiper arms and grills
- Front bumper
- Radiator grill, turn signals and headlights
- Engine hood with lock and cable
- Horn
- Front wall assembly
- Front cross member
- Pedal base assembly complete with steering column
- Heater and air conditioner
- Both front seats (complete)
- Front carpets (complete)
- Insulation sheets

Right Side of Car:

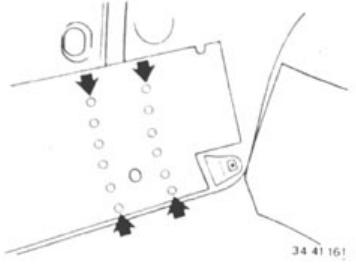
- Additional heat protection sheet on engine compartment wall
- Windshield washing fluid tank and air cleaner

REPLACING FRONT ENGINE CARRIER SECTION

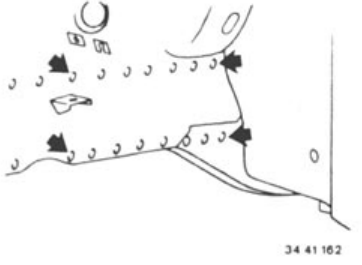
Note:
Most of the spot welded points on the engine carrier will not be accesssible with spot welders common in workshops.
Produce holes while drilling off spot welds in such a manner, that they can be used for plug spot welding later.



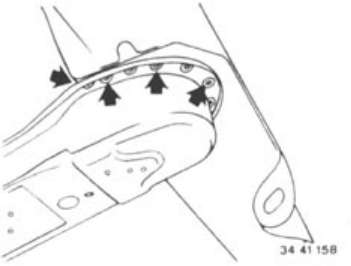
Drill off spot welds on inside and bottom.



Drill off rows of spot welds from the passenger compartment.

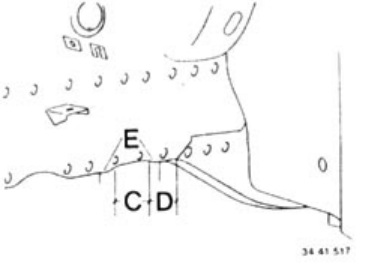


Drill off only the indicated spot welds on the outside.



Drill off connections on the cross member.

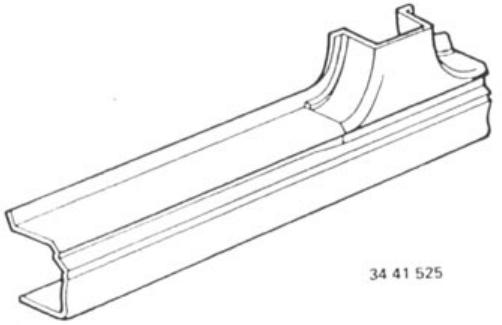
Take up engine carrier and cross member on a traightening bench for welding.



Installation:
Cringe the spot welding flange in zone C (= 30 mm / 1 3/16") toward inside by an angle of approx. 30° to guarantee clearance of wheels when the steering wheel is turned against lock.
Distance D = approx. 75 mm (3").
Zone E on left and right sides: approx. 40 mm (1 9/16").

41 11 250 REPLACING COVER FOR LEFT OR RIGHT FRONT SIDE MEMBER (PARTIAL REPLACEMENT A AND B PILLARS)

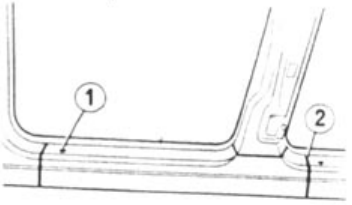
Refer to "Introduction" on page 41 - 0/1.



34 41 525

Remove or disconnect/detach the following parts.

- Ground pole on battery
- Front and rear doors
- Front and rear covers (on outside of entrance)
- Trim panel for B-pillar
- Seat belt
- Front seat
- Rear seat cushion
- Front and rear plates (on inside of entrance)
- Edge guard
- Radio loudspeaker cover
- Wire harness (A pillar)
- Front and rear carpets (partially)
- Pipe installations

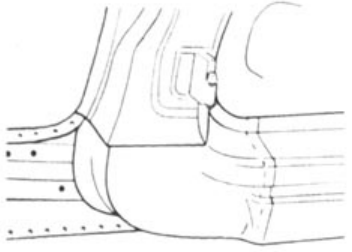


34 41 528

Draw cutting lines according to size of the replacement part.

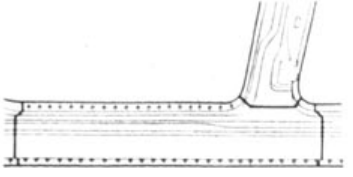
Note:
A vertical running reinforcement plate is located in front of hole (1) - provide sufficient distance.

Connection (2) is brazed in the corner.



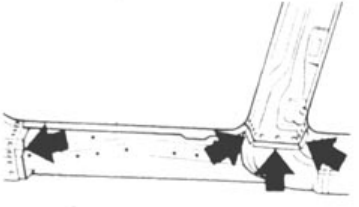
34 41 529

Note:
The B-pillar has double-panel walls.
The inside panel must not be damaged while cutting off.



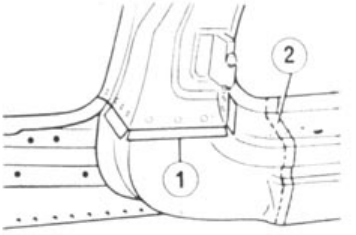
34 41 536

Cut out old section.



34 41 537

Produce and weld in reinforcement plates having a width of about 40 mm (1 9/16").

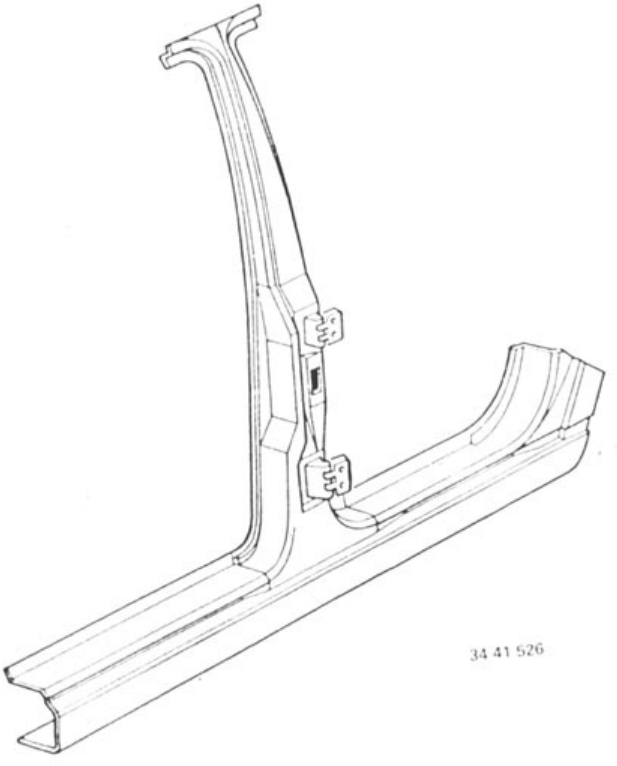


34 41 538

Plug weld connection (1) with the reinforcement plates.
Produce the connection at joint (2) in the same manner as the original connection.

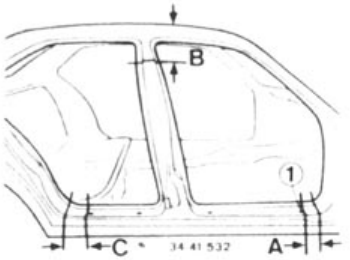
41 11 300 REPLACING COVER FOR LEFT OR RIGHT SIDE MEMBER WITH CENTER DOOR PILLAR (PARTIAL REPLACEMENT A AND B PILLARS)

Refer to "Introduction" on page 41 - 0/1.



Remove or disconnect/detach the following parts.

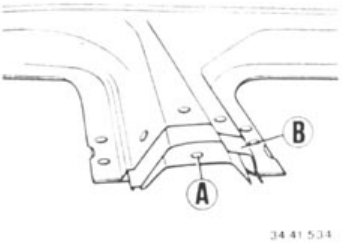
- Ground pole on battery
- Front and rear doors
- Front and rear covers (on outside on entrance)
- Trim panel for B-pillar
- Seat belt
- Front seat
- Rear seat cushion and backrest
- Front and rear covers (on inside of entrance)
- Edge guard
- Radio loudspeaker cover
- Wire harness (A pillar)
- Front and rear carpets (partially)
- Pipe installations
- Roof liner



Draw cutting lines.
Distance A to replacement part size
Distance B = 170 ± 20 mm
(6.693 ± 0.787")
Distance C = at least 50 mm (2")

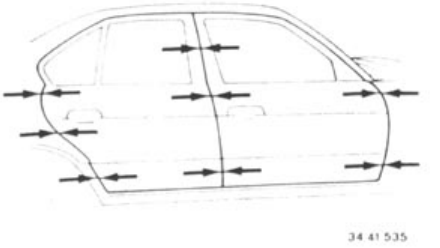
Note:
A vertical running reinforcement plate is located in front of hole (1) - provide sufficient distance.

Keep cutting line (C) out of the bend whenever possible (→ paint finish).

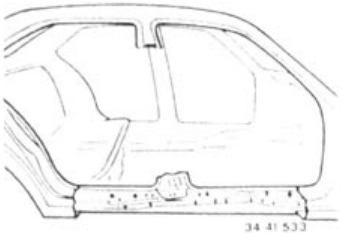


B-pillar reinforcement plates:

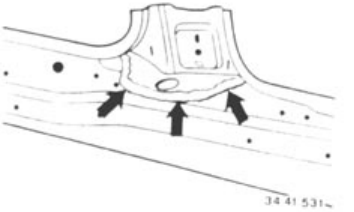
A Inside plate
B Outside plate



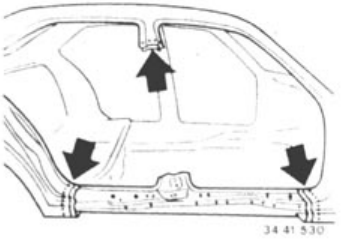
Align the replacement section with the doors.



Cut out old section.



Seal off the end plate on the B-pillar with a joint sealing compound before welding in the replacement section.



Produce and weld in reinforcement plates having a width of about 40 mm (1 9/16").

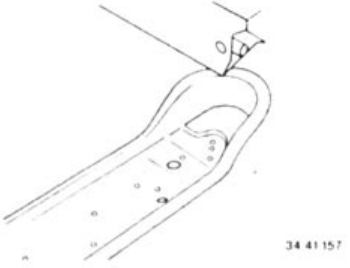


41 11 . . . REPLACING FRONT CROSS MEMBER

Refer to "Introduction" on page 41 - 0/1.

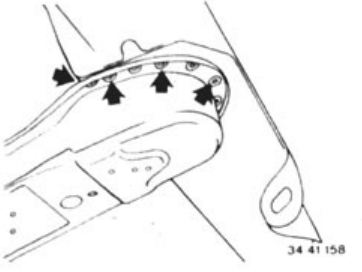
This repair will normally occur together with work on the engine carrier members.

Remove or cover all car parts, which are in the repair zone and subject to damage from heat, sparks or dust.



Set up car on a straightening bench. Insert cross member.

Important!
Check location of member - the end of the member could be inserted inversed.



Check for perfect spot welding.

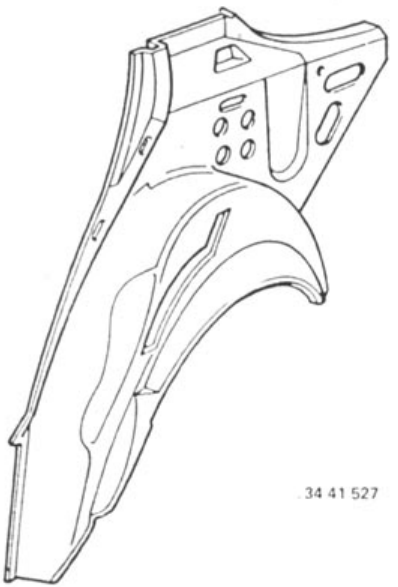
Sheet Metal Thickness:

Engine carrier	1.2 mm (0.047")
Cross member	0.8 mm (0.031")

41 14 151 REPLACING LEFT REAR WHEEL HOUSE OUTER SECTION AND SIDE PANEL

Procedures are described for the left side of the car.
Procedurés are analogous for the right side of the car.

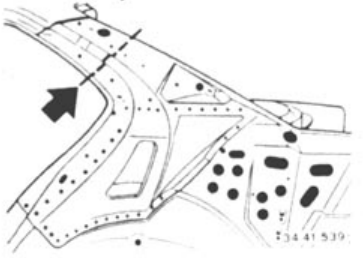
Refer to "Introduction" on page 41 - 0/1.



34 41 527

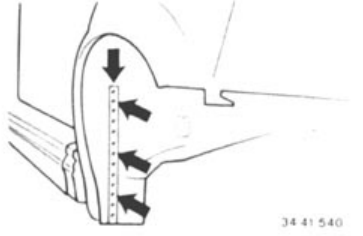
Remove or disconnect/detach the following parts.

- Side panel (see 41 35 105)
- Fuel tank complete with expansion tank
- Wire harness on C-pillar

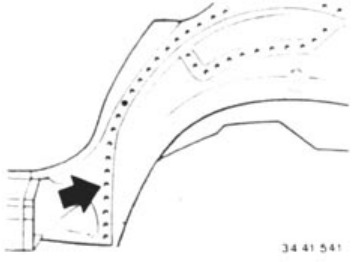


Place cut in the middle of the rear window frame (C-pillar) whenever possible.

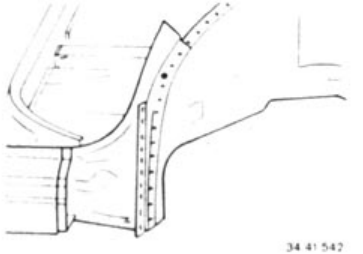
Note:
Note installed position of the antenna amplifier/trap circuit.



Drill off spot welds in wheel house.

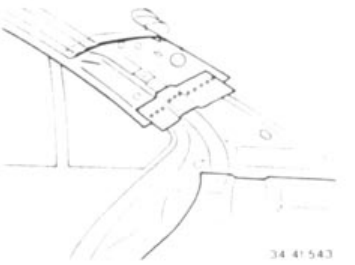


Drill off spot welds on the inside side member panel.
Bend open the inside panel and drill off the spot welds underneath.



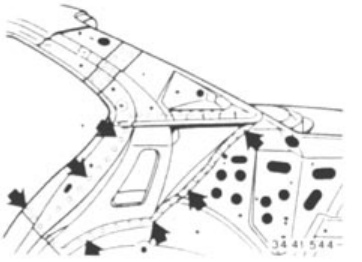
Straighten the inside side member panel and insert the outer wheel house section.

Installation:
Produce connections in the same manner as the original connections.



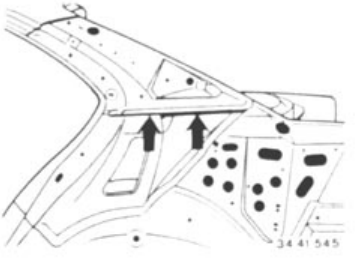
Produce a reinforcement plate having a width of about 40 mm (1 9/16").

Note:
Mount the reinforcement plate on the outside of the rear window frame (→ installed direction of antenna amplifier/trap circuit).

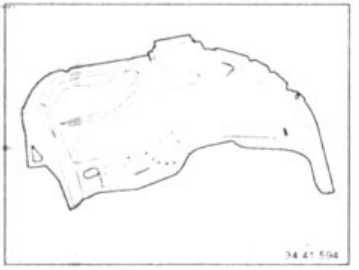


Fit in the rear window frame (C-pillar).

Installation:
Produce connections in the same manner as the original connections.



Seal off the end plate with a joint sealing compound before welding in the side panel.



41 14 ... REPLACING RIGHT REAR WHEEL HOUSE INNER SECTION (Side Panel and Wheel House Outer Section Removed)

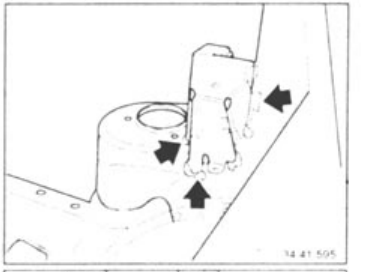
Touring

Refer to "Introduction" on page 41-0/1.

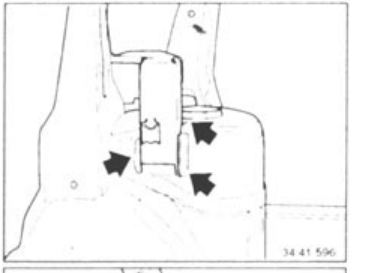
Remove or disconnect the following parts:

Same scope of work as for the right rear wheel house outer section.

Remove or cover all other car parts, which are in the repair zone and subject to be damaged from heat, sparks or dust.



Break the welding seams for the seat belt holder take-up.

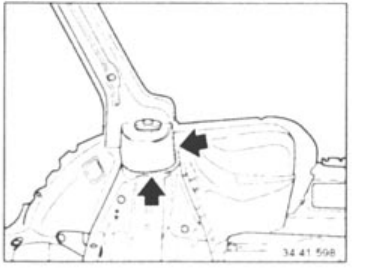


Break the welding seams for the seat belt holder take-up.
Remove the seat belt holder.



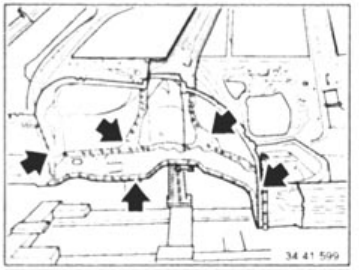
Uncover the front top wheel house joint.

Drill off welding spots.



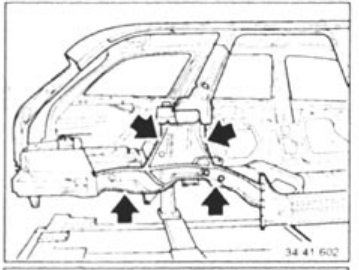
Uncover the rear top wheel house joint.

Drill off welding spots.

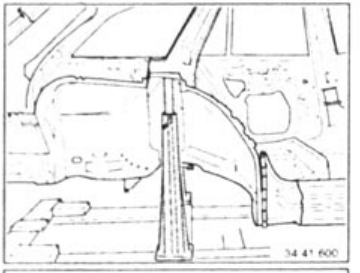


Uncover the inside wheel house, bottom side member, wheel house extension and spring support joint.

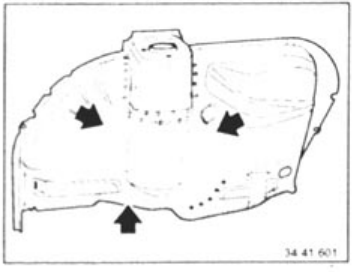
Drill off welding spots.



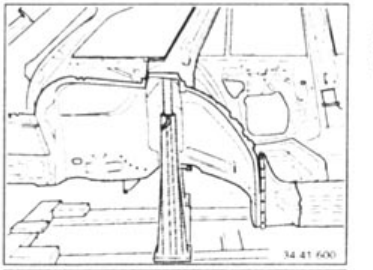
Remove the wheel house inner section.
Remove scrap metal.
Strighten and grind the mating surfaces.



Install and clamp the wheel house inner section with set of attachments.
Mark the mating surfaces.
Mark the location of holes for plug welding.



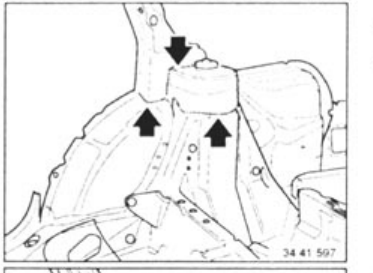
Remove the wheel house inner section.
Clean the mating surfaces.
Drill holes for plug welding.
Coat the mating surfaces with zinc dust paint.



Install and clamp the wheel house inner section with the set of attachments and spot weld.

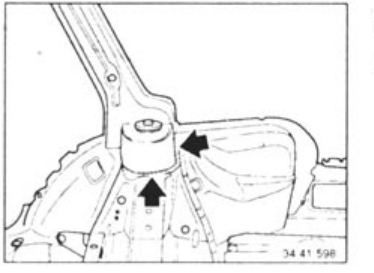


Plug weld the wheel house extension, side member at front top and wheel house inner section.



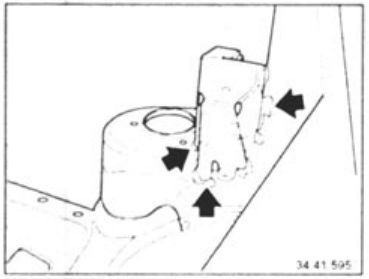
Weld the wheel house joint at top front.

Grind down the welding spots.

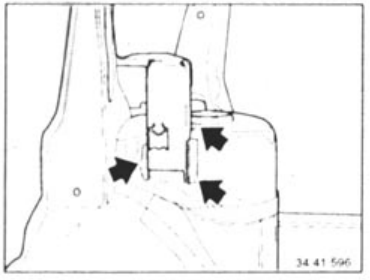


Weld the wheel house joint at top rear.

Grind down the welding spots.

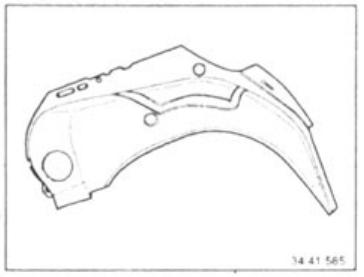


Clamp and weld the take-up for the seat belt holder.



Weld the seat belt holder take-up.

Grind down the welded surfaces.



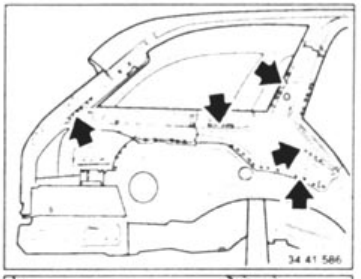
41 14 503 REPLACING RIGHT REAR WHEEL HOUSE OUTER SECTION (Side Panel Removed)

Touring

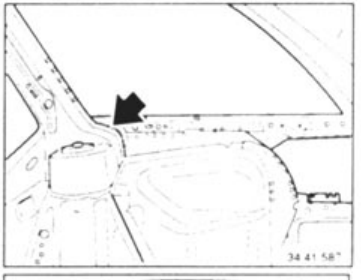
Refer to "information" on page 41-0/1.

Remove or disconnect the following parts:
Seat box entrance covers
Battery
Right trunk floor plate wire harness

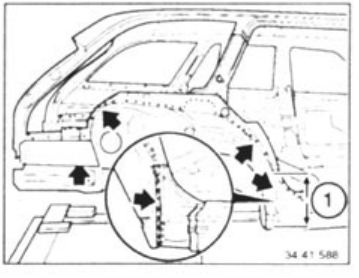
Remove or cover all other car parts, which are in the repair zone and subject to be damaged from heat, sparks or dust.



Drill off welding spots on wheel house and support member.
Drill off welding spots on C-pillar support member extension.



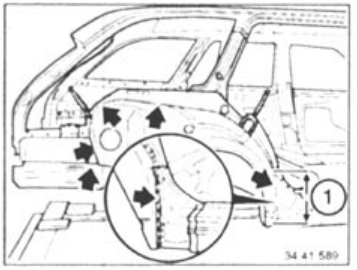
Break the welding seam on the wheel house at top.
Remove the support member together with the support member extension.



Uncover and drill off welding spots on the wheel house outer section.

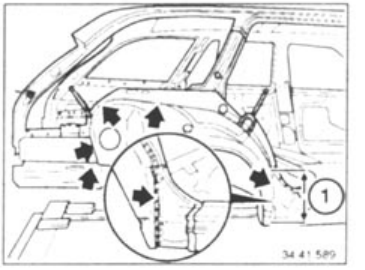
Important!
The wheel house inner section, wheel house outer section and side member are welded together in area (1).

Remove the wheel house outer section.
Remove scrap metal.
Straighten and grind the mating surfaces.



Install and clamp the wheel house outer section, mark the welding surfaces and remove the wheel house outer section again.
Clean and coat the welding surfaces with zinc dust paint.

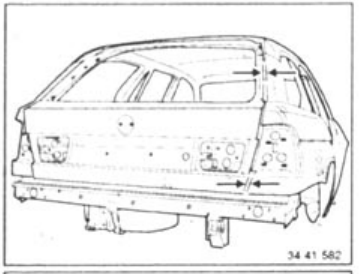
Important!
The wheel house inner section, wheel house outer section and side member are welded together in area (1).
Drill corresponding plug welding holes in the connecting parts.



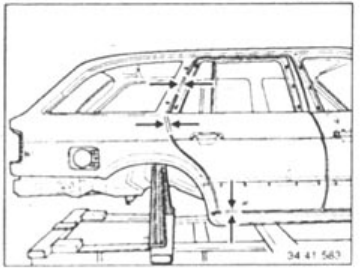
Weld the wheel house outer section.

Important!
The wheel house inner section, wheel house outer section and side member are welded together in area (1).
Plug welding must join all connecting parts together!

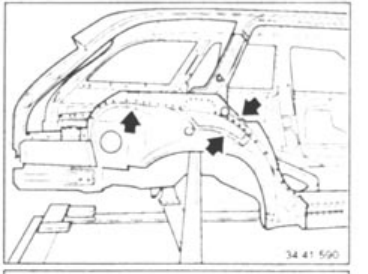
Grind the welded surfaces.



Install and clamp the wheel house outer section.
Install and clamp the side panel.

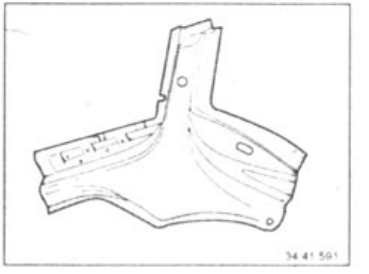


Align the side panel and wheel house outer section with the adjacent body parts.
Remove the side panel again.

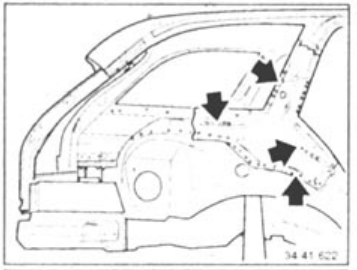


C-pillar Support Member

Clean and coat mating surfaces on the wheel house outer section with zin dust paint.

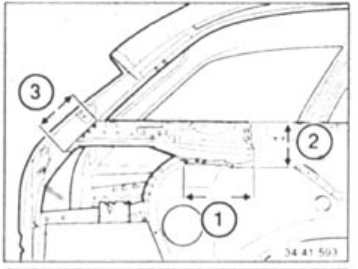


Clean and coat mating surfaces on the support member with zinc dust paint.

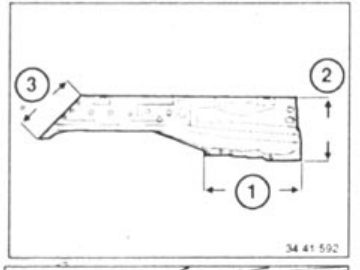


Fit in and spot weld the support member.

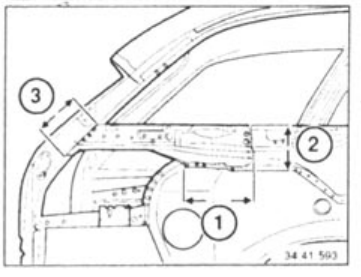
Grind the welded surfaces.



Fit in and clamp the support member extension.
Mark the mating surfaces and remove the support member extension again.
Coat the mating surfaces with zinc dust paint.

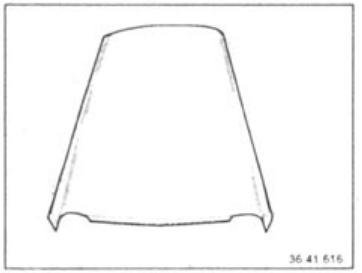


Drill plug welding holes in the support member extension in areas (1 and 2).
Clean area (3) for spot welding.
Coat the mating surfaces with zinc dust paint.



Fit in and weld the support member extension.
Plug weld in areas (1 and 2).
Spot weld in area (3).

Grind the welded surfaces.



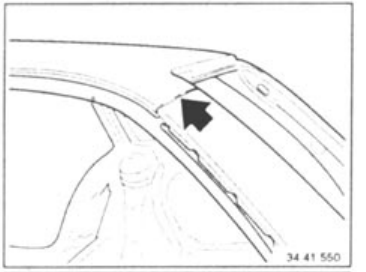
41 31 001 REPLACING ROOF PANEL (Version without Double Sun Roof)

Touring

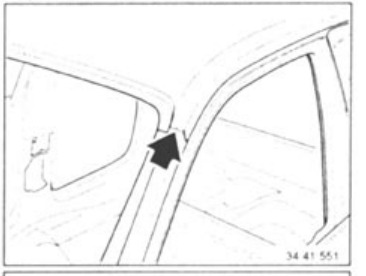
Refer to "Information" on page 41-0/1.

Remove or disconnect the following parts:
Windshield
Roof liner
Rear seat cushion
Battery ground lead
All rain molding strips and channels
Both rear side windows
Both front seats
Tailgate seal
Both rear seat backrests
Front and rear roof liner wires

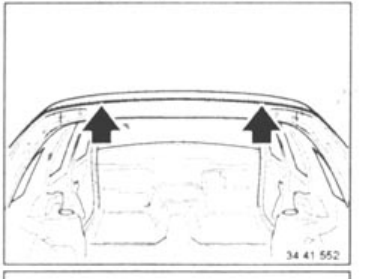
Remove or cover all other car parts, which are in the repair zone and subject to be damaged from heat, sparks or dust.



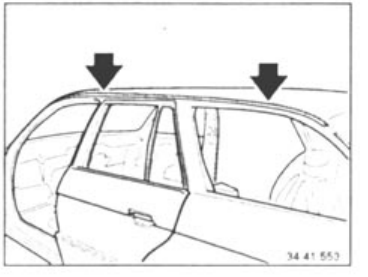
Uncover the D-pillar joints.



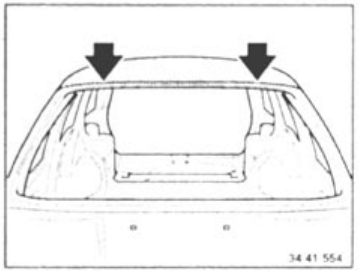
Uncover the A-pillar joints.



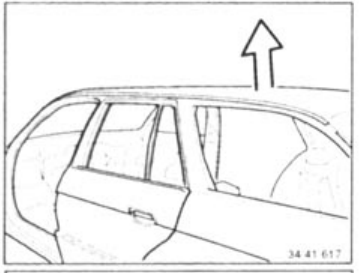
Cut through the rear roof frame roughly in front of the joints.



Cut through the side roof frames roughly in front of the joints.

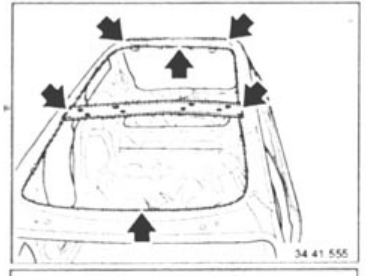


Cut through the front roof frame roughly in front of the joints.

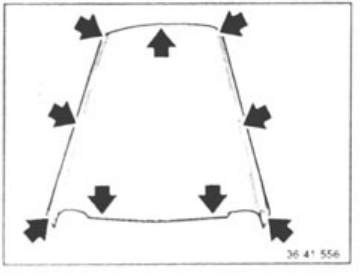


Remove the roof panel.

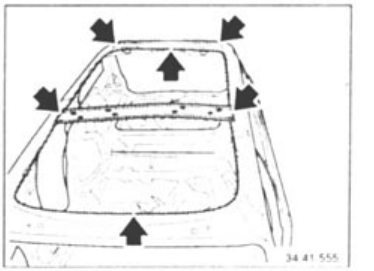
Important!
The roof panel may be heated at the surfaces coated with sealing compound to make removal of the roof panel easier.
Extract the caused vapors!



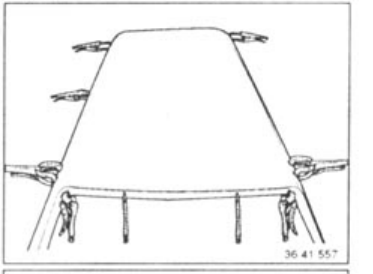
Remove scrap metal.
Straighten and grind the mating surfaces.
Remove sealing compound.



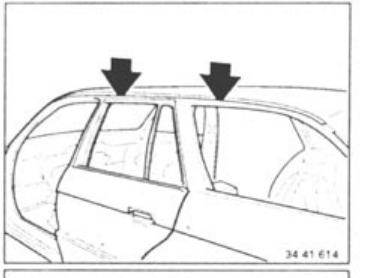
Fit in new roof panel and clean the mating surfaces.
Coat the mating surfaces with zinc dust paint.



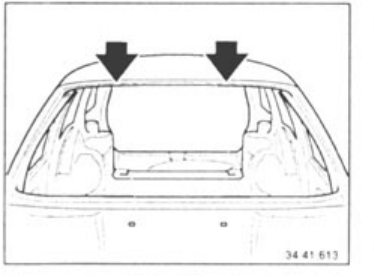
Coat the roof frame with sealing compound*.



Install and clamp the roof panel.

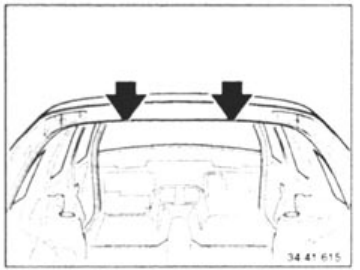


Spot weld the roof panel along the sides.

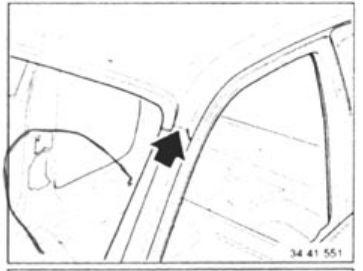


Spot weld the windshield frame.

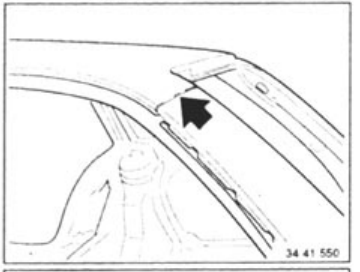
* Source of Supply: BMW Parts



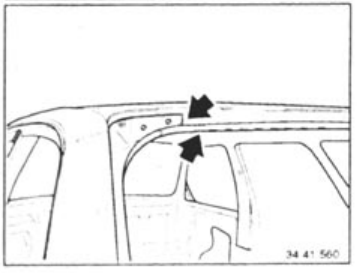
Spot weld the tailgate frame.



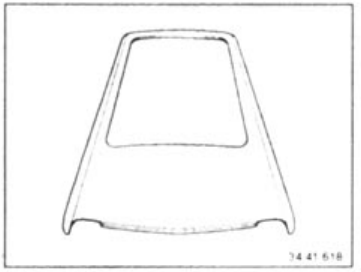
Braze the A-pillar mating surface, tin it out and grind the surface.



Braze the D-pillar mating surface, tin it out and grind the surface.



Braze the tailgate frame at top.
Grind the brazed surfaces.
Grind the welded surfaces.



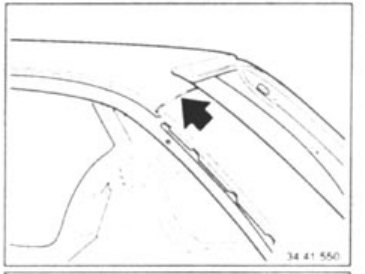
41 31 011 REPLACING ROOF PANEL
(Version with Double Sun Roof)

Touring

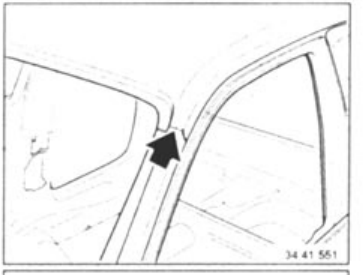
Refer to "Information" on page 41-0/1.

Remove or disconnect the following parts:
Windshield
Steel sun roof
Rear seat cushion
Battery ground lead
All rain molding strips and channels
Both rear side windows
Both front seats
Tailgate seal
Both rear seat backrests
Front and rear roof liner wires
Roof liner

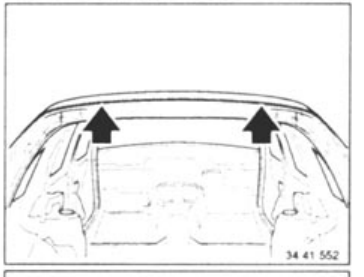
Remove or cover all other car parts, which are in the repair zone and subject to be damaged from heat, sparks or dust.



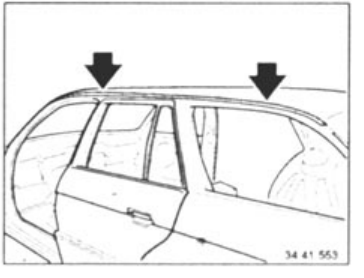
Uncover the D-pillar joints.



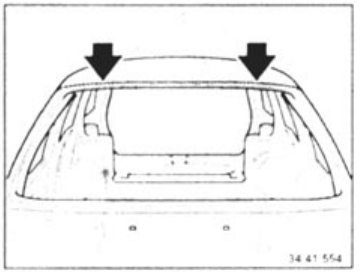
Uncover the A-pillar joints.



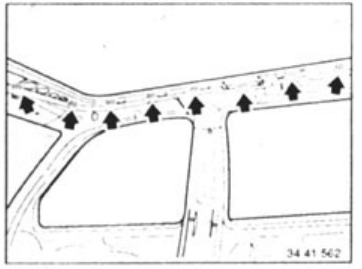
Cut through the rear roof frame roughly in front of the joints.



Cut through the side roof frames roughly in front of the joints.

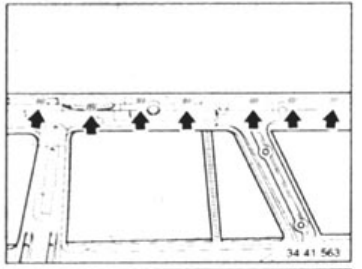


Cut through the front roof frame roughly in front of the joints.



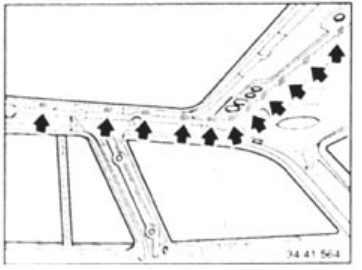
Grind the front roof panel mating surfaces on the roof frame.

Note:
The picture is a view of the right roof frame as seen from inside of the car.



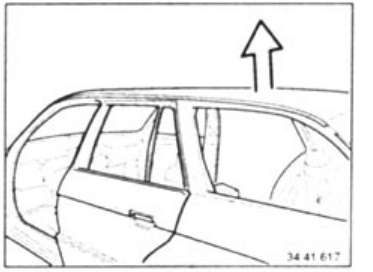
Grind the center roof panel mating surfaces on the roof frame.

Note:
The picture is a view of the right roof frame as seen from inside of the car.



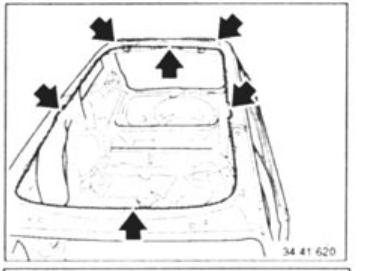
Grind the rear roof panel mating surfaces on the roof frame.

Note:
The picture is a view of the right roof frame as seen from inside of the car.

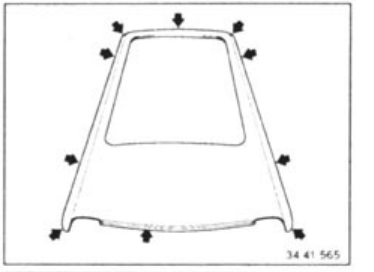


Remove the roof panel.

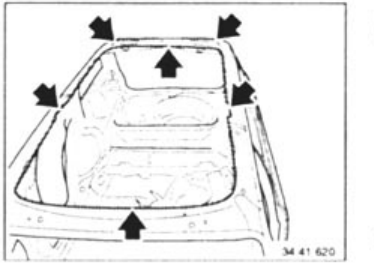
Important!
The roof panel may be heated at the surfaces coated with sealing compound to make removal of the roof panel easier.
Extract the caused vapors!



Remove scrap metal.
Straighten and grind the mating surfaces.
Remove sealing compound.

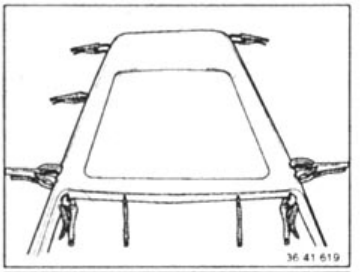


Fit in new roof panel and clean the mating surfaces.
Coat the mating surfaces with zinc dust paint.

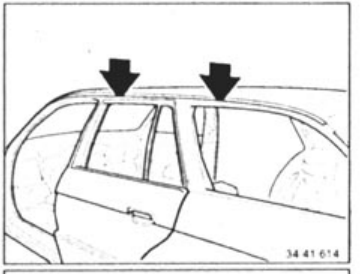


Coat the roof frame with sealing compound*.

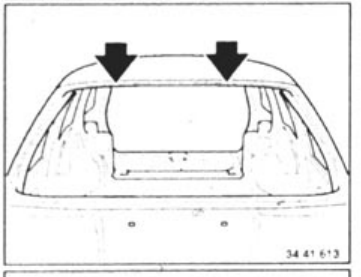
* Source of Supply: BMW Parts



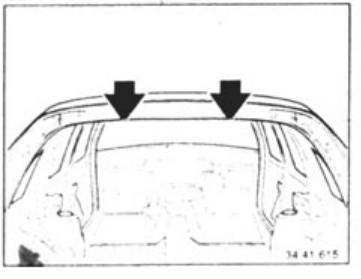
Install and clamp the roof panel.



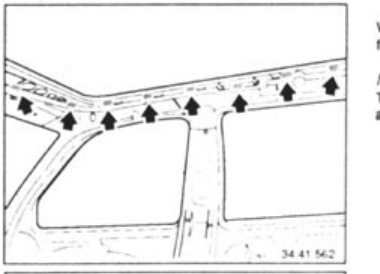
Spot weld the roof panel along the sides.



Spot weld the windshield frame.

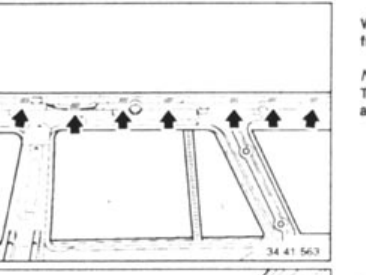


Spot weld the tailgate frame.



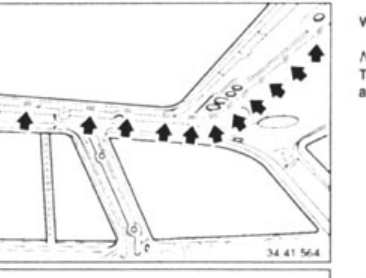
Weld the roof panel on the front roof frame.

Note:
The picture is a view of the right roof frame as seen from inside of the car.



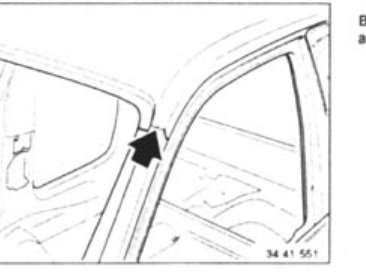
Weld the roof panel on the center roof frame.

Note:
The picture is a view of the right roof frame as seen from inside of the car.

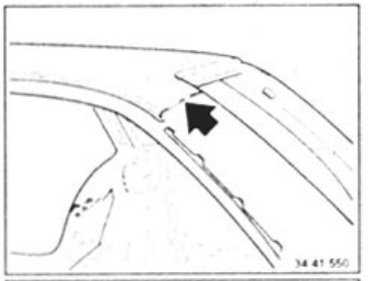


Weld the roof panel on the rear roof frame.

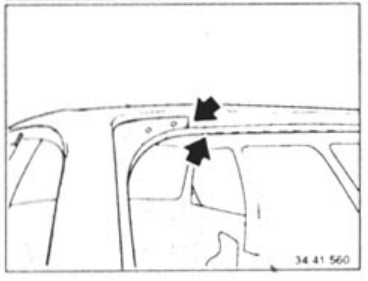
Note:
The picture is a view of the right roof frame as seen from inside of the car.



Braze the A-pillar mating surface, tin it out and grind the surface.



Braze the D-pillar mating surface, tin it out and grind the surface.



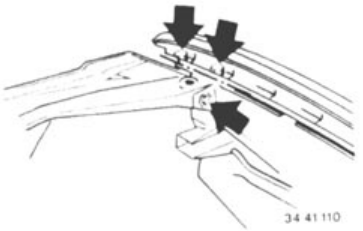
Braze the tailgate frame at top.
Grind the brazed surfaces.
Grind the welded surfaces.

41 33 001 REPLACING FRONT PANEL COMPLETE WITH FRONT WALL

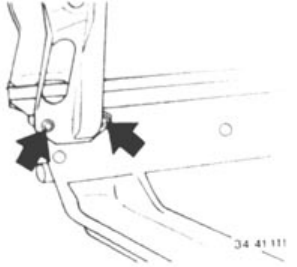
Refer to information on 41 - 0/1.
Front panel can be removed and installed without removal of side panels.

The following parts must be removed or disconnected.

Ground lead on battery, splash guard, front bumper assembly, all radiator grill sections, both double headlights with turn signals and electric leads, air cleaner with air flow sensor, washing fluid tank, radiator complete with coolant hoses, fan cowl and brackets, cooling coil on power steering, both horns, wire harness in front wall, engine hood, engine hood lock and hinge console for engine hood.



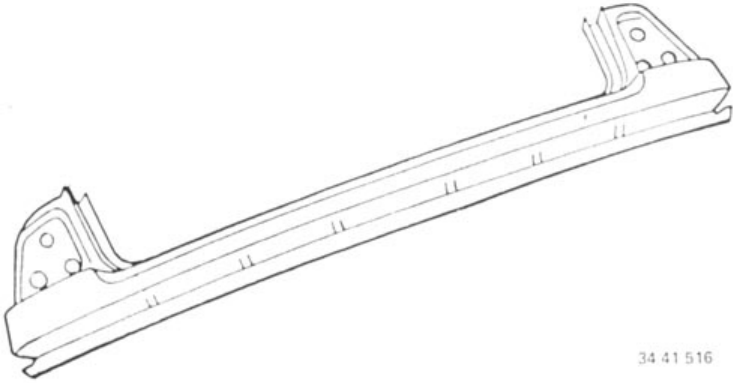
Unscrew left and right bolts.
Cut through sealing compound.



Unscrew bolts.
Lift off front panel.

41 34 041 REPLACING TAIL PANEL

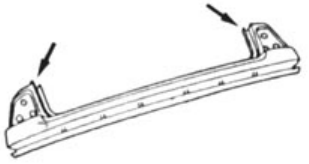
Refer to "Introduction" on page 41 - 0/1.



34 41 516

Remove or disconnect/detach the following parts.

- Ground lead on battery
- Rear bumper assembly
- Both bumper brackets complete with impact absorbers
- Trunk lid rubber seal
- Trunk trim panels
- Left and right stale air extractions
- Tank flap drive motor
- Both tail light assemblies with electric leads
- Both electric lead covers on trunk floor
- Spare wheel
- Trunk lid lock lower section
- Fuel tank complete with expansion tank



34 41 506

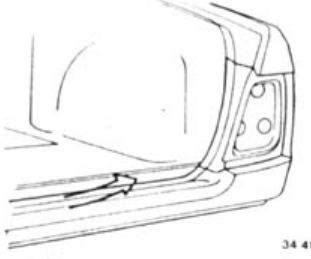
REPLACING TAIL PANEL

The "tail panel" replacement scope consists of the tail panel with spot welded shells for tail light assemblies.
A complete tail panel can only be installed after removal of one side panel.



34 41 507

Procedures with Installed Side Panels:
Drill out welded spots on the connection between the tail panel and tail light shell, and lift off the shell.



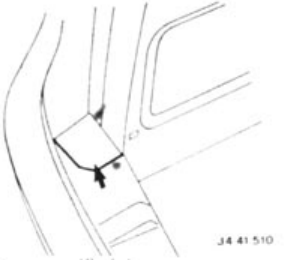
34 41 508

First install the tail panel with the remaining shell.



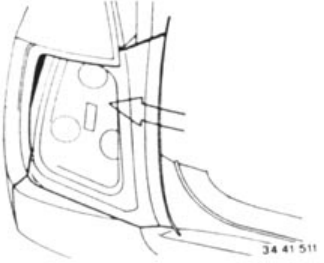
34 41 509

Check arrangement of overlapped sheet metal.



34 41 510

The metal connector on the box for air extraction is located above the tail panel.



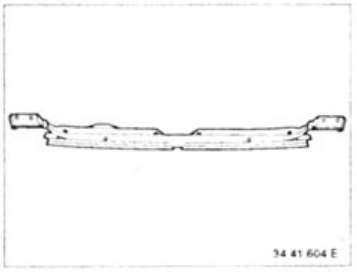
34 41 511

Install the cut out shell last.
Check arrangement of overlapped sheet metal.



34 41 512

When sealing, make sure that the gap between the trunk floor plate and tail panel is filled out completely on the inside and outside.



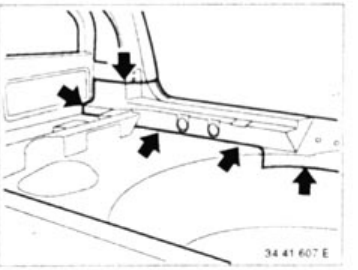
41 34 041 REPLACING TAIL PANEL

Touring

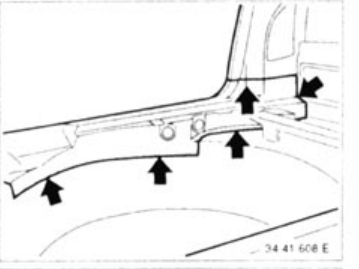
Refer to "Information" on page 41-0/1.

Remove or disconnect the following parts:
Battery ground lead
Rear bumper and brackets
Tailgate seal
Both tail light assemblies
Luggage compartment inlets
Fuel tank
Spare wheel
D-pillar trim panels
Washing fluid tank for tailgate window

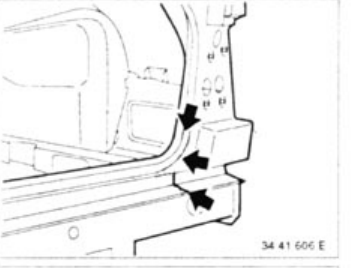
Remove or cover all other car parts, which are in the repair zone and subject to be damaged from heat, sparks or dust.



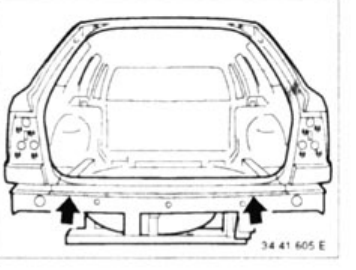
Cut out the tail panel roughly in front of the joints in the luggage compartment to the right.



Cut out the tail panel roughly in front of the joints in the luggage compartment to the left.

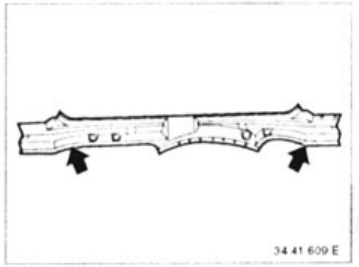


Cut out the tail panel roughly in front of the D-pillar joint.

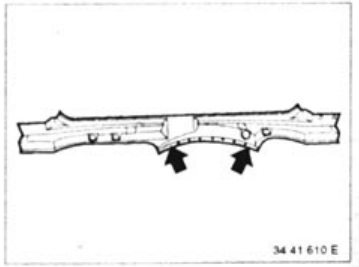


Cut out the tail panel roughly in front of the side panel joint.

Remove scrap metal.
Straighten and grind the mating surfaces.

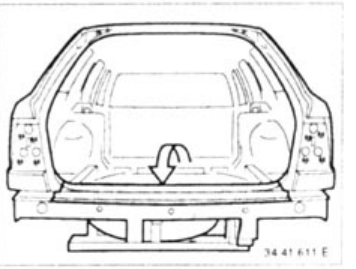


Clean the tail panel/luggage compartment floor plate mating surfaces and drill holes for plug welding.

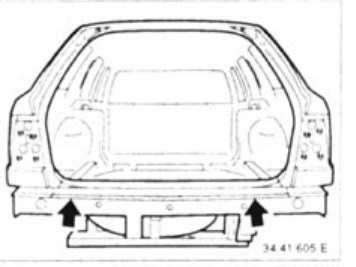


Clean the tail panel/spare wheel well mating surfaces and drill holes for plug welding.

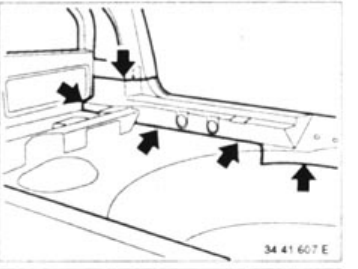
Coat the mating surfaces with zinc dust paint.



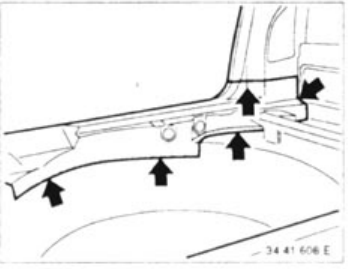
Fit in and clamp the tail panel from inside of the car.



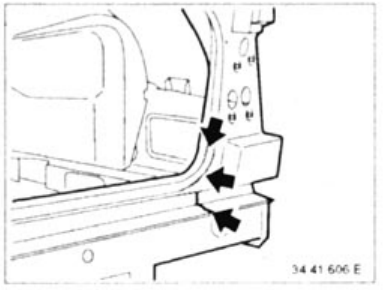
Weld the tail panel to the side panel mating surface.



Weld the tail panel to the mating surfaces in the luggage compartment to the right.



Weld the tail panel to the mating surfaces in the luggage compartment to the left.



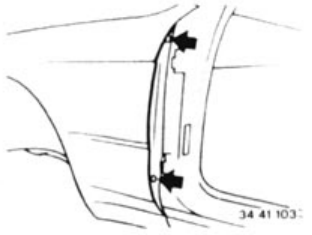
Braze the light bulb holder/D-pillar mating surface.

Grind the mating surfaces.

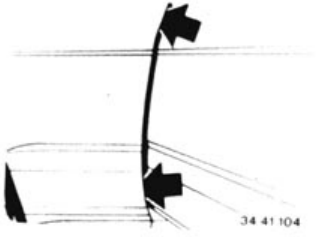
41 35 000 REMOVING AND INSTALLING OR REPLACING LEFT OR RIGHT FRONT SIDE PANEL

Refer to information on 41 - 0/1.

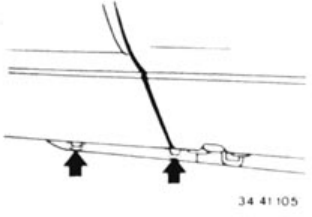
Remove or disconnect the following parts.
Front bumper with side bracket, both windshield wiper arms (only for left side panel), heater air grills, rubber seal between side panel and inside wheel trim. Transfer rubbing strip on side panel.



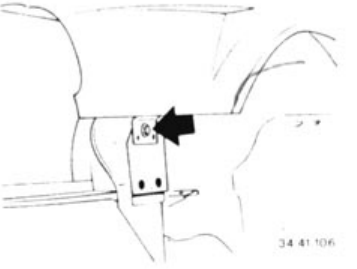
Unscrew screws.



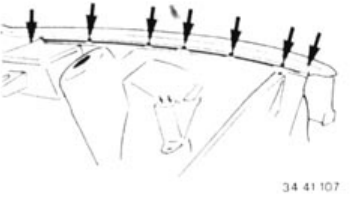
Note:
Be careful not to damage the paint finish, if the door is installed.



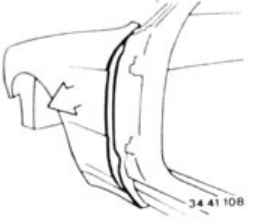
Unscrew screws.



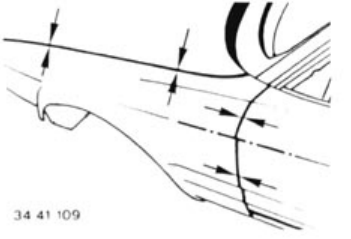
Unscrew screw (M 6).



Unscrew screws.



Lift off side panel.



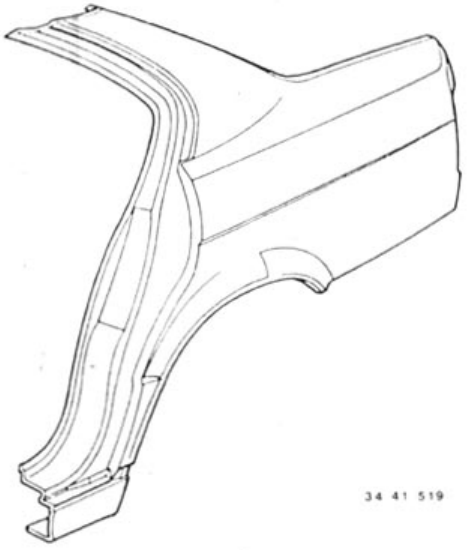
Installation:
Align side panel with the door gap and engine hood.

41–35/1.1

41 35 105/ REPLACING LEFT/RIGHT REAR SIDE PANEL
41 35 115 (PARTIAL REPLACEMENT (C PILLAR)

Procedures are described for the left side of the car.
Procedures are analogous for the right side of the car.

Refer to "Introduction" on page 41 - 0/1.



34 41 519

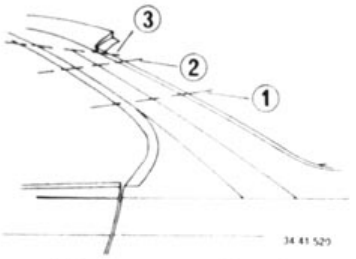
Remove or disconnect/detach the following parts.

Left Side:

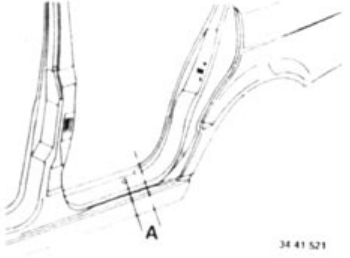
- Ground lead on battery or body ground point
- Trunk lid, rubber seal (trunk lid), trunk lid wire harness (partially)
- All trunk trim panels, car jack, wheel wrench, spare wheel
- Bumper assembly
- Tail light assembly
- Stale air extraction cover
- Complete rear seat cushion, seat belt lock
- Hatrack
- Roof liner
- Rear window
- Cover and carpet on entrance
- Wire harness (partially)
- Rubbing strip (side panel), plate (C-pillar), rain molding strip
- Rear wheel and wheel house panels

Right Side (Additonally):

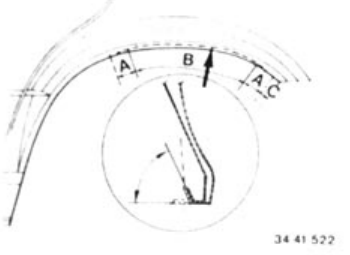
- Tank flap
- Fuel tank complete with expansion tank
- Central lock (tank flap)



Locate cutting line (1) as close as possible to the middle of the C-pillar. Uncover brazed seam (3) when a cutting line is required close to the roof joint and locate the cutting line (2) about 30 mm (1 3/16") below the brazed seam.

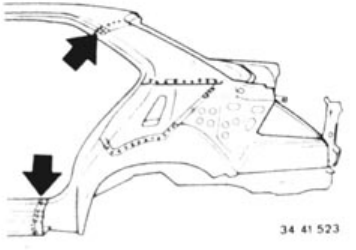


Locate cutting line.
Distance A = at least 50 mm (2").

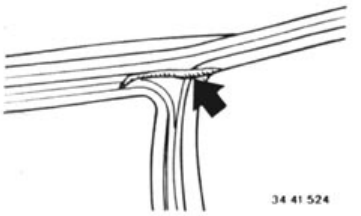


Bend down the cringed-up spot welding flange in the area of the wheel opening.

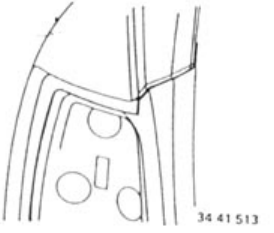
Installation:
Cringe the spot welding flange in zone B = 325 mm (12.795") toward the inside by an angle of 65°.
Zone A = 50 mm (2").
Distance C = 20 mm (0.787").



Produce reinforcement plates having a width of about 40 mm (1 9/16") and weld them in at pertinent points.



Braze the front trunk joint (connection with the rear window).

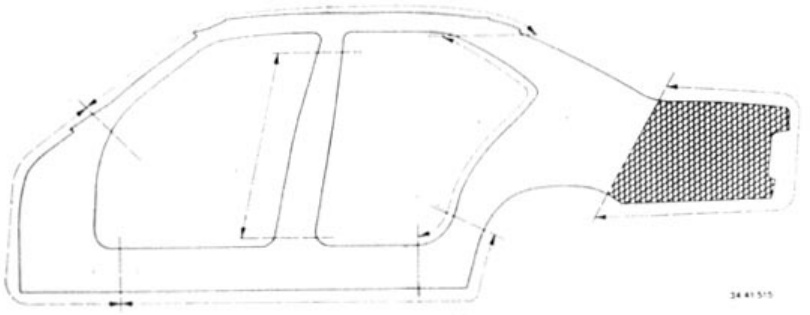


Check arrangement of overlapped sheet metal on the tail panel when installing the side panel.

41 35 337/ REPLACING LEFT/RIGHT REAR SIDE PANEL
41 35 338 (PARTIAL REPLACEMENT UP TO WHEEL HOUSE)

Procedures are described for the left side of the car.
Procedures are analogous for the right side of the car.

Refer to "Introduction" on page 41 - 0/1.

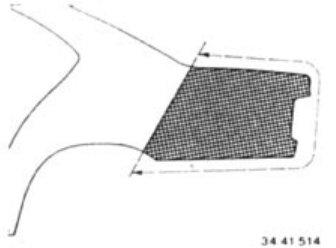


Remove or disconnect/detach the following parts.

- Ground lead on battery
- Rear bumper assembly
- Side bumper bracket
- Rubber seal for trunk lid
- Trunk mat
- Trunk trim panels
- Stale air extraction plate
- Wheel house panel
- Tail light assembly
- Tail panel
- Wire harness (partially)

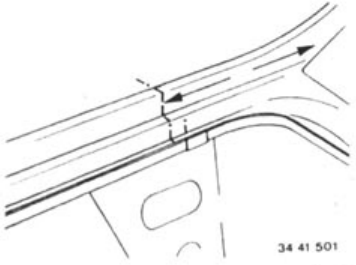
Additionally for Right Side Panel:

- Tank flap
- Complete fuel tank
- Expansion tank
- Central lock for tank flap

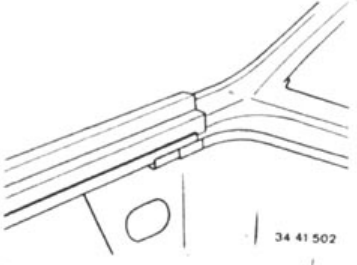


SECTION REPAIR ON REAR SIDE PANEL

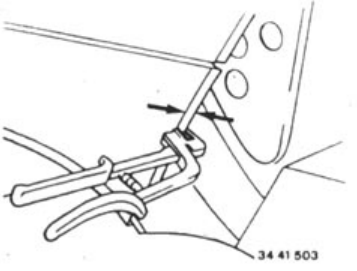
The panel section is cut out of a complete rear side panel in the factory.
Location of cut – also refer to plan for side rib sections.



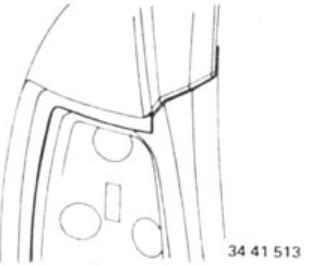
Important:
Locate the cut as far away from the rear window as possible.



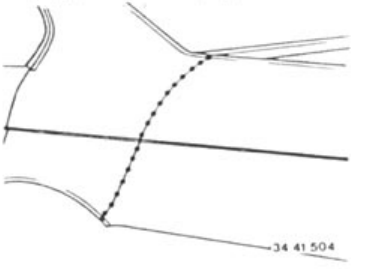
Whenever possible, the original connection should be used for connection with the trunk opening at the front.



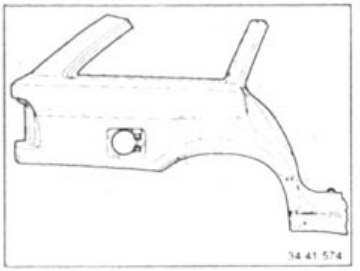
Cut connection to size allowing 10 mm (0.394") for overlapping and shoulder with a shouldering pliers.



Check arrangement of overlapped sheet metal on tail panel when installing the side panel.



Spot weld the joint until a continuous seam is produced.



41 35 115 REPLACING RIGHT REAR SIDE PANEL
(C-pillar Partial Replacement)

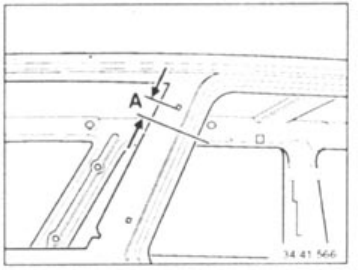
Touring

Refer to "Information" on page 41-0/1.

Remove or disconnect the following parts:
Battery ground lead
Rear bumper
Right rear side window
Tail light assembly
Roof liner
Fuel tank
Rubbing strip on side panel
Right rear seat belt
Luggage compartment inlets
Strip on right rain channel
Tailgate gas pressure props

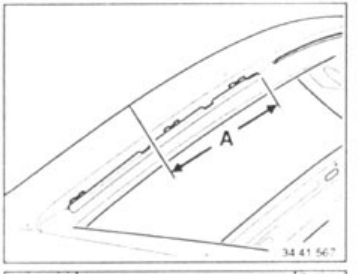
Important!
Support the tailgate!

Remove or cover all other car parts, which are in the repair zone and subject to be damaged from heat, sparks or dust.



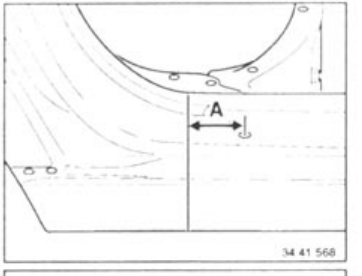
Determine, mark and cut the C-pillar along the cutting line.

Distance A = 45 mm.



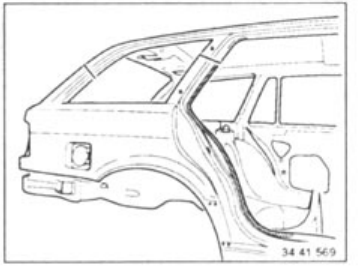
Determine, mark and cut the D-pillar along the cutting line.

Distance A = 200 mm.

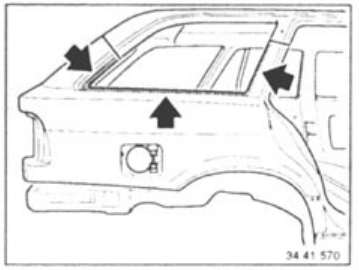


Determine, mark and cut the side member entrance along the cutting line.

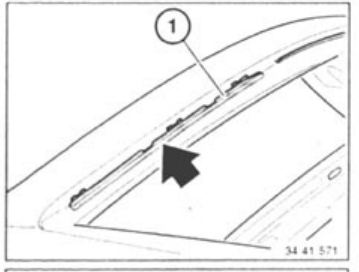
Distance A = 70 mm.



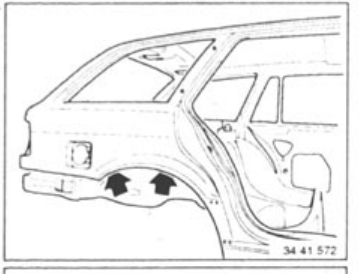
Drill off the welding spots in the door opening.



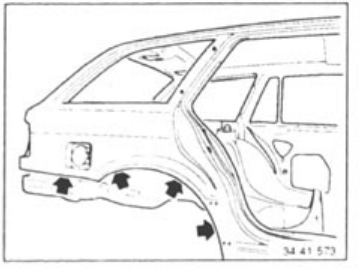
Uncover and drill off side window mating surface welding spots.



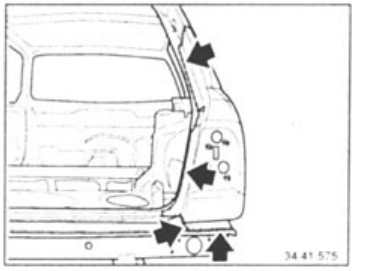
Drill off welding spots of bracket (1) and remove the bracket.



Unbend edge of the wheel house.

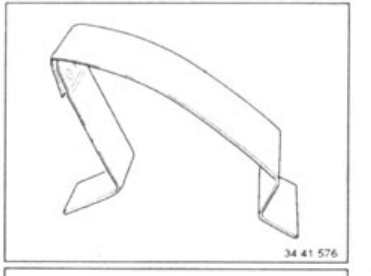


Uncover and drill off welding spots on wheel house and wheel house extension.



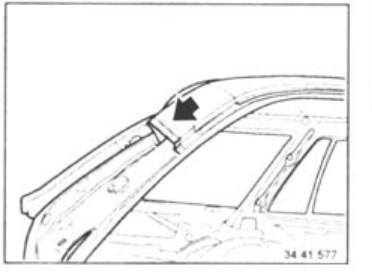
Cut off side panel roughly in front of the mating surfaces.
Remove the side panel.

Remove scrap metal.
Straighten and grind the mating surfaces.

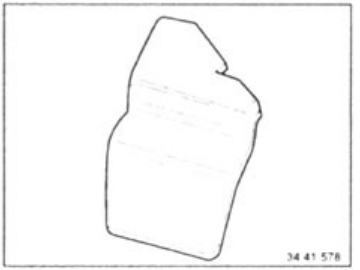


Produce, fit in and coat a reinforcement plate for the D-pillar with zinc dust paint.

Width = 60 mm.

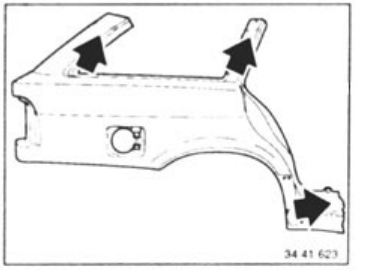


Drill holes in the D-pillar for plug welding.
Coat the mating surface with zinc dust paint.
Insert and weld the reinforcement plate 30 mm.
Grind the welded surface.

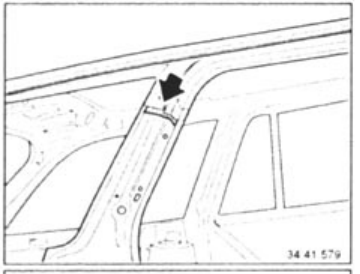


Produce, fit in and coat a reinforcement plate for the C-pillar with zinc dust paint.

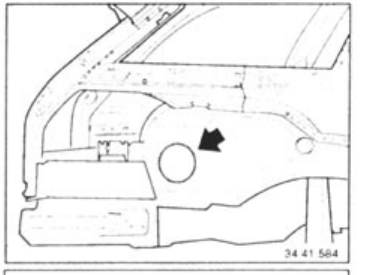
Width = 60 mm.



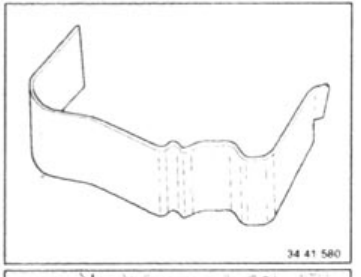
Cut the side panel to size and fit in in.
Drill holes for plug welding.



Drill holes in the C-pillar for plug welding.
Coat the mating surface with zinc dust paint.
Insert and weld the reinforcement plate 30 mm.
Grind the welded surface.

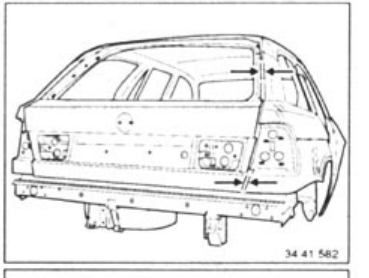


Apply sealing material* around the opening for the tank filler neck.

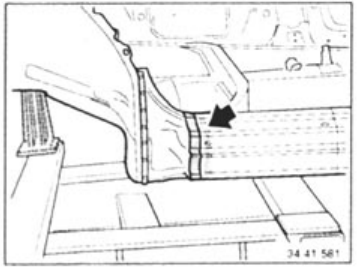


Produce, fit in and coat a reinforcement plate for the side member/entrance with zinc dust paint.

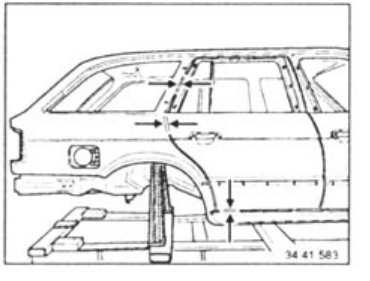
Width = 60 mm.



Install and clamp the side panel.
Align the side panel to the tailgate.

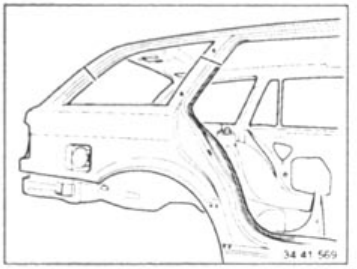


Drill holes in the side member/entrance for plug welding.
Coat the mating surface with zinc dust paint.
Insert and weld the reinforcement plate 30 mm.
Grind the welded surface.

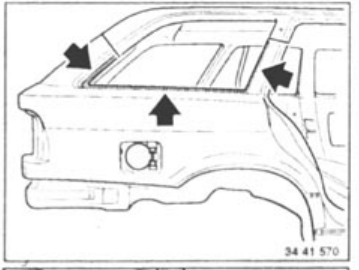


Align the side panel to the rear door and side member.

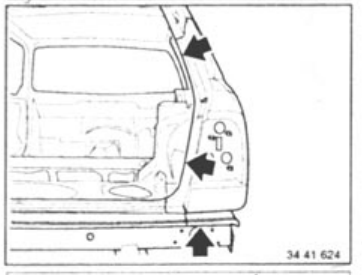
* Source of Supply: BMW Parts



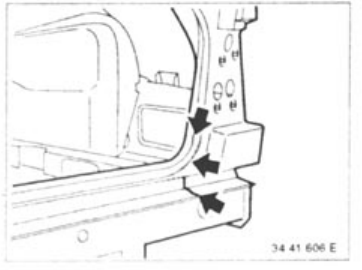
Spot weld the side panel in the area of the door opening.



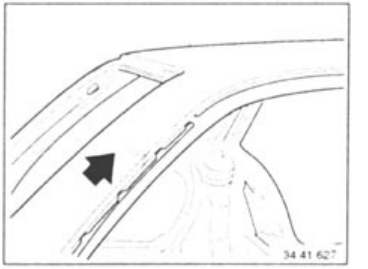
Spot weld the side panel in the area of the side window.



Spot weld the side panel in the area of the tailgate.

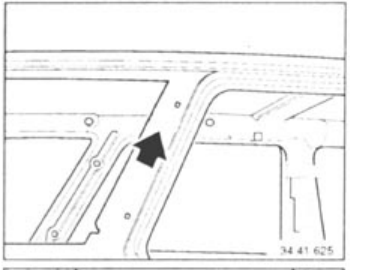


Braze the light bulb holder/D-pillar mating surface.



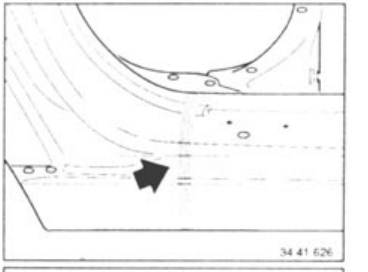
Plug weld the reinforcement plate at the D-pillar mating surface.
Afterwards produce single welding spots so close together that a continuous seam is produced.

Important!
Always let the one welding spot cool off slightly, before producing the adjacent one. Danger of distortion!



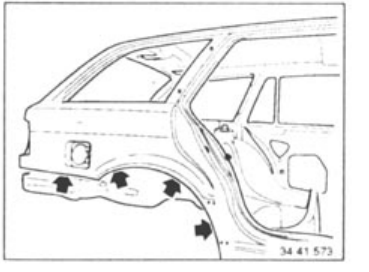
Plug weld the reinforcement plate at the C-pillar mating surface.
Afterwards produce single welding spots so close together that a continuous seam is produced.

Important!
Always let the one welding spot cool off slightly, before producing the adjacent one. Danger of distortion!



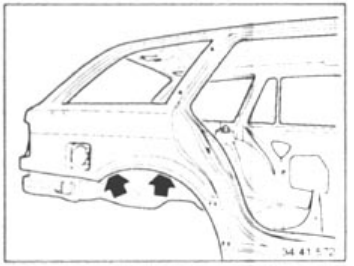
Plug weld the reinforcement plate at the side member/entrance mating surface.
Afterwards produce single welding spots so close together that a continuous seam is produced.

Important!
Always let the one welding spot cool off slightly, before producing the adjacent one. Danger of distortion!

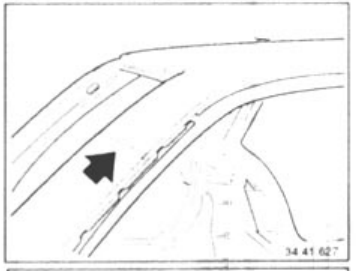


Weld the wheel house and wheel house extension mating surface.

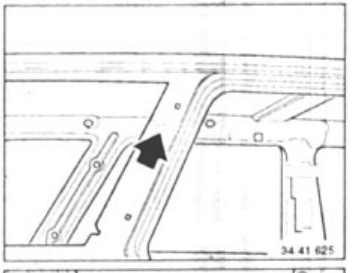
Grind the welded surfaces.



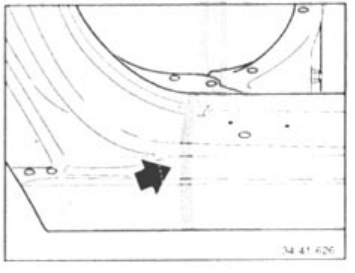
Cringe the edge of the wheel house.



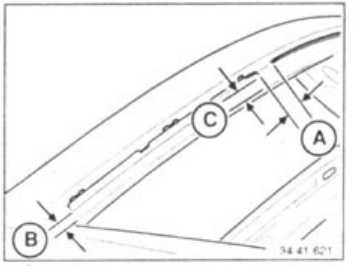
Tin the D-pillar mating surface and grind.



Tin the C-pillar mating surface and grind.



Tin the side member/entrance mating surface and grind.

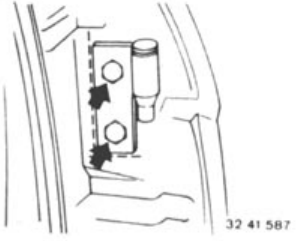


Position and weld the bracket on the side window.
Grind the welded surfaces.

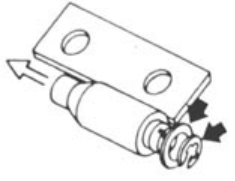
Distance A = 26 mm
Distance B = 20 mm
Distance C = 26 mm

41 51 ... REPLACING BEARING SLEEVES FOR DOOR HINGES

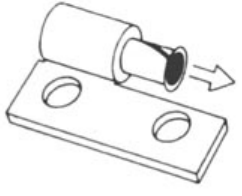
Remove front or rear door – see 41 51 080 or 41 52 080.
Note:
The bearing sleeve fitted with a hinge section is located on the door in case of the upper hinge and on the body in case of the lower hinge.
The hinge section must be unbolted on the door to replace the upper bearing sleeve.


32 41 587

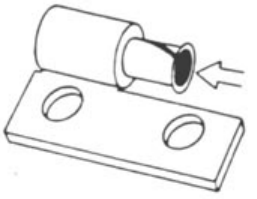
Mark position of door hinge.
Repair damaged paint finish.


32 41 588

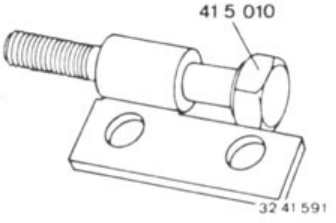
Lift off retainer and washer.
Pull out shaft bolt.


32 41 589

Remove old bearing sleeve.

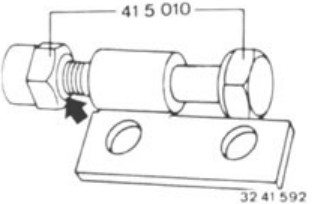

32 41 590

Insert new bearing sleeve.



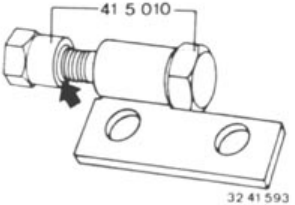
32 41 591

Slide in shaft bolt of Special Tool 41 5 010.



32 41 592

Screw on nut of Special Tool 41 5 010 with the conical end.
Lock the sleeve.
Unscrew nut.

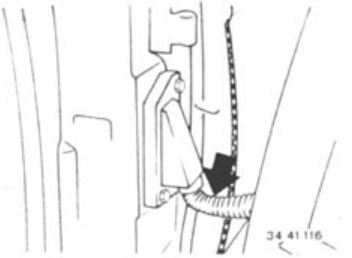


32 41 593

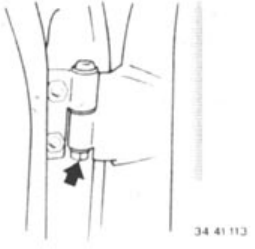
Screw on nut of Special Tool 41 5 010 with the flat end.
Press end of sleeve flat.
Installation:
Lubricate bearing surface with grease.

41 51 080/ REMOVING AND INSTALLING 41 52 080 LEFT OR RIGHT, FRONT OR REAR DOOR

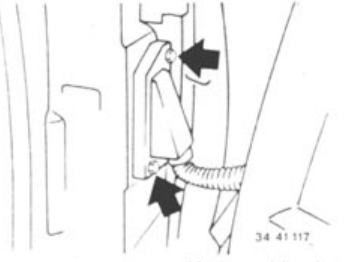
Procedures described here were performed on a front door.
Procedures are analogous for rear doors.



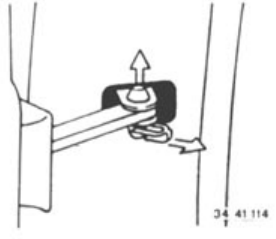
Caution!
Be careful not to damage the door, front panel or paint finish.
Cover with tape if necessary.
Keep loads off of leads from the door wire harness.



Unscrew hexagon head bolts at top and bottom.



Unscrew holding frame.



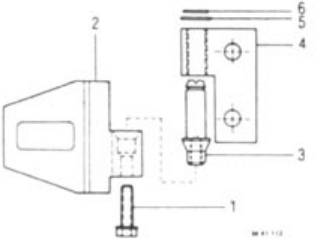
Pull off retainer.
Driver out pin upwards.



Pull plug out of A or B pillar.
Pull up clamp - this will disconnect the plug.

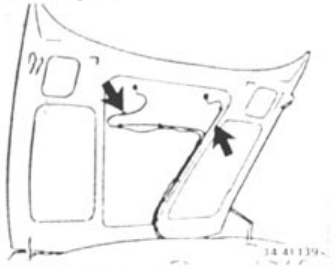


Lift door out of hinges and place on a suitable surface.



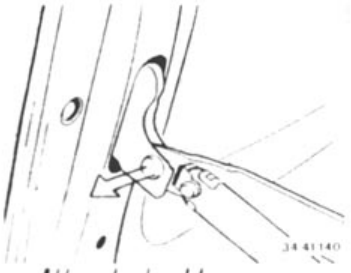
1 Hexagon head bolt
2 Body end hinge
3 Hinge pin
4 Door end hinge with bearing sleeve*
5 Washer
6 Retainer

* Sketch shows the top hinge. Bearing point is on the opposite end for the bottom hinge.

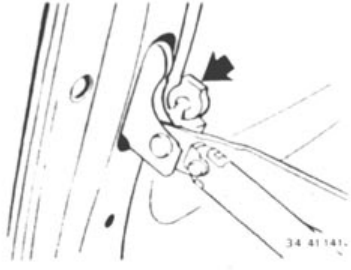


41 61 000 REMOVING AND INSTALLING ENGINE HOOD

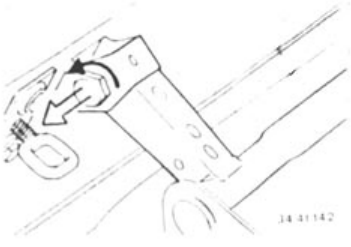
Note:
The hose and electric wire for the windshield water spray nozzles are not provided with con- nection points.
Prior to removal of the engine hood, the windshield washing fluid hose and nozzle heating wire harness must be removed from the engine hood.



Disengage the left and right engine hood holders.



Installation:
Clip in the plastic washers.

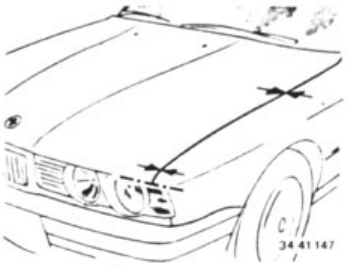


Unscrew the left and right shaft bolts.
Lift the engine hood off.

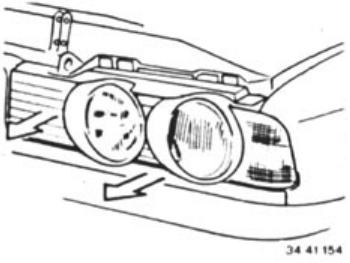
Installation:
Tightening torque = 5 Nm.

41 61 014 ALIGNING ENGINE HOOD

Note:
Engine hood, trunk lid and doors are aligned and bolted in an unfinished bodyshell.
Unpainted surfaces could become visible after subsequent alignment.
Such surfaces must be touched up with paint in pertinent body color.

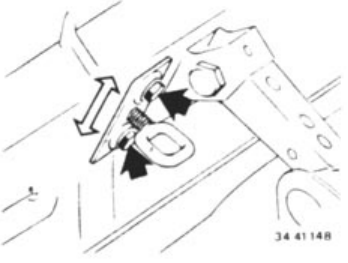


Align engine hood with the front side panels and on the side.



Aligning Engine Hood in Body Opening:

Remove left and right radiator grill sections – see 51 13 040.



Front Height Adjustment of Engine Hood:

Screw on lock only finger tight.
The lock will be aligned in forward direction by lowering the engine hood.
Tighten screws.



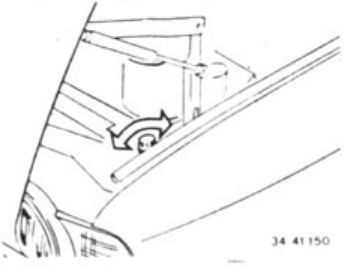
Loosen screws on lock.



Adjust the engine hood in height by loosening or tightening the lock, until the engine hood is approx. 1 mm (0.039") deeper than the side panel.



Loosen bolts on left and right hood hinges.

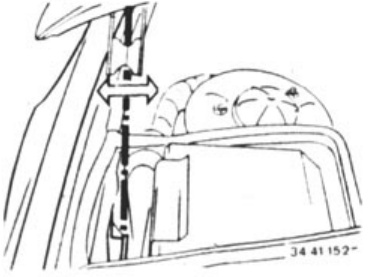


After finishing adjustments, unscrew stop pads far enough that the engine hood bears on them lightly and is in same plane with the side panels.

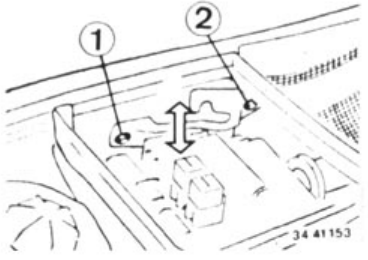


Adjusting Rear Guide Roller:

Loosen screws.



Adjust holder sidewards until the guide roller slides into the catch correctly.
Check gap between side panel and engine hood on left and right sides.

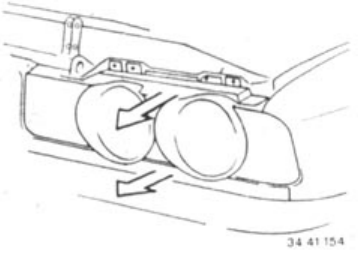


Rear Height Adjustment of Engine Hood:

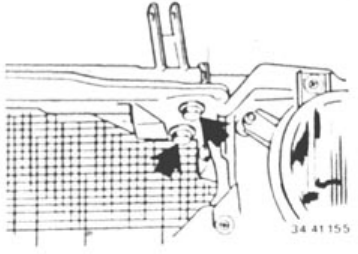
Loosen bolts (1 and 2).
Adjust catch with bolt (2) so that the closed engine hood is in same plane with the side panels.

41 61 545 REMOVING AND INSTALLING OR REPLACING ENGINE HOOD HINGE
– Engine Hood Removed –

Note:
Engine hood, trunk lid and doors are aligned and bolted in an unfinished bodyshell. Unpainted surfaces could become visible after subsequent alignment. These surfaces must then be painted with pertinent body color paint.


34 41 154

Remove left and right radiator grill sections – see 51 13 040.

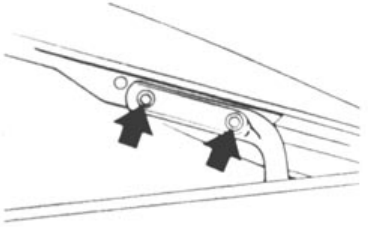

34 41 155

Unscrew hinges on left and right sides.
Align engine hood – see 41 61 014.

41 62 000 REMOVING AND INSTALLING TRUNK LID

Note:
Engine hood, trunk lid and doors are aligned and bolted in an unfinished bodyshell.
Unpainted surfaces could become visible after subsequent alignment.
These surfaces must be touched up with paint in the body color.
The electric supply lead for the trunk lid does not have a disconnection point. This means that the wire harness has to be taken out of the trunk lid.

Remove trunk lid after unscrewing bolts of hinges on the left and right sides.



34 41 128

Align trunk lid – see 41 62 014.

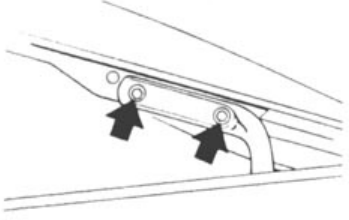
41 62 014 ALIGNING TRUNK LID

Note:
Engine hood, trunk lid and doors are fitted and bolted in an unfinished body shell. Unpainted surfaces could become visible after subsequent alignment.
These surfaces must be touched up with paint in the pertinent body color.

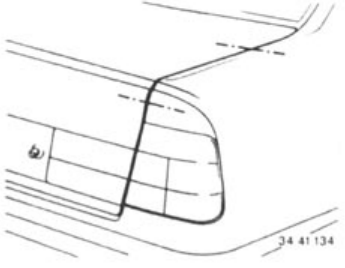

34 41 132

Aligning Trunk Lid in Body Opening:

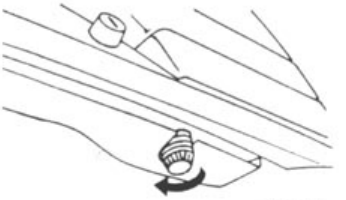
Unclip lid in trim panel.
Loosen lock, unscrewing completely if necessary.


34 41 128

Loosen bolts on left and right sides.


34 41 134

Align trunk lid with the side panels at the top and rear.

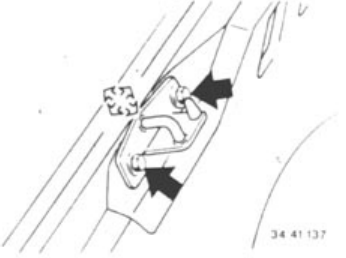

34 41 135

Rear Height Adjustment of Trunk Lid:

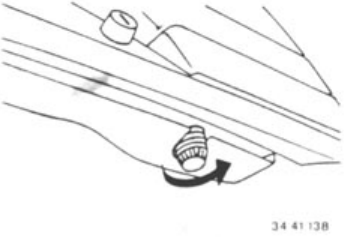
Screw in stop pads on left and right sides completely.


34 41 136

If applicable, unclip lid in trim panel.


34 41 137

Loosen bolts until the lock can be adjusted. There must be uniformly wide gaps on left and right sides after closing the trunk lid. Trunk lid should be approx. 1 mm (0.039") deeper than the side panels at the rear.


34 41 138

Unscrew stop pads far enough that the trunk lid bears on them lightly and is in the same plane with the side panels.

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51 0 ... INFORMATION FOR REPAIRING PLASTIC PARTS

The conditions mentioned below for plastic part repairs conform with legislation in Germany. Always conform with pertinent legislation in other countries.

These repairing instructions are provided for qualified workers and assume their skill, conscientiousness and sense of responsibility. The instructions are limited to factory approved repairing materials and methods as well as associated tips 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.

Note:
Repairs are an economical solution, so that optical deficiency cannot be excluded. Consequently repairs should only be carried out after receiving customer's approval.

The following E 34 parts are made of plastic and can be repaired with 3M 5900 plastic repairing material.

- M-Technic body attachments
- Bumpers

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.
- Holes of size 100 mm^2 or more.

Parts with these types of damage must be replaced!

Refer to the BMW Painting Manual for information on painting plastic parts.

Required Materials:

- Corundum 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 Grind Fabric 9030
- 3M 5900 plastic repairing material
- Mask
- Gloves

Source of Supply: BMW Parts

Safety Precautions:

- Extract sanding abrasion.
- Wear mask and gloves while grinding.
- Work only in well ventilated rooms.
- Wash hands frequently.
- Store food separately.
- Don't eat, drink or smoke while working.
- Don't inhale 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 a large amount of vapors is inhaled, go outdoors into the fresh air and, if necessary, visit a physician.

Information on Toxicology:

Irritates exes, 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.

Disposal:

Never let it get into drink water systems.
Single components of the repair material must be disposed as special refuse.
After mixing the single components and hardening, it can be brought to the normal refuse station.

Procedures:

1. Clean the repair area with plastic cleaner.

   Note:
   Allow the cleaned surface to air dry at room temperature about 10 minutes before applying the repairing material.

2. Smooth down the repair surface (grain size: P 80).
   Sand out the damaged spot V-shaped (grain size: P 36).
   In case of deep damage, clean the back of the repair area with plastic cleaner and sand smooth (grain size: P 36).

3. Remove sanding abrasion.

4. Paste aluminum adhesive tape on the face of the damaged spot.

5. Cut glass grid cloth to size of the damaged spot.

6. Mix the repairing material to instructions of the suppliers.

7. Apply a coat of repairing material on the back of the damaged spot. Place glass grid cloth on spot, cover it with repairing material and let it harden at room temperature about 20 minutes.

8. Pull off the aluminum adhesive tape and, if necessary, sand and clean the repair area again.

9. Apply coat of repairing material on face of the damaged spot and let it harden.

10. Smooth down the repaired surface (grain size: P 80); fine grind with grain size P 180 sandpaper.

Important!
The specified grain sizes are absolutely necessary to produce perfect results (thermal developement).

Procedures for Repairing Minor Bruises and Scratches:

1. Grind down damaged zone generously (down into the substrate) 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.

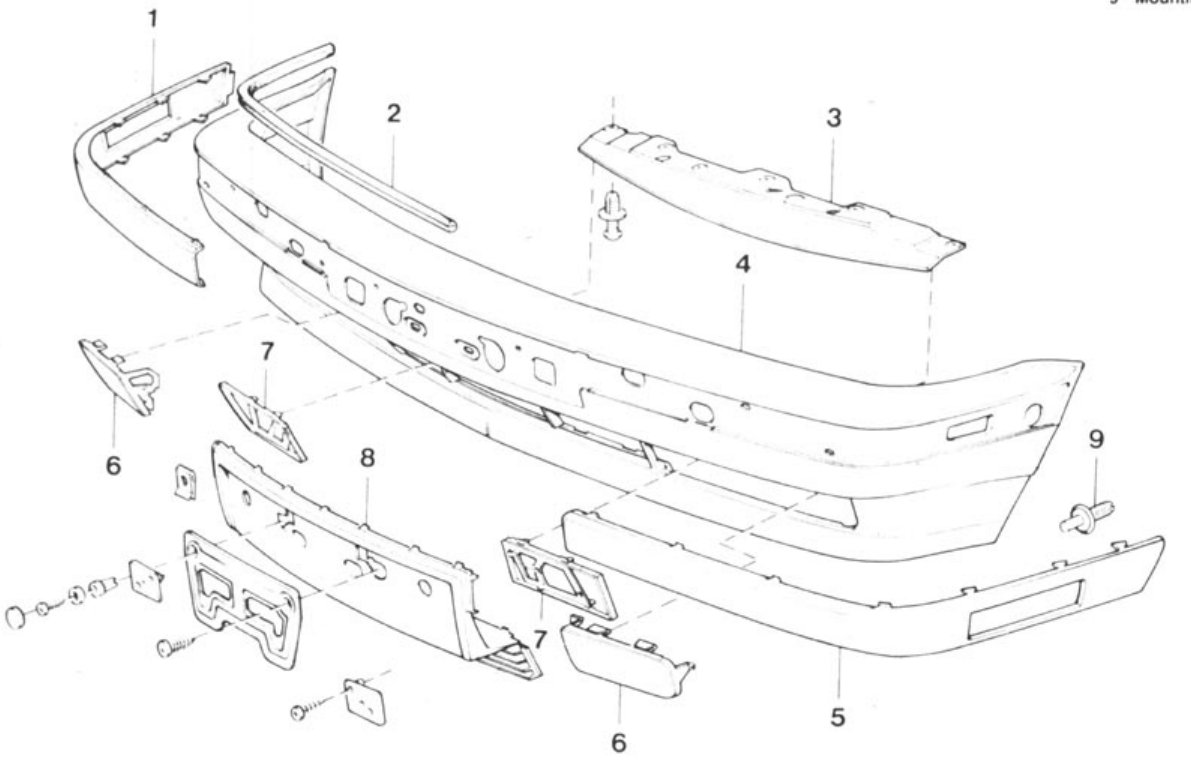
   Refer to the BMW Paint Spraying Manual for spraying instructions, materials and so on.

Caution!
Use mask and ensure sufficient ventilation.
Conform with accident prevention regulations 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 . . . REMOVING AND INSTALLING AND DISASSEMBLING FRONT BUMPER

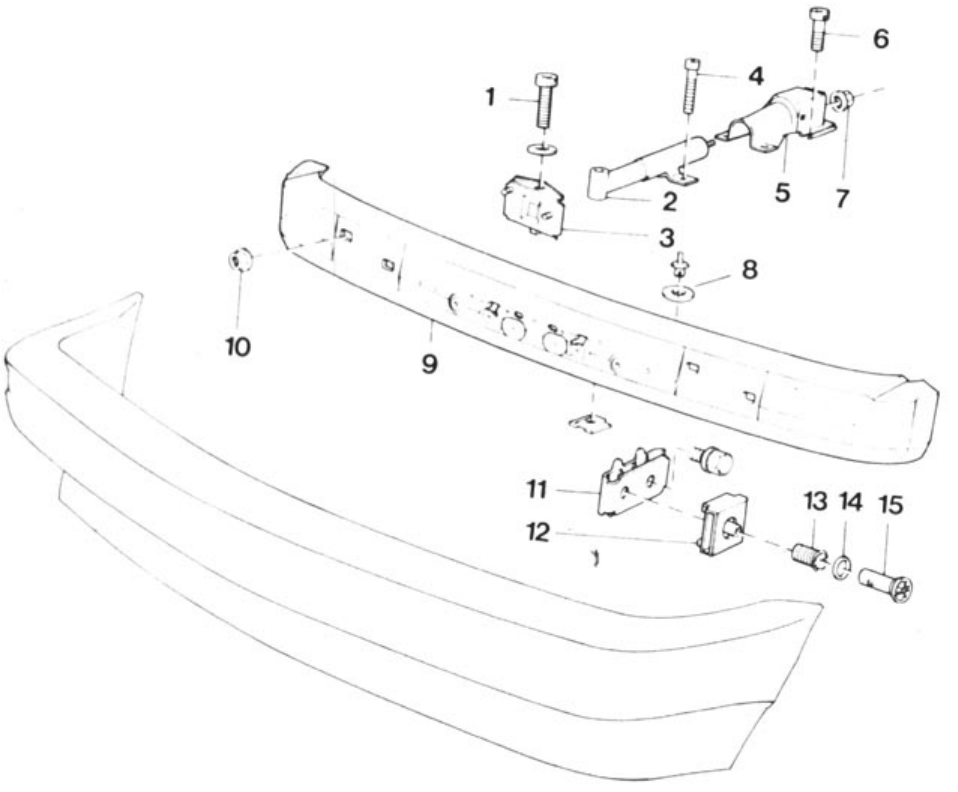
Survey of Bumper and Mounting Parts

1 Rubber guard, right
2 Rubber seal
3 Plate
4 Panel
5 Rubber guard, left
6 Cover (front fog lamp)
7 Cover (towing eye)
8 License plate holder
9 Mounting plug



34 51 001

Survey of Bumper and Mounting Parts



34 51 002

1 Fillister head bolt
2 Impact absorber
3 Bracket
4 Mounting bolt
5 Impact box
6 Mounting screw
7 Hexagon nut
8 Mounting plug
9 Member
10 Hexagon nut
11 Bracket
12 Slide
13 Threaded sleeve
14 O-ring
15 Retaining cap



Lift off rubber guards on left and right sides.



Installation:
Hook and clip in rubber guards on sides.

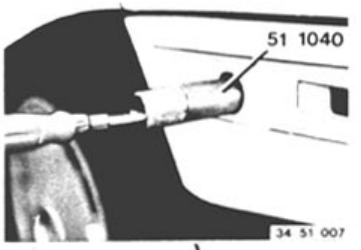


Unscrew bolts on left and right sides.
Installation:
Tightening Torque*.
Distance "A" = 5 to 6 mm (0.197 to 0.236") all around.
Check, adjusting if necessary.

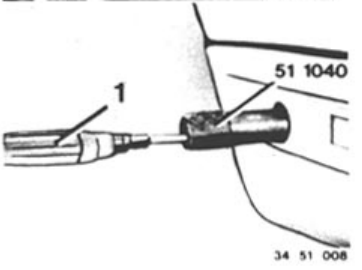


Pull off front bumper forward.
If applicable, disconnect plug for front fog lamps and connection for headlight cleaners.

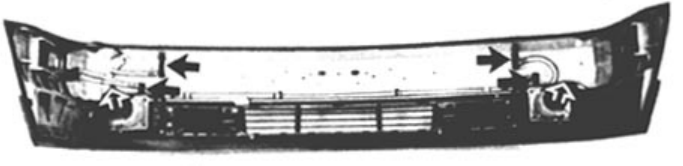
* See Specifications



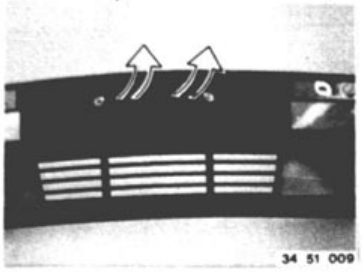
Installation:
If necessary, adjust bumper to be flush with the body with Special Tool 51 10 40.



Note:
Turn threaded sleeve with Special Tool 51 10 40 and hold retaining cap tight with a screwdriver (1).

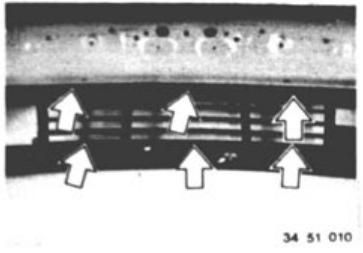


If applicable, lift out leads for front fog lamps and temperature sensors.
Lift out front fog lamps.
Lift out headlight cleaners.



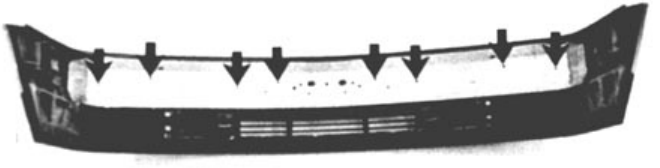
34 51 009

Lift out expansion rivets.



34 51 010

Lift out clamps.
Unscrew license plate holder.

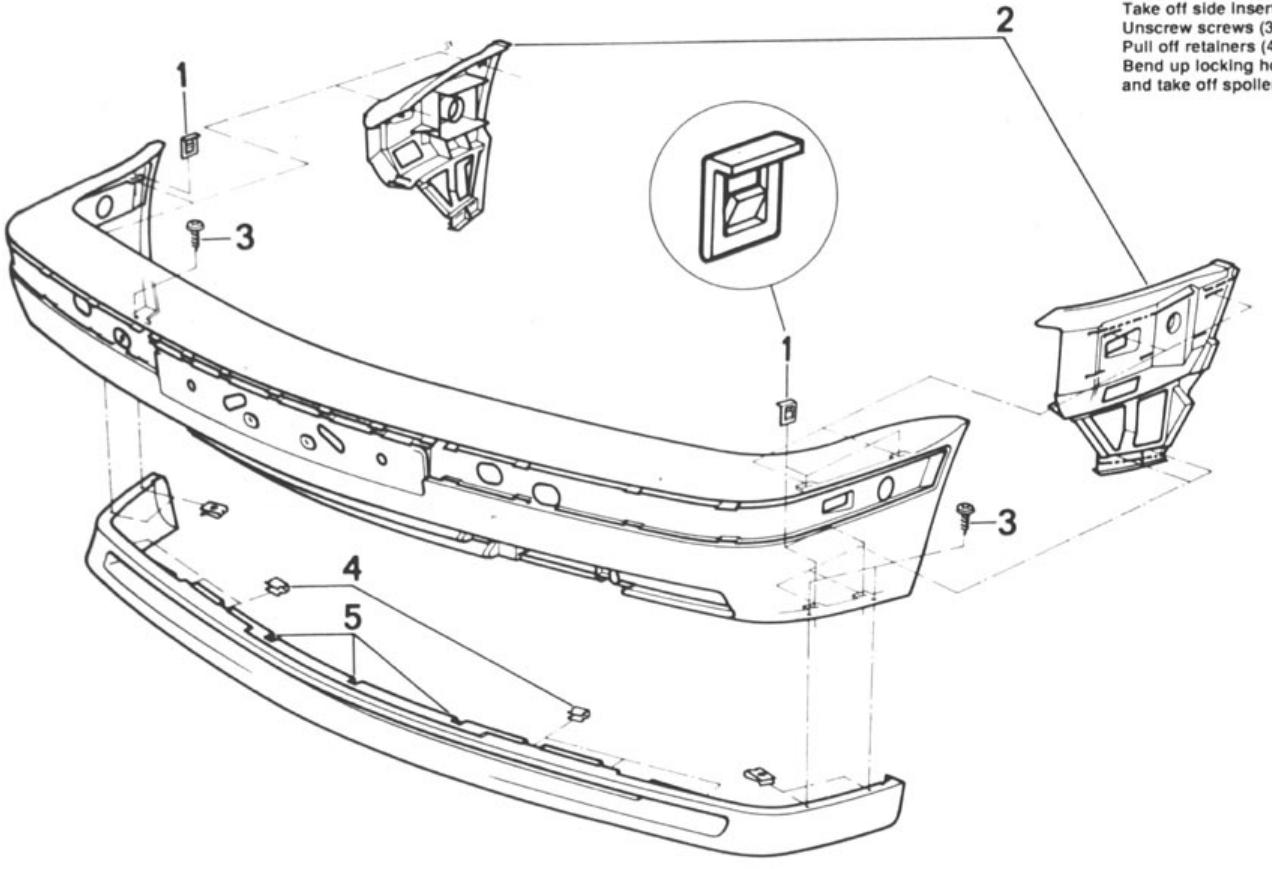


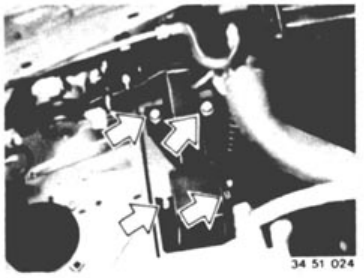
34 51 065

Lift out mounting plugs.
Take off trim panel.

51 11 . . . REMOVING AND INSTALLING SPOILER (M 5)

Remove front bumper – see 51 11 . . ..
Press locking hooks into wedges (1) and pull out wedges from above.
Take off side inserts (2).
Unscrew screws (3).
Pull off retainers (4) toward rear.
Bend up locking hooks (5) on spoiler and take off spoiler forward.





34 51 024

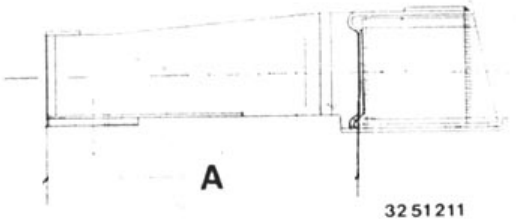
51 11 . . . REMOVING AND INSTALLING OR CHECKING IMPACT BOX AND IMPACT ABSORBERS

Remove bumper - see 51 11 . . ..
Unscrew screws.
Remove impact box.

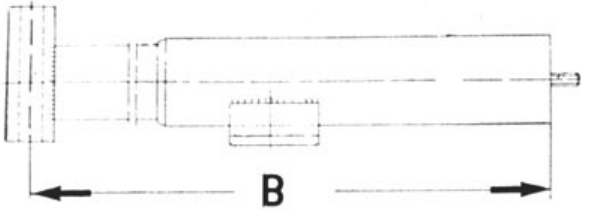
Installation:
Tightening torque*.

Control distance "A" = 166 ± 2 mm (6.535 ± 0.079") must not be exceeded, if the front bumper was replaced after repairing a car damaged in an accident (impact box is shown schematically).

Distance "B" for impact absorbers = 271 ± 2 mm (10.669 ± 0.079").



32 51 211

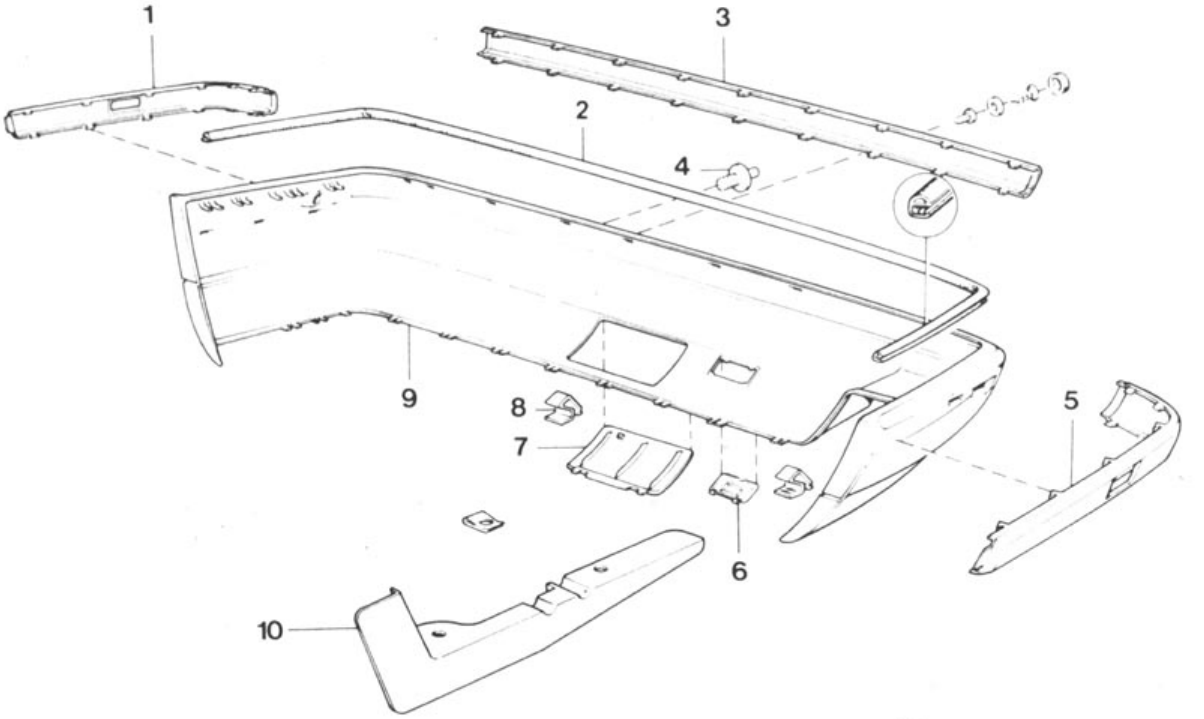


34 51 166

51 12 . . . REMOVING AND INSTALLING AND DISASSEMBLING REAR BUMPER

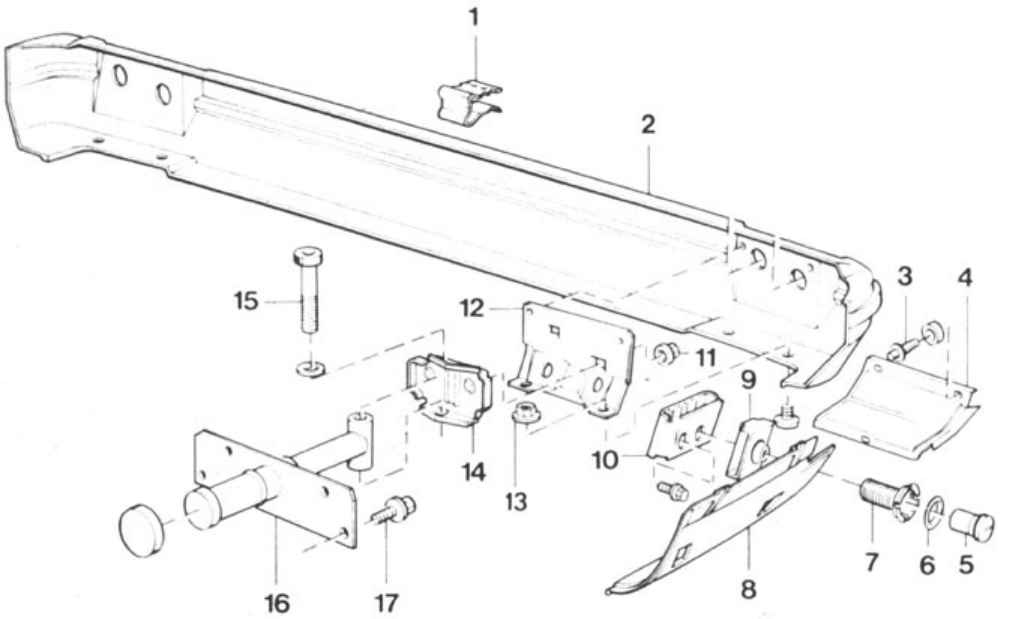
Survey of Bumper and Mounting Parts

1 Rubber guard, right
2 Rubber seal
3 Rubber guard, center
4 Mounting plug
5 Rubber guard, left
6 Cover for towing hook
7 Cover for trailer hitch
8 Mounting clip
9 Trim panel
10 Heat shield



34 51 011

51 12 . . . SURVEY OF REAR BUMPER AND MOUNTING PARTS



34 51 012

1 Mounting clip
2 Member
3 Mounting plug
4 Heat shield
5 Retaining cap
6 O-ring
7 Threaded sleeve
8 Heat shield
9 Slide
10 Bracket
11 Hexagon nut
12 Bracket
13 Hexagon nut
14 Bracket
15 Fillister head bolt
16 Impact absorber
17 Hexagon head screw



34 15 148

Lift off rubber guard carefully.



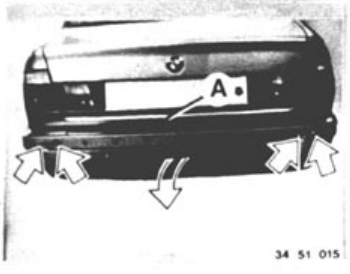
34 51 013

If applicable, lift off rubber guards on left and right sides.



34 51 014

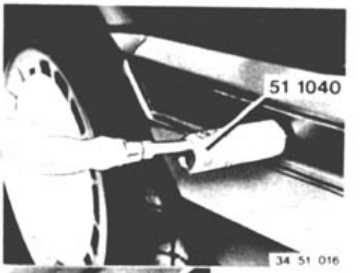
Installation:
Hook and clip in rubber guard on sides.



34 51 015

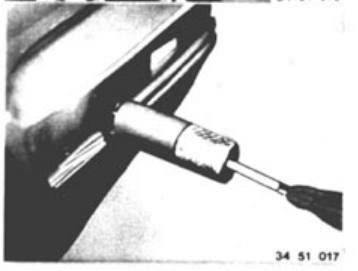
Unscrew bolts on left and right sides.
Remove bumper.
Installation:
Tightening torque*.
Check distance "A" = 5 to 6 mm (0.197 to 0.236") all around, adjusting if necessary.

* See Specifications



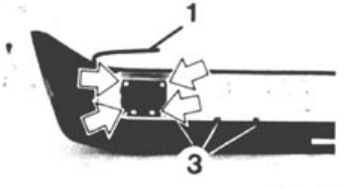
34 51 016

Installation:
If necessary, adjust bumper to be flush with the body with Special Tool 51 10 40.



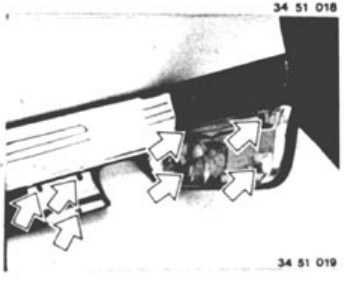
34 51 017

Note:
Turn threaded sleeve with Special Tool 51 10 40 and hold retaining cap tight with a screwdriver.



34 51 018

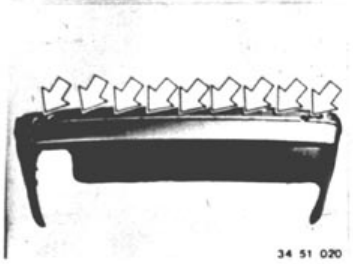
Pull off rubber seal (1).
Unscrew bolts.
Remove reinforcement (2).
Lift out clips (3).
Installation:
Tightening torque*.



34 51 019

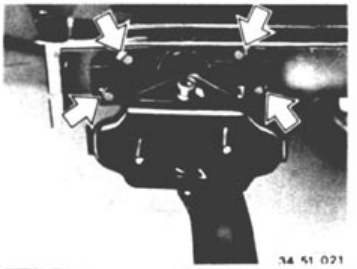
Lift out mounting plugs.
Remove heat shields.

* See Specifications



34 51 020

Lift out mounting plugs.
Take off trim panel.

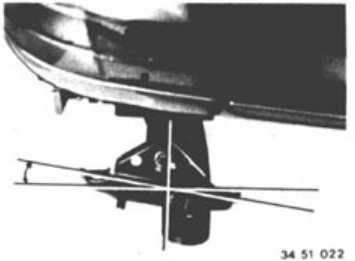


34 51 021

51 12 . . . REMOVING AND INSTALLING OR CHECKING IMPACT ABSORBERS

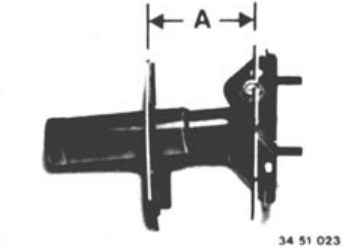
Remove bumper - see 51 12 . . ..
Unscrew bolts.
Lift out impact absorbers.

Installation:
Tightening torque*.



34 51 022

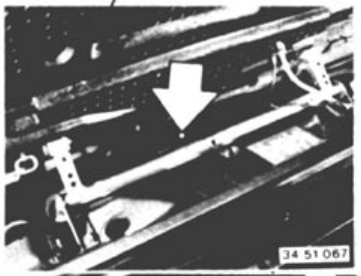
Installation:
Align bracket on impact absorber when necessary by loosening bolt (1).
Mount bumper and align bracket.
Take off bumper again.
Tighten bolt (1).
Tightening torque*.



34 51 023

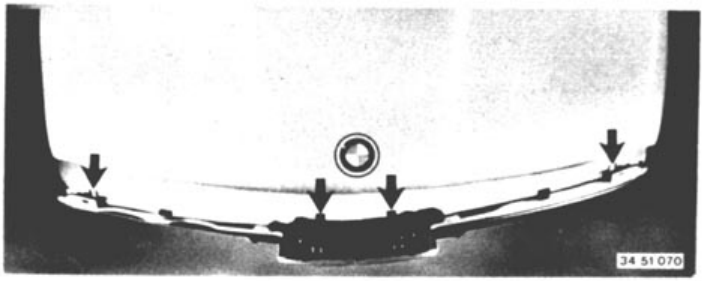
Checking Impact Absorbers:
Check that distance "A" is 98 ± 0.5 mm (3.858 ± 0.020") after repairing a car which was damaged in an accident.

* See Specifications



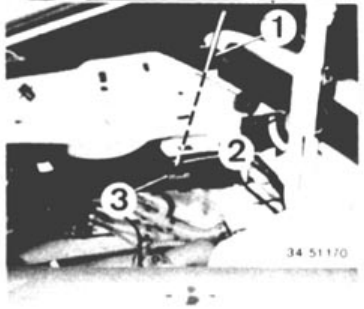
51 13 000 REMOVING AND INSTALLING CENTER RADIATOR GRILL SECTION

Raise engine hood.
Unscrew screw.



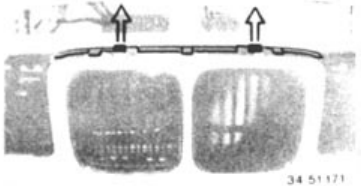
IView of Mounting Clips

Installation:
Clip on sides of radiator grill first.



Guide screwdriver (max. length = approx. 250 mm or 10" / max. blade width = 8 mm or 0.315") on left and right sides through opening (1) and bore (2).
Press down locking hook (3), while pulling the front panel forward.

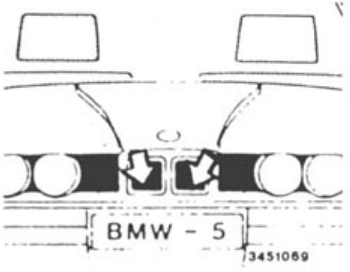
Note:
Headlight assembly was removed for the picture.



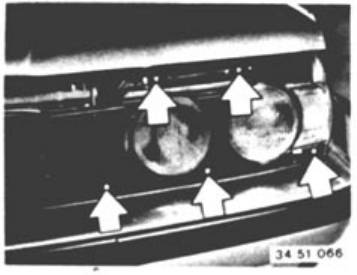
Bend up clips and top of front panel forward.

Bend open retainers.
Take off radiator grill.





Press down clips and take off front panel forward.

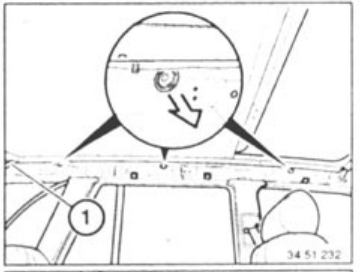


51 13 040 REMOVING AND INSTALLING SIDE RADIATOR GRILL SECTION

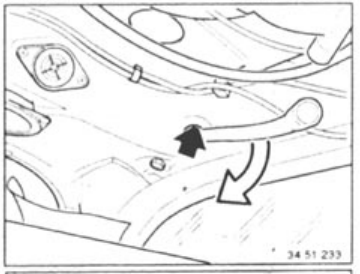
Remove center radiator grill section – see 51 13 000.
Unscrew screws.
Take off grill.

51 13 305 REMOVING AND INSTALLING / REPLACING LEFT OR RIGHT REELING

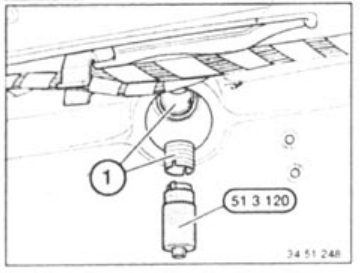
Remove roof liner at front and rear - refer to 51 44 041 and 51 44 043.
Remove left or right roof liner section - refer to 51 44 042.

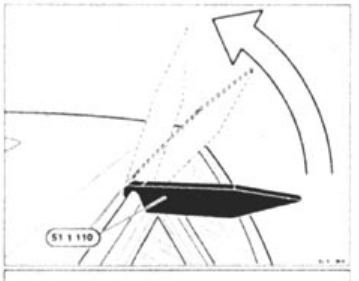


Remove rubber plugs and unscrew screws.
Loosen rear hose clamp (1) and pull the water drain hose off.



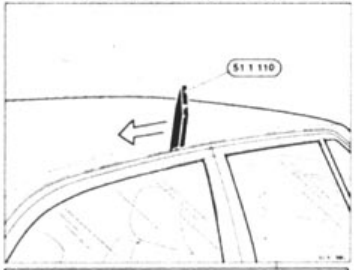
Press the water hose downwards and unscrew the screw.
Remove the roof reeling.





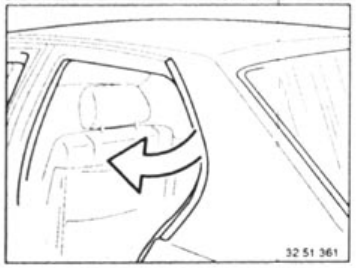
51 13 336 REPLACING LEFT OR RIGHT FRONT RAIN CHANNEL STRIP

Removing:
Apply Special Tool 51 1 110 in the rain channel and swing it upwards.

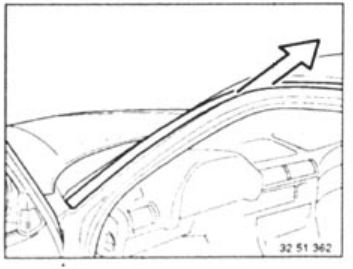


Caution!
Don't scratch the rain channel (paint)!

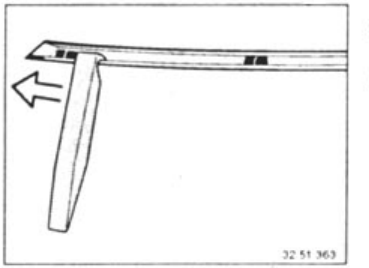
Push the clips separately forward into the cowl panel (A-pillar).



Open the rear door and unclip the plate (C-pillar).

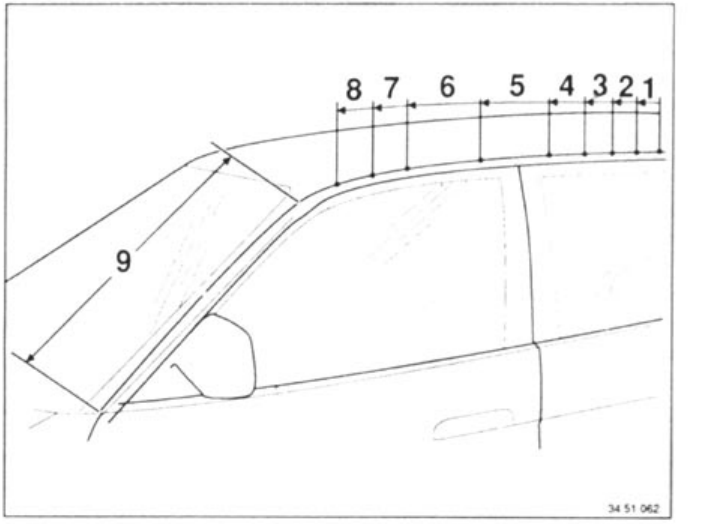


Open the front door, pull the rain channel strip forward slightly and pull it upwards off of the cowl panel.



Slide the clips out of the rain channel strip.

Installation:
Always replace damaged clips!



Installing:
Install clips on the rain channel.

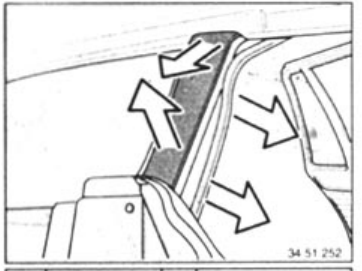
Clip Spacing Distances:

1	= 42 mm	from strip/plate (C-pillar) joint
2 / 3	= 60 mm	
4 / 5 / 6	= 195 mm	
7 / 8	= 60 mm	
9	= 4 clips spaced uniformly	

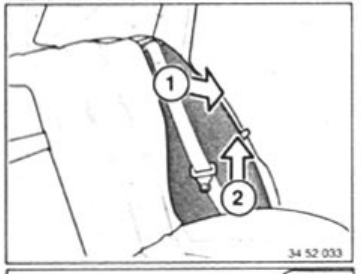
Gap between the C-pillar plate and rain channel strip: max. 0.2 mm.

Apply the rain channel strip and clip the C-pillar plate in.
Beginning at the rear, press down on the rain channel strip until it snaps into the clips.

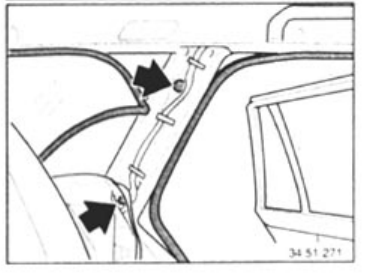
51 13 365 REMOVING AND INSTALLING PANEL ON LEFT OR RIGHT REAR ROOF PILLAR (C-Pillar)
51 13 366 REPLACING PANEL ON ROOF PILLAR (C-Pillar)



Pull off edge guards in rear door opening and on side window partially.
Unclip C-pillar panel.



Unclip (1) and lift out (2) backrest side section.



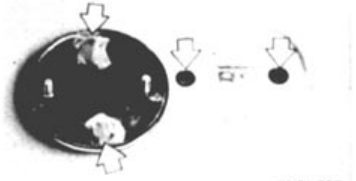
Lift out caps and unscrew screws.
Remove C-pillar panel on outside and pull it out of seal.

51 14 000 REMOVING AND INSTALLING FRONT BMW EMBLEM



Lift out emblem carefully.

Installation:
Replace plastic clip, if necessary.
Use Terostat tape, if necessary.



51 14 010 REMOVING AND INSTALLING REAR BMW EMBLEM



Lift out emblem carefully.

Installation:
Replace plastic clip, if necessary.
Use Terostat tape, if necessary.

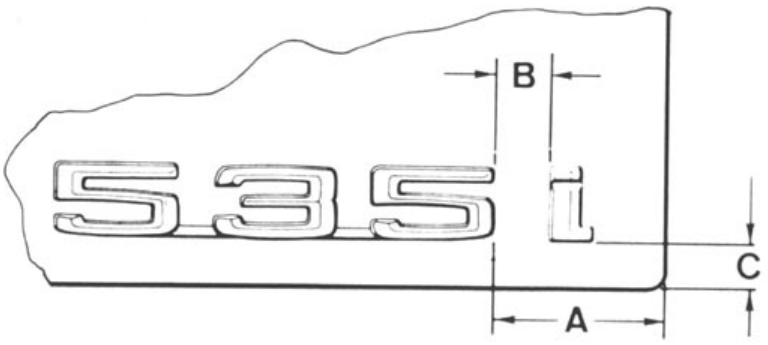
51 14 110 REPLACING REAR MODEL SIGN

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 on trunk lid with gasoline.
Model signs may only be installed 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.

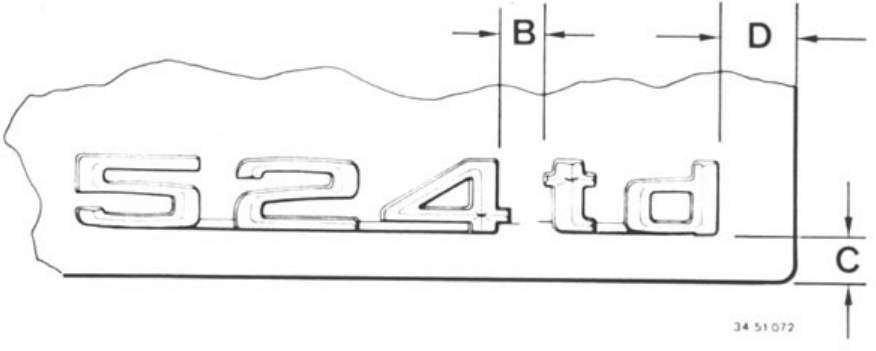
Distances in mm (inches).

BMW Models	A	B	C	D
520 i – 535 i	58 (2.283)	16 (0.630)	18 (0.709)	26 (1.024)
524 td		21 (0.827)	18 (0.709)	26 (1.024)

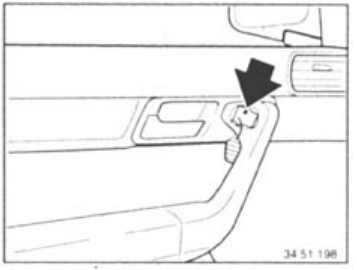
Note:
Model sign must be removed when baking paint at temperatures above 80° C (175° F).



34 51 071

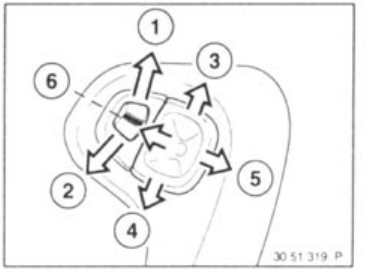


34 51 072



51 16 000 REMOVING AND INSTALLING OR REPLACING MIRROR ON LEFT OR RIGHT FRONT DOOR

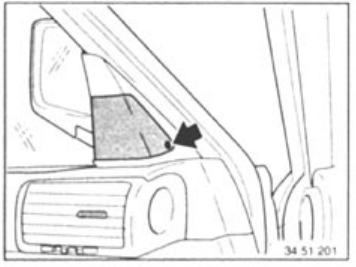
Unclip cap at bottom.
Push up and remove cap.



Installation:
Switch on ignition and check function.

Switch positions:
1 = Left outside mirror
2 = Right outside mirror

Mirror adjustments:
3/4 = Vertical plane
5/6 = Horizontal plane



Models with Sound System:

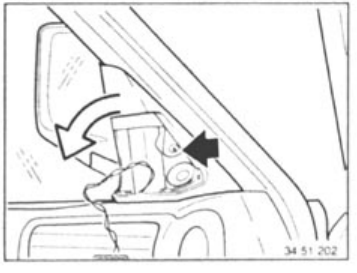
Unscrew screw.
Unclip loudspeaker at top and remove.
Pull plug off of loudspeaker.



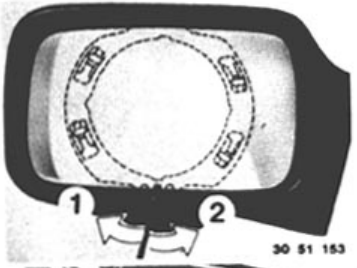
Pull foam rubber strips out of cover.



Unscrew screw.
Disconnect plug and remove mirror.



Unscrew screw and remove cover.





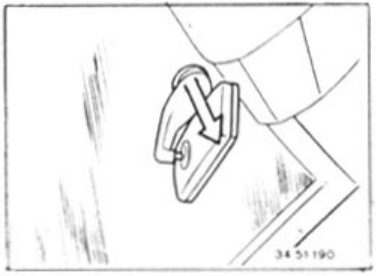
51 16 026 REPLACING GLASS FOR MIRROR

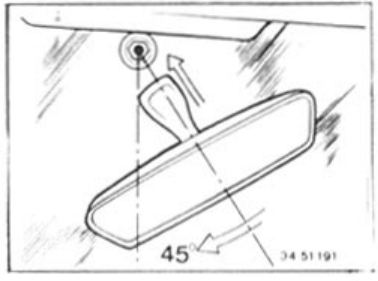
Insert screwdriver in housing opening (bottom) and turn the retaining ring.

1 = Unlocked
2 = Locked

Note:
Unlocking and locking will be noticed strongly when turning the retaining ring.

Heated Outside Mirror:
Pull off flat male plug and connect it on the new mirror glass.





51 16 060 REMOVING AND INSTALLING OR REPLACING MIRROR ON INSIDE OF CAR

Pull mirror back off of the mirror socket.

Installation:
1. Connect mirror base on the mirror socket with an approx. 45° turn.
2. Turn mirror base until it engages on the mirror socket.

51 16 ... CEMENTING MIRROR BASE

Material Requirements:

Mirror base cementing repair kit*
Primer XW 775*

1. Preparations

1.1 Cement at room temperature and make sure that in cold weather the window glass and base are brought to room temperature in the workshop long enough, in order to prevent moisture on the surface.

1.2 Mark position of mirror base on outside of the windshield.
Scratch off old cement on glass and base with a sharp tool.

1.3 Thoroughly clean cementing surface on glass and base with a clean shear wool cloth and alcohol cetone and let suface dry!
Never use paint thinners!

2. Primer Coat

Apply colorless, diluted primer on surface of windshield intended for cementing with help of cotton tips (Q-Tips or something similar).

Air drying time: at least 1 minute, max. 1 hour.

3. Cement Coat

3.1 Mixing Cement

Cut off sealing tips on containers of cement and hardener using a knife. Make sure that both openings are equal in size, as otherwise there would be mistakes in mixing.

The sealing cap for subsequent plugging of the double injector is located between both pistons of the injector. Break off sealing cap.

The required amount of cement and hardener is removed by applying light pressure on the pistons. The mixing ratio for cement and hardener is 1 to 1 (weight and volume). It is important that the same volumes of cement and hardener are removed (increase size of openings if necessary).

Both components react chemically with each other, Thorough, intensive and homogenous 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

At 20 to 25° C the mixture has an application time (potlife) of about 5 to 10 minutes. Apply a thin (approx. 0.5 mm thick) and uniform coat of cement on the base using 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.

3.3 Fixing Bonded Parts

Epoxide resin cements do not have an initial strength property. This makes the fixing of bonded parts necessary (adhesive tape or something similar).
The joining and fixing of bonded parts must be accomplished within the toplife.
Check that the arresting button is positioned correctly on the mirror base, 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 at the earliest after 12 hours.

4. Working Hygiene

Caution!
Cement is dangerous for health when vapors are inhaled or through 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.

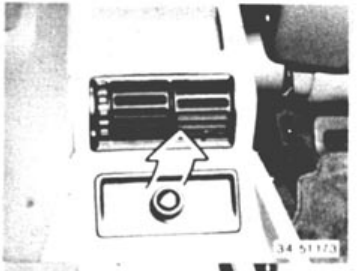
If the product gets on the skin, wash off with water and soap immediately.
If it gets in an eye, rinse the concerned eye thoroughly in water and go to a physician.

Make sure that the room is well ventilated and gloves are worn for the application of cement.

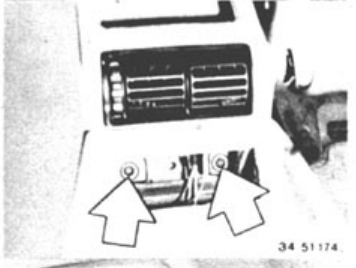
* Source of Supply: BMW Parts

51 16 200 REMOVING AND INSTALLING CENTER CONSOLE

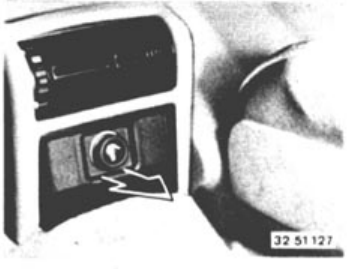
Remove trim panel for dashboard at bottom left.



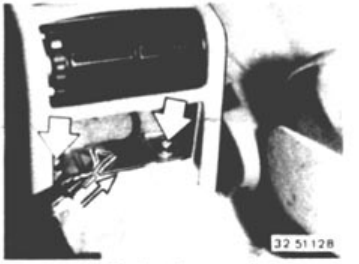
M 5:
Remove rear seat center armrest – see Group 52.
Lift out plate.
Pull off plugs.



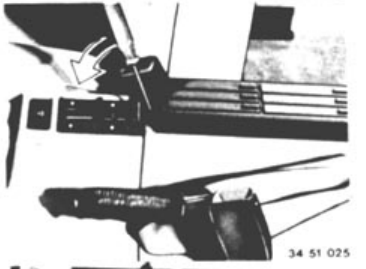
Unscrew screws.
Remove center console.



Lift out plate.



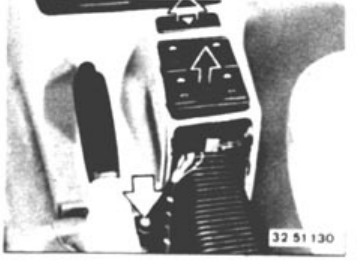
Pull off plugs.
Unscrew screws.



If applicable, lift out cassette box and pull off electric leads for lighting.



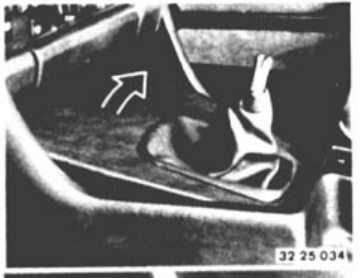
Lift trim panel off of parking brake lever.
Lift out plate (1).
Unscrew screws.
Lift out rear center console section.



Unscrew screw.
Lift out switch.



Pull off plugs.



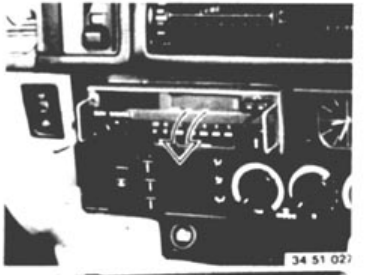
Cars with Manual Transmission:
Pull off shift lever knob.
Lift out dust cover.
Remove cover.



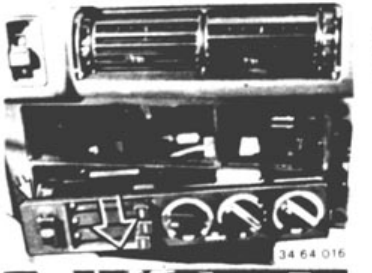
Cars with Automatic Transmission:
Unscrew screw.
Pull off selector lever.



Lift out cover.
Pull off plug.



If applicable, remove radio – see Group 65.



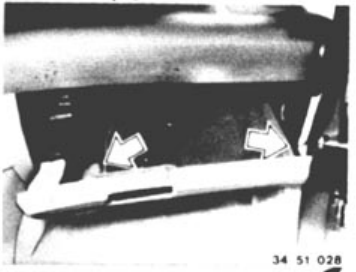
Lift out heater controls.
Pull off plugs.
Refer to Group 64.



Unscrew screws and lift out trim panels on left and right sides.

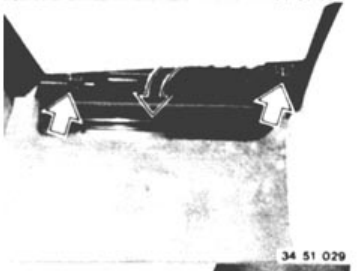


Lift out plate.
Unscrew screws.
Lift out center console.



51 16 360 REMOVING AND INSTALLING GLOVE BOX

Lift out clips.
Pull off retaining straps.



Unlock holders on left and right sides.
Lift out glove box.



Installation:
Guide in lock with tab facing forward.



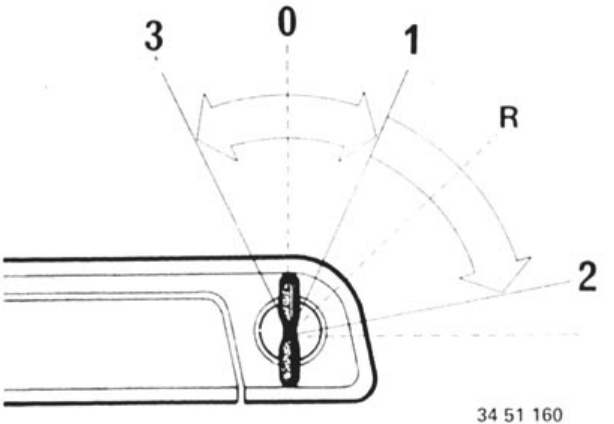
Installation:
Align and clip in glove box in closed state (shown removed in picture).

51 21 . . . REMOVING AND INSTALLING AND DISASSEMBLING FRONT DOOR OUTSIDE HANDLE COMPLETE WITH LOCK CYLINDER / INCLUDING DESCRIPTION OF FUNCTION

Electronic central locking (ZV) unlocks and locks all four doors, trunk lid and tank flap. It can be initiated from the locks of the front doors and trunk lid.

Central arresting (ZS) prevents the pulling up of catch buttons on the doors. Central arresting (or double locking) is only possible from the locks of both front doors.

Three microswitches each are operated via the lock cylinder mechanisms of both front doors.



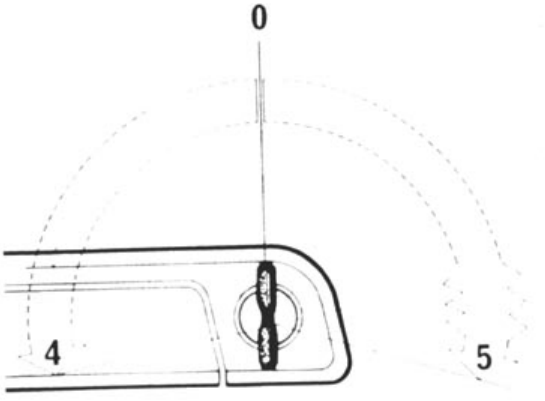
34 51 160

1 = Locking, the first microswitch responds. Key turned about 25° and the "locking" function is activated.
R = Catch, intermediate position for "arresting", the second microswitch responds, Key turned about 45° and the "arresting" function is activated.
2 = Arresting, key turned about 85°.
3 = Unlocking, the second microswitch responds again. Key turned counter-clockwise about 25° and the "unlocking" function is activated. Key can be pulled out only in position "0".

Unlocking or Locking Mechanically:

Both front doors can be unlocked or locked mechanically in case of faults in the central locking system or failure of the car's battery.

Note:
If locked, only the front passenger's door of cars produced after 9/89 can be unlocked mechanically.



34 51 161

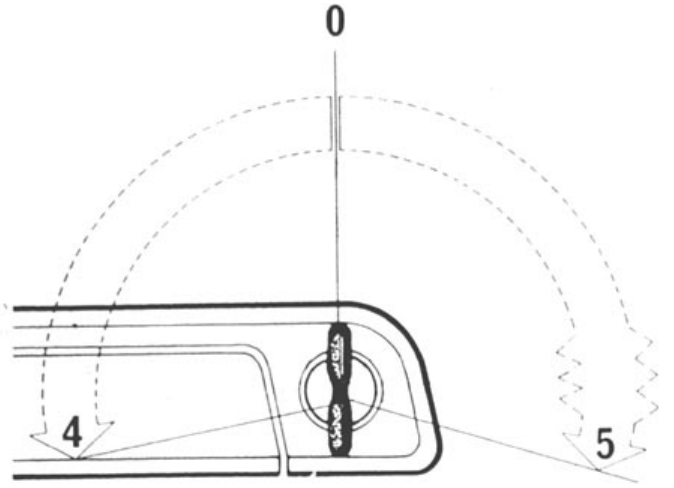
4 = Mechanical unlocking, door handle lifted and key turned past noticable resistance to position "4" (about 110°).
5 = Mechanical locking, key turned past noticable resistance to position "5" (about 110°).

SYNCHRONIZATION OF LOCKS:

Synchronization of the lock is necessary if the locking system is "asynchronous".

The locks are "asynchronous", if for example:

- The lock of a door in an activated locking system was unlocked mechanicallyly (only still possible on the front passenger's door of vehicles produced since 9/89).
- The locks had been locked centrally with the driver's door open (in vehicles produced since 9/89 central locking with an opened driver's door is possible, without making the locks "asynchronous").



34 51 161

Synchronizing Locks ((only still possible on the front passenger's door of vehicles produced since 9/89):

- Lock the locks mechanically (double-lock) by turning the key beyond noticeable resistance into position (5) (approximately 110°).



Caution!

The lock cylinder can only be removed and installed with the main key!

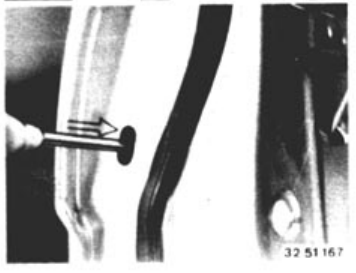
Installation note:
Check function,
refer to 51 26 ...

Remove door trim panel at front,
refer to 51 41 000.
Close door window.



Caution!
For safety reasons, disconnect plug connector from window regulator motor.

Lift out covering.

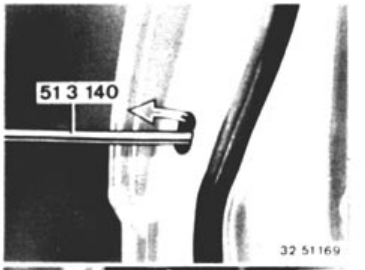


Push forward catch with special tool 51 3 190.

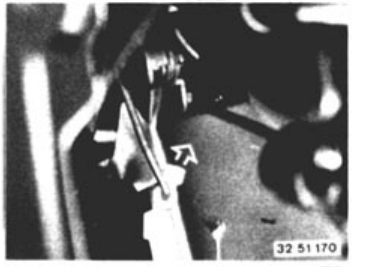
Note:
Secure handle finisher panel to prevent it dropping.



Installation note:
Ensure the rubber seal is fitted correctly.
Press handle finisher panel against body.

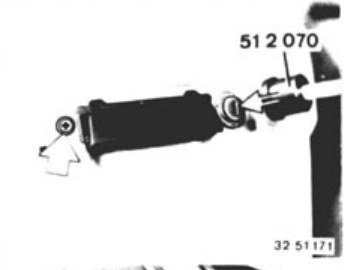


Installation note:
Pull in catch with special tool 51 3 190.

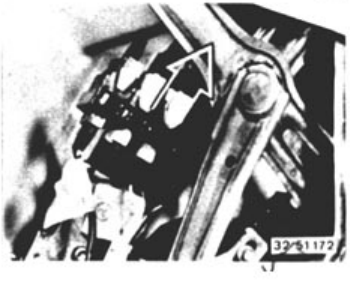


Lift out retainer.
Detach linkage.

Installation note:
Rotary latch in position "closed", lock in position "closed".

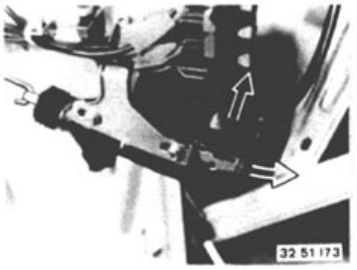


Release screw.
Release nut with tool 51 2 070.
Lift out complete door handle.

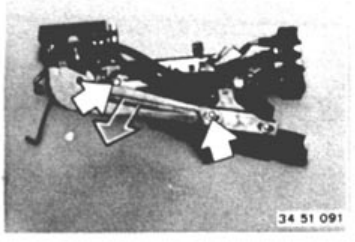


Disconnect plug connector.

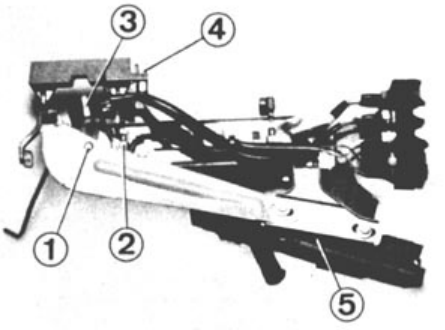
Installation note:
Formed plug connectors only fit in mating socket.



Push the retainer back.
Pull the plug off.



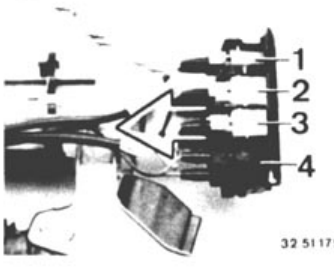
Unscrew the screws.
Remove the metal panel.



34 51 075

View of Door Handle Assembly:

1 = Lock cylinder
2 = Door lock heater
3 = Microswitch
(locking contacts)
4 = Microswitch
(door lock heater)
5 = Central lock drive
(basic setting about the center of the slot)



32 51 175

Cut off wire strap.
Open the plug receptacle.
Disconnect the plug.

1 = Door lock heater microswitch
2 = Door lock heater
3 = Locking contact
4 = Terminal 30 and burglar alarm

Installation:
Check for correct seating of the locking hooks.



Caution!
Clamp has strong spring force.
Wear protective goggles.

Lift the clamp out.
Remove the microswitch.



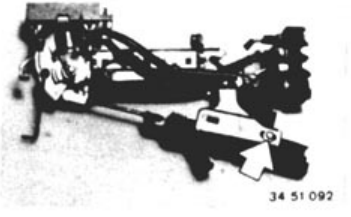
Caution!
Clamp has strong spring force.
Wear protective goggles.

Lift the clamp out.
Remove the microswitch together with the housing..

Installation:
Microswitches are marked with
L for left or
R for right.

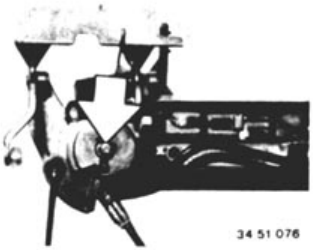


Remove microswitch.



Unscrew screws.
Lift the drive out.

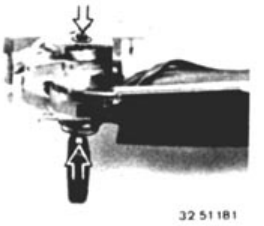
Installation:
Adjust drive - refer to 51 26 . . ..



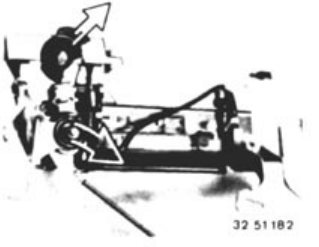
Disassembling Lock Cylinder:
Insert the master key into the lock cylinder.

Note:
Correct removal and installation of the lock cylinder are only possible with the master key!

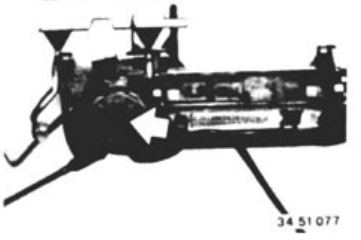
Important!
Don't damage the notched pin and bore.
Press the notched pin out using a pointed pliers (don't knock it out!).



Squeeze the lock cylinder together (slight tension).



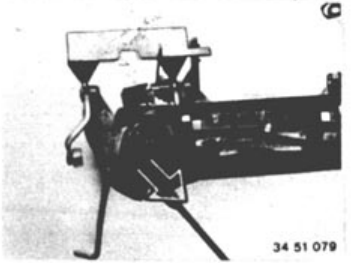
Lift the cam sleeve off carefully so that the spring remains in the cam sleeve.



Installation:
Insert the cam sleeve correctly.

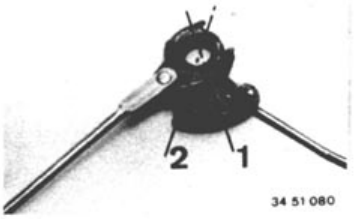

34 51 078

Installation:
Insert the spring correctly.


34 51 079

Lift the complete emergency unlocking mechanism off of the linkage and do not disassemble further if possible.

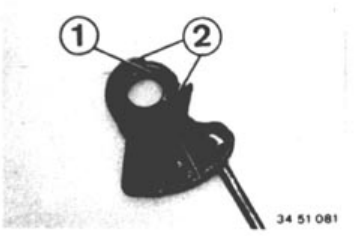
Note:
The emergency unlocking mechanism is only installed on the front passenger's side of vehicles produced since 9/89. This emergency unlocking mechanism is then a single component which cannot be disassembled.



34 51 080

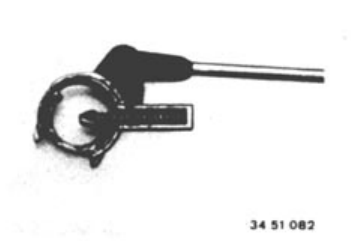
Installation:
Assemble the emergency unlocking mechanism in normal position.

1 = Normal position
2 = Emergency unlocked position



34 51 081

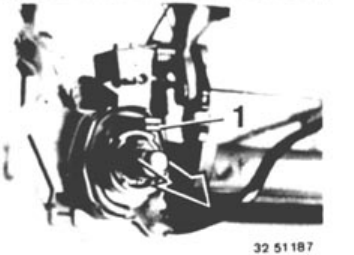
Installation:
Adjust groove (1) to the center of opening (2).
The letter (L for left or R for right) on the washer faces up.


34 51 082

Installation:
Install the catch in such a manner that the wedge tip points away from the spring like an arrow.


34 51 083

Installation:
Assemble the emergency unlocking mechanism.



32 51 187

Lift the sleeve out carefully.

Installation:
Install the sleeve with tongue (1) facing up.


32 51 188

Pull the lock cylinder out carefully.

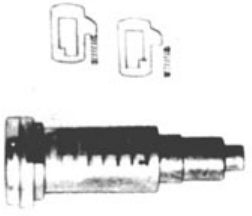
Installation:
Push the key retainer down using a pointed item.
Push the lock cylinder in completely and hold it in until the notched pin is inserted into the cam sleeve.



Hold the spring and ball in position with grease*.
Check for correct seating of the ball and spring.

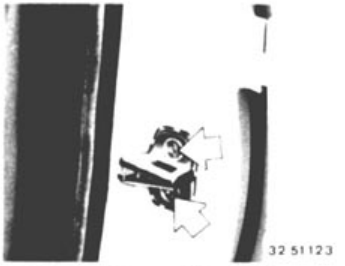


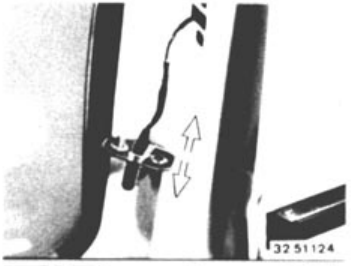
Installation:
The flat side of the lock cylinder faces up.
Lubricate the tumblers with grease*.

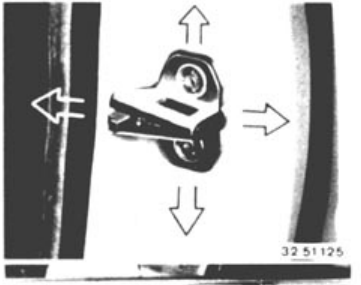


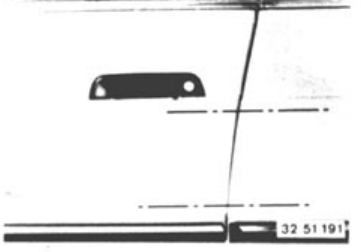
When using a repair kit lock cylinder, the old tumblers must be used as samples.
Take the tumbler out of the old lock cylinder and note the stamped number.
Insert new tumbler having the same stamped number in the pertinent chamber together with new spring and supplied grease.
Proceed in the same manner with the remaining tumblers.

* Source of Supply: BMW Parts









51 21 003 REPLACING LEFT OR RIGHT FRONT DOOR STRIKER

Mark the installed position of the door striker with a pencil.

Important!
Prevent the threaded plate in the B-pillar from falling down.

Unscrew screws and remove the door striker.

Installation:
Tightening torque*.

Disconnect the plug.

Installation:
Check the switch.

Switch opened = continuity.
Switch pressed = break.

Installation:
Screw the door striker on lightly and align it with the door lock.

Installation:
Adjust the door striker that the outside surface of the closed front door is 1 mm further out than the outside surface of the rear door.

* Refer to Specifications

51 21 090 REMOVING AND INSTALLING / REPLACING LEFT OR RIGHT FRONT DOOR LOCK

Installation:
Check function.

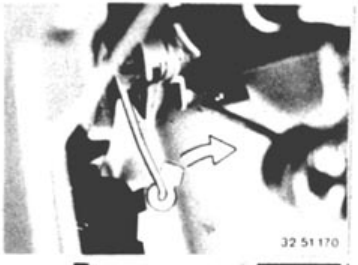
Remove front door trim panel - refer to 51 41 000.
Raise the door window.

Caution!
Disconnect the power window motor plug in the interest of safety.

Pull the lower window guide out of the window guide rail.
Unscrew screw.
Pull the window guide rail downwards.

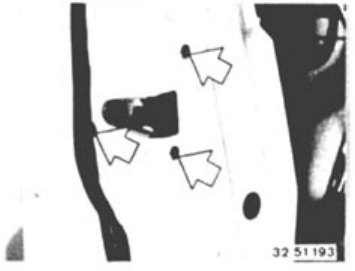

34 51 186

Installation:
Attach the window guide rail at top in the opening of the door panel with the hook.
Check for correct seating.

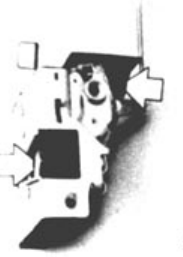

32 51 170

Remove the retainer.
Disconnect the linkage.

Installation:
Rotary latch in "locked position and lock in "locked" position.

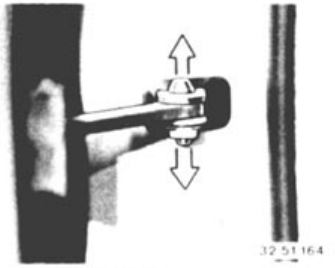

32 51 193

Pull the rubber door seal off partially.
Unscrew screws.
Remove the door lock.


32 51 194

Installation:
Lubricate the door lock with grease*.
Check function.

* Source of Supply: BMW Parts

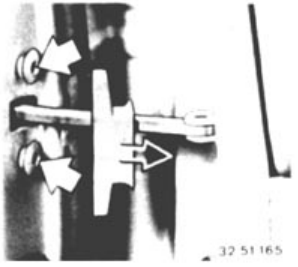


51 21 280 REMOVING AND INSTALLING FRONT DOOR RETARDER

Remove front door trim panel - refer to 51 41 000.

Caution!
Disconnect the power window motor plug in the interest of safety.

Unscrew the lockplate.
Drive the pin out upwards.



Lift the rubber cover out.
Unscrew screws and remove the door retarder towards the inside.

Installation:
Lubricate the door retarder with grease*.

* Source of Supply: BMW Parts

66 10 ... REPLACING BATTERIES FOR INFRARED SENDER



32 51 220

Fold the key out.
Unscrew screw.



32 51 221

Fold the key in.
Swing the cover out.



32 51 222

Important!
If the battery replacement described below is accomplished within one minute, the system does not have to be initialized again!

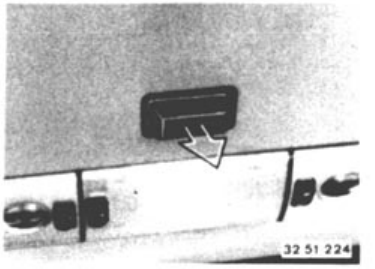
Unscrew screw.
Remove batteries.



32 51 223

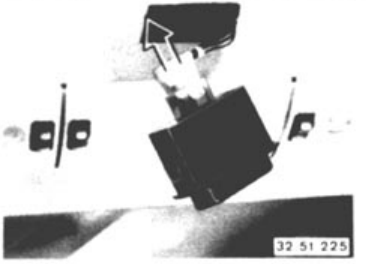
Installation:
Insert the batteries correctly.

66 10 ... REMOVING AND INSTALLING INFRARED RECEIVER



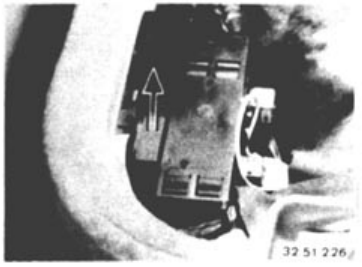
32 51 224

Pull the receiver out.



32 51 225

Disconnect the plug.



66 10 ... REMOVING AND INSTALLING INFRARED LOGIC UNIT

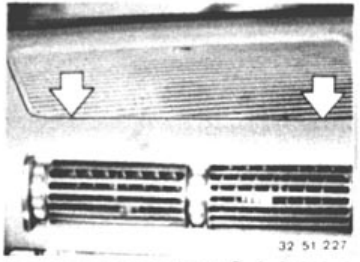
Remove the left rear seat (or rear seat cushion) - refer to Group 52.
Pull the infrared logic unit out.



66 10 ... REMOVING AND INSTALLING KEY BIT

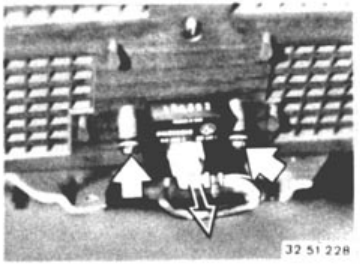
Spare infrared senders can be supplied without the key bit.
To exchange the key bit, unscrew the screw and transfer the key bit.

Installation:
Use a new screw and lock at end of threads.



66 10 ... REMOVING AND INSTALLING DISPLAY UNIT

Unscrew screws.
Remove ventilation grill.

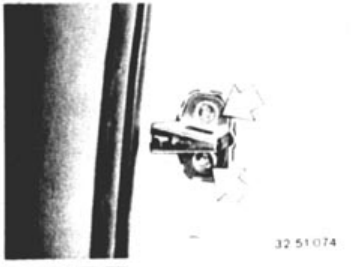


Disconnect the plug.
Unscrew screws and lift the display unit out.

51 22 001 REPLACING (ADJUSTING) LEFT OR RIGHT REAR DOOR STRIKER



Installation:
Adjust door striker that outside surface of closed door is 1 mm further out than outside surface of rear side panel.
Tighten door striker screws.
Tighten torque*.



Note:
If necessary, mark installed position with a pencil.

Unscrew screws and lift out door striker.

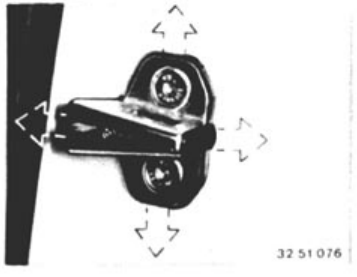
Installation:
Tightening torque*.



Disconnect plug.

Installation:
Check switch.

Switch opened = power flow
Switch pressed = interruption



Installation:
Screw on door striker only finger tight and align with door lock.

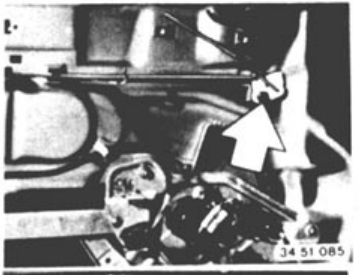
* Refer to Specifications

* Refer to Specifications

51 22 090 REMOVING AND INSTALLING LEFT OR RIGHT REAR DOOR LOCK

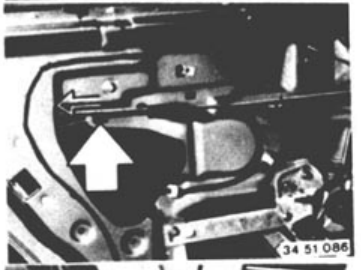
Installation:
Check function.

Remove door trim panel - refer to 51 42 000.

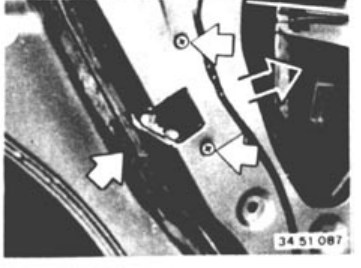


Caution!
Disconnect plug on power window motor in the interest of safety.

Unscrew screw.

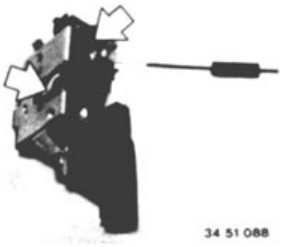


Lift out clip.
Disconnect cable.



Unscrew screws.
Remove lock.

Installation:
Tightening torque*.



Installation:
Lubricate door lock with grease**.
Check function.

* Refer to Specifications

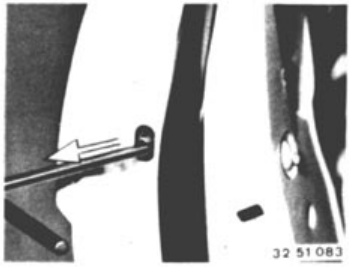
** Source of Supply: BMW Parts

51 22 170 Removing and installing or replacing outer handle of left or right rear door

Installation note:
Check function

Remove door trim panel, refer to 51 42 000.

Caution!
For safety reasons, disconnect plug connector from window regulator motor.


32 51 083

Installation note:
Pull in catch with special tool 51 3 190.

Release screws and remove outside handle.

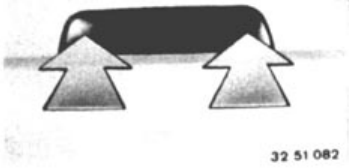

32 51 084


32 51 081

Lift out covering.
Push forward catch with special tool 51 3 190.

Note:
Secure handle finisher panel to prevent it dropping.

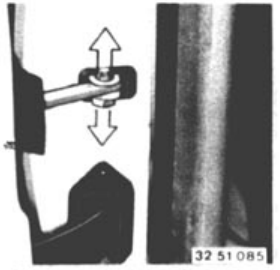
Installation note:
Check handle finisher panel is fitted correctly and press against body.


32 51 082

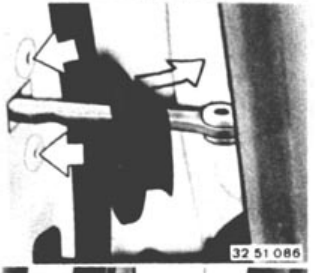
51 22 280 REMOVING AND INSTALLING OR REPLACING LEFT OR RIGHT REAR DOOR RETARDER

Remove door trim panel - refer to 51 4" 000.

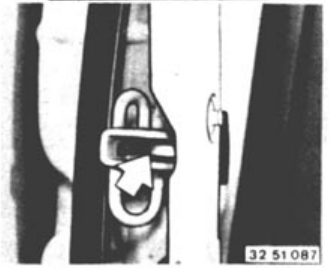
Caution!
Disconnect the power window motor plug in the interest of safety.



Unscrew lockplate.
Drive out pin upwards.

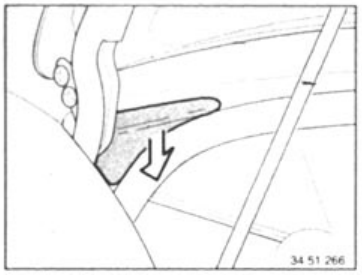


Lift out rubber cover.
Unscrew screws and remove door retarder towards the inside.



Installation:
Lubricate door retarder with grease**.

** Source of Supply: BMW Parts

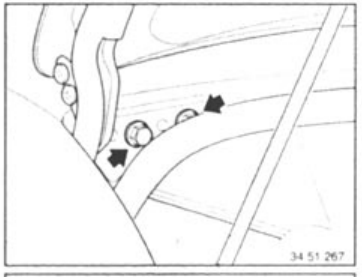


51 24 ... ADJUSTING TAILGATE (Touring)

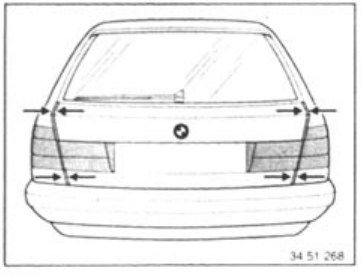
Remove tailgate gas pressure props - refer to 51 24 300.

Raise the tailgate.

Lift the plate out towards the rear.



Unscrew left and right screws.



Adjust the tailgate to have equal size gaps on the left and right sides and be flush with the body.

51 24 004 ADJUSTING TAILGATE LOCK (Touring)

The following parts must be removed or disconnected:

Requirement — tailgate adjusted correctly.

- Tailgate lock lower section (adjust)
- Stop pads

51 24 040 REMOVING AND INSTALLING / REPLACING TAILGATE LOCK AND LOCK SHACKLE (Touring)

The following parts must be removed or disconnacted:

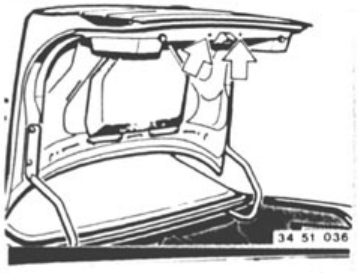
- Tailgate lock (adjust)
- Tailgate trim panel (remove)
- Lock upper section
- Operating rod
- Microswitch
- Drive motor
- Tailgate lock lower section



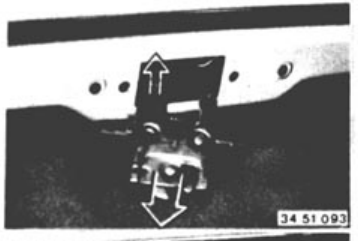
51 24 040 REMOVING AND INSTALLING / REPLACING TRUNK LID LOCK AND LOCK SHACKLE

Installation:
Check function.

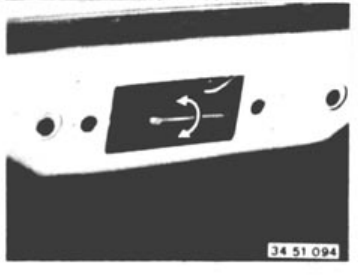
Pull the trim panel off partially.



Unscrew screws.



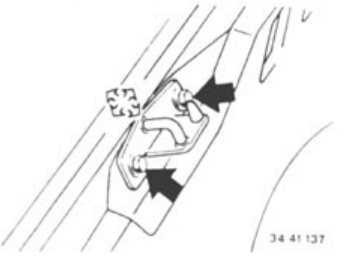
Disconnect the linkage.
Disconnect the plug.
Lift the trunk lid lock out (removed in the picture).



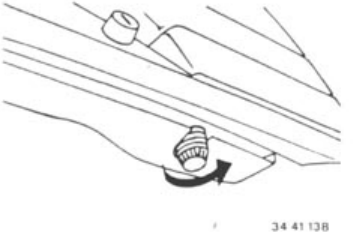
Installation:
If necessary, eliminate the linkage play by turning the ball socket.



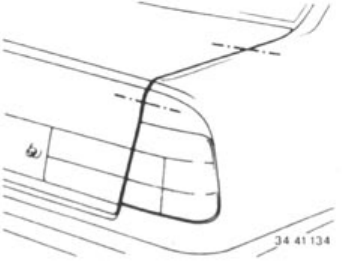
Lift the plate out.
Unscrew screws.



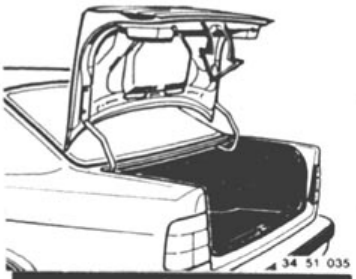
Adjust the lock shackle by sliding it in the slots.



Adjust the rubber pads by turning them to have the trunk lid bear on them with slight preload.



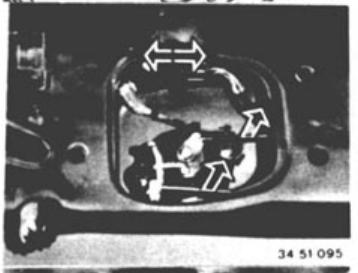
Checking:
The top surface of a closed trunk lid should be in the same plane as the edges of the side panels.


34 51 035

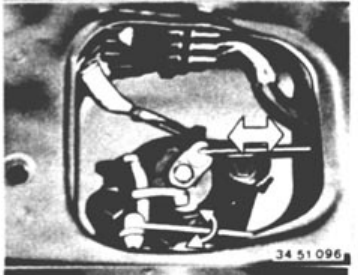
51 24 100 REMOVING AND INSTALLING / REPLACING TRUNK LID LOCK (LOCK CYLINDER)

Installation:
Check function.

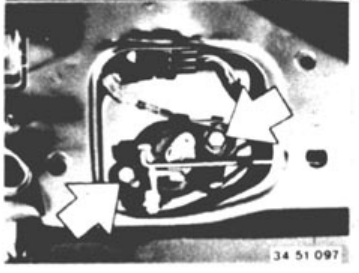
Pull the trim panel off partially.


34 51 095

Disconnect the plug.
Disengage the linkage.


34 51 096

Installation:
Eliminate linkage play by turning the ball socket on the trunk lid lock.
Adjust central lock drive - refer to 51 26 ...

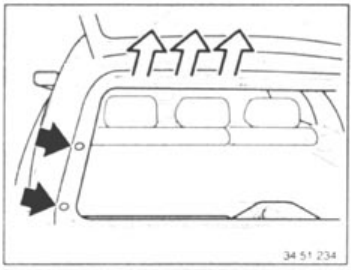

34 51 097

Unscrew screws.
Remove lock.

51 24 140 REMOVING AND INSTALLING / REPLACING TAILGATE WINDOW LOCK (Touring)

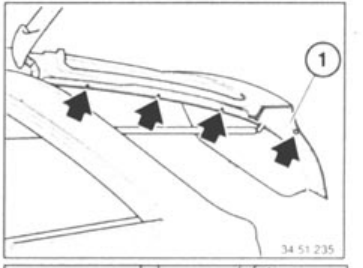
The following parts must be removed or disconnected:

- Tailgate trim panel
- Lock lower section
- Drive motor
- Microswitch



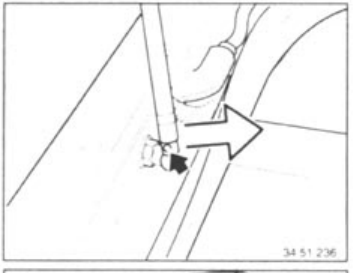
51 24 300 REMOVING AND INSTALLING / REPLACING LEFT OR RIGHT GAS PRESSURE PROP FOR TAILGATE (Touring)

Open the tailgate window.
Remove rubber pads (1) and unscrew the screws.
Remove the plate upwards.

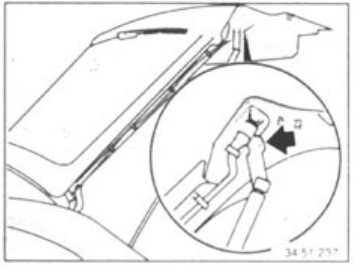


Raise the tailgate.
Unscrew screw (1) on the side and remove the plate.

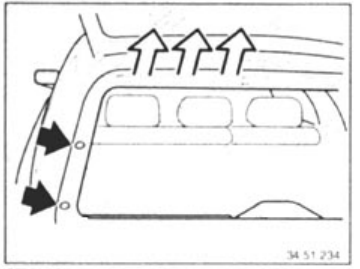
Installation:
Replace damaged clips if necessary.



Remove the spring retainer.
Lift the gas pressure prop out.

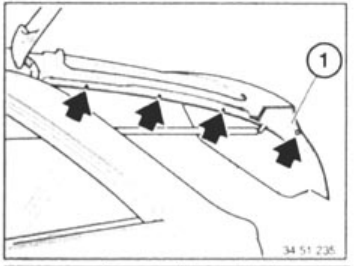


Unscrew screw and remove the gas pressure prop.



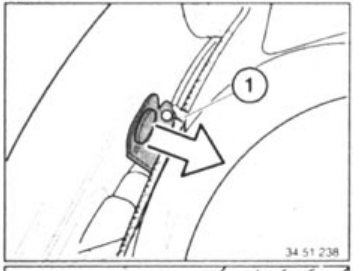
51 24 321 REMOVING AND INSTALLING / REPLACING LEFT OR RIGHT GAS PRESSURE PROP FOR TAILGATE WINDOW (Touring)

Open tailgate window.
Lift out rubber pads (1) and unscrew screws.
Lift out panel at top.

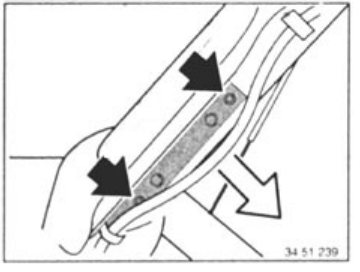


Raise tailgate.
Unscrew screw (1), lift out at side and remove panel.

Installation:
If necessary, replace damaged clips.

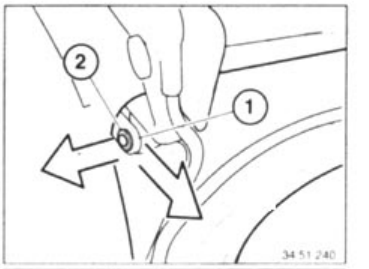


Loosen wire strap (1).
Unclip the clip towards the inside and remove the holder.

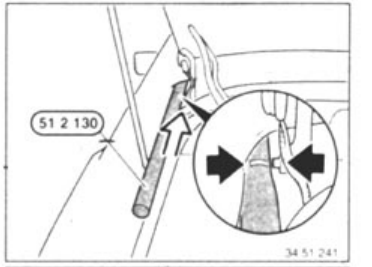


Push the hose aside slightly.
Unscrew screws and remove holder.

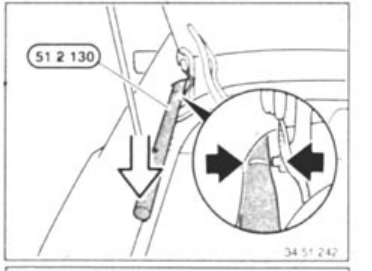
Installation:
Route the hose correctly.



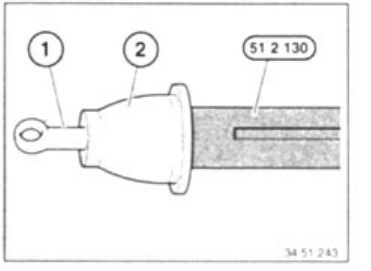
Pull off retainer (1).
Pull off gas pressure prop (2).



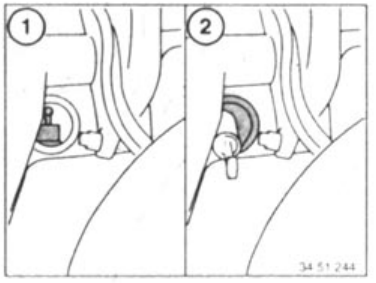
Slide Special Tool 51 2 130 over the gas pressure prop with the slot at bottom, until the mark is aligned with the pin.



Push the rear end of the special tool down to unclip the gas pressure prop.



Installation:
Slide new gas pressure prop (1) into the special tool and pull on rubber grommet (2). Replace a damaged rubber grommet if necessary.



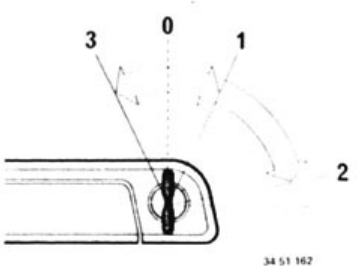
Installation:

Press new gas pressure prop onto nipple (1) and pull off installing rod carefully. Check for correct seating of rubber grommet (2).

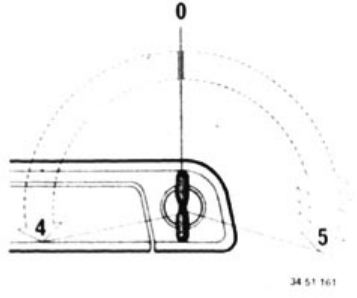
51 26 . . . CHECKING FUNCTION OF LEFT OR RIGHT FRONT DOOR OUTSIDE HANDLE WITH LOCK CYLINDER

Note:
The various functions can only be checked insofar as the special equipment is installed in the car.

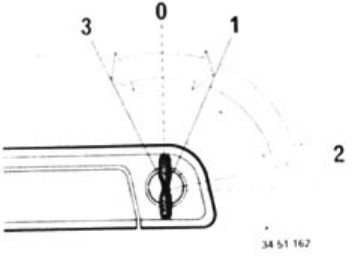
Turn on ignition.
Lower all windows.
Open the power sun roof.
Turn off ignition.
Unlock and lock driver's door.
Lock all other doors, trunk lid and tank flap.



Lock doors – key position (1).
Double-lock doors – kep position (2) (loud click heard twice). Catch buttons cannot be pulled up and burglar alarm is set.
Unlock doors – key position (3), burglar alarm is unactivated.
Check unlocking of tank flap and trunk lid, insofar as the trunk lid lock is not in "double-locked" position (2) (also refer to checking function of trunk lid lock/lock cylinder).
Unlock door manually – position (4).



Lock door manually (includes synchronization of the locking system) – key position (5).



Switch on door lock heating and inside light delay by
a) locking doors again,
b) waiting at least 35 seconds after locking and
c) lifting the door handle at least 5 seconds – the inside lights will be switched on and off again after about 5 seconds.

Door lock heating is switched on for about 40 seconds. It can be switched on again afterwards by lifting the door handle. Door locking heating can be activated only 3 times within 10 minutes. Interlocking is activated for 16 minutes afterwards, but this can be cancelled by unlocking and locking the car.

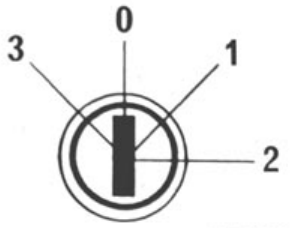
Check heating of lock cylinder with a thumb, rechecking door lock heating if necessary.

Note:
Door locking heating and inside light delay can only be operated from the driver's door lock.

Operate the comfort closing of power windows and power sun roof by holding the key in position (1) or (2).

Check locking of trunk lid and tank flap.

Note:
See Group 51 Test Plan in case of faults.

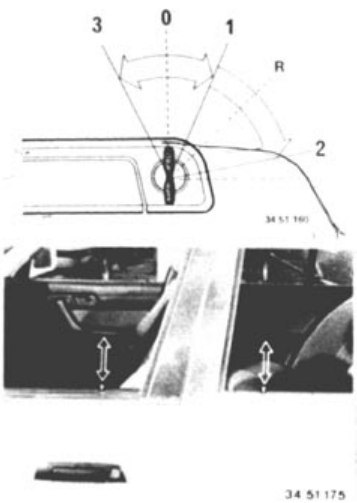


34 51 164

51 26 . . . CHECKING FUNCTION OF TRUNK LID LOCK/LOCK CYLINDER

Lock – key position (1).
Double-lock – key position (2).
Trunk lid remains locked, if door lock is unlocked.
Unlock – key position (3).

Note:
Refer to Group 51 Test Plan in case of faults.



51 26 . . . CHECKING ADJUSTING OF CENTRAL LOCK DRIVES FOR FRONT AND REAR DOORS

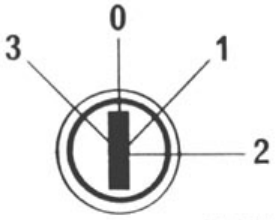
Lower all windows.
Close all doors, trunk lid and tank flap.
Lock and double-lock doors – key position (2) (loud click heard twice).

Move catch button on each door up and down.

Central lock drive is adjusted correctly, if there is slight play.
A play of more than 5 mm (0.197") is excessive.

Unlock doors.

Note:
Adjust pertinent central lock drive in case of deviation – see 51 26 . . ..



51 26 . . . CHECKING ADJUSTMENT OF CENTRAL LOCK DRIVE FOR TRUNK LID

Lock car from the trunk lid lock – key position (1).
Note switching point, marking it on the lock cylinder if necessary.
Unlock car – key position (3).
Note switching point, marking it on the lock cylinder if necessary.

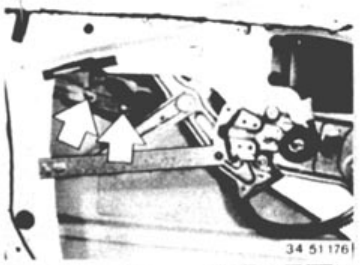
Central lock drive is adjusted correctly, if "V" (switching points 1 and 3) is symmetric to position 0 (key positioned perpendicularly).

Note:
Adjust central lock drive in case of deviation – see 51 26 . . ..

51 25 . . . ADJUSTING CENTRAL LOCK DRIVE OF LEFT OR RIGHT FRONT DOOR

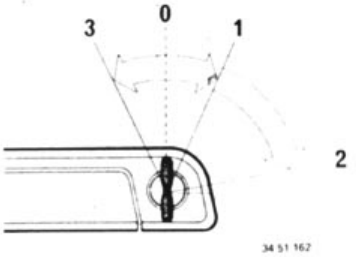
Requirements:
Use master key.
Locking system is synchronized – see 51 21 . . ..

Close door window.
Remove door trim panel – see 51 41 000.

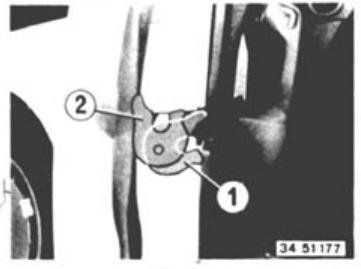


Caution!
Pull off plug on power window motor in the interest of safety.

Loosen central lock drive screws.

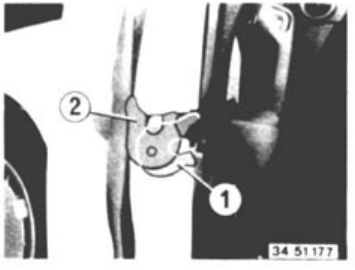


Unlock car – key position (3).



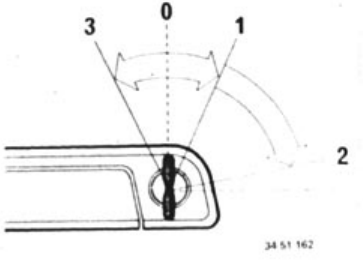
Turn striker (D) to closed position 2 (2nd catch).

1 = Opened
2 = Closed



Lift door handle and turn striker back into opened position 1 with a pencil or something similar.

1 = Opened
2 = Closed



Double-lock car on the opened door – key position (2) (loud click heard twice).

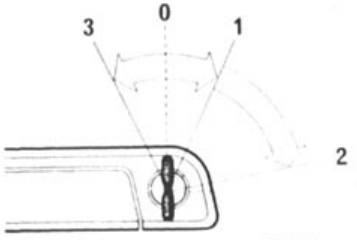
Check function.

Compress central lock drive and pull forward without force until there is no play.
Tighten screws of central lock drive in this position.
Tightening torque = 2 Nm (1.5 ft. lbs.).

51 26 . . . ADJUSTING CENTRAL LOCK DRIVER OF LEFT OR RIGHT REAR DOOR

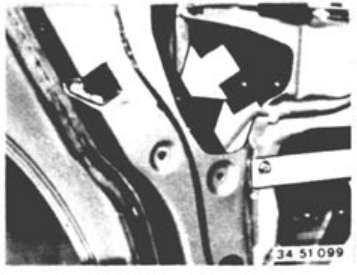
Requirements:
Use master key.
Locking system is synchronized – see 51 21 . . ..

Close door window.
Remove door trim panel – see 51 42 000.



Caution!
Pull plug off of power window motor in the interest of safety.

Double-lock car from lock of driver's or front passenger's door – key position (2) (loud click heard twice).



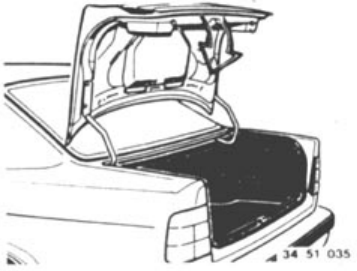
Loosen screws of central lock drive.

Compress central lock drive and pull it down without force until there is no play.
Tighten screws of central lock drive in this position.
Tightening torque = 2 Nm (1.5 ft. lbs.).

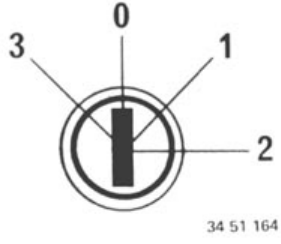
Check function.

51 26 . . . ADJUSTING CENTRAL LOCK DRIVE OF TRUNK LID

Requirements:
Use master key.
Locking system is synchronized – see 51 21 . . ..



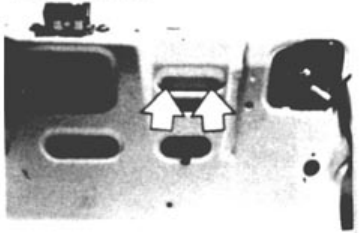
Raise trunk lid.
Lift off trim panel partially.



Turn key in trunk lid lock (lock cylinder) to "double-locked" position (2) – key horizontal.

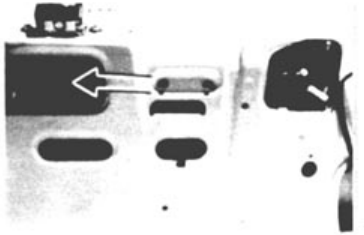
Remove key.

Important!
Don't leave the key in the trunk!



34 51 178

Loosen screws of central lock drive.



34 51 179

Pull central lock drive to the left (away from the lock) without force until there is no play.
Tighten screws of central lock drive in this position.
Tightening torque = 2 Nm (1.5 ft. lbs.).

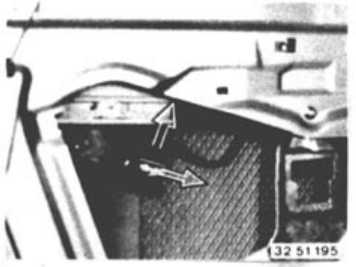
Check function.

51 26 000 REPLACING SWITCH FOR LEFT OR RIGHT FRONT DOOR LOCK (CENTRAL LOCK DRIVE)

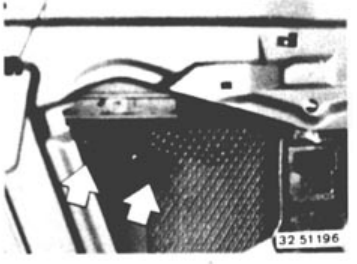
Remove front door trim panel – see 51 41 000.

Caution!
Pull off plug on power window motor in the interest of safety.

Installation:
Adjust central lock drive – see 51 26 . . ..



Pull back retainer.
Lift out plug.



Unscrew screws.
Lift out drive.



Installation:
Check for correct seating of linkage on the drive (shown removed).

51 26 010 REPLACING SWITCH FOR LEFT OR RIGHT REAR DOOR LOCK (CENTRAL LOCK DRIVE)

Remove rear door trim panel – see 51 42 000.

Caution!
Pull off plug on power window motor in the interest of safety.

Installation:
Adjust central lock drive – see 51 26 . . ..



Pull back retainer.
Lift out plug.



Unscrew screws.
Lift out drive.

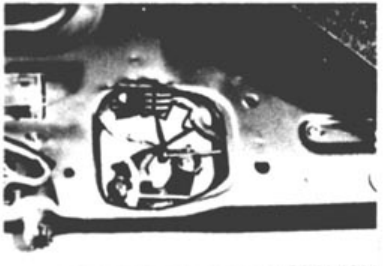


Installation:
Check for correct seating of drive on the striker (shown removed).

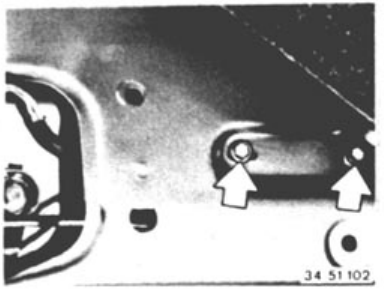
51 26 020 REPLACING SWITCH FOR TRUNK LID LOCK (CENTRAL LOCK DRIVE)

Disconnect trim panel partially.

Installation:
Adjust central lock drive – see 51 26 . . ..



Disconnect linkage.



Unscrew screws.
Remove drive.

51 31 ... Notes on window installation

The windshield and rear window (also rear side windows on E34 touring) are cemented (positively locked) with the body. This improves the torsional strength of the vehicle. The mounting procedure described in the following must be complied with in order to guarantee correctly cemented windows.
Two different repair cases are described:

1. When replacing the windshield or rear window, the retaining clips of the ornamental trim frame are already fitted on the window glass.

2. When removing and installing the windshield or rear window, the retaining clips of the ornamental trim strips must be fitted by hand.

Note:
When using SikaTack - Ultrafast (hot treatment) the cement cartridge must be heated to 80°C for one hour in a cartridge heating oven*.
Before placing cartridge in oven, pierce aluminium cover at rear end.

Removal:

The cement beading of the window glass is cut through with an electric cutting tool with an oscillating blade* without damaging paintwork around the body aperture. protective goggles and gloves must be worn when cutting out windows.
Paintwork damage at the body aperture must be repaired with BMW EP prime filler*. Large damaged spots must be ground down to bare metal and coated with BMW EP prime filler (2K) (layer thickness 30 ... 40 m). If complete build-up of paint finish is required in a visible area, the prime-coated cement flange must be covered with adhesive tape prior to application of the final coat of paint.

Preparing for assembly:

Note:
When using SikaTack - Ultrafast (hot treatment):
Before applying, cement cartridge must be heated to 80 °C for one hour in oven*.
Sealed cement can be heated several times and remain stable at 80 °C for approx. 10 hours.

The window is coated with a UV-impermeable glass ceramic material on the inside edges to protect the cement beading.

A PVC lip is applied over the entire circumference of the side window (E34 touring). This lip must have no irregularities which could disturb the application of the cement beading.

As the result of plastisizer drift in the PVC, the PVC coating must be treated as follows in the cementing area when replacing a side window (E34 touring):

- Roughen surface with sanding paper, 220 grain size
- Clean twice with 2-propanol (100 % alcohol)
- Drying time approx. 1 minute
- Apply black primer 5001* (Gurit-Essex)
- Drying time approx. 15 minutes
- Use cement Sikaflex 255 FC or SikaTack - Ultrafast*

Caution!
The PVC coating on the side window (touring) must not be treated with Sika Cleaner 205*.

Thinly coat glass ceramic surface of windshield or rear window with cleaner (Cleaner 205 repair kit)*. The primer must be allowed to air for at least 10 minutes. Clean body aperture with 2-propanol (100 % alcohol, available from pharmacies). Only use the 1-component polyurethane cements approved by BMW (Sikaflex 255 FC for cold treatment or SikaTack - Ultrafast for hot treatment)*. To apply uniform cement bead to window, use cartridge gun (operated with compressed air or electric power)*.

Assembly:

Caution!
Assembly must be completed within 10 minutes otherwise the cement beading will form a skin thus preventing satisfactory bonding.
Before it hardens, remove all cement residue with cleaner (Sika remover 208)*. While cleaning, do not press out the window glass again. Hardened cement can only be removed by machine.

The vehicle can be towed or driven without a windshield, rear or side window.

A side window should be opened to prevent pressure building up in the passenger compartment when closing doors.

* Source of supply: BMW Parts Service

* Source of supply: BMW Parts Service

The cement hardens by means of a reaction with air moisture at room temperature. The minimum hardening time is achieved at 22°C and 38 % relative humidity, refer to table.
The vehicle must not be subjected to one-sided loads during the minimum hardening time (for example having one wheel up on the kurb, workshop hoist etc.). Park on level ground in the workshop.

Cements and minimum hardening times:

Cement	Minimum hardening time without front passenger's airbag (vehicle can be driven)	Minimum hardening time with front passenger's airbag (countries without compulsory belt regulation)
Sikaflex 255 FC* (cold treatment)	4 hours	20 hours**
SikaTack - Ultrafast (hot treatment)	2 hours	12 hours**

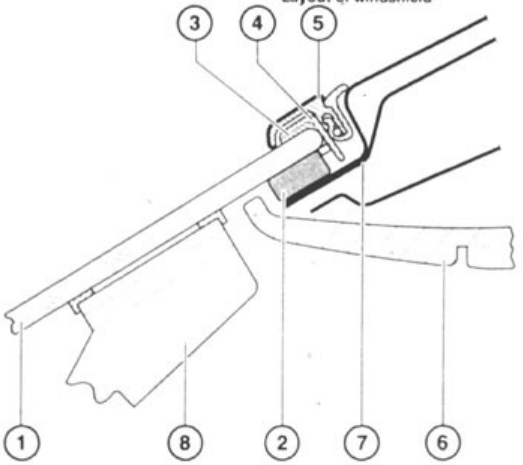
** Note:
In the case of vehicles with front passenger's airbag, the vehicle can be handed over to the customer after the hardening time has elapsed (vehicle can be driven), dependent on cement with the following warning:
All passengers must wear seat belt after cementing windshield, specifying minimum hardening time (refer to table, countries without compulsory belt regulations).

* Source of supply: BMW Parts Service

51 31 000 Removing and installing windshield

Observe notes on cementing windows, refer to 51 31 ...
Remove both wiper arms, refer to 61 61 100.

Layout of windshield



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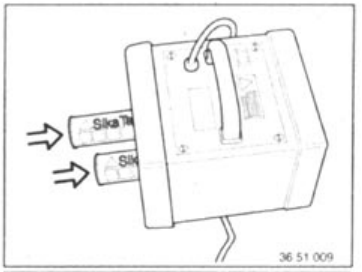
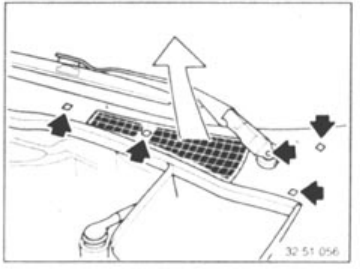
1 Windshield
2 Cement beading
3 Adhesive film
4 Clip
5 Ornamental trim frame
6 Headlining panel
7 Body
8 Inner rear view mirror

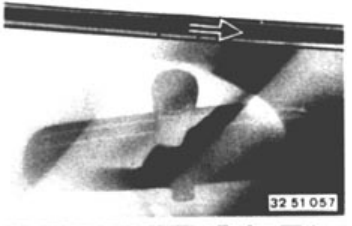


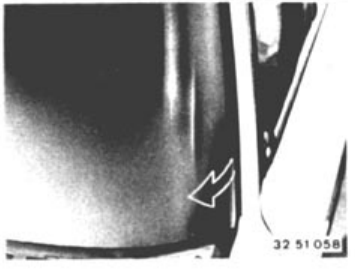
Only hot treatment with SikaTack - Ultrafast:
Before inserting cartridge in oven, pierce aluminium cover at rear end.
heat cement cartridge to 80°C for one hour in oven*.



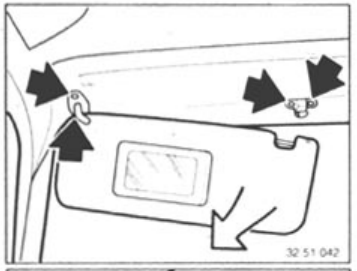
Lift out clips.
Remove covering.

Slide covering to one side.



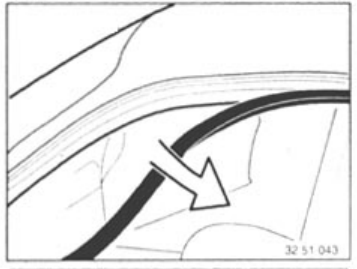


Lever out trim mouldings.
Replace defective trim mouldings if necessary.



Lift out sun vizor and release screws.
Remove sun vizor and hinged bracket.

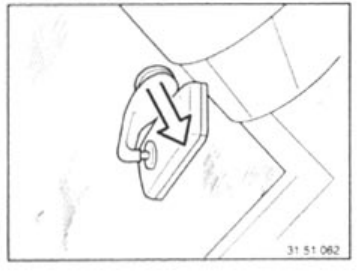
Version with interior light package:
Disconnect plug connector from sun vizor and hinged bracket.



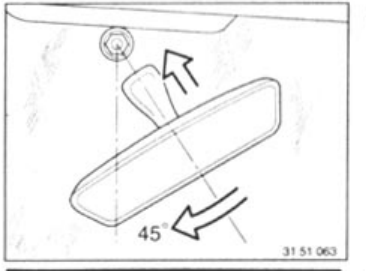
Partly remove door weatherstrip.



Lift out A-pillar trim panel.

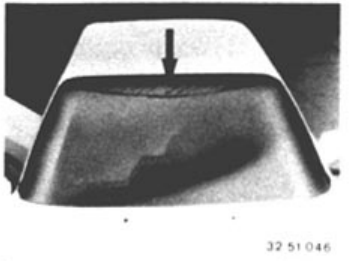


Pull mirror back and remove from mirror socket.

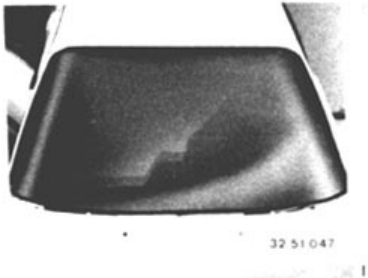


Installation note:

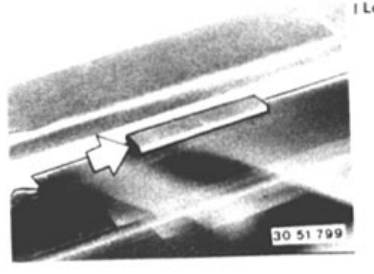
1. Fit mirror base on mirror socket turned by approx. 45°.
2. Turn mirror base until it engages on the mirror socket.



Slightly pull down headlining.



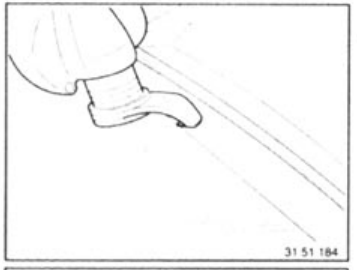
Mask off body.



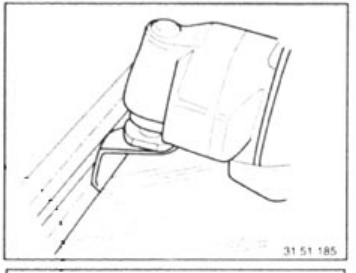
Lever out clips.



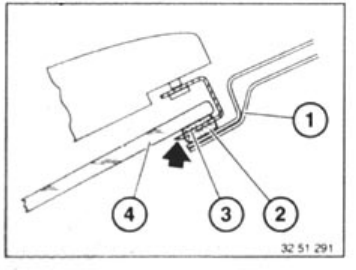
Fit knife blade* on tool*.
If necessary, resharpen knife blade with machine running.



Carefully insert knife* between body and windshield.



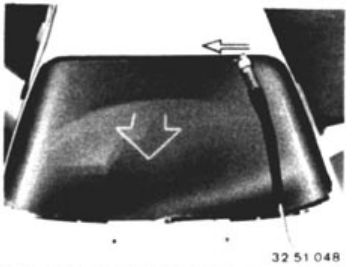
Guide web of knife parallel to windshield.



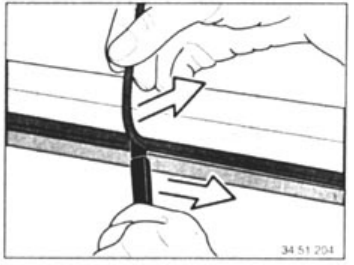
Cut through cement bead as close as possible to the windshield.

1 Body aperture
2 Cement bead
3 Knife
4 Windshield

* Source of supply: BMW Parts Service



Cut through cement bead all round and lift out windshield with special tool 51 3 010.



Cut off old cement in body aperture down to a thickness of approx. 0.5 mm.

Cut off old cement carefully with a general-purpose knife (sharp as razor blade) to avoid damaging the paint finish in the body aperture.

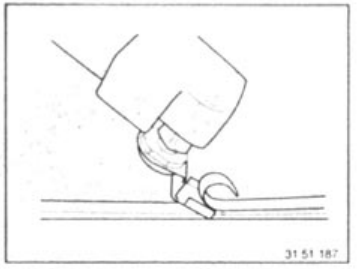


Caution!
Damaged paint finish must always be repaired to guarantee longterm corrosion protection! For this purpose, use BMW EP prime filler (2K)!

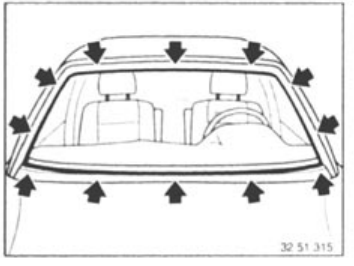
Remove residual cement, sand out scratches in areas not visible and touch up with BMW EP prime filler.

Large damaged spots must be ground down to bare metal and coated with BMW prime filler (2K) (layer thickness 30 ... 40 m). If complete build-up of paint finish is required in a visible area, the prime-coated cement flange must be covered with adhesive tape prior to application of the final coat paint.

* Source of supply: BMW Parts Service



When re-using the windshield.
Move cement residue on windshield with knife to approx. 0.5 mm.



Caution!
The BMW EP prime filler must be completely hardened!

Coat windshield and body in area of bonding surface with primer (repair kit)*.

Note:
Drying time approx. 10 minutes.

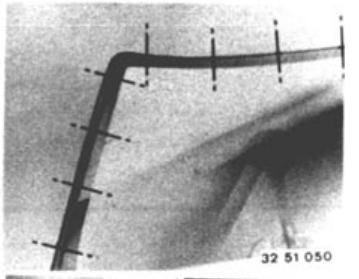


When re-using the windshield:
Fit clips by hand.
Pull off protective film from adhesive strips.



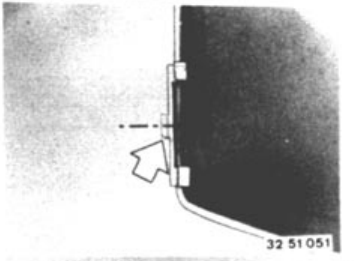
Moisten adhesive film in water to facilitate mounting.

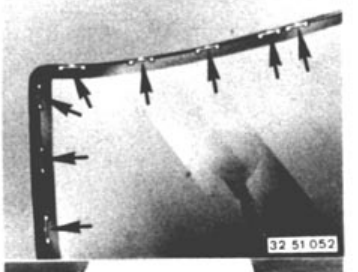
* Source of supply: BMW Parts Service



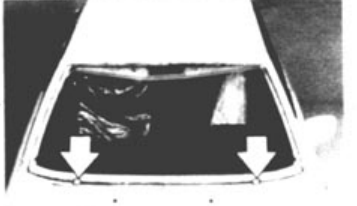
Mark windshield corresponding to cutouts in trim mouldings.
Centre of trim moulding cutout = center of clip

Fit clip corresponding to marks.





Clip in ornamental moulding.



Fit adjusting blocks (repair kit)* in body aperture.

* Source of supply: BMW Parts Service



30 51 812

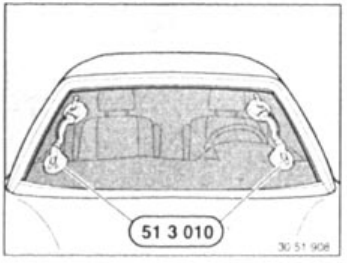
Note:
By turning the adjusting blocks, 3 different heights can be set in steps of 1.5 mm.



30 51 792

Open cartridge (repair kit)*, fit in applicator gun and screw on corresponding nozzle.

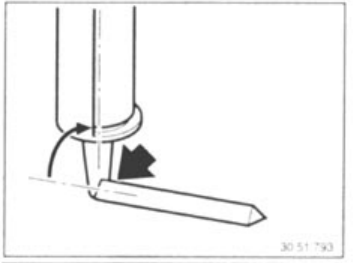
Note:
Note "use by" date of cement.



30 51 908

Insert windshield in body aperture with special tool 51 3 010 and fit in position.

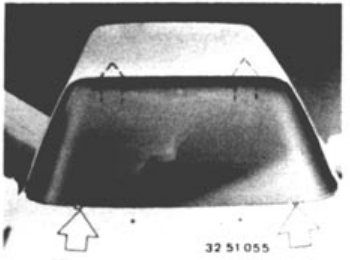
Note:
Ornamental trim mouldings and clips can be shifted slightly (until moisture evaporates) thus adjusting them to the body aperture.



30 51 793

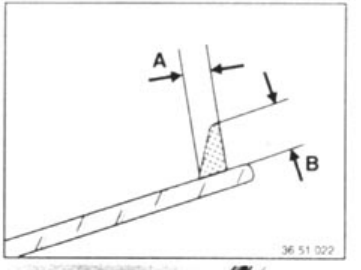
If necessary, produce a sample bead before cementing. The cartridge must be perpendicular to the windshield.

Apply cement bead with uniform advance feed pulling rate.



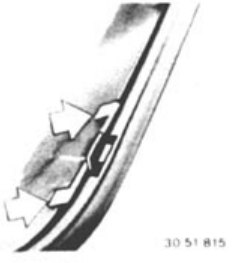
32 51 055

Turn adjusting blocks until the windshield rests evenly.



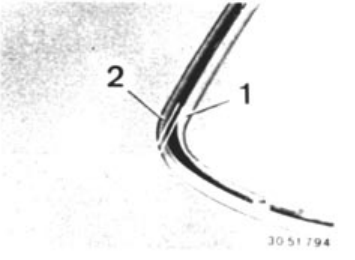
36 51 022

Shape of cement bead.
A = 10 mm
B = 12 mm



30 51 815

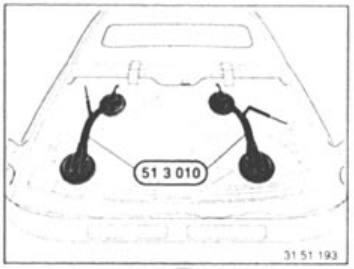
Lift out windshield with special tool 51 3 010.
Cut off lugs on clips.



30 51 794

Apply cement bead (1) all round windshield.
Maintain distance (A) to edge of windshield (2).
A = 5 mm

* Source of supply: BMW Parts Service



Carefully fit windshield with special tool 51 3 010 and press in position.
Ensure even spacing between body and trim moulding.
Secure windshield in this position with fabric adhesive tape (e.g. Tesa).

Length: 300 mm
Width: 50 mm



Caution!
Before it hardens, remove residual cement with Sika cleaner (remover) 208.
Do not press windshield back out before it has hardened.
Hardened cement can only be removed by machine.

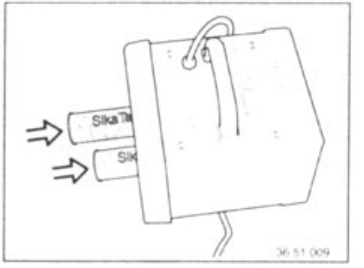


Note:
Leaks can be localized by spraying water under the sealing lip or by using an ultrasonic leak detection device. The leaks can then be sealed off with the aid of a corresponding nozzle*.

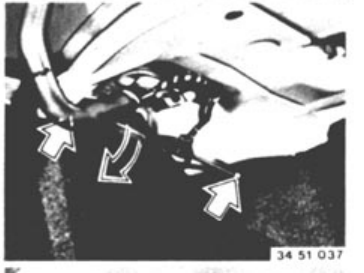
* Source of supply: BMW Parts Service

51 31 200 Removing and installing rear window

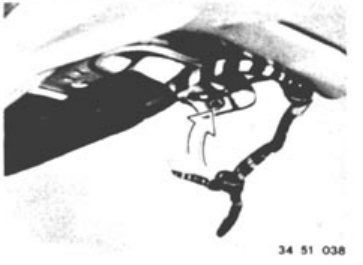
The same conditions as for the windshield apply to the rear window.



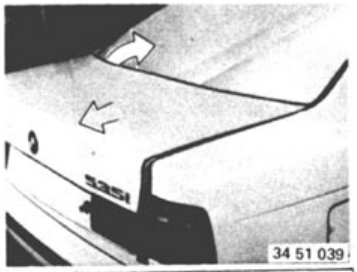
Only hot treatment with SikaTack - Ultrafast:
Before inserting cartridge in oven, pierce aluminium cover at rear end.
Heat cement cartridge to 80°C for one hour in oven*.



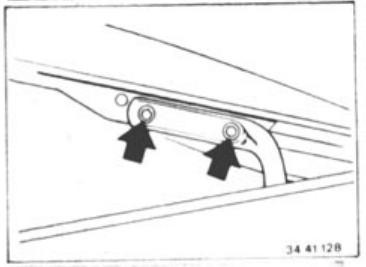
Secure trunk lid to prevent dropping down and detach left/right damper.



Release left/right screw.



Pull back trunk lid as far as it will go and pull out rubber seal.

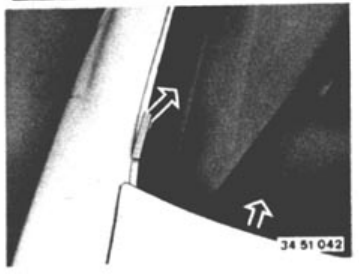


On vehicles as of Fall 1989, it is no longer possible to pull forward the trunk lid.
Release screws and place trunk lid in luggage compartment.

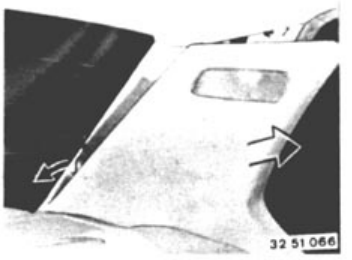
Installation note:
Align and fit trunk lid in position, refer to 41 62 014.



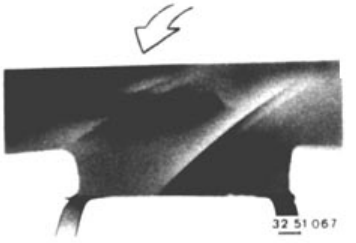
Slide covering to one side and unclip ornamental trim frame.



Lift out clips and adjusting blocks.



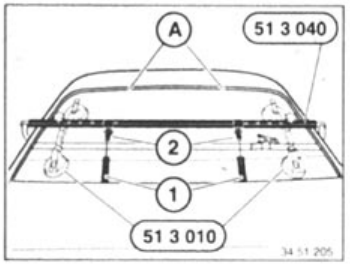
Unclip left and right C-pillar trim panels to inside, disconnect plug connectors from interior lamps and remove C-pillar trim panels by pulling forward.
Disconnect plug connector from heated rear window and antenna.



Slightly pull down headlining.

Mask off trunk lid and body.

The further procedure is identical to job instructions 51 31 000.



Installation note:
Carefully fit rear window in position with special tool 51 3 040 in conjunction with special tool 51 3 010. Position the suction lifters as far as possible on the outside. Attach positioning hooks (1) at bottom of rear window frame and screw in knurled screws (2) until dimension (A) is set between the ornamental trim moulding at the top roof joint and the body. Pretension rear window with belt. Check dimension (A) once again and correct if necessary.
Fit rubber seal at bottom

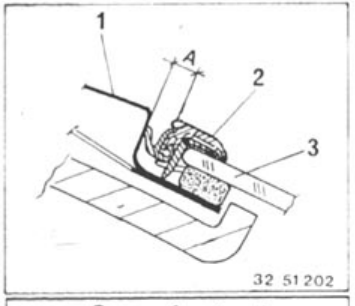
Dimension (A) = 6 mm



Caution!
If the rear window was destroyed, glass splinters must be cleaned out of the safety belt automatic-locking retractor.

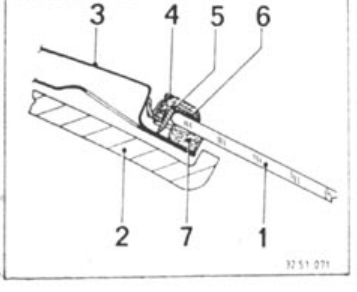


Note:
Leaks can be localized by spaying water under the sealing lips or by using an ultrasonic leak detection device. The leaks can then be sealed using an appropriate nozzle (repair kit*)



Layout of rear window cementing joint:
1 Body
2 Ornamental trim frame
3 Rear window

Dimension (A) = 6 mm



1 Rear window
2 Headlining
3 Body
4 Ornamental trim frame
5 Clip
6 Adhesive film
7 Cement bead

* Source of supply: BMW Parts Service

51 31 200 Removing and installing rear window (touring)

Open rear window.

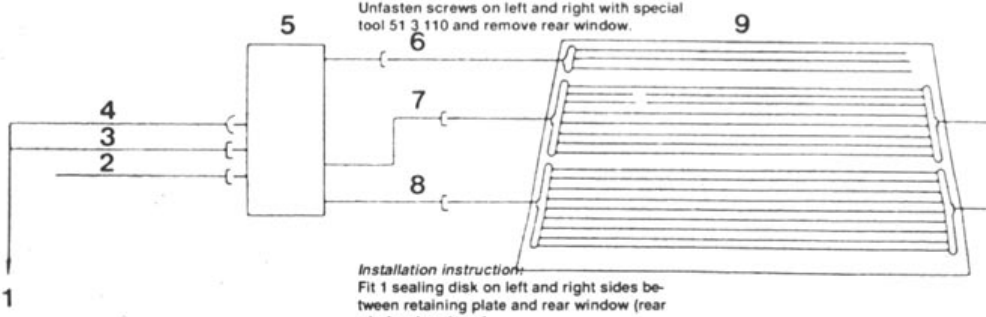
Unclip panel on left and right and remove adhesive tape.

Installation instruction:
Secure cable with adhesive tape.

Lift out rubber grommet and detach plug for rear window heating.

Installation instruction:
Function test

Unfasten screws on left and right with special tool 51 3 110 and remove rear window.



Installation instruction:
Fit 1 sealing disk on left and right sides between retaining plate and rear window (rear window breakage).
Adjust rear window.
Tightening torque*

51 31 201 Adjust rear window (touring)

Removing trim for trunk lid, see 51 49 000.

Prerequisite is that trunk lid is correctly set.

Open rear window.

Unclip panel on left and right and remove adhesive tape.

Installation instruction:
Secure cable with adhesive tape.

Loosen screws on left and right sides with special tool 51 3 110.

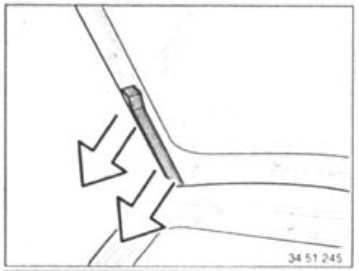
Adjust dimension (A) equally on left and right sides.

34 51 041

Dimension (B) underneath approx. 5 mm.

Tighten the screws.

* Refer to Specifications

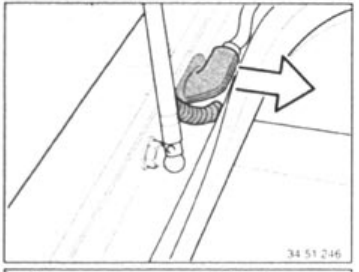


51 31 200 Removing and installing rear window (touring)

Open rear window.

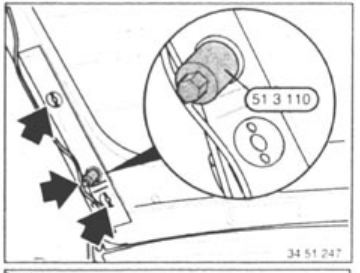
Unclip finisher on left and right and remove adhesive tape.

Installation note:
Secure cable with adhesive tape.

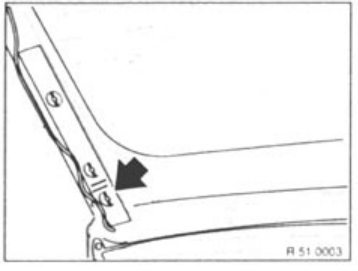


Lift out rubber grommet and disconnect plug connector for rear window heating.

Installation note:
Check function.



Release screws on left and right with special tool 51 3 110 and detach rear window.



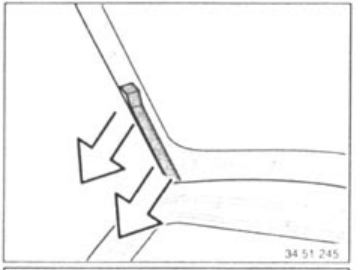
Installation note:
Place a sealing disk between the retaining plate and rear window on the left and right (rear window breakage).
Adjust rear window.
For tightening torque 51 31 1AZ

* Refer to Technical Data

51 31 201 Adjusting rear window (touring)

Remove trim panel for trunk lid, refer to 51 49 000.

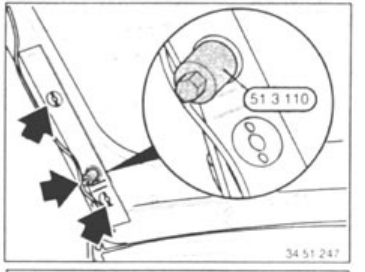
Precondition, turn lid set correctly.



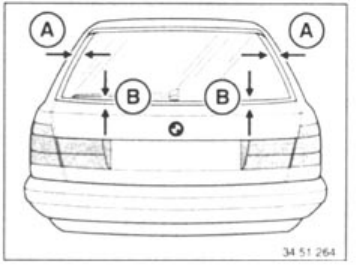
Open rear window.

Unclip finisher on left and right and remove adhesive tape.

Installation note:
Secure cable with adhesive tape.



Release screws on left and right with special tool 51 3 110.

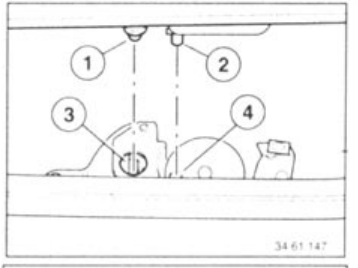


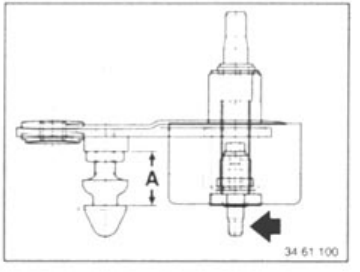
Adjust dimension (A) evenly on left and right.

Dimension (B) at bottom approx. 5 mm.

Firmly tighten screws.

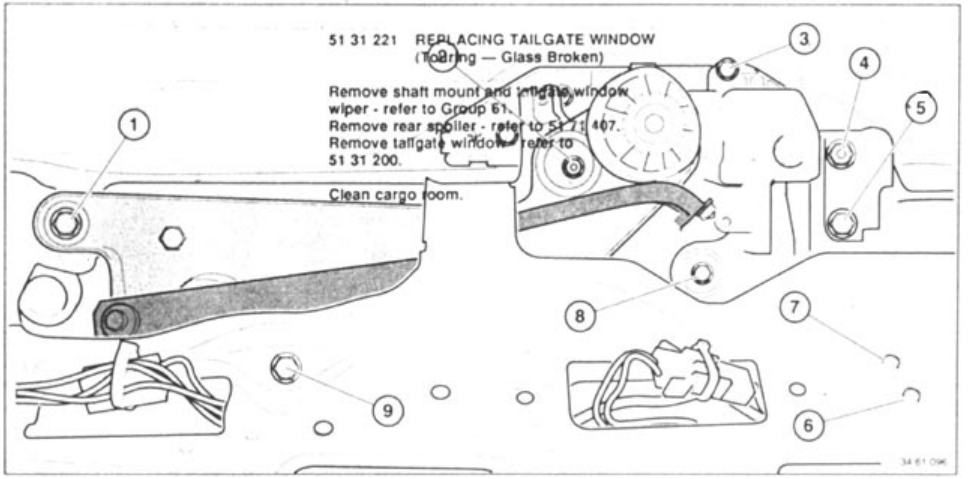






Loosen screws (1 ... 9).
Close the tailgate window.
The lockpin must be adjusted to correct depth distance!
Tighten screws (1 ... 9).
Tightening torque*.
Check the wiped zone - refer to Group 61.
Check function.

* Refer to Specifications


51 31 221 REPLACING TAILGATE WINDOW
(Touring — Glass Broken)
Remove shaft mount and tailgate window wiper - refer to Group 61.
Remove rear spoiler - refer to 51 71 407.
Remove tailgate window - refer to 51 31 200.
Clean cargo room.
1
2
3
4
5
6
7
8
9

51 31 ... REPAIRING STONE DAMAGE ON LAMINATED SAFETY GLASS WINDSHIELDS (CLEAR OR TINTED GLASS)

These instructions are meant for skilled workers, who are well qualified, work conscientiously and accept full responsibility for their work. Instructions are limited to factory approved repair materials*, repairing methods as well as associated tips to make the work easier. Instructions only describe general procedures. The actual scope of work will have to be adapted to the degree of damage. The repair is an economical solution, so that optical impairment cannot be excluded. Consequently repairing should only be carried out when ordered by the customer.

Conditions listed below for the repairing of laminated safety glass windshields conform with legislation in Germany. Always conform with legislation valid in other countries.

Important!

- Only damage on outside surface of windshields may be repaired. Inside of window and plastic sheet must not be damaged in any manner whatsoever.
- Repairing should be carried out as soon as possible after occurrence of the damage. The penetration of moisture or dirt must not be visible in the damaged spot.
- Impact spot cavities must not exceed a diameter of 5 mm.
- Cracks leading away from the impact spot must not be longer than 50 mm. They must not end in the rubber window frame or ornamental strip.
- Repairs must only be carried out outside of the field of vision (see sketch). Visibility through the repaired surface must be clear, penetrant for light and without distortion as well as possible.
- Conform with working instructions!

A = 240 mm
B = 290 mm
C = Limited by wiped zone

* Source of Supply: BMW Parts

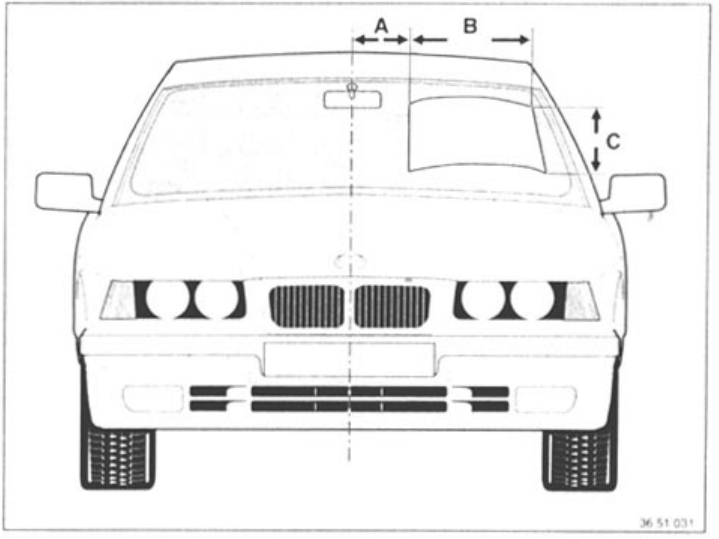
51 31 ... Repairing stone chip damage on laminated safety glass windshields (clear or tinted glass)

These repair instructions are intended for qualified skilled workers who work professionally, conscientiously and who accept full responsibility for their work. These repair instructions are restricted to BMW approved materials (DUOBOND*), the repair method as well as related tips to simplify the work involved. These instructions can only illustrate the general procedure. The actual scope of work should be adapted to suit the extent of damage.
The repair constitutes a cost-effective and fast solution although the final appearance may be impaired. The repair should be offered to the customer on inspection or for used vehicles and on special customer request.

The conditions listed below for repairing laminated safety glass windshields conform with legislation in Germany.
Always conform with prevailing national legislation.

Caution!

- Only damage on outer surface of windshield should be repaired. Inside of window and plastic film between inside glass and outside glass must not be damaged in any way.
- Repairs should be carried out as soon as possible after the damage has occurred. The penetration of moisture or dirt must not be visible in the damaged area.
- Impact spot cavities must not exceed a diameter of 5 mm.
- Cracks leading away from the impact spot must not be longer than 50 mm. They must not end in the rubber weatherstrip or in the ornamental trim frame.
- Repairs must only be carried out outside the field of vision (refer to diagram). Visibility through the repaired surface must be clear, transparent and with minimum distortion.
- Note handling instructions!

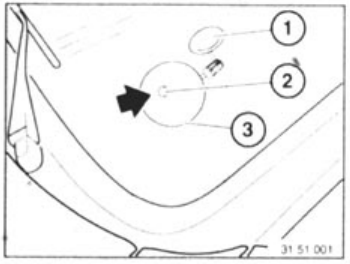


A = 240 mm
B = 290 mm
C = Limitation by wipe zone

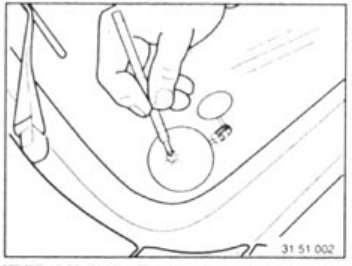
* Source of supply: BMW Parts Service



Note:
Allow vehicle to assume room temperature (>20°C), heat front shield from inside.

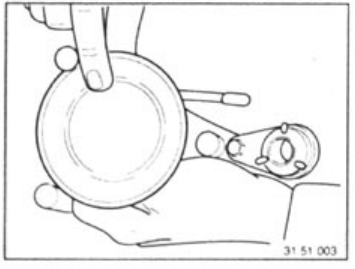


Thinly coat suction cup (1) of concentrating mirror reflector with gel and position suction cup on the windshield from the inside such that the damaged point (2) can be viewed from the outside in the concentrating mirror reflector (3).

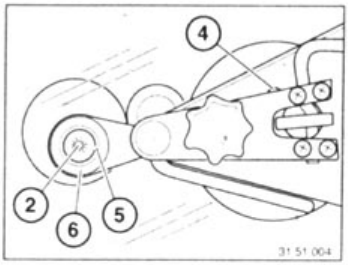


Using a marking tool, remove all glass splinters from the impact point working from the outside so that a roughened surface is obtained.

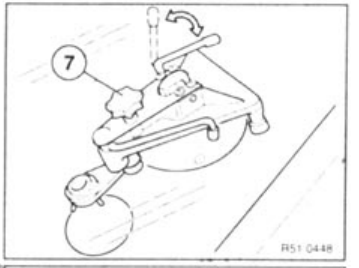
Caution!
Do not enlarge hole of impact point.



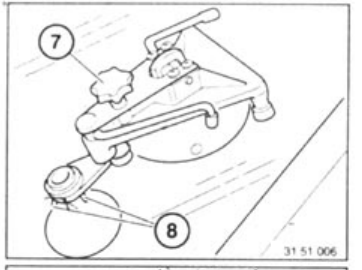
Thinly coat suction cup of tool holder with gel.



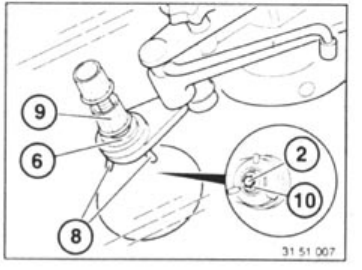
Position tool holder (4) on windshield from the outside so that the opening (5) of the sputnik head (6) is located exactly above the impact point (2).



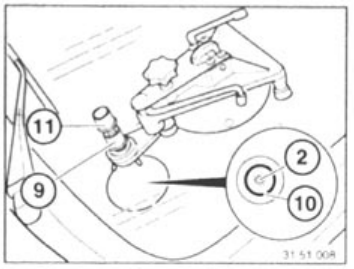
First turn back knurled screw (7). Move locking lever forward and then back again (suction cup holds firm).



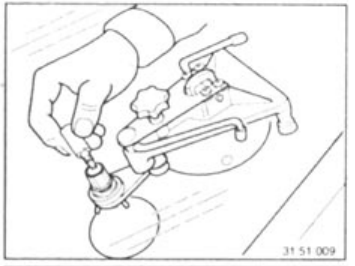
Turn knurled screw (7) until the feet (8) of the sputnik head rest firmly on the windshield (do not screw in too tight, this may cause tension and crack the windshield).



Screw cylinder (9) into sputnik head (6) until rubber seal (10) firmly surrounds impact point (2) on the windshield and the feet of sputnik head (8) just begin to lift a little (do not screw in too much, tension can occur, causing the windshield to crack).

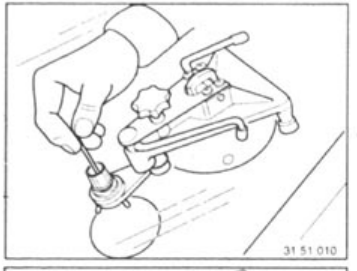


Unscrew injector (11) out of cylinder (9), then screw into cylinder (9) from above and check whether rubber seal (10) is positioned centrally above the impact point (2).
Correct position if necessary.

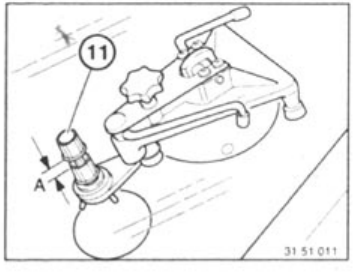


Open resin bottles and fill approx. 1/3 of the contents into the cylinder.

Caution!
Reseal resin bottles immediately after use and protect from UV light.

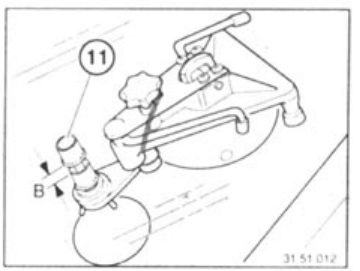


Stir out any air bubbles in the filled resin with a wooden stick.



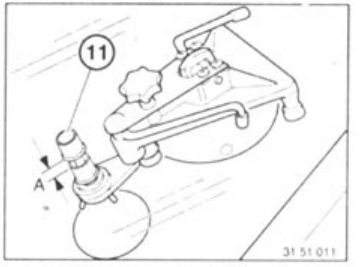
Screw injector (11) up to dimension (A) into the cylinder (slight resistance can be felt) and leave set-up for approx. 5 minutes.
Dimension (A) = 5 mm

Note:
A pressure of approx. 16 bar is exerted in this position. While observing the impact point it can be seen that the air at this point disappears slowly (indicated by black shadow).



Quickly unscrew injector (11) to dimension (B).
Dimension (B) = 12 mm

Note:
In this position, a vacuum is now effective which "draws out" the remaining air from the impact point.

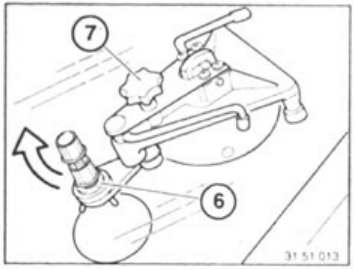


Once again screw injector (11) into cylinder up to dimension (A) (slight resistance can be felt) and leave everything rest for several minutes.
Dimension (A) = 5 mm

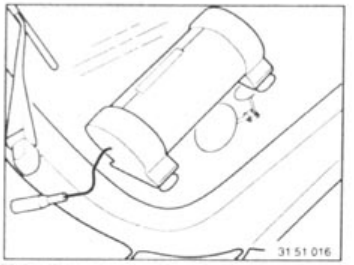


Repeat this alternative pressure-vacuum procedure several times and then leave the injector (11) for a time in an intermediate position between dimension (A) and dimension (B).

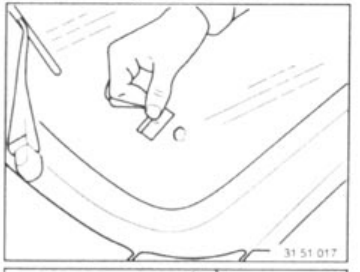
Note:
If not all air is completely removed, while applying pressure, heat up the windshield with a lighter for several seconds (not too long, tension can occur causing the windshield to crack). Hold the flame as close to the glass as possible, but without touching it.



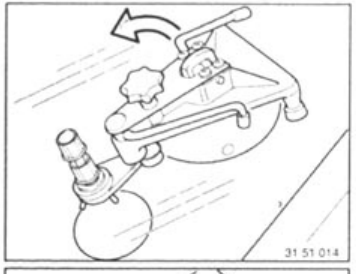
Release knurled screw (7), swivel sputnik head (6) to one side and observe the repair point from the top and from various angles in the concentrating reflector mirror. There must now be no more visible air inclusions.
If, however, air inclusions are still visible, swivel sputnik head (6) back over the impact point and screw in knurled screw (7) as before. Repeat alternating pressure-vacuum procedure.



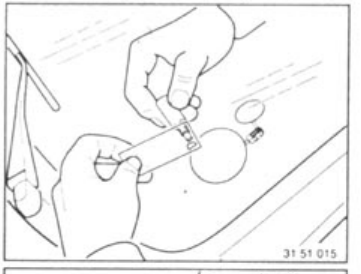
Mount UV lamp over repair point and press into position (press suction cups one after the other).
Connect UV lamp and allow resin to harden for approx. 10 minutes.



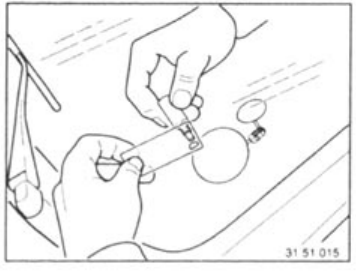
Remove UV lamp, peel off transparent film and scrape off surplus resin with a razor blade.



Push locking lever forward and remove tool holder from windshield.

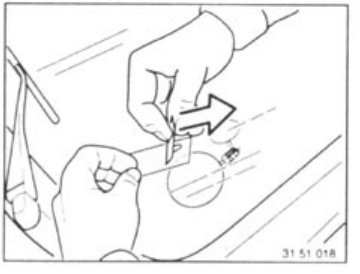


Once again allow a drop of resin to drop onto the impact point and cover with a piece of transparent film.

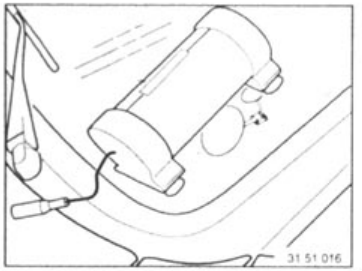


Allow one drop of resin to drip onto the impact point and cover with transparent film.

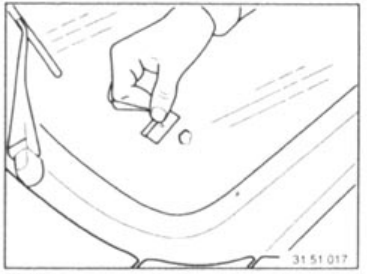
Note:
Only place transparent film on impact point. Do not press!



Carefully pass razor blade over transparent film so that surplus resin emerges from the sides.



Once again mount UV lamp over repair point and press down firmly (press suction cups one after the other).
Connect UV lamp and allow resin to harden for approx. 10 minutes.



Remove UV lamp, peel off transparent film and scrape off surplus resin about the repair point with a razor blade.

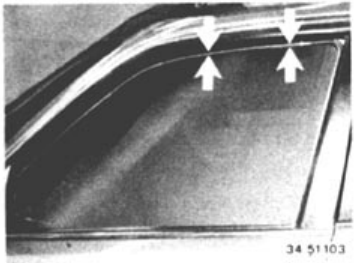
Caution!
Do not scrape over impact point (2)!



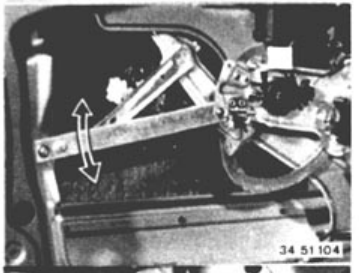
Polish repair point with a lint-free rag and polish until surface is clean and smooth.

51 32 154 ADJUSTING LEFT OR RIGHT FRONT DOOR WINDOW

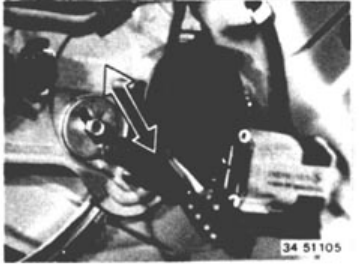
Remove front door trim panel – see 51 41 000.



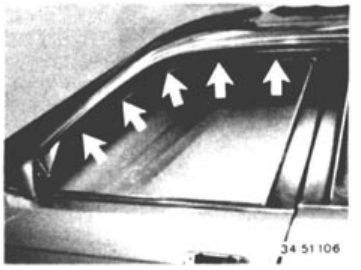
Door window must be parallel to the window frame and submerged to an uniform depth in the top window seal.



The window can be adjusted parallel to the window frame by adjusting the guide rails.



The door window is limited at the top by the adjustable stop.

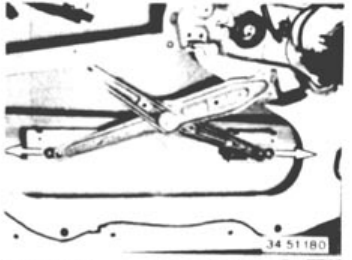


Note:
Rubber seal must bear uniformly on the door window glass (to prevent wind noise).

51 32 170 REMOVING AND INSTALLING FRONT DOOR WINDOW

Remove mirror – see 51 16 000.
Remove door trim panel – see 51 41 000.

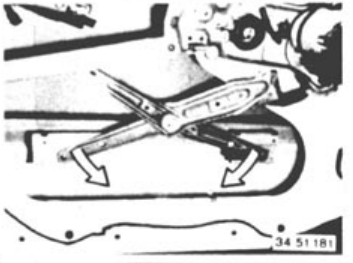
Installation:
Adjust front door window – see 51 32 154.



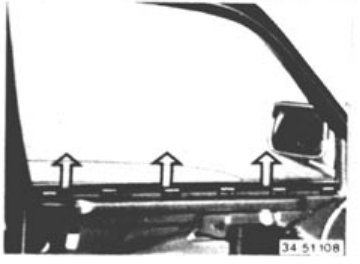
Lower door window.

Caution!
Pull off plug on power window motor in the interest of safety.

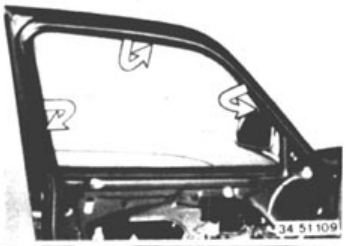
Pull out retainer from the side.



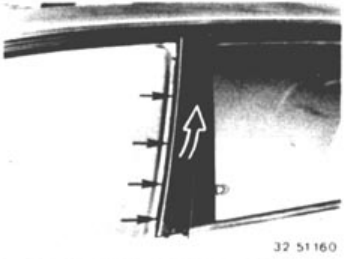
Disengage window lifting arms in slides.



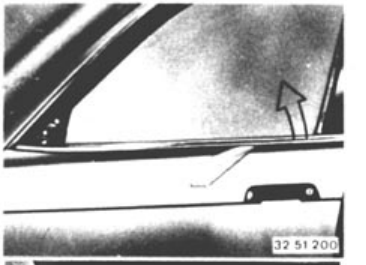
Lift out window recess seal and ornamental strip.



Lift out ornamental frame.



Lift out rubber guide.
Unscrew screws.
Lift off plate.



Lift out ornamental strip.



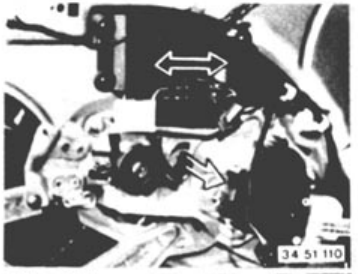
Pull out window glass from above.

Installation:
Insert window glass in guides on left and right sides.

51 33 000 REMOVING AND INSTALLING POWER WINDOW REGULATOR IN FRONT DOOR

Remove front door trim panel – see 51 41 000.

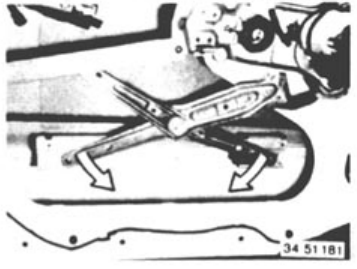
Installation:
If necessary, adjust front door window – see 51 32 154.



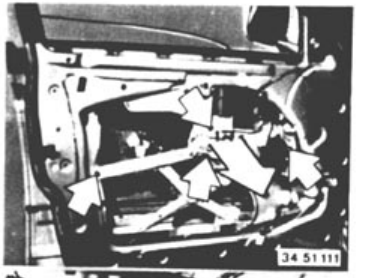
Lower door window.
Lift out microswitch.
Pull off plug.



Pull out retainer from the side.



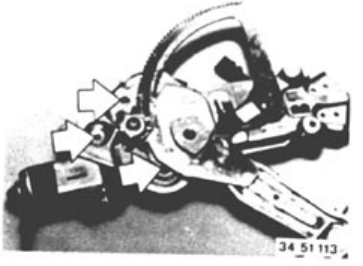
Disengage window lifting arms in slides.



Loosen screws; drill off rivets if applicable.
Lift out complete window regulator.



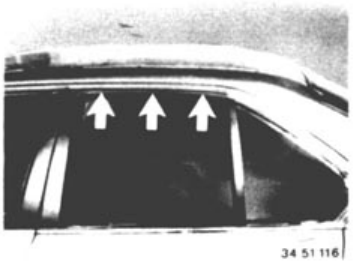
Installation:
If applicable, replace drilled off rivets with M 6 x 10 screws, 6.4 washers and M 6 hexagon nuts.
Tightening torque = 9 Nm (6.5 ft. lbs.).



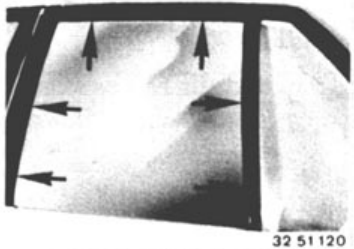
Unscrew screws.
Take off gearbox/motor.

51 34 154 ADJUSTING REAR DOOR WINDOW

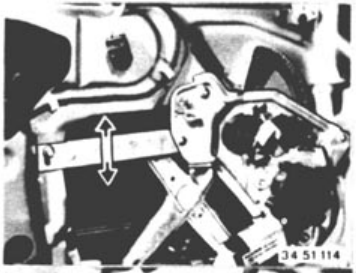
Remove rear door trim panel – see 51 42 000.


34 51 116

Note:
Rubber seal must bear uniformly on the door window glass (to prevent wind noise).


32 51 120

Door window glass must be parallel to the window frame and run into the upper window seal uniformly.


34 51 114

The window can be adjusted parallel to the ornamental frame by adjusting the guide rails.

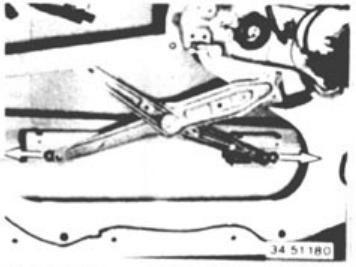

34 51 115

Door window glass is limited at the top by an adjustable stop.

51 34 171 REPLACING LEFT OR RIGHT REAR DOOR WINDOW

Remove door trim panel – see 51 42 000.

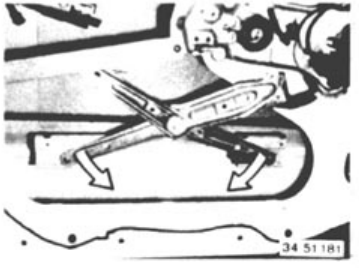
Installation:
If necessary, adjust rear door window – see 51 34 154.



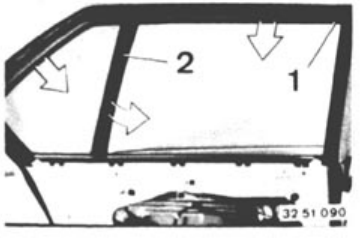
Lower door window.

Caution!
Pull off plug on power window motor in the interest of safety.

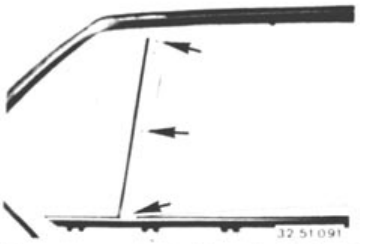
Pull out retainer from the side.



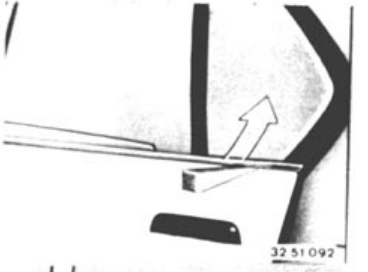
Disengage window lifting arms in the slides.



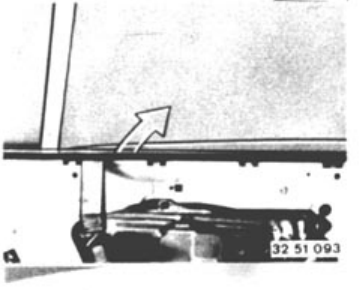
Lift off plates (1 and 2).



Unscrew screws.
Lift off plate.

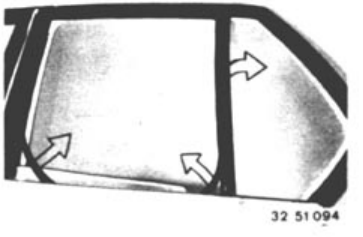


Lift off ornamental strip.

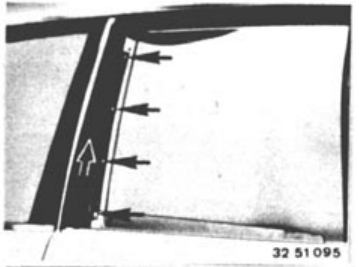


Lift off window recess seal.

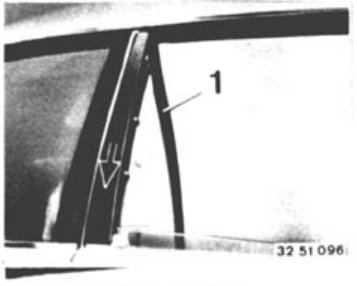
Installation:
If necessary, replace clips.



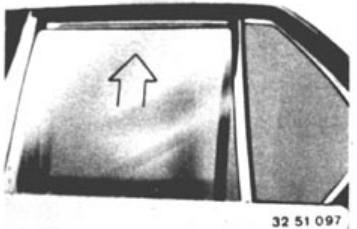
Lift off plate.
Pull out window guide.



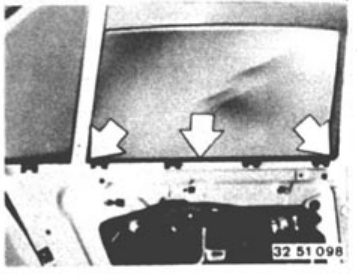
Unscrew screws.
Lift off plate.



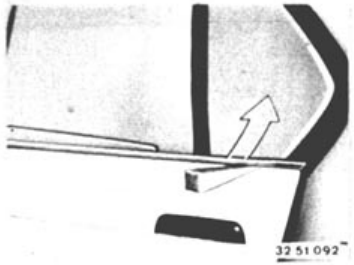
Installation:
Coat rubber seal (1) with a lubricant for rubber parts.
Engage and press down plate.



Pull out window glass from above.

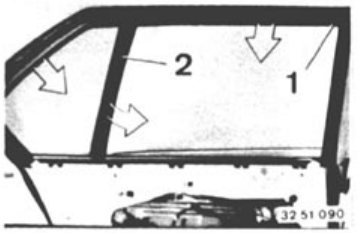


Installation:
Insert window glass in guides on the left and right sides.

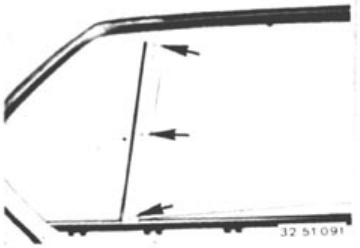


51 34 191 REPLACING WINDOW FIXED IN LEFT OR RIGHT REAR DOOR WINDOW FRAME

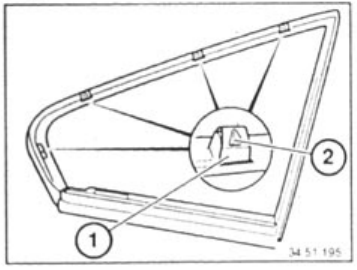
Remove rear door trim panel – see 51 42 000.
Remove ornamental strip.
Lift out ornamental strip on outside.



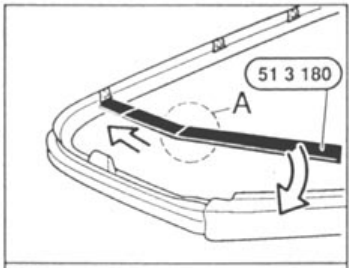
Lift off frame (1).
Lift off plate (2).



Unscrew screws and lift off plate.

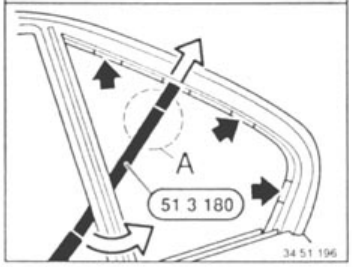


Note:
Clips (1) on the rubber blocks of the window rubber frame have a tab (2) on one side. These tabs of the clips engage in openings in the door frame.

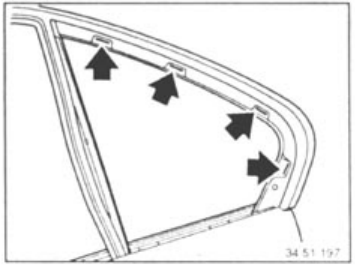


Apply tip of Special Tool 51 3 180 on the edge of the clip from the inside and press in clip firmly. In so doing support the tool on the window at (A) and press out the window glass in this manner.

— Showed Removed —



Apply the same procedures on the remaining clips and press out the window glass step by step.



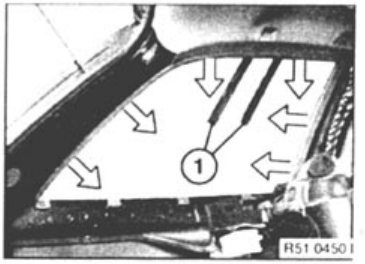
Installation:
Rub in rubber frame with a lubricant* and let clips on the rubber frame engage in the openings of the door frame.

* Source of Supply: **HWB**

51 36 070 Removing and installing rear left or right side window (touring)

Note information on mounting windows, refer to 51 31 ...

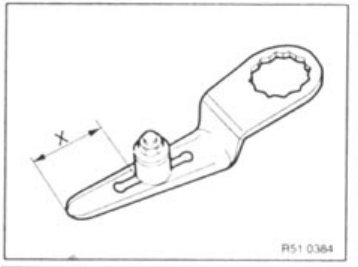
Remove outer window cavity cover strip, refer to 51 37 240.
Remove inner window cavity cover strip, refer to 51 37 261.
Remove outer trim finisher on C-pillar, refer to 51 13 365.



Completely remove edge protective strip of side window and mask off this area with fabric adhesive tape.

Only with side window antenna:

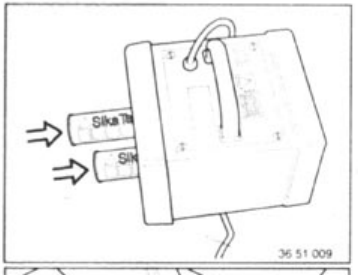
Mask off antenna wires with fabric adhesive tape (1) (risk of damage).



Fit straight knife blade* with adjustable setting roller on tool* and set dimension (X).

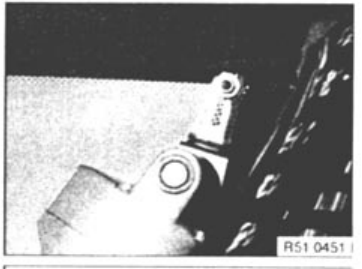
Top from C-pillar to D-pillar:
Dimension (X) = 28 mm

Front from top to bottom of C-pillar:
Dimension (X) = 35 mm

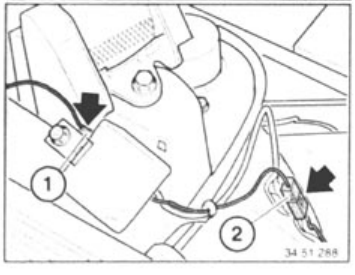


Only hot treatment with SikaTack - Ultrafast*:

Before inserting cartridge in oven, pierce aluminium cover at rear end.
Heat cement cartridge to 80 °C for one hour in cartridge oven*.



Carefully insert knife* between body and side window weatherstrip at top of C-pillar.
Guide web of knife parallel to side window weatherstrip.
Cut through cement bead as close as possible to body aperture.



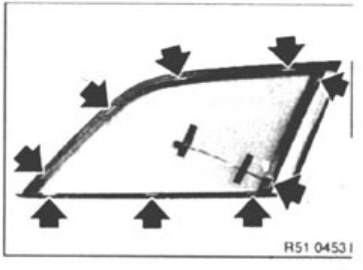
Only LH side with side window antenna:

Disconnect antenna plug connector (1).

Version, antitheft system with interior protection:

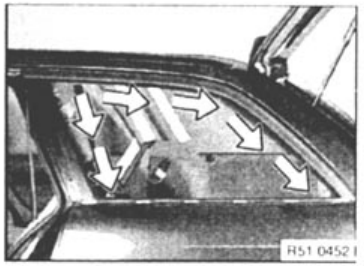
Disconnect plug connector (2).
If necessary, secure cable with cable tie to side window.

* Source of supply: BMW Parts Service

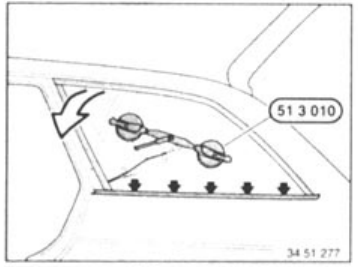


Note:
When cutting, try not to damage the spacer knobs on the PVC coating.
If they are damaged, the utmost care must be taken during installation.

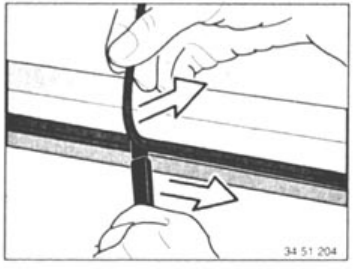
* Source of supply: BMW Parts Service



Cut through cement bead from top of C-pillar down and then up to the D-pillar.

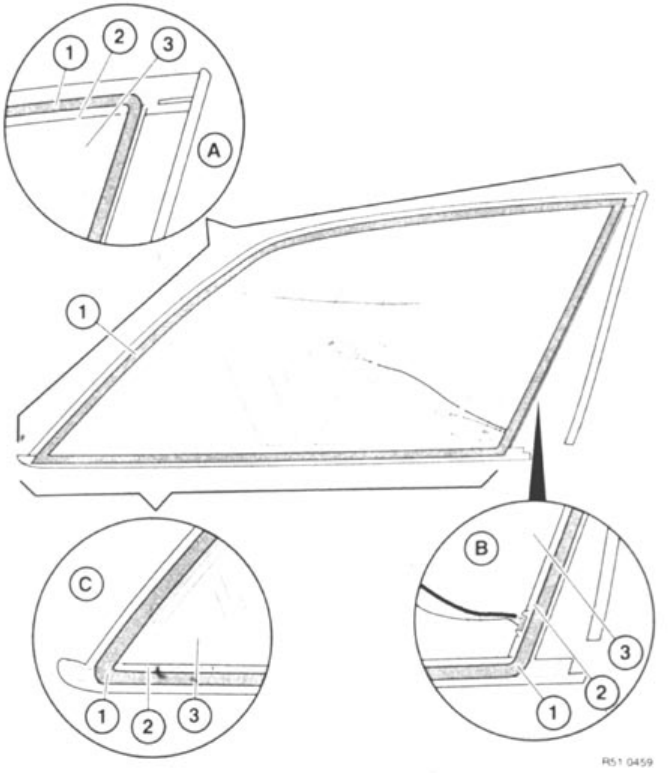


Lift out side window with special tool 51 3 010. Carefully cut through cement bead at the bottom with a scalpel (surgical knife) or with knife blade* (11 mm long).



Cut off remaining cement in body aperture down to a thickness of approx. 0.5 mm.

Cut off old cement carefully with a general purpose knife (razor sharp) in order to avoid damaging the paint finish in the body aperture.



The remaining cement (1) must be cut off flush all round with the PVC web (2). Height of PVC web (2) with respect to PVC coating all round (without cement) is approx. 3.5 mm.
Height of PVC web (2) to side window (3) is:
(A) top approx. 6 mm
(B) vertically to C-pillar, approx. 5.0 mm
(C) bottom approx. 6.4 mm

Caution!
Damaged paint finish must always be repaired to guarantee longterm corrosion protection.
Remove residual cement. Sand out scratches in areas not visible and touch up with BMW EP prime filler (2 K)*.

Large damaged spots must be ground down to bare metal and coated with BMW EP prime filler (2 K)* (layer thickness 30 ... 40 m).
The BMW EP prime filler must be allowed to harden.

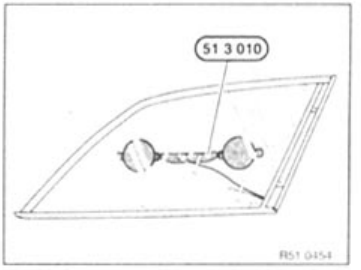
(A) Applying cement on existing cement bead:
- Coat residual cement bead on side window and body aperture with cleaner (Cleaner 205*)
- Drying time approx. 1 minute

(B) Applying cement on PVC coating (only where old cement bead peeled off):
As the result of plastisizer drift in the PVC, the PVC coating on the side window must be treated as follows in the cementing area:

- Roughen surface with sanding paper, grain size 220
- Clean twice with 2-propanol (100 % alcohol, available from pharmacies)
- Drying time approx. 1 minute
- Apply black primer 5001 (Gurit Essex)
- Drying time approx. 15 minutes

- Clean body aperture with 2-propanol
- Drying time approx. 1 minute

Caution!
The PVC coating on the side window must not be treated with Sikaflex Cleaner 205.

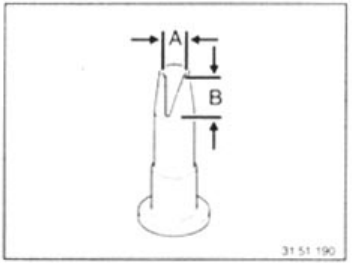


Secure special tool 51 3 010 on outside of window.

Note:
Moisten suction surfaces.



Remove outer window cavity cover strip, for this purpose, place side window in body aperture (without cement) and align.



Cut nozzle to size.

Application on PVC coating:

(A) = 6 mm
(B) = 11 ... 12 mm

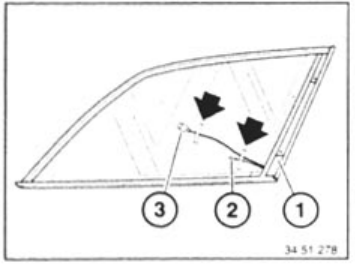
Application on old cement:

(A) = 6 mm
(B) = 8 mm

Note:
To apply uniform cement bead, use cartridge piston* (operated with compressed air or electric power).

Note "use by" date of cement!

If necessary adjust the height of the cement bead in the case of height differences of the old cement by varying the application speed.



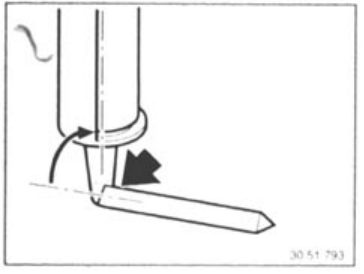
Fit C-pillar finisher (1) in weatherstrip. If necessary, secure antenna wire (2) and wire for interior protection (3) with adhesive tape.

* Source of supply: BMW Parts Service

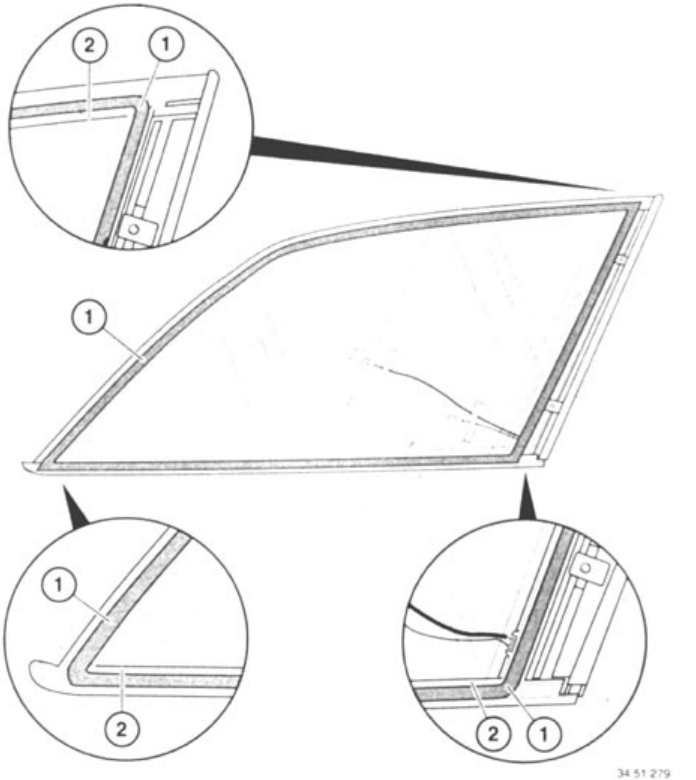
* Source of supply: BMW Parts Service



Mask off bottom of body aperture with an approx. 10 mm wide (thin) strip of masking tape.



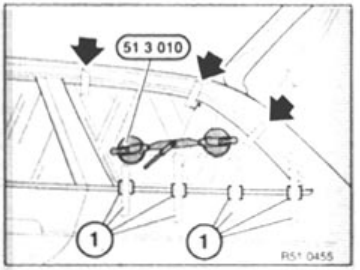
If necessary, produce a sample bead before cementing. Cartridge must be perpendicular to side window.



The cement bead (1) should be started at the bottom rear corner of the window.

Apply cement bead (1) all round side window (in one operation without stopping).
Maintain distance of approx. 1 mm to PVC web (2).
Join bead at joint with wooden spatula.

* Source of supply: **BMW Parts Service**

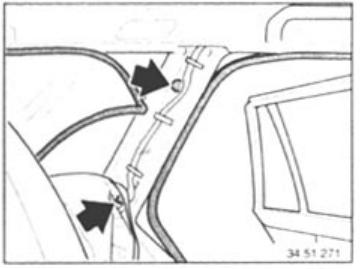


Using special tool 51 3 010, place side window in body aperture, fit in position and secure with fabric adhesive tape.
If necessary place polystyrene (1) on bottom trim moulding.

Note:
Ensure the side window is aligned flush with the outer skin panel.



Caution!
Before it hardens, remove residual cement with Sikaflex Cleaner (remover) 208*. While cleaning, do not press side window back out before it has hardened.

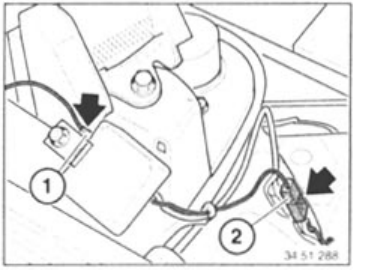


Firmly tighten screws of C-pillar finisher and fit caps.



Note:
Leaks can be localized by spraying water under the sealing lips or by using an ultrasonic leak detection device*. Leaks can then be sealed with the aid of an appropriate nozzle (repair kit)*.

* Source of supply: BMW Parts Service



Installation note:
Connect valve (1) for window antenna.

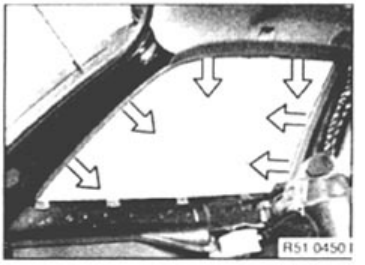
Tie back cable (2) (rattling noise) on vehicles without interior protection facility.

* Source of supply: BMW Parts Service

51 36 071 Replacing rear left or right side window (touring)

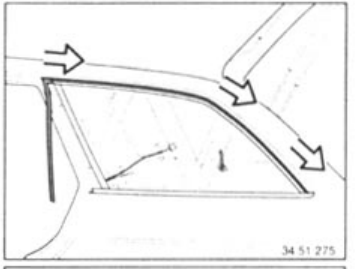
Note information on mounting windows, refer to 51 31 ...

Remove outer window cavity cover strip, refer to 51 37 240.
Remove inner window cavity cover strip, refer to 51 37 261.
Remove outer trim finisher on C-pillar, refer to 51 13 365.

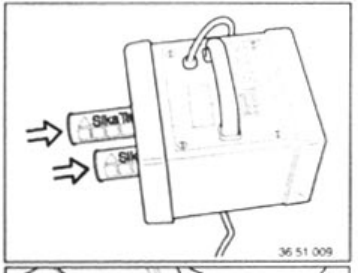


Completely remove edge protective strip of side window.

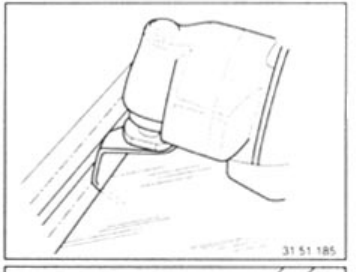
Mask off body and outer trim moulding all round side window.



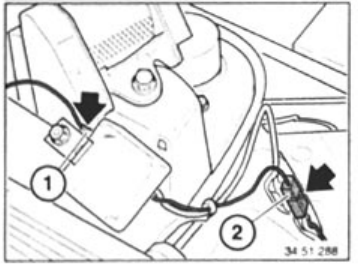
Cut off PVC coating with knife blade (razor sharp) along top trim moulding.



Only hot treatment with SikaTack - Ultrafast*:
Before inserting cartridge in oven, pierce aluminium cover at rear end.
Heat cement cartridge to 80 °C for one hour in cartridge oven*.



Fit knife blade* (24 mm) long on tool*.
Carefully insert knife* between body and side window.
Guide web of knife parallel to side window.
Cut through cement bead as close as possible to rear window glass.



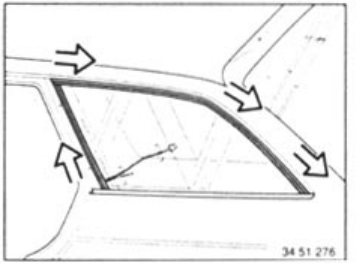
Only LH side with side window antenna:

Disconnect antenna plug connector (1).

Version, antitheft system with interior protection:

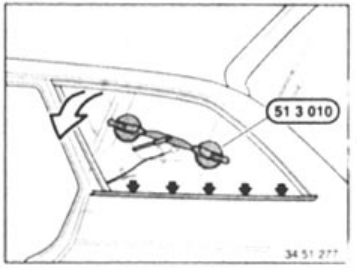
Disconnect plug connector (2).
If necessary, secure cable with cable tie to side window.

* Source of supply: BMW Parts Service

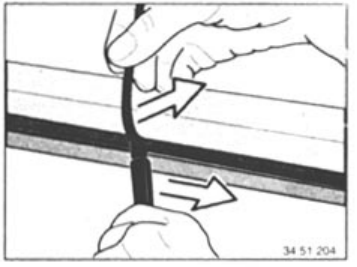


Cut through cement bead.

* Source of supply: BMW Part Service



Lift out side window at top with special tool 51 3 010 and carefully cut through cement bead with general purpose knife (razor sharp).



Cut off remaining cement in body aperture down to a thickness of approx. 0.5 mm.

Cut off residual cement carefully with a general purpose knife (razor sharp) in order to avoid damaging the paint finish in the body aperture.

Caution!
Damaged paint finish must always be repaired to guarantee longterm corrosion protection.

Remove residual cement. Sand out scratches in areas not visible and touch up with BMW EP prime filler (2 K)*.

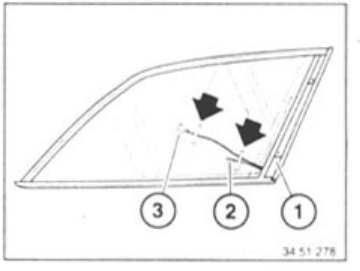
Large damaged spots must be ground down to bare metal and coated with BMW EP prime filler (2 K)* (layer thickness 30 ... 40 m).
The BMW EP prime filler must be allowed to harden.

Clean body flange with 2-propanol (100 % alcohol) (drying time approx. 1 minute)

As the result of plastisizer drift in the PVC, the PVC coating on the side window must be treated as follows in the cementing area:

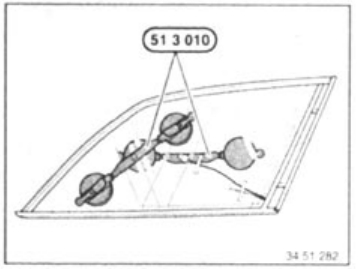
- Roughen surface with sanding paper, grain size 220
- Clean twice with 2-propanol (100 % alcohol, available from pharmacies)
- Drying time approx. 1 minute
- Apply black primer 5001 (Gurit Essex)
- Drying time approx. 15 minutes

Caution!
The PVC coating on the side window must not be treated with Sikaflex Cleaner 205.



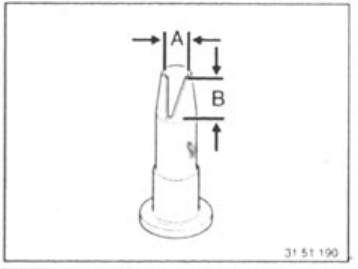
Fit C-pillar finisher (1) in weatherstrip. If necessary, secure antenna wire (2) and wire for interior protection (3) with adhesive tape.

* Source of supply: BMW Parts Service



Secure special tool 51 3 010 (with joint) on outside of window.
Secure special tool 51 3 010 (without joint) on inside of window.

Note:
Moisten suction areas.



Cut nozzle to size.

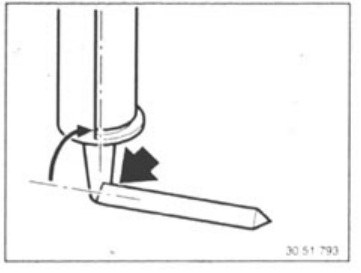
Application on PVC coating:
(A) = 6 mm
(B) = 11 ... 12 mm

Note:
To apply uniform cement bead, use cartridge piston* (operated with compressed air or electric power).

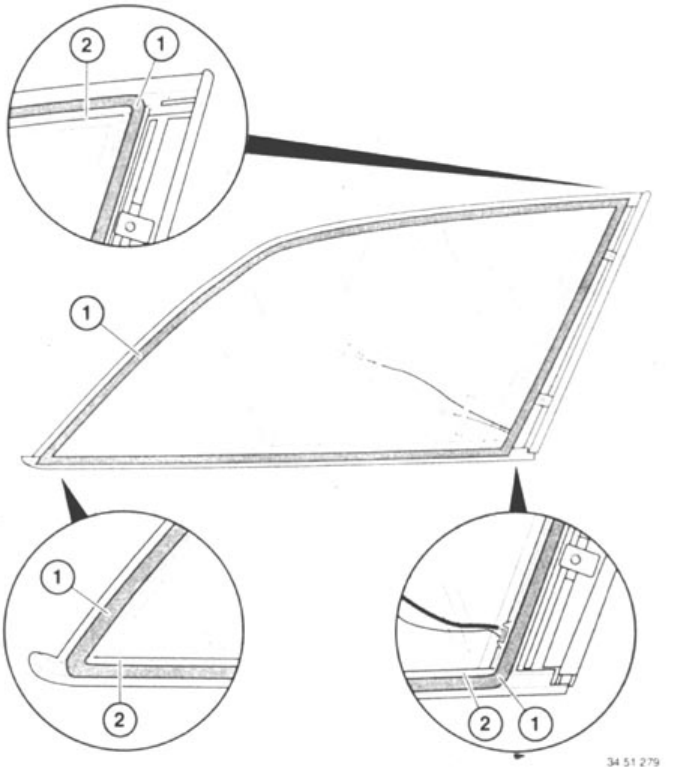


Note:
Note "use by" date of cement!

Firmly tighten lashing lug at D-pillar (required for tensioning after fitting side window).



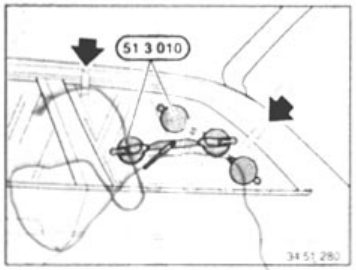
If necessary, produce a sample bead before cementing. Cartridge must be perpendicular to side window.



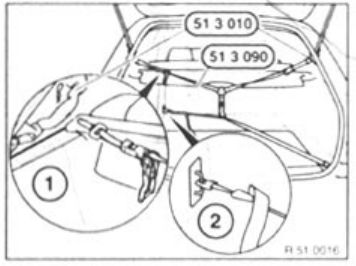
The cement bead (1) should be started at the bottom rear corner of the window.

Apply cement bead (1) all round side window (in one operation without stopping).
Maintain distance of approx. 1 mm to PVC web (2).
Join bead at joint with wooden spatula.

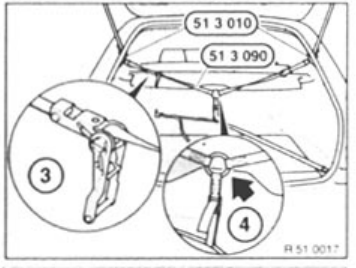
* Source of supply: BMW Parts Service



Using special tool 51 3 010, place side window in body aperture, fit in position and secure with fabric adhesive tape.



Secure special tool 51 3 010 (without joint) on inside of window.
Secure special tool 51 3 090 (tensioning strap) to top of special tool 51 3 010 (1).
Attach tensioning strap diagonally in bottom lashing lugs and firmly tighten (2).

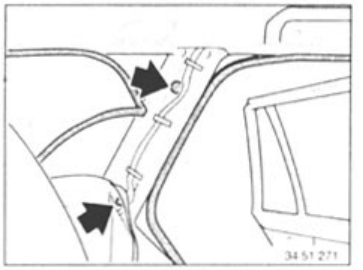


Tighten belt tensioner in center (4) so that the lug is located approx. 400 mm above the floor inlay (4).
Tighten top belt tensioner (3) so that lug can be pulled back approx. 20 mm (4).



Caution!
Before it hardens, remove residual cement with Sikaflex Cleaner (remover) 208*. While cleaning, do not press side window back out before it has hardened.

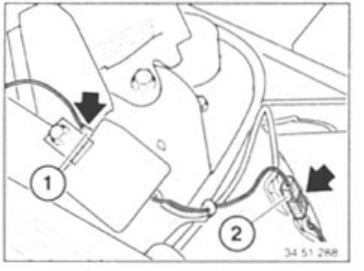
* Source of supply: BMW Parts Service



Firmly tighten screws of C-pillar finisher and fit caps.



Note:
Leaks can be localized by spraying water under the sealing lips or by using an ultrasonic leak detection device*. Leaks can then be sealed with the aid of an appropriate nozzle (repair kit)*.



Installation note:
Connect valve (1) for window antenna.

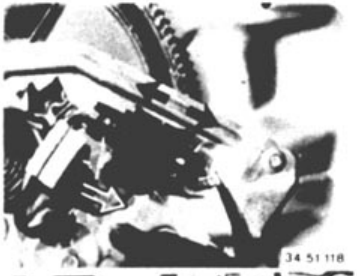
Tie back cable (2) (rattling noise) on vehicles without interior protection facility.

* Source of supply: BMW Parts Service

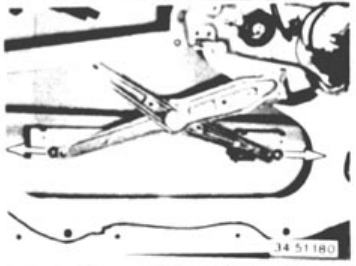
51 37 000 REMOVING AND INSTALLING POWER WINDOW REGULATOR IN LEFT OR RIGHT REAR DOOR

Lower door window.
Remove rear door trim panel – see 51 42 000.

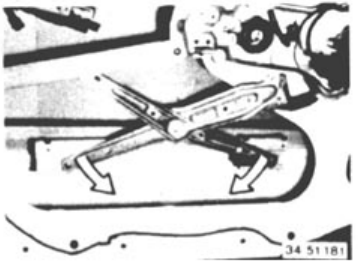
Installation:
Adjust rear door window – see 51 34 020.



Pull off clip.
Lift out microswitch.
Disconnect plug.



Pull out retainer from the side.



Disengage window lifting arms in the slides.



Unscrew screws; drill off rivets if applicable.
Remove complete window regulator.



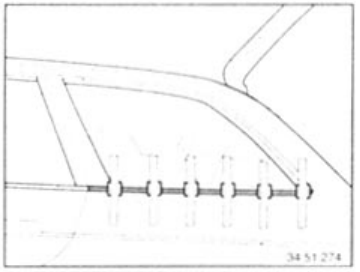
Installation:
If applicable, replace drilled off rivets with M 6 x 10 hexagon heads screws, 6.4 washers and M 6 hexagon nuts.
Tightening torque = 9 Nm (6.5 ft. lbs.).



Unscrew screws.
Remove gearbox/motor.

51 37 240 REMOVING AND INSTALLING / REPLACING WINDOW RECESS STRIP ON OUTSIDE OF LEFT OR RIGHT REAR SIDE WINDOW (Touring)

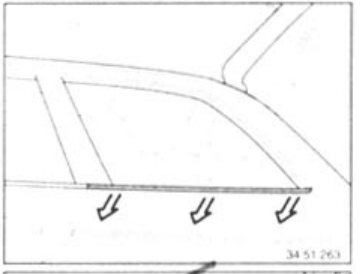
Note:
Ornamental strips are cemented on side windows of cars produced up to May/June of 1992 and on replacement side windows produced up to September of 1992.



Press on and align strip.
Place a wooden block on each oof the six securing beads and clamp down with adhesive tape.
Hardening time: at least 4 hours.

Cemented Strips:

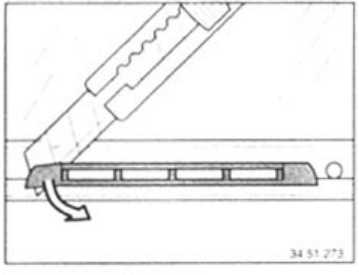
Cover painted surface below strip with adhesive tape.
Press out strip at rear top slightly using a creaser and cut through cement on strip using a standard knife (sharp as razor blade).



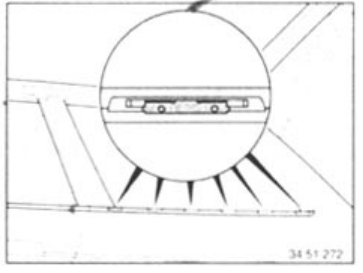
Clipped Strips:

Prior to removing, ensure that strip is not cemented by carefully lifting the rear end of the strip using a creaser.

Unclip strip from rear to front end using a creaser.



Cut off bead on PVC sprayed on rear side window but for about 1 mm.



Installation:
Clips must seat centered and must not be damaged.
If applicable, replace damaged clips.

Refer to 51 31 ... for information on installing windows.

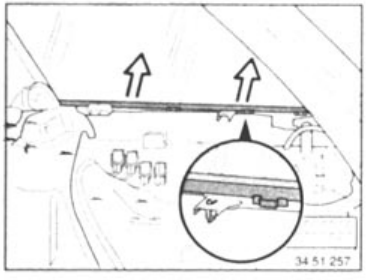
Clean strip and sprayed PVC, coat with primer* and air dry about 10 minutes.

Apply window cement in strip opposite the securing beads.

* Source of Supply: BMW Parts

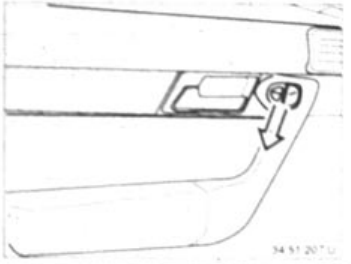
51 37 261 REPLACING WINDOW RECESS STRIP ON INSIDE OF LEFT OR RIGHT REAR SIDE WINDOW (Touring)

Remove cargo room wheel house trim panel - refer to 51 47 151 or 51 47 161.



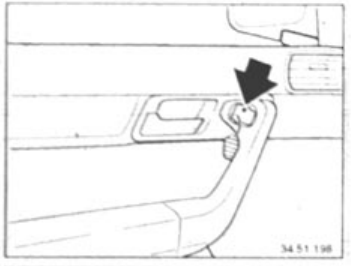
Pull off ornamental strip.

Installation:
Ensure that strip snaps into clips correctly.

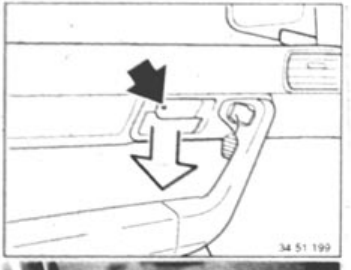


51 41 000 REMOVING AND INSTALLING LEFT OR RIGHT FRONT DOOR TRIM PANEL

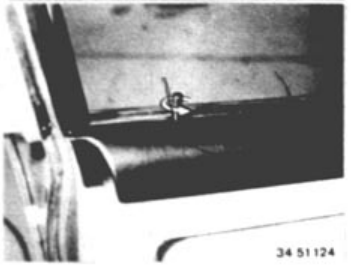
Pull the outside mirror adjusting knob off.
Remove the mirror switch using Special Tool 61 1 300 and disconnect the plug.



Unscrew screw.



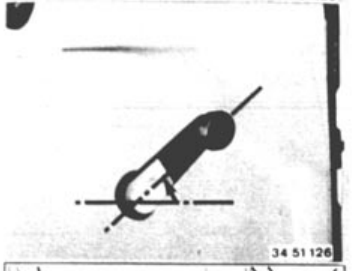
Remove the screw cover.
Unscrew screw and pull the opener recess plate out.



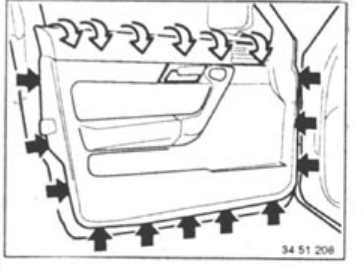
Unscrew the catch button.



Lift the plate out.
Unscrew screw and remove the window winder.



Installation:
Install the window winder with the window closed as shown.



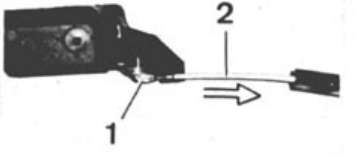
Unclip the trim panel.

Important!
Unclip each clip separately.

Lift the trim panel out towards the rear.

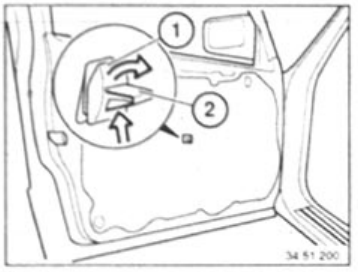
Installation:
Replace damaged clips.

1 = Cable core
2 = Cable sleeve

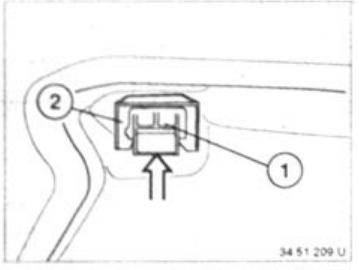


Pull the cable sleeve back and disconnect the cable core.

Installation:
Check for correct seating of the cable sleeve.

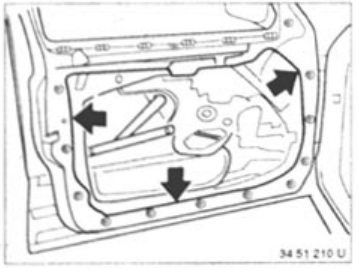


Squeeze locking hook (2) with a pliers and pull off clamp (1).

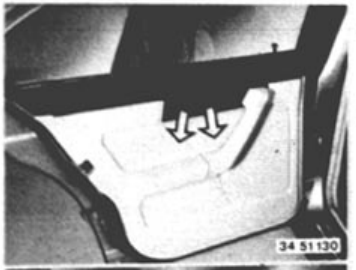


Installation:
Insert clamp (1) in holder (2) on the door trim panel.

Important!
Note the direction of insertion.



Installation:
Check the butyl cord prior to installation of the trim panel, replacing if necessary.

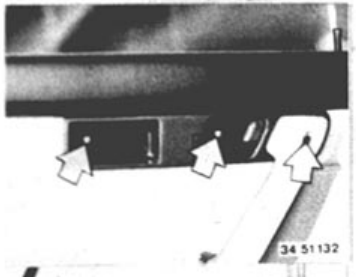


51 42 000 **REMOVING AND INSTALLING LEFT OR RIGHT REAR DOOR TRIM PANEL**

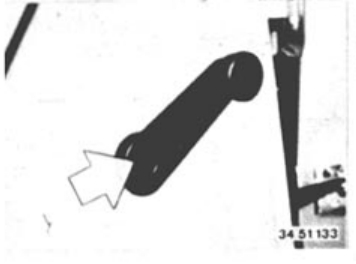
Lift out power window switch.
Pull off plug.



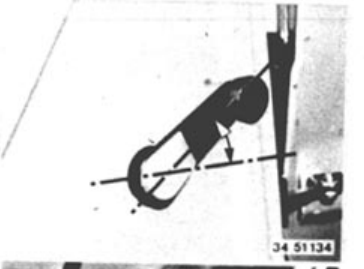
Lift out plates.
Unscrew catch button.



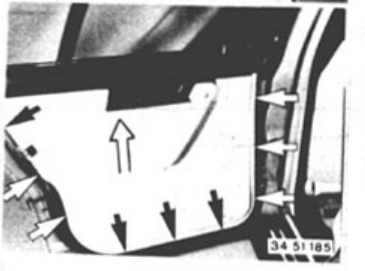
Unscrew screws.



Lift off plate.
Unscrew screw and take off window winder.



Installation:
Mount window winder as shown with the window closed (raised).

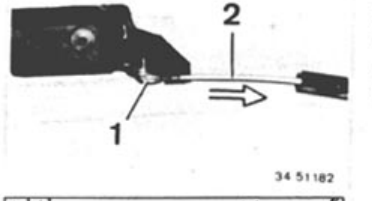


Unclip trim panel.

Important!
Unclip each clip separately.

Lift out trim panel from above.

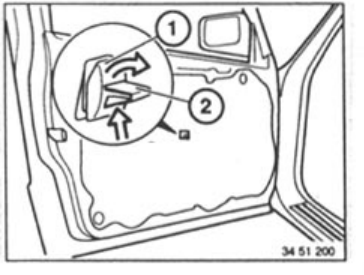
Installation:
Replace damaged clips.



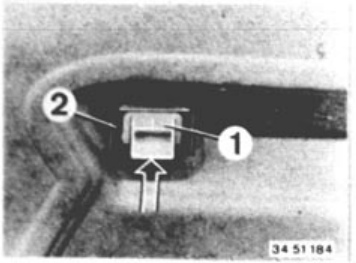
1 = Cable core
2 = Cable sleeve

Pull back cable sleeve and disconnect cable core.

Installation:
Check that cable sleeve seats correctly.



Squeeze locking hook (2) with a pliers and pull off clamp (1).

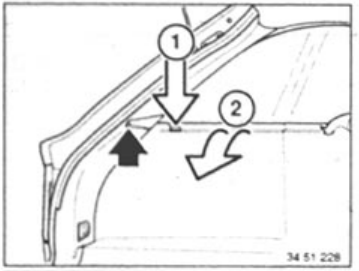


Installation:
Insert clamp (1) in holder (2) on the door trim panel.

Important!
Note the direction of insertion.

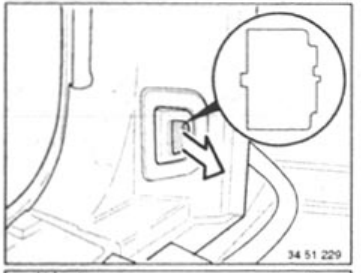


Installation:
Check butyl string, replacing if necessary, prior to installation of the trim panel.

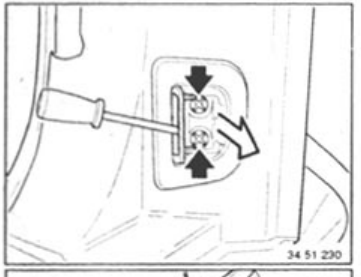


51 43 252 REPLACING TRIM PANEL FOR LEFT OR RIGHT REAR ROOF PILLAR (D-PILLAR)

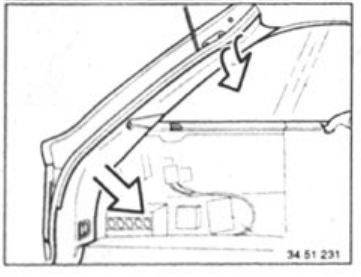
Unlock (1) the side trim panel, fold it up and take it out (2).
Unscrew screw.



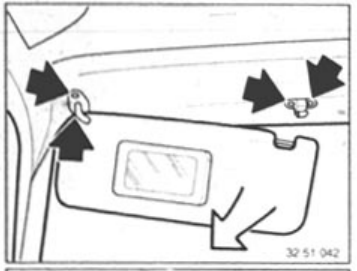
Remove plate.



Unscrew screws and remove escutcheons.

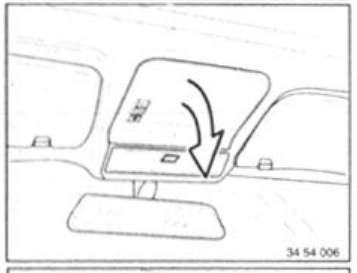


Unclip the D-pillar trim panel at top and remove it.

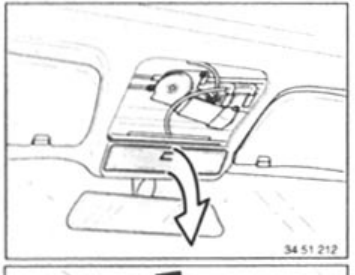


51 44 011 Removing and installing or replacing complete headlining (sunroof version)

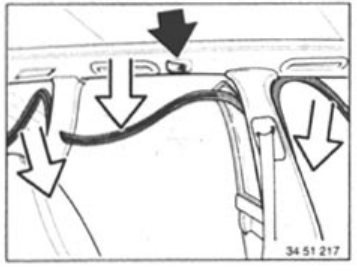
Remove sun vizors and support brackets on left and right.
If necessary, disconnect plug connector for mirror light.



Unclip panel, pull down and disconnect plug connector.



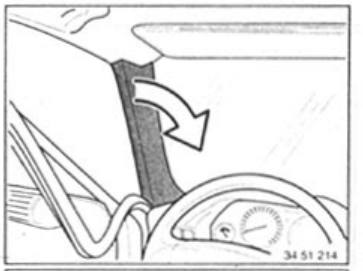
Unclip interior light and disconnect plug.



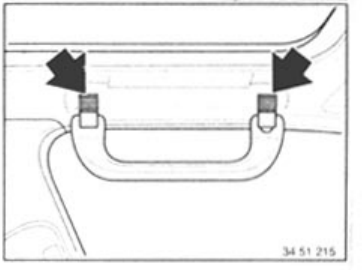
Partly remove edge guard strip on left and right in front door, rear door and at rear side window.

Note:
If edge guard strip is fitted too loosely in area of D-pillar, fix a approx. 250 mm long strip of fabric adhesive tape over the body flange.

If necessary remove holder for net partition.



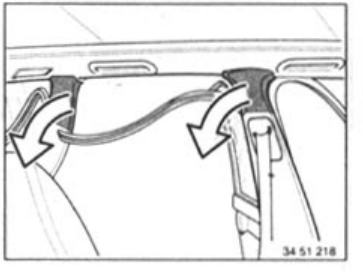
Unclip A-pillar trim panels on left and right.



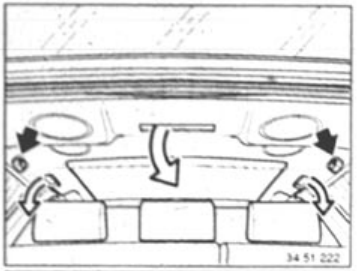
Unclip finishers, release screws and remove all grab handles.

Completely remove edge guard strip from sunroof.

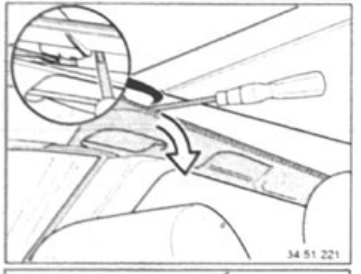
Remove front section of headlining.



Partly unclip B-pillar and C-pillar trim panel at top.

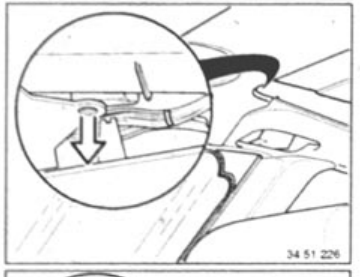


Unclip rear inside light at left and right, and disconnect plugs.
If applicable, remove holders for network cutouts at left and right-hand sides.

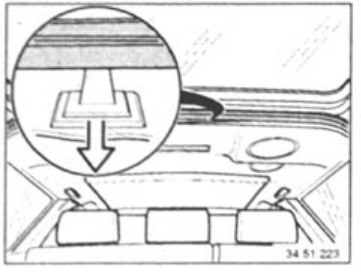


Caution!
Unclip carefully to avoid damaging sun roof cassette.

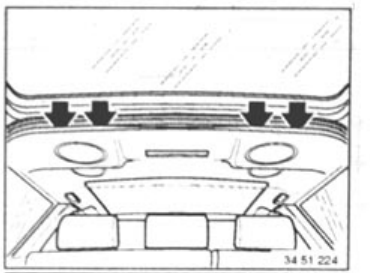
Unclip and remove left and right roof liner side sections.



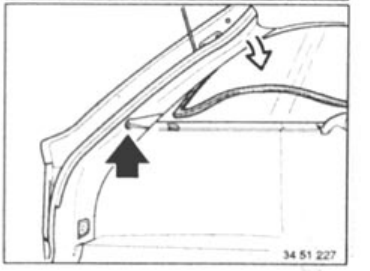
Remove left and right rivets.



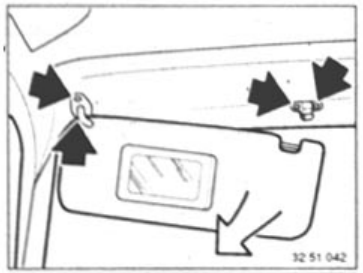
Press down on roof liner rear section slightly and unclip.



If applicable, unclip left and right loudspeaker covers.

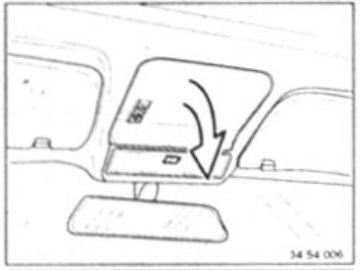


Unscrew left and right screws.
Unclip D-pillar trim panel partially and remove roof liner rear section.

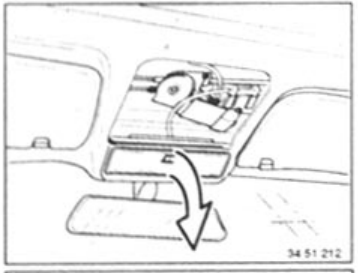


51 44 041 REMOVING AND INSTALLING / REPLACING ROOF LINER FRONT SECTION
(Version with Sun Roof)

Unscrew the left and right sun vizors and holders.
If applicable, disconnect the plug of the inside light for the mirror.



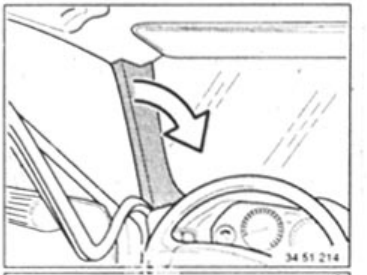
Unclip the cover downwards and disconnect the plug.



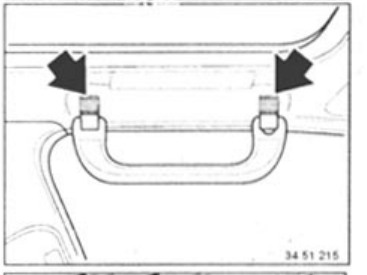
Unclip the inside light and disconnect the plug.



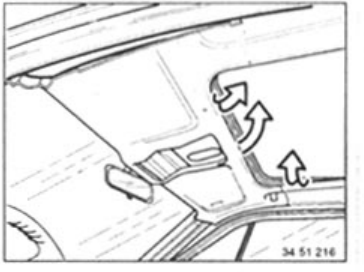
Pull the edge guards off partially in the front door openings.



Unclip the left and right A-pillar trim panels.

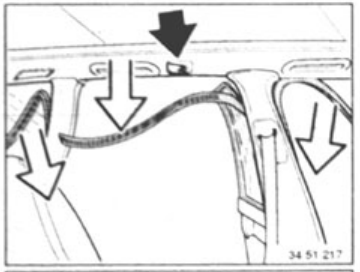


Unclips covers, unscrew screws and remove the left and right grab handles.

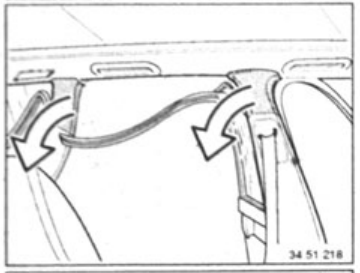


Pull the edge guard off partially and remove the roof liner front section.

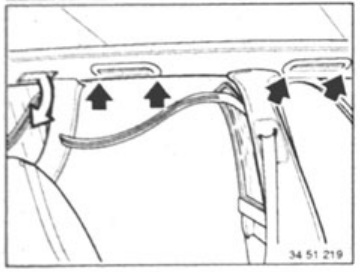
51 44 042 REMOVING AND INSTALLING / REPLACING LEFT OR RIGHT ROOF LINER SIDE SECTION (Version with Sun Roof)



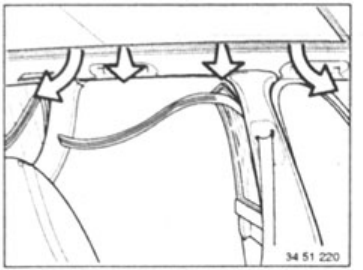
Pull off edge guards partially in front and rear door openings as well as on rear side windows.
If applicable, remove holder for network cutout.



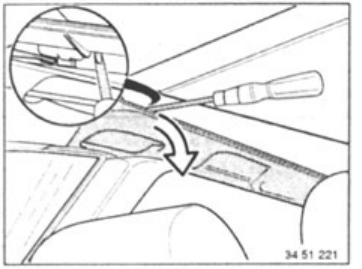
Unclip B and C pillar trim panels at top partially.



Unclips covers, unscrew screws and remove grab handles.
Unclip inside light and disconnect plug.

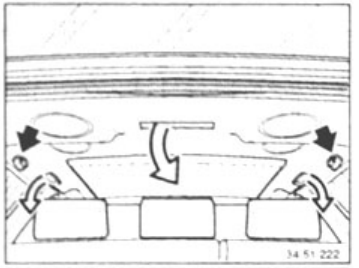


Pull off edge guards partially.



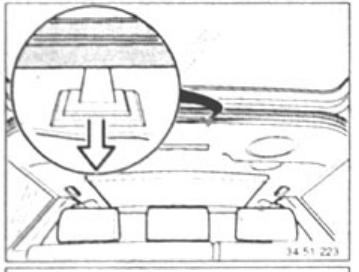
Caution!
Unclip carefully to avoid damaging the sun roof cassette.

Unclip and remove roof liner side section.

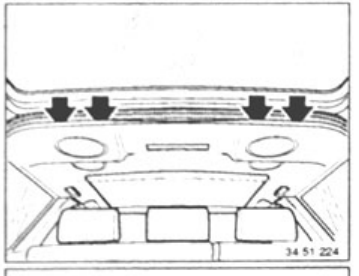


51 44 043 REMOVING AND INSTALLING / REPLACING ROOF LINER REAR SECTION (Version with Sun Roof)

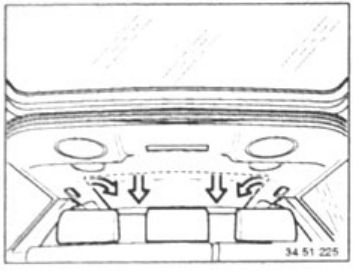
Unclip rear inside light at left and right, and disconnect plugs.
If applicable, remove holders for network cutouts at left and right-hand sides.



Press down on the roof liner rear section slightly and unclip.

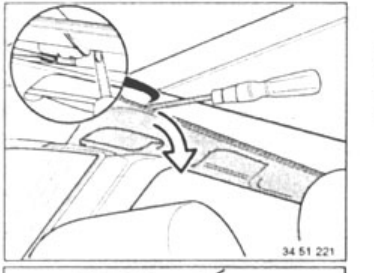


If applicable, unclip left and right loud-speaker covers.



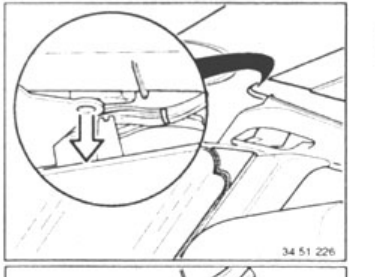
Loosen edge guard partially.
Pull edge guards off of C-pillar trim panels and rear side windows partially.

Unclip left and right C-pillar trim panels partially.

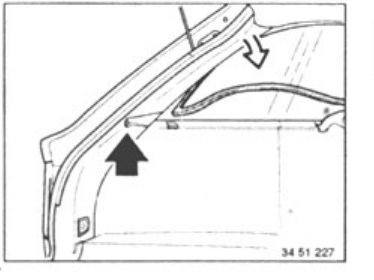


Caution!
Unclip carefully to avoid damaging the sun roof cassette.

Unclip rear roof liner section at left and right sides partially.



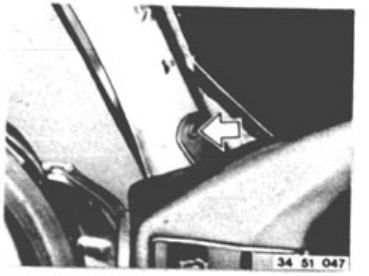
Press down on the rear of the roof liner side section slightly and remove rivet.



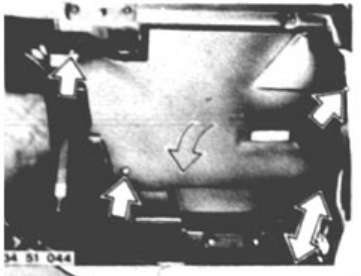
Unscrew left and right screws.
Unclip D-pillar trim panel partially and remove roof liner rear section.

51 45 030 REMOVING AND INSTALLING DASHBOARD TRIM PANEL

Remove center console – see 51 16 200.
Remove glove box – see 51 16 360.
Remove instrument cluster – see 62 61 000.



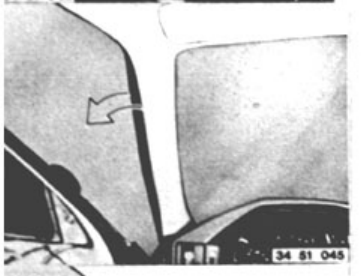
Unscrew screws on left and right sides.



Unscrew screws.
Remove trim panel.
If applicable, disconnect plug for radio speaker.



Unscrew screws on left and right sides.



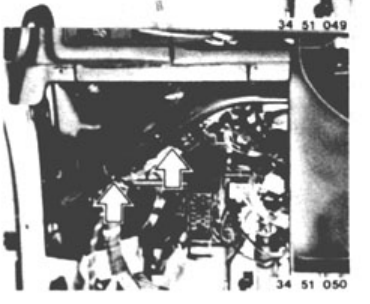
Pull off rubber seals for left and right doors carefully.



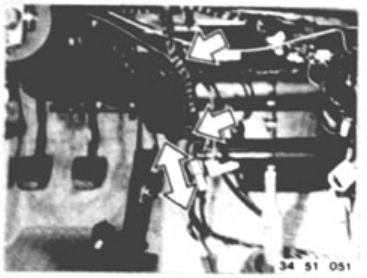
Disconnect plug.



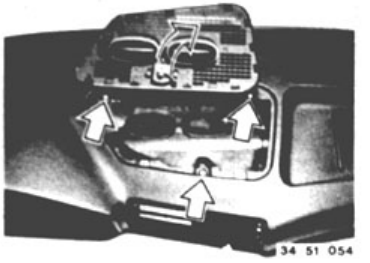
Lift trim panel off of left and right A pillars.



Disconnect wire connector.

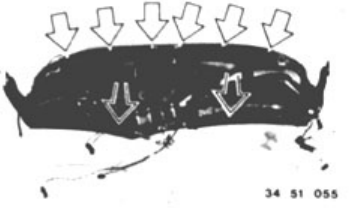


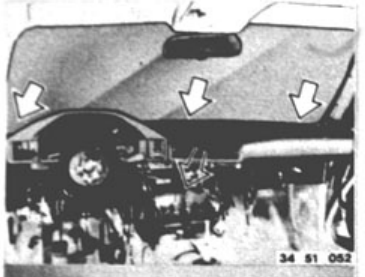
Disconnect wire connector.
Pull off plug.



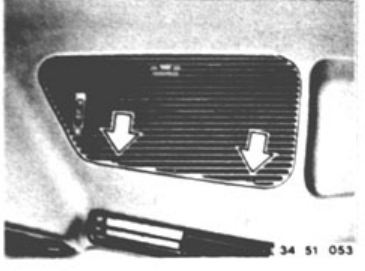
Unscrew screws.
If applicable, pull off plug.

Unscrew screws.
Remove air ducts.





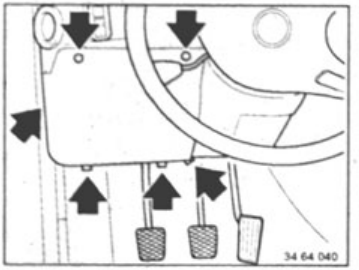
Lift out dashboard.
Installation:
Check for correct seating of mounting clips on body.
Align instrument panel.



Unscrew screw.
Lift out air grill.

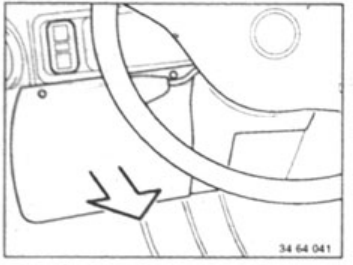


Disconnect wire connector.
Remove wire harness.

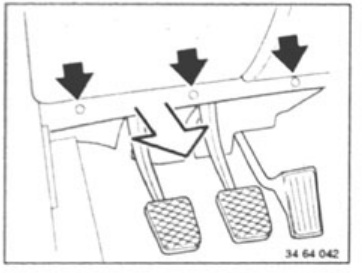


51 45 180 REMOVING AND INSTALLING DASHBOARD TRIM PANEL AT BOTTOM LEFT

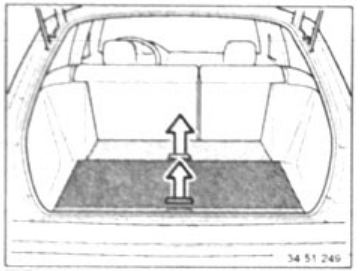
Lift out plugs.
Unscrew screws.



Lift off trim panel.

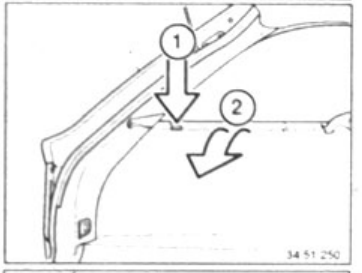


Unscrew screws.
Lift off trim panel.

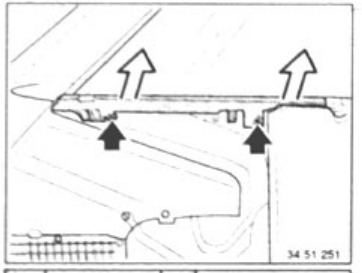


51 47 151 REMOVING AND INSTALLING / REPLACING LEFT WHEEL HOUSE TRIM PANEL IN CARGO ROOM

Remove the front and rear trunk covers.
Remove the interior divider.

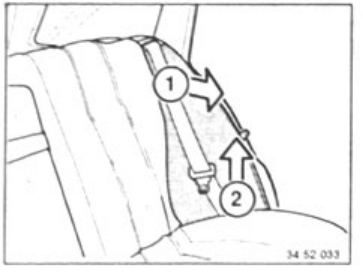


Unlock (1) the side trim panel, fold it down and remove it (2).

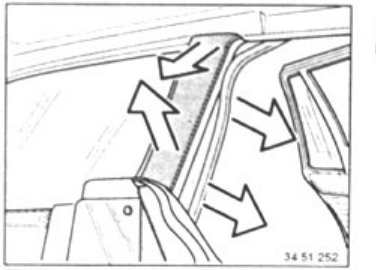


Unscrew screws and remove the grill upwards.

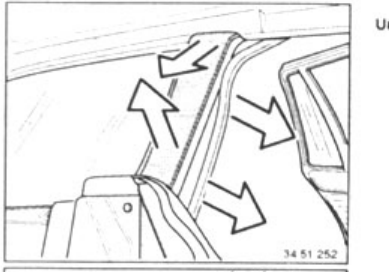
Installation.
Clip the grill in correctly.



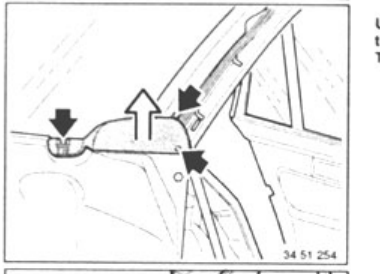
Lift (1) the backrest side section out and remove it upwards (2).



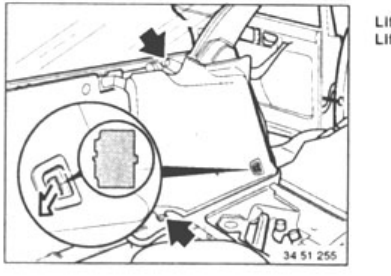
Pull the edge guard off of the rear door partially.



Unclip the C-pillar trim panel.



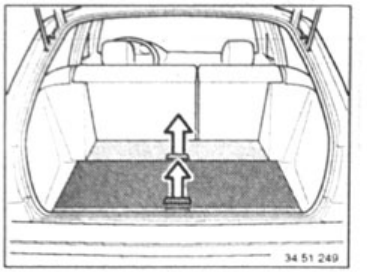
Unscrew screws and unclip the cover for the automatic seat belt reel.
Take the belt strap out.



Lift the securing plugs out.
Lift the covers off of the escutcheon.

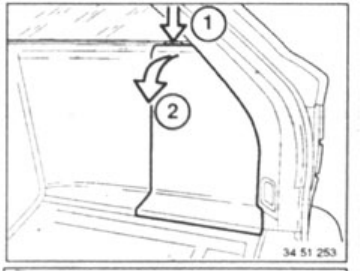


Unscrew screws.
Lift the escutcheon out and remove the side trim panel.

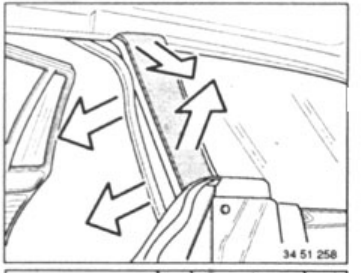


51 47 161 REMOVING AND INSTALLING / REPLACING RIGHT WHEEL HOUSE TRIM PANEL IN CARGO ROOM

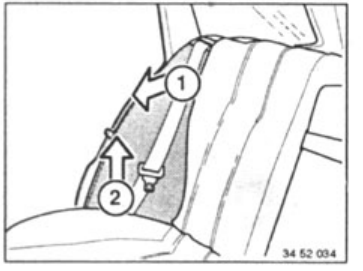
Remove the front and rear trunk covers.
Remove the interior divider.



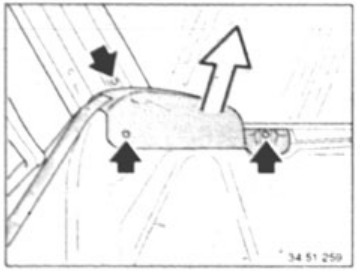
Unlock (1) the side trim panel, fold it down and remove it (2).



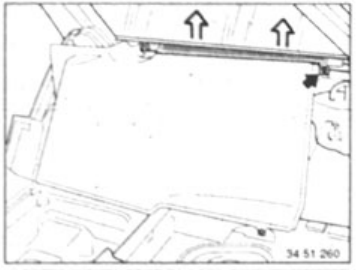
Pull the edge guard off partially.
Unclip and remove the C-pillar trim panel.



Lift (1) the backrest side section out and remove it upwards (2).

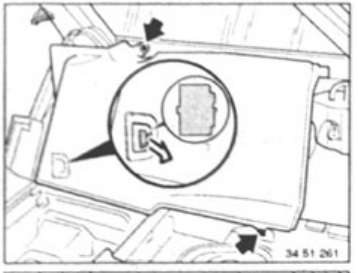


Unscrew screws and unclip the cover for the automatic seat belt reel.
Take the belt strap out.



Unscrew screws and remove the grill upwards.

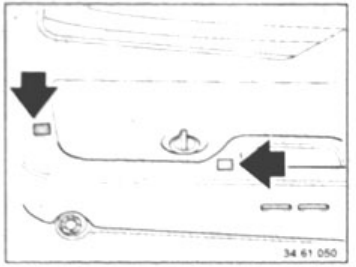
Installation:
Clip the grill in correctly.



Lift the securing plugs out.
Lift the covers off of the escutcheon.

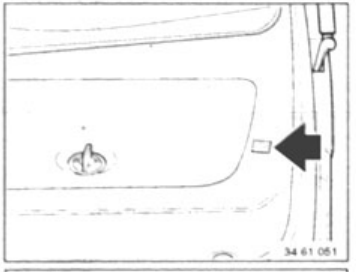


Unscrew screws.
Lift the escutcheon out and remove the side trim panel.

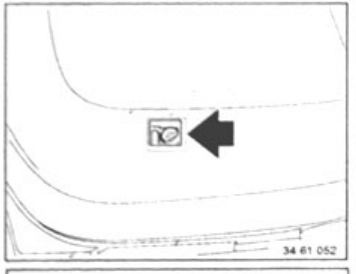


51 49 000 REMOVING AND INSTALLING / REPLACING TRIM PANEL FOR TAILGATE

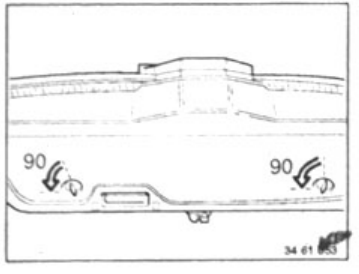
Unclip caps on screws.



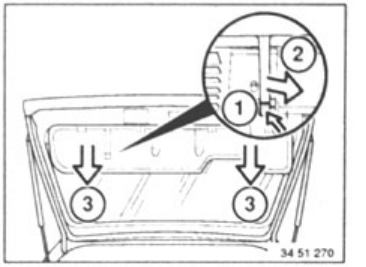
Unclip cap on screws.



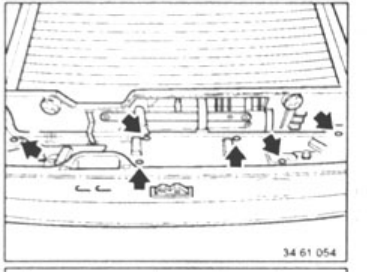
Unscrew screws.



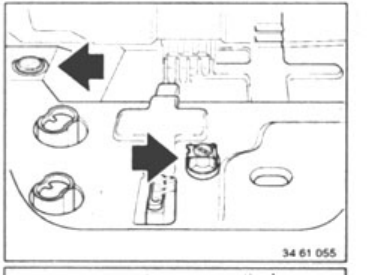
Open the toolbox.



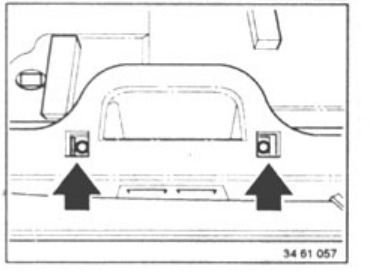
Push (1) the latch and lift (2) the retaining strap out.
Remove the toolbox downwards (3).



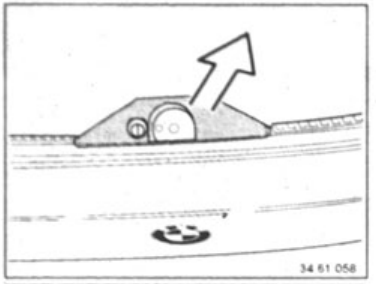
Remove clips.



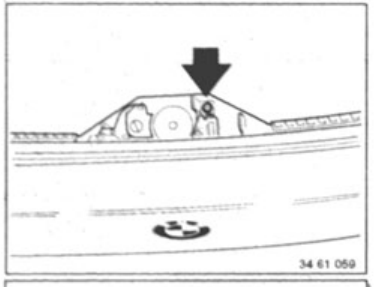
Unscrew left and right screws.



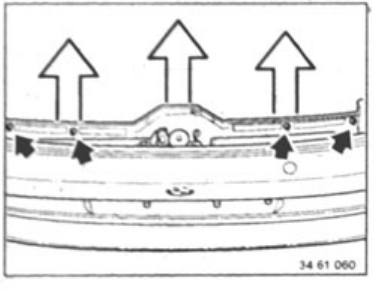
Unscrew screws.
Unscrew screws of handle recess plate.



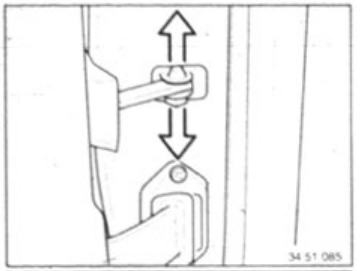
Shut the tailgate.
Unscrew the cap on the wiper crank.



Unscrew screw.

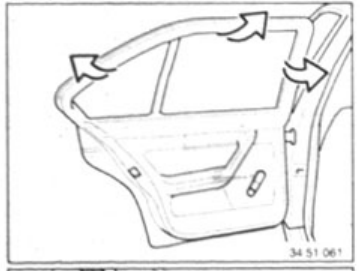


Take trim panel out of the clips carefully.
Remove the trim panel.

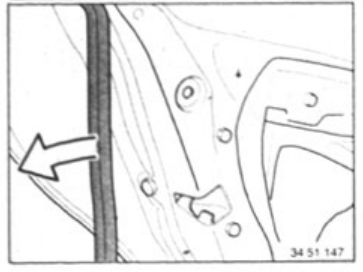


51 71 200 REMOVING AND INSTALLING / REPLACING SEAL ON LEFT OR RIGHT REAR DOOR

Lift out door retarder and, if necessary, cover.

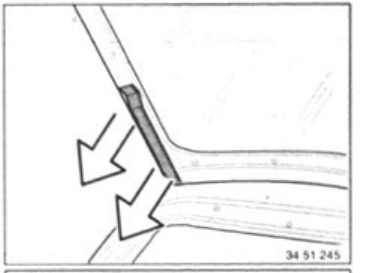


Lift out plates.



Pull off seal carefully.
If necessary, clean cementing surface with gasoline.

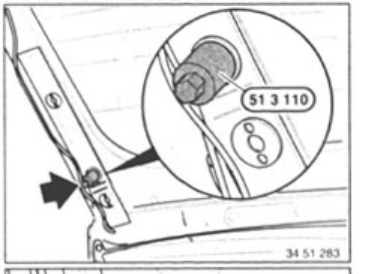
Other steps are identical with those described in 51 71 000.



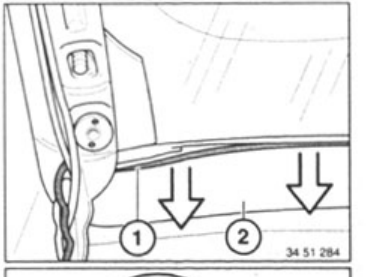
51 71 407 REPLACING REAR SPOILER (Touring)

Open tailgate window.
Unclip panels on left and right hand sides and pull off adhesive tape.

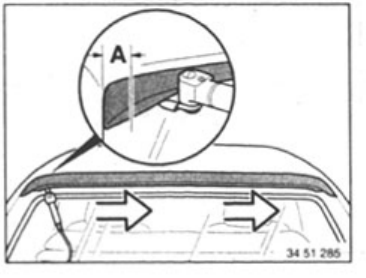
Installation:
Secure wires with adhesive tape.



Unscrew screw on left and right hand sides using Special Tool 51 3 110.



Pull wiring (1) out of spoiler (2).



Cut through cement bead with a straight oscillating knife*.
Cut outside with knife only up to (A) (screw).

Distance A = 40 mm.

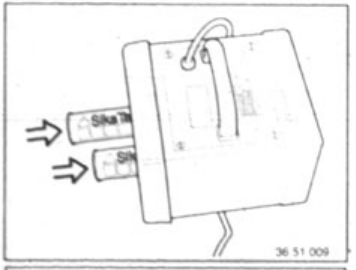
* Source of Supply: BMW Parts



Note information on mounting windows, refer to 51 31 ...

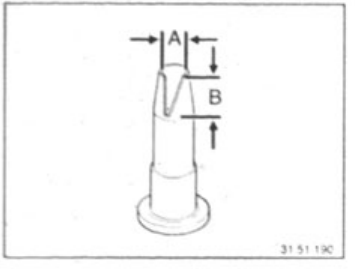
Remove cement residue on rear window
Clean rear window and spoiler and coat cementing surface with primer (repair kit)*.

Note:
Drying time approx. 10 minutes.



Only hot treatment with SikaTack - Ultrafast:

Before inserting cartridge in oven, pierce aluminium cover at rear end.
Heat cement cartridge to 80°C for one hour in oven*.

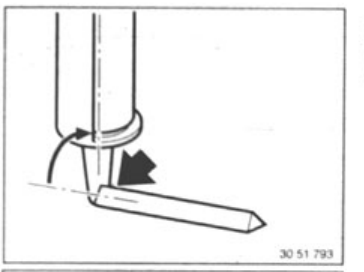


Cut nozzle to size.

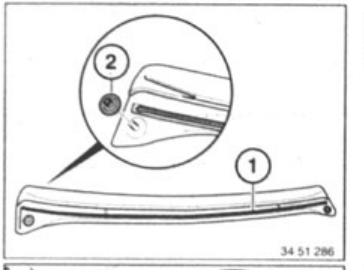
Dimension:
(A) = 6 ... 7 mm
(B) = 5 ... 6 mm

Note:
To apply uniform cement bead, use cartridge pistol* (operated with compressed air or electric power).

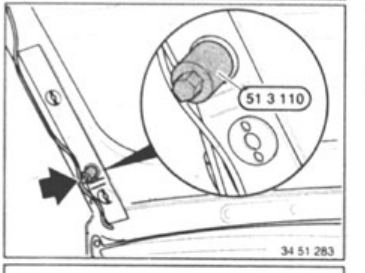
* Source of supply: BMW Parts Service



If necessary, produce a sample bead before cementing.
Cartridge must be perpendicular to rear window.

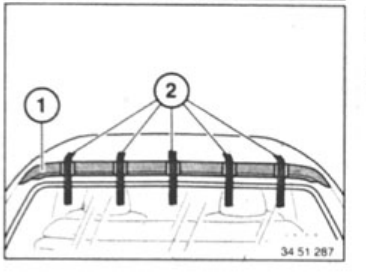


Apply cement bead (1) in groove of spoiler.
Press grommet (2) onto screws on left and right.



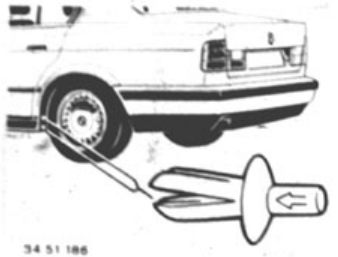
Fit spoiler on rear window, press down, align and firmly tighten with special tool 51 3 110.

For tightening torque, refer to Technical Data 51 71 2AZ



Tension rear spoiler (1) with wooden blocks and fabric adhesive tape (2).

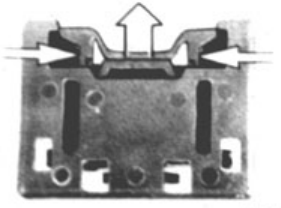
For hardening time, refer to 51 31 ..., table of minimum hardening times.



34 51 186

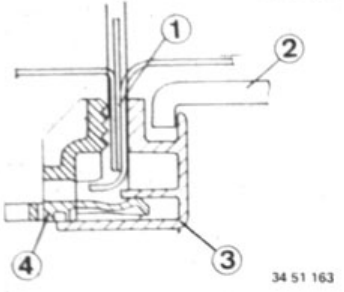
51 71 447 REMOVING AND INSTALLING PANEL FOR COVER ON LEFT OR RIGHT SIDE MEMBER

Remove rear wheel – see Group 36.
Knock out plug (1) in the expander rivet.
Pull out expander rivet.



34 51 187

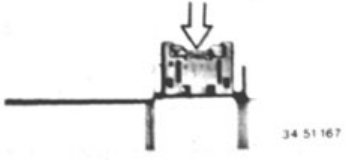
Squeeze clamping parts on the sides in the clamps with a circlip pliers and pull out.



34 51 163

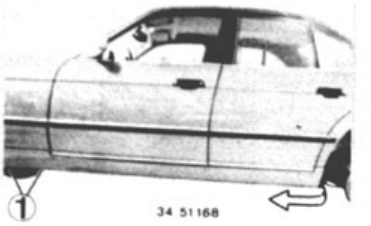
Installation:
Check for correct seating of clamps and clamping parts.

1 Sheet metal fold on side member
2 Panel (plastic)
3 Clamp
4 Clamping part



34 51 167

Installation:
Squeeze clamping part and clamp on the sheet metal fold with a pliers.



34 51 168

Unscrew screws (1).
Pull panel out of clips from behind.

Installation:
Replace damaged expander rivets, clamps and clips.

52 Seats

52 0	. . .	General information	52- 0/1
52 10 000		Front seat, left or right – remove and install	52- 10/1
	. . .	Front seat, left or right – disassemble and assemble (seat removed)	52- 10/2
	. . .	Front power seat, left or right – disassemble and assemble (seat removed)	52- 10/4
	. . .	Seat rails and drives	52- 10/5
	205	Armrest on front seat – remove and install	52- 10/8
52 11 501		Covers for left or right front seat – replace	52- 11/1
52 20 000		Rear seat cushion and backrest – remove and install	52- 20/1
	. . .	Rear seat center armrest – remove and install (M5)	52- 20/2
	. . .	Load-through mechanism	52- 20/3
	. . .	Split rear seat cushion and backrests – remove and install	52- 20/4
	070	Rear seat backrest, left or right (touring) – remove and install or replace	52- 20/6
	075	Rear seat backrest side section, left or right (touring) – remove and install or replace	52- 20/6

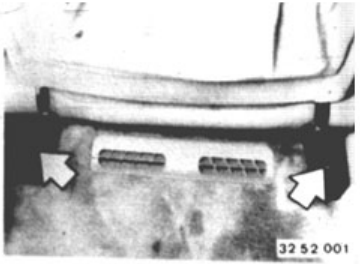
52 0 . . . GENERAL INFORMATION

Power Seats:
Troubleshooting - refer to Car Electric/Electronic Test Plan 52 00.

Caution!
The seat belt lock tensioner must first be deactivated before removing this type of front seat - refer to Group 72.

52 10 000 REMOVING AND INSTALLING LEFT OR RIGHT FRONT SEAT

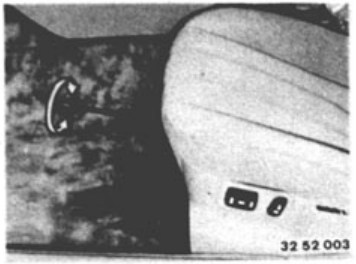
Caution!
Deactivate seat belt lock tensioner - refer to Group 72.



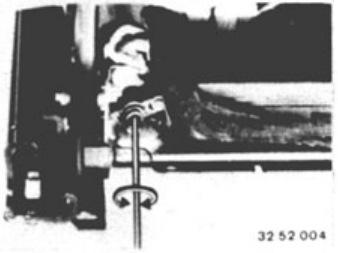
Unscrew bolts - if necessary, run seat forward.

Installation:
Tightening torque*.

Pull out headrest with one jerk.

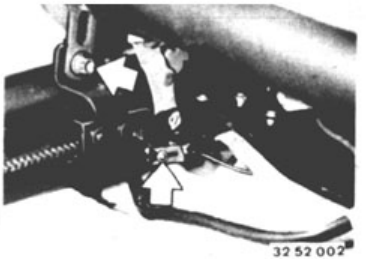


Note:
A power seat can be adjusted manually in forward/back direction with help of a screwdriver (4 mm wide blade) in case of power control failure.



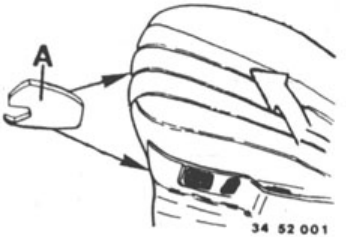
Insert screwdriver into hole of potentiometer or motor and turn until the bolts are accessible.

* Refer to Specifications



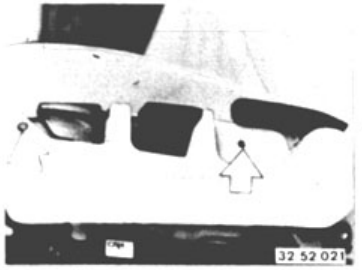
Run seat up to "high" position.
Disconnect cable for seat belt height adjustment.
Unscrew seat belt.

Installation:
Tightening torque*.



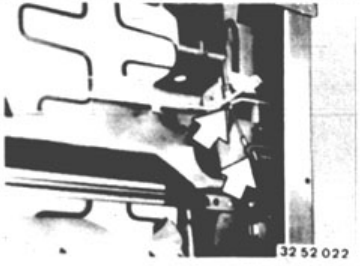
Lift rear end of seat and slide seat forward out of the front brackets (A).
If applicable, disconnect plugs.
Remove seat.

* Refer to Specifications

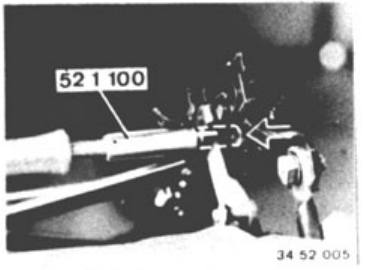


52 10 . . . DISASSEMBLING AND ASSEMBLING FRONT SEAT

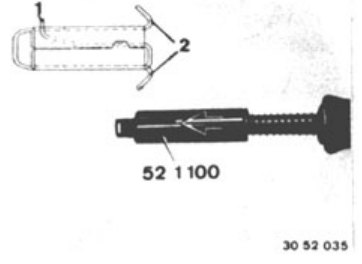
Unclip and unscrew trim panels on left and right sides with Special Tool 00 2 130.
Operate all levers to move all springs into final position.



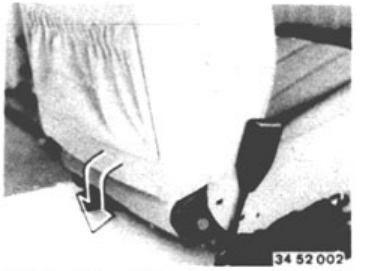
Seat Rails:
Disconnect cable.



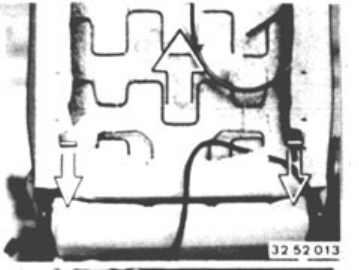
Insert Special Tool 52 1 100 in bearing pins (four) and drive them out.



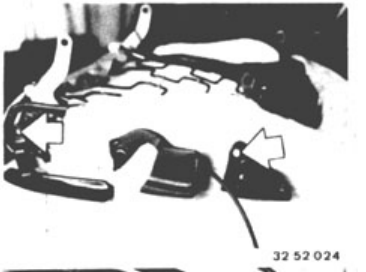
Installation:
Pins must be replaced.
Drive in pins against stop with Special Tool 52 1 100.
Check whether retainer(1) engages and that stops (2) are not damaged.



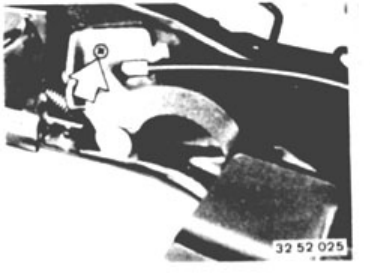
Backrest:
Push up trim panel, pull out of clips at bottom and remove.
Remove headrest with one jerk.



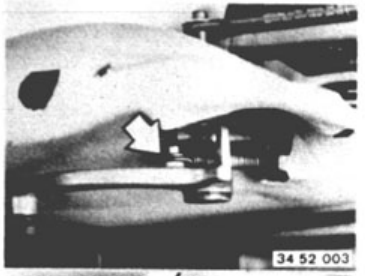
Press down levers on left and right sides with a pliers and pull up backrest.



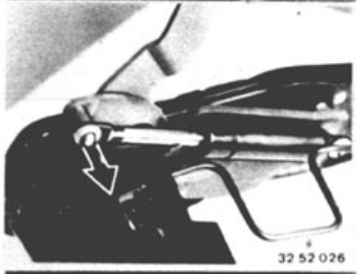
Seat Cushion:
Unscrew levers.
Take off seat cushion cover.



Unscrew console.



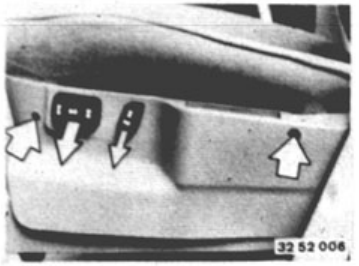
Note:
Return spring with circlip.



Pull off retainers.
Take off gas pressure spring.



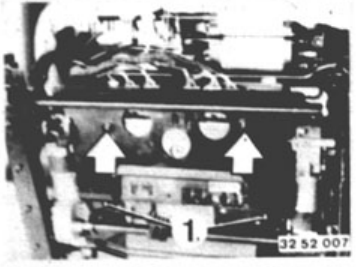
Installation:
Connect gas pressure spring with Special Tool 00 5 600 and secure with new retainers.



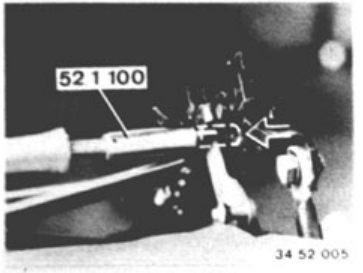
52 10 . . . DISASSEMBLING AND ASSEMBLING FRONT POWER SEAT

– Seat Removed –

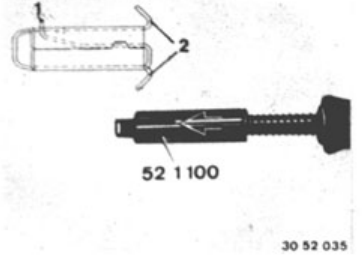
Seat Rails:
Unclip and unscrew trim panels on left and right sides with Special Tool 00 2 130.



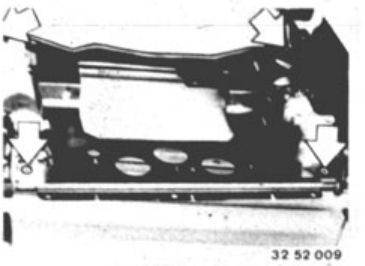
Unscrew control unit – pull off plug.
Installation:
Plug connections are coded.
Control unit bears in rubber mounts (1).



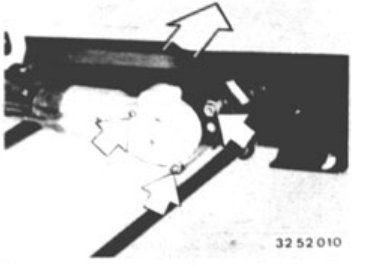
Guide Special Tool 52 1 100 into bearing pins (four) and drive them out.



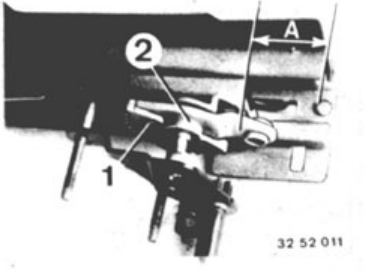
Installation:
Pins must be replaced.
Drive in pins against stop with Special Tool 52 1 100.
Check whether retainer (1) engages and that stops (2) are not damaged.



Drill out rivets remove plate.

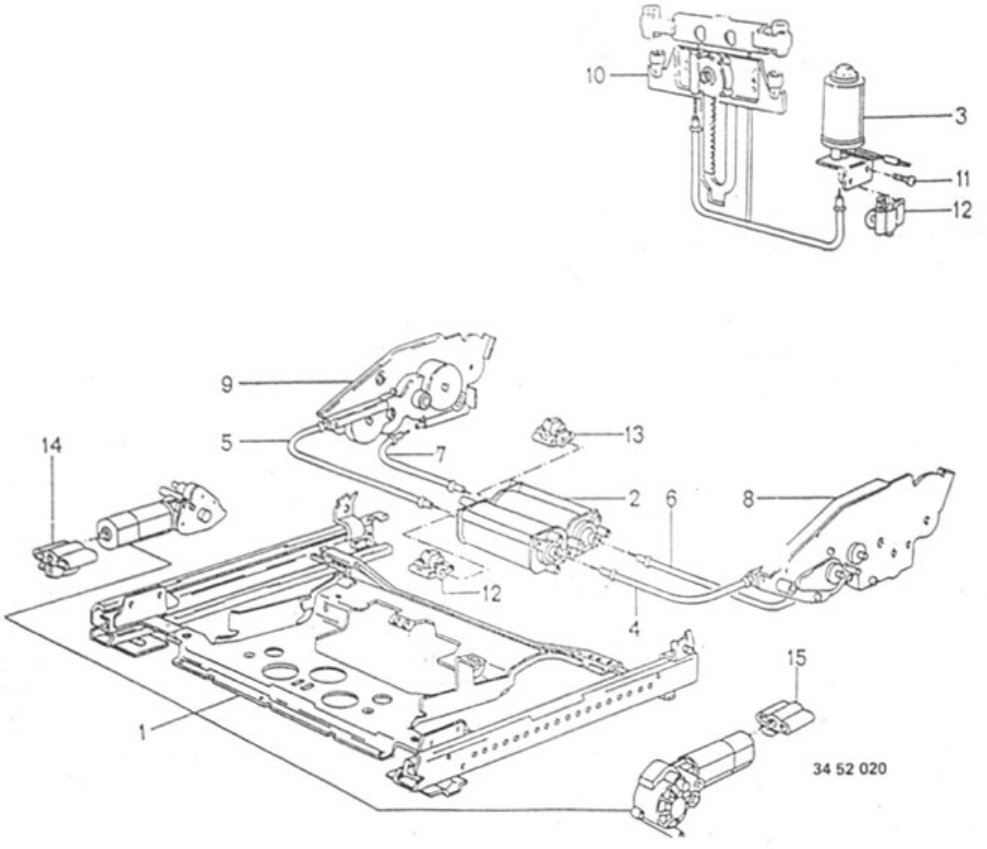


Unscrew motor (front seat height).
Unscrew bolts take off rails.
Installation:
Lubricate gear wheel with grease.

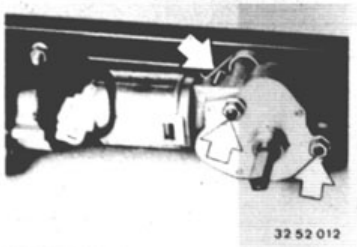


Installation:
Same distance (A) on left and right rails and toothed element (1) in same position.
Lubricate splines with grease.
Install sleeve (2).

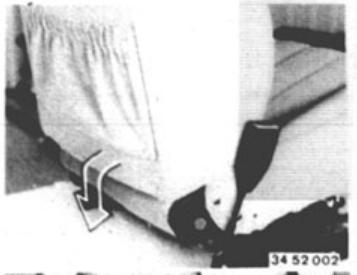
52 10 . . . SEAT RAILS AND DRIVES



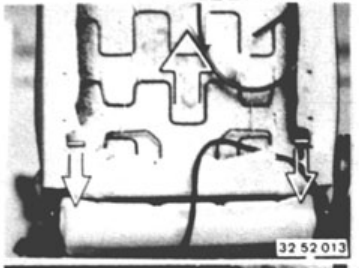
1 Seat rails with drives
2 Up/down seat drive
3 Drive
4 Up/down seat drive shaft, left
5 Up/down seat drive shaft, right
6 Backrest drive shaft, left
7 Backrest drive shaft, right
8 Gearbox, left
9 Gearbox, right
10 Headrest gearbox
11 Oval head screw
12 Headrest and up/down seat drive regulator
13 Backrest drive regulator
14 Forward/back seat drive regulator
15 Seat inclination drive regulator



Unscrew motor (forward/back).
Installation:
Lubricate splines with grease.
Connect spring before tightening the nuts.



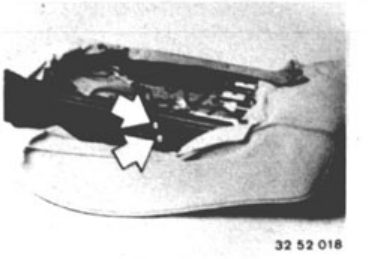
Backrest:
Push up backrest trim panel and pull it out of clips at bottom.



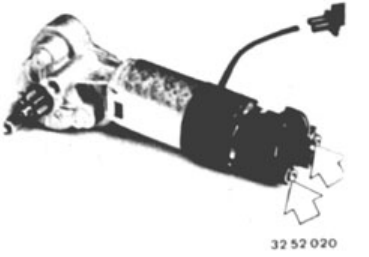
Pull off plug and disconnect leads on backrest.
Press down levers on left and right sides with a pliers – take off backrest.
Installation:
Connect plugs/leads that colors match.



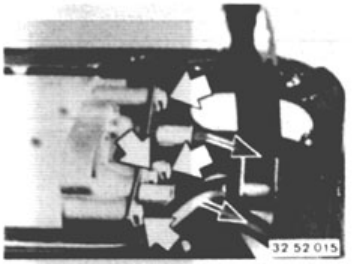
Pull out headrest.
Unscrew cover partially.
Unscrew bolts – take off gearbox.
Drive shaft is connected permanently on the gearbox.



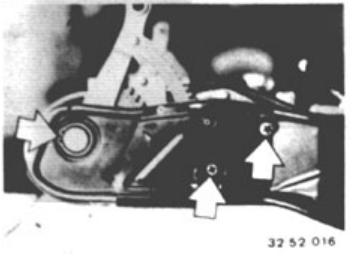
Unscrew motor.



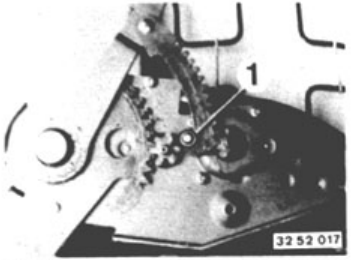
Unscrew potentiometer.



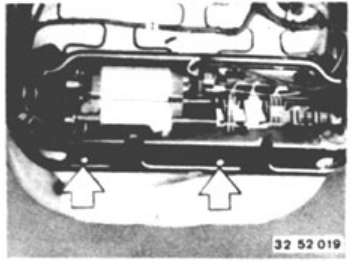
Seat:
Loosen seat cover partially.
Unscrew bolts and pull shaft out of both motors.
Installation:
Position of backrest and seat height same on left and right sides; correct by turning shafts if necessary.



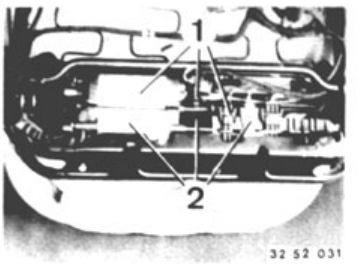
Unscrew screws.
Lift out circlip.
Remove backrest fittings.



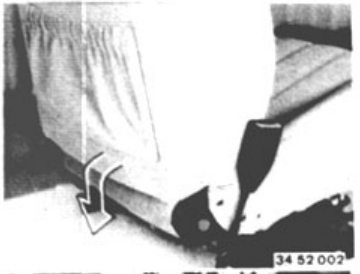
Installation:
Lubricate splines with grease.
Insert sleeve (1).



Unscrew motors.



Note:
1 Motor for backrest with black plug and potentiometer 1 379 095.9
2 Motor for seat up/down with white plug and potentiometer 1 379 094.9

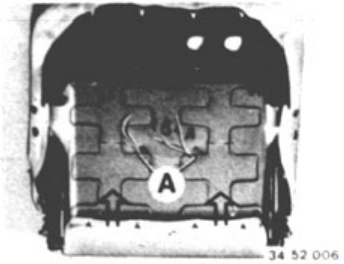


52 10 205 REMOVING AND INSTALLING ARMREST ON FRONT SEAT

Push up trim panel, pull out of clips at bottom and remove.



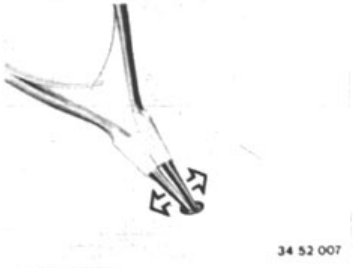
Unscrew nuts – take off armrest.



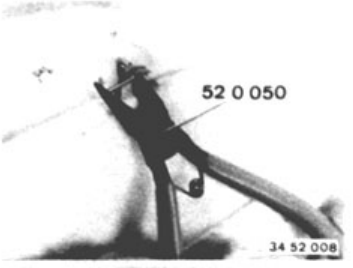
52 11 501 REPLACING SEAT CUSHION COVER FOR LEFT OR RIGHT FRONT SEAT

– Seat Removed/Backrest Taken Off of Seat –

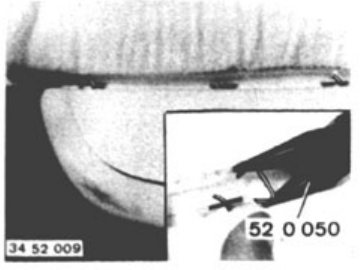
Seat Cushion:
Bend hooks to unlock and disconnect cover. Disconnect tensioning string (A) and take off cover.



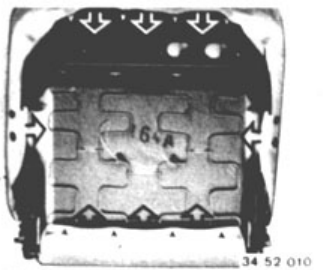
Bend open clips (use pliers for circlips) and separate cover from the padding.



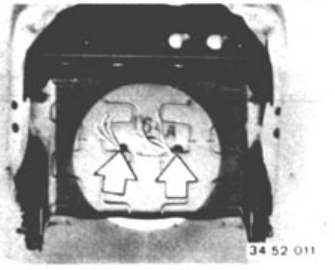
Install new cover (both tongues) with clips and Special Tool 52 0 050 on the padding (steel wire).



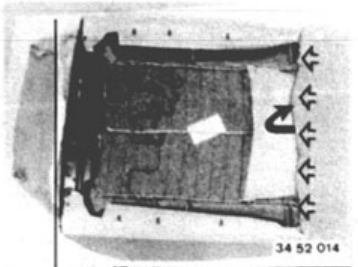
Install cover on both sides with clips and Special Tool 52 0 050 on the padding (steel wire).



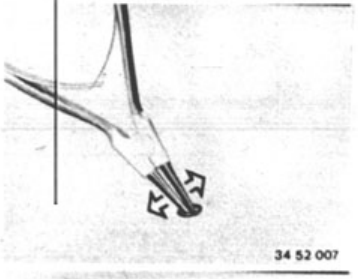
Connect cover in hooks with uniform tightness and without folds, beginning at the front. Bend hooks to lock.



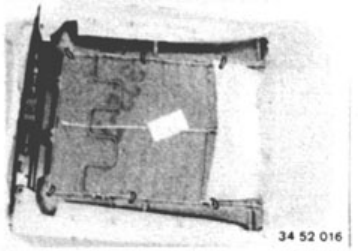
Secure cover on seat frame with the string under light tension.



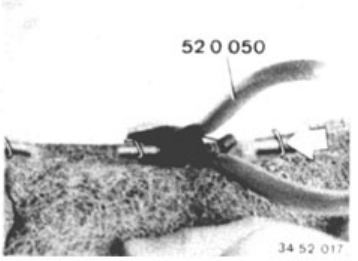
Backrest:
Bend open all hooks and disconnect cover.



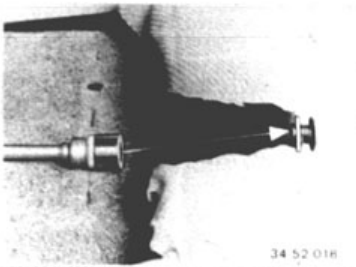
Bend open all clips which connect the cover on the frame (use pliers for circlips).



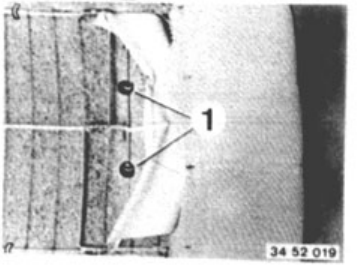
Bend open all clips.
Separate cover from padding.



Pull new cover over padding and align.
Secure cover on padding (bead) with clips and Special Tool 52 0 050, beginning at the top.

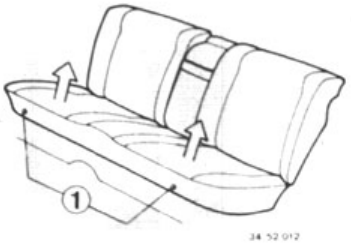


If applicable, transfer covers.



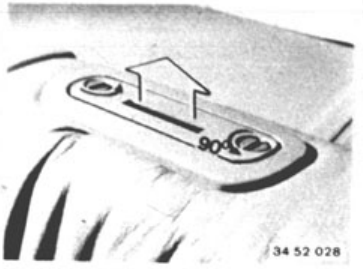
Secure padding and tensioning tongues (1) on the frame with clips.

Connect cover in hooks with uniform tension and without folds, beginning at top.
Bend hooks to lock.



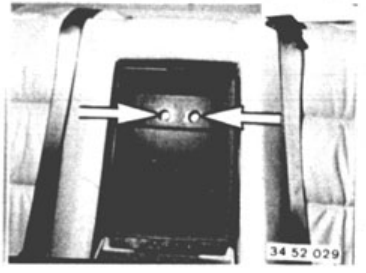
52 20 000 REMOVING AND INSTALLING REAR SEAT CUSHION AND BACKREST

Pull up seat cushion out of clips (1).
Pull out headrests from above.

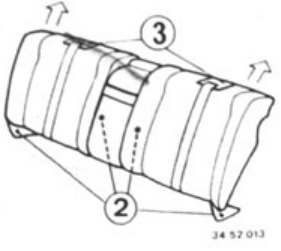


Turn retainers 90°.
Lift out cover from above.

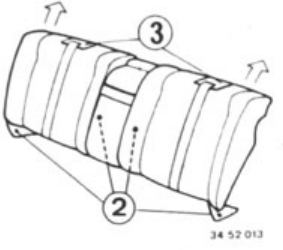
Fold down center armrest.
Unscrew nuts (2).
Lift out seat belt strap covers (3).
Pull up backrest out of holders.



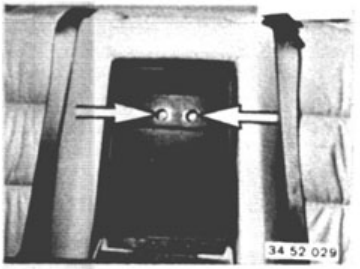
Open console (middle).
Compress tabs.
Remove console.



M 5:
Pull seperate seats out of clips (1) as above.
Pull up headrests to remove.

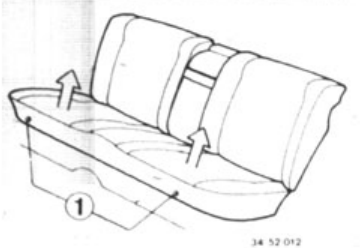


Lift out seat belt strap covers (3).
Unscrew nuts (2) and lift backrest out of holders from above.

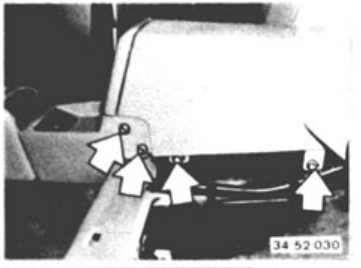


52 20 . . . REMOVING AND INSTALLING REAR SEAT CENTER ARMREST (M 5)

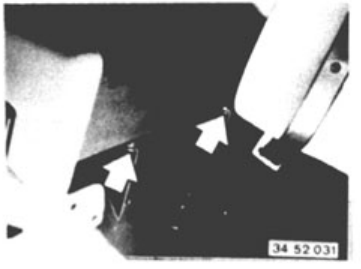
Open console (middle).
Compress tabs and remove console.



Pull up separate seat cushions out of clips (1).

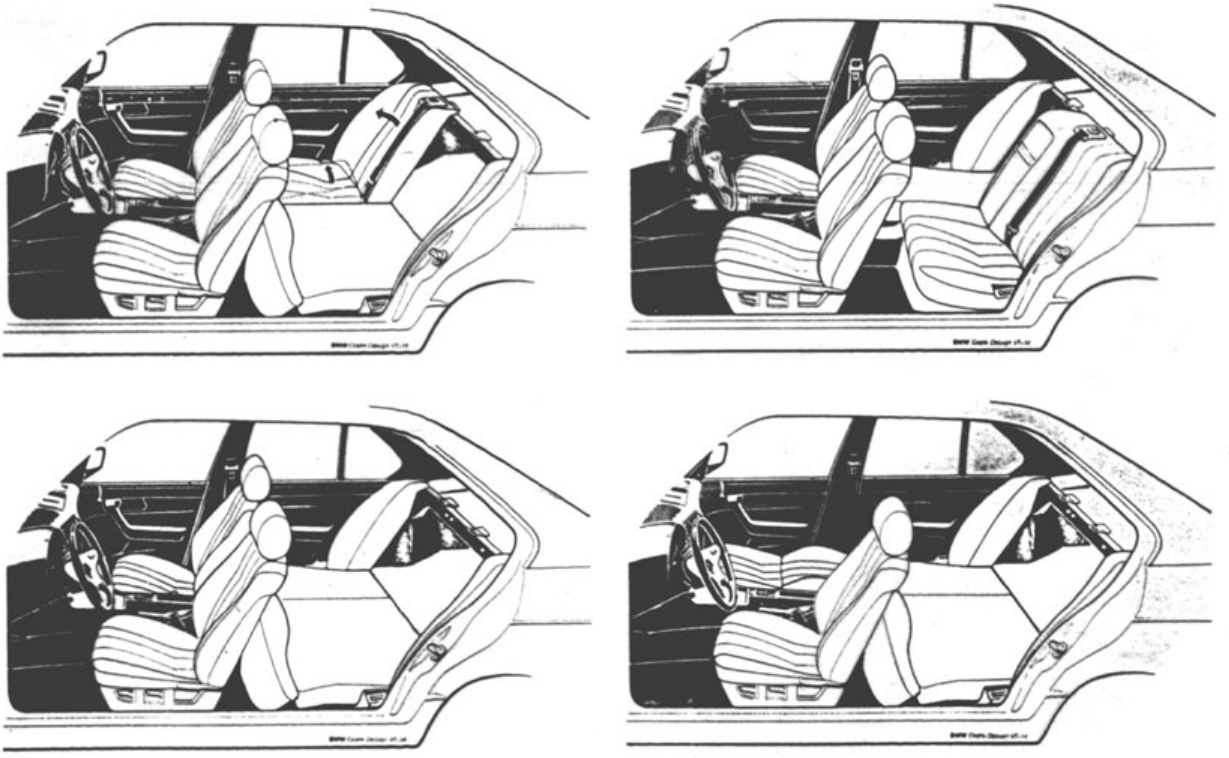


Unscrew screws on left and right sides.
Remove cover from above.



Unscrew screws on left and right sides.
Take out drawer.

CARGO ROOM CONVERSION SYSTEM



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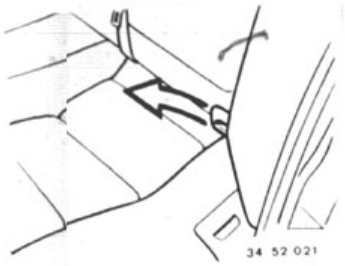
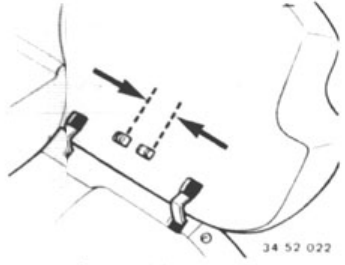


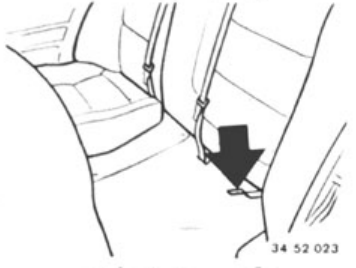
52 20 . . . REMOVING AND INSTALLING SPLIT REAR SEAT CUSHION AND BACKREST

Lift rear seat cushion on the pulling strap and tilt it forward.

Note:
Position front side forward slightly if necessary.

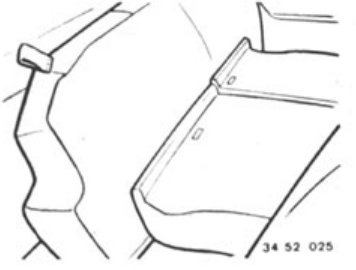


Compress both unlocking levers and lift out seat cushion forward.

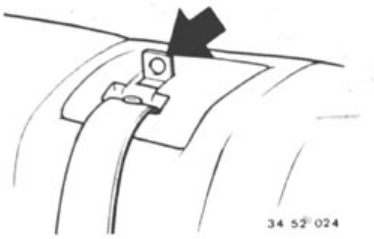


The rear seat backrest is unlocked automatically and can be tilted forward.

Note:
If locked unintentionally, press the lever – releasing the lever will unlock the backrest.



Tilt the rear seat backrest forward, unlock retainers with a screwdriver and lift out the backrest.



Installation:
Check for correct locking of the rear seat backrest (seat belt function).
Checking: red pin must be fully recessed.

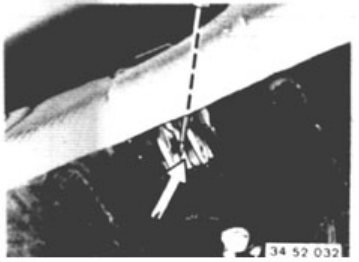


Removing Seat Belt Lock:
Unscrew cover on backrest.
Unscrew cover on rear wall.



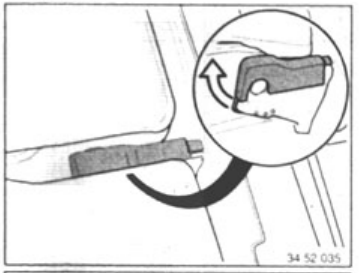
Lift out seat belt lock/cover.
Lift out seat belt lock from above.
Disconnect cable on the arrest.

Installation:
Adjust cable in such a manner that the backrest is unlocked after pressing down and releasing the unlocking lever.



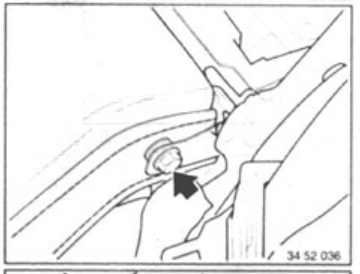
Note:
Unlocking the Seat Backrest in Case of Failure:
Take off top seat belt cover and press down on lever with a screwdriver.

Picture was taken on a removed seat backrest with its rear wall taken off.



52 20 070 REMOVING AND INSTALLING / REPLACING COMPLETE LEFT OR RIGHT REAR SEAT BACKREST (Touring)

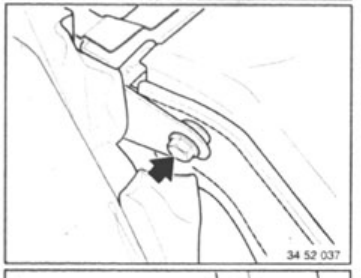
Remove rear seat backrest side section - refer to 52 20 075.
Fold both backrests forward.
Remove the plate between the backrests upwards.



Left Backrest:

Unscrew screw on outside.

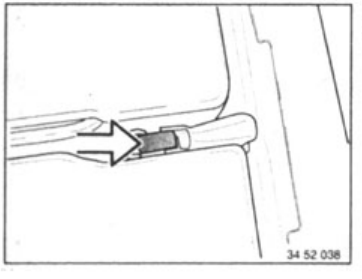
Installation:
Install the screw with Loctite**.
Tightening torque*.



Right Backrest:

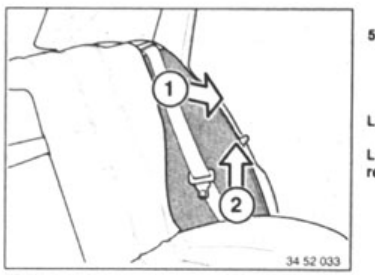
Unscrew screw on outside.

Installation:
Install the screw with Loctite**.
Tightening torque*.



Push the lock back and remove the backrest upwards.

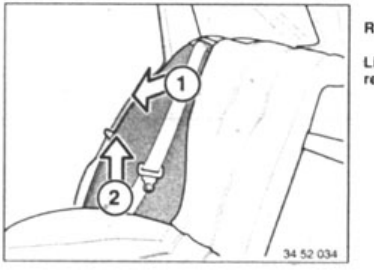
* Refer to Specifications
** Source of Supply: BMW Parts



52 20 075 REMOVING AND INSTALLING / REPLACING LEFT OR RIGHT REAR SEAT BACKREST SIDE SECTION (Touring)

Left Backrest Side Section:

Lift (1) backrest side section out and remove upwards (2).



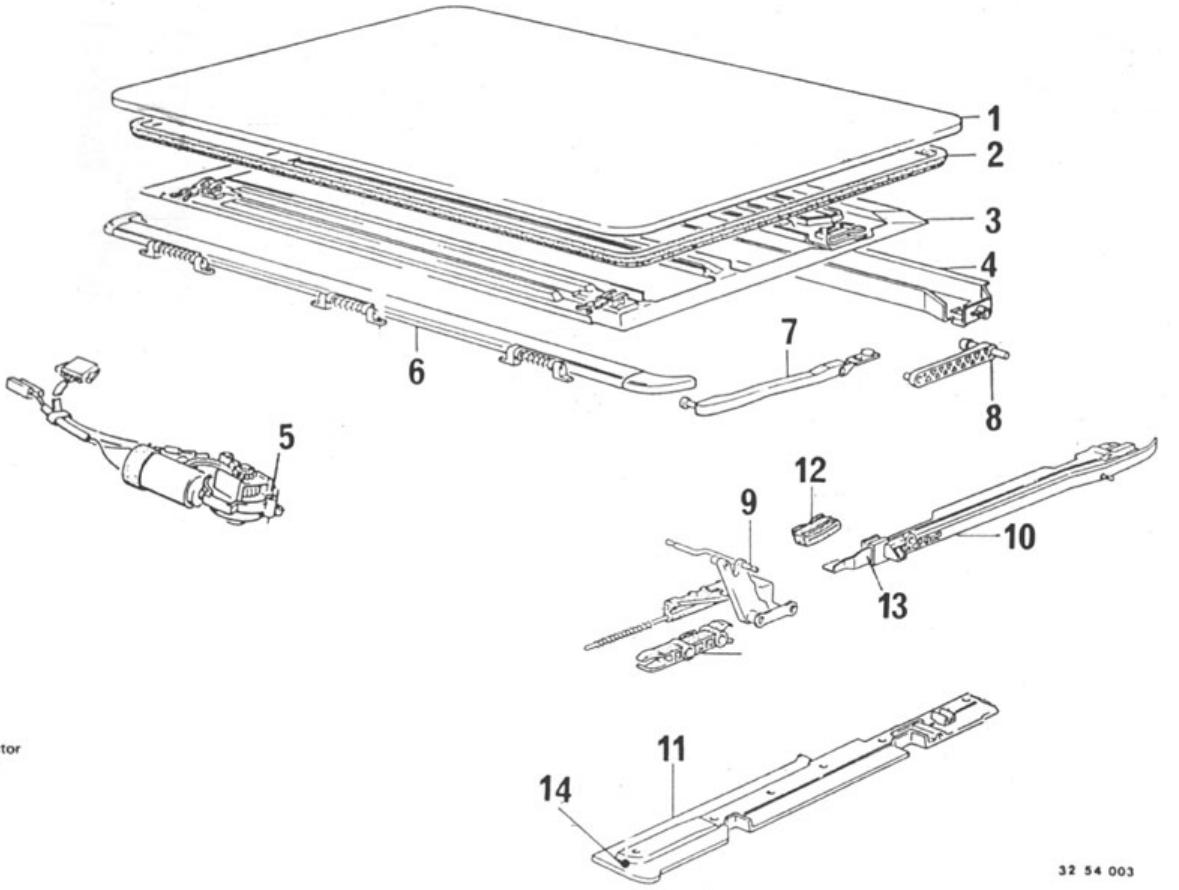
Right Backrest Side Section:

Lift (1) backrest side section out and remove upwards (2).

54 Hood, sunroof

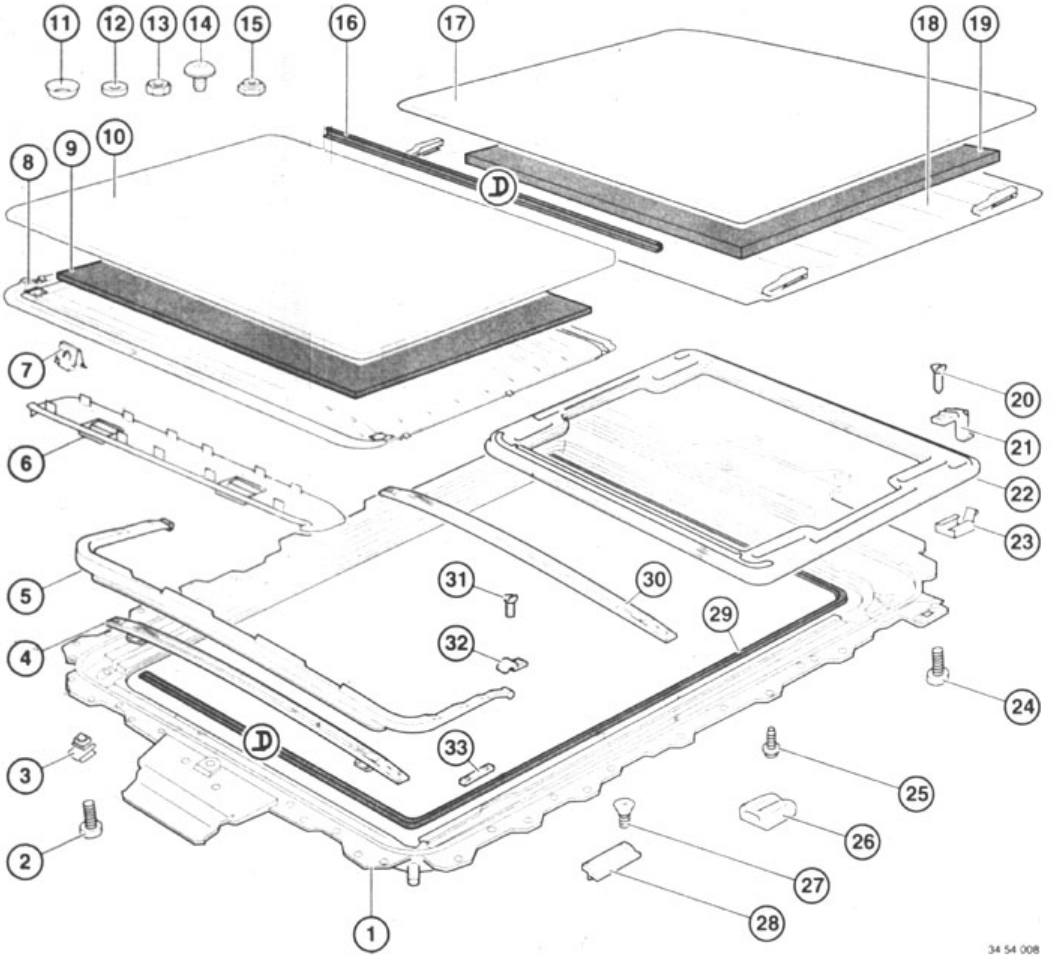
		Arrangement of slide/tilt sunroof	54- 0/1
54 0	...	Arrangement of double slide/tilt sunroof	54- 0/2
	...	Function description of double slide/tilt sunroof (touring)	54- 0/4
	...	Emergency closing mechanism – slide/tilt sunroof (touring)	54- 0/5
	...	Initialization of slide/tilt sunroof (touring)	54- 0/6
	...	Operating logic of slide/tilt sunroof (touring)	54- 0/7
	...	Notes on the repair of cemented gaskets on slide/tilt sunroof	54- 0/9
54 12	004	Slide/tilt sunroof – adjust	54- 12/1
	005	Slide/tilt sunroof lid (touring) – adjust at front	54- 12/2
	006	Slide/tilt sunroof lid (touring) – adjust at back	54- 12/2
	100	Slide/tilt sunroof lid – remove and install	54- 12/3
	102	Slide/tilt sunroof lid (touring) – remove and install at front	54- 12/4
	103	Slide/tilt sunroof lid (touring) – replace at front	54- 12/4
	104	Slide/tilt sunroof lid (touring) – replace at back	54- 12/5
	106	Slide/tilt sunroof lid (touring) – remove and install at back	54- 12/6
	120	Gasket on slide/tilt sunroof lid – replace	54- 12/7
	121	Gasket for slide/tilt sunroof lid (touring) – replace at front	54- 12/7
	122	Gasket on slide/tilt aperture (touring) – replace	54- 12/8
	132	Headlining for slide/tilt sunroof lid (touring) – remove and install or replace at front	54- 12/8
	133	Headlining for slide/tilt sunroof lid (touring) – remove and install or replace at back	54- 12/9
	210	Slide/tilt sunroof (frame, touring), complete unit – remove and install	54- 12/10
	230	Gearbox (manual) for slide/tilt sunroof – remove and install or replace	54- 12/12
	241	Both drive cables for slide/tilt sunroof actuation – replace	54- 12/13
	245	Both drive cables at front for slide/tilt sunroof actuation – remove and install/replace	54- 12/14
	246	Both drive cables at back for slide/tilt sunroof actuation – remove and install/replace	54- 12/15
	255	Both actuating units / actuators – replace	54- 12/15
	496	Wind deflector (touring) – remove and install/replace	54- 12/16
	512	Microswitch (reversing type) for slide/tilt sunroof motor – replace	54- 12/17
54 13	005	Coupling on gearbox unit (touring) at front – remove and install/replace	54- 13/1
	006	Coupling on gearbox unit (touring) at back – remove and install/replace	54- 13/1
	010	Motor and gearbox for slide/tilt sunroof actuation – remove and install	54- 13/2
	011	Motor for slide/tilt sunroof actuation (touring) at front – remove and install or replace	54- 13/2
	012	Motor for slide/tilt sunroof (touring) at back – remove and install	54- 13/3
	015	Module for slide/tilt sunroof (touring) at back – remove and install or replace	54- 13/3
		Slide/tilt sunroof – troubleshoot	54- 90/1

SUN ROOF LAYOUT DRAWING



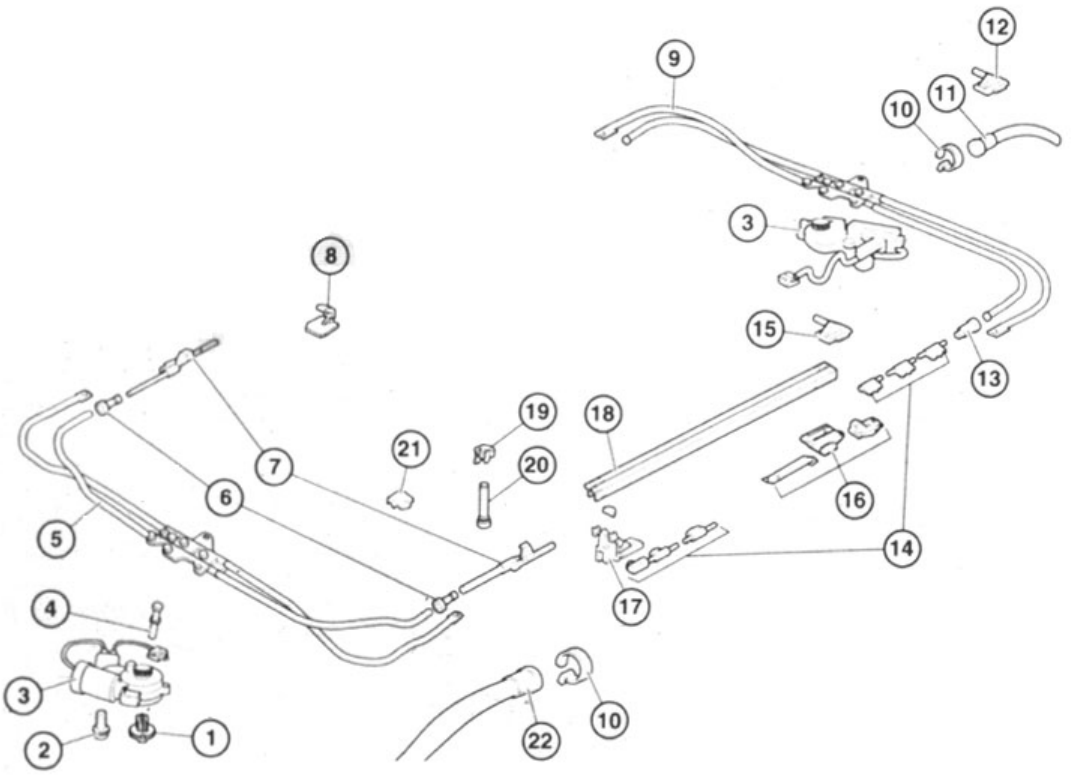
1 Lid
2 Seal
3 Roof liner frame
4 Water drain
5 Motor/gearbox
6 Wind deflector
7 Linkage for wind deflector
8 Linkage for water drain
9 Drive cable
10 Gate
11 Cover rail
12 Slide
13 Retainer
14 Rubber pad

54 0 . . . DUAL LID SUN ROOF



1 Frame lower section
2 Screw
3 Nut clip
4 Front cross member
5 Wind deflector
6 Plate
7 Retainer
8 Front roof liner frame
9 Front soundproofing sheet
10 Front lid
11 Center lid molded washer (version status)
12 Lid washer
13 Center lid nut (version status)
14 Center lid screw (version status)
15 Center lid nut
16 Front lid seal
17 Rear lid
18 Rear roof liner frame
19 Rear soundproofing sheet
20 Oval head screw
21 Clamp
22 Lid frame
23 Retainer
24 Oval head screw
25 Self-tapping screw
26 Slide
27 Countersunk screw
28 Cover
29 Sun roof opening seal
30 Cross member
31 Oval head ctsk. screw
32 Wind deflector holder
33 Threaded plate

54.0 ... Layout of dual sliding/tilting sunroof



1 Coupling
2 Hexagon screw
3 Front/rear actuator motor
4 Rivet
5 Guide tube, front
6 Tube seal, front L/R
7 Operating cable, L/R
8 Slide leaf spring
9 Guide tube, rear
10 Hose clip
11 Water hose, rear
12 Slide, rear
13 Pipe seal, rear
14 Operating cable, right
15 Slide, center
16 Control lever, L/R
17 Slide, front
18 Guide rail
19 Lock washer
20 Stud
21 Pipe clip$_{A}$
22 Water hose, front

R54 0123

54 0 ... Functional description, dual sliding/tilting sunroof, touring

The dual tilt/slid sunroof has diagnostic capabilities.

o Control logic (one-touch function)

The following sunroof cover positions can be set automatically by briefly pressing (one-touch) the control switch:

- front vent position (tilt end position)
- front end position open
- rear end position open (block)
- comfort ventilation, both sunroof covers open (block center)
- convenient close from any cover position

When taking up the various positions (also convenient closing) the selected function can be stopped with the one-touch function or by pressing up the button.

All positions can be set manually.

o Trap guard (finger guard)

The trap guard is active:

- during convenient closing via control switch or door switch
- one-touch close function for front and rear cover
- packet shift forward or back

The trap guard is not active:

- 4 mm before end position
- during automatic one-touch open function
- during initialization
- during manual opening and closing
- closing the vent position (front tilt position)

o Emergency closing (mechanical)

Should the electrical drive fail, the sliding/tilting sunroof can be closed mechanically with a hand crank (hexagon socket screw is in front panel of control switch.

Note:
The sliding/tilting sunroof must be initialized after repair.

o Consumer load cutout

All sliding/tilting sunroof functions are interrupted during the starter procedure. On completion of the start procedure, the interrupted functions are not continued.

o Initialization

Initialization is necessary after emergency operation, completed repairs on the sliding/tilting sunroof or after a break in the power supply.
Initialization is carried out in absolute zero position (both sunroof covers closed against mechanical limit stop and headlining frame, duration approx. 20 seconds).

Caution!
The trap guard is not active during initialization and no automatic one-touch function can be carried out.

o Convenient closing

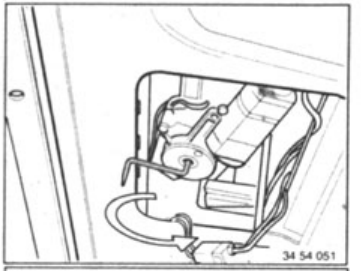
Convenient closing via door lock:
Initially, all windows are closed with electric window regulators.
The sliding/tilting sunroof is slowly closed from any position for as long as the key is turned in the "lock and arrest" position.

Convenient closing via control switch:
The sliding/tilting sunroof is closed from any position when the control switch is briefly pressed upward.

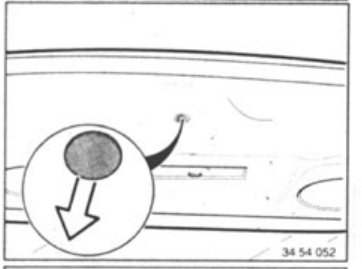
54 0 . . . EMERGENCY (MANUAL) CLOSING SUN ROOF (Touring)

Sun roof lids can be closed by hand if the electric drive fails.

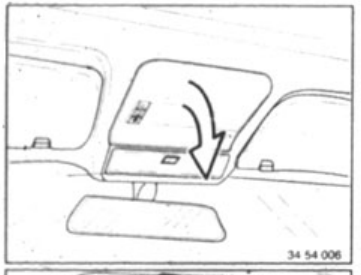
Installation:
After working on the sun roof initialization must be carried out - refer to 54 00 . . .



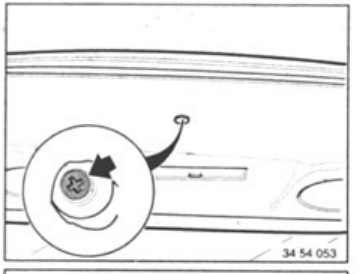
Insert manual winder (hexagon socket key) and turn counterclockwise to close front lid (until lift position is reached).



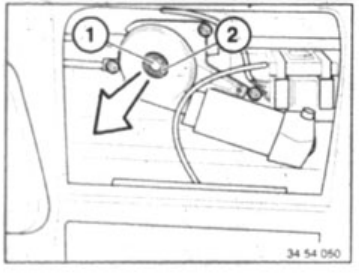
Remove rear plug downwards.



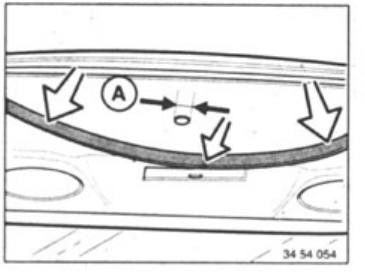
Remove panel.



Unscrew screw.

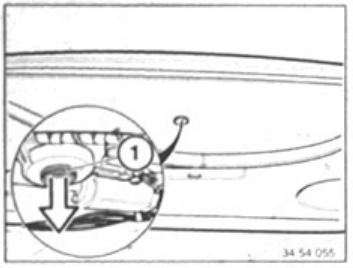


Unscrew screw (1) and pull out clutch (2) downwards.

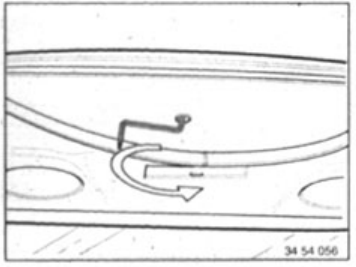


Pull off edge guard partially, if plug diameter is < (A).

Diameter (A) = 20 mm



Remove coupling (1) by pulling downward. If necessary with the aid of the crank handle at the hexagon crank.



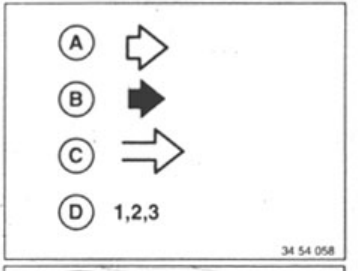
Fit hand crank (key for hexagon socket screw) and close rear sunroof cover by turning in counterclockwise direction.

54 0 ... Initialising sliding/tilting sunroof, touring

Initialization is necessary on completion of repairs, after emergency sunroof operation or after an interruption in the power supply. Initialization is carried out in absolute zero position (both covers against mechanical limit stop).

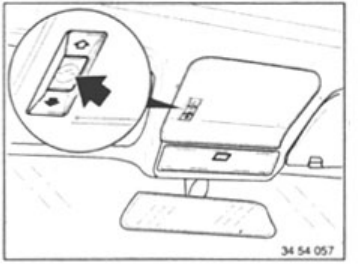
Caution!
The trap guard is not active during initialization. - Risk of jamming -

The one-touch function is not active during initialization.

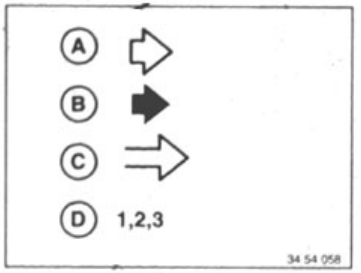


Operation:

(A) briefly press
(B) press permanently
(C) cover movement
(D) sequence of (A) and (B)



Completely close sliding/tilting sunroof. When both sunroof covers and headliner frame are closed, continue to press close for a further 20 seconds, initialization is now completed.

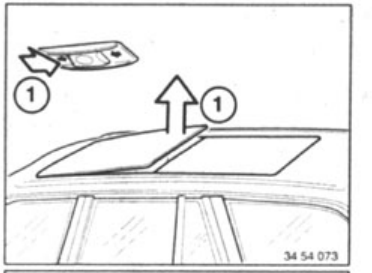


54 0 ... SUN ROOF OPERATING LOGIC (Touring)

Operation Explanations:

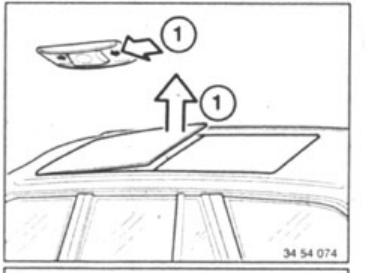
A Brief tipping (automatic tip operation)
B Constant pressing (manual operation)
C Movement of lids
D Sequence of A and B

Note:
All of the lid positions described below can also be operated manually (B) until the desired position is reached.
All tip operations can also be stopped by tipping the selected operation a second time or tipping upwards.

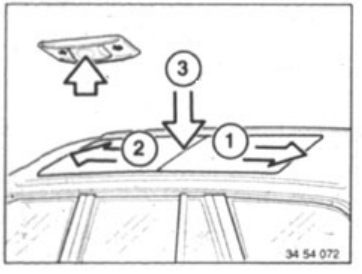


Front Lid in Fan Position (Final Lift Position):

1 Final lift position (can also be operated from the other side - see next picture)

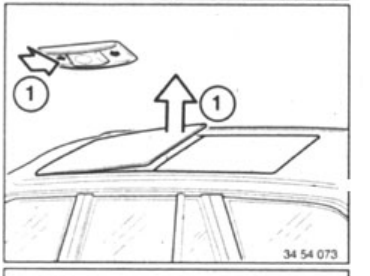


1 Final lift position



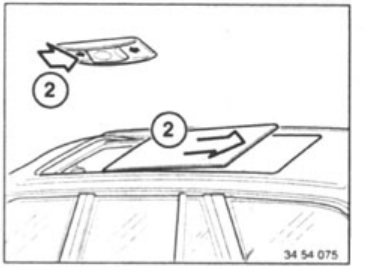
Both lids can be closed completely from any position (comfort closing).

Note:
Clamping protection is active during comfort closing and is switched off 4 mm before reaching final position (neutral).

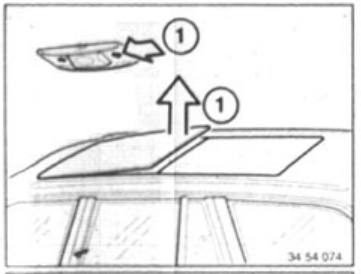


Open Front Lid (Final Position)

1 Final lift position

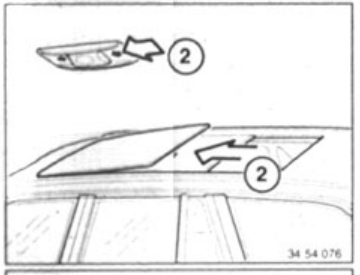


2 Open front lid (final position)

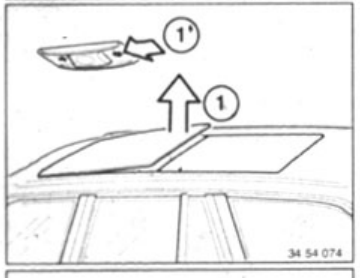


Open Rear Lid (Final Position, Produce Block):

1 Final lift position

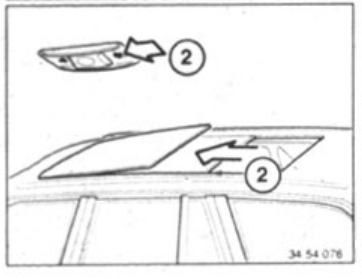


2 Open rear lid (final position)

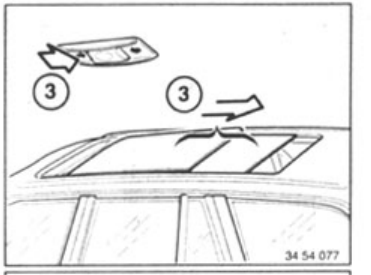


Comfort Venting (Both Lids Open):

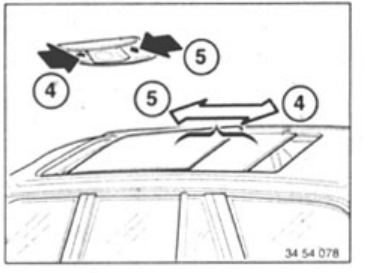
1 Front lid to final lift position



2 Open rear lid (final position)



3 Open both lids to block (final position)



4 Move block towards rear (variable)
5 Move block towards front (variable)

54 0 . . . INSTRUCTIONS FOR REPAIRING CEMENTED SEALS ON SUN ROOF

1. Types of Damage

1.1 Partially Loosened Seals
- Up to 120 mm repaired by hand
- Up to 200 mm repaired with pressing-on tools on straight surfaces

1.2 More Serious Damage (Mechanical Injuries, Largely Loosened Seals)

2. Possible Repairs

2.1 Partially loosened seals consisting of rubber/adhesive tape or adhesive tape/paint cemented joints can be recemented with cyanacrylate cement (Loctite No. 380*).

Procedures:

a) Clean damaged surfaces.
- Remove grease and other residues from the cemented surface.
- Use cotton or lintless paper towels (one-time use).

b) If solvents are used, air dry the repair surface at least 2 minutes.

c) Apply a very thin bead of cyanacrylate cement on the adhesive tape using a fine nozzle.
- Avoid contact on skin!
- Do not smear cement on visible painted surfaces.

d) Press on rubber seal. Pressing-on time at least 30 seconds. Only contact pressure is necessary, which must be maintained for the 30 seconds. The cement can be subjected to loads only after 2 minutes. This waiting time is absolutely essential.

2.2 Complete replacement of the rubber seal is necessary in case of a largely loosened seal and/or damaged rubber profile – refer to 54 12 121 and 54 12 122.

Procedures:

a) Peeling off damaged rubber seal:
- Pull off rubber seal slowly at an angle of 15 to 25°, ensuring that the mackle (bond between adhesive tape and seal) is maintained.
- If the mackle itself has become loose, pull the adhesive tape off of the roof opening edges and/or lid carefully and slowly at an angle of 15 to 25°.
- If necessary, peel off older seals with help of a hot air blower (don't damage the paint finish), whereby the rubber seal/adhesive tape bond should not be separated.

b) Pull liner (protective film on adhesive surface) off of rubber seal section by section.
Take hold on tab!

c) Apply rubber seal on roof opening edge beginning at rear center. Use upper lip as application edge. Press on seal continuously by hand. Unwind and press seal in radii carefully without tension (critical area). If positioned incorrectly, the seal can still be pulled off, repositioned and pressed on again.

d) Mark the butt joint by pressing the loose end of the flock on the already cemented end (small particles of flock stick on the adhesive tape) and cut off seal straight and press on the loose end at the same height.

e) Press on seal using a roller. Pressing-on force: approx. 30 N.

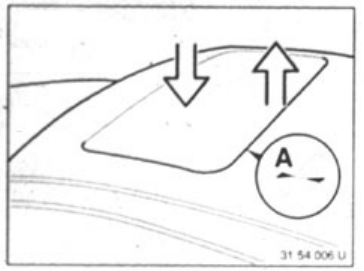
f) Tear off the rear and side tearing-off lips in area of the narrow flange.

Important!
Never touch the uncovered adhesive surface after pulling off the liner.

3. Checking Rubber Seal:
- Cemented seals must be checked for correct position and perfect adhesion. The adhesion can be checked by pushing back the sealing lip. The force required to peel off the seal immediately after cementing must be greater than 10 N/cm.

4. General Information on Rubber Seal Profiles:
- Seals, which are supplied with partially loosened liners, must not be installed.
- Store seals at 15 to 25° C.
- If the liner becomes loosen during handling prior to cementing, the seal may still be installed.
- Cement at ambient and object temperature of > 18° C.
Temperatures between 40 and 50° C will increase the initial adhesion considerably.
- Seals, which are subjected to temperatures above 80° C after cementing, will be very difficult to remove.

* Source of Supply: BMW Parts



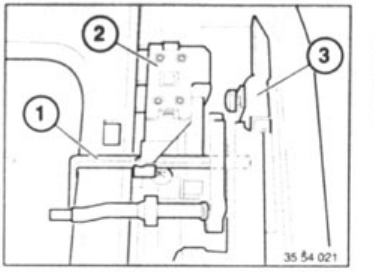
54 12 004 ADJUSTING SUN ROOF

Ideal Adjustment:

Height:
Front = 1 mm deeper than roof panel
Rear = 1 mm higher than roof panel

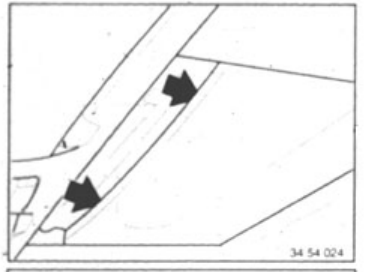
Length:
Equal distance (A) between lid and roof at front and rear – check with a plastic gage.

A = approx. 0.2 mm

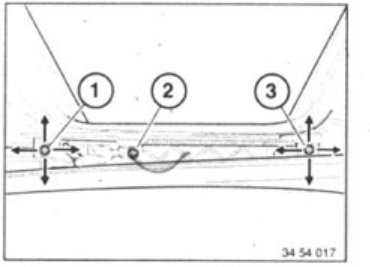


Arrest the sun roof in "0" position at left and right using a 4 mm hexagon key (1). Lid was removed in picture for better understanding.
Key (1) arrests the drive, cable (2) and gate (3).

If necessary, remove the motor/gear unit to be able to move the drive cables.

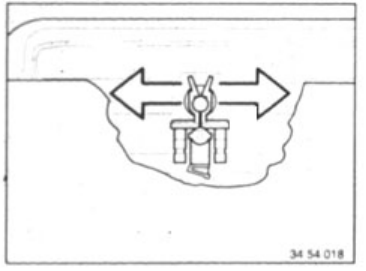


Open the sun roof about 10 cm.



Loosen screws (1 ... 3) at the left and right using Special Tool 00 2 130.
Adjust the lid.
If applicable, install the motor/gear unit in "0" position - refer to 54 13 010.
Remove the hexagon key.

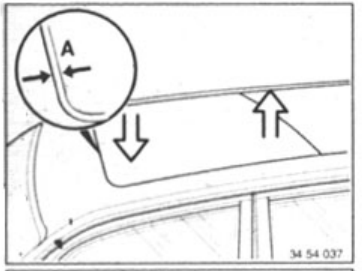
Installation:
Install new screws.
Tightening torque = 3.5 Nm.



Spread left and right clamps apart and slide the roof liner frame back.
Shut the sun roof.

54 12 005 ADJUSTING FRONT SUN ROOF LID (Touring)

Remove front roof liner frame - refer to 54 12 132.

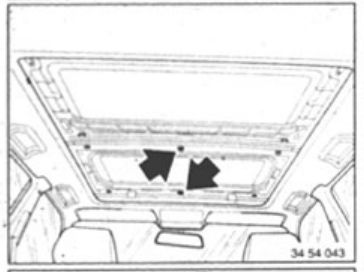


Ideal Adjustment:

Equal distance (A) of lid to roof at front and to rear lid.

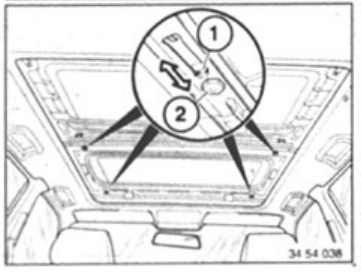
Height:

Front flush or up to 1.5 mm deeper
Rear flush or up to 1.5 mm higher



Loosen screws.

Installation:
Tightening torque*.



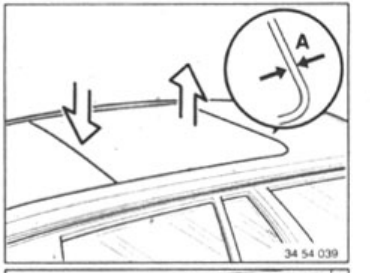
Unscrew all four nuts (2) and push the four adjusting wedges (1) in or out far enough until the ideal adjustment is reached.

Installation:
Tightening torque*.

* Refer to Specifications

54 12 006 ADJUSTING REAR SUN ROOF LID (Touring)

Remove front and rear roof liner frames - refer to 54 12 132 and 54 12 133.

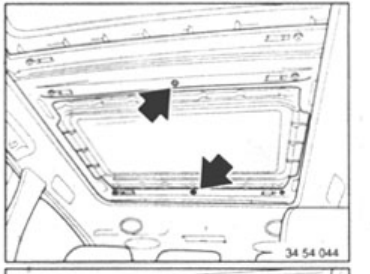


Ideal Adjustment:

Equal distance (A) of lid to front lid and roof at rear.

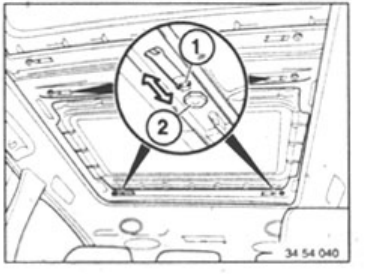
Height:

Front flush or up to 1.5 mm deeper
Rear flush or up to 1.5 mm higher



Loosen screws.

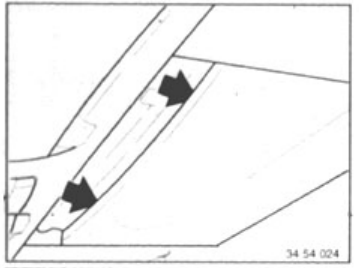
Installation:
Tightening torque*.



Unscrew all four nuts (2) and push the four adjusting wedges (1) in or out far enough until the ideal adjustment is reached.

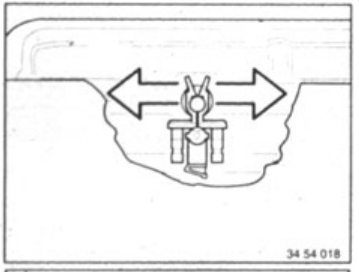
Installation:
Tightening torque*.

* Refer to Specifications

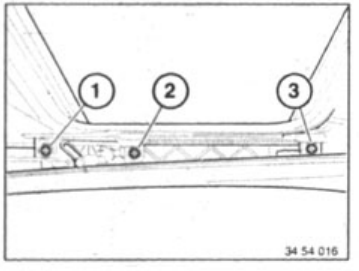


54 12 100 REMOVING AND INSTALLING SUN ROOF LID

Open sun roof about 10 cm.

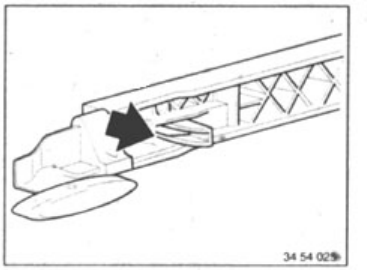


Spread left and right clamps apart and slide roof liner frame back.



Shut roof and loosen screws (1 and 3) using Special Tool 00 2 130.
Unscrew screw (2).
Remove lid.

Installation:
Adjust lid - refer to 54 12 004.
Replace screws.
Tightening torque = 3.5 Nm.

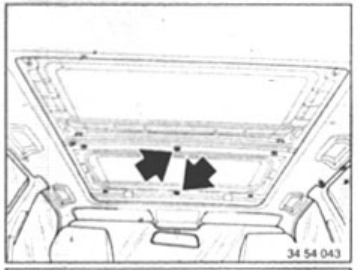


Pull left and right retainers towards inside and remove lid upwards.

54 12 102 Removing and installing front sliding / tilting sunroof cover (touring)

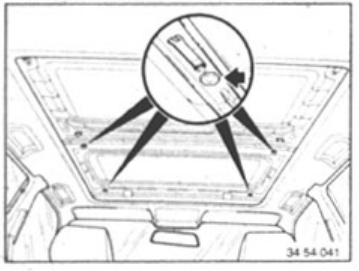
Remove front headlining frame,
refer to 54 12 132.

Switch off ignition.



Release screws.

Installation note:
Refer to installation note in 54 12 103.
Replace screws (micro-encapsulated).
For tightening torque,
refer to Technical Data 54 12 2AZ.



Release nuts and remove sliding/tilting sunroof cover by pulling upward.

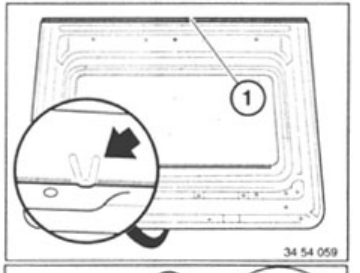
Installation note:
Adjust front sliding/tilting sunroof cover,
refer to 54 12 005.
Replace nuts (micro-encapsulated).
For tightening torque,
refer to Technical Data 54 12 2AZ.



54 12 103 Replacing front sliding/tilting sunroof cover (touring)

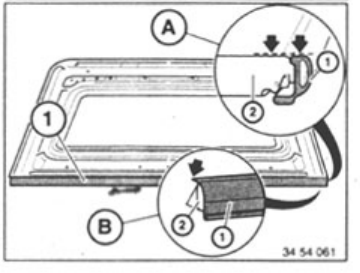
Caution!
Note serial number (status),
refer to BMW Service Information
54 03 92 (514).

Note repair instructions for bonded seals on sliding/tilting sunroof, refer to 54 0 ...
Remove front sunroof cover, refer to 54 12 102.

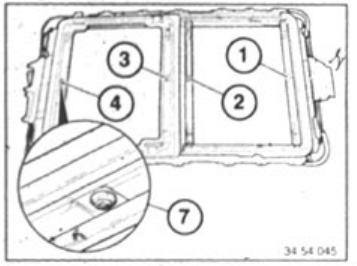


Remove front rain channel.

Note:
The front sunroof cover features a (V) stamped on the front side and has a weatherstrip (1) at the rear.



Clean bonding surface.
(A) Adhere weatherstrip (1) flush with respect to upper edge of sunroof cover (2).
(B) Weatherstrip (1) must protrude slightly at outside left and right sunroof cover (2).



Installation note:

1.a) Tilt/slide sunroof cassette *without* embossing (1 ... 4) on cross member and weld *nuts* (5) and (6) on both sunroof covers:

⇒ install 4 formed washers (7) on cross members.

1.b) Tilt/slide sunroof cassette *without* embossing (1 ... 4) on cross member and weld *stud* (5) and (6) on both sunroof covers:

› cannot be installed

› replace cassette

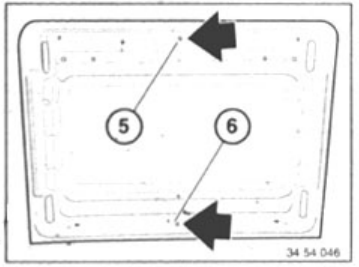


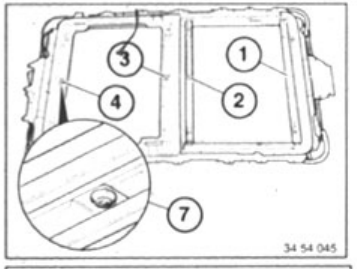
54 12 104 Replacing rear sliding/tilting sunroof cover (touring)

Caution!

Note serial number (status), refer to BMW Service Information 54 03 92 (514).

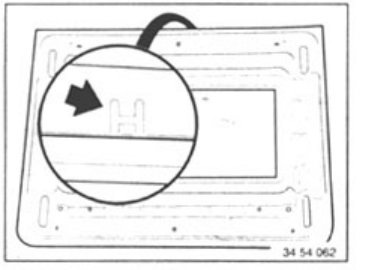
Remove rear sliding/tilting sunroof cover, refer to 54 12 106.



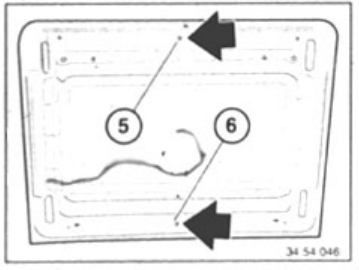


2.a) Tilt/slide sunroof cassette *with* embossing (1 ... 4) on cross members and one weld *stud* on rear sunroof cover (5) through cross member (4).
3 bonded washers (1 ... 3), adhere 1 formed washer (7) on cross member (4).
Fit M6 nut for weld stud (5) with Loctite 270*.

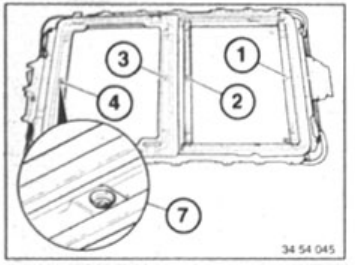
2.b) Tilt/slide sunroof cassette *with* embossing (1 ... 4) on cross members and weld *nuts* (5) and (6) on both sunroof covers: remove old washers (bonded) and fit 4 formed washers (7) on cross members.



Note:
Rear sunroof cover features a (H) stamped on the front side and has no weatherstrip.



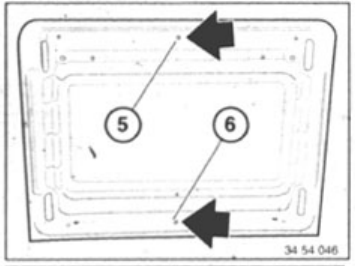
* Source of supply: BMW Parts Service

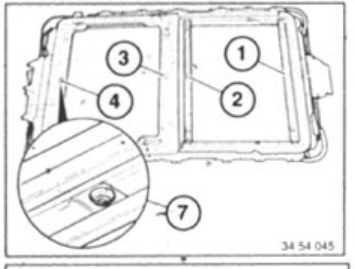


Installation note:

1.a) Tilt/slide sunroof cassette *without* embossing (1 ... 4) on cross member and weld *nuts* (5) and (6) on both sunroof covers:
- install 4 formed washers (7) on cross members.

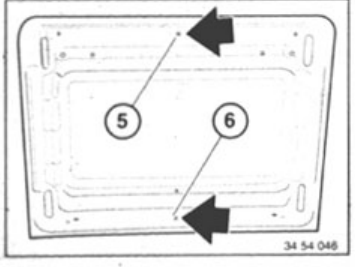
1.b) Tilt/slide sunroof cassette *without* embossing (1 ... 4) on cross member and weld *stud* (5) and (6) on both sunroof covers:
- cannot be installed
- replace cassette





2.a) Tilt/slide sunroof cassette *with* embossing (1 ... 4) on cross members and one weld *stud* on rear sunroof cover (5) through cross member (4).
3 bonded washers (1 ... 3), adhere 1 formed washer (7) on cross member (4).
Fit M6 nut for weld stud (5) with Loctite 270*.

2.b) Tilt/slide sunroof cassette *with* embossing (1 ... 4) on cross members and weld *nuts* (5) and (6) on both sunroof covers: remove old washers (bonded) and fit 4 formed washers (7) on cross members.



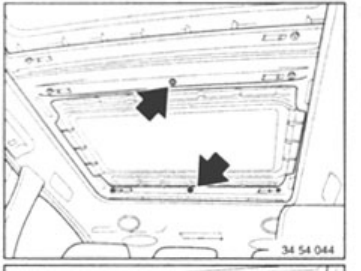
* Source of supply: BMW Parts Service

54 12 106 Removing and installing rear sliding/tilting sunroof cover (touring)

Remove front and rear headlining frame, refer to 54 12 132 and 54 12 133.

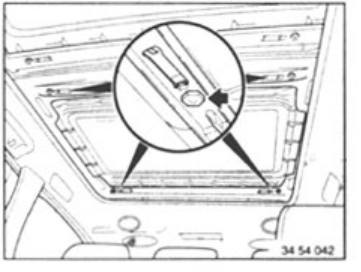
Switch off ignition.

Installation note:
Grease slide rails of cross members, (Renax GL1, Fuchs).



Release screws.

Installation note:
Replace screws (micro-encapsulated).
For tightening torque, refer to Technical Data 54 12 2AZ.



Release nuts and remove sliding/tilting sunroof cover by lifting upward.

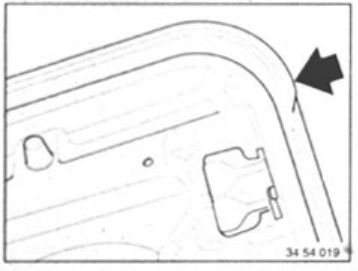
Installation note:
Observe installation note in 54 12 104. Adjust rear sliding/tilting sunroof cover, refer to 54 12 006.
Replace nuts (micro-encapsulated).
For tightening torque, refer to Technical Data 54 12 2AZ.



54 12 120 Replacing weatherstrip for sliding / tilting sunroof cover

Note:
If weatherstrip is peeling off, it can be repaired with cyan acrylic adhesive (Loctite 380)*, refer to 54 0 ... Repairing bonded weatherstrips on sliding/tilting sunroof.

Remove and install sliding/tilting sunroof cover, refer to 54 12 100.



Remove weatherstrip from sunroof cover.
Remove remnants of adhesive.

Installation note:
Install weatherstrip with adhesive*.
Sealing lip facing forward.

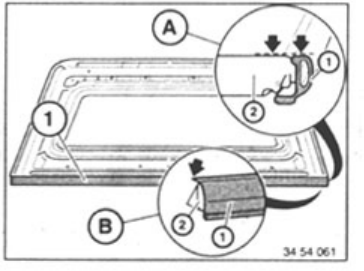
* Source of supply: BMW Parts Service



54 12 121 Replacing front weatherstrip for sliding / tilting sunroof cover (touring)

Note:
If weatherstrip is peeling off, it can be repaired with cyan acrylic adhesive (Loctite 380)*, refer to 54 0 ... Repairing bonded weatherstrips on sliding/tilting sunroof.

Remove front sliding/tilting sunroof cover, refer to 54 12 102.



Remove weatherstrip (1).
Clean bonding surface.
(A) Bond weatherstrip (1) flush with upper edge of sunroof cover (2).
(B) Weatherstrip (1) must project a little at outer left and right sunroof cover (2).

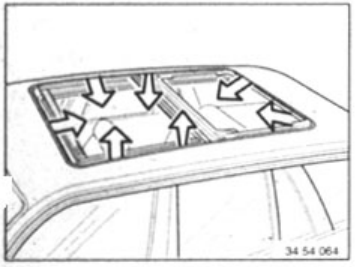
* Source of supply: BMW Parts Service



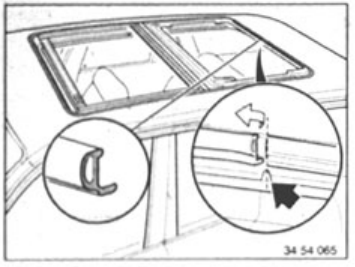
54 12 122 Replacing weatherstrip at sliding / tilting sunroof aperture (touring)

Note:
If weatherstrip is peeling off, it can be repaired with cyan acrylic adhesive (Loctite 380)*, refer to 54 0 ... Repairing bonded weatherstrips on sliding/tilting sunroof.

Remove front and rear sliding/tilting sunroof cover, refer to 54 12 102 and 54 12 106.



Remove weatherstrip.



Start disassembly and assembly at rear center.

* Source of supply: BMW Parts Service

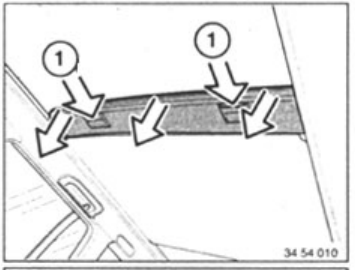
54 12 132 Removing and installing or replacing front headlining frame for sliding / tilting sunroof cover (touring)

Open front sliding/tilting sunroof.

Note:
The front finisher need only be removed for adjustment work, removal or replacement of the front sunroof cover.

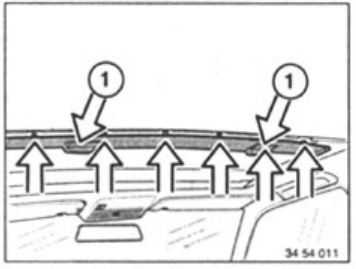


As of production date mid-March 92, the finishers are only clipped on(similar to A-pillar trim panel).
These finishers cannot be mounted on "old" sunroof covers.



Date of production before mid-March '92:

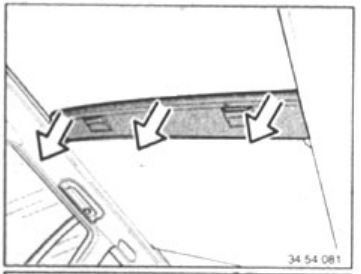
If necessary, release front screws.
Press back finisher (1) and unclip at bottom.



Installation note:
Fit finisher at front, push forward (1) and clip in at rear.

If clips on finisher defective and no suitable finisher is available: Drill 3 holes through rear finisher and through headlining panel.

Protect headlining panel from corrosion.
Secure finisher with 3 self-tapping screws (as front).

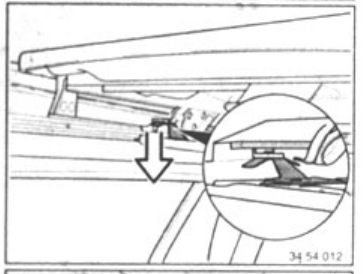


Production date after mid-March '92:

Unclip finisher at bottom

54 12 133 Removing and installing or replacing headliner frame for sliding / tilting sunroof cover (touring)

Remove front headliner frame, refer to 54 12 132.



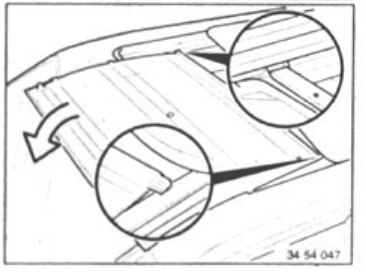
Press down spring on left and right and slide headliner frame forward.

Installation note:
Engage left and right spring correctly.



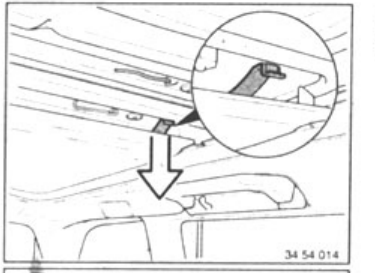
Pull forward headliner frame.
Press out front sliding blocks over recess and upward, slide headliner frame back a little until it can be lifted over the wind deflector.

Pull headliner frame forward again and also press out center sliding blocks.

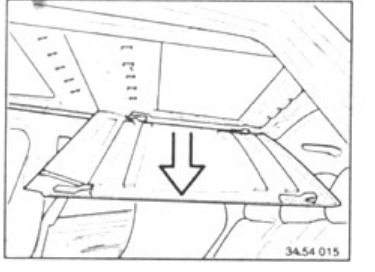


Turn headliner frame and pull upward.

Installation note:
Check function.



Close sliding/tilting sunroof.
Press down spring on left and right and pull headliner frame forward a little.



Press up headliner frame on right and remove by pulling down to left.

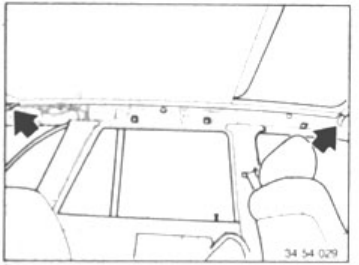
Installation note:
Engage spring on left and right correctly.
Check function.

54 12 210 REMOVING AND INSTALLING COMPLETE SUN ROOF FRAME (Touring)

Important!
Check manufacturing number (version status) - refer to Service Information of Group 54.

Switch off ignition.

Remove roof liner tensioners - refer to Group 51.

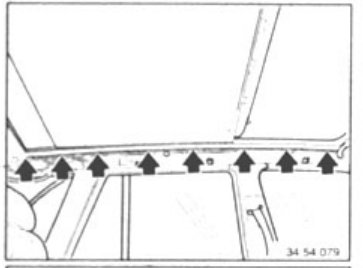


Loosen hose clamps at front and rear, left and right.

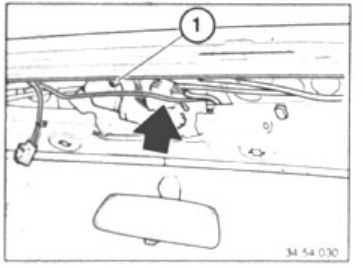
Note:
Secure clamps to prevent them from falling into the A-pillars.

Pull off water drain hoses.

Installation:
Check function and for leaks.



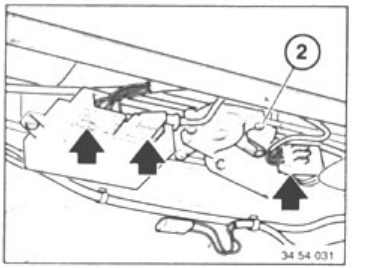
Pull complete wire harness off of sun roof cassette.



Disconnect rear plug and unscrew screw (1).

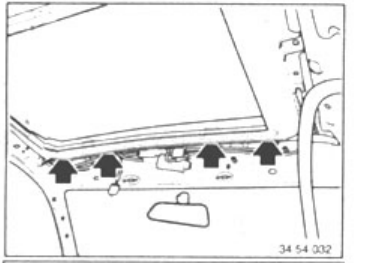
Installation:
Tightening torque*.

* Refer to Specifications



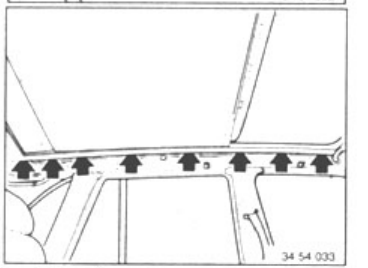
Disconnect plugs (also refer to "Replacing Module" in 54 13 015).
Unscrew screw (2).

Installation:
Tightening torque*.
After disconnecting plug on module the sun roof must be initialized - refer to 54 00 . . ..



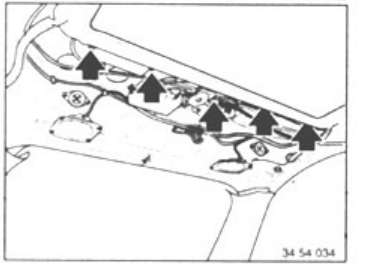
Unscrew screws.

Installation:
Tightening torque*.



Unscrew left and right screws.

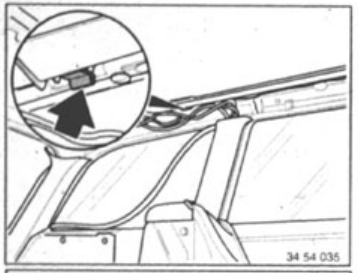
Installation:
Tightening torque*.



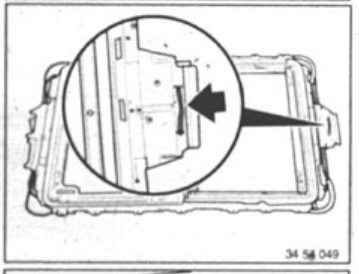
Unscrew rear screws.

Installation:
Tightening torque*.

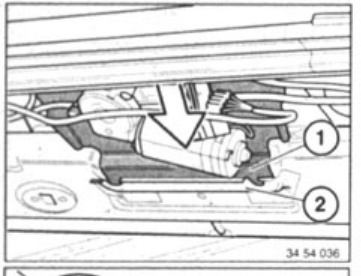
* Refer to Specifications



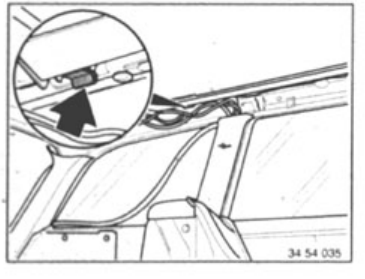
Unclip retainers at left and right sides and lift out sun roof cassette towards rear through the tailgate opening with help from a second person.



Installation:
Paste approx. 10 cm long strip of Norton tape* at front.

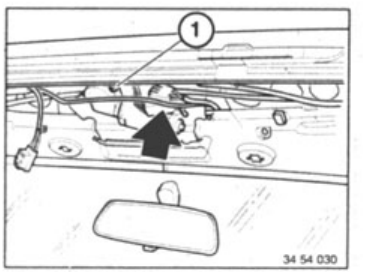


Installation:
Insert front end of sun roof cassette (1) into sheet metal slot (2).

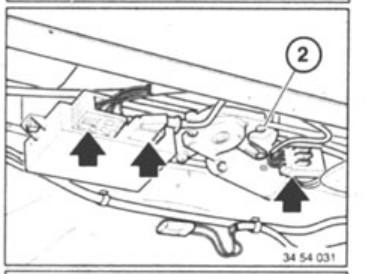


Installation:
Clip rear end in retainers on left and right sides.

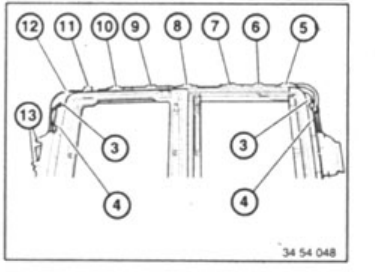
* Source of Supply: BMW Parts



Installation:
Tighten front screw (1).
Tightening torque*.



Installation:
Tighten rear screw (2).
Tightening torque*.

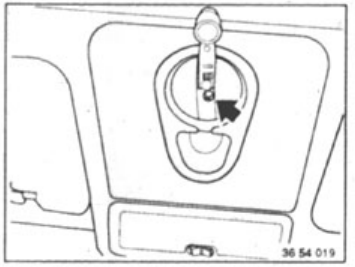


Installation:
Keep to following screw tightening sequence:

(3)	front left and right
(4)	front left and right
(5 ... 12)	each left and right
(3)	rear left and right
(4)	rear left and right
(13)	last one

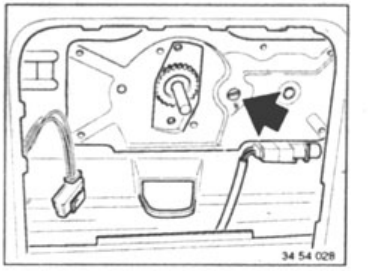
Tightening torque*.

* Refer to Specifications



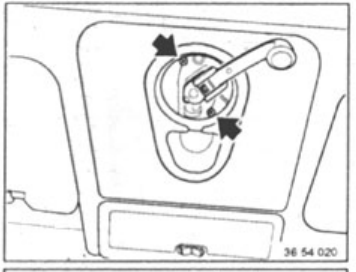
54 12 230 REMOVING AND INSTALLING / REPLACING GEAR UNIT FOR MANUAL SUN ROOF

Shut the roof.
Unscrew screw.

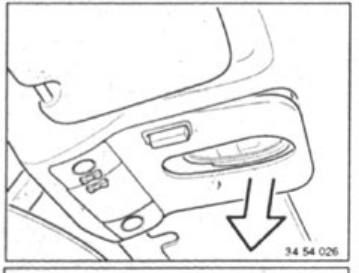


Unscrew screw and remove gear unit.

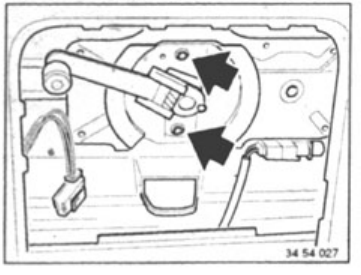
Installation:
Install winder and turn the gear unit to "0" position (pressure point).
Lubricate pinion lightly with grease*.



Unscrew screws and remove winder recess plate.



Lift and remove trim panel.

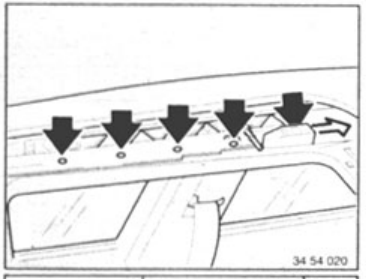


Unscrew winder.

* Source of Supply: BMW Parts

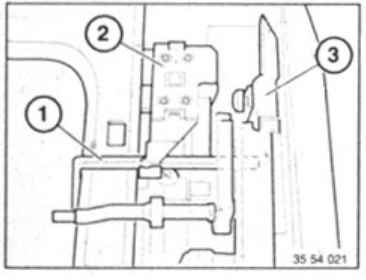
54 12 241 REPLACING BOTH SUN ROOF DRIVE CABLES

Remove sun roof lid - refer to 54 12 100.
Remove motor/gear unit - refer to 54 13 010; or remove gear unit - refer to 54 12 230.

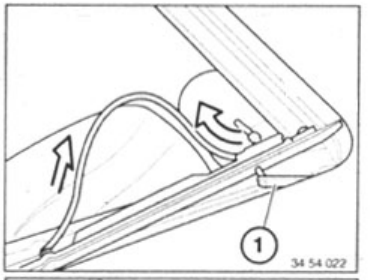


Push drive cables back uniformly on both sides.
Remove cover.

Installation:
Replace screws.
Tightening torque = 1.8 Nm;
for both rear screws = 2.8 Nm.

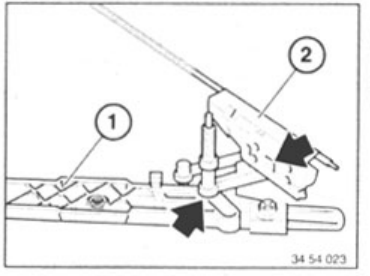


Installation:
Pull drive cables forward on both sides.
Arrest drive cable (2) and gate (3) in "0" position using key (1).
Install motor/gear unit.



Pull drive cables out of guide pipes.
Press off linkage (1).

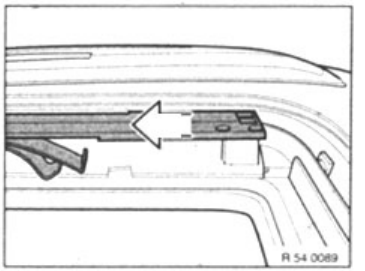
Installation:
Braided drive cables may not be lubricated.



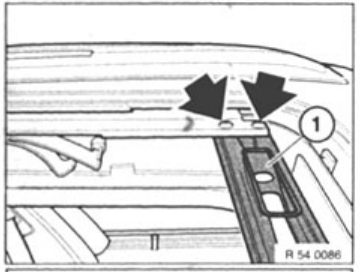
Press drive cable (2) off of gate (1) in center position.
Drive cable (2) is marked:
L = left
R = right

54 12 245 Removing and installing or replacing both front drive cables for actuation of sliding/tilting sunroof

Remove front sliding/tilting sunroof, refer to 54 12 102.
Remove front motor, refer to 54 13 011.

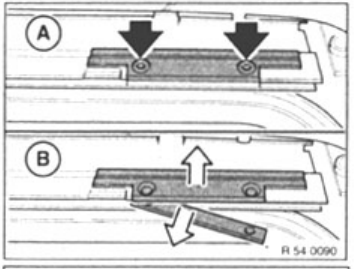


With guide carriage at front, slide guide rail backwards until the assembly cover is exposed.



Unfasten screws on left/right and remove transverse traverse (1).

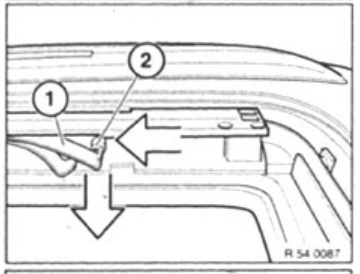
Note:
If necessary, stick down washer.



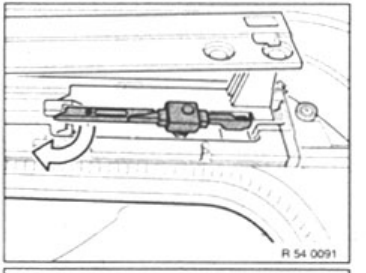
(A) Unfasten screws.
(B) Remove assembly cover and threaded plate on left/right sides.

Installation:
Replace screws (micro-encapsulated).

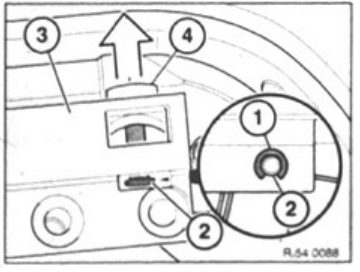
With guide carriage at front, pull guide rail forwards (neutral position).



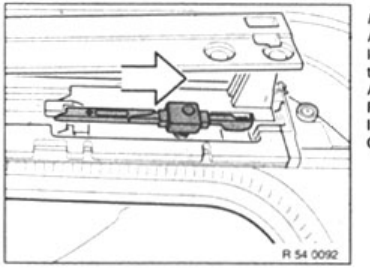
Press down spring (1) on left/right and slide sliding member backwards (2).



Pull drive cables backwards: these are marked for left and right sides.



Remove retaining ring (1) on retaining pin (2) on left/right sides.
Drive out retaining pin (2) with punch.
Remove guide rail (3) from guide carriage (4) by lifting upwards.

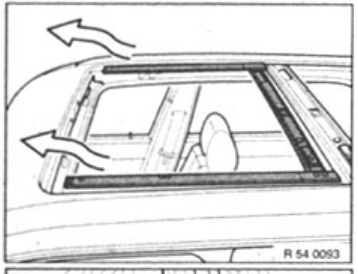


Installation:
After fitting the assembly covers, slide left/right drive cables forwards to detent position (basic setting).
Apply a drop of oil to the drive cables.
Fit motor and retaining pin.
Initialization: refer to 54 0 ....
Check function.

54 12 246 Removing and installing or replacing both rear drive cables for actuation of sliding/tilting sunroof

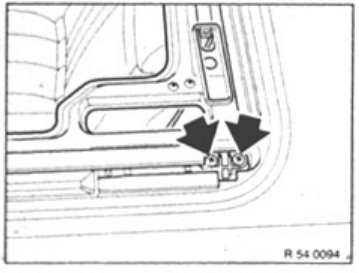
54 12 255 Replace both actuating units/folding units

Remove wind deflector, refer to 54 12 496.
Remove front drive cable, refer to 54 12 245.
Remove rear sliding/tilting sunroof cover, refer to 54 12 106.



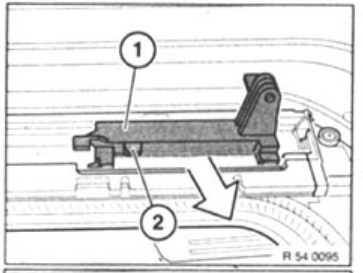
Remove front cover frame from actuating unit/folding unit on left/right sides.

Remove rear motor, refer to 54 13 012.



Unfasten screws and remove holding-down device on left/right sides

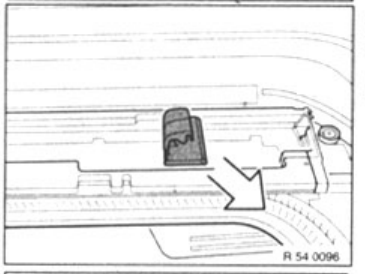
Installation:
Coat underside of holding-down device with grease.



Remove sliding carriage (1) on left/right sides of front cover from sliding rails.

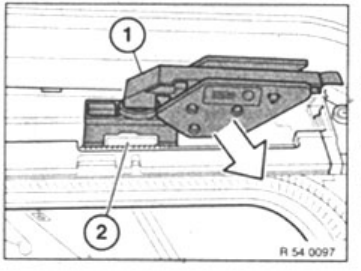
Caution!
Do not lose fulcrum pads (2) (bevel faces towards rear).

Installation:
Apply grease to underside of sliding carriage.



Extend spring bracket on left/right sides and remove from sliding rails.

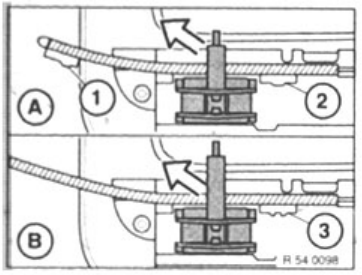
Installation:
Apply grease to underside of spring bracket.



Extend actuating unit/folding unit (1) on left/right sides as far as assembly aperture. Slightly raise rear drive cable (2) and remove actuating unit / folding unit (1) on left/right sides from sliding rails.

Installation:
Apply grease to underside of folding unit.

Note:
This job 54 12 255 (replacing both actuating units / folding units) ends here.
Observe the following installation instructions:



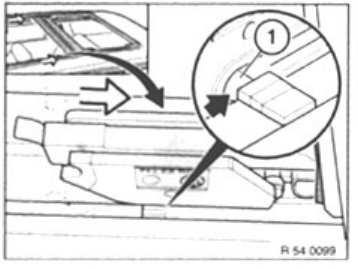
Shift rear cover frame such that sliding blocks fall out of bracket.

Pull forward rear operating cable on left/right.
Remove front (A) and rear (B) slides from sliding rails.
Disconnect both operating cables.

Installation note:
The rear slide (B) is longer.
All slides and operating cable holders are coded.

1 Coding for tilt control
2 Coding for front slide
3 Coding for rear slide

Lubricate operating cable with one drop of oil.
Grease bottom of slides.

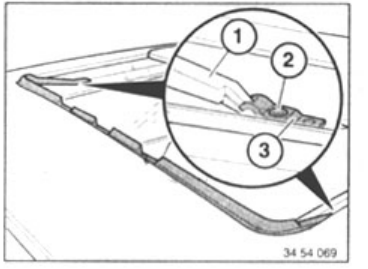


Installation note:
Push back operating cable with slides and tilt control until guide pin (1) engages in bracket of tilt control (basic setting).

Remove rear motor.
Operating cables can now no longer be adjusted.
Initialize, refer to 54 0 ...
Check function.

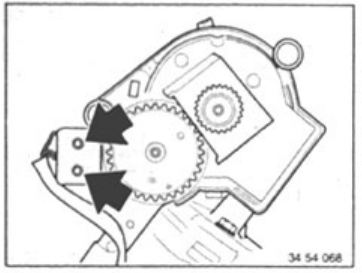
54 12 496 Removing and installing or replacing wind deflector (touring)

Open front sliding/tilting sunroof cover.



Release left/right screw (2).
Remove left/right mount (3) and detach wind deflector (1).

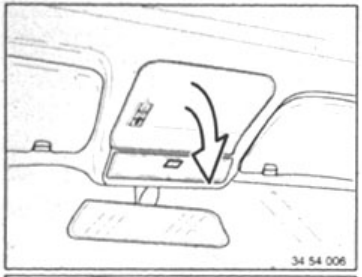
For tightening torque,
refer to Technical Data 54 12 7AZ



54 12 512 Replacing microswitch for sliding/tilting sunroof motor

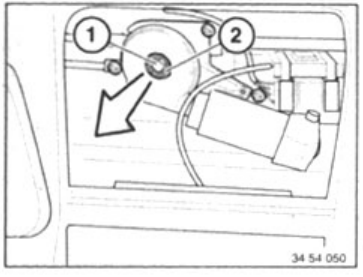
Removing and installing motor/gearbox unit, refer to 54 13 010.

Drill out hollow rivets and rivet new micro-switch into place.

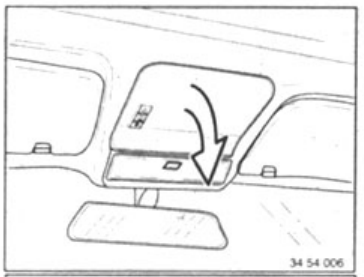


54 13 005 Removing and installing or replacing coupling on front gearbox (touring)

Ignition off.
Lift out cover with folding leg.
Unclip hand crank from the cover.
Completely close sunroof (neutral position).
If necessary, close sunroof with help of emergency operator, refer to 54 0 ...

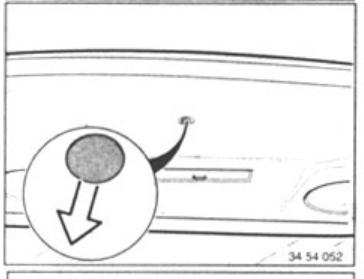


If necessary, unfasten screw (1) (old construction status).
Lift coupling (2) out with hand crank pointing downwards.



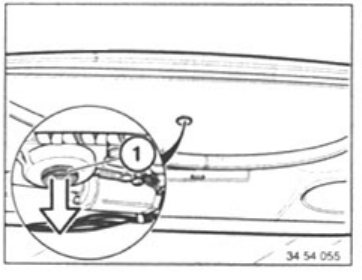
54 13 006 Removing and installing or replacing rear coupling on gearbox unit (touring)

Ignition off.
Lift out cover with folding leg.
Unclip hand crank from cover.
Sliding/tilting sunroof must be in neutral position, if necessary close using emergency operating mode: refer to 54 0 ...

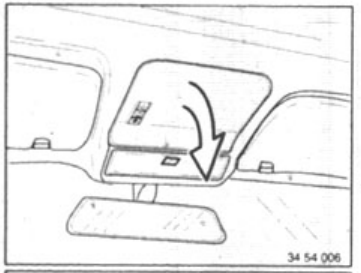


Lift out plug by pulling downwards.

Note:
If the plug diameter is < 20 mm, partially remove edge trim.

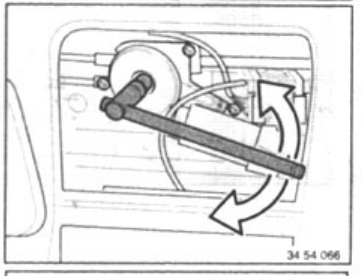


If necessary, unfasten screw on the coupling (old construction status).
Lift coupling (1) out with hand crank pointing downwards.

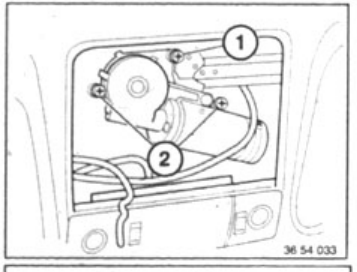


54 13 010 REMOVING AND INSTALLING SUN ROOF MOTOR AND GEARBOX

Switch off ignition.
Lift out cover using a creaser.

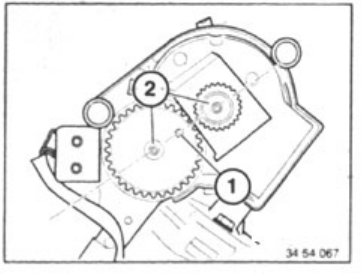


Shut roof.
If necessary, shut roof manually using the hexagon socket key.

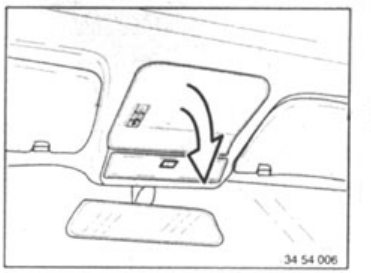


Unscrew screws (1 and 2).
Disconnect plug and remove motor/gearbox unit.

Installation:
Screw (1) is longer.
Tightening torque = 2.8 Nm.



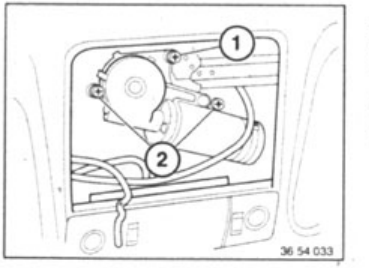
Installation:
Install motor/gearbox unit only with closed roof and motor in zero position = bore (1) on one line with shafts (2).
If necessary, turn with help of hexagon socket key.



54 13 011 REMOVING AND INSTALLING / REPLACING FRONT SUN ROOF LID MOTOR (Touring)

Switch off ignition.
Lift out cover using a creaser.

Shut roof completely (zero position).
If necessary, emergency (manual) closing - refer to 54 00 . . ..



Unscrew screws.
Disconnect plug and remove motor/gearbox unit.

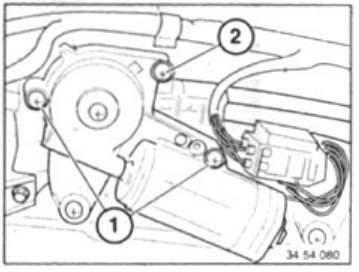
Installation:
Tightening torque*.
Initialize sun roof - refer to 54 00 . . ..

* Refer to Specifications

54 13 012 REMOVING AND INSTALLING / REPLACING REAR SUN ROOF LID MOTOR (Touring)

Switch off ignition.
Remove rear roof liner section - refer to Group 51.

Shut roof completely (zero position).
If necessary, emergency (manual) closing - refer to 54 00 . . ..

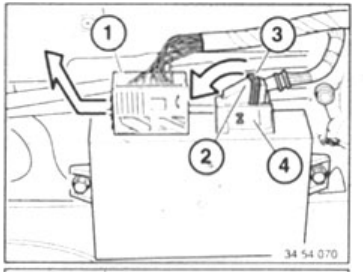


Unscrew screws (1 and 2).
Disconnect plug and remove motor/gear-box unit.

Installation:
Screw (1) is longer.
Tightening torque = 2.8 Nm.

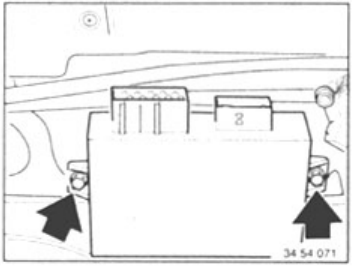
54 13 015 REMOVING AND INSTALLING / REPLACING SUN ROOF MODULE (Touring - Rear)

Switch off ignition.
Remove rear roof liner section - refer Group 51.



Disconnect plug (1).
Press down retainer (2) and lift out plug (4) together with arrest (3) to the left.

Installation:
Carry out initialization.



Unscrew screws and remove module.

* Refer to Specifications

TROUBLESHOOTING SUN ROOF

Condition	Cause	Correction
Rattling noise	a) Front sliding shoes loose / defective	a) Tighten / replace front sliding shoes
	b) Sun roof maladjusted	b) Adjust sun roof
	c) Rubber stop missing	c) Install rubber stop (cover rails, gate, drive cables)
Whistling noise	a) Excessive gap between roof and lid (front/rear)	a) Adjust lid, replace seal if necessary
Water entering car through roof liner	a) Sun roof maladjusted in 0 position	a) Adjust in 0 position
	b) Seals loose / damaged	b) Tighten / replace seals
	c) Wrong seal installed. Different seal profiles front/rear	c) Install original parts
	d) Drain hoses plugged	d) Clean drain hoses
Roof lid lifts onesidedly	a) Drive cables maladjusted	a) Adjust drive cables in 0 position
Sun roof lid moves too slow (motor runs slowly)	a) Maladjustment	a) Adjust sun roof in 0 position
	b) Transmission defective	b) Replace motor/gearbox unit

61 Electrical system

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GENERAL INFORMATION

Important When Disconnecting Battery:

Disconnecting the battery will erase fault memories of control units, so that fault memories should first be interrogated and any possible faults printed.
The radio can only be operated after disconnection of the battery by entering the radio code again, so that the customer should first be asked for his radio code card.
Note stored stations so that they can be stored again after connection of the battery.
The stored data of the on-board computer and clock will also be lost.
If car is fitted with an infrared locking system, all keys must be recoded - refer to Car Electric/Electronic Test Plan for additional information.
To disconnect the battery (located underneath rear seat), remove cover on rear seat base at right bottom and unscrew ground cable at ground connection point.
Disconnect battery ground lead if battery is located in engine compartment.

Important With Connected Battery:

Working on components, wire connections and so on could cause faults to be stored in fault memories of concerned control units.
If instructions in this Repair Manual specify disconnection of the battery, this must always be conformed with in the interest of safety.

Outside Starting Aid

Do not start the engine with help of starting sprays.

Preparations:
Conform with the following when starting engine with starting cable.
Ensure that starting cable wires are of appropriate cross section size.
Only use fuse-protected starting cables.
Check whether the current supplying battery has 12 V voltage.
If engine is started from battery of another car, ensure that there is no contact between the bodies of both cars.

Caution!
Never touch ignition system components under current – dangerous high tension!

Procedures:
Always conform with the procedures to avoid injury to persons or damage to parts.
Select range P in cars with an automatic transmission and apply the parking brake.
Move the shift lever of cars with manual transmission into neutral and apply the parking brake.
Ensure that the starting cables cannot get caught in rotating parts, e.g. fan.
First connect both positive poles of the batteries with one starting cable (red).
Use the positive connection point in the engine compartment for cars with the battery in the trunk.
Then connect the second starting cable (black) between the negative pole of the current supplying battery and engine or body ground of the car to be started.

Caution!
Never connect the second starting cable (black) on the negative pole of the battery in the car to be started. Produced gas could be ignited by sparks – danger of explosion!

If the battery in the car supplying power is weak, start the engine of this car and let it run at idling speed.
After the engine of the car to be started has started up, first disconnect the starting cable on the negative pole / ground connection. Then remove the starting cable from the positive poles.

Outside Starting Aid and Car Telephone

Siemens C 2:
When starting the car's engine with outside help from another car, remember that overvoltage could damage the Siemens C 2 telephone. Consequently always disconnect the sender and receiver from the electric system before using outside starting aids.

Siemens C 3 and Motorola C 451:
Senders and receivers of Siemens C 3 and Motorola C 451 telephones are protected against overvoltage, but calls may not be made or received during outside starting.

Always pay attention to the operating instructions of different type and different make telephones. In case of doubt disconnect the sender and receiver from the car's electric system.

Windshield Wipers (Wiping Motor)

In case of disturbance intermittent wiper and wiper speed step 1 are switched off by a protector.
This protection remains effective even after eliminating the fault and can be cancelled by switching off the ignition (terminals 15 and R) for 3 minutes.

Windshield Wipers (Wiper Contact Force Motor)

In case of disturbance the wiper contact force regulating motor is switched off by a protector.
This protection remains effective even after eliminating the fault and can be cancelled by

a) disconnecting the battery for 30 seconds (*important*: all fault memories will be erased!)
   or
b) operating car (automatic cancellation).

Instructions for Removing and Installing Electronic Control Units

Important!
Disconnecting the car's battery will cancel fault memories of control units, so that it is absolutely essential to interrogate fault memories prior to disconnection of the car's battery and to have the faults printed with the BMW Service Tester's printer. Stored faults must then be investigated.
Disconnection and connection of control unit plugs always requires that the ignition be switched off.
Removal and installation of components, relays, fuses, etc. could cause the storage of faults in fault memories of control units capable of self-diagnosis. Consequently after finishing work on the electrical system it is always necessary to interrogate fault memories, investigate stored faults and cancel the fault memories.

Battery Care and Maintenance

The electrolyte level of present low-maintenance batteries should be checked at least annually or at intervals of 25,000 km and corrected to the max. mark specified by the battery supplier with distilled water when necessary.
Discharging by the power consumption of control units even in standby mode is added to the natural self-discharging of a battery due to the increasing number of control units used in cars today. The batteries of cars in storage should be recharged at the latest every six weeks to maintain the service life and avoid excessive discharging (refer to battery recharging calender). The time for self-discharging depends on the car model and equipment.

Charging Battery:

If a standard or fast charger (e.g. Bosch SL 24 90*) is used to charge a battery, the battery must be disconnected from the car's electrical system and removed in order to avoid damage to paint finishes and upholstery by the escaping gas.
Excessively discharged batteries could be damaged or destroyed by the very high initial current (high temperature).
The battery can remain connected when using an electronic charger (e.g. Siemens VB 80).
The electronics deos not permit critical peak voltage.
An electronic charger also charges an excessively discharged battery with reduced current until a certain basic voltage is reached.
Refer to Service Information 61 08 88 if there is doubt as to whether or not the battery charger in the workshop is suitable.

Important!
Always first measure the open circuit voltage before charging a battery installed in the car. If this voltage is 10 V or less, it cannot be excluded that one or more cells are faulty or that the battery as a whole is already pre-damaged.
In this case it is always necessary to remove the battery as escaping gas while charging could damage interior equipment.
Attempt to regenerate the faulty cells with low charging current.
Remove plugs from the separate cells in the interest of safety.
Also refer to 61-21/1.

Testing Battery:

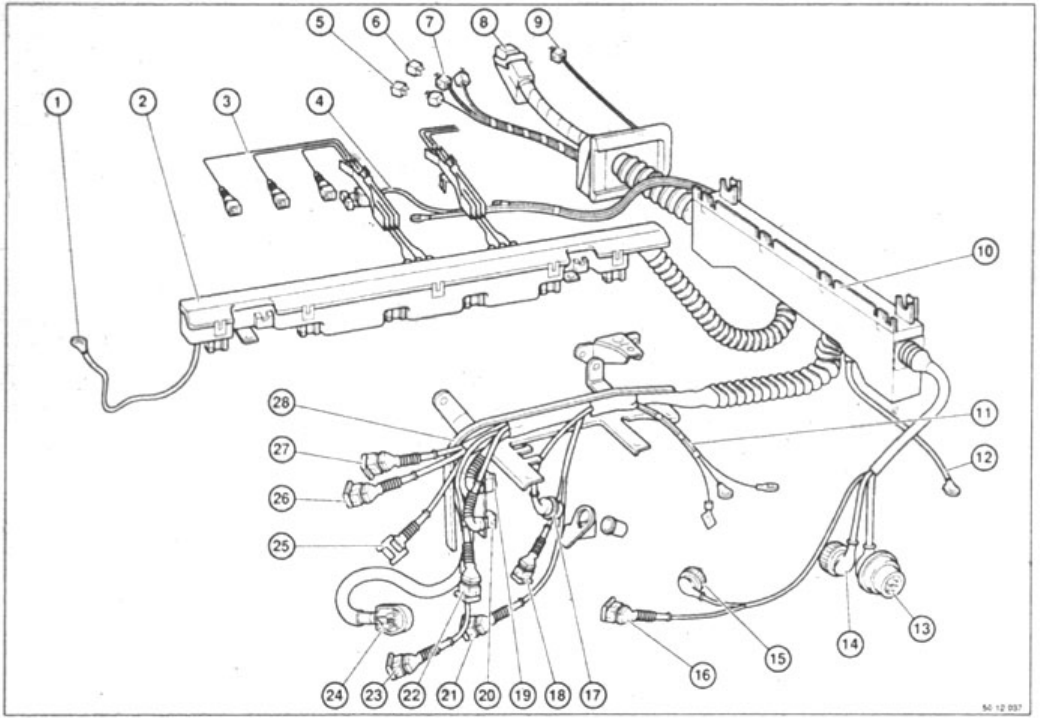
An objective statement on the charged condition of a battery is only possible by way of a load test with cold testing current.
This test can be carried out with a battery tester, for example

Bosch T 12 220* or preferrably with
Bosch T 12 200*.

Additional information on load tests is contained in the pertinent operating instructions (refer to 61-20/1).

The acid density of a battery can also be used to determine the charged condition.
This test, however, is not as positive due to the design-orientated dispersion range of acid density (e.g. charged standard battery version = acid density 1.28 kg/ltr. — tropic version = acid density 1.23 kg/ltr.).
Another interferring factor is the acid layer immediately after filling with distilled water.
Battery wear with partially sulphated and/or strongly contaminated paltes will also lead to incorrect acid density test results.

* Source of Supply: BMW Parts



61 11 051 REPLACING WIRE HARNESS SECTION FOR ENGINE (M50)

1 Ground lead 4a of ignition coils (primary end)
2 Injection plate wiring channel
3 Wires to ignition coils
4 Battery positive wires
5 Relay for DME control unit
6 Relay for electric fuel pump
7 Relay for oxygen sensor heater
8 88-pin plug for DME control unit
9 Plug for air conditioner
10 Firewall wiring channel
11 Connections for starter
12 Battery positive wire for starter
13 Connection for diagnostic plug
14 Connection for engine plug
15 Connection for air mass sensor
16 Connection for tank venting valve
17 Connection for catalytic converter
18 Connection for intake air temp. sensor
19 Connection for cylinder ident. sender
20 Connection for TDC sender of DME
21 Connection for throttle valve potentiom.
22 Connection for oil pressure switch
23 Connection for oil level switch
24 Connections for alternator
25 Connection for coolant temp. sensor of DME
26 Connection for temp. gage sender
27 Connection of idling control
28 Wire harness carrier on engine block

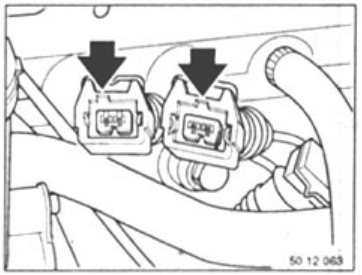
The following plug connections could be installed:

VANOS control unit (tied back in vicinity of the oil filter).
Refer to 11 36 010.

Knock sensors 1 and 2

Caution!
Mixing up both of these plugs will lead to engine damage!
Refer to 12 14 600.

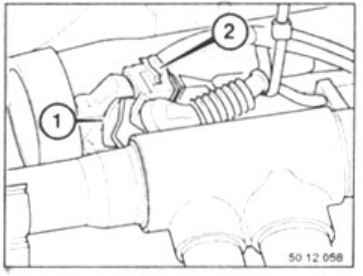
- Disconnect battery ground lead.
- Remove intake manifold.
- Remove cover from right fuse/relay plate.
- Remove cover from air conditioner pipes.
- Remove holder for wire harness from right wheel house.
- Remove cover for wire harness from firewall.
- Disconnect wire harness from right wheel house.
- Disconnect ground wire from body at right side.
- Disconnect battery positive lead.
- Remove holder for wire harness in right fuse/relay plate.
- Unscrew electric wire duct from firewall.
- Mark relays and plugs in fuse/relay plate.
- Remove complete wire harness from fuse/relay plate.
- Remove cover from valve cover.
- Pull all plugs off of ignition coils.
- Unclip wires in cover.
- Mark plugs and disconnect plugs from engine.
- Disconnect engine plug and diagnosis plug.
- Cut off wire straps from carrier on the engine block at the right and remove wire harness.



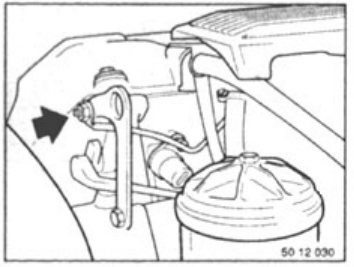
Important!
The engine wire harness for Bosch DME and Siemens MS 40 are different.

New part numbers.

Changed coding of plugs for sensors (e.g. temperature sensor, idling speed control, engine control unit).

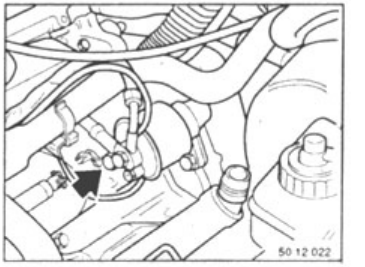


Additional connections for knock sensors (1 and 2) below the idling speed control (Siemens MS 40).

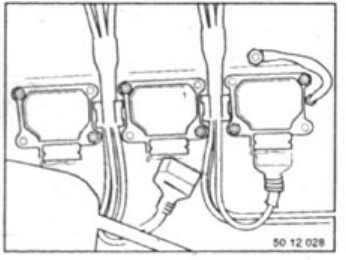


ENGINE WIRE HARNESS PLUG CONNECTIONS

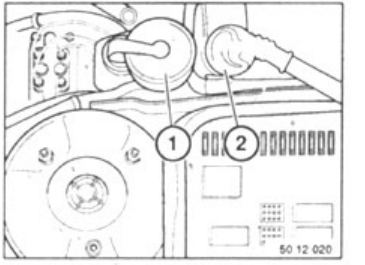
Mutual ground lead of ignition coils (primary circuit)



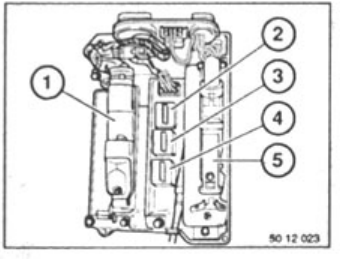
Connections of starter motor



Plugs of ignition coils

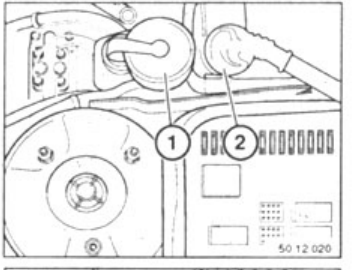


1 Diagnosis plug

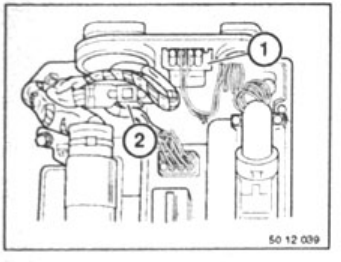


Electronic box plug connections

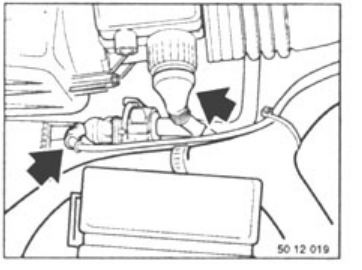
1 Motronic control unit plug (DME)
2 DME master relay
3 Fuel pump relay
4 Oxygen sensor heating relay
5 ABS control unit plug



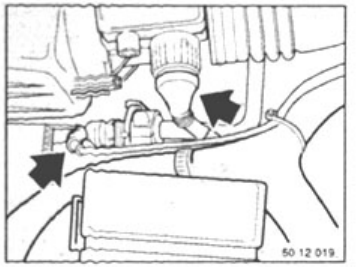
2 Engine plug



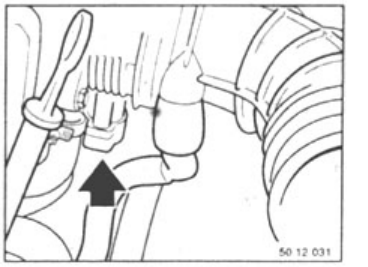
1 Air conditioner additional wire harness plug
2 Cruise control additional wire harness plug



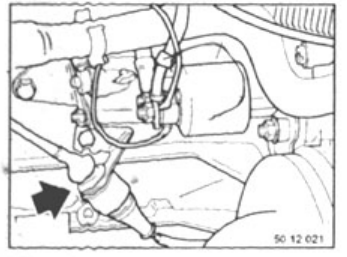
1 Air mass sensor



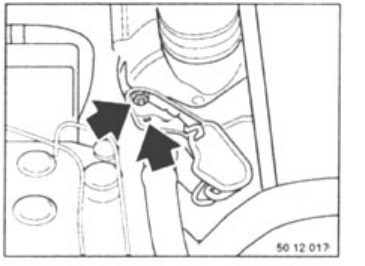
2 Tank vent valve



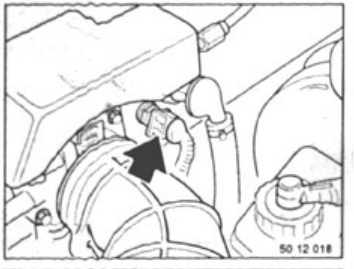
Plug for throttle valve potentiometer



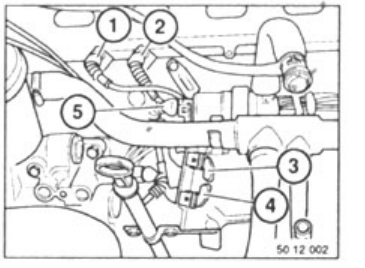
Plug of catalytic converter



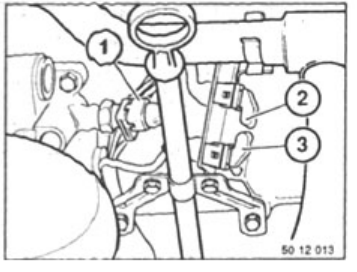
Connections of alternator



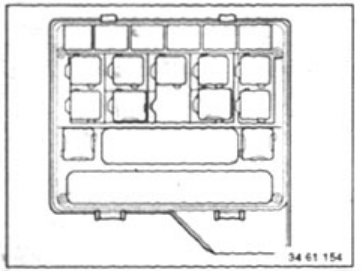
Plug of intake air temperature sensor



1 Coolant temperature sensor for DME
2 Temperature sender for temperature gage
3 Cylinder identification for DME
4 TDC sender for DME
5 Idle speed control

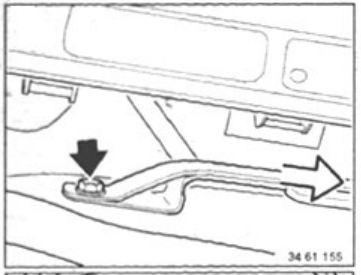


1 Oil pressure sender
2 Cylinder identifying sender for DME
3 TDC sender for DME

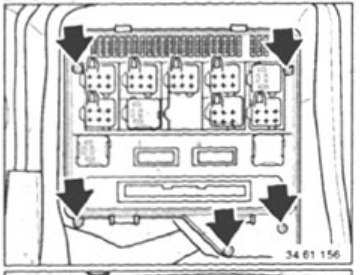


61 13 021 REMOVING AND INSTALLING FUSE/RELAY BOX

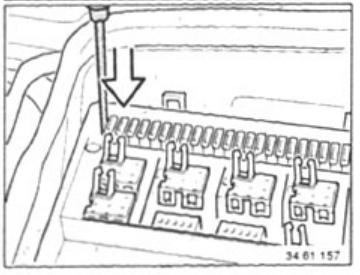
Disconnect battery ground lead.
Mark and lift out all relays.
See Test Plan for relay connection plan.



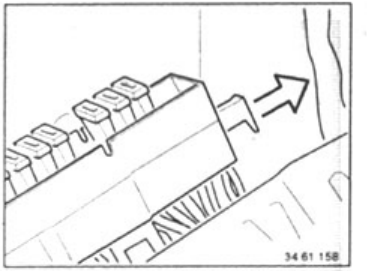
Mark installed position of cover holder.
Unscrew screws and lift out cover holder.



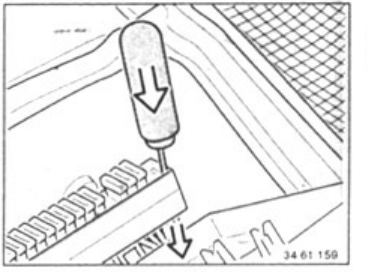
Unscrew screws (with Torx socket) and lift upper box sections.



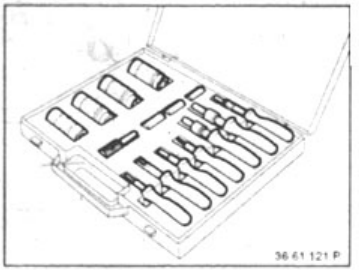
Push back clips on left and right sides of fuse plate and lift out plate downwards.



Lift lockpin out of holder.



Push back tab of pertinent plug with Special Tool 61 1 141 and pull out plug downwards.

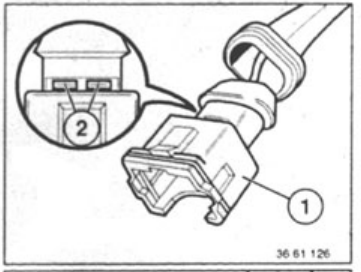


61 13 ... REMOVING AND INSTALLING WIRE CONNECTORS IN PLUG RECEPTACLES

Use set of Special Tools 61 1 150 for this purpose.

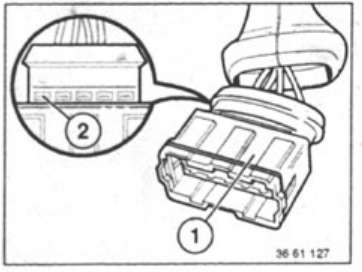
Application Information:

Only plugs with additional receptacle lock are described in these instructions. The pins of plugs not described in this section can be pressed out with a suitable pressing out tool. After repairing plugs it is always very important to make sure that the locks of plugs have engaged.

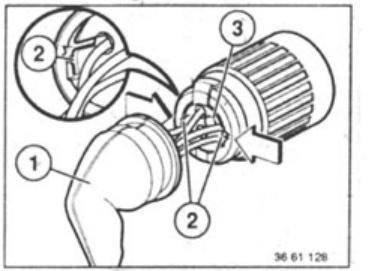


Ultrasonic Bonded Plugs

Pins of plug (1) are bonded ultrasonically and cannot be replaced.
They can be recognized by the bonds (2) on the long side of the plug.

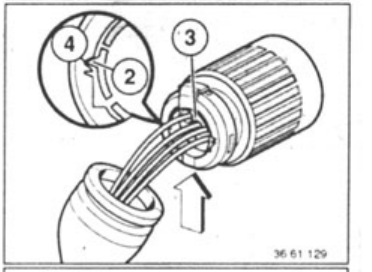


Pins of plug (1) are bonded ultrasonically and cannot be replaced.
They can be recognized by the bonds (2) on the long side of the plug.

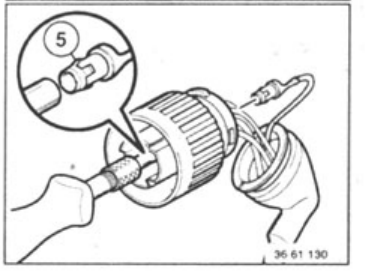


7 and 8 Pin Round Male Plugs

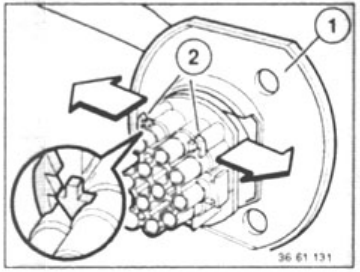
Pull rubber grommet (1) off carefully.
Push back retainers (2) of interior plug (3) carefully.



Slide interior plug (3) in direction of arrow until retainers (2) lock in locking groove (4).

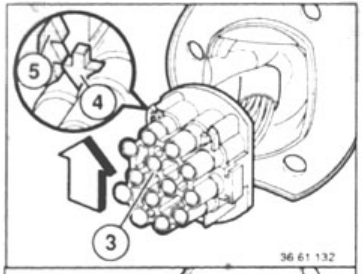


Push back steel spring locks (5) of pertinent pin using Special Tool 61 1 132 and pull out wires.

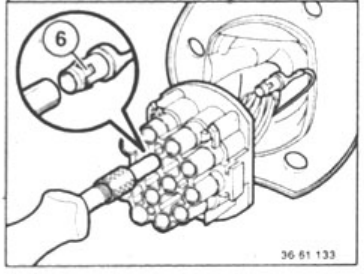


13 Pin Round Male Plug

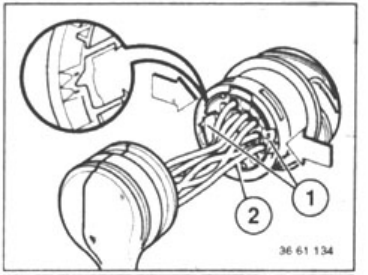
Pull rubber sleeve (1) off.
Pull lock (2) out carefully in direction of arrow.



Move plug lower section (3) in direction of arrow far enough that retainers (4) lock in locking groove (5).

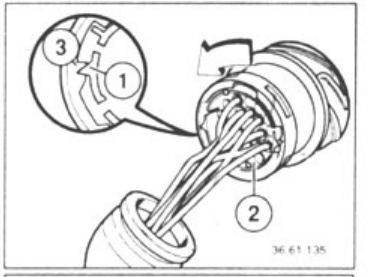


Push back steel spring locks (6) of pertinent pin using Special Tool 61 1 132 and pull out wire.

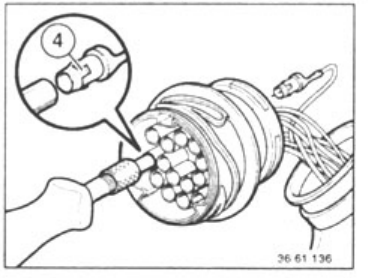


20 Pin Round Male Plug

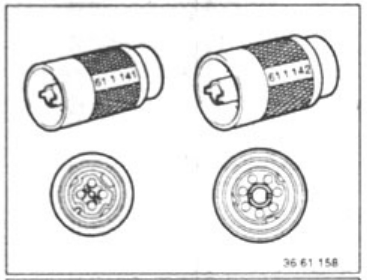
Push back retainers (1) of interior plug (2) carefully.



Turn interior plug (2) far enough that retainers (1) lock in locking groove (3).



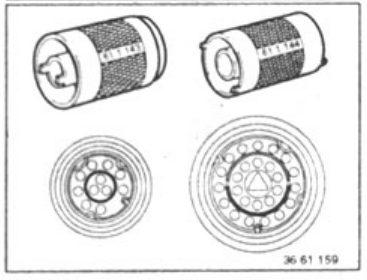
Push back steel spring locks (4) of pertinent pin using Special Tool 61 1 132 and pull out wire.



Round Male Plugs with Single Core Seal

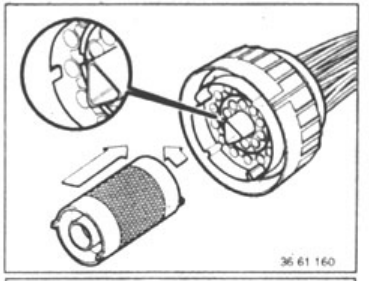
Special Tool 61 1 141 = unlocking tool for 4-pin plug.

Special Tool 61 1 142 = unlocking tool for 7-pin plug.

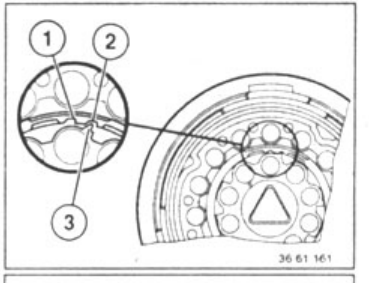


Special Tool 61 1 143 = unlocking tool for 12-pin plug.

Special Tool 61 1 144 = unlocking tool for 25-pin plug.

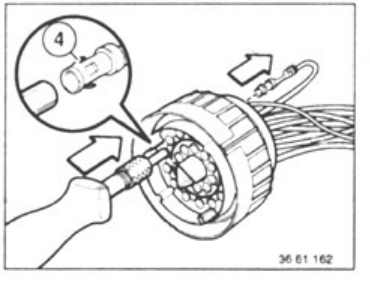


Unlock plug.
Insert suitable connection end of special tool into plug and turn counterclockwise approx. 3 degrees.

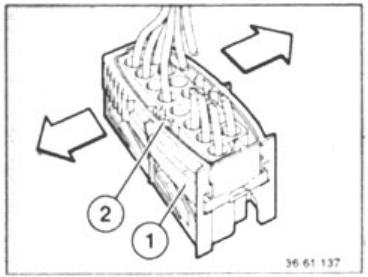


Plug locked:
Position of retainer (3) in locking groove (2).

Plug unlocked:
Retainer (3) in groove (1).

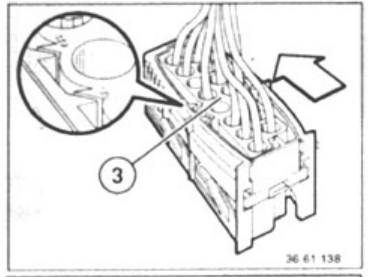


Push back steel spring locks (4) of pertinent pin using Special Tool 61 1 132 and pull out wire.

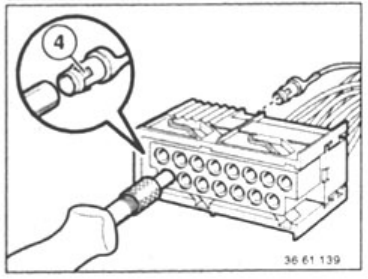


15 Pin Plug

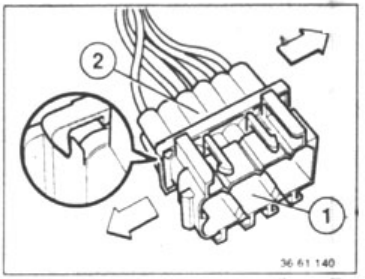
Pull exterior plug (1) out slightly in area of retainers (2) carefully.



Pull interior plug (3) in direction of arrow as far as stop.

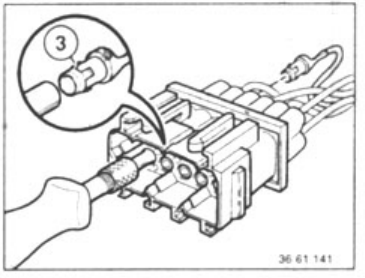


Push back steel spring locks (4) of pertinent pin using Special Tool 61 1 132 and pull out wire.

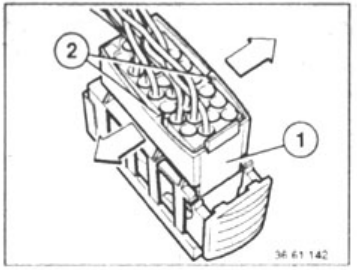


8 and 12 Pin Plugs

Move plug upper section (1) and plug lower section (2) against each other in direction of arrow.

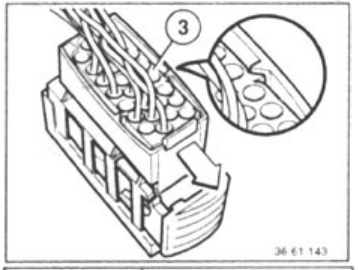


Push back steel spring locks (3) of pertinent pin using Special Tool 61 1 132 and pull out wire.

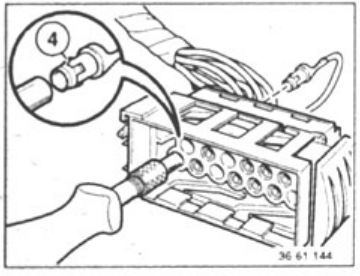


30 Pin Plug

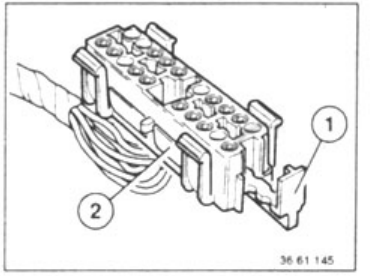
Pull exterior plug (1) out slightly in area of retainers (2) carefully.



Pull interior plug (3) in direction of arrow as far as stop.

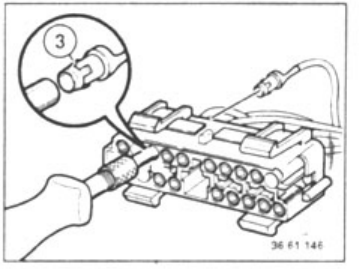


Push back steel spring locks (4) of pertinent pin using Special Tool 61 1 132 and pull out wire.

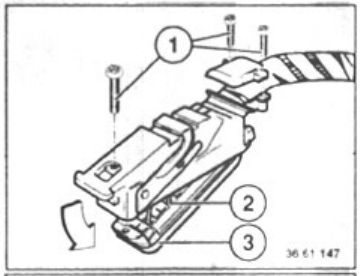


20 Pin Relay Module Plug

Pull locking slide (1) out of plug (2).

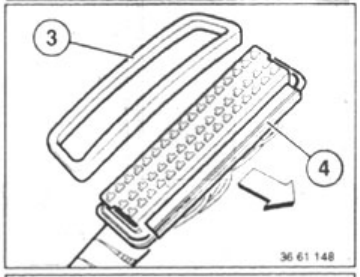


Push back steel spring locks (3) of pertinent pin using Special Tool 61 1 132 and pull out wire.

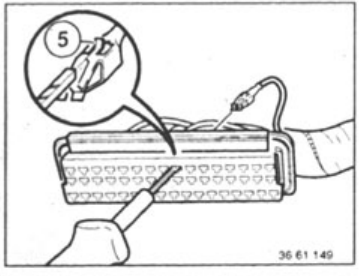


25, 35 and 55 Pin Control Unit Plugs

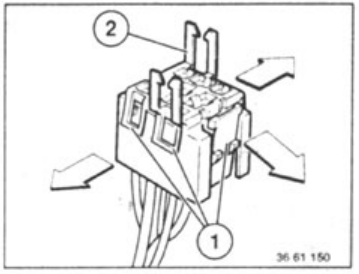
Unscrew phillips screws (1).
Pry out pin sender (2) with seal (3) in direction of arrow.



Pull off seal (3).
Pull out receptacle lock (4) in direction of arrow and unlock.

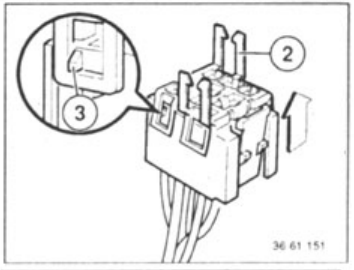


Push back steel spring lock (5) of pertinent pin using Special Tool 61 1 134 and pull out wire.

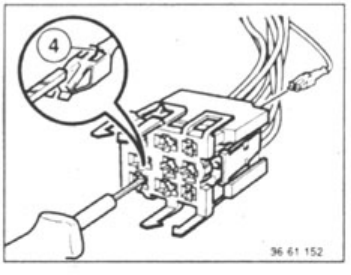


Relay Carrier

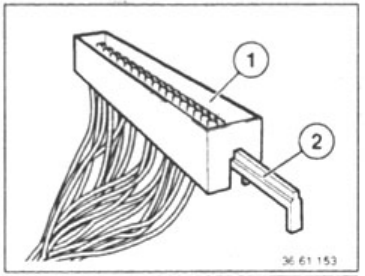
Carefully pull retainer (1) of relay holder (2) in direction of arrow.



Pull relay holder (2) in direction of arrow into first catch (3).

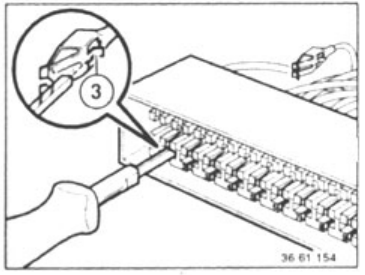


Push back steel spring lock (4) of pertinent pin and pull out wire.
Press out size 6.8 double flat spring pins with Special Tool 61 1 136.
Press out size 2.8 double flat spring pins with Special Tool 61 1 137.

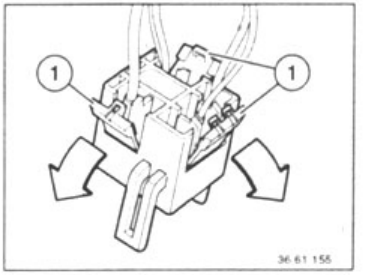


Fuse Plate

Pull concerned fuse out of fuse plate (1). (Mark positions when removing all fuses.) Pull locking slide (2) out of fuse plate (1) as far as stop.

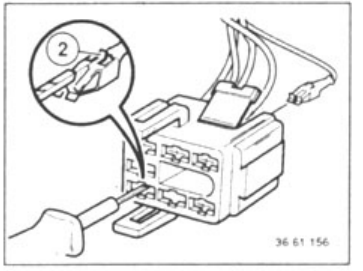


Push back steel spring locks (3) of pertinent pin using Special Tool 61 1 136 and pull out wire.

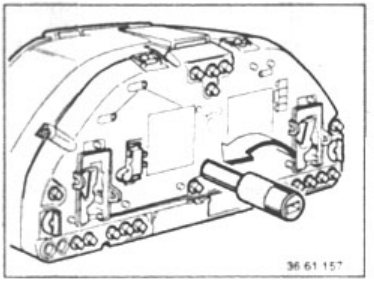


Main Relay Plug of DME

Unlock locking flap (1) of concerned wire.

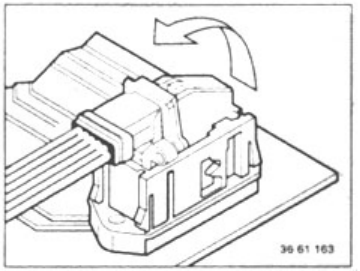


Push back steel spring locks (2) of pertinent pin using Special Tool 61 1 137 and pull out wire.



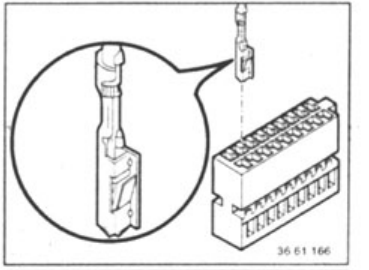
Display Lamp

Apply Special Tool 61 1 138 on concerned display lamp, turn counterclockwise (in direction of arrow) 90° and take out display lamp.

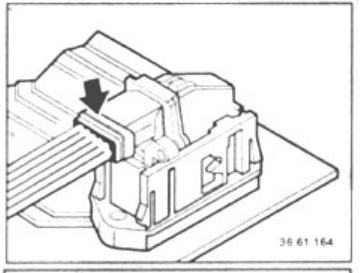


20 Pin Elo Plug (Electronic Plug since 9'91)

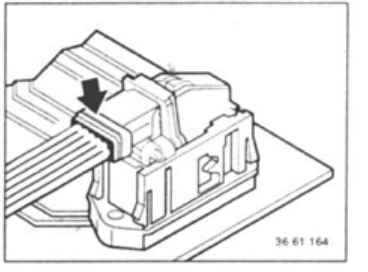
Unlock lock.



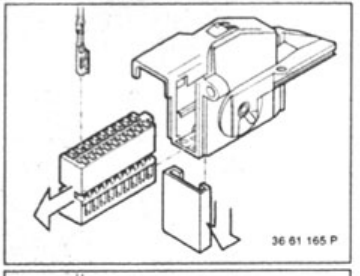
Unlock pin.



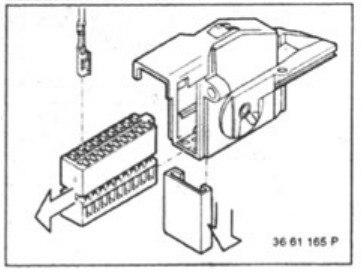
Loosen wire strap.



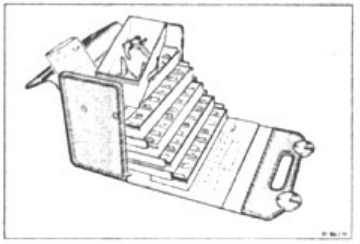
Important!
Don't forget to install the wire strap.

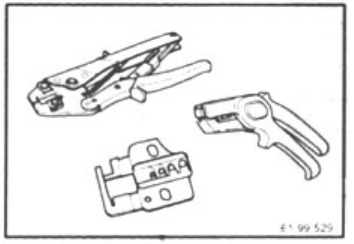


Pull off cover.



Pull out pin carrier.





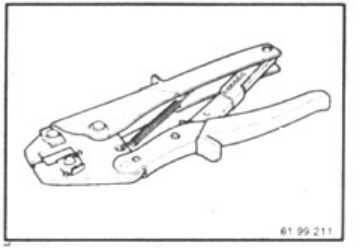
61 13 ... REPAIRING WIRE HARNESS WITH HELP OF ELECTRIC SYSTEM REPAIR ASSORTMENT IV (Special Tool 61 9 020)

Safety Information:
Always find the cause of damage (e.g. sharp edge body parts, faulty equipment, seized mechanisms, corrosion from penetrated water, etc.) before repairing a wire harness.
Interrogate fault memories.
Eliminate cause of damage.
Disconnect battery ground cable.

Important!
Only repair a wire harness if according to the wiring diagram no safety relevant systems (e.g. ABS, active rear axle kinematics, airbag, etc.) are influenced.
Otherwise replace the faulty wire harness or use repair wires (refer to Service Information of Gr. 34 and Parts).

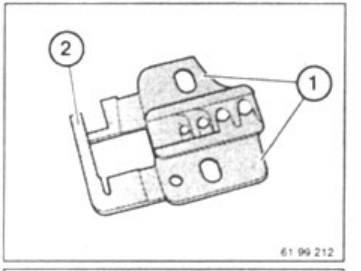
Check function and interrogate fault memories again after repairing a wire harness.
Eliminate new faults if applicable and erase the fault memories.

Instructions are supplied with Special Tool 61 9 020.
Information for ordering parts and a list of parts are also part of these instructions.



SPECIAL TOOLS FOR WIRE HARNESS REPAIRS

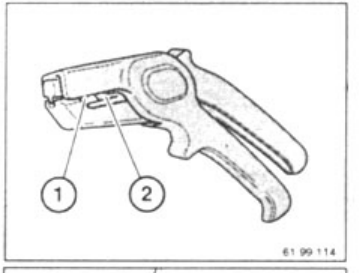
Hand pliers without matrix 61 9 041 (part of Special Tool 61 9 020).



Matrix 61 9 042 for hand pliers 61 9 041 (part of Special Tool 61 9 020).
Applications:

1 Crimping stops on electric wires in cross section size from 0.5 to 2.5 mm^2.

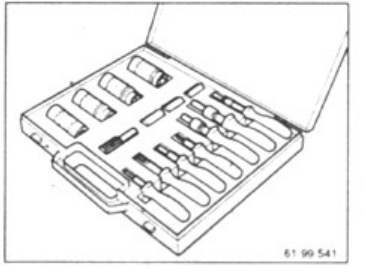
2 Pushing contact sleeves onto comb type connectors.



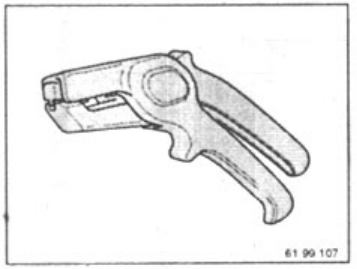
Stripping pliers with wire cutter 61 9 043 (part of Special Tool 61 9 020).
Applications:

1 Stripping PVC insulation from wires in cross section size from 0.5 to 4.0 mm^2.

2 Cutting copper and aluminum wires in cross section size up to 2 mm^2.

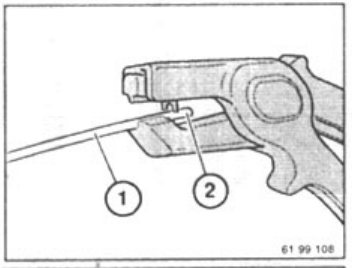


Special Tool 61 1 150.
Set of unlocking tools for 2.5 mm plug system; pressing-out tools for pins.



STRIPPING WIRES

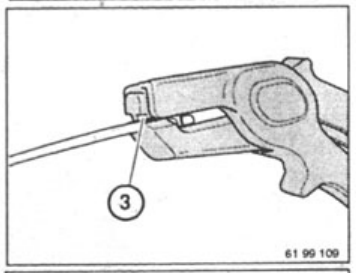
Use Special Tool 61 9 043.



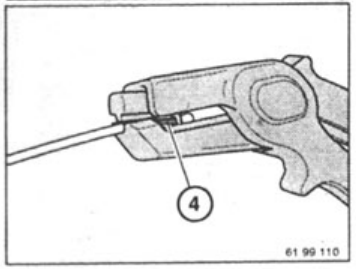
Guide in wire (1) until behind the knife. Length of wire behind the knife is equal to the stripped length.

Stripped Length:

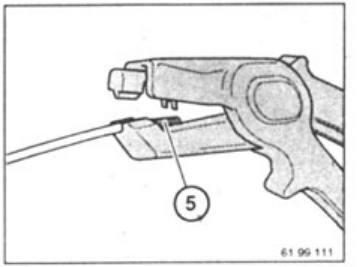
Wire Size in mm^2	Stripped Length in mm
0.35 to 0.50	4.0
0.75 to 1.00	4.5
1.00 to 2.50	5.0



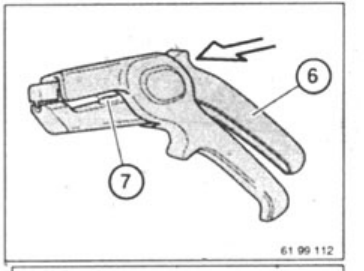
Squeeze pliers until the wire is held tight by jaws (3).



Squeeze pliers further as far as stop. This strips wire (4).



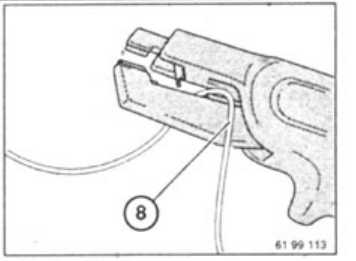
Open pliers and remove stripped wire (5).



CUTTING WIRES

Use Special Tool 61 9 043.

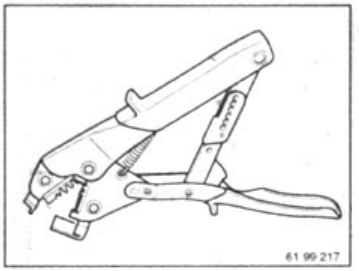
Push upper grip of stripping pliers (6) in direction of arrow until the cutters are visible.
Open pliers in final position and hold in this position.



Hold wire (8) between the cutters and squeeze pliers as far as stop.



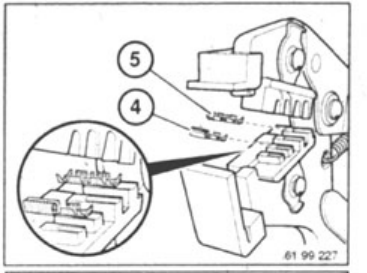
Refer to the instructions supplied with Special Tool 61 9 020 for further information.



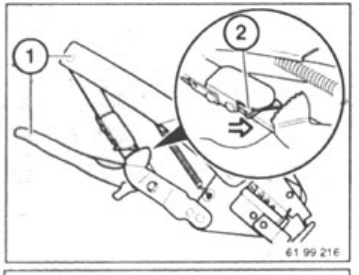
CRIMPING ON STOPS

Use Special Tools 61 9 041 and 61 9 042.

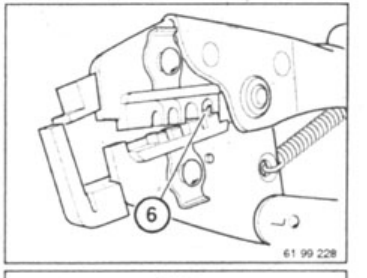
Strip wire.



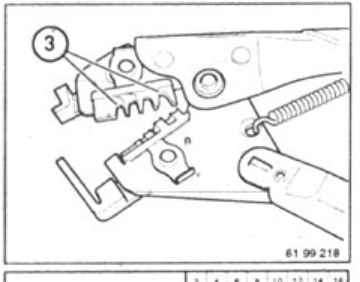
Place contact (stop) in previously determined nest.



Unlock special tool:
Squeeze grips (1) lightly and push unlocking lever (2) in direction of arrow.
OR:
Squeeze pliers as far as stop which unlocks the pliers automatically.

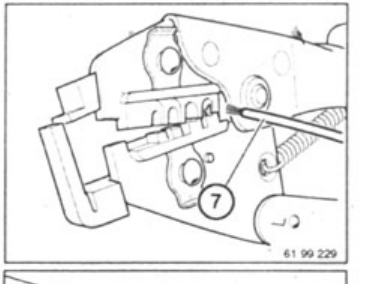


Preload contact by squeezing the matrix in the hand pliers.
Important!
Only squeeze the hand pliers enough to prevent the contact from falling out of the matrix in the hand pliers.

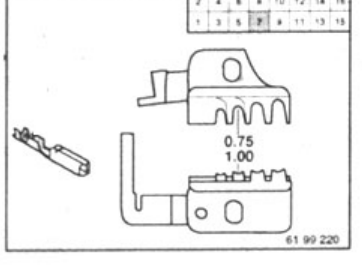


Designations on nests (3) of Special Tool 61 9 042 indicate which contacts can be used in which crimping nests.
The following wire cross section sizes and their corresponding stops can be used.

0.35 to 0.5	mm^2
0.75 to 1.0	mm^2
1.5	mm^2
2.5	mm^2

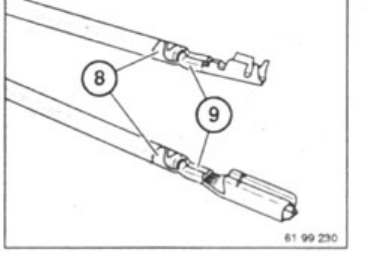


Insert stripped wire end (7) into contact.
Ensure that insulation and stripped wire end seat correctly in the contact.
Squeeze hand pliers as far as stop — the hand pliers unlocks automatically.

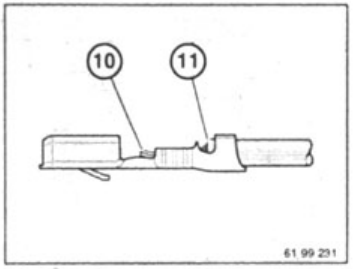


Example:
Contact sleeve 1.5 - 2.5 mm^2 for comb type connector.

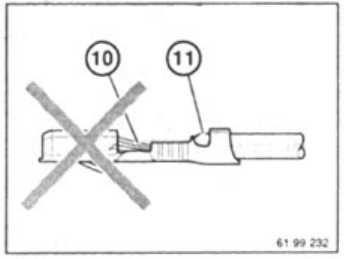
Refer to the instructions supplied with Special Tool 61 9 020 for further information.



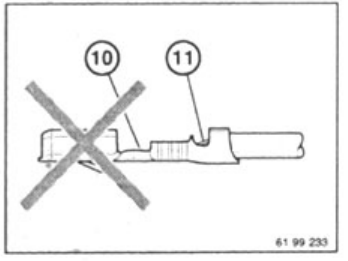
Take contact out of hand pliers.
Check insulation crimp (8) and wire crimp (9) for correct crimping as shown in the this and following figures.



Correct Crimping:
Visible wire end (10).
Visible insulation end (11).

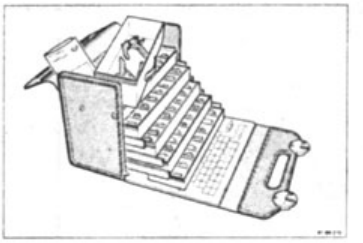


Incorrect Crimping:
Wire end (10) inserted too far.
Insulation end (11) in wire crimp.
If necessary, repeat crimping with a new contact.



Wire end (10) not visible.
Insulation end (11) not visible.
If necessary, repeat crimping with a new contact.

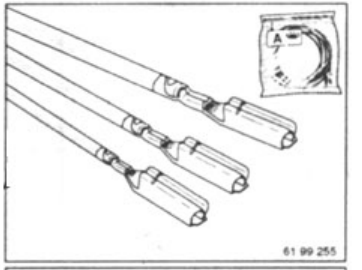
Refer to tbe instructions supplied with Special Tool 61 9 020 for further information.



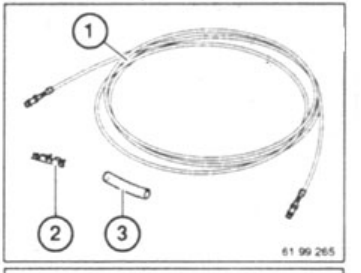
REPAIRING PLUG ON WIRE HARNESS

Ten different sets of tools are provided in Special Tool 61 9 020 for wire harness repairs.

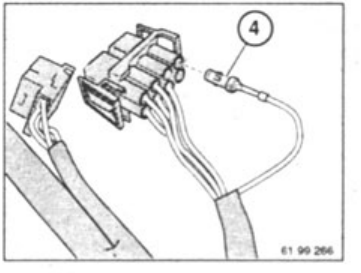
Refer to the instructions supplied with Special Tool 61 9 020 for further information.



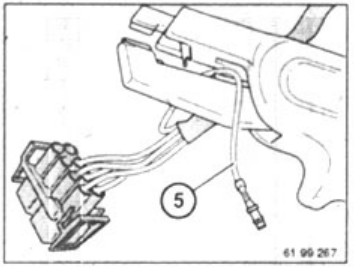
Example:
Repair Set A for contact sleeves on comb type connectors.



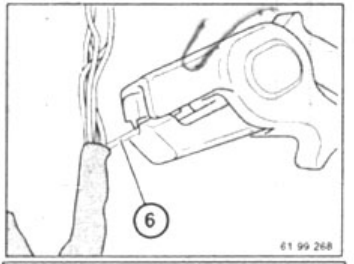
Select repair set and remove following parts.
Prepared wire end in required wire cross section size (1), butt connector for selected wire cross section size (2), shrink-on sleeve (3).



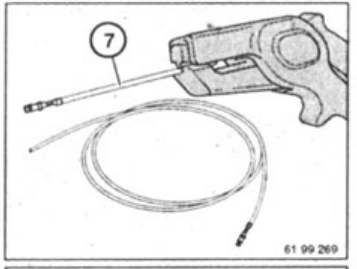
Unlock receptacle, using Special Tool 61 1 150 for this purpose.
Also refer to insructions supplied with Special Tool 61 1 150.
Mark damaged contact (4) with socket number of receptacle and press it out of the receptacle using the pertinent special tool contained in Special Tool 61 1 150.



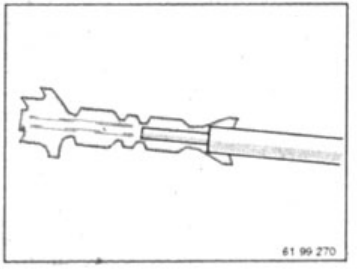
Cut off wire with faulty contact (5) at point which is easily accessible.
Important!
Check maximum length of repair wire!
If more than one wire has to be repaired, the cuts of wire ends must be arranged offset so that the wire harness will not be too thick at the repaired point.



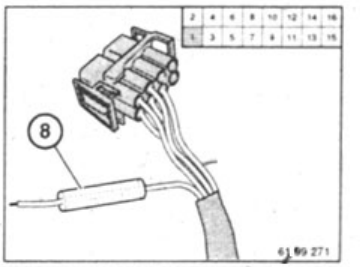
Strip wire harness wire end (6).



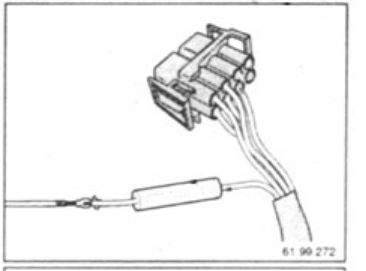
Cut off repair wire (7) to required length and strip end of wire.



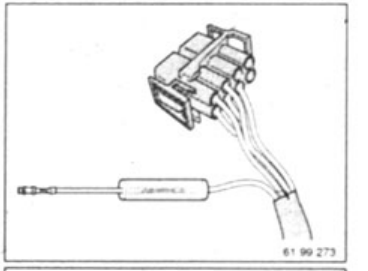
Crimp butt connector on wire harness end.



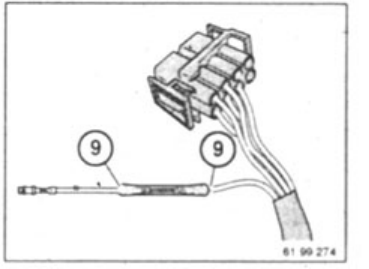
Install shrink-on sleeve (8) on unused wire end.



Crimp unused wire end with butt connector.

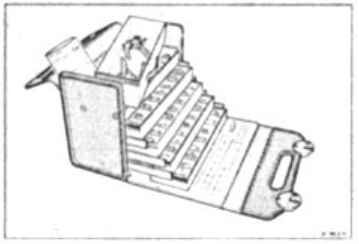


Pull shrink-on sleeve over butt connector.



Shrink the shrink-on sleeve with heat from a hot air blower until cement flows out of both ends (8 and 9) of the shrink-on sleeve uniformly.
Important!
Don't burn the shrink-on sleeve.

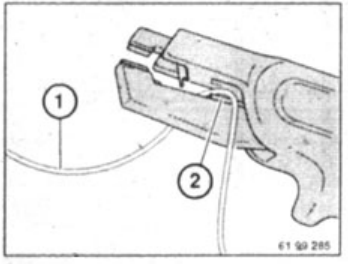
Install contact in receptacle.



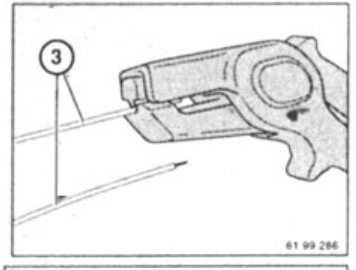
INSTALLING COMB TYPE CONNECTOR FOR SERVICE INSTALLED EQUIPMENT

Comb type connector, required insulating parts and tools are contained in Special Tool 61 9 020.

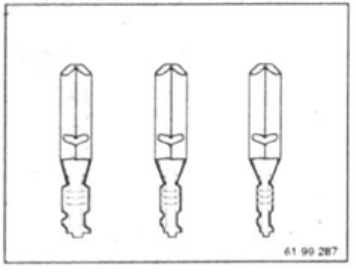
Refer to the instructions supplied with Special Tool 61 9 020 for further information.



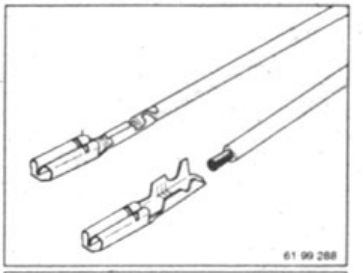
Cut through wire loop in wire harness using Special Tool 61 9 043.



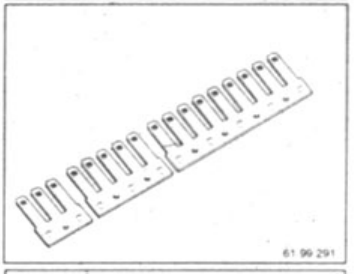
Strip both wire ends.



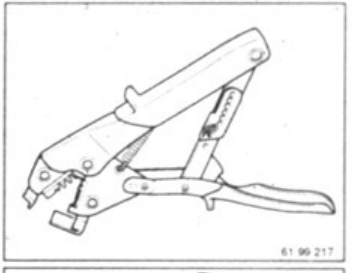
Select contacts to fit wire cross section size.



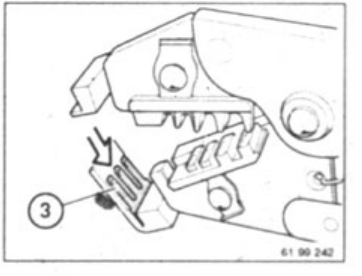
Crimp on contacts using Special Tools 61 9 041 and 61 9 042.



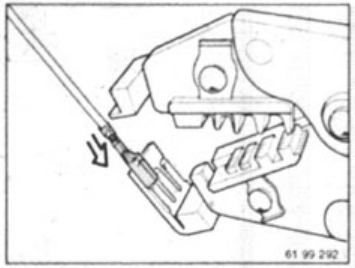
Take comb type connector out of Special Tool 61 9 020 and shorten it to the required number of pins.



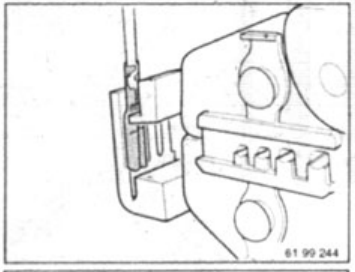
Use Special Tools 61 9 041 and 61 9 042.



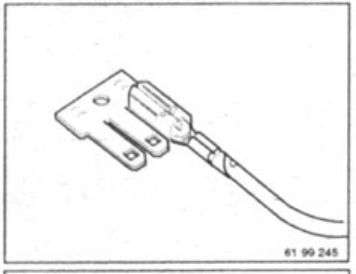
Place sized comb type connector in Special Tools 61 9 041 and 61 9 042.



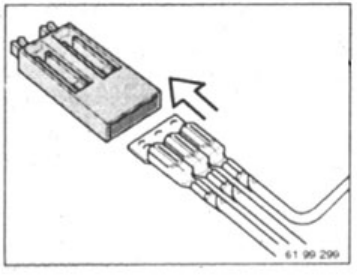
Place wire with contact on comb type connector.



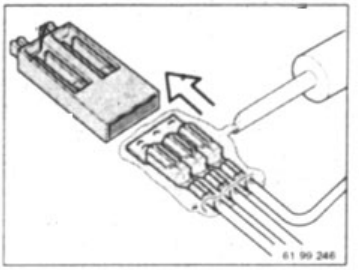
Squeeze special tool and push on contact as far as stop.



Installed comb type connector.



Slide assembled comb type connector into insulation receptacle until it locks.
Mount insulation receptacle on body.



The insulation receptacle must be sealed if it is installed outside of the car's interior compartment.
Seal the receptacle with silicone and mount it on the body.

Refer to the instructions supplied with Special Tool 61 9 020 for further information.



TOOLS FOR WIRE HARNESS REPAIRS OF REPAIR ASSORTMENTS I, II AND III

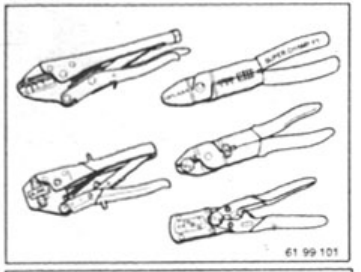
These repair assortments are available from BMW Parts.

Repair assortment for electric system I
Order No. 81 24 9 408 080

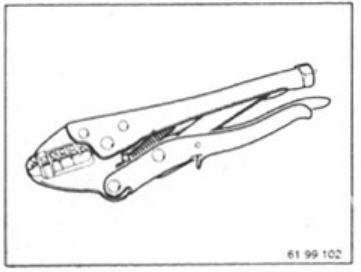
Repair assortment for electric system II
Order No. 81 24 9 408 300

Repair assortment for electric system III
Order No. 81 24 9 408 400

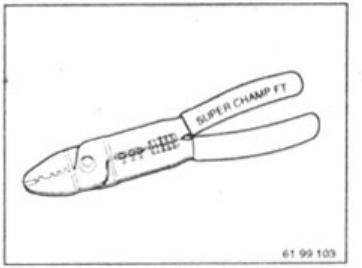
They are primarily required for repairs on models of E 12, E 21, E 23, E 24, E 28 and E 30 Series.



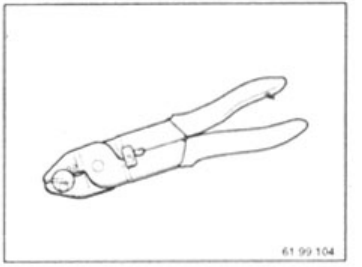
Survey of applied hand pliers in boxes for Electric Systems I, II and III.



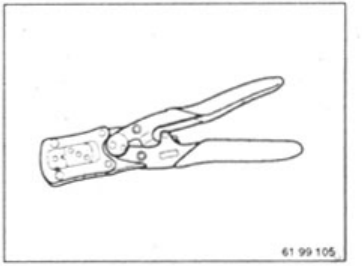
Hand pliers Cimpac II from Electric System Box I
Order No. 81 24 9 408 125



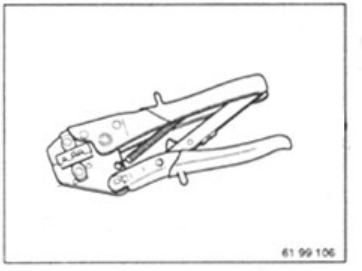
Hand pliers Super Champ FT from Electric System Box I
Order No. 81 24 9 408 126



Hand pliers for ignition lead contacts from Electric System Box I
Order No. 81 24 9 408 127



Hand pliers for "Modu" (electronic contacts) from Electric System Box II
Order No. 81 24 9 408 351



Hand pliers for 2,5 mm contacts from Electric System Box III
Order No. 81 24 9 408 449



Other installation and tool application information:
Operating instructions: Order No. 61 8 084
Wire repairing tool of repair assortments for Electric Systems I, II and III.

Contents of instructions among others:
1 Application of tools
2 Reduced susceptibility to repairs
3 Better repair process

Send orders for operating instructions to:
Cartool GmbH
Alfred Brehm Str. 5
8070 Ingolstadt
Germany

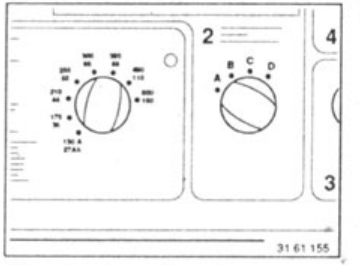
BATTERY HIGH CURRENT TEST
- for Starter Batteries -

Test with Bosch Tester 12 200E*.

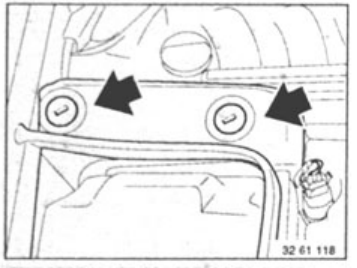


Connect the battery tester and set the cold testing current/rated capacity according to the battery specifications.

There is high current load of approx. 200 A, with electronic evaluation of the voltage curve during and after load.
This test is presently the most dependable method of evaluating the charged condition and physical battey condition (such as cell shorts, sulphatation).

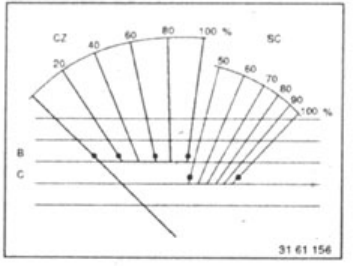


Switch all consumers off.
Switch the ignition off and wait 5 minutes.
Start the test as described in the operating instructions.

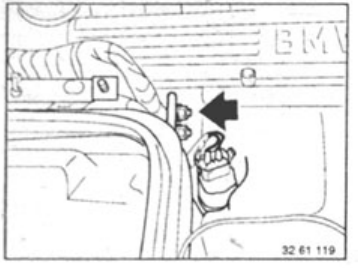


Test Procedures:

Connect the battery tester.
Ground point of engine wire harness at electronic box in front of the engine compartment firewall.
Remove cover.



Only scales B and C are required for the evaluation of batteries.



* Source of Supply: BMW Parts

LIMITS FOR EVALUATION OF ALL BATTERIES (Except Telephone Batteries)

Charged Condition[1]	Starting Power[1]	Test Results		
		OK	Charge	Faulty
Test Step 1 — Before Charging Battery				
Not testable			X	
Less than 50 % [2]			X	
More than 50 %	Less than 75 %		X	
More than 50 %	More than 75 % [3]		X	
More than 80 %	More than 75 %	X		
Test Step 2 — After Charging Battery				
Not testable				X
Less than 50 % [2]	Less than 75 %			X
More than 50 %	More than 75 % [3]		X	

1) Charged condition and starting power must always by evaluated combined

2) Test Charge — Longer than 5 hours with charger Gossen CG 2 or Siemens/Gossen VB 801

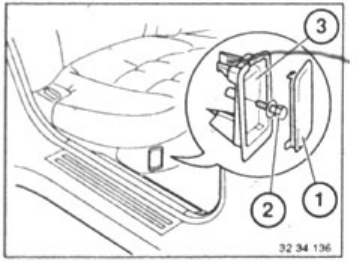
3) Full Charge — Until charged condition is more than 80 %

Note:
If the battery was tested from the positive connection point in the engine compartment, repeat the test direct on the battery to be sure of correct test results.

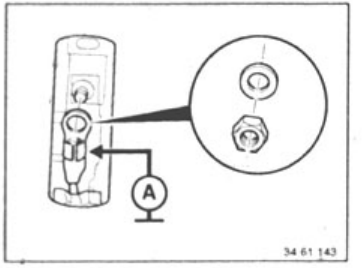
61 20 ... CHECKING BATTERY IN OPEN CIRCUIT CURRENT TEST

If the battery is okay after the high current test, battery discharging could be caused by excessive open circuit current consumption.

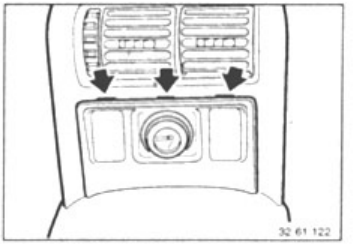
Before Open Circuit Current Test:
Vehicle must have been unused at least 3 hours.
Switch aa consumers off which can be switched off (ignition, inside lights, reading lamps, seat heating, additional heater, additional ventilator, telephone, etc.).
Shut the glovebox, trunk/tailgate lid and engine hood.

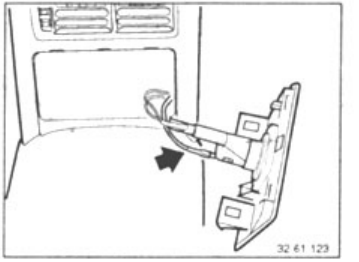


Keep to the following procedures so that possibly seizing relays do not fail.



Connecting Ammeter:
Connect the positive lead of the ammeter to the disconnected ground connection.
Connect the ground lead of the ammeter to the door lock striker.





If the striker is lined with plastic, the cigar lighter ground wire in the rear of the car must be used.
Remove the panel.

Remove the shrink-fit hose on the body end of the battery ground lead (see pictures) for a battery installed underneath the rear seat. Clip on a cable with an alligator clip at this point (Hirschmann AK 2 S clip together with test leads, red = Order No. 61 1 472 and black = Order No. 61 1 474).
Clip a second cable on the striker of the right rear door, or of ground on the rear cigar lighter.

Close, lock and arrest (double-lock) the driver's door, front passenger's door and left rear door.
The right rear door remains open.
Disconnect the battery ground lead with connected alligator clip on the ground connection point carefully 5 minutes after the locking step and bend it away.
Static current now flows only via the multimeter.

Simulation of the closed car by pressing the door contact switch on the striker.
Read static current value on the multimeter.

If the static current is more than

50 mA,

it can be assumed that a hidden consumer is loading the battery.
The hidden consumer can be pinpointed by pulling off fuses, possibly relays and control units one after the other.

When testing and possibly troubleshooting have been concluded, the multimeter must be removed in reverse order of installation so that the memories of the radio, on-board computer and various control units are not cancelled.

Static Current Test in Cars with Burglar Alarm:

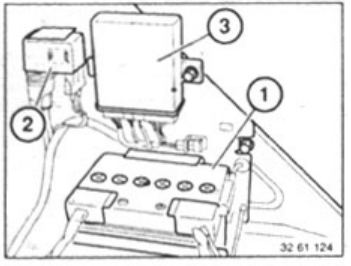
In order to be able to measure the actual static current, the door contact of the open right rear door must be pressed 5 minutes after the locking step.

The door contact must not be released immediately after reading the static current, because then the burglar alarm horn would be active. This excessive current for the selected measuring range of the multimeter could destroy the instrument, but at least the installed fuse.

The ground lead must always be reconnected in reverse order of disconnection, in order to be able to deactivate and unlock the car correctly.

61 20 . . . REMOVING AND INSTALLING ADDITIONAL BATTERY

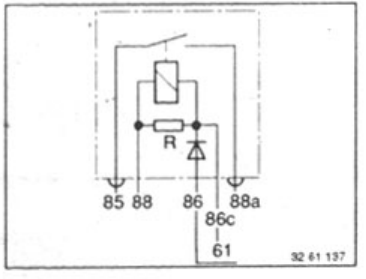
Disconnect ground leads of both batteries.
Remove trim panel on tail panel.
Bend trunk trim panel on right wheel house aside.



1 Additional battery

2 Battery cut-off relay

3 Parked car heating control unit



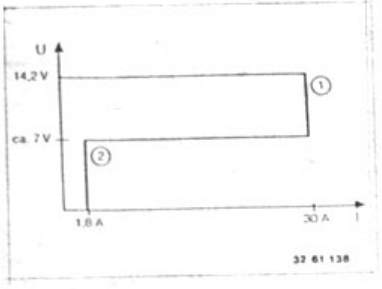
Wiring diagram: battery cut-off relay

61 21 . . . CHARGING BATTERY

Only chargers with the following properties are suitable for charging the battery in the car with connected car power supply.

- Current limitation for strongly discharged batteries (regeneration of slightly predamaged batteries).
- Switchover or shutoff after reaching 14.4 V gassing voltage.
- Direct current voltage with harmonic wave less than 1 V.

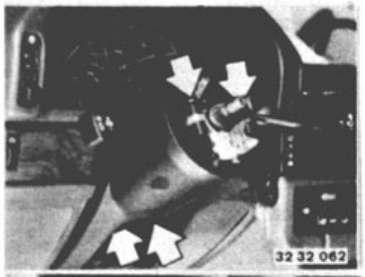
Sample Chargers:
Siemens/Gossen VB 801
Gossen CG32
See voltage/induction charging curve.



Voltage/Induction Charging Curve Shows:

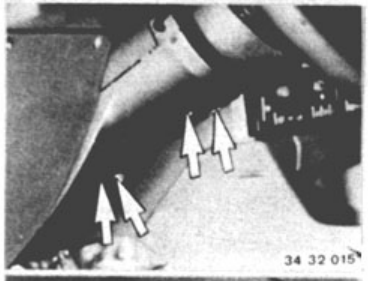
1. Charging with minimum current up to gassing limit voltage of 14.2 V, whereby charging in range of about 13.2 to 14.2 V could last relatively long, because in this limit range charging is with very low current.
2. Charging of strongly discharged batteries with an initial current of approx. 2 A up to a terminal voltage of approx. 7 V, at which maximum charging current cuts in.

Battery chargers without these properties lead to damage in the car.
The battery must be disconnected from the car power supply system when using any other chargers.
Take battery out of the car when charging with non-regulated chargers (see Operating Instructions).



61 31 ... REPLACING ONE STEERING COLUMN SWITCH

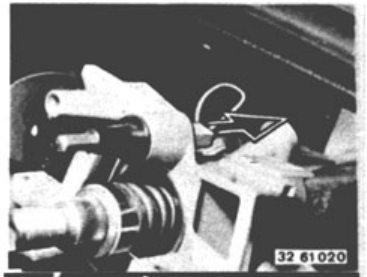
Disconnect battery ground lead.
Remove steering wheel – see 32 33 000.
Remove trim panel for dashboard at bottom left – see 51 45 180.
Unscrew screws and take off lower steering column casing section.



Cars with Airbag:
Unscrew screws and take off lower steering column casing section.



Drive out pin and lift out expansion rivet.
Take off upper steering column casing section.



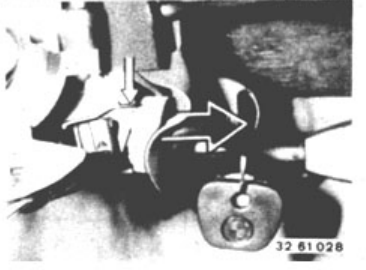
61 31 016 REPLACING TURN SIGNAL/ HEADLIGHT DIMMER SWITCH

Remove casing sections – see "Replacing One Steering Column Switch".
Pull off plug.



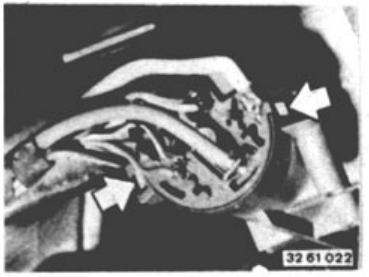
Squeeze locking hooks on both sides and pull out switch.
Disconnect all plug connections.

Installation:
Mount turn signal switch in turn signal indicating position and then install the steering wheel.



61 31 018 REPLACING CRUISE CONTROL SELECTING SWITCH

Remove casing sections - see "Replacing One Steering Column Switch".
Press down on lever and pull out switch.
Disconnect plug.

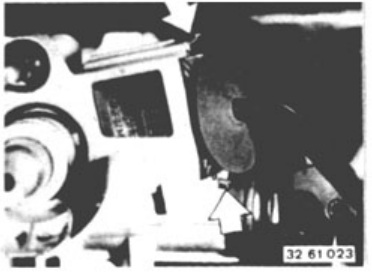


61 31 020 REPLACING IGNITION SWITCH

Remove casing - refer to "Replacing One Steering Column Switch".
Compress retainers on both sides and pull out switch.
Disconnect plug.

Important!
After installation carry out mechanical (lock cylinder) and electric (e.g. ignition, radio, etc.) tests.

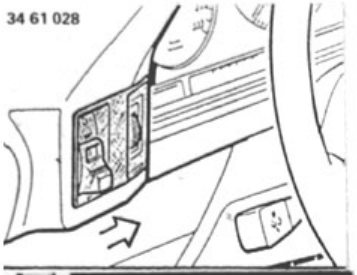
Installation:
Check position of ignition switch to steering wheel lock and turn signal switch to steering wheel.



61 31 040 REPLACING WIPER SWITCH

Remove casing - refer to "Replacing One Steering Column Switch".
Compress retainers on both sides and pull out switch.
Disconnect plug.

Installation:
Check position of turn signal switch to steering wheel.



61 31 028 REPLACING LIGHT SWITCH

Push switch frame to the right and press in locking hook with a 1.0 mm thick feeler gage blade.



Remove switch frame.



Pull off plug.
Press switch forward out of the switch frame.

Installation:
Press in locking hooks with a feeler gage blade and engage switch frame in the dashboard.

61 31 070 REPLACING SWITCH FOR FRONT FOG LAMPS

See "Replacing Light Switch" in 61 31 028.

61 31 ... REPLACING SWITCH FOR DIMMING INSTRUMENT LIGHT

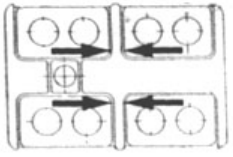
See "Replacing Light Switch" in 61 31 028.

61 31 ... REPLACING SWITCH FOR HEADLIGHT VERTICAL AIM CONTROL

See "Replacing Light Switch" in 61 31 028.

61 31 051 REPLACING SWITCH FOR HEATER BLOWER

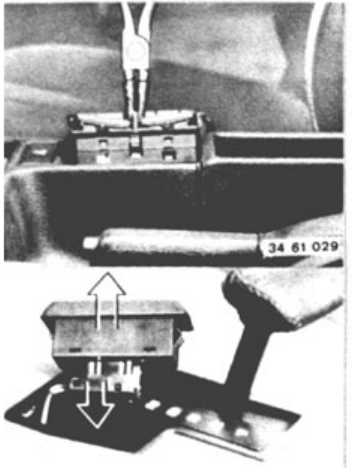
See "Replacing Heater Controls" in 64 11 200.



34 61 027

61 31 115 REPLACING SWITCH FOR POWER WINDOWS

Wrap adhesive tape around a round-edged pliers.
Apply round-edged pliers on left and right sides of the middle bar and pull up on left and right sides separately to pull out the switch.



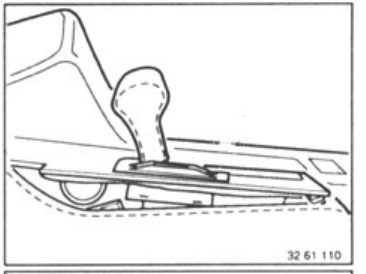
32 25 010

Note:
Operate switch so that it will be easier to apply the round-edged pliers.

61 31 265 REPLACING PROGRAM SWITCH FOR TRANSMISSION CONTROL (EH)

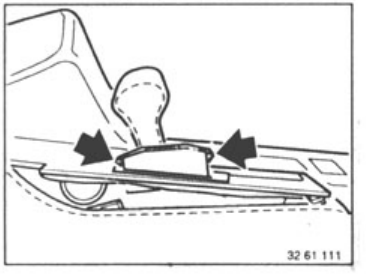
Testing – see BMW Test Plan in Gr. 24.

Checking:
Program switch is moved to positi with the ignition "ON".



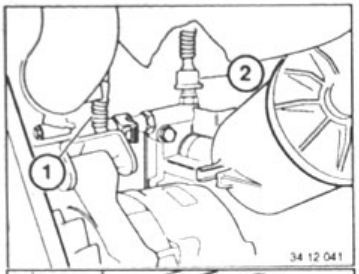
32 61 110

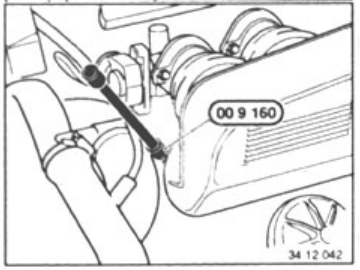
Pry out wood ornament on center console.



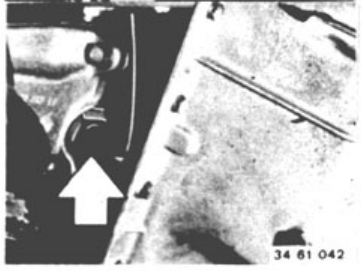
32 61 111

Press out switch.
Pull off plug.









61 31 280 REPLACING OIL PRESSURE SWITCH

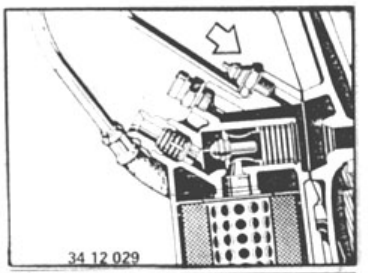
S 38:
Oil pressure switch (1) is on base of the oil filter.
Unscrew oil filter cover to have the oil in the oil filter flow back into the oil pan.
Pull off plug.

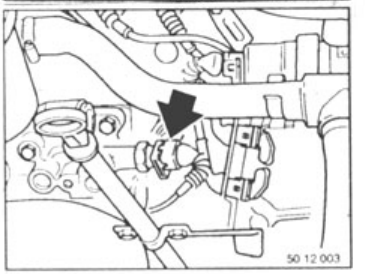
Unscrew switch.

Installation:
Tighten oil filter cover.
Install switch.

M 30:
Unscrew coolant expansion tank.
Remove oil pressure switch.

M 20:
Remove engine splash guard – see Group 11.
Pull off plug.
Remove oil pressure switch.

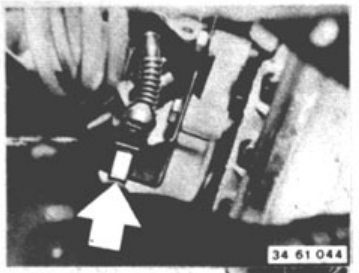




M 21:
Pull off plug.
Remove oil pressure switch.

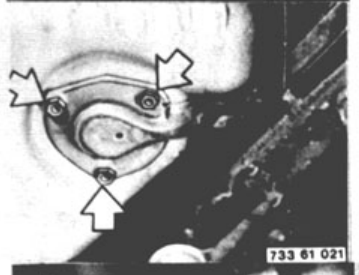
M 50:
Unscrew oil filter cover to have the oil in the oil filter flow back into the oil pan.
Unscrew switch.

Installation:
Tighten oil filter cover.
Install switch.

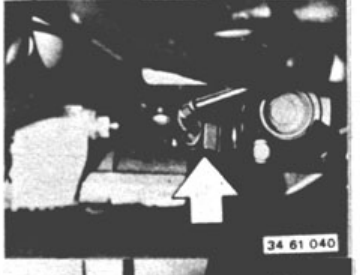


61 31 282 REPLACING ENGINE OIL LEVEL SWITCH

M 30 and S 38:
Drain engine oil.
Disconnect plug on engine carrier.

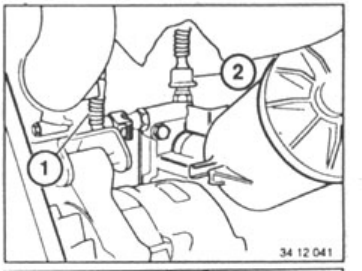


Unscrew screws.
Remove switch.



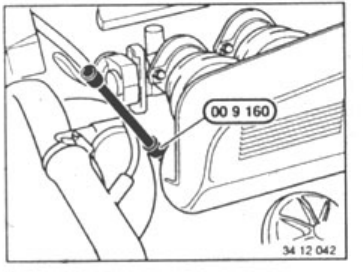
M 20:
Disconnect plug between engine block and alternator.
Unscrew screws.
Pull out switch.



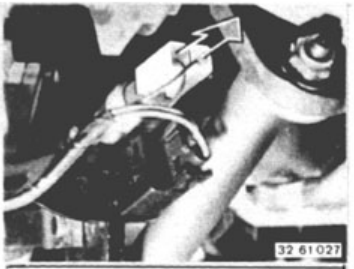


61 31 . . . REPLACING OIL TEMPERATURE SENDER

S 38:
Oil temperature sender (2) is on base of the oil filter.
Unscrew oil filter cover to have oil in the oil filter flow back into the oil pan.
Pull off plug.
Remove sender with Special Tool 00 9 160.

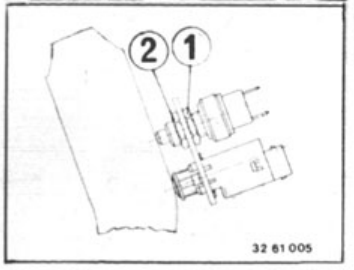


Installation:
Tighten oil filter cover.
Install sender.

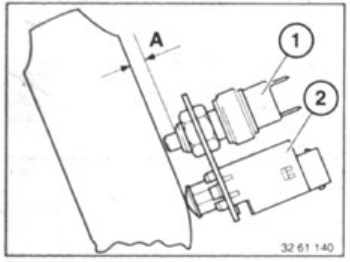


61 31 300 Replacing brake light test switch

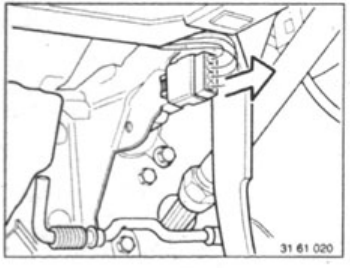
Remove dashboard trim panel at bottom left - 51 45 180.
Remove cable plug.
Remove cover.



Unfasten nut (1), unscrew nut (2) and draw test switch backwards.



Installation:
Brake pedal in rest position.
Adjust brake light test switch.
Dimension A = 5.5 - 6.0 mm
1 = Brake light test switch
2 = Brake light test switch
3 = Brake pedal (in rest position)

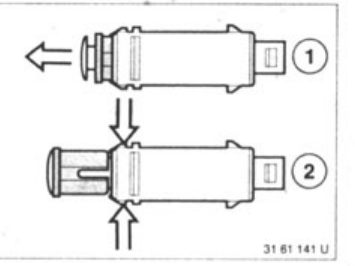


Note:
In cars whose switch has a 4-pin plug housing, the brake light switch and the brake light test switch share the same housing.
Adjustment as per 61 31 310.



61 31 310 Replacing brake light switch

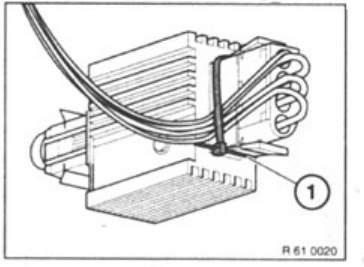
Remove dashboard trim panel at bottom left - 51 45 180.
Remove cable plug.



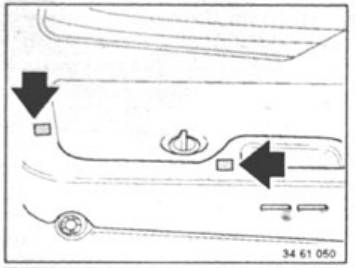
Depress brake pedal.
1 Pull tappet and sleeve straight forwards.
2 Press together retaining clips and pull switch backwards.

Installation:
Install switch as shown in 2,
Adjustment is performed automatically.
Release pedal slowly to neutral position.

Caution!
Adjustment of the switch can be changed if brake pedal springs back.
Check function.

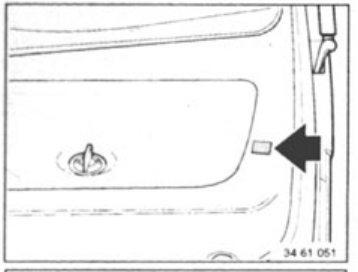


Caution!
On vehicles with electronic brake light switch (identified on radiator fins), always tie back lines to switch with cable clip (1).

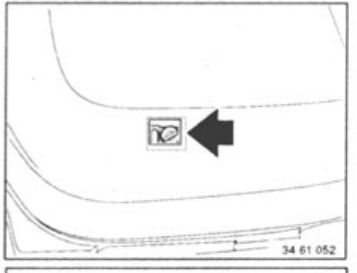


61 31 350 REMOVING AND INSTALLING / REPLACING TAILGATE GRIP MICROSWITCH

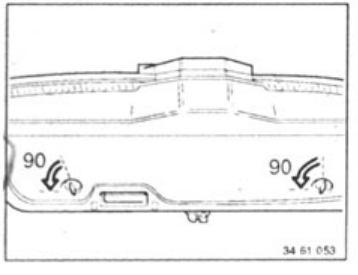
Remove the tailgate trim panel.
Unclip caps of screws.



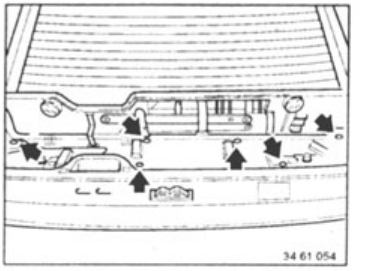
Unclip cap of screws.



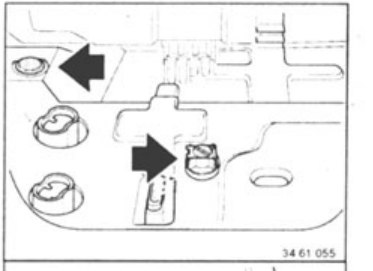
Unscrew screws.



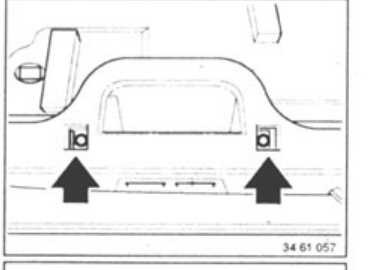
Open the toolbox.



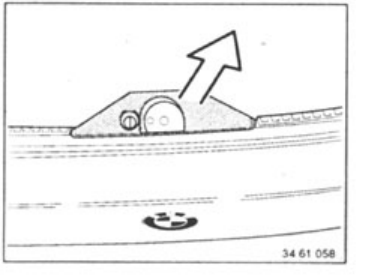
Remove clips.



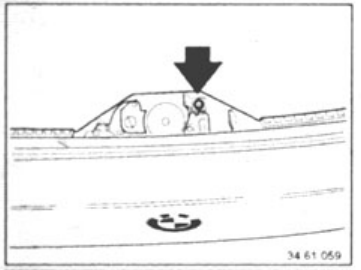
Unscrew left and right screws.



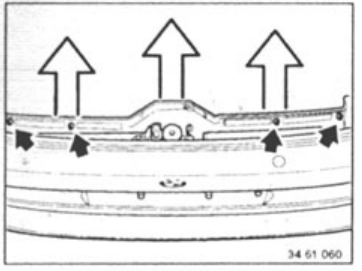
Unscrew screws.



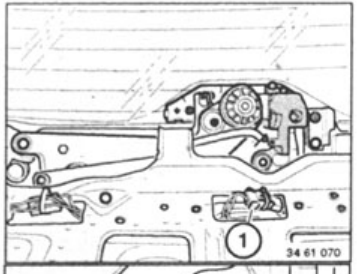
Shut the tailgate.
Unscrew cap of the wiper crank.



Unscrew screw.

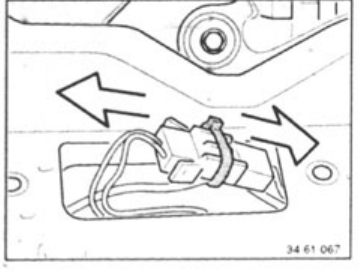


Take the trim panel out of the clips carefully.
Shut the tailgate.

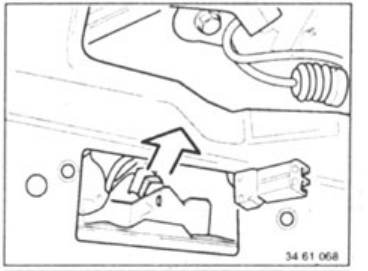


Tailgate Survey:

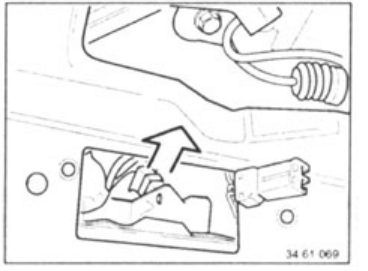
Disconnect plug (1).



Loosen the wire strap.
Disconnect the plug.

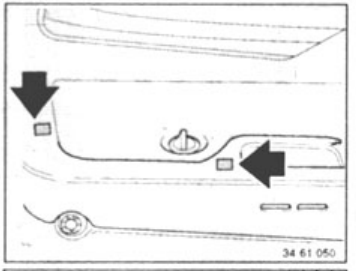


Push the retainer back.



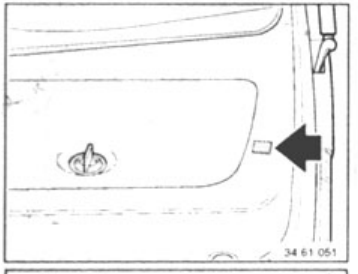
Remove the switch.

Installation:
Check the installed position of the microswitch.
Check function.

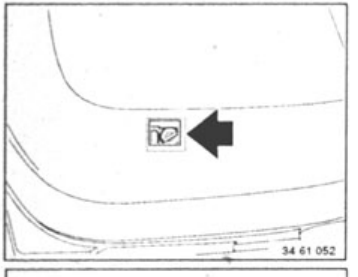


61 31 352 REMOVING AND INSTALLING / REPLACING TAILGATE LOCK (LOCK CYLINDER) MICRO-SWITCH

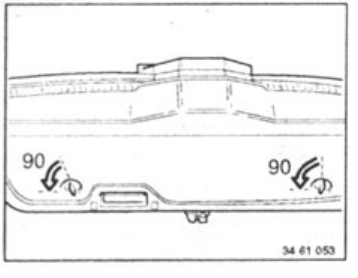
Remove the tailgate trim panel.
Unclip caps of screws.



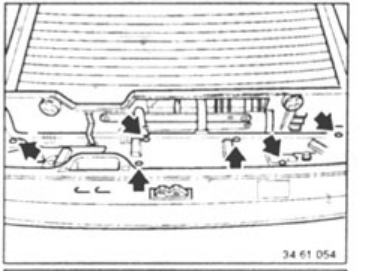
Unclip cap of screws.



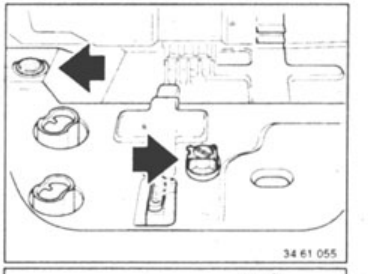
Unscrew screws.



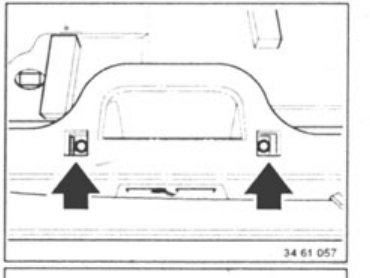
Open the toolbox.



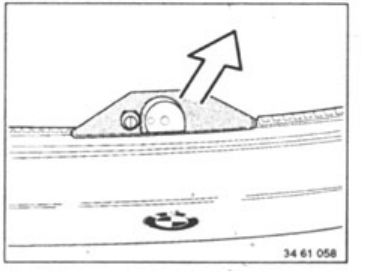
Remove clips.



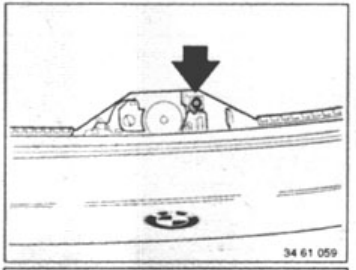
Unscrew left and right screws.



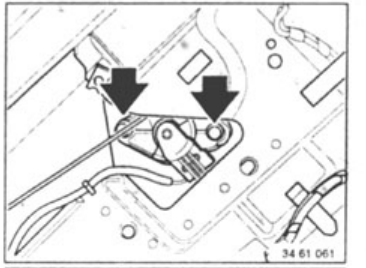
Unscrew screws.
Unscrew screws of the grip recess plate.



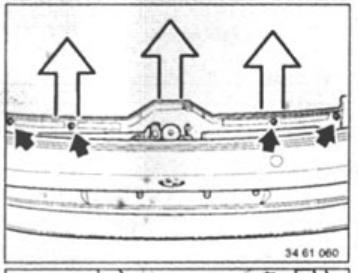
Shut the tailgate.
Unscrew cap of the wiper crank.



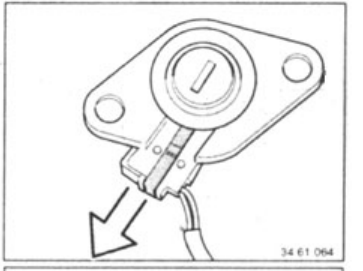
Unscrew screw.



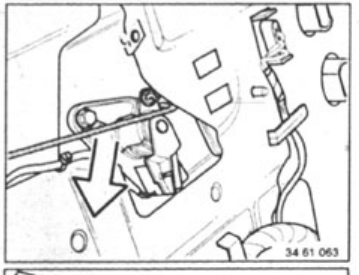
Unscrew screws.
Tightening torque*.



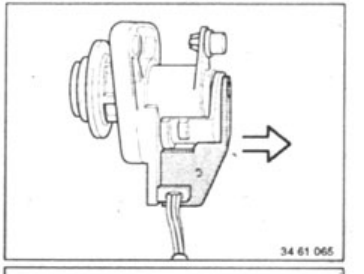
Take trim panel out of the clips carefully.



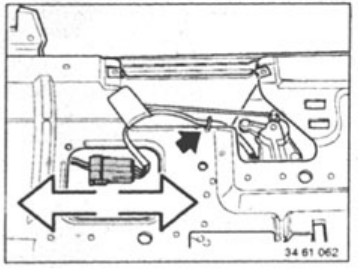
Push the retainer back.



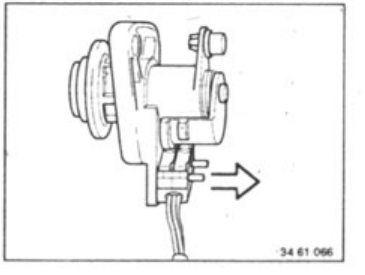
Disengage the linkage.



Remove cap.

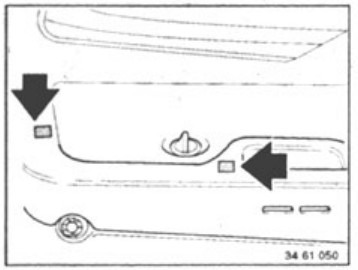


Loosen the wire strap.
Disconnect the plug.



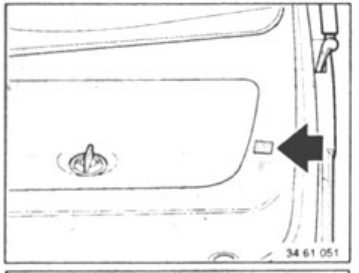
Installation:
Check the installed position of the micro-switch.
Check function.

* Refer to Specifications

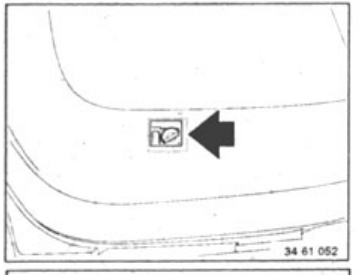


61 31 355 REMOVING AND INSTALLING / REPLACING TAILGATE WINDOW LOCK MICROSWITCH

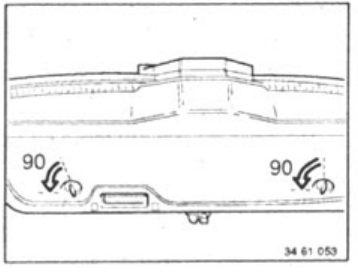
Remove the tailgate trim panel.
Unclip caps of screws.



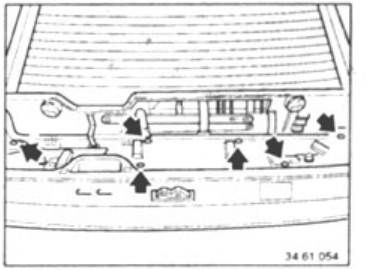
Unclip cap of screws.



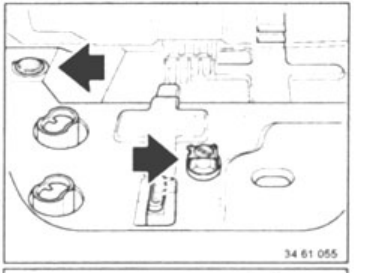
Unscrew screws.



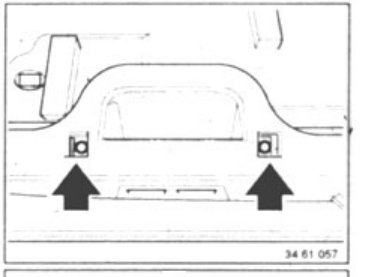
Open the toolbox.



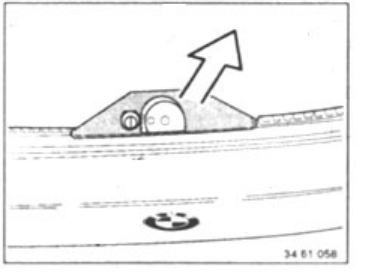
Remove clips.



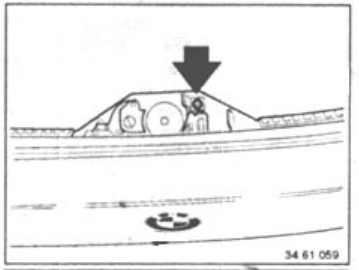
Unscrew left and right screws.



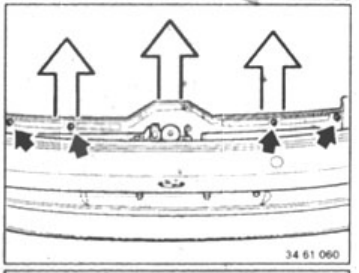
Unscrew screws.
Unscrew screws of the grip recess plate.



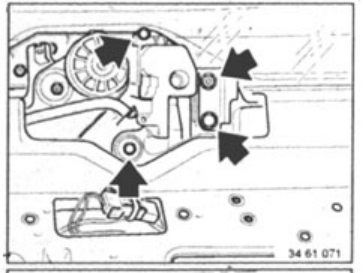
Shut the tailgate.
Unscrew cap of the wiper crank.



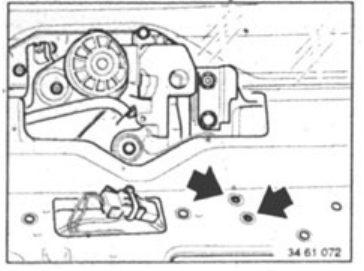
Unscrew screw.



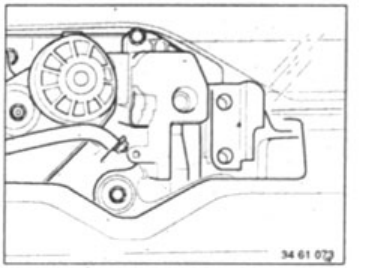
Take trim panel out of the clips carefully.



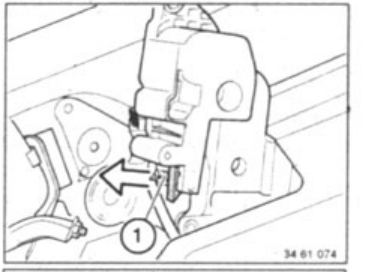
Unscrew screws.



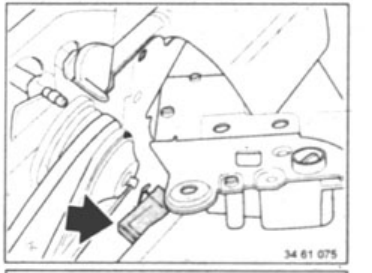
Unscrew screws of the support.



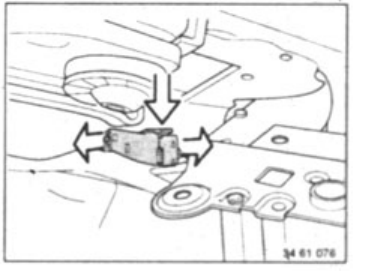
Support removed.



Press the retaining hook back.
Loosen the wire strap.
Remove microswitch (1).

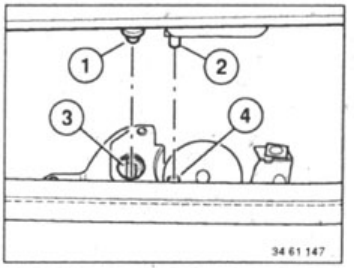


Disconnect the plug.

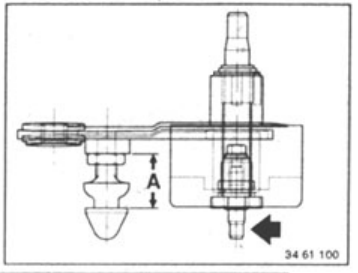


Disconnect the plug.

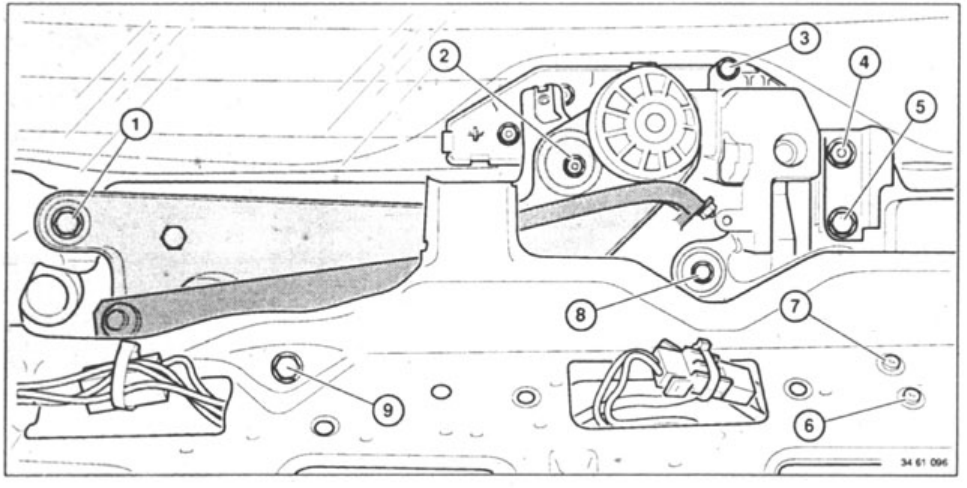
Installation:
Check the installed position of the micro-switch.
Check function.



Installation:
Lockpin (1) of the tailgate window lock and crankpin (2) of the wiper must engage in lock (3 and 4) of the tailgate.

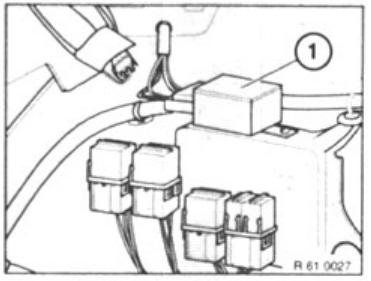


The lockpin of the tailgate window lock must be adjusted to a depth distance A = 20.5 mm so that the crankpin of the wiper arm will engage deep enough in the opening of the output disk.



Unscrew screws (1 ... 9).
Shut the tailgate window.
The lockpin should be adjusted to correct depth!
Tighten screws (1 ... 9).
Tightening torque*.
Check the wiped zone.
Check function.

* Refer to Specifications



61 31 437 Removing and installing or replacing wipe/wash control unit for rear window

Remove wheel arch trim from right side of trunk, refer to 51 47 161.

Remove control unit (1).

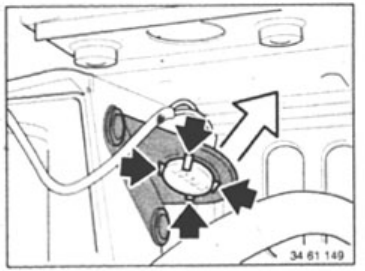
61 31 440 REMOVING AND INSTALLING REPLACING TEMPERATURE SWITCH FOR HEATED WINDSHIELD SPRAY NOZZLES

Description of Operation:
The temperature switch is series connected with the heated spray nozzles.
ON temperature: 2 to 10° C
OFF temperature: 8 to 16° C

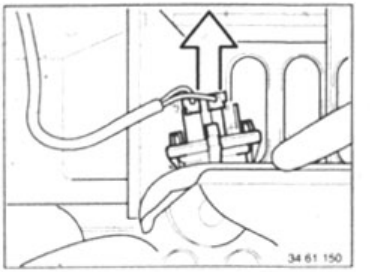
When Troubleshooting:
Switch is open most of the time as the ambient temperature is usually higher than 16° C.
Application of cold spray will very seldom cause switching on, as a reaction time of several minutes is acceptable.

Remove front bumper - refer to Group 51.

Location:
Below impact absorber on right-hand side of car.



Unclip switch in holder.

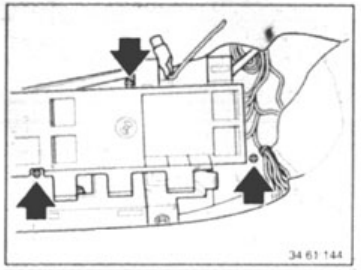


Disconnect plug.

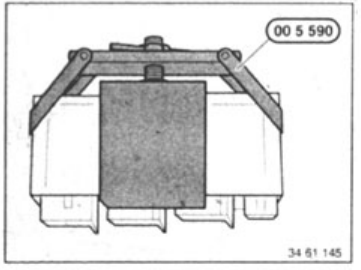
Additional information:
wiring diagrams for E 34 models.

61 31 470 REPLACING RELAYS/MODULE (UNDER REAR SEAT)

Interrogate the fault memories.
Disconnect the battery.
Remove the rear seat cushion - refer to Group 52.



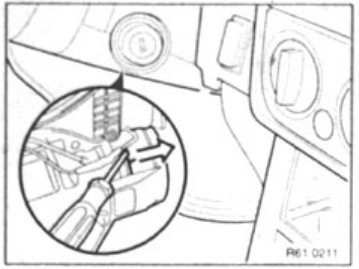
Unscrew screws.
Remove the cover.



Apply Special Tool 00 5 590.
Pull the module off.

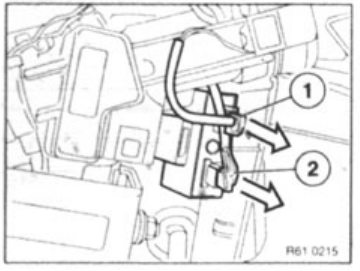
Removed in this picture.

Caution!
If the battery is not disconnected, wrong equipment versions will be stored taking the basic module as an example.
In this case some special equipment would not be recognized.
For example, the power window regulators would not work.

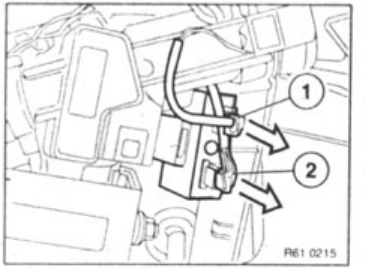


61 35 900 Removing and installing or replacing ring antenna of electronic vehicle immobilizer

Remove steering column shroud at bottom.
Unclip ring antenna.

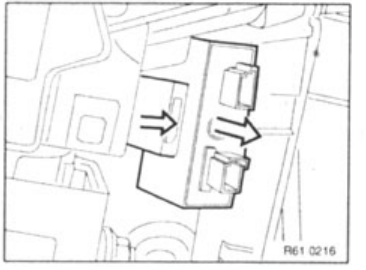


Disconnect plug connector (1) and remove ring antenna.

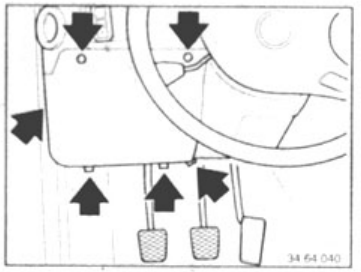


61 35 905 Removing and installing or replacing transceiver module of electronic vehicle immobilizer

Remove steering column shroud at bottom.
Disconnect plug connectors (1 and 2).

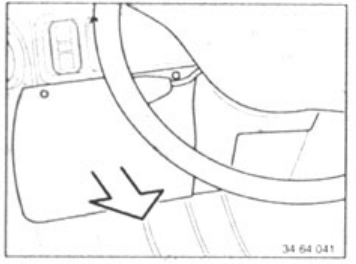


Press clip towards module and remove module by pulling downward.

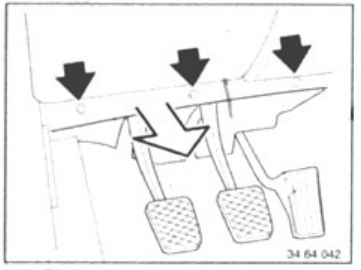


61 35 910 Removing and installing or replacing control unit for electronic vehicle immobilizer

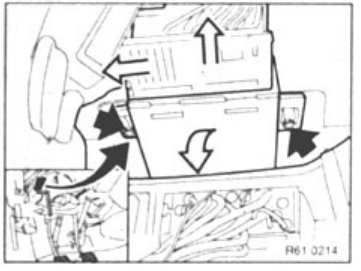
Remove plug.
Release screws.



Detach trim panel.
Remove knee guard if necessary. (US)



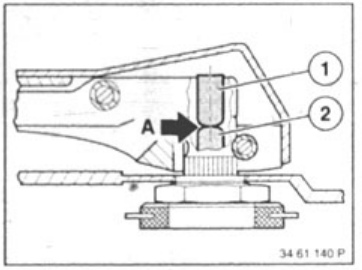
Release screws.
Detach trim panel.



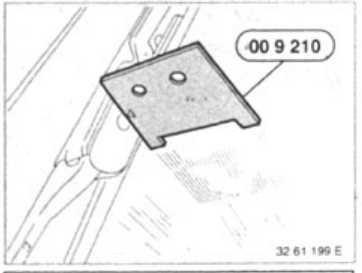
Disconnect plug connector, release screws and remove control unit.

61 61 . . . Adjusting or checking windshield wiper arm angle of contact on windshield

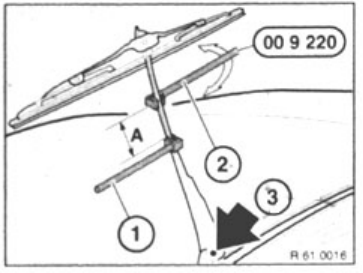
The approach angle of the wiper arm on the front windshield is the principal determining factor for wipe quality during intermittent operation and wipe quality at low roadspeeds.



For cars with contact pressure adjustment, the clearance between adjusting screw (1) and tappet (2) must be A = 0 - 0.2 mm when the ignition is switched off and the wiper blade is fitted.

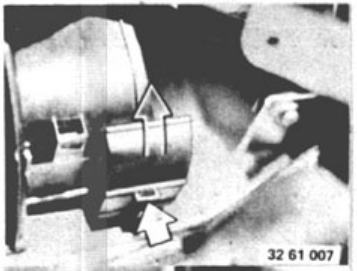


Special tool 00 9 210.
(Latest version is gray in color and has two holes).
Fit to the fulcrum point of the blade on the windshield.
Point of windscreen glass application and vehicle designation are provided on the special tool.



If the approach angle is incorrect, the wiper arm must be turned to its correct position using special tool 00 9 220.
Procedures:
Select largest possible distance "A" between special tool 1 and special tool 2.
Brace special tool 1 to ensure that no stress is applied to joint 3 while being bent.
Twist special tool 2.

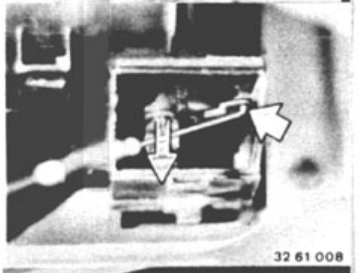
Check function.



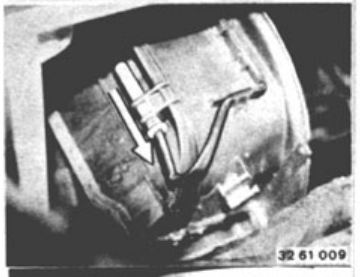
61 61 270 REMOVING AND INSTALLING COMPLETE WIPER CONSOLE

Run wipers to parked position.
Remove heater blower - refer to 64 11 . . ..
Take off cover.

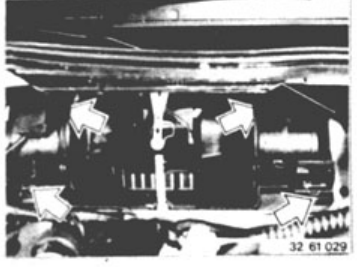
Important!
Set air volume control wheel to zero and switch ignition on and off before disconnecting cable in order to have the drive motor close the ventilation flaps.



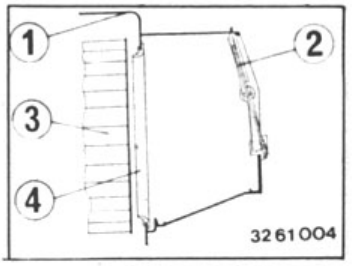
Disconnect battery ground lead.
Disconnect cable completely.
Lift out linkage carefully.



Pull off temperature sensor.

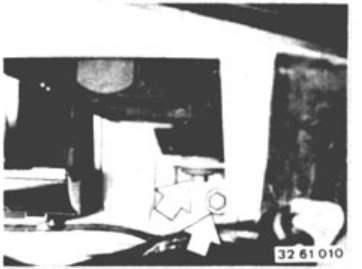


Remove retainers, lift cover slightly and remove inlet cowls on left and right sides.
Then remove cover.

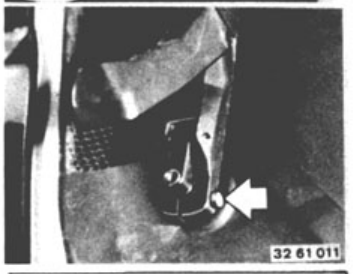


Installation:
Check installed direction of inlet cowls.

1 Housing
2 Fresh air flap
3 Blower wheel (not yet installed)
4 Inlet cowl

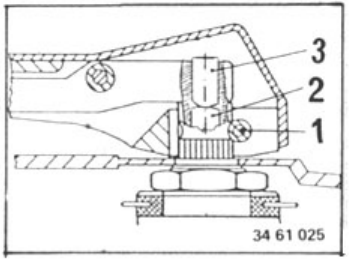


Unscrew screws.



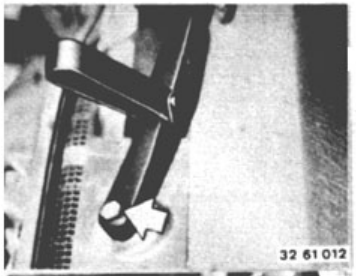
Unscrew wiper arms.

Left Wiper Arm:
Fold up cover, unscrew screw and take off wiper arm, widening the gap with a screwdriver if necessary.



Installation:
Press on wiper arm fully as otherwise wiper contact force regulation will not work correctly.
Tighten screw (1) to specified torque*.
Screw in stud (3) as far as pin (2) until there is no longer play.
In cars without wiper contact force regulation tighten wiper arm nut to specified torque*.
Wait 15 minutes and tighten again to specified torque*.

* Refer to Specifications

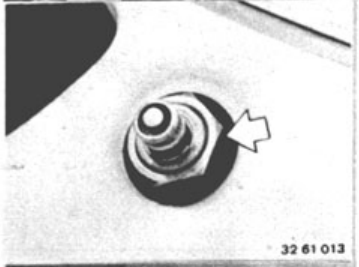


Right Wiper Arm:
Fold up cover, unscrew nut and take off wiper arm.

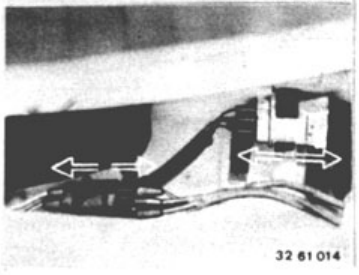
Installation:
Tighten wiper arm nut to specified torque*. Wait 15 minutes and tighten again to specified torque*.



Lift out retainers and remove cover.

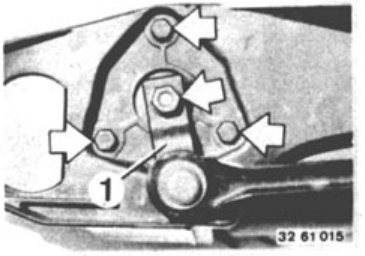


Unscrew nuts on both wiper shafts and pull down on wiper linkage.



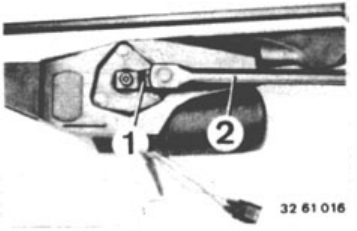
Disconnect plug and lift out complete wiper console.

* Refer to Specifications

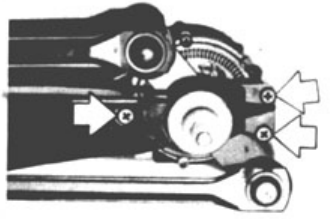


Removing Wiper Motor:
Unscrew bolts and nut.

Note:
Mark position of motor shaft to wiper linkage (1) when reinstalling the same motor.

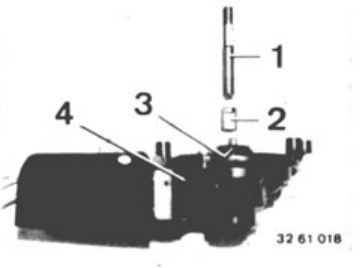


Installation:
Connect motor briefly and run to neutral position (wipers parked) when installing a new motor.
Align parts (1 and 2) of wiper linkage that they are in a straight line and then install the motor.



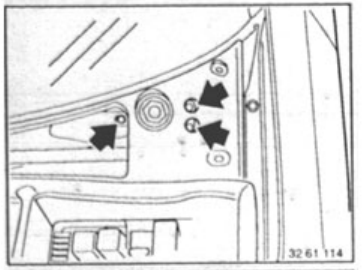
Removing Wiper Contact Force Regulating Motor:
Unscrew bolts and remove motor.

Installation:
Always only replace the wiper contact force regulating motor complete, as precise adjustment is not possible. Exchange motors are supplied adjusted.

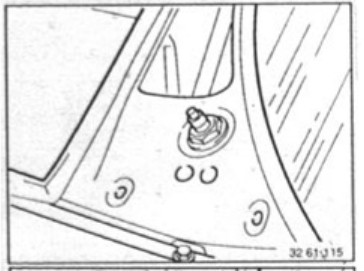


61 61 285 REMOVING AND INSTALLING OR REPLACING WIPER CONTACT PRESSURE CONTROL MOTOR

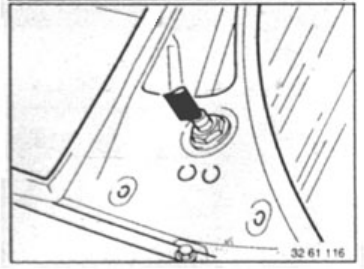
Remove left and right wiper arms.
Unscrew left trim panel.

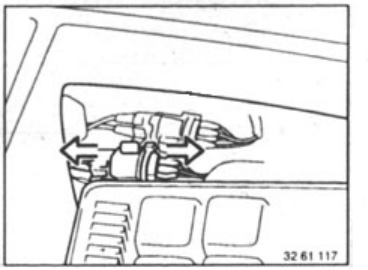


Unscrew screws.



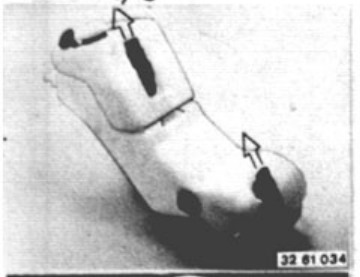
Pull out plunger of contact pressure control system with a magnet and hold it with adhesive tape.





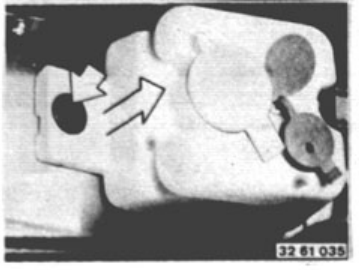
Disconnect white plug.
Unclip wires in holder on cover of contact pressure control motor.

Remove wiper contact pressure control motor.
Cancel fault memory.
Check function after installation.



61 67 000 REPLACING WASHING FLUID TANK FOR HEADLIGHT CLEANERS

Drain tank.
Lift out pumps with hoses and leads (shown on removed tank in picture for better understanding).

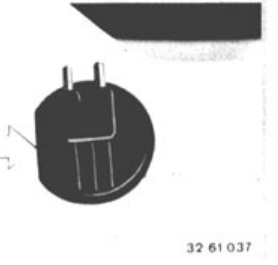


Unscrew screw and lift tank.
Pull off leads on level switch and lift out tank.



61 61 ... REPLACING LEVEL SWITCH

Drain tank.
Pull off electric leads on level switch.
Lift out switch.



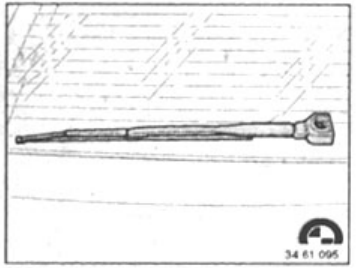
Installation:
Check that switch is positioned correctly.

61 62 ... DESCRIPTION OF TAILGATE WINDOW WIPER OPERATION

The wiper has two modes of operation.

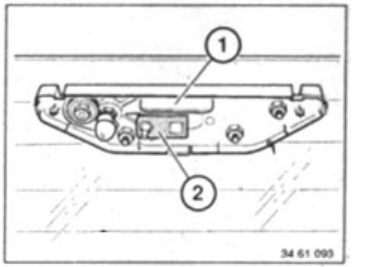
1. Intermittent function for tailgate window wiper.
2. Tip function: automatic washing of tailgate window.
   Washing fluid is sprayed onto the tailgate window and the wiper is switched on.

Wiper operation is interlocked when the tailgate window is opened.
In the tailgate window lock there is a microswitch which is operated by the lockpin of the tailgate window.
The washing function is accomplished with help of a stroke-type nozzle.

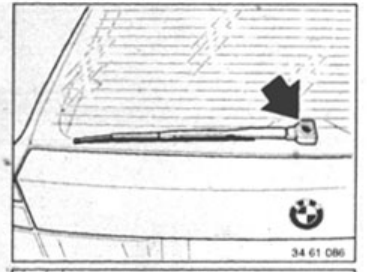


61 62 004 ADJUSTING WIPED ZONE OF TAILGATE WINDOW WIPER

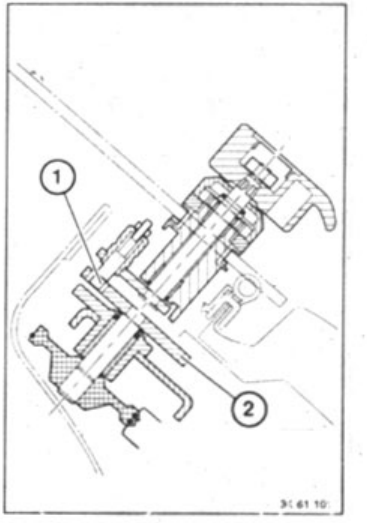
Let the wiper run to parked position.
Parked position = wiper arm parallel to the heating wires.
Switch the wiper off.
Switch the ignition off.



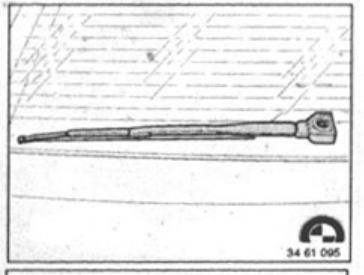
Parked position of wiper shaft mount: crank (2) must bear on stop (1).



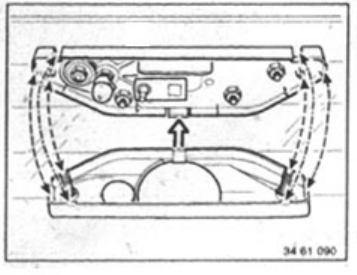
Unclip cap of screw.



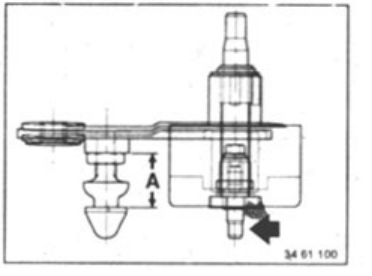
Side Section View of Assembly:
1 Spring-loaded crankpin in wiper shaft mount to take the wiper arm
2 Output disk of wiper motor



Unscrew screw.
Tightening torque*.
Correct the parked position.
Parked position = wiper arm parallel to the heating wires.
Check the function.
If it is not possible to adjust the wiped zone, the console of the tailgate window wiper must be adjusted.
Continue with the following steps.



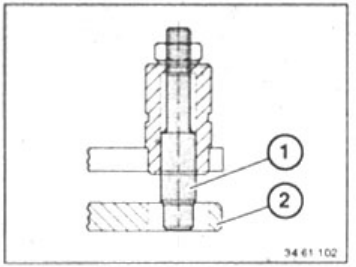
Open the tailgate window.
Unclip cap of the wiper shaft mount.



Side View of Wiper Shaft Mount

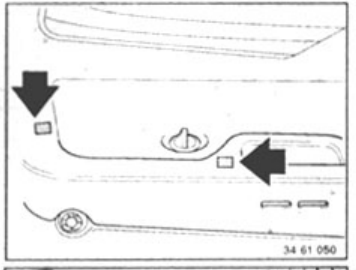
Shown removed in this picture.

* Refer to Specifications

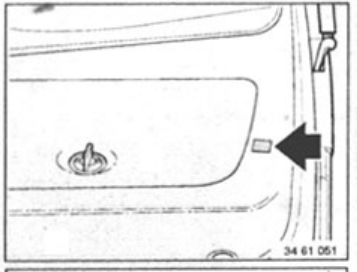


Crankpin (1) must engage in output disk (2) of the wiper motor.

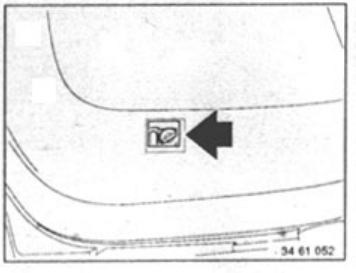
Important!
Crankpin (1) must not protrude beyond output disk (2)!
Adjustments are made on the lockpin of the tailgate window lock.



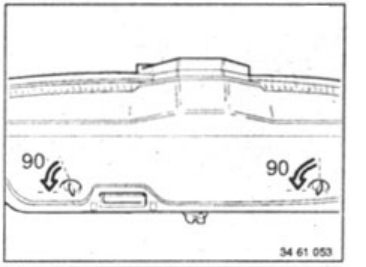
Remove the tailgate trim panel.
Unclip caps of screws.



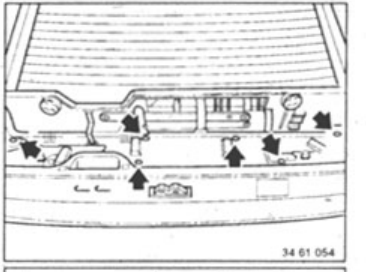
Unclip cap of screws.



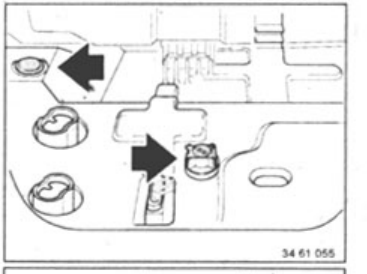
Unscrew screws.



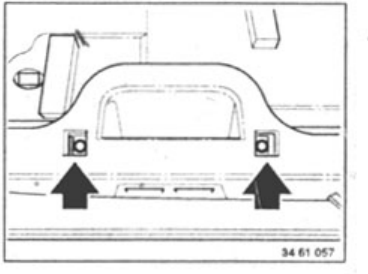
Open the toolbox.



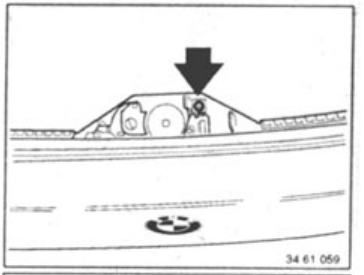
Remove clips.



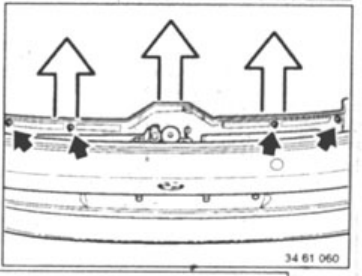
Unscrew left and right screws.



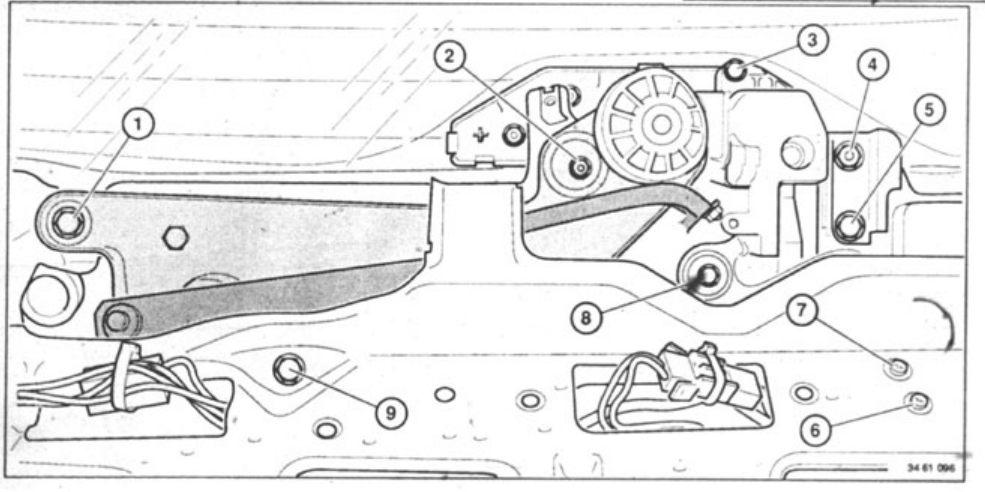
Unscrew screws.
Unscrew screws of the grip recess plate.



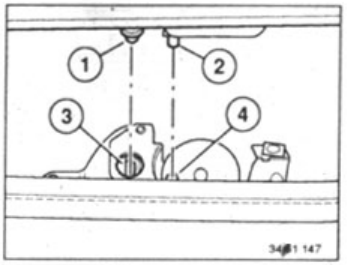
Shut the tailgate.
Remove the motor crank cover.
Unscrew screw.



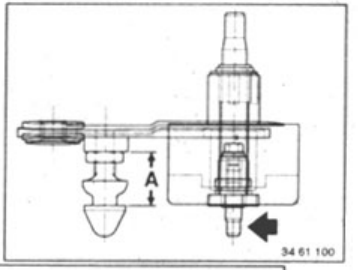
Take trim panel out of the clips carefully.
Remove the trim panel.



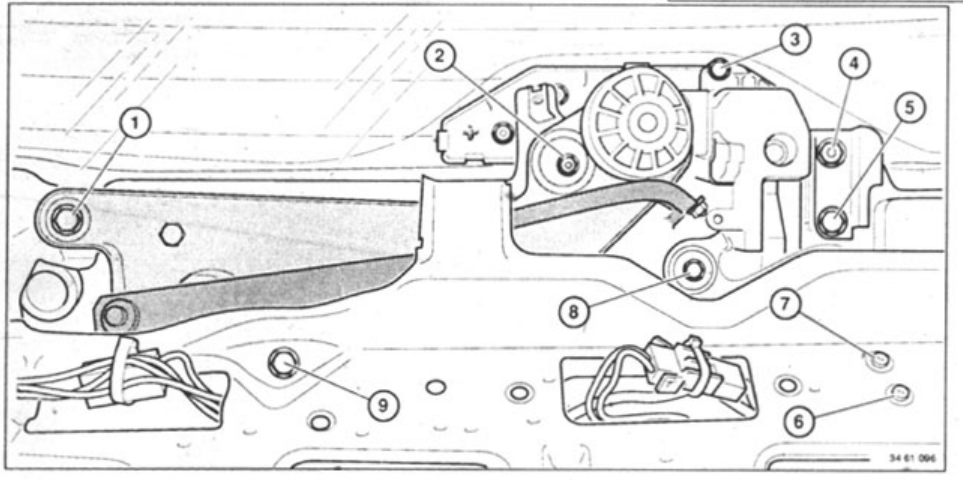
Unscrew screws of the console.
Shut the tailgate window.



Installation:
Lockpin (1) of the tailgate window lock and crankpin (2) of the wiper must engage in lock (3 and 4) of the tailgate.

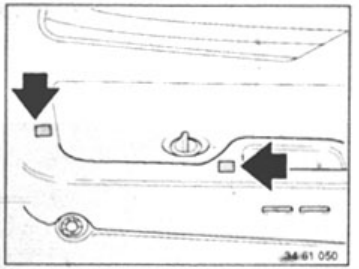


The lockpin of the tailgate window lock must be adjusted to a depth distance A = 20.5 mm so that the crankpin of the wiper arm will engage deep enough in the opening of the output disk.



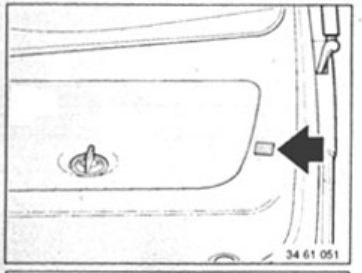
Unscrew screws (1 ... 9).
Shut the tailgate window.
The lockpin should be adjusted to correct depth!
Tighten screws (1 ... 9).
Tightening torque*.
Check the wiped zone.
Check function.

* Refer to Specifications

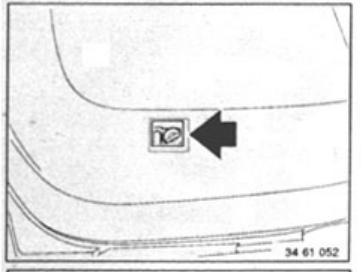


61 62 060 REMOVING AND INSTALLING / REPLACING TAILGATE WINDOW WIPER MOTOR

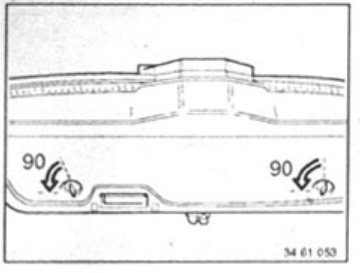
Remove the tailgate trim panel.
Unclip caps of screws.



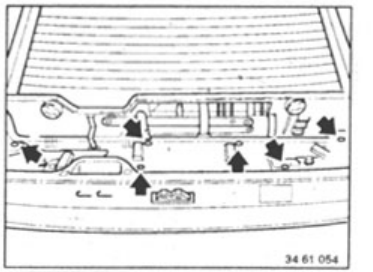
Unclip cap of screws.



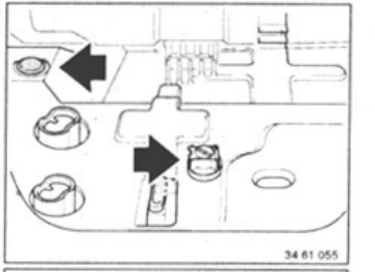
Unscrew screws.



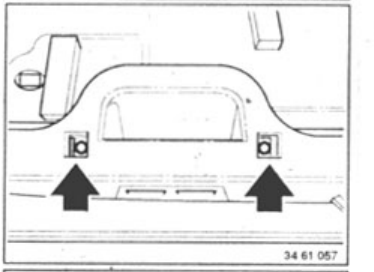
Open the toolbox.



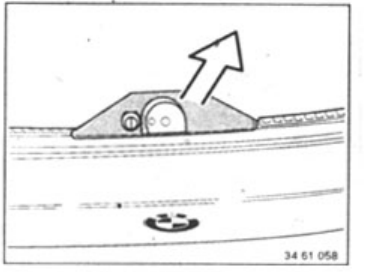
Remove clips.



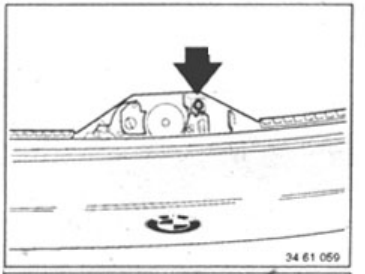
Unscrew left and right screws.



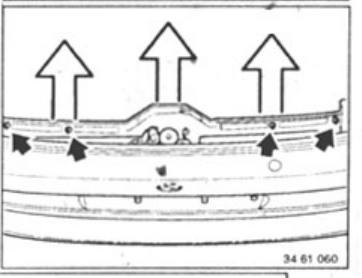
Unscrew screws.
Unscrew screws of the grip recess plate.



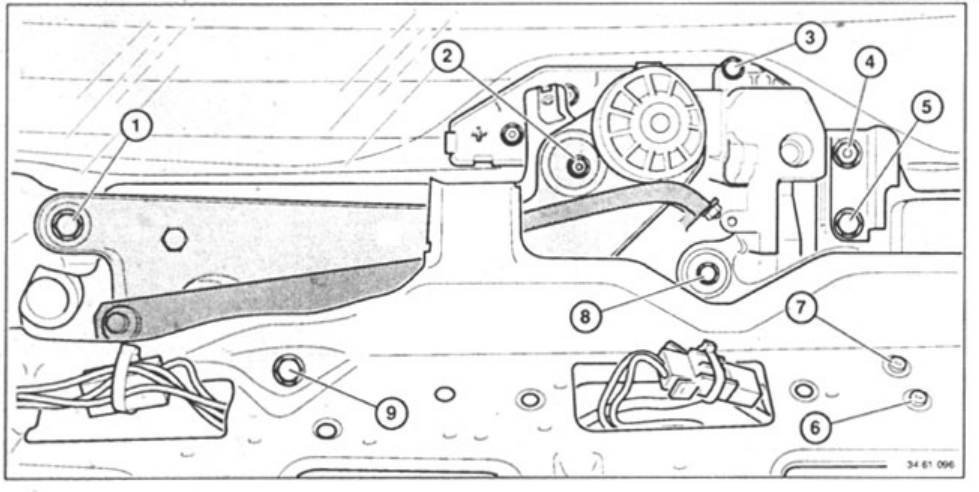
Shut the tailgate.
Remove cap of the wiper crank.



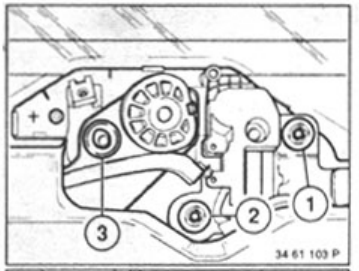
Unscrew screw.



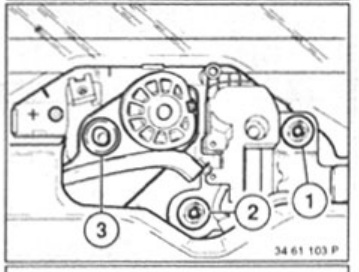
Take trim panel out of the clips carefully.
Remove the trim panel.



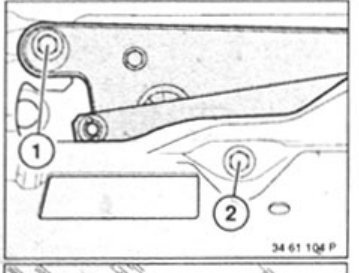
Unscrew screws (1 ... 9) of the console.



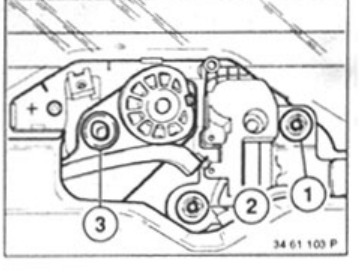
Installation:
Long screw in rubber mount (1).



Wiper adjustments are made in the slots of the securing points.

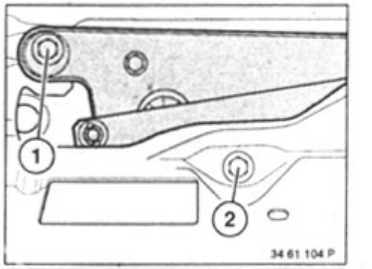


Console Screws:
1 Long screw
2 Short screw

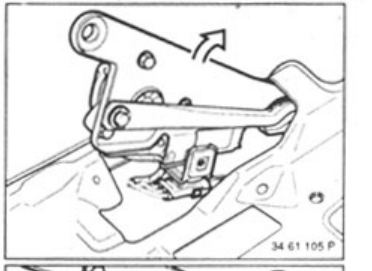


Important!
The screws with large washers must be used for rubber mounts (1 and 2).
Tightening torque*.

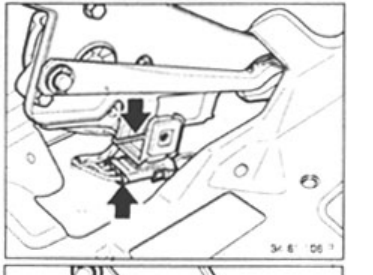
* **Refer to Specifications**



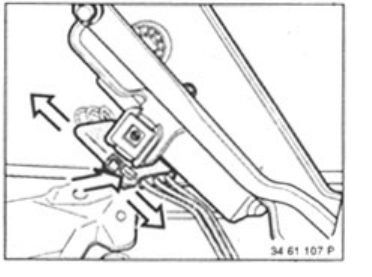
Unscrew screws (1 and 2).
Tightening torque*.



Lift wiper assembly out of the body partially.

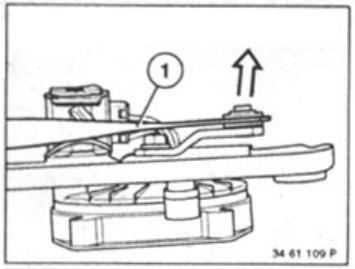


Loosen the wire strap.

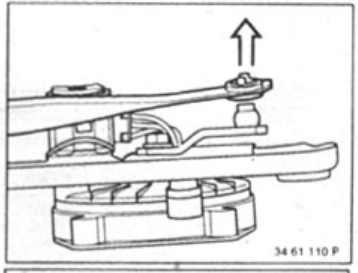


Disconnect the plug.

* **Refer to Specifications**

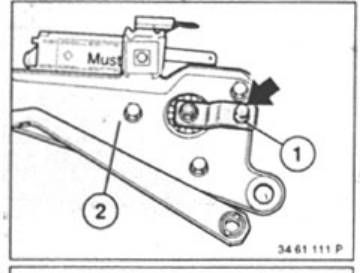


Lift wiper assembly out of the body completely.



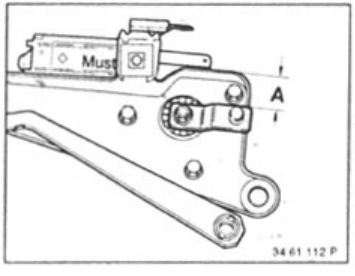
General Wiper Assembly View:

Lever the connecting rod out.

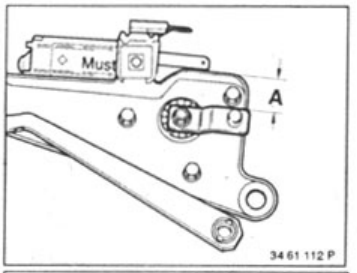


Pull the connecting rod off of the ball-headed pin.

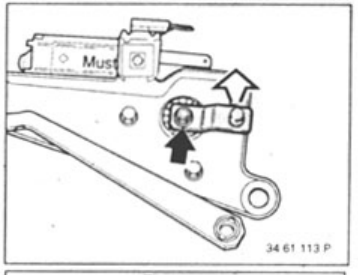
Important!
Don't damage the ball-headed pin bearing in the connecting rod.

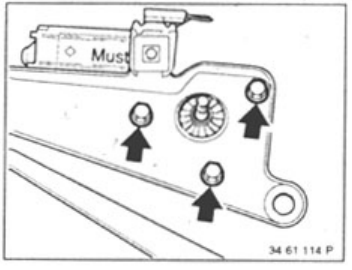


Mark the crank position of motor crank (1) to wiper console (2).



Installation:
Motor Crank Adjustment:
Run the wiper motor to parked position.
Mount the wiper motor on the console.
Mount the motor crank.
Adjust distance (A) to 24 mm.
Tighten the motor crank.
Tightening torque*.



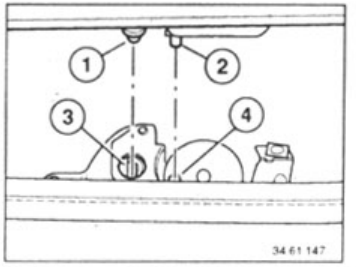


Unscrew screw.
Lever the motor crank off.
Tightening torque*.

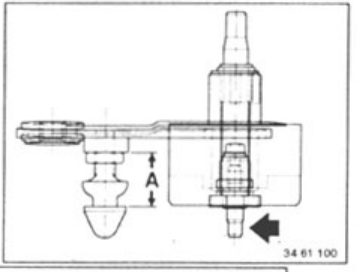
Unscrew screws.
Tightening torque*.

Installation:
Adjust the wiped zone - refer to 61 62 004.
Check the function.

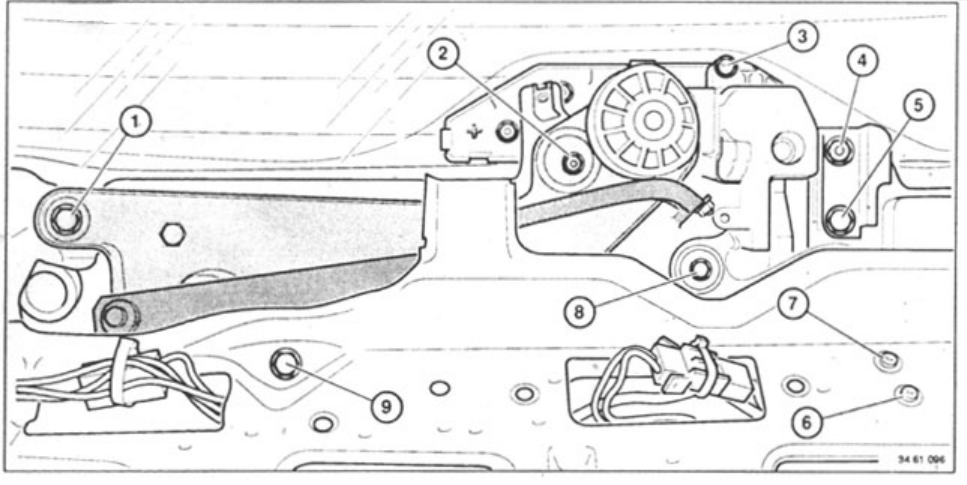
* **Refer to Specifications**



Installation:
Lockpin (1) of the tailgate window lock and crankpin (2) of the wiper must engage in lock (3 and 4) of the tailgate.

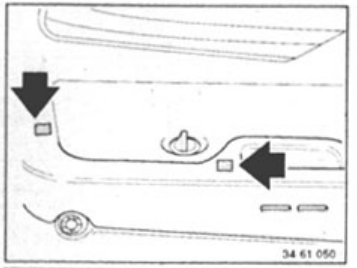


The lockpin of the tailgate window lock must be adjusted to a depth distance A = 20.5 mm so that the crankpin of the wiper arm will engage deep enough in the opening of the output disk.



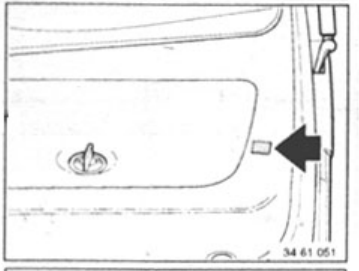
Unscrew screws (1 ... 9).
Shut the tailgate window.
The lockpin should be adjusted to correct depth!
Tighten screws (1 ... 9).
Tightening torque*.
Check the wiped zone.
Check function.

* **Refer to Specifications**

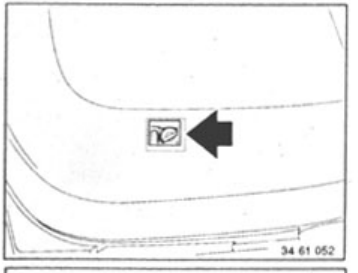


61 62 070 REMOVING AND INSTALLING CONSOLE (LINKAGE) FOR TAILGATE WINDOW WIPER

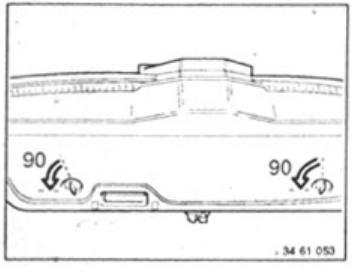
Remove the tailgate trim panel.
Unclip caps of screws.



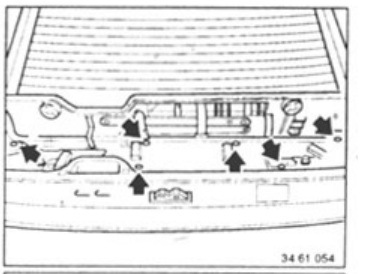
Unclip cap of screws.



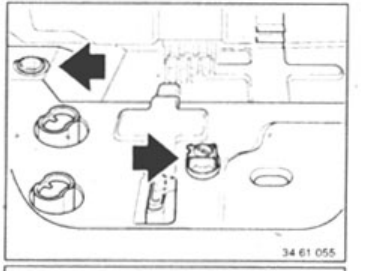
Unscrew screws.



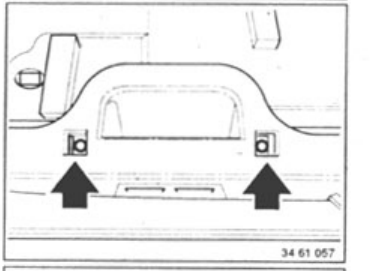
Open the toolbox.



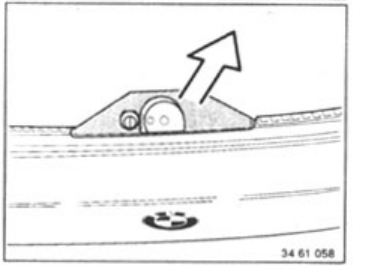
Remove clips.



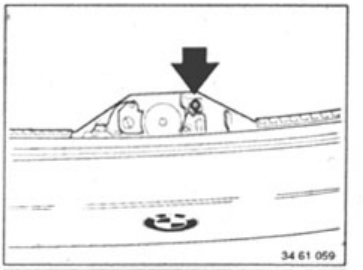
Unscrew left and right screws.



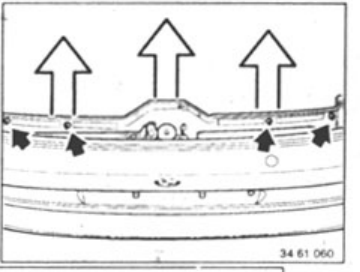
Unscrew screws.
Unscrew screws of the grip recess plate.



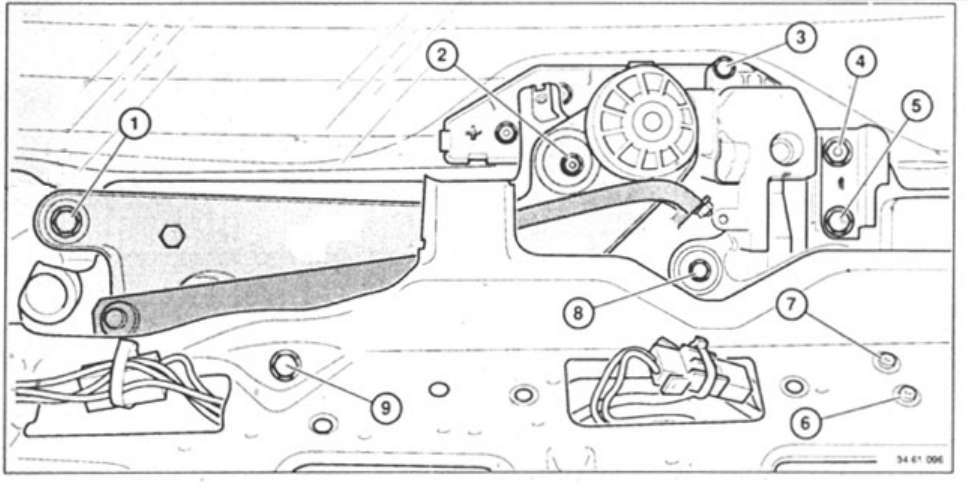
Shut the tailgate.
Remove the motor crank cap.



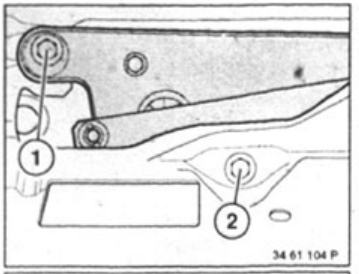
Unscrew screw.



Take trim panel out of the clips carefully.
Remove the trim panel.

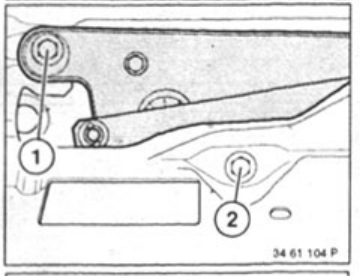


Unscrew screws (1 ... 9).

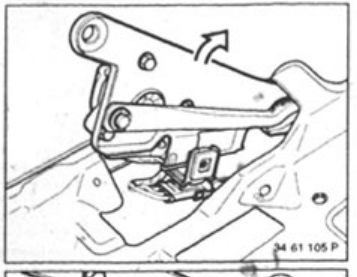


Console Screws:
1 Long screw
2 Short screw

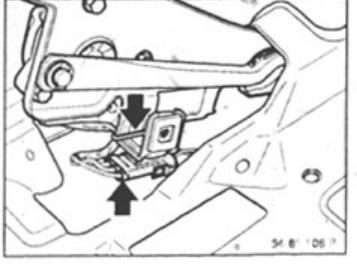
Important!
The screws with large washers must be used for rubber mounts (1 and 2).



Unscrew screws (1 and 2).
Tightening torque*.

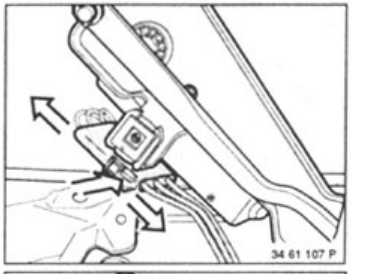


Lift wiper assembly out of the body partially.

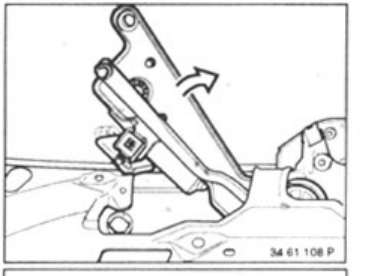


Loosen wire strap.

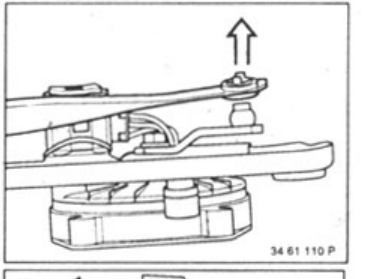
* Refer to Specifications



Disconnect the plug.

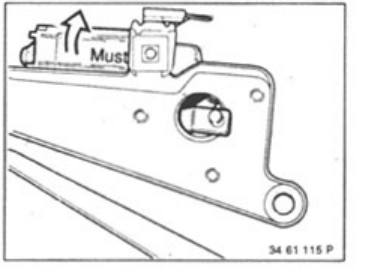


Lift wiper assembly out of the body completely.



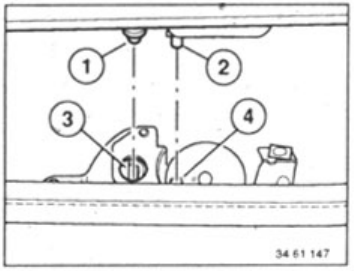
Pull the drive rod off of the ball- headed pin.

Important!
Don't damage the ball-headed pin bearing in the drive rod.

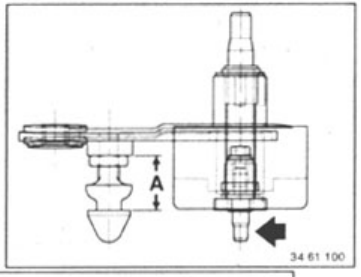


Unscrew the wiper motor screws.
Remove the wiper motor.
Tightening torque*.

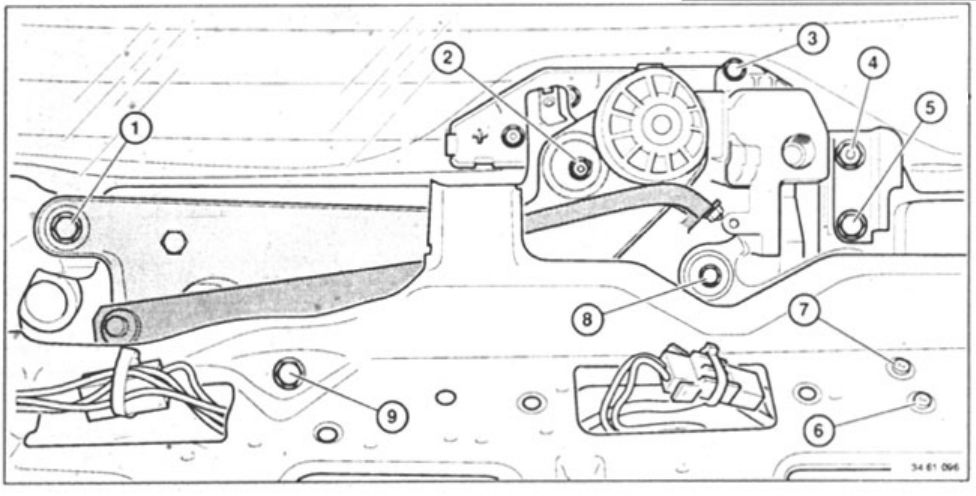
* Refer to Specifications



Installation:
Lockpin (1) of the tailgate window lock and crankpin (2) of the wiper must engage in lock (3 and 4) of the tailgate.



The lockpin of the tailgate window lock must be adjusted to a depth distance A = 20.5 mm so that the crankpin of the wiper arm will engage deep enough in the opening of the output disk.

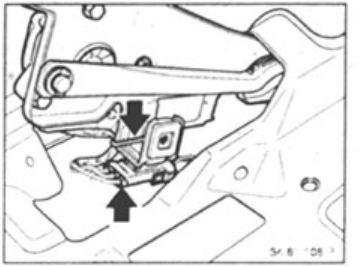


Unscrew screws (1 ... 9).
Shut the tailgate window.
The lockpin should be adjusted to correct depth!
Tighten screws (1 ... 9).
Tightening torque*.
Check the wiped zone.
Check function.

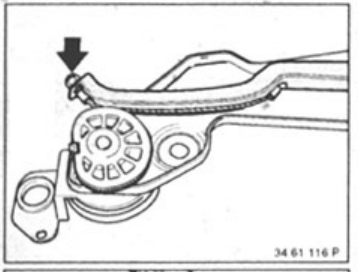
* Refer to Specifications

61 62 070 REPLACING CONSOLE (LINKAGE) FOR TAILGATE WINDOW WIPER

Refer to "Removing and Installing Console (Linkage) for Tailgate Window Wiper" in 61 62 070.

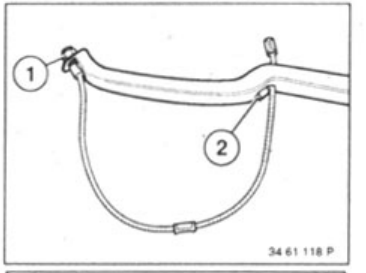


Loosen the wire strap.



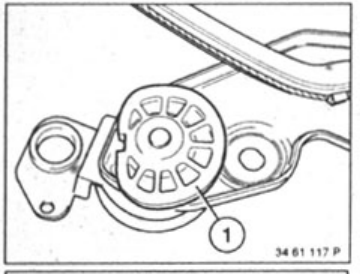
Unscrew nut of cable.

Installation:
Replace the cable nut.

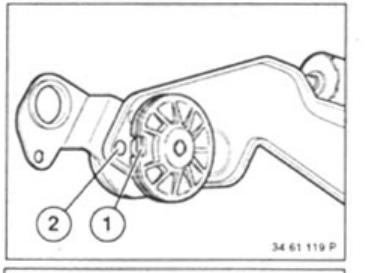


Cable installation:

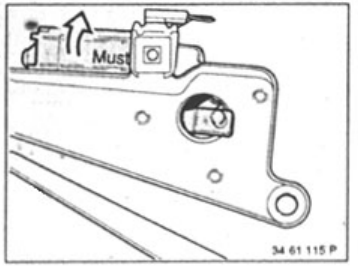
Work cable into drive rod (1).
Install nut (2) on the threads.



Installation:
Inspect the cable for damage.
If output disk (1) is damaged, it is absolutely essential to replace the cable in order to avoid predamaging the new console.

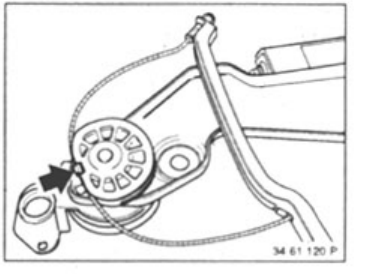


Adjusting Installed Position of Drive Disk:
Align the center of the attaching eye opening (1) with the center of rivet (2).

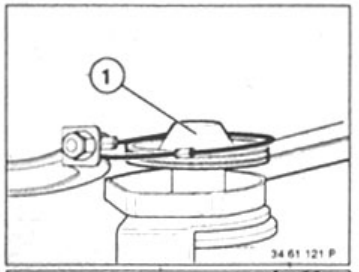


Unscrew the wiper motor screws.
Remove the wiper motor.
Tightening torque*.

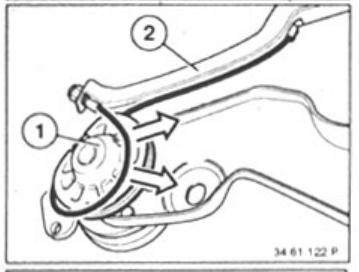
* Refer to Specifications



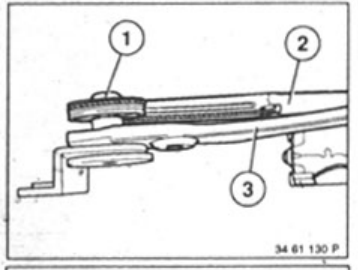
Place the cable eye in the drive disk.



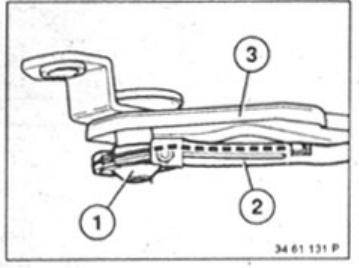
Routing of Cable on Drive Disk (1)

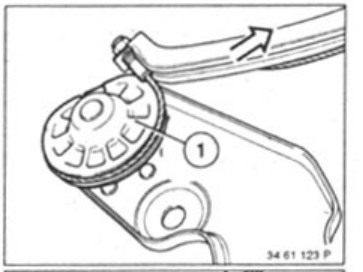


Place cable in drive disk (1).



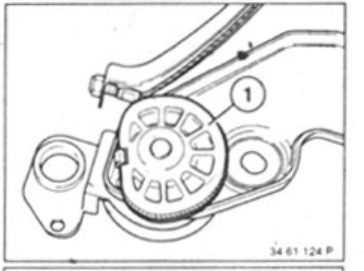
Top View of Cable Routing on Drive Disk (1)



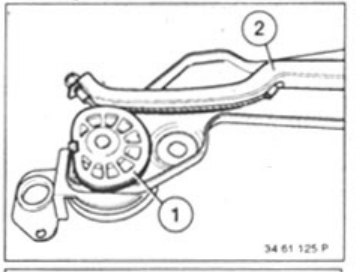


Install the drive cable on drive disk (1) with help of the drive rod.

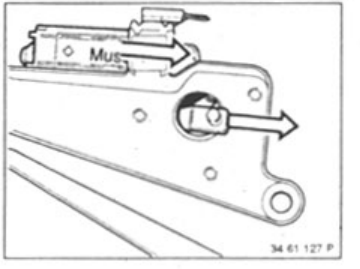
Important!
Don't damage the drive disk.



Cable installed

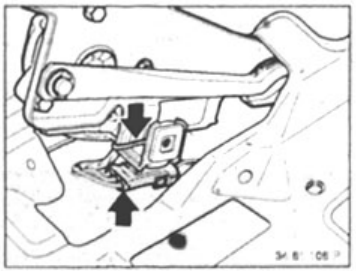


Bring drive rod (2) into normal position.



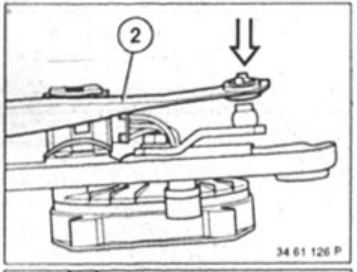
Run the motor to parked position.
Mount the motor on the console.
Tightening torque*.

* Refer to Specifications

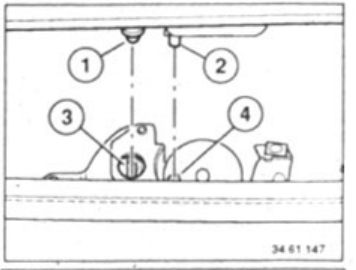


Install the wire strap.

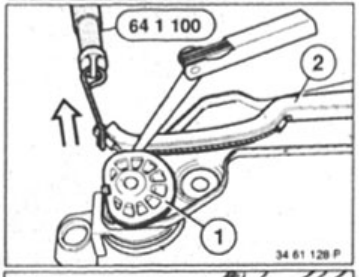
Installation:
Installing Wiper Assembly:



Mount the drive rod on the motor crank.



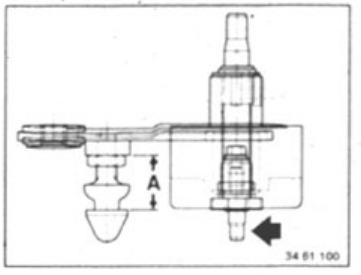
Installation:
Lockpin (1) of the tailgate window lock and crankpin (2) of the wiper must engage in lock (3 and 4) of the tailgate.



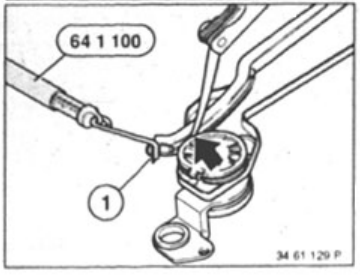
Adjusting Cable Tension:

Drive linkage attached.
Wiper in parked position.

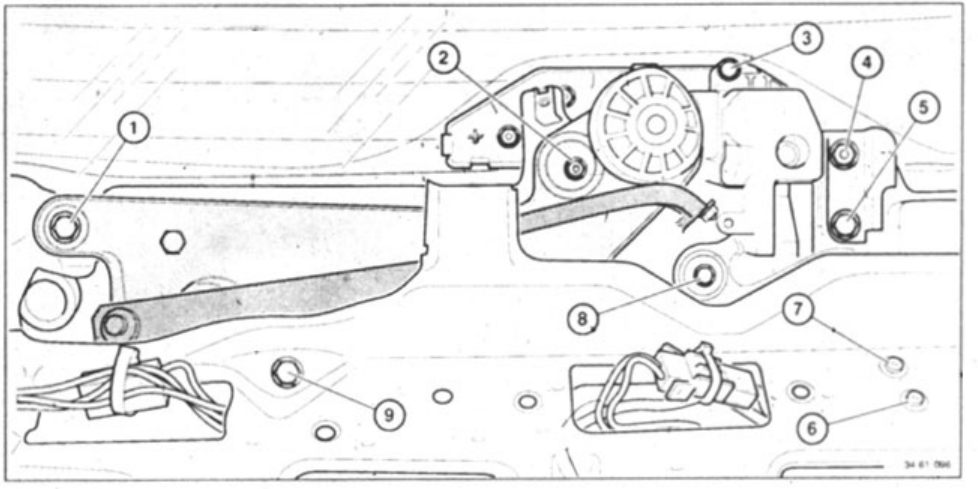
Apply Special Tool 64 1 100 (scale) on the cable connection point.
Pull drive linkage (2) upwards vertically.



The lockpin of the tailgate window lock must be adjusted to a depth distance A = 20.5 mm so that the crankpin of the wiper arm will engage deep enough in the opening of the output disk.



Nut (1) must be tightened in such a manner that with a force of 25 N the clearance between the drive linkage and drive disk is not more and also not less than 0.1 to 0.4 mm.

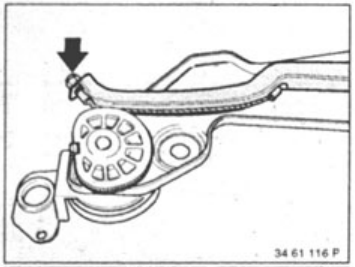


Unscrew screws (1 ... 9).
Shut the tailgate window.
The lockpin should be adjusted to correct depth!
Tighten screws (1 ... 9).
Tightening torque*.
Check the wiped zone.
Check function.

* Refer to Specifications

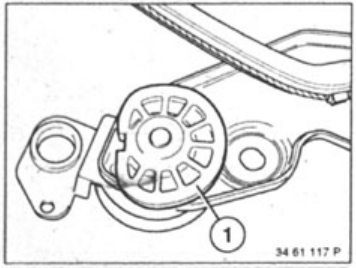
61 62 080 REMOVING AND INSTALLING / REPLACING DRIVE ROD FOR TAILGATE WINDOW WIPER

Refer to "Removing and Installing Console (Linkage) for Tailgate Window Wiper" in 61 62 070.

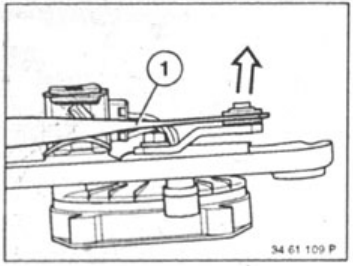


Unscrew nut of cable.

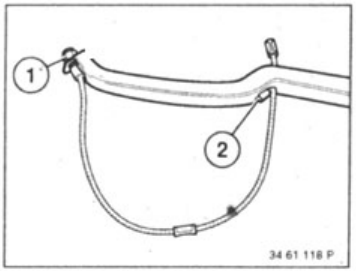
Installation:
Replace the cable nut.



Installation:
Inspect the cable for damage.
If output disk (1) is damaged, it is absolutely essential to replace the cable in order to avoid predamaging the new console.

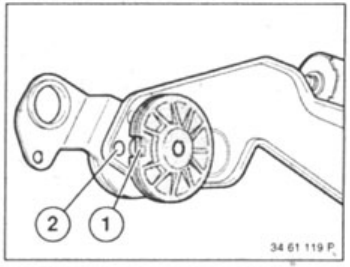


Lever drive rod (1) off the the ball-headed pin of the motor crank.
Inspect the ball-headed pin of the motor crank for damage.
Replace the drive rod.

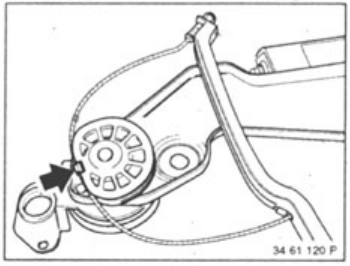


Cable installation:

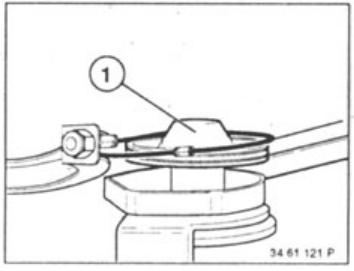
Work cable into drive rod (1).
Install nut (2) on the threads.



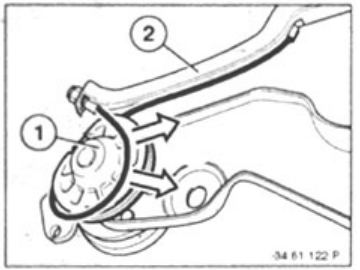
Adjusting Installed Position of Drive Disk:
Align the center of the attaching eye opening (1) with the center of rivet (2).



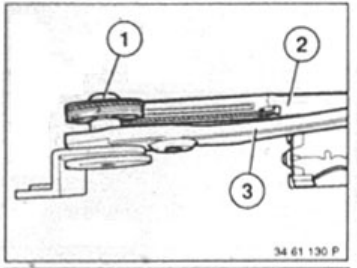
Place the cable eye in the drive disk.



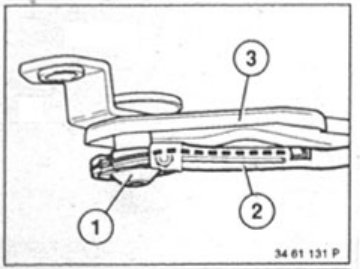
Routing of Cable on Drive Disk (1)

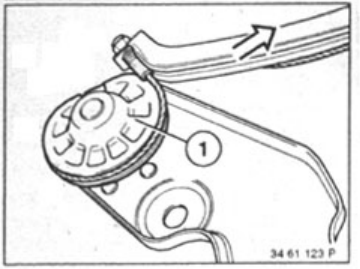


Place cable in drive disk (1).



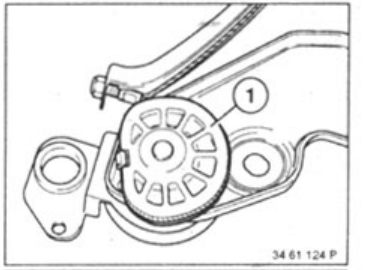
Top View of Cable Routing on Drive Disk (1)



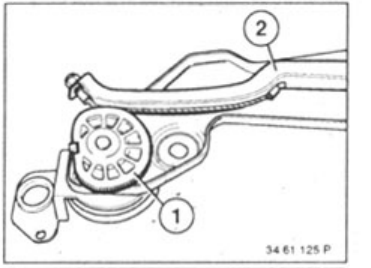


Install the drive cable on drive disk (1) with help of the drive rod.

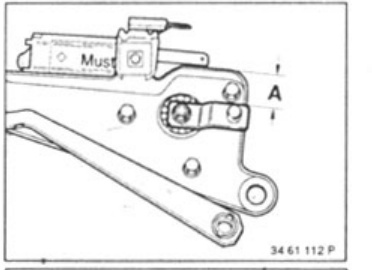
Important!
Don't damage the drive disk.



Cable installed

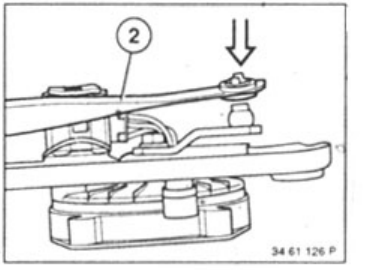


Bring drive rod (2) into normal position.



Run the motor to parked position.

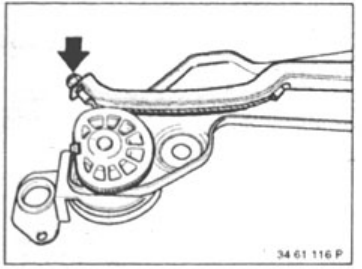
Distance A = 24 mm.



Mount drive rod (1) on the ball-headed pin of the motor crank.
Install the wiper console.
Adjust the wiped zone - refer to 61 62 004.
Check the function.

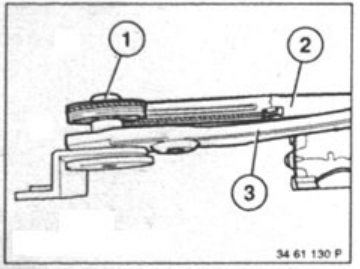
61 62 085 REMOVING AND INSTALLING / REPLACING CABLE OF DRIVE ROD FOR TAILGATE WINDOW WIPER

Refer to "Removing and Installing Console (Linkage) for Tailgate Window Wiper" in 61 62 070.

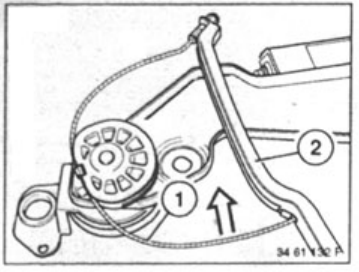


Unscrew nut of cable.

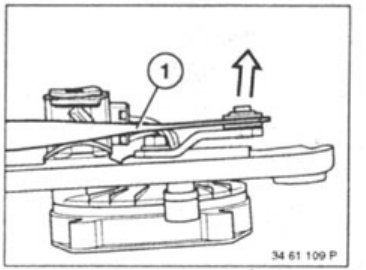
Installation:
Replace the cable nut.



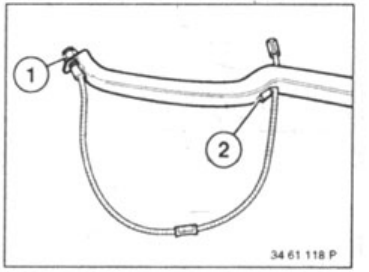
Installation:
It is absolutely essential to replace console (3), if cable roller (1) is damaged,



Disconnect cable (1) from drive rod (2).

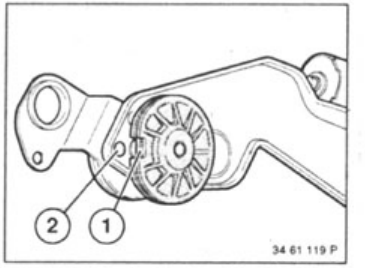


Lever drive rod (1) off the the ball-headed pin of the motor crank.
Replace the drive rod.

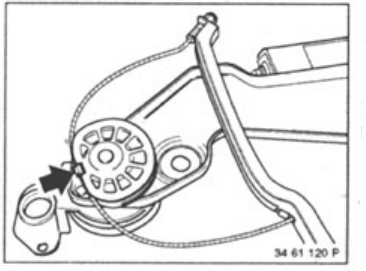


Cable installation:

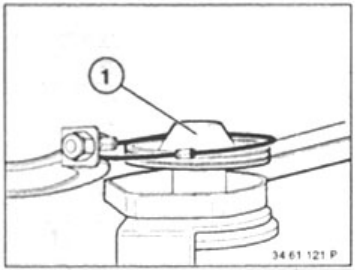
Work cable into drive rod (1).
Install nut (2) on the threads.



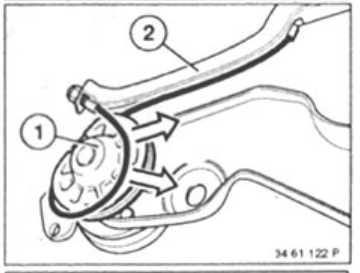
Adjusting Installed Position of Drive Disk:
Align the center of the cable roller opening (1) with the center of rivet (2).



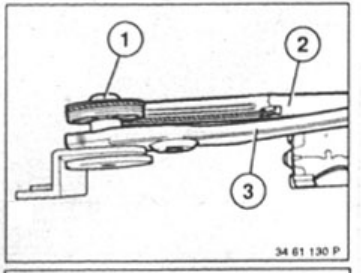
Place the cable eye in the drive disk.



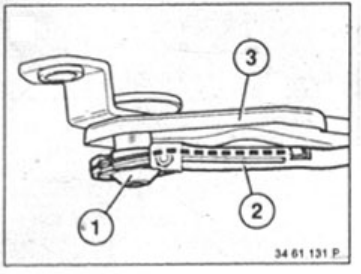
Routing of Cable on Drive Disk (1)

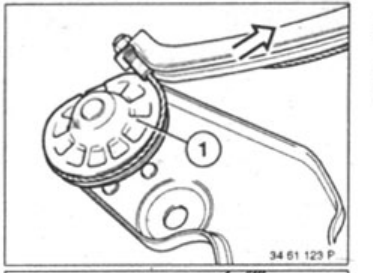


Place cable in drive disk (1).



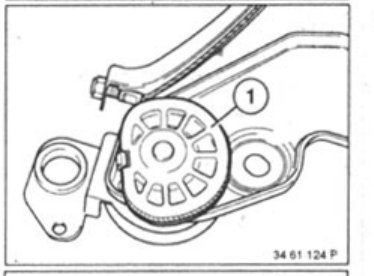
Top View of Cable Routing on Drive Disk (1)



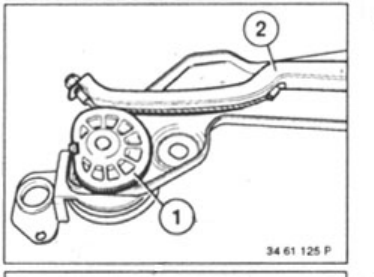


Install the drive cable on drive disk (1) with help of the drive rod (2).

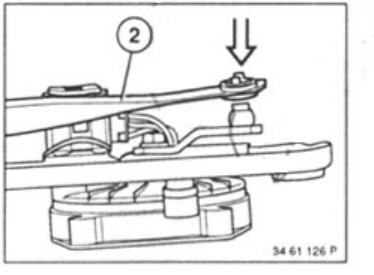
Important!
Don't damage the drive disk.



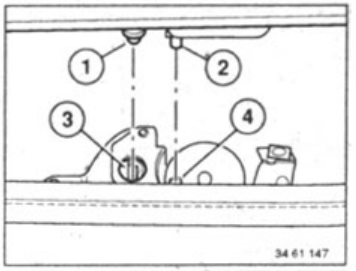
Cable installed



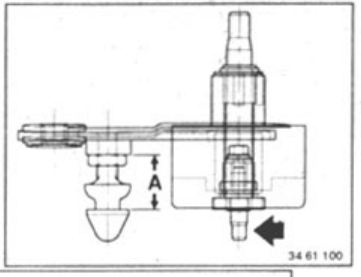
Bring drive rod (2) into normal position.



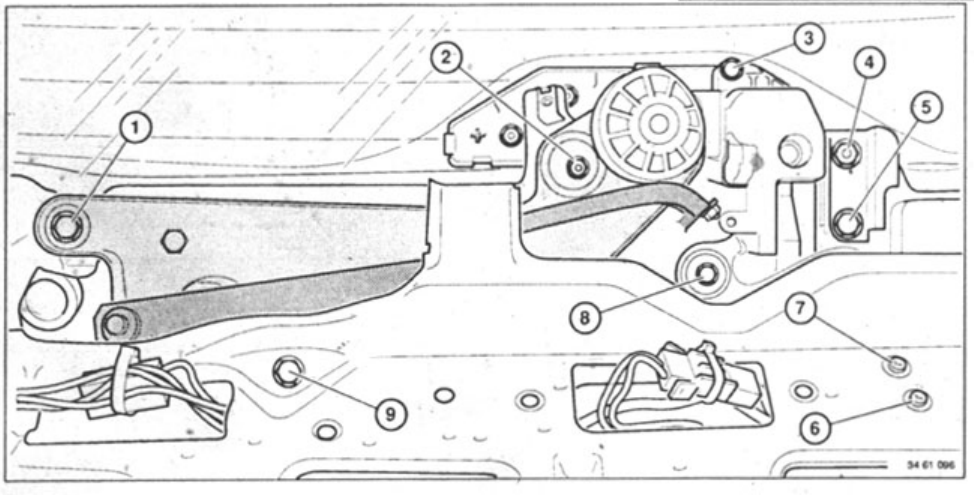
Mount drive rod (2) on the ball-headed pin of the motor crank.
Install the wiper console.



Installation:
Lockpin (1) of the tailgate window lock and crankpin (2) of the wiper must engage in lock (3 and 4) of the tailgate.

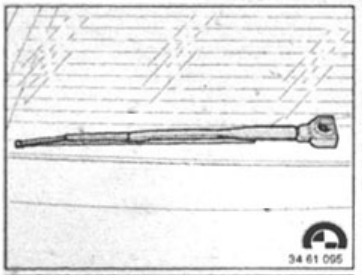


The lockpin of the tailgate window lock must be adjusted to a depth distance A = 20.5 mm so that the crankpin of the wiper arm will engage deep enough in the opening of the output disk.



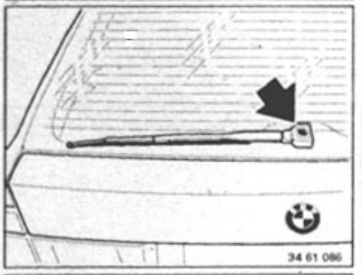
Unscrew screws (1 ... 9).
Shut the tailgate window.
The lockpin should be adjusted to correct depth!
Tighten screws (1 ... 9).
Tightening torque*.

* **Refer to Specifications**

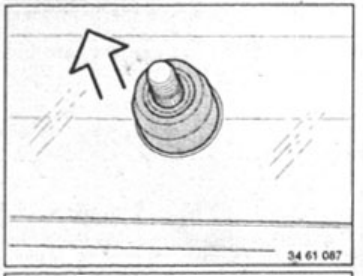


61 62 090 REMOVING AND INSTALLING / REPLACING SHAFT MOUNT FOR TAILGATE WINDOW WIPER

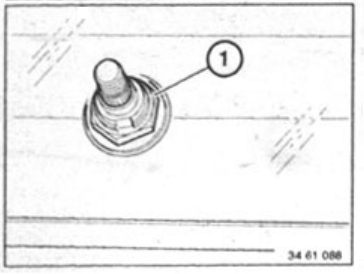
Operate the wiper to parked position.
Switch the wiper off.
Switch the ignition off.



Unclip cap on the screw.
Remove the wiper arm.
Unscrew screw.

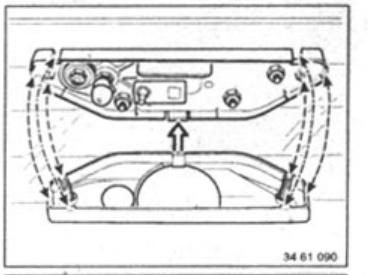


Remove the outside shaft cover.

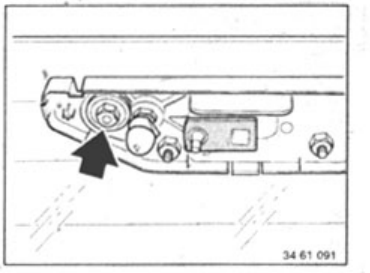


Unscrew screw.
Tightening torque*.

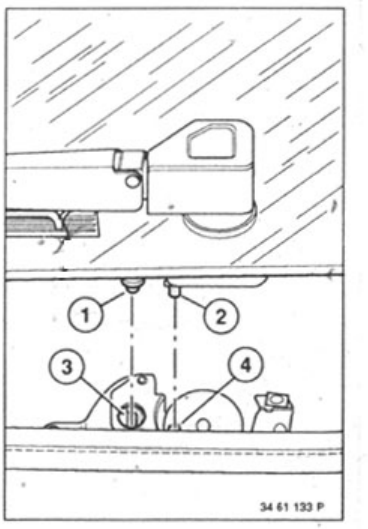
* Refer to Specifications



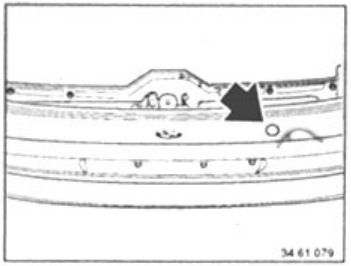
Unclip the inside cover.



Unscrew screw.
Remove the shaft mount.

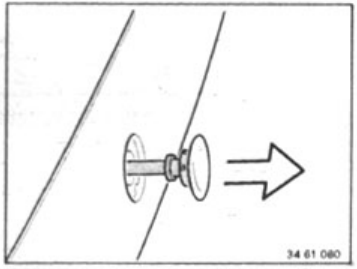


Install the shaft mount.
Lockpin (1) must engage in striker (3).
Wiper crank (2) must engage in the output disk of wiper crank (4).

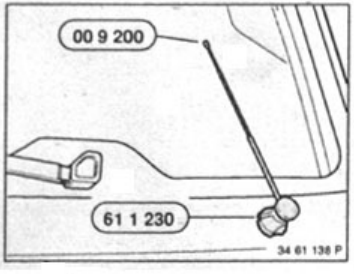


61 62 100 ADJUSTING WATER SPRAY NOZZLE FOR TAILGATE WINDOW

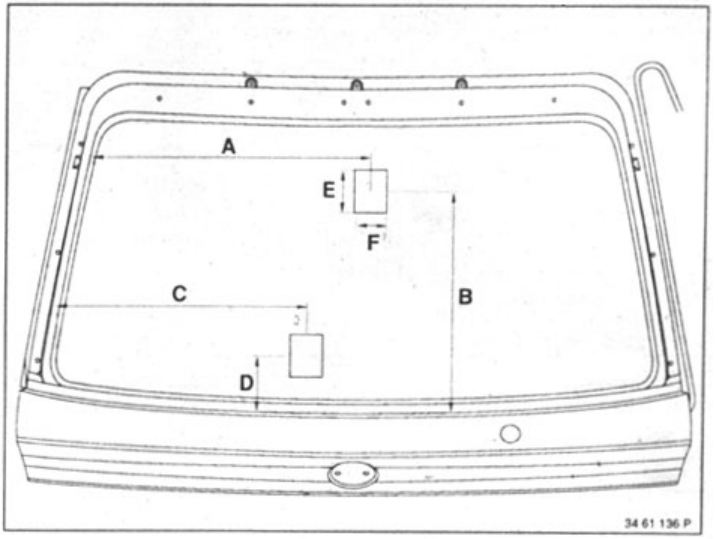
Shut the tailgate.
Move the water spray nozzle out.



Hold the water spray nozzle tight in run out position.

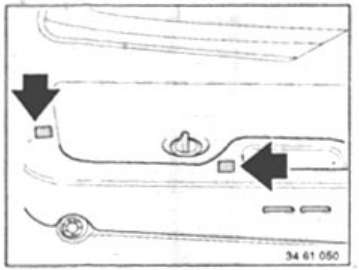


Arrest the water spray nozzle in run out position using Special Tool 61 1 230.
Insert Special Tool 00 9 200 into the nozzle.
Mark point of contact with the tailgate window.



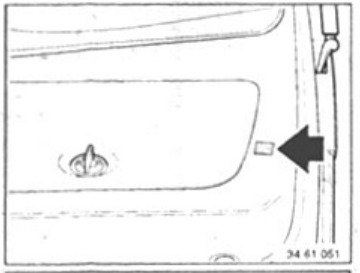
Adjustment Distances in mm:

A	=	605
B	=	375
C	=	545
D	=	135
E	=	80
F	=	60

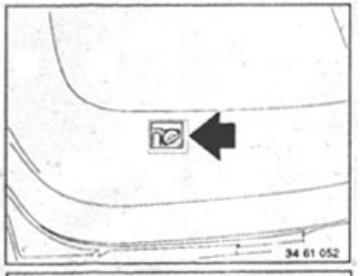


61 62 110 REMOVING AND INSTALLING / REPLACING WATER SPRAY NOZZLE FOR TAILGATE WINDOW

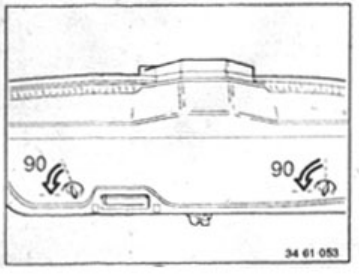
Remove the tailgate trim panel.
Unclip caps on the screws.



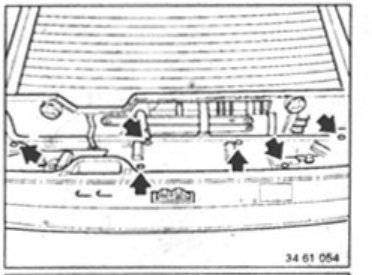
Unclip cap on the screws.



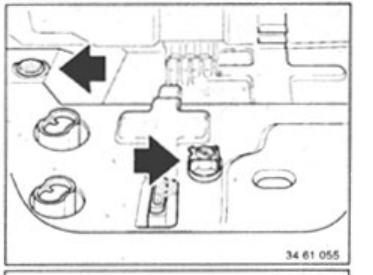
Unscrew screws.



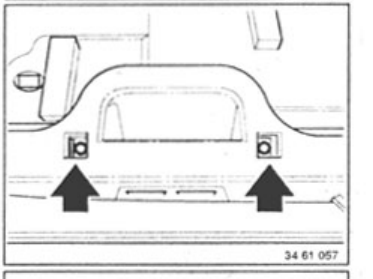
Open the toolbox.



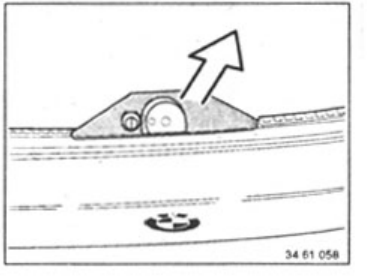
Remove clips.



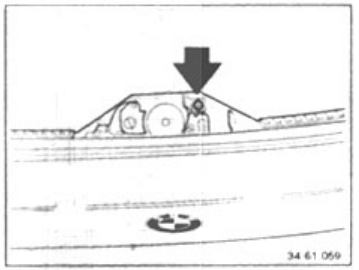
Unscrew left and right screws.



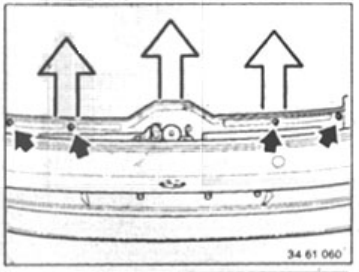
Unscrew screws.
Unscrew screws of the grip recess plate.



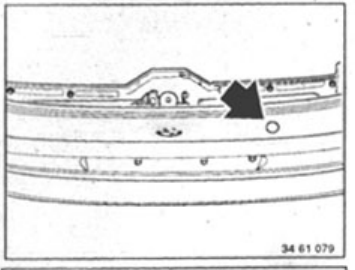
Shut the tailgate.
Pull the cap off of the motor crank.



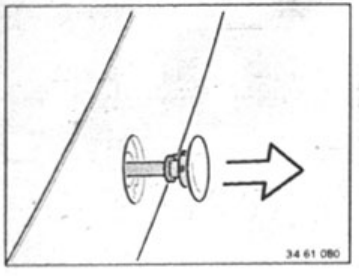
Unscrew screw.



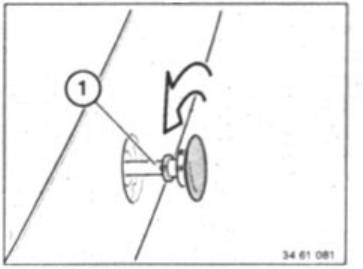
Take trim panel out of the clips carefully.
Remove the trim panel.



Shut the tailgate.
Run the water spray nozzle out.

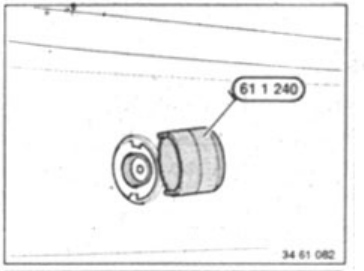


Hold the water spray nozzle tight in run out position.

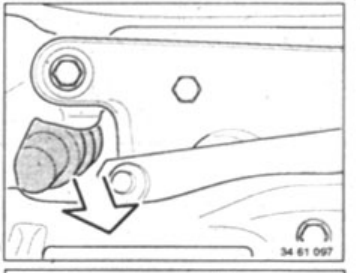


Hold tight on telescope rod (1) of the nozzle and unscrew the matched-color cap.

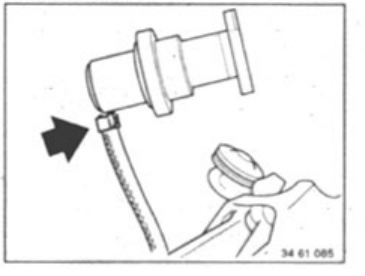
Important!
Don't scratch the painted cap.



Unscrew the slotted nut using Special Tool 61 1 240.
Tightening torque*.

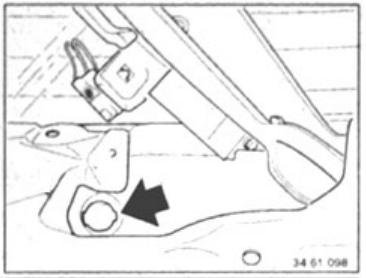


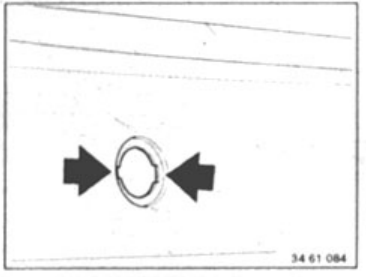
Raise the tailgate.
Remove the water spray nozzle.



Loosen the hose clamp.
Remove the water spray nozzle.

* Refer to Specifications



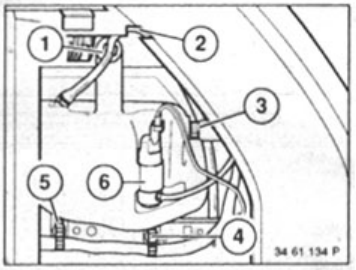


Installation:
The water spray nozzle is coded machanically so that it cannot be installed displaced by 180°.

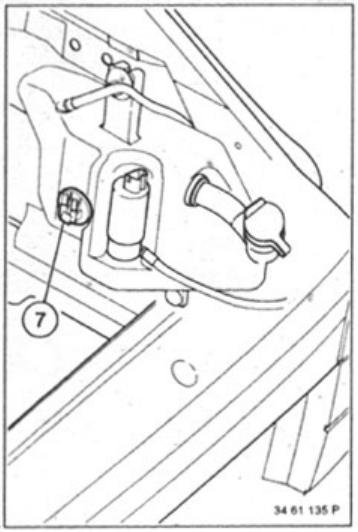
Adjust the water spray nozzle - refer to 61 62 110.
Fill the washing fluid tank.

61 62 130 REPLACING WASHING FLUID TANK FOR TAILGATE WINDOW

Remove the right rear side trim panel cover.
Empty the washing fluid tank.



Loosen the hose clamp on spill hose (2).
Pull the hose off.
Loosen the hose clamp on filler hose (3).
Pull the hose off.
Pull washing fluid pump (6) out of the tank.
Unscrew screws (1, 4 and 5).

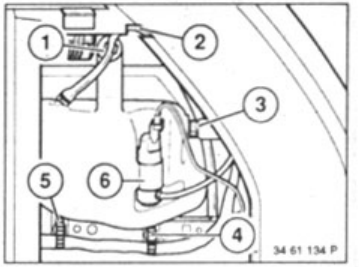


Remove fluid level switch (7).
Remove the washing fluid tank.

Installation:
Fill the washing fluid tank.
Check the function.

61 62 130 REMOVING AND INSTALLING / REPLACING WASHING FLUID PUMP FOR TAILGATE WINDOW

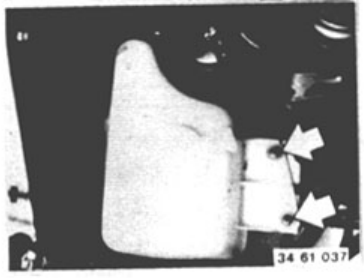
Remove the right rear side trim panel cover.
Empty the washing fluid tank.



Pull washing fluid pump (6) out of the tank.
Loosen the hose clamp.
Pull the hose off.
Disconnect the plug.
Check the rubber seal in the washing fluid tank for damage, replacing it if necessary.

Installation:
Fill the washing fluid tank.
Check the function.





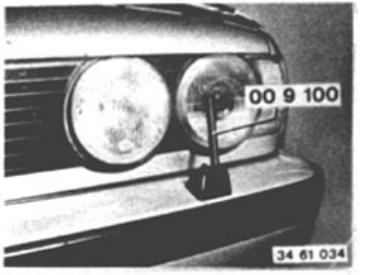
61 67 . . . REPLACING WASHING FLUID PUMP FOR HEADLIGHT CLEANERS

Disconnect air supply hose for the alternator – see Group 12.
Remove headlight cover – see Gr. 63.

Empty supply tank.
Unscrew mounting screws.
Pull up tank, loosen hose clamp and pull off hose.

Remove pump.

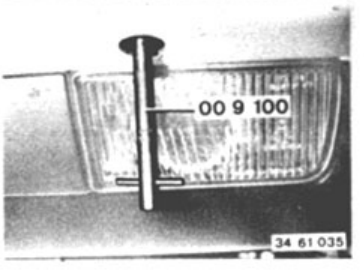
Important!
Hose must not be bent after installation.



61 67 040 ADJUSTING SPRAY JETS FOR HEADLIGHT CLEANERS

Spray Contact Point:
Middle of headlight.

Special Tool 00 9 100



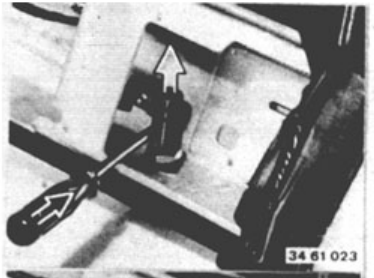
ADJUSTING SPRAY JETS FOR FRONT FOG LAMPS

Spray Contact Point:
Middle of fog lamp.

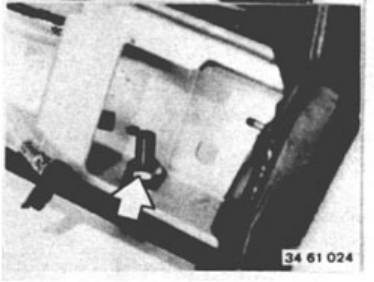
Special Tool 00 9 100

61 67 060 Replacing spray nozzle for headlight cleaning system

Release screw and lift off finisher.
Remove bumper, refer to Group 51.



Detach retaining clip with screwdriver and lift out line from spray nozzle.



Release nut and remove spray nozzle from bumper.

Adjusting spray nozzles:
Connect BMW Service Tester.
Simulate SRA status list outputs, and adjust spray direction of nozzles with special tool (00 09 100) connected. Refer to 61 17 040.

61 71 004 AIMING WATER SPRAY NOZZLES FOR WINDSHIELD

The water spray should contact the windshield in the middle of the zone.
The dimensions are given for LHD models; dimensions for RHD models are inverse.

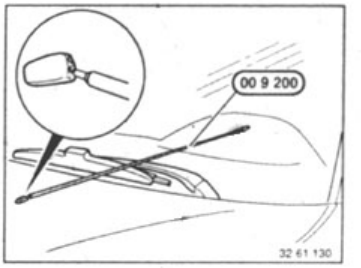
Adjustment distances in mm:

A1 = 215
A2 = 540

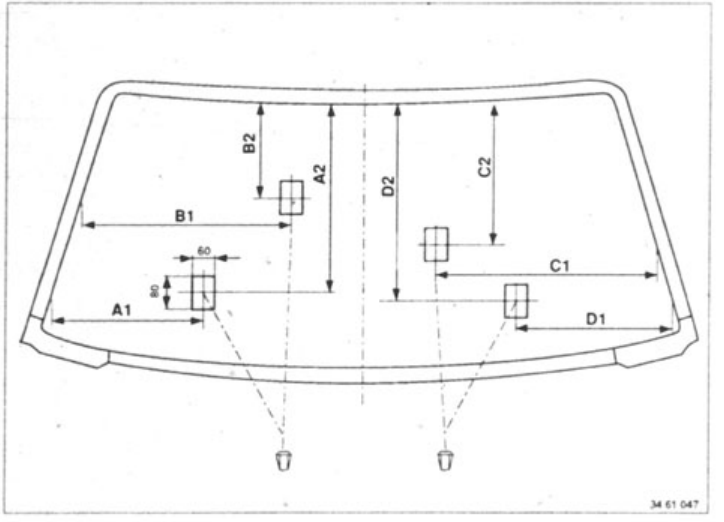
B1 = 442
B2 = 245

C1 = 465
C2 = 286

D1 = 220
D2 = 550



Mark the points of contact with pieces of tape.
Adjust the aiming of water spray nozzles using Special Tool 00 9 200.



61 90 . . . TROUBLESHOOTING DRIVE AND CONTROL UNIT FOR ELECTRIC SUN SHADE

Testing Requirements:
Battery charged.
Fuse okay.
Terminal R switched on continuously.

Test Step 1:

Remove sun shade switch.
Pull switch off of wire harness plug.

Measure voltage on wire harness plug between pins 5 and 4.
Specification: approx. battery voltage.
no → Repair wires.

yes

Measure voltage on wire harness plug between pins 5 and 1.
Specification: approx. battery voltage.
no → Repair wires.

yes

Measure voltage between pins 6 and 2, with term. 58 switched on.
Specification: approx. battery voltage.
no → Repair wires for switch light.

yes

Continue with Test Step 2.

Test Step 2:

Check function of switch.
Switch removed.

Bridge (short) pins 5 and 4 on wire harness plug.
Sun shade runs up.

no → Continue with Test Step 4.

yes ↓

Bridge (short) pins 5 and 1 on wire harness plug.
Sun shade runs down.

no → Continue with Test Step 4.

yes ↓

Continue with Test Step 3.

Test Step 3:

Check switch.
Switch removed.

Measure resistance between pins 4 and 5. Switch pressed in run up direction.
Specification: approx. 0.2 ohm.

no → Actual value = ∞ = switch faulty.

yes ↓

Measure resistance between pins 1 and 5. Switch pressed in run down direction.
Specification: approx. 0.2 ohm.

no → Actual value = ∞ = switch faulty.

yes ↓

Continue with Test Step 4.

Test Step 4:

Check leads from switch to 4-pin plug on right C-pillar.

Measure resistance of blue wire from switch to 4-pin plug.
Specification: approx. 0.3 ohm.

no → Actual value = ∞ = check wire, repairing if necessary.

yes ↓

Measure resistance of black wire from switch to 4-pin plug.
Specification: approx. 0.3 ohm.

no → Actual value = ∞ = check wires for damage, repairing if necessary.

yes ↓

Continue with Test Step 5.

Test Step 5:

Check power supply of control unit.

Four-pin plug on C-pillar disconnected.
Tested on wire harness end plug.

Approx. battery voltage on red/white wire against car ground? — no → Check / repair wire and fuse.

↓ yes

Approx. battery voltage between red/white wire and brown wire? — no → Check / repair ground wire.

↓ yes

Continue with Test Step 6.

Test Step 6:

Check control wire from switch to control unit.
Plug on C-pillar disconnected.

Operate switch in run up direction.
Measure voltage on blue wire against car ground.
Specification: approx. battery voltage.

→ no → Check wire, repairing if necessary.

yes

Operate switch in run down direction.
Measure voltage on black wire against car ground.
Specification: approx. battery voltage.

→ no → Check wire, repairing if necessary.

yes

Continue with Test Step 7.

Test Step 7:

Check control unit power supply.

Four-pin plug on C-pillar connected.
Complete hatrack removed.

Pull 5-pin plug off of control unit.
Measure voltage on wire harness plug between pin 5 and car ground.
Specification: approx. battery voltage.

no → Repair 4-pin plug on C-pillar or wire from plug on C-pillar to control unit.

yes ↓

Measure voltage between pins 5 and 3.
Specification: approx. battery voltage.

no → Repair 4-pin plug on C-pillar or ground wire from plug on C-pillar to control unit.

yes ↓

Continue with Test Step 8.

Test Step 8:

Check control voltage from switch to control unit.

Four-pin plug on C-pillar connected. Five-pin plug on control unit disconnected.

Operate switch in open direction. Measure voltage on 5-pin plug between pin 1 and car ground. Specification: approx. battery voltage.

no → **Repair 4-pin plug on C-pillar or wire from plug on C-pillar to control unit.**

yes ↓

Operate switch in close direction. Measure voltage on 5-pin plug between pin 2 and car ground. Specification: approx. battery voltage.

no → **Repair 4-pin plug on C-pillar or wire from plug on C-pillar to control unit.**

yes ↓

Continue with Test Step 9.

Test Step 9:

Check output voltage of control unit.

Five-pin plug connected.
Four-pin control unit plug disconnected.

Measure voltage on 4-pin control unit plug between pin 1 and car ground.
Switch operated in run down direction.
Specification: approx. battery voltage.

no → Control unit faulty.

yes

Measure voltage between pin 2 and car ground.
Switch operated in run up direction.
Specification: approx. battery voltage.

no → Control unit faulty.

yes

Continue with Test Step 10.

Test Step 10:

Check drive.

Requirements:
Drive not seized mechanically.
Drive removed from hatrack for testing.

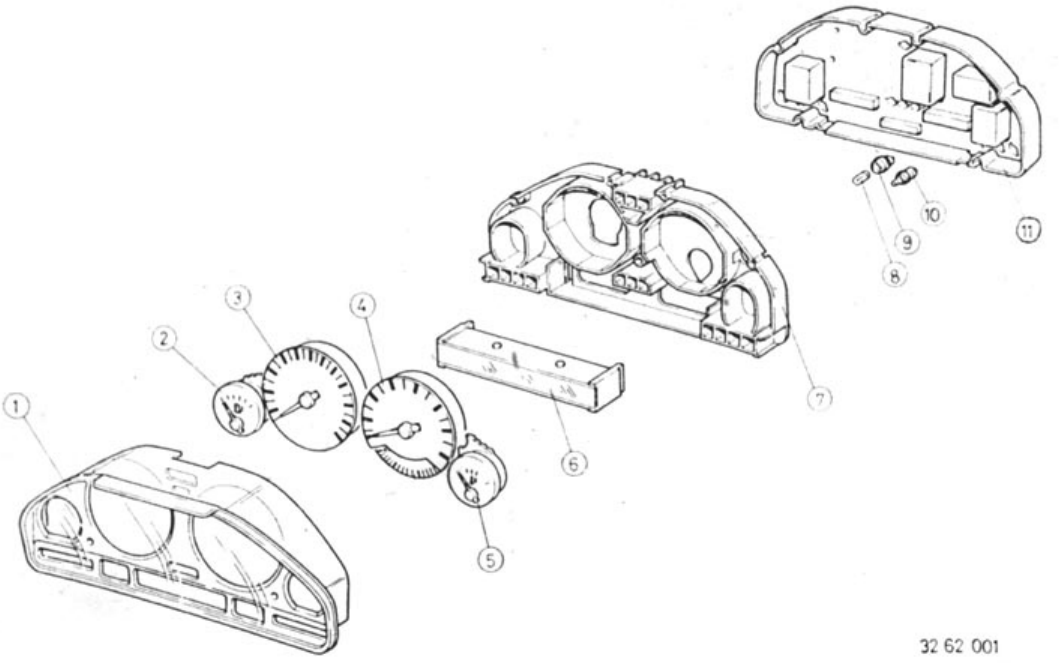
Supply 12 V power to drive direct on the plug.

Drive functions? _____ no . Drive faulty.

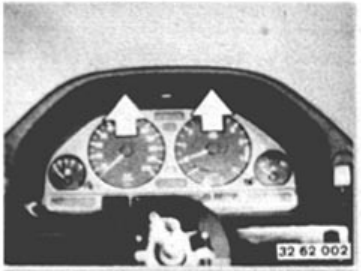
62 Instruments

	Overview of instrument cluster	62-	11/1
62 11 . . .	Instrument cluster – remove and disassemble	62-	11/2
070	Coding plug (plug in wiring harness) – replace	62-	11/4
070	Coding plug (plug in instrument cluster) – replace	62-	11/4
62 16 071	Signal generator – replace	62-	16/1
62 99 . . .	Lights in instrument cluster – replace	62-	99/1

INSTRUMENT CLUSTER SURVEY

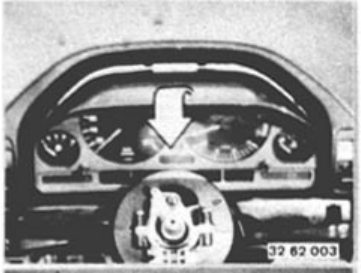


1 Instrument carrier
2 Fuel gage
3 Speedometer
4 Tachometer and economy control
5 Temperature gage
6 LCD module
7 System carrier
8 Light bulb
9 Bulb holder
10 Socket lamp
11 Baseplate



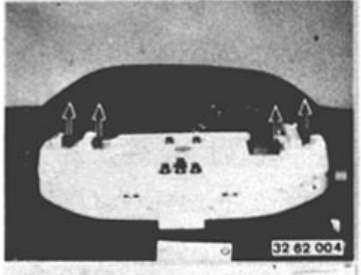
62 11 . . . REMOVING /DISASSEMBLING INSTRUMENT CLUSTER

Remove steering wheel - see 32 33 000.
Unscrew screws.



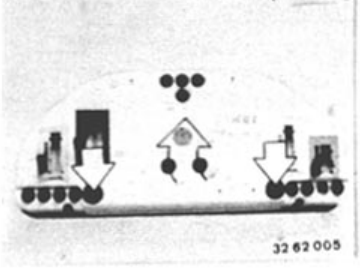
Pry out top of instrument cluster slightly and pull forward up to the steering column.
Then fold it down completely and remove.

Note:
Place a cloth on the steering column to avoid scratching the glass.

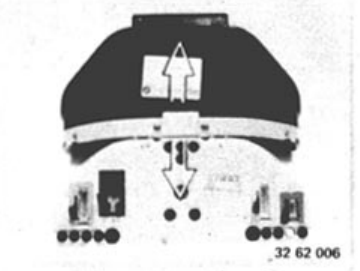


Press up levers next to the plugs and then pull off plugs.

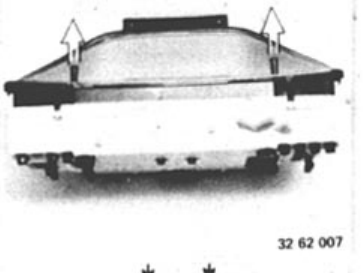
Installation:
Levers must be positioned up when inserting the plugs.



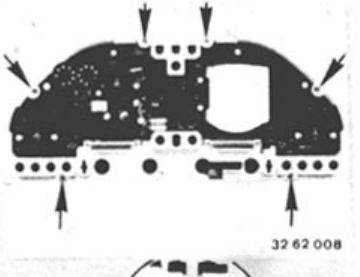
(High Version)
Turn toggle screws 90˚ counterclockwise and fold up housing with electronic printed circuit board.



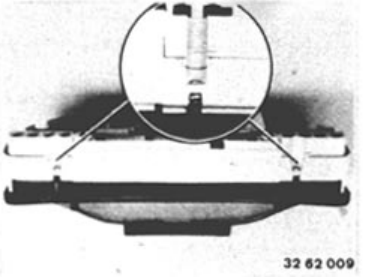
Pull both housing sections apart.



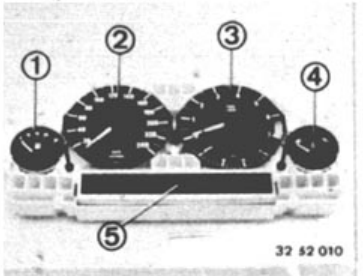
Pull off knobs.



Unscrew screws and pull system carrier off of the instrument carrier.

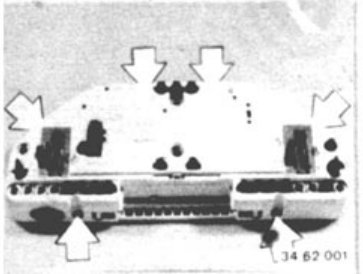


Note:
Make sure that the LCD module does not fall out while pulling off.
Note spacers on the bottom screws.

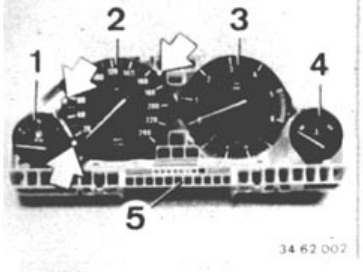


Pull up pertinent gage carefully to replace it.

1 Fuel gage
2 Speedometer
3 Tachometer and economy control
4 Temperature gage
5 LCD module

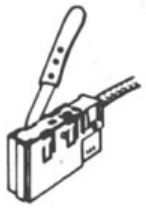


(Standard Version)
Unscrew screws and pull off system carrier on the instrument carrier.



To replace, pull up pertinent instrument carefully.
First loosen screws when removing the speedometer.

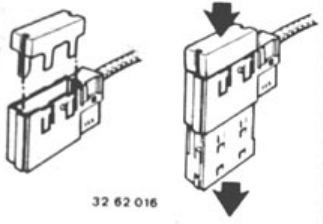
1 Fuel gage
2 Speedometer
3 Tachometer and economy control
4 Temperature gage
5 Range display



32 62 015

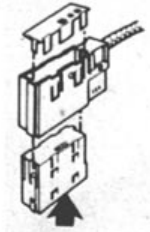
62 11 070 REPLACING CODING PLUG (Plug in Wire Harness)

Remove instrument cluster – see 62 11 000.
Remove back wall on coding plug carrier with a knife.



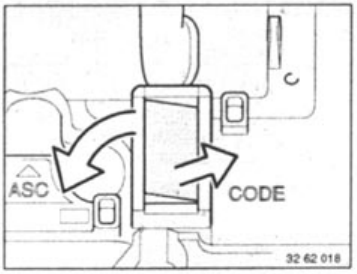
32 62 016

Insert unlocking tool (part of "coding plug" repair kit) in carrier from behind and press out the coding plug.



32 62 017

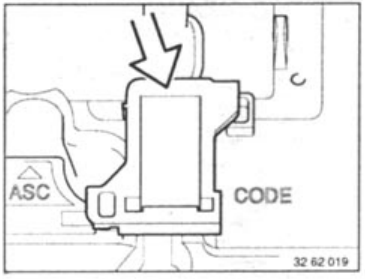
Slide replacement coding plug into carrier from front until it engages.
Lock by sliding the replacement cover (orange) on to the carrier from behind.



32 62 018

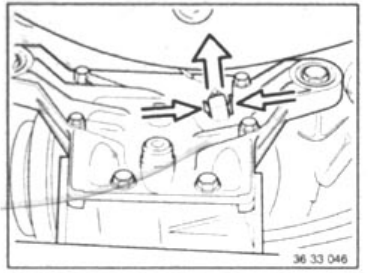
62 11 070 REPLACING CODING PLUG (Plug in Instrument Cluster)

Remove instrument cluster – see 62 11 000.
Cut out locking frame with a knife and pull out coding plug.



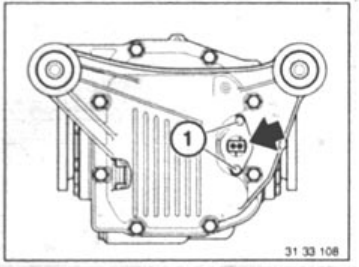
32 62 019

Insert new coding plug and clip on locking frame.

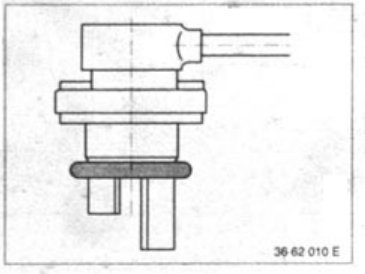


62 16 071 REPLACING PULSE SENDER

Compress retainers and disconnect plug.



Unscrew screws (1) and lift out pulse sender.

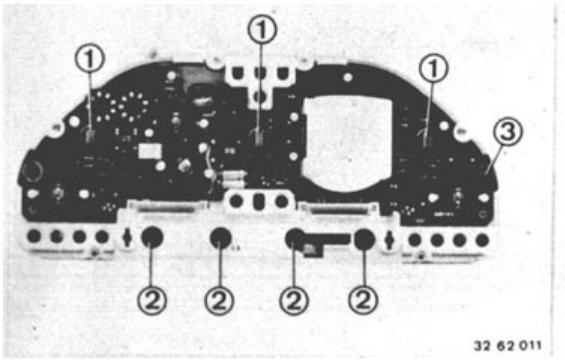


Installation:
Replace O-ring and dip it in or coat it with HLS-90 oil.
Slide O-ring on to speedometer sender shaft only up to slip phase (A).
Place sender with O-ring in rear axle and tighten both screws uniformly.
Tightening torque*.

* **Refer to Specifications**

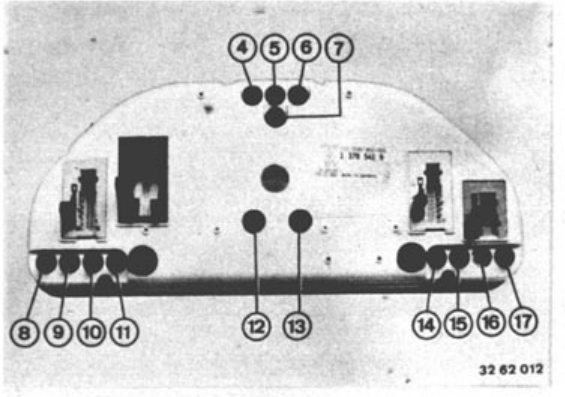
62 99 . . . REPLACING LAMPS IN INSTRUMENT CLUSTER

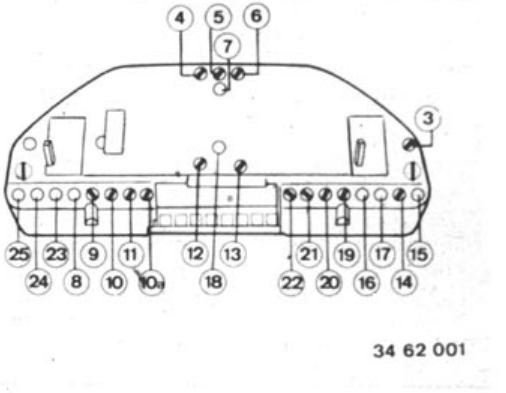
Remove instrument cluster - see 62 11 . . ..



1 Lamp for instruments
2 Lamp for LCD module
3 Fuel reserve
4 Right turn signals
5 High beams
6 Left turn signals
7 Turn signals (trailer hitched)
8 SRS
9 ABS
10 Brake fluid level and brake pad wear
11 Parking brake
12 Engine oil pressure
13 Battery charge
14 Rear fog lights
15 Front fog lamps
16 Not used
17 Not used
18 ASC
19 Fuel filter)
20 Not used)
21 Preheating) Diesel
22 Start engine)
23 Fasten seat belts
24 Ride level height control
25 Electronic absorber control

(Standard Version)





63 Lights

63 10 004	Aiming headlights	63-	10/1
63 12 120	Left or right double headlight assembly complete with headlight carrier – remove and install	63-	12/1
250	Headlight (for high beam), left or right – replace	63-	12/2
280	Headlight (for low beam), left or right – replace	63-	12/2
63 13 435	Actuator motor for headlight vertical aim control – replace	63-	12/3
. . .	Left or right complete turn signal indicator lamp – remove and install	63-	0/1
63 17 . . .	Fog light, left or right – replace	63-	0/1
63 21 . . .	Tail light cluster, left or right – replace	63-	21/1
63 25 000	Auxiliary brake light – remove and install or replace	63-	25/1
63 26 000	License plate light, left or right – replace	63-	0/1
63 99 . . .	Bulbs in left or right headlight assembly – replace	63-	99/1
315	Bulbs in left or right tail light – replace	63-	99/2

63-10/1

63 10 004 Adjusting headlights

Test precondition:

Check tire pressure and adjust if necessary. Load down driver's seat with one person (approx. 75 kg). Fuel tank full or additional weight in trunk. Park vehicle on level surface. Align adjusting device to longitudinal axis of vehicle and parallel to parking surface. Adjust marking line to dimension e (e.g. 12 cm/10 m) on aimer. The scale graduations on the aimer correspond to a gradient in cm at a distance of 10 m. The figure shows a marking line on a vertical wall 10 m away from headlight glass lenses. The same figure is also provided in the adjusting device on an adjustable plate.

Adjusting procedure:

For vertical adjustment, the light/dark boundary of the low-beam headlight must be aligned with the horizontal marking line of the adjusting device. For lateral adjustment, the kinked line must start below the central mark on the horizontal marking line.
The center point of the high-beam headlight is adjusted to the central mark.

Key

e = H - h = 12 cm on vertical wall at 10 m distance, or adjustment value on aimer.

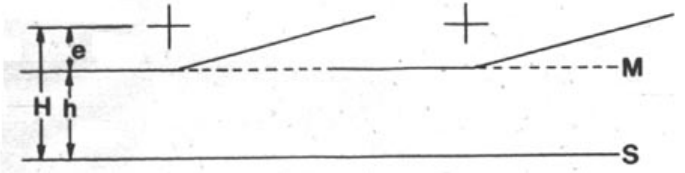
H = Height of headlight center point above parking surface

h = Height or marking line above parking surface

\+ = Central mark = Centre point of headlights

M = Marking line

S = Parking surface

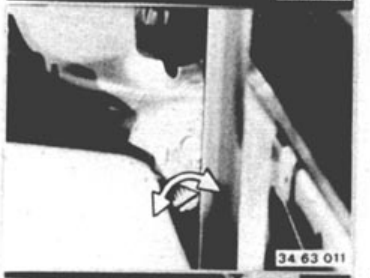


30 63 067



32 63 022

The headlight vertical aim is adjusted with screw (2) accessible from front grille.


34 63 011

Lateral adjustment takes place from the engine compartment (same as E30).



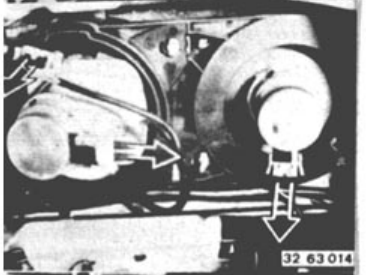
32 63 021

High-beam is adjusted from the front through the grille.
1 = Lateral adjustment
2 = Vertical adjustment



63 12 120 REMOVING AND INSTALLING LEFT OR RIGHT DOUBLE HEADLIGHT COMPLETE WITH CONSOLE

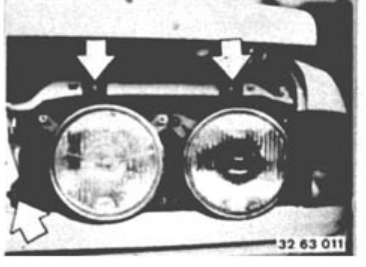
Remove radiator grill - see 51 13 000. Turn clips 90°, lift out alternator vent and pull out headlight cover from above.



Pull off plug.



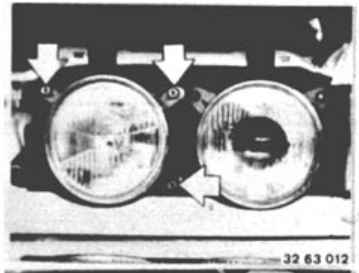
Unscrew screws.



Unscrew screws and remove headlight with console.

63 12 250 REPLACING LEFT OR RIGHT HEADLIGHT (HIGH BEAM)

Remove radiator grill - see 51 13 . . ..



Heat plastic sleeves with a hot air blower and lift out reflector.

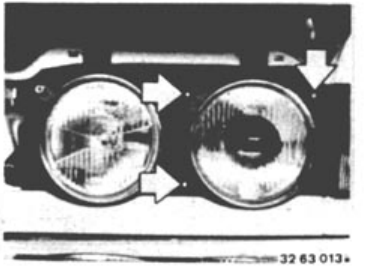
Installation:
First insert plastic bushings on ball-head pins and then press headlight on bushings.



1 = Lateral adjustment
2 = Vertical adjustment

63 12 280 REPLACING LEFT OR RIGHT HEADLIGHT (LOW BEAM)

Remove radiator grill - see 51 13 . . ..



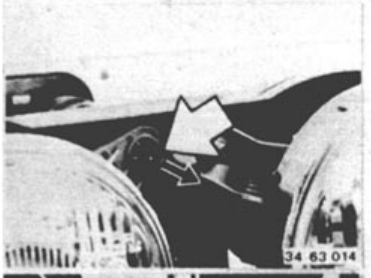
Heat plastic sleeves with a hot air blower and lift out reflector.

Installation:
First insert plastic bushings on ball-head pins and then press headlight on bushings.

1 = Lateral adjustment
2 = Vertical adjustment

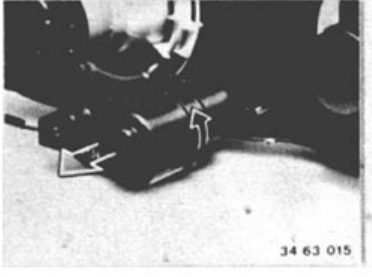
63 12 450/455 Removing and installing or replacing headlight vertical aim control

Remove front grille, refer to Group 51 13 ...



Heat up plastic bush with hot air blower and lift out ball head.

Note:
Headlight installed. Shown on removed headlight for better illustration.

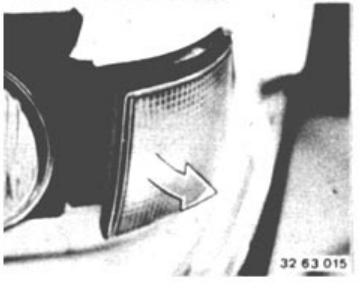


Disconnect plug connection.
Turn actuator motor and lift out.

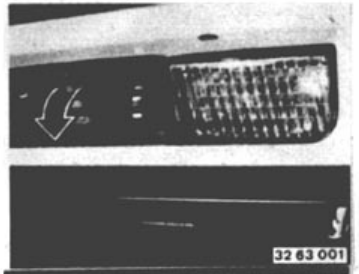


63 13 . . . REMOVING AND INSTALLING LEFT OR RIGHT FRONT TURN SIGNAL ASSEMBLY

Pull off plug.
Unscrew screws.

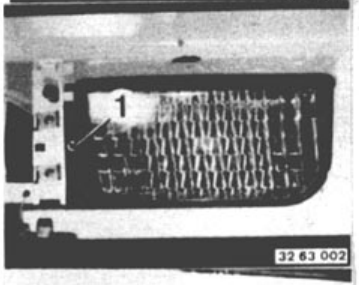


Pull turn signal forward and take out of holder on front side panel.

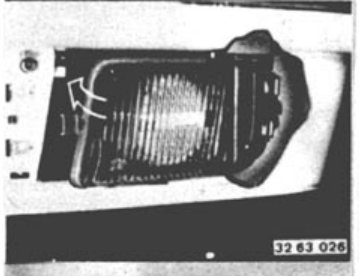


63 17 . . . REPLACING LEFT OR RIGHT FRONT FOG LAMP

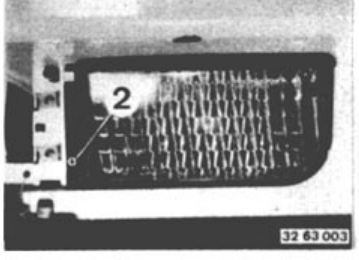
Lift out cover of towing eye.



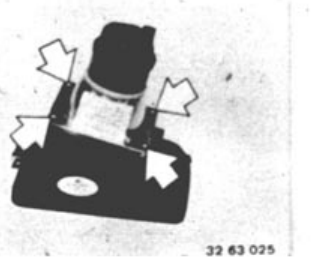
Unscrew screw (1).
Remove front fog lamp and pull off plug.



Installation:
First attach front fog lamp on the side and then tighten the screw.



Aiming:
Aim front fog lamps with a headlight aimer by turning screw (2).



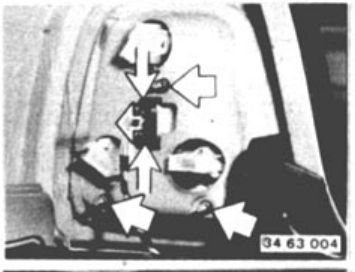
63 17 . . . REPLACING (ELLIPSOID) LENS FOR FRONT FOG LAMP

Remove front fog lamp - see 63 17 . . .
Unscrew screws and take off lens.

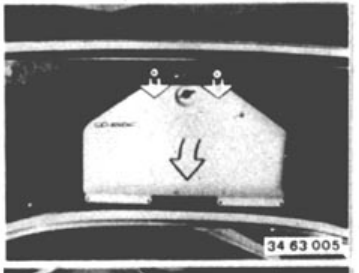


63 21 . . . REPLACING LEFT OR RIGHT TAIL LIGHT ASSEMBLY

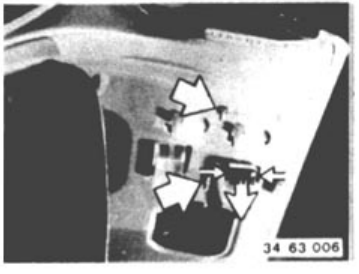
Turn clips 90° and lift them out.
Push back side trim panel.



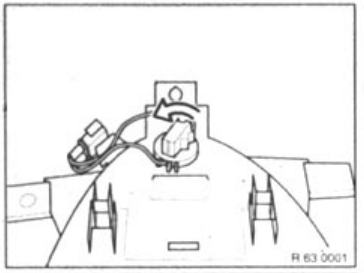
Pull off plugs.
Unscrew nuts.
Lift out tail light assembly.



Lift out clips and lift trunk lid trim panel.

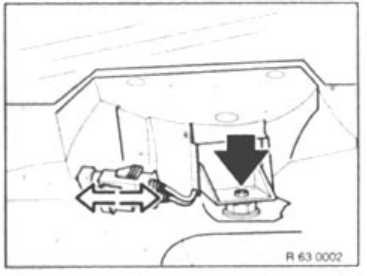


Pull off plugs.
Unscrew nut.
Lift out tail lights.

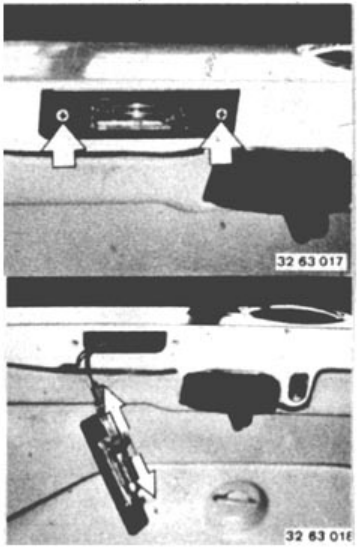


63 25 000 Removing and installing or replacing auxiliary brake light

Lim
Turn lamp socket (from trunk) and pull out.



Remove rear window shelf, refer to 51 46 000
Disconnect plug connection.
Release screws and remove brake light.



63 26 000 REPLACING LEFT OR RIGHT LICENSE PLATE LIGHT

Unscrew screws and remove light.

Pull off plug.

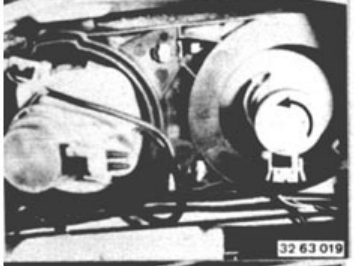
Note:
Light bulb type*.

* See Specifications

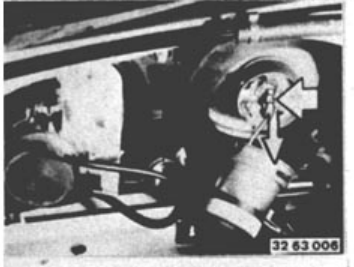


63 99 . . . REPLACING LIGHT BULBS IN LEFT OR RIGHT HEADLIGHT ASSEMBLY

Turn clips 90°, lift out alternator vent and pull out headlight cover from above.



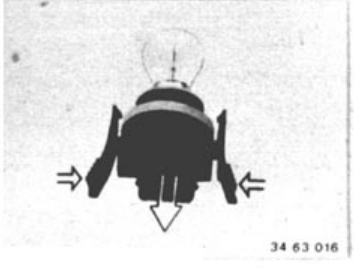
(High Beam Headlight)
Turn cap counterclockwise and take off.



Pull off plug.
Open holder and remove light bulb.

Note:
Never take hold of light bulb on glass.

Light bulb type*

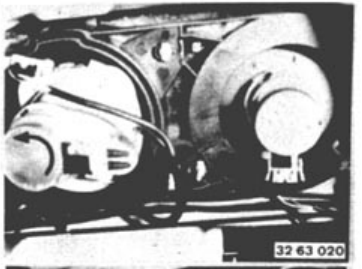


(Turn Signal)
Compress bulb holder on both clips and pull out toward rear.

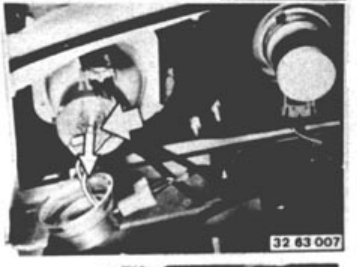
Note:
Picture was taken on removed bulb holder.

Light bulb type*

* See Specifications



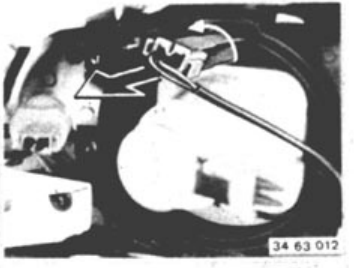
(Low Beam Headlight)
Turn cap counterclockwise and take off.



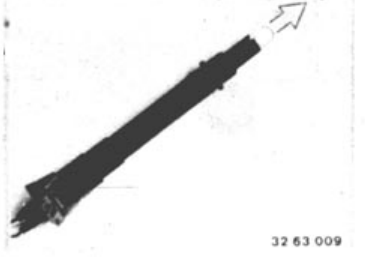
Pull off plug.
Open holder and remove light bulb.

Note:
Never take hold of light bulb on glass.

Light bulb type*



Turn and pull out bulb holder toward rear.



(Parking Light)
Pull light bulb out of holder and install a new light bulb.

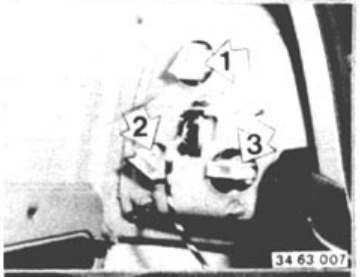
Note:
Light bulb type*

* See Specifications



63 99 315 REPLACING LIGHT BULB(S) IN LEFT OR RIGHT TAIL LIGHT ASSEMBLY

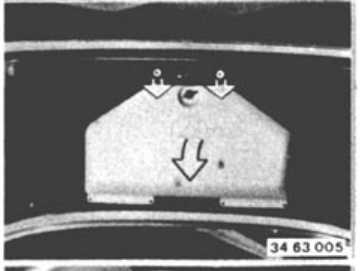
Turn clip 90° and lift out.
Push back side trim panel.



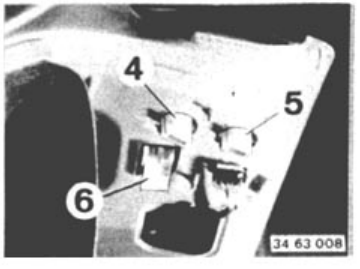
Turn lamp socket counterclockwise and lift out lamp socket with light bulb.

1 Turn signal
2 Stop light
3 Tail light

Note:
Pertinent light bulb type will be found on the lamp socket.

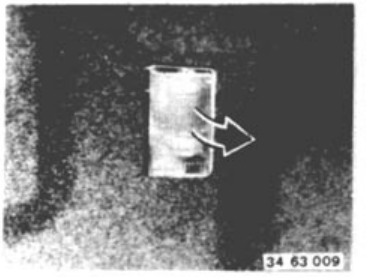


Lift out clips and lift trunk lid trim panel.



Turn lamp socket counterclockwise and lift out lamp socket with light bulb.

4 Backup light
5 Rear fog light
6 Trunk light

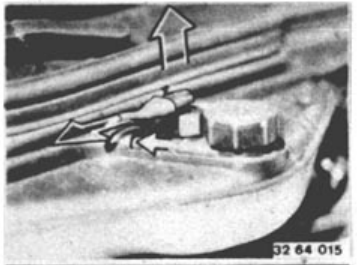


63 99 451 REPLACING LIGHT BULB FOR TRUNK LIGHT

Pull off lamp cover and lift out light bulb.

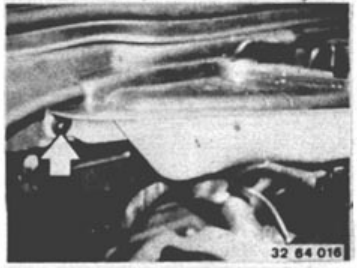
64 Heating and air conditioning

64 11 200	Heating system – remove and install (heating)	64-	11/1
205	Heating system – remove and install (air conditioning unit)	64-	11/2
207	Heater – replace (IHKA and IHKR)	64-	11/4
207	Heater – replace (HR)	64-	11/5
210	Heater fan – remove and install or replace	64-	11/6
	Splash wall – remove	64-	11/6
260	Auxiliary water pump – replace	64-	11/8
270	Valve insert for water valve – remove and install or replace	64-	11/9
271	Water valve – remove and install	64-	11/9
590	Output stage for fan – replace (IHKA, IHKR I)	64-	11/10
220	Resistance for fan motor – replace (HR, IHKR II and IHKR III)	64-	11/11
750	Operating unit – remove and install (heating and air conditioning HR, IHKR)	64-	11/11
750	Heater actuation – remove (automatic air conditioning system IHKA)	64-	11/12
61 31 551	Switch for fan – replace (heating)	64-	11/12
64 11 760	Control unit for heating control – replace (heating)	64-	11/12
765	Control unit for rear window – replace (air conditioning control)	64-	11/13
765	Control unit for heating and air conditioning – replace (IHKA, IHKR)	64-	11/14
775	Fan for interior temperature sensor – replace (only air conditioning control and automatic system)	64-	11/15
785	Printed circuit board for heating actuation – replace (only in automatic air conditioning system)	64-	11/15
. . .	LED's – replace	64-	11/16
. . .	One Bowden cable – replace (HR)	64-	11/17
. . .	Actuator motor – replace (IHKA, IHKR)	64-	11/17
933	External temperature sensor – replace	64-	11/18
939	Temperature sensor for heater, left or right – replace	64-	11/19
937	Condenser sensor – replace	64-	11/20
64 31 010	Microfilter – replace (heating)	64-	31/1
010	Microfilter – replace (air conditioning unit)	64-	31/2
	Function of refrigerant circuit (R12)	64-	50/1
	Service device (R12)	64-	50/2
64 50 009	Air conditioning unit – evacuate and fill (R12)	64-	50/3
	Air conditioner – suction-clean (R12)	64-	50/4
	Old refrigerator oil (R12) – drain	64-	50/4
	Air conditioner (R12) – discharge	64-	50/5
	System – fill	64-	50/6
	Leaks (R12) – detect	64-	50/6
	Refrigerant (R12) – clean	64-	50/7
	Troubleshooting using pressure measurement (R12)	64-	50/8
	Air conditioner – check efficiency (R12)	64-	50/9
	Function of refrigerant circuit (R134a)	64-	50/10
	Service device (SECU 134)	64-	50/11
009	Air conditioning system – evacuate and fill (R134a)	64-	50/12
	Air conditioner – suction-clean (R134a)	64-	50/13
	Old refrigerant – drain	64-	50/13
	Air conditioner (R134a) – discharge	64-	50/14
	System (R134a) – fill	64-	50/15
	Leaks (R134a) – detect	64-	50/16
	Refrigerant (R134a) – clean	64-	50/17
	Troubleshooting using pressure measurement (R134a)	64-	50/18
	Air conditioner – check efficiency (R134)	64-	50/19
64 51 000	Evaporator – clean	64-	51/1
	Vehicles with IHKA	64-	51/1
	On vehicles with IHKR	64-	51/2
510	Evaporator – remove and install	64-	51/4
520	Expansion valve – remove and install or replace	64-	51/4
64 52 . . .	Valve core – remove and install	64-	52/1
020	Compressor for air conditioning system – replace (M20, M30)	64-	52/2
020	Compressor for air conditioning unit – replace (M60)	64-	52/3
020	Compressor for air conditioning unit – replace (M51)	64-	52/4
020	Compressor for air conditioning unit – replace (50)	64-	52/5
61 31 . . .	Temperature switch for compressor – replace	64-	52/6
64 52 061	Compressor coupling – replace (M20, M30, M50 with Vee belt)	64-	52/7
061	Compressor coupling – replace (on Seiki compressor)	64-	52/8
061	Compressor coupling – replace (on Nippondenso compressor)	64-	52/9
64 53 510	Dryer flask for air conditioning system – replace	64-	53/1
520	Safety pressure switch (high, medium, low pressure switch) – replace	64-	53/2
550	Condenser for air conditioning system – remove and install or replace	64-	53/3



64 11 200 REMOVING AND INSTALLING HEATER
(Heating System)

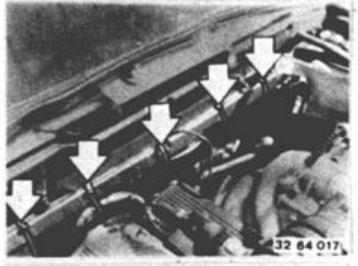
Pull the profile rubber part up.
Disconnect the plug and spill hose at the expansion tank.



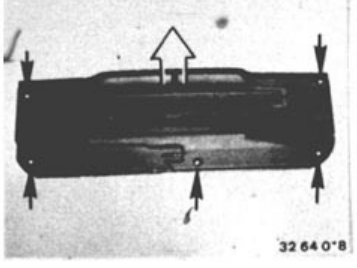
524td, 530i and 535i:
Unscrew nuts on left and right sides of the expansion tank and lay the tank aside.

Note:
Don't bend the coolant hose.

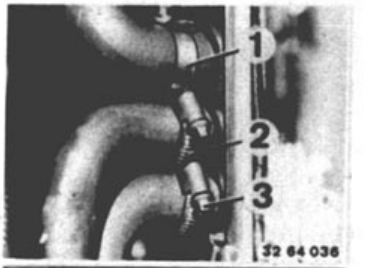
520i and 525i:
If applicable, unscrew and lay the intensive cleaning fluid tank aside.



Cut the wire straps off.



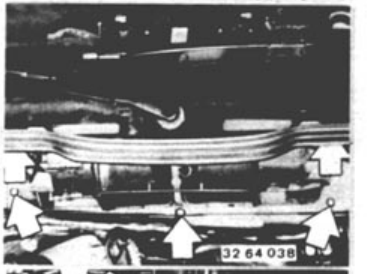
Unscrew screws and pull the cover up.



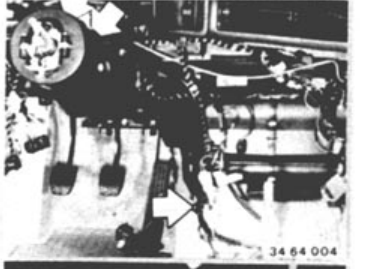
Disconnect heater hoses (1 ... 3).

1 Water return
2 Water feed, right
3 Water feed, left

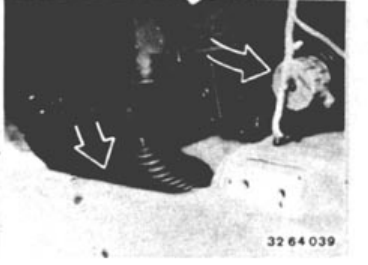
Important!
Blow air into return pipe (1) of the heater to remove residual water from the heater core.



Unscrew screws.



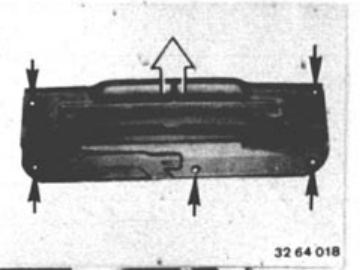
Unscrew screws and lift the left holder out.



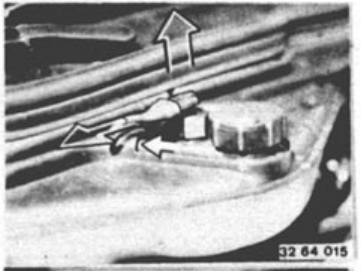
Lift the left and right air ducts out.
Remove the heater.

64 11 205 REMOVING AND INSTALLING HEATER
(Air Conditioning System)

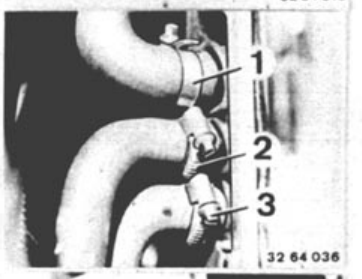
Suck refrigerant out of the air conditioner (refer to page 64-50/4 or operating instructions of pertinent sucking machine).
Remove complete dashboard - refer to Group 51.



Unscrew screws and pull the cover up.



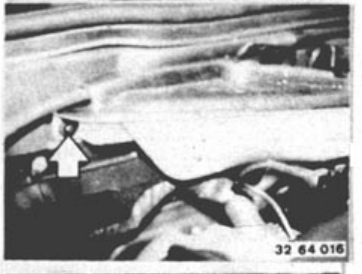
Pull the profile rubber part up.
Disconnect the plug and spill hose at the expansion tank.



Disconnect heater hoses (1 ... 3).

1 Water return
2 Water feed, right
3 Water feed, left

Important!
Blow air into return pipe (1) of the heater to remove residual water from the heater core.



524td, 530i and 535i:
Unscrew nuts on left and right sides of the expansion tank and lay the tank aside.

Note:
Don't bend the coolant hose.

520i and 525i:
If applicable, unscrew and lay the intensive cleaning fluid tank aside.



Unscrew nut.

Installation:
Tightening torque*.
Replace the O-rings.

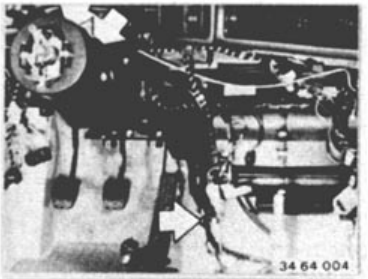


Cut the wire straps off.

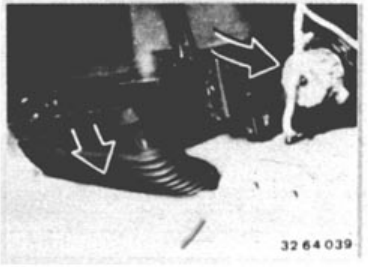


Unscrew screws.

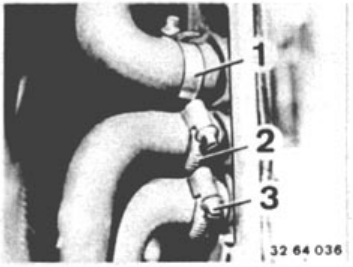
* Refer to Specifications



Unscrew screws and lift the left holder out.



Lift the left and right air ducts out.
Remove the heater.



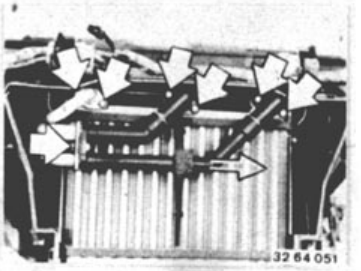
64 11 207 REPLACING HEATER CORE (IHKA and IHKR)

Remove center console and glovebox - refer to Group 51).
Disconnect heater hoses (1 ... 3).

1 Water return
2 Water feed, right
3 Water feed, left

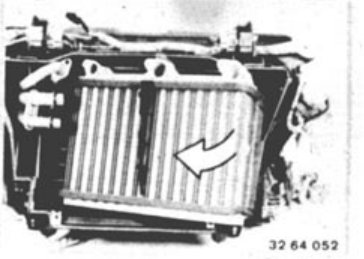
Important!
Blow air into return pipe (1) of the heater to remove residual water from the heater core.

Installation:
Add coolant and bleed the cooling circuit - refer to Group 17.

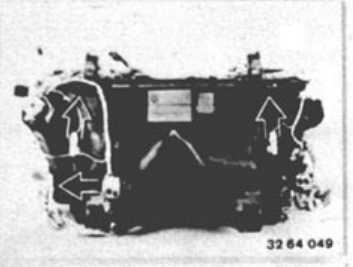


Unscrew screws.
Lift the heater pipes out.

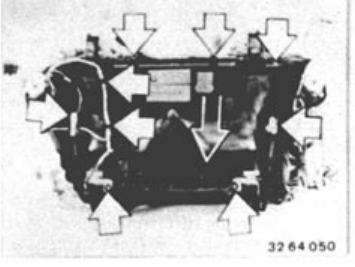
Installation:
Replace the O-rings.



Lift the heater core out from the right side.



Lift the front ventilation drive motor out and pull plugs off of both heat exchanger sensors.

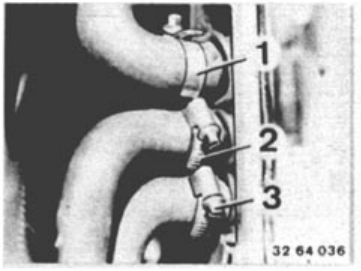


Unscrew screws, loosen wire straps and clamps, and remove the cover.

Installation:
Check for correct seating of the cover.

64 11 207 REPLACING HEATER CORE (HR)

Remove the dashboard trim panel at bottom left and the center console - refer to Group 51.

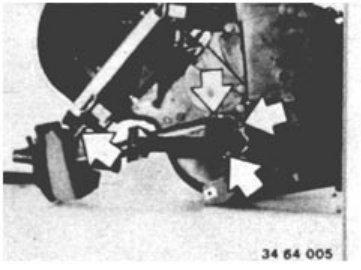


Disconnect heater hoses (1 ... 3).

1 Water return
2 Water feed, right
3 Water feed, left

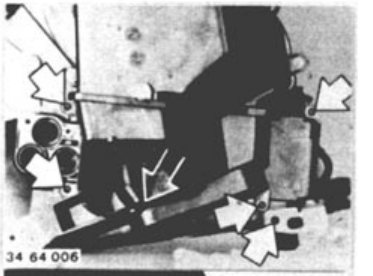
Important!
Blow air into return pipe (1) of the heater to remove residual water from the heater core.

Installation:
Add coolant and bleed the cooling circuit - refer to Group 17.

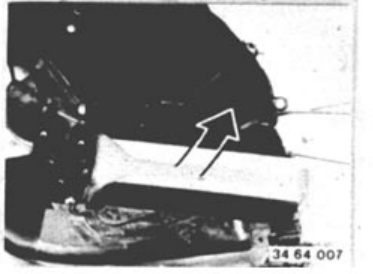


Unscrew screws and lift the heater pipes out.

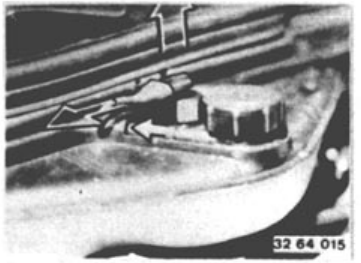
Note:
The heater remains installed (heater was removed for this picture only in the interest of better understanding).



Unscrew screws and lift the cover out.

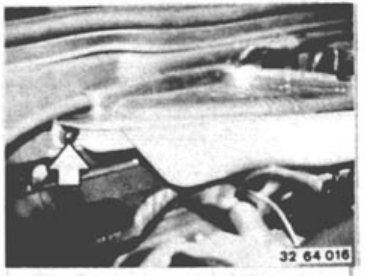


Lift the heater core out.



64 11 210 Removing and installing or replacing fan for heating system

Remove splash wall:
524td, 530i, 535i,
Disconnect negative terminal (battery).
Lift up rubber profile. If necessary, remove plug and overflow hose on expansion tank.

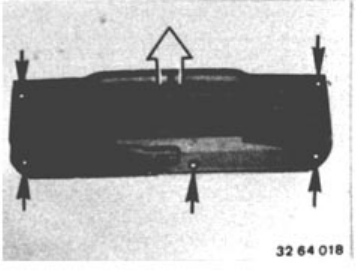


Unfasten nuts on left and right sides of expansion tank and place tank to one side.

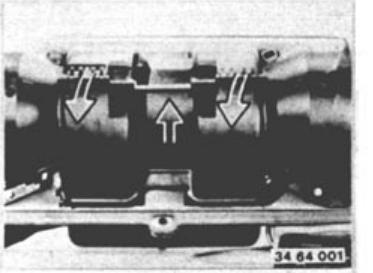
Note:
Do not bend coolant hose.
520i, 525i: if necessary, remove container for intensive cleaning and place to one side.



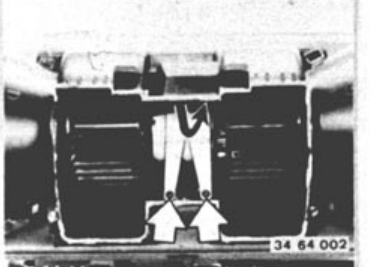
Cut off wire straps.



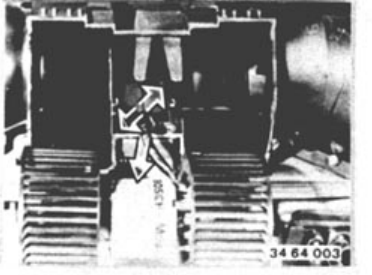
Unfasten screws and lift off cover.



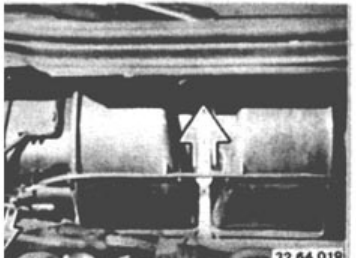
On heating system:
Remove fan:
Unfasten clips and remove cover.



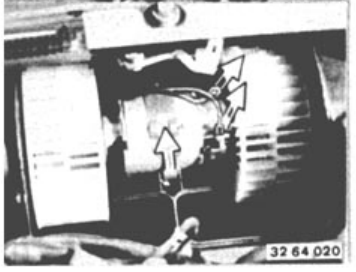
Unfasten screws and lift up bracket.



Unfasten fan motor and remove plug.



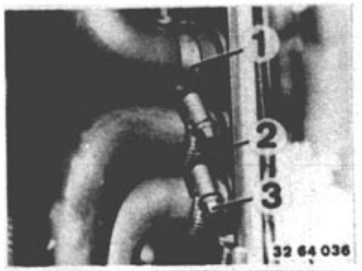
On air-conditioning system:
Remove splash wall, refer to 64 11 210
Disconnect Bowden cable and unclip from cover.
Open plastic tab and remove cover.



Pull off plugs.
Lift off metal tab and remove fan.

Installation:
The position of the fan motor is predetermined by the shape of the housing.

Caution!
Do not remove or twist fan gears on motor shaft since the motor is balanced in a unit together with the fan gears.



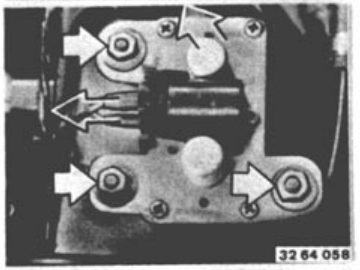
64 11 260 REPLACING ADDITIONAL WATER PUMP

Disconnect heater hoses (2 and 3).

Installation:
Add coolant and bleed the cooling circuit - refer to Group 17.

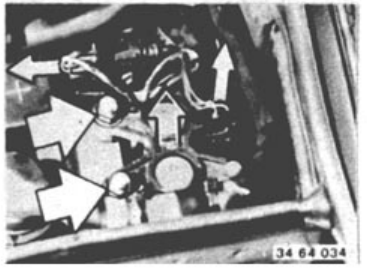


Disconnect the additional hose from the additional water pump.



Version with Metal Upper Section:

Disconnect the plug.
Unscrew nuts and lift the water valve out together with the pump.

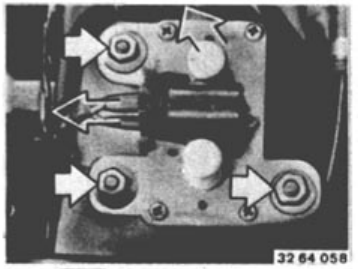


Version with Plastic Upper Section:

Disconnect the plug.
Unscrew nuts and lift the water valve out together with the pump.



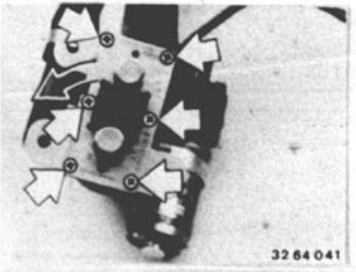
Loosen the clamp and unscrew screw.
Remove the pump.



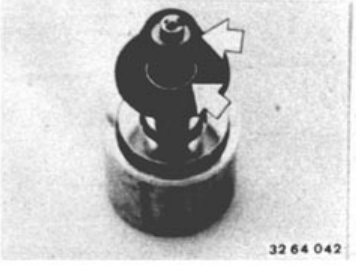
64 11 270 REMOVING AND INSTALLING / REPLACING VALVE INSERT FOR WATER VALVE

Only for Version with Metal Upper Section:

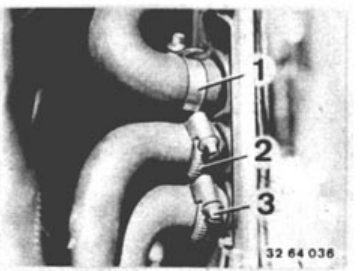
Disconnect the plug and unscrew screws.



Unscrew screws and remove the cover.



Lift the complete valve insert out.



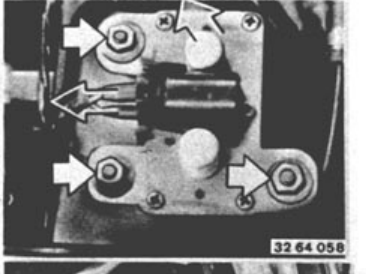
64 11 271 REMOVING AND INSTALLING WATER VALVE

Disconnect heater hoses (2 and 3).

Installation:
Add coolant and bleed the cooling circuit - refer to Group 17.

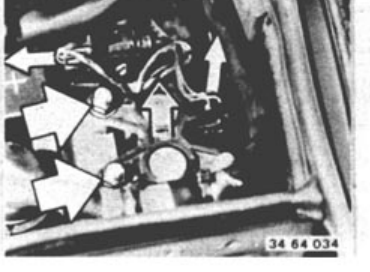


Disconnect the additional hose from the additional water pump.



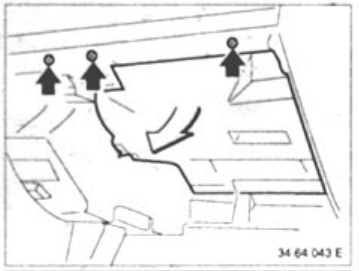
Version with Metal Upper Section:

Disconnect the plug.
Unscrew nuts and lift the water valve out together with the pump.



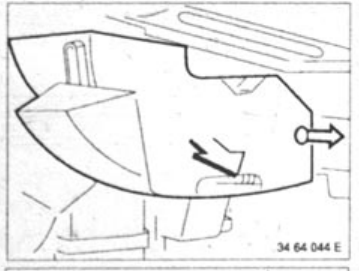
Version with Plastic Upper Section:

Disconnect the plug.
Unscrew nuts and lift the water valve out together with the pump.

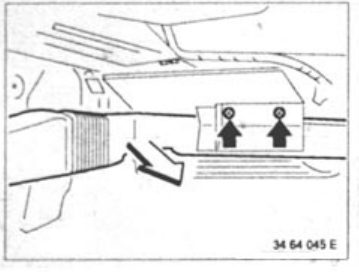


64 11 590 REPLACING FINAL STAGE FOR BLOWER
(IHKA and IHKR I)

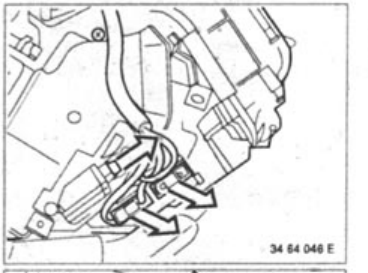
Remove the glovebox - refer to Group 51.
Unscrew screws.
Pull the trim panel forward out of the rear clips.



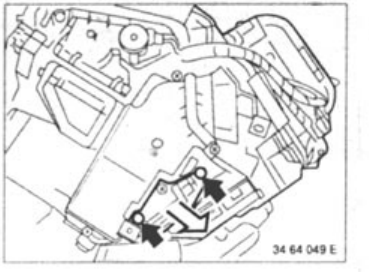
Pull the clip out and remove the cover.



Unscrew screws and lift the air duct out.



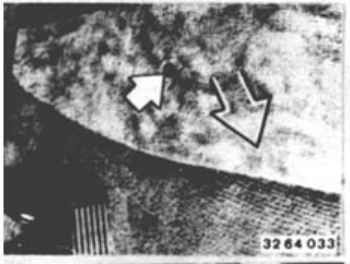
Disconnect all plugs on the control unit and final stage, and place the wire harness on top.



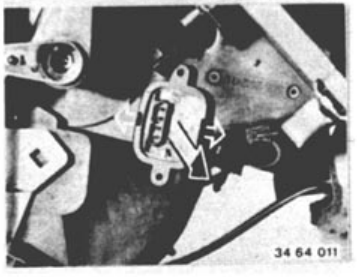
Unscrew screws and pull the final stage out.

64 11 220 Replace resistance for fan motor. (HR, IHKR II and IHKR III)

on HR:
Remove glovebox and underside trim, refer to Gr. 51 ...



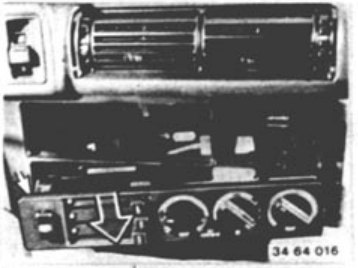
on IHKR II and III:
Unfasten screw and remove trim on left side.



Remove plug,
force apart clips and lift out resistance.

64 11 750 Removing and installing operating unit. (Heating and air conditioning control unit HR, IHKR)

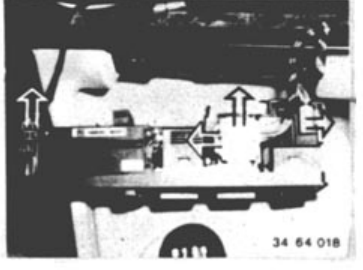
Remove radio panel or radio, refer to Gr. 65.



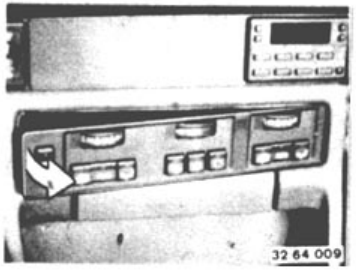
Reach through radio aperture and press together clips on operating section, lifting out operating section on left side.



Press together counter-support, unclip and lift out inner Bowden cable on operating lever.

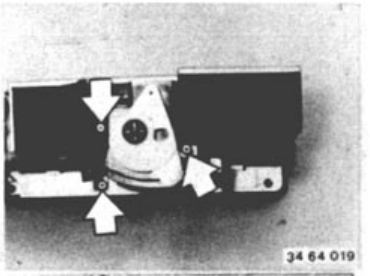


Disconnect plug.



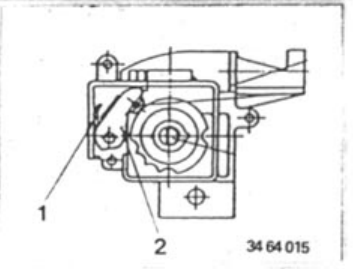
64 11 750 REMOVING HEATER CONTROLS
(Automatic Climate Control IHKA)

Remove the rear window defogger switch cover.
Insert a screwdriver through the rear window defogger switch opening and push the lock back.
Lift the control unit out and disconnect the plugs.

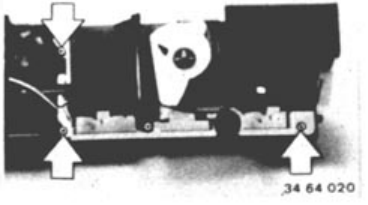


61 31 551 REPLACING SWITCH FOR BLOWER
(Heating System)

Remove the heater controls - refer to 64 11 750.
Unscrew screws and remove the blower switch.

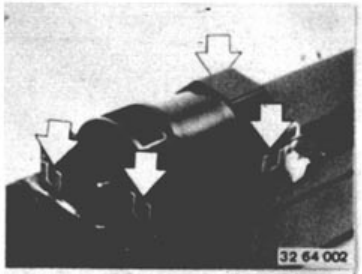


Important!
Ensure that the catch lever (2) and spring (3) do not slide out while removing the blower switch.



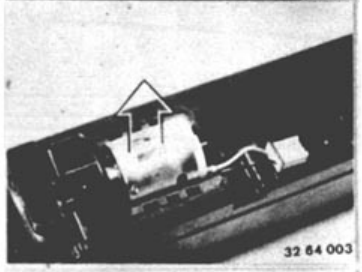
64 11 760 REPLACING CONTROL UNIT FOR HEATING REGULATION
(Heating System)

Remove the heater controls - refer to 64 11 750.
Remove the blower switch - refer to 64 31 551 above.
Unscrew screws and remove the heating regulation control unit.

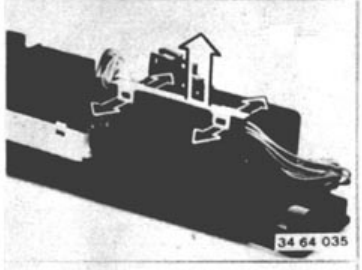


64 11 765 Replacing control unit for rear window (air-conditioning control)

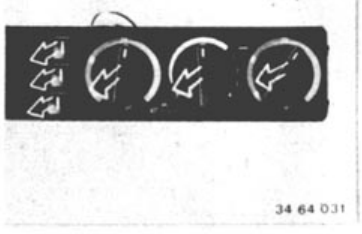
Remove heating actuation, refer to 64 11 750
To remove the fan, slightly raise the clips on the cover and remove lid.



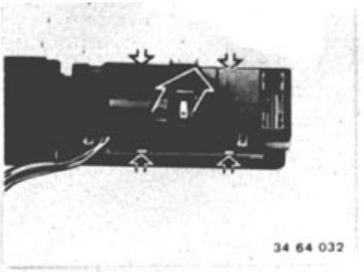
Remove plug and lift out fan assembly.



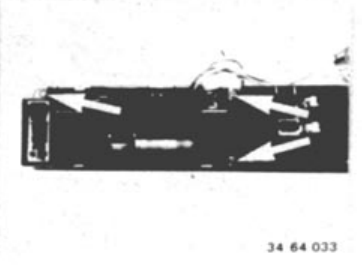
Slightly raise clips on cable cover and lift off cover.



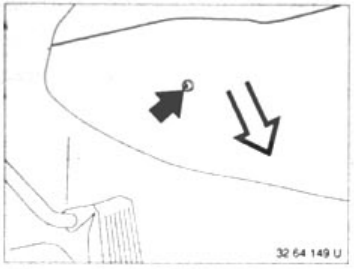
Remove operating knobs.



Press together clips and lift out cover.



Unfasten screws and lift out control unit together with Bowden cable unit.

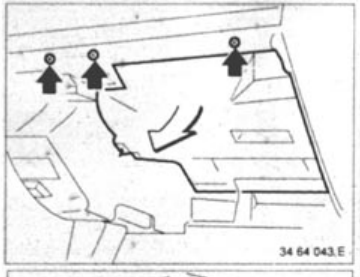


64 11 765 Replacing control unit for heating and air-conditioning control (IHKA, IHKR)

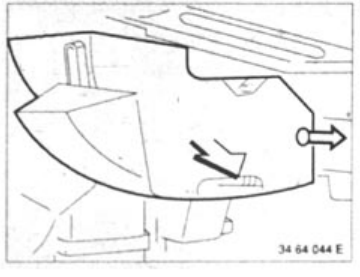
Remove glovebox, refer to Group 51: unfasten screw and remove trim from left and right sides.



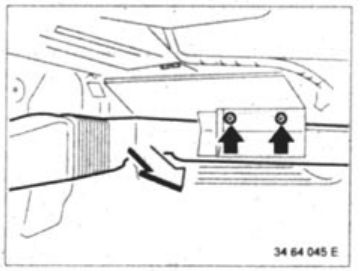
Remove plug from left side of control unit.



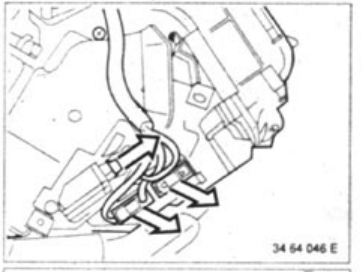
Unscrew bolts.
Remove trim by pulling away from rear clip.



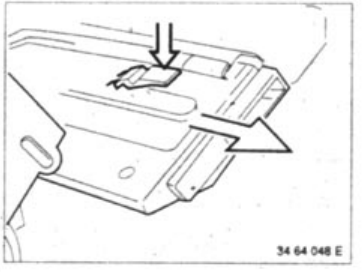
Remove clip and lift out cover.



Unfasten screws and lift out ventilation duct.

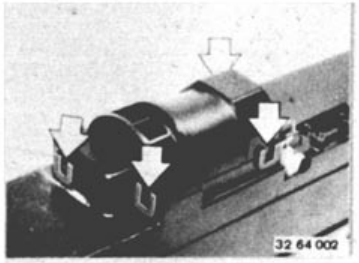


Remove all plugs on control unit and output stage and place wiring harness on top.



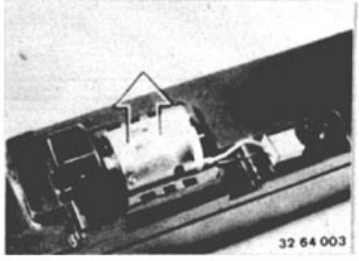
Press down clips and lift control unit out on right side.

Caution!
The new IHKR control unit must be coded: refer to Information Diagnosis/Encoding

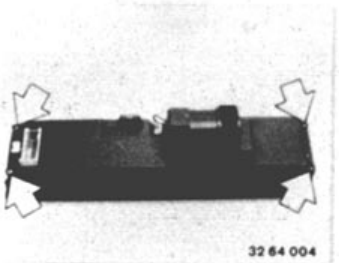


64 11 775 REPLACING FAN FOR INSIDE TEMPERATURE SENSOR (Only Air Conditioning System and Automatic Climate Control)

Remove the heater controls - refer to 64 11 750.
To remove the sensor fan, lift the clips on the cover slightly and remove the cover.

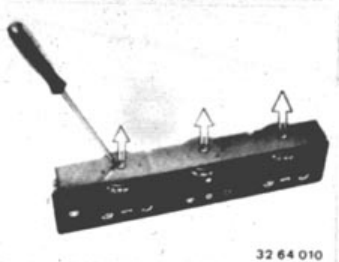


Disconnect the plug and remove the sensor fan.

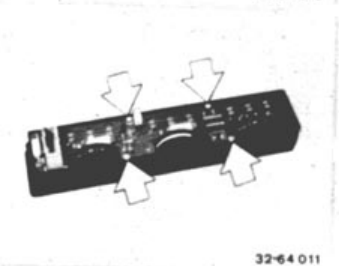


64 11 785 REPLACING PRINTED CIRCUIT BOARD FOR HEATER CONTROLS (Only Automatic Climate Control)

Remove the heater controls - refer to 64 11 750.
Remove the sensor fan - refer to 64 11 775.
Unscrew screws and remove the cover.



Push the retainer back on the pin and lever the pin out.



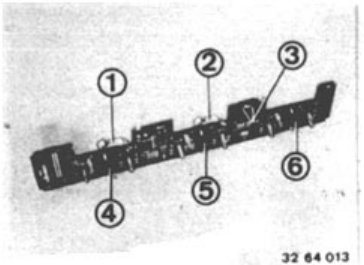
Unscrew screws and remove the printed circuit board.

Note:
Push the microswitch back while removing.



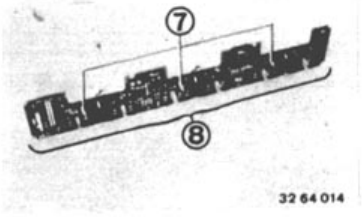
Simply pull control wheels or buttons out upwards to replace them.

Installation:
Ensure correct position of the control wheel to the potentiometer.



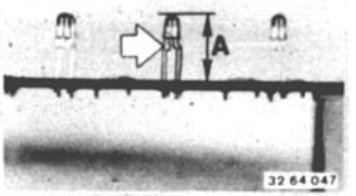
32 64 013

Printed Circuit Board Connections:
1 Microswitch - temperature (driver)
2 Microswitch - fan
3 Inside temperature sensor
4 Potentiometer - temperature (driver)
5 Potentiometer - fan
6 Potentiometer - temperature (front passenger)

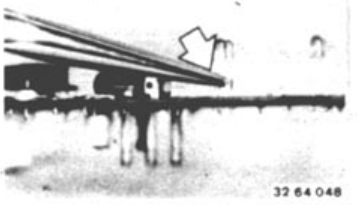


32 64 014

7 Light bulbs
8 Light emitting diodes



32 64 047


32 64 048

64 11 ... REPLACING LIGHT EMITTING DIODES

Check the installed direction and depth before unsoldering.
Cathode is marked with a tab.

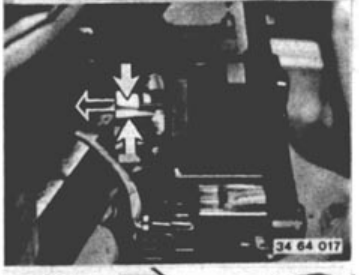
Distance A = approx. 12 mm

Make sure of good carrying off of heat (via pliers or tweezers) while unsoldering and soldering.



64 11 ... REPLACING ONE CABLE (HR)

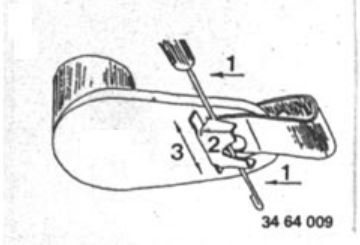
Remove the radio opening mask or radio - refer to Group 65.
Squeeze the clip and lift the control panel out to the left.



Squeeze the clip of the concerned cable, lift it out of the counterholder and disconnect from the heater controls.

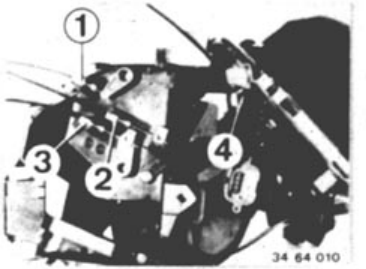


Remove the glovebox and bottom trim panel - refer to Group 51.
Lift the internal cable out of the clip.
Squeeze clip (1) and press the cable out of the holder.



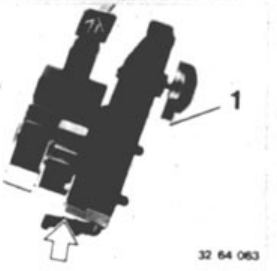
The cables are adjusted automatically with a special clip by moving the control left to the left or right stop.

1 = installed direction of internal cable
2 = Special clip
3 = Moved direction of internal cable



Note:
Cables and levers are marked with different colors.

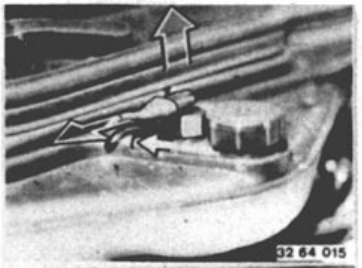
1 = red
2 = blue
3 = green
4 = yellow



64 11 ... REPLACING DRIVE MOTOR (IHKA and IHKR)

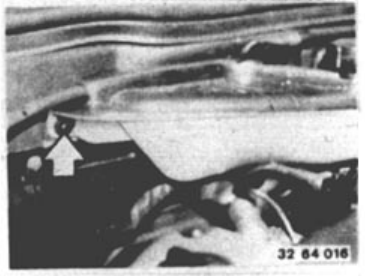
Disconnect the plug.
Press down on the retainer and lift the motor out.

Installation:
Check for correct location of the stop.



64 11 933 REPLACING OUTSIDE TEMPERATURE SENSOR

524td, 530i and 535i:
Disconnect the battery ground lead.
Pull the profile rubber part up.
Disconnect the plug and spill nose at the expansion tank.



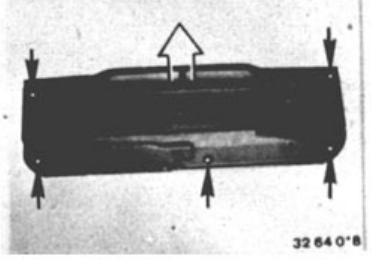
Unscrew nuts on left and right sides of the expansion tank and lay it aside.

Note:
Don't bend the coolant hose.

520i and 525i:
If applicable, unscrew and lay the intensive cleaning fluid tank aside.



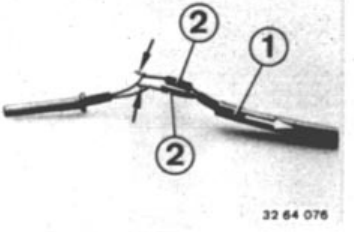
Cut the wire straps off.



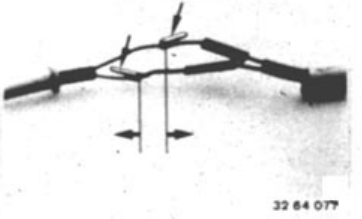
Unscrew screws and pull the cover up.



Cut through the wires about 3 cm away from the sensor and remove about 4 cm of the insulating hose.

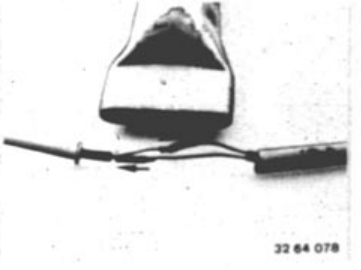


Install shrink-fit hose (1) and insulating hose (2) on the wire.
Connect the ends of wires from the new sensor with the wires.

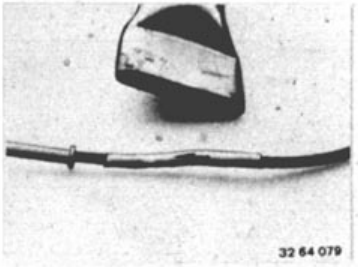


Solder the ends of wires.

Note:
Ensure that the soldered points are offset (danger of short circuit).



Push insulating hoses over the soldered points and shrink by heating with a hot air blower.



Push the shrink-fit hose over the wires and shrink by heating with a hot air blower.

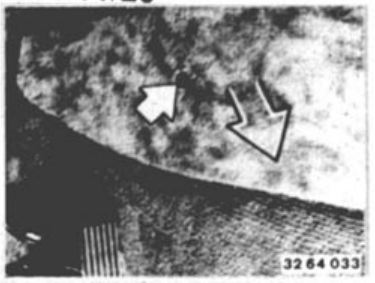
64 11 939 REPLACING TEMPERATURE SENSOR FOR LEFT OR RIGHT HEATER CORE

Remove the center console - refer to Gr. 51.



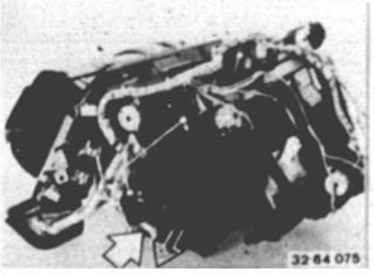
Disconnect the plug and lift the temperature sensor out.

Note:
Shown in picture on a removed heater for better understanding.



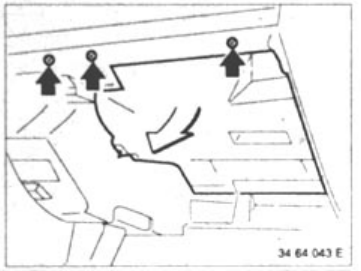
64 11 937 REPLACING EVAPORATOR TEMPERATURE SENSOR

Unscrew screw and pull trim panel off of the center console.



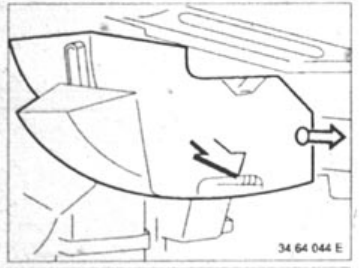
Disconnect the plug and lift the evaporator temperature sensor out.

Note:
Shown in picture on a removed heater for better understanding.

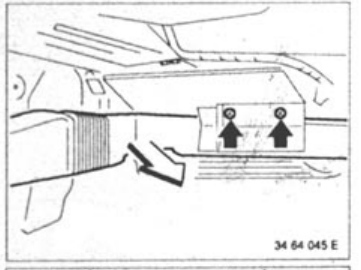


64 31 010 REPLACING MICROFILTER (Heating System)

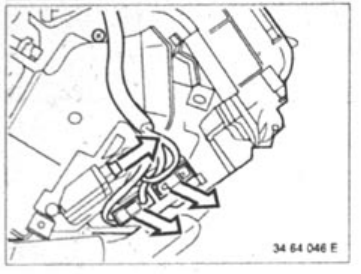
Remove the glovebox - refer to Group 51.
Unscrew screws.
Pull the trim panel forward out of the rear clip.



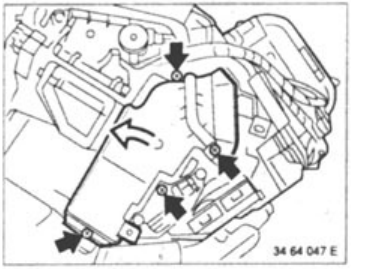
Pull the clip out and remove the cover.



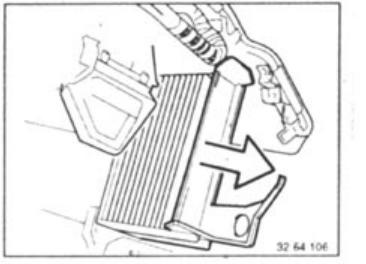
Unscrew screws and lift the air duct out.



Pull all plugs off of the control unit and place the wire harness on top.

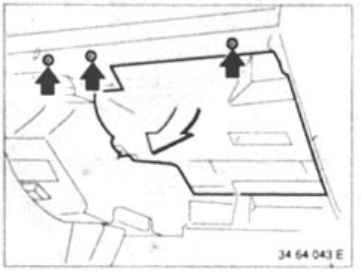


Unscrew screws and remove the cover.



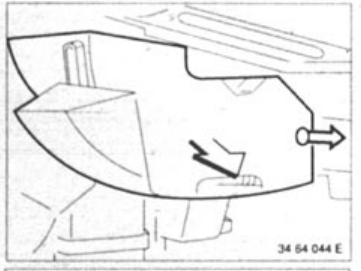
Pull the microfilter out.

Note:
In RHD models the microfilter is split in length so that it can be pulled on to the steering column.

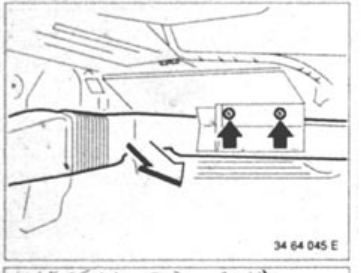


64 31 010 REPLACING MICROFILTER (Air Conditioning System)

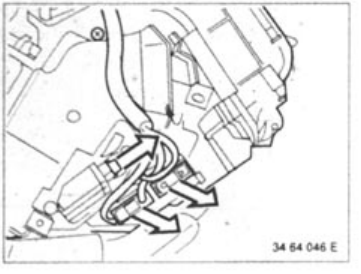
Remove the glovebox - refer to Group 51.
Unscrew screws.
Pull the trim panel forward out of the rear clip.



Pull the clip out and remove the cover.



Unscrew screws and lift the air duct out.

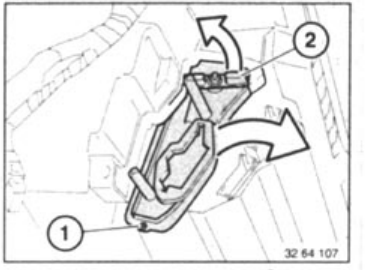


Pull all plugs off of the control unit and place the wire harness on top.

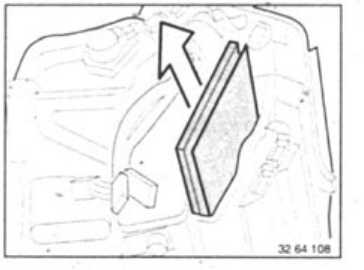
With Automatic Climate Control:
Also pull plug off of the final stage.



With Automatic Climate Control:
Unscrew screws and pull the final stage out.



Unscrew screw (1), turn holder (2) about 90° and remove the cover.



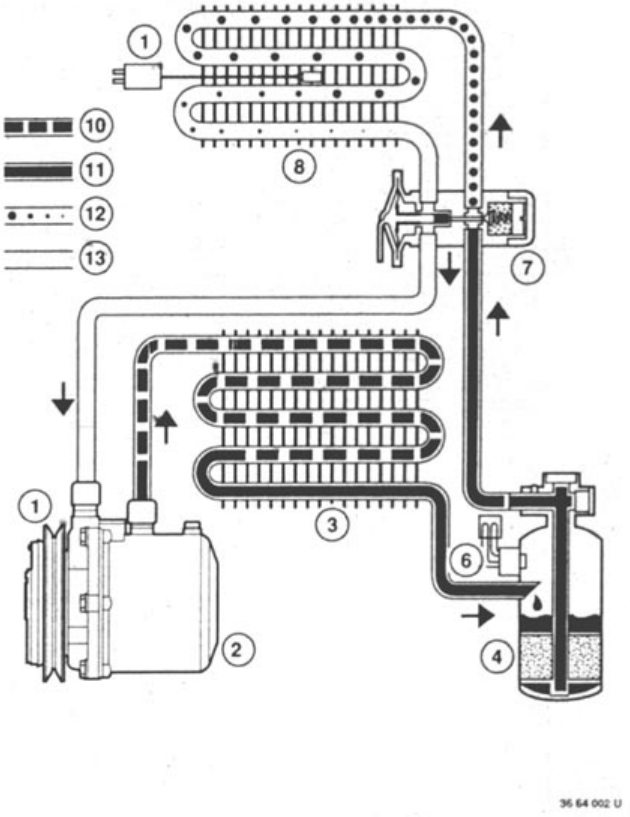
Pull the microfilter out.

Note:
In RHD models the microfilter is split in length so that it can be pulled on to the steering column.

DESCRIPTION OF REFRIGERANT CIRCUIT FUNCTION R 12)

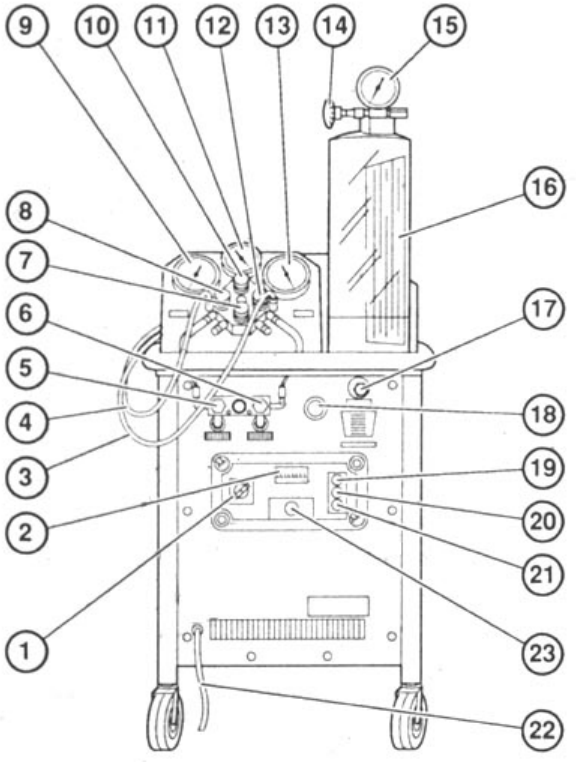
After switching on the air conditioner the refrigerant circuit is activated in that the solenoid clutch receives current. This produces positive connection between the pulley and armature clutch plate and the compressor is driven.

The compressor, a major component of the system, increases the pressure of refrigerant vapors. Refrigerant vapors are drawn in on the intake side of the compressor. The refrigerant is compressed, whereby the vapor temperature rises. The high pressure vapors pass via a high pressure pipe to a condenser located on the face of the engine radiator. The hot refrigerant is cooled off by wind from driving and an additional fan. Refrigerant vapors condense and turn into liquid when reaching the dew point temperature. The high pressurized refrigerant is delivered to the drier. The drier removes moisture from the refrigerant and sometimes also acids, but the latter only in the amount of 6 to 10 grams for R 12 or 10 to 16 grams for R 134 a systems.
Refrigerant continues on to the expansion valve from the drier. The expansion valve makes up a point of separation in the system. The expansion valve meters the refrigerant. Volume of refrigerant is controlled by the temperature and pressure at the outlet of the evaporator. The refrigerant evaporates and cools off considerably in the evaporator. The fresh air – respectively circulated air – flowing past the cold evaporator, with blower support, is cooled accordingly and delivered into the passenger compartment via nozzles.
The evaporated refrigerant is drawn in again by the compressor, whereby the refrigerant circuit is completed.
Moisture from the fresh or circulated air, flowing past the evaporator, condenses on the cold fins. The condensation on the evaporator is discharged outdoors via rubber hoses on the transmission tunnel and could cause a puddle of up to 200 ml underneath a parked car depending on the atmospheric moisture. This is completely normal and does not indicate a leak.
It could happen that the condensation water freezes on the fins of the evaporator. An evaporator temperature sensor prevents the formation of ice in that is switches the compressor off at 2° C. The compressor is switched on again with a reversing range of 2° C. A safety switch (high or low pressure pressostat) switches the air conditioner off when pressure is too high or too low. This prevents damage to the air conditioner. A medium pressure pressostat switches the second stage of an addition fan on at a pressure of about 18 bar.
In this manner the compressor is not switched off and on so often, as the maximum high pressure is not reached so fast.



36 64 002 U

1 Solenoid clutch
2 Compressor
3 Condenser
4 Drier
6 Safety switches (high/low pressure pressostats)
7 Expansion valve
8 Evaporator
9 Temperature switch
10 High pressure gas
11 High pressure liquid
12 Low pressure liquid
13 Low pressure gas



36 64 003

SERVICE STATION (R 12)

1 Main switch
2 Operation hour counter
3 High pressure hose
4 Low pressure hose
5 Refrigerant inlet valve
6 Refrigerant outlet valve
7 Vacuum pump valve
8 Low pressure valve
9 Low pressure gage
10 Vacuum meter valve
11 Vacuum meter
12 High pressure valve
13 High pressure gage
14 Charging cylinder valve
15 Charging cylinder high pressure gage
16 Charging cylinder with scale
17 Refrigerant drain valve
18 Moisture indicator
19 Control lamp - red
20 Control lamp - yellow
21 Control lamp - green
22 Power supply cord
23 Charging cylinder push button switch

64 50 009 DISCHARGING AND CHARGING AIR CONDITIONER (R 12)

Safety Precautions for Handling Refrigerant:

The air conditioning system is filled with safety refrigerant Frigen R 12 or Frigen R 134a gradually as from the beginning of 1991.

Important!

R 12 and R 134a must never be mixed as even the most minute mixed quantities would lead to decomposition in the system. Consequently systems for R 12 may only be filled with R 12 and vice versa. Different refrigerant oils are used for both systems and must also not be mixed. Vehicles with R 134a systems as well as parts for replacements are marked. The service station for R 134a is green and marked R 134a. The service station for R 12 is blue.

Frigen R 12 is very dangerous for the environment because of fluorchlorhydrocarbons (FCH) and must be drawn out, cleaned and refilled in a system with a service station. Frigen R 134 A does not contain FCH, but it should also be drawn out, cleaned and refilled with a service station.

Although these refrigerants are non-toxic, non-flammable and non-explosive in any mixing ratio with air at normal temperature, there must be conformance with safety precautions.

Avoid any contact with liquid or gas refrigerants. Wear goggles and gloves when working on the refrigerant circuit. Refrigerant on the skin will cause frostbite. Wash off concerned parts of body with cold water thoroughly. If refrigerant gets in the eyes, also rinse out with water and then contact a physician immediately. Frigen is heavier than air and could, if it gets into the atmosphere in spite of working with a service station, lead to asphyxiation – especially in working pits – which would not be readily noticed since the gas has no color or odor.
Turn on available extraction systems.

Absolute cleanliness and as thorough as possible discharging of the air conditioner (at least 30 minutes extraction of moisture from the refrigerant circuit) are required for perfect air conditioner operation.

Frigen R 12 and even more so R 134 A take on moisture very quickly. Plug opened pipes, condenser, evaporator, compressor or drier with plugs immediately.

Important!

Also in this case the plugs must not be mixed up and should be stored separately.

When replacing parts the plugs should be removed only immediately before connection of pipes.

In case of warranty claims, old parts must be fitted with plugs to be able to determine the cause of damage.

If an air conditioner is completely drained because of leaks or accident, the drier must always be replaced as too much moisture will have entered the unit.

There should never be welding on a filled air conditioner or in the close vicinity. There could be danger of an explosion because of the excessive pressure produced when refrigerant is heated.
In addition, refrigerants decompose at high temperature or when exposed to open flame. Decomposed products are injurious to health.
Store full refrigerant cylinders that they are not subjected to direct sunshine or other sources of heat (max. 45° C).

Important!

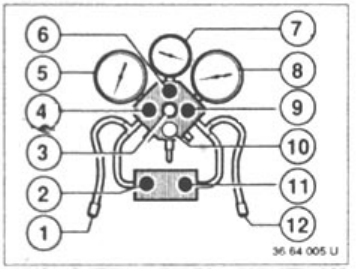
After each refilling check protective caps of charging valves for handtight fit. They serve as additional seals.

The following procedures describe sucking, discharging and charging air conditioners with help of a SECU service station from the company "Behr".
Refer to pertinent operating instructions for changes in the service station design.

Prior to starting any operation, the service station must be brought into basic setting.
Basic setting means: All shut-off valves of the service station and both hose valves must be closed.

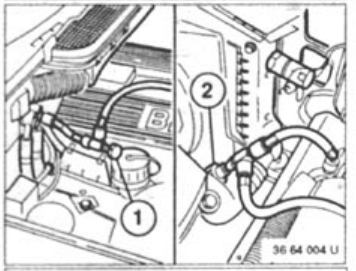
Important!

When using a different service station, refer to the pertinent operating instructions.

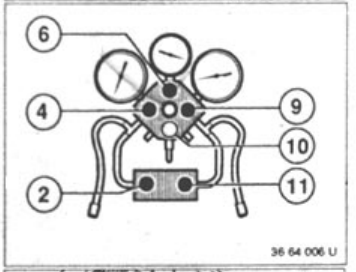


SUCKING REFRIGERANT (R 12) OUT OF AIR CONDITIONER:

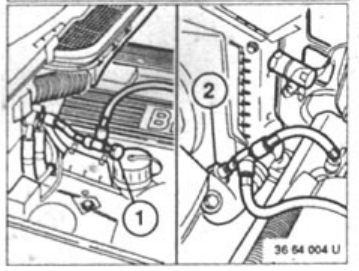
Description of pressure gage assembly
1 Low pressure hose (blue)
2 Refrigerant inlet valve
3 Sight glass
4 Low pressure valve
5 Low pressure gage
6 Vacuum meter valve
7 Vacuum meter
8 High pressure gage
9 High pressure valve
10 Vacuum pump valve
11 Refrigerant outlet valve
12 High pressure hose (red)



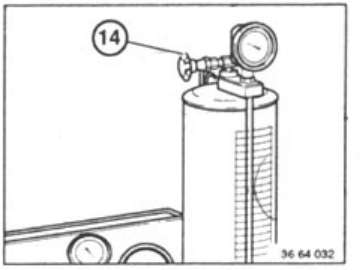
Bring service station into basic setting (refer to page 64-50/3).
Connect service station to vehicle.
Connect blue hose to low pressure side (thick pipe).
Connect red hose to high pressure side (thin pipe).



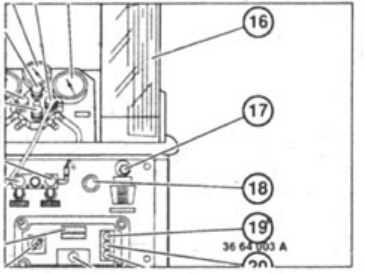
First suck out the service station to ensure that there is no residual refrigerant in the service station.
Open valves (2, 4 and 9) and start the sucking operation.
After the service station has been switched off, the red control lamp lights up, write or note the volume of refrigerant in the charging cylinder (information is required for fault finding to evaluate the system).



Open valves (1 and 2) on vehicle.
This causes refrigerant to flow into the service station and the red control lamp goes out.
Operate start button again and suck refrigerant out of the entire system.
The air conditioner system of the vehicle is empty when the service station is again switched off.

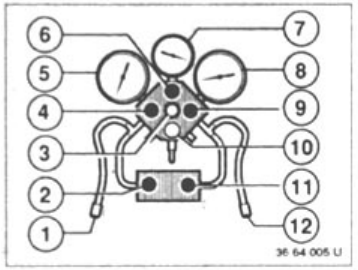


Bring service station into basic setting (refer to page 64-50/3).
Open valve (14) slowly until refrigerant flows into the service station. Start the sucking operation. Refrigerant is circulated (cleaned) in the service station. In this manner the complete refrigerant is converted into gas which had entered the oil trap in liquid state during the sucking out operation. Close valve (14) again after about 10 minutes. The present volume can be read on the charging cylinder after the unit has switched off. Open valve (14) slowly until the red control lamp goes out.



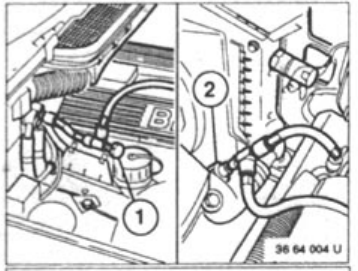
Drain old refrigerant oil (R 12).
Open valve (17) slowly about 1/4 turn and drain the sucked out refrigerant oil into the measuring cup.
If there is no more oil in the oil trap, it will close automatically.
Measure amount of drained refrigerant oil.
Suck out system again afterwards and bring into basic setting.

Important!
If the oil running out foams very strongly, there is still liquid refrigerant in the oil. In this case the refrigerant must be cleaned again.
Never reuse drained refrigerant oil and dispose it as special refuse.
The same amount of new refrigerant oil plus 10 cm^3 must be filled in the air conditioner after discharging.

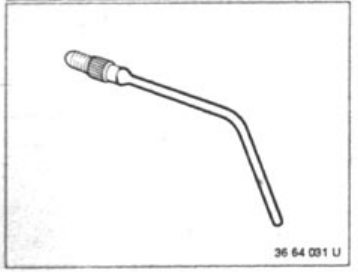


DISCHARGING AIR CONDITIONER:

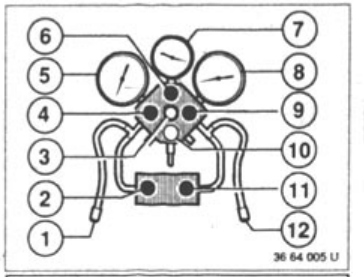
Bring service station into basic setting (refer to page 64-50/3).
Open valves (4, 6, 9 and 10).
Switch on vacuum pump. This only discharges the battery of pressure gages. Maximum possible vacuum is reached after about 1 to 2 minutes. The needle of vacuum meter (7) must then be above or below the zero. This strongly depends on current weather conditions. In high pressure weather zones the maximum possible vacuum will be lower than in deep pressure weather zones. The battery of pressure gages has a leak if the zero point is not approximately reached or vacuum is not built up.
Close valve (10) and switch off vacuum pump after reaching maximum vacuum. The battery of pressure gages does not leak if the pressure does not rise after about 1 to 2 minutes.
Afterwards set needle of vacuum meter (7) to zero (with adjusting screw on top of the vacuum meter) and close valve (6).



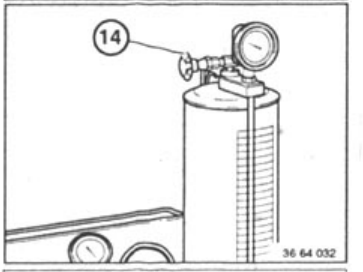
Open valves (1 and 2) slowly.
Then discharge the entire system briefly.



Close valve (9) and switch vacuum pump off.
Unscrew high pressure hose from pressure gage assembly and connect to the supplied suction pipe.

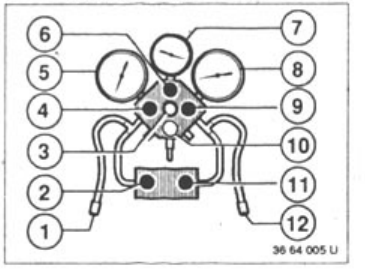


Switch on vacuum pump and using the suction pipe suck the previously measured amount of new refrigerant oil out of the measuring cup into the system. Switch off vacuum pump as soon as the total amount of oil is in the system, in order to avoid sucking in "moist" air. Reconnect high pressure hose to connection (12) and open valve (9). Switch on vacuum pump again and discharge system at least 30 minutes.



The previously sucked out refrigerant can be cleaned simultaneously to the discharging process.
This requires opening valve (14) slightly (1 to 1 1/2 turns) and switching on suction.

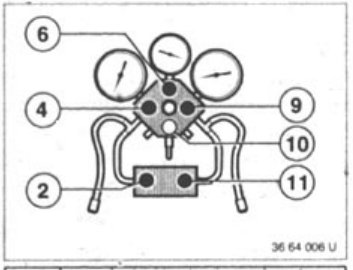
Important!
Stop the cleaning process after about 10 to 15 minutes. Discharging still runs.



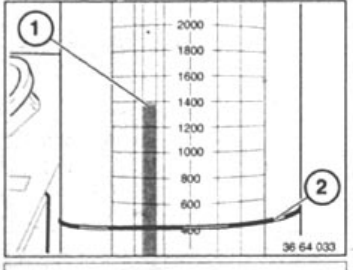
After discharging, close valve (10) and switch off vacuum pump.
There is no longer moisture in the system if the needle of vacuum meter (7) remains at 0 over a period of at least 3 to 5 minutes. However, if the needle rises in small jumps this is indication of water drops which are evaporating and causing the pressure to rise. In such a case discharging must be continued.

Filling the system:

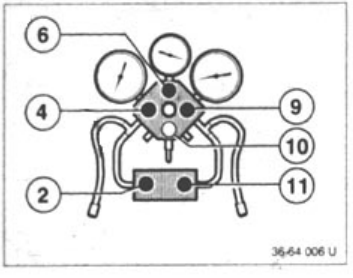
Prerequisites for correct charging are sufficient refrigerant as well as pressure in the charging cylinder of at least 9 to 11 bar. If there is not enough refrigerant in the charging cylinder, this must be compensated by sucking refrigerant out of the pressure cylinder. Insufficient pressure can be increased by switching on the charging cylinder heater or by cleaning the refrigerant.



Adjust service station to basic setting.
Open valves (4 and 9).
Open valve (11) briefly and close again so that refrigerant can flow up to the filler hoses.

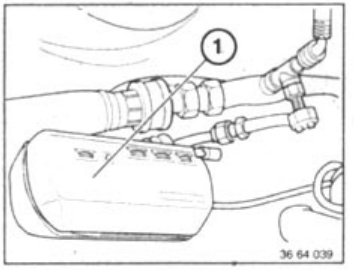


Read charging cylinder level (1), subtract specified fill quantity* from this value and mark new volume level with a rubber band (2).



Open valves (1) and (2) on the filling hoses. Then open valve (11) again and observe the level in the charging cylinder. If there is an approximately correct filling volume* in the system, close and open valve (11) in steps until the correct volume is in the system.

* Refer to Technical Data

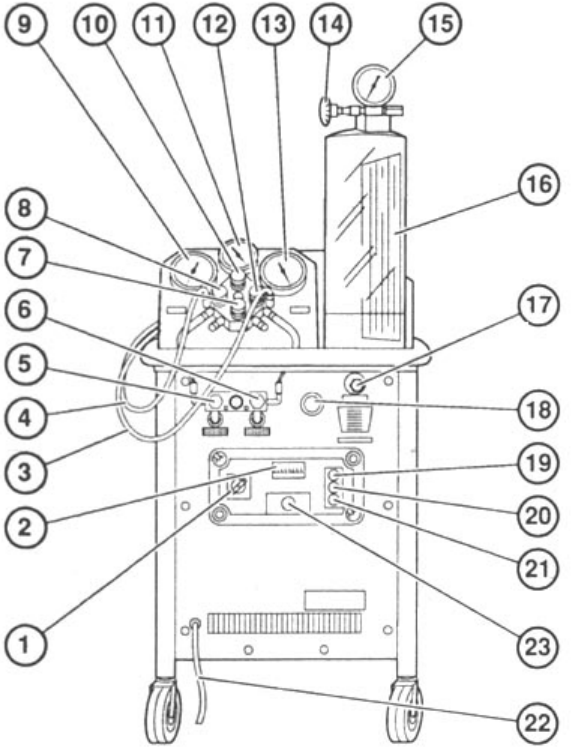


Detecting Leaks (R 12):

In the vacuum leak test it is possible for leaks not to be detected at loose pipe connections because these might be pressed against the sealing surface, thus preventing them from leaking. Consequently leak detection is absolutely essential after filling the system. If leaks are determined while discharging the system, the system must be filled with about 200 to 300 grams of refrigerant.
Afterwards calibrate leak detector (1)** according to the operating instructions.
Check air conditioner for leaks with leak detector (1).
Tighten loose pipes and mark location of leaks (hairline).
Suck out refrigerant, eliminate leaks and discharge again. If no leakage is detected, the system must be filled with the specified volume of refrigerant *. Run the engine, adjust the air-conditioning unit as for the A/C performance measurement to ensure that the pressure in the system rises to approx. 12 to 15 bar. Then switch off the engine and repeat the leak examination (starting on the pressure side).

Note:
Always check below an assumed point of leakage on pipes and components as refrigerant is heavier than air.

* Refer to Technical Data
** Refer to Workshop Equipment and Planning Documentation



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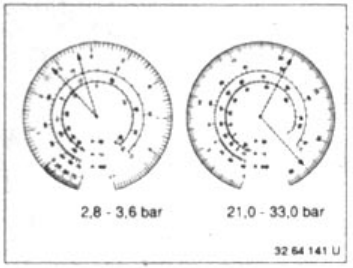
CLEANING REFRIGERANT (R 12):

Bring service station into basic setting (refer to page 64-50/3).
Open valve (14) on charging cylinder slightly (1 to 1 and 1/2 turns).
Switch on suction and let cleaning run at least ten minutes.
Close valve (14) and wait until the compressor is automatically switched off.
In the cleaning process the refrigerant is pumped through a drier integrated in the service station where it is dried and cleaned to remove particles of dirt. A moisture indicator (18) shows the refrigerant's moisture content. Cleaning time should not exceed 10 to 15 minutes. If the moisture indicator still shows moisture after this time, the drier is saturated and must be replaced (refer to operating instructions of the service station). Afterwards the refrigerant must be cleaned again.

If the compressor is switched off during the cleaning process, the reasons for this could be as follows.

1. Insufficient/excessive pressure in intake of the compressor.
   This is applicable, if the charging cylinder valve is opened too little or too much. The intake pressure can be read on pressure gage (9) during the cleaning phase by opening valve (5).

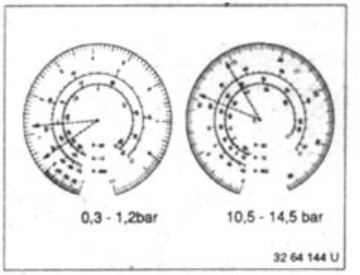
2. Excessive pressure (> 17 bar) in charging cylinder.
   This means non-condensable gas in the circuit. In this case close valve (14) and discharge the non-condensable gas via the Schrader valve on the charging cylinder. If there is no gas in the charging cylinder and the pressure is still too high, wait until the refrigerant in the charging cylinder has reached ambient temperature. Afterwards switch on cleaning again until the moisture indicator no longer indicates moisture. Then close valve (14) and wait until the compressor switches off automatically.



TROUBLESHOOTING BY MEASURING PRESSURE (R 12):

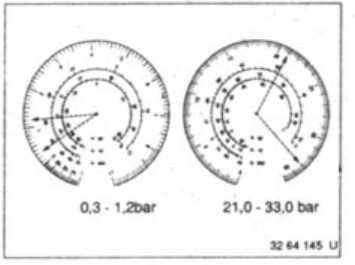
Connect service station to car and open both valves on the charging hoses. Adjust air conditioner on the control unit in such a manner as described for measuring air conditioner efficiency (refer to page 64-50/9). Run engine of car at approx. 2,000 rpm.
High inlet and outlet pressures indicate an overcharged system, contaminated condenser or defective additional fan.

Remedy:
Suck out refrigerant, discharge and recharge system, clean condenser and check additional fan, replacing if necessary.



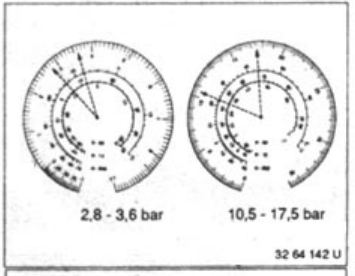
Low inlet pressure and normal outlet pressure indicate an insufficient charged volume or restricted low pressure side of the system.

Remedy:
1. Check whether evaporator has ice; then check evaporator sensor.
2. Suck out and measure refrigerant. If sucked out volume is approximately the same as specified charge volume*, check flow of expansion valve; then discharge and recharge system.



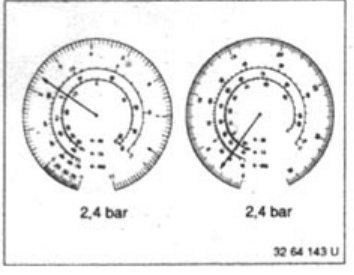
Low inlet pressure and high outlet pressure indicate a restricted high pressure side.

Remedy.
Check condenser, drier and expansion valve.



High inlet pressure and normal outlet pressure indicate a defective compressor.

Remedy:
Replace compressor.



Compressor does not run with equal inlet and outlet pressures.

Remedy:
If icing-up protector has switched the compressor off, check evaporator sensor or check power supply to the magnetic coupling (refer to Electric/Electronic Test for Group 64).
Otherwise check magnetic coupling mechanically (slips).

* Refer to Specifications

CHECKING AIR CONDITIONER EFFICIENCY (R 12)

The following conditions must be fulfilled for this test.

1. Modic or BMW Service Tester
2. Thermometer
3. Intake air temperature of about 50° C

Ref. Point 1:
Connect Modic or BMW Service Tester to car and have the evaporator temperature displayed.

Ref. Point 2:
Install temperature sensor approx. 5 cm below the car's roof liner at height of B-pillar and locate the display unit outside.

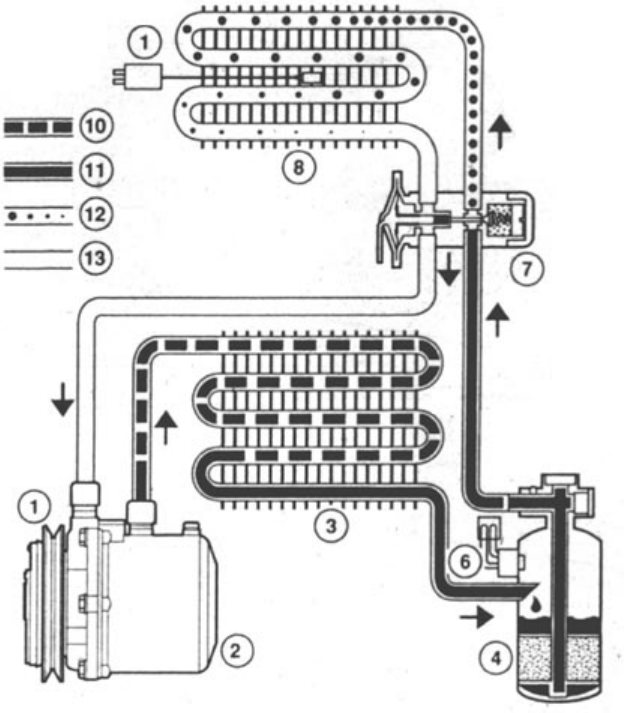
Ref. Point 3:
Set heater to maximum heating. Switch on and set air conditioner to circulated air mode. Set car's blower to speed step 4 or maximum speed. Shut all windows and doors. Start and run engine at approx. 2,000 rpm. Use a pedal prop to accelerate in cars with EML, DDE or M60 engine.

Afterwards heat up the passenger compartment to about 50° C. The compressor must no longer switch off. Now measure the passenger compartment temperature and evaporator temperature and subtract the values from each other. There should be a difference of about 40° C.
If this difference in temperature is not reached, connect the service station. Measure the low pressure and high pressure and compare with troubleshooting by means of a pressure test (refer to page 64-50/8).

DESCRIPTION OF REFRIGERANT CIRCUIT FUNCTION R 134a)

After switching on the air conditioner the refrigerant circuit is activated in that the magnetic coupling receives current. This produces positive connection between the pulley and armature clutch plate and the compressor is driven.

The compressor, a major component of the system, increases the pressure of refrigerant vapors. Refrigerant vapors are drawn in on the intake side of the compressor. The refrigerant is compressed, whereby the vapor temperature rises. The high pressure vapors pass via a high pressure pipe to a condenser located on the face of the engine radiator. The hot refrigerant is cooled off by wind from driving and an additional fan. Refrigerant vapors condense and turn into liquid when reaching the dew point temperature. The high pressurized refrigerant is delivered to the drier. The drier removes moisture from the refrigerant and sometimes also acids, but the latter only in the amount of 6 to 10 grams in R 12 systems or 10 to 16 grams in R 134a systems.
Refrigerant continues on to the expansion valve from the drier. The expansion valve makes up a point of separation in the system. The expansion valve meters the refrigerant. Volume of refrigerant is controlled by the temperature and pressure at the outlet of the evaporator. The refrigerant evaporates and cools off considerably in the evaporator. The fresh air – respectively circulated air – flowing past the cold evaporator, with blower support, is cooled accordingly and delivered into the passenger compartment via nozzles.
The evaporated refrigerant is drawn in again by the compressor, whereby the refrigerant circuit is completed.
Moisture from the fresh or circulated air, flowing past the evaporator, condenses on the cold fins. The condensation on the evaporator is discharged outdoors via rubber hoses on the transmission tunnel and could cause a puddle of up to 200 ml underneath a parked car depending on the atmospheric moisture. This is completely normal and does not indicate a leak.
It could happen that the condensation water freezes on the fins of the evaporator. An evaporator temperature sensor prevents the formation of ice in that it switches the compressor off at 2° C. The compressor is switched on again with a reversing range of 2° C. A safety switch (high or low pressure pressostat) switches the air conditioner off when pressure is too high or too low. This prevents damage to the air conditioner. A medium pressure pressostat switches the second stage of an additional fan on at a pressure of about 18 bar.
In this manner the compressor is not switched off and on so often, as the maximum high pressure is not reached so fast.



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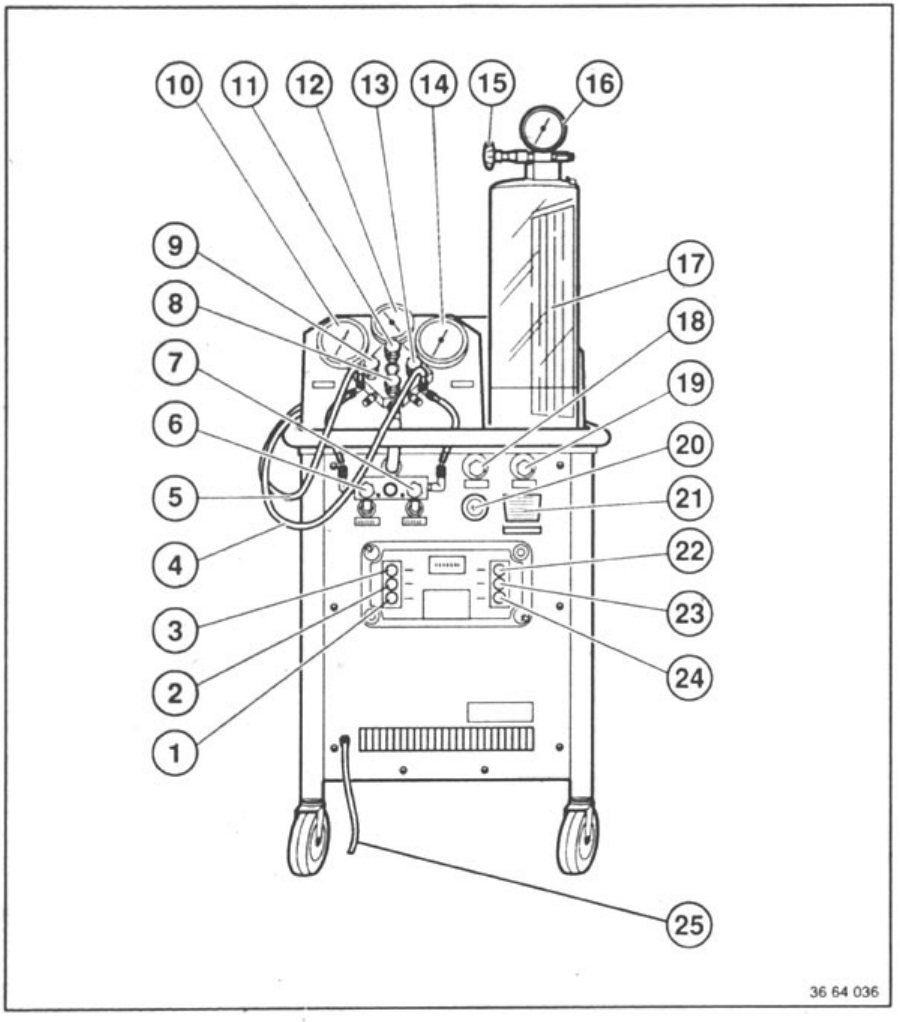
1 Magnetic coupling
2 Compressor
3 Condenser
4 Drier
6 Safety switches (high and low pressure pressostats)
7 Expansion valve
8 Evaporator
9 Temperature switch
10 High pressure gas
11 High pressure liquid
12 Low pressure liquid
13 Low pressure gas



SERVICE STATION (SECU 134)

1 Main switch
2 SUCKING/CLEANING switch
3 SUCKING end control lamp
4 High pressure hose
5 Low pressure hose
6 Refrigerant inlet valve
7 Refrigerant outlet valve
8 Vacuum pump valve
9 Low pressure valve
10 Low pressure gage
11 Vacuum meter valve
12 Vacuum meter
13 High pressure valve
14 High pressure gage
15 Charging cylinder valve
16 Charging cylinder high pressure gage
17 Charging cylinder with scale
18 Refrigerant oil filler valve
19 Refrigerant oil drain valve
20 Moisture indicator
21 Measuring cup
22 VACUUM PUMP switch
23 Red control lamp
24 HEATER switch
25 Power cord

64 50 009 DISCHARGING AND CHARGING AIR CONDITIONER (R 134a)

Safety Precautions for Handling Refrigerant:

The air conditioning system is filled with safety refrigerant Frigen R 12 or Frigen R 134a gradually as from the beginning of 1991.

Important!

R 12 and R 134a must never be mixed as even the most minute mixed quantities would lead to decomposition in the system. Consequently systems for R 12 may only be filled with R 12 and vice versa. Different refrigerant oils are used for both systems and must also not be mixed. Vehicles with R 134a systems as well as parts for replacements are marked. The service station for R 134a is green and marked R 134a. The service station for R 12 is blue.

Frigen R 12 is very dangerous for the environment because of fluorchlorhydrocarbons (FCH) and must be drawn out, cleaned and refilled in a system with a service station. Frigen R 134 A does not contain FCH, but it should also be drawn out, cleaned and refilled with a service station.

Although these refrigerants are non-toxic, non-flammable and non-explosive in any mixing ratio with air at normal temperature, there must be conformance with safety precautions.

Avoid any contact with liquid or gas refrigerants. Wear goggles and gloves when working on the refrigerant circuit. Refrigerant on the skin will cause frostbite. Wash off concerned parts of body with cold water thoroughly. If refrigerant gets in the eyes, also rinse out with water and then contact a physician immediately. Frigen is heavier than air and could, if it gets into the atmosphere in spite of working with a service station, lead to asphyxiation – especially in working pits – which would not be readily noticed since the gas has no color or odor.
Turn on available extraction systems.

Absolute cleanliness and as thorough as possible discharging of the air conditioner (at least 30 minutes extraction of moisture from the refrigerant circuit) are required for perfect air conditioner operation.

Frigen R 12 and even more so R 134 A take on moisture very quickly. Plug opened pipes, condenser, evaporator, compressor or drier with plugs immediately.

Important!

Also in this case the plugs must not be mixed up and should be stored separately.

When replacing parts the plugs should be removed only immediately before connection of pipes.

In case of warranty claims, old parts must be fitted with plugs to be able to determine the cause of damage.

If an air conditioner is completely drained because of leaks or accident, the drier must always be replaced as too much moisture will have entered the unit.

There should never be welding on a filled air conditioner or in the close vicinity. There could be danger of an explosion because of the excessive pressure produced when refrigerant is heated.
In addition, refrigerants decompose at high temperature or when exposed to open flame. Decomposed products are injurious to health.
Store full refrigerant cylinders that they are not subjected to direct sunshine or other sources of heat (max. 45° C).

Important!

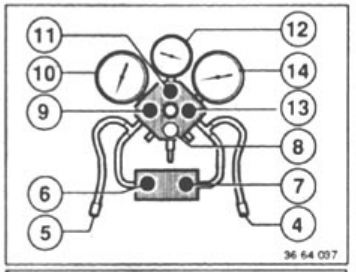
After each refilling check protective caps of charging valves for handtight fit. They serve as additional seals.

The following procedures describe sucking, discharging and charging air conditioners with help of a SECU 134 service station from the company "Behr".
Refer to pertinent operating instructions for changes in the service station design.

Prior to starting any operation, the service station must be brought into basic setting.
Basic setting means: All shut-off valves of the service station and both hose valves must be closed.

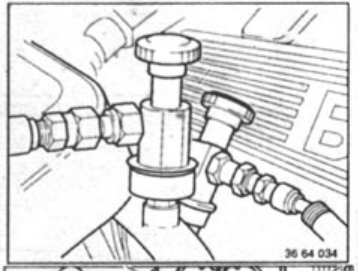
Important!

When using a different service station, refer to the pertinent operating instructions.

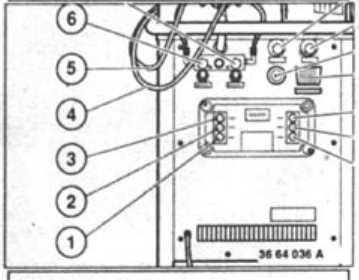


SUCKING REFRIGERANT OUT OF AIR CONDITIONER (R 134a)

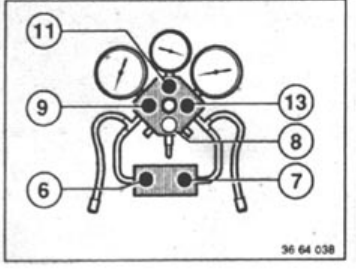
Description of pressure gage assembly
4 High pressure hose (red)
5 Low pressure hose (blue)
6 Refrigerant inlet valve
7 Refrigerant outlet valve
8 Vacuum pump valve
9 Low pressure valve
10 Low pressure gage
11 Vacuum meter valve
12 Vacuum meter
13 High pressure valve
14 High pressure gage



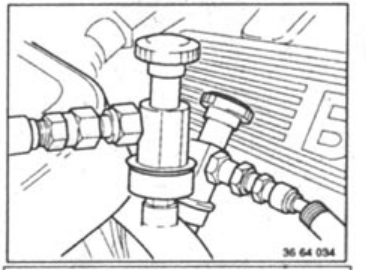
Bring service station into basic setting (refer to page 64-50/12).
Connect service station to vehicle.
Connect blue hose to low pressure side (thick pipe).
Connect red hose to high pressure side (thin pipe).
The quick-action couplings are different in diameter to avoid mixing them up.



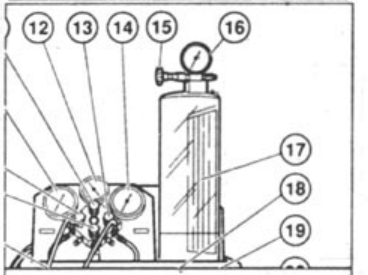
Switch on service station using main switch (1). Switch on suction after white control lamp (3) has gone out. Suction is switched off automatically if entire refrigerant has been sucked out of the service station.
Write down or note volume in the charging cylinder.



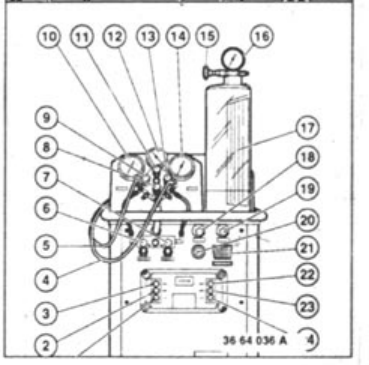
Open valves (6, 9 and 13). This causes refrigerant to flow into the service station and the white control lamp goes out.



Open valves on the quick-action couplings. Start suction again and suck out entire sys- tem until the unit is switched off again.

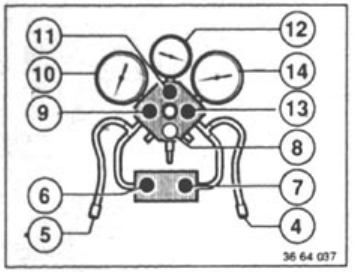


Bring service station into basic setting (refer to page 64-50/12).
Open valve (15) slowly until refrigerant gas flows into the service station. Switch on suction. Refrigerant is circulated (cleaned) in the service station. This converts entire refrigerant into gas which had entered the oil trap in liquid state during suction. Close valve (15) again after about 10 minutes.
Read volume in charging cylinder from scale (17) after unit has switched off and write down or note value (required for evaluation of system during troubleshooting).



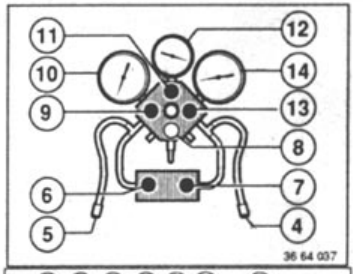
Drain old refrigerant oil.
Open valve (15) slowly until white control lamp (3) goes out. Open valve (19) slowly about 1/4 turn and drain the sucked out refrigerant oil into the measuring cup.
If there is no more oil in the oil trap, it will close automatically.
Measure amount of drained refrigerant oil.
Close valve (19) again.
Suck out service station again afterwards.

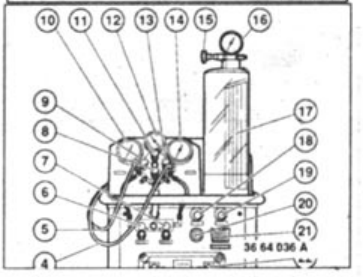
Important!
If the oil running out foams very strongly, there is still liquid refrigerant in the oil. In this case the refrigerant must be cleaned again.
Never reuse drained refrigerant oil and dispose it as special refuse.
After discharging the system must again be filled with the same amount of new refrigerant oil plus 10 cm^3.



DISCHARGING AIR CONDITIONER R 134a)

Bring service station into basic setting (refer to page 64-50/12).
Open valves (8, 9, 11 and 13).
Switch on vacuum pump. This only discharges the pressure gage assembly and charging hoses up to the quick-action couplings.
Maximum possible vacuum is reached after about 1 to 2 minutes. The needle of vacuum meter (12) must then be above or below the zero. This strongly depends on current weather conditions. In high pressure weather zones the maximum possible vacuum will be lower than in deep pressure weather zones. The pressure gage assembly or charging hoses leak if the zero point is not approximately reached or vacuum is not built up.
Close valve (8) and switch off vacuum pump after reaching maximum vacuum. Pressure gage assembly and charging hoses do not leak if the pressure does not rise after about 1 to 2 minutes.
Afterwards set needle of vacuum meter (12) to zero (with adjusting screw on top of the vacuum meter) and close valve (11).

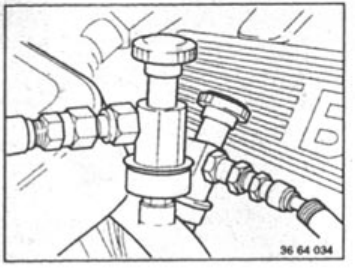




If the pressure has risen, open valve (6). Switch on suction again until the unit is again switched off.
Close valve (6) and open valves (8 and 11). Switch on vacuum pump and discharge the air conditioner at least 15 minutes.

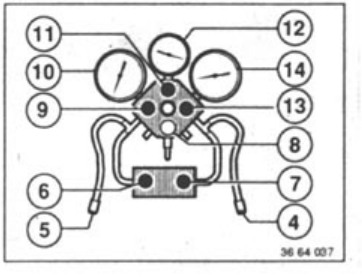
Refrigerant in the service station can be cleaned simultaneously to the discharging process. This is only necessary when moisture indicator (20) indicates moisture. This requires opening valve (15) slightly (1 to 1 1/2 turns) and switching on suction.

Important!
Stop the cleaning process after about 10 to 15 minutes by closing valve (15). Discharging still runs.
If indicator (20) still indicates moisture after the cleaning period, discharging must also be interrupted and the drier in the service station replaced (refer to operating instructions of service station).



Open the valves slowly.

Important!
If this causes a rise in pressure in gages (10 and 14), the system must be sucked out again. Pressure can only rise if the air conditioner is not opened, but only refrigerant was sucked out for troubleshooting.
The pressure rise is caused by conversion of small residual amounts of liquid refrigerant into gas in the system.

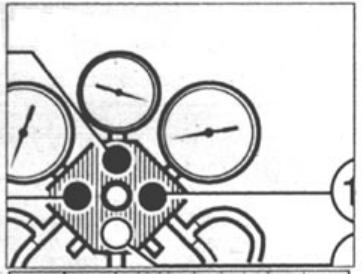


After discharging, close valve (8) and switch off vacuum pump.
There is no longer moisture in the system if the needle of vacuum meter (12) remains at 0 over a period of at least 2 to 3 minutes. However, if the needle rises in small jumps this is indication of moisture which is evaporating and causing the pressure to rise. In such a case discharging must be continued.
The system leaks if the needle rises continuously. In this case the leak must be eliminated (refer to detecting leaks on page 64-50/16).

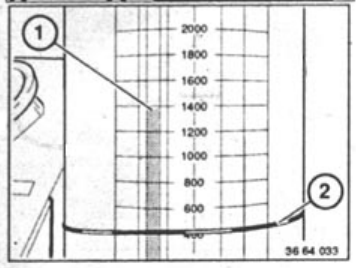
CHARGING SYSTEM (R 134a)

Requirements for correct charging are a sufficient amount of refrigerant and pressure in the charging cylinder of at least 9 to 11 bar. If there is not enough refrigerant in the charging cylinder, this must be compensated by sucking refrigerant out of the pressure cylinder. Insufficient pressure can be increased by switching on the charging cylinder heater. Check whether the refrigerant is dry on the moisture indicator. If not, clean the refrigerant - refer to page 64-50/17.

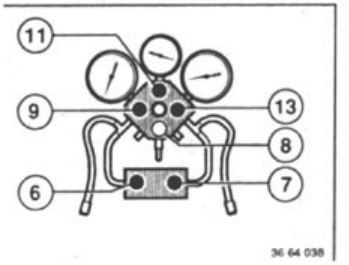
Important!
Charging must be carried out exclusively via the red high pressure hose.



Bring the service station into basic setting (refer to page 64-50/12).
Open valve (7) briefly and close again so that refrigerant can reach the red charging hose.

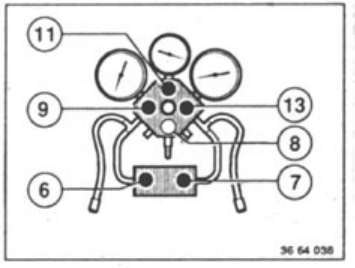


Read charging cylinder volume (1), subtract the specified volume* from this value and mark this charging volume level with rubber band (2).



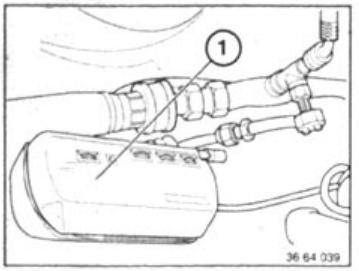
Open valve on red charging hose.
Then open valve (7) again and observe charging volume level in the charging cylinder.
If the system has approximately the specified charge volume*, close and open valve (7) in brief steps until the system has the specified charge volume.
Close valve on red charging hose.
Open valves (6, 9 and 13) and switch on suction.
This sucks refrigerant out of the hoses and service station.
If the unit switches off, charging has been completed and charging hoses can be disconnected from the vehicle.

Installation:
Insert sealing caps in the vehicle's connectors again.



* Refer to Specifications

* Refer to Specifications

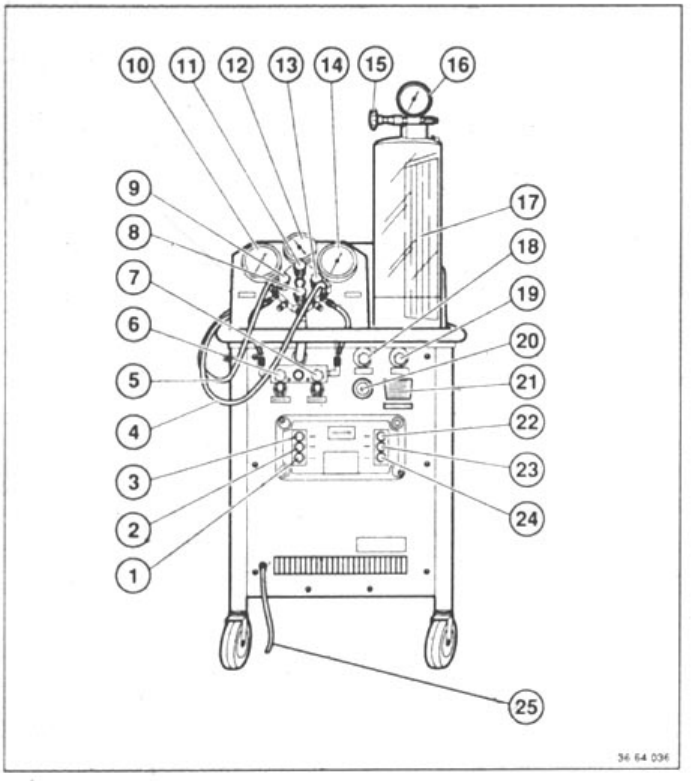


Detecting Leaks (R 134a):

In the vacuum leak test it is possible for leaks not to be detected at loose pipe connections as these might be pressed against the sealing surface, thus preventing them from leaking. Consequently leak detection is absolutely essential after charging the system. If leaks are detected while draining the system, the system must be filled with about 200 to 300 grams of refrigerant.
Afterwards calibrate leak detector (1)** according to the operating instructions.
Check air conditioner for leaks with leak detector (1).
Tighten loose pipes and mark location of leaks (hairline).
Suck out refrigerant, eliminate leaks and discharge again. If no leaks are detected, the system should be filled with the specified volume of refrigerant *. Run the engine and adjust the air-conditioning unit as per the A/C performance measurement so that the pressure in the system rises to approx. 12 to 15 bar. Then switch off the engine and repeat the leak examination (starting on the pressure side).

Note:
Always check below each assumed point of leakage on pipes and components because refrigerant is heavier than air.

* Refer to Technical Data
** Refer to Workshop Equipment Planning Documentation



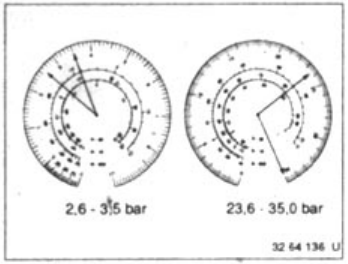
CLEANING REFRIGERANT (R 134a)

Bring service station into basic setting (refer to page 64-50/12).
Open valve (15) on charging cylinder slightly (1 to 1 and 1/2 turns).
Switch on suction (2) and let cleaning run at least ten minutes.
Close valve (15) and wait until control lamp (3) lights up and the compressor is automatically switched off.
In the cleaning process the refrigerant is pumped through a drier integrated in the service station where it is dried and cleaned to remove particles of dirt. A moisture indicator (20) shows the refrigerant's moisture content. Cleaning time should not exceed 10 to 15 minutes. If the moisture indicator still shows moisture after this time, the drier is saturated and must be replaced (refer to operating instructions of the service station). Afterwards the refrigerant must be cleaned again.

If the compressor is switched off during the cleaning process, the reasons for this could be as follows.

1. Insufficient/excessive pressure in intake of the compressor. This is applicable, if the charging cylinder valve is opened too little or too much.

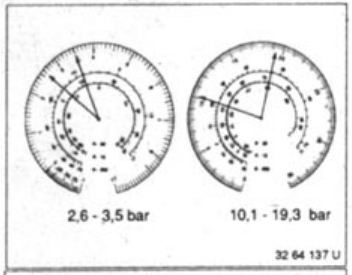
2. Excessive pressure (> 17 bar) in charging cylinder. This means non-condensable gas in the circuit. In this case close valve (15) and discharge the non-condensable gas via the Schrader valve on the charging cylinder or wait until refrigerant in the charging cylinder has reached ambient temperature. Afterwards switch on suction until there is no longer refrigerant in the service station and the compressor is switched off automatically.



TROUBLESHOOTING BY MEASURING PRESSURE (R 134a)

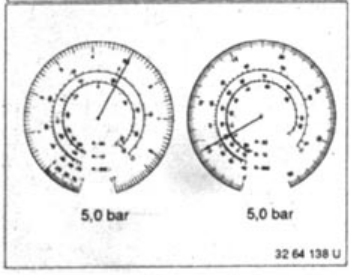
Connect service station to car and open both valves on the charging hoses. Adjust air conditioner on the control unit in such a manner as described for measuring air conditioner efficiency (refer to page 64-50/9). Run engine of car at approx. 2,000 rpm.
High inlet and outlet pressures indicate an overcharged system, contaminated condenser or defective additional fan.

Remedy:
Suck out refrigerant, discharge and recharge system, clean condenser and check additional fan, replacing if necessary.



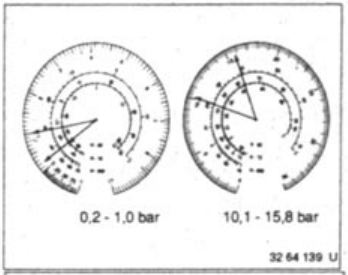
High inlet pressure and normal outlet pressure indicate a defective compressor.

Remedy:
Replace compressor.



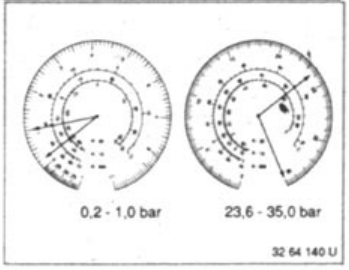
Compressor does not run with equal inlet and outlet pressures.

Remedy.
If icing-up protector has switched the compressor off, check evaporator sensor or check power supply to the magnetic coupling (refer to Electric/Electronic Test for Group 64).
Otherwise check magnetic coupling mechanically (slips).



Low inlet pressure and normal outlet pressure indicate an insufficient charged volume or restricted low pressure side of the system.

Remedy:
1. Check whether evaporator has ice; then check evaporator sensor.
2. Suck out and measure refrigerant. If sucked out volume is approximately the same as specified charge volume*, check flow of expansion valve; then discharge and recharge system.



Low inlet pressure and high outlet pressure indicate a restricted high pressure side.

Remedy:
Check condenser, drier and expansion valve.

* Refer to Specifications

CHECKING AIR CONDITIONER EFFICIENCY (R 134a)

The following conditions must be fulfilled for this test.

1. Modic or BMW Service Tester
2. Thermometer
3. Intake air temperature of about 50° C

Ref. Point 1:

Connect Modic or BMW Service Tester to car and have the evaporator temperature displayed.

Ref. Point 2:

Install temperature sensor approx. 5 cm below the car's roof liner at height of B-pillar and locate the display unit outside.

Ref. Point 3:

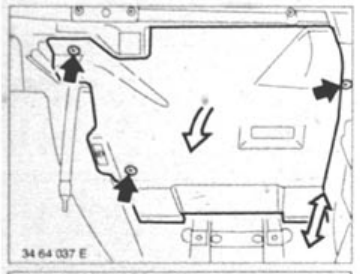
Set heater to maximum heating. Switch on and set air conditioner to circulated air mode. Set car's blower to speed step 4 or maximum speed. Shut all windows and doors. Start and run engine at approx. 2,000 rpm.

Afterwards heat up the passenger compartment to about 50° C. The compressor must no longer switch off. Now measure the passenger compartment temperature and evaporator temperature and subtract the values from each other. There should be a difference of about 40° C.
If this difference in temperature is not reached, connect the service station. Measure the low pressure and high pressure and compare with troubleshooting by means of a pressure test (refer to page 64-50/18).

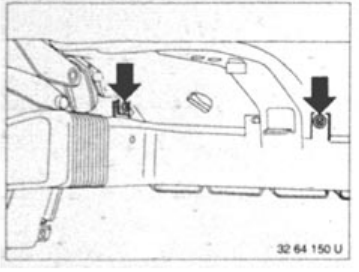
64 51 000 CLEANING EVAPORATOR

It could happen that bacteria settle on the fins of the evaporator. This is caused by the condensation water which collects on the fins after switching the compressor off. There could temporarily be an unpleasant odor in the car when the compressor is switched on again. Consequently the evaporator should be cleaned at regular intervals.

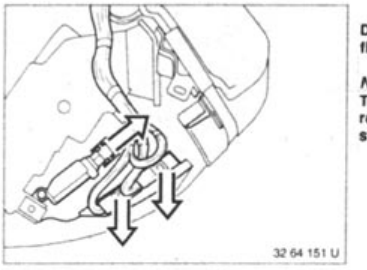
Note:
It is recoomended to drive the car to a washbay and do the cleaning there, as the water will run out through the drain holes in the transmission tunnel.



Cars with IHKA:
Remove the glovebox - refer to Group 51.
Unscrew screws and remove the trim panel.
If applicable, disconnect the loudspeaker plugs.

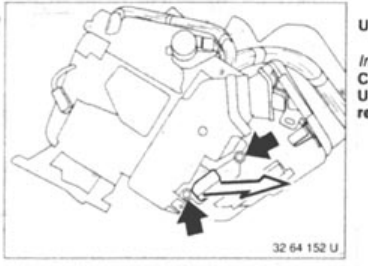


Unscrew screws and fold the air duct down.



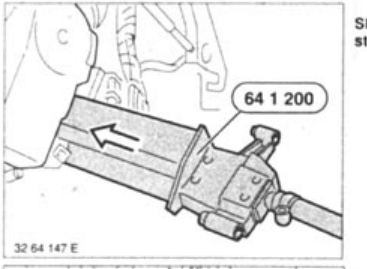
Disconnect wires from the control unit and final stage.

Norte:
The heater remains installed and was only removed in this picture for better understanding.



Unscrew screws and pull the final stage out.

Important!
Cars with Microfilter:
Unscrew cover, pull the microfilter out and reinstall the cover.

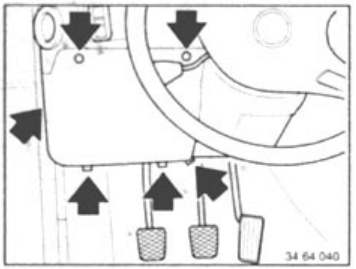


Slide Special Tool 64 1 200 into the final stage opening and secure.

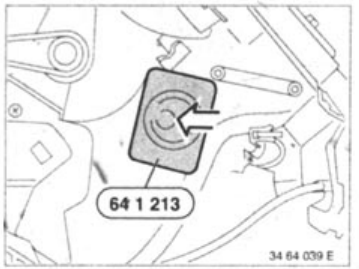


Apply about 1 liter of 5 per cent cleaning solution* onto the evaporator by moving the spray nozzle pipe back and forth uniformly.

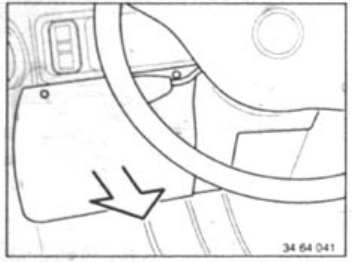
* Refer to Service Information



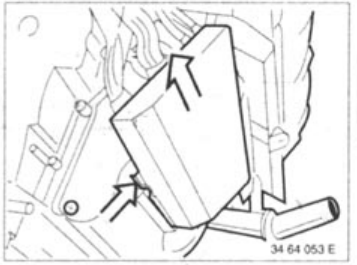
Cars with IHKR:
Remove plugs.
Unscrew screws.



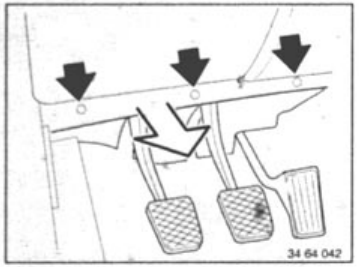
Clip Special Tool 64 1 213 in opening of the resistor.



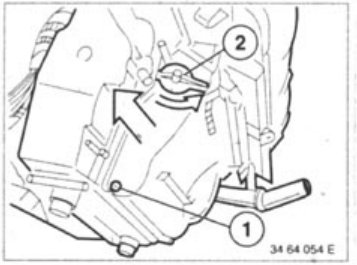
Remove trim panel.



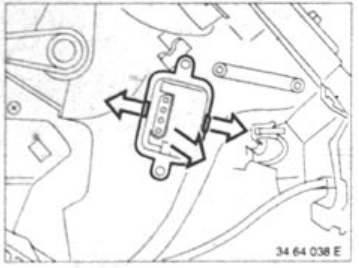
Unclip and pull out control unit.



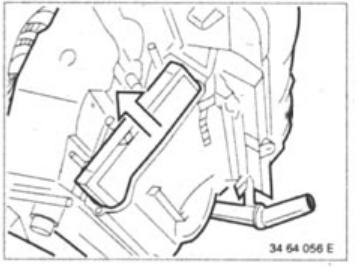
Unscrew screws.
Remove trim panel.



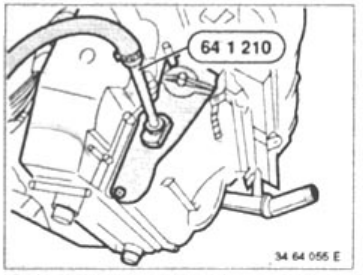
Unscrew screw (1), turn lever (2) about 90° and remove cover.



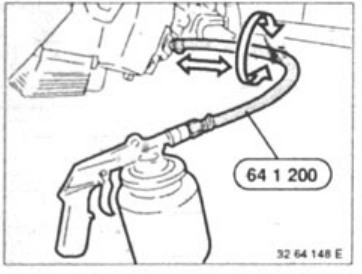
Disconnect plug, spread clips apart and lift out resistor.



If applicable, pull out microfilter.



Slide Special Tool 64 1 210 into opening and secure.



Apply about 1 liter of 5 per cent cleaning solution* on to evaporator by moving the spray nozzle pipe back and forth uniformly.

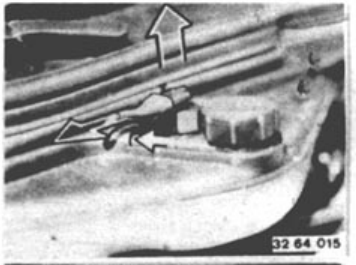
Leave the cleaning solution on the evaporator for about 10 to 15 minutes.

Afterwards rinse off the evaporator with a large amount of water (at least 6 liters of water).

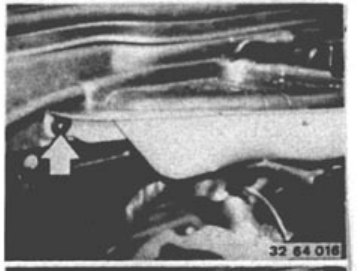
* Refer to Service Information

64 51 510 Removing and installing evaporator
64 51 520 Removing and installing or replacing expansion valve

Drain refrigerant out of air-conditioning unit with the help of a service unit (refer to 64 50 009 or relevant operating manual for Service Station).



Lift up rubber profile.
Remove plug and overflow hose from expansion tank.

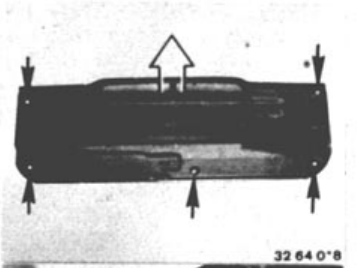


Unfasten nuts on left and right sides of expansion tank and place container to one side.

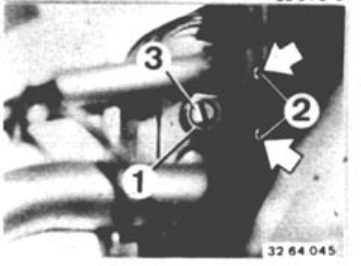
Note:
Do not bend coolant hose.



Cut wire straps off.
Tie up wiring harness and, if necessary, carefully bend down fuel lines.



Unfasten screws and remove cover plate by lifting upwards.



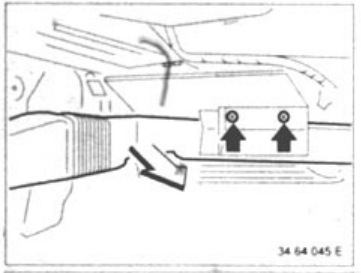
Unfasten nut (1), screws (2) and stud bolt (3).

Installation:
Replace O-rings.

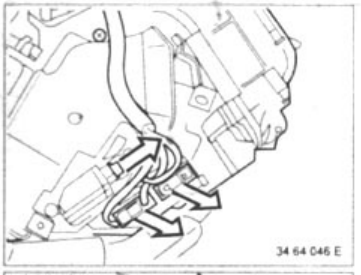
Caution!
Stud bolt is secured with Loctite 270, if necessary, preheat with hot air blower.

Remove glovebox, refer to 51 16 360.
Unfasten screws.
Remove trim by pulling forwards out of rear clip.

Lift out clip and remove cover.

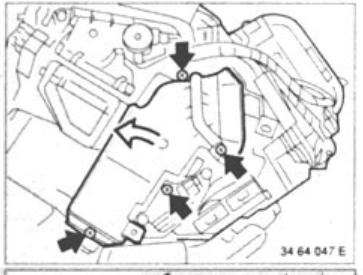


Unfasten screws and lift out ventilation duct.

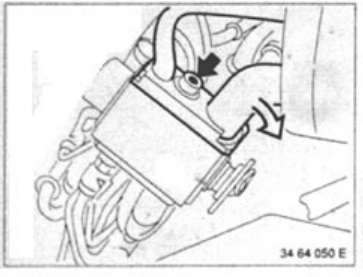


Remove all plugs from control unit and lift up wiring harness.

On the automatic air-conditioning system: also remove the plug from the output stage.

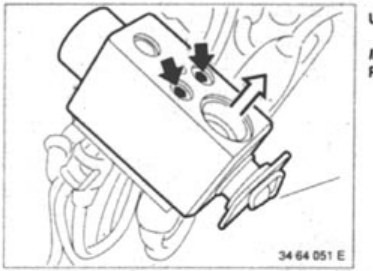


Unfasten screws and remove cover.



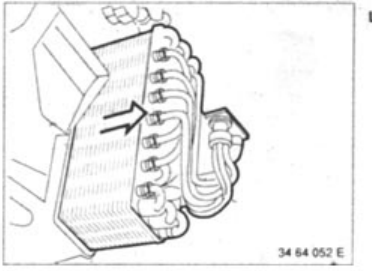
Unfasten screw and lift out twin tube.

Installation:
Replace O-rings.

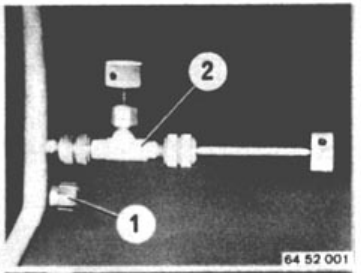


Unfasten screws and lift out expansion valve.

Installation:
Replace O-rings.

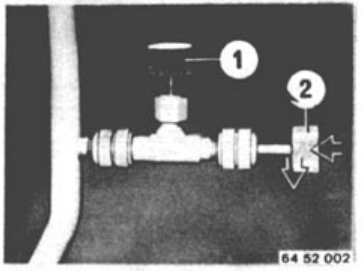


Lift out evaporator.

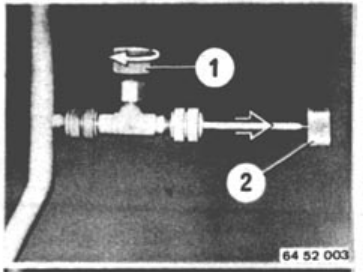


64 52 ... REMOVING AND INSTALLING VALVE CORE

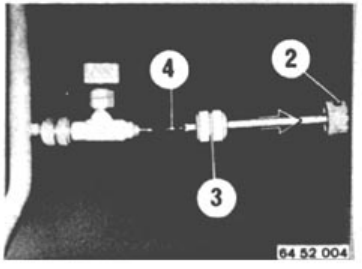
Unscrew cap (1).
Screw valve core remove (2) on.



Open valve (1).
Unscrew the valve core with valve turner (2).



Pull valve turner (2) back together with the valve core.
Shut valve (1).



Unscrew coupling nut (3) and remove valve turner (2) together with valve core (4).

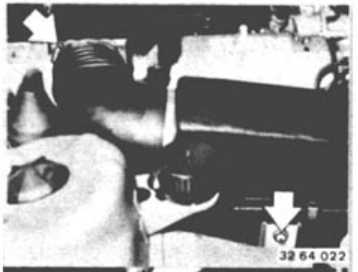


730 64 304

Installation:
Refrigerant-proof valve cores can be recognized on the transparent seal (1).

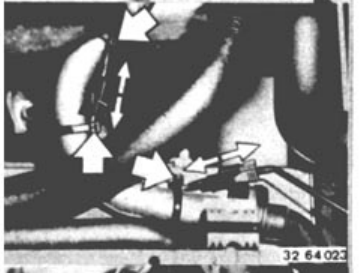
64 52 020 REPLACING AC COMPRESSOR (M20, M30, M35)

Suck refrigerant out of the air conditioner with help of a service station (refer to 64 50 009 or operating instructions supplied with pertinent service station).

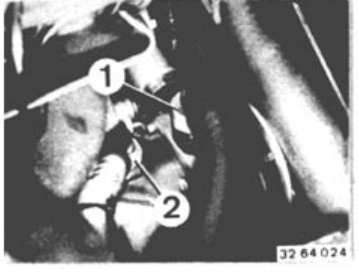


Loosen hose clamp and unscrew nut.
Remove air cleaner.

Important!
Check that air cleaner is in correct installed position.



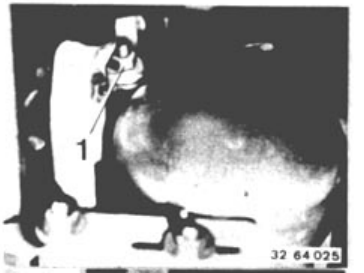
Cut through wire strap and disconnect plug.



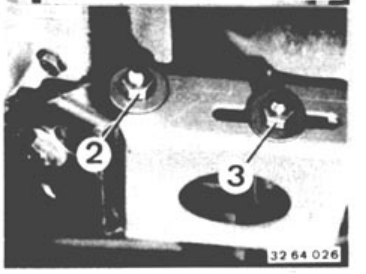
Unscrew suction hose (1) and pressure hose (2).
Insert plugs into open connections without delay.

Installation:
Check O-rings, replacing them if necessary.
Tightening torque*.

* Refer to Specifications

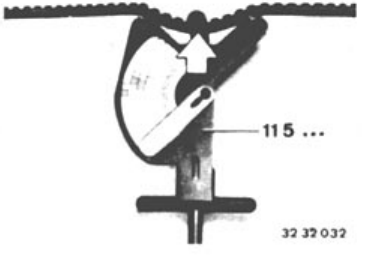


Lift the car and unscrew splash guard.
Loosen screw (1).



Loosen screw (2).
Unscrew adjusting screw (3).
Remove drive belt, then unscrew screw (1) completely and remove compressor.

Installation:
Remove plugs from connections only briefly before connecting the hoses.
Check for sufficient amount of oil* in the compressor.
Discharge, charge and check the air conditioner for leaks after finishing installation.



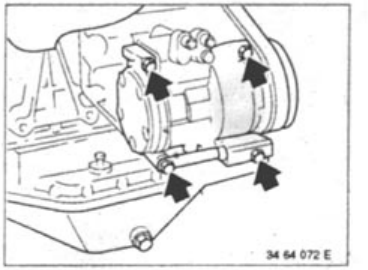
Check and, if necessary, correct the drive belt tension using Special Tool 11 5 . . ..

Note:
The pulling hook must be applied on the tip of a tooth.

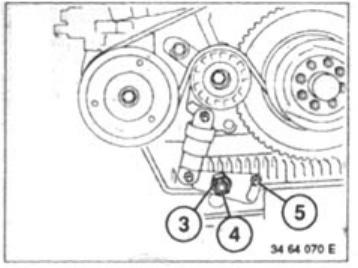
* Refer to Specifications

64 52 020 REPLACING AC COMPRESSOR (M60)

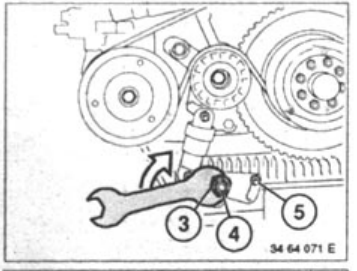
Remove engine splash guard.
Suck refrigerant out of air conditioner (refer to 64 50 009 or operating instructions supplied with pertinent service station).



Unscrew bolts.
Disconnect plug.
Remove compressor downwards.

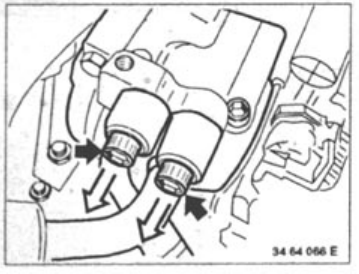


Loosen nuts (4 and 5) on tensioning roller and take ribbed drive belt off of compressor.



Installation:
Turn tensioning roller on hexagon (3) as far as stop, tighten nut (5) first and then nut (4).

Tightening torque = 24 Nm.

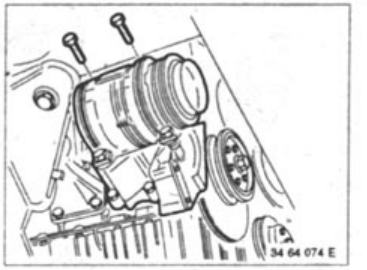


Unscrew couplings and remove suction and pressure pipes.

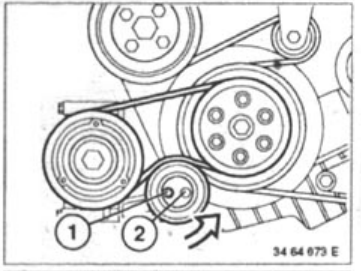
Installation:
Replace O-rings.

64 52 020 REPLACING AC COMPRESSOR (M51)

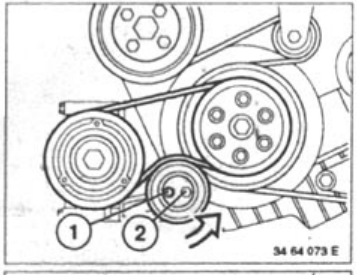
Remove engine splash guard.
Suck refrigerant out of air conditioner (refer to 64 50 009 or operating instructions supplied with pertinent service station).



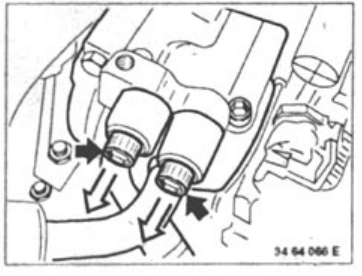
Unscrew bolts.
Disconnect plug.
Remove compressor downwards.



Loosen bolt (1) and take drive belt off of compressor.



Installation:
Loosen bolt (1) enough that tensioning roller can turn without friction.
Insert torque wrench into hexagon socket (2) and apply torque* against drive belt, hold and tighten bolt (1).

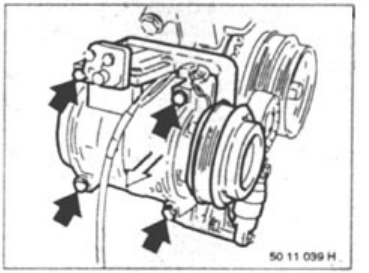


Unscrew couplings and remove suction and pressure pipes.

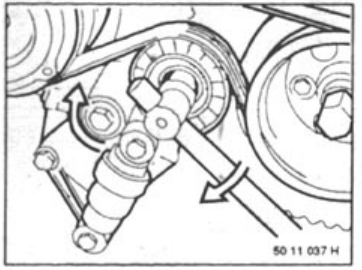
* Refer to Specifications

64 52 020 REPLACING AC COMPRESSOR (M50)

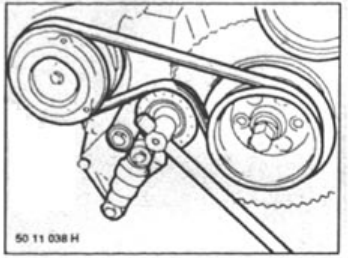
Remove engine splash guard.
Suck refrigerant out of air conditioner (refer to 64 50 009 or operating instructions supplied with pertinent service station).



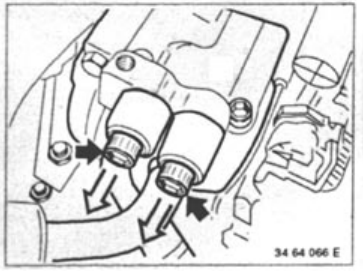
Unscrew bolts.
Disconnect plug.
Remove compressor downwards.



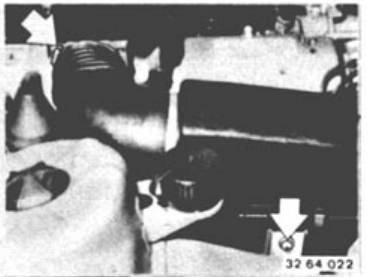
Slackening Drive Belt:
Insert hexagon socket key into bolt of tensioning roller.
Turning slowly in clockwise direction will compress the tensioning element and loosen the drive belt.



Installation:
Check arrangement of ribbed drive belt.
When installing the ribbed drive belt, compress the tensioning element again and install belt.
Check for correct seating in grooves.



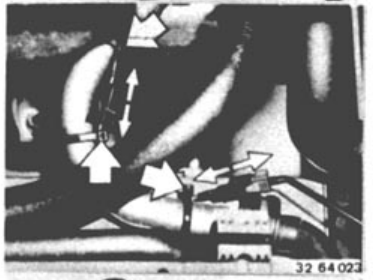
Unscrew couplings and remove suction and pressure pipes.



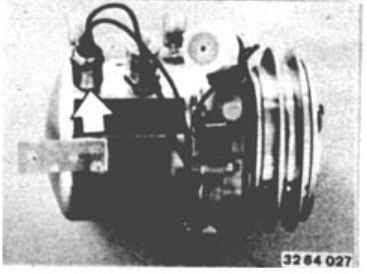
61 31 ... REPLACING TEMPERATURE SWITCH FOR COMPRESSOR

Loosen the hose clamp and unscrew the nut.
Remove the air cleaner.

Important!
Check that the air cleaner is in correct installed position.



Cut through the wire strap and disconnect the plug.

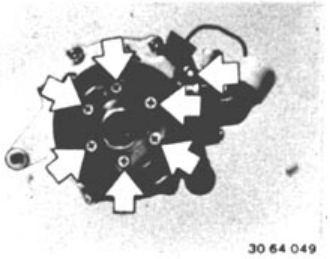


Remove the temperature switch.

Note:
Shown on removed compressor, as it would not be visible because of the pressure hose in installed state.

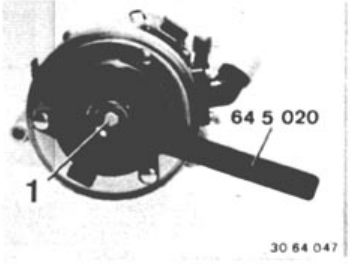
64 52 061 Replacing compressor coupling (M20,M30, M50 with Vee belt)

Remove splash guard.
Unfasten Vee belt.



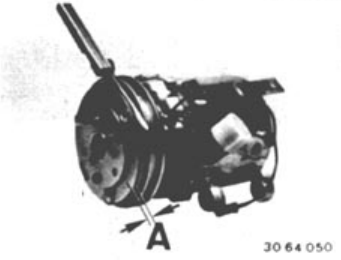
30 64 049

Unscrew bolts. Disconnect cable tie and plug connection. Remove magnetic coil.



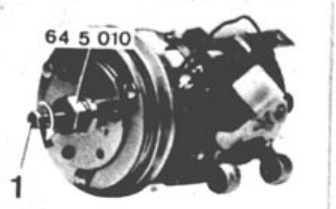
30 64 047

Grip drive plate with special tool 64 5 020 and unfasten screw (1).



30 64 050

Installation:
Check for correct clearance A (0.5...0.8) between drive plate and pulley wheel disc.
If necessary, adjust with shims.



30 64 048

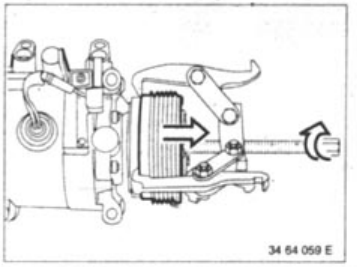
Screw extractor tool 64 5 010 into the drive plate. Turn screw (1) in opposite direction to compressor shaft and remove drive plate.

Caution!
When removing, ensure that shims do not drop down.

Bend up lug on retaining tab, unfasten grooved nut with special tool 64 1 110 and remove pulley wheel.

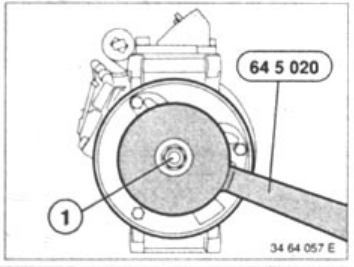
64 52 061 Replacing compressor coupling (for Seiki compressor)

Remove compressor, refer to 64 52 020.

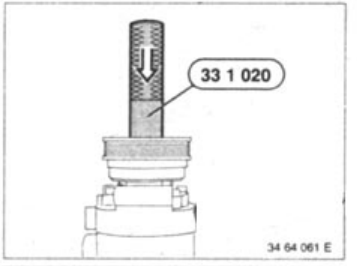


Remove pulley wheel with standard three-claw extractor tool.

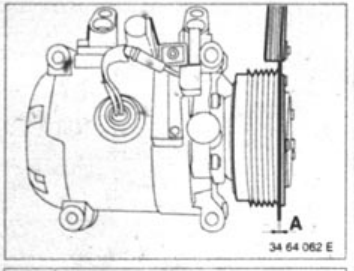
Caution!
Apply pulling claws only on joint between solenoid coil and pulley as otherwise pulley could be damaged.



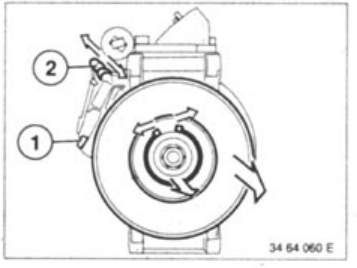
Grip drive plate with special tool 64 5 020 and unfasten screw (1). Remove drive plate.



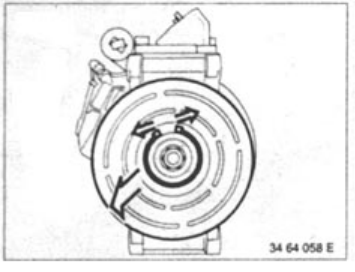
Installation:
Drive pulley on to bearing set carefully using special tool 33 1 020.



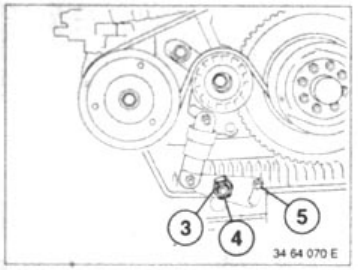
Installation:
Check correct clearance A (0.5 . . . 0.8 mm) between drive plate and pulley wheel. If necessary, adjust with shims.



Expans retaining ring and remove.
Unscrew bolt (1).
Disconnect plug connection (2) and remove solenoid coil.



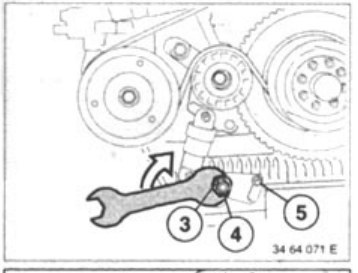
Expand retaining ring and remove.



64 52 061 Replace compressor coupling (on Nippondenso compressor)

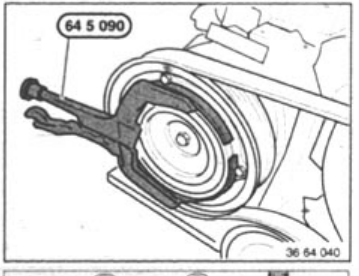
Unscrew and remove splash guard.

Loosen nuts (4 and 5) on the tensioning roller and remove toothed pulley belt from compressor.

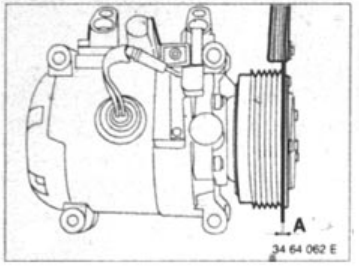


Installation:
Turn tensioning roller on hex head (3) until tight, then tighten nut (5) followed by nut (4).

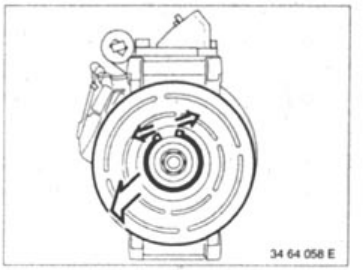
Tightening torque = 24 Nm



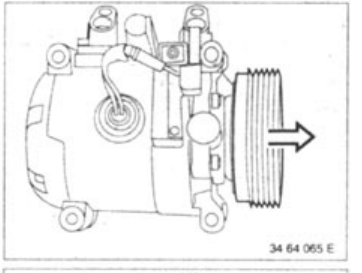
Grip drive plate with special tool 64 5 090, unfasten central screw and remove drive plate.



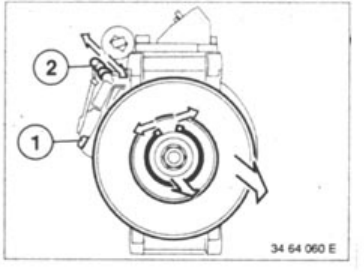
Installation:
Check correct clearance A (0.5 . . . 0.8 mm) between drive plate and pulley wheel. If necessary, adjust with shims.



Expand retaining ring.



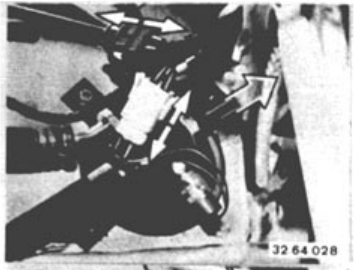
Remove pulley wheel.



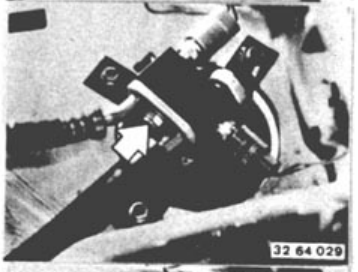
Expand retaining ring and remove. Unscrew bolt (1). Disconnect plug (2). Remove solenoid coil.

64 53 510 Replacing dryer flask for air conditioner

Removing container for windshield washing unit, refer to Gr. 61 61 ...
Drain off refrigerant from air-conditioning unit, refer to 64 50 009 or operating manual for relevant Service Station)

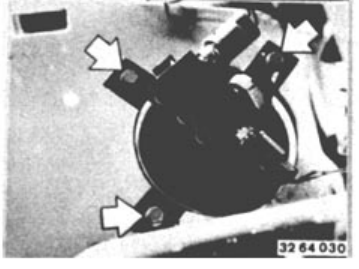


Disconnect or separate plug.



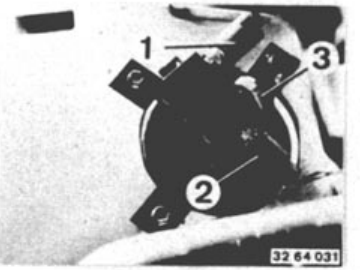
Unfasten nut and disconnect lines.

Installation:
Tightening torque*
Check O-rings and replace if necessary.



Unfasten screws and remove dryer flask.

* Refer to Technical Data

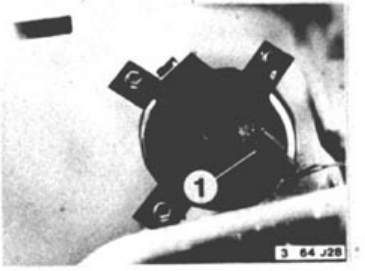


Remove safety pressure switch and screw onto new dryer flask.

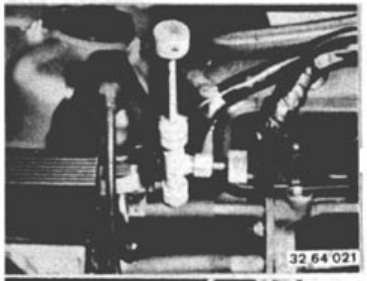
Installation:
Tightening torque*
Install with screw cement HWB No. 81 22 9 407 144.

1 = High pressure switch
2 = Medium pressure switch
3 = Low pressure switch

Installation:
Do not remove sealing plug from connections until shortly before connecting up the lines. Check that oil quantity* is sufficient. After successful installation, evacuate air-conditioning unit, charge and check for leaks.

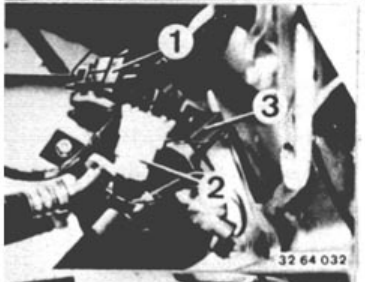


From 2/88, only 1 pressure switch with three functions is fitted. (low pressure, high pressure, medium pressure)



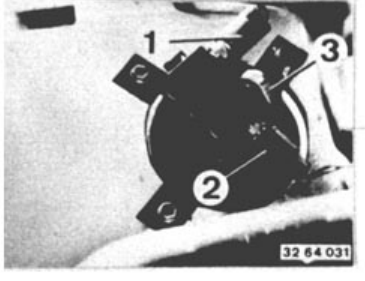
64 53 520 Replacing safety high pressure switch (high, medium, low pressure switch)

Remove switch for windshield wash system, refer to Gr. 61 61 ...
Drain refrigerant off from air conditioning unit (refer to 64 50 009 or operating manual for relevant Service Station)



Remove or disconnect plug on safety pressure switch which is to be replaced.

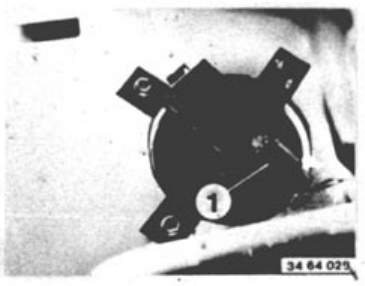
1 Plug on high pressure switch
2 Plug on medium pressure switch
3 Plug on low pressure switch



Remove safety pressure switch.
Immediately seal all open connections with blind plugs.

1 Plug on high pressure switch
2 Plug on medium pressure switch
3 Plug on low pressure switch

Installation:
Tightening torque*
Fit switch with screw securing device HWB No. 81 22 9 407 144.
After successful installation - evacuate and fill air conditioner and check for leaks.

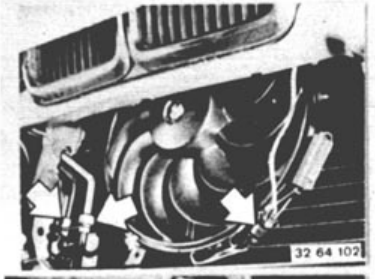


On version with a multi-function pressure switch (high, medium and low pressure), disconnect plug connection (1) and unscrew switch.

* Refer to Technical Data

64 53 550 Removing and installing or replacing condenser for air conditioning unit

Remove bumper and BMW kidney grille.
Drain refrigerant off from air conditioning unit (refer to 64 50 009 or operating manual for relevant Service Station)



Unfasten nuts, disconnect plug connection.



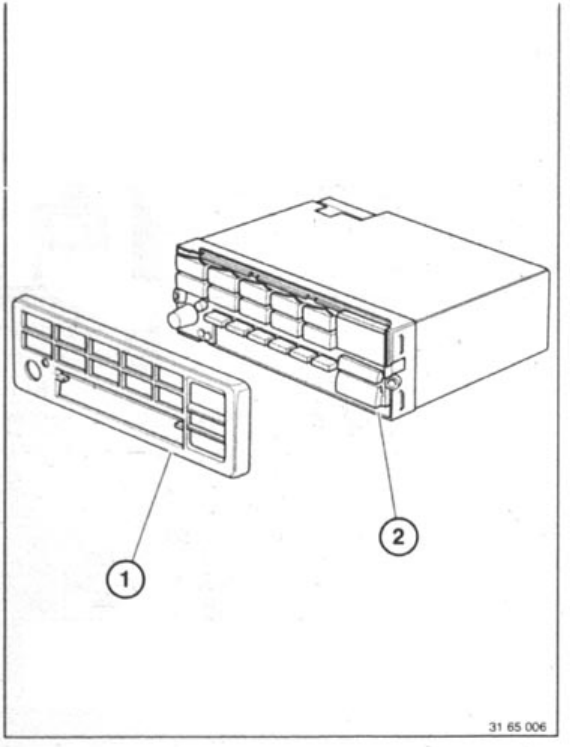
Unscrew bolts.

Lift up condenser and remove by pulling downwards.

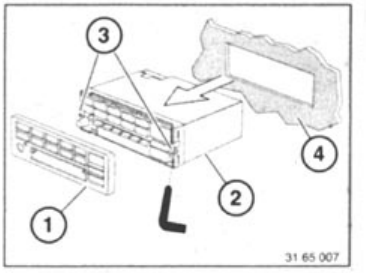
65 Radio and special equipment

65 11 030	Radio (Business) – remove and install or replace	65- 11/1
030	Radio (Bavaria C II or C Reverse II)	65- 11/2
030	Radio “Bavaria Elektronic” – remove and install or replace	65- 11/3
030	Radio “Becker Mexiko Elektronic” – remove and install or replace	65- 11/4
030	Radio “Bavaria Mono Digital” – remove and install or replace	65- 11/5
65 12 000	Front loudspeakers – remove and install or replace (footwell, left)	65- 12/1
000	Front loudspeakers – remove and install or replace (footwell, right)	65- 12/1
020	Rear loudspeakers – remove and install or replace (left or right)	65- 12/2
65 13 050	Loudspeakers – remove and install or replace (in instrument panel)	65- 13/1
070	Loudspeakers, left or right – remove and install or replace (in mirror triangle)	65- 13/1
	Fault diagnosis for Bavaria radio C Professional	65- 99/1
	Connecting wires – check	65- 99/1
	Pin assignments	65- 99/2
	Overview of defect codes	65- 99/3
	Defect code 01	65- 99/4
	Defect code 02	65- 99/5
	Defect code 03	65- 99/6
	Defect code 04	65- 99/7
	Defect code 05	65- 99/8
	Defect code 06	65- 99/8
	Defect code 07	65- 99/9
	Defect code 08	65- 99/9
	Defect code 09	66- 99/10
	Defect code 10	65- 99/11
	Test mode for BMW car radio (Bavaria C III)	65- 99/12
	Test mode for BMW car radio (Bavaria C Reverse III)	65- 99/13
	Test mode for BMW car radio (Bavaria C Reverse RDS)	65- 99/14
	Test mode for BMW car radio (Bavaria C PROFESSIONAL)	65- 99/15
	Test mode for BMW car radio (Bavaria C PROFESSIONAL RDS)	65- 99/17
	List for use of adapter leads between radio and vehicle wiring harness	65- 99/19
	Bavaria radios – troubleshoot	65- 99/20
84 11 510	Eject box – remove and install	refer to HG-84

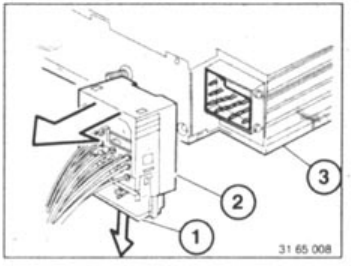
65 11 030 REMOVING AND INSTALLING OR REPLACING RADIO (Business)



1 Mask
2 Radio

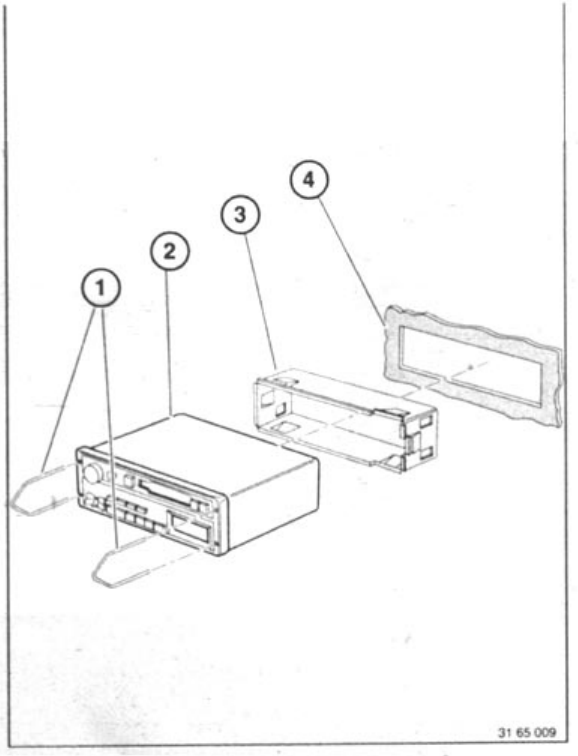


Pull off mask (1).
Unscrew screws (3) on left and right sides.
Pull radio (2) out of radio opening.

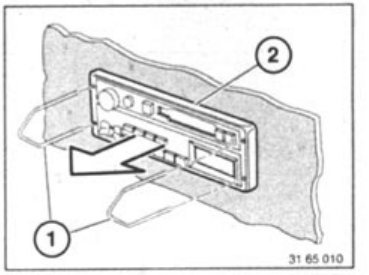


Pull out lock (1) and disconnect plug (2) on radio (3).

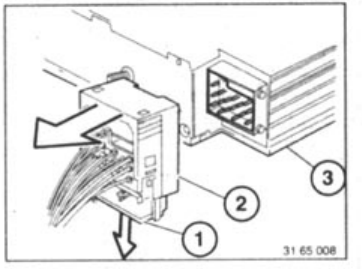
65 11 030 RADIO (Bavaria C II or C Reverse II)



1 Unlocking hooks
2 Radio
3 Radio console
4 Radio opening

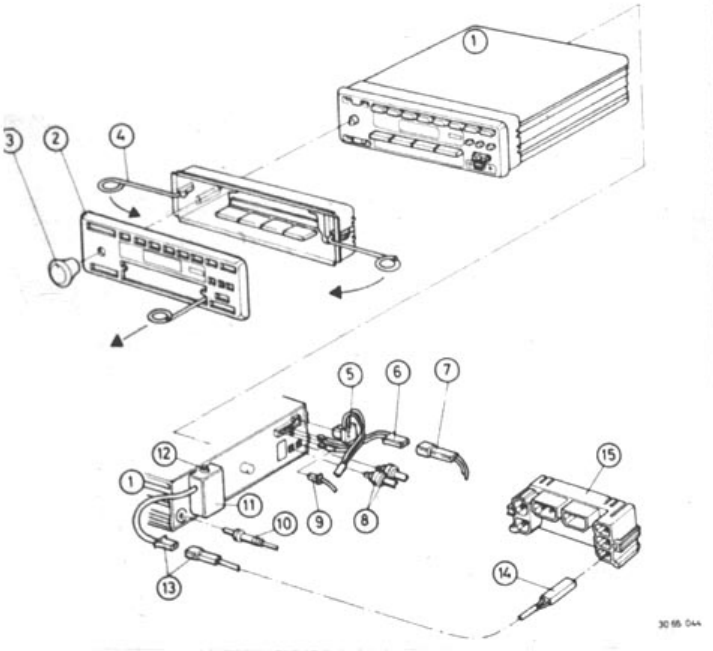


Press unlocking hooks (1) into radio on left and right sides.
Pull out radio carefully with hooks.



Pull out lock (1) and disconnect plug (2) on radio (3).

1.3 Radio "Bavaria Electronic"



1 Radio
2 Mask
3 Knob
4 Unlocking hook for radio removal
5 Plug for B + and ground
6 Adapter
7 Plug for power supply to electronics and lights
8 Plug for speakers
9 Plug for automatic antenna
10 Plug for antenna
11 Adapter for noise-dependent loudness regulation
12 Switch for 11
13 Plug for 11
14 Plug for 11
15 Plug receptacle on instrument carrier

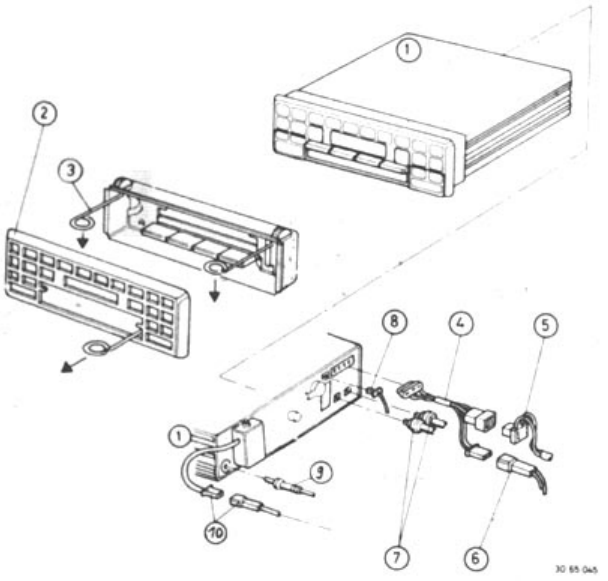


Pull off knob.
Take off mask carefully with the unlocking hook.
Note:
Only attach hook on mask.



Push back clamps on left and right sides with unlocking hooks and pull out radio.

1.4 Radio "Becker Mexico Electronic"



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 lights
7 Plug for speakers
8 Plug for automatic antenna
9 Plug for antenna
10 Connection for speed-dependent loudness regulation

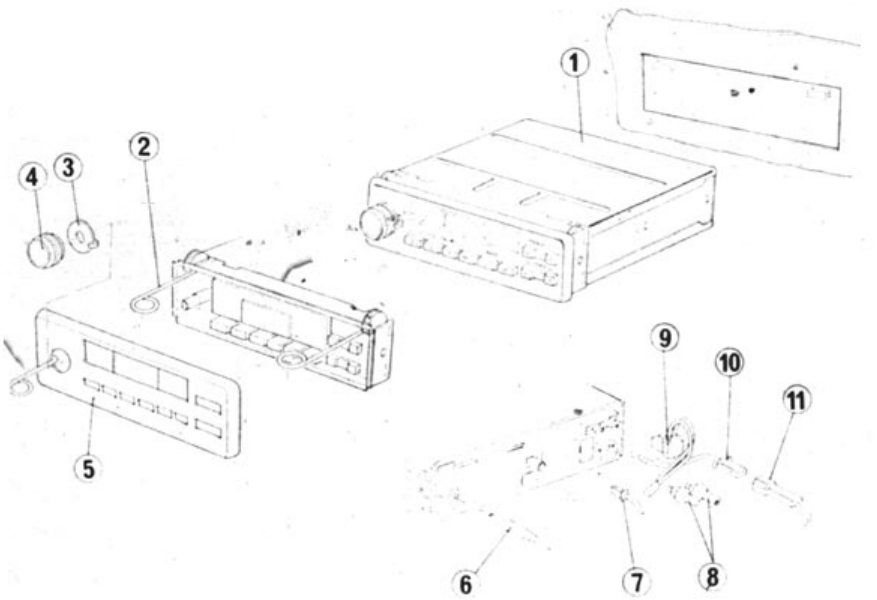


Take off control panel with unlocking hooks (1).
Note:
Control panel fits very tight.



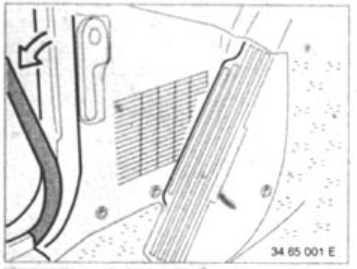
Push back clamps on left and right sides with unlocking hooks and pull out radio.

BMW Radio Bavaria Mono Digital



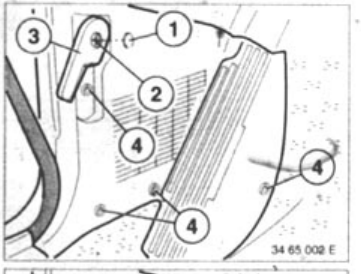
30 65 355

1 Radio
2 Unlocking hook for removal
3 Sound control
4 Knob
5 Mask
6 Antenna plug
7 Power connection for automatic antenna
8 Speaker plug
9 Plug for B + and ground
10 Adapter
11 Plug for power supply (term. 30)

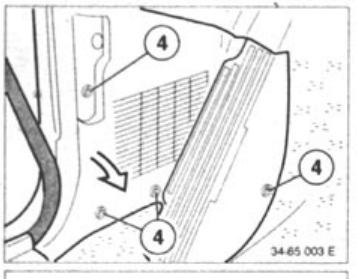


65 12 000 REMOVING AND INSTALLING OR REPLACING FRONT LOUDSPEAKER (Footwell - Left)

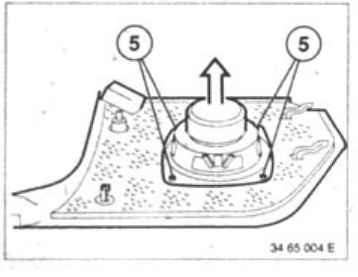
Pull off door seal.



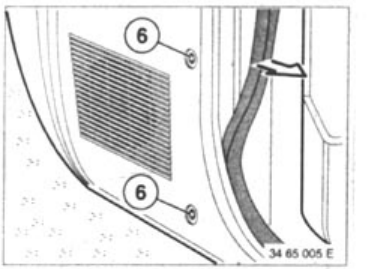
Pry out cap (1), unscrew screw (2) and pull off lever (3).



Turn retainers (4) about 90° and lift out side trim panel.

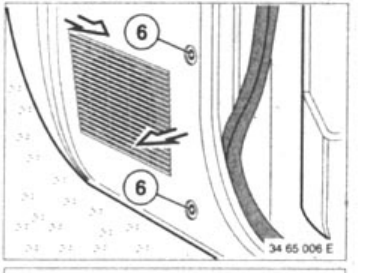


Pull off plug, unscrew nuts (5) and remove loudspeaker.

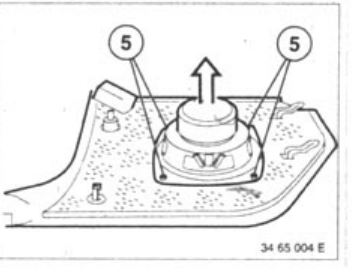


65 12 200 REMOVING AND INSTALLING OR REPLACING FRONT LOUDSPEAKER (Footwell - Right)

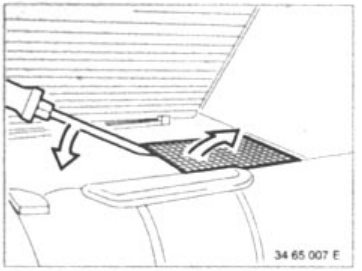
Pull off door seal and turn retainers (6) about 90°.



Lift side trim panel in area of retainers and pull out towards rear.

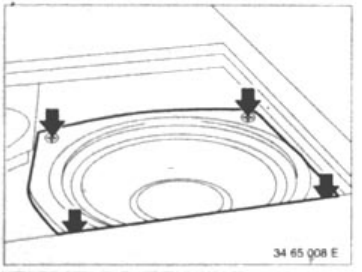


Pull off plug, unscrew nuts (5) and remove loudspeaker.

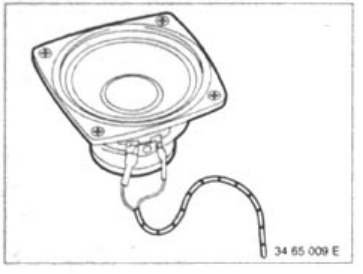


65 12 020 REMOVING AND INSTALLING OR REPLACING REAR LOUDSPEAKER (Left or Right)

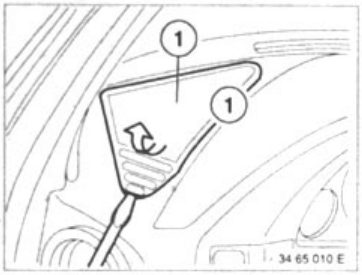
Pry out loudspeaker mask.



Unscrew screws and lift loudspeaker.

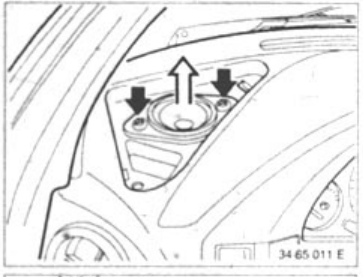


Pull off plug and remove loudspeaker completely.



65 13 050 REMOVING AND INSTALLING OR REPLACING LOUD-SPEAKER (in Dashboard)

Pry out cover (1).



Unscrew screws and lift loudspeaker.



Pull off plug and remove loudspeaker completely.



65 13 070 REMOVING AND INSTALLING OR REPLACING LOUD-SPEAKER (in Mirror Triangle)

Unscrew screw.
Unclip loudspeaker at top and fold forward.



Pull off plug and remove loudspeaker.

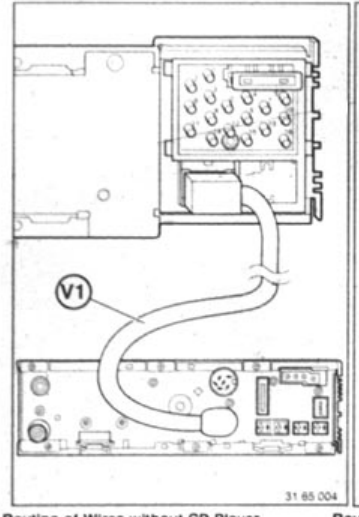
TROUBLESHOOTING BAVARIA C PROFESSIONAL RADIO

Bavaria C4 is available in two version, with or without CD player.
Controls and receiver are separated from each other for both versions. Controls are located in the dashboard as always, while the receiver and when applicable CD player are in the trunk. Because of this a connecting wire is required from the controls to the receiver and CD player, which later in the course of troubleshooting will be referred to as V1 (without CD player) or V2 (with CD player).
Wires V1 and V2 only differ in length, because connecting wire Vr leads from the controls to the CD player first and from there together with V3 to the receiver.

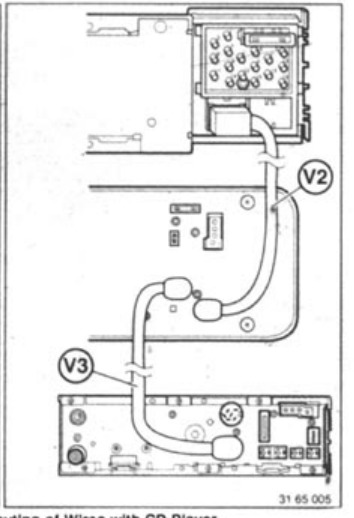
Checking Connecting Wires

Connecting wires must be checked for continuity and short circuit.
Procedures:
Unplug connecting wire on both ends.
Connect a short circuit bridge (Special Tool . . . . . .) on 12-pin Elo plug of V1 or V2 wire to the controls.
Measure at the other end with a multimeter and test points, whether there is continuity between the various pin.
Remove short circuit bridge.
There should no longer be continuity between pins.

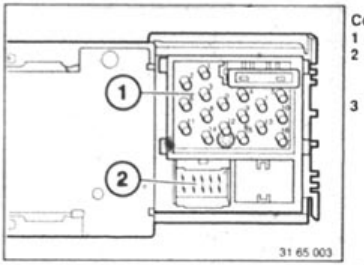
Proceed accordingly with the V3 wire. Only a different short circuit bridge (Special Tool . . . . . .) is required.



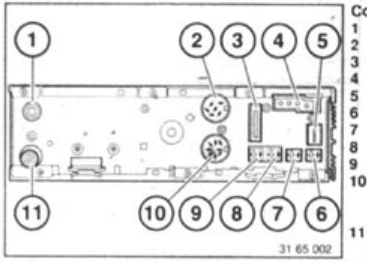
Routing of Wires without CD Player



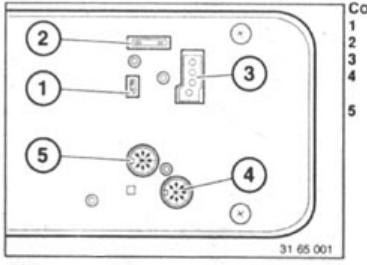
Routing of Wires with CD Player



Connections for Control End:
1 Plug, 17-pin (power supply)
2 Plug, 10-pin (to receiver with connecting wire V1 or to CD player with connecting wire V2)
3 Fuse = 3 amperes



Connections for Receiver End:
1 Ant. div.
2 Remote control
3 Fuse = 5 amperes
4 Plug, 4-pin (power supply)
5 Plug, 1-pin (electric antenna)
6 Loudspeaker front left
7 Loudspeaker front right
8 Loudspeaker rear left
9 Loudspeaker rear right
10 Plug, 8-pin (from controls with connecting wire V1 or from CD player with connecting wire V3)
11 Antenna connection



Connections for CD Player End:
1 Plug, 1-pin (12 V control outlet)
2 Fuse = 3 amperes
3 Plug (power supply)
4 Plug (to receiver with connecting wire V3)
5 Plug (from controls with connecting wire V2)

PIN CONNECTIONS

17 Pin Plug (Controls)

Pin	0		LAC-I bus
Pin	1...3		Not used
Pin	4		Telephone mute
Pin	5	Term. 75	(connected pos.)
Pin	6		Not used
Pin	7		DAC-I bus
Pin	8		Not used
Pin	9	Term. 30	(permanent pos.)
Pin	10	GAL	Speedometer outlet
Pin	11 + 12		Not used
Pin	13	Term. 58g	Light
Pin	14		Not used
Pin	15	Term. 31	(ground)
Pin	16		Autom. antenna

4-Pin Plug (Receiver)

Pin	1	Term. 31	(ground)
Pin	2	Term. 75	(connected pos.)
Pin	3		Not used
Pin	4	Term. 30	(permanent pos.)

4 Pin Plug (CD Player)

Pin	1	Term. 31	(ground)
Pin	2		Not used
Pin	3		Not used
Pin	4	Term. 30	(permanent pos.)

FAULT SURVEY

The objective of troubleshooting is the systematic determination of sources of fault. Possible fault conditions are listed in this fault survey. Certain procedures are specified for each fault condition, which lead to the source of fault by answering a question with YES or NO.

The connection of all plugs on different components should be checked for tight fit prior to troubleshooting.

Cannot be switched on, i.e. radio has no reaction	_____	Fault 01
Cannot be switched on, i.e. only click heard from control unit (no sound, display remains dark)	_____	Fault 02
Cannot be switched off	_____	Replace control unit
No sound from one or more loudspeakers with radio, cassette or CD player on (dsiplays are visible)	_____	Fault 03
No sound from one or both channels only with cassette on	_____	Fault 04
Sound quality disturbed with cassette on	_____	Fault 05
Faulty cassette drive such as IN/OUT, fast forward or reverse	_____	Fault 06
Radio reception faulty	_____	Fault 07
CD player rejection button for CD magazine does not work	_____	Fault 08
CD player failure	_____	Fault 09
Faulty reaction to loudness or sound quality adjustments	_____	Fault 10
Faulty displays (undefined symbols displayed)	_____	Replace control unit

FAULT 01

Radio cannot be switched on – no reaction

Is there battery voltage on 17 pin plug in control unit between pins 9 and 15? — no → Repair break in positive or ground wire.

↓ yes

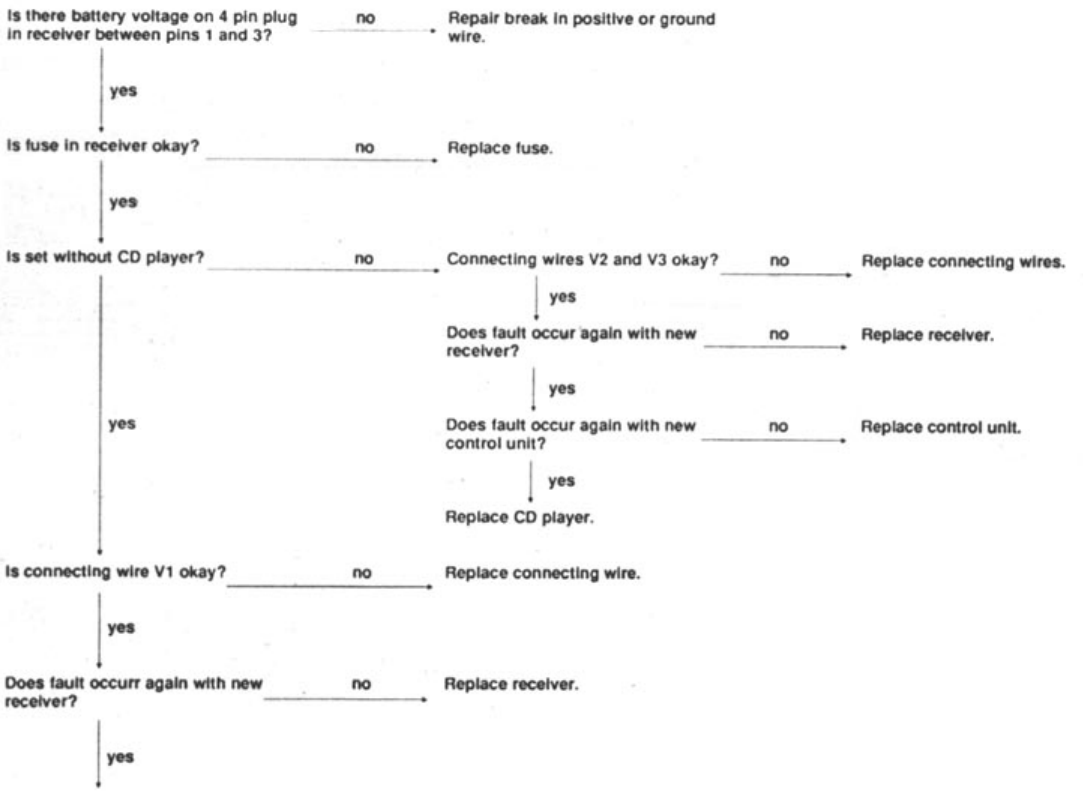
Is fuse in control unit okay? — no → Replace fuse.

↓ yes

Replace control unit.

FAULT 02

Radio does not switch on. Click heard in control unit, but no sound and display is dark.



yes

Replace control unit.

FAULT 03

No sound from one or more loudspeakers with radio, cassette player or CD player on (displays shown in display)

Sound control in center position? — no → Turn sound control to center position (see operating instructions).

yes

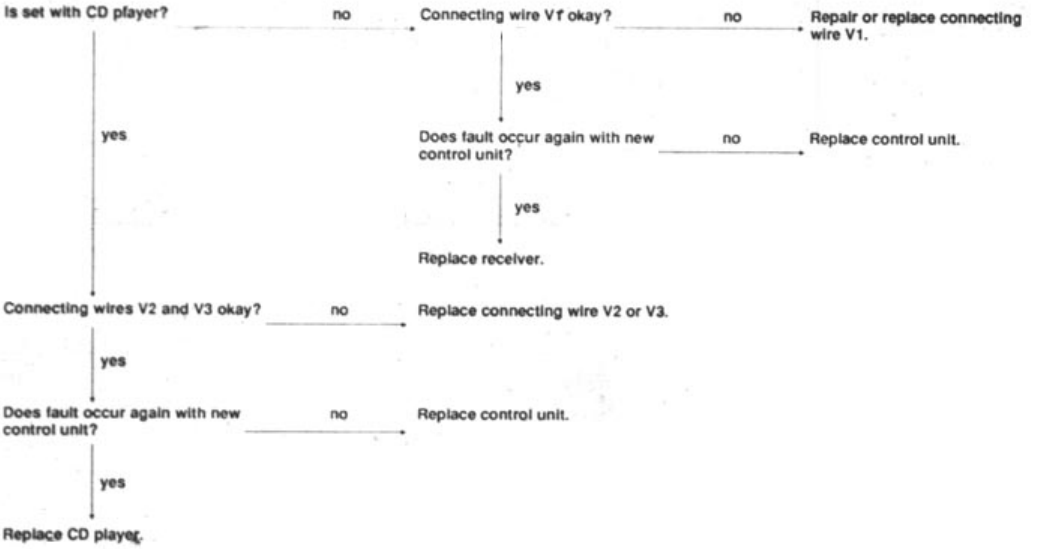
Are loudspeaker outlets on receiver okay (control with test loudspeaker)? — no → Replace receiver.

yes

Repair loudspeakers or loudspeaker connections.

FAULT 04

Cassette player on – no sound from one or both channels



FAULT 05

Sound quality of cassette player is poor.

Is sound control in center position? — no → Adjust sound control (see operating instructions).

yes ↓

Does fault also occur with a different cassette of known good sound quality? — no → Previously used cassette is faulty or poorly recorded.

yes ↓

Does fault still occur after cleaning sound head? — no → Control unit is okay.

yes ↓

Replace control unit.

FAULT 06

Cassette play drive malfunctions, e.g. faulty IN/OUT, fast forward or reverse

Does fault also occur with other cassette? — no → Cassette has mechanical fault.

yes ↓

Replace control unit.
(*Note:* **Leave seized cassette in control unit; don't remove with force.**)

FAULT 07

Radio reception faulty

Does fault also occur with a new receiver? — no → Replace receiver.

yes ↓

Check antenna or antenna system and replace faulty part.

FAULT 08

CD player ejection button for CD magazine ejection does not react

Is there battery voltage on 4 pin plug in CD player between pins 7 and 4? — no → Check power supply in vehicle.

yes ↓

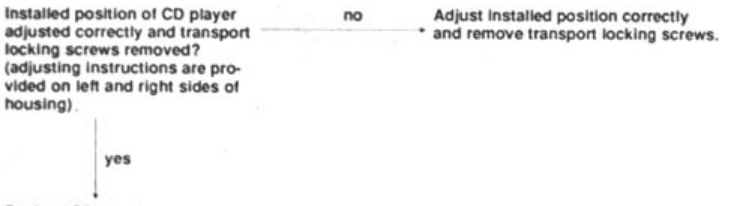
Is fuse in CD player okay? — no → Replace fuse.

yes ↓

Replace CD player.

FAULT 09

CD player failure



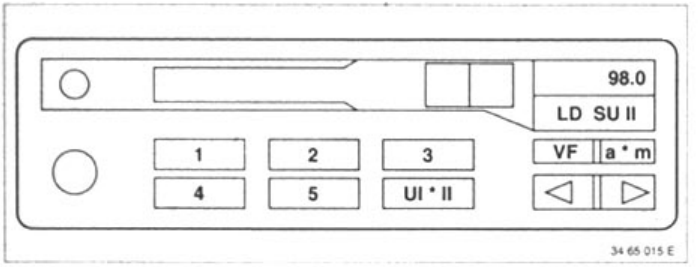
FAULT 10

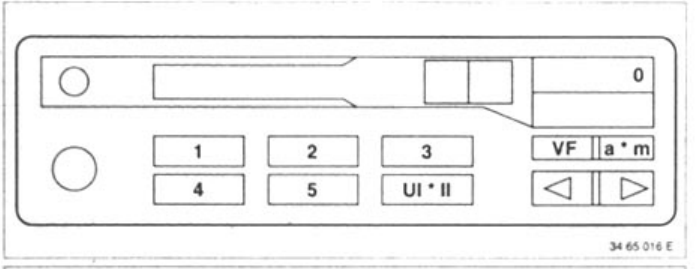
Faulty reaction to loudness and sound control adjustments

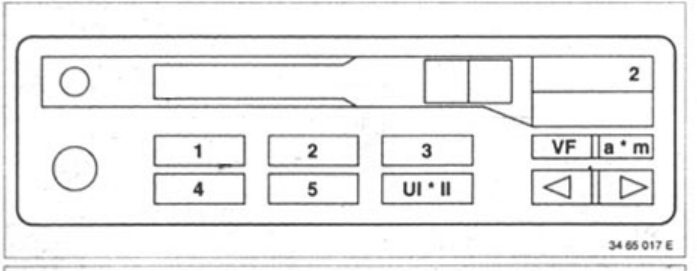
Does fault still occur with a new receiver? — no → Replace receiver.

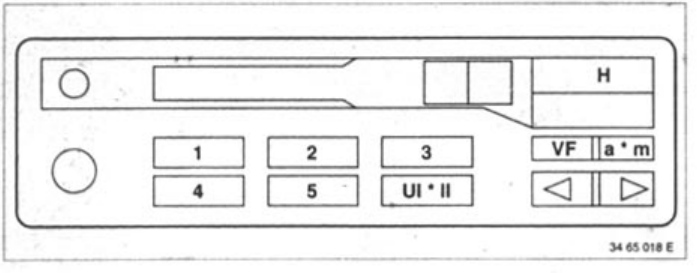
yes ↓

Replace control unit.









TEST MODE FOR BMW CAR RADIO (BAVARIA C III)

"BAVARIA C III" radios contain a test mode, with which various types of internal information can be displayed and various operating conditions set.

Starting Test Mode:

Press keys "2" and "5" simultaneously while switching the radio on. A capital "S" appears in the display next to the wave range. The selected station is still received.

This service mode is abandoned by switching the radio on and off once.

Changing Loudness Boost for Traffic Reports:

Press key "VF" for about 4 seconds until a "0" appears in the display. The station will be a little louder. The loudness boost can be adjusted in 5 steps by using the automatic tuning rocker.
The factory setting is "0".
The regulation range is ± 6.25 dB.

This mode is abandoned by pressing the "VF" key again. The test mode remains activated.

Adjusting Road Speed Dependent Loudness:

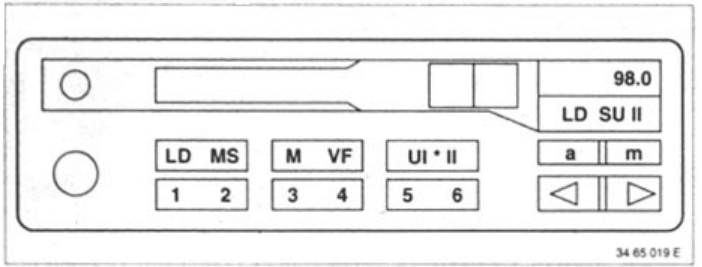
Press station key "3" for about 4 seconds until "2" appears in the display. This value can be changed by using the automatic tuning rocker.
The factory setting is "2".
Regulation range: "1": weak increase
"2": medium increase
"3": strong increase

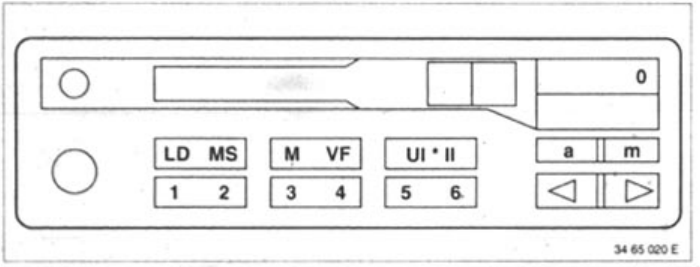
This mode is abandoned by pressing the "3" key again. The test mode remains activated.

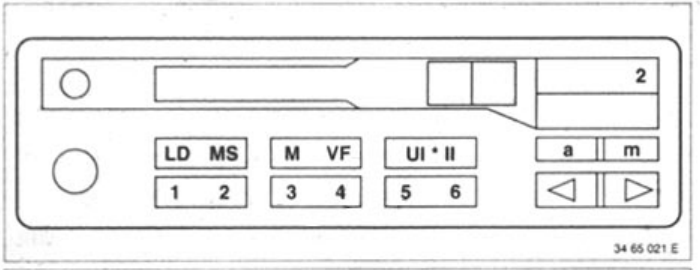
Switching from "Distance" to "Local" in Italian Mode:

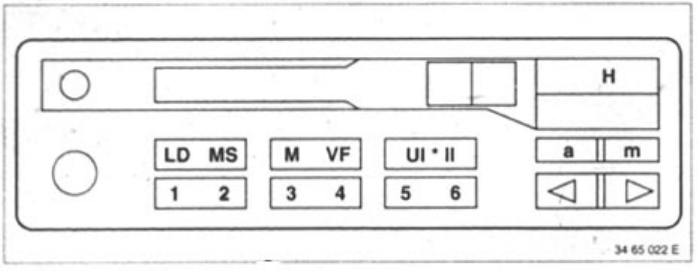
Press rocker "a*m" for about 4 seconds until "H" or "L" appears in the display. This setting can be changed by using the automatic tuning rocker.
The factory setting is "H".
Regulation range: "H": distance
"L": local

This mode is abandoned by pressing the "a*m" key again. The test mode remains activated.









TEST MODE FOR BMW CAR RADIO (BAVARIA C REVERSE III)

"BAVARIA C REVERSE III" radios contain a test mode, with which various types of internal information can be displayed and various operating conditions set.

Starting Test Mode:

Press keys "2" and "5" simultaneously while switching the radio on. A capital "S" appears in the display.

This service mode is abandoned by switching the radio on and off once.

Changing Loudness Boost for Traffic Reports:

Press key "VF" for about 4 seconds until a "0" appears in the display. The station will be a little louder. The loudness boost can be adjusted in 5 steps by using the automatic tuning rocker.
The factory setting is "0".
The regulation range is ± 6.25 dB.

This mode is abandoned by pressing the "VF" key again. The test mode remains activated.

Adjusting Road Speed Dependent Loudness:

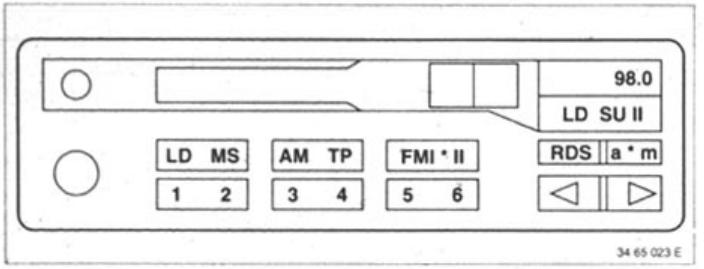
Press station key "3" for about 4 seconds until "2" appears in the display. This value can be changed by using the automatic tuning rocker.
The factory setting is "2".
Regulation range: "1": weak increase
"2": medium increase
"3": strong increase

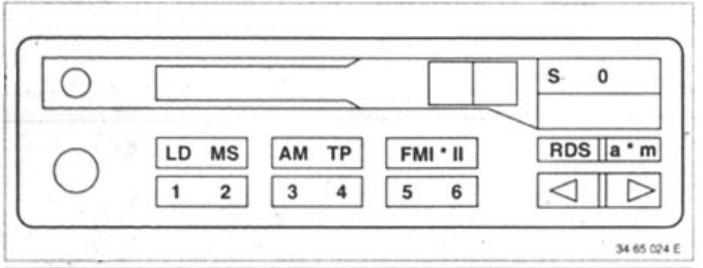
This mode is abandoned by pressing the "3" key again. The test mode remains activated.

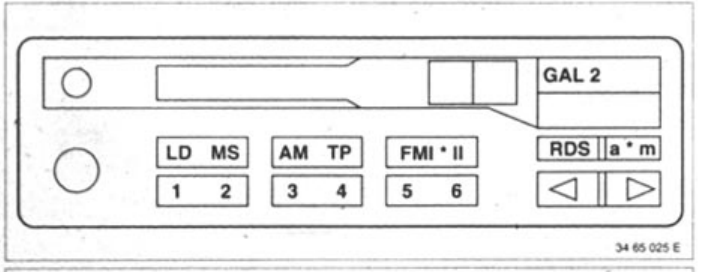
Switching from "Distance" to "Local" in Italian Mode:

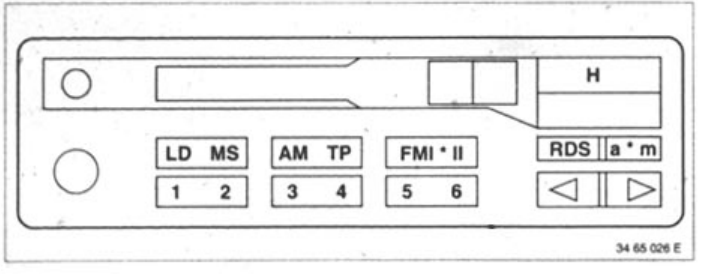
Press rocker "m" for about 4 seconds until "H" or "L" appears in the display. This setting can be changed by using the automatic tuning rocker.
The factory setting is "H".
Regulation range: "H": distance
"L": local

This mode is abandoned by pressing the "m" key again. The test mode remains activated.









TEST MODE FOR BMW CAR RADIO (BAVARIA C REVERSE RDS)

"BAVARIA C REVERSE RDS" radios contain a test mode, with which various types of internal information can be displayed and various operating conditions set.

Starting Test Mode:

Press keys "2" and "5" simultaneously while switching the radio on. A capital "S" appears in the display.

This service mode is abandoned by switching the radio on and off once.

Changing Loudness Boost for Traffic Reports:

Press key "TP" for about 4 seconds until a "0" appears in the display. The station will be a little louder. The loudness boost can be adjusted in 5 steps by using the automatic tuning rocker.
The factory setting is "0".
The regulation range is ± 6.25 dB.

This mode is abandoned by pressing the "TP" key again. The test mode remains activated.

Adjusting Road Speed Dependent Loudness:

Press station key "3" for about 4 seconds until "2" appears in the display. This value can be changed by using the automatic tuning rocker.
The factory setting is "2".
Regulation range: "1": weak increase
"2": medium increase
"3": strong increase

This mode is abandoned by pressing the "3" key again. The test mode remains activated.

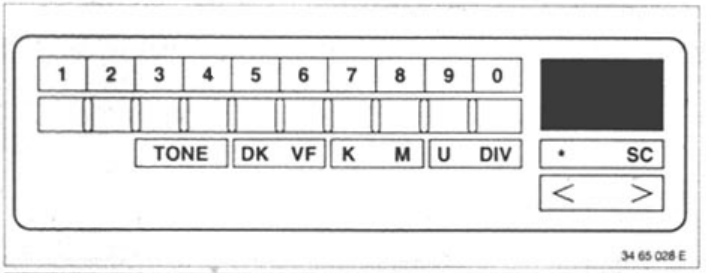
Switching from "Distance" to "Local" in Italian Mode:

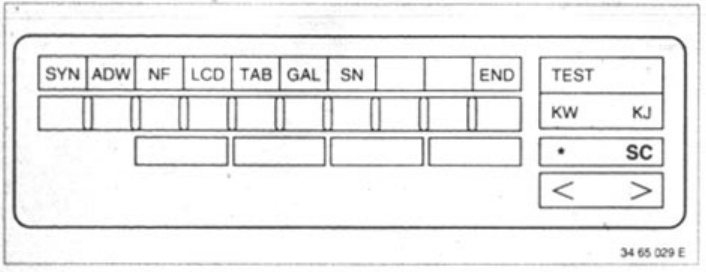
Press rocker "a*m" for about 4 seconds until "H" or "L" appears in the display. This setting can be changed by using the automatic tuning rocker.
The factory setting is "H".
Regulation range: "H": distance
"L": local

This mode is abandoned by pressing the "a*m" key again. The test mode remains activated.

Adjusting Viewing Angle for Display:

The angle of view can be changed by pressing the "RDS" key (E-31).
Factory setting: dark display with direct view.





TEST MODE FOR BMW CAR RADIO (BAVARIA C PROFESSIONAL)

"BAVARIA C PROFESSIONAL" radios contain a test mode, with which various types of internal information can be displayed and various operating conditions set.

Starting Test Mode:

Press key "*" and then simultaneously operate keys "8" and "0" within the first eight seconds after the radio has been switched on. The basic menu is displayed.

The entire test is menu controlled.

Basic Menu:
The available test functions can be interrogated via the basic menu.
Various codes for the different functions appear in the C-display for this purpose and these functions can be activated by operating the pertinent key located below the multi-function keyboard.

The different codes activate the following functions:

SYN:	Synthesizer set to a fixed frequency
ADW:	Input values of 8 analog/digital converter displayed
NF:	Volume, bass, treble and fader values on sound control module displayed in dB
LCD:	LCD test
TAB:	Stored frequency tables displayed
GAL:	One of three road speed dependent loudness tables activated
SN:	Serial numbers and software status displayed

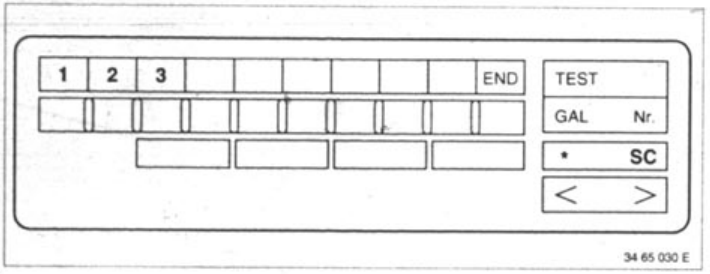
In addition, the software status of the front software (week and year) appears in the B-display.

The test is stopped by pressing the key below "END".

LCD Test (LCD):
Four different test patterns are switched on in series for all light emitting diodes (LEDs) during the LCD test:

- All LEDs switched on
- Chessboard pattern
- Chessboard pattern inverted for second test
- All LEDs switched off

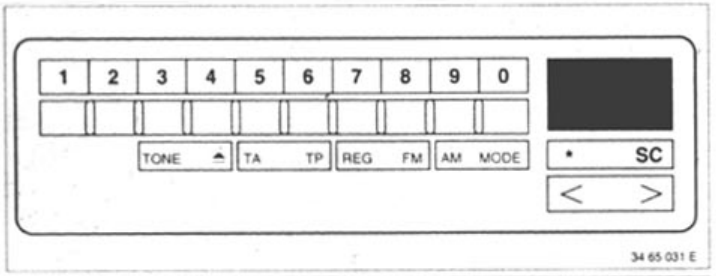
The test can be stopped at any time by pressing key "0", but also returns to the main menu after display of all four test patterns.

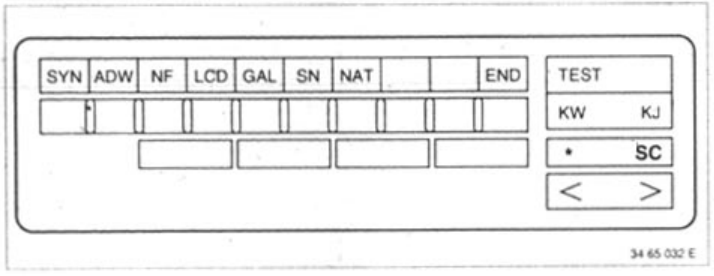


Road Speed Dependent Loudness Control (GAL):

With help of this test one of the three road speed dependent loudness tables is activated, through which one each road speed dependent loudness offset can be determined and reported to the radio.
The instantaneously activated table can be read in the B-display.
The table number is stored in EEPROM.

Return to the main menu is accomplished by pressing the key below "END".





TEST MODE FOR BMW CAR RADIO (BAVARIA C PROFESSIONAL RDS)

"BAVARIA C PROFESSIONAL RDS" radios contain a test mode, with which various types of internal information can be displayed and various operating conditions set.

Starting Test Mode:

Press key "*" and then simultaneously operate keys "8" and "0" within the first eight seconds after the radio has been switched on. The basic menu is displayed.

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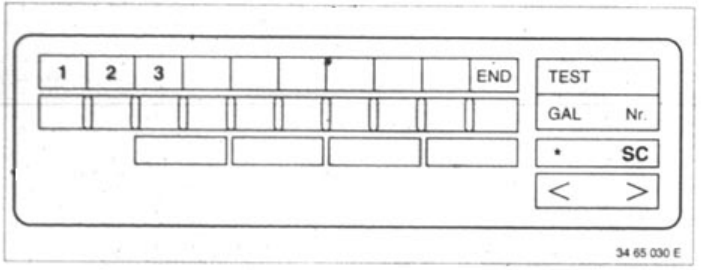
The different codes activate the following functions:

SYN:	Synthesizer set to a fixed frequency
ADW:	Input values of 8 analog/digital converter displayed
NF:	Volume, bass, treble and fader values on sound control module displayed in dB
LCD:	LCD test
GAL:	One of three road speed dependent loudness tables activated
SN:	Serial numbers and software status displayed
NAT:	Application range (USA, EUR) set

In addition, the software status of the front software (week and year) appears in the B-display.

The test is stopped by pressing the key below "END".



LCD Test (LCD):
Four different test patterns are switched on in series for all light emitting diodes (LEDs) during the LCD test:

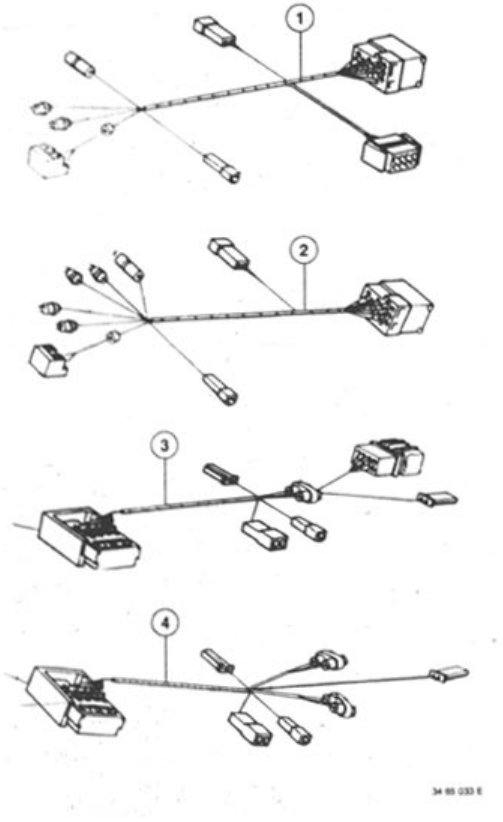
- All LEDs switched on
- Chessboard pattern
- Chessboard pattern inverted for second test
- All LEDs switched off

The test can be stopped at any time by pressing key "0", but also returns to the main menu after display of all four test patterns.

Road Speed Dependent Loudness Control (GAL):

With help of this test one of the three road speed dependent loudness tables is activated, through which one each road speed dependent loudness offset can be determined and reported to the radio.
The instantaneously activated table can be read in the B-display.
The table number is stored in EEPROM.

Return to the main menu is accomplished by pressing the key below "END".



LIST OF ADAPTER LEADS FOR USE BETWEEN RADIO AND VEHICLE WIRE HARNESS

Part Number	Fig. No.	Plug on Vehicle Wire Harness	Connection on Radio
65 12 8 350 007	1	17-pin plug and HiFi sound system with four channel radio	Separate plugs for power supply, GAL, antenna and four loudspeaker jacks
65 12 8 350 190	1	17-pin plug, HiFi sound system and phase rotation on amplifier with four channel radio	Separate plugs for power supply, GAL, antenna and four loudspeaker jacks
65 12 8 350 189	1	17-pin plug and stereo system with four channel radio	Separate plugs for power supply, GAL, antenna and four loudspeaker jacks
65 12 8 350 188	2	17-pin plug and stereo system with two channel radio and fade control	Separate plugs for power supply, GAL, antenna and four loudspeaker jacks
65 12 8 350 191	2	17-pin plug and HiFi sound system with two channel radio and fade control	Separate plugs for power supply, GAL, antenna and four loudspeaker jacks
65 12 8 350 192	3	Separate plugs for power supply, GAL, antenna and two loudspeaker plugs and fade control	17-pin connection on radio
82 11 9 410 558	4	Separate plugs for power supply, GAL, antenna and four loudspeaker plugs and fade control	17-pin connection on radio

TROUBLESHOOTING BAVARIA RADIOS

Condition	Cause	Correction
Scale light on, but no sound or noise in loudspeakers with loudness set at maximum. Automatic tuning works perfectly.	Loudspeaker plug on radio loose Break in loudspeaker wiring Plugs on fade control loose Loudspeakers defective Radio defective	Tighten plug Replace wiring Tighten plugs Replace loudspeakers Replace radio
Noise with loudness set at maximum, but no reception	Antenna plug not connected to radio Break in antenna wiring Antenna Radio defective	Connect plug Replace wiring Refer to "checking antenna" Replace radio
Loud noise while driving	Antenna wiring and plug Antenna Local reception range was abandoned Station key or station tuned in incorrectly Station too weak Radio set to sound-off for traffic reports	Check, replace or tighten if necessary Refer to "checking antenna" Tune in new station Tune in station Tune in stronger station Unset sound-off and tune in station correctly
Unsatisfactory sound quality	Foreign particles in loudspeaker diaphragm or diaphragm damaged Loudspeaker installed with tension All loudspeakers are not connected identically when using more than one loudspeaker per channel Fade control not in middle position Only when cassette player is used	Remove foreign particles or replace loudspeaker Loosen and screw on loudspeaker without tension Check for identical poles Adjust fade control to middle position Clean the cassette drive using the cleaning cassette
Cassette ejected while playing	Cassette without SM mechanism: Cassette tape unwinds too hard Cassette housing distorted C 90 or C 120 cassette used	Run cassette forward and backward completely once Use a different cassette These cassettes have very thin tape and tend very quickly to unwind to hard; consequently only use C 60 cassettes.

TROUBLESHOOTING BAVARIA RADIOS

Condition	Cause	Correction
Crackling ans sizzling noise	Engine or ignition interference	Tune in a weak station. Run engine at approx. 5,000 rpm, switch ignition off. If interference noise stops by switching off the ignition, it concerns ignition interference. CHECKING Distributor cap shielding Ground strap for shielding connected Shielded capacitor 2.2 µF to ignition coil terminal (15) *Important!* Not for thyristor ignition Shielded filter in lead 1 Ignition leads, plug connectors, distributor cap, ignition coil for perfect connection and resistance* Distributor rotor resistance* Hairline cracks in distributor cap, distributor rotor, ignition coil neck, spark plugs, plug connectors Ground strap from engine to body Ground strap from engine hood to body Ground connection of radio Engine hood closed correctly
Crackling and clicking noise	Defective alternator regulator	Race engine enough until interference noise can be clearly heard. Now switch on headlights and rear window defogger. The regulator is defective if the interference noise stops or changes.
Howling or whistling noise, depending on engine speed	Interference from alternator	Remove drive belts and run engine briefly. If this produces interference, replace or service install capacitor on terminal (+) of alternator.
Sizzling and clicking noise only while driving, but stops after operating brake pedal	Electrostatic charge	Install wheel hub contacts on front axle
Howling and crackling noise when equipment is switched on	Windshield wiper motor, additional water pump,	Install 2 x 0.47 µF shielded filters
Scale light not on or no display and no reception	Fuse blown Power supply wire loose or not connected Radio defective	Replace fuse Connect wire Replace radio

* Refer to Specifications

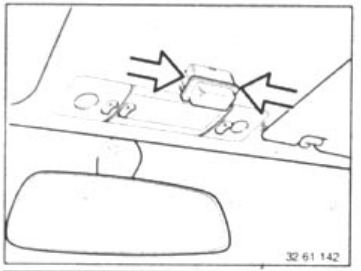
66 Transmit and receive equipment

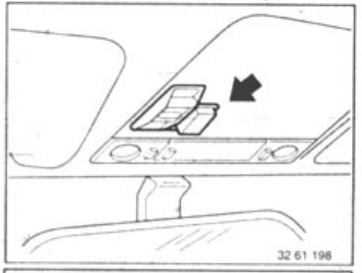
66 10 000	Infrared locking system – check function	66-	10/1
010	Receiver (infrared locking system) – remove and install or replace	66-	10/1
020	Logic unit (infrared locking system) – remove and install or replace	66-	10/2
030	Display unit (infrared locking system) – remove and install or replace	66-	10/2
. . .	Infrared transmitter – initialize	66-	10/3
. . .	Compact infrared transmitter – initialize	66-	10/3
66 20 010	Control unit (park distance control) – remove and install or replace	66-	20/1
050	Rear ultrasonic converters, all – remove and install or replace	66-	20/2
060	Rear speakers (park distance control) – remove and install or replace	66-	20/4

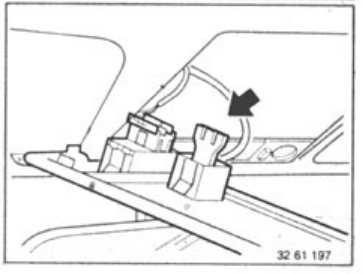
66 10 000 Check function of infrared locking system

Refer to Electrical Troubleshooting Manual for function description and troubleshooting instructions:
5 Series

Caution!
From September 1992, the compact infrared locking system will be installed.
Recognition feature: Receiver and control unit are installed in rear view mirror.
Refer to Electrical Troubleshooting Manual for function description and troubleshooting instructions:
5 Series.







66 10 010 Removing, installing or replacing the receiver (infrared locking system)

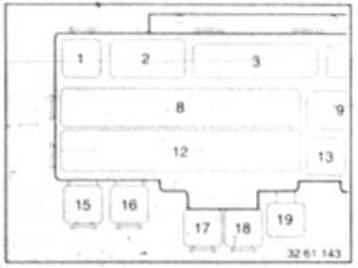
Location:
Without sliding/tilting sunroof:
In front headliner.
Compress retainers and lift out receiver.
Disconnect plug.

With sliding/tilting sunroof:
In the cover for the sliding/tilting sunroof drive unit.
Unclip roof section.
Press together the retaining hooks in the receiver.
Lift out receiver.
Disconnect plug.

Caution!
From September 1992, the compact infrared locking system will be installed.
Recognition feature: Receiver and control unit are installed in the inside rear view mirror.

66 10 020 Removing, installing or replacing logic section (infrared locking system)

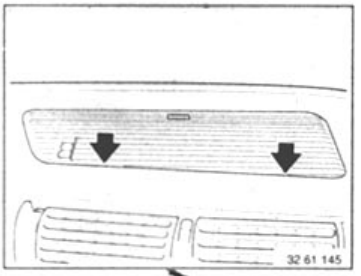
Location: In power distributor at back.
Remove rear seat, refer to 52 20 000.



(2) Control unit (logic section) of the infrared locking system

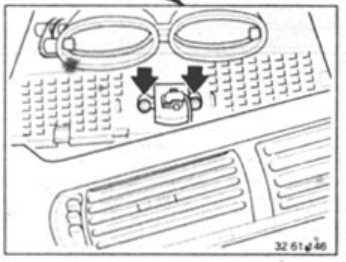
Caution!
From September 1992 the compact infrared locking system will be installed.
Recognition feature: Receiver and control unit are installed in the inside rear view mirror.

Installation:
Whenever the logic section is removed or exchanged (control unit), all the infrared transmitters (max. 4 units fitted) must be re-initialized.

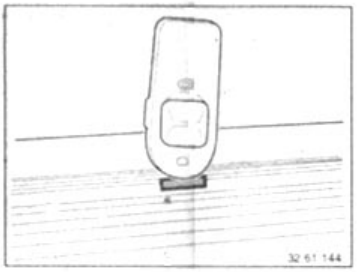


66 10 030 Removing, installing or replacing the display unit (infrared locking system)

Unfasten screws on ventilation grill.



Unscrew bolts.
Disconnect plug.



66 10 . . . Initializing the infrared transmitter

Initialization of the transmitter is required:
if the transmitted was without electric power for more than one minute
when commissioning a new transmitter

It is not necessary to initialize a transmitter:
when changing a transmitter battery in less than one minute. (buffer store with integral condenser)

Initialization:

1. Switch on ignition with second key in vehicle
2. Place transmitter directly on display section (LED must point in direction of operator)
3. Press UNLOCK until the LED on the transmitter starts to flash.
   Transmitter is now initialized.

Note:
When a transmitter is reinitialized, this cancels all previously initialized units in a system (up to 4 units may be fitted).
This means that all transmitters fitted in a system have to be initialized again.
This procedure must be carried out within 15 minutes. During this time, the ignition must not be switched off.

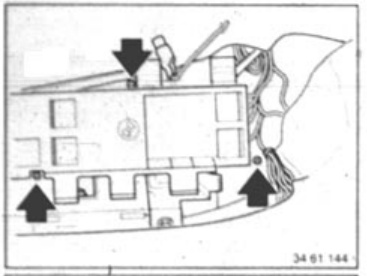
66 10 . . . Initializing compact infrared transmitter

Caution!
From September 1992, the compact infrared locking system will be installed.
Recognition feature: Transmitter and control unit are installed in the inside rear view mirror.

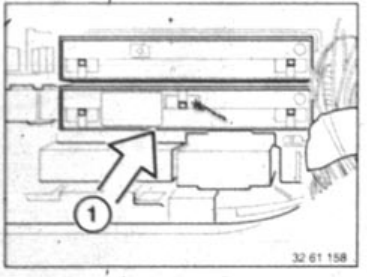
Initializing a transmitter: refer to vehicle-specific Owner's Manual.

66 20 010 Removing and installing or replacing control unit (Park Distance Control)

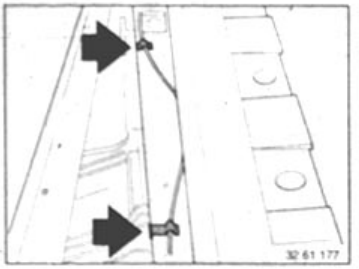
Installation location:
In power distributor beneath back seat.
Removing back seat, see Group 52.



Remove screws.
Remove cover.



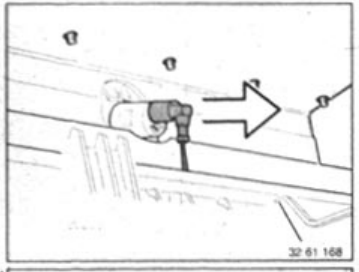
Remove control unit (1).



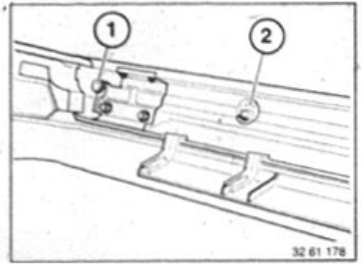
66 20 050 Removing and installing or replacing all ultrasonic converters

Removing rear bumper, see Group 51.
Pull bumper slightly forwards.
Unclip leads from clips in bumper.

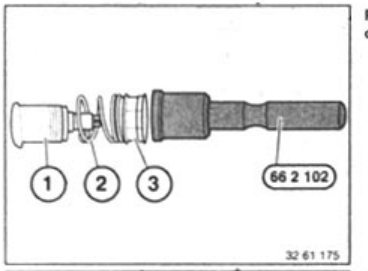
Disconnect plug connections on ultrasonic converter.



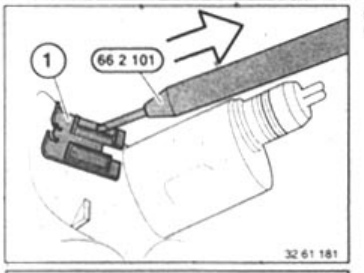
Ultrasonic converter on left side of car.



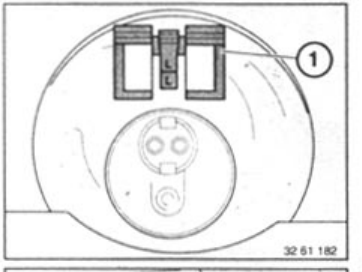
Ultrasonic converter on right side of car.

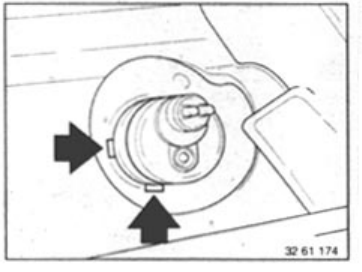


Removing ultrasonic converters (2) and (3) in center of car.

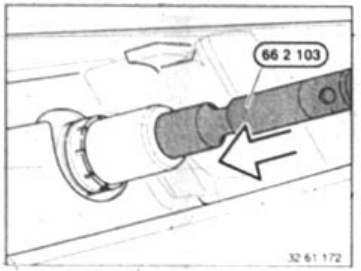


Pull slide (1) down as far as stop with special tool 66 2 101.

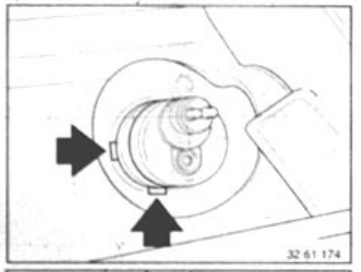




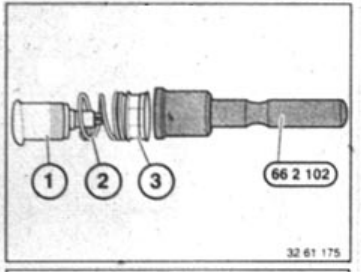
Installation instruction:
Locate ultrasonic converter in the grooves in the bumper (locking device).



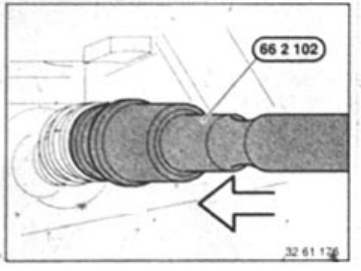
Ultrasonic converters (1) and (4) on the outside of the bumper.
Press special tool 66 2 103 firmly home: locking ring is unlocked.

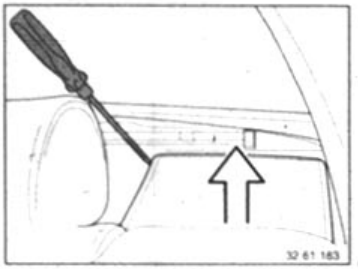


Installation instruction:
Ultrasonic converter must locate in the grooves on the bumper.



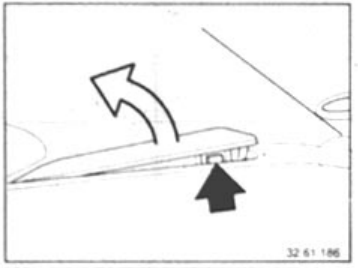
Installed order:
(Illustrated here in dismantled condition).
Install ultrasonic converter in bumper, fit spring (2), locking ring (3) and slide home with special tool 66 2 102.
Locking ring (3) must audibly locate and ultrasonic converter must be mounted firmly on the bumper.



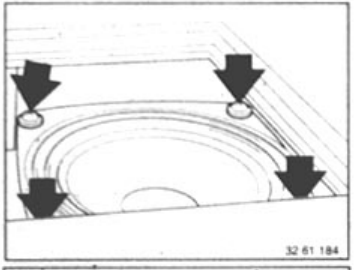


66 20 060 Removing and installing or replacing rear loudspeakers (park distance control)

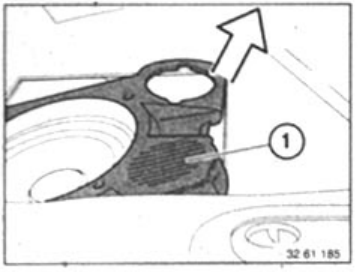
Unclip rear loudspeaker panel.



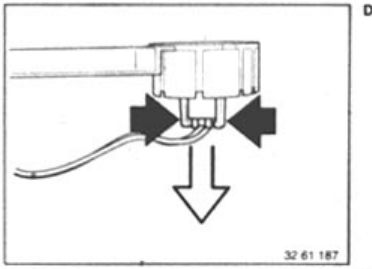
Detail of loudspeaker panel.



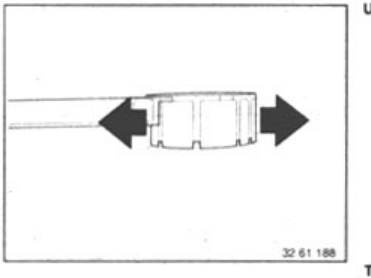
Unfasten screws in the loudspeaker panel.



Remove loudspeaker.
(1) Loudspeaker for Park Distance Control

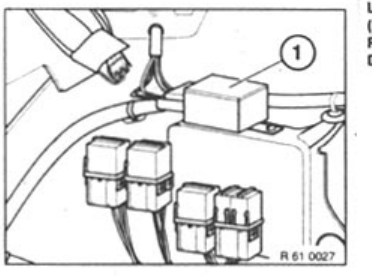


Disconnect plug.



Unclip loudspeaker.

Touring:
Remove right side wheel arch trim in trunk, see 51 47 161.

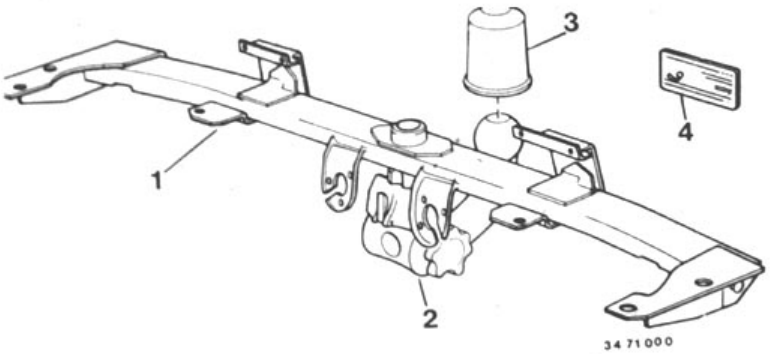


Loudspeaker is mounted beside wiper relay (1).
Remove screw.
Disconnect plug.

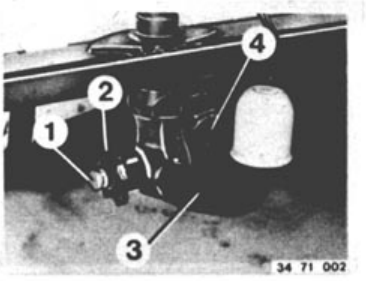
71 Engine / chassis equipment / accessories

71 60 . . . Overview of trailer hitch with detachable ball hitch 71- 60/1
. . . Trailer module – remove and install 71- 60/2
. . . Connector assignments of 13-pin plug connection 71- 60/3

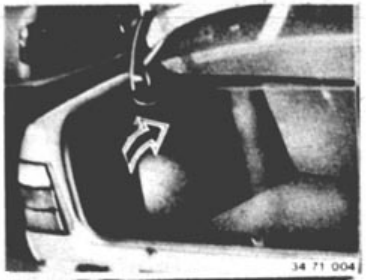
TRAILER HITCH WITH REMOVABLE BALL HEAD



1 Trailer hitch (carrier)
2 Removable ball head
3 Cover
4 Data plate

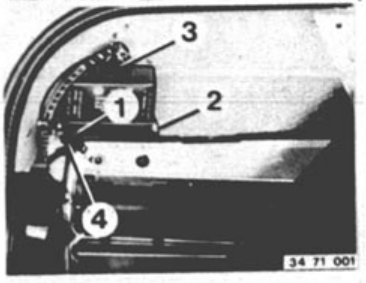


1 Key
2 Handwheel for removable ball head (pull out, turn and remove ball head)
3 Ball head
4 Socket

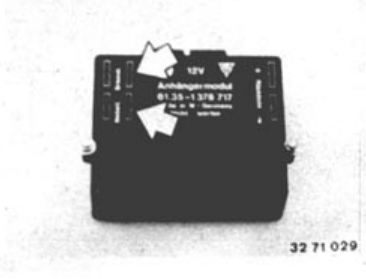


71 60 . . . REMOVING AND INSTALLING TRAILER MODULE

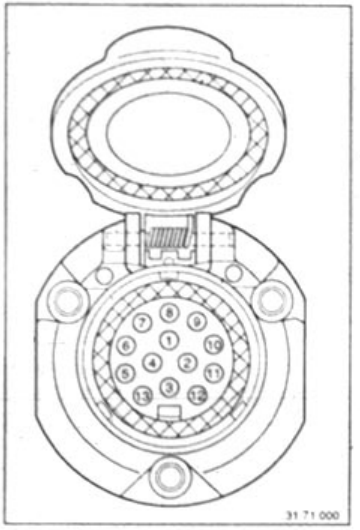
Lift off trim panel partially.



Unscrew screws (1 and 2).
Pull off plugs (3 and 4).
Lift out trailer module.



Spare fuses.
Note:
Also refer to fuses 18 and 22 in the fusebox should the system fail.



71 60 ... CONNECTIONS OF 13 PIN PLUG

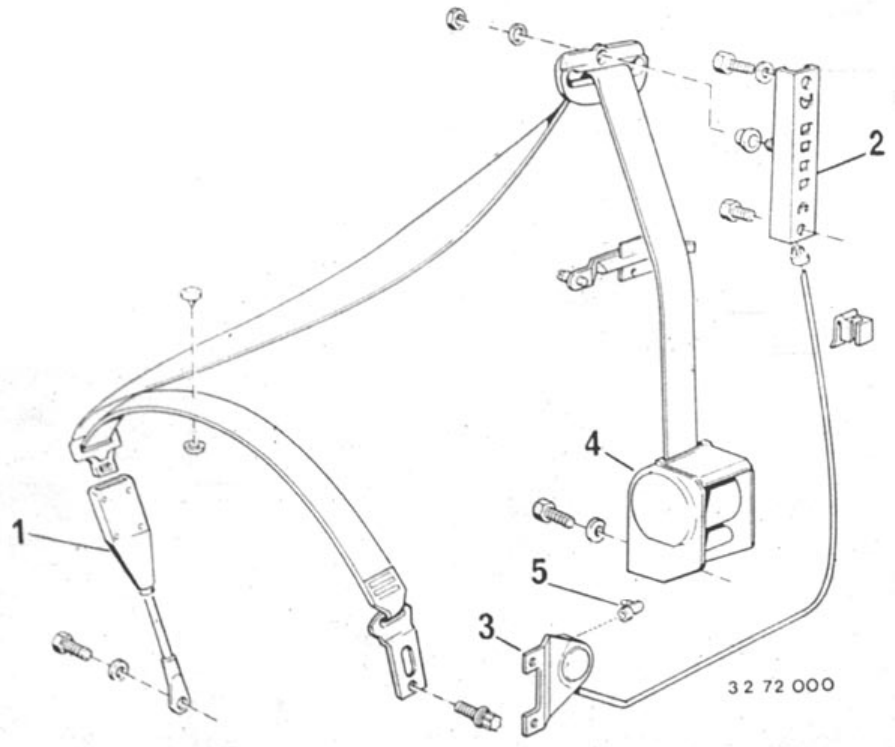
Pin 1	Turn signal indicator, left
Pin 2	Tail fog lights
Pin 3 *	Ground (for circuit of contacts 1 through 8)
Pin 4	Turn signal indicator, right
Pin 5	Right tail light, identity light, marker light and license plate light
Pin 6	Brake lights
Pin 7	Left tail light, identity light, marker light and license plate light
Pin 8	Backup light and/or backup device for overrun brake
Pin 9	Power supply (permanent positive)
Pin 10	Positive charge wire for battery in trailer
Pin 11	Not used
Pin 12	Not used
Pin 13 *	Ground (for circuit of contacts 9 through 12)

* Ground wires may not be connected electrically conductive on the trailer end.

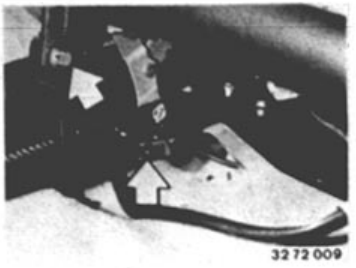
72 Body equipment and accessories

	Layout of seat belt	72- 11/1
72 11 030	Front seat belt – remove and install or replace	72- 11/2
102	Seat belts (complete), all – remove and install or replace	72- 11/4
	Buckle pretensioner	72- 11/5
. . .	Buckle pretensioner – disarm	72- 11/6
. . .	Automatic reel seat belt – check	72- 11/7
	Checklist for automatic reel seat belt	72- 90/1

Seat Belt Arrangement:
1 Lower strap
2 Belt height control
3 Cable roller
4 Automatic reel
5 Installation on seat
The belt height control is connected directly on the front seat with a cable.
Consequently the position of the upper strap in relation to total height depends on the seat's forward/back position.



Seat forward = lower position
Seat back = upper position

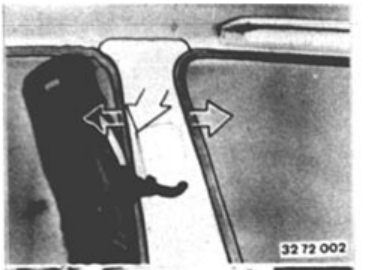


72 11 030 REMOVING AND INSTALLING OR REPLACING FRONT SEAT BELT

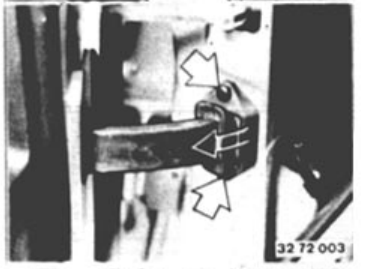
Important!
Models with Seat Belt Tensioner:
Conform with safety precautions! Improper handling could cause triggering of the belt tensioner and lead to injury. Disconnect battery and cover negative pole or terminal.

Run seat forward and to highest position.
Unscrew bolts on left and right sides.
Disconnect cable.

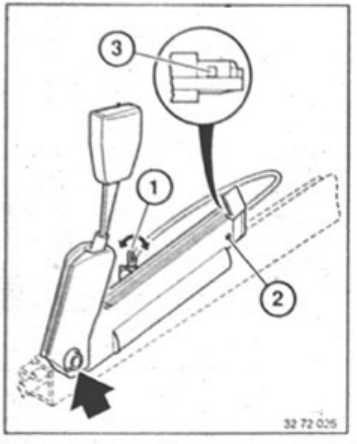
Installation:
Tightening torque*.



Pull off rubber door seal partially and lift out trim panel.



Unscrew screws.
Lift out plug partially.

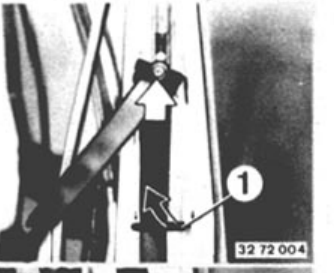


With Seat Belt Lock Tensioner:
Remove seat - refer to Group 52.

Important!
Deactivate seat belt lock tensioner.
Twist cable (1) out of holder and disconnect on seat.
Power seat: screw in screw (2), display (3) changes from "green" to "red".

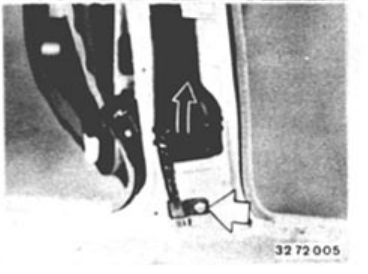
Remove seat belt lock tensioner.

Installation:
Tightening torque*.
Cable must be secured with a cable strap above the attachment point through the opening in the holder.



Unscrew screw.
Lift out guide (1).

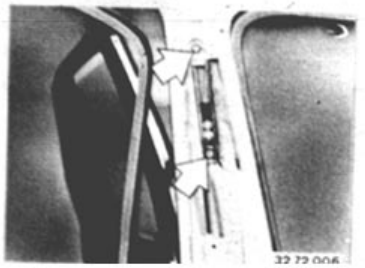
Installation:
Tightening torque*.



Unscrew screw.
Lift out holder.
Remove seat belt reel.

Installation:
Tightening torque*.

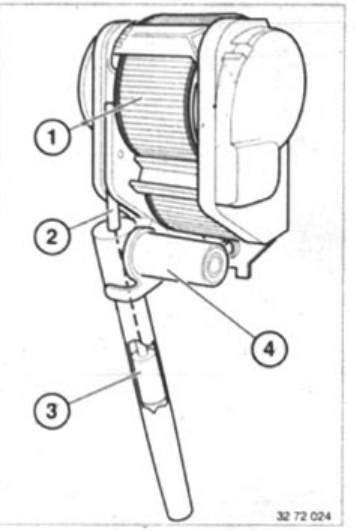
* Refer to Specifications



Unscrew screw.
Remove seat belt height adjuster together with cable.

Installation:
Tightening torque*.

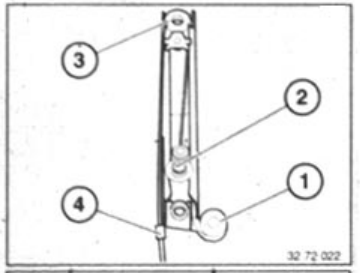
Note:
If necessary, the complete seat belt height adjuster must be replaced, including the cable.



Seat Belt Tensioner

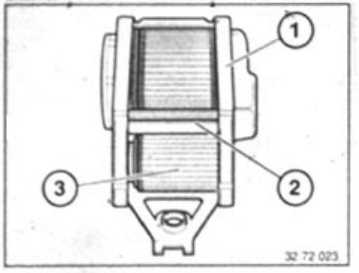
1 Reel
2 Steel wire cable
3 Piston in cylinder
4 Gas generator

Refer to Group 32 for description of operation.



Seat Belt Height Adjuster

1 Spring
2 Upper belt anchorage point
3 Reversing roller
4 Cable



Seat Belt Reel

1 Reel
2 Clamp
3 Friction roller

* Refer to Specifications



72 11 102 REMOVING AND INSTALLING OR REPLACING ALL REAR SEAT BELTS (Complete)

Remove rear seat cushion and backrest - refer to Group 52.

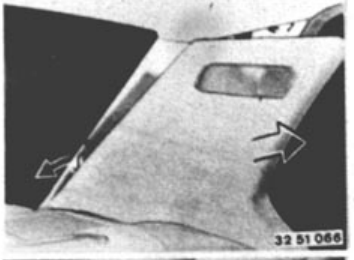
Unscrew bolt.

Installation:
Tightening torque*.

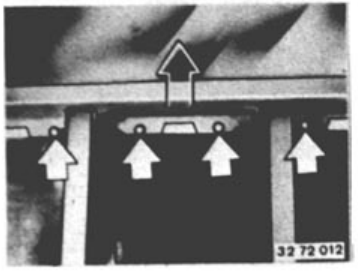


Unscrew bolt.

Installation:
Check for correct seating of belt anchorage.
Tightening torque*.

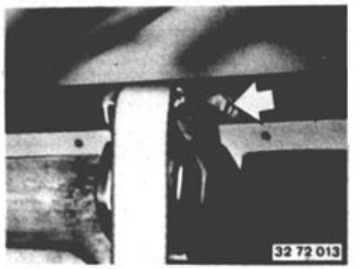


Lift out C-pillar trim panel.



Remove clips.
Remove console.

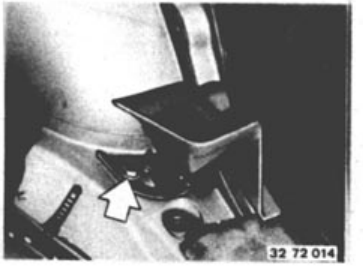
* Refer to Specifications



Unscrew bolt.
Remove seat belt reel.

Installation:
Tightening torque*.

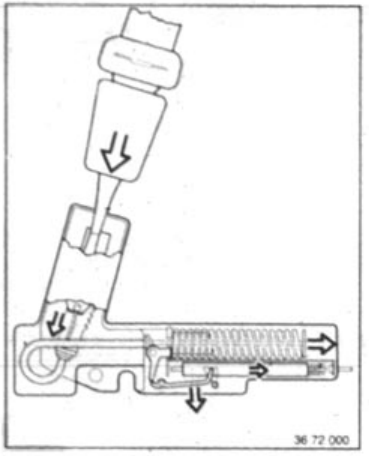
Removing seat belt reel in "touring" models - refer to Removing Cargo Room Trim Panels in Group 51.
Load-through installation - refer to Gr. 51.



Unscrew bolt.
Remove seat belt lock.

Installation:
Tightening torque*.

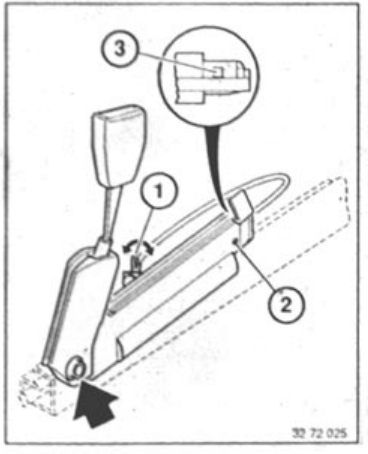
* Refer to Specifications



SEAT BELT LOCK TENSIONER

Description:

A mechanical impact sensor activates the system in case of a head-on collision.
A pre-tensioned spring pulls back the belt lock approx. 55 mm.
Shoulder and waist belts are tensioned.

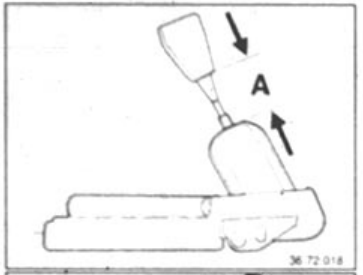


Manual Seats:
To avoid unwanted activation while adjusting seat (sudden movement against the final stop) or working on seat the system is activated and deactivated with help of cable (1).

Power Seats:
The system is deactivated by screwing in screw (2) for working on the seat.
Check color of display (3).
Red = deactivated
Green = activated

Caution!
The system is activated when the cable is connected on seat or green display is visible.

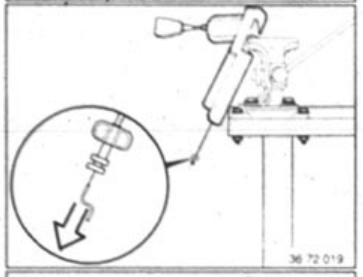
An activated seat belt lock tensioner must always be replaced.



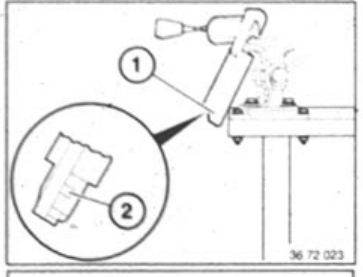
72 11 ... DEACTIVATING SEAT BELT LOCK TENSIONER

Caution!
Conform with country's accident prevention regulations.

The seat belt lock tensioner is "activated" when distance (A) is > 10 mm.

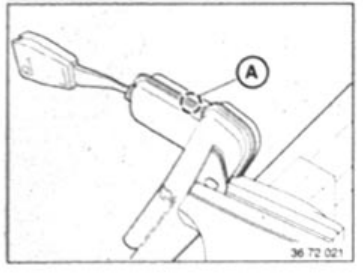


**Clamp seat belt lock tensioner in a vise at the point where it is bolted to the seat.
Belt whip must be horizontal.
Pull locking cable out as far as stop and hold it tight with a pliers.**

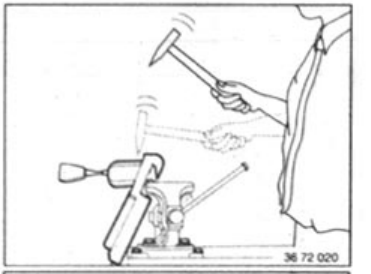


Seat Belt Lock Tensioner for Power Seats:

Turn screw (1) until green mark (2) appears in the window = seat belt lock tensioner is activated.

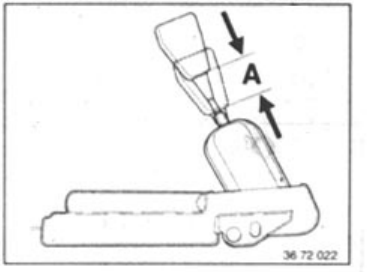


Caution!
Keep hands away from the belt lock tensioner while deactivating — *danger of injury!*
**Apply a firm knocj from the fin of a hammer weighing 500 grams to the belt lock tensioner in zone (A).
This will loosen the belt lock tensioner.**



Belt lock must face away from the body of the mechanic.

Caution!
Persons, who have to be on the belt lock side, must stand at least 3 meters away in the interest of safety.



Deactivating will cause the belt lock to be pulled back into the housing suddenly by distance (A) of approx. 55 mm.

72 11 . . . INSPECTING AUTOMATIC REEL SEAT BELTS

The automatic reel has two independent activating systems for the locking of seat belts.

The first activating system should lock the automatic 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.
To check, seat backrest must be set upright and both hands held in supporting position close to the steering wheel. Afterwards the brakes must be applied fully while driving on a dry surface and at a road speed equal to twice walking speed.
The seat belt should lock.

The second activating system is for additional safety and controlled by inertia mass.
This system is also okay, if the reel locks when pulling out the belt suddenly.

The automatic reel does not require servicing and must not be opened.

The belt should retract on its own as far as possible when released in parked position.
If the last section is not wound, the return spring could be weak or broken and there could be excessive friction in belt guides.

An unusable 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.

To fasten a seat belt the tongue should insert easily and with a loud click in the lock.
When pressing the "PRESS" button the belt tongue should be ejected from the lock by spring force.
If the lock cover is missing or damaged, the seat belt must be replaced.
When replacing a seat belt, the lower strap must also be replaced.
The tongue of the lower strap on the seat rail could be deformed by the impact of an accident in the case of seat belts integrated in a seat.
Attempts should never be made to straighten the seat or seat rail.

Belt straps should only be cleaned with a luke-warm soap solution or a commercial fine laundry detergent.

Belt straps must never be cleaned chemically or dyed.

Automatic reel seat belts must be replaced in case of

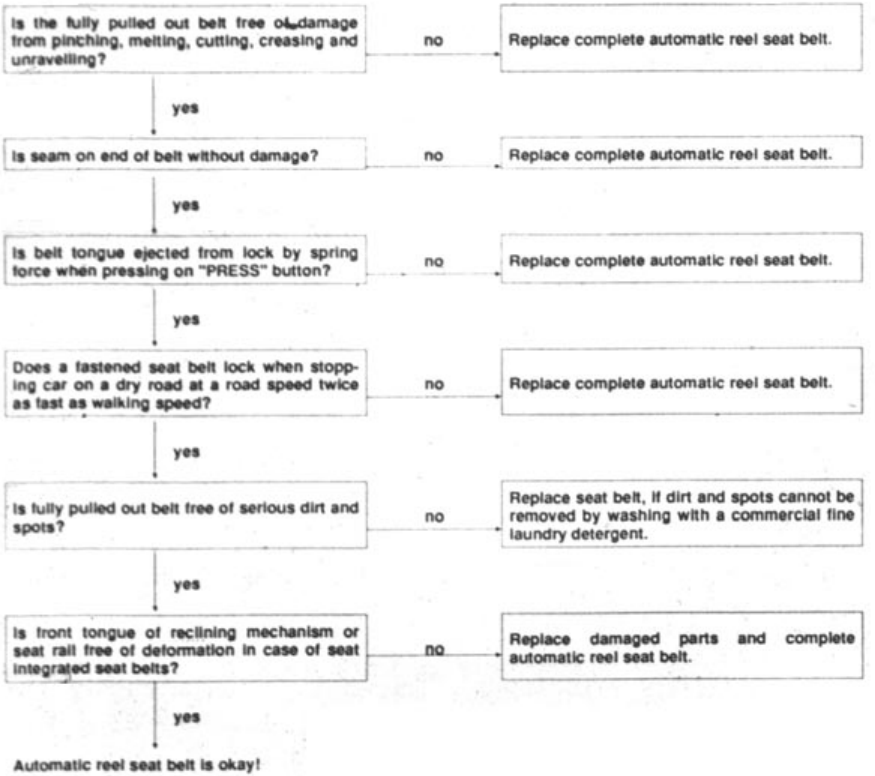
- activated belt tensioner
- creases,
- unravelling,
- pinches,
- tears and cuts,
- traces of melting,
- traces of abrasion in plastic cover on belt opening for tongue or
- damaged seams on end of belt strap.

Also refer to Check List for Automatic Reel Seat Belts.

CHECK LIST FOR AUTOMATIC REEL SEAT BELTS

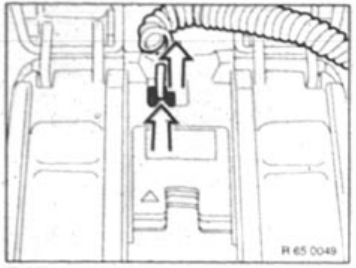


CHECK LIST FOR AUTOMATIC REEL SEAT BELTS



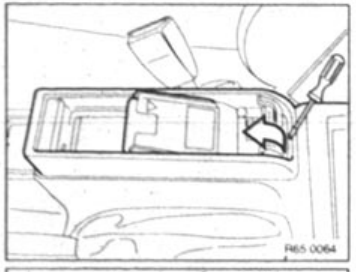
84 Communications system

84 11 510 Eject box – remove and install or replace 84- 11/1

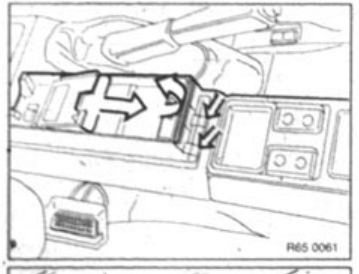


84 11 510 Removing and installing eject box

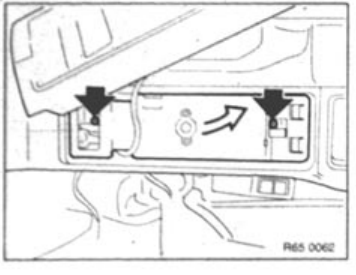
Lift off telephone receiver.
Press together clip and disconnect plug connector.



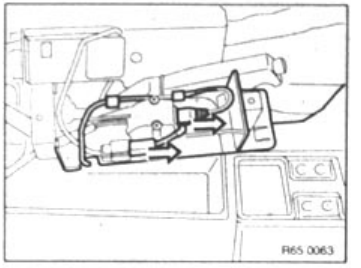
Unclip rear finisher, raise and lift out by pulling forward.



Press down clips, slide eject box forward and lift out by pulling upward, place to one side.



Release screws and pull out support bracket.



Disconnect plug connections and completely lift out eject box.

97 Body cavity sealing and undercoating

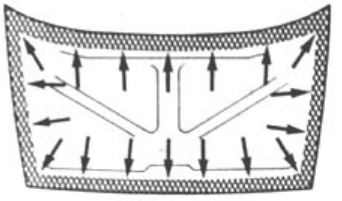
Body cavity sealing 97- 00/1

97-00/1

BODY CAVITY SEALING - 5 SERIES / E 34

Preparations for Body Sealing:
Protect wheels with covers*.

- Underside of car must be clean and dry.
- If necessary, repair damaged undercoating including wheel houses and side panels with PVC and treat with tectyl.
  The thickness of the undercoating should not exceed 0.25 mm (0.010").
- Inspect car for damaged paint finish or damage from flying stones and, if applicable, repair after receiving permission from the customer.
- Body sealing compound and car should have room temperature (about 20° C / 68° F).
- Check spray pattern of guns and nozzles.
- When drilling holes, dip the stepped drill bit in sealing compound to hold the burrs.
- Remove dripping sealing compound.
- Plug all drilled holes with plugs dipped in tectyl after finishing sealing procedures.
- Spray engine and engine compartment with engine wax to cover well.
- When repairing accident damage or replacing body parts, seal body cavities immediately after paint spraying and prior to installation of engine, axles, transmission, trim panels, etc.. If repair welding is only accessible onesidedly, the side, which produces a cavity, must be sealed with wax. This is also applicable to rear side panels, above the wheel house to the roof joint, as well as doors, especially in the upper corner areas.
- Coat thickness should be at least 0.03 mm (0.001").



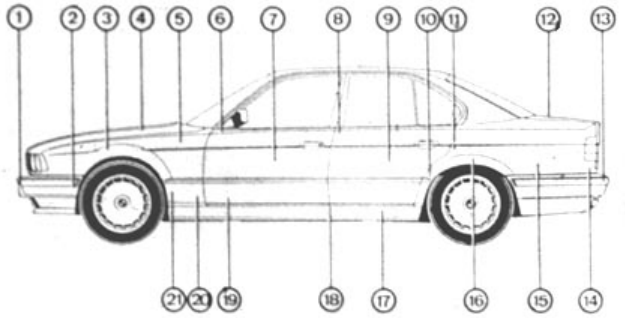
32 97 000

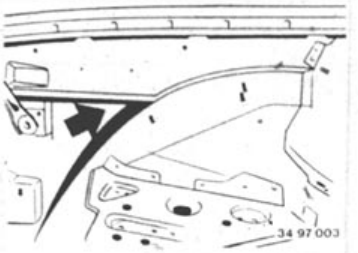
Let the sealing compound penetrate into gaps and spot welding-flanges completely.
Gaps and flanges are to be sealed in this manner.

Note:
Mentioned holes are in reference to only one side of the car.
Also seal body cavities on the other side accordingly as required.

Body cavity sealing performed after body repairs must be confirmed in the annual inspection sheets.

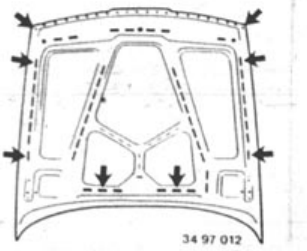
* Source of Supply: HWB





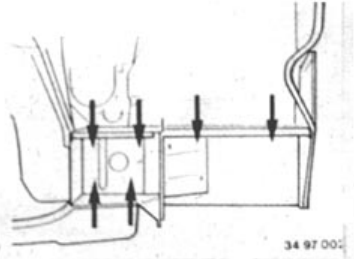
3. Support member/front wheel house

   hook-type sonde



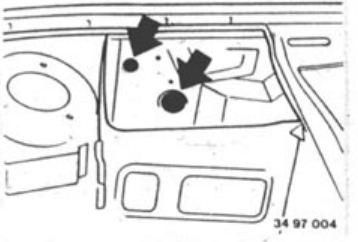
4. Engine hood

   - hook-type sonde
   - nylon sonde



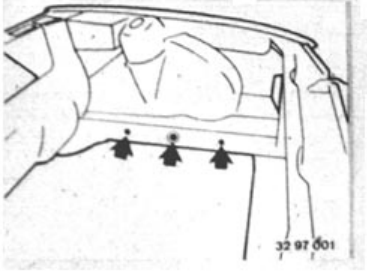
1. Front bumoer take-up

   - spray gun



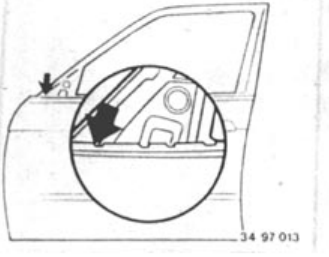
5. Support member/front wheel house

   - nylon sonde



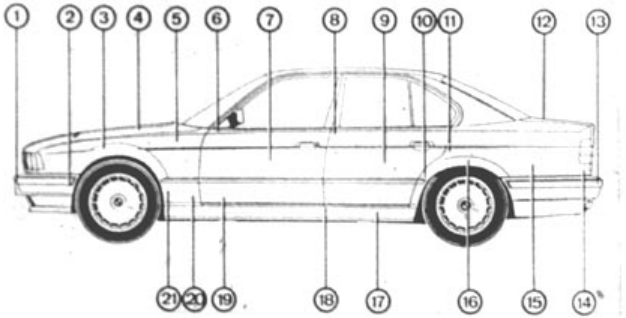
2. Front engine carrier member

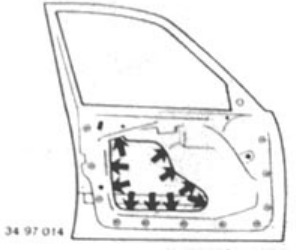
   - nylon sonde



6. Front door

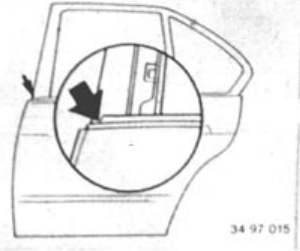
   - hook-type sonde





7. Front door

- spray gun



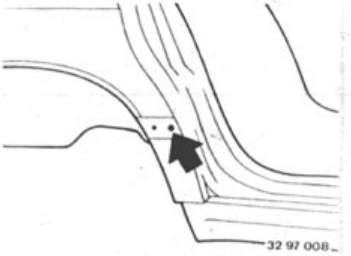
8. Rear door

- hook-type sonde



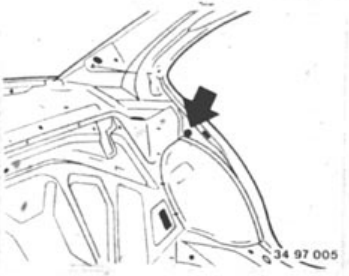
9. Rear door

- spray gun



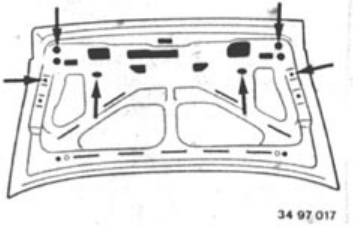
10. Rear wheel house. outside

- hook-type sonde
  Turn 360° while spraying.



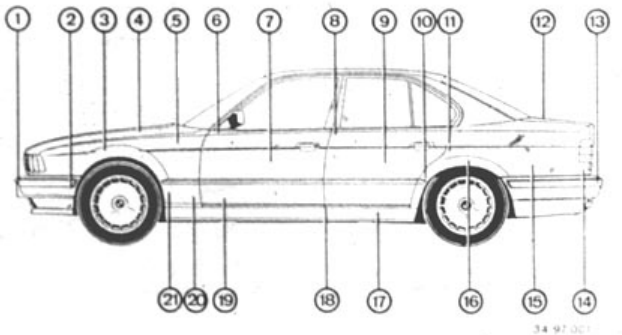
11. Rear wheel house, inside

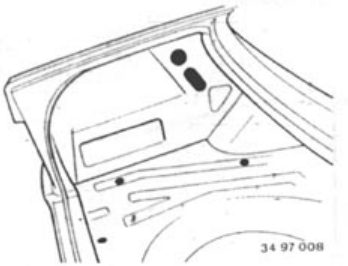
- nylon sonde



12. Trunk lid

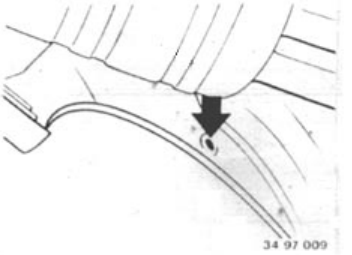
- hook-type sonde
- nylon sonde





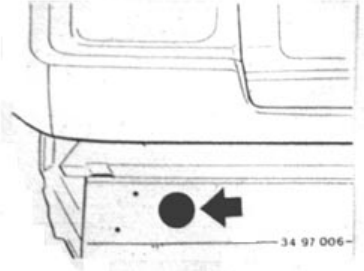
15. Turnk

- nylon sonde



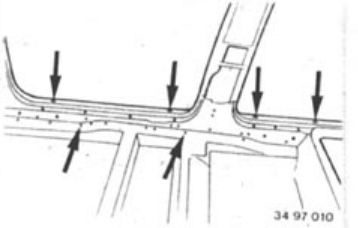
16. Rear wheel house
(accessible from bottom of wheel house)

- nylon sonde



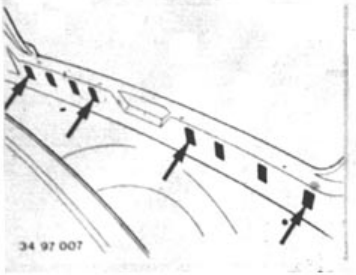
13. Rear bumper take-up

- nylon sonde



17. Side member

- nylon sonde



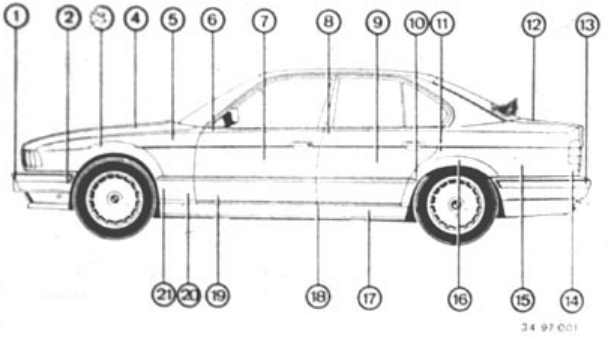
14. Tail panel

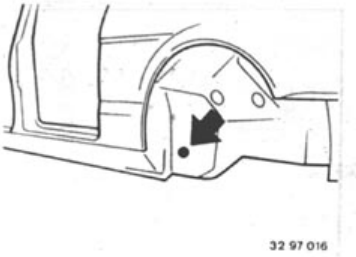
- nylon sonde



18. B-pillar

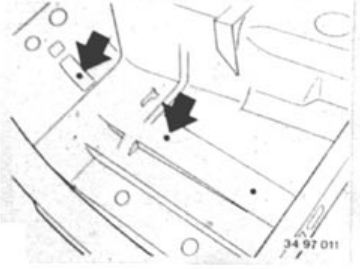
- nylon sonde





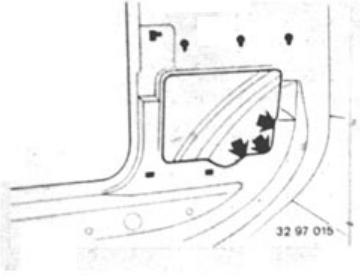
21. Front wheel house

- nylon sonde



19. Engine carrier, inside

- nylon sonde



20. A-pillar, bottom

- nylon sonde
- hook-type sonde
  Turn 90° while spraying.

Construction group 23 Manual transmission

Getrag 242/4 Speed transmission

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	Shift mechanism – layout drawing	23- 11
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23 22 551	$3^{rd}/4^{th}$ gear set – replace	23- 24
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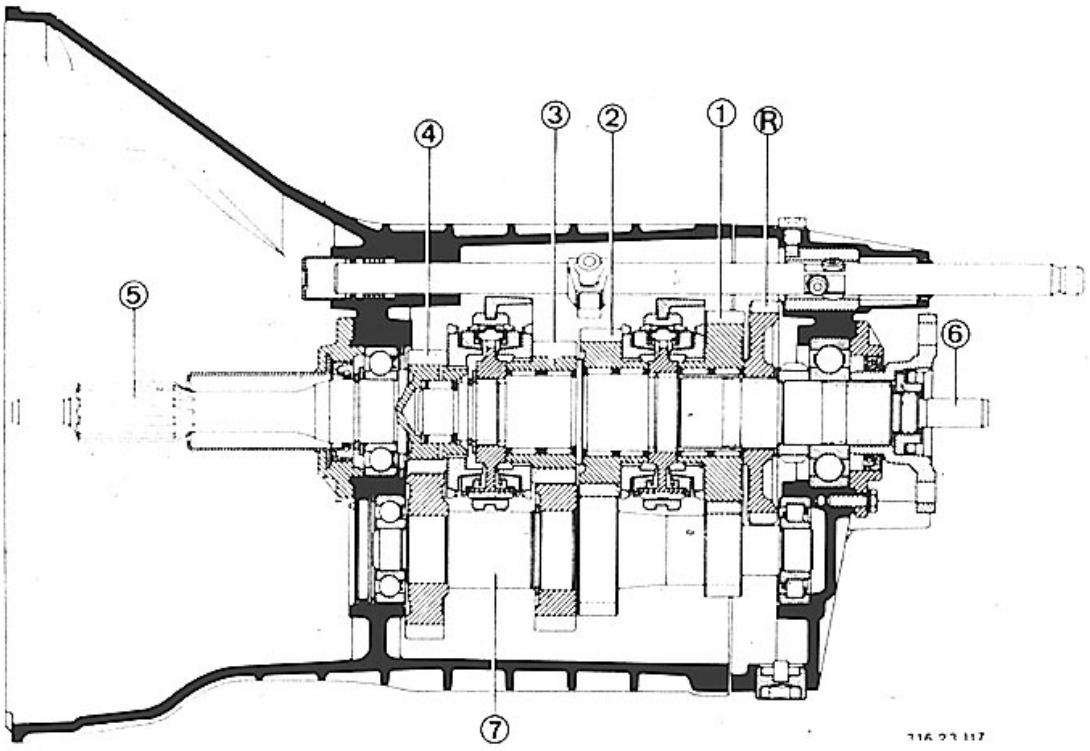
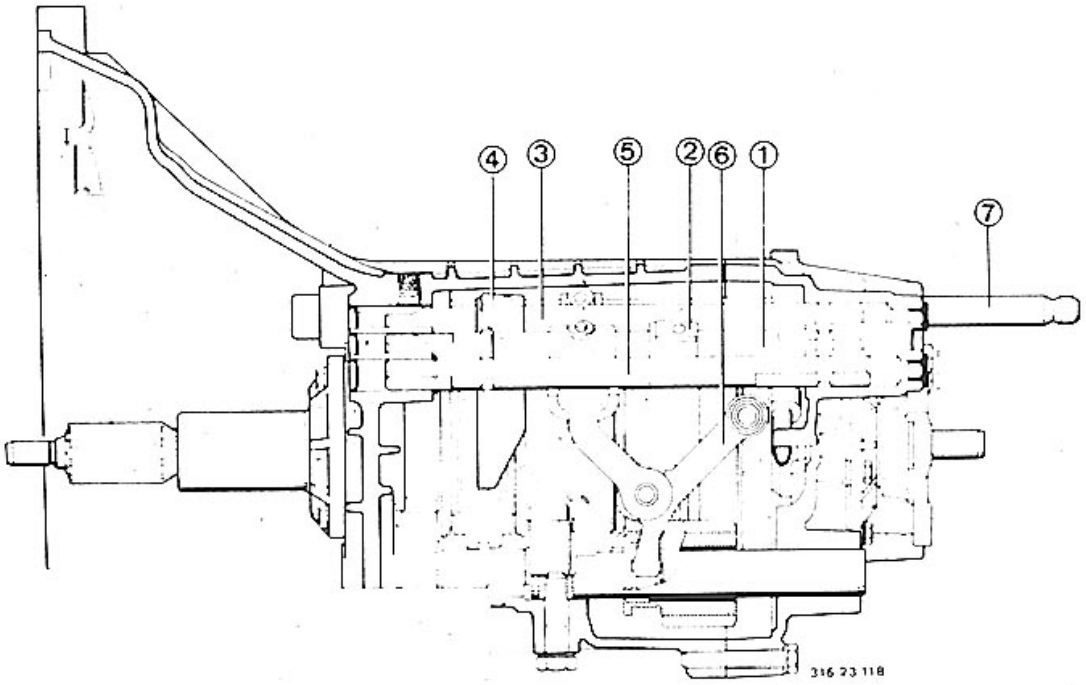


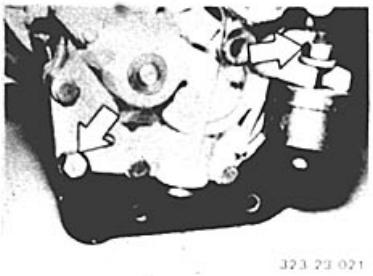
ASSEMBLY DRAWING OF GETRAG 242 FOUR SPEED MANUAL TRANSMISSION

1 First gear
2 Second gear
3 Third gear
4 Fourth gear
R Reverse gear
5 Input shaft
6 Output shaft
7 Layshaft



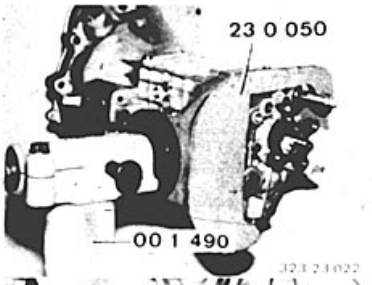
ASSEMBLY DRAWING OF SHIFT MECHANISM for Getrag 242 Four Speed Manual Transmission

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

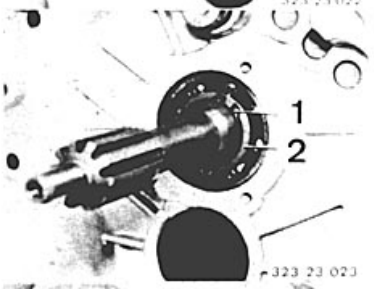
23 11 000 REMOVING AND INSTALLING/ SEALING TRANSMISSION CASE FRONT SECTION

Remove transmission – see 23 00 022 in pertinent model repair manual microfiche beginning with 1985 models.
Unscrew bracket and rubber mounts.



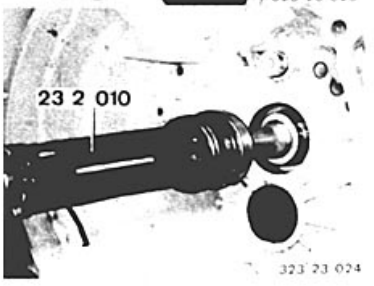
323 23 022

Mount transmission on Special Tools 23 0 050 and 00 1 490.
Drain oil.



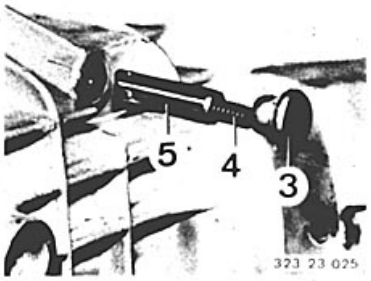
323 23 023

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.



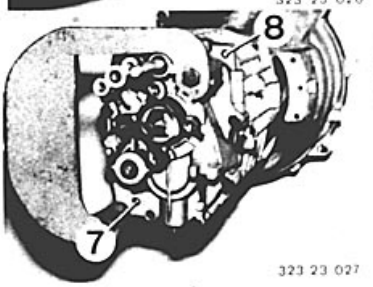
323 23 025

Remove cover (3).
Remove spring (4) and lockpin (5).
Check installed position.



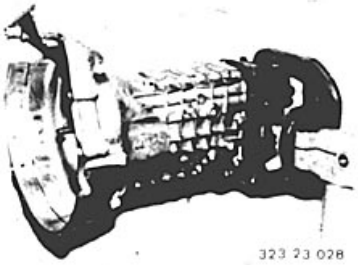
323 23 026

Unscrew bolt (6).
Installation:
Install bolt with bolt cement**.
Tightening torque*.



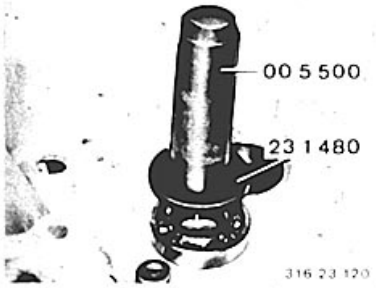
323 23 027

Unscrew transmission case cover mounting bolts.
Drive dowel pins (7 and 8) out of transmission case.

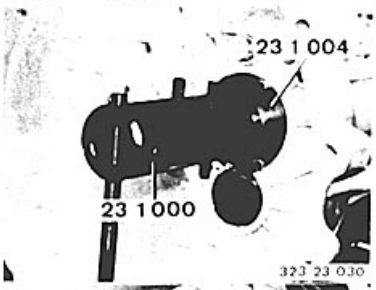

323 23 028

Pull off transmission case.
Installation:
Replace gasket.
Important!
Shims on input shaft and layshaft.

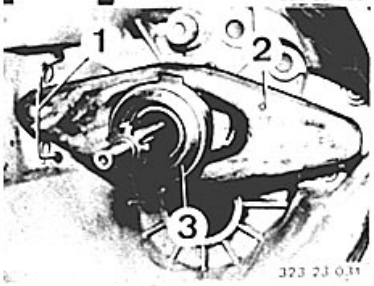
* See Specifications
** Source: HWB



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.

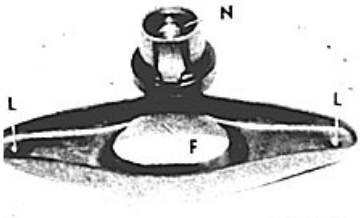


Pull input shaft into grooved ball bearing with Special Tools 23 1 004 and 23 1 000, or push case on to case cover.
Bolt transmission case.
Tightening torque*.
Install lockpins, shims and circlip.



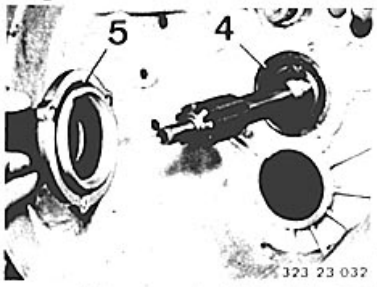
23 11 621 SEALING OR REPLACING COVER FOR CLUTCH RELEASE GUIDE TUBE
– Transmission Removed –

Lift out spring (1) and remove release lever (2) with thrust bearing (3).

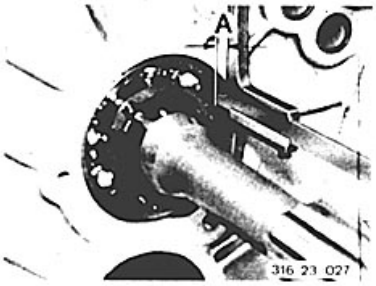


Installation:
Pack lubricating groove (N) with Molykote Longterm 2*.
Coat guides (F) and bearings (L) with Molykote Longterm 2*.
Non-conformance could cause release bearing to seize on guide sleeve.

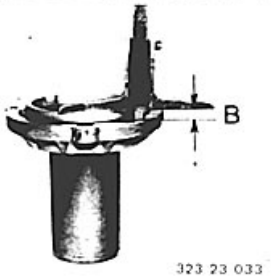
* See Specifications
** Source: HWB



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

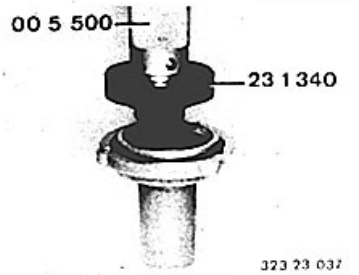
* See Specifications



316 23 121

23 12 501 REPLACING RADIAL OIL SEAL FOR INPUT SHAFT
– Transmission Removed –

Remove guide sleeve – see 23 11 621.
Lift out radial oil seal.



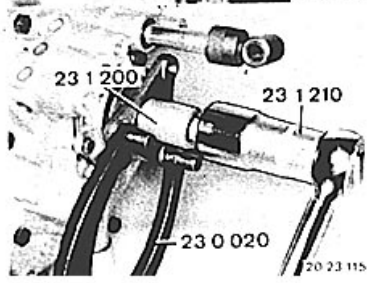
323 23 037

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 –

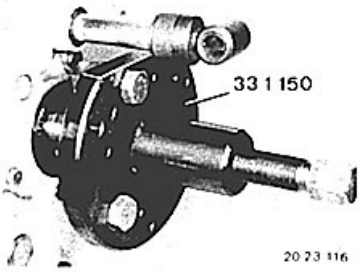
Remove lockplate (1).
Installation:
Replace lockplate.



20 23 115

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



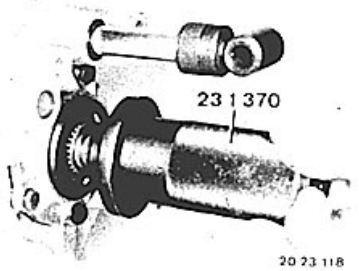
20 23 116

Pull off output flange with Special Tool 33 1 150.



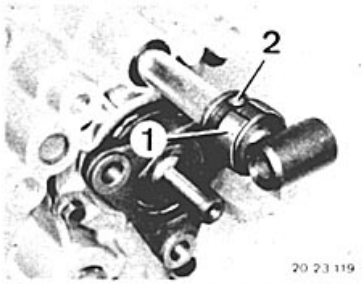
20 23 117

Pull out radial oil seal with Special Tool 00 5 010.



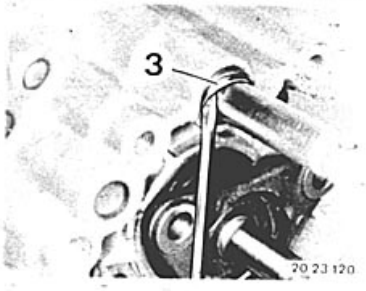
20 23 118

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 –

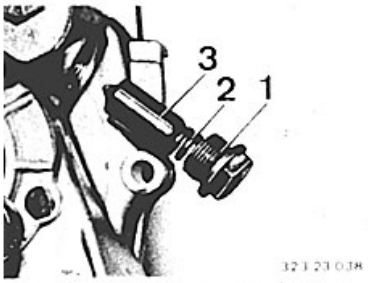
Remove locking sleeve (1).
Drive out pin (2) upwards.
Take off selector rod joint.
Installation:
Install selector rod joint that offset end of bearing sleeve faces toward the right when looking forward in car.



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 –

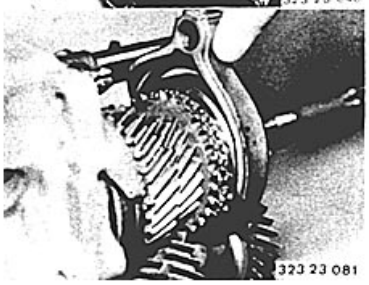
Unscrew plug (1).
Remove spring (2) and lockpin (3).
Installation:
Seal bearing surface of plug (1) with sealing compound**.



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



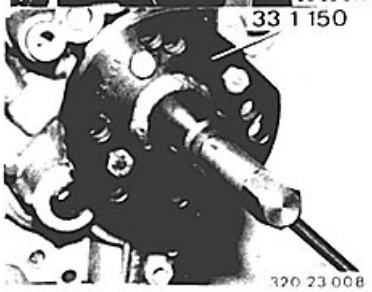
Unscrew bolt (7) enough that selector arm (S) for reverse gear can be removed.
Pull out selector rod (8).
Loose balls!



Remove lockplate.
Installation:
Replace lockplate.

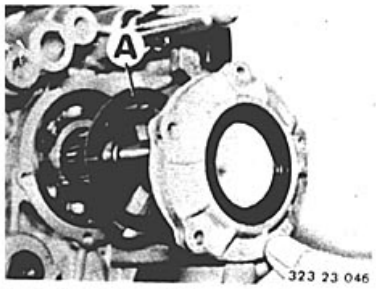


Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.
Installation:
Tightening torque*.
Install collar nut with a bolt locking agent**.

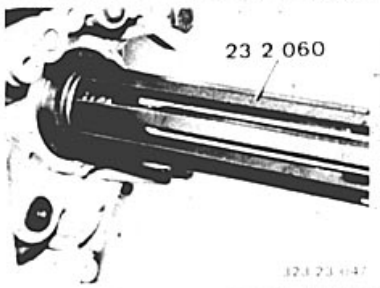


Pull off output flange with Special Tool 33 1 150.

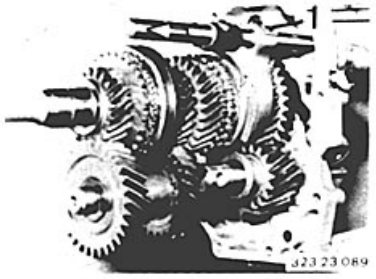
* See Specifications
** Source HWB



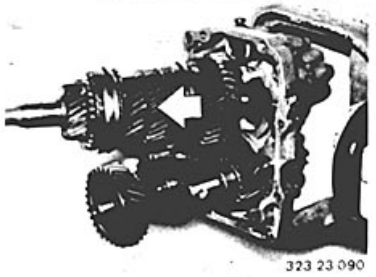
Detach support ring.
Important!
Shim (A).
Installation:
Replace gasket.
Remove old gasket with an adhesive remover*.



Pull grooved ball bearing off of output shaft and out of transmission case cover with Special Tool 23 2 060.

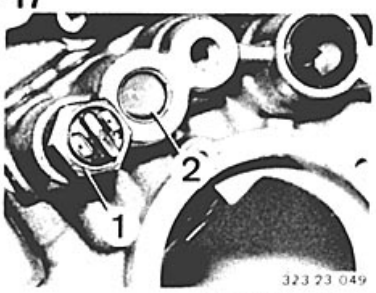


Drive out pin (1).
Pull out 1st/2nd gear selector rod.
Loose balls!
Remove selector fork.
Installation:
Replace pin.

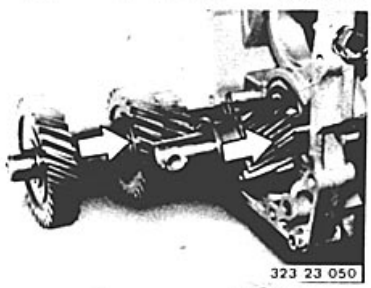


Remove input shaft and output shaft.
Remove layshaft.
Installation:
Check condition of all bearings, replacing if necessary (see 23 21 701).

* 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).



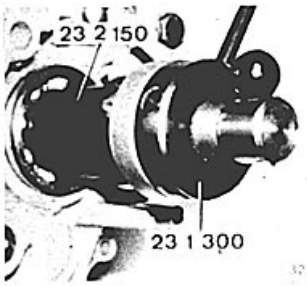
Install layshaft and reverse gear with collar facing forward.
Version with Grooved Ball Bearing:
Heat case rear section in area of ball bearing to about 80° C (176° F) with a hot air blower.



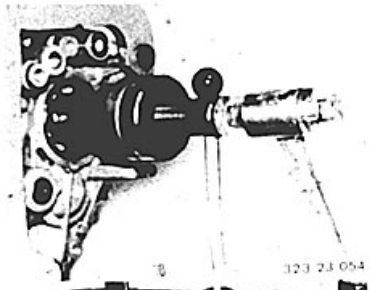
Insert input shaft and output shaft assembly in case rear section.



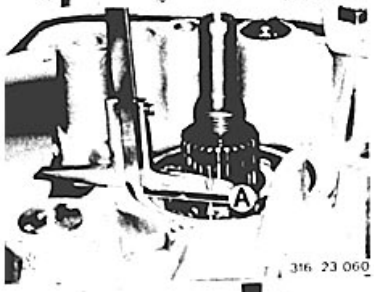
Insert grooved ball bearing in case rear section lightly.



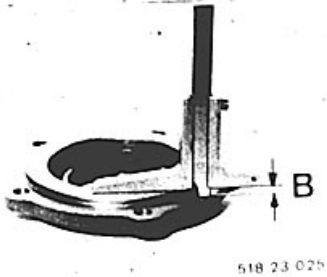
Press grooved ball bearing on output shaft and into case rear section with Special Tools 23 2 150 and 23 1 300.



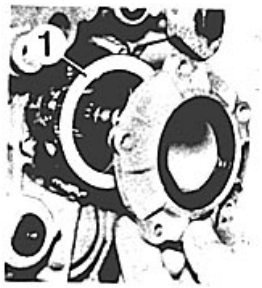
Drive in grooved ball bearing to fit tight by applying light knocks.



Measure distance (A) from case rear section to grooved ball bearing.



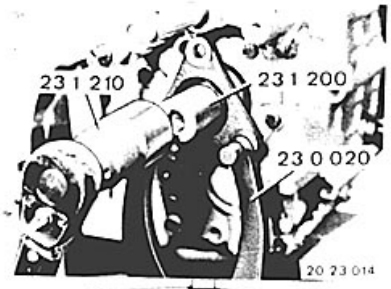
Measure collar height (B) without gasket.
Important!
Use 0.2 mm (0.008") for gasket thickness in calculations.



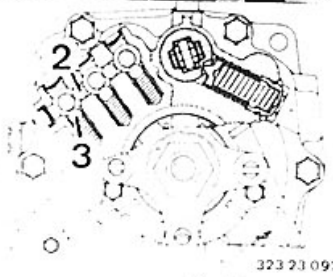
There should not be any play between grooved ball bearing and sealing cover.
All play must be taken up with shims (1).
Example:

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

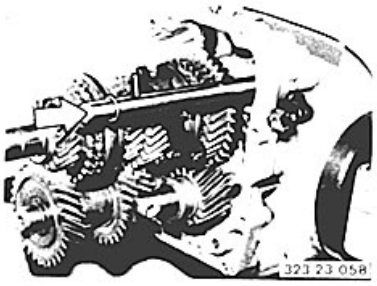
Tighten sealing cover*.



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

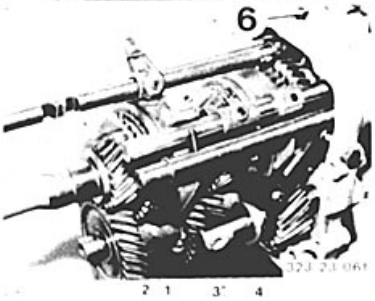


Insert detent balls.
Install selector rod for reverse gear.

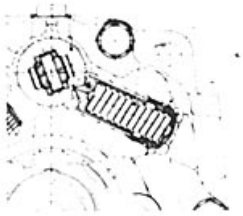
* See Specifications for tightening torque
** Source: HWB



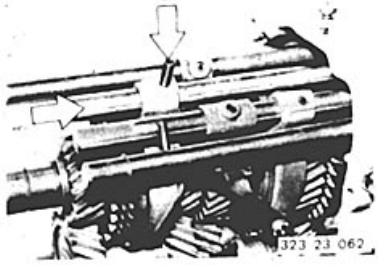
Place 1st/2nd gear selector fork in operating sleeve.
Insert locking and detent balls.
Install selector rod.
Mount selector fork with 6 x 24 mm pin.



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*.

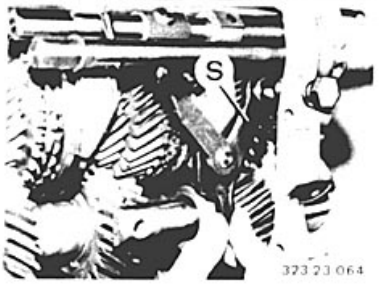


Insert locking and detent balls.
Install 3rd/4th gear selector rod.
Mount selector fork with 6 x 24 mm pin.

* See Specifications
** Source: HWB

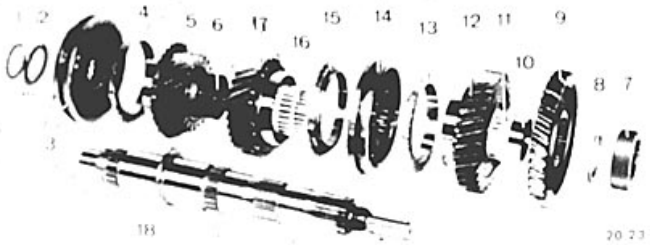


Install backup light switch (1) and end cover (2).

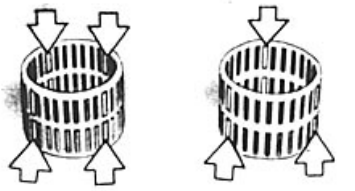


Install selector arm (S) for reverse gear with collar facing case.
Important!
Install selector arm without stress.
Clearance is required between selector arm and groove of reverse gear wheel.
Tightening torque*.

* See Specifications

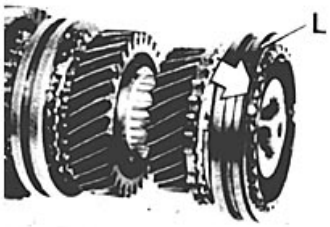


20 23 105



320 23 114

Important!
Split needle bearings.
Slots without needles are provided in 90° and 120° steps to guarantee uniform support of the needles.

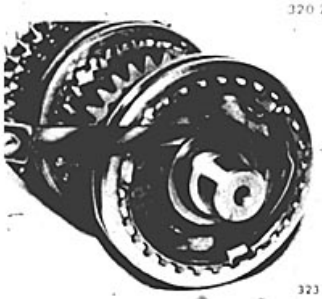


320 23 086

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.

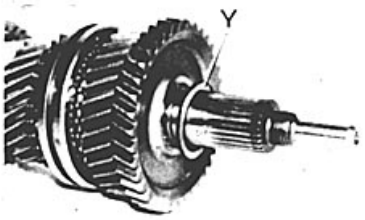


323 23 079



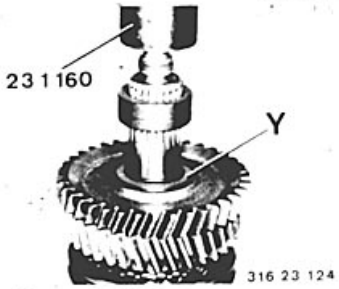
20 23 106

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.



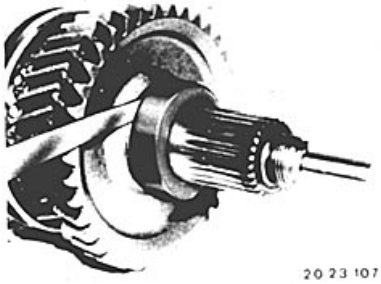
323 23 066

Assemble output shaft.
Important!
Adjust axial play to 0 ... 0.09 mm (0 ... 0.0035") with shim Y.



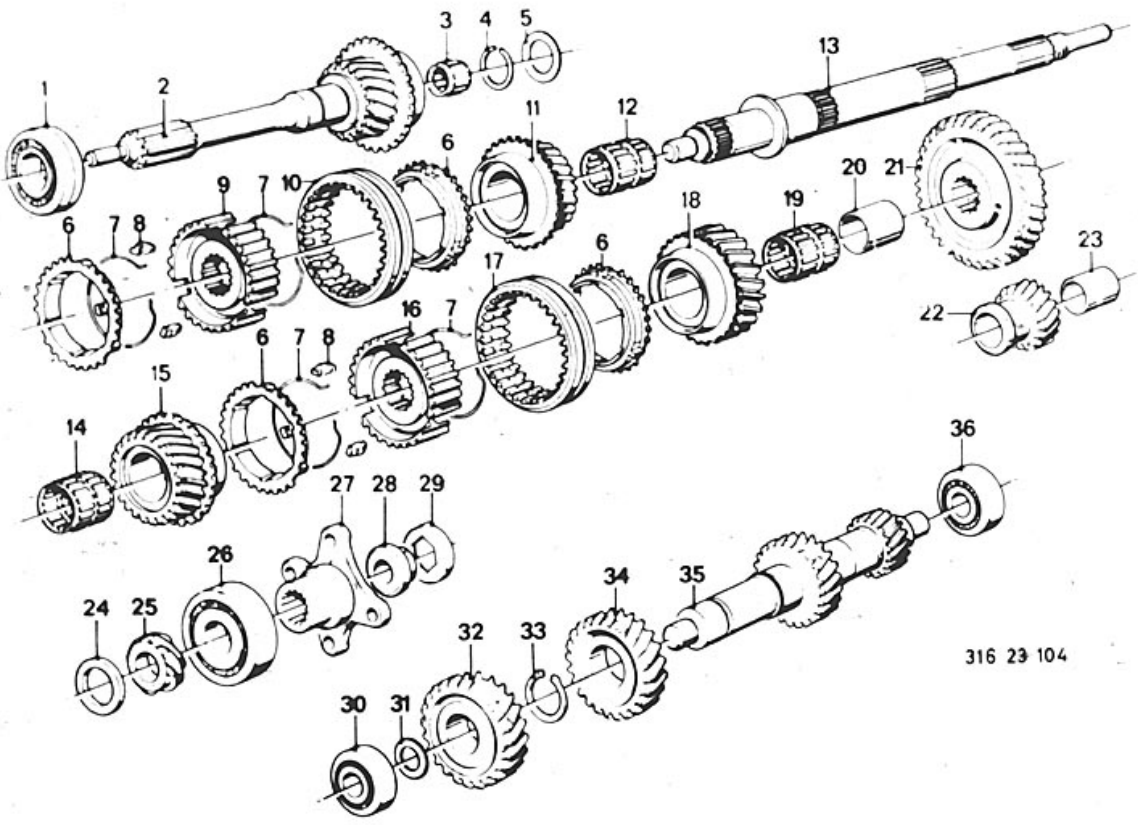
316 23 124

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 –



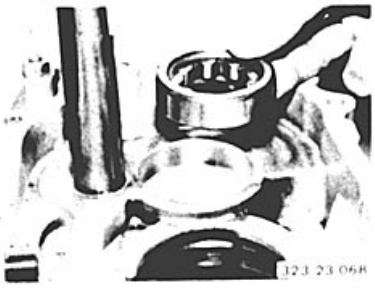
323 23 055

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.



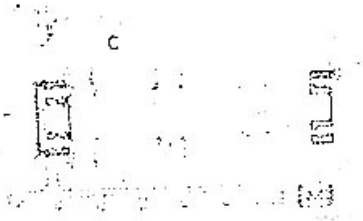
323 23 068

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.



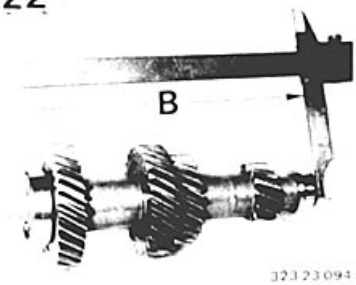
Determine thickness of shim C.



323 23 069

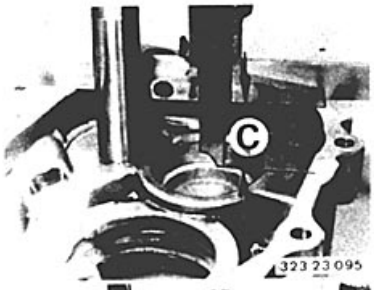
Remove grooved ball bearing in case front section after heating case front section in area of bearing to about 80° C (176° F) with a hot air blower.

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:

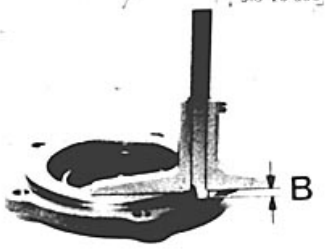
A	170.0 mm (6.693")
+ C	38.7 mm (1.523")
+	0.2 mm (0.008") gasket thickness
	208.9 mm (8.224")
– B	208.5 mm (8.208")
	0.4 mm (0.016")
–	0.1 ...0.2 mm (0.004,..0.008") axial play
	0.2 ...0.3 mm (0.008...0.012") shim th.



316 23 060

B) Output Shaft:

Measure distance A from case cover to grooved ball bearing.

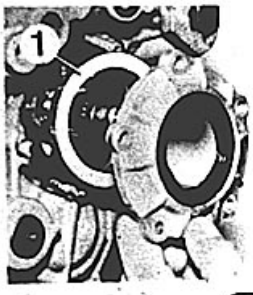


518 23 025

Measure collar height B without gasket.

Important!

Use 0.2 mm (0.008") for gasket thickness in calculations.



323 23 057

There should not be play between grooved ball bearing and sealing cover.
Take up all play with shims (1).
Example:

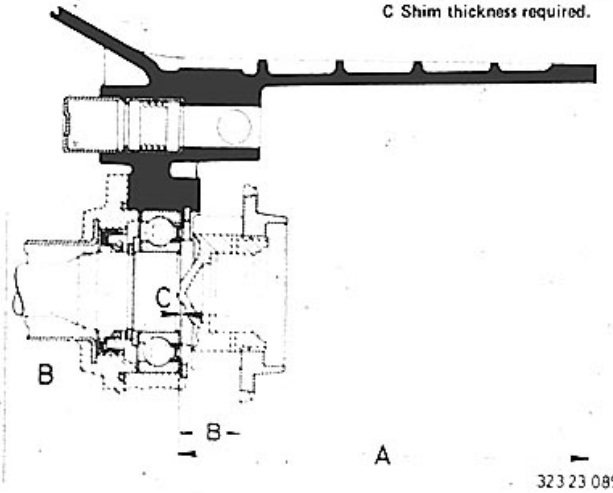
A	3.0 mm (0.118")
– B	2.8 mm (0.110")
	0.2 mm (0.008")
+	0.2 mm (0.008") gasket thickness
	0.4 mm (0.016") shim thickness

Tighten sealing cover.
Mount and lock output flange.

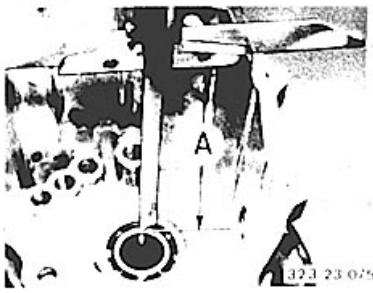

323 23 074

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.

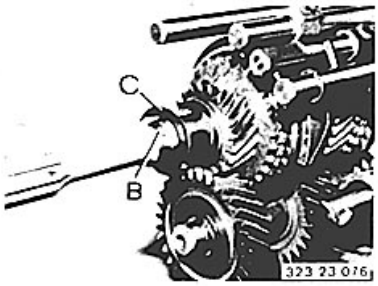


323 23 085



323 23 075

Measure distance A from case sealing surface to grooved ball bearing.

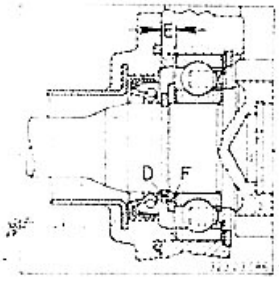


323 23 076

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

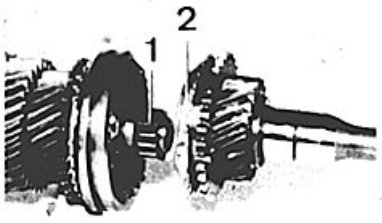
Install shim C on input shaft.



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")

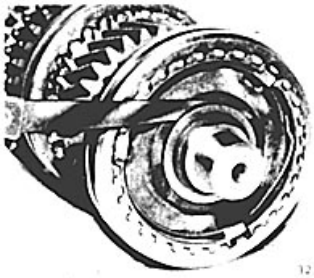
Install support ring F.



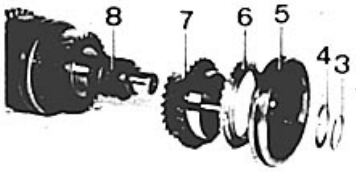
323 23 077

23 22 551 REPLACING 3RD AND 4TH GEAR WHEEL SET
– Output Shaft Removed –

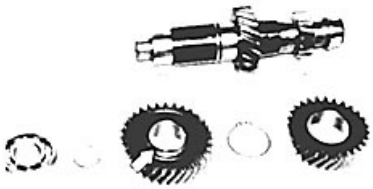
Pull input shaft with needle cage (1) and synchromesh ring (2) off of output shaft.



323 23 078



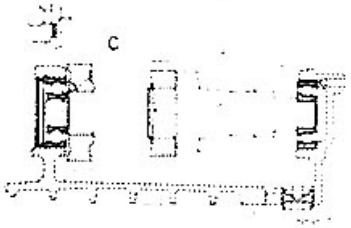
Remove circlip (3).
Pull off support ring (4), guide sleeve (5), synchromesh ring (6) and 3rd gear (7) with needle cage (8).
Installation:
Replace circlip.
Important!
Shouldered end of sliding sleeve (5) faces 4th gear.



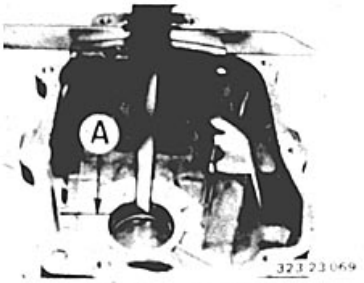
316 23 091

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.



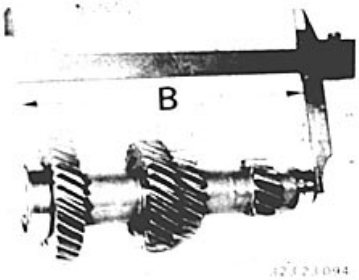
Installation:
Adjust play between circlip and guide sleeve to 0 ... 0.09 mm (0 ... 0.0035") with shims.



Measure distance A from case sealing surface to circlip.

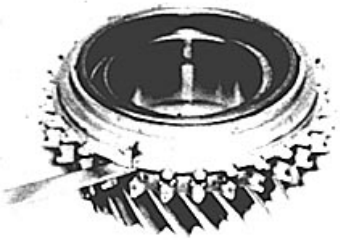


Measure distance C from case sealing surface to bearing outer race on cover without gasket.
Use 0.2 mm (0.008") for gasket thickness in calculations.



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

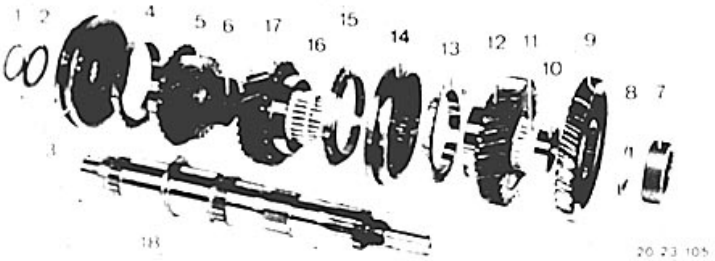


316 23 095

23 23 503 DISASSEMBLING/ASSEMBLING COMPLETE SYNCHRONIZATION

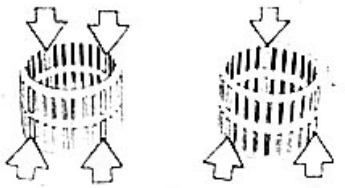
– Transmission Removed –

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).



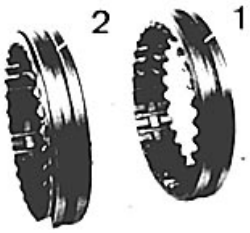
320 23 113

Important!
Split needle bearings:
Slots are provided without needles in steps of 90° or 120° to guarantee uniform support of the needles.



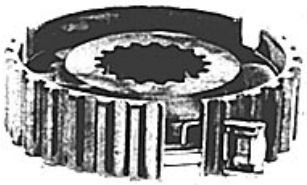
316 23 125

Press sliding sleeve off of synchronizer.
Installation:
Push flat teeth of sliding sleeve over thrust pieces.



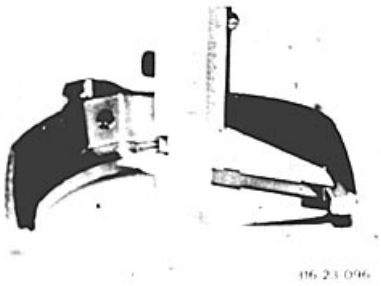
20 23 106

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.



320 23 [illegible]

Offset hooks of synchromeshing springs in an axial groove to each other.
Connect thrust pieces in synchromeshing springs.



316 23 006

23 31 501 REPLACING 1ST/2ND AND 3RD/ 4TH GEAR SELECTOR FORKS

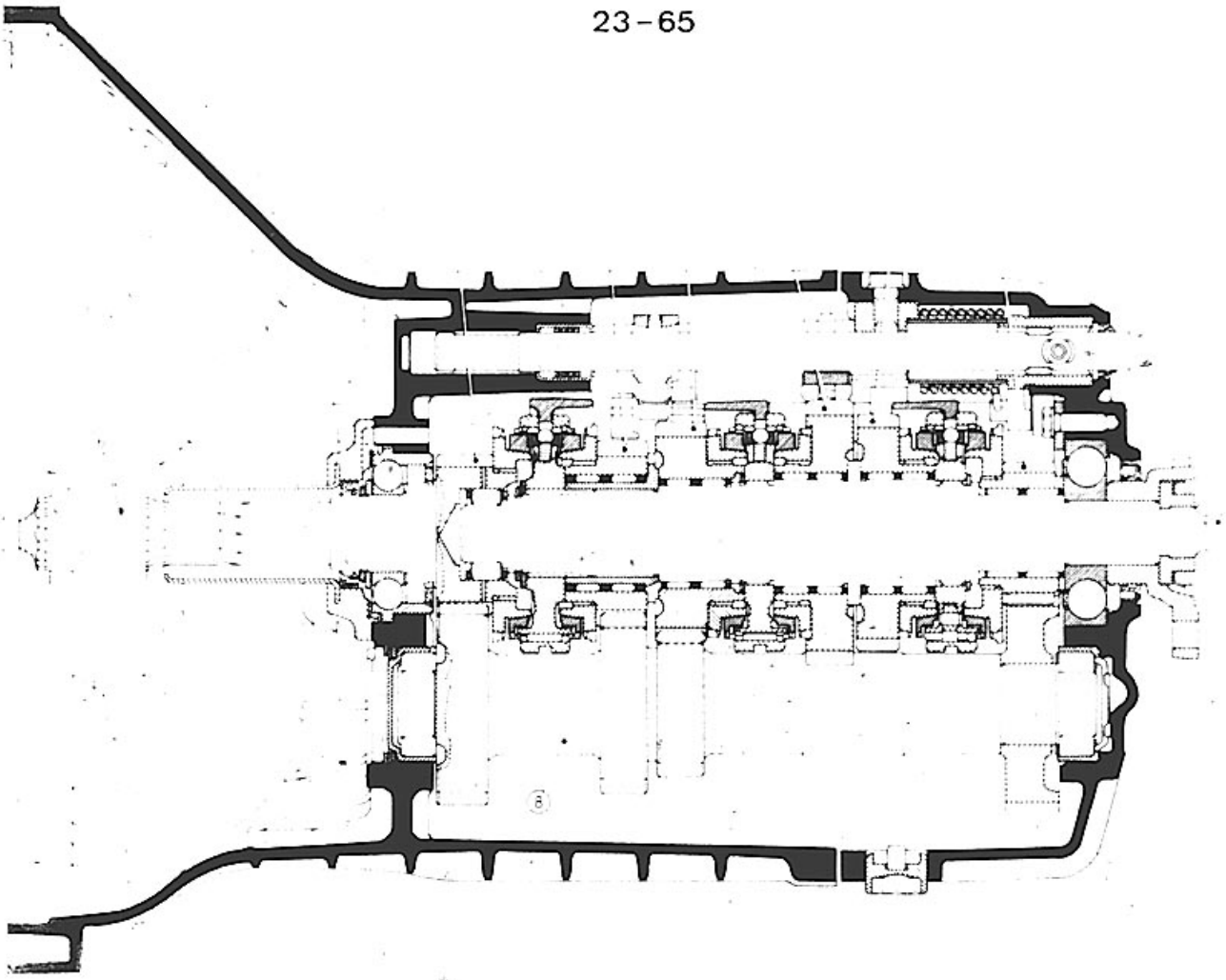
Remove input and output shafts 23 21 500.
Check wear* of selector forks.

* See Specifications

Construction group 23 Manual transmission

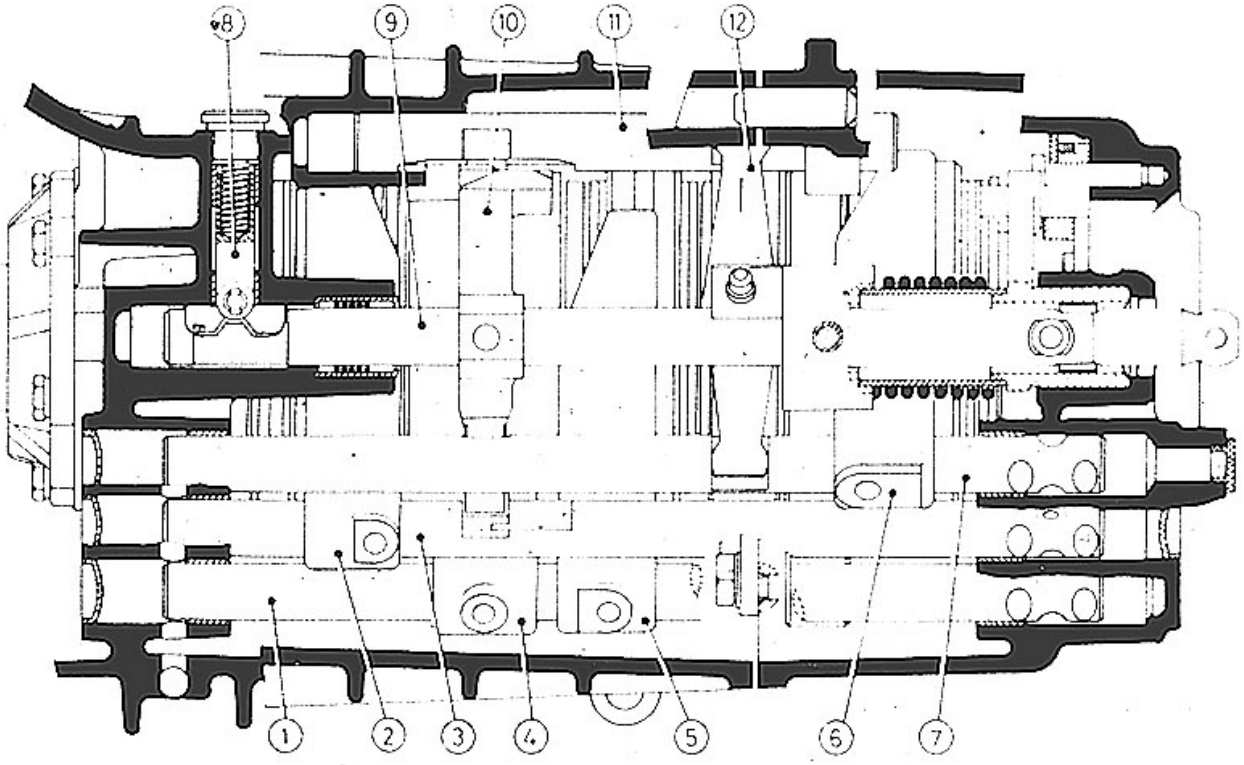
Getrag 240 Manual transmission (overdrive)

	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



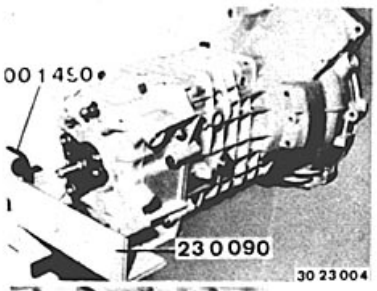
ASSEMBLY DRAWING OF GETRAG 240 FIVE SPEED OVERDRIVE MANUAL TRANSMISSION

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



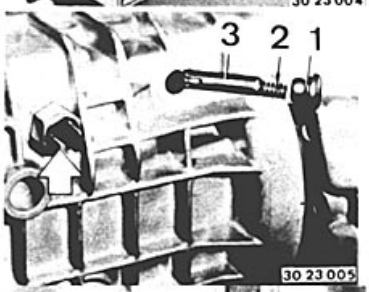
ASSEMBLY DRAWING OF SHIFT PARTS FOR 240 FIVE SPEED OVERDRIVE MANUAL TRANSMISSION

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.

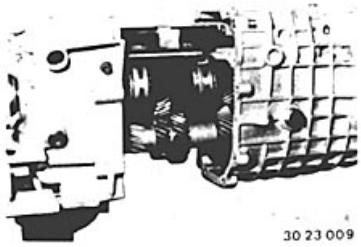


Unscrew bolt (6).
Installation:
Install bolt with a bolt cement**.
Tightening torque*.

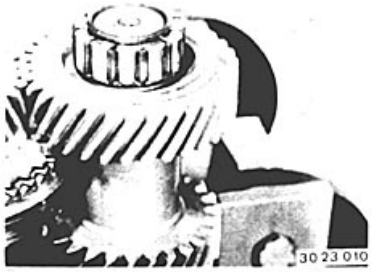
* See Specifications
** Source: HWB



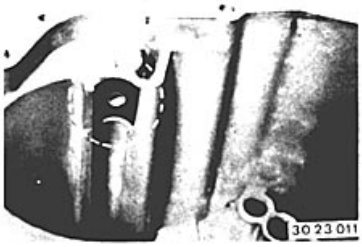
Drive out dowel pins.
Unscrew bolts.
Installation:
Check length of bolts.
Bolt (1) = 8 x 60 mm.



Pull off case front section.
Installation:
Coat sealing surface with sealing compound**.
Sealing surface must be thoroughly clean and dried of oil.

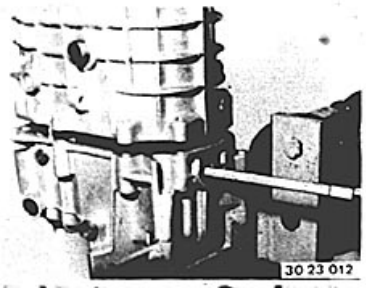


Install roller bearing on layshaft that small diameter end faces up.

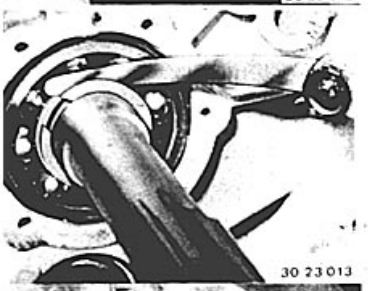


Coat case front section in area of reverse gear shaft with sealing compound**.
Surface must be thoroughly clean and dried of oil.

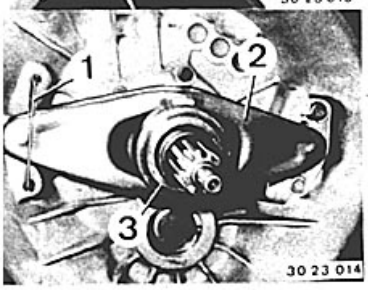
** Source: HWB



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.

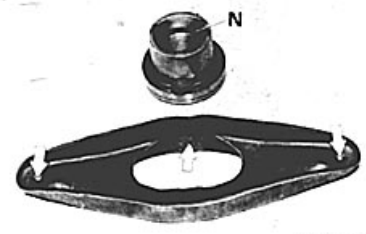


Install spacer and circlip.
Adjust play between bearing race and circlip to 0 ... 0.09 mm (0 ... 0.0035").

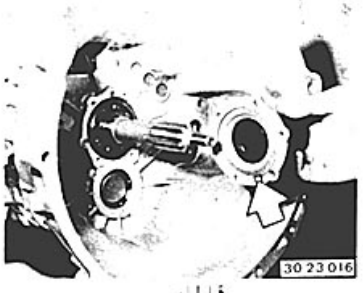


23 11 623 REMOVING AND INSTALLING GUIDE SLEEVE FOR CLUTCH RELEASE
– Transmission Removed –

Lift out spring (1) and remove release lever (2) with thrust bearing (3).



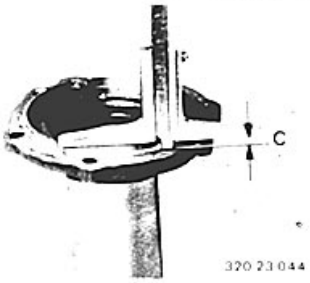
Installation:
Pack lubricating groove (N) with Molykote Longterm 2.
Coat guides (F) and bearings (L) with Molykote Longterm 2.
Non-conformance could cause release bearing to seize on guide sleeve.



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.

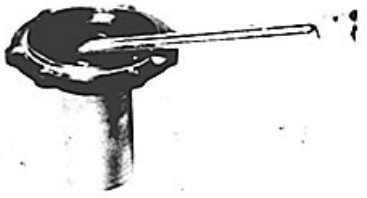


Measure distance (C) from guide sleeve protrusion to outside surface.
Example:

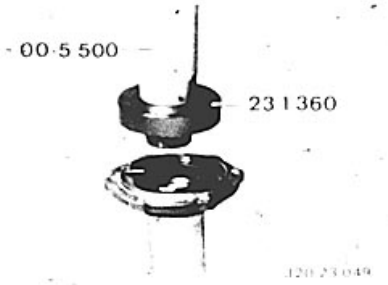
B	4.0 mm (0.157")
– C	2.6 mm (0.102")
	1.4 mm (0.055") spacer thickness

* See Specifications

** Source: HWB



320 23 048

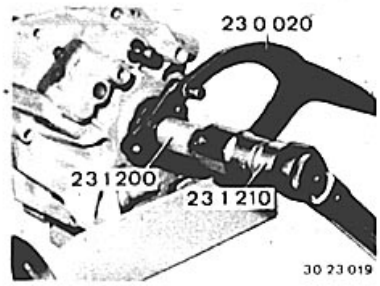


320 23 049

23 12 503 REPLACING RADIAL OIL SEAL FOR INPUT SHAFT
- Transmission Removed -

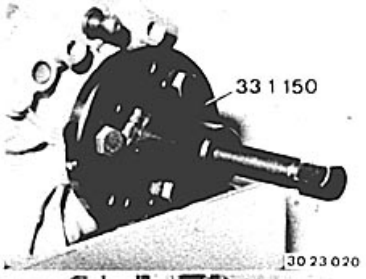
Remove guide sleeve - see 23 11 622.
Lift-out radial oil seal.

Drive in radial oil seal with Special Tools 23 1 360 and 00 5 500.
Open end faces up.
Lubricate sealing lip with oil.

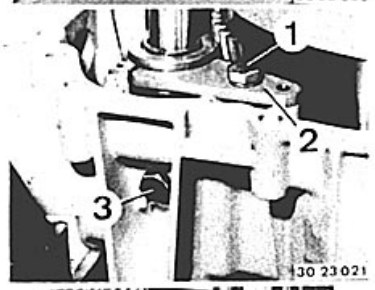


23 21 503 REMOVING AND INSTALLING INPUT AND OUTPUT SHAFT ASSEMBLY –TRANSMISSION REMOVED–

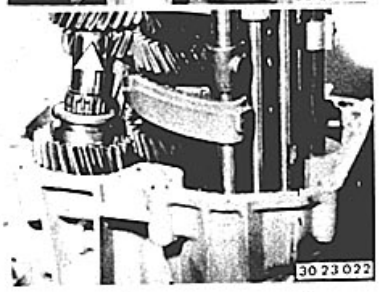
Remove transmission case front section 23 11 013.
Remove lockplate.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.



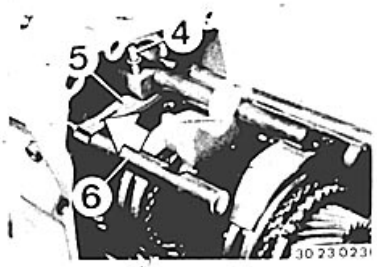
Pull off output flange with Special Tool 33 1 150.



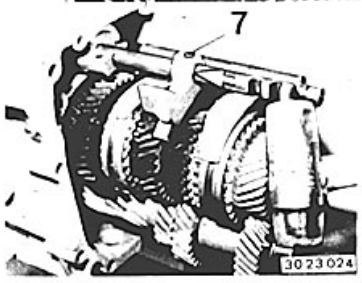
Unscrew bolt (1).
Remove holder (2).
Unscrew bolt (3).



Remove shaft with reverse gear and needle bearing.



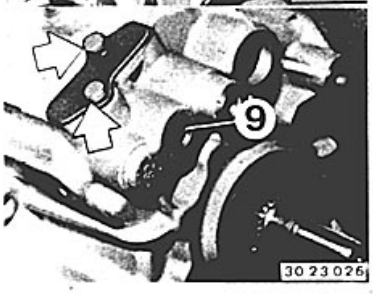
Pull out pin (4) for operating lever (5).
Pull out selector rail (6).
Remove operating lever (5).
Installation:
Install operating lever that notch faces up and in direction of selector rail.



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.

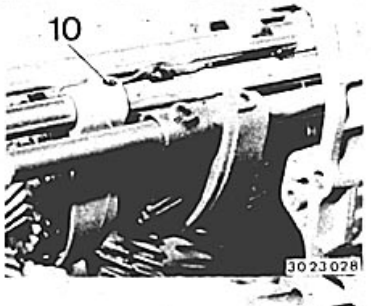


Detach end plate.
Installation:
Install end plate with sealing compound**.
Sealing surface must be thoroughly clean and dried of oil.
Remove end plate (9).
Installation:
Replace end plate.

** Source: HWB

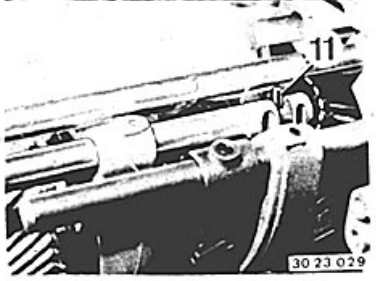


Remove three springs.



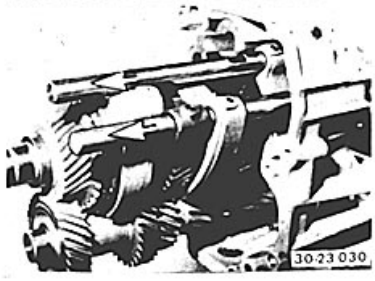
Drive pin (10) out of the 3rd/4th gear shift fork.

Installation:
Install a new pin.

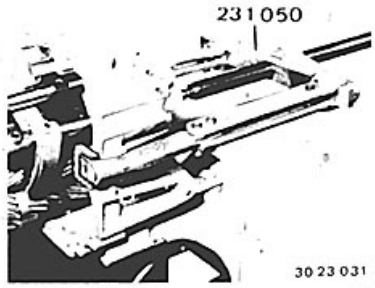


Knock out 3rd/4th gear shift rod forward.

Important!
Lockpin (11) in shift rod.

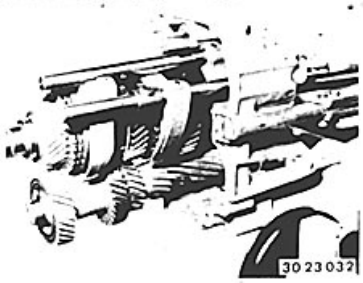


Engage 2nd and reverse gears by moving 1st/2nd and 5th/reverse gear shift rods forward.



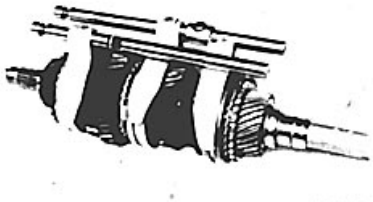
Press input shaft, output shaft and layshaft out of the rear case section with Special Tool 23 1 050.

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.



Important!
Make sure that shift rods and the layshaft do not clamp while pressing out. The layshaft must not fall down in this step.

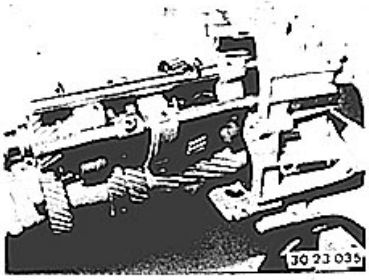
Installation:
Check condition of all bearings, replacing if necessary.



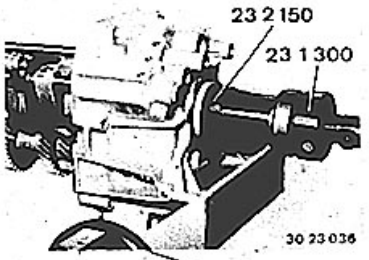
Installation:
Install 3rd/4th gear shift fork and shift rods with shift forks for 1st/2nd and 5th/reverse gears.



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.



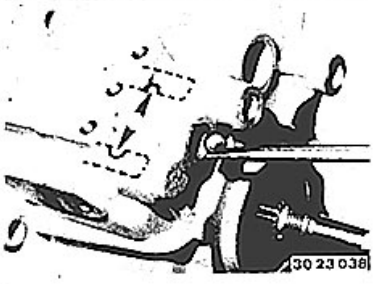
Heat grooved ball bearing inner race in case rear section to approx. 80° C (175° F) with a hot air blower.
Second and reverse gears are engaged.
Insert input shaft, output shaft and layshaft in case rear section.
Align selector rods.



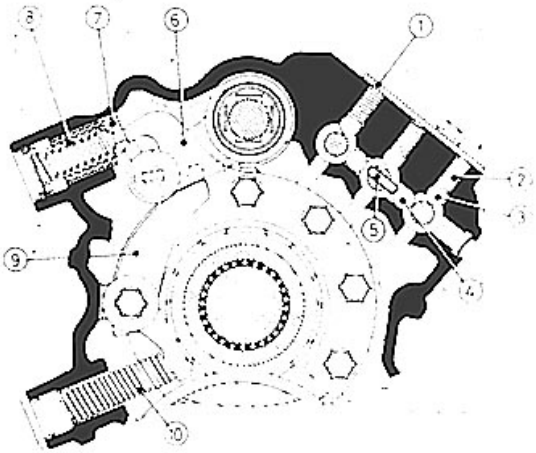
Pull input shaft, output shaft and layshaft into case rear section with Special Tools 23 1 300 and 23 2 150.
Important!
Make sure selector rods and layshaft are not clamped while pulling in parts.



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.



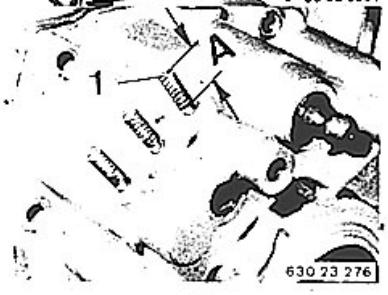
Install two detent balls with grease.
Push in 3rd/4th gear selector rod against lock.



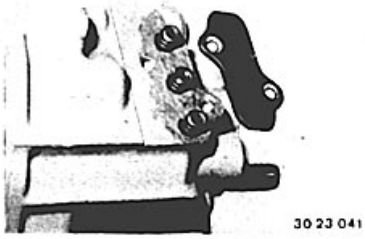
Arrest Assembly:
1 End cover
2 Spring
3 Locking ball
4 Detent ball
5 Lockpin
6 Selector arm
7 Lockpin
8 Spring
9 Locking screw
10 Spring



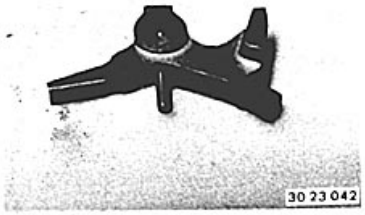
Drive 6 x 24 mm pin into 3rd/4th gear selector fork (counterhold).



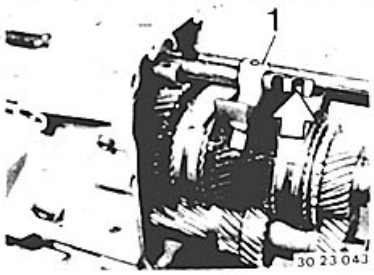
Install 3 locking balls and 3 springs.
Important!
Version with Different Length Springs:
Install the short spring (1) with relaxed length (A) = 15.9 mm (0.626") for 5th/reverse gear selector rod.



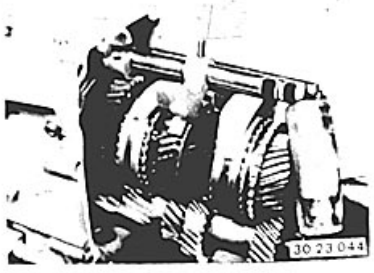
Install end cover after coating with sealing compound**.
Install end cover with sealing compound**.



Drive pin out of selector arm.

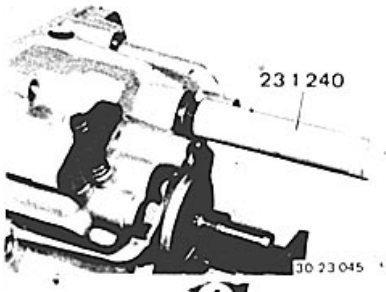


Hold 4 rollers in position with grease.
Slide in selector shaft and install selector arm (1) at same time.
Important!
Opening in selector shaft faces out.



Drive in 6 x 26 mm pin (counterhold).

** Source: HWB

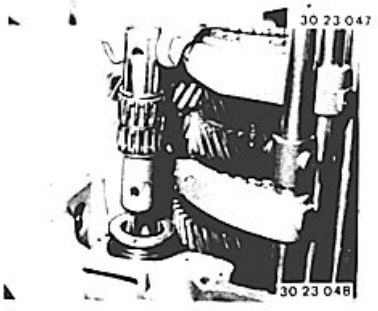


Lubricate sealing lips of radial oil seal with oil.
Drive in radial oil seal with Special Tool 23 1 240.



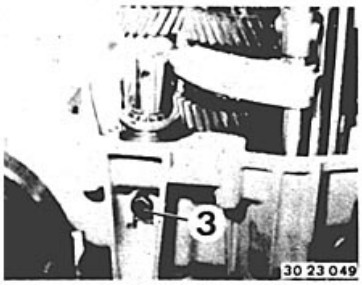
Install selector rail.
Groove (1) in selector rail faces up.
Install operating lever (5) with notch facing up and toward selector rail.
Install pin (4).

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.

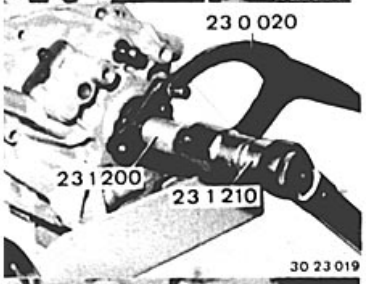
** Source: HWB



Mount shaft with bolt (3).
Install bolt with a locking compound**.



Insert holder (2), press out and secure in this position.

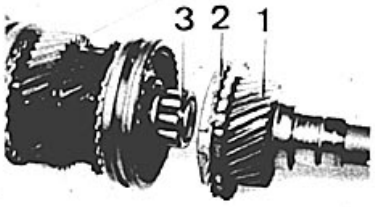


Install output flange.
Install collar nut with a locking compound**.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Tighten* collar nut with Special Tool 23 1 210.



Install lockplate.

* See Specifications for tightening torque
** Source: HWB

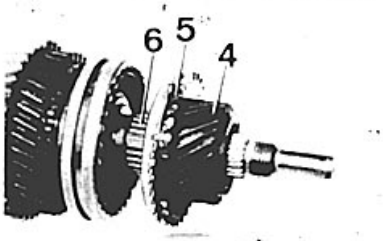


30 23 051

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 23 052

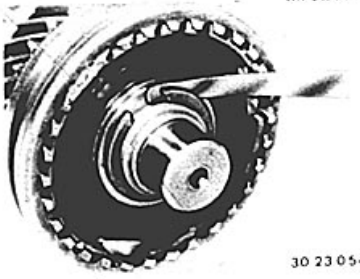
Pull off 5th gear wheel (4), synchromesh ring (5) and needle bearing (6).



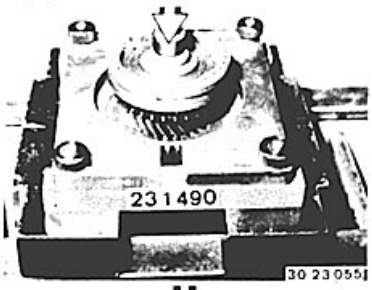
30 23 053

Lift out circlip (7).
Take off spacer (8).

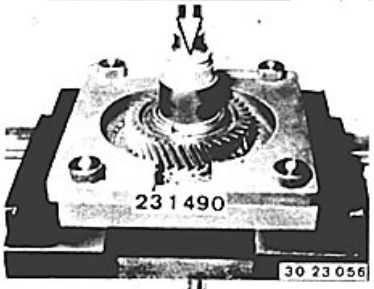
Installation:
Always replace the circlip.


30 23 054

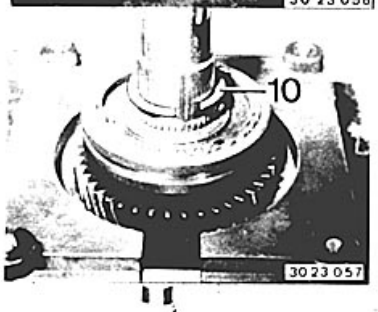
Installation:
Adjust play between the circlip and guide sleeve to 0 ... 0.09 mm (0 to 0.0035").



Press off 3rd gear wheel, guide and operating sleeves with Special Tool 23 1 490.
Take off needle bearing.
Pressing-off force*.

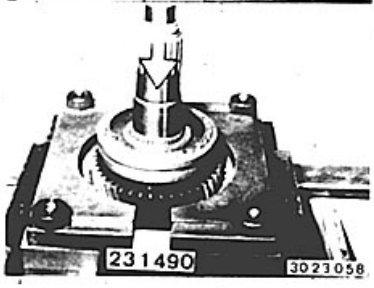


Press off bearing sleeve and 2nd gear wheel with Special Tool 23 1 490.
Remove needle bearing and synchromesh ring.



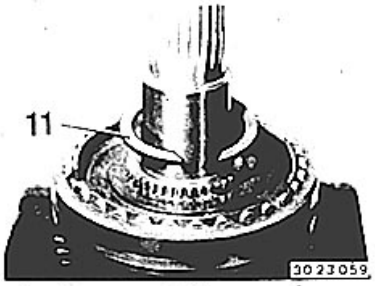
Important!
Circlip (10) must be removed before pressing off the 1st gear wheel.

Installation:
Always replace the circlip.



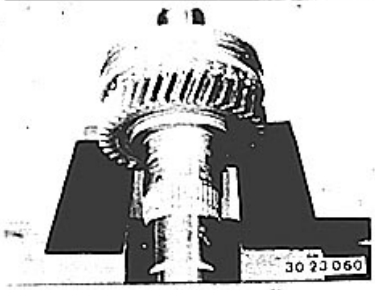
Press off 1st gear wheel, guide and operating sleeves with Special Tool 23 1 490.
Take off needle bearing.
Pressing-off force*.

* See Specifications

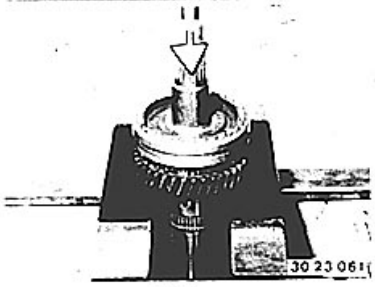


Important!
Circlip (11) must be removed prior to pressing off the reverse gear wheel.

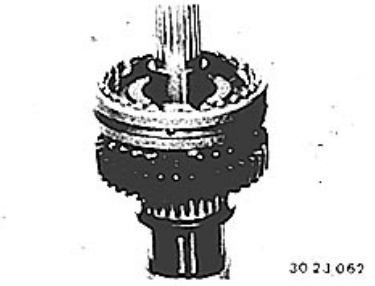
Installation:
Always replace the circlip.



Place output shaft next to the collar.

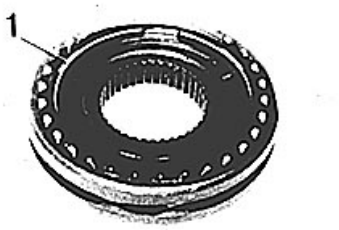


Press guide and operating sleeves as well as reverse gear wheel off of the output shaft.
Take off needle bearing.
Pressing-off force*.

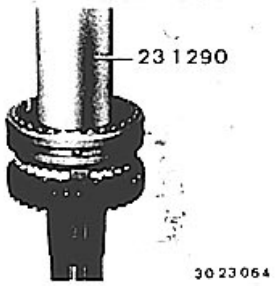


Assembling:
Note:
Check wear of synchromesh rings prior to assembling (see 23 23 505).
Install needle bearing, reverse gear wheel and synchromesh ring (only for version with synchronized reverse gear).
Insert guide and operating sleeves on splines of the output shaft.
Important!
Version with 3 identification Grooves:
Grooves must face the 5th gear wheel.

*** See Specifications**

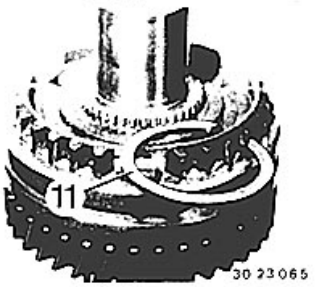


Important!
Version without Synchronized Reverse Gear:
Retainer (1) in the guide sleeve faces the reverse gear wheel.



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).

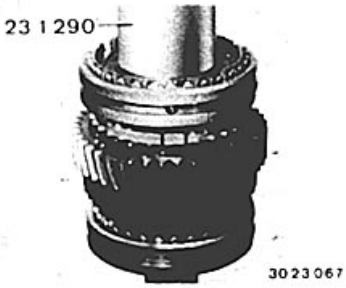


Install needle bearing, 1st gear wheel and synchromesh ring.
Slide guide and operating sleeves on splines of the output shaft.

Shouldered Operating Sleeve Version:
Shouldered end faces 2nd gear wheel.

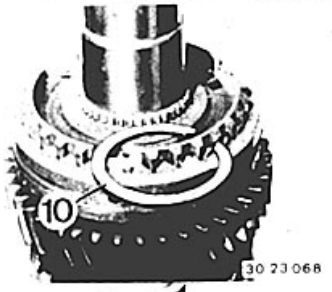
Version with Identification Groove:
Groove faces 1st gear wheel.

*** 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).



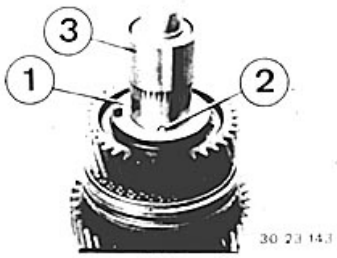
Install needle bearing, synchromesh ring and 2nd gear wheel.

Important!
Collar for the bearing sleeve on the output shaft must protrude slightly. If necessary, check circlip (10) for correct seating.

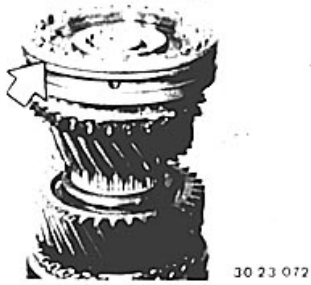


Heat bearing sleeve to about 80° C (175° F) with a hot air blower and install on the output shaft.

* See Specifications

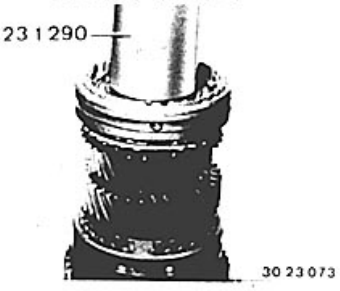


Version with Thrust Washer:
Install thrust washer (1) and ball (2).
Heat bearing sleeve (3) without collar to about 80° C (175° F) with a hot air blower and install on the output shaft.



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.

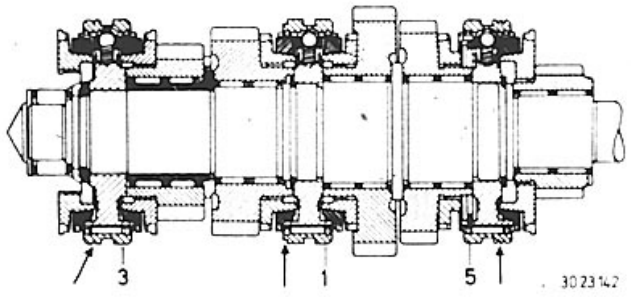
Important!
Make sure that tabs on synchromesh ring are aligned with openings in the guide sleeve while pressing on.

Install spacer and circlip.

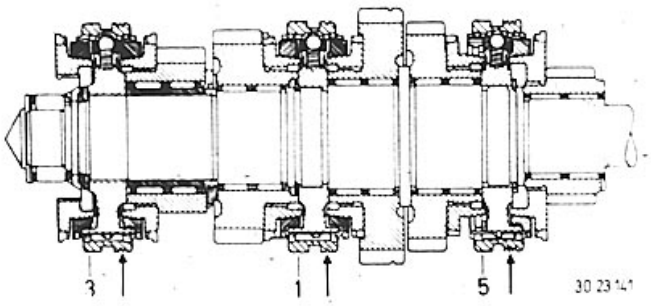
Pressing-on force*.

* See Specifications

23–76a

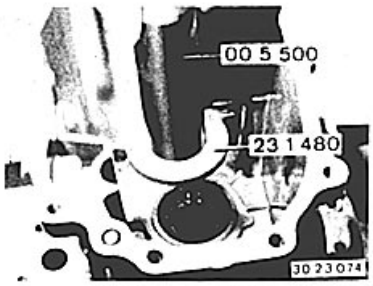


Identification and Installed Location of Operating Sleeves:
Date of introduction: 8.85
Operating sleeve (1) for 1st/2nd gears.
Operating sleeve installed with shouldered end facing 2nd gear wheel.
Operating sleeve (3) for 3rd/4th gears with one identification groove.
Operating sleeve installed with groove 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).



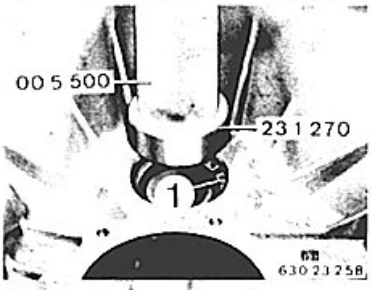
23 21 703 REPLACING BEARINGS OF ALL TRANSMISSION SHAFTS
– Transmission Removed –

Remove input/output shaft assembly – see 23 21 503.

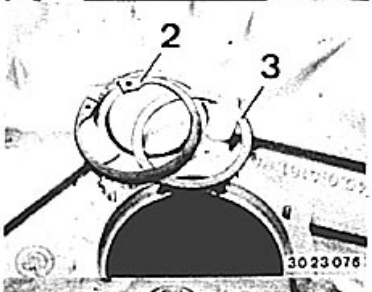
A) Input Shaft, Layshaft in Case Front Section

Input Shaft:
Drive out grooved ball bearing with Special Tools 23 1 480 and 00 5 500.

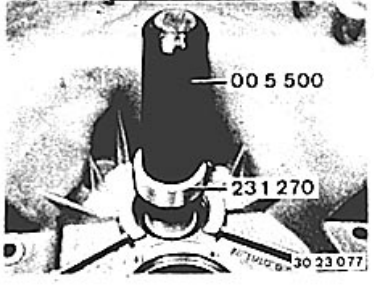
Important!
Collar is on clutch end.



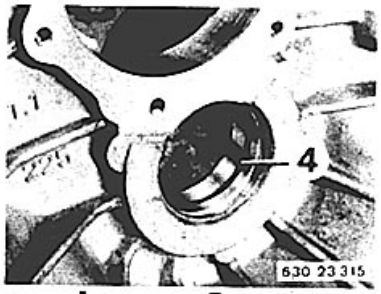
Layshaft:
Loosen circlip (1) with a single knock from Special Tool 23 1 270 used in conjunction with Special Tool 00 5 500.



Lift out circlip (2).
Remove spacer (3).



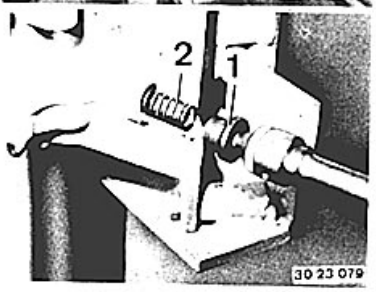
Drive out bearing shell toward the inside with Special Tools 23 1 270 and 00 5 500.



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

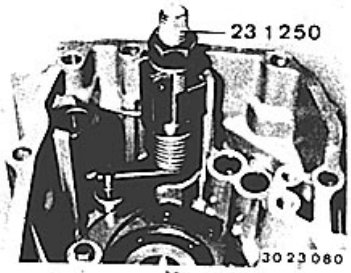


Output Shaft:
Unscrew bolt (1).

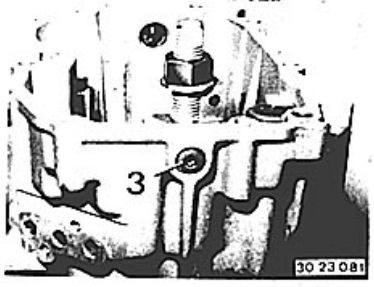
Caution!
Spring pressure.

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.

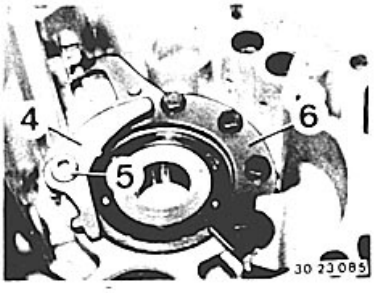
Important!
Roller.



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

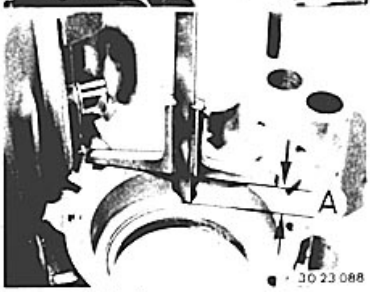


Installation:
Check the installed position of locking lever (4) and thrust pin (7).

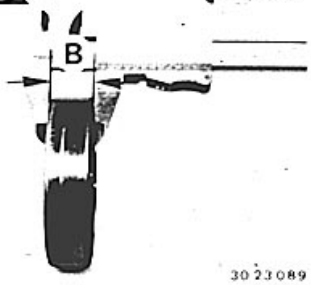


Lift out radial oil seal.
Drive out grooved ball bearing with Special Tools 23 1 120 and 00 5 500.

Important!
Shim X.



Determine thickness of shim X.
Measure distance (A).



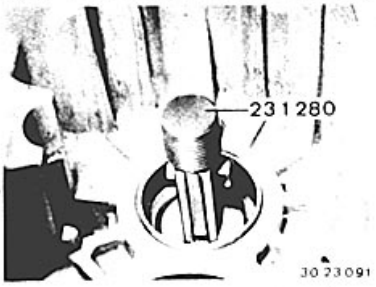
Measure distance (B).

Example:

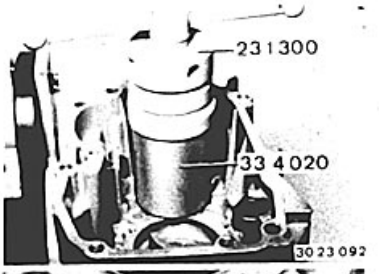
	A =	17.5 mm (0.689")
–	B =	17.0 mm (0.669")
	X =	0.5 mm (0.020") thick shim



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.



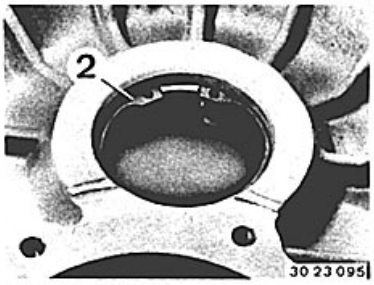
Apply Special Tool 33 4 020.
Screw on Special Tool 23 1 300.
Pull out bearing shell.



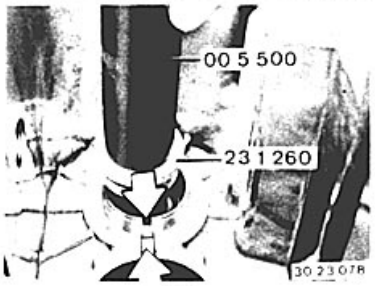
Installation:
Install bearing shell that the slot in the bearing shell is aligned with the bead (turning lock) in the case.



Drive in bearing shell with Special Tools 23 1 260 and 00 5 500.

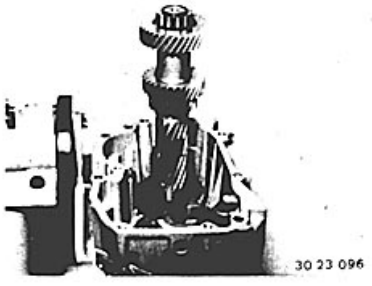


Determining Axial Play of Layshaft:
Install circlip (2).

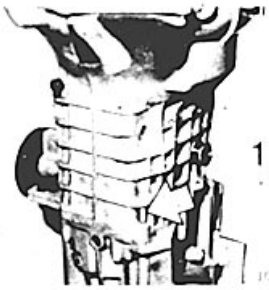


Install old shims.
Drive in bearing shell to fit tight in the front case section with Special Tools 23 1 260 and 00 5 500.

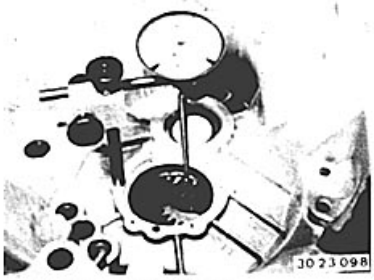
Important!
The oil groove must be aligned with the groove in the case.



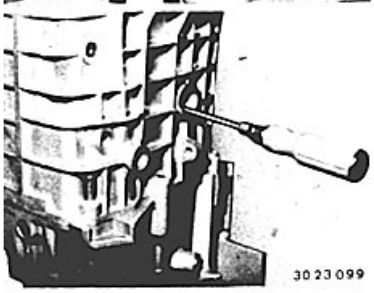
Place layshaft with roller bearings in the rear case section.



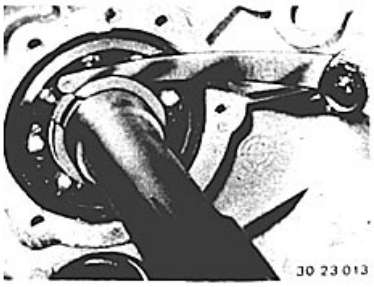
Mount front case section and secure with two bolts opposite each other.
Center front case section slightly with dowel pins.
Unscrew oil filler plug (1).



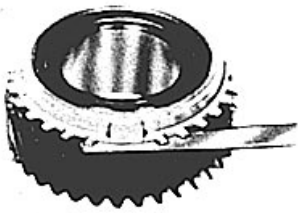
Mount holder with dial gage.
Dial gage must bear on tooth of the layshaft.



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.



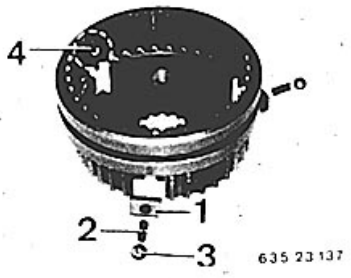
30 23 101

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).

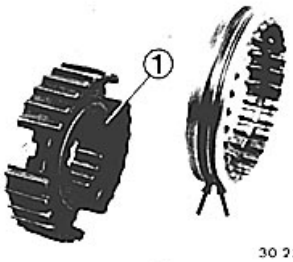
Installation:
Bores (4) or flattened teeth on the operating sleeve must be aligned with ball (3).



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.

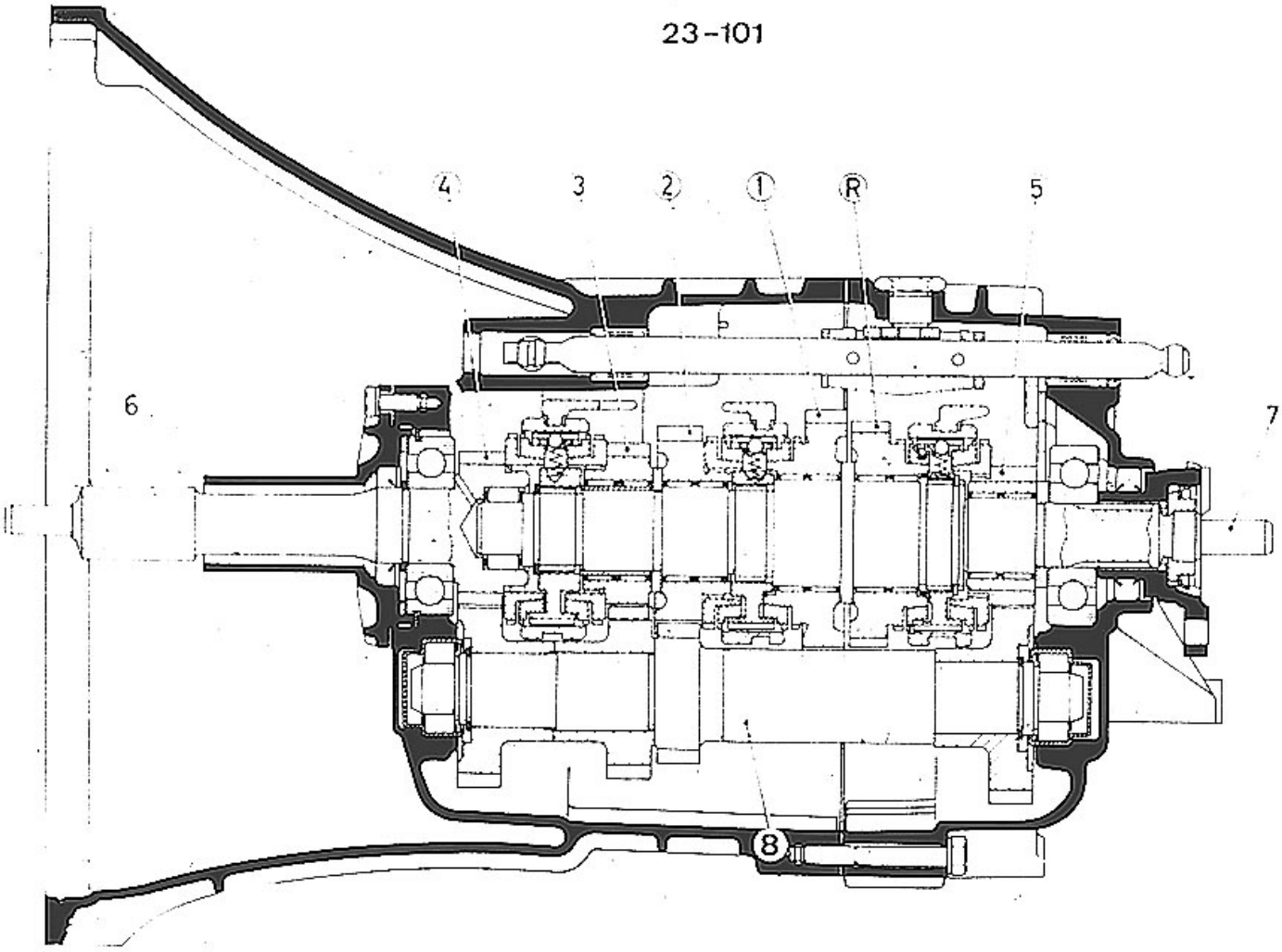
Important!
Shouldered end of thrust pieces faces the operating sleeve.
Insert guide sleeve in operating sleeve to half its length.
Press in balls far enough, until the guide sleeve can be pressed into the operating sleeve.

*** See Specifications**

Construction group 23 Manual transmission

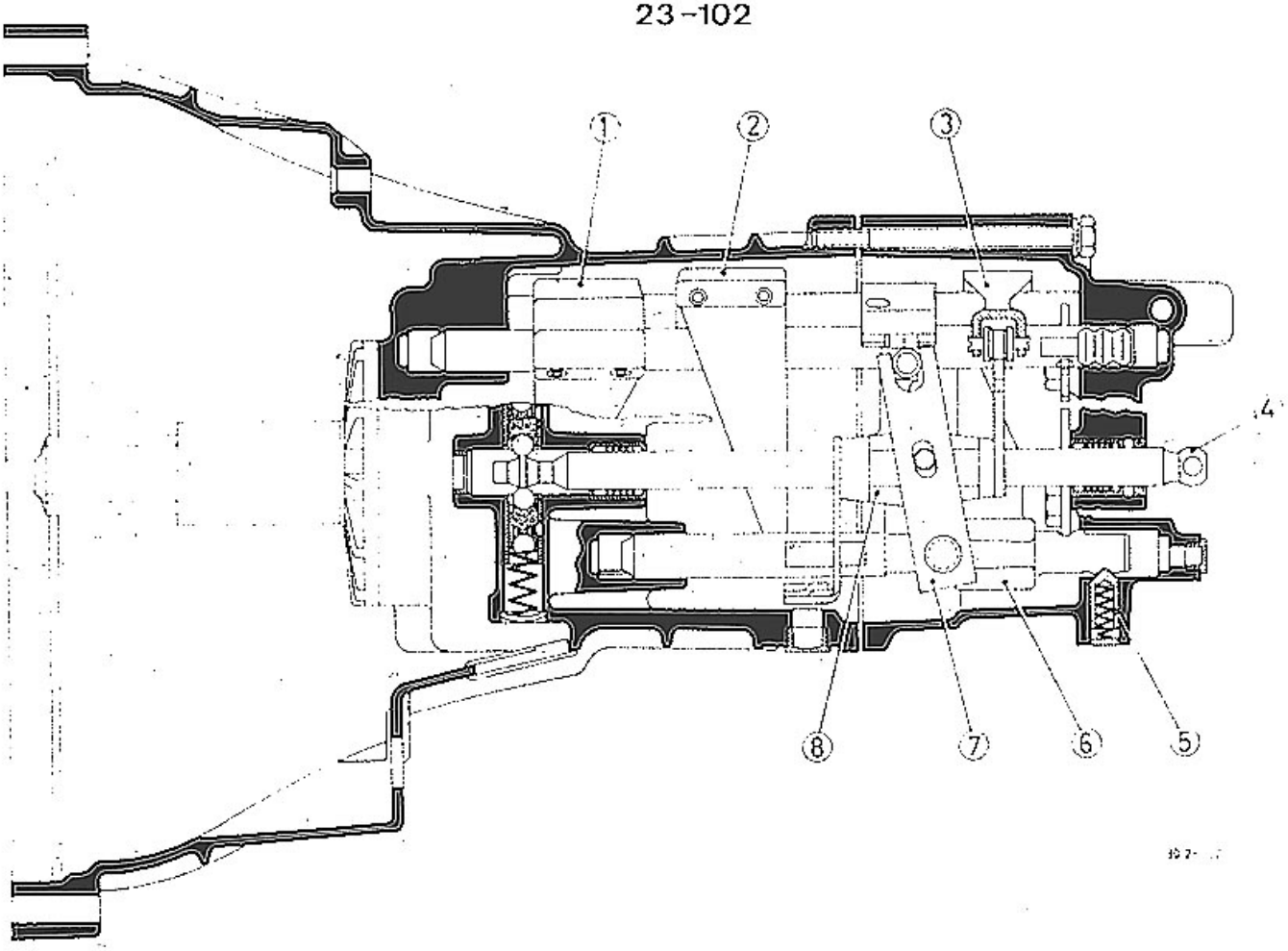
ZF – S5 – 16 Manual transmission (overdrive)

	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



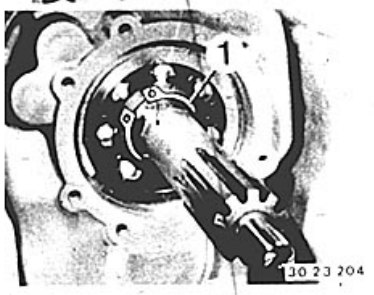
ASSEMBLY DRAWING OF SHIFT PARTS FOR ZF – S5 – 16 FIVE SPEED OVERDRIVE MANUAL TRANSMISSION

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



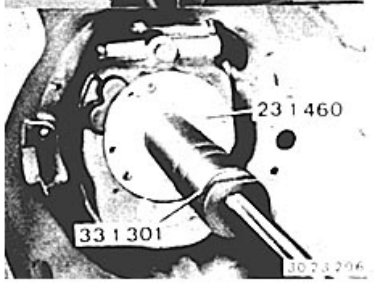
Remove transmission – see pertinent model repair manual microfiche since 1985 models – 23 00 022.
Mount Special Tool 23 0 090 on Special Tool 00 1 490.
Mount transmission on special tool assembly.
Drain oil.



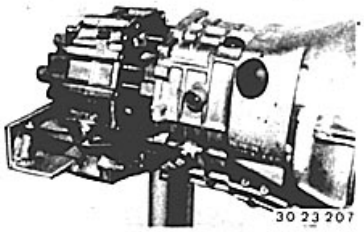
Remove guide sleeve 23 11 624.
Lift out circlip (1).



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.

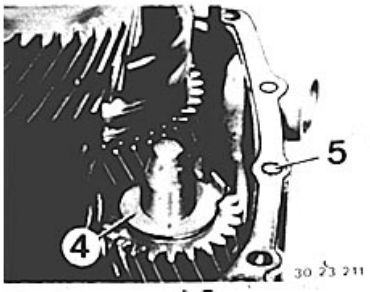


Drive out end cap (3).
Installation:
Replace end cap and insert with sealing compound**.

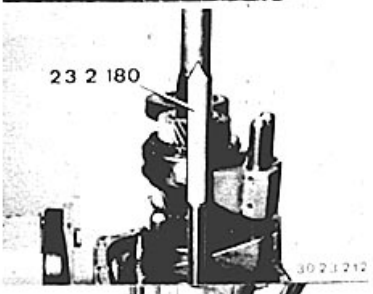


Drive out grooved ball bearing in direction of clutch housing.

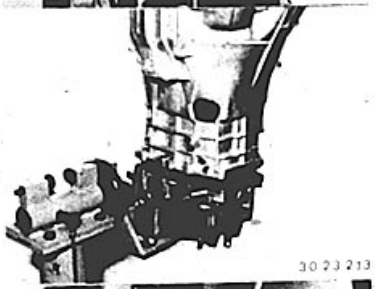
** Source: HWB



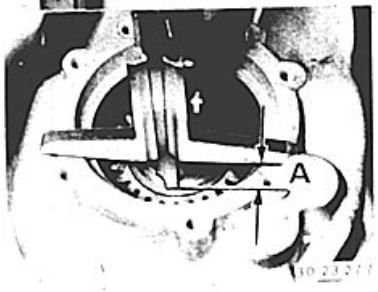
Hold thrust washer (4) on the reverse gear shaft with grease that the angle faces bore (5) in the rear case section.
New version without angle.
Install gasket with grease.



Apply Special Tool 23 2 180 on the shift shaft.

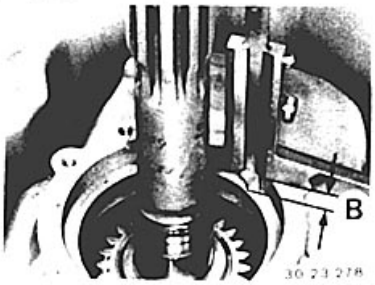


Mount front case section and bolt on rear case section.
Tightening torque*.
Remove Special Tool 23 2 180.
Install end cover for shift shaft.



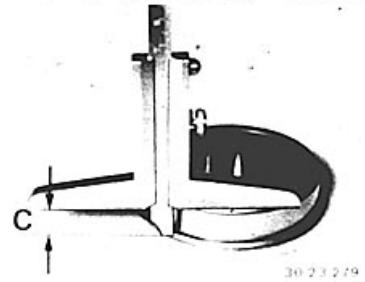
The axial play of the input shaft has to be adjusted after replacing the case or bearings.
Input shaft must bear on the synchromesh ring.
Measure distance (A) from sealing surface of the guide sleeve to the input shaft.

* 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.

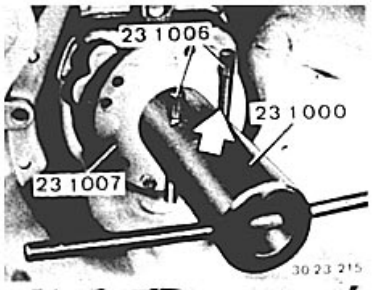
Example:

	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.



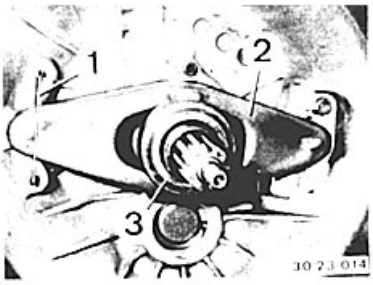
Press grooved ball bearing on to drive shaft or into front case section with Special Tool 23 1 007 used together with Special Tools 23 1 000 and 23 1 006.

Important!
Apply Special Tools 23 1 006 in such a manner that the flat side faces the drive shaft.



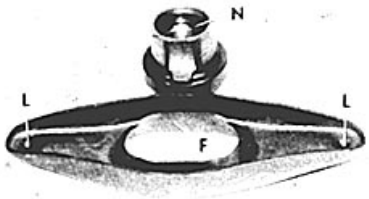
Drive on grooved ball bearing further and further simultaneously with light knocks from a hammer.
Install circlip and reverse gear switch.

Note:
Coat operating pin of the reverse gear switch with oil.



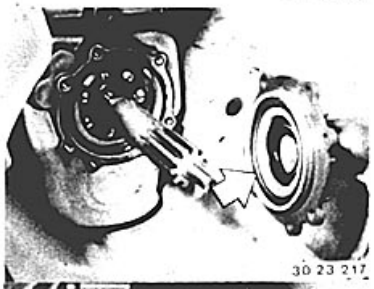
23 11 624 REMOVING AND INSTALLING GUIDE SLEEVE FOR CLUTCH RELEASE
–TRANSMISSION REMOVED–

Lift out spring (1) and remove release lever (2) with thrust bearing (3).

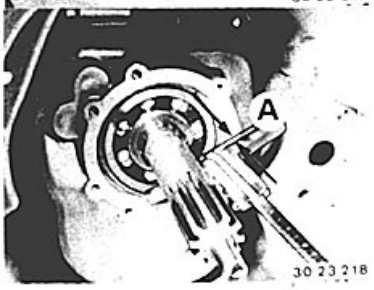


30 23 025

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.

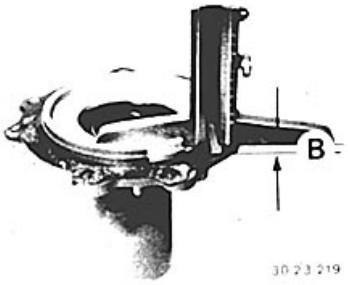


Detach guide sleeve.
Important!
Spacer.
Installation:
Replace gasket.
Remove old gasket with adhesive remover**.



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:

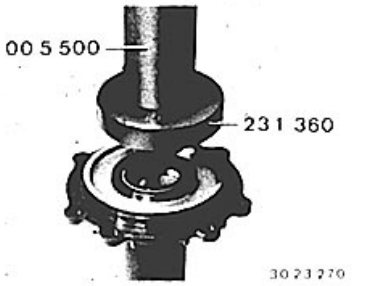
A	5.2 mm (0.205")
– B	3.2 mm (0.126")
	2.0 mm (0.079") spacer thickness



30 23 303

23 12 504 REPLACING RADIAL OIL SEAL FOR INPUT SHAFT
- Transmission Removed -

Remove guide sleeve - see 23 11 624.
Lift out radial oil seal.



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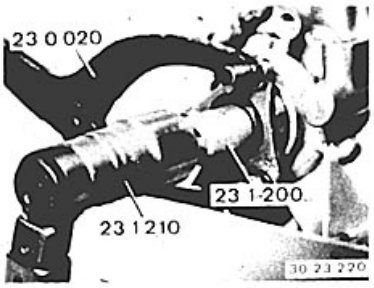
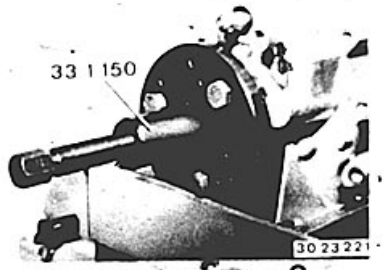
Drive in new radial oil seal with Special Tools 23 1 360 and 00 5 500.
Lubricate sealing lip with oil.



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 off output flange with Special Tool 33 1 150.



Remove end plugs (1 ... 3).

Caution!
Spring force.

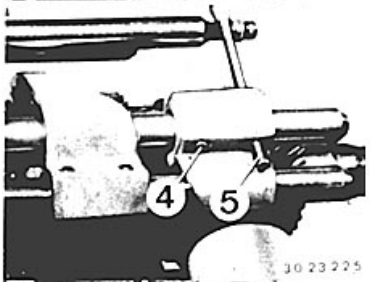
Installation:
Replace end plugs.



Remove three springs.



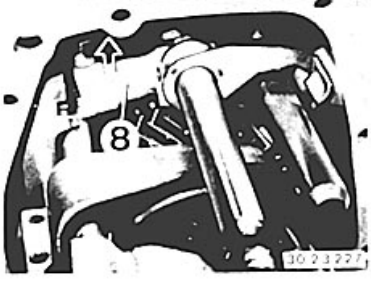
Pull out three catch pins with a circlip pliers as far as possible.
Catch pins can only be pulled out completely after removal of the lock.



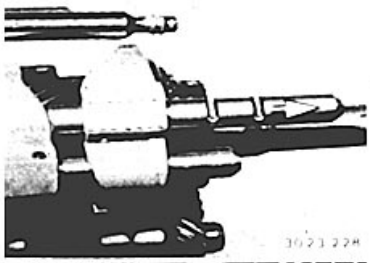
Drive pins (4 and 5) out of the 3rd/4th gear shift fork while counterholding.
New Version:
* pin.



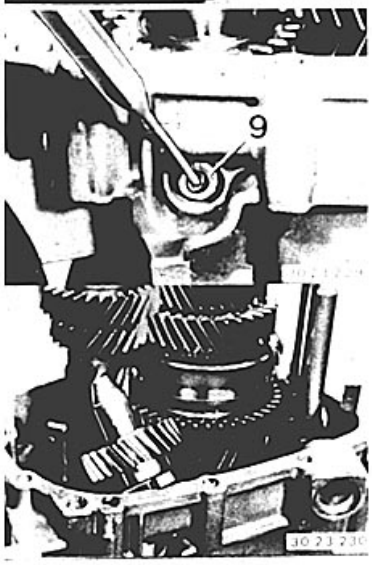
Push back leaf spring (6) for reverse gear with Special Tool 23 2 170 far enough, until shift finger (7) is accessible.
It must be possible to turn the shift shaft back and forth easily.



Swing shift finger (8) out of groove in the shift rod.



Pull out 3rd/4th gear shift rod.



If applicable, remove lock in hexagon socket of bolt.
Unscrew bolt (9).

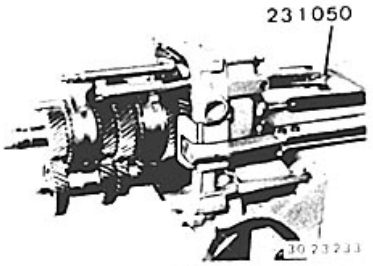
Important!
Seal between case and bolt.

Remove reverse gear shaft, reverse gear wheel with needle bearing and thrust washer.

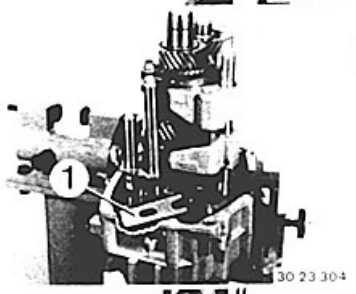
Remove bolt (10) for operating lever.



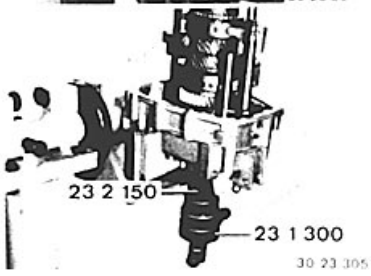
Important!
Engage reverse gear by sliding the operating sleeve forward before pressing out the gear wheel set.



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.

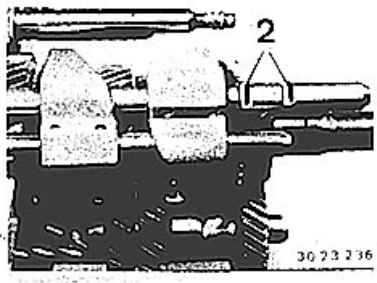


Installing:
Reverse gear is engaged.
Install input and output shafts with shift rod for 1st/2nd gears, 3rd/4th gear shift fork, shift rod for 5th/reverse gears, shift shaft and layshaft in rear case section.
Important!
Check installed position of operating lever (1).

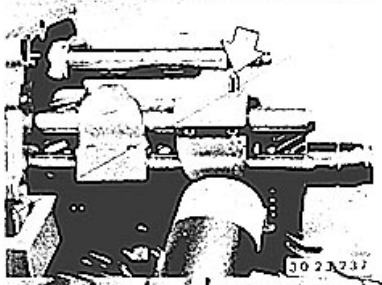


Pull input shaft, output shaft and layshaft into rear case section with Special Tools 23 1 300 and 23 2 150.

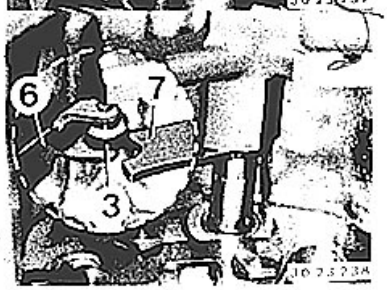
Important!
Make sure that shift rods, shift shaft and layshaft do not clamp while pulling in.



Take out reverse gear.
Slide in 3rd/4th gear shift rod with openings (2) facing up.
New version: one opening.

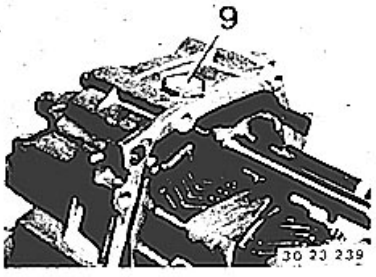


Drive in pins for 3rd/4th gear shift fork while counterholding.
New version: 1 pin.



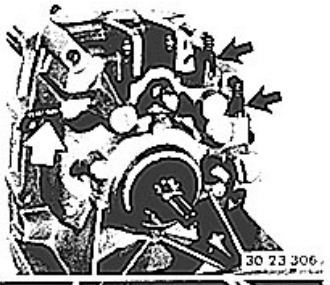
Remove Special Tool 23 2 170 for the leaf spring.

Important!
Roller (3) on leaf spring (6) must engage in the shift finger (7).

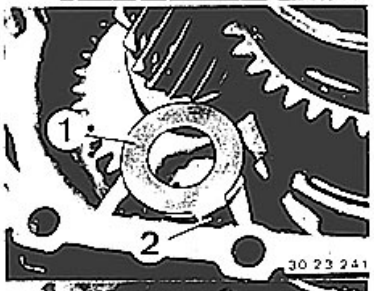


Install bolt (9) for operating lever.
Tip of bolt must engage in bore in operating lever.
Tightening torque*.

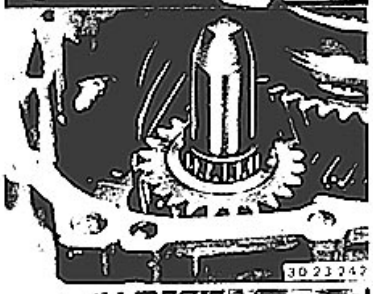
* See Specifications



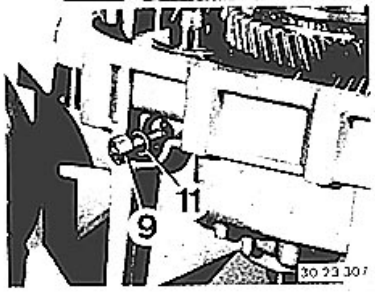
Insert three catch pins with springs in case.
Install new end plugs approx. 0.5 mm (0.020") below the case edge and punch lock slightly.



Install thrust washer (1) with angle (2) in upper opening on the case.
New version: without angle.

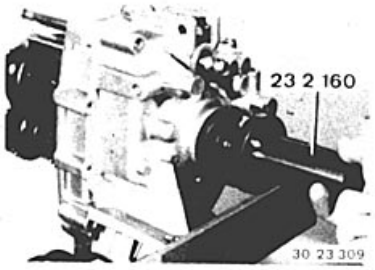


Install reverse gear wheel with long collar facing case, two needle bearings and shaft.

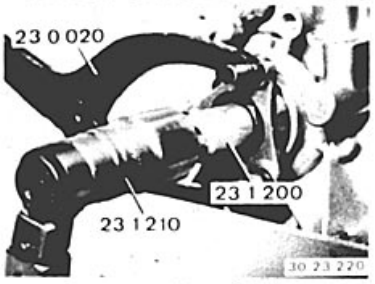


Install seal (11) on bolt.
Tighten bolt (9) to correct torque* and install new locking cap.

* See Specifications



Drive in radial oil seal flush with Special Tool 23 2 160.
Lubricate sealing lip with oil.

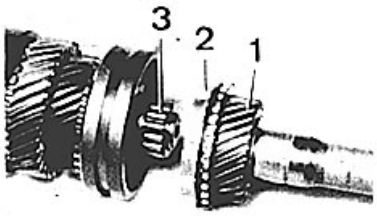


Insert or knock on output flange.
Install collar nut with a bolt cement**.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Tighten collar nut with Special Tool 23 1 210.
Tightening torque*.



Install and lock lockplate in the groove.

* See Specifications
** Source of Supply: HWB

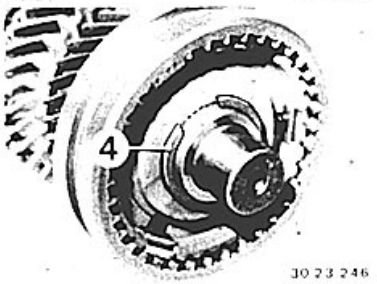


30 23 245

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.



30 23 246

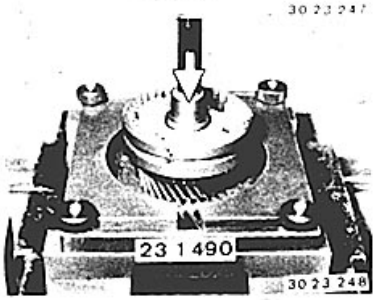
Lift out circlip (4).

Installation:
Always replace the circlip.



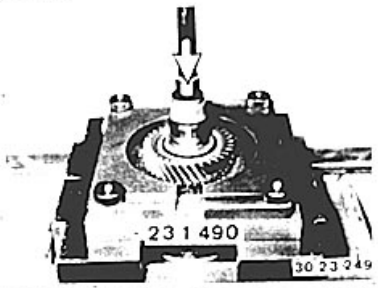
30 23 247

Installation:
Remove guide sleeve play with circlip (4).
Circlips are available in different thicknesses from Parts.



30 23 248

Press 3rd gear wheel, guide and operating sleeves off of the output shaft with Special Tool 23 1 490.
Take off needle bearing.



30 23 249

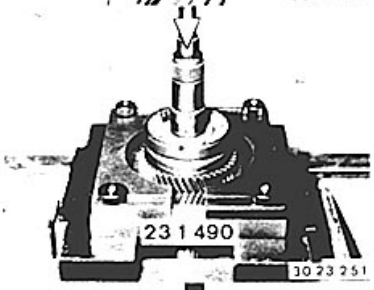
Press bearing sleeve, thrust washer and 2nd gear wheel off of the output shaft with Special Tool 23 1 490.
Take off needle bearing and sintered metal synchromesh ring.



30 23 250

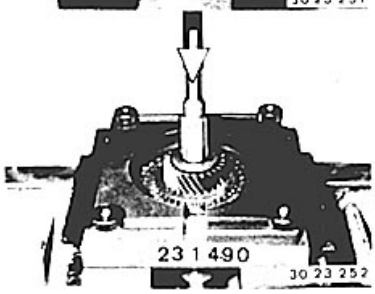
Important!
Circlip (5) must be removed before pressing off the 1st gear wheel.

Installation:
Always replace the circlip.



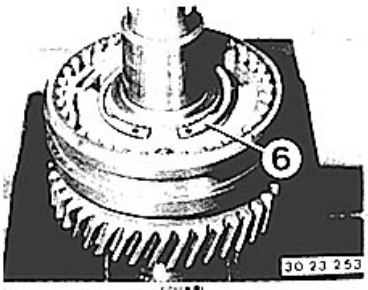
30 23 251

Press 1st gear wheel, guide and operating sleeves off of the output shaft with Special Tool 23 1 490.
Take off needle bearing.

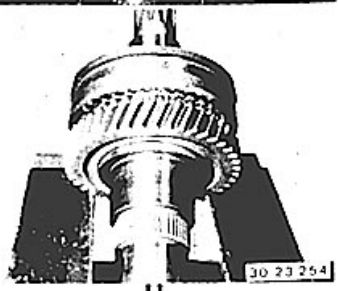


30 23 252

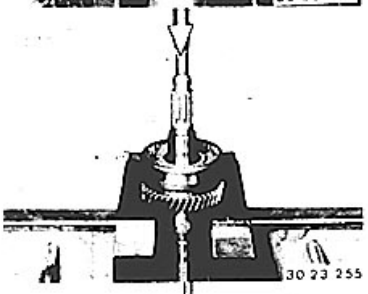
Press thrust washer and 5th gear wheel off of the output shaft with Special Tool 23 1 490.
Take off brass synchromesh ring and needle bearing.



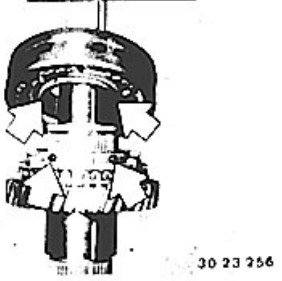
Important!
Circlip (6) must be removed before pressing off reverse gear.
Installation
Always replace circlip.



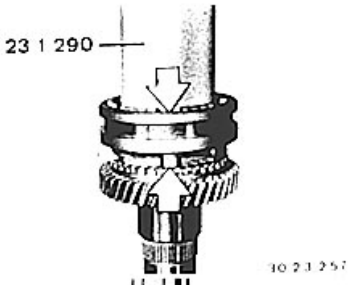
Install output shaft next to collar.



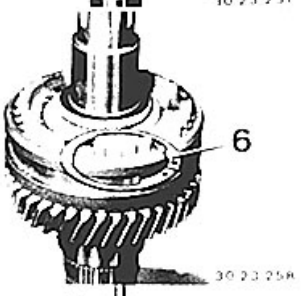
Press guide sleeve with sliding sleeve and reverse gear off of output shaft.
Remove needle bearing.
Only for version with reverse gear synchronization:
Brass synchromesh ring with 6 balls.



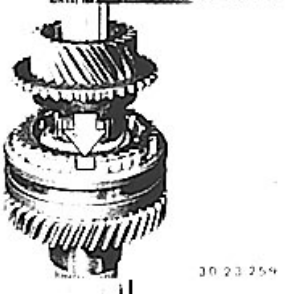
Assembling:
Install needle bearing, reverse gear and brass synchromesh ring with 6 grease held balls (only for version with reverse gear synchronization).
Install guide and sliding sleeve with narrow collar facing reverse gear.



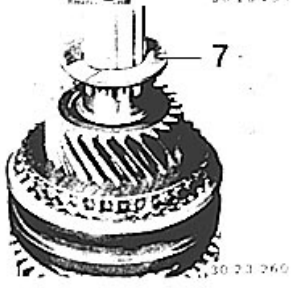
Press on guide sleeve to fit tight with Special Tool 23 1 290.
Important!
Make sure that short tabs of synchromesh ring are aligned with groove in pressure pieces when pressing on guide sleeve.



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.

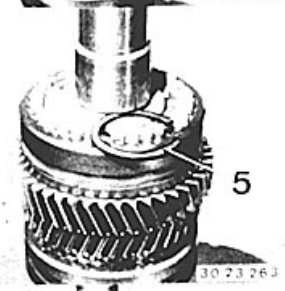


Install needle bearing, 1st gear wheel and sintered metal synchromesh ring.
Install guide and operating sleeves with the narrow collar facing the 1st gear wheel.



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).



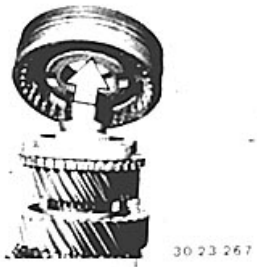
Install sintered metal synchromesh ring with its short tabs in the groove of thrust pieces.
Install needle bearing and 2nd gear wheel.



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.

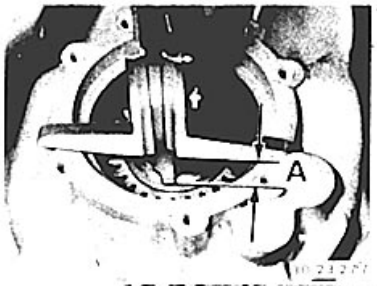
Note:
Version with identification Groove:
Groove faces the 3rd gear wheel.



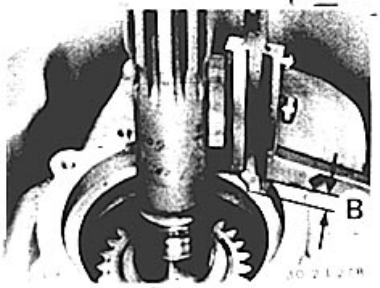
Press on guide sleeve to fit tight with Special Tool 23 1 290.

Important!
Make sure that short tabs on synchromesh ring are aligned with groove in thrust pieces while pressing on.

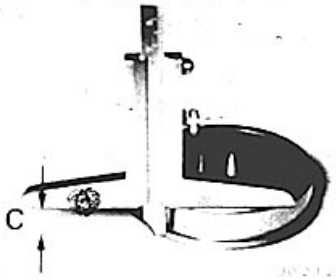
Install circlip.



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.

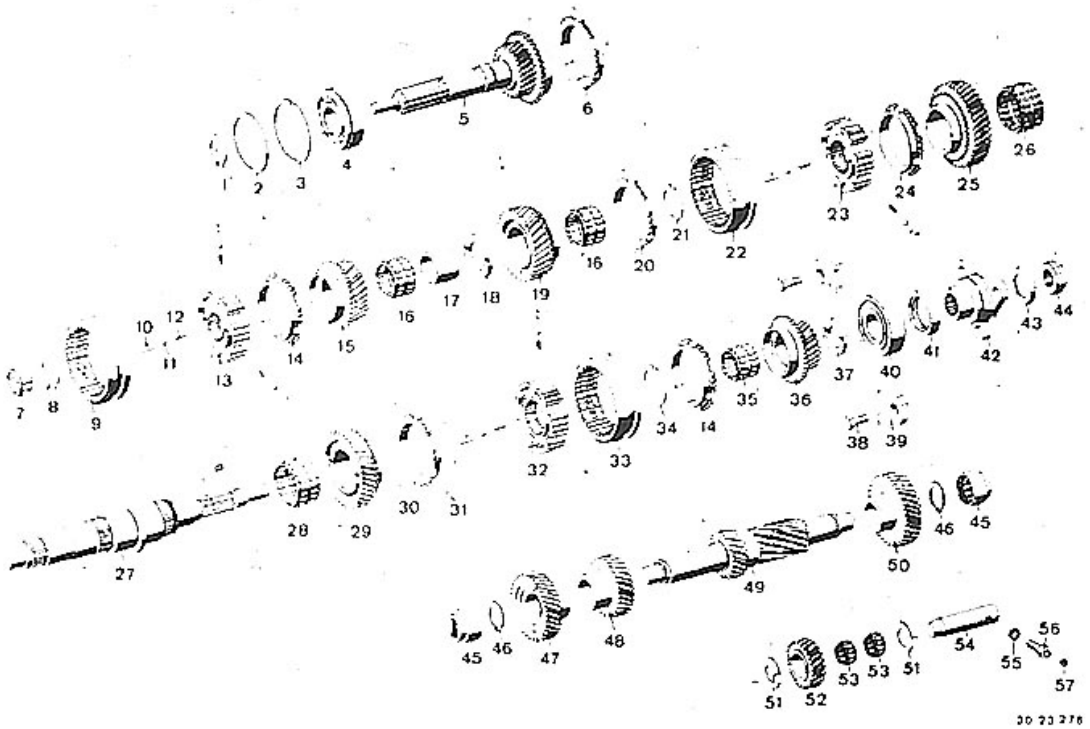


Measure distance (C) from bearing outer race to circlip.
Note
Circlip must be pressed tight in groove for measuring.
Example:

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

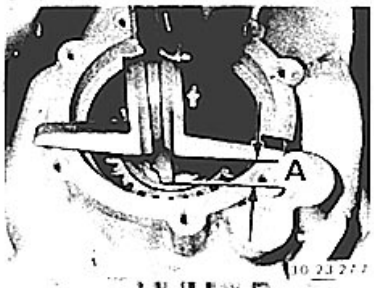


1 Circlip
2 Spacer
3 Circlip
4 Grooved ball bearing
5 Input shaft
6 Synchromesh ring
7 Roller bearing
8 Circlip
9 Sliding sleeve
10 Pressure piece
11 Ball
12 Spring
13 Guide sleeve
14 Synchromesh ring
15 3rd gear
16 Needle bearing
17 Bearing sleeve
18 Thrust washer
19 2nd gear
20 Synchromesh ring
21 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

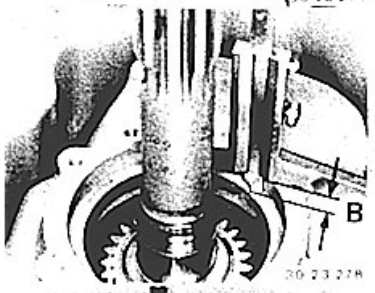


23 21 704 REPLACING BEARINGS OF ALL TRANSMISSION SHAFTS –TRANSMISSION REMOVED–

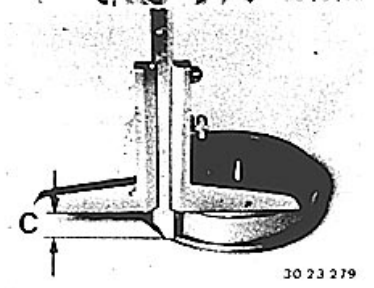
Remove transmission case front section 23 11 014.
A) Input Shaft, Layshaft in Case Front Section:
Input Shaft:
Drive out grooved ball bearing in direction of clutch housing.



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.



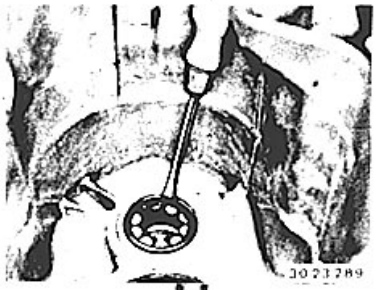
Measure distance (B) from guide sleeve sealing surface to circlip bearing surface.



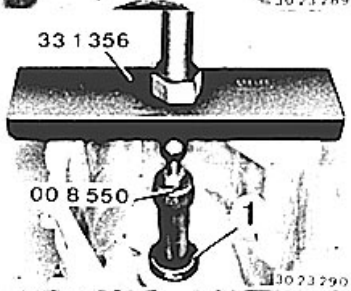
Measure distance (C) from bearing outer race to circlip.
Note:
Circlip must be pressed tight in groove for measuring.
Example:

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")

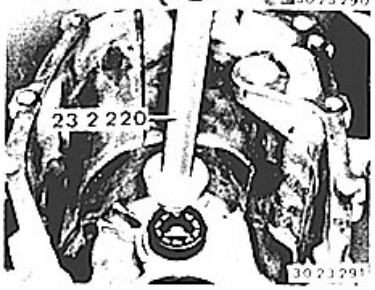
Axial play required: 1.1 to 1.3 mm (0.043 to 0.051").
Different size circlips are available from Parts.



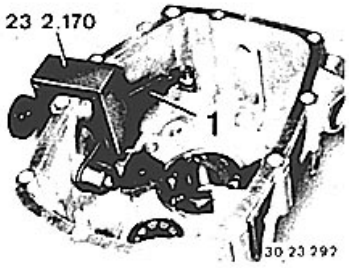
Layshaft:
Destroy roller cage of bearing.
Remove cage with rollers.



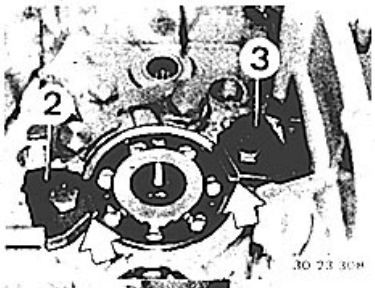
Pull out bearing outer race (1) with Special Tools 00 8 550 (without supports) and 33 1 356.



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.

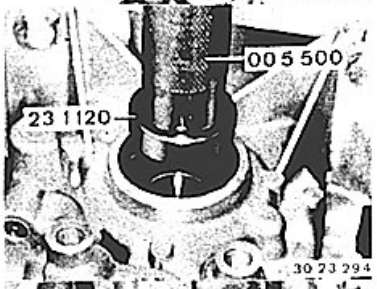


B) Output Shaft, Layshaft in Case Rear Section:
Remove input and output shaft assembly 23 21 504.
Output Shaft:
Remove Special Tool 23 2 170.
Pull off leaf spring (1).

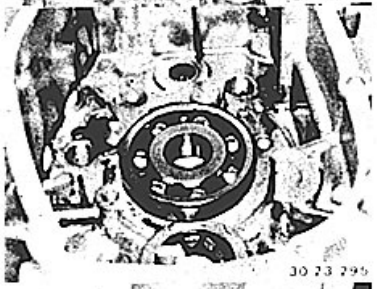


Unscrew bolts.
Take off clamps (2 and 3).

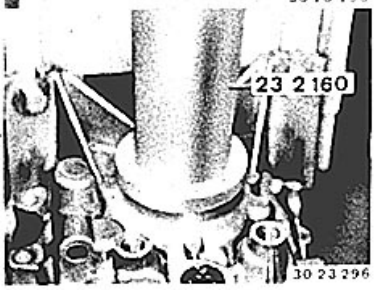
Installation:
Install clamps with curved surface facing the bearing outer race.
Tightening torque*.



Lift out radial oil seal.
Drive out grooved ball bearing with Special Tools 23 1 120 and 00 5 500.

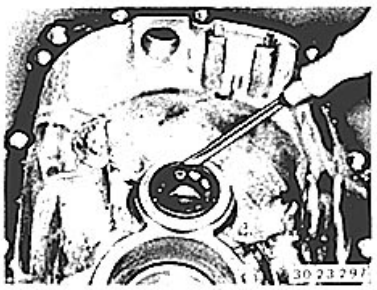


Heat rear case section in area of the grooved ball bearing to about 80° C (175° F) with a hot air blower.
Install grooved ball bearing.
If applicable, drive in bearing to fit tight with Special Tool 24 1 100.

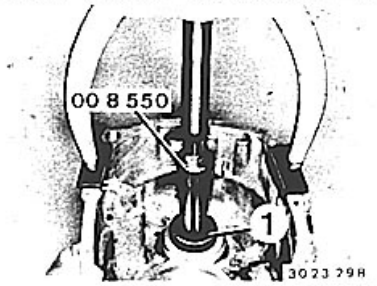


Drive in radial oil seal with Special Tool 23 2 160.
Lubricate sealing lip with oil.

* See Specifications

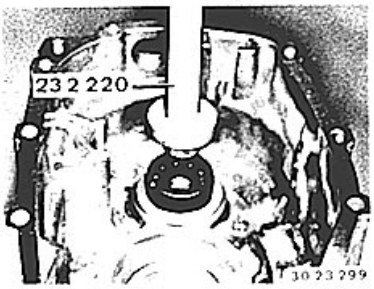


Layshaft:
Destroy roller cage of the bearing.
Remove cage with rollers.

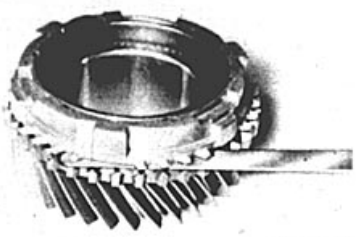


Pull out bearing outer race (1) with Special Tools 00 8 550 and a support.

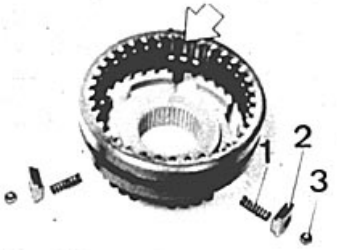
Important!
Use a piece of flat iron or something similar between the support and sealing surface, to avoid damaging the sealing surface.



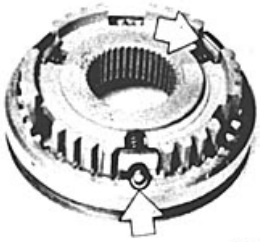
Heat rear case section in area of the roller bearing to about 80° C (175° F) with a hot air blower.
Drive in roller bearing with Special Tool 23 2 220.



30 23 271



30 23 272



30 23 273

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.

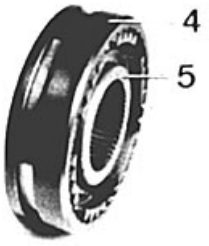
Note:
Twist and press down synchromesh ring for measuring.
Synchromesh rings should bear uniformly on the entire surface.

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.

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

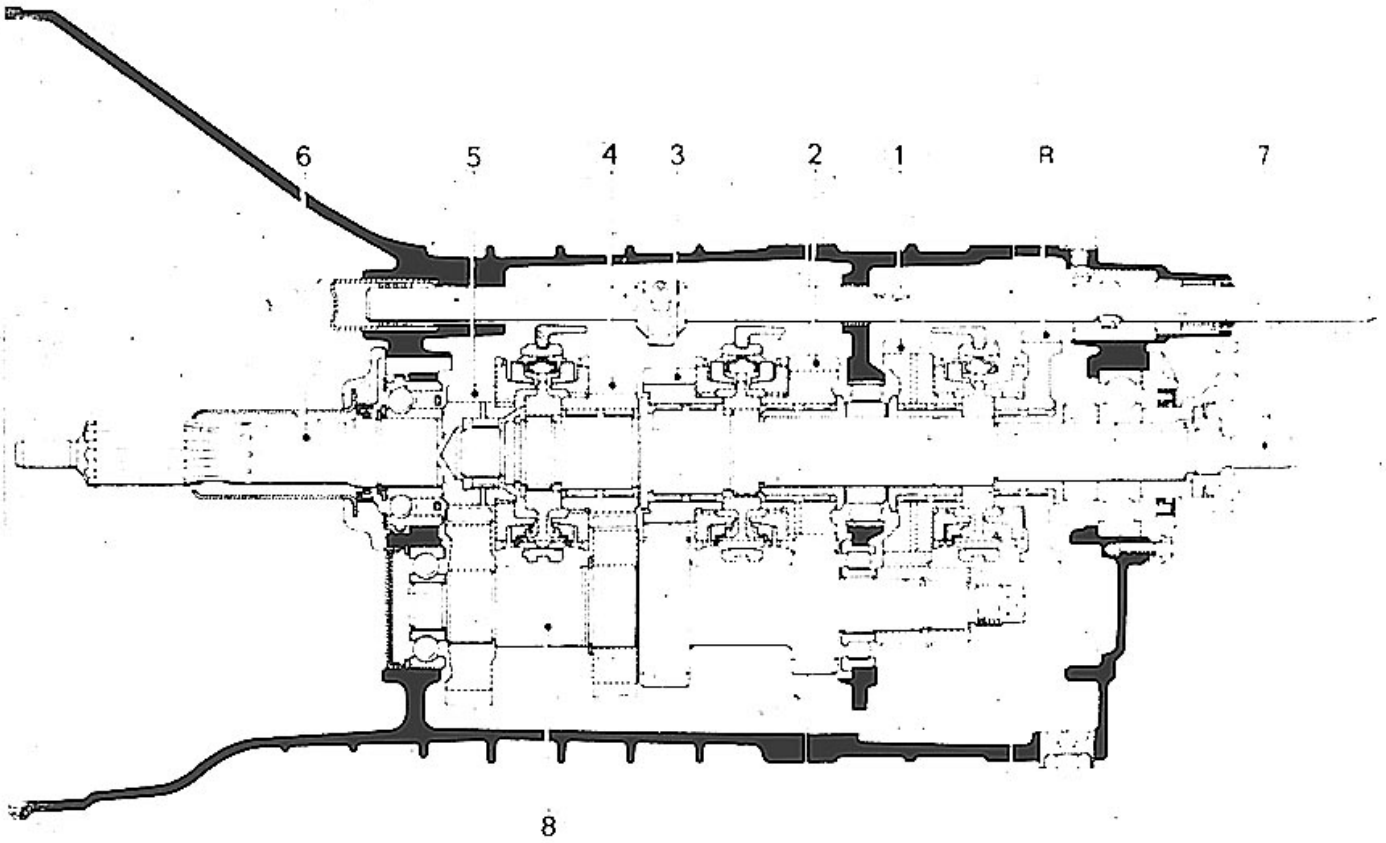
5th/Reverse Gear Synchronization:
Check installed position of operating sleeve.
Wide surface end (6) of operating sleeve faces narrow collar (7).

* See Specifications

Construction group 23 Manual transmission

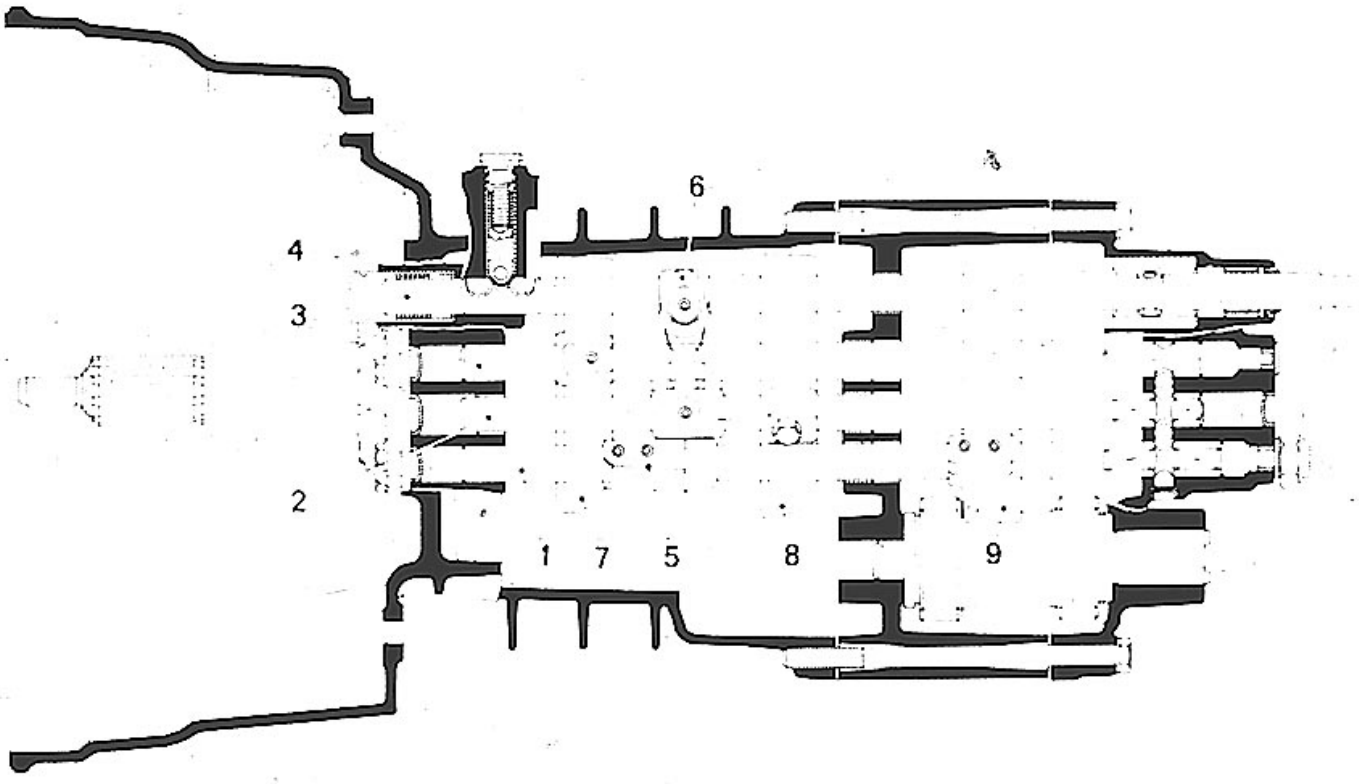
Getrag 245 Five speed manual transmission (sport)

	Transmission – assembly drawing	23-	140
	Shift mechanism – assembly drawing	23-	141
23 11 005	Transmission case front section – remove and install / seal	23-	142
040	Transmission case rear section – remove and install / seal	23-	143
622	Clutch release guide sleeve – remove and install / replace	23-	147
23 12 502	Radial oil seal for input shaft – replace	23-	148
23 21 501	Input and output shaft assembly – remove and install	23-	149
552	Output shaft – replace	23-	151
703	Bearings of all transmission shafts – replace	23-	154
23 23 004	Synchronisation – disassemble and assemble	23-	157



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

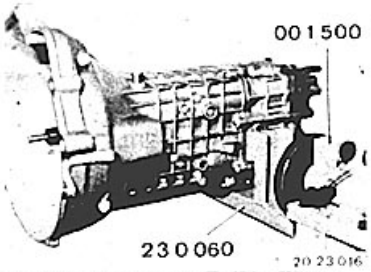
1 Selector rod, 1st/reverse gear
2 Selector rod, 2nd/3rd gear
3 Selector rod, 4th/5th gear
4 Selector shaft
5 Dog
6 Selector arm
7 Selector fork 4th/5th gear
8 Selector fork 2nd/3rd gear
9 Selector fork 1st/rev. gear



20 23 015

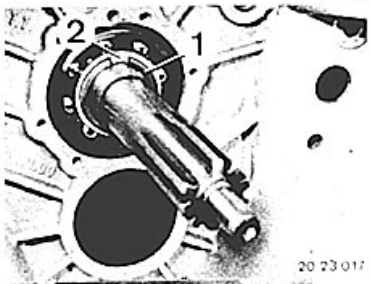
23 11 005 · REMOVING AND INSTALLING/ SEALING TRANSMISSION CASE FRONT SECTION

Remove transmission – see pertinent model repair manual microfiche since 1985 models – 23 00 022.
Unscrew brackets for exhaust assembly and rubber mounts.



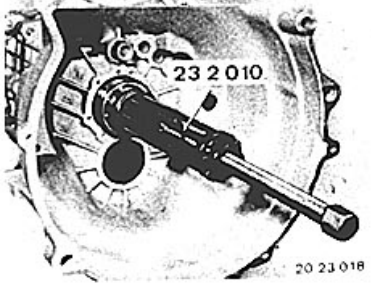
20 23 016

Mount Special Tool 23 0 060 on assembly stand 00 1 490.
Mount transmission on special tool.
Drain oil.



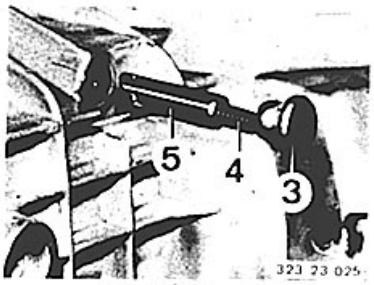
20 23 017

Remove guide sleeve 23 11 622.
Lift out circlip (1).
Remove spacer (2).
Installation:
Always replace circlip.



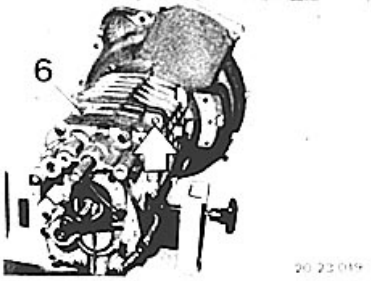
20 23 018

Pull out grooved ball bearing with Special Tool 23 2 020.



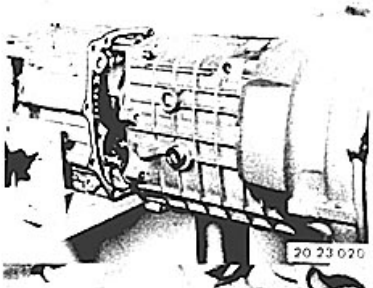
323 23 025

Lift out cover (3).
Remove spring (4) and lockpin (5).
Check installed position.



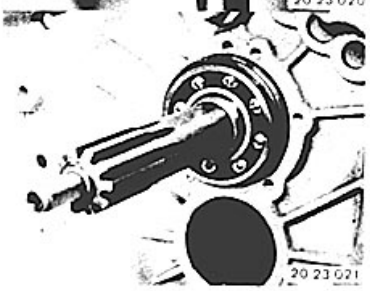
20 23 019

Drive out dowel pins.
Unscrew bolts on cover.
Loosen screw (6).



20 23 020

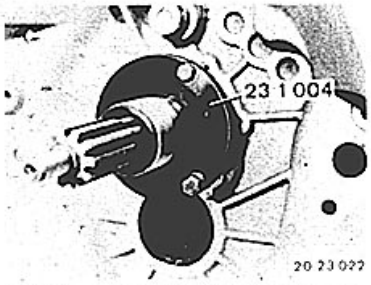
Pull off transmission case.
Installation:
Mount transmission case with a surface sealant**.
Sealing surface must be thoroughly cleaned and dried of oil.



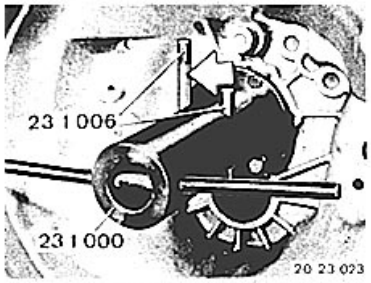
20 23 021

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.

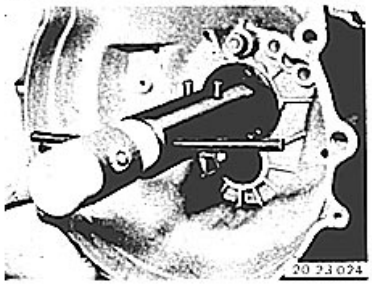
* See Specifications
** Source: HWB



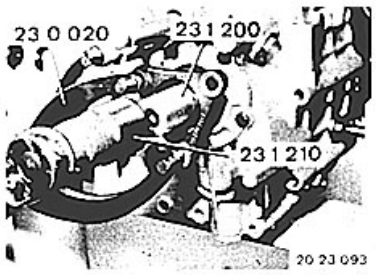
Mount Special Tool 23 1 004 on case with three 6 x 35 mm bolts, but not too tight.



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.

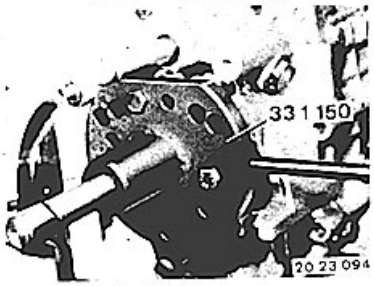


Drive in grooved ball bearing to fit tight by applying light knocks.
Install spacers and circlip.
Install lockpin.

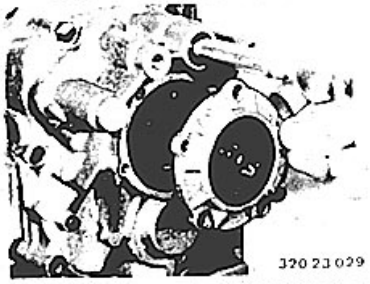


23 11 040 REMOVING AND INSTALLING/ SEALING TRANSMISSION CASE REAR SECTION

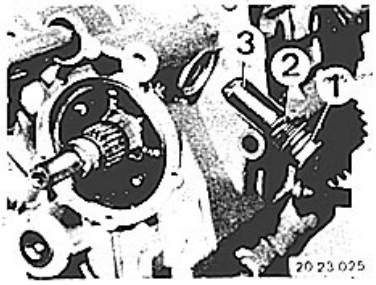
Remove transmission case front section * 23 11 005.
Lift off lockplate.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Unscrew nut with Special Tool 23 1 210.
Installation:
Tightening torque*.
Install collar nut with bolt cement**.



Pull off output flange with Special Tool 33 1 150.

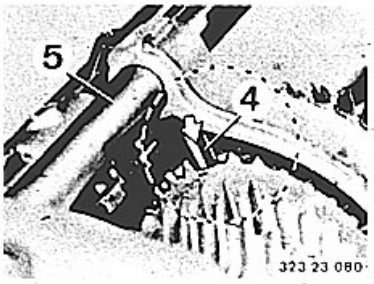


Take off cover.
Important!
Shims.
Installation:
Replace gasket.



Unscrew plug (1).
Pull out spring (2) and lockpin (3).
Installation:
Coat bearing surface of plug (1) with a surface sealant**.

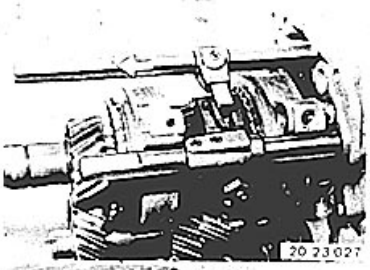
* See Specifications
** Source: HWB



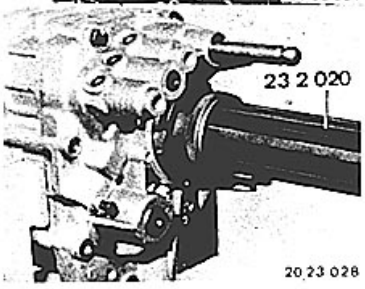
Engage 4th gear.
Turn input shaft until opening in 4th gear aligns with pin.
Drive out pin (4) downward in this position, until selector rod (5) can be pulled out (loose balls).
Important!
Drive pin between tooth flanks of operating sleeve.
Installation:
Replace pin.



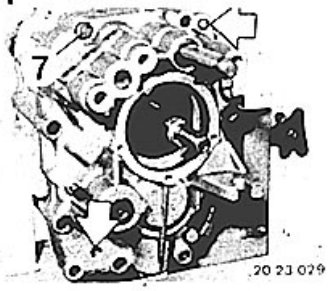
Remove lockwire.
Unscrew bolt (6).
Installation:
Lock bolt with wire.
Pull out 2nd/3rd gear selector rod.



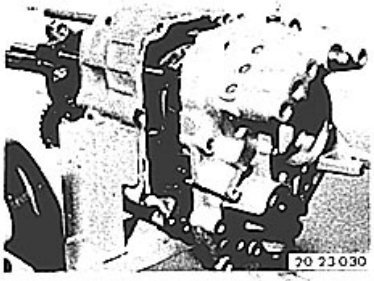
Pull out selector shaft forward as far as possible.



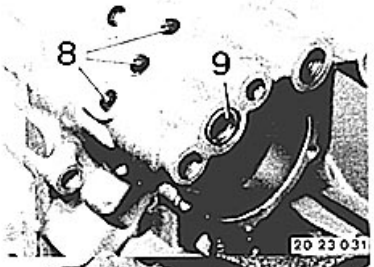
Pull out grooved ball bearing with Special Tool 23 2 020 and the long spindle of Special Tool 23 2 060.



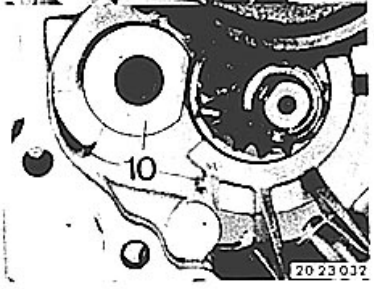
Drive out dowel pins.
Unscrew bolt (7).



Pull off case rear section.
Important!
Spacer between double gear wheel and intermediate case.



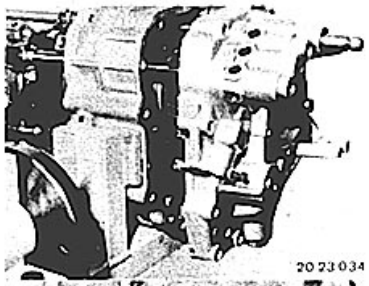
Unscrew backup light switch.
Remove plugs (8 and 9).
Installation:
Replace plugs.



Hold spacer (10) in position with grease.
Check installed position.



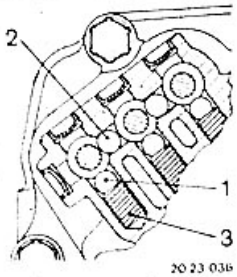
Install needle bearing (1), spacer (2), needle bearing (3) and double gear wheel (4) on shaft.



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.

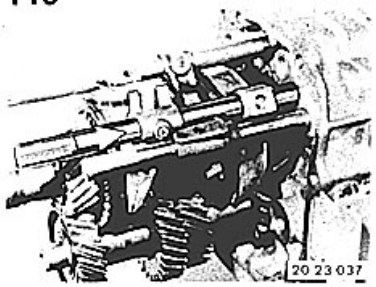


Insert locking balls and press down.
Slide on and bolt rear case section in this position.



Arrangement of Detent and Locking Balls:
1 Locking ball
2 Detent ball
3 Spring

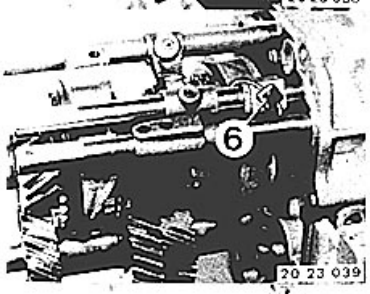
* Source: HWB



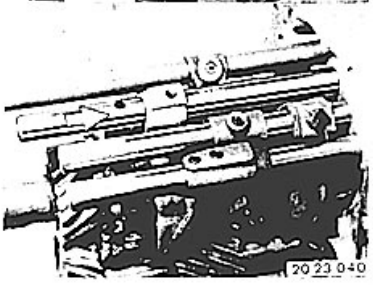
Slide 2nd/3rd gear selector rod into rear case section up to spring.



Insert locking balls.
Insert detent balls and press down.
In this position push selector rod through up to lock.



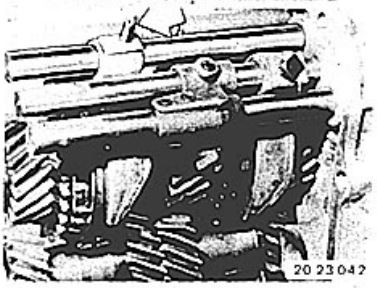
Mount 2nd/3rd gear selector fork with bolt (6) and lock bolt with wire.



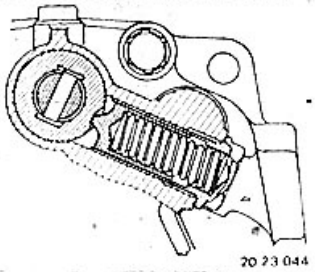
Slide in 4th/5th gear selector rod up to spring on rear case section.



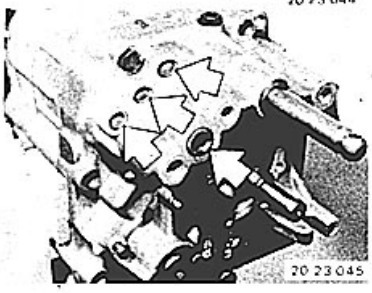
Insert detent balls.
Insert locking balls and press down.
Push 4th/5th gear selector rod through up to lock in this position.



Mount 4th/5th gear selector fork with a 6 x 24 mm pin.

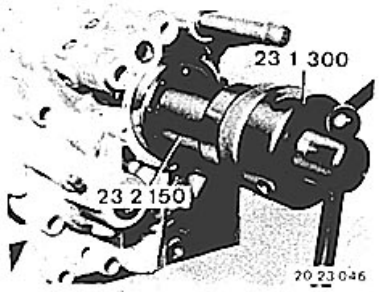


Install lockpin.
Check installed position.
Coat bearing surface of plug with a surface sealant**.
Tightening torque*.

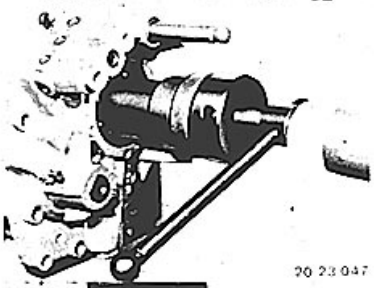


Install all plugs and backup light switch.

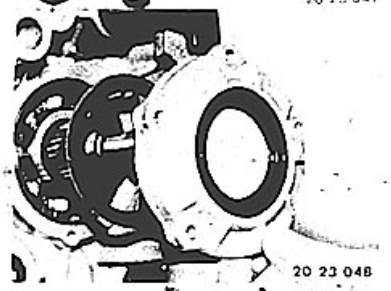
* See Specifications
** Source: HWB



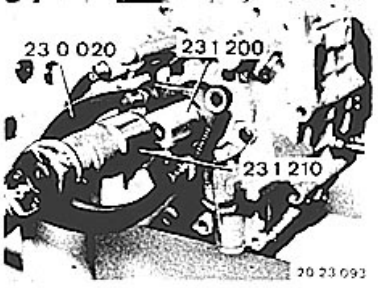
Install and pull grooved ball bearing into rear case section with Special Tools 23 1 300 and 23 2 150.



Drive in grooved ball bearing to fit tight by applying light knocks.

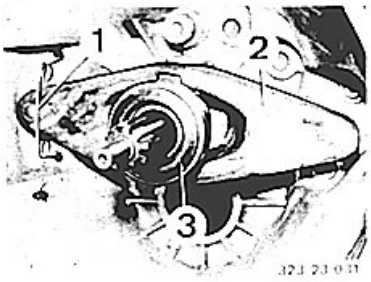


Install gasket.
Insert spacer and mount cover.
Tightening torque*.



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.

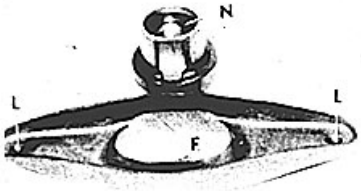
* See Specifications
** Source: HWB



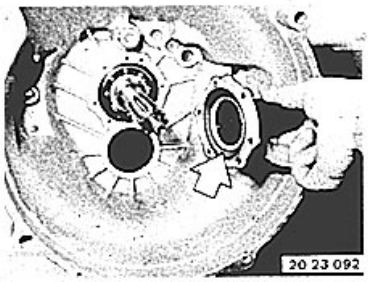
323 23 031

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).



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.



20 23 092

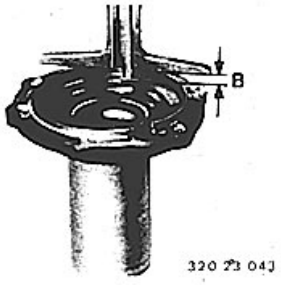
Detach guide sleeve.
Important!
Spacer.
Installation:
Install guide sleeve with surface sealant**.
Sealing surface must be cleaned thoroughly and dried of oil.
Tightening torque*.



320 23 042

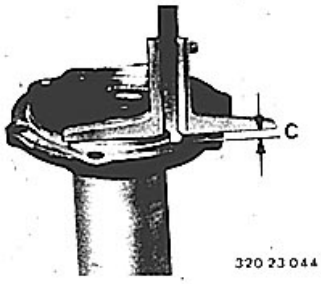
Installation:
If applicable, correct play to 0 ... 0.09 mm (0 ... 0.0035") with a shim.
Determine thickness of shim (spacer).
Measure distance (A) from bearing outer race to case sealing surface.

* See Specifications
** Source: HWB



320 23 043

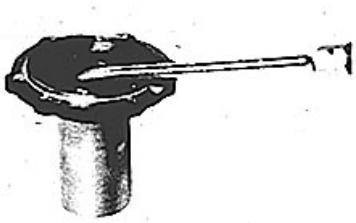
Measure distance (B) from guide sleeve protrusion to inside surface.



320 23 044

Measure distance (C) from guide sleeve protrusion to outside surface.
Example:

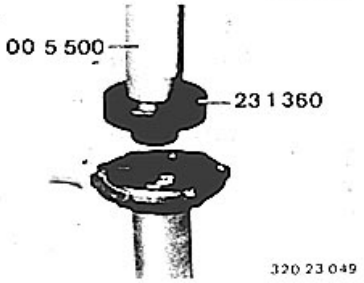
	B	4.0 mm (0.157")
+	A	0.3 mm (0.012")
		4.3 mm (0.169")
–	C	2.8 mm (0.110")
		1.5 mm (0.059") spacer thickness



320 23 048

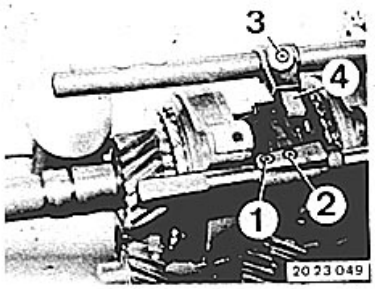
23 12 502 REPLACING RADIAL OIL SEAL FOR INPUT SHAFT –TRANSMISSION REMOVED–

Remove guide sleeve 23 11 622.
Lift out radial oil seal.



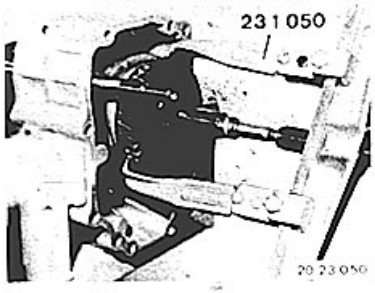
320 23 049

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.

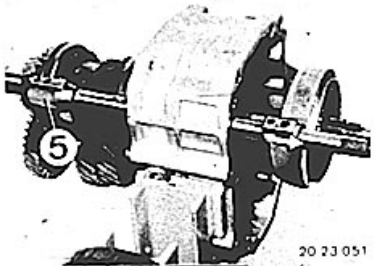


23 21 501 REMOVING AND INSTALLING INPUT AND OUTPUT SHAFT ASSEMBLY – FRONT AND REAR CASE SECTIONS REMOVED

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.



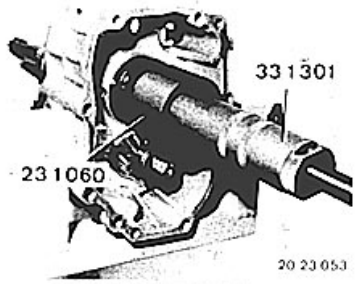
Pull spacer, reverse gear and bearing sleeve off of output shaft with Special Tool 23 1 050.



Take off dog (5).
Pull out selector rod with selector fork and guide sleeve toward rear.



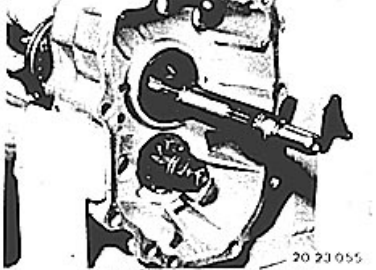
Remove synchromesh ring and 1st gear with needle bearing.



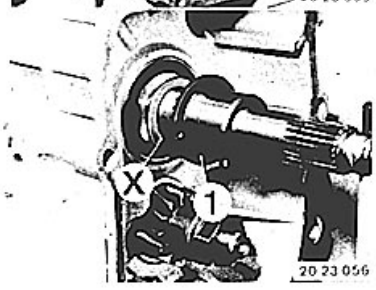
Pull bearing sleeve off of output shaft with Special Tools 23 1 060 and 33 1 301.
Important!
Shim (X).



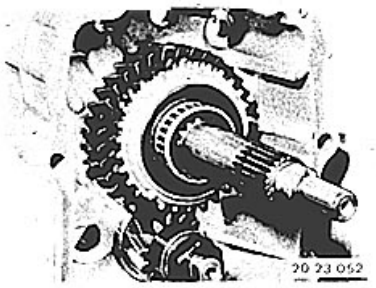
Heat intermediate case in area of layshaft bearing to approx. 80° C (175° F) with a hot air blower.
Pull input shaft/output shaft and layshaft out of intermediate case.
Installation:
Check condition of all bearings, replacing if necessary (see 23 21 703).



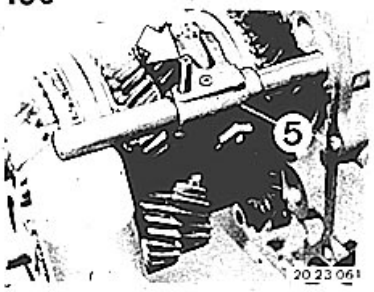
Installation:
Heat intermediate case in area of layshaft bearing to approx. 80° C (175° F) with a hot air blower.
Install input shaft/output shaft and layshaft.



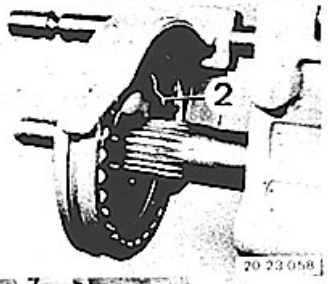
Install shim (X) on output shaft.
Heat bearing sleeve (1) to approx. 80° C (175° F) with a hot air blower and install on output shaft.



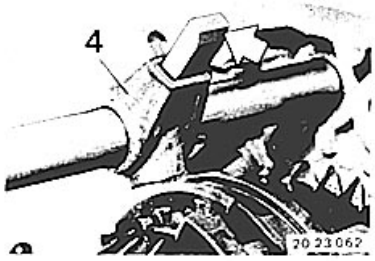
Install needle bearing, 1st gear and synchromesh ring on output shaft.



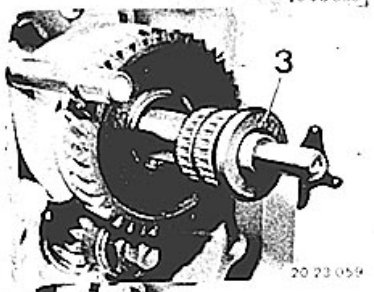
Slide on dog (5) and secure with 6 x 26 mm pins (counterhold).
Install 2nd/3rd and 4th/5th gear selector forks.



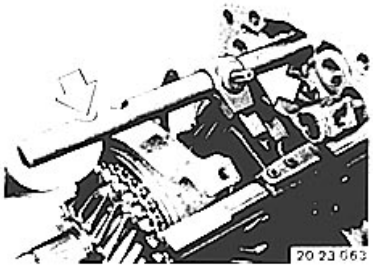
Insert 1st/reverse gear selector rod with selector fork in intermediate case.
Run guide sleeve into selector fork that synchromesh spring (2) faces 1st gear.



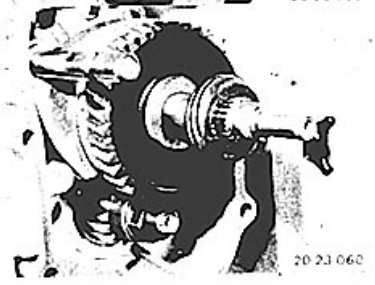
Push in selector shaft.
Slide selector arm (4) on to selector shaft in such a manner that bevel on arm faces dog.



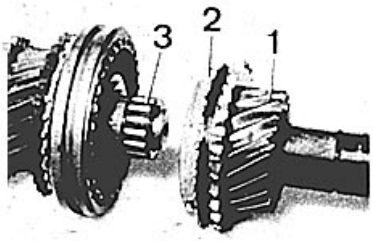
Slide guide sleeve on to spline of output shaft.
Important!
Guide tabs on 1st gear synchromesh ring into guide sleeve.
Install reverse gear and split needle bearing.
Heat bearing sleeve (3) to approx. 80° C (175° F) with a hot air blower and slide on to output shaft.



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.



Install spacer.



20 23 064

23 21 552 REPLACING OUTPUT SHAFT
– Output Shaft Removed –

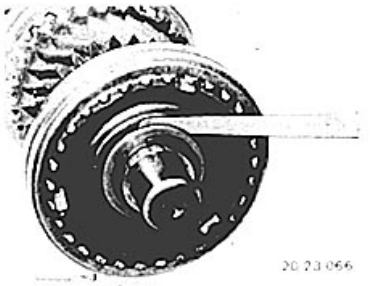
Pull off input shaft (1), synchromesh ring (2) and needle bearing (3).

Note:
To avoid mixing up synchromesh rings while disassembling the output shaft, it is recommended to mark synchromesh rings for pertinent gear wheels.

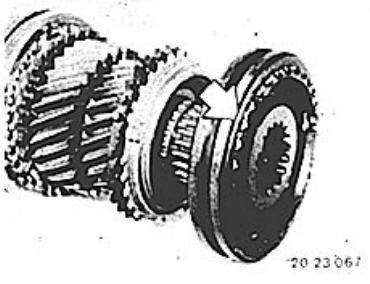


20 23 065

Lift out snap ring (4).
Take off shim (5).

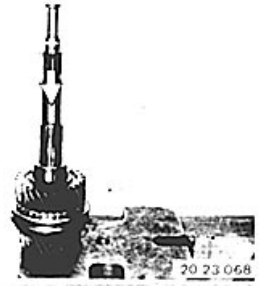

20 23 066

Installation:
Eliminate all play between the snap ring and guide sleeve.
Replace snap ring (4).

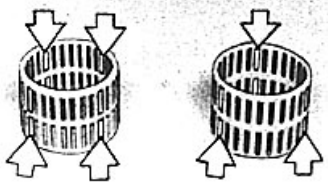

20 23 067

Take off guide sleeve, synchromesh ring, 4th gear wheel and split needle bearing.

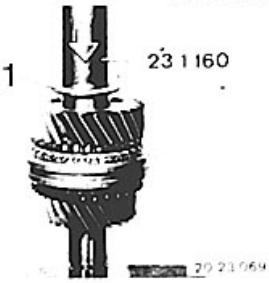
Important! – Installation:
The stepped end of the operating sleeve faces the 5th gear wheel.


20 23 068

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.


320 23 114

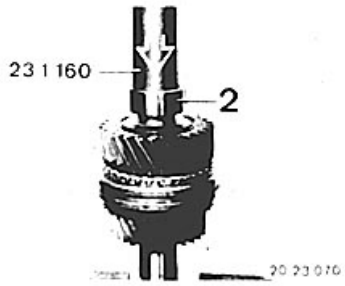
Important!
Split needle bearing:
Slots without needles are provided at angles of 90° and 120° to guarantee uniform bearing of the needles.



20 23 069

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.



20 23 070

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.

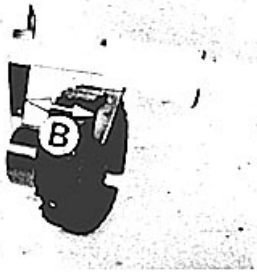


20 23 072

Pull operating sleeve off of 1st/reverse gear guide sleeve.

Installation

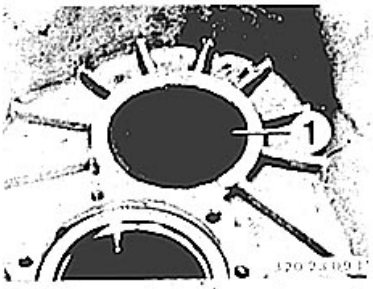
Install operating sleeve that its flat teeth slide over the pressure pieces.



20 23 073

Insert reverse gear bearing sleeve in guide sleeve.
Measure distance (B) from guide sleeve collar to bearing sleeve.
Example:

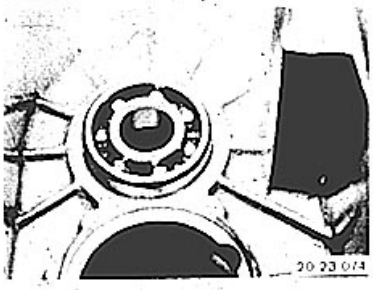
	A	46.8 mm (1.842")
–	B	46,3 mm (1.822")
	X	0,5 mm (0.020")



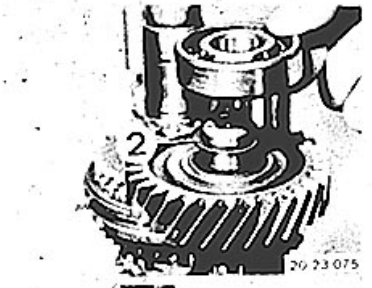
23 21 703 REPLACING BEARINGS OF ALL TRANSMISSION SHAFTS
– Transmission Removed –

A) Input Shaft, Layshaft in Front Case Section:

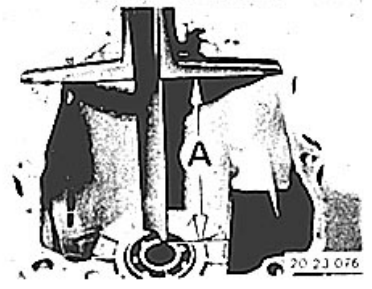
Remove transmission case – see 23 11 005.
Remove end plug (1).
Installation:
Replace end plug and install with sealing compound**.
Remove grooved ball bearing.



Heat transmission case in area of bearing to about 80° C (175° F) with a hot air blower.
Install grooved ball bearing.

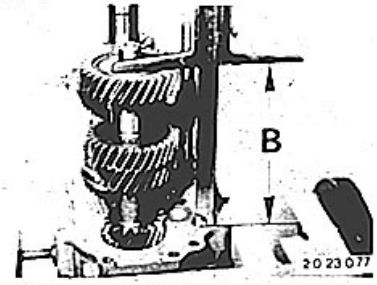


Adjust axial play of layshaft.
Determine thickness of spacer (2) between bearing and layshaft.



Measure distance (A) from case sealing surface to grooved ball bearing.

** Source: HWB

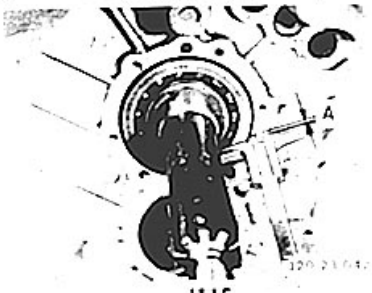


Measure distance (B) from layshaft to sealing surface.
Example:

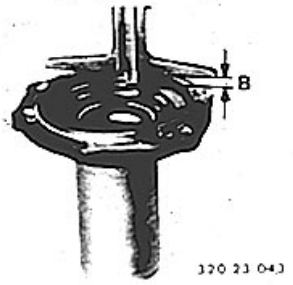
A	155.8 mm (6.134")
– B	155.3 mm (6.114")
	0.5 mm (0.020")
–	0.1 ... 0.2 mm (0.004...0.008") axial pl.
	0.3 ... 0.4 mm (0.012...0.016") spacer



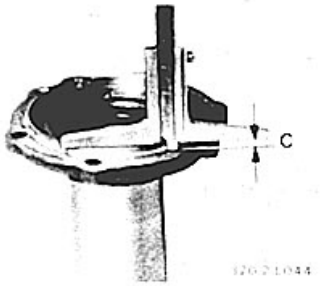
Install front case section.
Adjust play between circlip and bearing inner race to 0 ... 0.09 mm (0 ... 0.0035") with shims.



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.



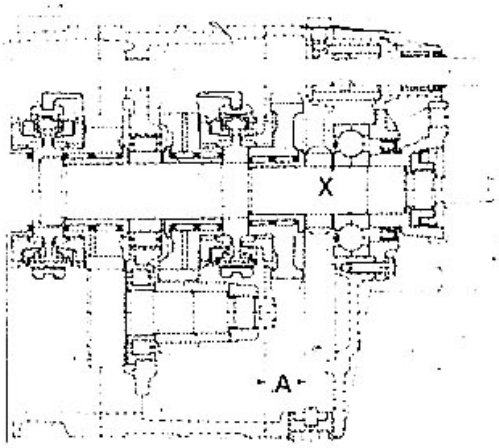
Measure distance (B) from guide sleeve protrusion to inside surface.

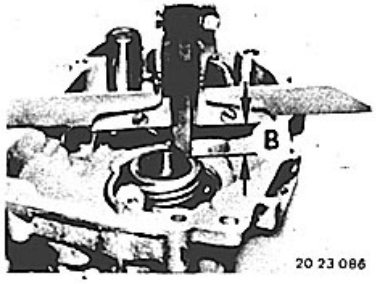


Measure distance (C) from guide sleeve protrusion to outside surface.
Example:

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

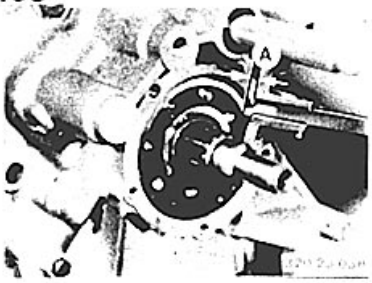
B) Output Shaft in Rear Case Section:
Remove rear case section 23 11 040.
Press in grooved ball bearing to fit tight in rear case section. Check distance (A), adjusting with shim X betw. bearing and spacer if necessary.



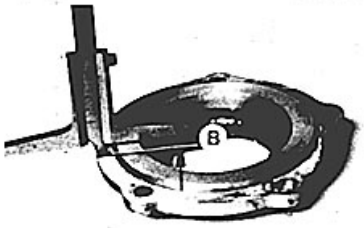


Install spacer on grooved ball bearing.
Measure distance (B) from sealing surface to spacer.
Example:

A	22.0 ± 0.1 mm (0.866 ± 0.004") nominal
– B	21.6 mm (0.850")
	0.4 mm (0.016") spacer

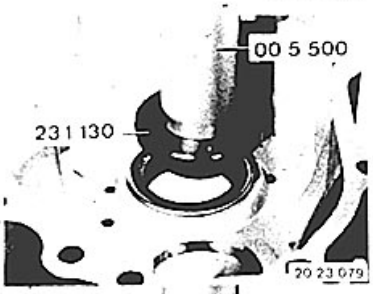


Eliminate play between grooved ball bearing and cover.
Measure distance (A) from case cover to grooved ball bearing.

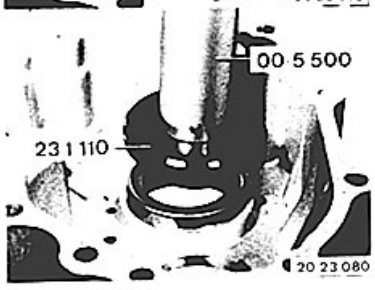


Measure collar height (B), without gasket.
Important!
Use 0.2 mm (0.008") for gasket thickness in calculations.
Example:

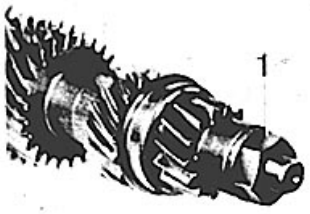
A	3.0 mm (0.118")
– B	2.9 mm (0.114")
	0.1 mm (0.004")
+	0.2 mm (0.008") gasket thickness
	0.3 mm (0.012") shim thickness



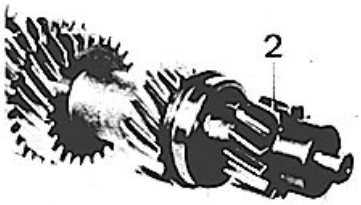
C) Output Shaft, Layshaft in Intermediate Case:
Remove input/output shaft assembly – see 23 21 501.
Drive out roller bearing for output shaft with Special Tools 23 1 130 and 00 5 500.



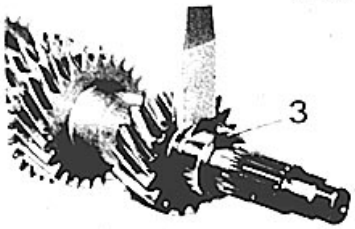
Drive in roller bearing with Special Tools 23 1 110 and 00 5 500.



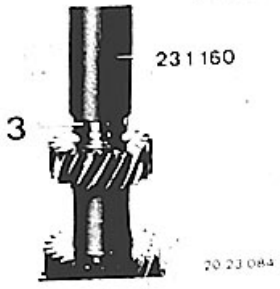
Unscrew collar nut (1).
Installation:
Install collar nut with bolt cement**.
Tightening torque*.



Pull off gear (2).



Take off roller bearing.
Press bearing inner race (3) off of layshaft with, if necessary, Special Tool 00 7 500.



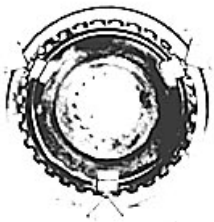
Install bearing inner race (3) with collar facing gear and press on with Special Tool 23 1 160.

* 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.



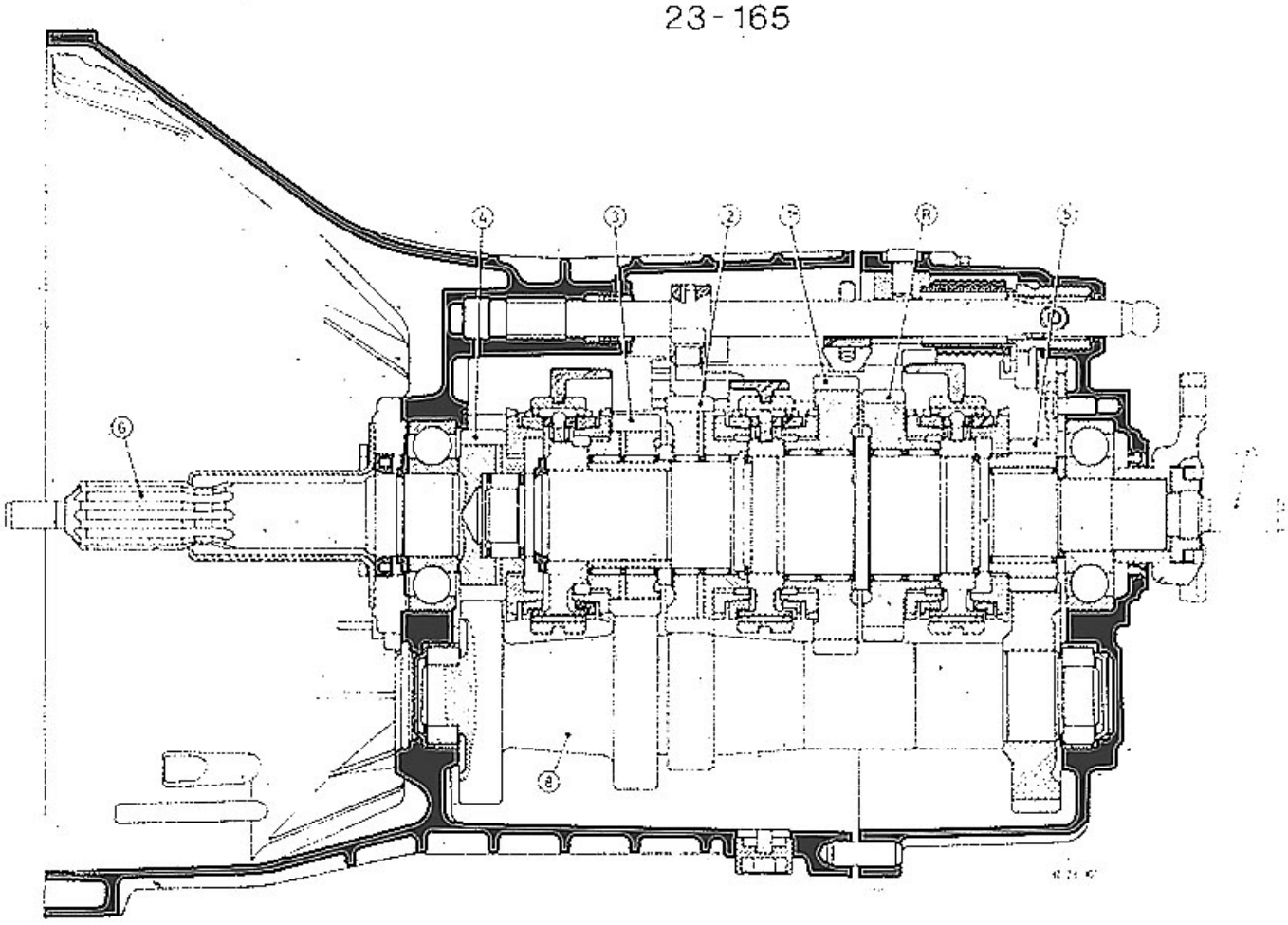
Offset hooks of synchromesh springs in an axial groove to each other.
Engage pressure pieces in synchromesh springs.

* See Specifications

Construction group 23 Manual transmission

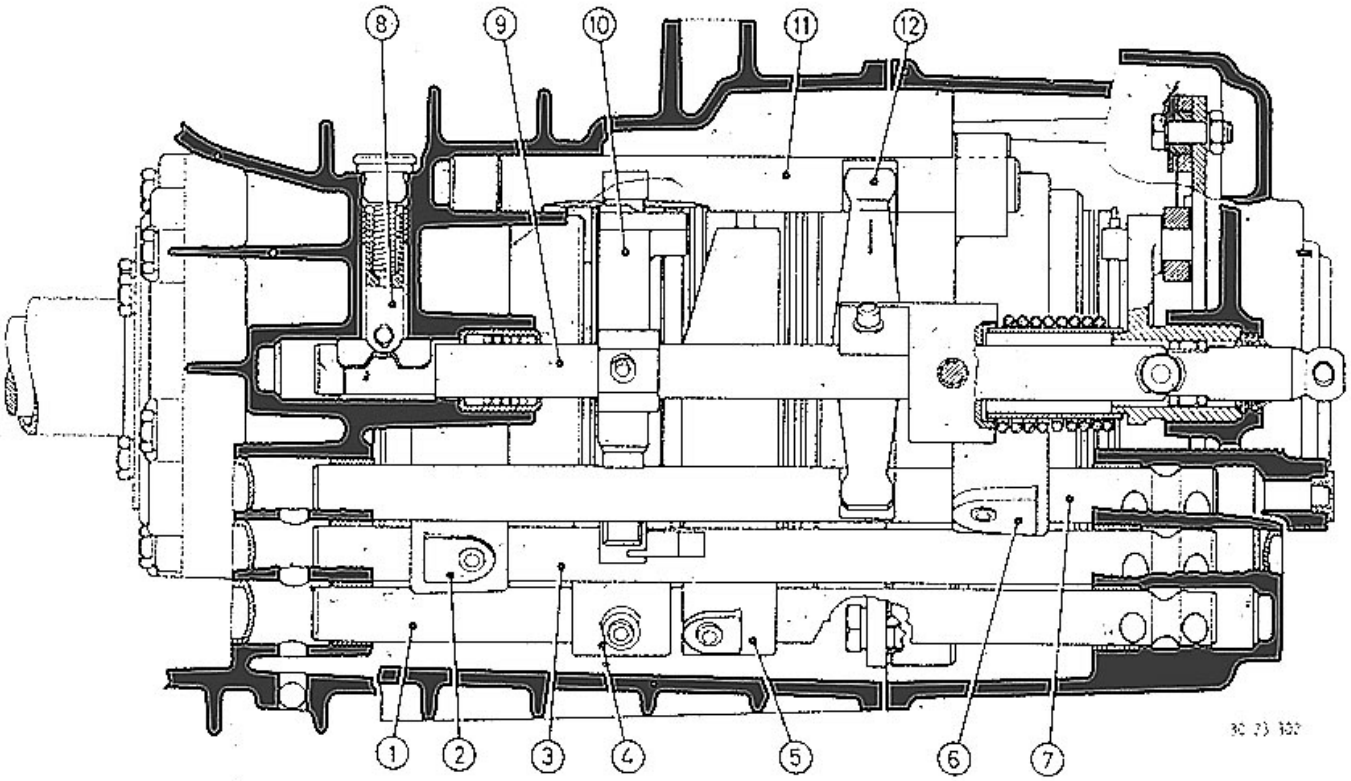
Getrag 260 Five speed overdrive transmission

	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



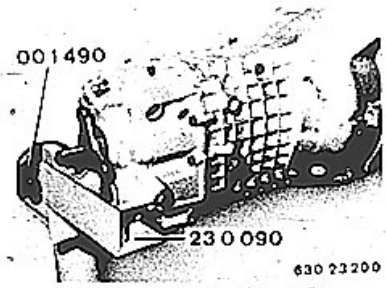
ASSEMBLY DRAWING OF GETRAG 260 FIVE SPEED OVERDRIVE MANUAL TRANSMISSION

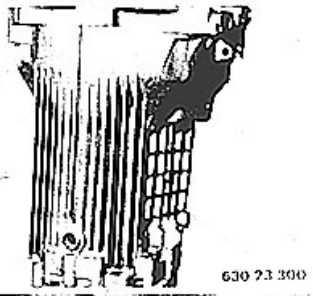
1 First gear
2 Second gear
3 Third gear
4 Fourth gear
5 Fifth gear
6 Reverse gear
6 Input shaft
7 Output shaft
8 Layshaft

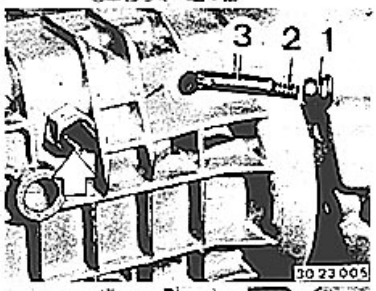


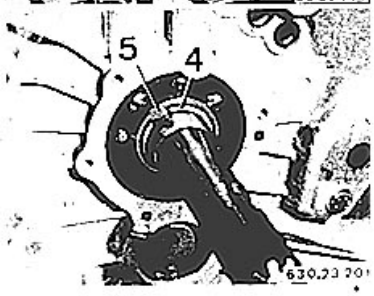
ASSEMBLY DRAWING OF SHIFT MECHANISM FOR GETRAG 260 FIVE SPEED OVERDRIVE MANUAL TRANSMISSION

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

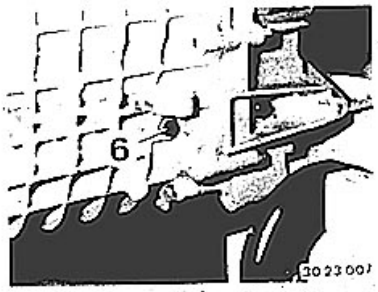
Remove transmission - see 23 00 022 in model repair manual beginning with 1985 models.
Mount Special Tool 23 0 090 on Special Tool 00 1 490.
Mount transmission on special tool.
Drain oil.

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.

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!

Lift out snap ring (4).
Take off washer (5).

Installation:
Always replace the snap ring.



Unscrew bolt (6).

Installation:
Install bolt with a bolt cement**.
Tightening torque*.

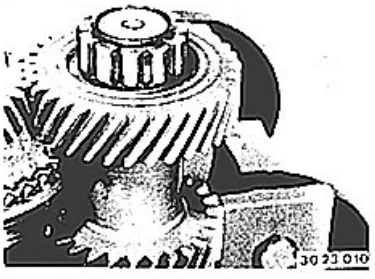


Drive out cylindrical pin.
Unscrew bolts.

Installation:
Check length of bolts.
Bolt (1) = 8 x 60 mm.



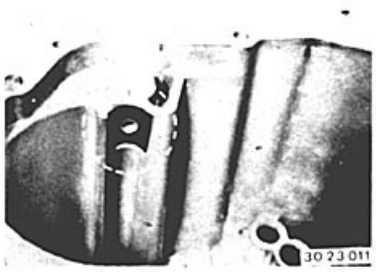
Pull off front case section with Special Tools 23 1 460 and 33 1 301.



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.

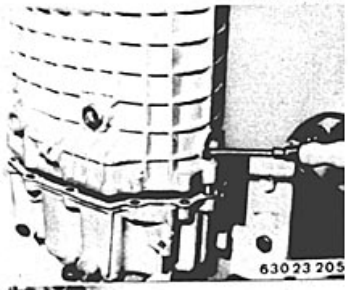
* See Specifications
** Source of Supply: HWB



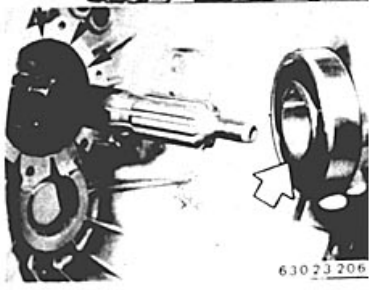
Coat front case section in area of the reverse gear shaft with a surface sealing compound**.
Surface must be cleaned thoroughly and dried of oil.



Remove grooved ball bearing for input shaft.
Important! - Installation:
Inner race of the grooved ball bearing protrudes.
Install with protrusion face the gear set.

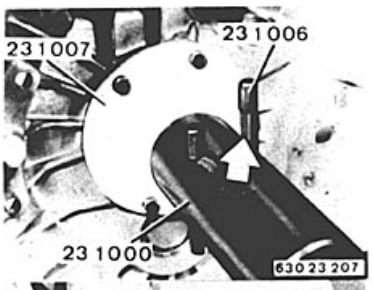


Unscrew oil drain plug.
Coat sealing surface with surface sealing compound**.
Sealing surface must be cleaned thoroughly and dried of oil.
Mount front case section.
Align intermediate shaft through bore for oil drain plug in such a manner, that roller bearing of intermediate shaft slides into the bearing shell.
Tighten front case section bolts.
Tightening torque*.
Install lockpin and reverse gear switch.

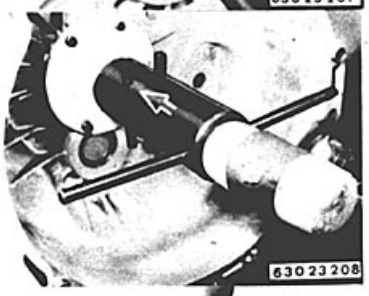


Heat* bearing inner race and front case section in area of grooved ball bearing with a hot air blower.
Push on grooved ball bearing as far as possible.
Protrusion of inner race faces the gear set.

* 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.

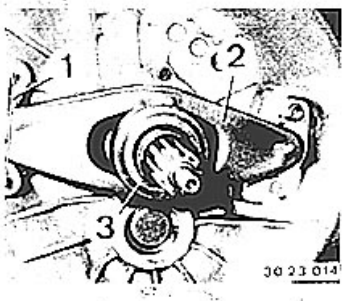


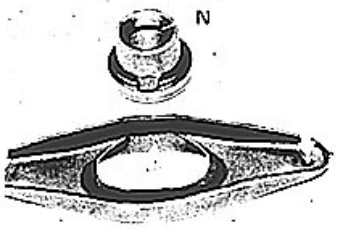
Transmission 260 / 6 or 260 Sport:
The front case section cannot be pressed on due to the uniform thickness of the input shaft.
Double bearing is installed in the front case section.
Heat bearing inner race to about 80° C (175° F) with a hot air blower.
Caution!
Protect plastic cage against heat.
Mount front case section, whereby the input shaft must be pulled out.
Tighten front case section bolts.
Tightening torque*.

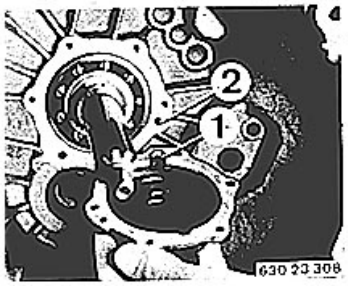


Install shim and circlip.
Reduce any possible play between the bearing inner race and circlip to 0 ... 0.09 mm (0 to 0.0035").

* 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.

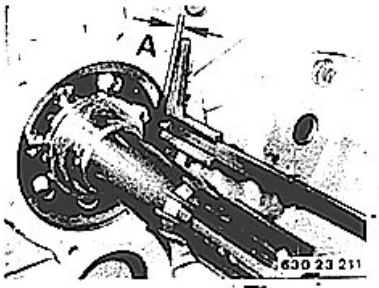
Important!
Use Microlube 261** for version with a double-mass flywheel.

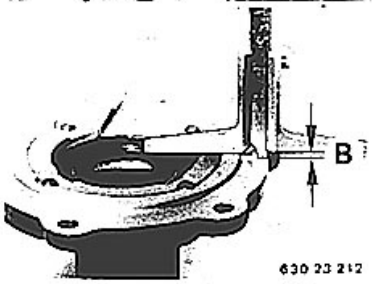
Unscrew guide sleeve.

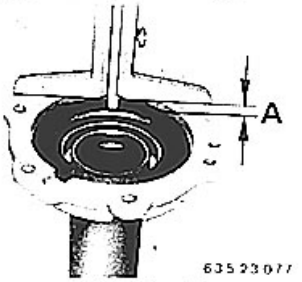
Important!
Spacer.

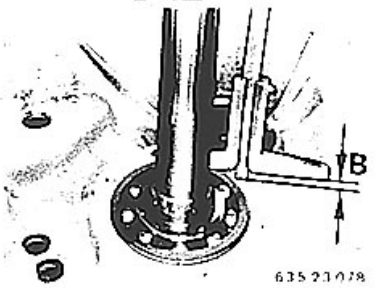
Installation:
Mount guide sleeve that oil groove (1) is aligned with oil bore (2) in transmission case, or "up/down" marks on guide sleeve are aligned and arrow on face points to middle of layshaft.
Install guide sleeve and bolts with a sealant**.
Sealing surface and bolts must be cleaned thoroughly 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:

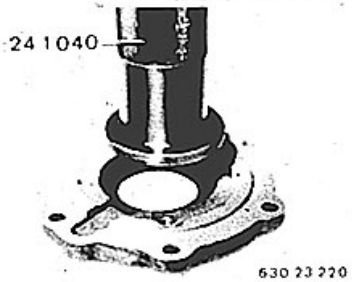
A	3.0 mm (0.118")
– B	2.6 mm (0.102")
Spacer	0.4 mm (0.016")



630 23 219

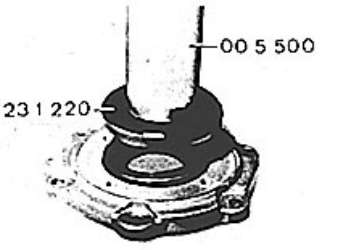
23 12 503 REPLACING RADIAL OIL SEAL FOR INPUT SHAFT
- Transmission Removed -

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.



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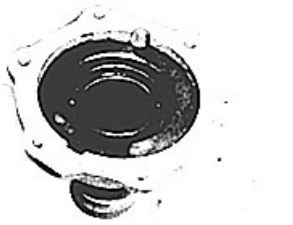
Drive in radial oil seal with Special Tools 23 1 220 and 00 5 500.
Lubricate sealing lip of radial oil seal with oil.



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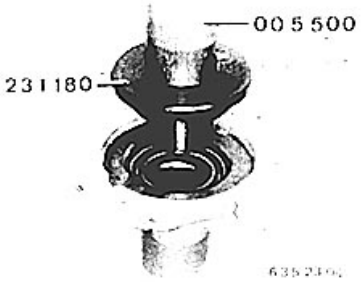
Transmission 260 / 6 or 260 Sport:
Lift out radial oil seal.



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

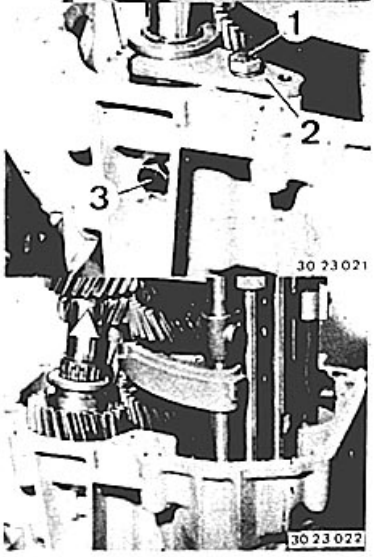


23 21 503 REMOVING AND INSTALLING INPUT AND OUTPUT SHAFT ASSEMBLY
– Transmission Removed –

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.

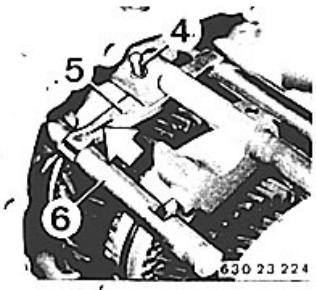


Pull off output flange with Special Tool 23 1 150.

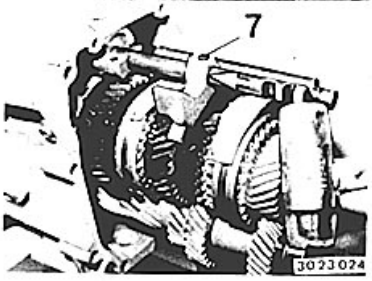


Unscrew bolt (1).
Remove holder (2).
Unscrew bolt (3).

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.

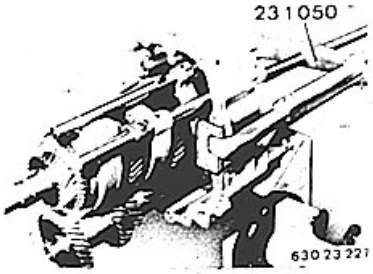


Detach end plate.
Installation:
Install end plate with sealing compound**.
Sealing surface must be cleaned thoroughly and dried of oil.
Remove end plate (9).
Installation:
Replace end plate.

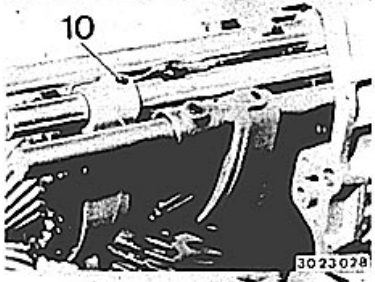
** Source: HWB



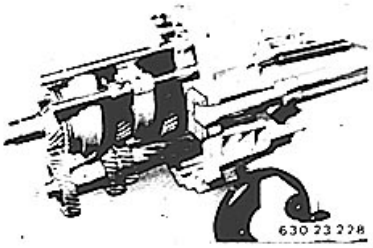
Remove 3 springs and 3 balls.
Note:
Springs differ in length (see installation).



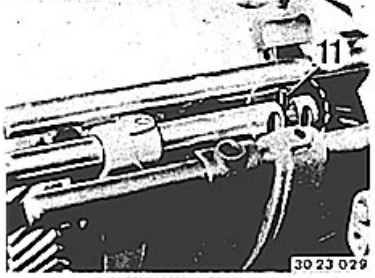
Press input shaft, output shaft and layshaft out of case rear section with Special Tool 23 1 050.
Important!
To avoid damage on sealing surface, use a piece of wood, aluminum or similar material between claws and sealing surface.



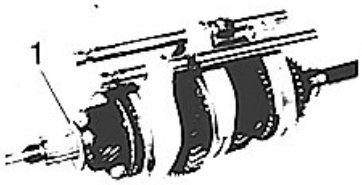
Drive out pin (10) in 3rd/4th gear selector fork.
Installation:
Replace pin.



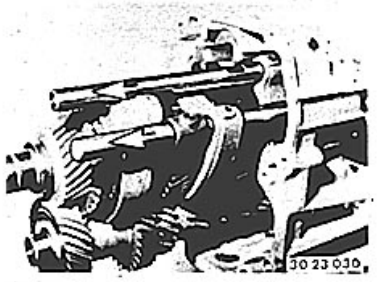
Important!
Be careful not to clamp selector rods and layshaft while pressing out parts.
Layshaft must not tilt off in this step.
Installation:
Check condition of all bearings, replacing if necessary.



Knock out 3rd/4th gear selector fork forward.
Important!
Lockpin (11) in selector fork.



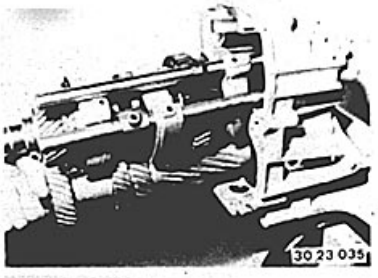
Installing:
Install 3rd/4th gear selector fork and 1st/2nd as well as 5th/reverse gear selector rods with selector forks.
Check thrust washer (1) (only for 260/5).



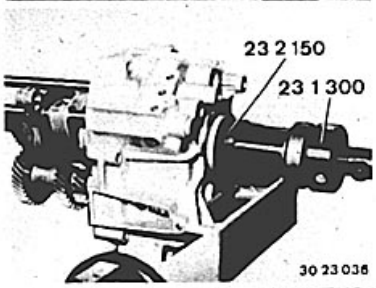
Engage 2nd and reverse gears by pushing 1st/2nd and 5th/reverse gear selector rods forward.



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.

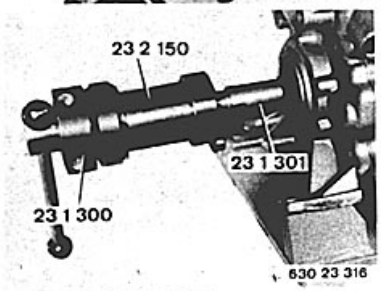


Heat grooved ball bearing inner race in rear case section to about 80° C (175° F) with a hot air blower.
2nd and reverse gears are engaged.
Install input shaft, output shaft and layshaft in rear case section.
Align shift rods.

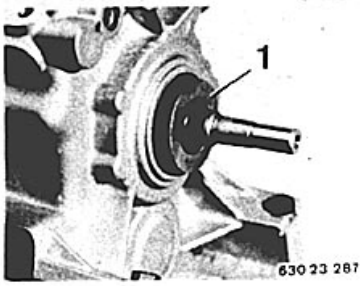


Pull input shaft, output shaft and layshaft into rear case section with Special Tools 23 1 300 and 23 2 150.

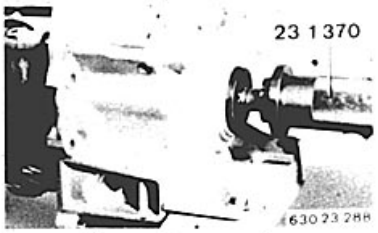
Important!
Make sure shift rods and layshaft are not clamped while pulling in.



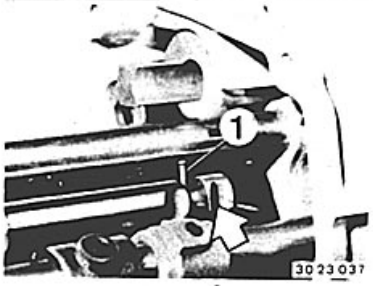
Note:
Screw Special Tool 23 1 301 between both above mentioned special tools for the version with a longer output journal.



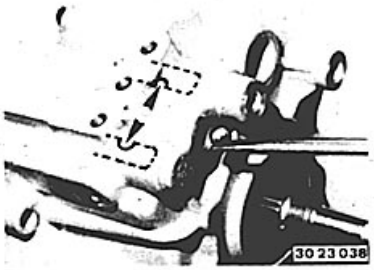
260/6 Transmission:
Install input shaft and output shaft with 3rd/4th gear shift forks and 1st/2nd and 5th/reverse gear shift rods or layshaft in the rear case section.
Heat bearing inner race (1) to about 80° C (175° F) with a hot air blower and slide it on the output shaft, pressing on with Special Tool 23 1 160 if necessary.



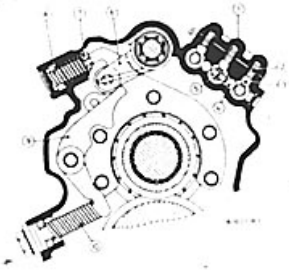
Drive in radial oil seal flush with Special Tool 23 1 370.
Lubricate sealing lip with oil.



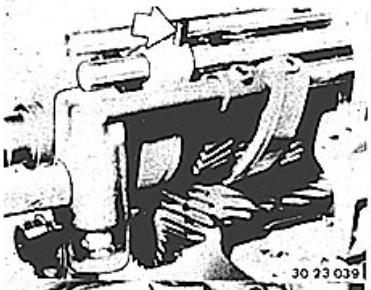
Move shift rods into neutral position.
Push 3rd/4th gear shift rod through the shift forks.
Place lockpin (1) in the shift rod with grease.
Push in shift rod up to the bore.
Opening on shift rod faces up.



Insert two locking balls with grease.
Push in 3rd/4th gear shift rod up to the arrest.



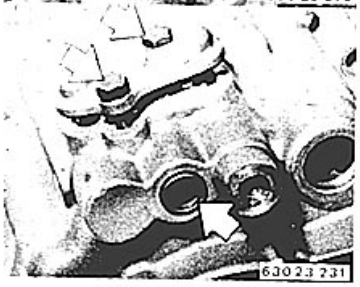
Arrest Assembly:
1 Cap
2 Spring
3 Dentent ball
4 Locking ball
5 Lockpin
6 Selector arm
7 Lockpin
8 Spring
9 Locking lever
10 Spring



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.

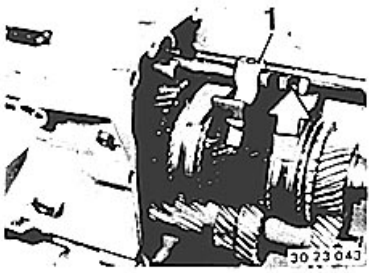


Install end cap after coating with sealing compound**.
Install end cover with sealing compound**.

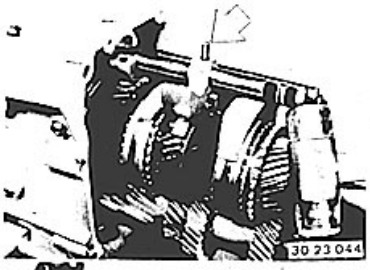


Drive pin out of selector arm.

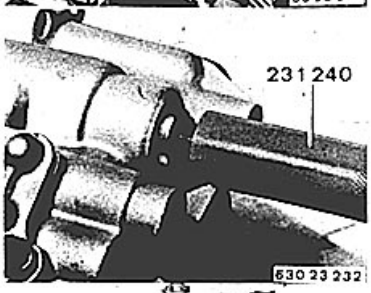
** Source: HWB



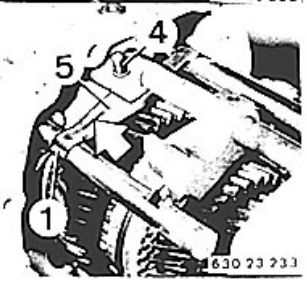
Hold 4 rollers in position with grease.
Slide in selector shaft and install selector arm (1) at same time.
Important!
Opening in selector shaft faces out.



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.



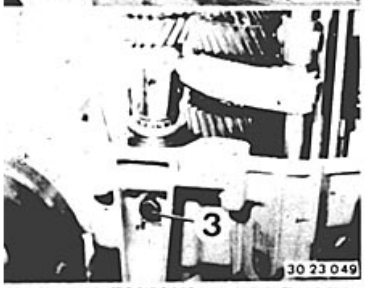
Install selector rail.
Groove (1) in selector rail faces up.
Install operating lever (5) with notch facing up and toward selector rail.
Install pin (4).



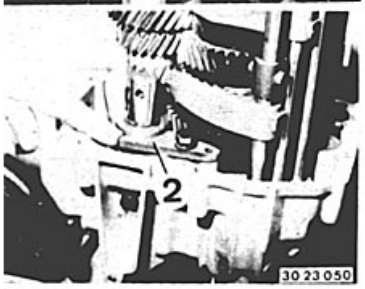
Coat case rear section in area of reverse gear shaft with sealing compound**.
Surface must be cleaned thoroughly and dried of oil.



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

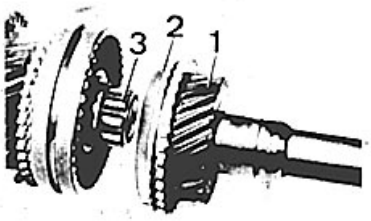


Install output flange.
Install collar nut with a bolt cement**.
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Tighten collar nut with Special Tool 23 1 210.
Tightening torque*.
Version with Integrated Vibration Damper:
Hold output flange with Special Tool 23 1 320.



Install lockplate.

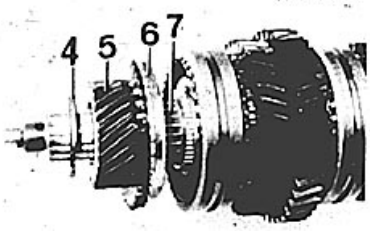
* See Specifications
** Source: HWB



630 23 236

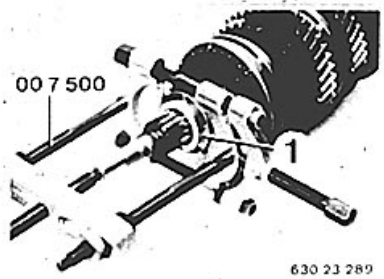
23 21 554 REPLACING OUTPUT SHAFT
– Output Shaft Removed –

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 synchromesh rings and corresponding gear wheels when disassembling the output shaft.



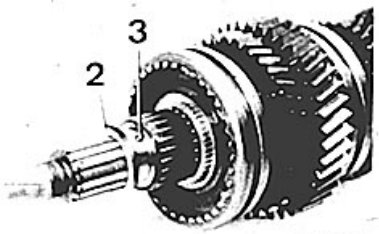
630 23 237

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.



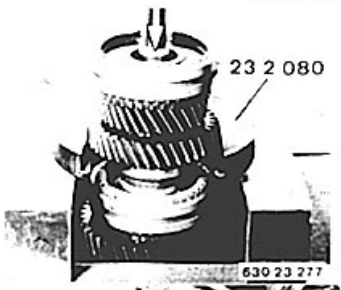
630 23 238

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

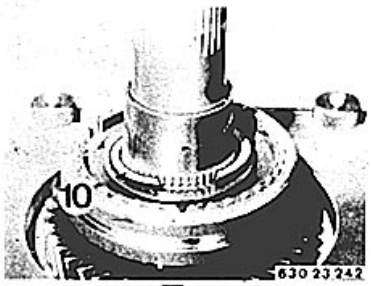
Press 2nd gear, bearing sleeve, 3rd gear, synchromesh ring and guiding sleeve with sliding sleeve off of output shaft with Special Tool 23 2 080.
Pressing off force*.



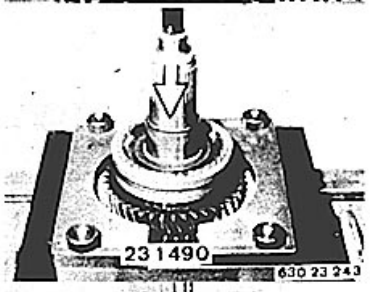
630 23 291

Transmissions 260/6 and 260/5**:
Note thrust washer (2) and ball (3) between 2nd and 3rd gear wheels.

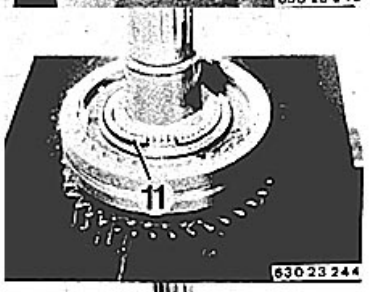
* See Specifications
** Since 7.85



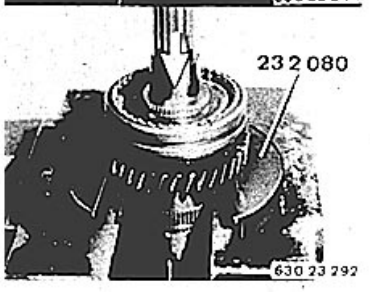
Important!
Circlip (10) must be removed before pressing off the first gear wheel.
Installation:
Always replace circlip.



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*.

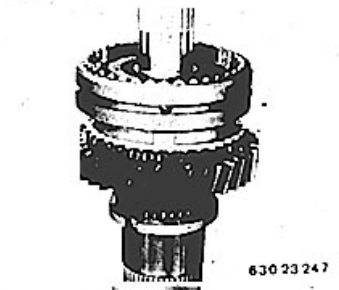


Important!
Circlip (11) must be removed before pressing off the reverse gear wheel.
Installation:
Always replace circlip.s

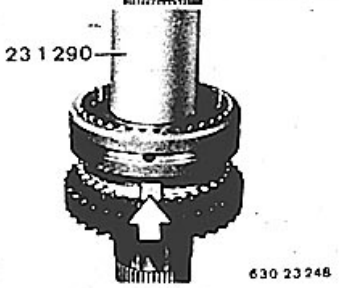


Press off guide as well as operating sleeve and reverse gear wheel with Special Tool 23 2 080, with the bottom end facing the gear wheel.
Take off needle bearing.
Pressing-off force*.

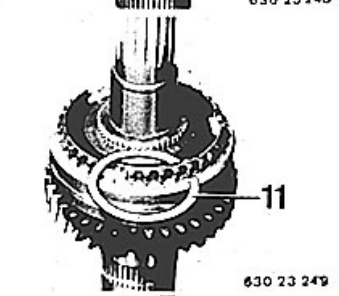
* See Specifications



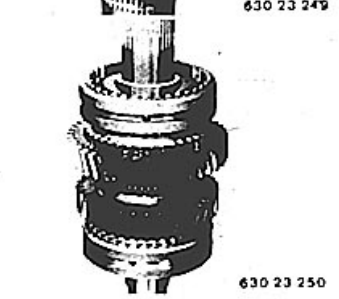
Assembling:
Note:
Check wear of synchromesh rings before assembling (see 23 23 505).
Install needle bearing, reverse gear wheel and synchromesh ring.
Slide guide and operating sleeve on splines of the output shaft.
Transmission 260/6 and 260/5** or 260 Sport:
Shouldered end of operating sleeve faces 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.

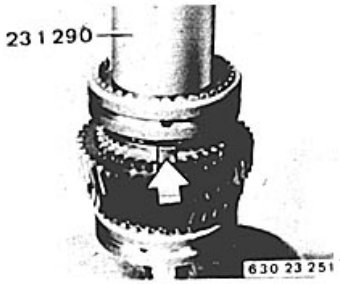


Move operating sleeve in direction of reverse gear wheel.
Adjust guide sleeve to be without play with circlip (11).
Circlips are available from Parts in different thicknesses between 1.7 and 2.0 mm (0.067 and 0.079").
Install circlip (11).



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



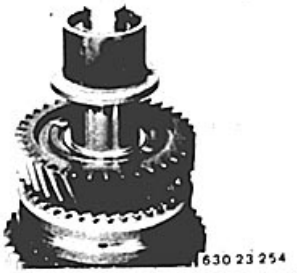
Press on guide sleeve to fit tight with Special Tool 23 1 290.
Pressing-on force*.
Important!
Make sure tabs on synchromesh ring are aligned with openings in the guide sleeve while pressing on.



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).



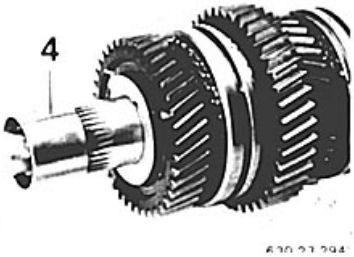
Install needle bearing, synchromesh ring and 2nd gear wheel.
Important!
Collar for bearing sleeve on the output shaft must protrude slightly.
If necessary, check whether circlip (10) seats correctly.



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).



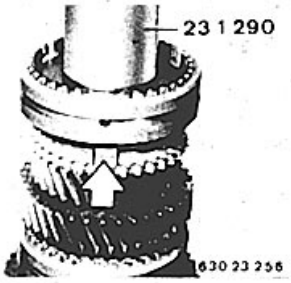
Transmission 260/6 and 260 Sport:
Heat bearing sleeve (4) without collar to about 80° C (175° F) with a hot air blower and install on the output shaft.

** Since 7.85



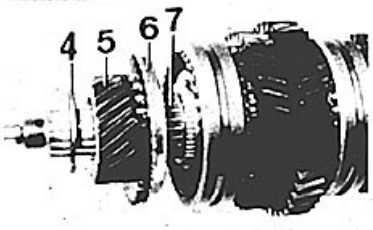
630 23 255

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.



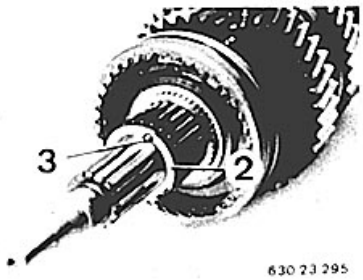
630 23 256

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

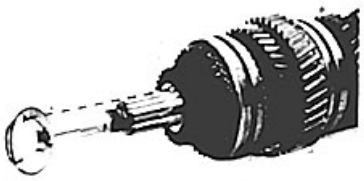
Pull off thrust washer (4), 5th gear wheel (5), synchromesh ring (6) and needle bearing (7).



630 23 295

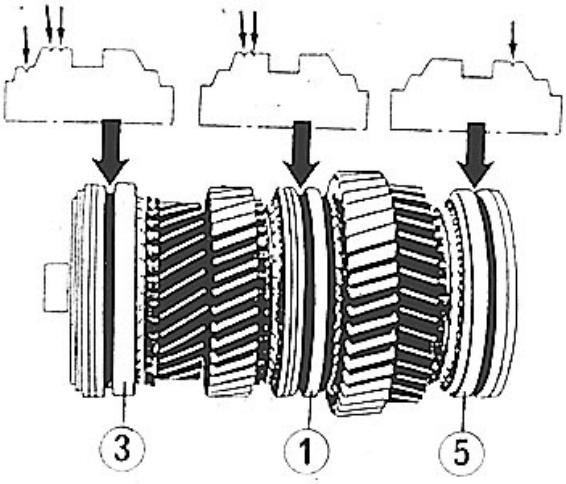
Transmission 260/6:
Slide needle bearing on output shaft.
Insert ball (3).
Install thrust washer (2) with opening facing the ball.
Install synchromesh ring and 5th gear wheel.

* See Specifications

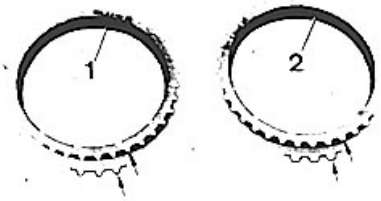


630 23 296

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



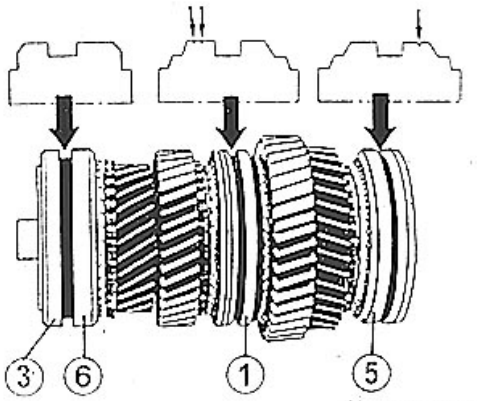
630 23 305

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.

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.

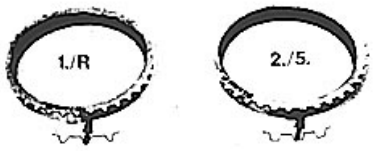
Important!
Modified shift components cannot be used in transmissions manufactured before 5.85 (shifting problems).



630 23 313

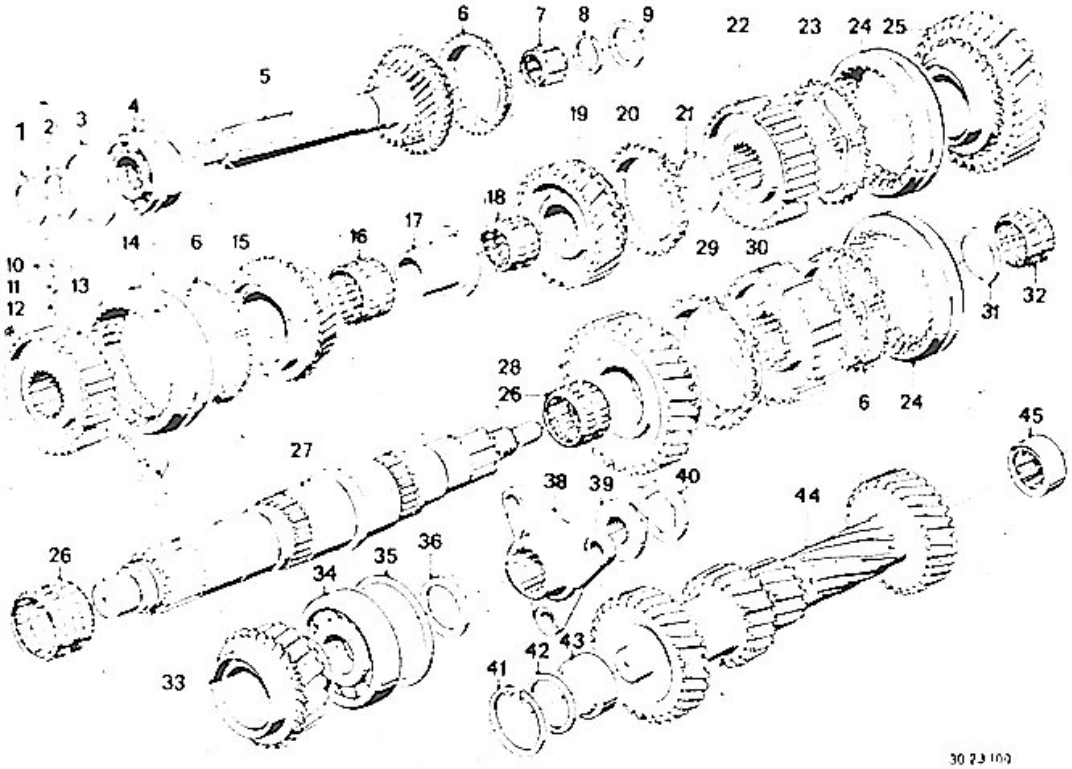
Transmission 260/6:

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.



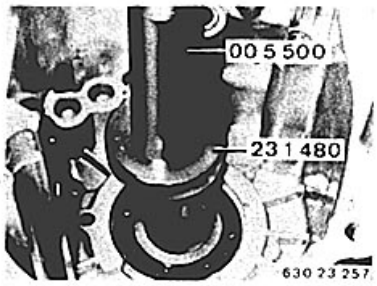
630 23 299

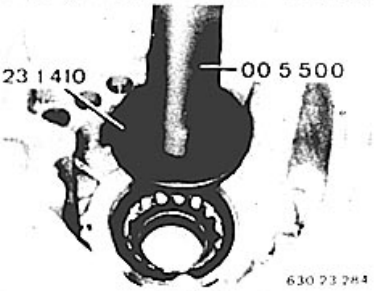
Identification of Synchromesh Rings:
To avoid mixing up synchromesh rings among each other, it is important to note the drawing number and tooth width.
Synchromesh rings for 1st/reverse gears have engraved drawing no. 011.8.0241.10 and narrow teeth.
Synchromesh ring for 2nd gear has engraved drawing 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.

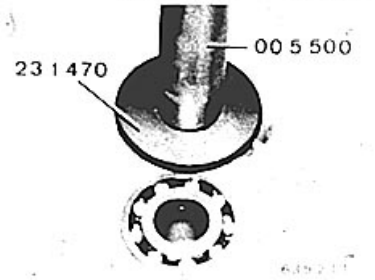


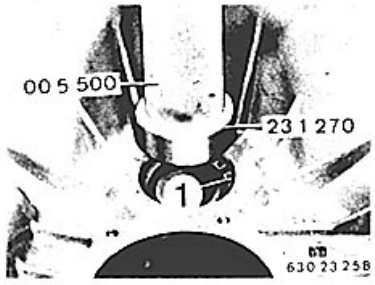
Layout of Gear Set and Bearings

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

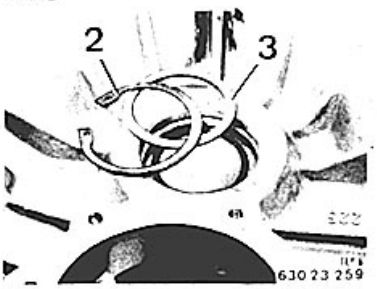
Input Shaft:
Drive out grooved ball bearing with Special Tools 23 1 480 and 00 5 500 – see 23 11 013.

Transmission 260/6:
Drive out double bearing with Special Tools 23 1 410 and 00 5 500.

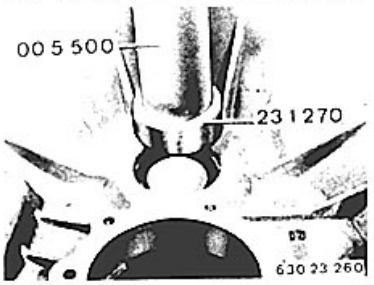
Transmission 260/6:
Heat front case section in area of the bearing to about 80° C (175° F) with a hot air blower.

Important!
Install bearings with rollers for gear wheel set, driving in to fit tight with Special Tools 23 1 470 and 00 5 500.

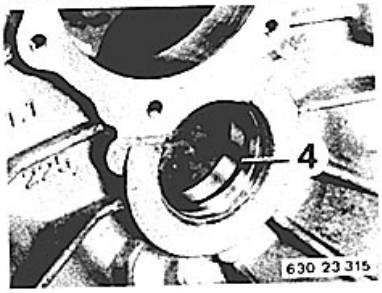
Layshaft:
Loosen circlip (1) with a single knock from Special Tool 23 1 270 used in conjunction with Special Tool 00 5 500.



Lift out circlip (2).
Remove shim (3).

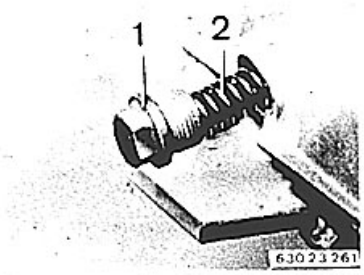


Drive out bearing shell toward inside with Special Tools 23 1 270 and 00 5 500.



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.



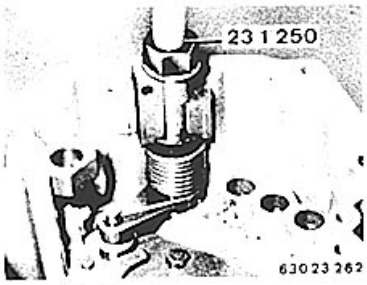
B) Output Shaft, Layshaft in Rear Case Section

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).

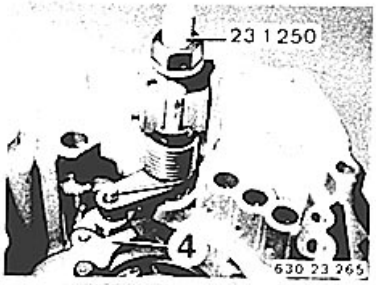
Installation:
Install screw with a bolt cement**.
Tightening torque*.



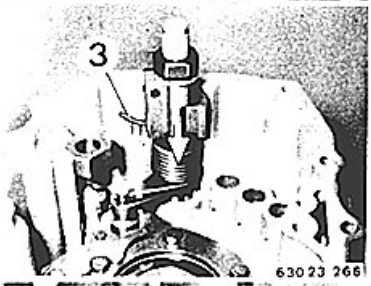
Remove selector arm from above.

Important!
Roller.

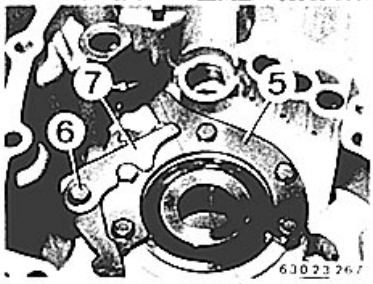
* See Specifications
** Source of Supply: HWB



Installation:
Insert selector arm with Special Tool 23 1 250.
Swing out selector arm with roller over locking lever (4).

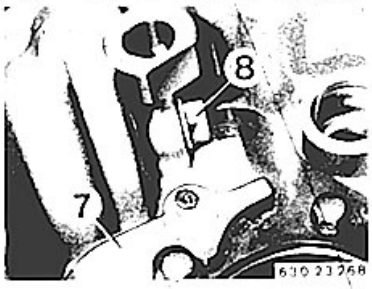


Move end of spring (3) over the raised point into installed position.
Press down on the selector arm in this position (do not knock down).
Install the socket head screw with a bolt cement** and tighten with correct torque* prior to removal of the special tool.



Remove bearing holder (5).

Important!
Do not loosen bolt (6).
Locking lever (7) remains on the bearing holder.



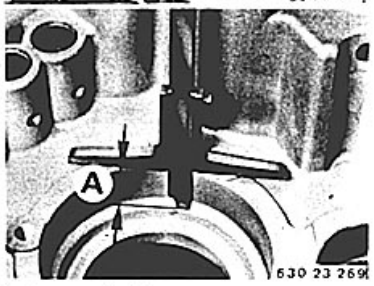
Installation:
Check installed position of locking lever (7) and thrust pin (8).

* See Specifications
** Source of Supply: HWB

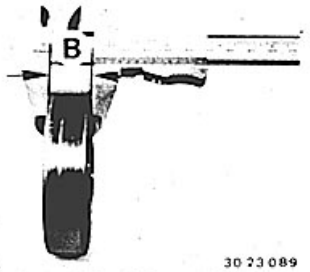


Lift out radial oil seal.
Drive out grooved ball bearing with Special Tools 23 1 120 and 00 5 500.

Important!
Shim X.

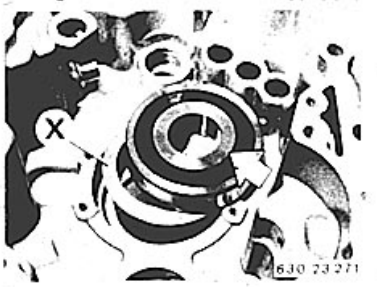


Determine thickness of shim X.
Measure distance (A).



Measure distance (B).

Example:
A = 20.3 mm (0.799")
– B = 20.0 mm (0.787")
X = 0.3 mm (0.012") thick shim

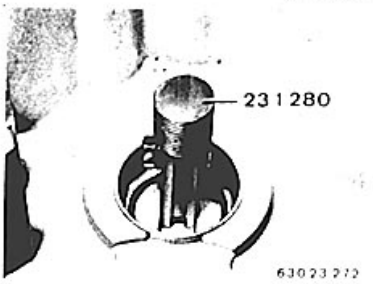


Heat rear case section in area of the grooved ball bearing to about 80° C (175° F) with a hot air blower.
Install shim X.
Install grooved ball bearing.

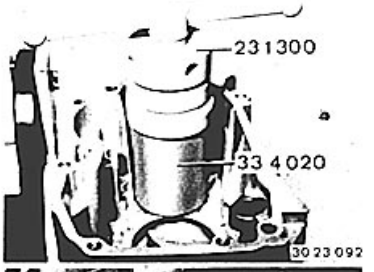
Important!
The grooved ball bearing inner race has a protrusion which faces the gear wheel set.
If necessary, drive in against the stop with Special Tool 23 1 470.



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.



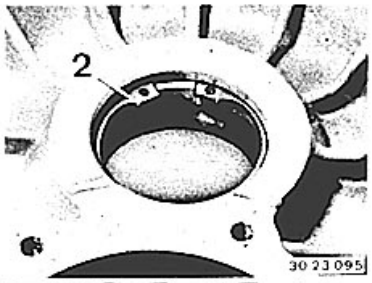
Layshaft:
Insert the stronger end of Special Tool 23 1 280 in the bearing shell.



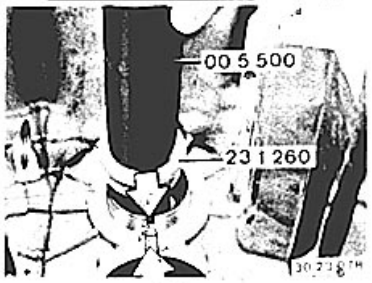
Apply Special Tool 33 4 020.
Screw on Special Tool 23 1 300.
Pull out bearing shell.



Drive in bearing shell with Special Tools 23 1 260 and 00 5 500.

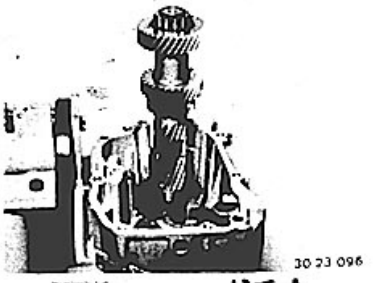


Determining Axial Play of Layshaft:
Install circlip (2).

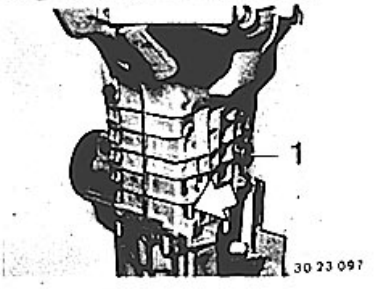


Install old shims.
Drive in bearing shell to fit tight in front case section with Special Tools 23 1 260 and 00 5 500.

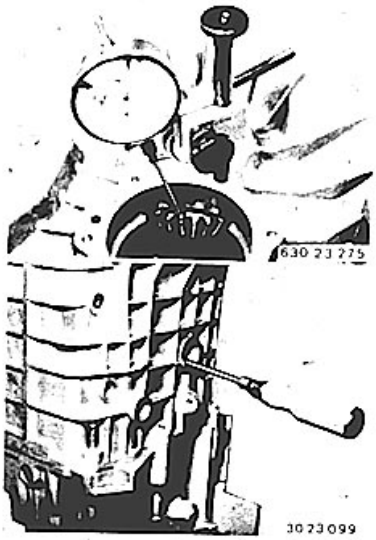
Important!
Oil groove must be aligned with groove in the case.



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).

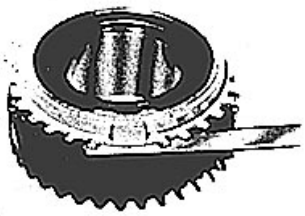


Mount holder with dial gage.
Dial gage must be applied on a tooth of the layshaft.

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.



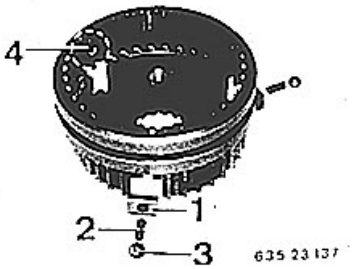
Install gear wheel set.
Determine thickness of shim for input shaft.
Install old shim and circlip.
Reduce play to 0 ... 0.09 mm (0 to 0.0035").
Determine thickness of shim for the guide sleeve – see 23 11 623.



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

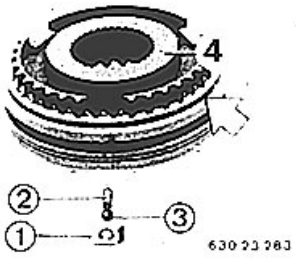
Disassemble synchronization.
Thrust piece (1), spring (2) and ball (3).
Installation:
Bore (4) in operating sleeve must be aligned with ball (3).



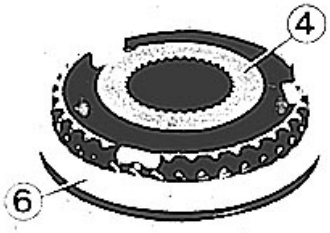
30 23 104

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 23 283



630 23 109

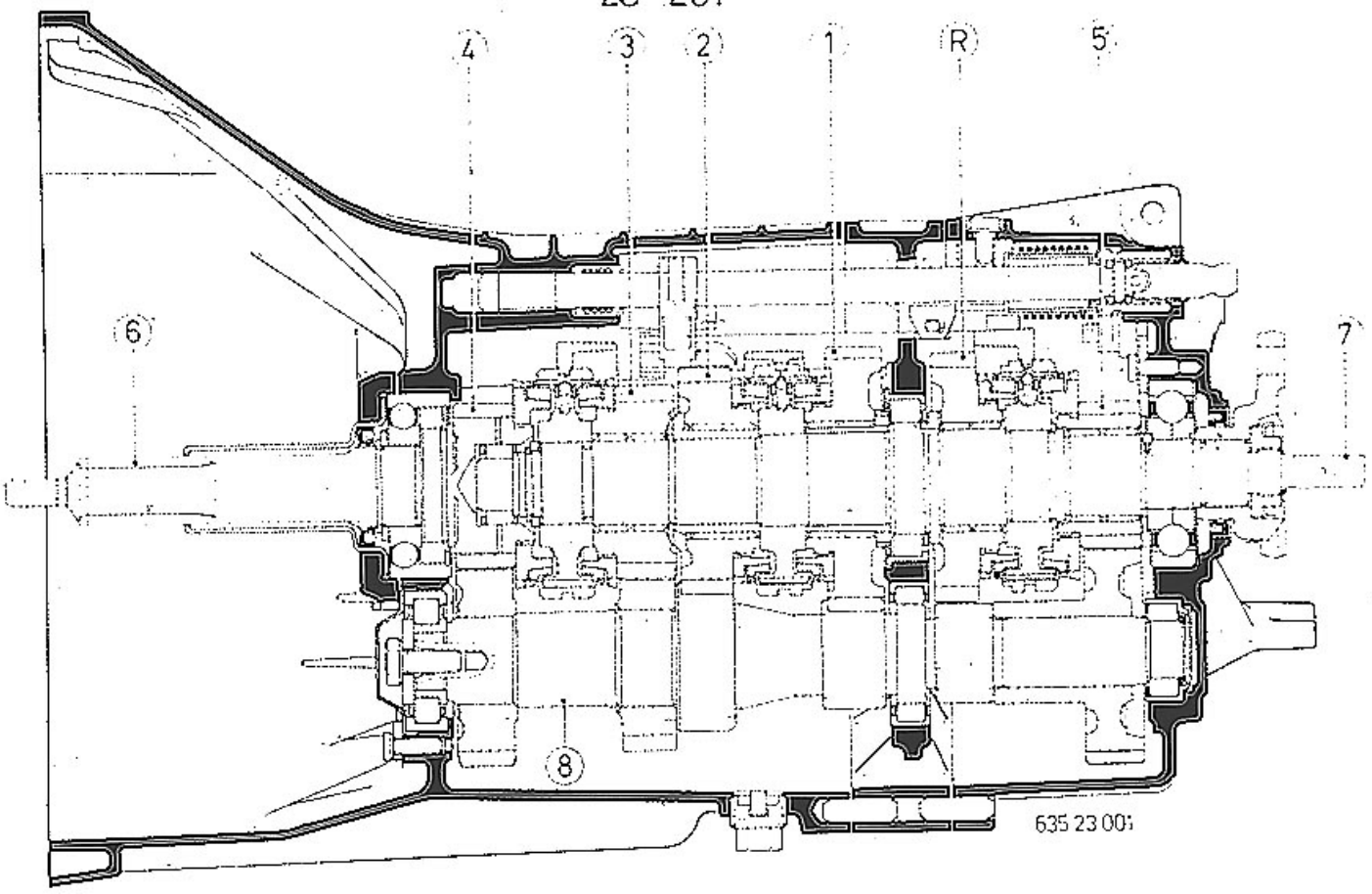
Modified Synchronization Since 5.85:
Sliding sleeves with asymmetric splines.
Thrust pieces (1), spring (2) and balls (3) in weaker version.
Installation:
Bevelled ends of thrust pieces face the sliding sleeve.
For the 3rd/4th gear guide sleeve it is important to make sure that the bevelled end of sliding sleeve (marked with 3 grooves) faces the long collar (4) of the guide sleeve.

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

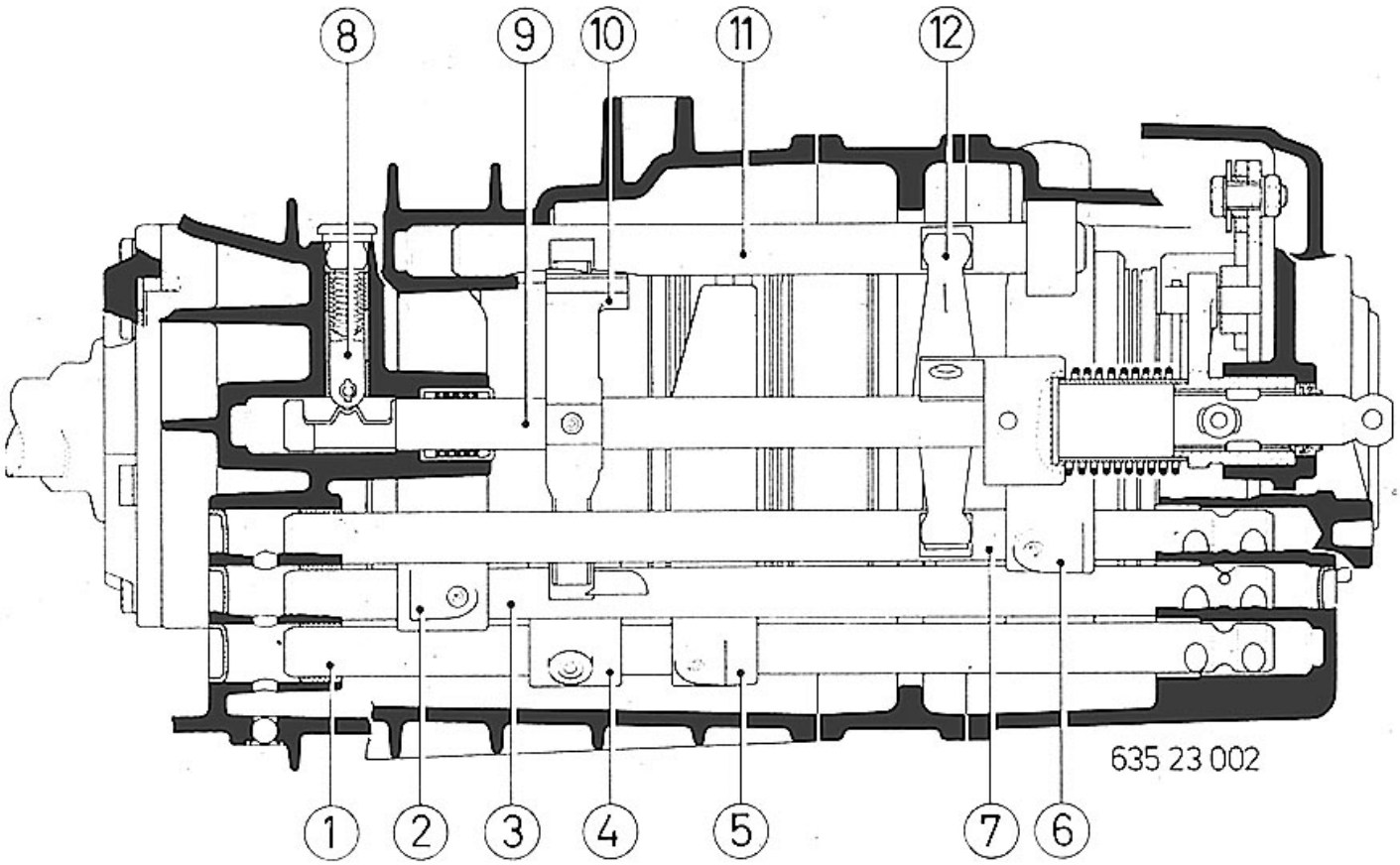
Getrag 280 Five speed sport transmission

	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

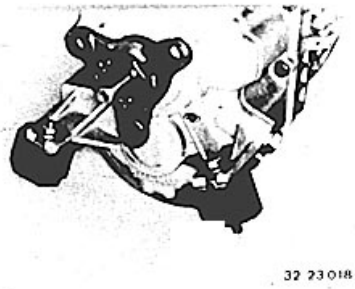


280/Sport Shift Components

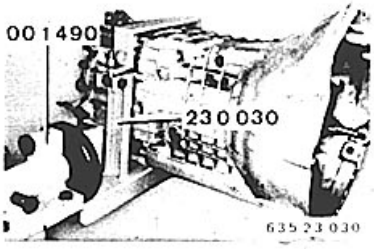
1 Selector rod – 1st/2nd gear
2 Selector fork – 3rd/4th gear
3 Selector rod – 3rd/4th gear
4 Drive
5 Selector fork – 1st/2nd gear
6 Selector fork – reverse/5th gear
7 Selector rod – reverse/5th gear
8 Lockpin
9 Shift shaft
10 Shift arm
11 Shift rail
12 Reversing lever

Continued in next column!

23 11 006 REMOVING AND INSTALLING OR SEALING FRONT AND REAR CASE SECTIONS


32 23 018

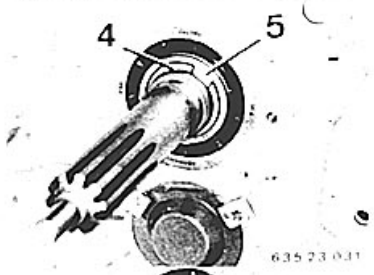
Remove transmission – see 23 00 022 in the Model Repair Manual.
Unscrew rubber mounts.



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.

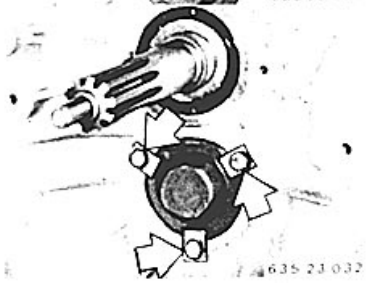
Important!
Use correct oil grade – see Operating Fluids.
Oil volume*.



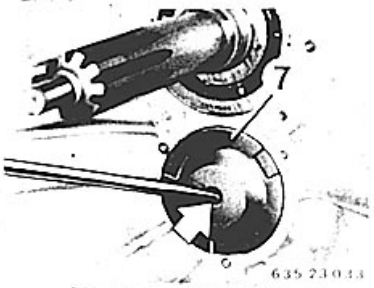
635 23 031

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.

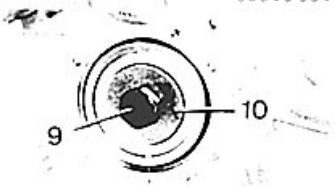
Installation:
Replace sealing cover.



635 23 034

Take off sealing cover.

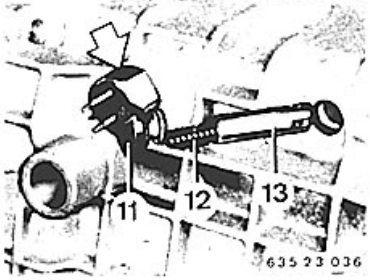
Important!
Shim (8).



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**.

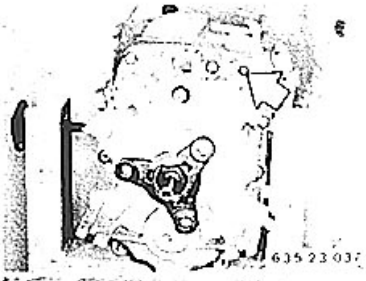


635 23 036

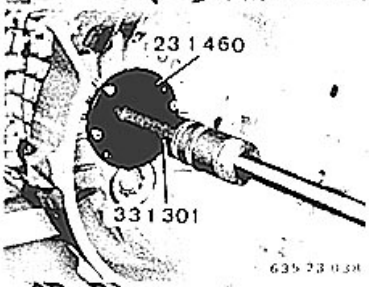
Unscrew backup light switch.
Lift out cover (11).
Pull out spring (12) and lockpin (13).
Check the installed position.

* See Specifications

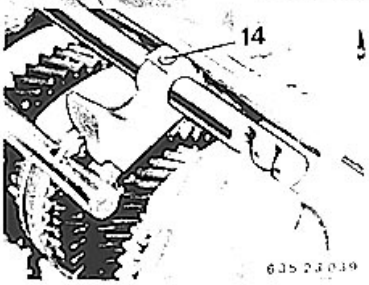
** Source of Supply: HWB



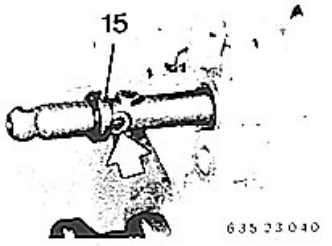
Knock back cylindrical pins.
Unscrew mounting bolts.



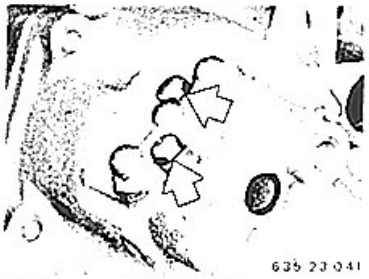
Pull off case front section with Special Tools 23 1 460 and 33 1 301.



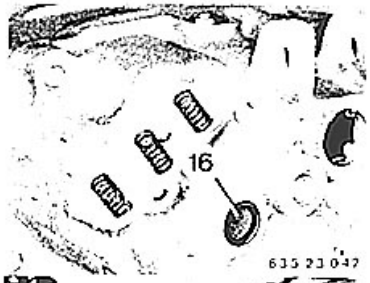
Fourth gear is engaged.
Drive pin (14) out of selector shaft (counterhold).



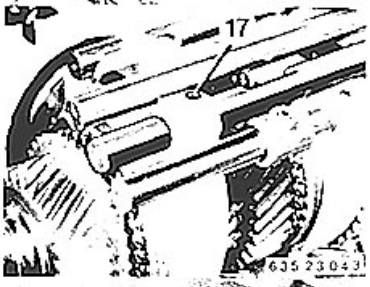
Drive out selector shaft toward rear.
Radial oil seal (15) will also be pulled out.
Important!
Needles on selector shaft.
Take off selector arm.
Installation:
Replace radial oil seal.



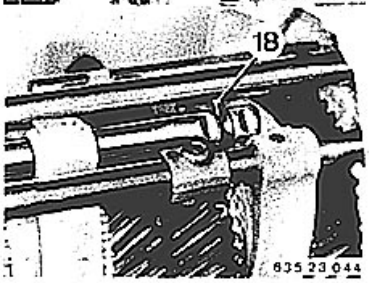
Remove end cap.
Installation:
Install end cap with sealing compound**.



Remove 3 springs.
Remove plug (16).
Installation
Replace plug.

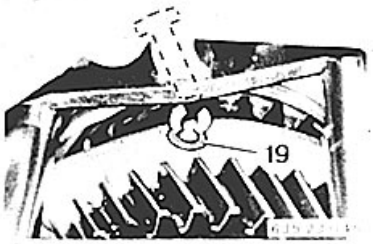


Take out fourth gear.
Drive pin (17) out of 3rd/4th gear selector rod (counterhold).

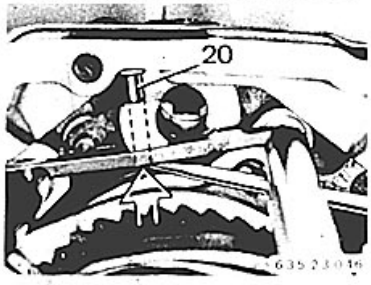


Knock out 3rd/4th gear selector rod toward front.
Important!
Lockpin (18).

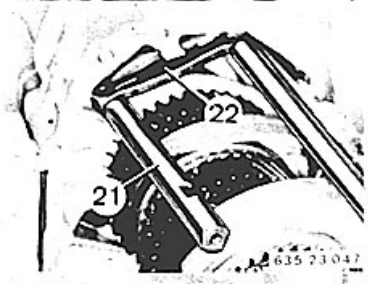
** Source: HWB



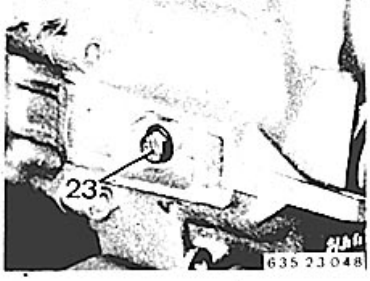
Pull off retainer (19) on shaft bolt for operating lever.



Push up shaft bolt (20).

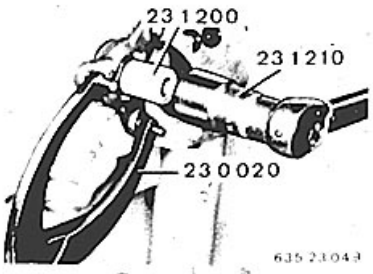


Pull out selector rail (21) forward.
Take off operating lever (22).
Installation:
Mark on operating lever faces up.



Unscrew bolt (23) for reverse gear shaft.
Installation:
Install bolt with bolt cement**.

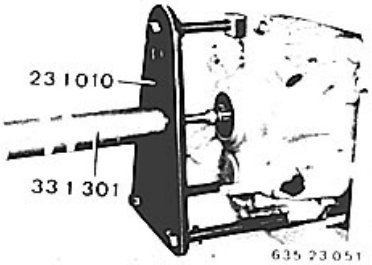
** Source: HWB



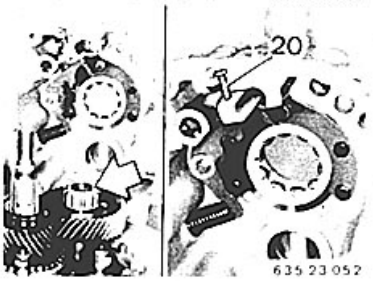
Lift out lockplate.-
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.



Pull off output flange with Special Tool 33 1 150.

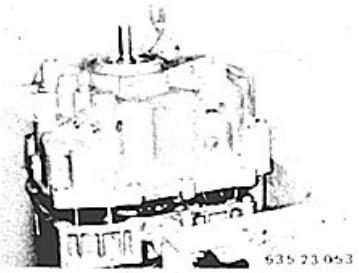


Knock back dowel pins.
Pull off case rear section with Special Tools 23 1 010 and 33 1 301.

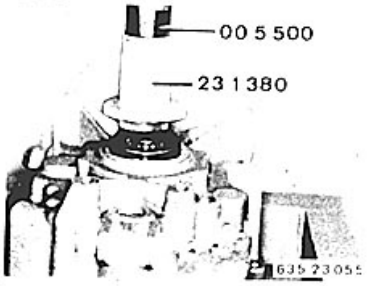


Coat sealing surface with sealing compound**.
Sealing surface cleaned thoroughly and dried of oil.
Install roller bearing with small diameter of plastic cage facing up.
Important!
Shaft bolt (20) for operating lever must be installed and bearing inner race removed, by lifting out radial oil seal, before mounting case rear section.

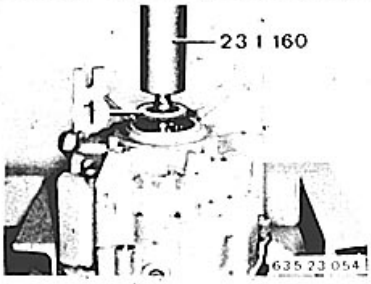
** Source: HWB



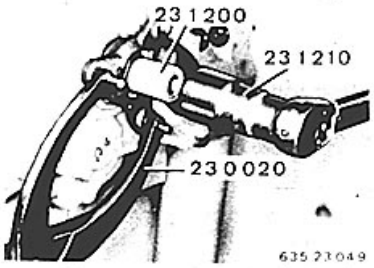
Mount rear case section.
Center 1st/2nd gear selector rod.
Drive in dowel pins.



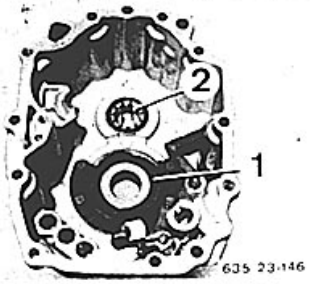
Drive in radial oil seal with Special Tools 23 1 380 and 00 5 500.
Lubricate sealing lip with oil.



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.



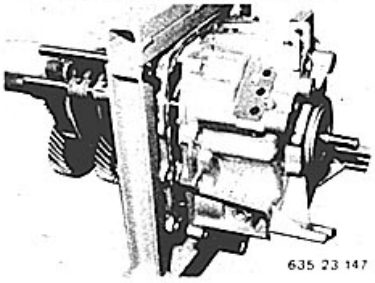
Mount the output flange.
Install collar nut with a bolt cement**
Apply Special Tool 23 1 200.
Hold output flange with Special Tool 23 0 020 and tighten the collar nut with Special Tool 23 1 210.
Tightening torque*.



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.

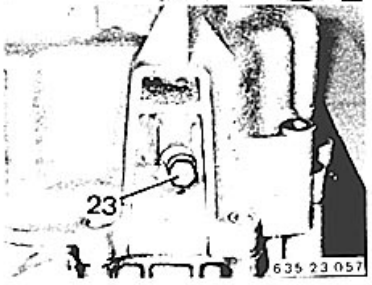


Install lockplate.



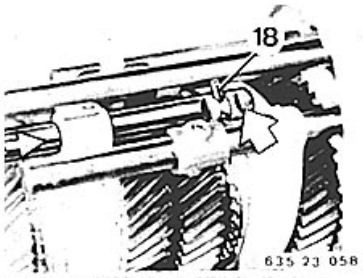
Heat ball bearing inner race to about 80° C (175° F) with a hot air blower.
Mount rear case section in horizontal position of the gear wheel set.
Align 1st/2nd and 5th/reverse gear selector rods with the bores.
Mount cover up to the transfer case.
Turn the gear wheel set during this step to have roller bearing slide into the layshaft.
Drive in dowel pin.

** Source of Supply: HWB

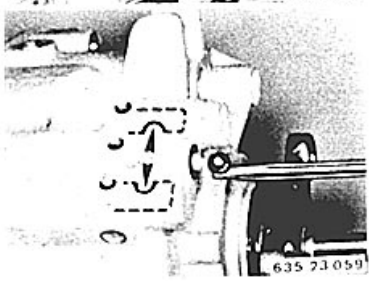


Install bolt (23) for the reverse gear shaft with a bolt cement** and tighten with correct torque*.

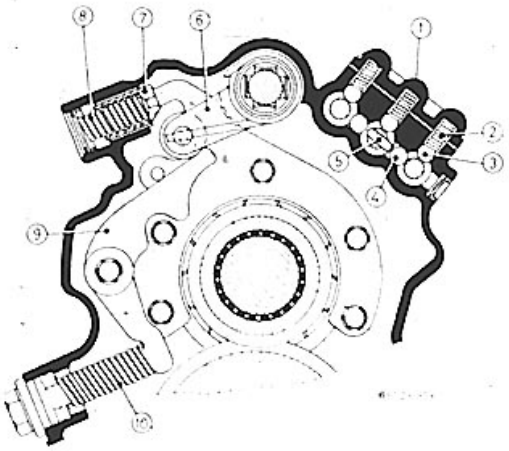
* See Specifications
** Source of Supply: HWB



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.

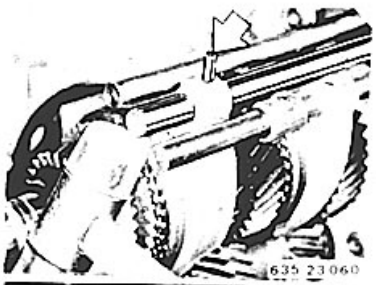


Install two locking balls with grease.
Push in 3rd/4th gear selector rod up to the arrest.



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).

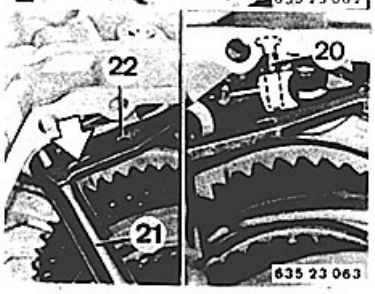


Insert three arresting balls and three springs.

Important!
Check length of spring.
Untensioned length of
springs (1) = 20 mm (0.787") and
spring (2) = 16 mm (0.630").

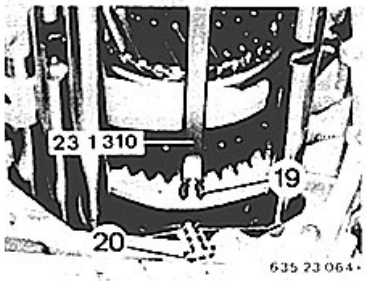


Coat end cap with a sealing compound** and tighten with correct torque*.
Install end cover (16) with a sealing compound**.

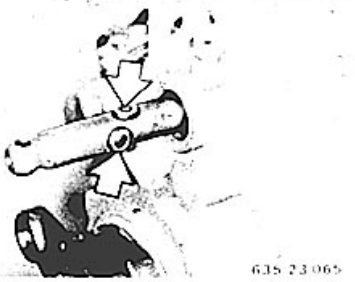


Install shift rail (21).
Push up shaft bolt (20) and install the reversing lever (22) with the mark facing up and toward the shift rail.

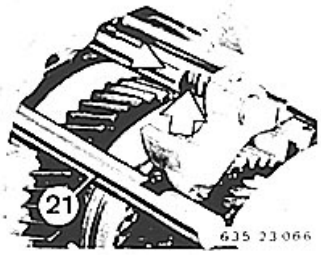
* See Specifications
** Source of Supply: HWB



Set input shaft upright.
Push shaft bolt (20) in direction of the gear wheel set.
Install circlip (19) with Special Tool 23 1 310.

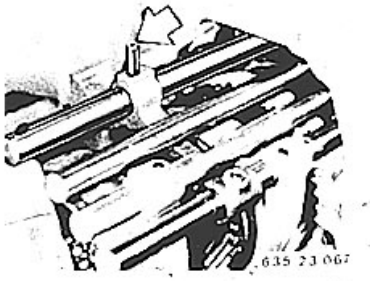


Hold the four rollers in position with grease.

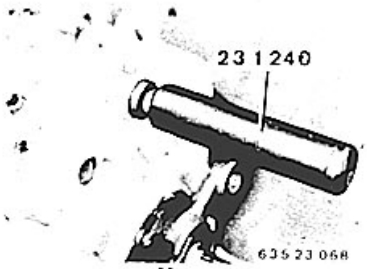


Insert shift arm.
Push in shift shaft.

Important!
Opening in shift shaft faces shift rail (21).



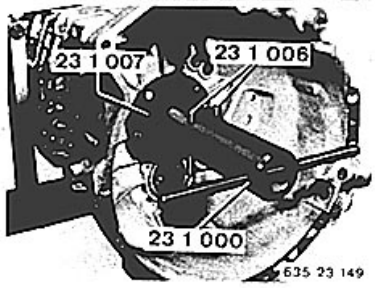
Drive in 6 x 26 mm dowel pin (counterhold).



Lubricate sealing lip of the radial oil seal with oil.
Drive in radial oil seal with Special Tool 23 1 240.



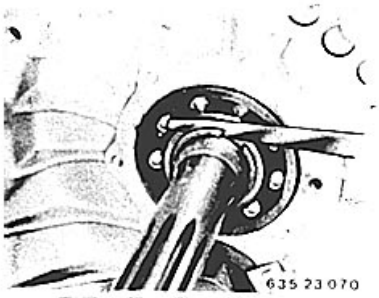
Coat sealing surface with a sealing compound**.
Sealing surface must be thoroughly cleaned and dried of oil.
Heat bearing inner race for input shaft to about 80° C (175° F) with a hot air blower.
Mount front case section while pulling out the input shaft.
Tighten front case section with correct torque*.



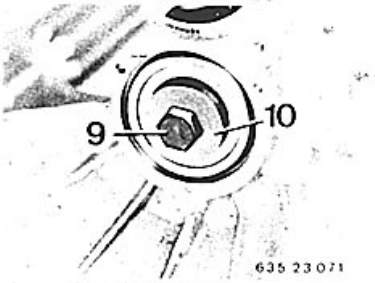
Version with Closed Bearing:
Coat sealing surface with a sealing compound**.
Sealing surface must be thoroughly cleaned and dried of oil.
Heat ball bearing inner race to about 80° C (175° F) with a hot air blower.
Mount case as far as possible.
Mount Special Tool 23 1 007 on the front case section.
Press 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.

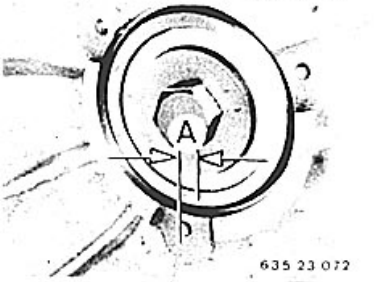
* See Specifications
** Source of Supply: HWB



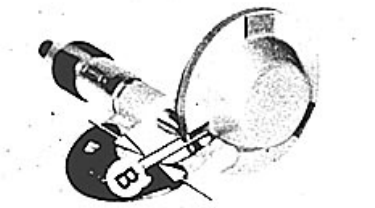
Install shim and circlip.
Reduce any play between the bearing inner race and circlip to 0 ... 0.09 mm (0 to 0.0035").



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.

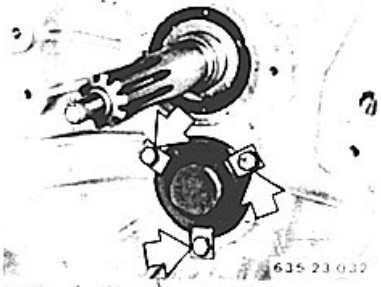
Example:
A = 1.4 mm (0.055")
– B = 0.9 mm (0.035")
0.5 mm (0.020") thick shim

* See Specifications
** Source of Supply: HWB

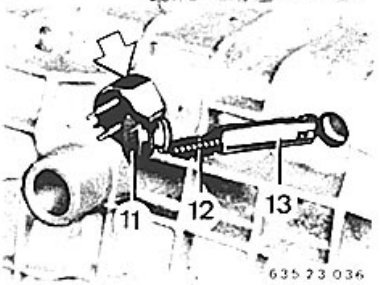


Hold shim of determined thickness in position with grease.
Drive in sealing cover (7) to fit tight with Special Tool 33 4 020.

Important!
Install sealing cover that recesses on the sealing cover are aligned with openings on the case.

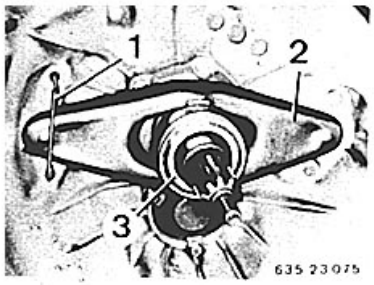


Tighten tabs with correct torque*.
Install bolts with a bolt cement**.



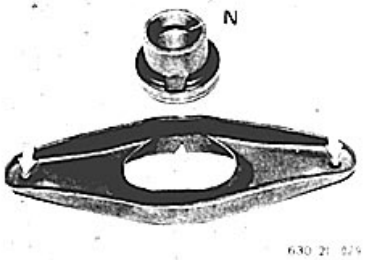
Install lockpin (13), spring (12) and cover (11).
Check installed position of the lockpin.

* See Specifications
** Source of Supply: HWB



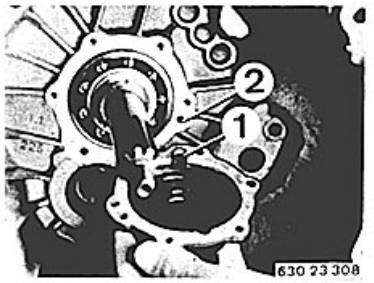
23 11 622 REMOVING AND INSTALLING GUIDE SLEEVE FOR CLUTCH RELEASE
– Transmission Removed –

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.

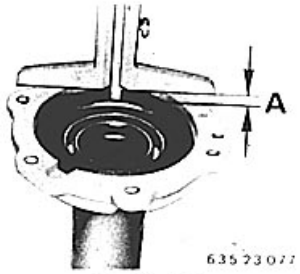
Important!
Use Microlube 261 on version with a double-mass flywheel.**



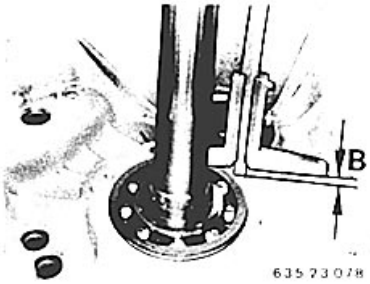
Unscrew guide sleeve.

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

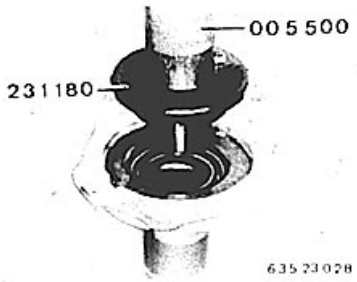
* See Specifications
** Source of Supply: HWB

23 12 502 REPLACING RADIAL OIL SEAL FOR INPUT SHAFT –TRANSMISSION REMOVED–



635 23 148

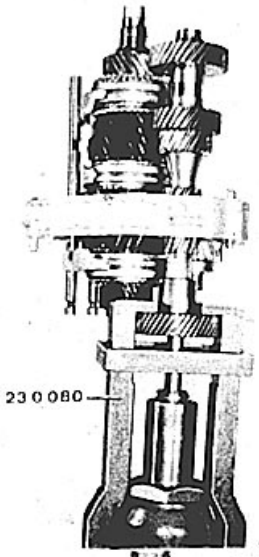
Remove guide sleeve 23 11 622.
Lift out radial oil seal.



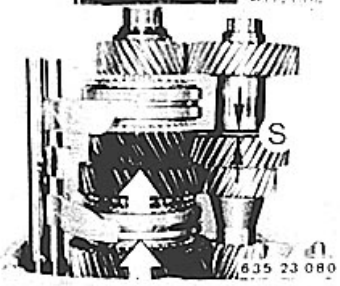
635 23 028

Drive in radial oil seal with Special Tools 23 1 180 and 00 5 500.
Open end faces up.
Lubricate sealing lip with oil.

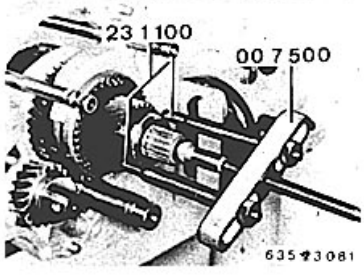
23 21 501 REMOVING AND INSTALLING INPUT/OUTPUT SHAFT ASSY. –CASE FRONT AND REAR SECTIONS REMOVED–



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*.

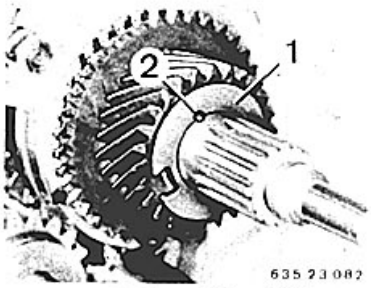


Caution!
To avoid damaging the 3rd gear when pulling off 5th gear, make sure that play (S) is always provided between 3rd gear and layshaft.
Push up output shaft if necessary.

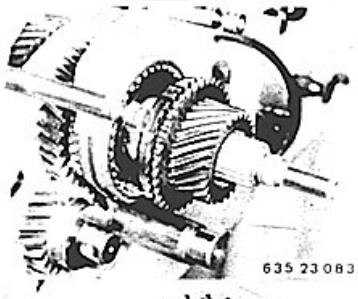


Take up intermediate case with gear set in Special Tool 23 0 030 again.
Pull bearing inner race off of output shaft with Special Tools 23 1 100 and 00 7 500.
Machine pulling hooks accordingly to fit in slots.

* See Specifications



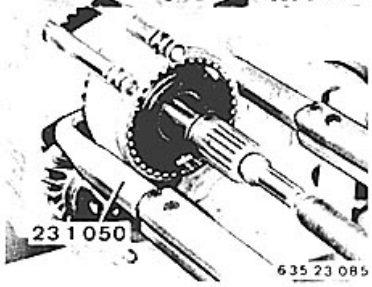
Take off washer (1) and ball (2).



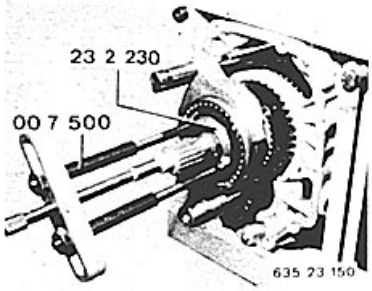
Pull off 5th gear with synchromesh ring and split needle bearing.



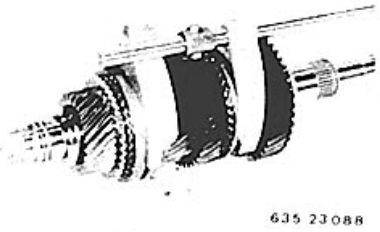
Remove circlip (3).
Installation:
Replace circlip.



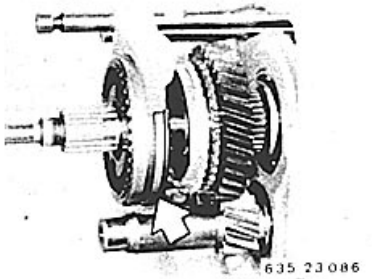
Pull off reverse gear with operating rod and guide sleeve, with Special Tool 23 1 050.



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).

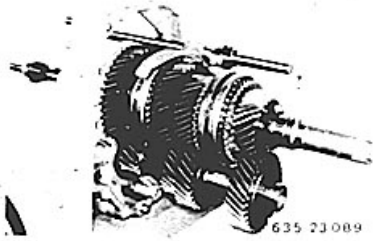


Take shift rod with 1st/2nd gear shift fork and 3rd/4th gear shift fork off of the gear set assembly.

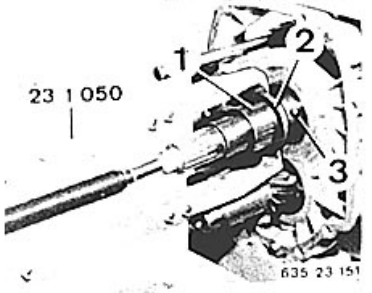


Take guide sleeve with shift fork and shift rod, synchromesh ring, reverse gear and needle bearing off of the output shaft.

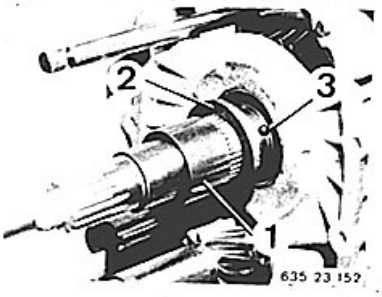
Important!
Installation:
Shouldered end of operating sleeve must face the reverse gear.



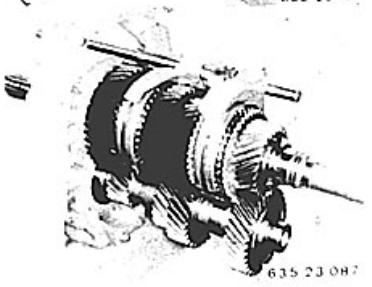
Installation:
Insert input shaft, output shaft with 1st/2nd gear shift rod and layshaft into the intermediate case.



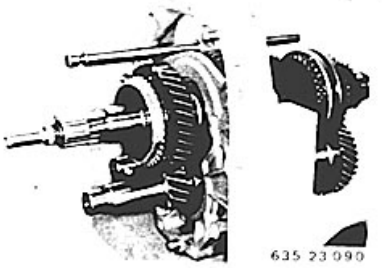
Version with Bearing Sleeve:
Drive output shaft forward with light knocks from a plastic hammer until the pulling-off claws can be applied.
Pull bearing sleeve (1) and thrust washer (2) off of the output shaft using Special Tool 23 1 050 (Kukko).
Remove ball (3).



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.



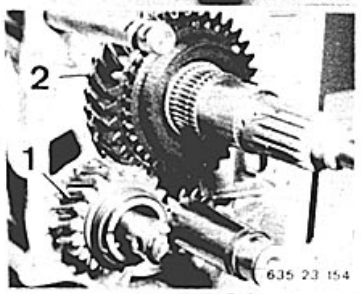
Pull input shaft, output shaft with 1st/2nd gear shift rod, 3rd/4th gear shift fork and layshaft out of the intermediate case.



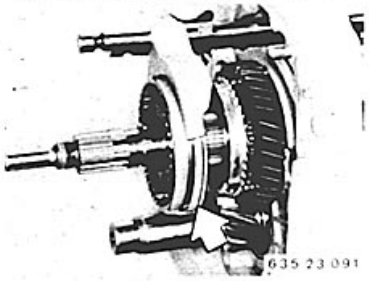
Install needle bearing, reverse gear and synchromesh ring on the output shaft.



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.

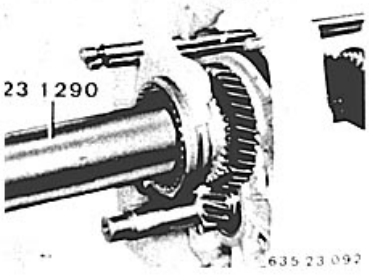


Push on intermediate gear wheel in this position up to the tooth ring of the gear wheel.
Turn tooth ring (2) on the gear wheel until the teeth of the gear wheel and intermediate gear wheel (1) mesh.
Mount intermediate gear wheel against the bearing surface.



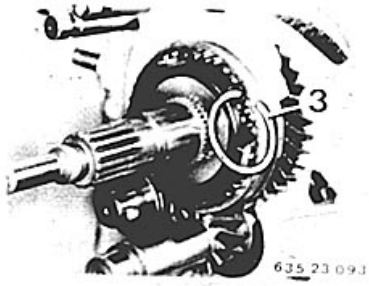
Install guide sleeve with operating sleeve and selector rod with 5th/ reverse gear selector fork on the output shaft.

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.

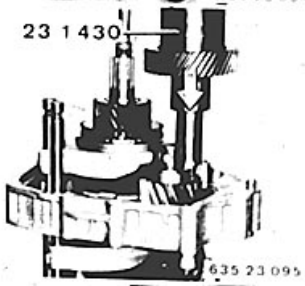
Important!
Tabs on synchromesh ring must be aligned with openings of guide sleeve.



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.

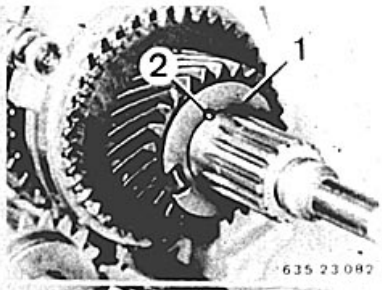


Take transfer case with gear wheel set off of Special Tool 23 0 030 and set up in a press.
Lubricate pressing surface of the layshaft with oil.
Heat 5th gear wheel uniformly to 150° C (300° F), checking temperature with a thermocolor crayon.
Install 5th gear wheel on the layshaft and press on to fit tight with Special Tool 23 1 430.
Pressing-on force*.



Important!
Lift and turn the 5th gear wheel until the teeth mesh.

* See Specifications



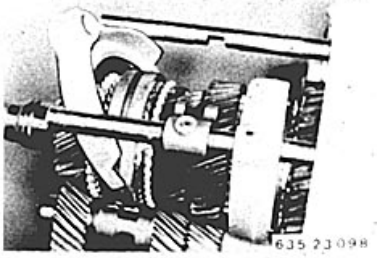
Install split needle bearing.
Insert ball (2) with grease.
Push on washer (1).

Note:
A transmission with code OH does not have a ball.

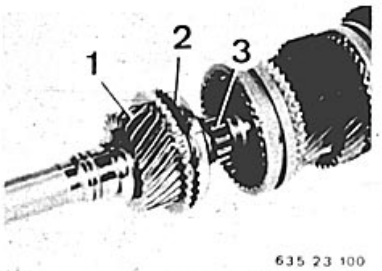


Installation:
Heat ball bearing inner race to about 80° C (175° F) with a hot air blower and push it on the output shaft.

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.

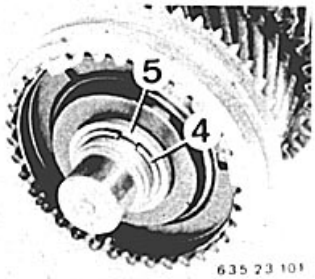


635 23 100

23 21 552 REPLACING OUTPUT SHAFT
– Output Shaft Removed –

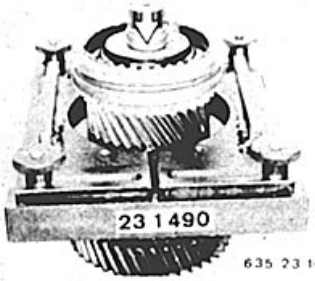
Pull off input shaft (1), synchromesh ring (2) and needle bearing (3).

Note:
To avoid mixing up synchromesh rings while disassembling the output shaft, it is recommended to mark synchromesh rings for pertinent gear wheels.



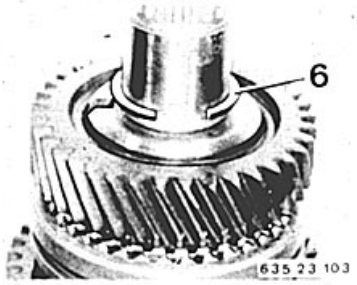
635 23 101

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*.

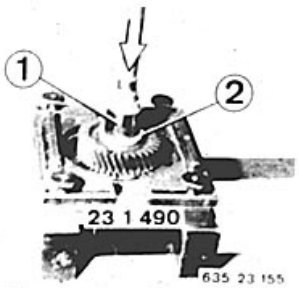


635 23 103

Lift out circlip (6).

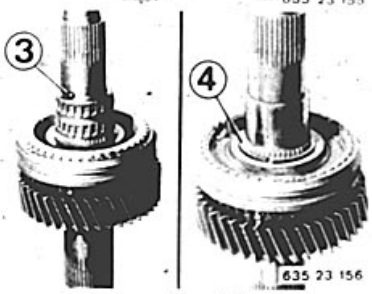
Installation:
Replace circlip.

* 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.



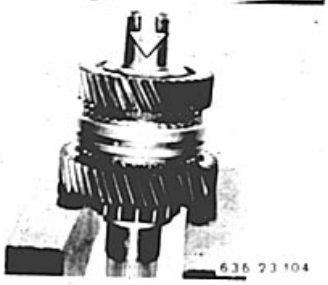
635 23 156

Take off ball (3), needle bearing and 2nd gear synchromesh ring.
Lift out circlip (4).

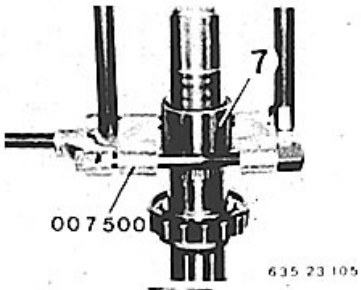
Installation:
Replace circlip.


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.

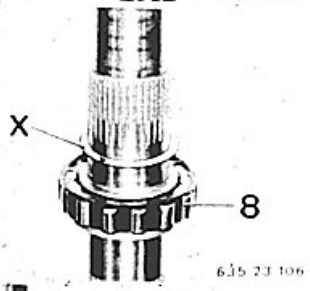

635 23 104

Press 2nd gear wheel, guide sleeve and 1st gear wheel off of the output shaft.



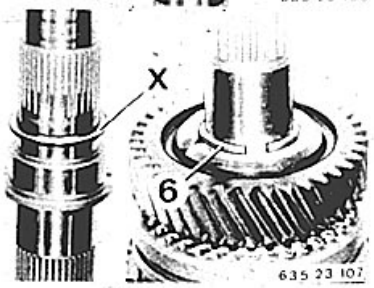
635 23 105

Pull collar (7) off of the output shaft with Special Tool 00 7 500.



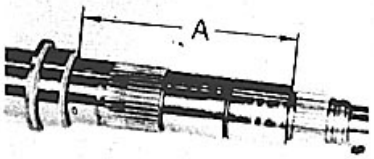
635 23 106

Take off shim (X) and roller bearing (8).



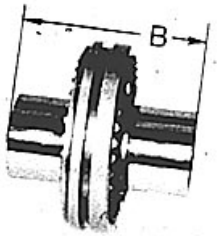
635 23 107

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").

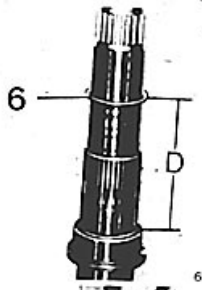


635 23 109

Assemble 1st gear collar, 1st/2nd gear guide sleeve and 2nd gear collar.
Measure distance (B).
For example: 93.1 mm (3.665").

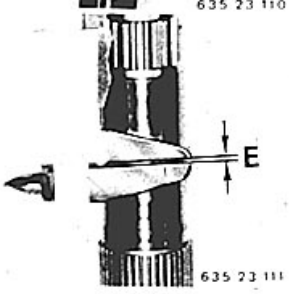
Example:

	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").

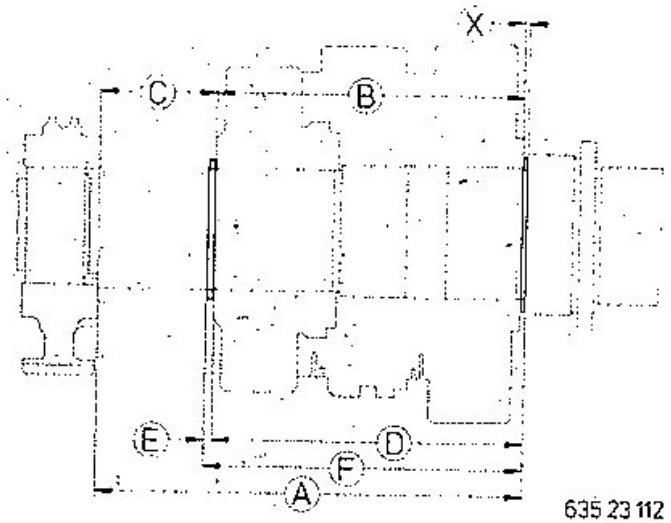


635 23 111

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 (3.665")
+ 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



Install roller bearing (9) with the small diameter end of the plastic cage facing the collar.
Install shim (X) of determined thickness.

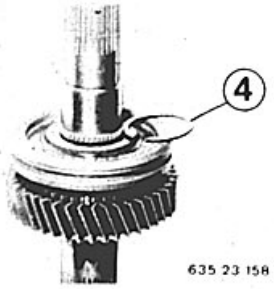
Heat collar (7) to about 80° C (175° F) with a hot air blower.
Install collar.

Install needle bearing, 1st gear wheel and synchromesh ring on the output shaft.

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.

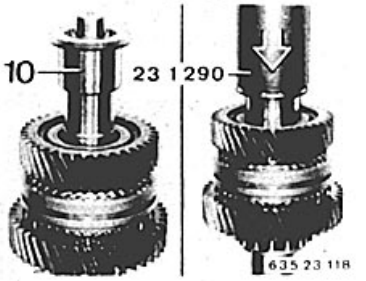
* See Specifications



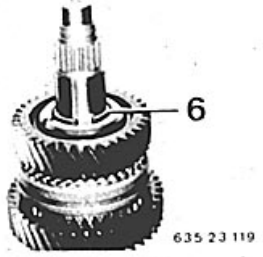
Install circlip (4) if still available. Play of the guide sleeve must be eliminated with the circlip. Circlips are available from Parts in different thicknesses from 1.7 to 1.95 mm (0.067 to 0.077").



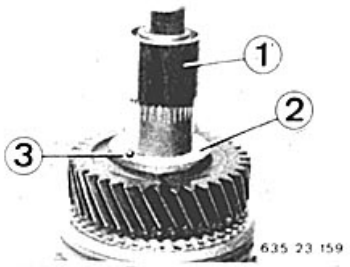
Install synchromesh ring, needle bearing and 2nd gear wheel.



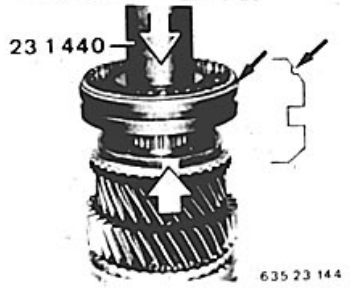
Heat collar (10) to about 80° C (175° F) with a hot air blower and install it on the output shaft, pressing it on to fit tight with Special Tool 23 1 290 when necessary.
Turn the 2nd gear wheel to prevent seizure of the needle bearing.



Install circlip (6) of determined thickness.

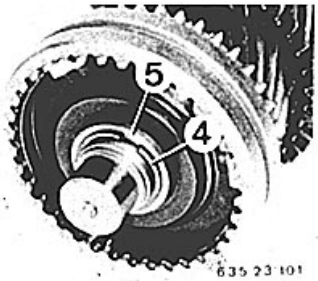


Install ball (3) and thrust washer (2). Heat bearing sleeve (1) to about 80° C (175° F) with a hot air blower and install it on the output shaft.



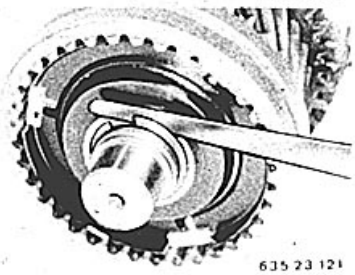
Install needle bearing, 3rd gear wheel and synchromesh ring.
Install 3rd/4th gear guide sleeve with the stepped end facing the 3rd gear wheel and press on with Special Tool 23 1 440.
Version with Groove:
Groove faces the 4th gear wheel.

Important!
Tabs on the synchromesh ring must be aligned with openings in the guide sleeve.



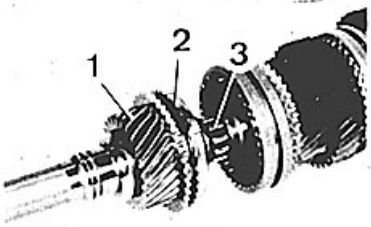
635 23 101

Install shim (5) and circlip (4).



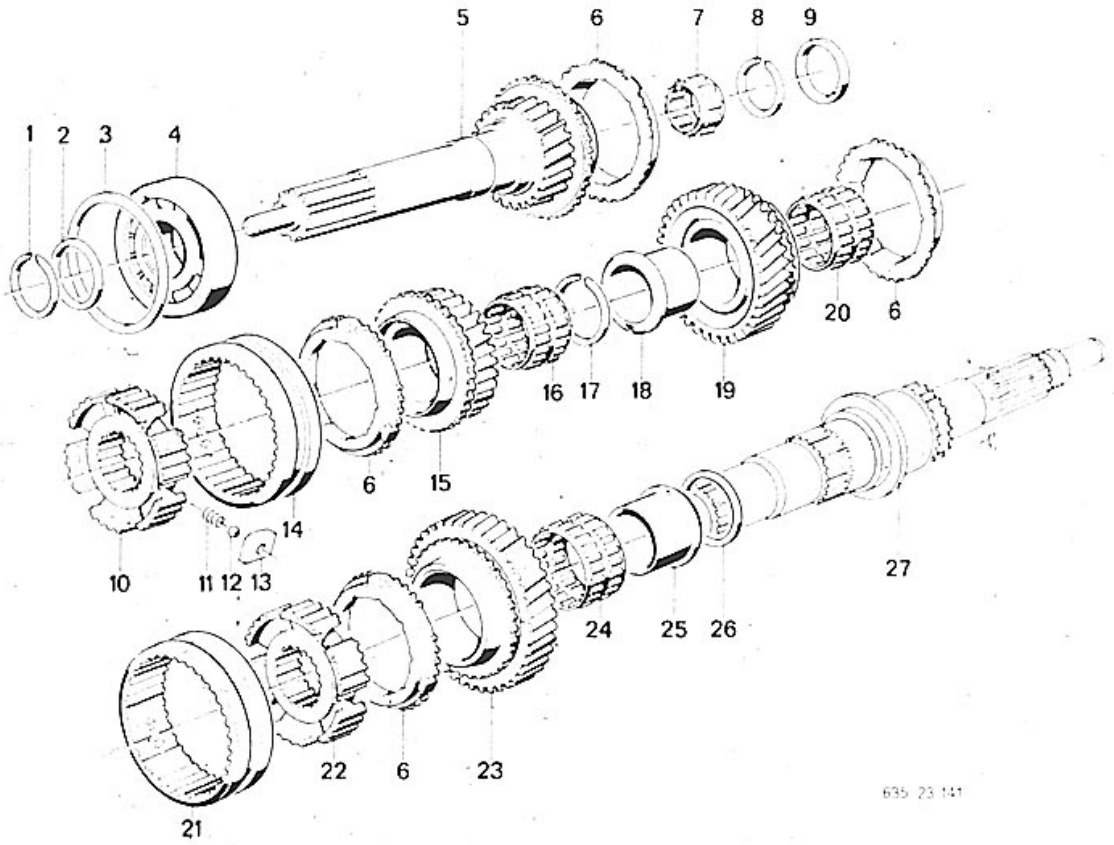
635 23 121

Installation:
Reduce play between the circlip and g
sleeve to 0 ... 0.09 (0 ... 0.0035").



635 23 100

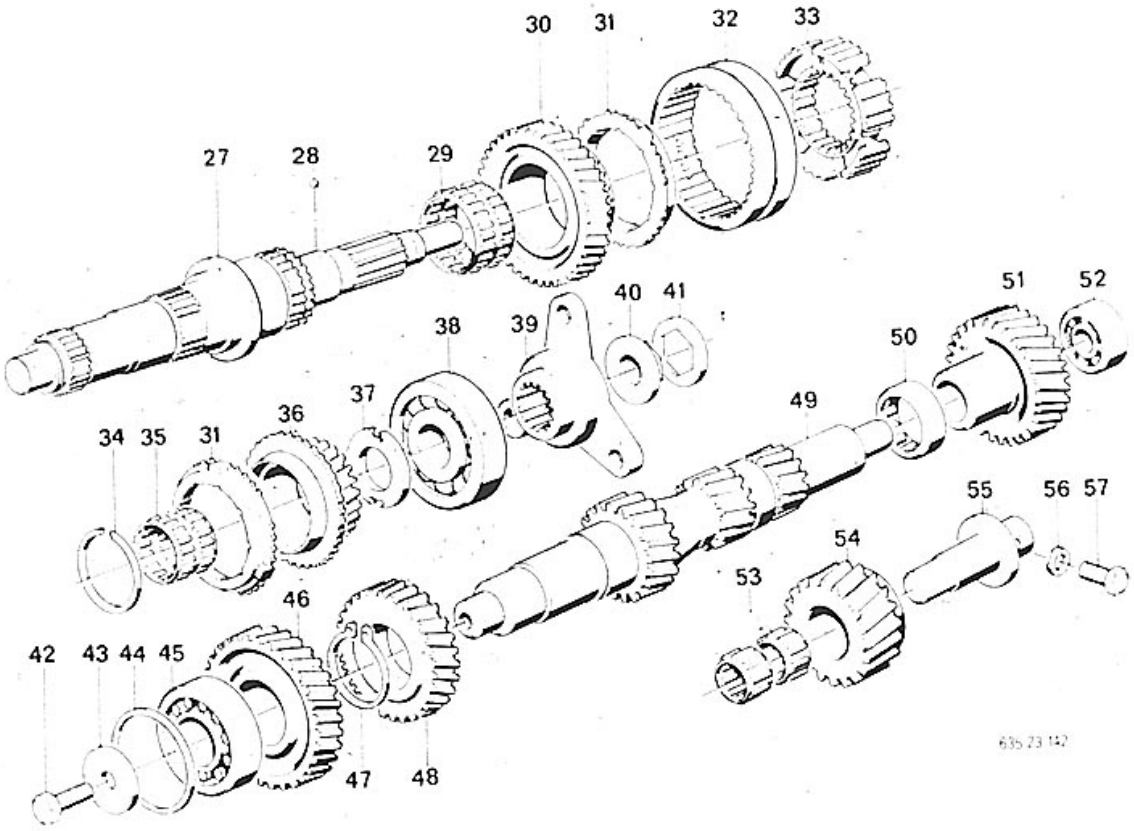
Install needle bearing (3), synchromesh ring (2) and input shaft (1).



Layout of Gears and Bearings

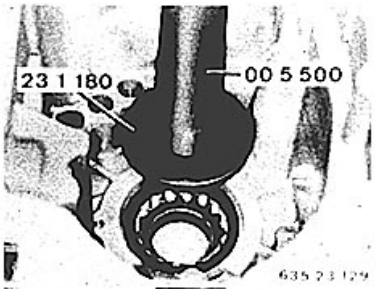
1 Circlip
2 Spacer
3 Spacer
4 Bearing
5 Drive shaft with 4th gear
6 Synchromesh ring
7 Needle bearing
8 Circlip
9 Spacer
10 Guide sleeve
11 Spring
12 Ball
13 Drive
14 Operating sleeve
15 3rd gear wheel
16 Needle bearing
17 Circlip
18 Spacer
19 2nd gear wheel
20 Needle bearing
21 Operating sleeve
22 Guide sleeve
23 1st gear wheel
24 Needle bearing
25 Spacer
26 Spacer
27 Output shaft

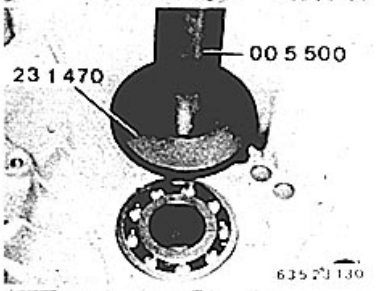
23 - 219a

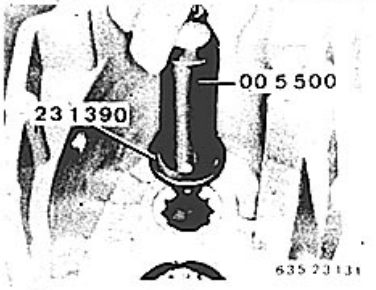


Layout of Gears and Bearings

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





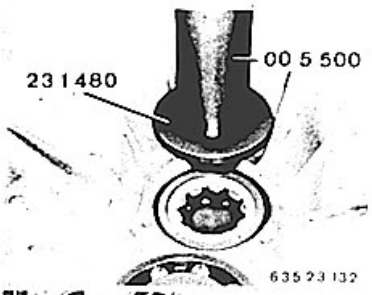


23 21 702 REPLACING BEARINGS OF ALL TRANSMISSION SHAFTS –TRANSMISSION REMOVED–

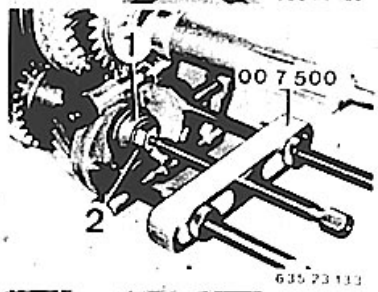
A) Input Shaft, Layshaft in Case Front Section:
Remove case front and rear sections 23 11 006.
Remove input/output shaft assy. 23 21 501.
Drive out bearing with Special Tools 23 1 180 and 00 5 500.

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.

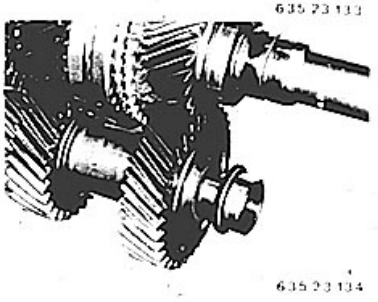
Layshaft:
Drive out roller bearing with Special Tools 23 1 390 and 00 5 500.



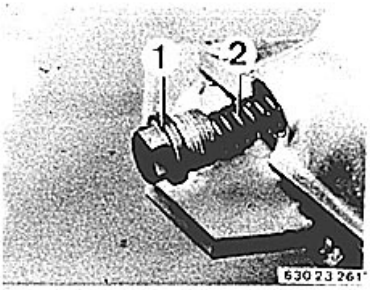
Heat case front section in area of bearing to approx. 80° C (175° F) with a hot air blower.
Drive in roller bearing with Special Tools 23 1 480 and 00 5 500.
Determine thickness of spacer between bearing outer race and sealing cover (see 23 11 006).



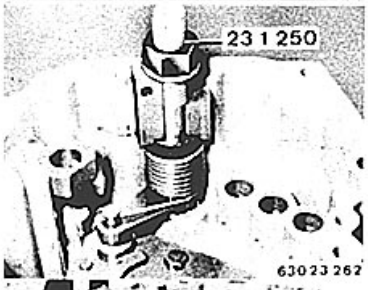
Pull bearing inner race (1) off of layshaft with Special Tool 00 7 500.
Caution!
Bolt (2) must be screwed in tapped bore to avoid damage on threads.



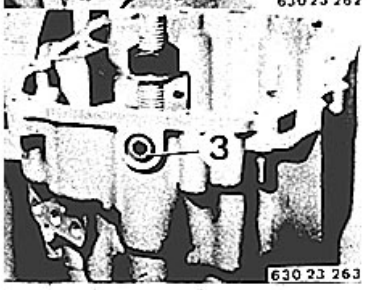
Heat new bearing inner race to approx. 80° C (175° F) with a hot air blower and install on layshaft.
If necessary, drive on to fit tight with Special Tool 23 1 160.



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.

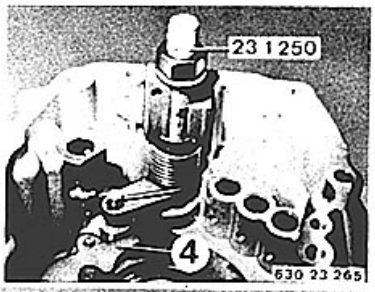


Remove socket head screw (3).
Installation:
Install screw with bolt cement**.
Tightening torque*.

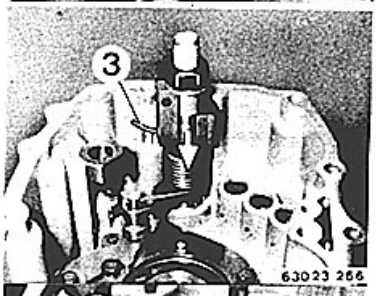


Remove selector arm from above.
Important!
Roller.

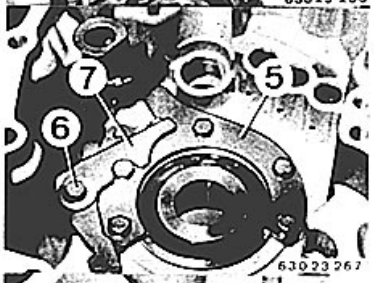
* See Specifications
** Source: HWB



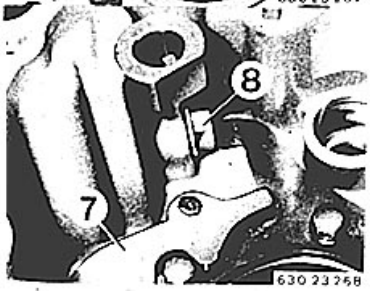
Installation:
Insert selector arm with Special Tool 23 1 250.
Swing out selector arm with roller above locking lever (4).



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.

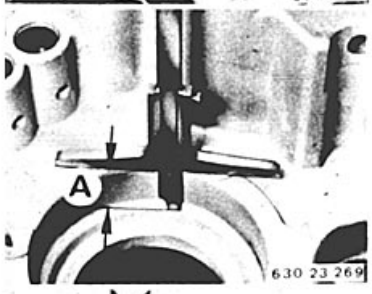


Installation:
Check installed position of locking lever (7) and thrust pin (8).

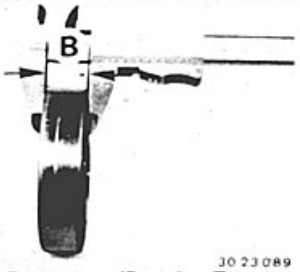
* See Specifications
** Source: HWB



Lift out radial oil seal.
Drive out grooved ball bearing with Special Tools 23 1 120 and 00 5 500.
Important!
Spacer (D).

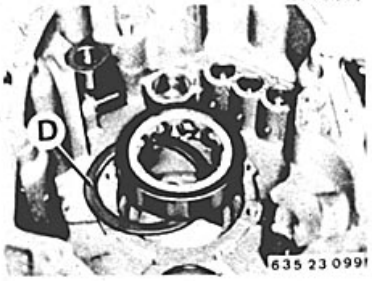


Determine thickness of spacer (D).
Measure distance (A).

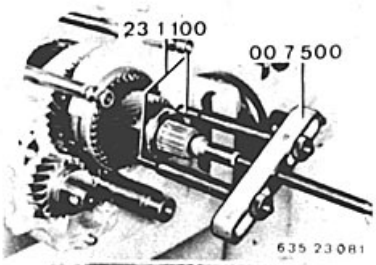


Measure distance (B).
Example:

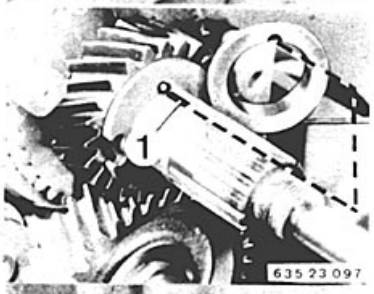
	A	20.3 mm (0.799")
–	B	20.0 mm (0.787")
	D	0.3 mm (0.012") spacer thickn.



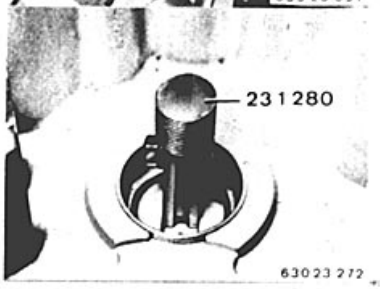
Heat case rear section in area of grooved ball bearing to approx. 80° C (175° F).
Insert spacer (D).
Install grooved ball bearing.
If necessary, drive in bearing against stop with Special Tool 23 1 470.



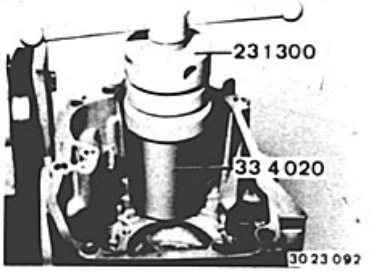
Pull bearing inner race off of output shaft with Special Tools 23 1 100 and 00 7 500.
Machine Special Tools 23 1 100 accordingly to fit in slots.



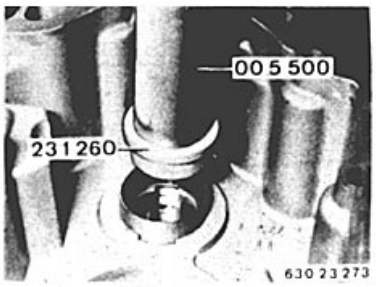
Heat ball bearing inner race to approx. 80° C (175° F) with a hot air blower and install on output shaft.
Important!
Turning lock.
Opening in bearing inner race must engage in ball.
Draw line (1) to make installation of bearing race easier.



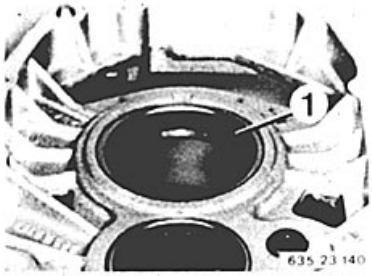
Layshaft:
Insert Special Tool 23 1 280 in bearing shell.



Apply Special Tool 33 4 020.
Screw on Special Tool 23 1 300.
Pull out bearing shell.

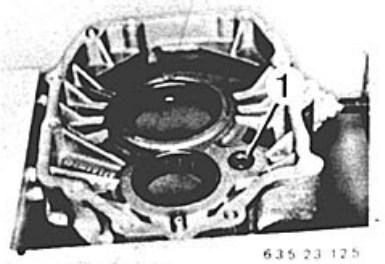


Drive in bearing shell with Special Tools 23 1 260 and 00 5 500.

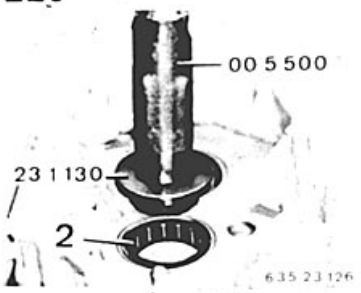


C) Output Shaft, Layshaft, Reverse Gear Wheel in Transfer Case

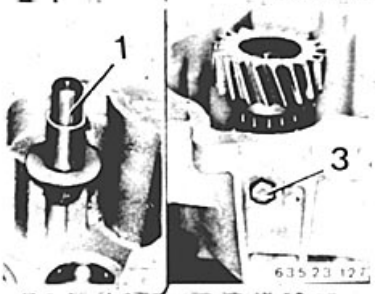
Output Shaft:
Check whether bearing outer race (1) can be reused.
The bearing outer race can be replaced only together with the complete transfer case.
Replacing the roller bearing on the output shaft requires removal of the output shaft – see 23 21 552.



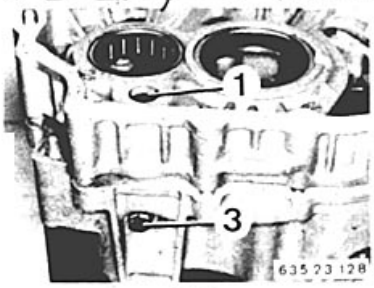
The reverse gear wheel shaft must be removed for removal of the roller bearing of the layshaft.
Press or drive out reverse gear wheel shaft (1).



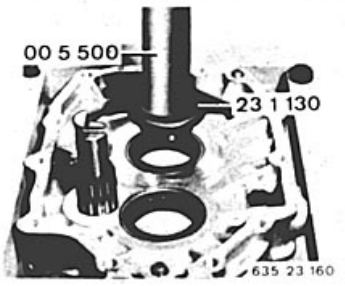
Drive out (and in) roller bearing (2) with Special Tools 23 1 130 and 00 5 500.
The roller bearing must be flush.



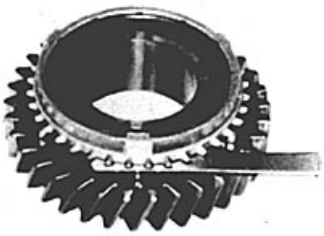
Mount reverse gear shaft (1) on the rear case section with bolt (3).
Install needle bearing and reverse gear wheel.



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.



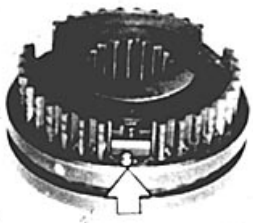
Version with Two Roller Bearings in Transfer Case:
Drive out (and in) both roller bearings with Special Tools 23 1 130 and 00 5 500.
The circlip must be removed for replacement of the needle bearing for the reverse gear wheel.



635 23 136



635 23 145



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.

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.

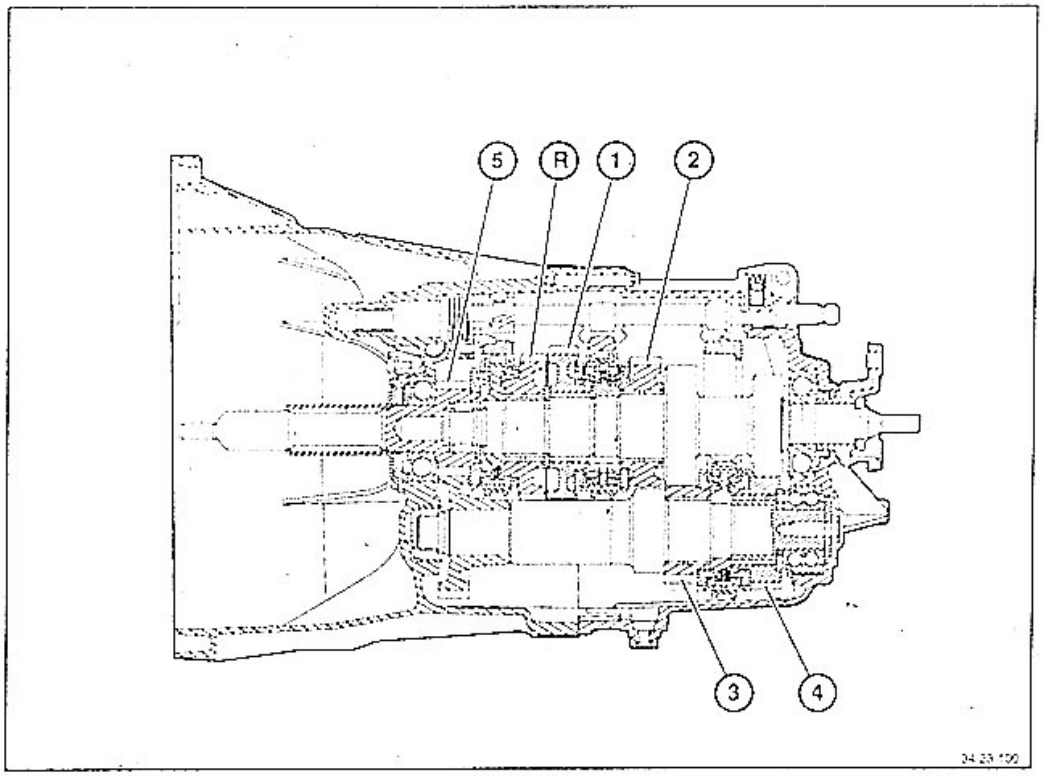
* See Specifications

Construction group 23 Manual transmission

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

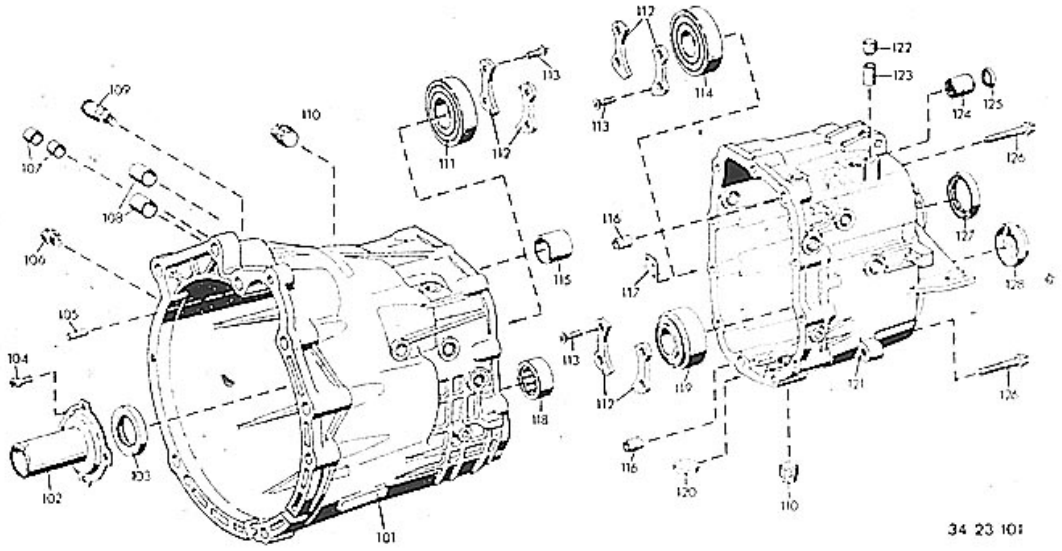
23-400



Cross Section Drawing View of Type
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

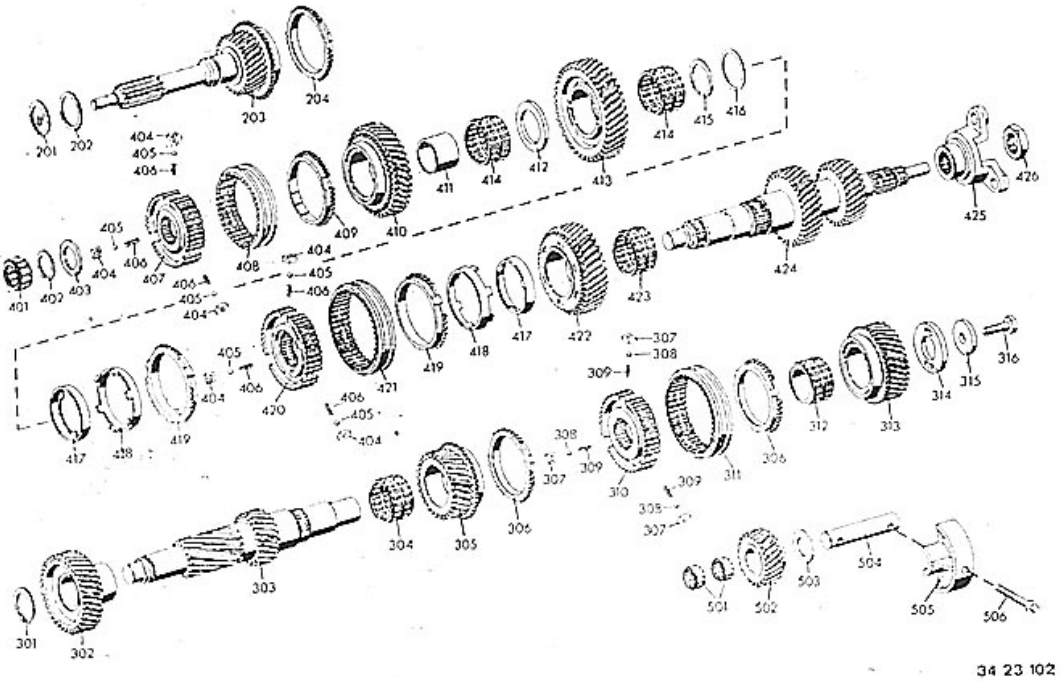
23–401



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

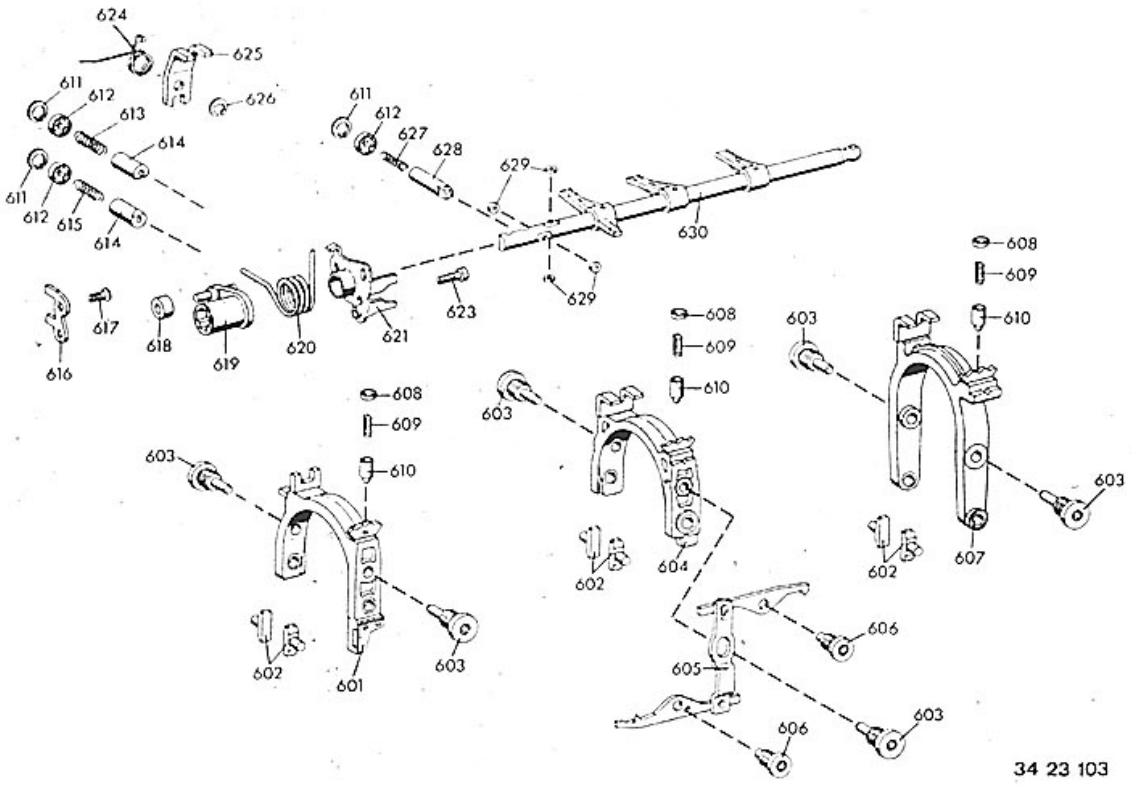
23–402



Drawing of Gears and Shafts

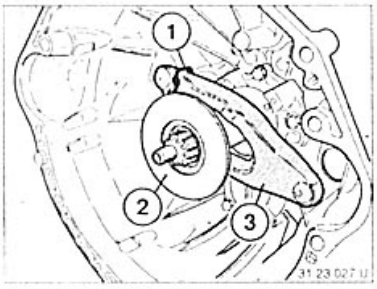
201 Circlip
202 Spacer
203 Input shaft
204 Synchromesh ring
301 Circlip
302 5th gear
303 Layshaft
304 Needle bearing
305 3rd gear
306 Synchromesh ring
307 Thrust piece
308 Ball
309 Spring
310 Guide sleeve
311 Operating sleeve
312 Needle bearing
313 4th gear
314 Thrust washer
315 Washer
316 Bolt
401 Grooved 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



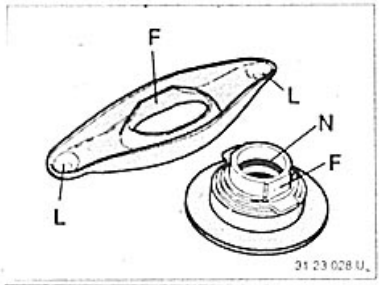
Drawing of Shift Elements

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

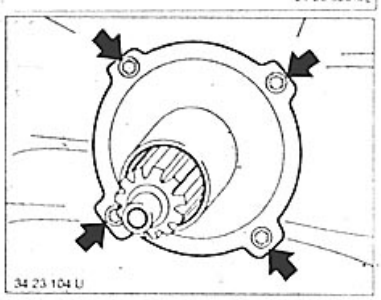


23 12 505 REPLACING RADIAL OIL SEAL FOR INPUT SHAFT

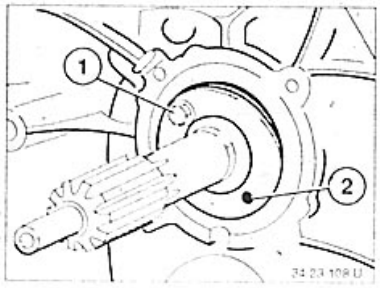
Remove transmission – refer to 23 00 023 in Model Repair Manual.
Lift out spring (1) and remove release lever (3) together with release bearing (2).



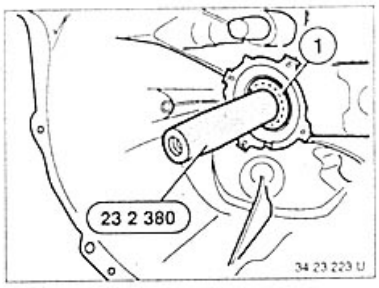
Installation:
Fill lubricating groove (N) with Molykote Longterm 2.
Coat guides (F) and bearings (L) with Molykote Longterm 2.
Non-conformance could cause seizure of the release bearing on the guide sleeve.



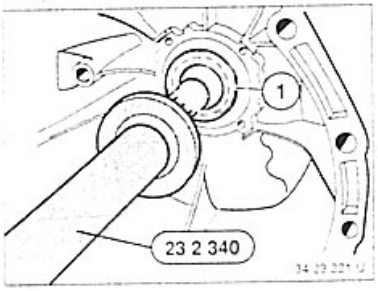
Unscrew guide tube.



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).

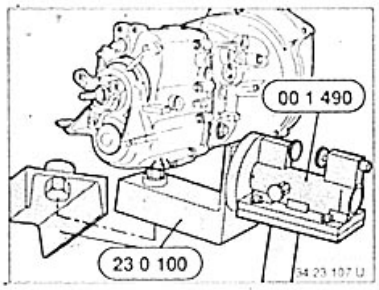


Lubricate sealing lip of radial oil seal with ATF.
Apply Special Tool 23 2 380 on the input shaft.
Slide on radial oil seal (1) as far as case.



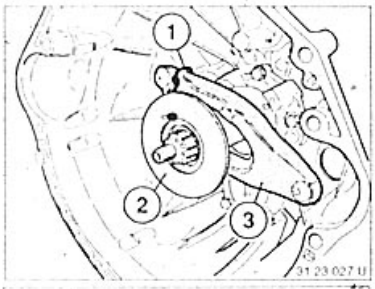
Pull off Special Tool 23 2 380.
Drive in radial oil seal (1) flush with Special Tool 23 2 340.
Mount guide tube.
Tightening torque*.

* See Specifications

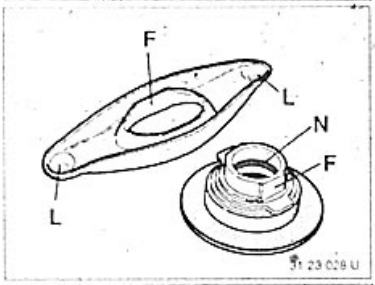


23 21 502 REMOVING AND INSTALLING INPUT AND OUTPUT SHAFT ASSEMBLY

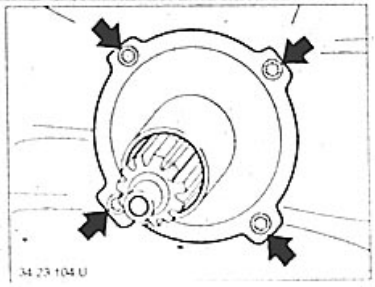
Remove transmission – refer to 23 00 023 in Model Repair Manual.
Unscrew drain plug.
Drain oil.
Screw Special Tool 23 0 100 into drain plug bore and secure.
Take up Special Tool 23 0 100 in Special Tool 00 1 490.



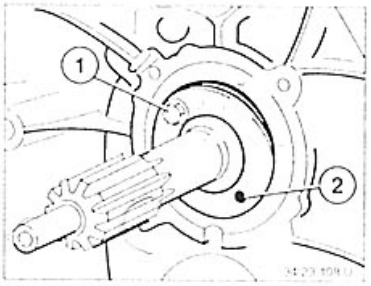
Lift out spring (1) and remove release lever (3) together with release bearing (2).



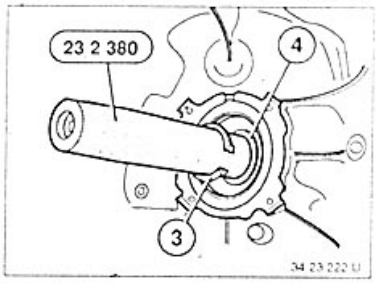
Installation:
Fill lubricating groove (N) with Molykote Longterm 2.
Coat guides (F) and bearings (L) with Molykote Longterm 2.
Non-conformance could cause seizure of the release bearing on the guide sleeve.



Unscrew guide tube.



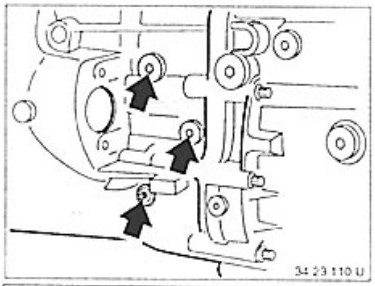
Remove radial oil seal.
Locate and puncture bores (1 and 2) with a scriber.
Drive in radial oil seal to one side as far as stop.
Screw a suitable self-tapping screw into the opposite bore.
Remove radial oil seal by pulling out on the self-tapping screw (pliers).



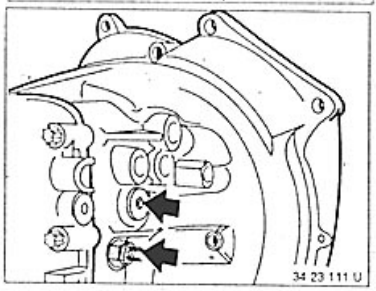
Caution!
Special Tool 23 2 380 must be used on the input shaft to remove circlip (3) so that the input shaft is not damaged.

Lift out circlip (3) and pull off over Special Tool 23 2 380.
Take off spacer (4).

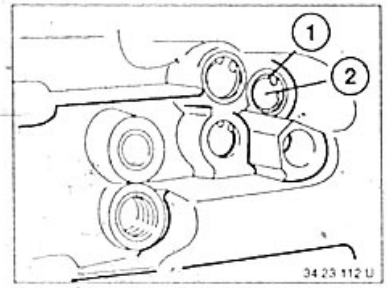
Installation:
Replace circlip (3).



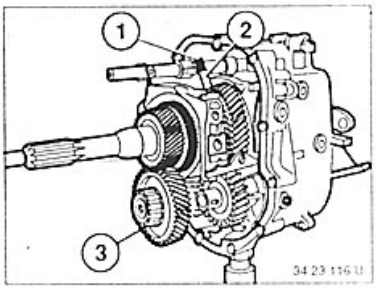
Unscrew left bearing shaft bolt and reverse gear shaft bolt in the front case section.



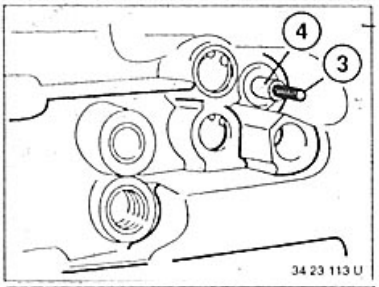
Unscrew reverse gear switch and right bearing shaft bolt in the front case section.



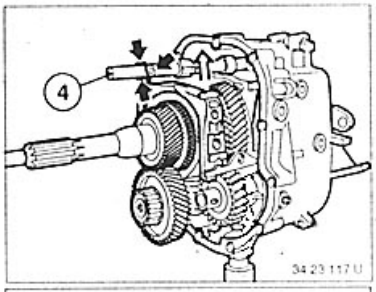
Lift out circlip (1).
Remove sealing cap (2).



Remove loose spring (1) and thrust pin (2).
Take off needle bearing (3).

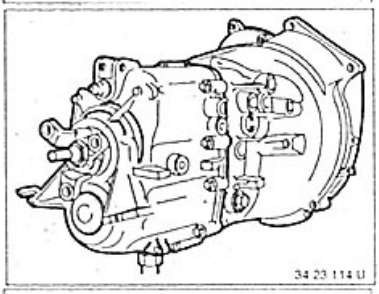


Lift out spring (3) and catch pin (4).

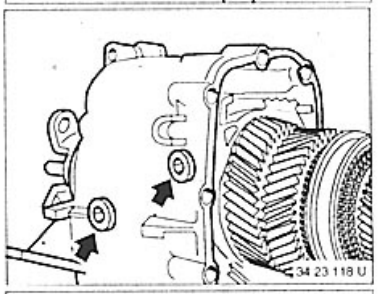


Pull out shift shaft (4).

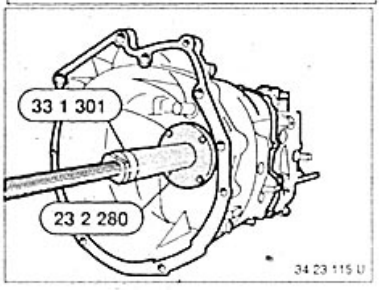
Important!
Needles on shift shaft.
Take off 5th/reverse gear shift arm upwards.



Unscrew case bolts.

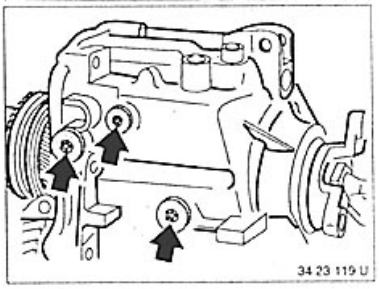


Remove two bearing shafts on the right-hand side.

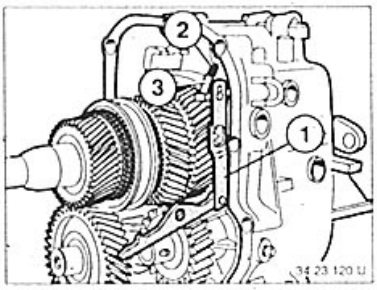


Pull off front case section using Special Tools 23 2 280 and 33 1 301.

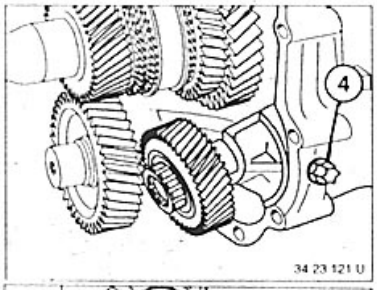
Installation:
Bearings or elements of the bearing brackets could be damaged while pulling off the front case section.
Always replace bearings or elements.



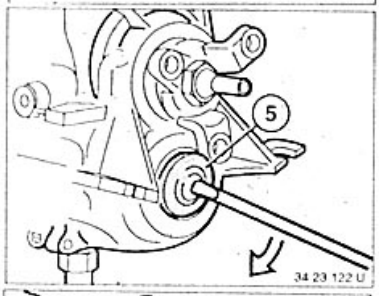
Remove three bearing shafts on the left-hand side.



Remove complete locking lever (1).
Remove spring (2) and thrust pin (3).

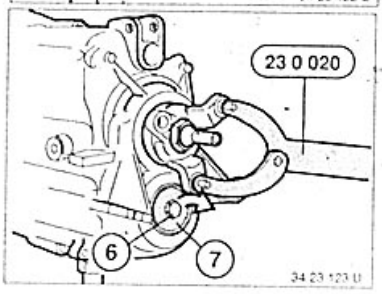


Unscrew bolt (4).
Remove reverse gear with needle bearings, thrust washer, shaft anf half-shell.



Puncture through middle of sealing cap (5).
Lever out sealing cap (5) with a screwdriver inserted into the hole.

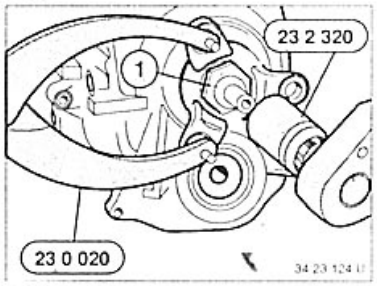
Installation:
Replace sealing cap.



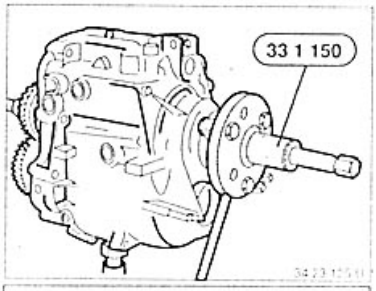
Engage a gear by hand.
Hold output flange with Special Tool 23 0 020.
Unscrew bolt (6).

Important!
Left-hand threads.

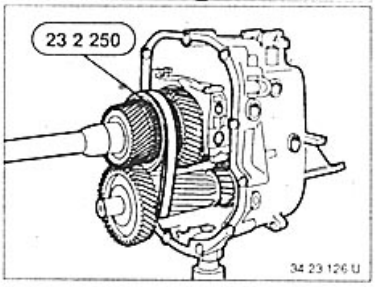
Remove washer (7).
Take out engaged gear.



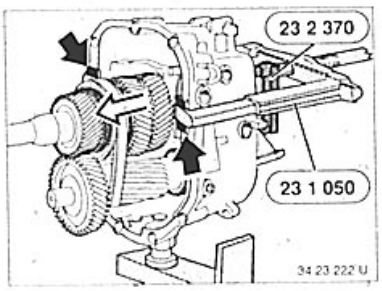
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut (1) with Special Tool 23 2 320.



Pull off output flange using Special Tool 33 1 150.



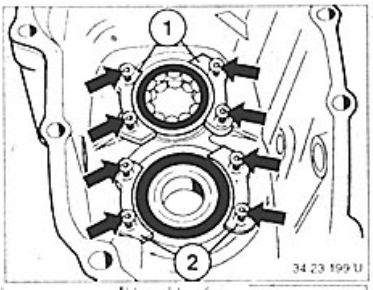
Compress gear set at 5th/reverse gear operating sleeve with layshaft.
Use Special Tool 23 2 250.



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.

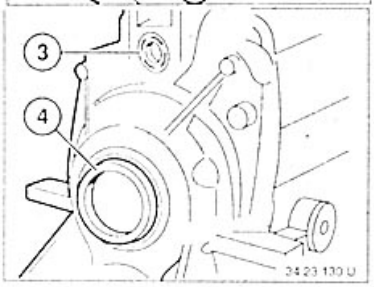
Important!
Use a piece of wood, plastic or similar on the sealing surfaces.
Press out gear set and layshaft uniformly. Make sure that the gear set and layshaft do not clamp while pressing out.

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.

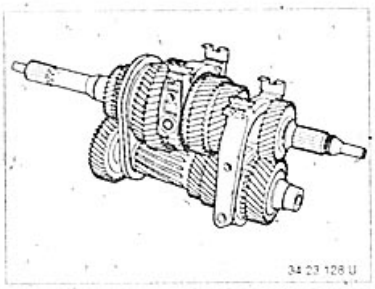


Replace bearings or elements for bearing brackets of the output shaft/layshaft (also refer to 23 21 705).
Screw on elements (1 and 2).

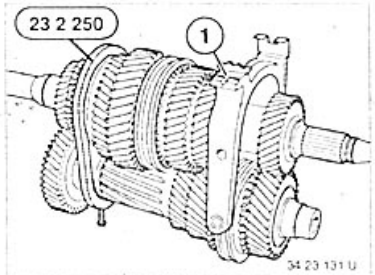
Installation:
Install bolts with a bolt cement**.
Tightening torque*.



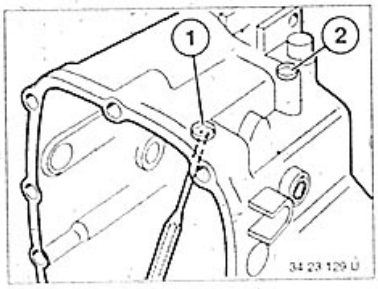
Lever out radial oil seals (3 and 4) for the output shaft and shift shaft.



Take out gear set with 1st/2nd and 3rd/4th gear shift arms and layshaft.

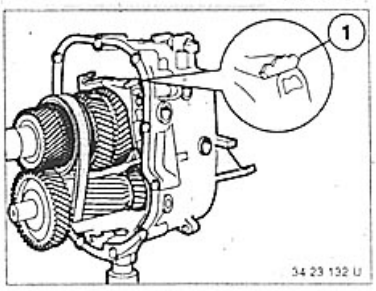


Compress the gear set at the 5th/reverse gear operating sleeve with the layshaft.
Use Special Tool 23 2 250.
Place 3rd/4th gear shift arm with slide on the 3rd/4th gear operating sleeve.
Have the shift arm bear on the 3rd gear of the output shaft.
Install shift arm with lock (1) in direction of the left-hand 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.

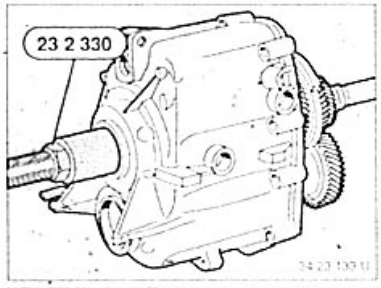
Installation:
Replace sealing caps.



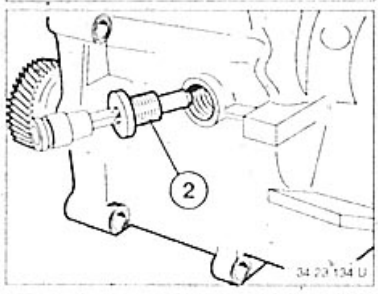
Place gear set with shift arm in the rear case section.
Place 1st/2nd gear shift arm with slide in the 1st/2nd gear operating sleeve.

Important!
Mount the shift arm with lock (1) in direction of the left-hand side input shaft.

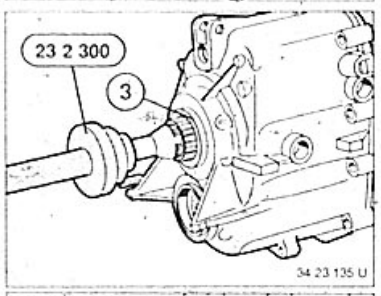
* See Specifications
** Source of Supply: BMW Parts



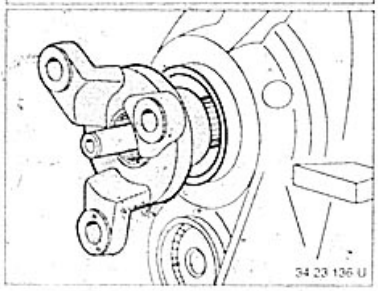
Apply Special Tool 23 2 330 on the output shaft journal.
Pull output shaft in to fit tight with Special Tool 23 2 330.
Make sure that shift arms and layshaft are not canted while pulling in; align if necessary.
Remove Special Tool 23 2 330.



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*.

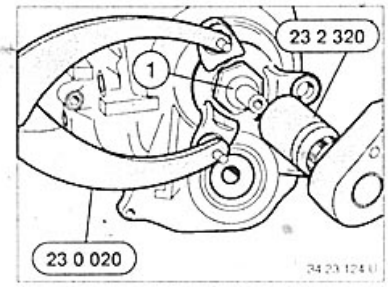


Lubricate sealing lip of radial oil seal with oil.
Drive in radial oil seal (3) for the output flange with Special Tool 23 2 300.

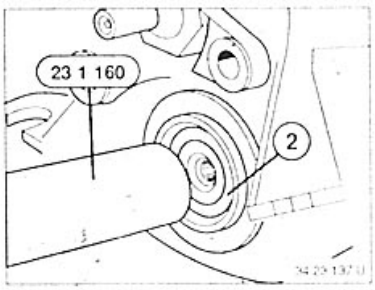


Heat output flange to about 80° C with a hot air blower.
Slide output flange on to the output shaft.
If necessary, drive on to fit tight with Special Tool 23 1 160.

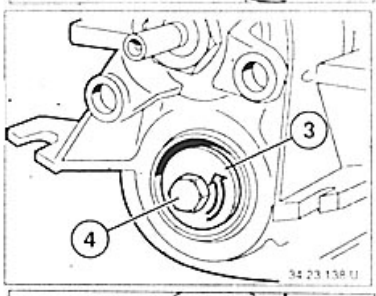
* See Specifications



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*.

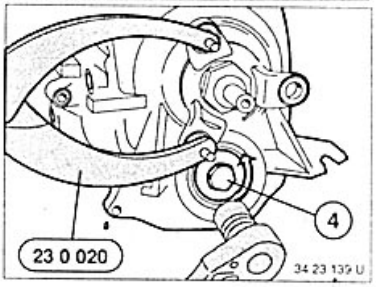


Heat ball bearing inner race (2) for layshaft to about 80° C with a hot air blower.
Press on ball bearing inner race (2) to fit tight with Special Tool 23 1 160; drive on with light knocks if necessary.



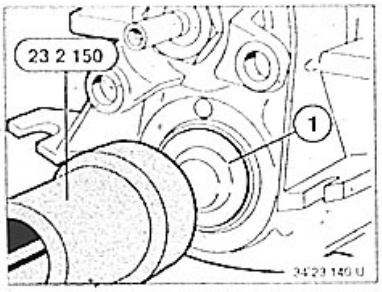
Install washer (3) and bolt (4) with bolt cement**.

Important!
Bolt (4) has left-hand threads.

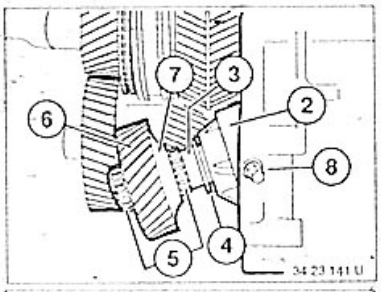


Remove Special Tool 23 2 250 from the gear set.
Engage a gear.
Hold output flange with Special Tool 23 0 020.
Tighten bolt (4).
Tightening torque*.
Disengage the gear.

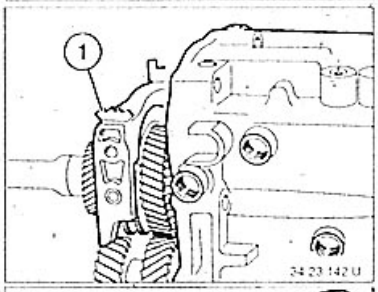
* See Specifications
** Source of Supply: BMW Parts



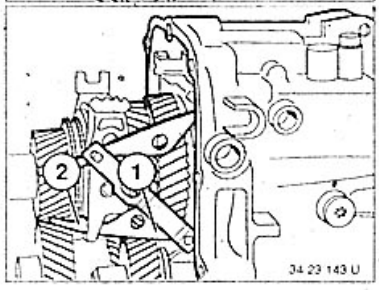
Insert and drive in sealing cap (1) flush with Special Tool 23 2 150.



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.

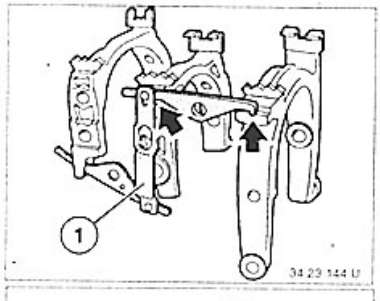


Install 5th/reverse gear shift arm and slide with catch (1) facing to the left in the 5th/reverse gear operating sleeve.

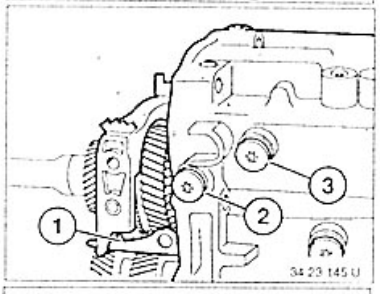


Guide in locking lever (1) with long tongue (2) in the slot of the 5th/reverse gear shift arm.

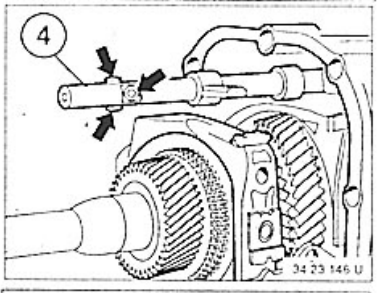
* See Specifications
** Source of Supply: BMW Parts



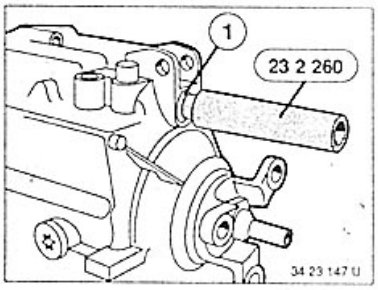
Swing locking lever (1) towards the inside and in so doing attach it in the openings of the 1st/2nd and 3rd/4th gear shift arms.



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.

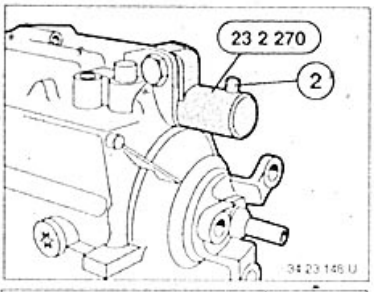


Guide in shift shaft (4) horizontally.
Hold four needles in position with grease.

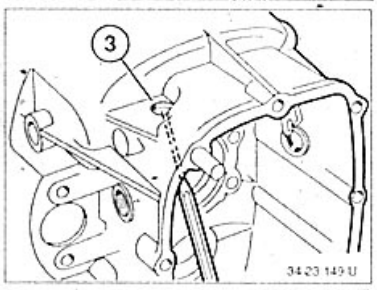


Drive in radial oil seal (1) for the shift shaft with Special Tool 23 2 260.

* See Specifications

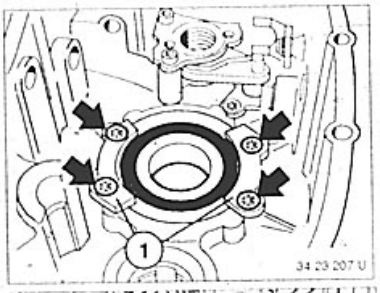


Hold the shift shaft in neutral position with Special Tool 23 2 270.
Use a 8 mm bolt and cylindrical pin (2) from the shift joint or a suitable mandrel for holding the shift shaft.



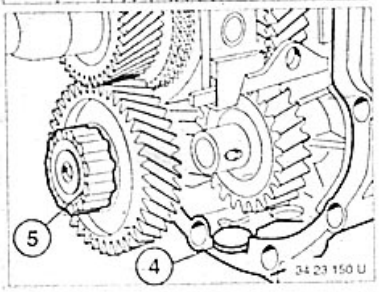
Clean the front case section.
Drive out sealing cap (3) for the catch pin from inside to outside using a punch.

Installation:
Replace sealing cap.



Replace bearings or elements for bearing brackets of the output shaft (also refer to 28 21 705).
Unscrew elements (1).

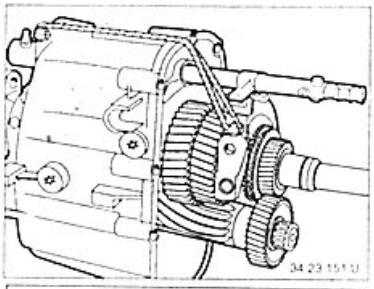
Installation:
Install bolts with a bolt cement**.
Tightening torque*.



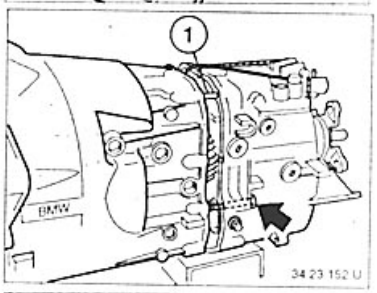
Place magnet (4) in the rear case section.
Install needle bearing (5) with the small diameter end on the outside.

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**.

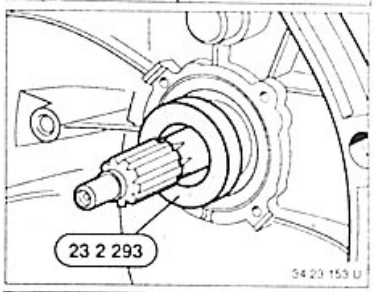
* See Specifications
** Source of Supply: BMW Parts



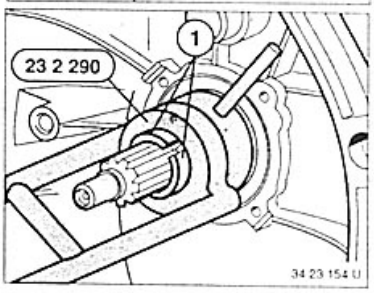
Hold the 5th/reverse gear shift arm in horizontal position with a piece of string to make installation easier.



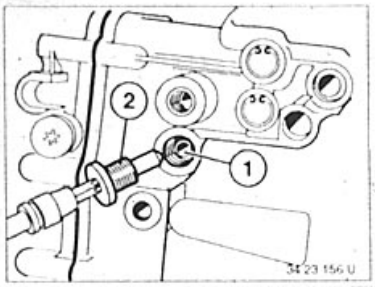
Mount the front case section as far as centering pins (1).
Screw two 8 x 75 mm bolts into the rear case section opposite each other on the left and right sides to center the case.



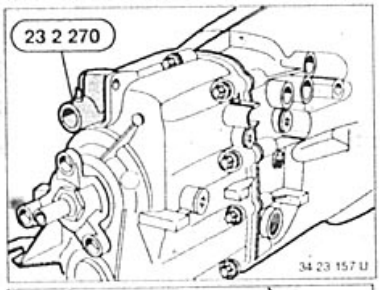
Place Special Tool 23 2 293 (thrust ring) from Special Tool 23 2 290 in the front case section.



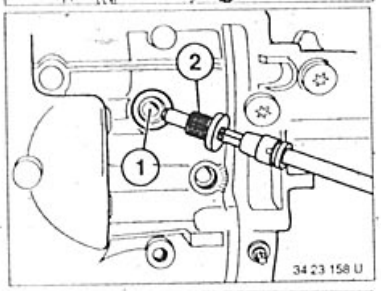
Apply Special Tool 23 2 290 on the input shaft.
Place supporting shells (1) on the input shaft that the tapered sides face in.
Unscrewing the spindle presses the front case section on to the input shaft.



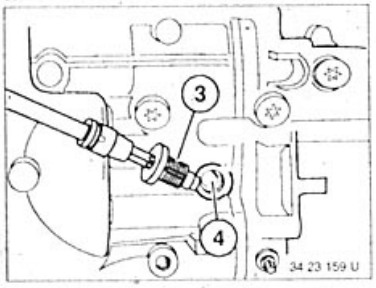
Press the front case section on only so far that the piece of string can still be removed after installation of the right bearing shaft.
Center 5th/reverse gear shift arm (1) with the bore and screw in the right bearing shaft (2) by hand, but do not tighten.
Remove piece of string.
Press on the front 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.

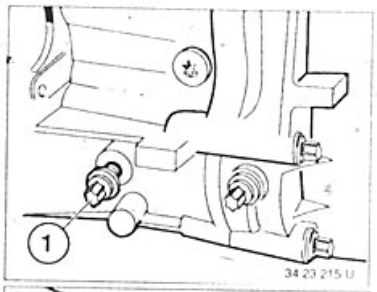


Center 5th/reverse gear shift arm (1) with the bore and screw in the left bearing shaft (2) by hand.
Tighten left and right bearing shafts (2).
Tightening torque*.

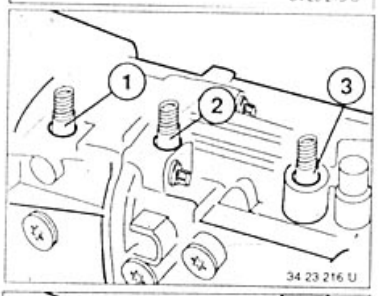


Install bearing shaft (3) for the locking lever.
This requires turning the transmission until bore (4) in the locking lever is aligned with the bore in the case.
In this position screw in bearing shaft (3) by hand and then tighten:
Tightening torque*.

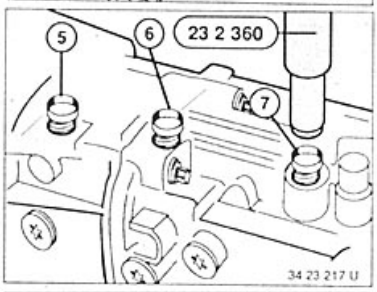
* See Specifications



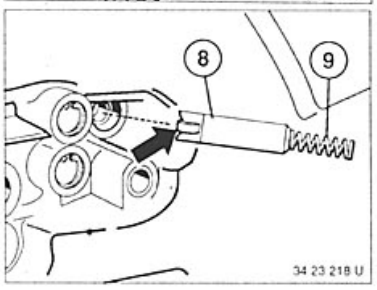
Coat shoulder of the bolt head with a sealing compound**.
Install bolt (1) for the reverse gear shaft bolt with a bolt cement**.
Tighten bolt bolts.
Tightening torque*.



Place catch pins (1 ... 3) with springs in the shift arms.



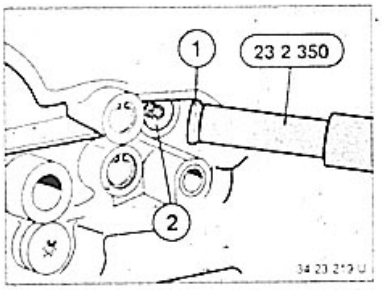
Knock in sealing caps (5 ... 7) with Special Tool 23 2 360.



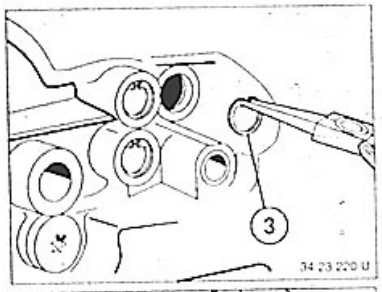
Catch pin (8) and spring (9)

Important!
Check installed position of catch pin (8).
Roller must be horizontal.

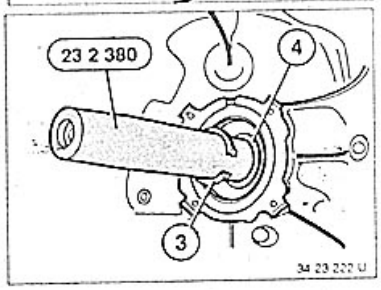
* See Specifications
** Source of Supply: BMW Parts



Install sealing cap (1) in bore (2) with help of Special Tool 23 2 350 and push in as far as possible.

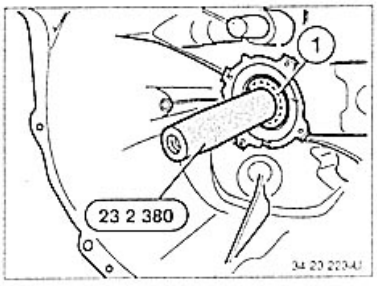


Install circlip (3) and press in as far as groove with Special Tool 23 2 350.
Check for correct seating of the circlip (visual inspection).
Install the reverse gear switch.

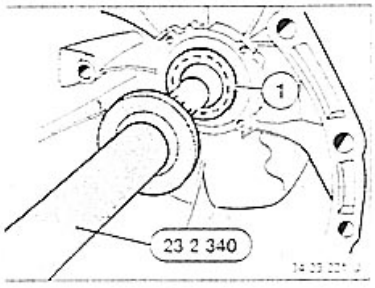


Install spacer (4).

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.

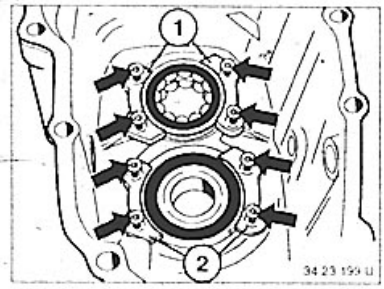


Lubricate sealing lip of the radial oil seal with ATF.
Apply Special Tool 23 2 380 on the input shaft.
Push on radial oil seal (1) as far as the case.



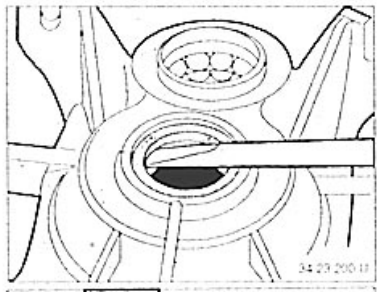
Remove Special Tool 23 2 380.
Drive in radial oil seal (1) flush with Special Tool 23 2 340.
Mount guide tube.
Tightening torque*.

* See Specifications



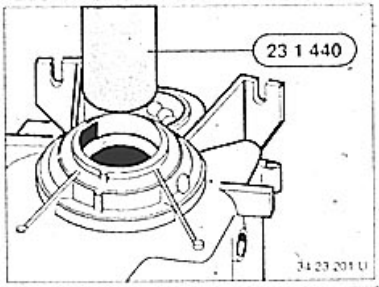
23 21 705 REPLACING BEARINGS OF ALL TRANSMISSION SHAFTS
– Input and Output Shafts Removed –

Rear Case Section:
Unscrew bolts.
Remove elements (1 and 2).

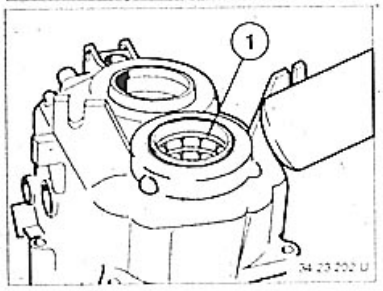


Lever out radial oil seal for the output flange.

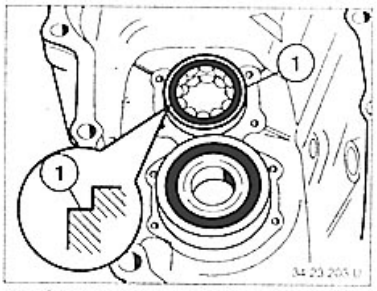
Installation:
Replace radial oil seal.



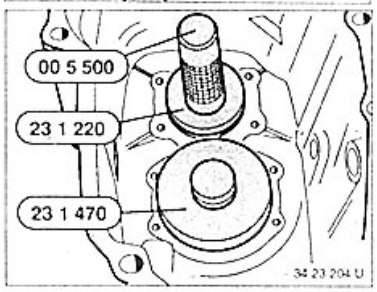
Drive out the ball bearing for the output shaft toward the inside, using Special Tool 23 1 440.



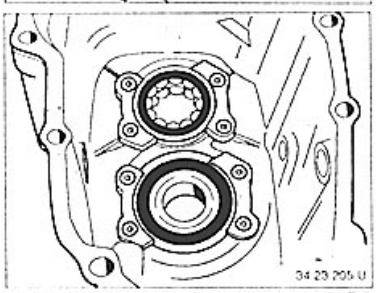
Layshaft:
Heat case in area of the ball bearing to about 80° C with a hot air blower.
Remove ball bearing (1) toward the inside.
Clean the rear case section to remove dirt.



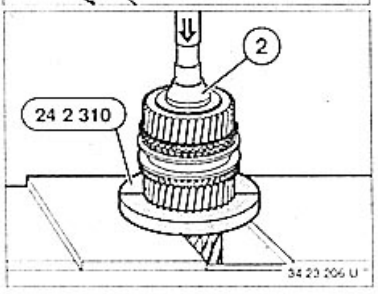
Heat rear case section in area of the ball bearing uniformly to about 80° C with a hot air blower.
Install ball bearings for output shaft and layshaft.
Insert ball bearing for the layshaft with the shouldered end (1) facing in.



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.

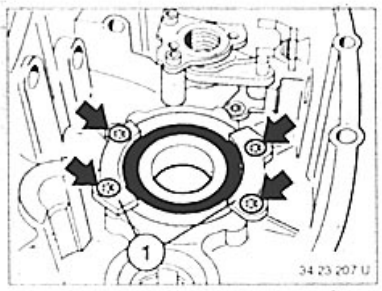


Install elements.
Install bolts with a bolt cement and tighten.**
Tightening torque*.



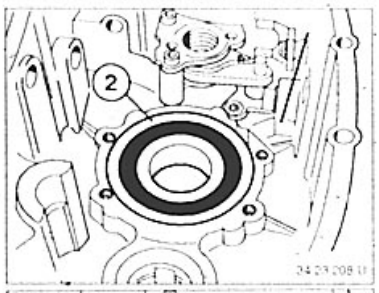
The 3rd/4th gear has to be pressed off with Special Tool 23 2 310 to be able to replace bearing inner race (2).
Removal – refer to "Replacing 3rd/4th Gear Synchronization" in 23 23 507.

* **See Specifications**
** **Source of Supply: BMW Parts**

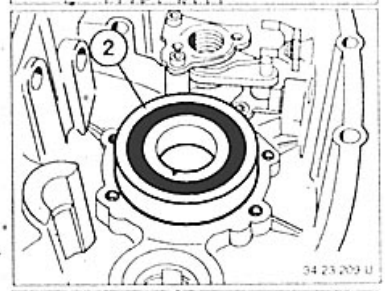


Bearings in Front Case Section

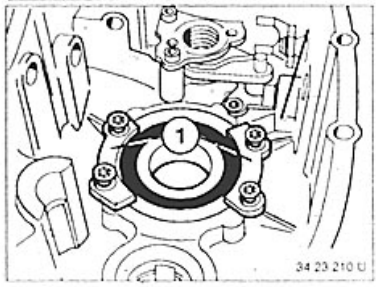
Input shaft:
Unscrew bolts.
Remove elements (1).



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.

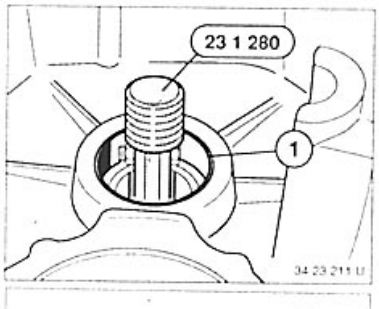


Heat case in area of the ball bearing to about 80° C with a hot air blower.
Install ball bearing (2); if necessary drive it in to fit tight with Special Tool 23 1 470.



Install elements (1).
Install bolts with a bolt cement and tighten.**
Tightening torque*.

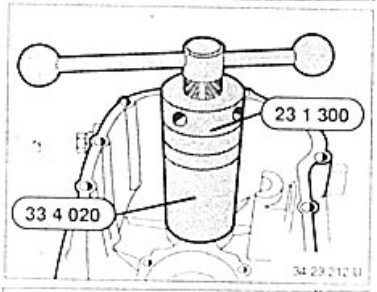
* See Specifications
** Source of Supply: BMW Parts



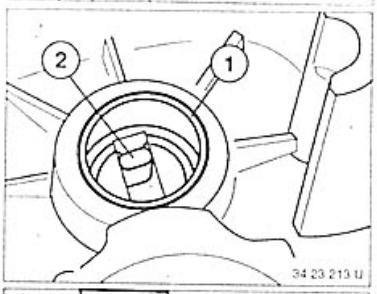
Layshaft:

1 = bearing shell for needle bearing

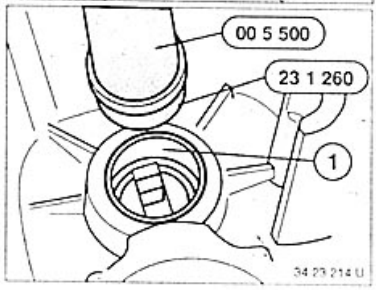
Place Special Tool 23 1 280 in bearing shell (1).



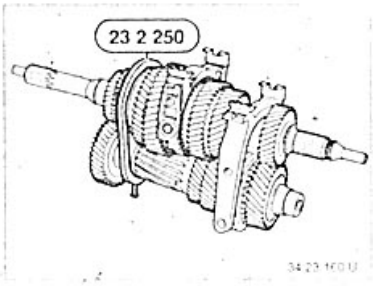
Apply Special Tool 33 4 020.
Screw on Special Tool 23 1 300.
Pull bearing shell out.



Installation:
Insert bearing shell (1) that the slot in the bearing shell is aligned with beads (2) (turning lock) in the case.

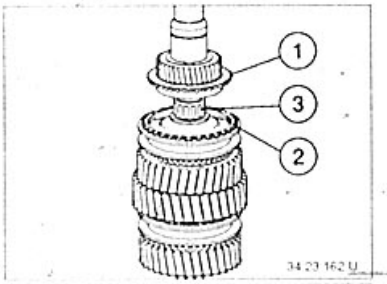


Drive in bearing shell (1) with Special Tools 23 1 260 and 00 5 500.

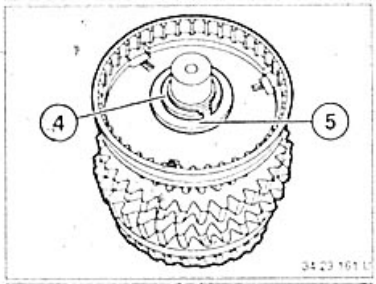


23 23 507 DISASSEMBLING AND ASSEMBLING COMPLETE SYNCHRONIZATION

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 input shaft (1), synchromesh ring (2) and needle bearing (3).

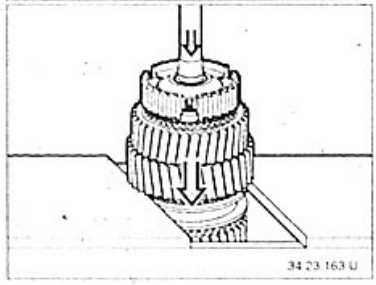


Clamp gear set in a vise fitted with soft jaws on the output shaft.
Pull off the 5th/reverse gear operating sleeve.

Important!
Loose thrust pieces, balls and springs.

Remove circlip (4) and spacer (5).

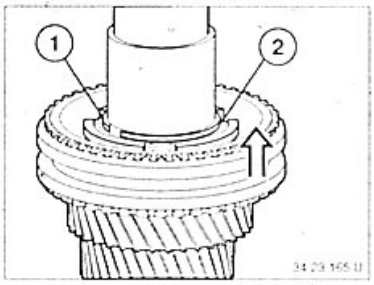
Installation:
Replace circlip (4).



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.



Pull off the needle bearing, synchromesh ring, intermediate ring and outer race.

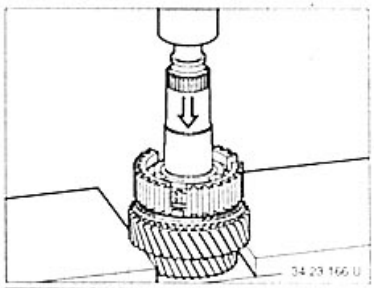


Pull off the 1st/2nd gear operating sleeve.

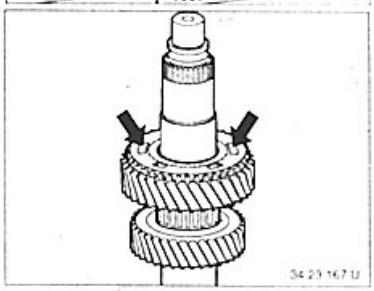
Important!
Loose thrust pieces, balls and springs.

Lift out circlip (1).
Take off spacer (2).

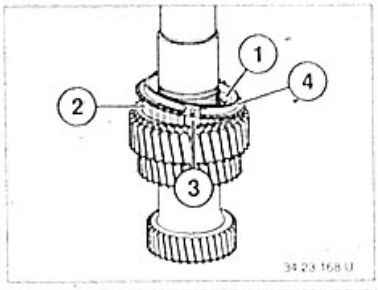
Installation:
Replace circlip (1).



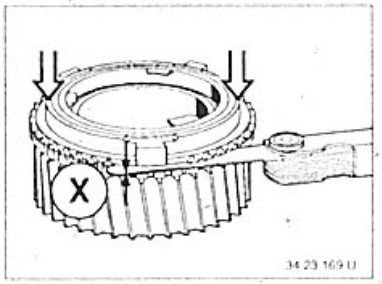
Place pressing-off liners on the 2nd gear.
Press the guide sleeve, 2nd gear with synchromesh ring and needle bearing off of the output shaft.



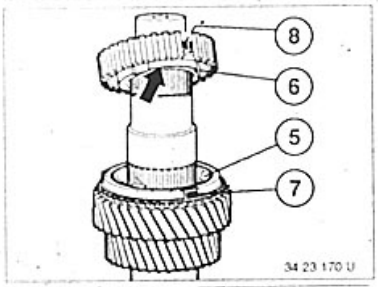
Assembling Gear Set:
Mount needle bearing and 2nd gear with the openings facing up.



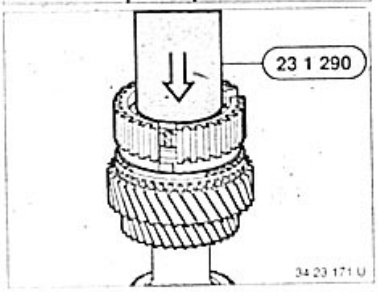
Install synchronization, consisting of:
Inner race (1), intermediate ring (2) with dogs (3) in the openings of the 1st gear and synchromesh ring (4).



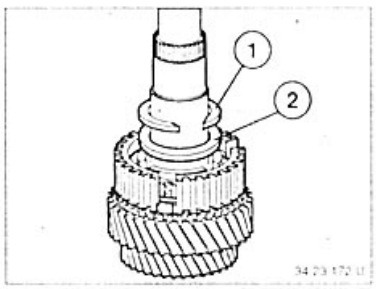
Inspect the 2nd gear synchronization for wear.
Measure distance X between the gear and synchromesh ring.
In so doing press down uniformly on the synchromesh ring by hand.
Specification: at least 0.9 mm.
Actual new part distance: 1.1 ... 1.6 mm.
When replacing, all three parts must be replaced at one time.



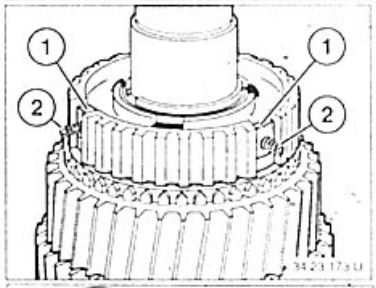
Heat guide sleeve to about 80° C with a hot air blower.
Mount the guide sleeve with the long shoulder facing the 2nd gear.
When mounting make sure that dogs (5) of the inner race are aligned with openings (6) in the gear.
In addition dogs (7) on the synchromesh ring must engage in grooves (8) of the guide sleeve.



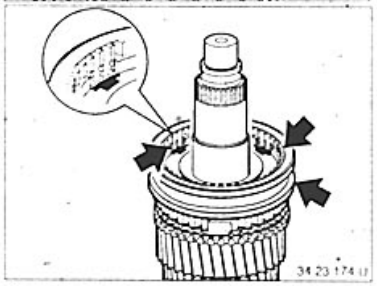
Press on guide sleeve to fit tight with Special Tool 23 1 290.



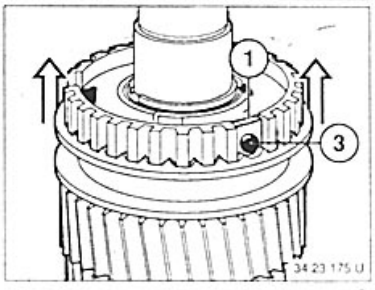
Install spacer (2).
Insert circlip (1).
The circlip must seat in the groove without play; if necessary replace spacer (1).
Spacers are available in different thicknesses in steps from 1.8 to 2.05 mm.



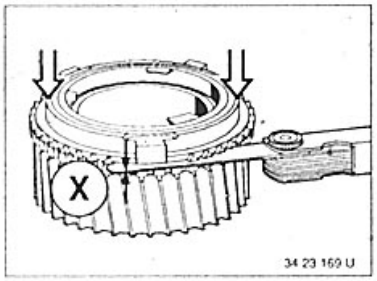
Place three thrust pieces (1) and three springs (2) in the opening of the guide sleeve.



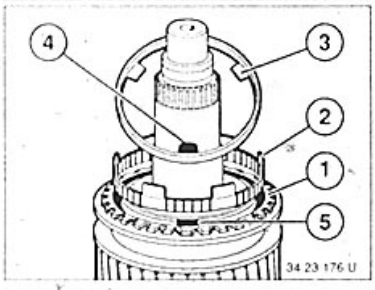
Mount the 1st/2nd gear operating sleeve with the flat side facing up or the bevelled side facing the 2nd gear.
The three set-back or opened teeth must point to the springs.



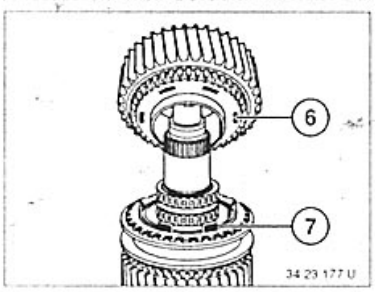
Tilt thrust pieces (1) out of the operating sleeve separately far enough that balls (3) can be placed on the springs.
Push in balls (3) and simultaneously press the thrust pieces into the operating sleeve.
Pull the operating sleeve upwards uniformly as far as the lock (neutral position).



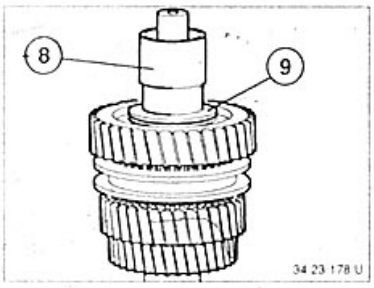
Inspect the 1st gear synchronization for wear.
Measure distance X between the gear and synchromesh ring.
In so doing press down uniformly on the synchromesh ring by hand.
Specification: at least 0.9 mm.
Actual new part distance: 1.1 ... 1.6 mm.
When replacing, all three parts must be replaced at one time.



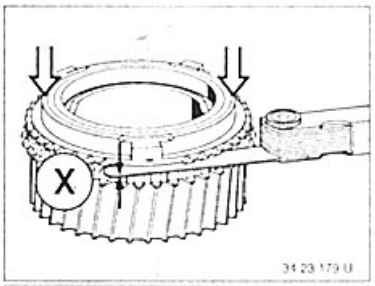
Install synchromesh ring (1), intermediate ring (2) and inner race (3) with dogs (4) in openings (5) of the guide sleeve.



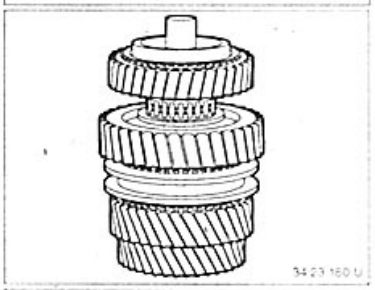
Mount needle bearing.
Install the 1st gear with grooves (6) facing the dogs (7).



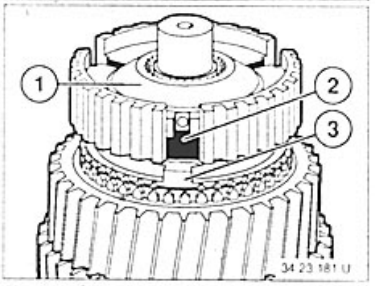
Heat thrust washer (9) and bearing sleeve (8) to about 80° C with a hot air blower and install then on the output shaft, pressing on if necessary.
Use Special Tool 23 1 290 for thrust washer.
Use Special Tool 33 1 342 for bearing sleeve.



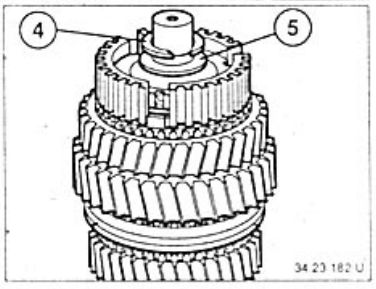
Inspect the reverse gear synchronization for wear.
Measure distance X between the gear and synchromesh ring.
In so doing press down uniformly on the synchromesh ring by hand.
Specification: at least 0.5mm.
Actual new part distance: 0.7 ... 1.15 mm.



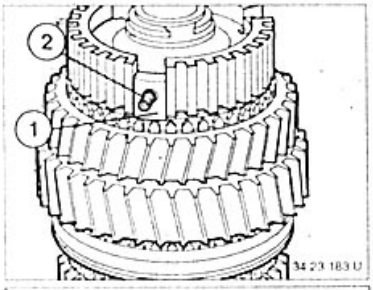
Mount the needle bearing and reverse gear.



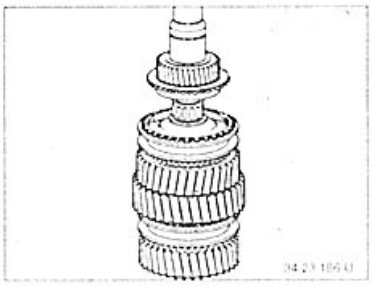
Place the reverse gear synchromesh ring on the reverse gear cone.
Heat the 5th/reverse gear guide sleeve to about 80° C with a hot air blower and install it on the output shaft with conical end (1) facing up; if necessary press on to fit tight with Special Tool 33 1 342.
Make sure that dogs (3) engage in opening (2).



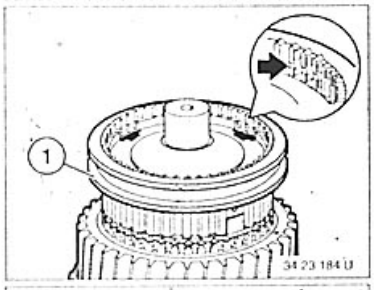
Install spacer (5) and circlip (4).
Circlip (4) must seat in the groove without play; replace spacer if necessary.
Spacers are available in different thicknesses in steps from 3.6 to 4.0 mm.
Knock in the circlip slightly.



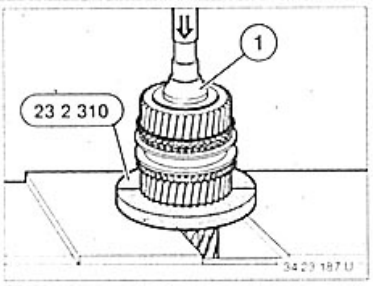
Place three thrust pieces (1) and three springs (2) in the opening of the guide sleeve.



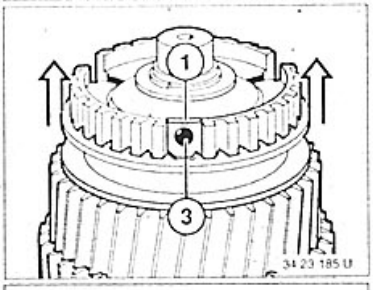
Install synchromesh ring.
Install needle bearing and input shaft with the 5th gear.



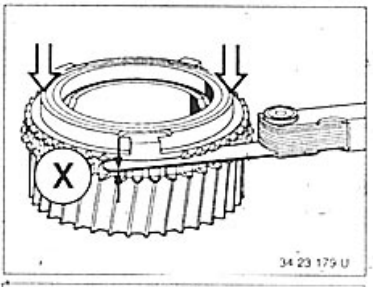
Install the operating sleeve with shouldered end (1) facing the reverse gear.



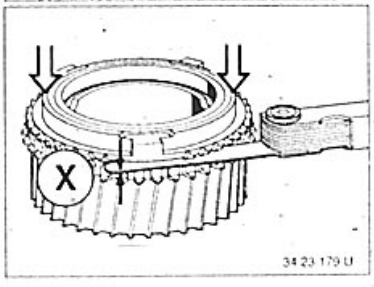
Layshaft:
Replace the 3rd/4th gear synchronization.
Apply Special Tool 23 2 310 on the 3rd gear.
Press bearing inner race (1), thrust washer, 4th gear with needle bearing, synchronization and 3rd gear with needle bearing off of the layshaft.



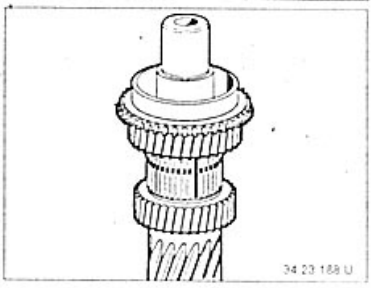
Tilt thrust pieces (1) out of the operating sleeve separately far enough that ball (3) can be placed on the springs.
Press balls (3) in and simultaneously push the thrust pieces into the operating sleeve.
Install the 5th gear synchromesh ring in the operating sleeve.
Pull the operating sleeve upwards uniformly as far as the lock (neutral position).



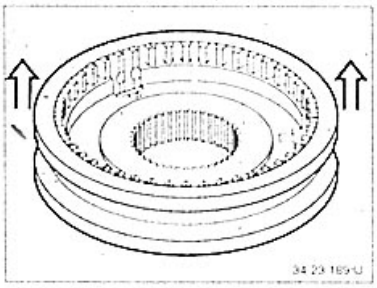
Assembling:
Inspect the 3rd/4th gear synchronization for wear.
Measure distance X between the gear and synchromesh ring.
In so doing press down uniformly on the synchromesh ring.
Specification: at least 0.75 mm.
Actual new part distance: 0.95 ... 1.35 mm.



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.

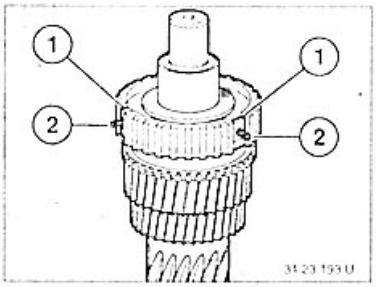


Install needle bearing and 4th gear.

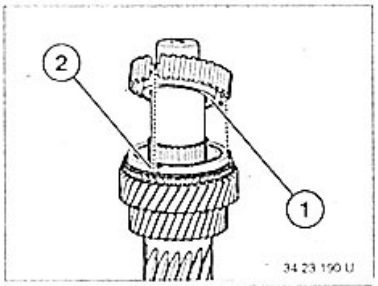


Pull the 3rd/4th gear operating sleeve off of the guide sleeve.

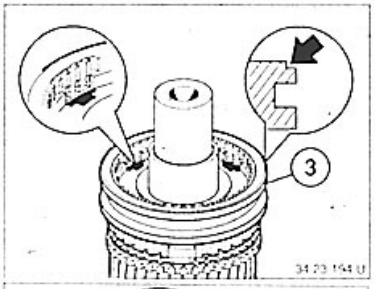
Important!
Loose balls, springs and thrust pieces.



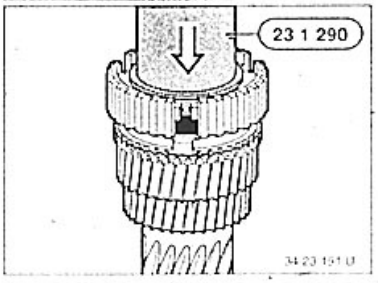
Insert three thrust pieces (1) and three springs (2) into the opening of the guide sleeve.



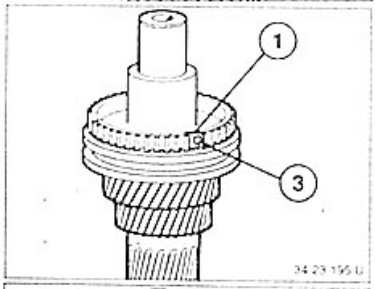
Place the synchromesh ring on the 3rd gear cone.
Heat the 3rd/4th gear guide sleeve to about 80° C with a hot air blower.
Install the guide sleeve with long shoulder (1) facing the 3rd gear.
When installing make sure that dogs (2) are aligned with the openings in the guide sleeve.



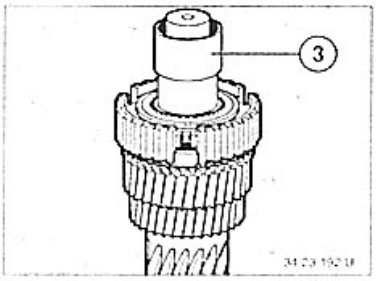
Install the 3rd/4th gear operating sleeve with the shouldered end (3) facing up.
The three set-back or opened teeth must point to the springs.



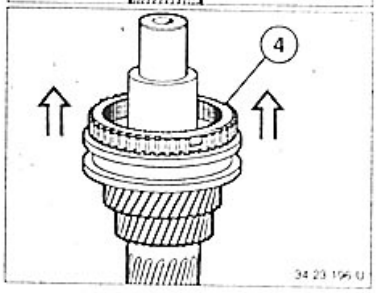
If necessary, press the guide sleeve on to fit tight with help of Special Tool 23 1 290.



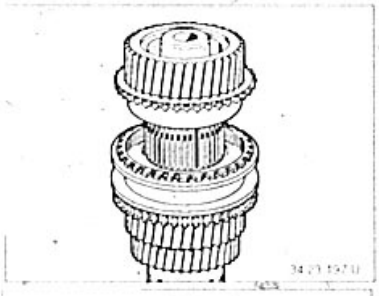
Tilt thrust pieces (1) out of the operating sleeve separately far enough that balls (3) can be placed on the springs.
Press balls (3) in and simultaneously push the thrust pieces into the operating sleeve.



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.

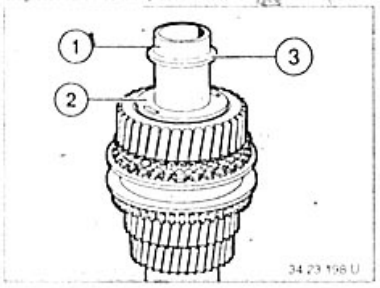


Install synchromesh ring (4) in the openings of the guide sleeve.
Pull the operating sleeve upwards uniformly as far as the lock (neutral position).



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.

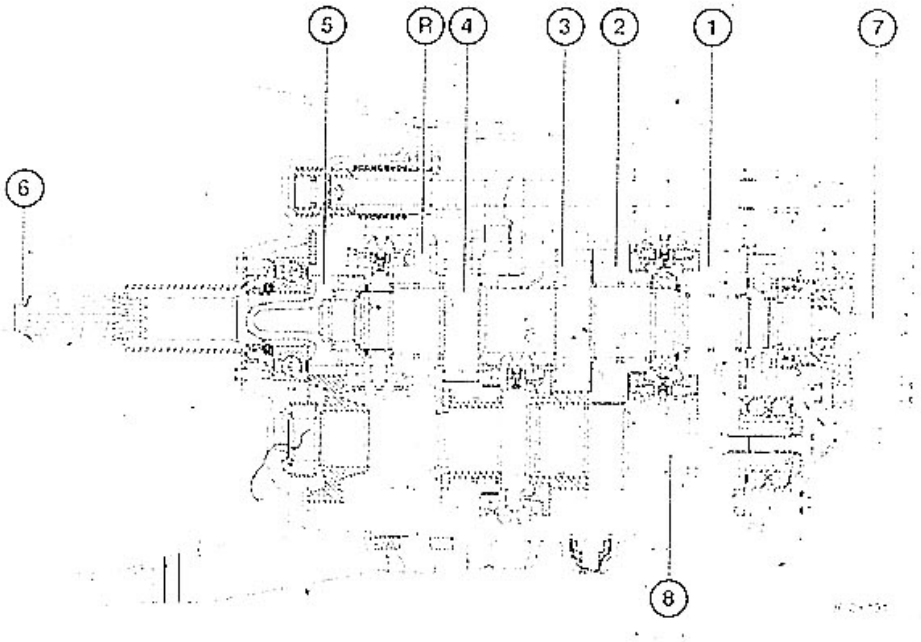


Heat thrust washer (2) and bearing inner race (1) to about 80° C with a hot air blower and install on the layshaft with shoulder (3) facing down.
If necessary, press them on to fit tight with help of Special Tool 23 1 160.

Construction group 23 Manual transmission

Five speed manual transmissions – type S5 D 200 G / 250 G

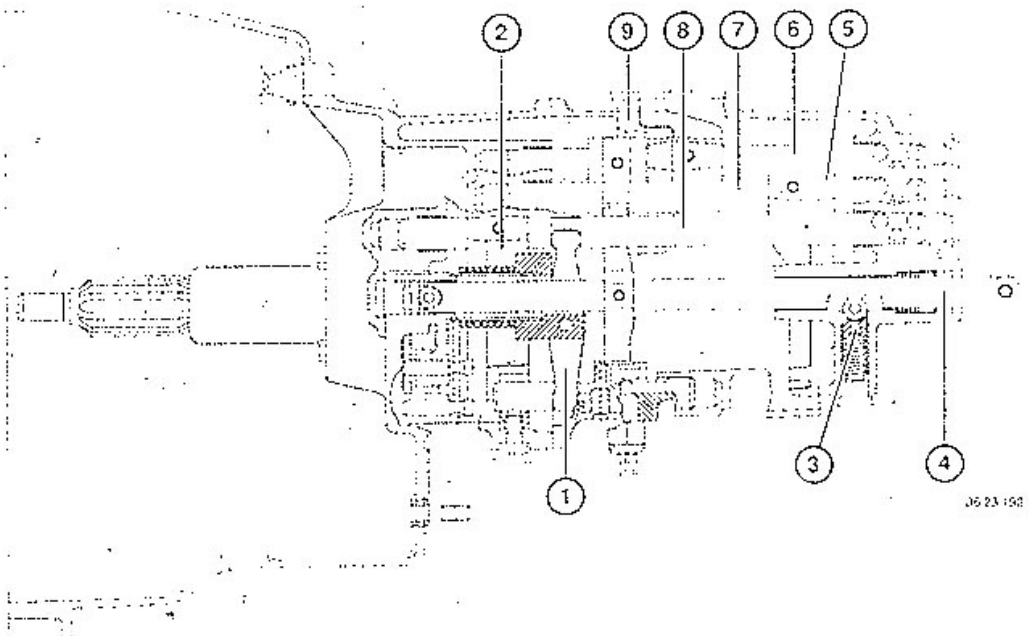
	Transmission – layout drawing	23- 450
	Shift elements – layout drawing	23- 451
23 12 506	Radial oil seal for input shaft – replace	23- 452
23 21 505	Input and output shaft assembly – remove and install	23- 453
706	Bearings of all transmission shafts – replace	23- 461
23 23 508	Synchronization – disassemble and assemble	23- 464



Cross Section Drawing of Transmission

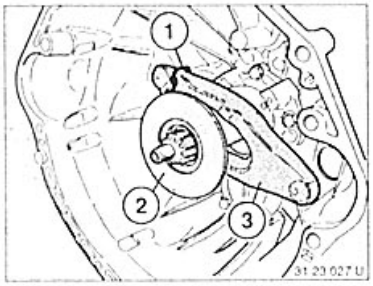
1 First gear
2 Second gear
3 Third gear
4 Fourth gear
5 Fifth gear
R Reverse gear
6 Input shaft
7 Output shaft
8 Layshaft

23-451



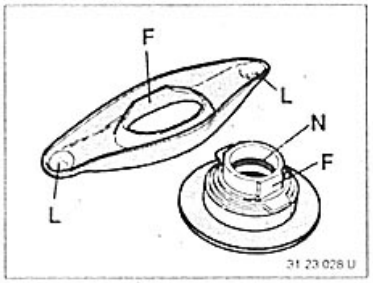
Cross Section Drawing of Shift Elements

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

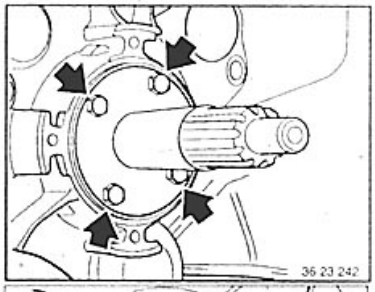


23 12 506 REPLACING RADIAL OIL SEAL FOR INPUT SHAFT

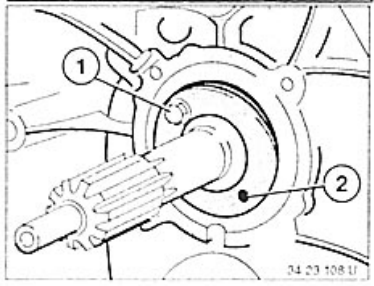
Remove transmission – refer to 23 00 023 in Model Repair Manual.
Lift out spring (1) and remove release lever (3) together with release bearing (2).



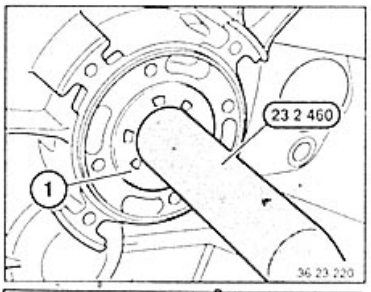
Installation:
Fill lubricating groove (N) with Klüber Microlube GL 261**.
Coat guides (F) and bearings (L) with Klüber Microlube GL 261**.
Non-conformance could cause seizure of the release bearing on the guide sleeve.



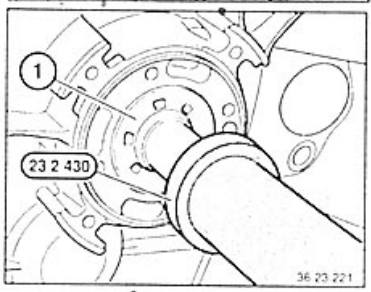
Unscrew guide tube.



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).



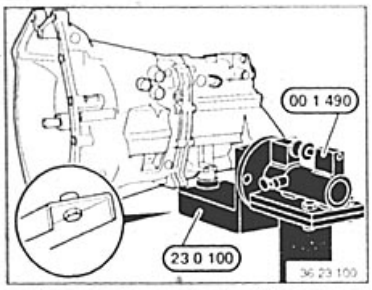
Lubricate sealing lip of radial oil seal with ATF.
Apply Special Tool 23 2 460 on the input shaft.
Slide on radial oil seal (1) as far as case.



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*.

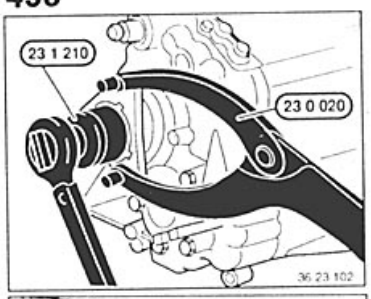
** Source of Supply: BMW Parts

* See Specifications

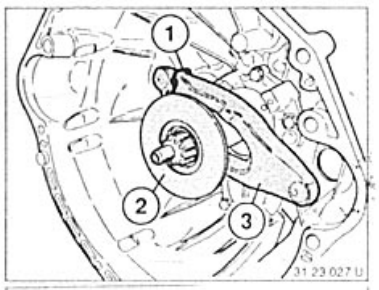


23 21 505 REMOVING AND INSTALLING INPUT AND OUTPUT SHAFT ASSEMBLY

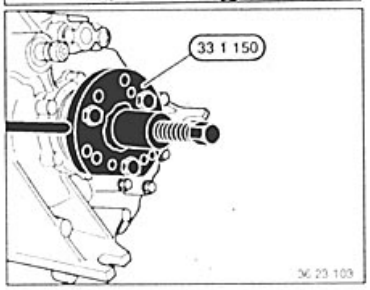
Remove transmission – refer to 23 00 023 in Model Repair Manual.
Unscrew drain plug.
Drain oil.
Screw Special Tool 23 0 100 into oil drain plug bore and secure.
Take up Special Tool 23 0 100 in Special Tool 00 1 490.



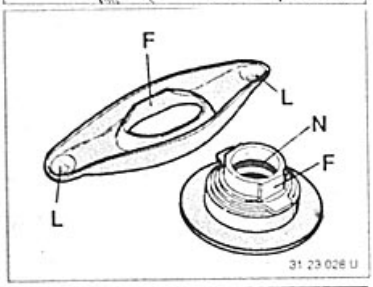
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.



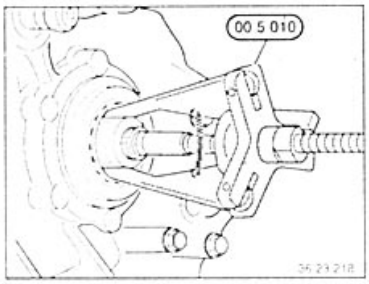
Lift out spring (1) and remove release lever (3) together with release bearing (2).



Pull off output flange by hand.
If too difficult, pull off output flange with Special Tool 33 1 150.

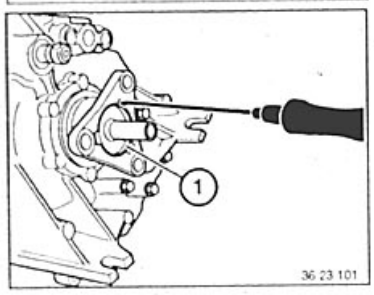


Installation:
Fill lubricating groove (N) with Klüber Microlube GL 261**.
Coat guides (F) and bearings (L) with Klüber Microlube GL 261**.
Non-conformance could cause seizure of the release bearing on the guide sleeve.



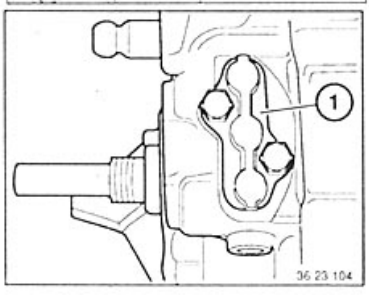
Pull out radial oil seal with Special Tool 00 5 010.

Installation:
Replace radial oil seal.



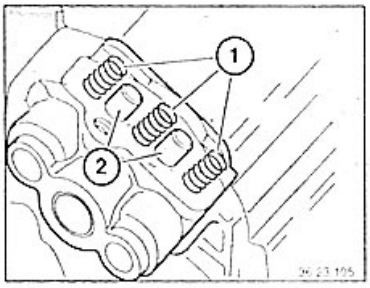
Lift out lock plate (1).

Installation:
Replace lock plate.

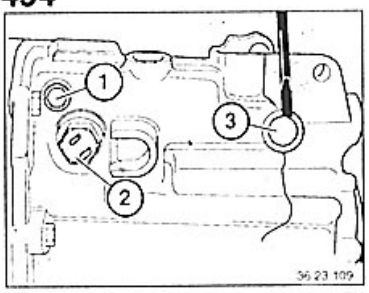


Unscrew end cover (1).

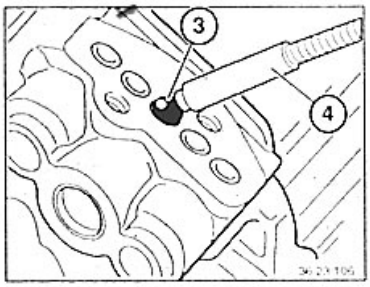
** Source of Supply: BMW Parts



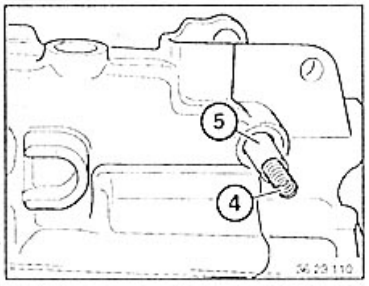
Remove springs (1) and pins (2).



Unscrew bolt (1) and reverse gear switch (2).
Lever out end cap (3).

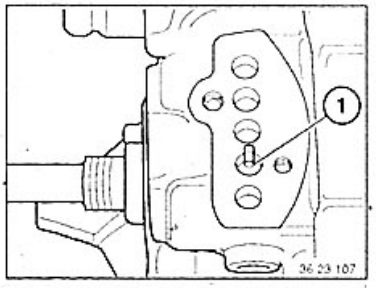


Remove arresting and locking balls (3) with help of magnet (4).

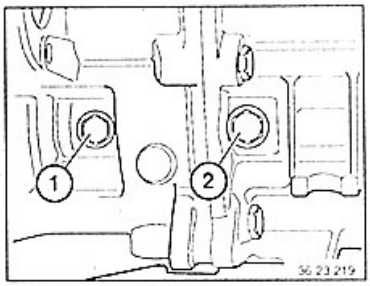


Remove spring (4) and catch pin (5).

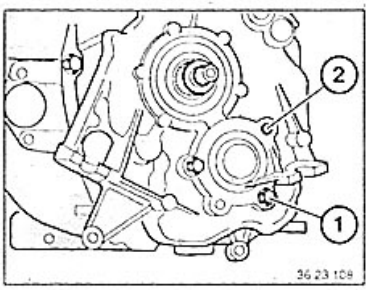
Installation:
Check installed position.



Position lock pin (1) in the middle.
To hold in this position the second gear must be engaged by hand.

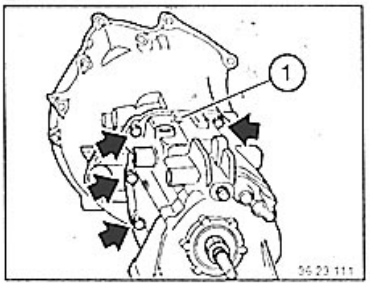


Unscrew reverse gear shaft mounting bolts (1 and 2).

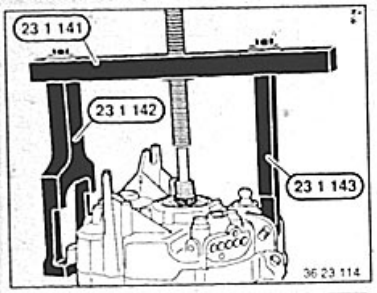


Unscrew four bolts (1) from cover.

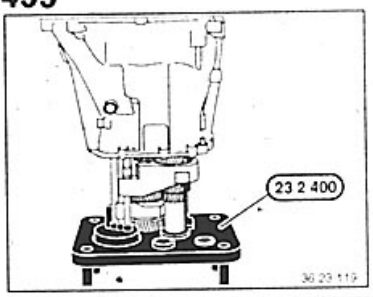
Important!
Pay attention to insulators (2) under heads of bolts.



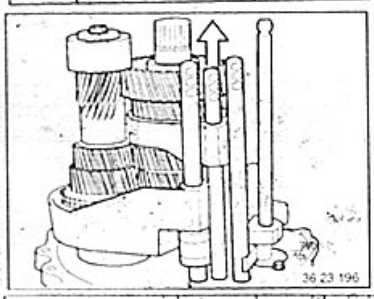
Loosen transmission case bolts.
Drive out two cylindrical pins (1) with a mandrel.



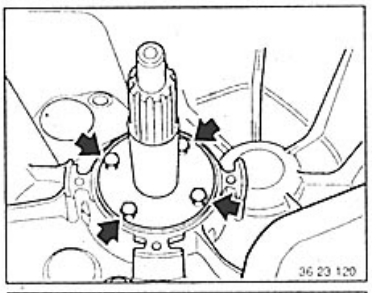
Remove transmission from Special Tool 00 1 490 and turn transmission to have it standing upright.
Mount Special Tool 23 1 141 on lower case section with help of Special Tools 23 1 142 and 23 1 143.
Pull off rear case section.



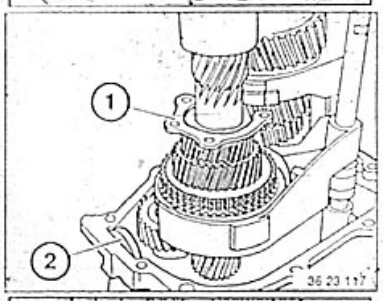
Place gear assembly set and front case section on Special Tool 23 2 400.



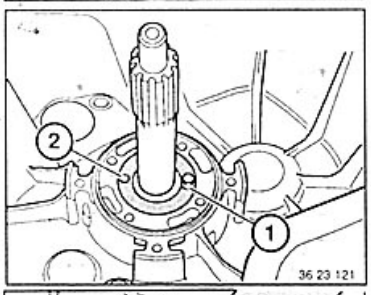
Disengage second gear by hand (neutral).



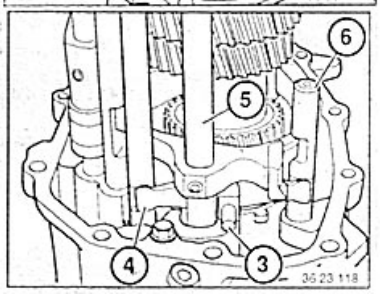
Unscrew guide tube.



Remove holder (1) and magnet (2).

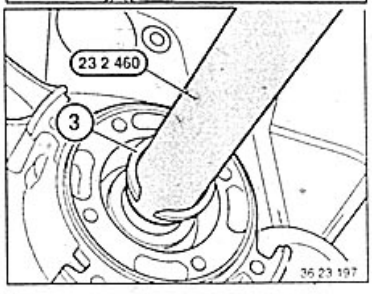


Remove radial oil seal.
Locate and puncture through bores (1 and 2) with a scriber.
Drive in radial oil seal to one side as far as stop.
Screw a suitable self-tapping screw into the opposite bore.
Remove radial oil seal by pulling out on the self-tapping screw (use pliers).



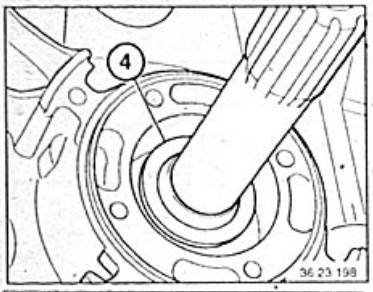
Remove shaft pin (3) and reversing lever (4).
Take off shift rail (6).
Pull out shift shaft (5).

Important!
Rollers.

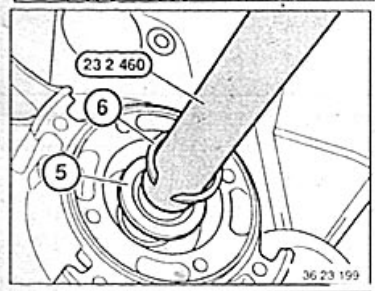


Important!
Special Tool 23 2 460 must be used on the input shaft when removing circlip (3), in order to avoid damaging the input shaft.
Lift out first circlip (3) and pull off over Special Tool 23 2 460.

Installation:
Replace circlip (3).



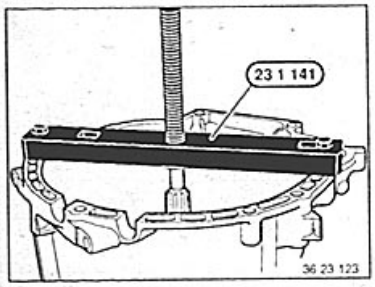
Pull off Special Tool 23 2 460.
Remove locking ring (4).



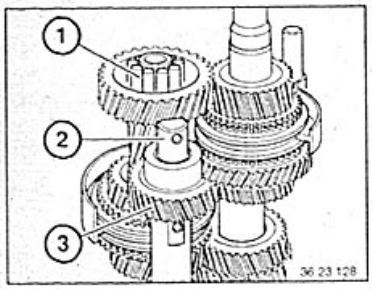
Important!
Special Tool 23 2 460 must be used on the input shaft when removing circlip (6), in order to avoid damaging the input shaft.
Lift out second circlip (6) and secure to Special Tool 23 2 460.
Pull Special Tool 23 2 460 with circlip (6) off of input shaft.

Installation:
Replace circlip (6).

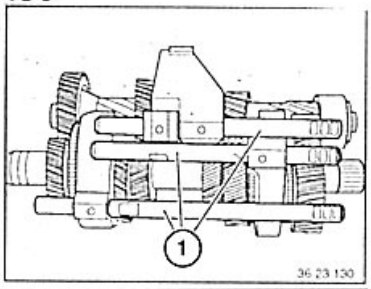
Lift out spacer (5).



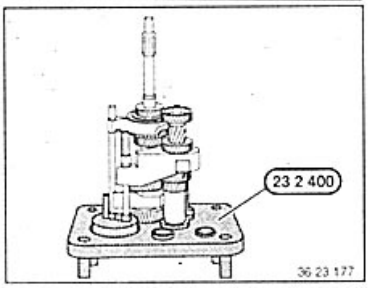
Apply Special Tool 23 1 141 on front transmission case section and secure on outside with two bolts.
Pull front case section off of gear assembly set.



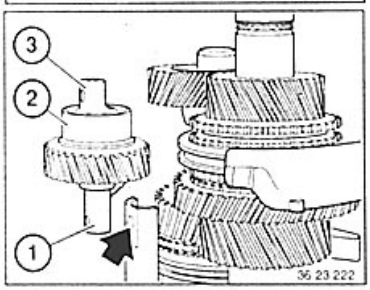
Remove roller bearing (1).
Remove reverse gear (3) and shaft (2).



Take gear assembly set with shift rods (1) off of Special Tool 23 2 400.

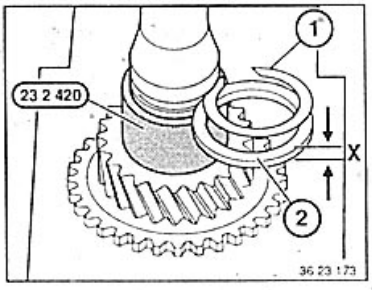


Installation:
Place complete gear assembly set with shift rods in Special Tool 23 2 400.



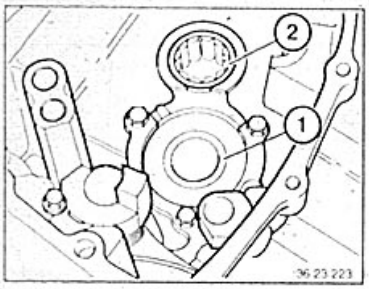
Install reverse gear with collar (2) facing up and shaft with long end (1) in Special Tool 23 2 400 and secure with one bolt.

Important!
Coat outside of short end (3) of reverse gear shaft with Loctite No. 574**.

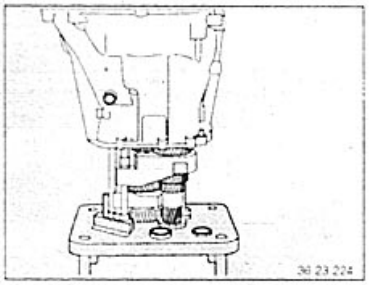


Check axial play of input shaft.
Apply Special Tool 23 2 420 on input shaft.
Install spacer (2) and new circlip (1) in groove.
Measure axial play with a feeler gage blade.
Axial play = 0.04 mm.
Spacer (2) is available from Parts with thickness X of 2.3 to 2.65 mm.

** Source of Supply: BMW Parts

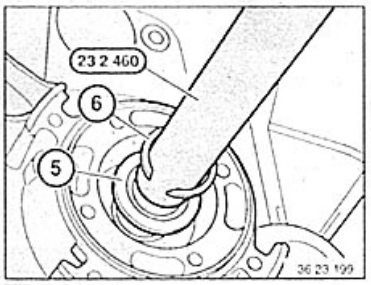


Align shift rods with each other.
Heat bearing inner race (1) of input shaft in front case section to about 110 ... 120° C (with hot air blower).
The heated temperature must be reached precisely — check with a temperature tester**.
Align shift rods with each other.
Insert roller bearing (2) after heating 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.

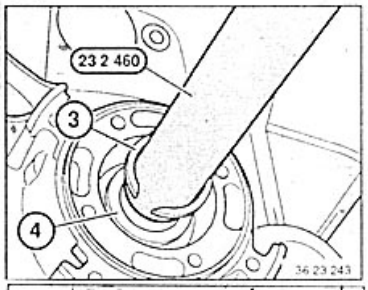
Note!
After assembling the complete transmission the fifth gear synchromesh ring can be loosened again by turning the input or output shaft.



Install spacer (5).

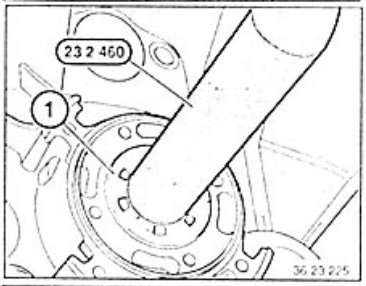
Important!
Special Tool 23 2 460 must be used on the input shaft when installing circlip (6), in order to avoid damaging the input shaft.
Slide circlip (6) over Special Tool 23 2 460 and into the second groove.

** Source of Supply: BMW Parts

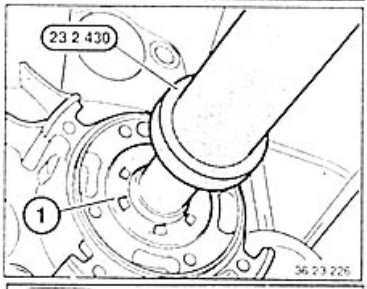


Insert locking ring (4).

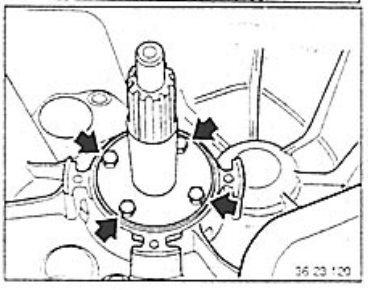
Important!
Special Tool 23 2 460 must be used on the input shaft when installing circlip (3), in order to avoid damaging the input shaft.
Slide circlip (3) over Special Tool 23 2 460 and into the first groove.



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.

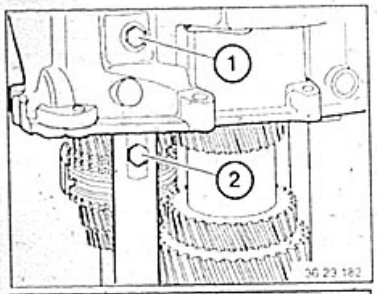


Drive in radial oil seal (1) with Special Tool 23 2 430.
Use a plastic hammer for driving in.

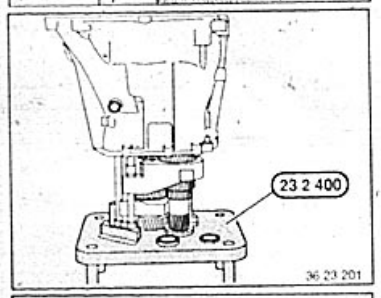


Mount guide tube.
Install bolts with bolt cement Loctite No. 242**.
Tightening torque*.

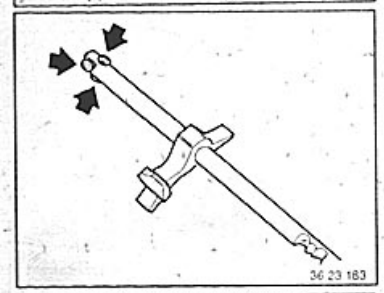
* See Specifications
** Source of Supply: BMW Parts



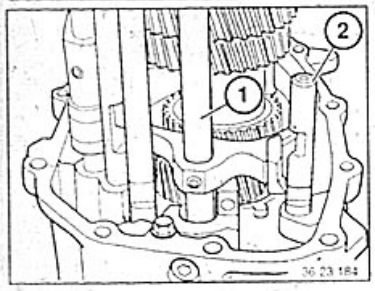
Mount reverse gear shaft on front case section.
Install bolt (1) with bolt cement Loctite No. 242** and tighten.
Tightening torque*.
Loosen bolt (2) on Special Tool 23 2 400.



Take front case section with gear assembly set off of Special Tool 23 2 400.
Position front case section with gear assembly set upright.

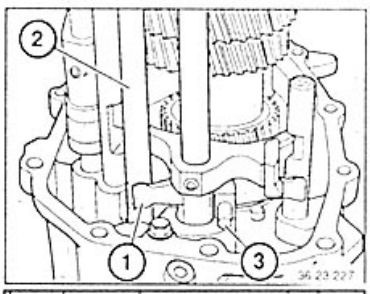


Hold four rollers on the shift shaft with help of grease.

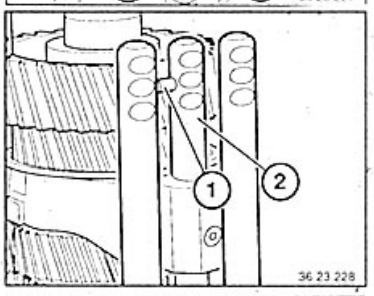


Place shift shaft (1) in front case section.
Install shift rail (2) with opening facing up towards case.

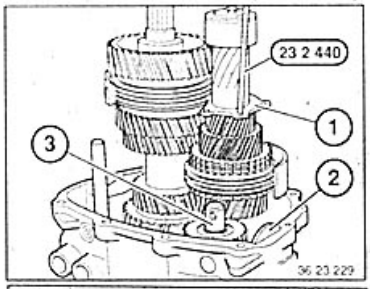
* See Specifications
** Source of Supply: BMW Parts



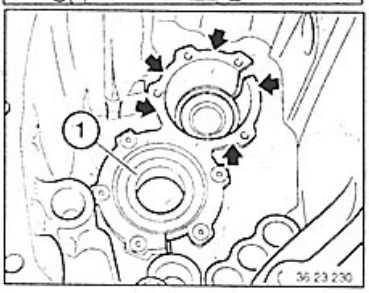
Install reversing lever with large round surface (1) facing 1st/2nd gear shift rod (2).
Ground surface must point towards case.
Hold reversing lever in position with pin (3).



Install lock pin (1) lubricated with grease in 1st/2nd gear shift rod (2) and secure in the middle.

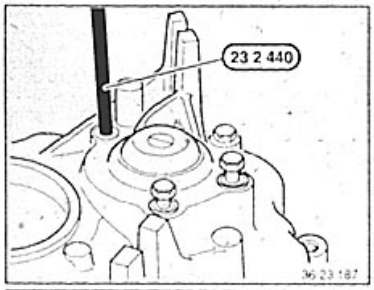


Clean and coat case sealing surfaces with Loctite No. 574**.
Mount holder (1) on 2nd gear of the layshaft with the straight end pointing towards the bearing.
Special Tool 23 2 440 must be screwed in for later assembly work.
Place magnet (2) in opening.
Align shift rods with each other.
Coat outside of reverse gear shaft (3) with Loctite No. 574**.

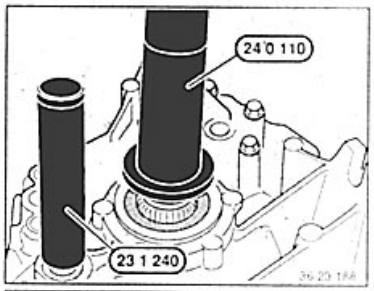


Lift out radial oil seal for shift shaft.
Heat bearing inner race (1) and rear case section in area of bearing to 110 ... 120° C (with hot air blower).
The heated temperature must be reached precisely — check with a temperature tester**.

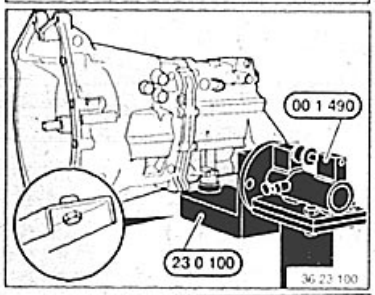
** Source of Supply: BMW Parts



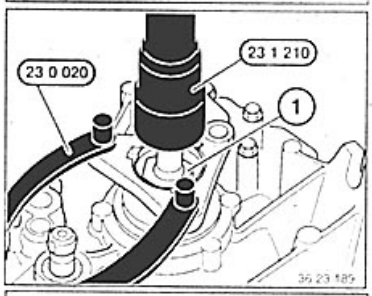
Mount rear case section as far as stop.
Install three bolts with new seals.
Remove Special Tool 23 2 440.
Screw in fourth bolt with a new seal.
Tighten all bolts.
Tightening torque*



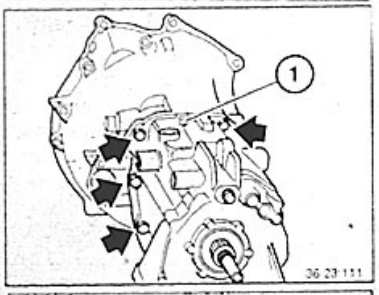
Install radial oil seals for shift shaft and output shaft.
Coat sealing lips with ATF.
Drive in radial oil seal for output shaft with Special Tool 24 0 110 and radial oil seal for shift shaft with Special Tool 23 1 240.
Use a plastic hammer for driving in.



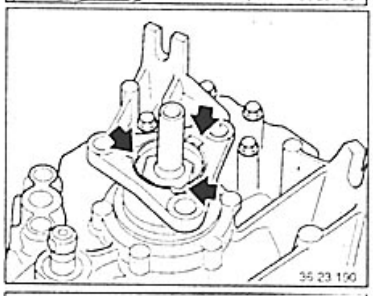
Lightly secure front and rear case sections with two bolts located opposite each other.
Take up transmission in Special Tools 23 0 100 and 00 1 490 again.



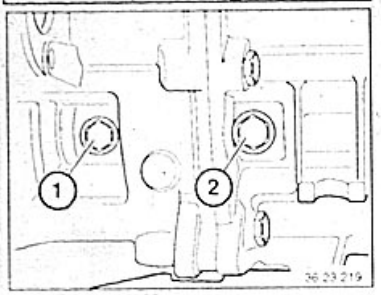
Heat output flange to about 80° C (with hot air blower) and install on output shaft, driving on to fit tight if necessary.
Install collar nut (1) with bolt cement Loctite No. 242**.
Hold output flange with Special Tool 23 0 020.
Tighten collar nut with Special Tool 23 1 210.
Tightening torque*.



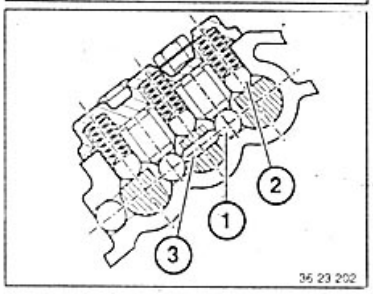
Drive in dowel pins (1).
Screw in and tighten all case bolts.
Tightening torque*.



Install and secure lock plate.



Loosen bolt (1) slightly.
Install reverse gear shaft bolt (2) with bolt cement Loctite No. 242**.
Tighten bolts (1 and 2).
Tightening torque*.

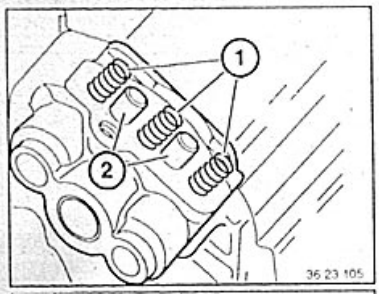


Install arresting and locking balls.

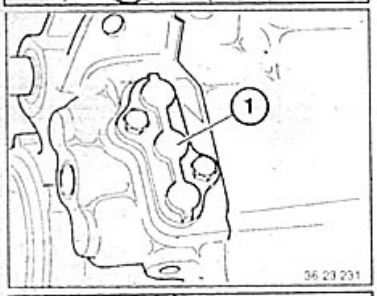
1 = Locking ball
2 = Arresting ball
3 = Lock pin

* See Specifications
** Source of Supply: BMW Parts

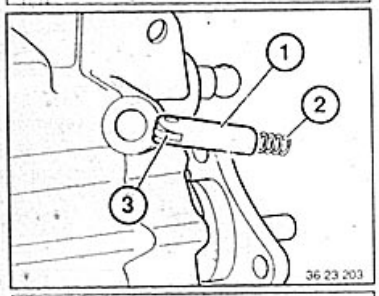
* See Specifications
** Source of Supply: BMW Parts



Install springs (1) and dowel pins (2).

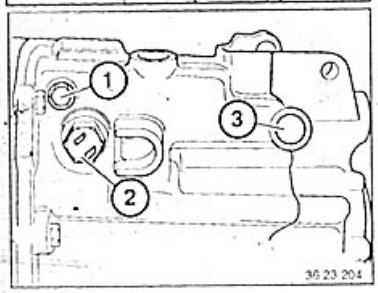


Mount end cover (1).
Install bolts with bolt cement Loctite No. 242** and tighten.
Tightening torque*.



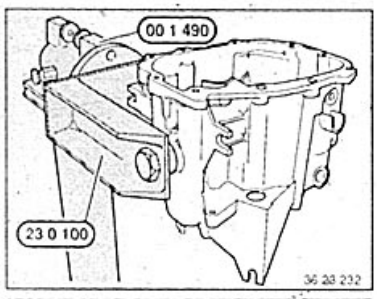
Install catch pin (1) and spring (2).

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).

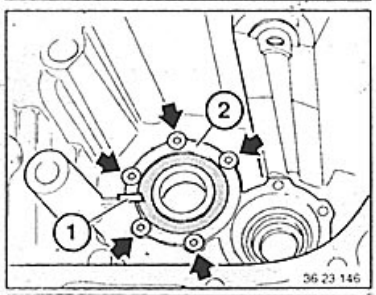
* See Specifications
** Source of Supply: BMW Parts



23 21 706 REPLACING BEARINGS OF ALL TRANSMISSION SHAFTS
– Input and Output Shafts Removed –

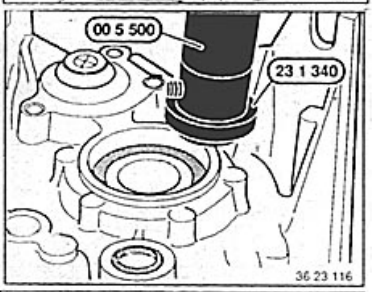
Rear Case Section – Output Shaft Bearing:

Take up rear case section on Special Tools 23 0 100 and 00 1 490.

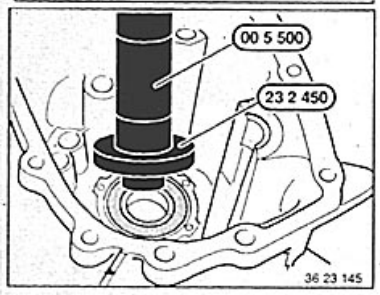


Unscrew holder (2).
Remove oil scraper plate (1) if installed.

Installation:
Also secure oil scraper plate (1).
Install bolts with bolt cement Loctite No. 242.**
Tightening torque*.

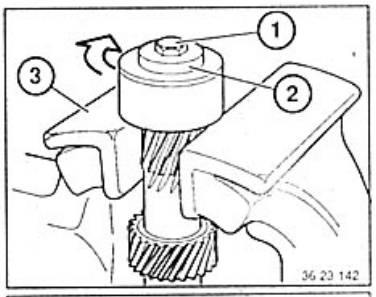


Drive out output shaft bearing from outside to inside with Special Tools 23 1 340 and 00 5 500.



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



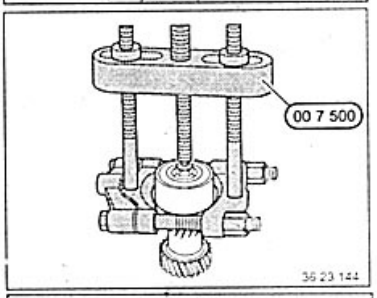
Layshaft Bearing:

Clamp layshaft in a vise fitted with two soft jaws (3).
Remove bolt (1).

Important!
Left-hand threads.

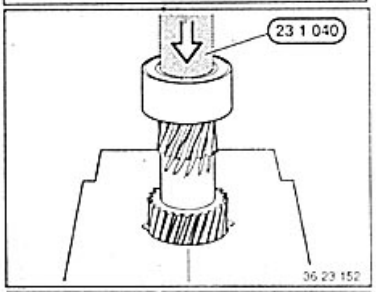
Remove washer (2).
Take layshaft out of vise.

Installation:
Bolt (1) must be replaced.

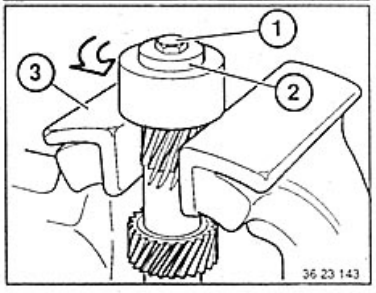


Pull ball bearing off of layshaft with Special Tool 00 7 500.
This requires screwing in the mounting bolt without washer again.

Important!
Bolt has left-hand threads.

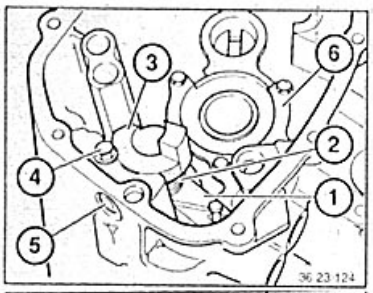


Heat bearing inner race to about 80° C (with hot air blower) and install on layshaft; if necessary press it on with help of Special Tool 23 1 040.



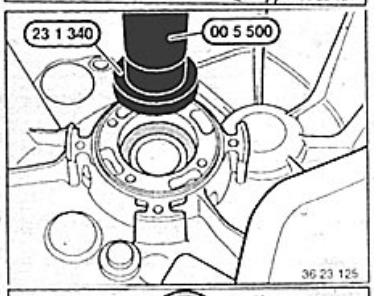
Clamp layshaft in a vise fitted with two soft jaws (3) again to tighten bolt (1).
Install washer (2).
Install new bolt (1) with bolt cement Loctite No. 242 and tighten.**
Tightening torque*.

* See Specifications
** Source of Supply: BMW Parts

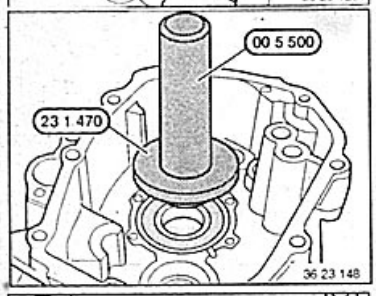


Front Case Section – Input Shaft Bearing:

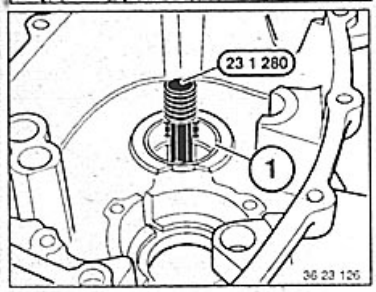
Remove selector arm (1).
This is done by unscrewing bolts (4 and 5) and then removing console (3), spring (2) and selector arm (1).
Unscrew holder (6).



Drive out bearing from inside to outside with Special Tools 23 1 340 and 00 5 500.

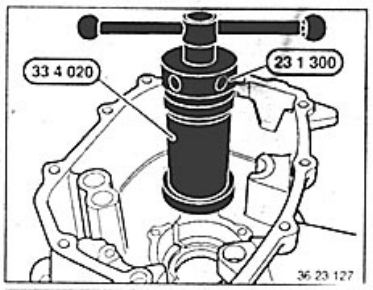


Heat front case section in area of bearing to about 80° C (with hot air blower).
Install bearing; if necessary drive it in to fit tight with help of Special Tools 23 1 470 and 00 5 500.

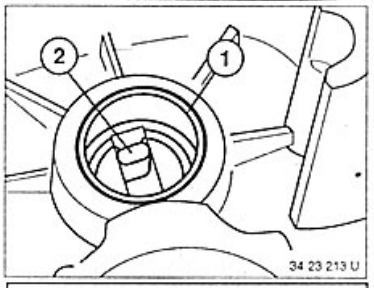


Layshaft Bearing:

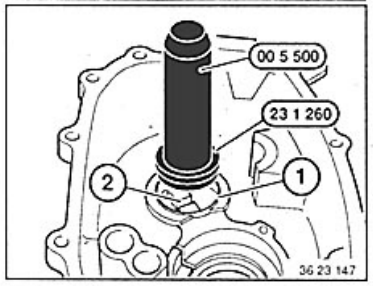
Place Special Tool 23 1 280 in bearing shell (1).



Apply Special Tool 33 4 020.
Screw on Special Tool 23 1 300.
Pull out bearing shell.

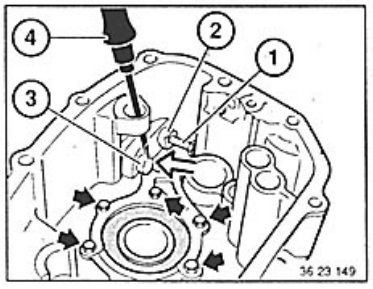


Installation:
Install bearing shell (1) that slot in bearing shell is aligned with anti-turning bead (2) in case.



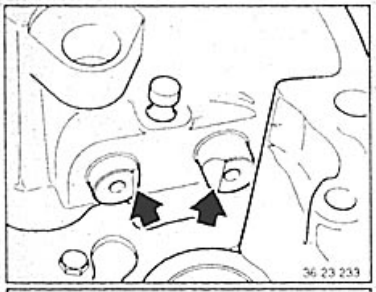
Drive in bearing shell (1) with Special Tools 23 1 260 and 00 5 500.

2 = Anti-turning bead (2)

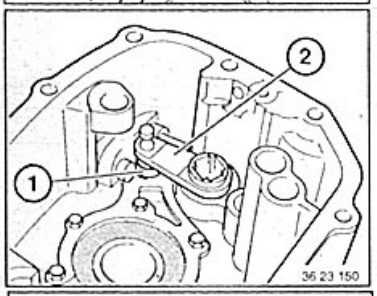


Install holder as follows.
Push lock pin (2) towards outside with bolt (1).
Push lock pin (3) towards outside with screwdriver (4).
Install holder and secure with bolts.
Install bolts with bolt cement Loctite No. 242**.
Tightening torque*.
Remove bolt (1).

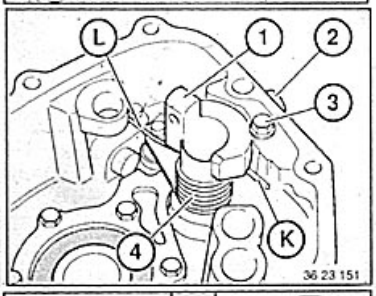
* See Specifications
** Source of Supply: BMW Parts



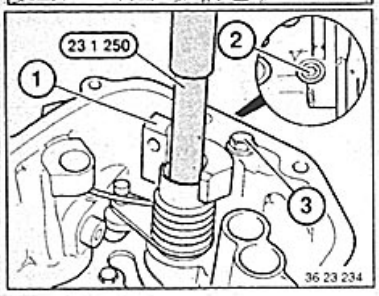
Check installed position of pressure pins.
Bevelled surfaces must point inwards towards each other.



Install roller (1) with selector arm (2).

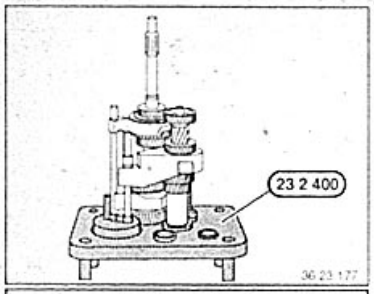


Install spring (4) and sleeve (1).
Attach short arm (K) of spring on case and long arm (L) in groove of selector arm.
Coat head of bolt (2) with Loctite No. 574** on inside.



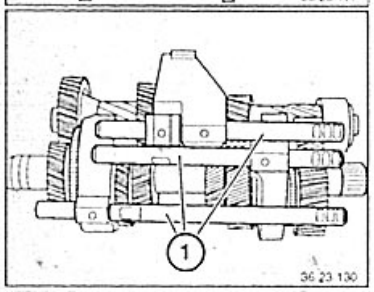
For easier installation (strong spring force) apply Special Tool 23 1 250 in selector arm and press sleeve (1) towards case.
In this position install bolt (2) with bolt cement Loctite No. 242** and tighten lightly.
Tighten bolt (2) to final torque last.
Tightening torque*.

* See Specifications
** Source of Supply: BMW Parts

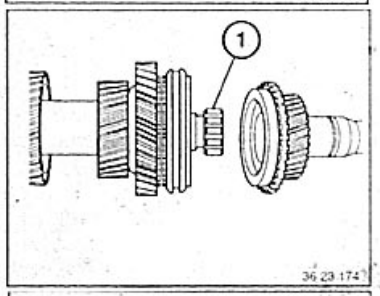


23 23 508 DISASSEMBLING AND ASSEMBLING COMPLETE SYNCHRONIZATION

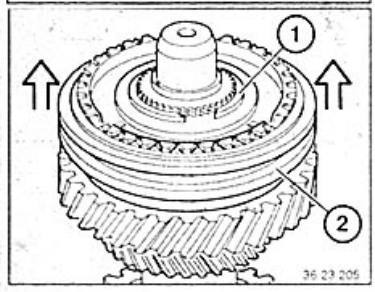
Remove input and output shaft assembly – refer to 23 21 505.
Remove gear assembly set with shift rods from Special Tool 23 2 400.



Pull off shift rods (1).
Remove layshaft from gear assembly set.



Pull off input shaft, needle bearing (1) and 5th gear synchromesh ring.

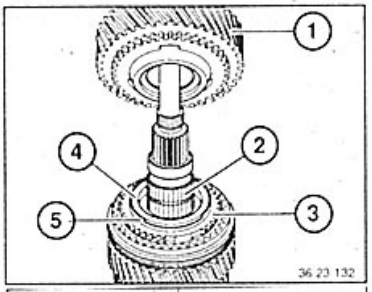


For easier installation, place output shaft in Special Tool 23 2 400.
Pull 5th/reverse gear operating sleeve (2) off of guide sleeve.

Important!
Loose thrust pieces, balls and springs.

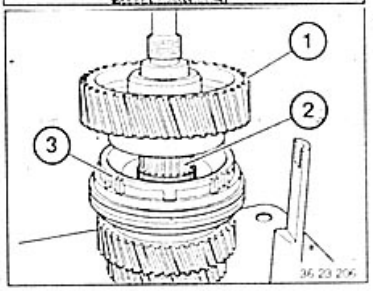
Lift out circlip (1).

Installation:
Replace circlip.

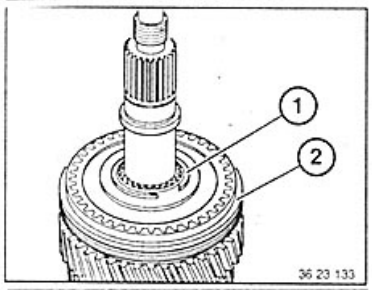


Turn output shaft around so that output end faces up.

Double Taper Synchronization:
Pull 1st gear (1), needle bearing (2), synchromesh ring (3), conical ring (4),and friction ring (5) off of output shaft.



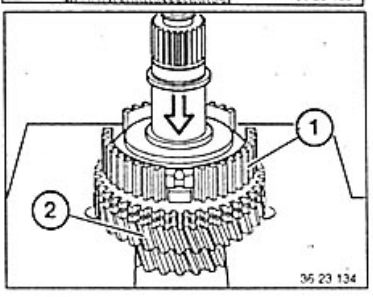
Single Taper Synchronization:
Pull 1st gear (1), needle bearing (2) and synchromesh ring (3) off of output shaft.



Lift out circlip (1).
Pull off 1st/2nd gear operating sleeve (2).

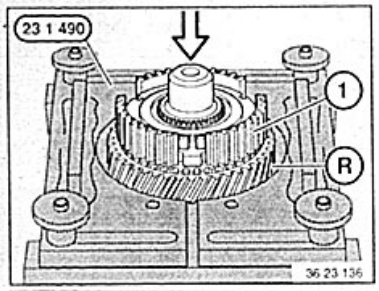
Important!
Loose thrust pieces, balls and springs.

Installation:
Replace circlip (1).

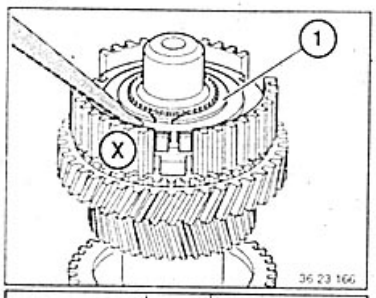


Press 2nd gear (2) and guide sleeve (1) off of output shaft.
Pressing-off force*.

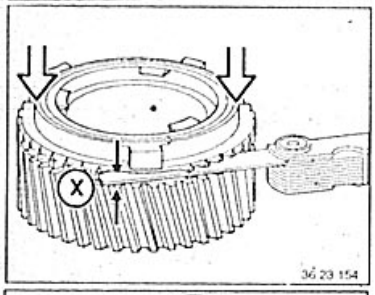
* **See Specifications**



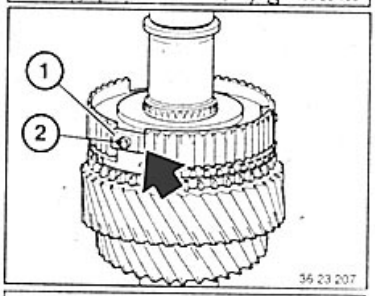
Using Special Tool 23 1 490, press reverse gear, synchromesh ring and guide sleeve (1) off of output shaft.
Pressing-off force*.



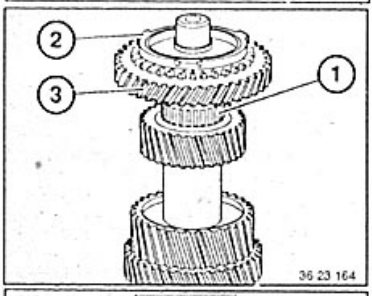
Install suitable circlip (1).
Circlips are available from Parts in thicknesses from 2.0 to 2.3 mm in steps of 0.05 mm.
Max. premissible axial play X = 0.04 mm.



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.

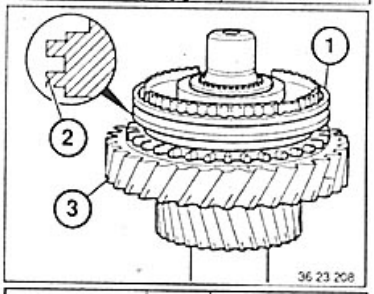


Place three thrust pieces (1) with bevels facing out and springs (2) in opening of guide sleeve.

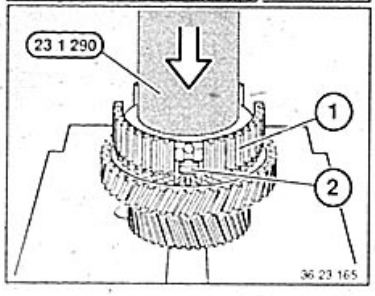


Assembling Gear Assembly Set:
Install needle bearing (1), reverse gear (3) and synchromesh ring (2).

Note:
Lightly lubricate bearing surfaces on needle bearing (1) and synchromesh ring (2) with ATF.



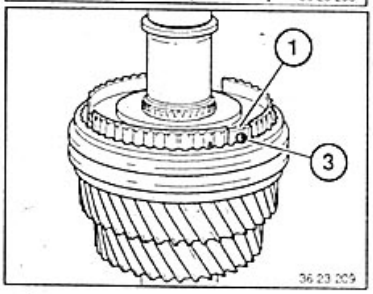
Mount operating sleeve (1) with identification groove (2) facing reverse gear (3).



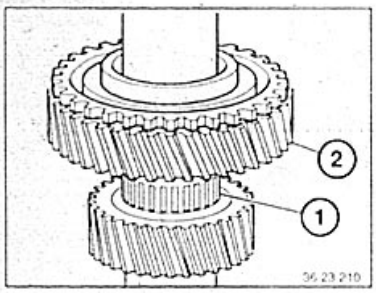
Heat 5th/reverse gear guide sleeve (1) to about 120° C (with hot air blower) and install on output shaft; if necessary press on to fit tight with help of Special Tool 23 1 290.

Important!
Make sure that stops (2) engage in opening of the guide sleeve while pressing on.
Pressing-on force*.

* See Specifications

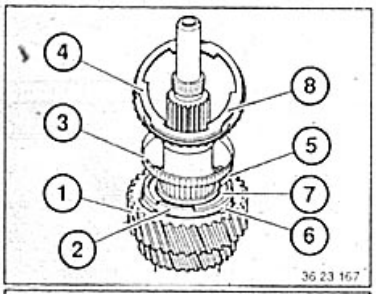


Tilt thrust pieces (1) out of operating sleeve separately far enough that balls (3) can be placed on the springs.
Press balls (3) towards inside and simultaneously press thrust pieces into the operating sleeve.
Place 5th gear synchromesh ring in the operating sleeve.
Pull operating sleeve upwards uniformly as far as lock (neutral position).



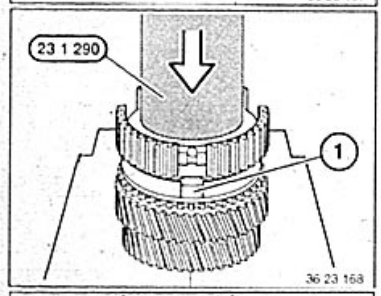
Turn output shaft around so that the output end faces up.
Install needle bearing (1) and 2nd gear (2) on output shaft.

Note:
Lubricate bearing surfaces on needle bearing with ATF.



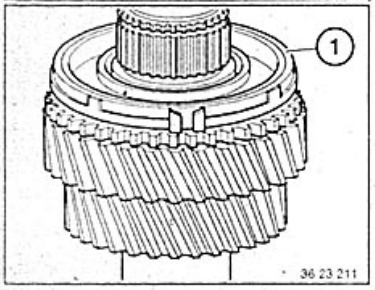
Double Taper Synchronization:

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).



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.

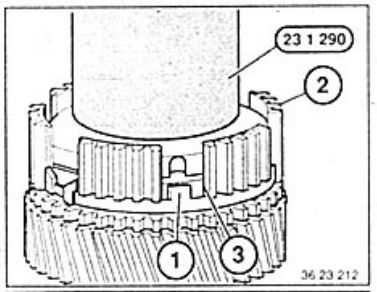
Important!
Make sure that stops (1) engage in opening of the guide sleeve while pressing on.
Pressing-on force*.



Single Taper Synchronization:

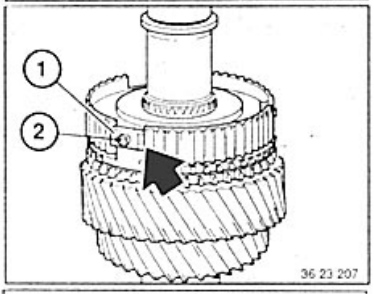
Install synchromesh ring (1).

* See Specifications

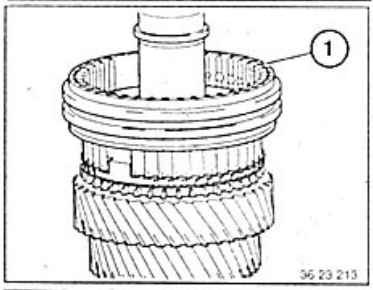


Single Taper Synchronization:

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*.

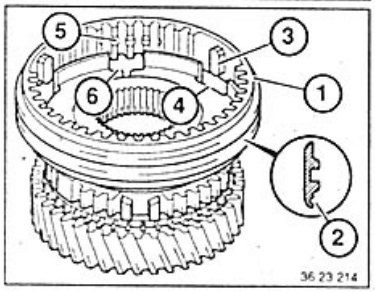


Insert three thrust pieces (1) with bevel facing out and three springs (2) into opening of guide sleeve.



Double Taper Synchronization:

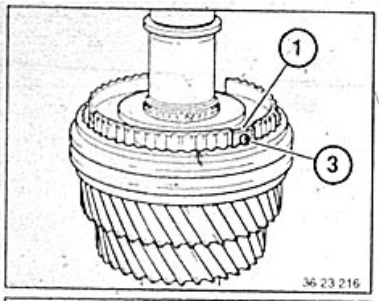
Install operating sleeve (1).



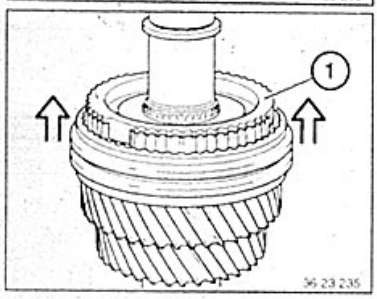
Single Taper Synchronization:

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.

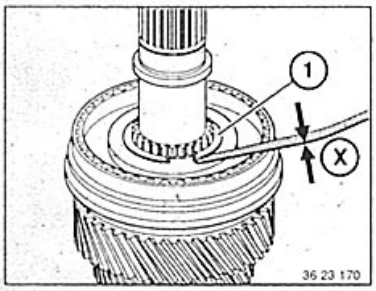
* See Specifications



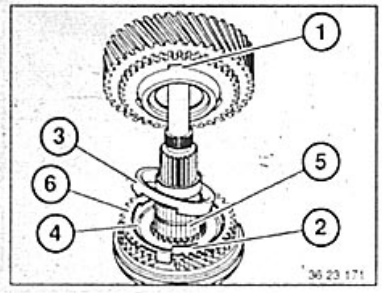
Tilt thrust pieces (1) out of operating sleeve separately far enough that balls (3) can be placed on the springs.
Press balls (3) towards inside and simultaneously press thrust pieces into the operating sleeve.



Place 1st gear synchromesh ring (1) into openings of guide sleeve.
Pull up operating sleeve uniformly as far as lock (neutral position).



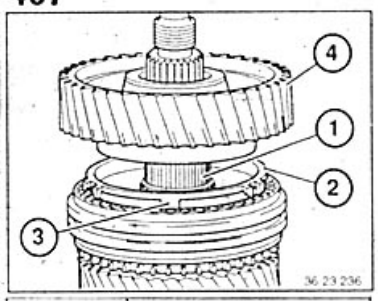
Install suitable circlip (1).
Circlips are available from Parts in thicknesses from 2.0 to 2.3 mm in steps of 0.05 mm.
Max. permissible axial play X = 0.04 mm.



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.

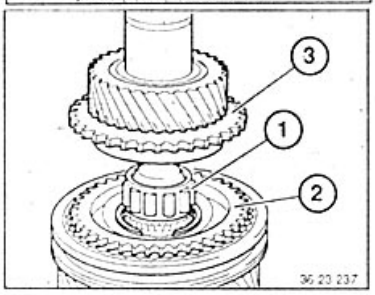


Single Taper Synchronization:

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.

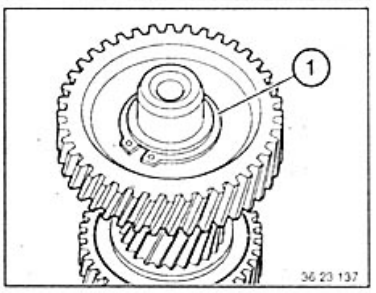
Install 1st gear (4).



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.

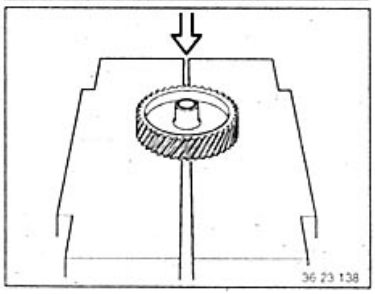
Lift input and output shaft assembly off of Special Tool 23 2 400 and lay aside.



Layshaft:

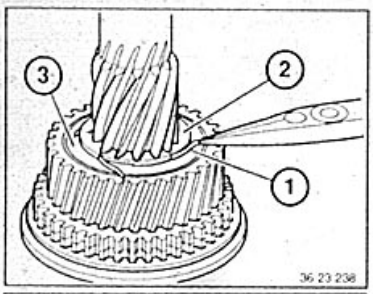
3rd/4th gear synchronization:
Place layshaft in Special Tool 23 2 400 to install synchronization.
Lift out circlip (1).

Installation:
Replace circlip (1).



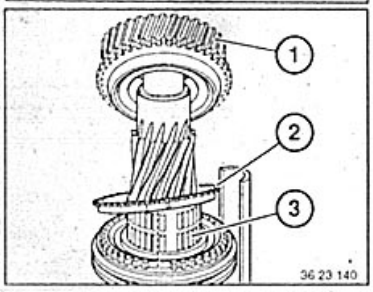
Take up layshaft in a press.
Select bearing surface on constant gear as large as possible.
Press constant gear off of layshaft.
Pressing-off force*.

* See Specifications

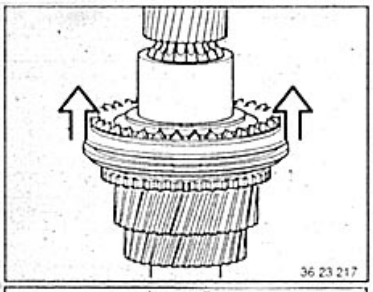


Remove locking ring (1) after unbending four tabs towards outside with a pliers.
Remove support (2) (two parts) and thrust washer (3).

Installation:
Replacing locking ring (1).

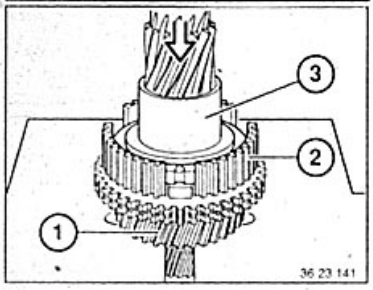


Remove 4th gear (1), synchromesh ring (2) and needle bearing (3).



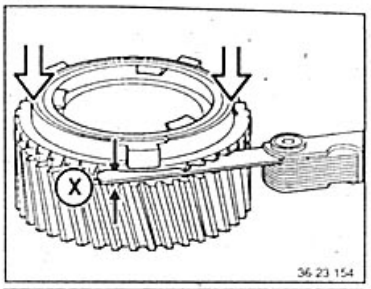
Pull off 3rd/4th gear operating sleeve upwards.

Important!
Loose thrust pieces, balls and springs.

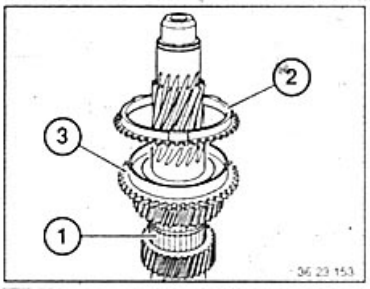


Take up layshaft in a press.
Press 3rd gear (1), guide sleeve (2) and bearing sleeve (3) off of layshaft.
Pressing-off force*.

* See Specifications

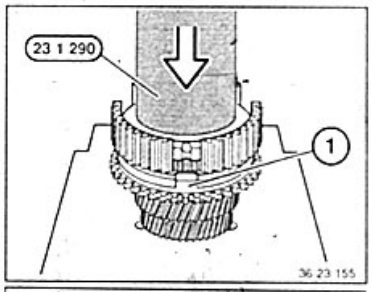


Inspect components of synchronization for wear prior to assembling.
Measure gap X between synchromesh ring and concerned gears for this purpose.
Measure in area of stops.
Press synchromesh ring uniformly in direction of taper.
Gap* of different gears.



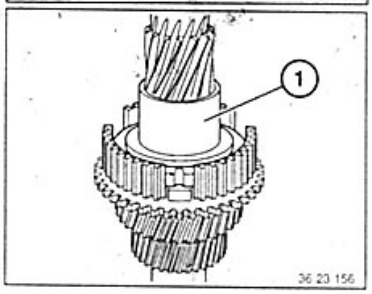
Install needle bearing (1), 3rd gear (3) and synchromesh ring (2).

Note:
Lubricate bearing surfaces on needle bearing and synchromesh ring with ATF.



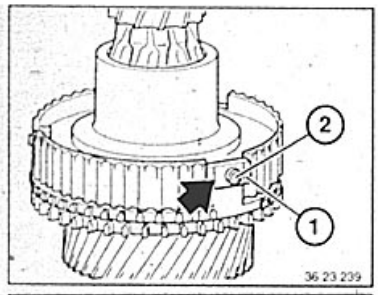
Heat guide sleeves to about 120° C (with hot air blower) and install on layshaft.
Install 3rd/4th gear guide sleeve and press on to fit tight with help of Special Tool 23 1 290.

Important!
Make sure that stops (1) engage in opening of guide sleeve while pressing on.
Pressing-on force*.

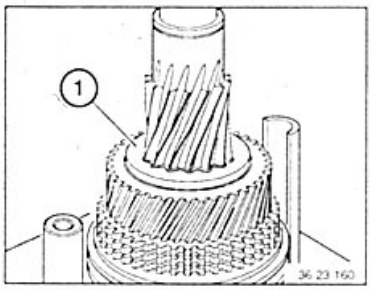


Heat bearing inner race (1) to about 80° C (with hot air blower) and push on to layshaft as far as stop.

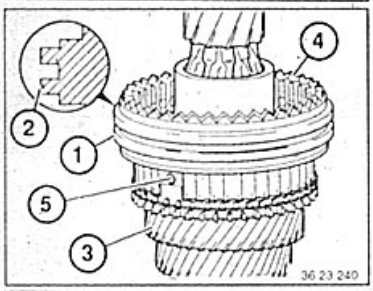
* See Specifications



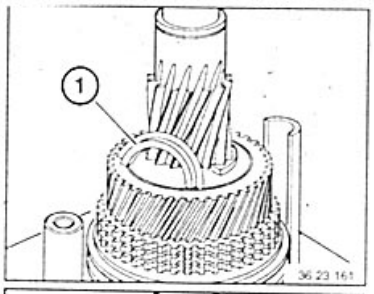
Place three thrust pieces (1) with bevel facing out and three springs (2) in opening of guide sleeve.



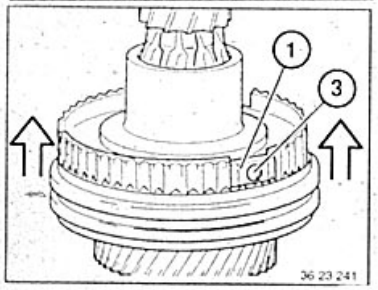
Install thrust washer (1) over splines as far as the bearing surface.



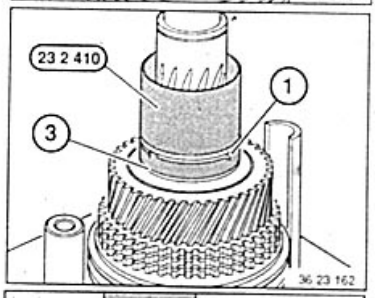
Install operating sleeve (1) with groove (2) pointing towards 3rd gear (3).
Three ground out teeth (4) must point towards springs (5) or slides.



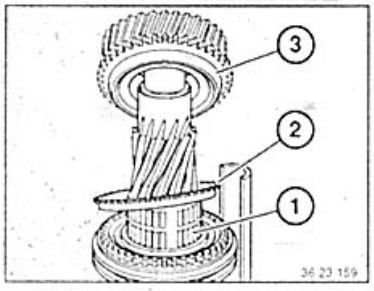
Install support (two parts) with small diameter (1) pointing down in groove.
The axial play must be adjusted after replacing the support.
Max. axial play = 0.04 mm.
Supports are available from Parts in thicknesses from 2.9 to 3.15 mm in steps of 0.05 mm.



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).

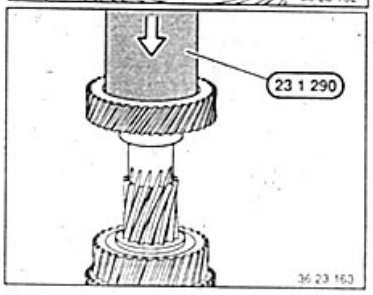


Apply Special Tool 23 2 410 on layshaft.
Clip in locking ring (1) with the four tabs in groove (3).



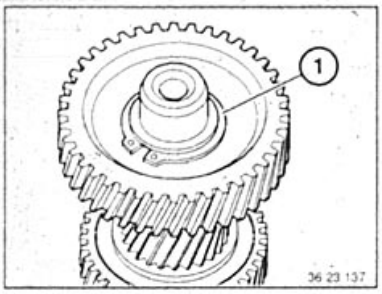
Install needle bearing (1), synchromesh ring (2) and 4th gear (3) on layshaft.

Note:
Lubricate bearing surfaces on needle bearing and synchromesh ring with ATF.

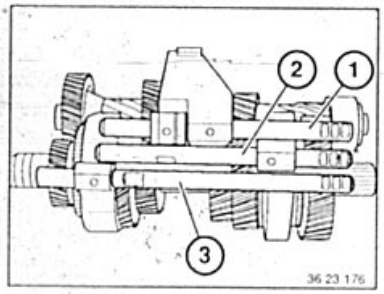


Heat constant gear to about 180° C (with heating plate).
Check temperature with temperature tester**.
Place layshaft in a press.
Install constant gear on layshaft and press on to fit tight with Special Tool 23 1 290.
Pressing-on force*.

* 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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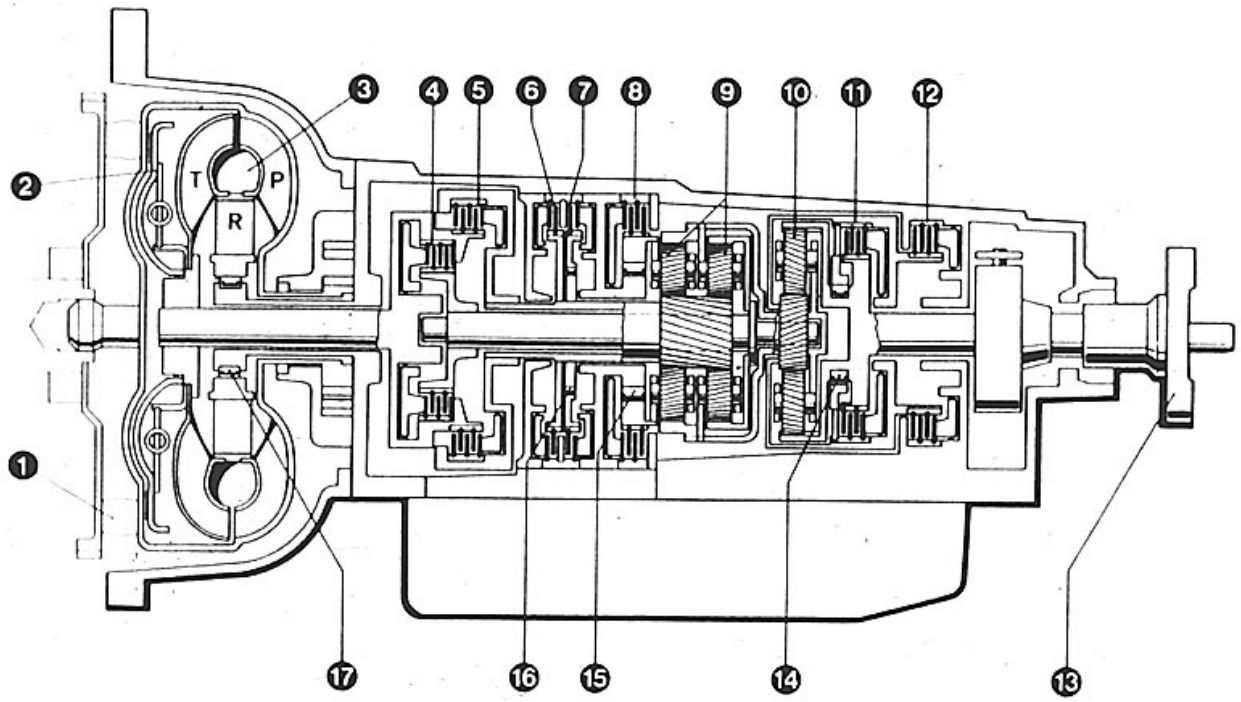
24 12 003	Radial oil seal for torque converter – replace	24- 161a
24 16 502	Transfer plate – replace	24- 161b
24 23 022	Plate clutches and brakes – replace	24- 162
24 31 002	Primary pump – remove and install	24- 172
24 40 003	Torque converter – remove and install	24- 173

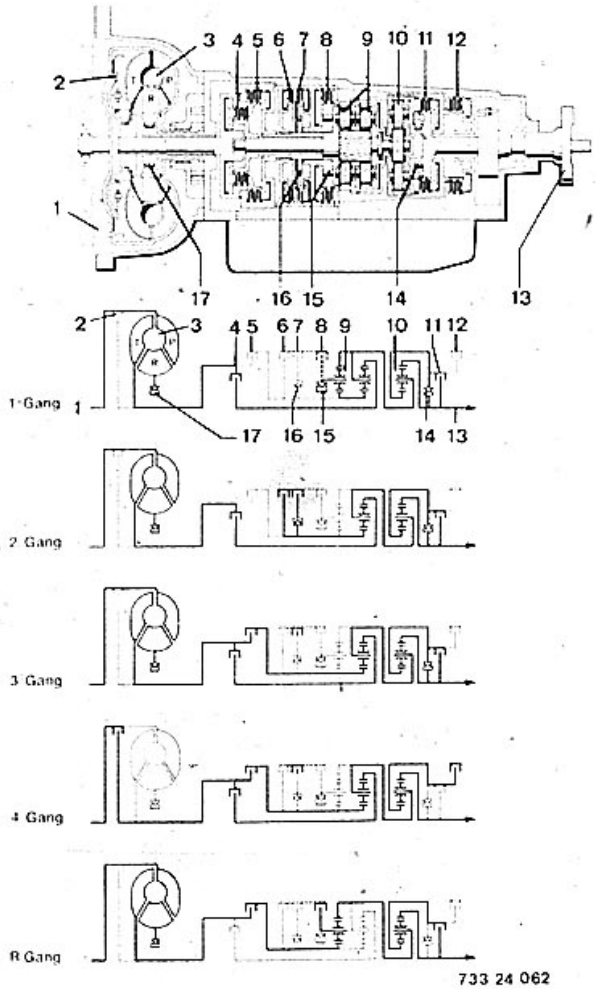


4 HP -22/24 Assembly Drawing

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

24-151

4 HP -22/24 Power Flow Diagrams



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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.

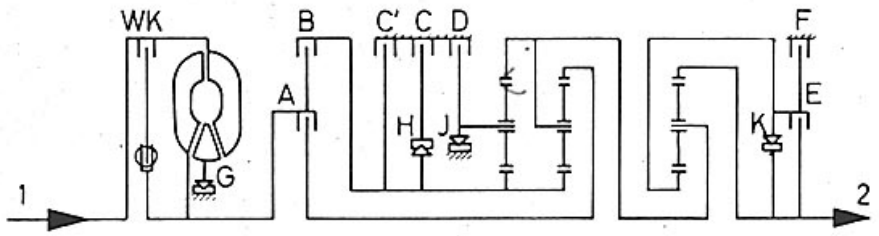
3rd Gear
Clutches 4, 5, 7 and 11 are engaged.
One-way clutches 15 and 16 are cancelled.
Planet gear sets 9 and 10 rotate as a block at ratio of 1 to 1.

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

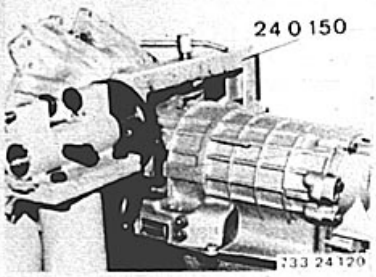
1 Input
2 Output
WK Converter lockup clutch
A ... F Clutches
G ... K One-way clutches



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

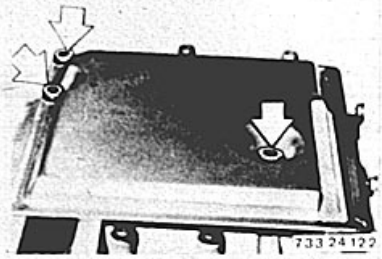
Gear	Clutch			Brake				One-way Clutch				WK	Solenoid Valve*)			
	A	B	E	C'	C	D	F	G	H	J	K		WK	RS	1	2
1st	X		X			(X)		(X)		X	X				+	+
2nd	X		X	X	X			(X)	X		X				/	+
3rd	X	X	X		X			(X)			X	(X)	(+)		/	/
4th	X	X			X		X	(X)				(X)	(+)		+	/
R		X	X			X		(X)						+	+	+



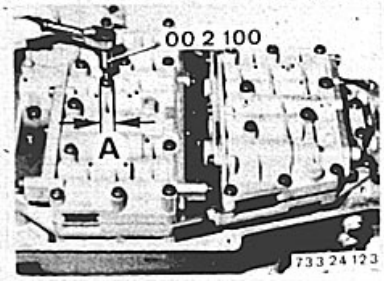
24 00 082 DISASSEMBLING AND ASSEMBLING TRANSMISSION

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

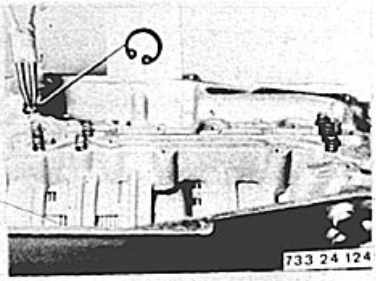


Unscrew oil sump.
Unscrew oil filter screen.
Unscrew Torx bolts with Special Tool 00 2 100.



Unscrew valve body.
Unscrew Torx bolts with Special Tool 00 2 100.

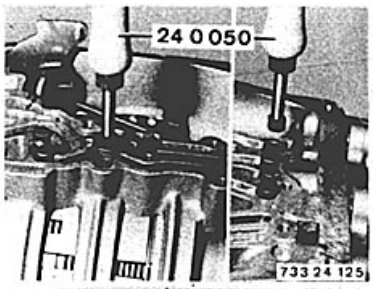
Important!
Only unscrew bolts with head size A = 12 mm (0.472").
The socket for the transmission wire harness must be removed for the EH version.



Lift out eight circlips.
Remove eight springs.

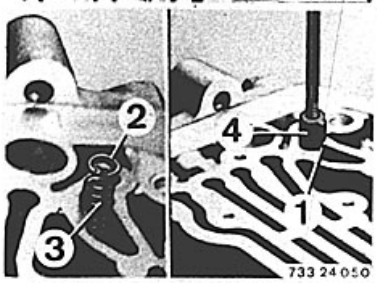
Installation:
Install long springs for the output.

EH Transmission:
Only three circlips and three springs have to be removed for cylinder F (output end).

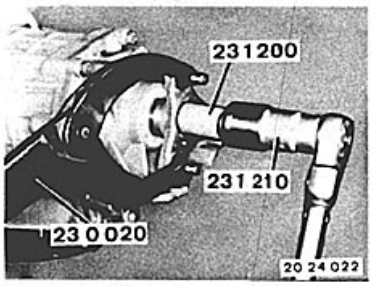


Pull out eight sealing sleeves with Special Tool 24 0 050.

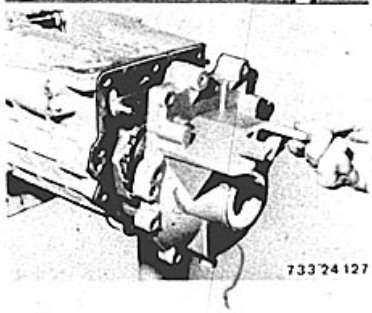
EH Transmission:
Only remove three sealing sleeves for cylinder F (output end).



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.

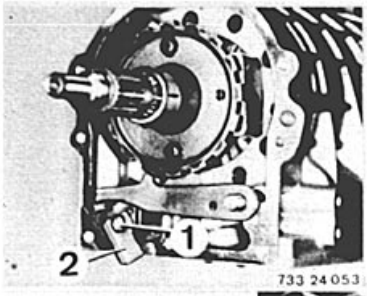


Lift off lockplate.
Use Special Tool 23 1 200 only for the version with a three-hole flange.
Hold output flange with Special Tool 23 0 020.
Unscrew collar nut with Special Tool 23 1 210.
Pull off output flange.

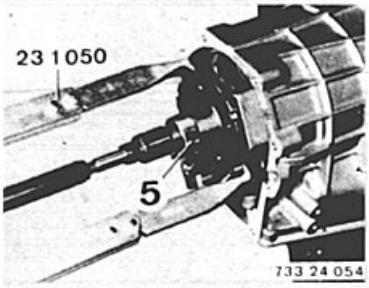


Unscrew transmission extension.

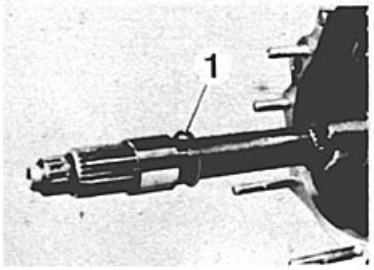
Installation:
Replace gasket.



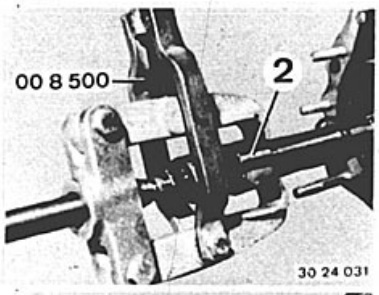
Loosen screw (1) enough with Special Tool 00 2 100 that bracket (2) can be folded down. Remove parking lock pawl, spring and bearing pin.
Caution!
Spring force.



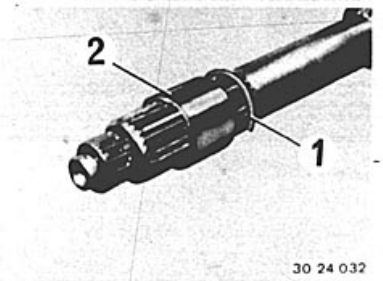
Pull off parking lock gear with regulator.
Note:
Check axial shim between output flange and parking lock gear.
Version with Spacer (5):
The parking lock gear must be pulled off with Special Tool 23 1 050.



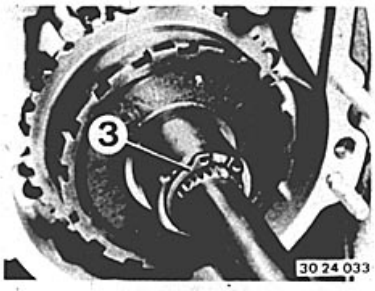
Version with Transfer Box:
Lift out and slide snap ring (1) forward.
Installation:
Replace snap ring.



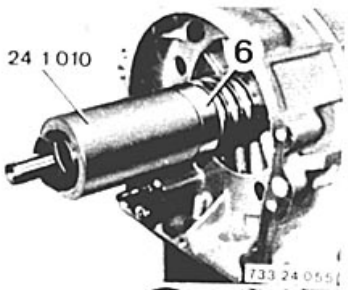
Pull bearing sleeve (2) off of the input shaft with Special Tool 00 8 500.



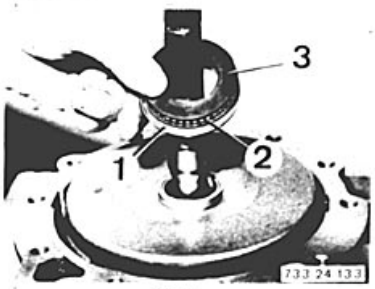
Installation:
Install snap ring (1) in groove of output shaft. Heat bearing sleeve (2) to approx. 80° C (175° F) with a hot air blower and slide it on to the output shaft against snap ring (1).



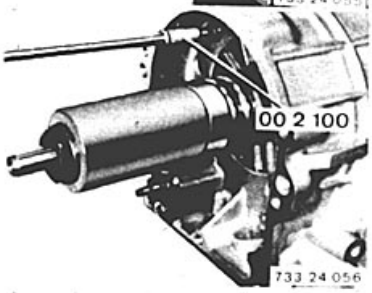
Lift out circlip (3).
Pull off parking lock gear with regulator.



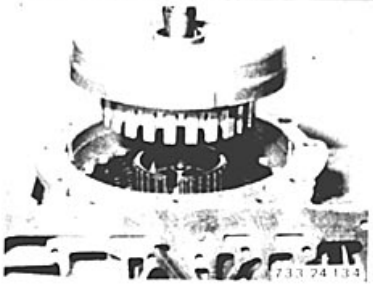
Place Special Tool 24 1 010 on output shaft and secure with collar nut.
Note:
For version with spacer (5) a suitable pipe (6) must be used to take up the distance between case and special tool sleeve.



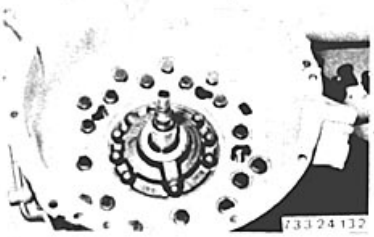
Remove angled washer (1), axial bearing (2) and thrust washer (3).



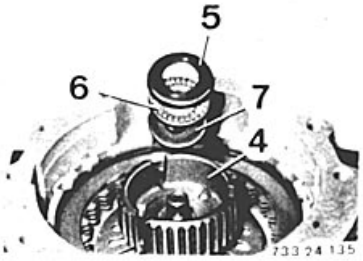
Unscrew Torx screws with Special Tool 00 2 100.



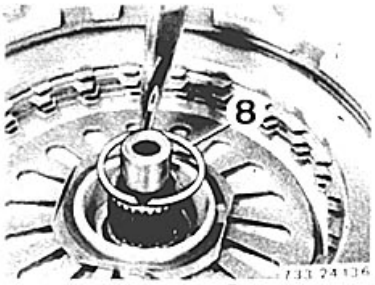
Remove input shaft with clutch A.



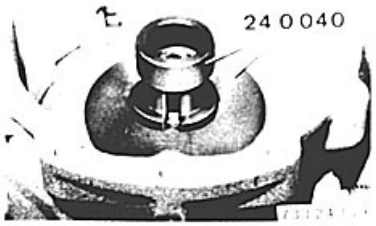
Set transmission upright.
Unscrew converter bell housing and transfer plate.
Note:
Only remove inner bolts of hole circle.



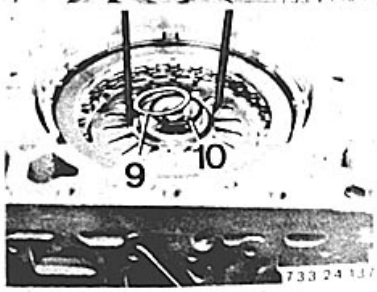
Remove plate carrier (4) for clutch A with angled washer (5), axial bearing (6) and thrust washer (7).



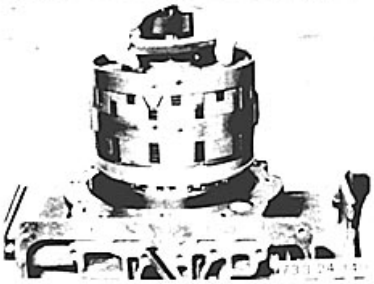
Remove snap ring (8) with help of two screwdrivers.
Installation:
Replace snap ring (8).



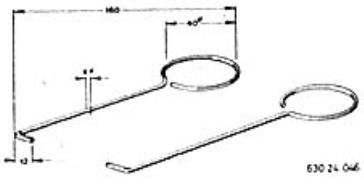
Apply Special Tool 24 0 040 on intermediate shaft.



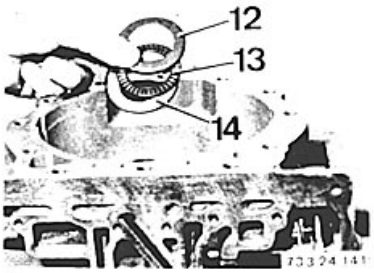
Pull out clutch B with two locally made hooks.
Installation:
Lift clutch until resistance is noticed and push back again.
Pull out clutch with one firm pull.
This will also pull out support (9) and seal (10).



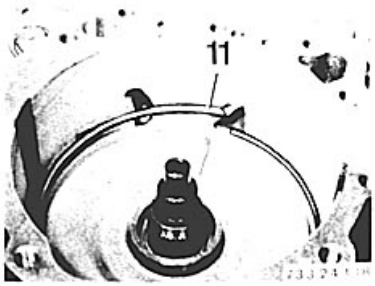
Pull out entire set.



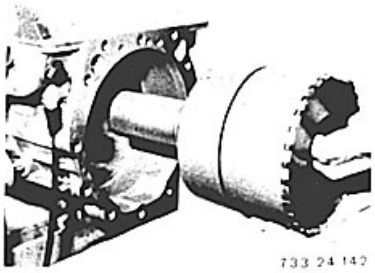
Sketch for local manufacture of hooks.
Dimensions in mm.



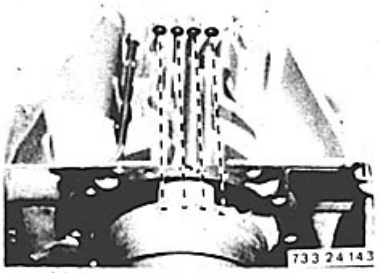
Remove angled washer (12), axial bearing (13) and thrust washer (14).



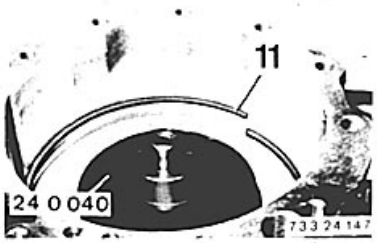
Lift out snap ring (11).



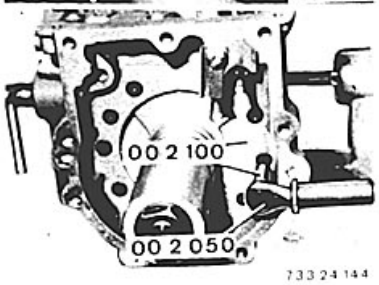
Position transmission case horizontally.
Remove 4th gear clutch set.



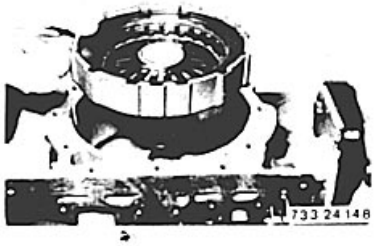
B) Assembling:
Install 4th gear clutch set.
Guide clutch set into transmission case that 4 oil feed bores are aligned with bores in case.



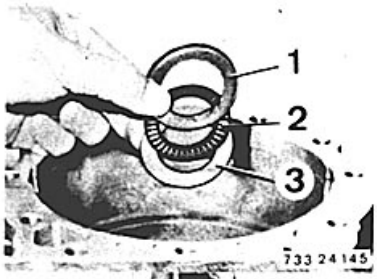
Insert snap ring (11).
Remove Special Tool 24 0 040.



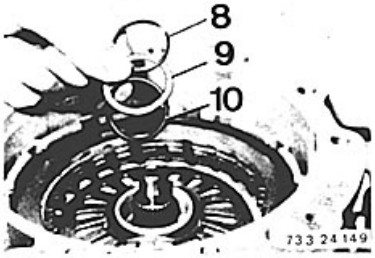
Bolt down clutch set with Special Tools 00 2 100 and 00 2 050.
Tightening torque*.



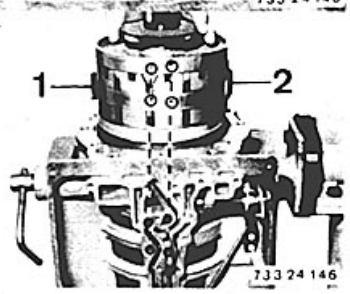
Insert and press clutch B against stop.



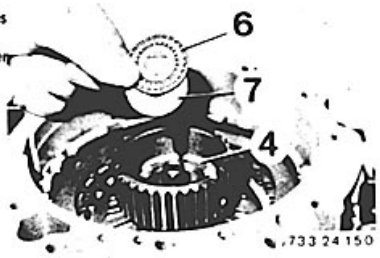
Set transmission upright.
Insert thrust washer (3), axial bearing (2) and angled washer (1) with collar facing up.
If necessary, use vaseline on shaft of clutch set.



Install seal (10), support (9) and snap ring (8).



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.

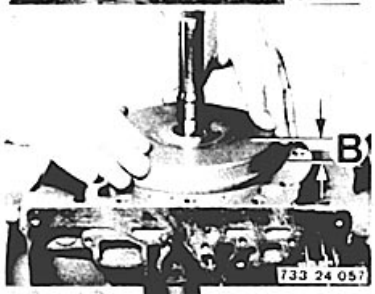


Insert plate carrier (4).
Install thrust washer (7) and axial bearing (6).

* See Specifications



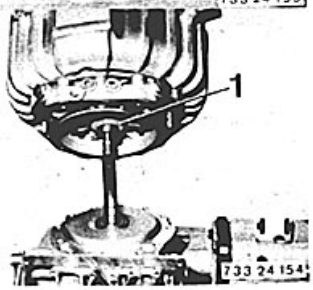
Paste angled washer (1) on cylinder A with grease (vaseline).



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).



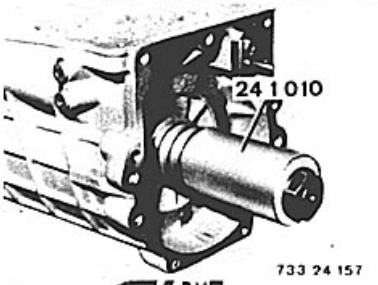
Paste on gasket and thrust washer (1) with grease (vaseline).



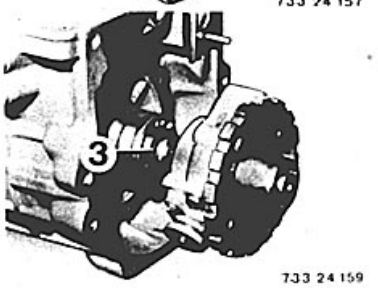
Install converter bell housing and tighten all bolts.
Tightening torque*.



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*.

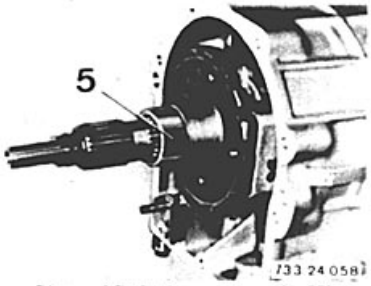


Remove Special Tool 24 1 010.



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.

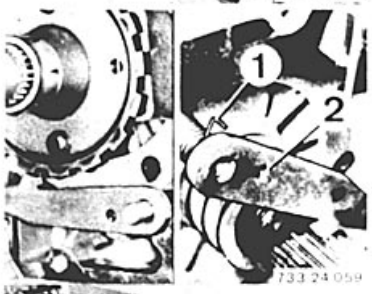
* See Specifications



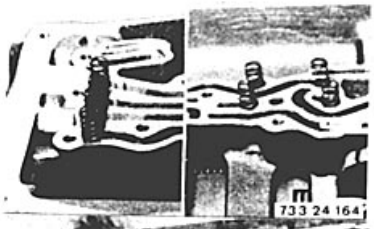
Important!
Version with Spacer (5):
Heat spacer (5) to about 80° C (175° F) with a hot air blower after mounting the parking lock gear and push spacer on to output shaft.



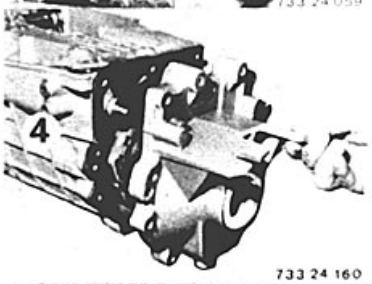
Install 8 sealing sleeves.
Press in sealing sleeves against the stop with a suitable mandrel.
Be careful not to damage the sealing sleeves.
EH Transmission:
Only 3 sealing sleeves have to be installed at cylinder F (output end).



Install parking lock pawl.
Connect return spring (1) in bore (2) of parking lock pawl.



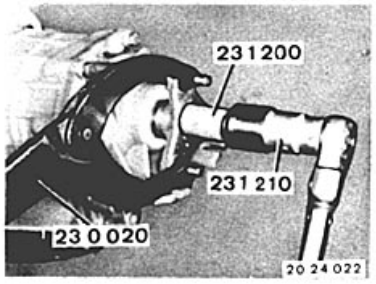
Install 8 springs and 8 circlips.
Important!
Longer springs must be installed to face cylinder F (output end).
EH Transmission:
Only 3 springs have to be installed on cylinder F (output end).



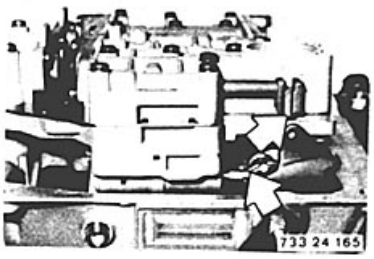
Paste on gasket (4) with grease.
Bolt on transmission extension.
Tightening torque*.



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.

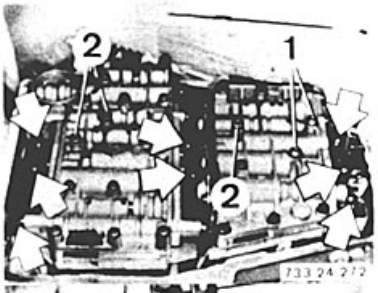


Install output flange.
Screw on collar nut with Hylomar SQ-32 M universal sealing compound.
Apply Special Tool 23 1 200 only for the version with a three-hole flange.
Hold output flange with Special Tool 23 0 020.
Tighten collar nut with Special Tool 23 1 210.
Tightening torque*.
Install lockplate.

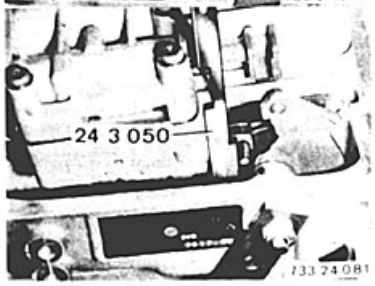


Mount valve body that selector valve can be connected in operating finger of pawl.
This requires pulling throttle cable slightly, so that accelerator cam does not clamp on throttle pressure valve.

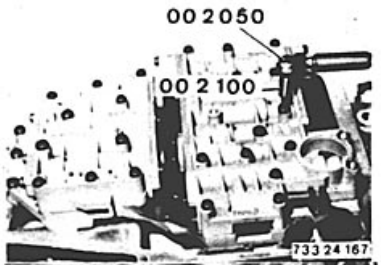
* See Specifications



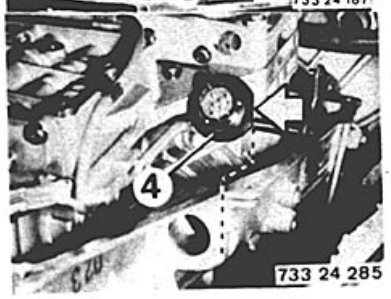
Screw in mounting bolts for valve body.
Important!
Bolts differ in length.
Bolts (1) – 65 mm long.
Bolts (2) – 60 mm long.



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").

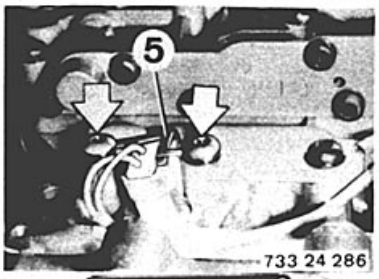


Tighten valve body bolts with correct tightening torque*.
Tighten bolts with Special Tools 00 2 100 and 00 2 050.

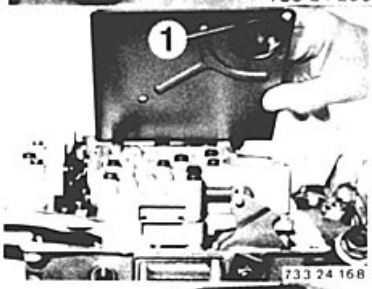


EH Transmission:
Check O-ring (4), replacing if necessary.
Insert socket with flat side facing out and bolt.
Tightening torque*.

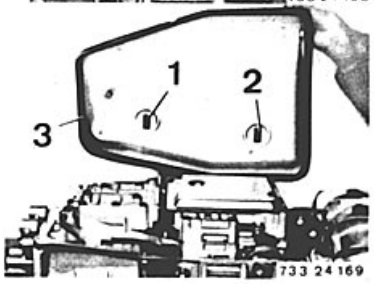
* See Specifications



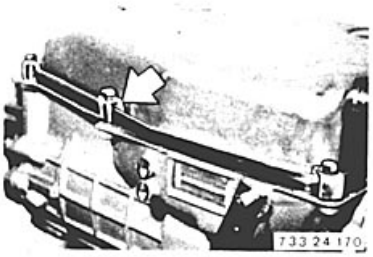
Note:
Also mount pulse transmitter on control unit.
Engage tabs of holder (5) in grooves of plug.



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

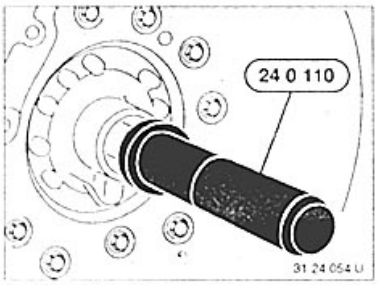


24 12 003 REPLACING RADIAL OIL SEAL FOR TORQUE CONVERTER

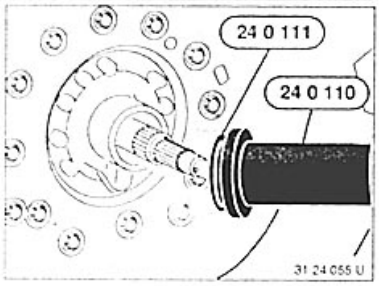
Remove torque converter – see 24 40 003.
Lift out radial oil seal.



Lubricate sealing lip with ATF.
Drive in radial oil seal to fit tight with Special Tool 24 0 090.

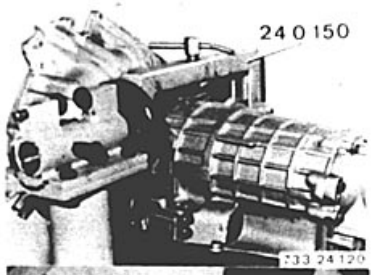


4 HP-24 Transmission:
Drive in radial oil seal to fit tight with Special Tool 24 0 110.
Special Tool 24 0 110 can also be used on 4 HP-22 transmissions.



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.

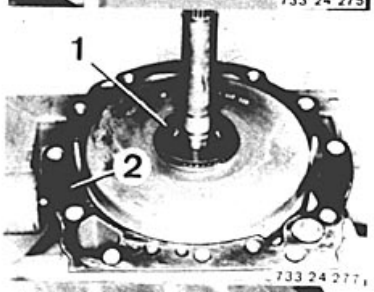
24 16 502 REPLACING TRANSFER PLATE – Transmission Removed –



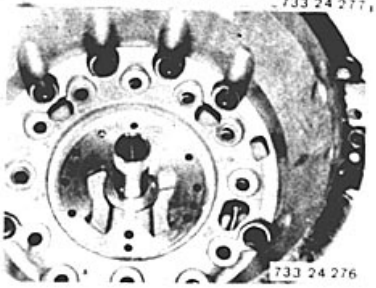
Remove torque converter 24 40 003.
Mount transmission on Special Tool 24 0 150 in conjunction with an assembly stand.
Important!
Only screw in bolts finger tight to avoid case distortion.



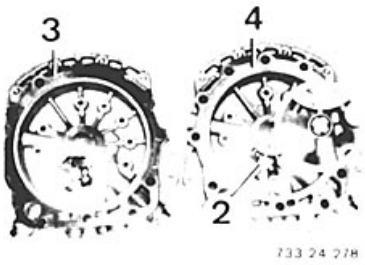
Unscrew converter bell housing and transfer plate, removing the inner bolts only and loosening the outer bolts for this purpose.



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).



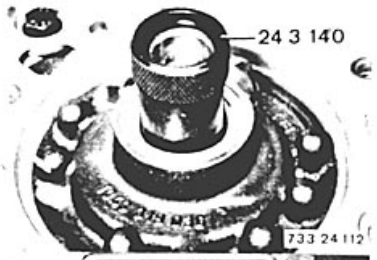
Remove primary pump (see 24 31 002).
Unscrew bolts.
Lift converter bell housing off of transfer plate.



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.



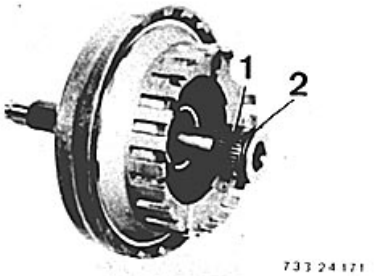
Transfer plugs (5 ... 8).
Check seals, replacing if necessary.
Tightening torque*.



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.



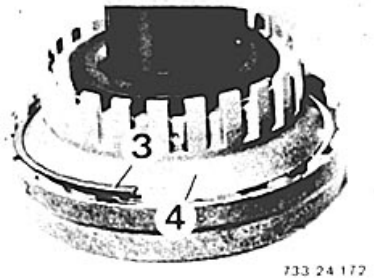
Mount converter bell housing and tighten all bolts to correct torque*.
Check axial play of input shaft.
Hold input shaft with Special Tool 24 0 010.
Apply Special Tool 00 2 510 (dial gage).
Check axial play by pulling input shaft.
Specification: 0.2 to 0.4 mm (0.008 to 0.016").
If play deviates, remove 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

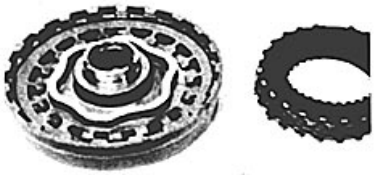
24 23 022 REPLACING PLATE TYPE CLUTCHES AND BRAKES

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.

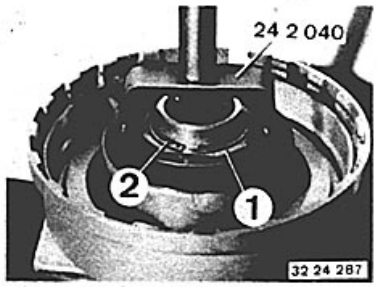


733 24 172

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.



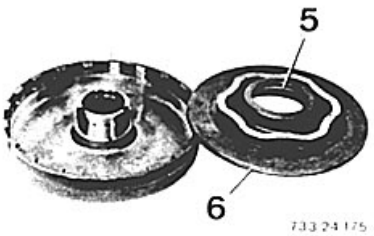
4 HP 24:
Bend open lockplate (1).
Press down on diaphragm spring with Special Tool 24 2 040.
Lift out snap ring (2).
Installation:
Replace and lock lockplate.
Install diaphragm spring with curved surface facing up.



733 24 174

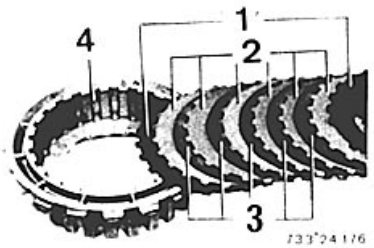
Press out clutch A piston with compressed air applied through oil bore.

Installation:
Replace O-rings (5 and 6).
Lubricate O-rings with a light coat of ATF to make installation easier.



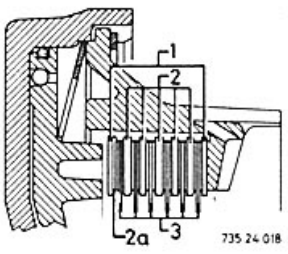
733 24 175

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

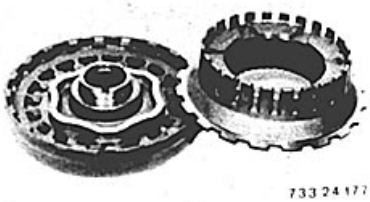


733 24 176

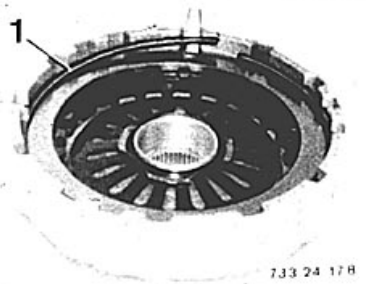
BMW 745 i:
Watch installed order of plates.
1 Spring plates
2 Steel plates 1.8 mm
2a Adjusting plate 1.8 or 1.2 mm
3 Lined plates
Important!
Only use complete installation kit for repairs.



735 24 018

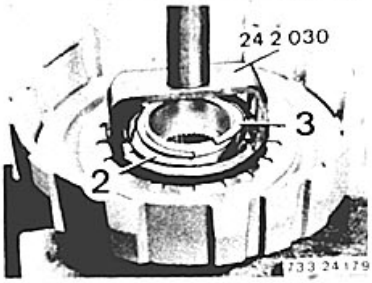

733 24 177

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.



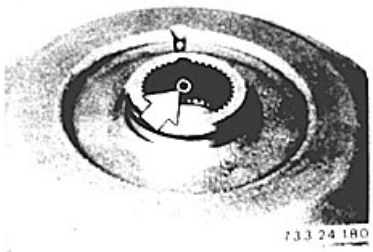
733 24 178

Clutch B:
Remove snap ring (1).
Remove steel and lined plates.
Important!
Note quantity of steel and lined plates.



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.

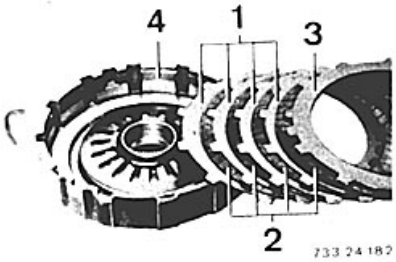

733 24 180

Press out clutch B piston with compressed air applied through oil bore.



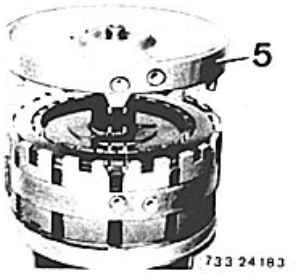
733 24 181

Installation:
Check O-rings (4 and 5), replacing if necessary.
Lubricate O-rings with a light coat of ATF to make installation easier.



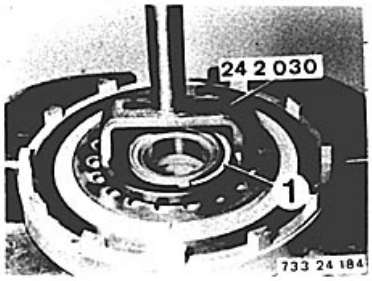
733 24 182

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.



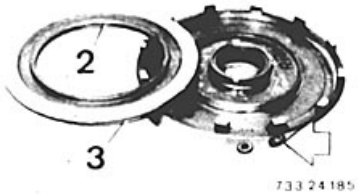
733 24 183

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.



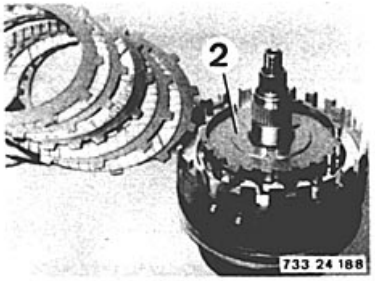
733 24 184

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.



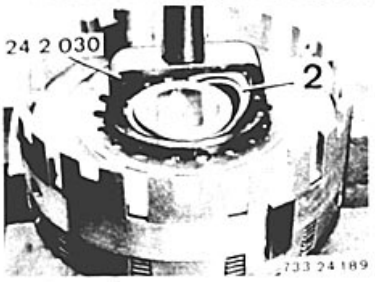
Press out piston for clutch C' with air pressure applied through the oil bore.

Installation:
Check O-rings (2 and 3), replacing if necessary.
Coat O-rings lightly with ATF to make installation easier.



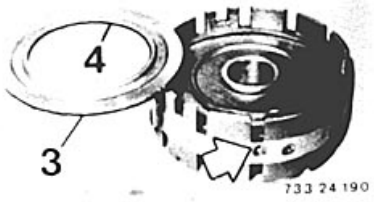
Remove all steel and lined plates.

Note:
Note number of steel and lined plates.
Pull out one-way clutch (2).



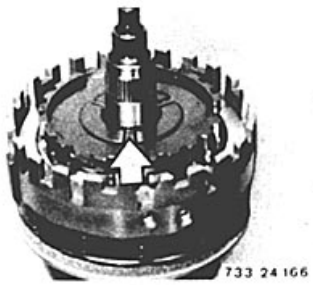
Press down disc spring with Special Tool 24 2 030 and lift out split retaining ring (2).

Installation:
Install disc spring with curved surface facing up.



Press out piston for clutch C with air pressure applied through the oil bore.

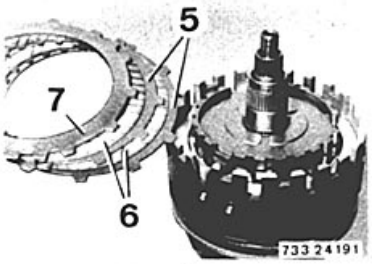
Installation:
Check O-rings (3 and 4), replacing if necessary.
Coat O-rings lightly with ATF to make installation easier.



Install one-way clutch.

Important!
Bent tabs or the word "oben" (= top) must be visible.

4 HP-24:
Rivet heads must be on top.



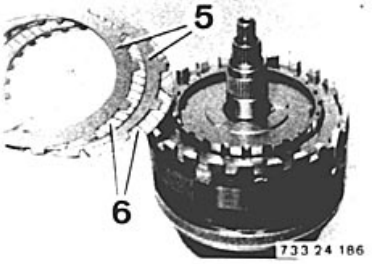
Installed Order:
Install noted number of removed steel and lined plates alternately, beginning with a steel plate.
5 Steel plates (1.8 mm)

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.



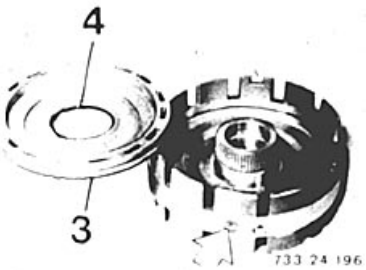


Installed Order for C':
Install noted number of removed steel and lined plates alternately, beginning with a steel plate.
5 Steel plates (1.8 mm)
6 Lined plates

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.



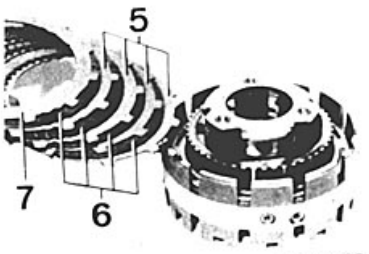
Clutch D:
Clutches C' and C removed.
Lift clutch member with clutch D off of planet gear set.



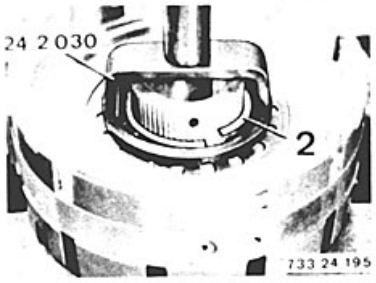
Place planet plate with one-way clutch on hub of cylinder D.



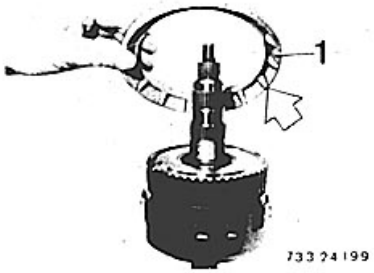
Remove snap ring (1).
Remove outer and lined plates.
Important!
Note quantity of steel and lined plates.



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.



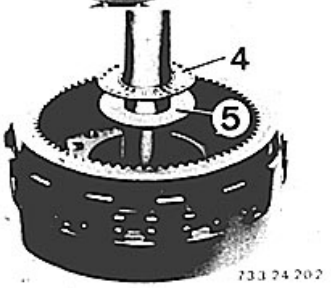
Disassemble planet gear set.
Remove support ring (1).
Installation:
Mount support ring with fins facing down.



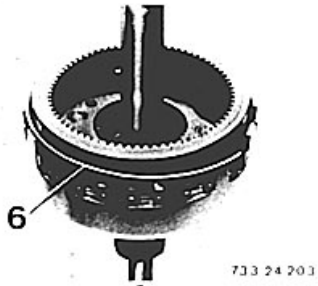
Take off planet gear set (2).



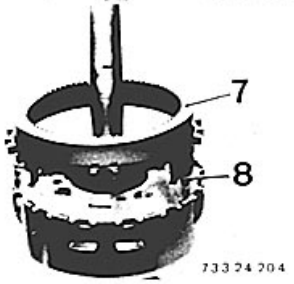
Pull out sun gear shaft (3).



Remove axial bearing (4) and thrust washer (5).



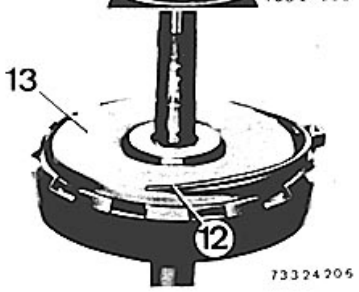
Lift out snap ring (6).



Remove hollow gear (7) and planet plate (8).



Remove thrust washers (9) and axial bearing (10).
Take off spacer (11).

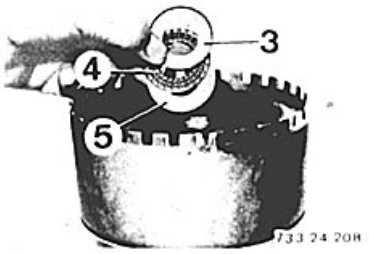


Lift out snap ring (12).
Take off hollow gear (13).



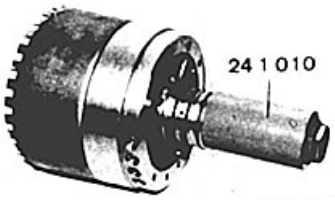
733 24 207

Clutches E and F:
Remove sun gear (1) and planet carrier (2).



733 24 208

Remove angled washer (3), axial bearing (4) and thrust washer (5)
Installation:
Install angled washer (3) with collar facing planet carrier.



733 24 209

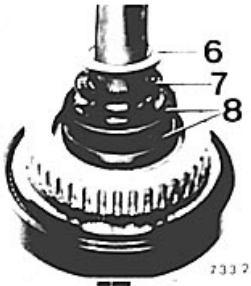
Take off Special Tool 24 1 010.


733 24 210

Lift cylinder F off of cylinder E.


733 24 211

Lift off cylinder E on output shell.



733 24 212

Take off thrust washer (6), axial bearing (7) and steel/copper angled washer (8).


733 24 213

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.



733 24 214

Clutch F:
Lift out snap ring (1).



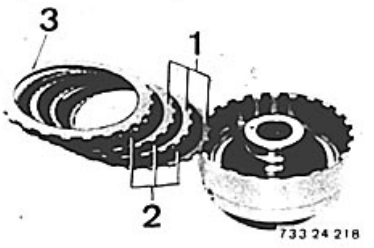
Remove plate set.
Important!
Note quantity of steel and lined plates.



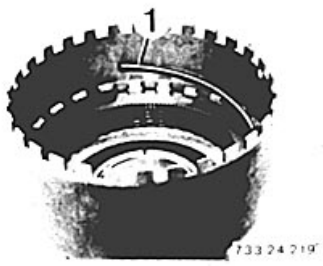
Remove piston for clutch F.
Press down on diaphragm spring with Special Tool 24 2 020 and lift out the split retaining ring (1).
Installation:
Insert diaphragm spring with curved surface facing up.



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.



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)



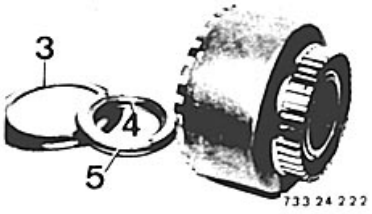
Clutch E:
Lift out snap ring (1).



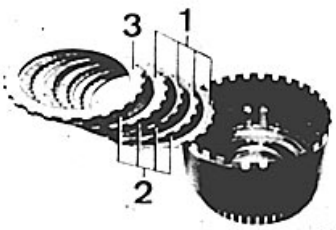
Remove plate set.
Important!
Note quantity of steel and lined plates.



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.



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.



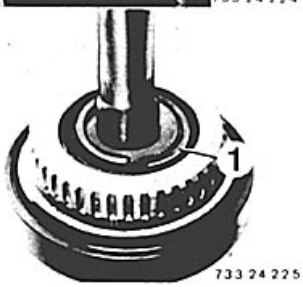
733 24 223

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



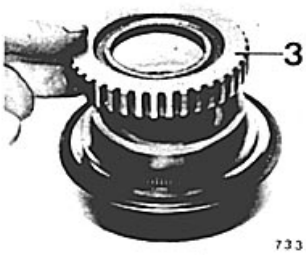
733 24 225

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

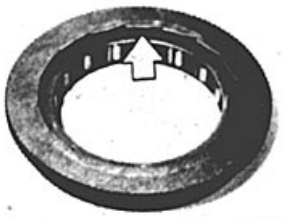
4 HP - 22:
Lift out snap ring (1).
Lift off one-way clutch.


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.



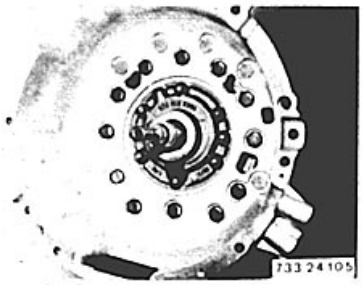
733 24 231

Use plate carrier (3) to turn one-way clutch outer race clockwise and mount race on inner race.



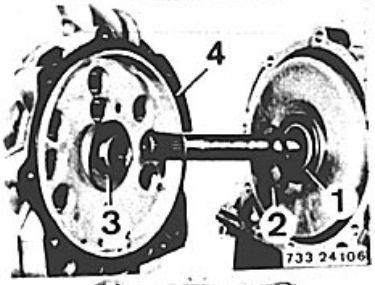
733 24 232

Clearance between one-way clutch inner race and outer race should be at least 0.1 mm (0.004").

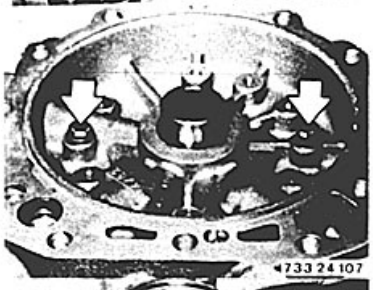


24 31 002 REMOVING AND INSTALLING PRIMARY PUMP

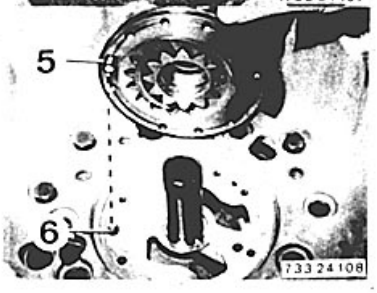
Remove torque converter – see 24 40 003.
Take off converter bell housing with connecting plate.



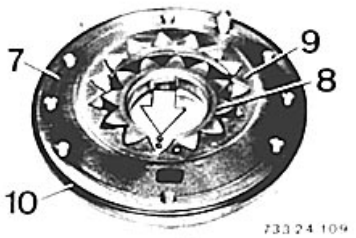
Installation:
Mount angled washer (1) with collar facing needle bearing (2) on input shaft.
Hold thrust washer (3) on converter bell housing with grease.
Replace gasket (4).



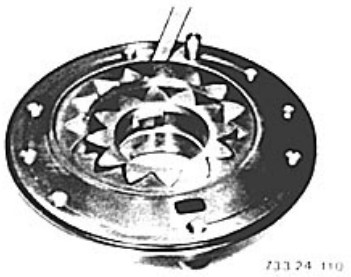
Unscrew primary pump on converter bell housing.
Loosen two bolts opposite each other by only several turns.
Loosen primary pump on converter bell housing with several light knocks.



Remove primary pump.
Installation:
Centering pin (5) must engage in bore (6).



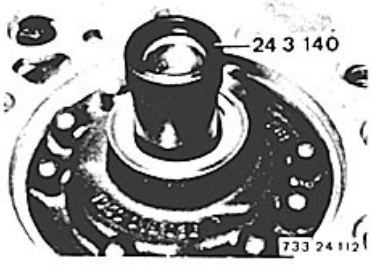
Installation:
Primary pump, consisting of pump body (7), hollow gear (8) and impeller (9), may only be replaced as an assembly.
Check O-ring (10), replacing if necessary.
Important!
Install hollow gear (8) and impeller (9) that punch marks face up.



Check radial play* between driven gear and pump body, while turning gear 360°.

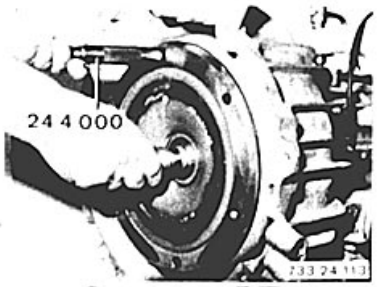


Check axial play* of both gears to face surface with a precision depth micrometer.



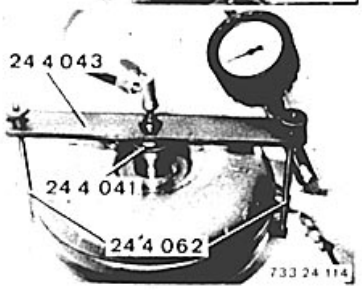
Check running of primary pump with Special Tool 24 3 140.

* See Specifications



24 40 003 REMOVING AND INSTALLING TORQUE CONVERTER

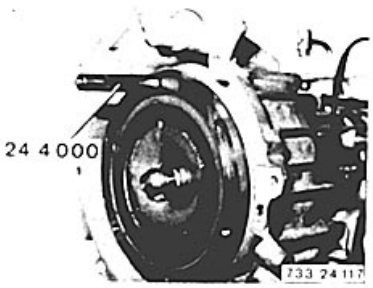
Remove transmission – see 24 00 022 in pertinent model repair manual microfiche beginning with 1985 models.
Pull torque converter out of primary pump carefully with Special Tool 24 4 000.
Caution!
Escaping ATF.



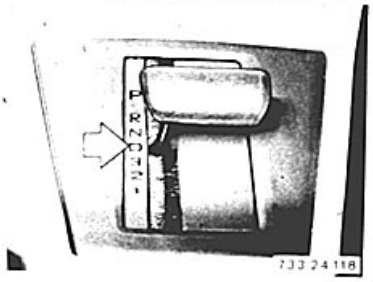
Installation:
Check torque converter for leaks with Special Tools 24 4 041, 24 4 043 and 24 4 062 or 24 4 044 for 4 HP 24.
Test pressure: 0.5 bar (7 psi).
Important!
Always use Special Tool 24 4 043 to prevent injury.



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.

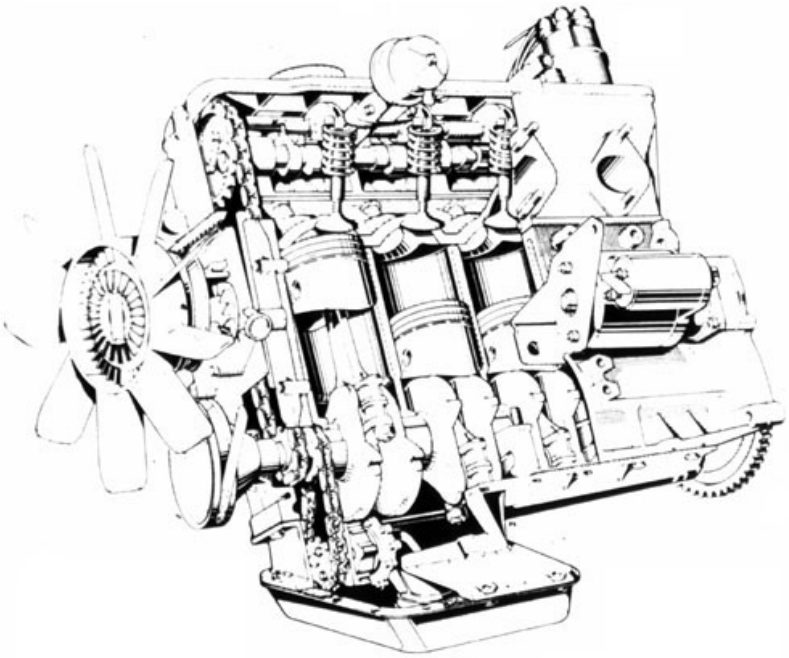
Torque converters cannot be cleaned with conventional workshop equipment and must be replaced when a transmission had been defective or an oil filter screen torn.
Converter identification*.

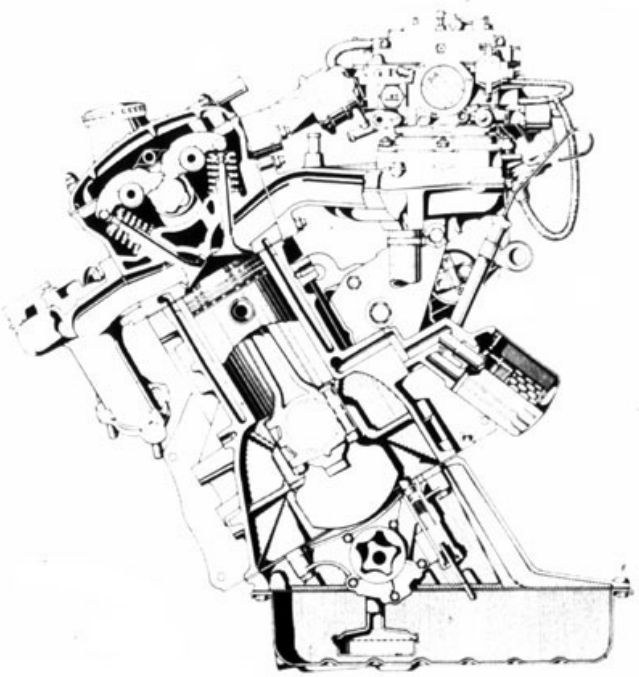
* See Specifications

11 Engine M10

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
591	Valve guide – replace (valves removed)	11- 3
595	Valve guide – inspect for wear	11- 3
600	Valve guide – ream	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- 10
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

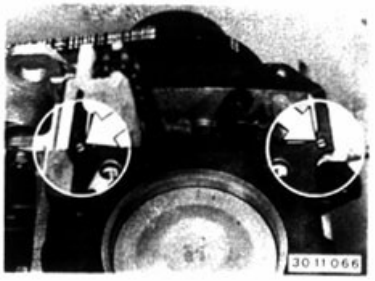
Disconnect hose (8).
Unscrew cylinder head cover.
Installation:
Tighten nuts and bolts in order of 1 ... 7.
Tightening torque*.
Also screw on holder for ignition lead.
Check gasket, replacing if necessary.



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.

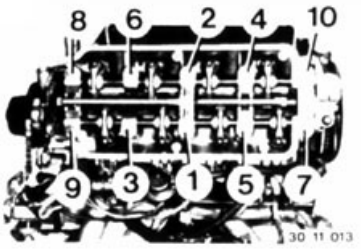


Remove piston for chain tensioner – see 11 31 090.
Unscrew sprocket.
Caution!
Never turn engine after removing the timing chain.
Installation:
Position timing chain that the bore for the dowel pin faces down.
Tightening torque*.



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.



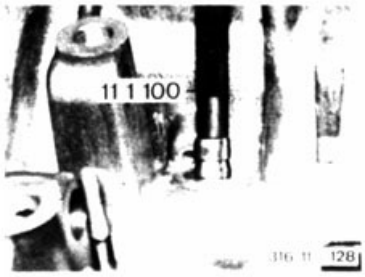
Tighten bolts in order of 1 ... 10 in 3 steps*.
Adjust valve clearance – see 11 34 004.
Adjust ignition timing – see 12 11 004.
Adjust engine idle speed and CO level – see 13 00 054.
Tighten cylinder head bolts to specified torque angle with Special Tool 11 2 110 regardless of the engine temperature 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



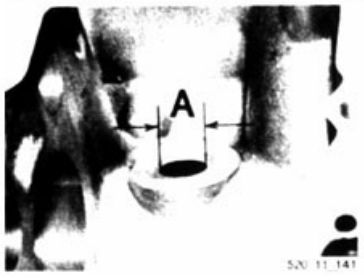
11 12 595 CHECKING VALVE GUIDE FOR WEAR
– Valve Removed –

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.

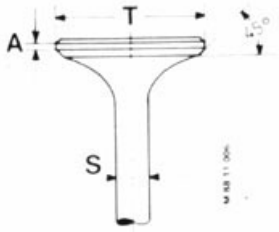


Check bore (A) in cylinder head.
If permissible diameter* is exceeded, bore must be reamed out and an oversize* valve guide installed.



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

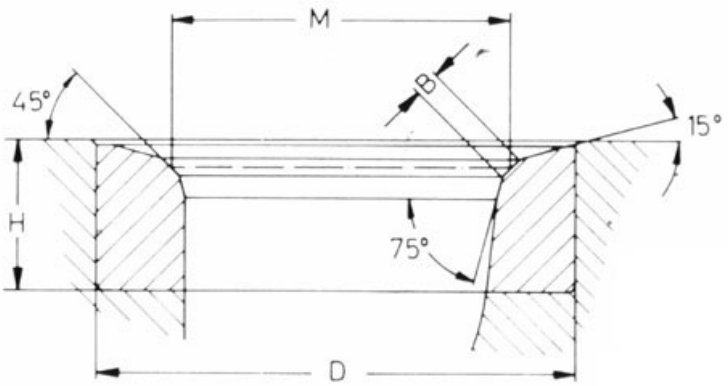


11 12 607 MACHINING VALVE SEATS AND VALVES
– Valves Removed –

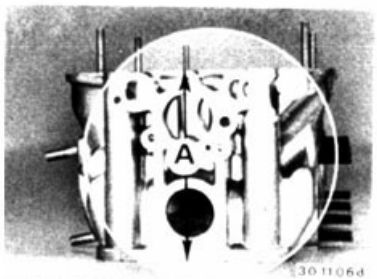
Valve must be replaced, if edge thickness A* is less than specified.

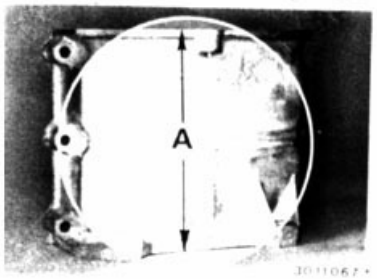


Machine correction angles* to produce valve seat diameter M* and valve seat width B*, after machining the valve seat angle*.
Grind in valves with grinding paste and check valves for leaks – see 11 34 509.



* See Specifications

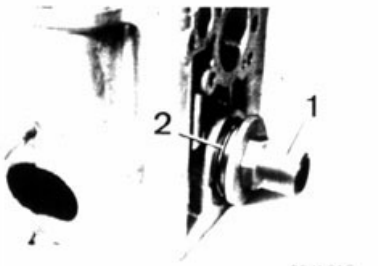


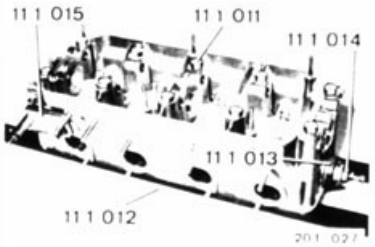


11 14 100 REMOVING AND INSTALLING/ SEALING UPPER TIMING CASE COVER

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

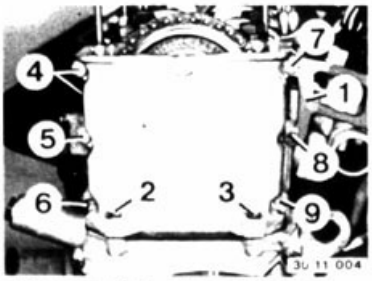
Disconnect battery ground lead.
Remove upper timing case cover 11 14 100.
Disconnect wires on alternator.
Unscrew bolt on crankcase.

Unscrew alternator with console and tensioning bar.

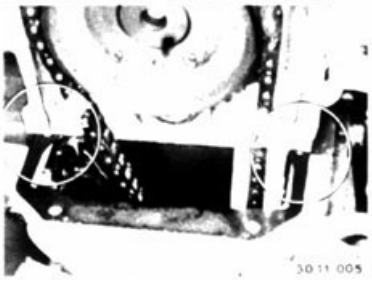
All Cars with Power Steering:
Loosen drive belt.
Unscrew bracket (1).
Pressure hoses remain connected.
Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.

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.

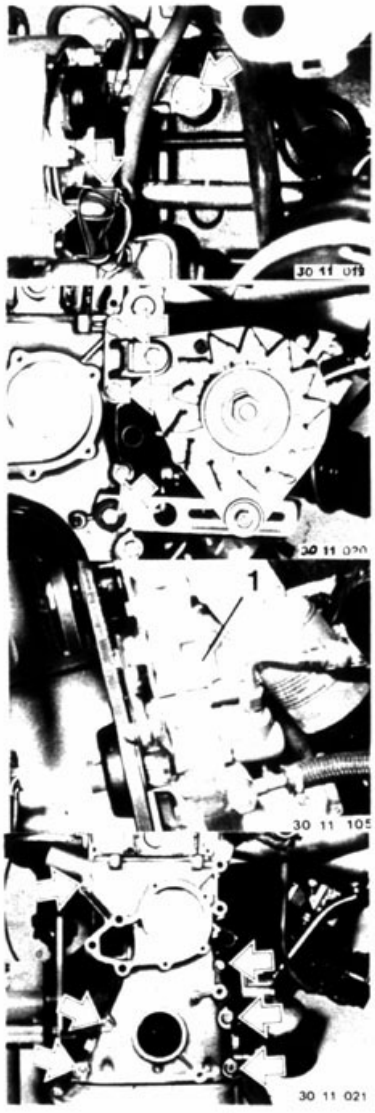


Unscrew bolts (1 ... 3).
Loosen remaining oil pan bolts.

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.

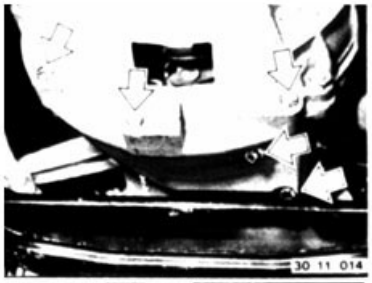
Take off timing case cover.
Installation
Coat mating surfaces between oil pan and crankcase with a brush-on type universal sealing compound / Three Bond Silicon 1207**.
Important!
Take-up web for tensioning piston must extend into oil pocket.

** Source: HWB



One Piece Oil Pan:
Unscrew reinforcement plate.

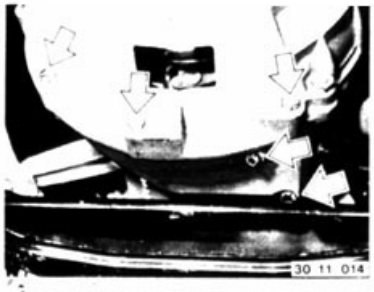
Unscrew oil pan bolts at front end.
Loosen all other oil pan bolts.



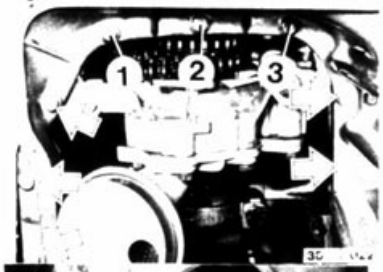
One Piece Oil Pan:
Unscrew reinforcement plate.



Unscrew front oil pan bolts.
Loosen all other oil pan bolts.



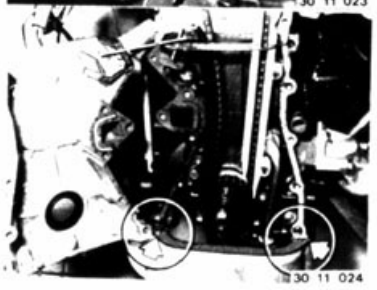
Two Piece Oil Pan:
Unscrew reinforcement plate.
Unscrew lower oil pan section – 11 13 020.



Unscrew bolts (1 ... 3).
Loosen all other oil pan bolts.
Installation:
Install bolts (1 ... 3) with Loctite No. 270**.

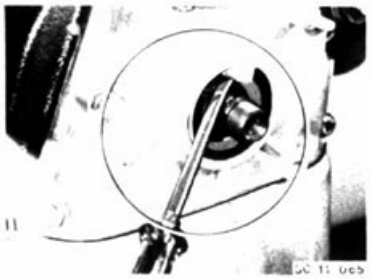


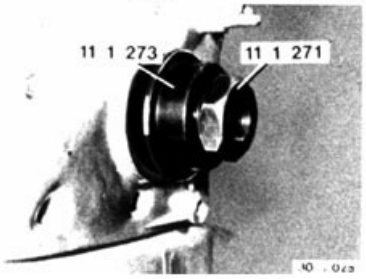
All Models:
Pry oil pan gasket off of timing case cover carefully with a knife.
Remove oil pan – see 11 13 000 – if oil pan gasket is damaged.



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



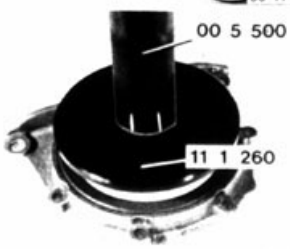


11 14 141 REPLACING RADIAL OIL SEAL IN TIMING CASE COVER

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*.

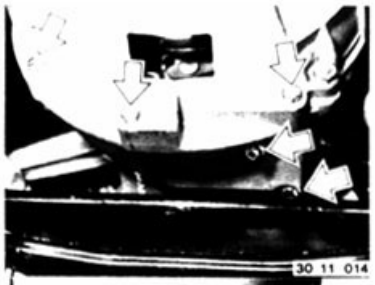


Unscrew crankshaft bearing caps and lift out crankshaft.
Installation
Bearing cap no. 1 is on sprocket end.
Install bearing shells and check bearing play, see 11 21 531.
Installation
Measure axial play after installing crankshaft loosen thrust bearing no. 3 again.
Center thrust bearing by applying knocks 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.

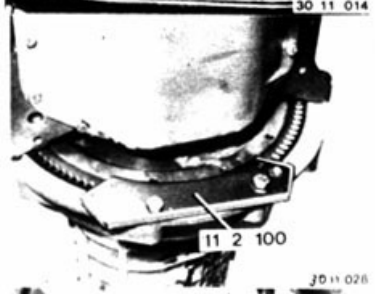
* See Specifications

* 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.

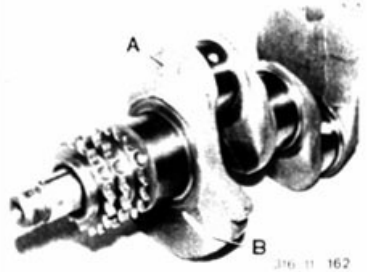
* See Specifications

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.

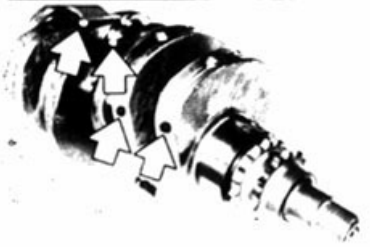


Crankshaft is surface treated and may only be reground in the factory.

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 *

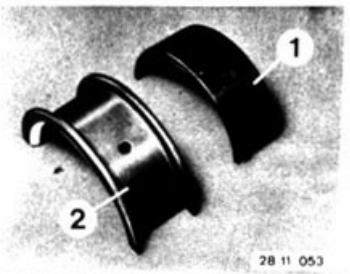


Replacement crankshafts are only supplied with bearing shells of double classification.
A crankshaft is marked with red or blue paint because of the main bearing journal tolerances.



Transferring Sprocket:
Lift out woodruff key (1).
Pull off sprocket with Special Tool 11 2 000.

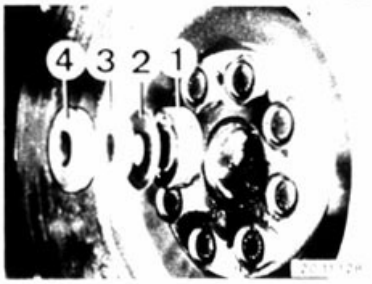
Installation
Heat sprocket to max. 200° C (390° F) for installation.



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.

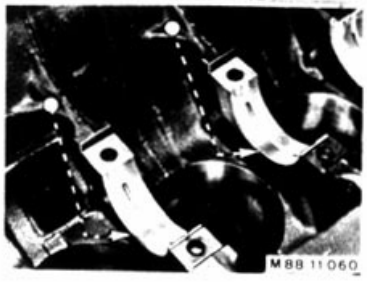
Check the ground size of main bearing journals.



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

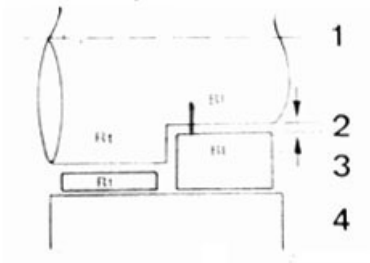


Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps with the correct torque*.
Do not turn the crankshaft.

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

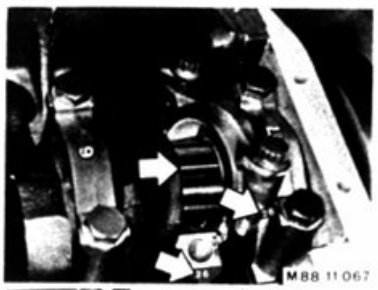
1 Crankshaft diameter
2 Bearing play
3 Bearing shell thickness
4 Console diameter



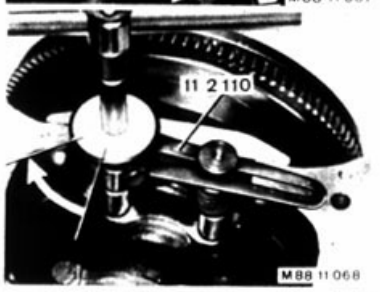
Replacing Conrod Bearing Shells:
Red or blue conrod bearing shells are installed standard depending on the color code mark on the connecting rod for a pertinent crankshaft ground size.

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*.



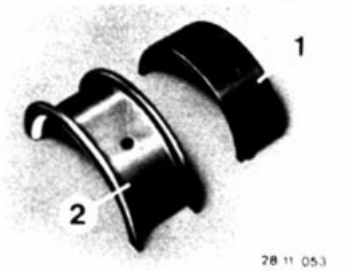
* See Specifications



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 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.

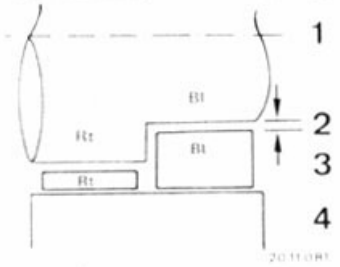
Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

* 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



11 21 571 REPLACING PILOT BEARING IN CRANKSHAFT

Remove clutch 21 21 000.
Pull out ball bearing with Special Tool 11 2 010.

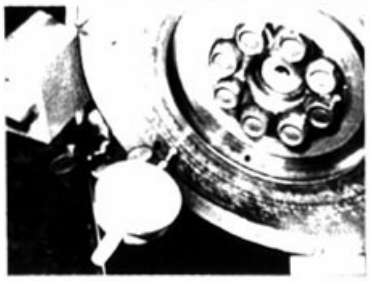


Installed Order:
1 Ball bearing
2 Cover
3 Felt ring
4 Capsule
Install cover (2) with stamp facing out.



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.



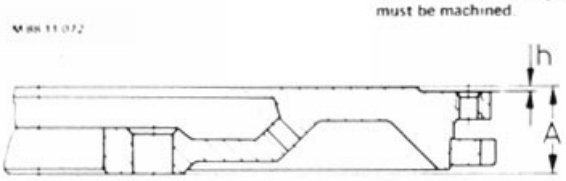


11 22 000 REMOVING AND INSTALLING FLYWHEEL

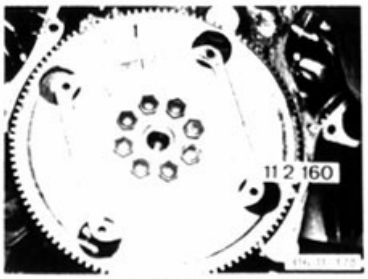
Remove clutch 21 21 000.
Hold flywheel with Special Tool 11 2 160.
Unscrew bolts and take off flywheel.
Installation
Clean tapped bores.
Install washer (1).
Replace and install expansion bolts with Loctite No. 270**.
Important!
Only coat threads of bolts.
Tightening torque*.

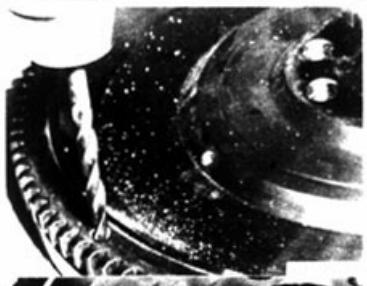
Check axial runout* of flywheel.

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.



28 11 305

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 11 306

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

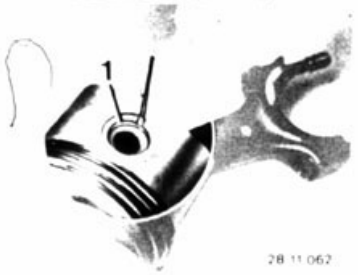
Important!
Don't turn connecting rods or crankshaft.
Take off bearing caps.
Read bearing play* on supplied scale by measuring width of flattened Plastigage.
Correct bearing play by installing new bearing shells, bearing shells of different machined size or with different color code.
For final installation, replace conrod bearing cap bolts and tighten bearing caps.
Tightening torque*.

* See Specifications



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.



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.



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

* See Specifications



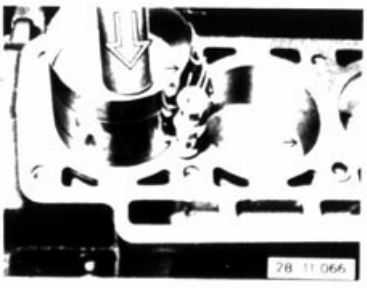
Set internal calipers to zero on micrometer with the measured piston diameter.

Measure cylinder bore with internal calipers at bottom, center and top in forward and rotational directions.
Check piston installed clearance*.





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 timing chain.

* See Specifications



28 11 067





11 25 651 REPLACING PISTON RINGS OF ONE PISTON
- Piston Removed -

Measure side clearance* of piston rings.

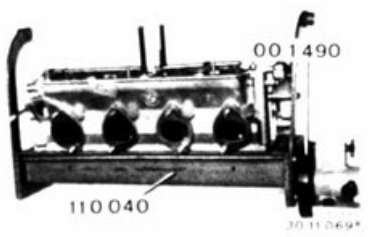
Remove piston rings and check end clearance*.

Installation:
Install piston rings with word "TOP" facing the piston crown.

1 Plain compression ring
2 Taper faced compression ring
3 Slotted oil scraper ring

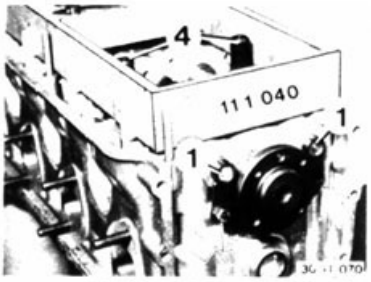
Note:
Identification can no longer be seen on used piston rings.
Lay piston rings aside in correct sequence and installed position.

* See Specifications



11 31 000 REMOVING AND INSTALLING CAMSHAFT

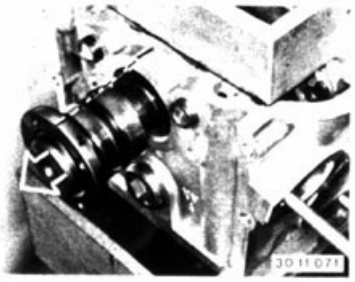
Remove cylinder head 11 12 100.
Mount cylinder head in Special Tool 11 1 040.



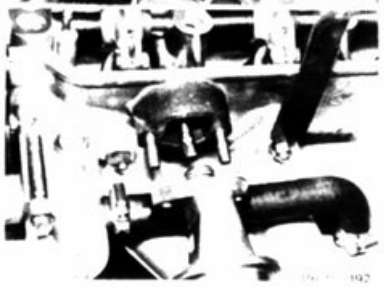
Insert dowel pins (4) and unscrew guide plate.
Installation:
Replace loose plugs (1) and install with Loctite No. 270**.
Camshaft must still turn easily after installing the guide plate.



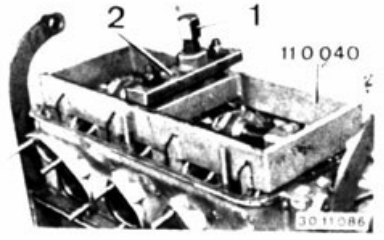
Unscrew oil line.
Installation:
Check installed position of seals.
Tightening torque*.



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.



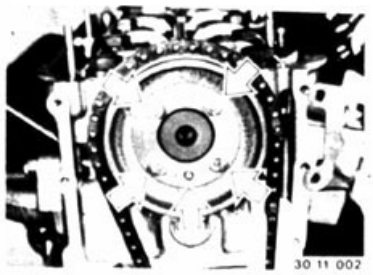
M 10 B 18 V:
Unscrew fuel pump.
Installation:
Check gaskets and insulating flange, replacing if necessary.
Pull out plunger partially.



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

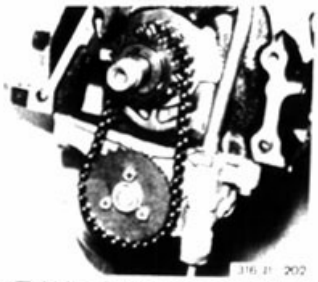


11 31 061 REPLACING SET OF TIMING CHAIN SPROCKETS

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



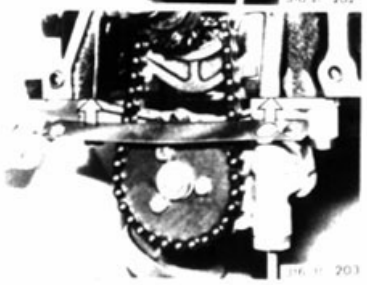
All Models:
Pull off sprocket with Special Tool 11 2 000
Installation
Heat sprocket to approx. 80° C (175° F)



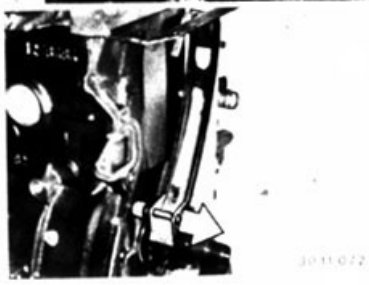
Installation
Chain must be tightened to give under light thumb pressure applied midway between two pulleys



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

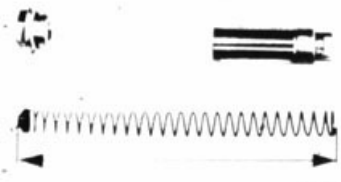


Remove lockwasher, swing tensioning rail toward inside and remove.

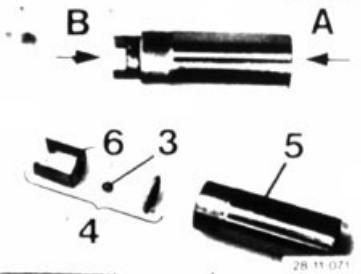


11 31 090 REMOVING AND INSTALLING CHAIN TENSIONER PISTON

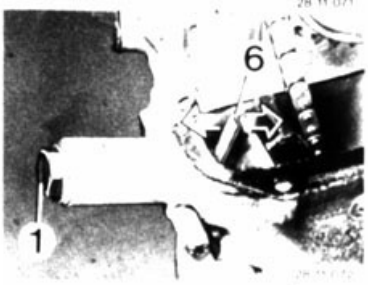
Unscrew plug (1).
Caution!
Strong spring force
Remove spring and piston
Installation
Replace seal (2).



Installation
Check spring length*
Tapered end of coil spring faces plug

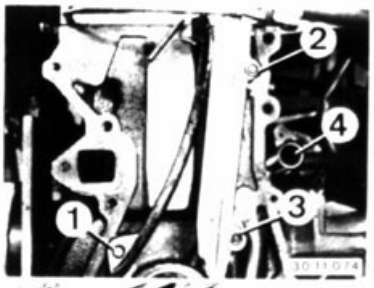


Checking Piston
Check free movement of ball (3) by shaking
Check function of valve by blowing air
in direction A = closed and
in direction B = opened
If applicable, drive valve (4) out of sleeve (5) and clean
Make sure vent slots (6) are not clogged



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.

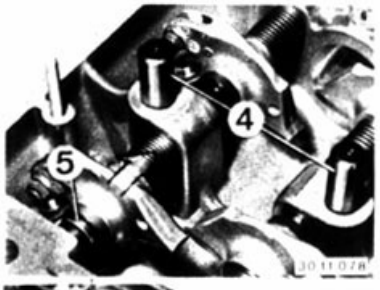


Swing guide rail aside and remove.

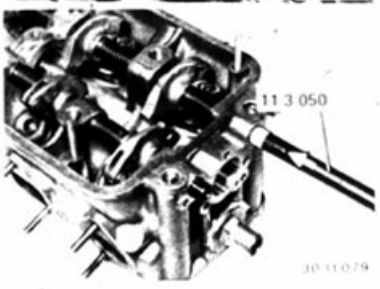


11 33 020 REMOVING AND INSTALLING ROCKER ARM SHAFTS

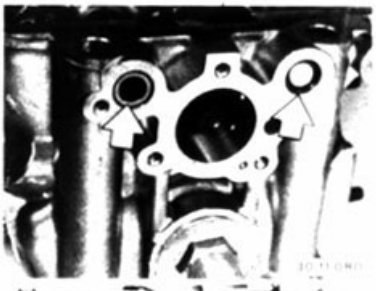
Remove camshaft 11 31 000
Unscrew distributor flange
Installation
Replace seal (1) and gasket (2)



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)

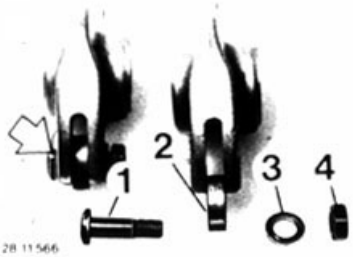
** Source: HWB



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

28 11 120

11 34 004 ADJUSTING VALVE CLEARANCE

Remove cylinder head cover 11 12 000
Crank engine with Special Tool 11 3 110

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

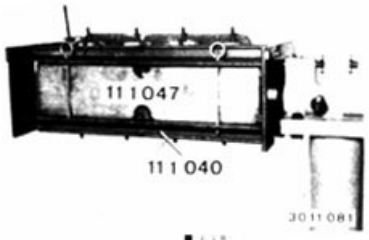
Tighten nut (1) with Special Tools 11 1 150 and 00 2 050.
Tightening torque*.



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 –

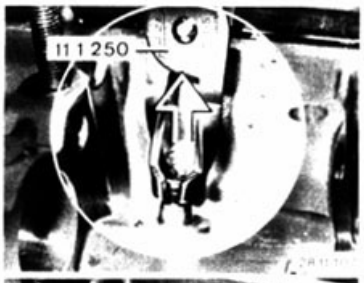
Place Special Tool 11 0 047 (tray) in Special Tool 11 1 040.



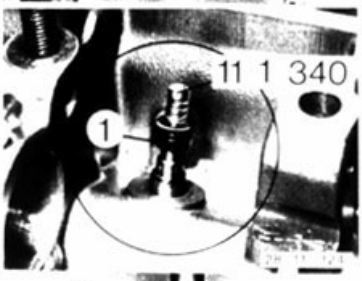
Press down on valve springs with Special Tool 11 1 040 and remove collets.



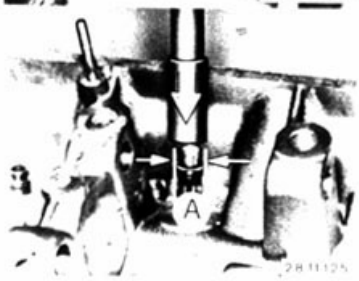
Remove upper spring retainer, valve springs and lower spring retainer.
Take tray out of special tool fixture and pull out valve.
Installation:
Only install valve springs with same color code, wire gauge size and length.
Lubricate valve guide and valve stem with oil.



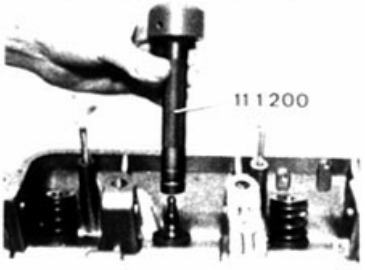
Pull off valve stem seal with Special Tool 11 1 250.



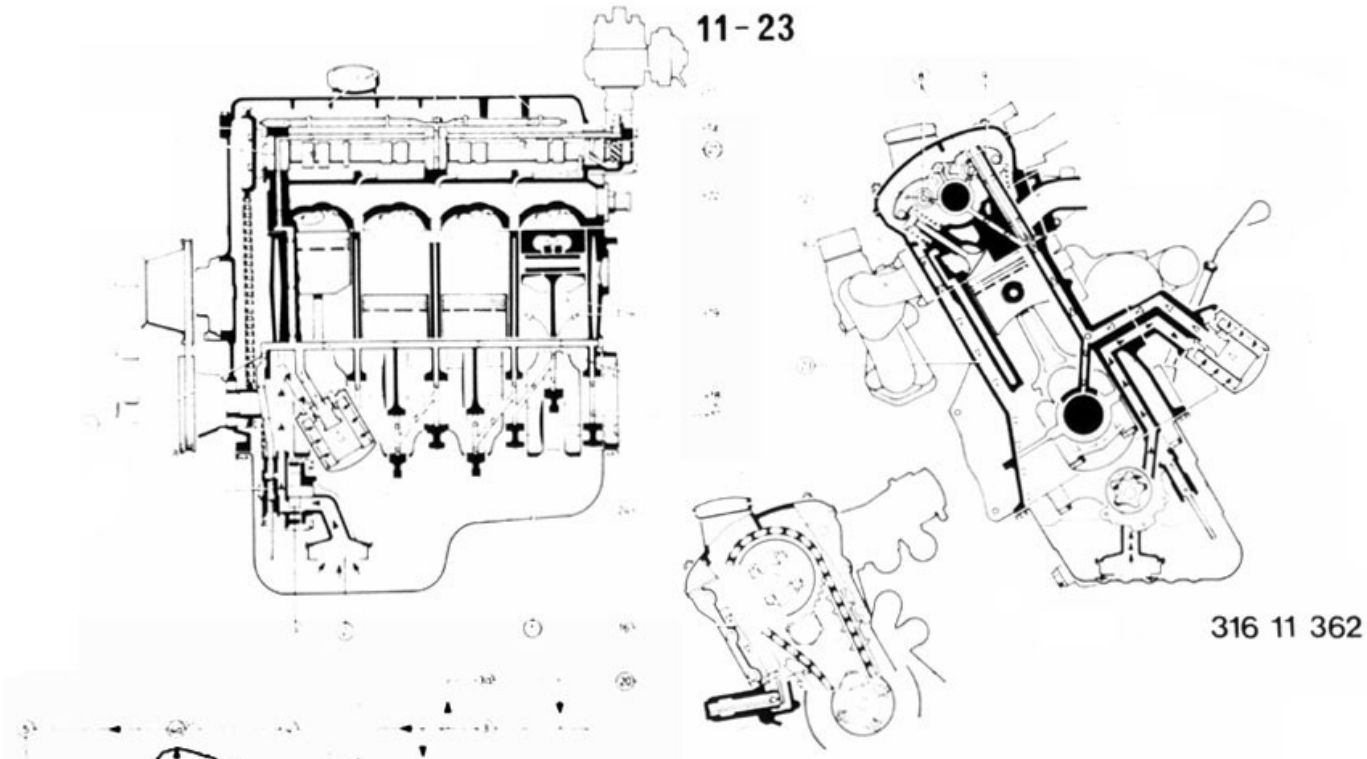
Install valve.
Use Special Tool 11 1 340 to avoid damaging valve stem seal.
Lubricate valve stem seal (1) with oil and install.
Special Tool Source:
Cartool
Alfred Brehm Str. 5
D–8070 Ingolstadt



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.

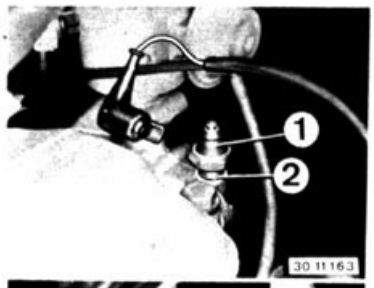


316 11 362

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



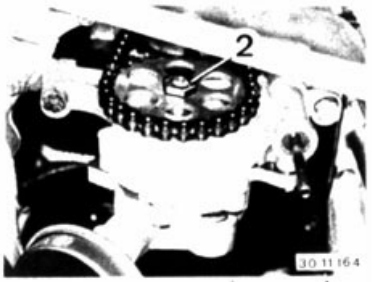
11 40 000 CHECKING ENGINE OIL PRESSURE

Pull off wires on oil pressure switch.
Unscrew oil pressure switch (1).
Installation:
Check seal (2), replacing if necessary.



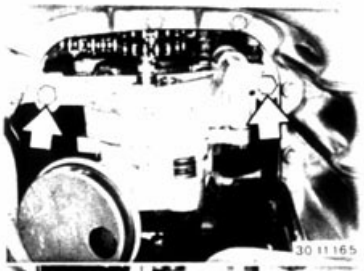
Screw in Special Tool 11 4 060.
Connect 10 bar (142 psi) pressure tester of BMW service test unit.
Check oil pressure*.

* See Specifications

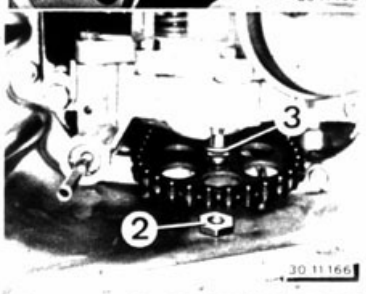


11 41 000 REMOVING AND INSTALLING OIL PUMP

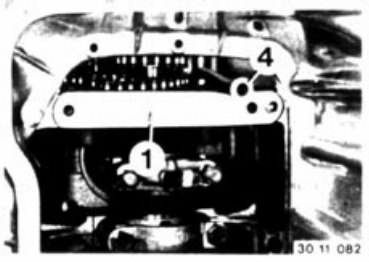
Remove oil pan lower section 11 13 020.
Unscrew nut (2) and take off sprocket.



Unscrew oil pump.

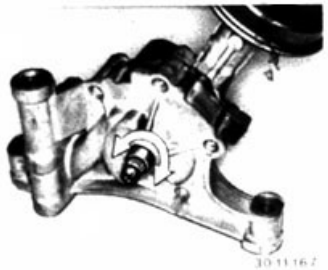


Installation:
Install shim (3).
Tightening torque* for nut (2).



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.



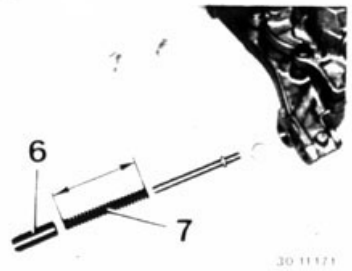
Clean oil filter screen.



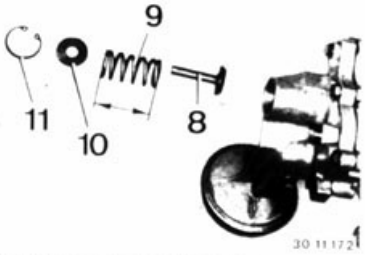
Disassemble oil pump.



Check oil pump for wear.
- Scoring in body
- Wear on rotors



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").



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").

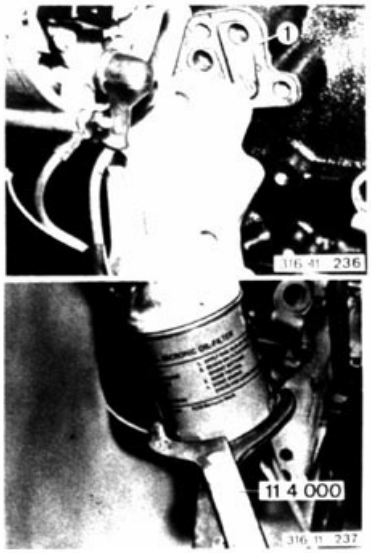


Installation:
Press in spring (9) and washer (10) with a wrench socket and install circlip (11).

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.



240

11 51 502 OVERHAULING WATER PUMP

Pull off hub with Special Tool 00 8 500 from Kukko.



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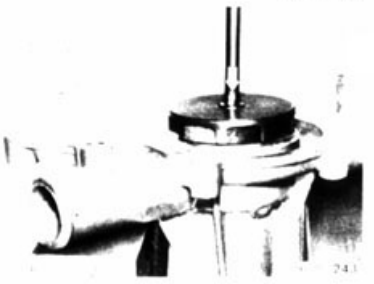
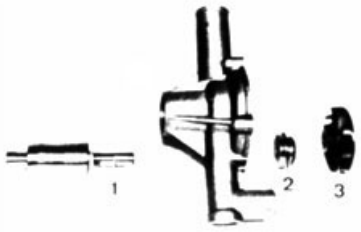
Installation
Distance (A)*



243

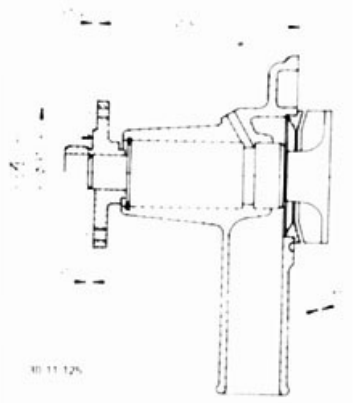
Remove circlip.

Press impeller off of shaft and water pump bearing out of housing.



244

Replace bearing (1) and seal (2).
Check impeller (3), replacing if necessary.

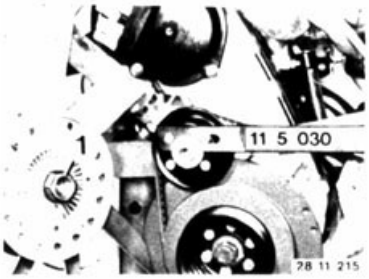


30.11.125

Installation
Press on impeller with Loctite No. 270**
Distance (B)* must always be held.

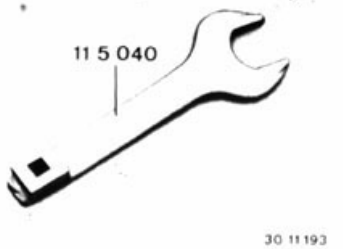
* See Specifications

* See Specifications
** Source: HWB

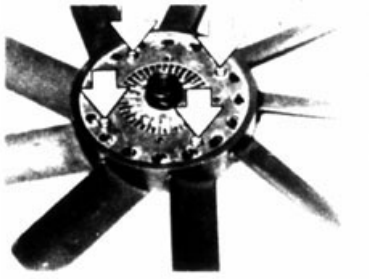


11 52 000 REMOVING AND INSTALLING FAN

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").

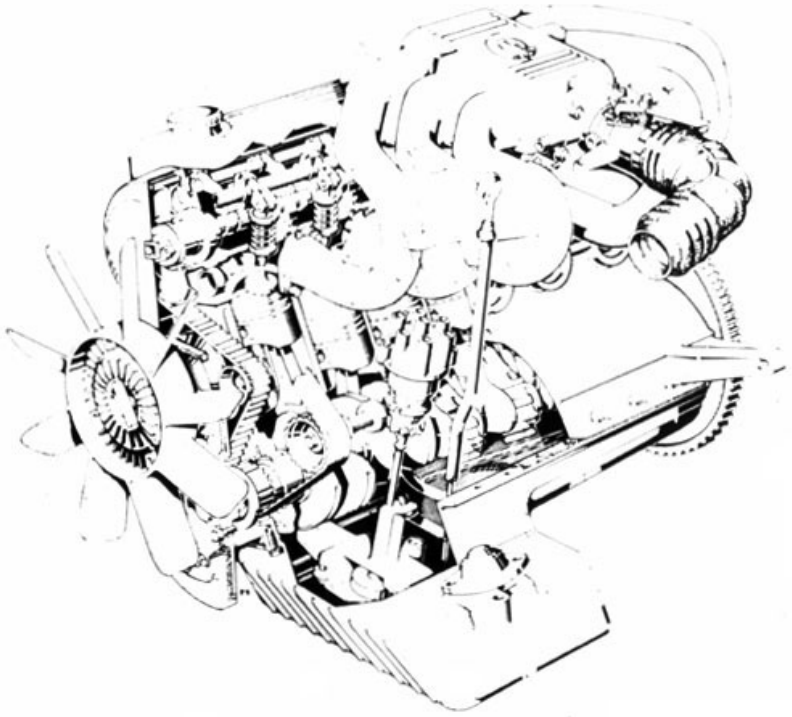
* See Specifications
*** See Workshop Equipment Catalog

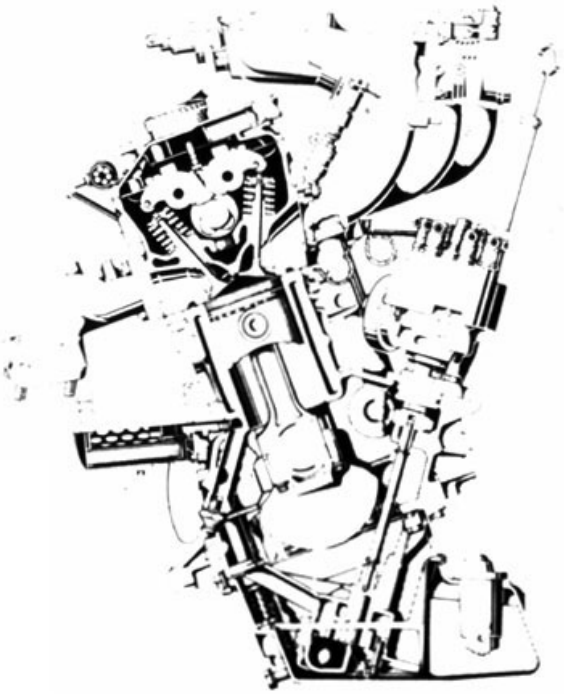
* See Specifications

11 Engine M20

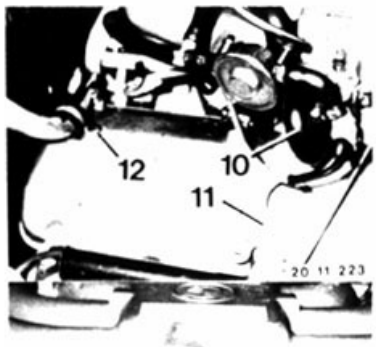
11 12 000	Cylinder head cover – remove and install	11- 101
101	Cylinder head gasket – replace	11- 101
240	Radial oil seal in end cover – replace	11- 102
500	Cylinder head – remove and install (engine removed)	11- 103
561	Valve guide – replace (valve removed)	11- 104
595	Valve guide – check for wear	11- 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- 109
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
571	Connecting rod bearing shells – replace (engine disassembled)	11- 113
11 25 000	Piston – remove and install	11- 114
651	Piston rings of one piston – replace (piston removed)	11- 115
11 31 000	Camshaft – remove and install	11- 116
110	Drive belt – replace	11- 117
11 33 020	Rocker arm shafts – remove and install (distributor engine)	11- 119
020	Rocker arm shafts – remove and install (DME engine)	11- 120
031	Rocker arms – replace	11- 121
11 34 004	Valve clearance – adjust	11- 121
509	Valves – check for leaks (camshaft removed)	11- 121
550	Valves – remove and install	11- 122
11 35 020	Distributor intermediate shaft – remove and install	11- 122
	Engine oil circuit	11- 123
11 40 000	Engine oil pressure – check	11- 124
11 41 000	Oil pump – remove and install	11- 125
110	Pressure safety valve – remove and install	11- 126
11 42 020	Full flow oil filter – replace	11- 126
11 43 101	Guide tube for oil dipstick – replace	11- 126
11 51 000	Water pump – remove and install	11- 127
502	Water pump – overhaul (water pump removed)	11- 128
11 52 000	Fan – remove and install	11- 129
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)

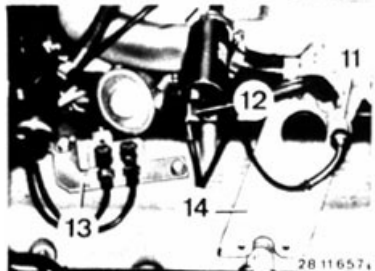


11 12 000 REMOVING AND INSTALLING CYLINDER HEAD COVER

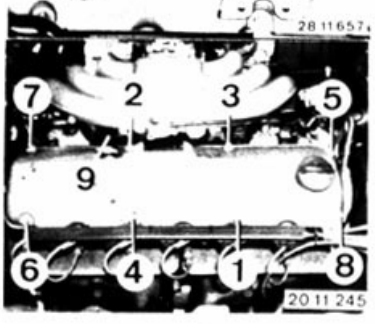
M 20 B 20 / B 23:
Pull off hose (10).
Unscrew support (11).
Unscrew clamp (12).



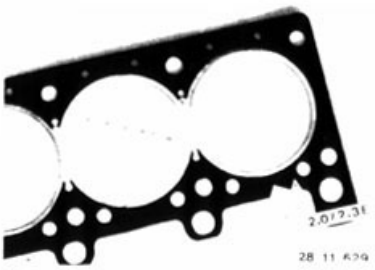
M 20 B 25:
Unscrew support (1).



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

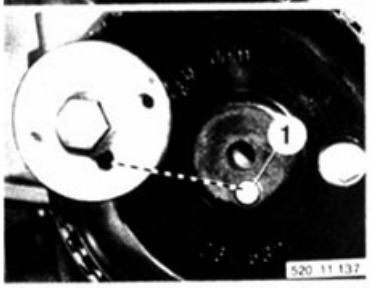
** Source: HWB



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.

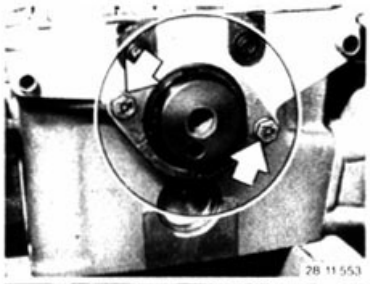


Unscrew toothed belt sprocket on camshaft.

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.

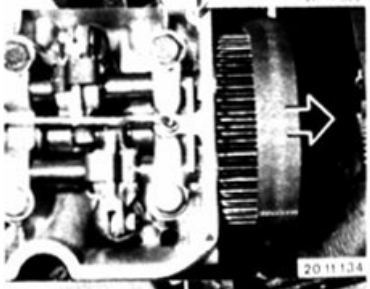


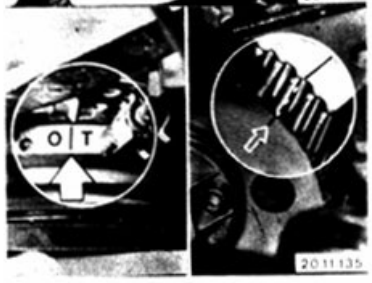
Replace radial oil seal (2) and round cord seal (3).

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).

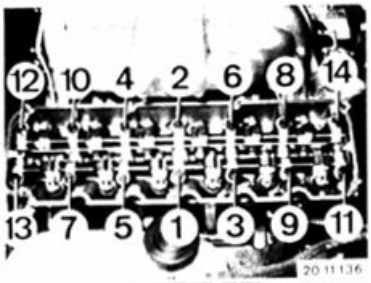
Take drive belt off of the camshaft sprocket.

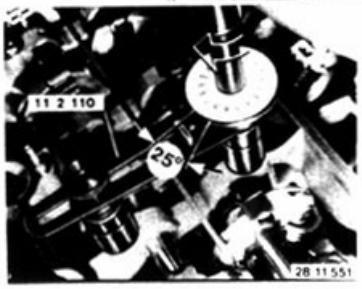
Caution!
Never crank engine after removing the drive belt.

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

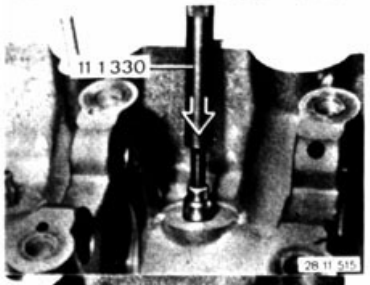
(no settling or warm running time)

Version A can be converted to Version B.

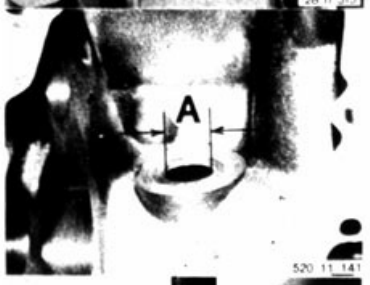


11 12 561 REPLACING VALVE GUIDE – Valve Removed

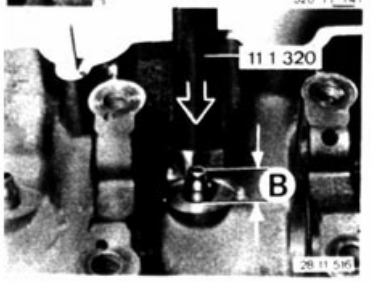
Check valve guide wear* with Special Tool 00 4 300.



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

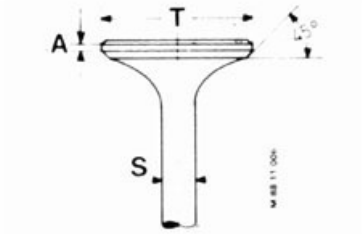
To measure amount of wear, install a new valve that end of valve stem is flush with valve guide.
Set up dial gage and measure tilt clearance.
Max. permissible tilt clearance*.



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

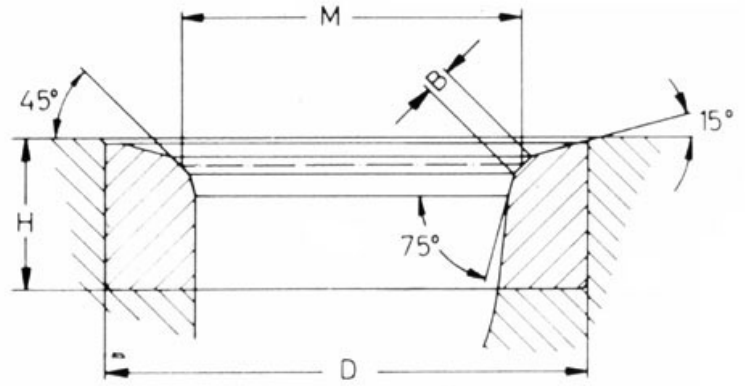


11 12 607 MACHINING VALVE SEATS AND VALVES
– Valves Removed –

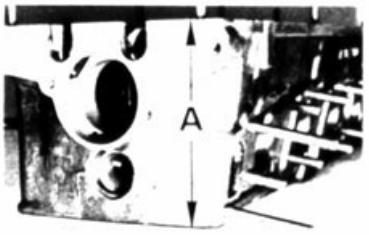
If edge thickness A* is less than specified, the valve must be replaced.



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.

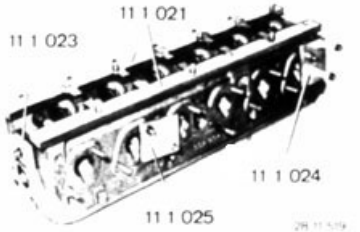


* See Specifications



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).



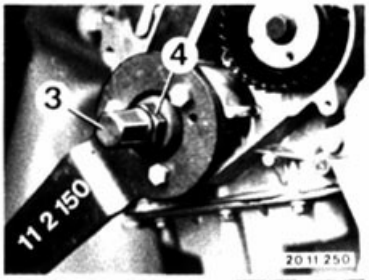
11 12 729 CHECKING CYLINDER HEAD FOR CRACKS IN WATER TEST
– Cylinder Head Disassembled

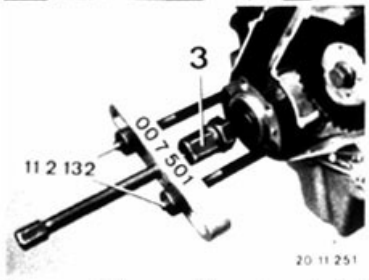
Mount Special Tools 11 1 021 on cylinder head (using cylinder head mounting bolts).
Close off water circuit on cylinder head with Special Tools 11 1 023, 11 1 024 and 11 1 025.



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

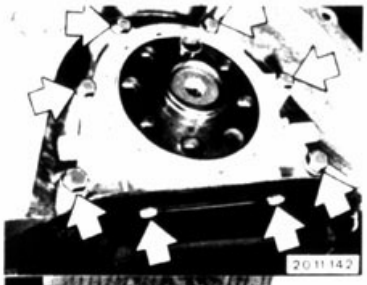
** Source of Supply: HWB

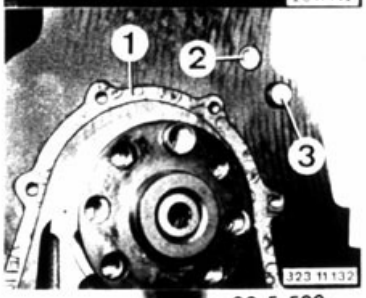


M 21 11 050

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.


20 11 142



323 11 132



30 11 027



30 11 026

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.

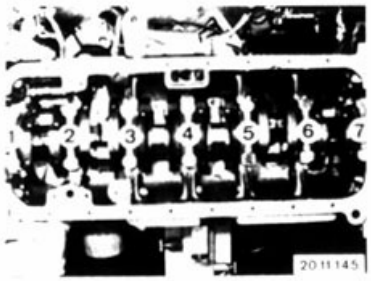


Remove flywheel 11 22 000.
Unscrew end cover.
Installation:
Replace gasket.
Use Special Tool 11 2 213 to avoid damaging radial oil seal.
Cut off gasket on oil pan sealing surface.



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



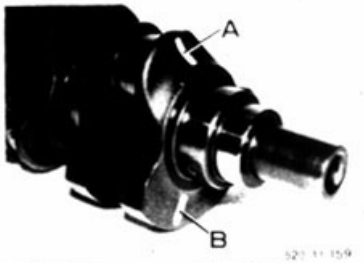
Unscrew crankshaft bearing caps and lift out crankshaft.
Installation:
Don't mix up bearing caps.
Bearing cap no. 1 is on drive belt end.
Bearing no. 6 is the thrust bearing.
Install bearing shells and check bearing play, see 11 21 531.

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.

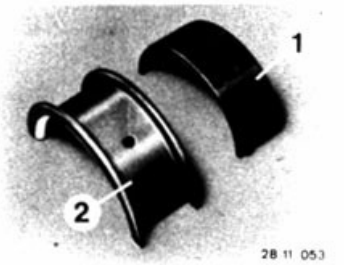
Installed Order:
Ball bearing (1), cover (2), felt ring (3) and capsule (4).

Insert cover (2) with embossment facing out.

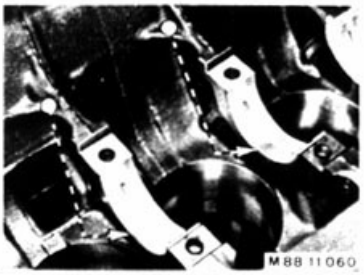
Fill bore in crankshaft with approx. 1 gram (0.035 oz.) of lubricating grease. Drive in pilot bearing with Special Tools 11 2 030 and 00 5 500.

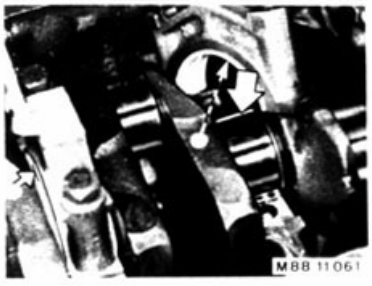
* See Specifications


28 11 308



28 11 053


M88 11 060


M88 11 061

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.

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.

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".

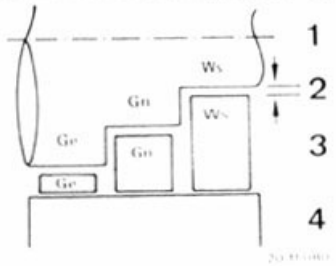
Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps with the correct torque*.
Do not turn the crankshaft.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

* See Specifications



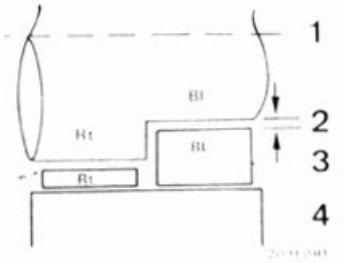
Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with different color code marks.



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.

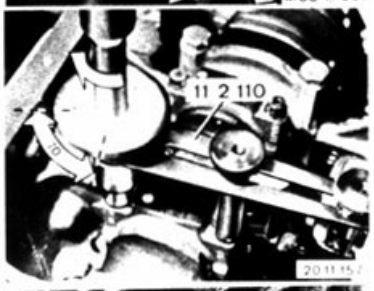
Only install the red bearing shells of a pertinent ground size for a replacement crankshaft.

* 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.

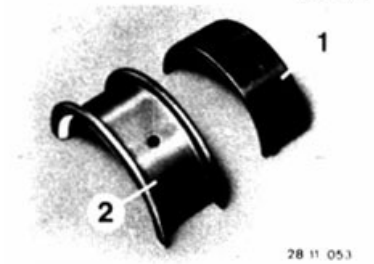


Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with different color code marks.
Replace conrod bolts for final installation and tighten the conrod caps in two steps (see above).

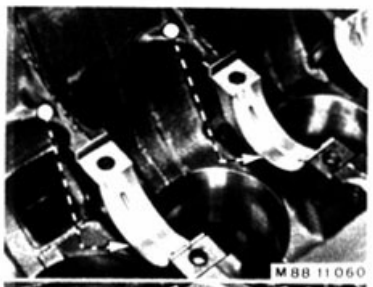
* See Specifications



28 11 308



28 11 053



M88 11060



M88 11061

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)

1 = Bearing shell 1–2–3–4–5–7
2 = Bearing shell 6 (pilot bearing)

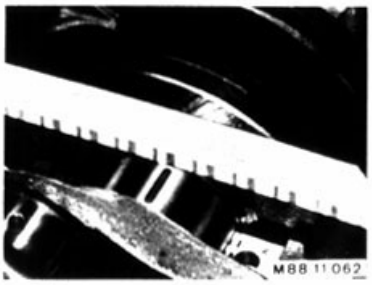
Color code mark is located on the side of a bearing shell.

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 the correct torque*.
Do not turn the crankshaft.

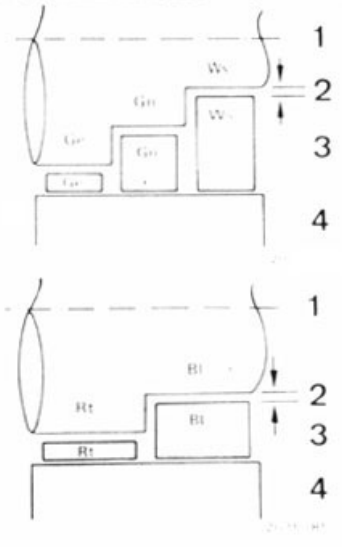
Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

* See Specifications



M88 11062

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

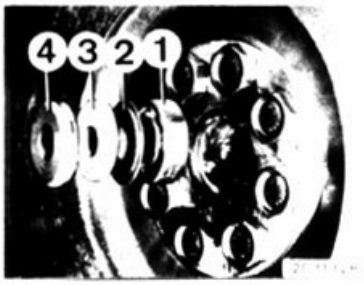
1 Crankshaft diameter
2 Bearing play
3 Bearing shell thickness
4 Console diameter

* See Specifications

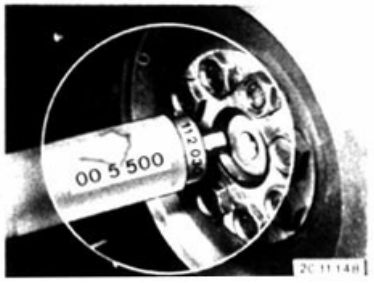


11 21 571 REPLACING PILOT BEARING IN CRANKSHAFT

Remove clutch 21 21 000.
Pull out ball bearing with Special Tool 11 2 010.

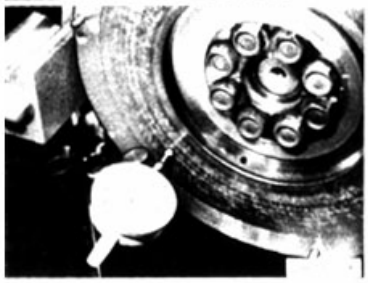


Installed Order:
1 Ball bearing
2 Cover
3 Felt ring
4 Capsule
Insert cover (2) with embossment facing out.



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

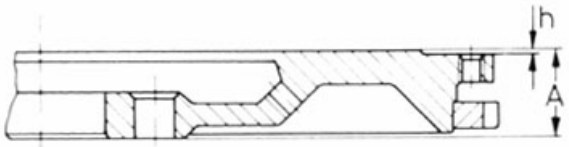
Remove clutch - see 21 21 000.
Hold flywheel with Special Tool 11 2 170.
Unscrew bolts and take off flywheel.

Installation:
Clean tapped bores.
Insert ring (1).
Install new bolts coated with microencapsulated cement.
Tightening torque*.

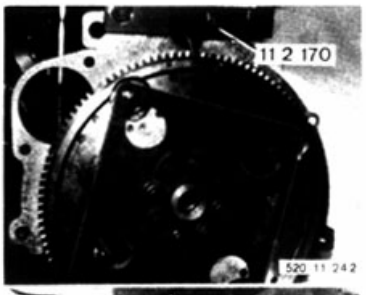
If necessary, check flywheel for axial runout*.

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

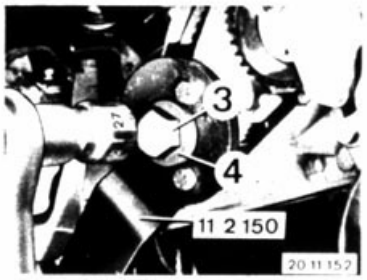
M 20 B 20 / B 27:
Take drive belts off of alternator, power steering pump and, if applicable, compressor for air conditioner.
Installation:
Tighten drive belts and check tightness with Special Tool 11 5 020.



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.

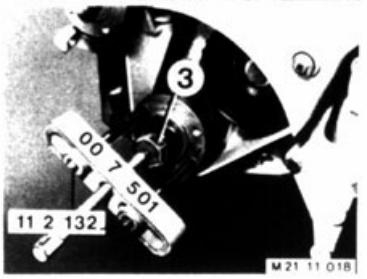


All:
Take pulley and vibration damper off of hub.
Installation:
Centering pin must be in bore of vibration damper.



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







20 11 157

11 24 571 REPLACING CONROD BEARING SHELLS

– Engine Disassembled

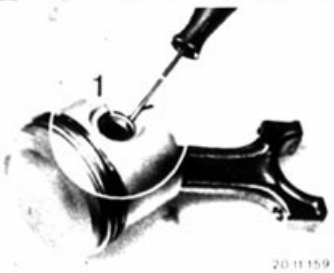
Place conrod bearing shells in connecting rods and conrod caps.
Double Classification:
Use red or blue conrod bearing shells according to color code on connecting rod.
Important!
Check machined size (conrod bearing diameter).

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

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





20.11.159



20.11.160

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.

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.

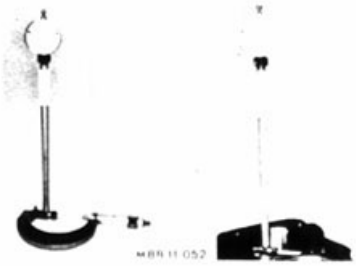
Important!
Check machined size (piston diameter)*.

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 well)	84
M 20 B 27 M U	9	3.5	84
M 20 B 27 M Z	8.5	3.6	84

* See Specifications



20.11.161



M86.11.052



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*.



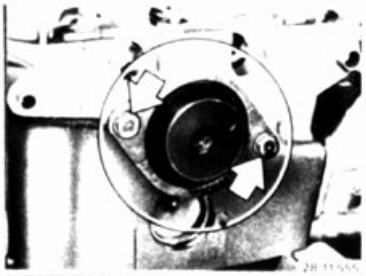
20.11.165

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

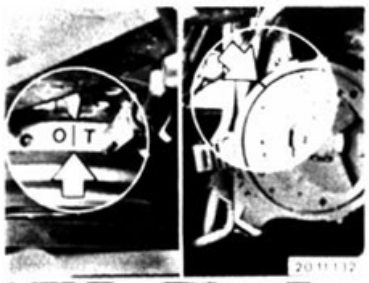
11 31 100 TIGHTENING TOOTHED DRIVE BELT

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

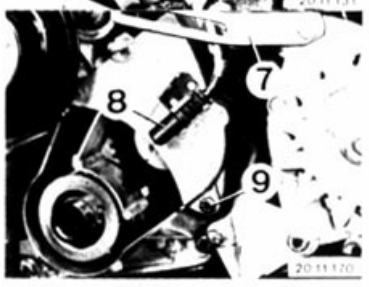
Important
Always replace an used toothed belt each time the tensioning rooler is loosened, regardless of the mileage ***
Distributor Engine
Set valves in cylinder no. 1 to TDC (speed governor aligned with notch in distributor housing)



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).
Oil 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).

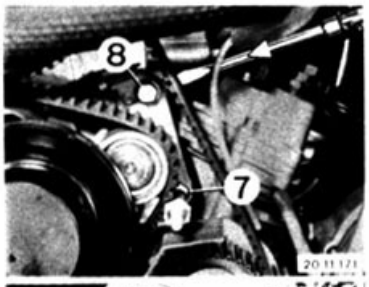


Turn crankshaft to move valves in cylinder no. 1 to TDC (arrow on camshaft sprocket faces mark on cylinder head).
Remove vibration damper - see 11 23 010.



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.

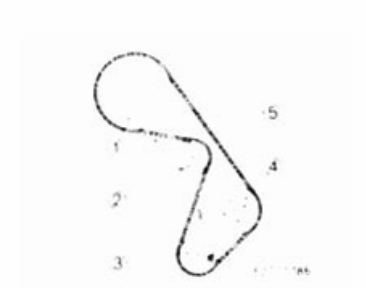
Installation
There are different toothed drive belt versions.

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".

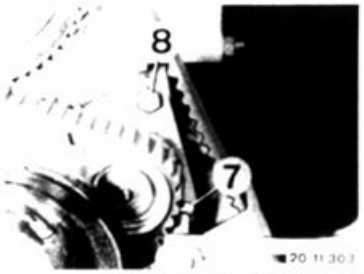
Versions A must be converted to B***.
Install toothed drive belt starting from the crankshaft sprocket and working opposite the engine's direction of rotation.

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





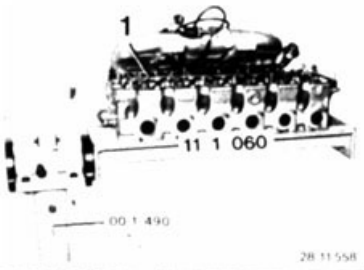
Tightening Toothed Drive Belt:

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).

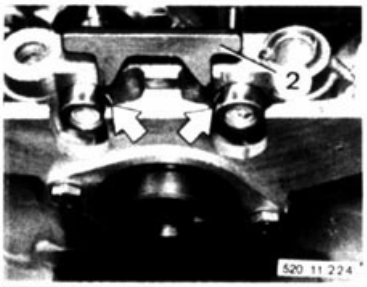
Check timing (mark on camshaft sprocket must be aligned precisely with mark on cylinder head with the crankshaft at TDC mark).

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

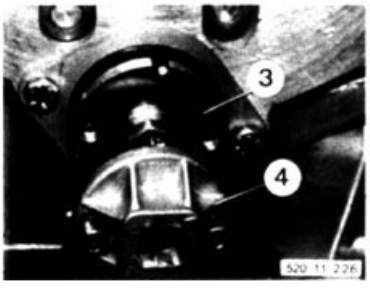
Engine with Distributor:
Remove cylinder head 11 12 100
Mount cylinder head on Special Tool 11 1 060 and bolt down with one cylinder head bolt
Unscrew oil line (1)



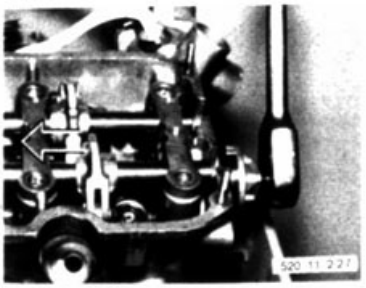
Unscrew toothed belt sprocket
Adjust clearance of all valves to maximum value.
Remove plugs.
Remove guide plate (2)
Installation
Guide plate (2) must fit in grooves of rocker arm shafts



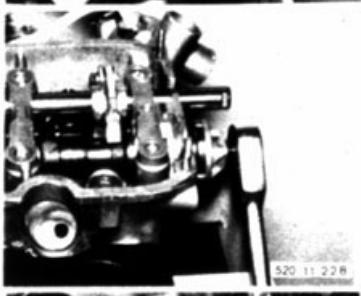
Lift out clamps.
Installation
Straight surface of clamp must fit in groove of rocker arm shafts



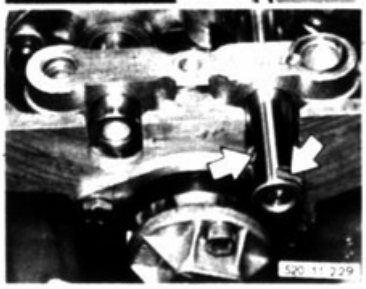
Mount disc (3) and adapter (4) on camshaft to turn the camshaft.



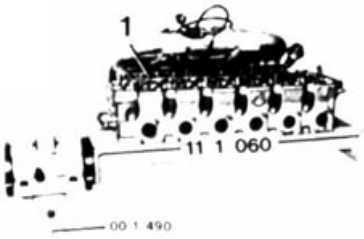
Removing Rocker Arm Shafts
a) Exhaust Side
Valves of cylinder no. 6 must overlap
Push in rocker arm of first cylinder
Turn camshaft on adapter toward intake side until pressure is taken off of all rocker arms
Pull out rocker arm shaft or drive out with Special Tool 11 3 050



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

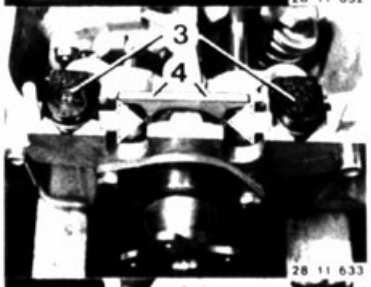


11 33 020 REMOVING AND INSTALLING ROCKER ARM SHAFTS

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



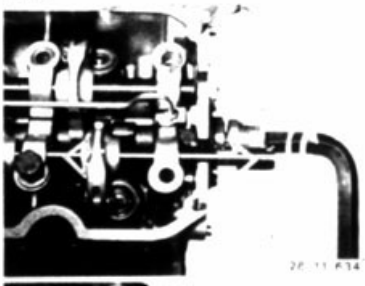
Mount adapter (2)
Adjust valve clearance of all valves to maximum value



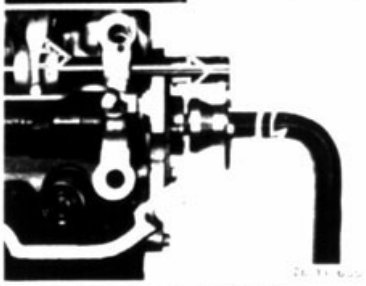
Lift out front and rear plugs (3)
Remove guide plate (4)
Installation
Guide plate (4) must fit in grooves of rocker arm shafts



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



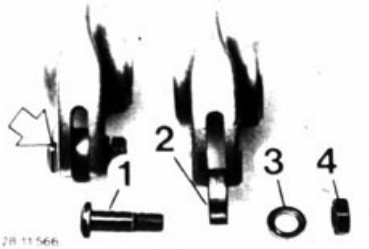
Replace worn rocker arm shafts and rocker arms
Installation
Install rocker arm shafts that oil bores (large face down toward valve guide and small oil bores and grooves for guide plate face in



28 11 565

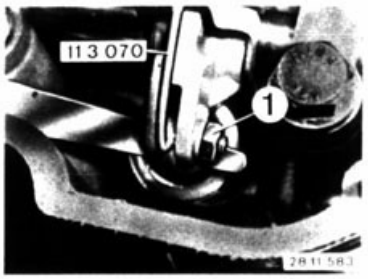
11 33 031 REPLACING ROCKER ARMS

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

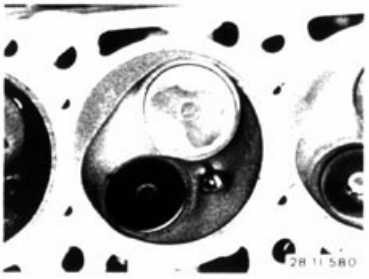
11 34 004 ADJUSTING VALVE CLEARANCE

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.



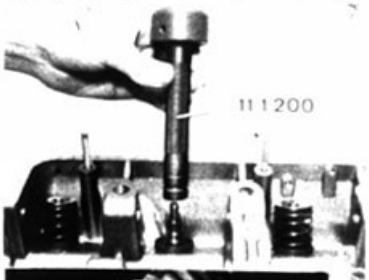
Pull off valve seal with Special Tool 11 1 250.



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").

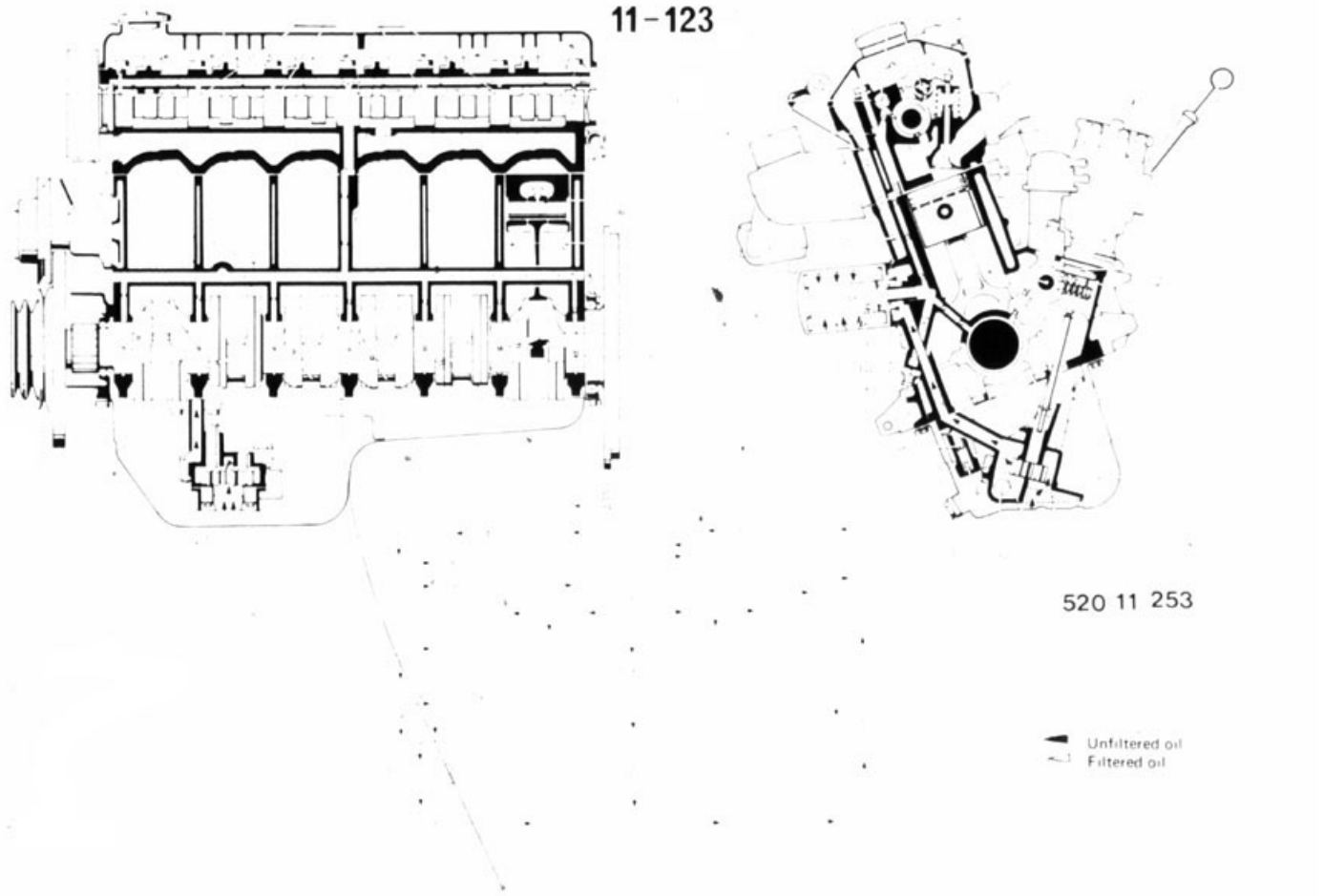


New, improved valve stem seals with grooves on the inside are pressed on by hand with Special Tool 11 1 200.
Special Tool 11 1 200 has two diameters – for 7 mm (0.276") and 8 mm (0.315") valve stem seals.



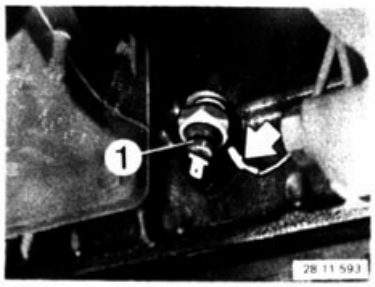
11 35 020 REMOVING AND INSTALLING DISTRIBUTOR INTERMEDIATE SHAFT

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



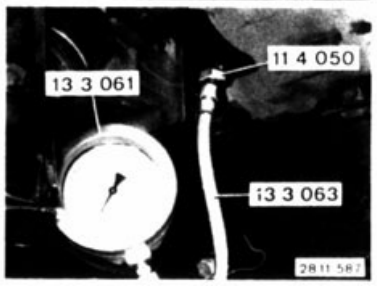
ENGINE OIL CIRCUIT

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

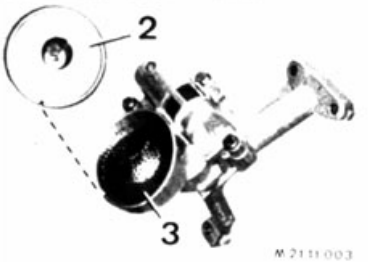




11 41 000 REMOVING AND INSTALLING OIL PUMP

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).

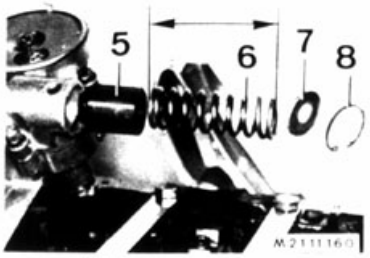


Check whether gears turn easily by turning the drive shaft.

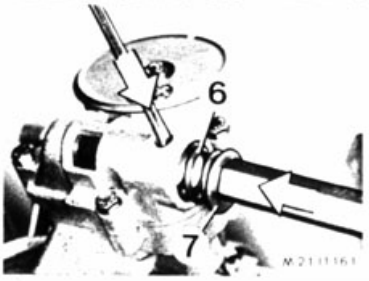
*** See Service Information of Gr. 11



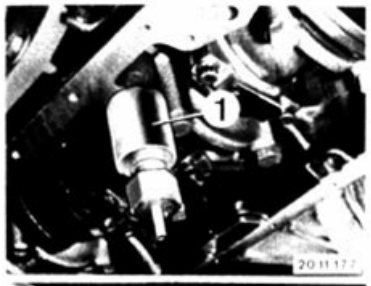
Unscrew oil pump cover and check oil pump for wear.
– Scoring in body / cover
– Wear on gears



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).





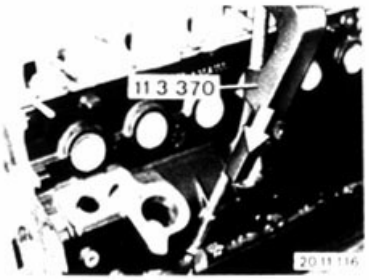
11 41 110 REMOVING AND INSTALLING PRESSURE RELIEF VALVE

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

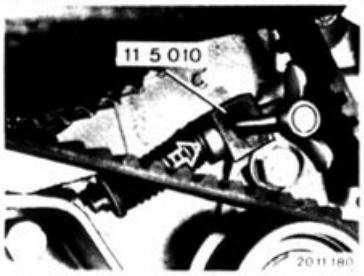


11 51 000 REMOVING AND INSTALLING WATER PUMP

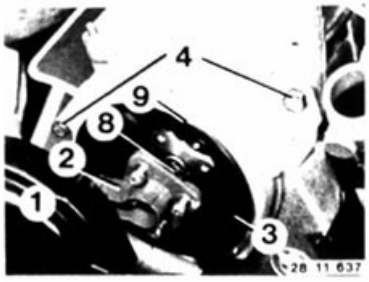
Engine with Distributor:
Drain coolant.
Loosen clamp (1).
Remove bolts (2) and take off suspension eye (3).
Remove fan 11 52 000.
Installation:
Fill and bleed cooling system 17 00 039.



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.



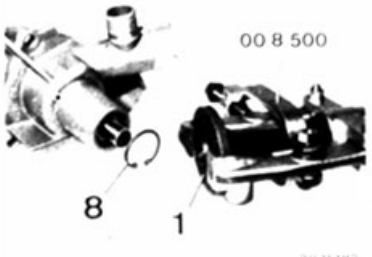
Compress spring clip and hold pin with Special Tool 11 5 010.
Installation
Check installed position of pin to water pump.



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.

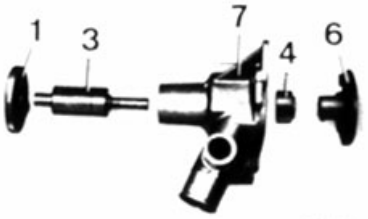


Disconnect water hoses (7 and 8).
Unscrew water pump.
Installation
Replace gasket.



11 51 502 OVERHAULING WATER PUMP
– WATER PUMP REMOVED –

Pull off hub (1) with Special Tool 00 8 500
Remove circlip (8)

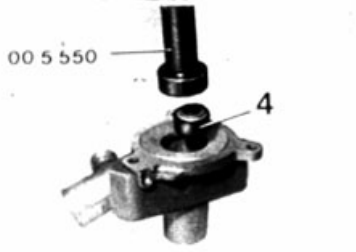


Replace bearing (3) and seal (4)
Check impeller (6), replacing if necessary
1 = Hub
2 = Water pump body
Installation
Press in bearing (3) against stop
Press on impeller (6)



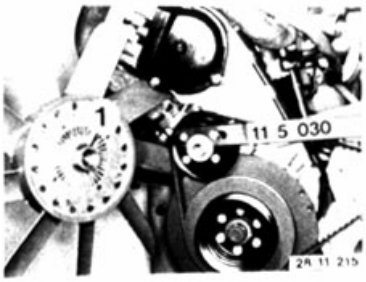
Press out water pump bearing

Check assembled distances



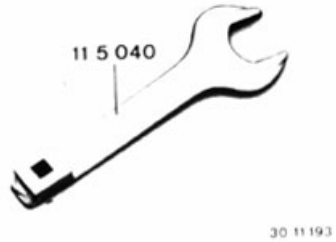
Drive out seal (4)
Installation
Press in seal (4) with Special Tool 00 5 550



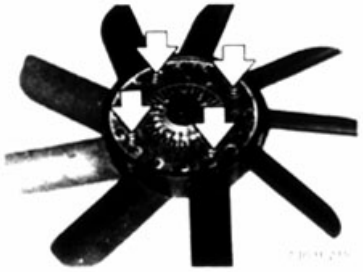


11 52 000 REMOVING AND INSTALLING FAN

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

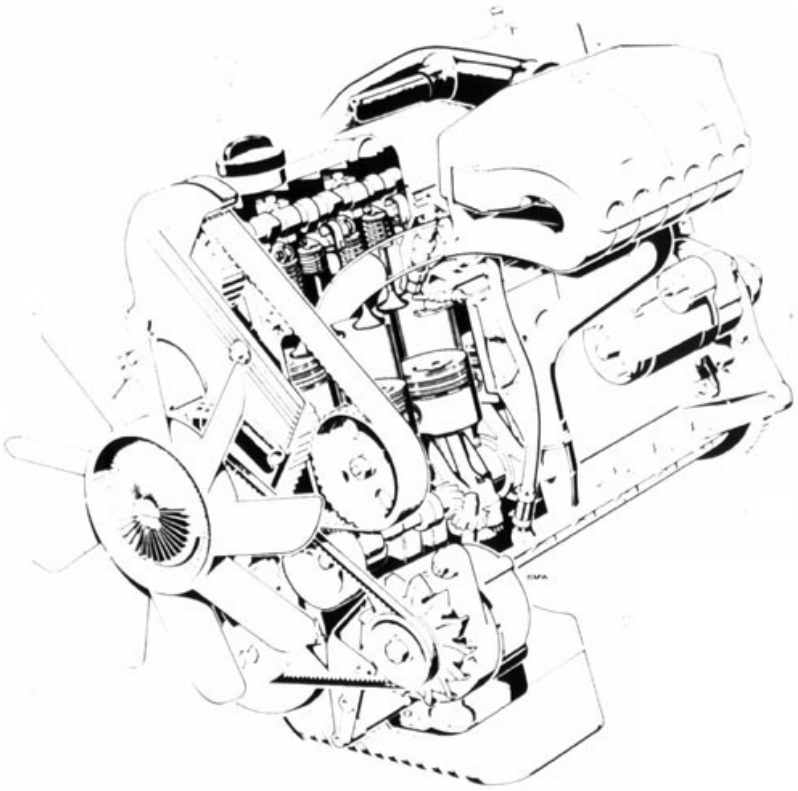
Pull off wire (1).
Unscrew transmitter.
Installation:
Replace seal (2).
Bleed cooling system – see 17 00 039.

* See Specifications
*** See Workshop Equipment Catalog

11 Engine M21

11 12 000	Cylinder head cover – remove and install	11- 201
101	Cylinder head gasket – replace	11- 202
240	Radial oil seal in end cover – replace	11- 203
500	Cylinder head – remove and install (engine removed)	11- 204
595	Valve guide – check for wear (valve removed)	11- 205
600	Valve guide – ream (valve removed)	11- 205
607	Valve seat – machine (cylinder head disassembled)	11- 205
729	Cylinder head – check for cracks in water test (cylinder head disassembled)	11- 206
11 14 175	Front end cover – remove and install	11- 207
180	Radial oil seal in front end cover – replace	11- 207
605	Radial oil seal in clutch end cover – replace	11- 208
11 21 000	Crankshaft – remove and install	11- 209
501	Crankshaft – replace (crankshaft removed)	11- 210
531	Crankshaft main bearing shells – replace (engine disassembled)	11- 210
571	Pilot bearing in crankshaft – replace	11- 211
11 22 000	Flywheel – remove and install	11- 211
051	Drive plate for torque converter – replace	11- 211
11 23 010	Vibration damper – replace	11- 212
031	Vibration damper hub – replace	11- 212
11 24 521	Connecting rods – replace (pistons removed)	11- 213
571	Connecting rod bearing shells – replace (engine disassembled)	11- 213
11 25 000	Piston – remove and install	11- 214
651	Piston rings of one piston – replace (piston removed)	11- 215
11 31 000	Camshaft – remove and install	11- 216
100	Drive belt – tighten	11- 217
110	Drive belt – remove and install	11- 218
11 33 050	Rocker arms – replace	11- 219
11 34 004	Valve clearance – adjust	11- 219
509	Valves – check for leaks (camshaft removed)	11- 219
550	Valves – remove and install	11- 220
11 35 020	Intermediate shaft – remove and install	11- 220
	Engine oil circuit	11- 221
11 40 000	Engine oil pressure – check	11- 222
11 41 000	Oil pump – remove and install	11- 223
11 42 020	Full flow oil filter – replace	11- 224
650	Oil spray jet – remove and install/replace (crankshaft removed)	11- 224
11 51 000	Water pump – remove and install	11- 224
502	Water pump – overhaul (water pump removed)	11- 225
11 52 000	Fan – remove and install	11- 226
020	Fan clutch – replace	11- 226
11 53 000	Coolant thermostat – remove and install	11- 226
080	Temperature transmitter – replace	11- 226

M 21 = Small 6 cylinder
D = Diesel
24 = Displacement (x 100)
W = Swirl chamber

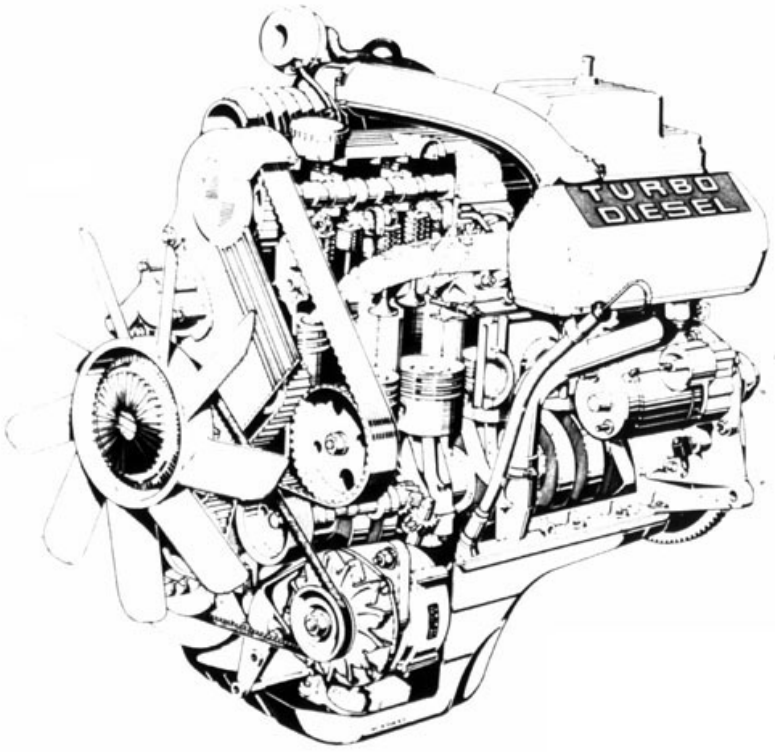


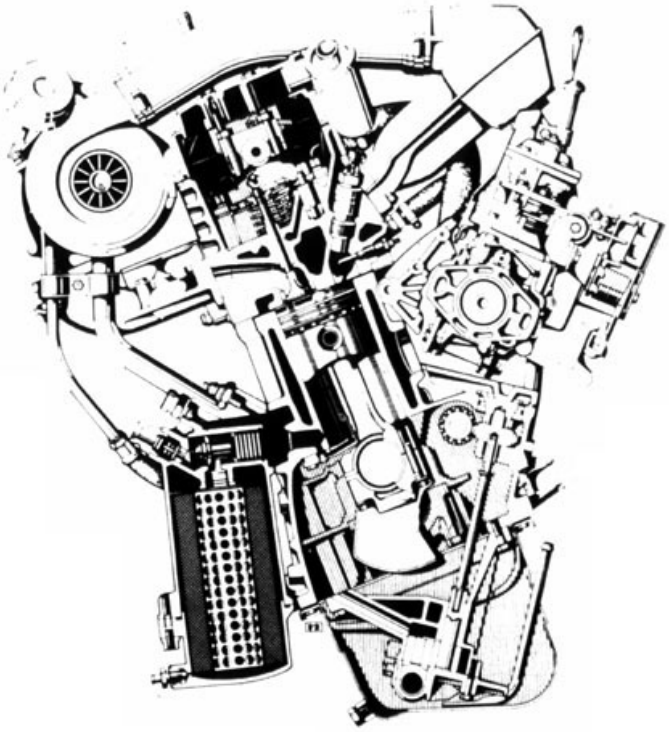
M 21 D 24 W – BMW 324 d / 524 d



11-200a

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

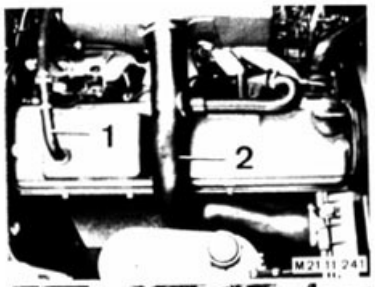
- Clean area around repair point thoroughly – e.g. prior to unscrewing lines, switches, etc.

  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.

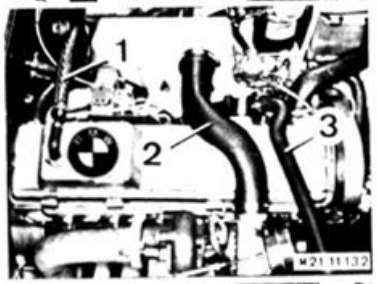
- Only install cleaned parts.
  Take new spare parts out of their packaging only immediately before installation.

- 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

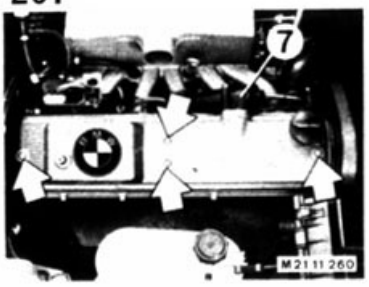
M 21 D 24 W:
Disconnect hoses (1 ... 2).



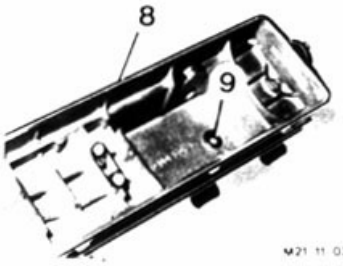
M 21 D 24 WA:
Disconnect hoses (1 ... 3).



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



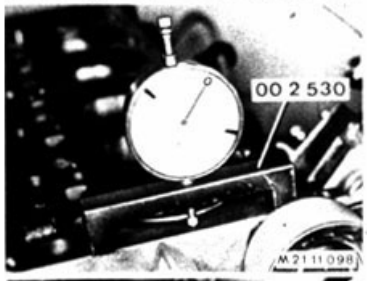
Remove oil trap (7).
Unscrew threaded sleeves and take off cylinder head cover.
Installation:
Install threaded sleeves with seals.
Check seal on oil trap, replacing if necessary.



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





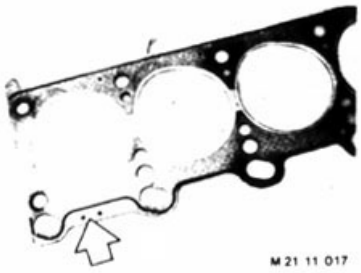


11 12 101 REPLACING CYLINDER HEAD GASKET

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 to 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.

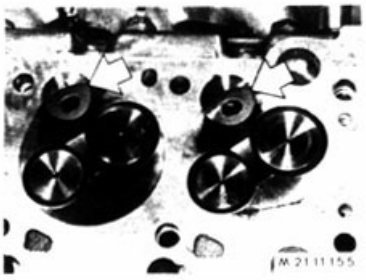
Measuring Piston Protrusion:
Place dial gauge in Special Tool 00 2 530 on cleaned cylinder head sealing surface and set to zero with pre load.

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.

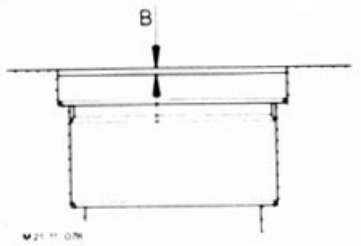


Piston with highest "piston protrusion" will determine thickness of cylinder head gasket.
Cylinder Head Gaskets:

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.



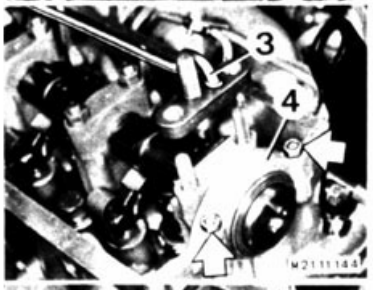
Burner retrusion = distance "B"*.

* See Specifications

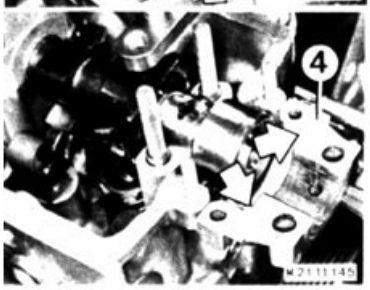


11 12 240 REPLACING RADIAL OIL SEAL IN END COVER

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.).



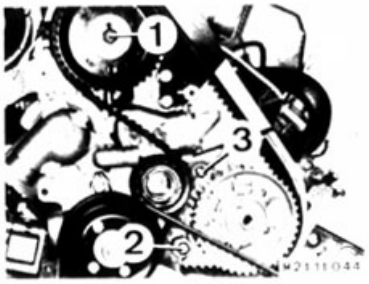
Turn cylinder no. 1 to TDC – cylinder no. 6 overlaps.



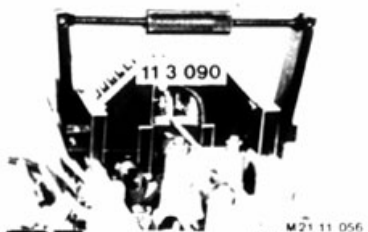
Hold crankshaft with Special Tool 11 2 300.



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



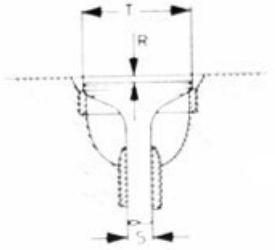
11 12 595 CHECKING VALVE GUIDE FOR WEAR
– Valve Removed –

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*.

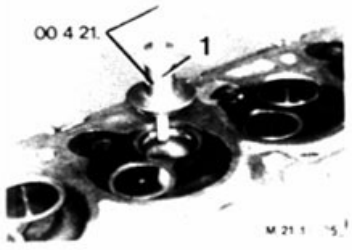


11 12 607 MACHINING VALVE SEAT
– Cylinder Head Disassembled

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.

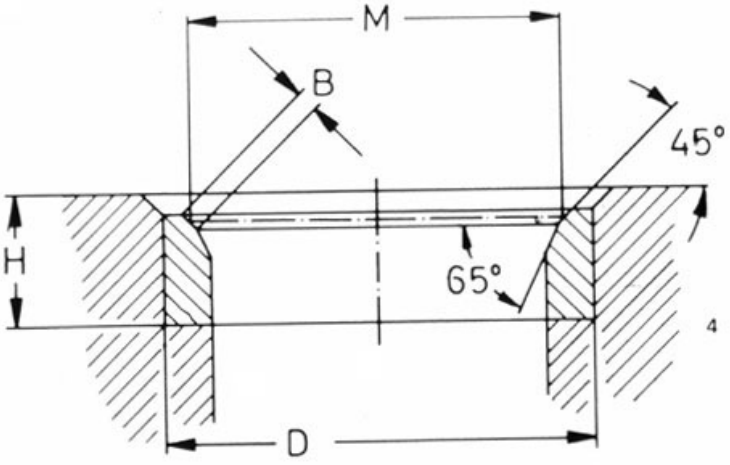


Valve retrusion R*.
Machine correction angles* to produce valve seat diameter M* and valve seat width B*, after machining the valve seat angle*.
Valves may not be ground in.
Check valves for leaks 11 34 509.



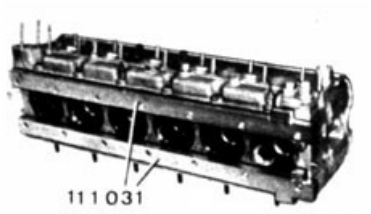
11 12 600 REAMING OUT VALVE GUIDE
– Valve Removed –

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

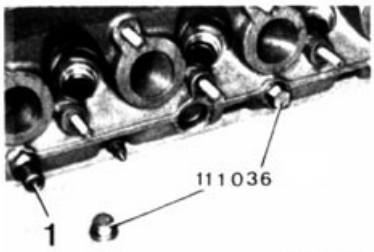


M 2111083

11 12 729 CHECKING CYLINDER HEAD FOR CRACKS IN WATER TEST

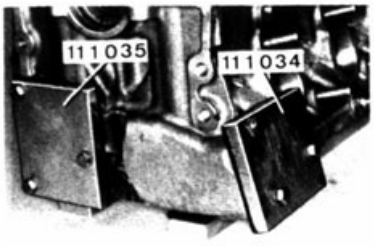
– Cylinder Head Disassembled –

Mount Special Tools 11 1 031 on cylinder head (using cylinder head bolts).



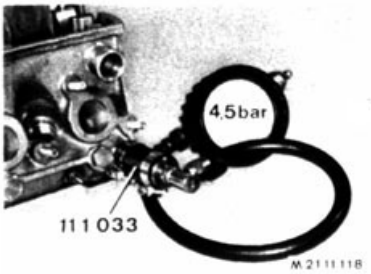
M 2111100

Unscrew adapter (1) and plug openings with Special Tools 11 1 036.
Insert seals.
Installation:
Install adapter with bolt cement**.



M 2111117

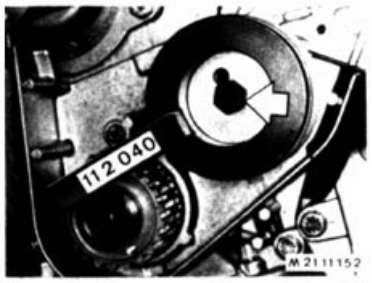
Apply Special Tools 11 1 034 and 11 1 035.



M 2111118

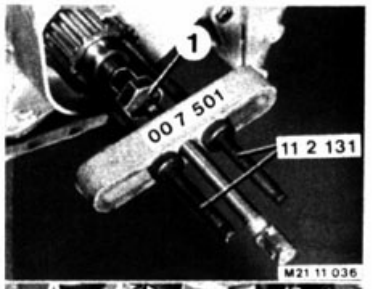
Attach Special Tool 11 1 033.
Apply compressed air on cylinder head.
Test pressure = 4.5 bar (64 psi).
Place cylinder head in water bath and check for leaks.
Note:
Relax water bath with a detergent if necessary.

** Source: HWB

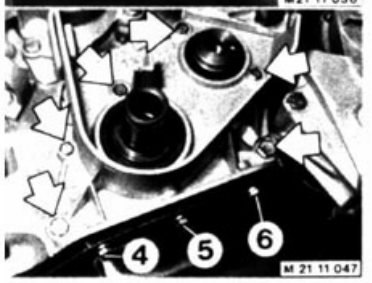


11 14 175 REMOVING AND INSTALLING FRONT END COVER

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).



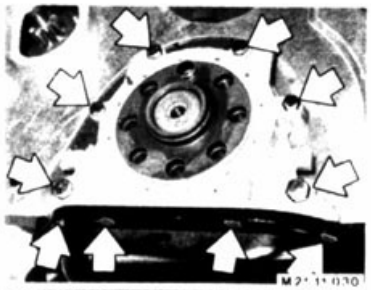
Check radial oil seals, replacing if necessary.
Use Special Tool 11 2 211 on crankshaft and Special Tool 11 2 212 on intermediate shaft when installing end cover.



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



11 14 605 REPLACING RADIAL OIL SEAL IN CLUTCH END COVER

– Transmission Removed –

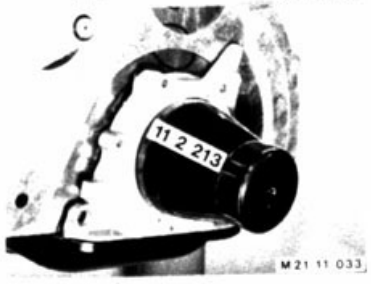
Remove flywheel 11 22 000.
Unscrew oil pan/end cover mounting bolts.
Only loosen other oil pan bolts.
Separate oil pan gasket on end cover carefully with a knife.
Take off end cover.
If oil pan gasket is damaged, remove oil pan and replace gasket 11 13 000.



Installation:
Replace gasket (1).
Coat holes of oil pan gasket with a brush on universal sealing compound ¹ Three Bond Silicon 1207**.

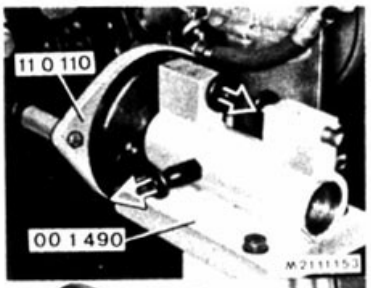


Press in radial oil seal with Special Tools 11 1 260 and 00 5 500.
Press in new radial oil seal to depth of approx. 1 to 2 mm (0.039 to 0.079") in contradiction to standard seal which was installed flush.
Lubricate sealing lip with oil.



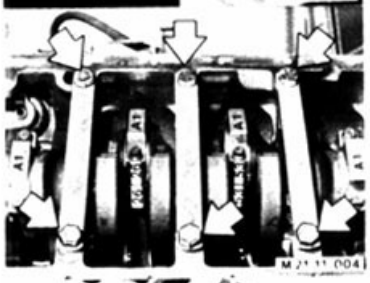
Installation:
Use Special Tool 11 2 213 to install end cover.

** 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



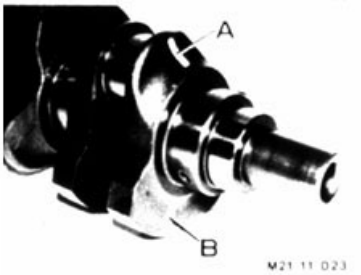
28 11 307

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



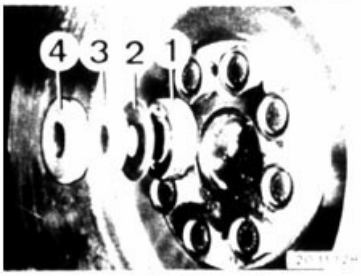
M21 11 023

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 *

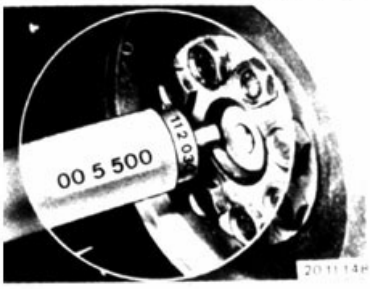
Main Bearing Journals (B)
1 paint stripe Size 1 *
2 paint stripes Size 2 *



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.

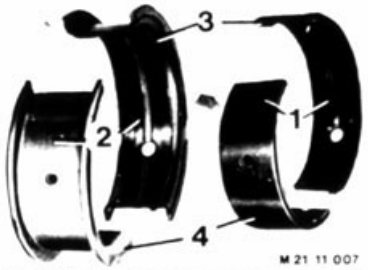


Fill bore in crankshaft with approx. 1 gram (0.035 oz.) of lubricating grease. Drive in pilot bearing with Special Tools 11 2 030 and 00 5 500.

* See Specifications


28 11 308

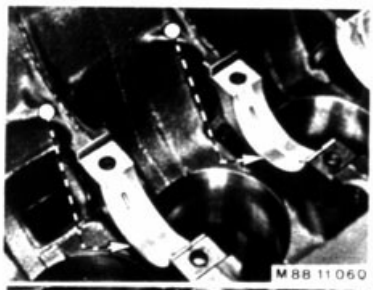
The crankshaft is marked with yellow, green or white paint depending on main bearing journal tolerances.



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

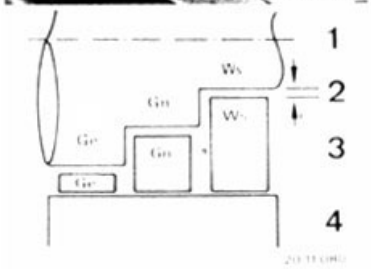
Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps with the correct torque*
Do not turn the crankshaft.

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*

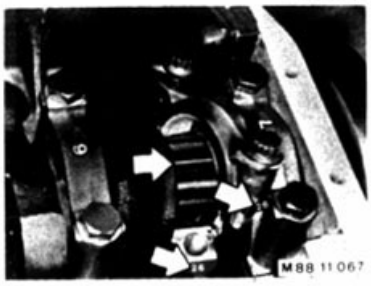
Triple Classification Color Codes:
Ge = yellow
Gn = green
Ws = white

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.

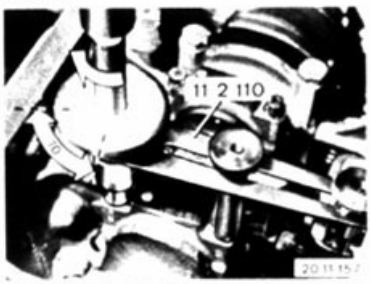
Install only red bearing shells of a pertinent ground size for a replacement crankshaft.



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.

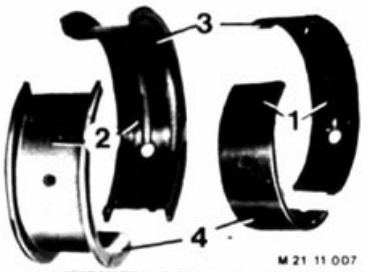


Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearings shells of a different machined size or with a different color code.
Replace conrod bolts for final installation and tighten the conrod bearing caps in two steps (see above).

* See Specifications



28 11 308



M 21 11 007



M88 11 060



M88 11 061

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.

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!

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.

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.

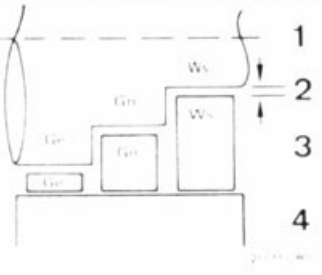
Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

* 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

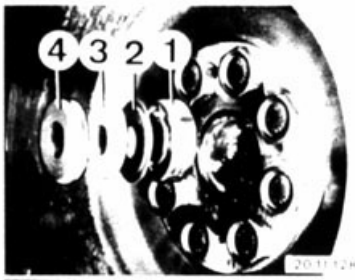
1 Crankshaft diameter
2 Bearing play
3 Bearing shell thickness
4 Console diameter

* See Specifications

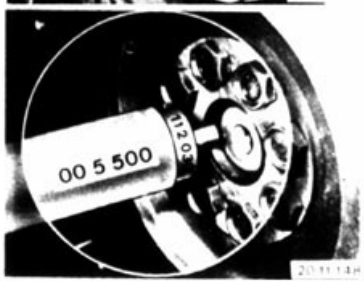


11 21 571 REPLACING PILOT BEARING IN CRANKSHAFT

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

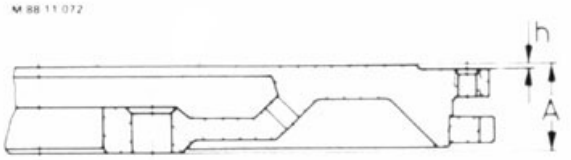
Remove clutch – see 21 21 000
Hold flywheel with Special Tool 11 2 170
Unscrew bolts and take off flywheel
Installation
Clean tapped bores
Insert ring (1)
Replace and install new expansion bolts with a bolt cement**
Tightening torque*

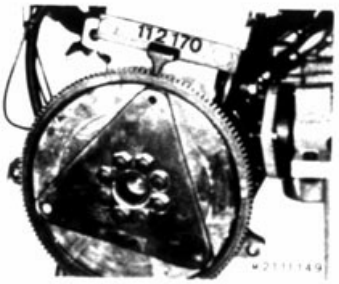


Check flywheel for axial runout*

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)*

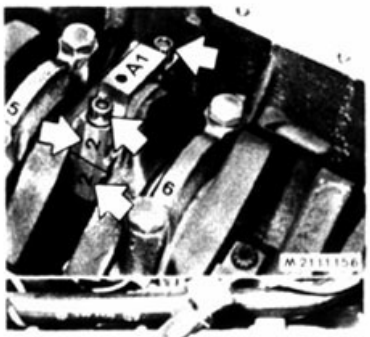


Install red or blue bearing shells in connecting rod bearing cap depending on color code on conrod bearing caps.
In BDC position place Type PG 1 plastigage on crankshaft wiped clean of oil and install conrod bearing caps that lubricating grooves are on one side.
Paired code numbers (0 ... 99) must be 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.



Only install a piston of same make and same weight class.
Weight class is die stamped with [illegible] or [illegible] 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 -

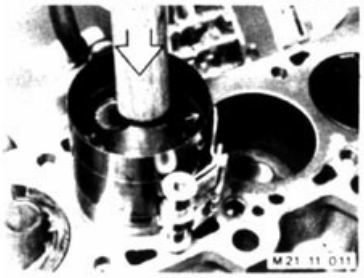
Measure side clearance* of piston rings (only possible on rings 2 and 3)



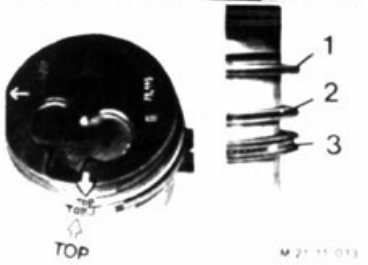
Screw Special Tool 11 2 050 on to connecting rod to avoid damaging oil spray jet (3).



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.

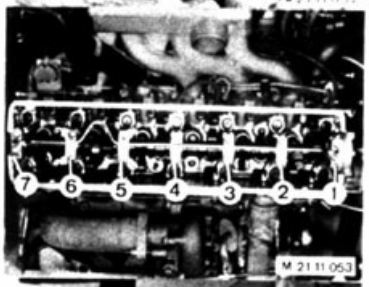


Loosen bolts (1 ... 2) and nut (3).
Loosen toothed belt and take it off of camshaft sprocket.
Unscrew bolt (1) and remove camshaft sprocket.
Installation:
Tightening torque*.

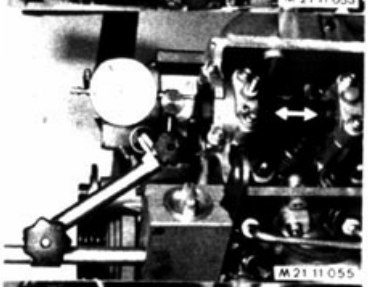
* See Specifications



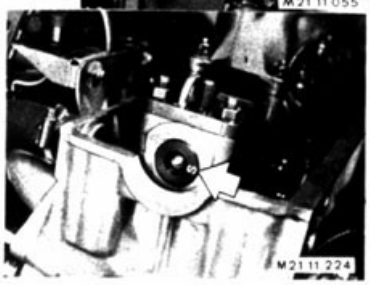
Installation:
Slide slot of pulley and bore of washer (2) over pin of camshaft.



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

11 31 100 TIGHTENING TOORHED DRIVE BELT

Remove air cleaner – see Group 13
Remove fan – 11 52 000.



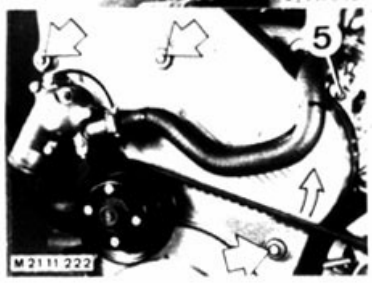
Turn cylinder no. 1 to TDC; valves of cylinder no. 6 overlap.



Hold crankshaft with Special Tool 11 2 300.



Disconnect hose (5) and unscrew cover.
Remove cylinder head cover 11 12 000.



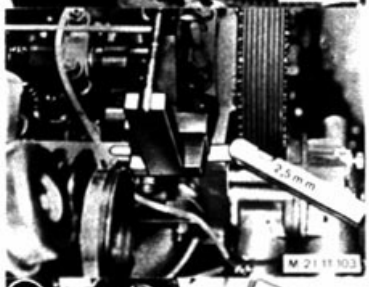
Loosen bolts (1 and 2) and nut (3).



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

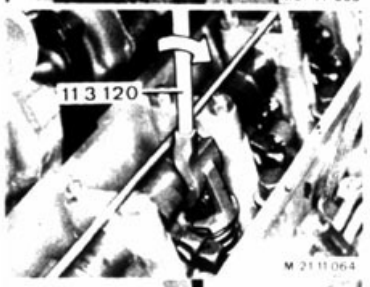


Toothed Drive Belt Layout
Adjust injection pump statically – see 13 51 005



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



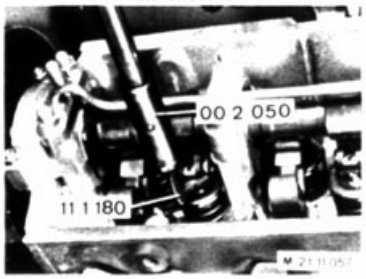
Installation
Press spring clip into groove of ball headed bolt
Adjust valve clearance 11 34 004

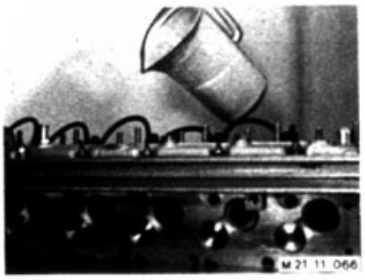
** Source: HWB



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*

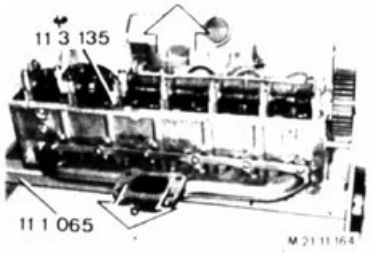




11 34 509 CHECKING VALVES FOR LEAKS – Camshaft Removed

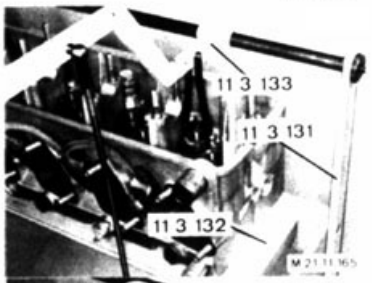
Fill intake and exhaust ports with gasoline outdoors or indoors with strict conformance of fire prevention regulations
Valves and valve seats must be inspected if the gasoline runs past the valve heads
Remove and install valves 11 34 550
Machine valve seats 11 12 607

* 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.

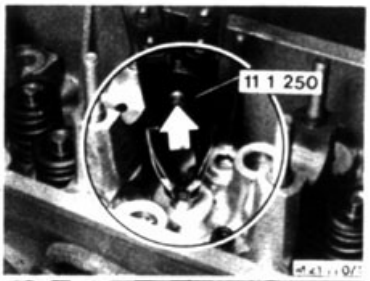


Press down valve springs and remove valve collets.



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.

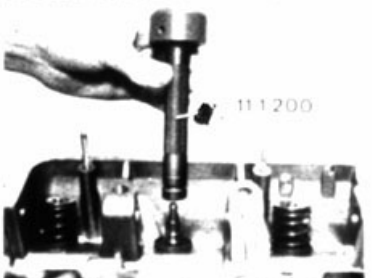
* See Specifications



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

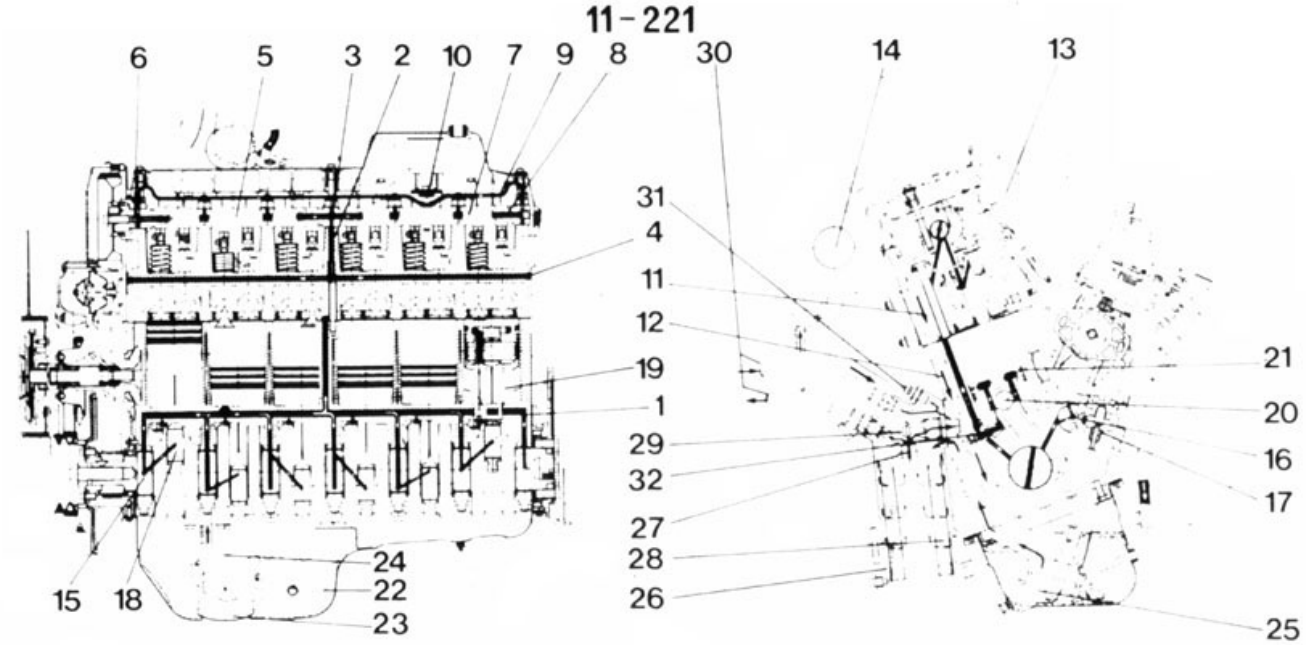


Press on valve stem seal against stop with Special Tool 11 1 170.
New, improved valve stem seals with grooves on the inside are pressed on by hand with Special Tool 11 1 200.
Special Tool 11 1 200 has two diameters for 7 mm (0.276") and 8 mm (0.315") valve stem seals.

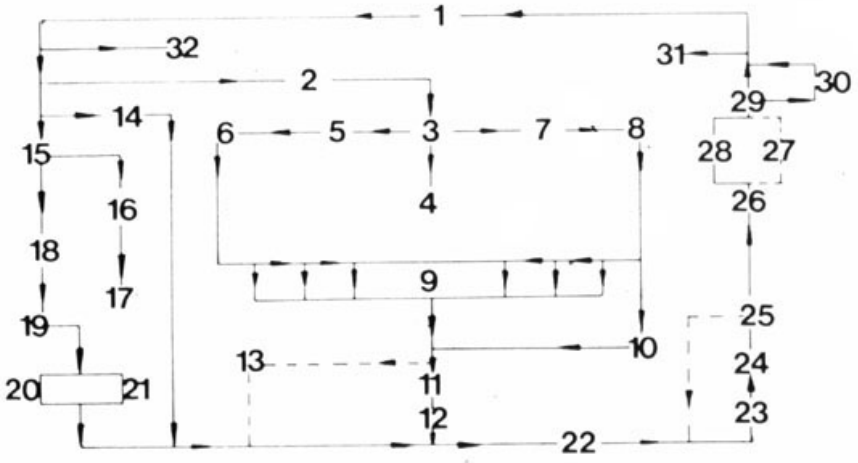


11 35 020 REMOVING AND INSTALLING INTERMEDIATE SHAFT

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.

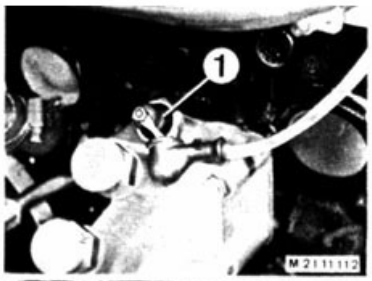


M21 11 086



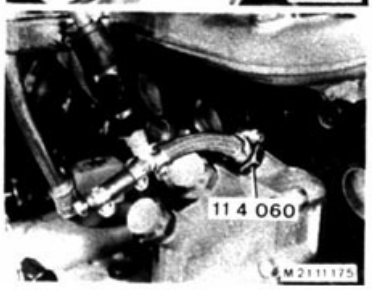
ENGINE OIL CIRCUIT

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

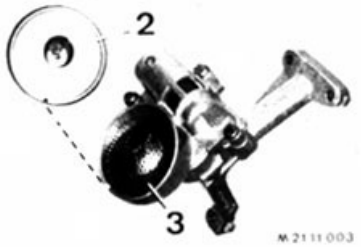


11 41 000 REMOVING AND INSTALLING OIL PUMP

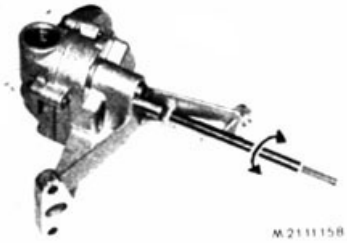
Remove oil pan 11 13 000.
Remove oil pump.



Installation
Guide drive shaft (1) into bearing.
Replace bearing, see 11 11 160.



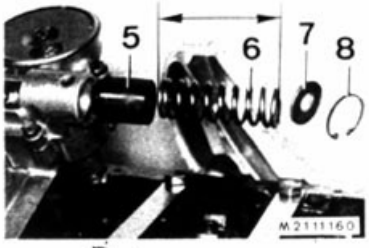
Testing and Servicing:
Unscrew cap (2) and clean oil filter screen (3).



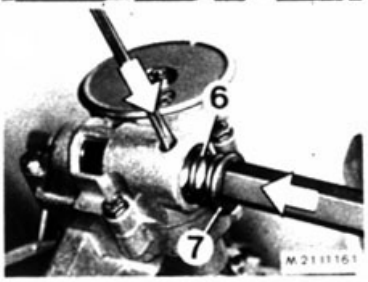
Check whether gears move easily by turning the drive shaft.



Unscrew oil pump cover and inspect oil pump for wear.
- Scoring in body / cover
- Wear on gears

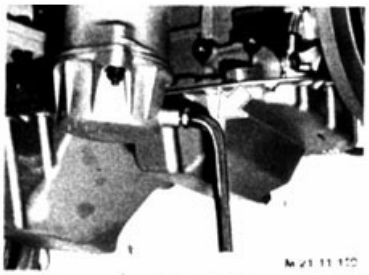


The engine oil pressure regulating valve regulates the engine oil pressure*.
Check that piston (5) moves easily.
Check length of spring (6) = 71.6 mm (2.819").



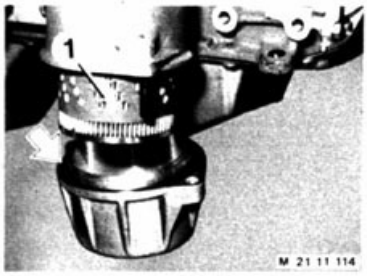
Installation
Press in spring (6) and washer (7), and hold in with a screwdriver.
Install circlip (8).

* 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.

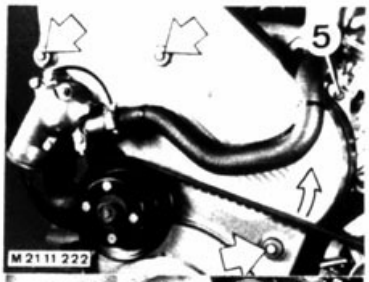


Unscrew screws and take out oil spray jet (3).

* 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.



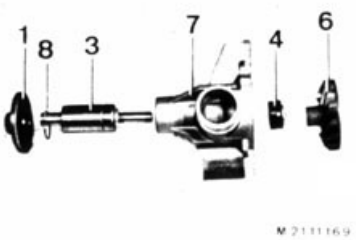
Installation:
Replace gasket (1).



M 21 11 166

11 51 502 OVERHAULING WATER PUMP
– WATER PUMP REMOVED –

Pull off hub (1) with Special Tool 00.8 500
Remove circlip (8).



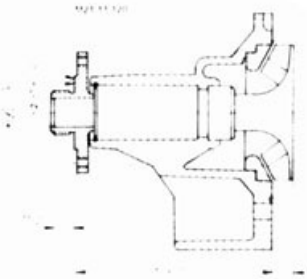
M 21 11 169

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.

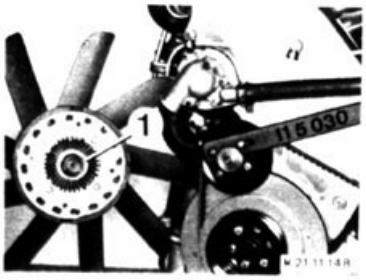


Check assembled distances.



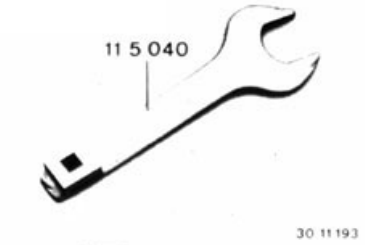
M 21 11 168

Drive out seal (4).
Installation:
Lubricate seal (4) with oil and press in with Special Tool 00 5 550.

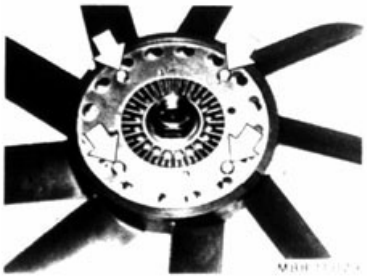


11 52 000 REMOVING AND INSTALLING FAN

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 oks stopped 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

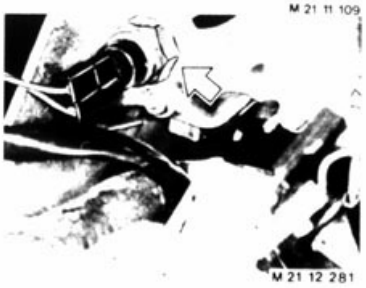
Remove fan – see 11 52 000.
Drain coolant partially.
Remove caps (1).
Remove thermostat.



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

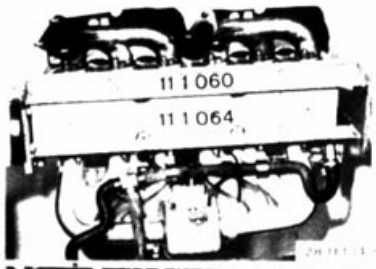
Pull off plug – unscrew transmitter.
Installation:
Replace seal.
Tightening torque*.
Testing – see Group 12.

* See Specifications
*** See Workshop Equipment Catalog

* See Specifications

11 Engine M30 since E32

11 12 000	Cylinder head cover – remove and install	11- 351
101	Cylinder head gasket – replace	11- 351
500	Cylinder head – remove and install (engine removed)	11- 352
595	Valve guide – inspect for wear	11- 354
600	Valve guide – ream	11- 354
607	Valve seats and valves – machine (cylinder head disassembled)	11- 354
719	Cylinder head sealing surface – machine (cylinder head disassembled)	11- 355
729	Cylinder head – check for cracks in water test (cylinder head disassembled)	11- 355
11 14 100	Timing case cover, upper – remove and install/seal	11- 356
120	Timing case cover, lower – remove and install/seal	11- 357
131	Radial oil seal in upper timing case cover – replace	11- 358
141	Radial oil seal in lower timing case cover – replace	11- 358
605	Radial oil seal in clutch end cover – replace	11- 359
11 21 000	Crankshaft – remove and install	11- 360
501	Crankshaft – replace (crankshaft removed)	11- 361
531	Crankshaft main bearing shells – replace (engine disassembled)	11- 361
571	Pilot bearing in crankshaft – replace	11- 362
11 22 000	Flywheel – remove and install	11- 363
051	Drive plate for torque converter – replace	11- 363
541	Starter gear ring – replace	11- 363
11 23 010	Vibration damper – replace	11- 364
031	Vibration damper hub – replace	11- 364
11 24 521	Connecting rod – replace (piston removed)	11- 365
571	Connecting rod bearing shells – replace (engine disassembled)	11- 365
11 25 000	Piston – remove and install	11- 366
651	Piston rings of one piston – replace (piston removed)	11- 367
11 31 000	Camshaft – remove and install (cylinder head removed)	11- 369
001	Camshaft – replace (camshaft removed)	11- 370
051	Timing chain – replace	11- 370
061	Timing chain sprockets – replace (timing chain removed)	11- 371
090	Timing chain tensioner piston – remove and install	11- 371
601	Timing chain tensioning rail / guide rail – replace (timing chain removed)	11- 372
11 33 020	Rocker arm shafts – remove and install	11- 373
031	Rocker arms – replace	11- 374
11 34 004	Valve clearance – adjust	11- 374
500	Valves – check for leaks (camshaft removed)	11- 374
550	Valves – remove and install (rocker arm shafts removed)	11- 375
11 40 000	Engine oil pressure – check	11- 376
11 41 000	Oil pump – remove and install	11- 376
151	Oil pump drive chain – replace	11- 377
11 42 021	Full flow oil filter – replace	11- 378
11 43 101	Oil dipstick guide tube – replace	11- 379
11 51 000	Water pump – remove and install	11- 379
11 52 000	Fan – remove and install	11- 380
020	Fan clutch – replace	11- 380
11 53 000	Coolant thermostat – remove and install	11- 380



11 34 550 REMOVING AND INSTALLING VALVES
– Rocker Arm Shafts Removed –

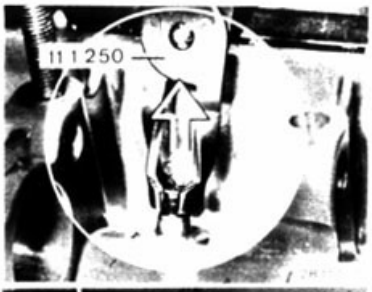
Place Special Tool 11 1 064 (tray) in Special Tool 11 1 060.



Press down valve springs with Special Tool 11 1 060 and remove collets.



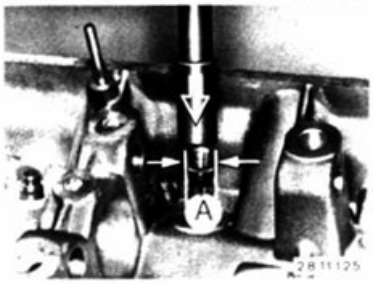
Remove upper spring retainer, valve springs and lower spring retainer.
Take tray out of special tool fixture and pull out valve.
Installation
Only install valve springs with same color code, wire gauge size and length.
Lubricate valve guide and valve stem with oil.



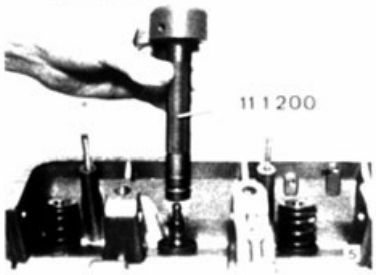
Pull off valve stem seal with Special Tool 11 1 250.



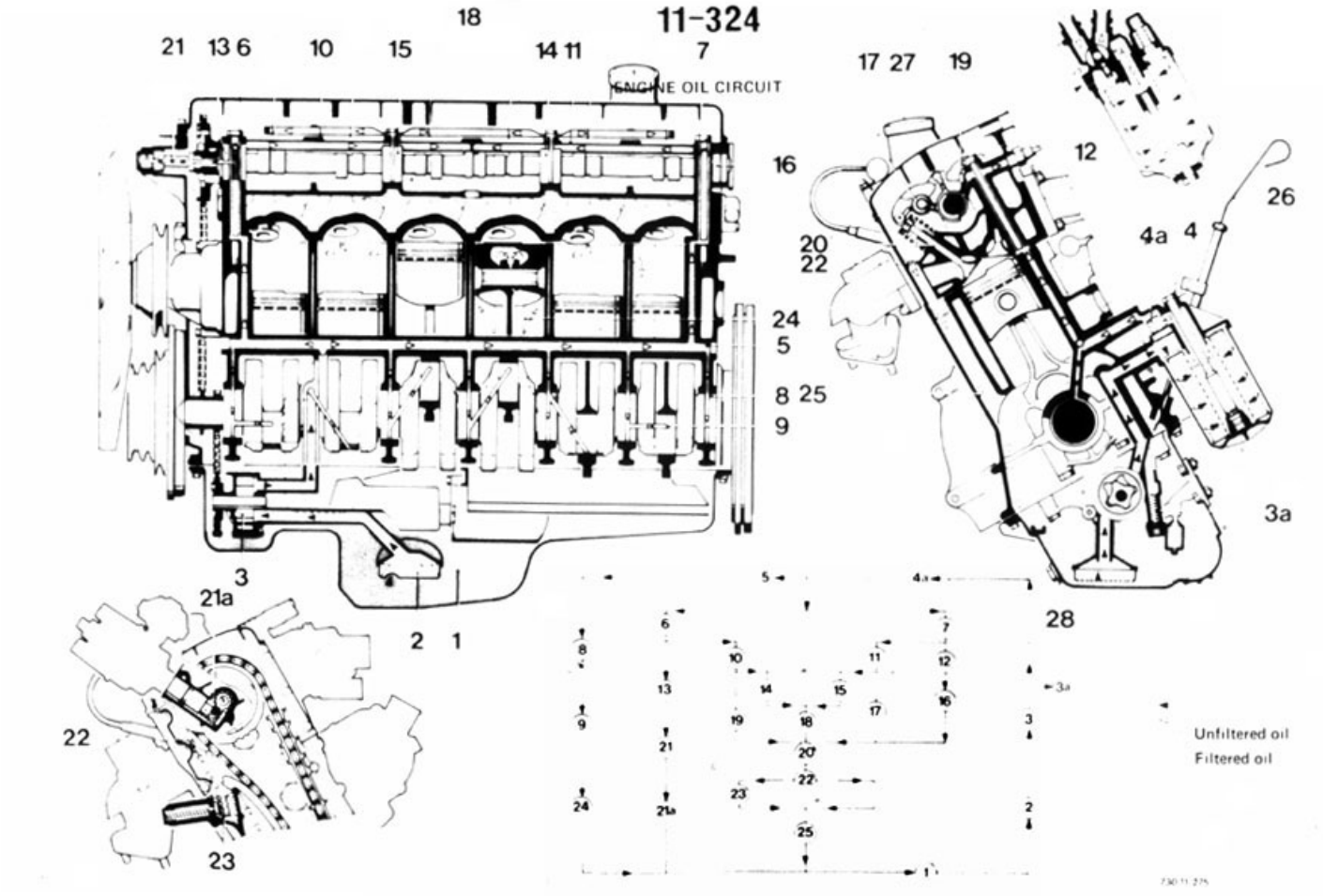
Install valve.
Use Special Tool 11 1 340 to avoid damaging the valve stem seal.
Lubricate valve stem seal (1) with oil and install.
Special Tool Source:
Cartool
Alfred Brehm Str. 5
D-8070 Ingolstadt



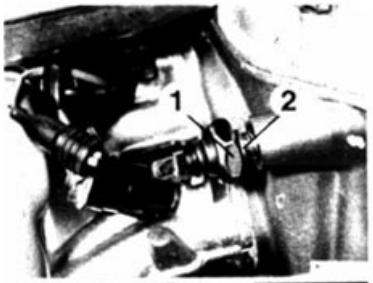
Press on valve stem seal against stop with Special Tool 11 1 090 when diameter A = 14.0 ± 0.2 mm (0.551 ± 0.008") or Special Tool 11 1 070 when diameter A = 14.3 ± 0.2 mm (0.563 ± 0.008").



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 (0.279") and 8 mm (0.315") valve stem seals.

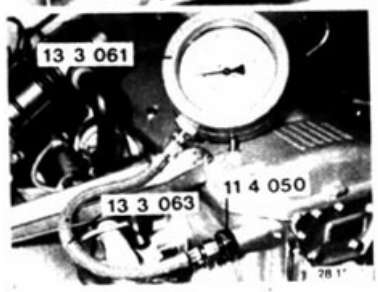


1 Oil pan
2 Intake with filter screen
3 Oil pump
3a Pressure relief valve
4 Oil filter
4a Safety valve (oil filter)
5 Main distribution passage
6 Front oil bore in cylinder head
7 Rear oil bore in cylinder head
8 Crankshaft bearing
9 Conrod bearing
10 Hollow rocker arm shaft, front
11 Hollow rocker arm shaft, rear
12 Transmitter for oil pressure indicator lamp
13 Front camshaft bearing
14 Camshaft bearing
15 Camshaft bearing
16 Rear camshaft bearing
17 Exhaust rocker arm bearing
18 Spray jets for camshaft lubrication
19 Intake rocker arm bearing
20 Valve guide
21 Bore in distributor drive
21a Spray oil for distributor drive
22 Overflow from cylinder head
23 Pocket / chain lubrication
24 Spray oil for piston pin
25 Oil drain bore
26 Oil dipstick
27 Oil filler neck
28 Oil drain bolt



11 40 000 CHECKING ENGINE OIL PRESSURE

Pull off wires on oil pressure switch.
Unscrew oil pressure switch (1).
Installation:
Check gasket (2), replacing if necessary.



Screw in Special Tool 11 4 050.
Connect hose 13 3 063 in conjunction with pressure tester 13 3 061.
Check oil pressure*.



11.41 000 REMOVING AND INSTALLING OIL PUMP

Pull out oil dipstick.
Remove oil pan 11 13 000.
Unscrew nut (1) and take off sprocket.
Unscrew bolts (2).

Unscrew holder (3) and remove oil pump.
Installation:
Mount holder without tension.

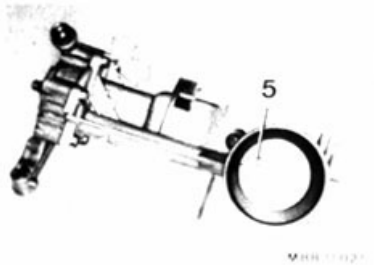
Installation:
Push on sprocket after mounting oil pump.
Tightening torque* for nut.

Installation / Chain Tightness:
Adjust chain tightness with shims (4 and 5) that chain will give at center under light thumb pressure.
Shims (4 and 5) must have the same thickness.

* See Specifications



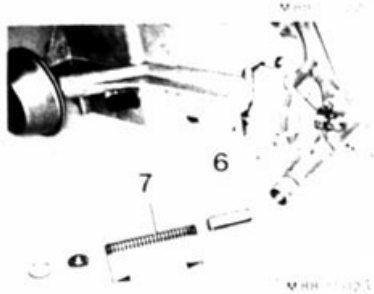
Testing and Servicing:
Check whether oil pump runs easily by turning the drive shaft.



Disassemble oil pump and clean oil filter screen (5).

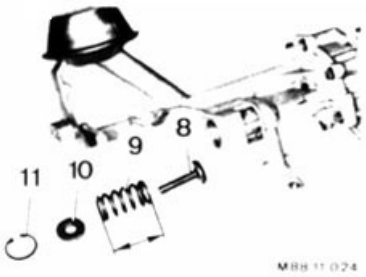


Check oil pump for wear.
– Scoring in body
– Wear on rotors



The pressure relief valve is installed 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").

* See Specifications



The 8 bar (112 psi) pressure relief valve regulates the oil pressure in front of the oil filter and prevents oil filter leakage.
Check piston seat (8).
Check length of spring (9) = 44 - 0.4 mm (1.732 - 0.016").



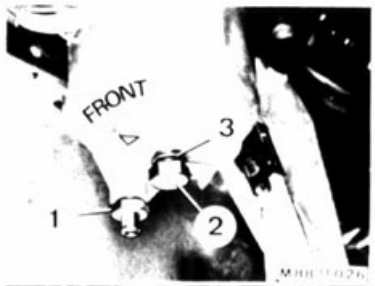
Installation:
Press in spring (9) and washer (10) with a wrench socket and install circlip (11).



11 41 151 REPLACING OIL PUMP DRIVE CHAIN

Remove oil pan 11 13 000.
Remove timing chain 11 31 051.
Unscrew nut (1) and take off sprocket.
Installation:
Adjust chain tightness, see 11 41 000.
Chain with green color code are longer than chains with red color code.
Tightening torque*.

* See Specifications

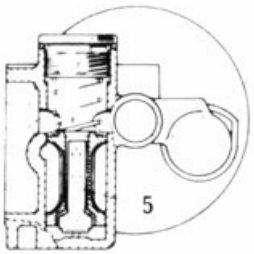




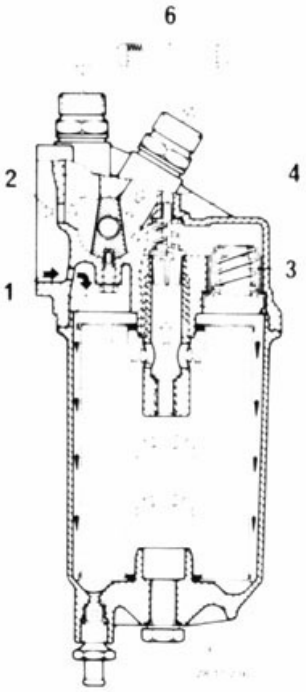
11 42 021 REPLACING FULL FLOW OIL FILTER

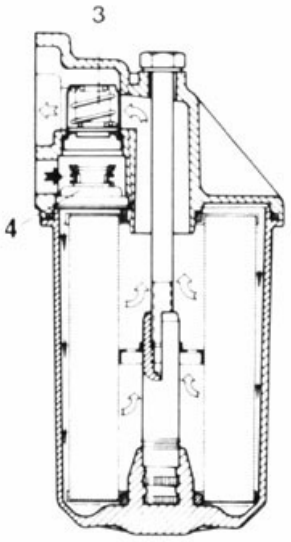
Unscrew oil drain plug (1) and drain oil.
Unscrew bolt (2).
Replace oil filter (5).

Installation
Check seals (3 and 4), replacing if necessary.
Mount oil filter housing that arrow faces forward (FRONT).
Tightening torque*.
Add engine oil***.



Model B 34



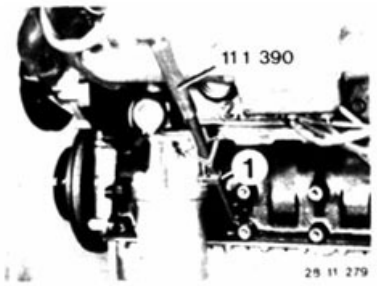


Model B 25
B 28
B 32

➡ Unfiltered oil
Filtered oil

1 Feed from pump
2 Return to main oil bore
3 Bypass valve – opening pressure 2.5 · 0.25 bar (35 · 3 psi)
4 Return inhibiting valve – opening pressure 0.1 · 0.05 bar (1.4 · 0.7 psi)
5 Thermostatic activator for switching oil cooler
6 Oil cooler

* See Specifications
*** See Service Information of Gr. 11



11 43 101 REPLACING OIL DIPSTICK GUIDE TUBE

Transfer clamp (1).
Insert guide tube with Loctite No. 270** and knock in against stop.
Important!
Always check oil level with grip eye of oil dip stick facing left when looking forward.
Non conformance could cause incorrect reading. In other words engine oil volume* would not be amount specified.



11 51 000 REMOVING AND INSTALLING WATER PUMP

Remove fan 11 52 000.
Take off drive belt and remove pulley.
Installation
Tighten drive belt and check tightness with Special Tool 11 5 020.



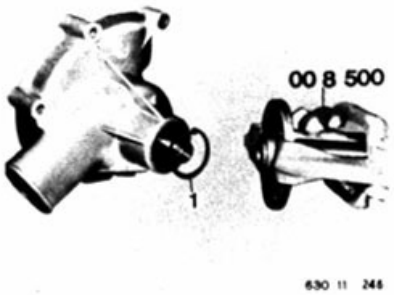
Detach suspension eye (1) and water hose (2).



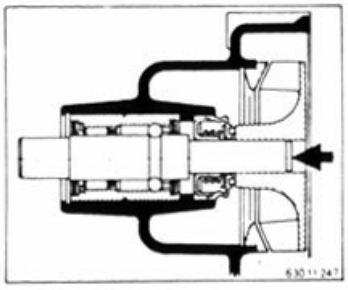
Detach water pump.
Installation:
Replace gasket.

* See Specifications
** Source: HWB

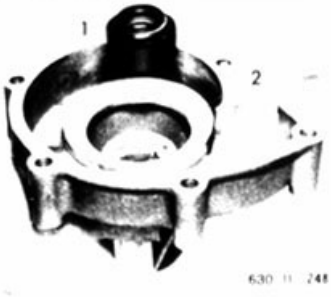
11 51 502 OVERHAULING WATER PUMP



Pull off hub with Special Tool 00 8 500.
Lift out circlip (1).

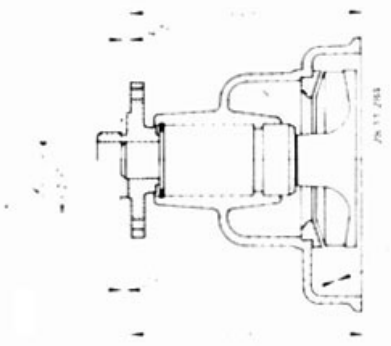


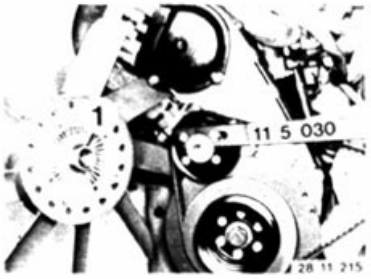
Press out water pump bearing.
Installation:
Press in water pump bearing against stop.
Press on impeller.



Drive out seal (1).
Installation:
Press in seal (1) with Special Tool 00 5 550.

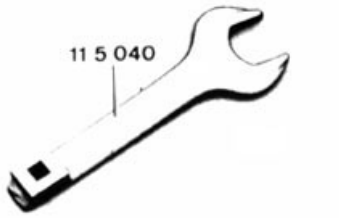
Check installed distances!



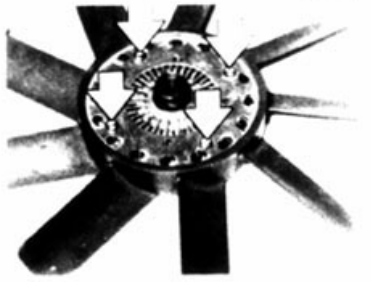


11 52 000 REMOVING AND INSTALLING FAN

Hold pulley with Special Tool 11 5 030 and unscrew coupling nut (1).
Important!
Left-hand threads – turn nut clockwise to unscrew.
Tightening torque*.

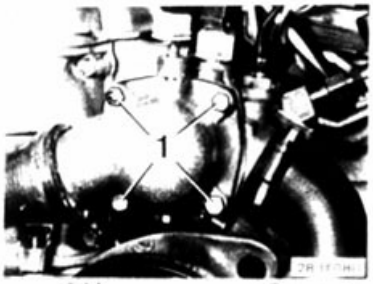


Installation:
Tighten fan with Special Tool 11 5 040. 40 Nm (29 ft. lbs.) tightening torque is equal to 30 Nm (22 ft. lbs.) setting on torque wrench.



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 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

Drain coolant partially.
Unscrew cover (1).
Installation:
Bleed cooling system – see 17 00 039.



Remove thermostat.
Replace gasket (2) and seal (3).
Installation:
Bar on thermostat faces out.



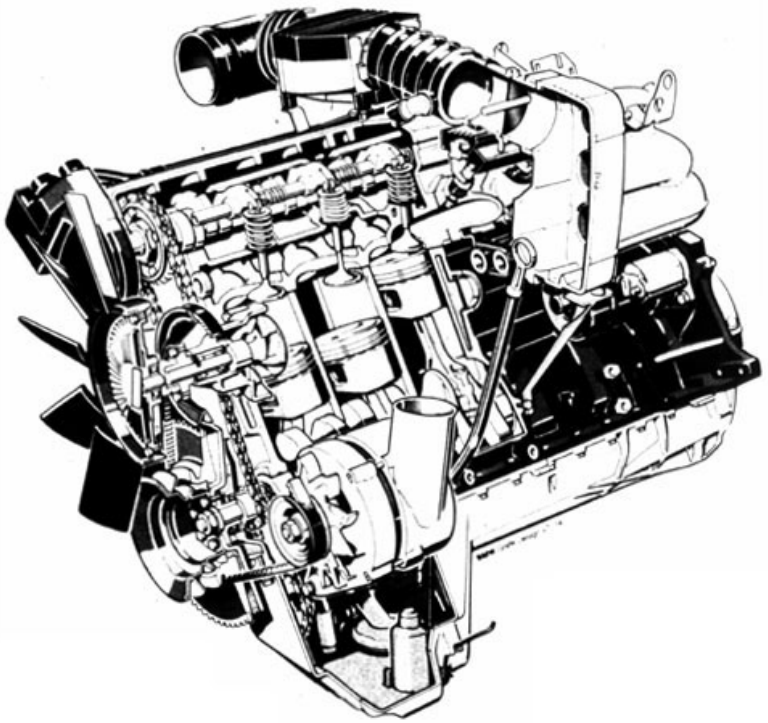
Since 1986 Models – Cast A:
Install new thermostat no. 1 713 040 with seal (4) facing cover.
Only B 25 / B 28:
Gasket (2) omitted only after introduction of thermostat housing cover 11 53 1 714 861 (without notch in sealing surface).

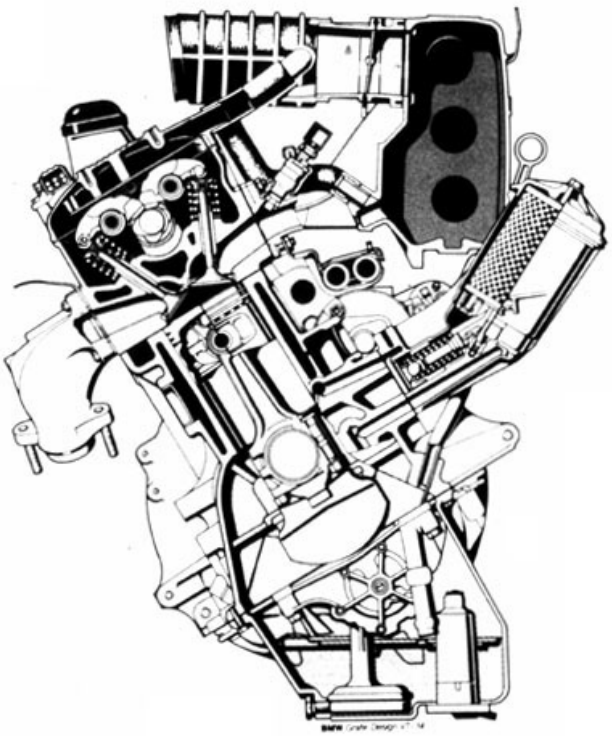


Testing Thermostat:
Does thermostat begin to open at specified temperature?
Check by placing thermostat in a hot water bath and comparing actual opening temperature against stamped value.

* See Specifications
*** See Workshop Equipment Catalog

M 30 = Large 6-cylinder
B = Gasoline
35 = Displacement (x 100)
M = Motronic
Z = Catalytic converter (worldwide)

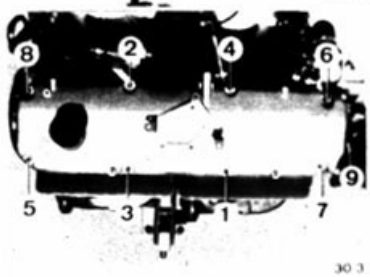




M 30 B 30 M = BMW 730 i
M 30 B 30 M Z = BMW 730 i (Catalytic Converter)
M 30 B 35 M = BMW 735 i
M 30 B 35 M Z = BMW 735 i (Catalytic Converter)



30 2

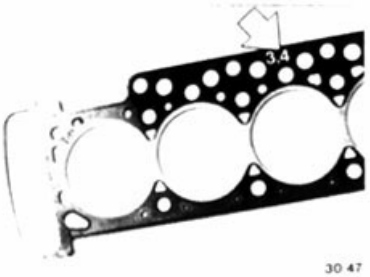


30 3

11 12 000 REMOVING AND INSTALLING CYLINDER HEAD COVER

Disconnect hose (1).
Unscrew ignition lead tube (2).

Remove cylinder head cover.
Installation:
Check gasket, replacing if necessary.
Check for correct seating of gasket and tighten bolts in order of 1 ... 9, mounting the idle speed drive with bolt (2).
Tightening torque: 10 · 1 Nm (7 · 0.5 ft. lbs.).



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11 12 101 REPLACING CYLINDER HEAD GASKET

Remove cylinder head – see 11 12 100.
Clean sealing surfaces on cylinder head and crankcase – use a gasket remover** and hard wood scraper.
Check levelness with steel ruler (commercial) and grind cylinder head sealing surface when necessary – see 11 12 719.
Installation:
Only use original cylinder head gaskets, since the openings and holes are matched precisely for coolant flow.

Stamped Identification:

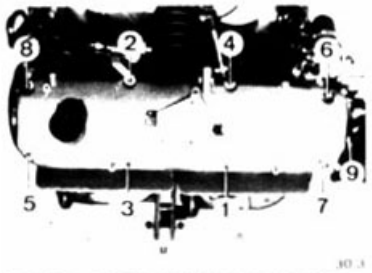
Engine	Code	Bore Diameter
M 30 B 30 M	3.0	89 mm (3.504")
M 30 B 35 M	3.4	92 mm (3.622")



30 46

Important!
A 0.3 mm (0.012") thicker gasket can be installed on a reground cylinder head, in order to avoid reducing the specified combustion chamber size.
This gasket can also be used when gasoline is causing engine knock.
Installation:
Coat bores with Three Bond Silicone 1207** before mounting the timing case cover.

** Source: HWB



30 3



30 48

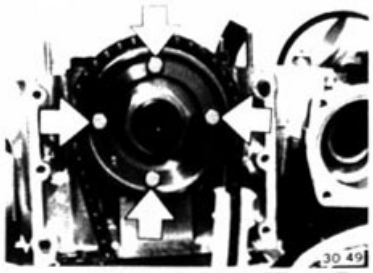
11 12 500 REMOVING AND INSTALLING CYLINDER HEAD
– Engine Removed –

Unscrew cylinder head cover.

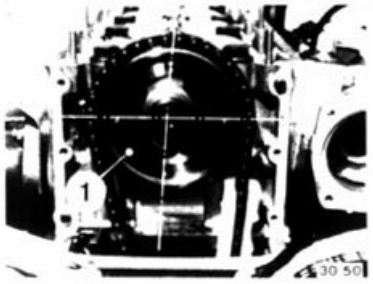
Installation

Check gasket, replacing if necessary.
Check for correct seating of gasket and tighten bolts in order of 1 ... 9, mounting idle speed drive with bolt (2).
Tightening torque: 10 · 1 Nm (7 · 1 ft. lbs.).

Set cylinder no. 1 to TDC.



30 49



30 50

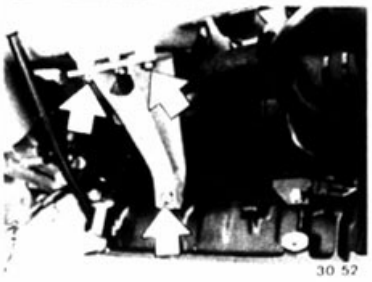
Remove upper timing case cover see 11 14 100.
Remove piston for chain tensioner see 11 31 090.
Unscrew sprocket.

Installation

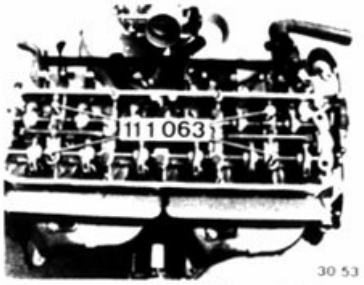
Mount chain that dowel pin (1) is at bottom left when tapped bores are perpendicular to the engine.
Tightening torque: 10 · 1 Nm (7 · 0.5 ft. lbs.).



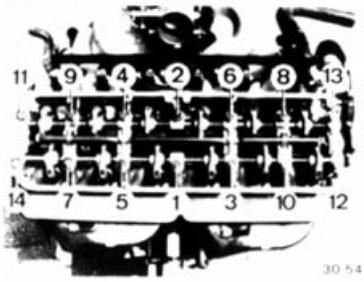
Disconnect hose.



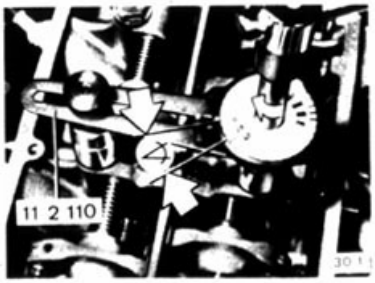
Unscrew support.



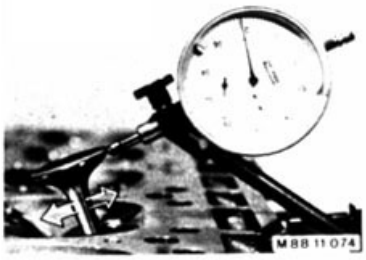
Unscrew cylinder head bolts in order of 14 ... 1.
Insert Special Tools 11 1 063 as shown in the picture to prevent the rocker arm shafts from moving or turning.
Lift off the cylinder head.



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 light coat of oil.
Replace cylinder head gasket - see 11 12 101.

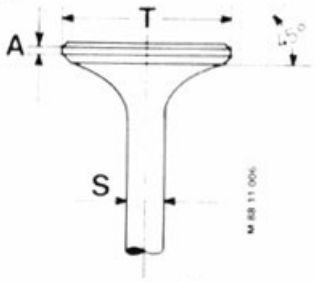


Tighten bolts in order of 1 ... 14 in 3 steps.
Important!
In step 1 first tighten bolts (1 ... 6) with torque of 60 ± 2 Nm (43 ± 1.5 ft. lbs.), then remove Special Tools 11 1 063 and finally tighten bolts (7 ... 14).
Wait 15 minutes.
Adjust valve clearance - see 11 34 004.
Step 2 = 33 ± 3° torque angle.
Run engine warm 25 minutes, adjusting engine if necessary.
Step 3 = 35 ± 5° torque angle.



11 12 595 CHECKING VALVE GUIDE FOR WEAR
– Valve Removed –

To measure, install a new valve that the end of the valve stem is flush with the valve guide. Mount dial gage and measure the tilt play.
Max. permissible tilt play = 0.8 mm (0.031").



11 12 607 MACHINING VALVE SEATS AND VALVES
– Valves Removed

The valve must be replaced, if the minimum edge thickness A cannot be held.

A Intake valve	1.3 mm (0.051")
A Exhaust valve	2.0 mm (0.079")
T Intake valve	
M 30 B 30	46 mm (1.811")
M 30 B 35	47 mm (1.850")
T Exhaust valve	38 mm (1.496")



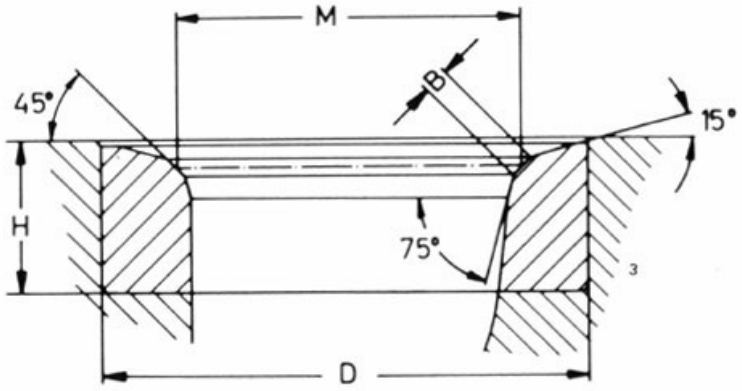
After machining the valve seat angle (45°), produce valve seat diameter M and valve seat width B by machining correction angles (15° / 75°). Grind in valves with grinding paste and check for leaks – see 11 34 509.

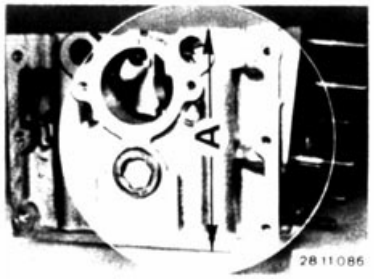
M Intake valve	
M 30 B 30	44.6 mm (1.756")
M 30 B 35	45.6 mm (1.795")
M Exhaust valve	36.6 mm (1.441")
B Intake valve	1.4 ± 0.4 mm (0.055 ± 0.016")
B Exhaust valve	1.7 ± 0.4 mm (0.067 ± 0.016")

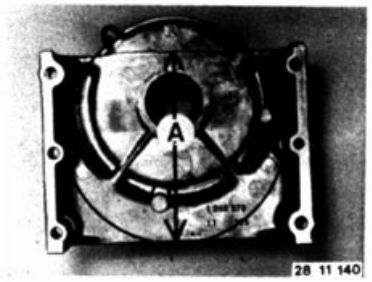


11 12 600 REAMING OUT VALVE GUIDE
– Valve Removed –

The valve guide must be reamed out and an oversize valve with larger stem diameter "S" = 8.1 or 8.2 mm (0.319 or 0.323") installed when there is excessive play between valve guide and valve stem, see 11 12 595.
The valve seat must also be machined in conjunction with this operation – see 11 12 607.
Press guide (1) against the valve seat and ream out the valve guide from the combustion chamber end – turning down the reamer once.







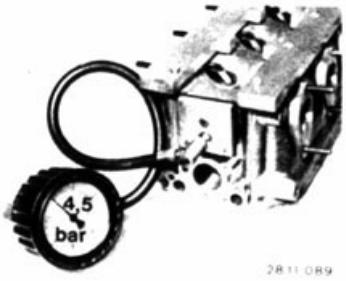
11 12 719 Grinding cylinder head sealing surface

- Cylinder Head dissembled -

The original total cylinder head thickness (A) = 129 ± 0.1 mm (5.079 ± 0.004") may not be reduced by more than 0.3 mm (0.012").
Install a 0.3 mm (0.012") thicker gasket on reground cylinder head - see 11 12 101.

Machine upper timing case cover accordingly- after grinding the cylinder head.





11 12 729 Checking cylinder head for cracks in water test.

- Cylinder head disassembled -

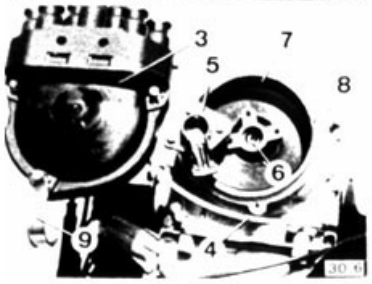
Mount Special Tools 11 1 012 on cylinder head.
Close off water circuit on cylinder head with Special Tools 11 1 016 and 11 1 017.

Fill cylinder head with compressed air.
Testing pressure: 4.5 bar (64 psi).
Place cylinder head in a water bath and check for cracks.

Note:
Water bath can be relaxed with a detergent if necessary.





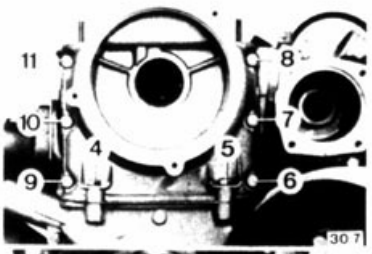


11 14 100 REMOVING AND INSTALLING/ SEALING UPPER TIMING CASE COVER

Remove cylinder head cover – see 11 12 000.
Drain coolant partially if necessary.
Unscrew cover (1) on thermostat housing.

Installation:
Replace seal (2).
Bleed cooling system – see 17 00 039.

Unscrew distributor cap (3).
Pull out lead (4).
Unscrew distributor finger (5).
Unscrew adapter (6).
Remove cover (7).
Installation:
Check rubber ring (8).
Use a seal on bolt (6).
Tightening torque: 23 · 1 Nm (16.5 · 0,5 ft. lbs.).
Install clamp (9).





Unscrew timing case cover.
Installation:
Tighten bolts (4 and 5) finger tight.
Then tighten bolts (6 ... 11) - bolts (8 and 9) are longer.
If applicable, replace damaged cylinder head gasket – see 11 12 101.

Important!
Coat holes with Three Bond Silicone 1207** before mounting the timing case cover.

** Source: HWB



11 14 120 REMOVING AND INSTALLING/ SEALING LOWER TIMING CASE COVER

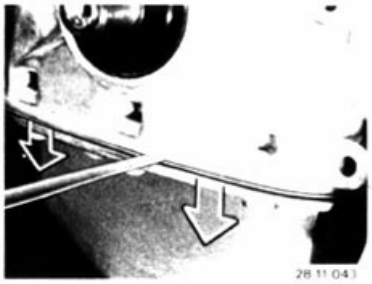
Remove fan – see 11 52 000.
Remove vibration damper with hub – see 11 23 000.
Remove upper timing case cover – see 11 14 100.
Remove piston for chain tensioner – see 11 31 090.
Unscrew pulley on water pump.



Unscrew power steering pump.
Unscrew bolts (1) – loosen remaining oil pan bolts.



Unscrew timing case cover.
Installation:
Mount TDC transmitter (6) and suspension eye (7).
Check length of bolts.

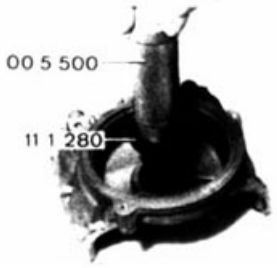


Loosen oil pan gasket on timing case cover carefully with a knife.
If oil pan gasket is damaged, remove oil pan see 11 13 000.



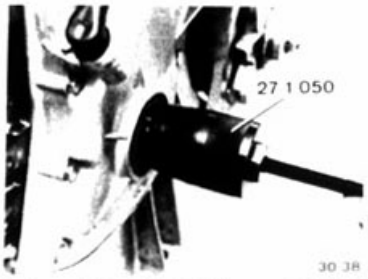
Take off timing case cover.
Installation:
Coat mating surfaces between oil pan and crankcase with Three Bond Silicone 1207**.
Important!
Holder for tensioning piston must be located in the oil pocket.

** Source: HWB



11 14 131 REPLACING RADIAL OIL SEAL IN UPPER TIMING CASE COVER

Remove upper timing case cover – see 11 14 100.
Lift out the radial oil seal.
Drive in new radial oil seal with Special Tools 11 1 280 and 00 5 500.
Lubricate sealing lip with oil.



11 14 141 REPLACING RADIAL OIL SEAL IN LOWER TIMING CASE COVER

Remove vibration damper with hub – see 11 23 031.
Cut off lip of seal and pull off seal with Special Tool 27 1 050.



Lubricate lip of radial oil seal with oil.
Drive in radial oil seal with Special Tools 11 1 273 and 11 1 272.



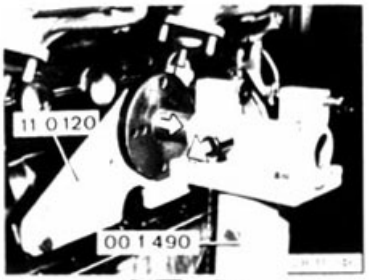
11 14 605 REPLACING RADIAL OIL SEAL IN CLUTCH END COVER
– Transmission Removed –

Remove flywheel – see 11 22 000.
Drain engine oil.
Loosen oil pan bolts.
Loosen gasket in area of end cover/oil pan joint carefully with a knife.
Unscrew end cover.
Replace gasket.
Remove oil pan – see 11 13 000 – if oil pan gasket was damaged.
Installation
Coat end cover/oil pan joint with Three Bond Silicone 1207**.
Use Special Tool 11 2 213 to avoid damaging the radial oil seal.



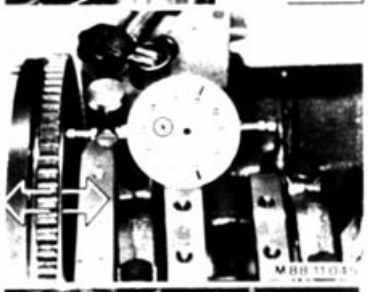
Press in radial oil seal with Special Tools 11 1 260 and 00 5 500.
Install new radial oil seal approx. 1 to 2 mm (0.039 to 0.079") deeper in contradiction to the standard seal, which had been installed flush.
Lubricate sealing lip with oil.

** Source: HWB



11 21 000 REMOVING AND INSTALLING CRANKSHAFT

Remove engine – see 11 00 050.
Unscrew bracket of right engine mount.
Mount crankcase in Special Tool 00 1 490 with help of Special Tool 11 0 120.



Remove clutch – see 21 21 000.
Remove cylinder head – see 11 12 100.
Remove timing chain – see 11 31 051.
Remove oil pump – see 11 41 000.
Measure axial play (0.085 to 0.174 mm = 0.0033 to 0.0068") before removing the crankshaft.
Check/replace the thrust bearing, if max. permissible play is exceeded.



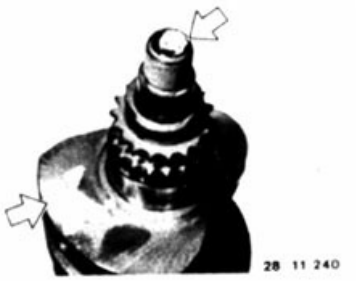
Remove flywheel – see 11 22 000.
Unscrew end cover.
Installation:
Replace gasket.
Use Special Tool 11 2 213 to avoid damaging the radial oil seal.
Cut off gasket along the oil pan sealing surface.



Mark conrod bearing caps and corresponding connecting rods, and unscrew.
Installation:
Replace conrod bearing shells and measure conrod bearing play – see 11 24 571.



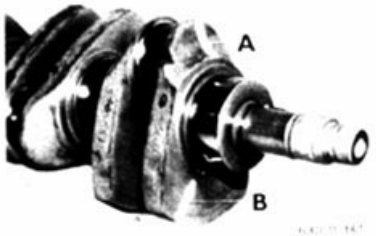
Unscrew crankshaft bearing caps and lift out the crankshaft.
Installation:
Bearing cap no. 1 is at the sprocket end.
Install bearing shells and check bearing play – see 11 21 531.
Installation:
Measure axial play after installation of crankshaft – loosen thrust bearing no. 4 again.
Center the thrust bearing by applying knocks on rear and front ends of the crankshaft with a plastic hammer.
Tighten thrust bearing again as specified.
Measure the axial play (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.


28 11 240

11 21 501 REPLACING CRANKSHAFT
– Crankshaft Removed –

Crankshaft Identification:

Engine	Stroke (mm)	Paint Dot or Code in Center	
M 30 B 30	88	white	L
M 30 B 35	86	blue	K

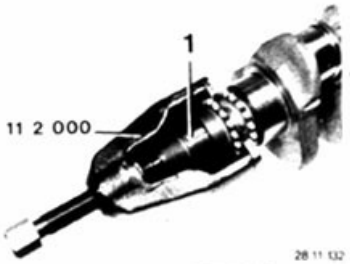


The crankshaft is surface treated and may only be reground in the factory.

Reground crankshafts are marked with stripes of paint.

Conrod Bearing Journal (A)
1 paint stripe Size 1 *
2 paint stripes Size 1 *

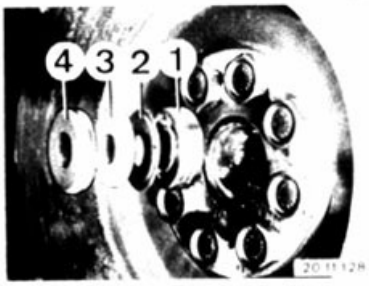
Main Bearing Journal (B)
1 paint stripe Size 1 *
2 paint stripes Size 2 *



28 11 132

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.



20 11 128

Cars with Manual Transmission:
Install pilot bearing for the transmission main bearing.

Installed Order:
Ball bearing (1), cover (2), felt ring (3) and capsule (4).
Insert cover (2) with the embossment facing out.

* See Specifications

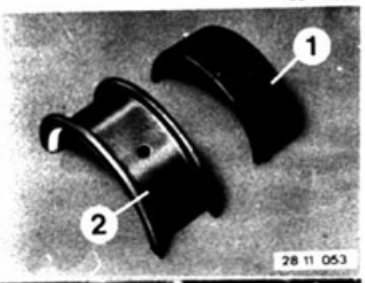


20 11 14H

Fill bore in the 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.


28 11 308

Replacement crankshafts are supplied only with bearing shells of double classification.
The crankshaft is marked with red or blue paint depending on main bearing journal tolerances.



28 11 053

1 = Bearing shell 1–2–3–5–6–7
2 = Bearing shell 4 (pilot bearing)

The color code mark is located on the side of a bearing shell.

Check the ground size of main bearing journals.


M88 11 060

Installing Instructions:
Install only "red" bearing shells in the crankcase (regardless of the old color code mark on the crankcase).
Install "red" or "blue" bearing shells in the bearing caps depending on the color code mark of crankshaft bearing journals.

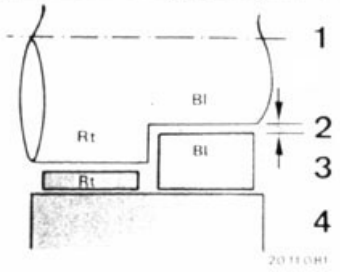


Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten the bearing caps with correct torque*.
Do not turn the crankshaft.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt



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*

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 pertinent crankshaft ground size.
Install only red bearing shells of a pertinent ground size for replacement crankshafts.

* See Specifications



Place Type PG-1 Plastigage on crankshaft wiped clean of oil in the BDC position.
Connecting rods and caps are marked with the same pair number (0 ... 99).
All pair numbers must be on the same side in one engine.
Mount conrod caps.
Tightening torque = 55 ± 3 Nm
(40 ± 2 ft. lbs.).

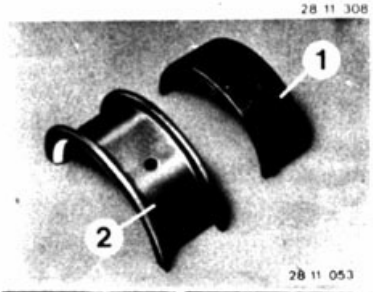


Important!
Do not turn the connecting rods or crankshaft.

Remove bearing caps.
Read 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, bearing shells of a different machined size or with a different color code.
Replace conrod bolts for final installation and tighten the conrod bearing caps.
Tightening torque = 55 ± 3 Nm
(40 ± 2 ft. lbs.).



28 11 308



28 11 053



M88 11 060



M88 11 061

11 21 531 REPLACING CRANKSHAFT MAIN BEARING SHELLS
– Engine Disassembled –

The crankshaft is marked with red or blue paint depending on main bearing journal tolerances.

Bearing shells have double classification and are marked with red or blue paint.

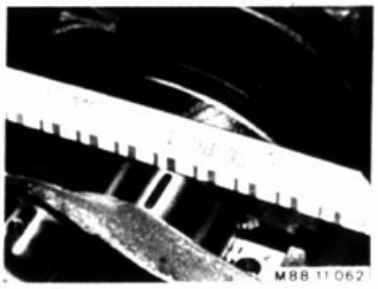
1 = Bearing shell 1–2–3–5–6–7
2 = Bearing shell 4 (pilot bearing)

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 mark on the crankcase has been washed off.
Install bearing shells in the bearing caps with the same color code mark as for the crankshaft.

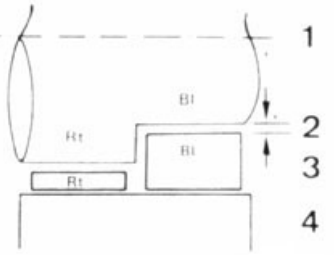
Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps with correct torque*.
Do not turn the crankshaft.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

* See Specifications



M88 11 062



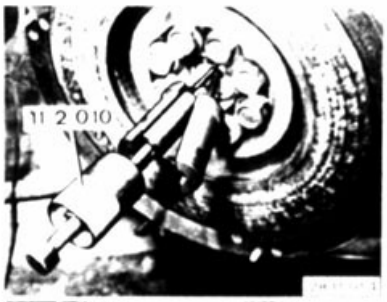
Remove bearing caps.
Read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells of a different machined size or with a different color code.

Survey of Color Code Shaft Diameter Bearing Shell Thickness*

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

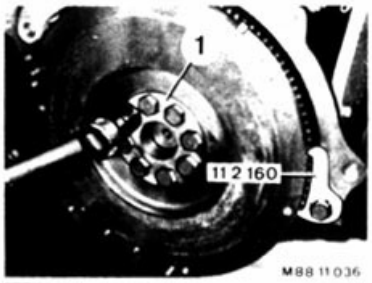
Remove clutch – see 21 21 000
Pull out ball bearing with Special Tool 11 2 010
Automatic Transmission:
Pull out adapter with Special Tool 11 2 020



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



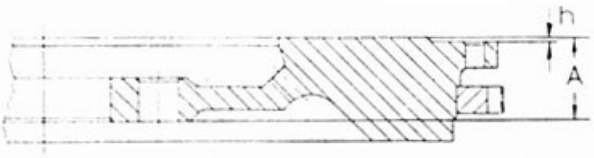


11 22 000 REMOVING AND INSTALLING FLYWHEEL

Remove clutch - see 21 21 000.
Hold flywheel with Special Tool 11 2 160.
Unscrew bolts and take off flywheel.
Installation
Clean tapped bores.
Use washer (1).
Replace and install new expansion bolts with Loctite No. 270*.
Tightening torque = 105 + - 7 Nm (76 + - 5 ft. lbs.).

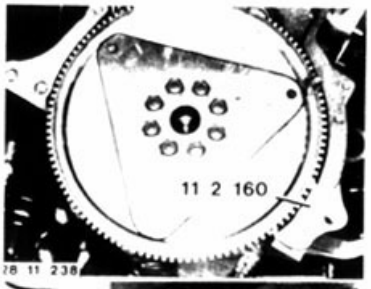
Check flywheel for axial runout*.

Friction surface may be machined to minimum thickness A.
If machining the friction surface reduces distance 'h' to zero, the flange surface (distance 'h') has to be machined.
A = at least 26.6 mm - 0.1 mm (1.031 - 0.004").
The friction surface of a double-mass flywheel cannot be machined.



30 61

* See Specifications
** Source of Supply: HWB









11 22 051 REPLACING DRIVE PLATE FOR TORQUE CONVERTER

Remove transmission - see Group 24.
Hold flywheel with Special Tool 11 2 160.
Unscrew bolts and take off flywheel.
Installation
Clean tapped bores.
Replace and install new expansion bolts with Loctite No. 270**.
Tightening torque = 105 + - 7 Nm (76 + - 5 ft. lbs.).

11 22 541 REPLACING STARTER GEAR RING

Drill a 6 mm (0.236") dia. hole approximately 8 mm (0.315") deep below a tooth gap, in order to make it easier to break the gear ring.

Break gear ring at drilled point with a chisel.

Installation
Heat a new starter gear ring to 200 ... 230 C (395 to 445 F).
Check temperature with a thermo-color pencil.
Tooth bevel faces the engine.
Install starter gear ring to fit snug all around with help of a brass mandrel.

** Source of Supply: HWB



11 23 010 REPLACING VIBRATION DAMPER

Take off drive belts for alternator, power steering pump and, if applicable, air conditioner compressor.
Unscrew pulley and take off vibration damper.

Installation
Centering pin (1) must be in bore of vibration damper.
Tightening torque = 22 ± 2 Nm (16 ± 1 ft. lbs.).
Tighten drive belts and check tightness with Special Tool 11 5 020.



11 23 031 REPLACING VIBRATION DAMPER HUB

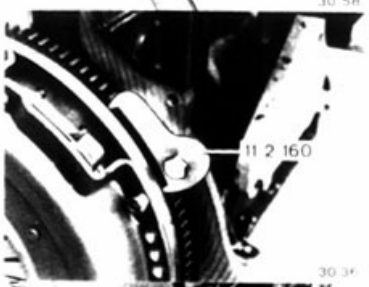
Take off drive belts for alternator, power steering pump and, if applicable, air conditioner compressor.
Unscrew pulley.

Installation
Tightening torque = 22 ± 2 Nm (16 ± 1 ft. lbs.).



Engine Installed in Car:
Apply Special Tool 11 2 220 and unscrew nut.

Installation
Tightening torque = 440 ± 10 Nm (318 ± 7 ft. lbs.).



Engine Removed:
Hold flywheel with Special Tool 11 2 160 and unscrew nut.
Take off vibration damper.

Note
One tapped bore is offset 1°. Consequently the hole pattern of the special tool will not fit in certain positions.



Pull hub off of the crankshaft with Special Tools 00 7 501 and 11 2 132.



30 31

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 bearing cap surface.
Connecting rods may not be machined to repair.



M88 11 065

Piston pin must slide through conrod bushing under light pressure.
Install conrod bearing shells – see 11 24 571.



30 32

11 24 571 REPLACING CONROD BEARING SHELLS
– Engine Disassembled

Install red or blue conrod bearing shells to match color code on connecting rod.
Important!
Check machined size (conrod bearing diameter).



30 33

Place Type PG-1 Plastigage on crankshaft wiped clean of oil in BDC position.
Connecting rods and bearing caps are marked with the same pairing code (0 ... 99).
All pairing codes must be on the same side in one engine.
Mount conrod bearing caps.
Tightening torque = 55 ± 3 Nm (40 ± 2 ft. lbs.).
Source for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D–8070 Ingolstadt



30 34

Important!
Don't turn connecting rods or crankshaft.
Remove bearing caps.
Check bearing play (0.020 to 0.055 mm = 0.0008 to 0.0022") by measuring width of flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells, bearing shells with different machined size or different color code.
Use new conrod bolts for final installation of the bearing caps.
Tightening torque = 55 ± 3 Nm (40 ± 2 ft. lbs.).



30 25

11 25 000 REMOVING AND INSTALLING PISTON

Remove engine and take off cylinder head, oil pan and oil pump.
Unscrew conrod bearing cap and press out piston with connecting rod upwards.
Important!
Mark installed position of connecting rod to crankcase, if conrod bearing shells do not have to be replaced.



30 26

Lift out circlip (1).
Press out piston pin.
Installation:
Piston pin is matched with piston and must not be mixed up.
Install connecting rod – see 11 24 571.
Only install piston of same make and same weight class.
Weight class is stamped with "+" or "–" in piston crown.
Important!
Check machined size (piston diameter)*.



30 27

Identification:

Engine	E	Piston Cup Height mm	Diameter mm
M 30 B 30 M.	9.2	2.91	89
M 30 B 30 M.Z	9.0	2.26	89
M 30 B 35 M.	9.2	1.4	92
M 30 B 35 M.Z	9.0	1.4	92



M88 11 051

Measure Installed Piston Clearance:
Measure piston diameter at checkpoint "A" with a micrometer.

Engine	Make	Checkpoint A mm (inch)
M 30 B 30 M	Alcan	17.0 (0.669)
	KS	20.8 (0.819)
M 30 B 35 M	Alcan	13.5 (0.531)
	Mahle	22.0 (0.866)

* See Specifications



Set internal calipers to zero on the micrometer with the measured piston diameter.



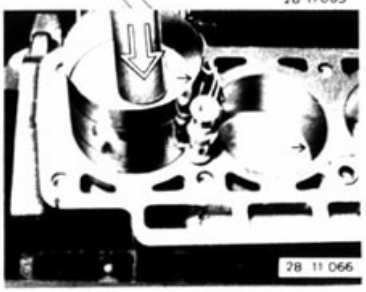
28 11 508

Measure cylinder bore at bottom, center and top with the internal calipers in driving and rotating directions.
New piston installed clearance: 0.02 to 0.05 mm (0.0008 to 0.0020").
Permissible total wear play: 0.15 mm (0.006").



28 11 065

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.



28 11 066

Insert piston that arrow faces timing chain.

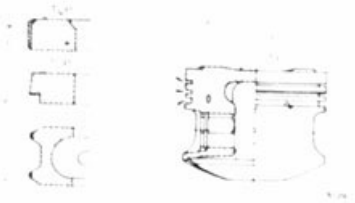


30 28

11 25 651 REPLACING PISTON RINGS OF ONE PISTON
– Piston Removed –

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.



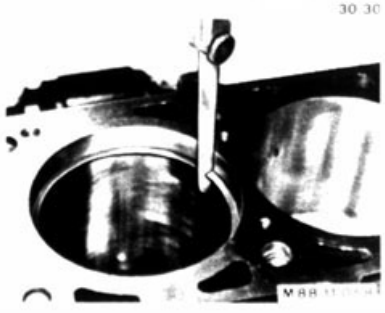
Installation:
Install piston rings with the word "TOP" facing the piston crown.

1 Plain compression ring
2 Bevelled face compression ring
3 Oil scraper ring with rubber lined spring



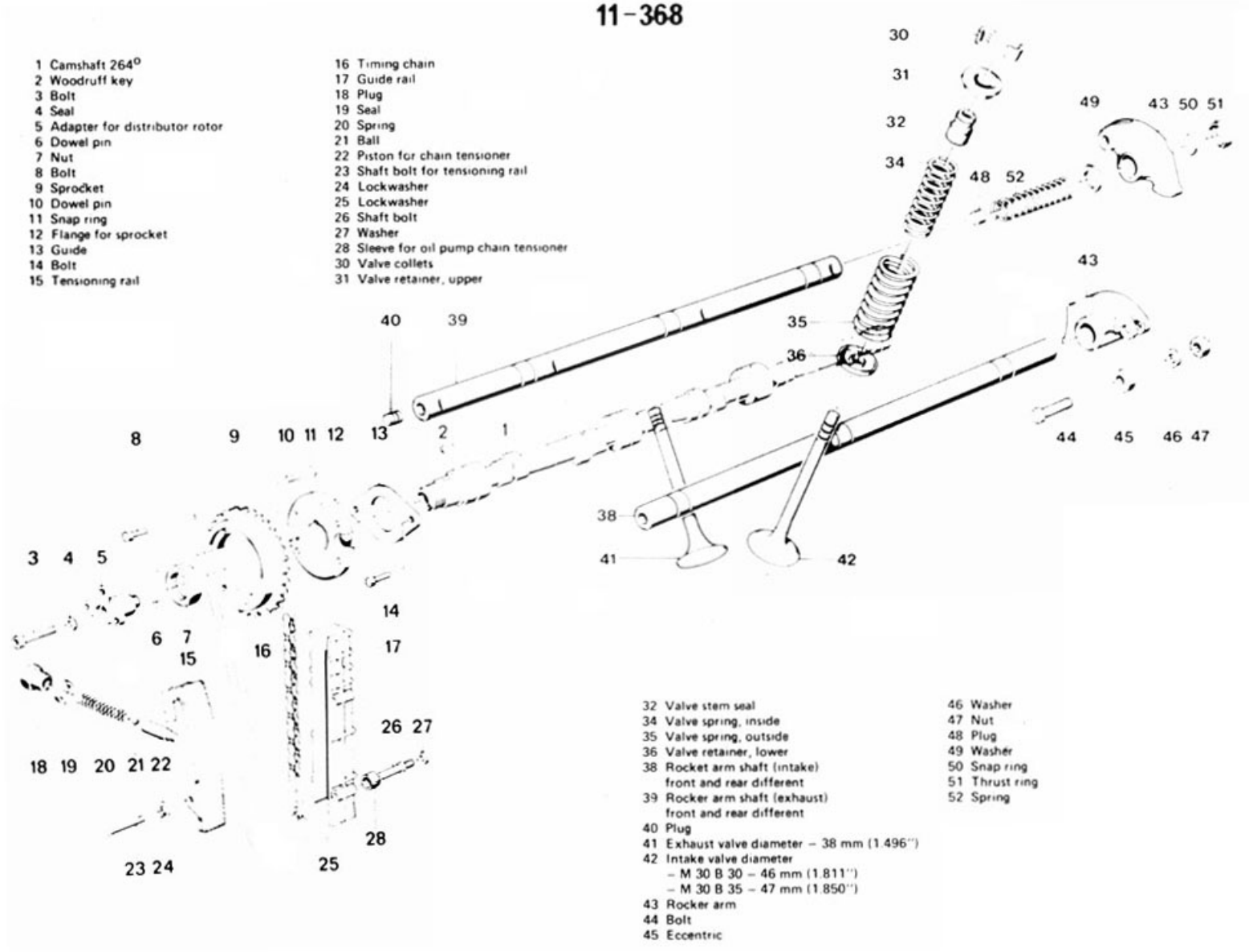
30 30

Measure side clearance.
Groove 1: 0.040 ... 0.072 mm
Groove 2: 0.030 ... 0.062 mm
Groove 3: 0.020 ... 0.055 mm

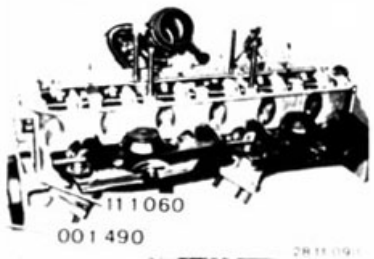


Measure end clearance.
Ring 1: 0.20 ... 0.45 mm
Ring 2: 0.40 ... 0.65 mm
Ring 3: 0.30 ... 0.60 mm

11-368

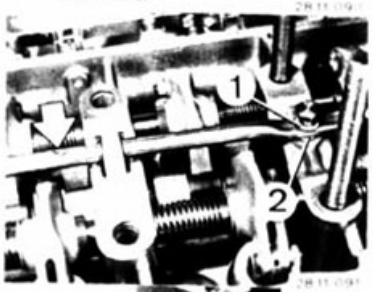


1 Camshaft 264°
2 Woodruff key
3 Bolt
4 Seal
5 Adapter for distributor rotor
6 Dowel pin
7 Nut
8 Bolt
9 Sprocket
10 Dowel pin
11 Snap ring
12 Flange for sprocket
13 Guide
14 Bolt
15 Tensioning rail
16 Timing chain
17 Guide rail
18 Plug
19 Seal
20 Spring
21 Ball
22 Piston for chain tensioner
23 Shaft bolt for tensioning rail
24 Lockwasher
25 Lockwasher
26 Shaft bolt
27 Washer
28 Sleeve for oil pump chain tensioner
30 Valve collets
31 Valve retainer, upper
32 Valve stem seal
34 Valve spring, inside
35 Valve spring, outside
36 Valve retainer, lower
38 Rocket arm shaft (intake)
front and rear different
39 Rocker arm shaft (exhaust)
front and rear different
40 Plug
41 Exhaust valve diameter – 38 mm (1.496")
42 Intake valve diameter
– M 30 B 30 – 46 mm (1.811")
– M 30 B 35 – 47 mm (1.850")
43 Rocker arm
44 Bolt
45 Eccentric
46 Washer
47 Nut
48 Plug
49 Washer
50 Snap ring
51 Thrust ring
52 Spring



11 31 000 REMOVING AND INSTALLING CAMSHAFT
– Cylinder Head Removed –

Mount Special Tool 11 1 060 on Special Tool 00 1 490.
Mount cylinder head on special tool fixture.



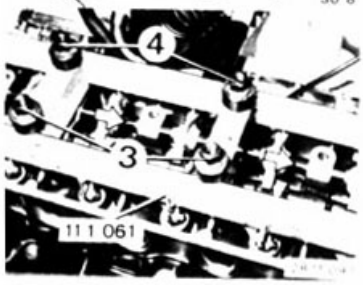
Unscrew oil pipe.

Installation
Use new bolts coated with microencapsulated cement.
Replace seals (1 and 2).
Tightening torque:
12 · 1 Nm (9 · 0.5 ft. lbs.)

Important!
Arrows on oil pipe face forward.

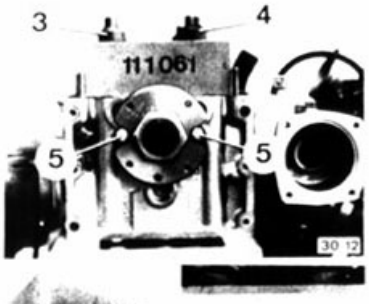


Adjust valve clearance of all valves to the maximum value.
Turn camshaft approx. 15° and apply Special Tool 11 1 061.



Push rocker arms of cylinders 2 and 4 (intake) forward and align special tool that the tabs bear on the eccentrics of the rocker arms.

Important!
To avoid contact between valve heads, first tighten nuts (3) (exhaust) against the stop and then screw in nuts (4) (intake) slightly.
Proceed in reverse order when removing the special tool.



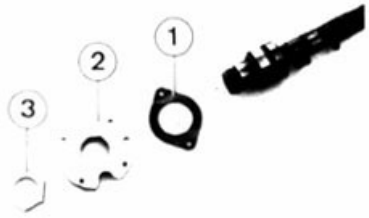
Unscrew bolts (5).
Pull out camshaft.

Important!
When tightening nuts (4) on the intake side, make sure that contact between valve heads is avoided.



Installation
It must be possible to turn the camshaft easily after installation of the guide plate.
Set valves in cylinder no. 6 to overlap before releasing pressure from the special tool.
Tapped bore in flange must be aligned with the cast boss.

Adjust valve clearance – see 11 34 004.



30 9

11 31 001 REPLACING CAMSHAFT
– Camshaft Removed –

Transfer flange for sprocket.
Guide (1), flange (2) and nut (3).
Tightening torque = 142 · 5 Nm (103 · 3.5 ft. lbs.).



30 10

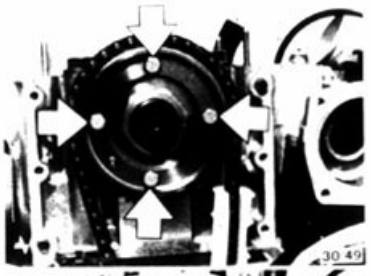
Camshaft Identification:

Engine	Degrees	Code
M 30 B 30 M	264	K
M 30 B 35 M	264	K



30 11

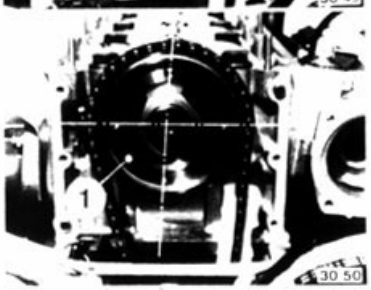
Installation
Check axial play (0.03 to 0.18 mm = 0.0012 to 0.0071") of camshaft, replacing guide if necessary.



30 49

11 31 051 REPLACING TIMING CHAIN

Remove upper timing case cover – see 11 14 100.
Remove lower timing case cover – see 11 14 120.
Set cylinder no. 1 to TDC.
Unscrew sprocket.
Caution!
Never crank engine after removing chain.



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Installation
Mount chain that dowel pin (1) is at bottom left when tapped bores are perpendicular to the engine – cylinder no. 1 must be at TDC.
Tightening torque = 10 · 1 Nm (7 · 0.5 ft. lbs.).

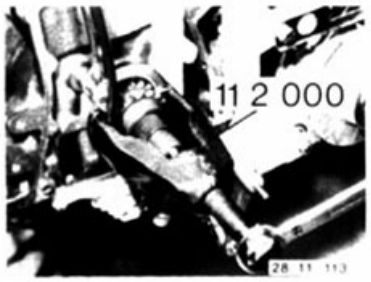


Take timing chain off of the lower sprocket and guide it out of the guide rail carefully.
Note
Timing chain is pre-stretched.

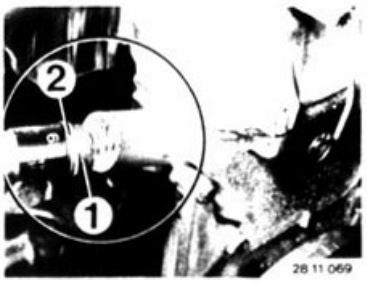


11 31 061 REPLACING SPROCKET SET
- Timing Chain Removed -

Remove oil pan - see 11 13 000.
Unscrew sprocket (1) on oil pump.
Take off chain.
Lift out woodruff key (2).

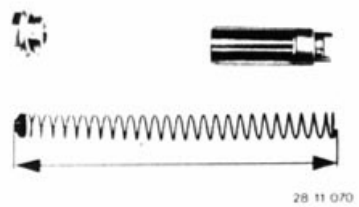


Pull off sprocket with Special Tool 11 2 000.
Installation
Heat sprocket to max. 200 C (390 F) for installation.
Tighten oil pump chain - see 11 41 000.

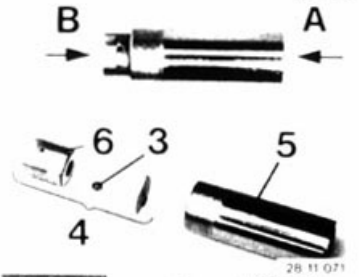


11 31 090 REMOVING AND INSTALLING PISTON FOR CHAIN TENSIONER

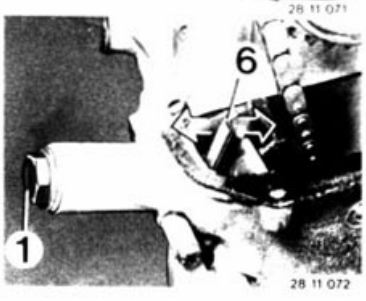
Unscrew plug (1).
Caution!
Strong spring force.
Remove spring and piston.
Installation
Replace seal (2).
Tightening torque = 35 +/- 5 Nm (25.5 +/- 3.5 ft. lbs.).



Installation
Check spring length.
Nominal value: 155.5 mm (6.122").
Conically wound end of spring faces the plug.



Check Piston:
Shake to check whether ball (3) moves easily.
Blow in air to check valve function.
- in direction A = closed
- in direction B = opened
If necessary, drive valve (4) out of sleeve (5) and clean.
Are ventilating slots (6) clogged?



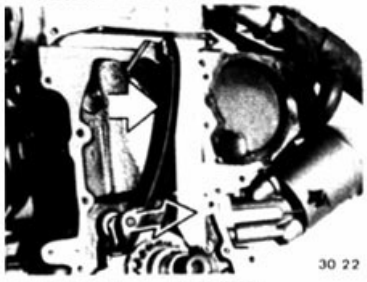
Take off cylinder head cover (see 11 12 000) to bleed the piston.
Remove upper timing case cover - see 11 14 100.
Move tensioning rail (6) back and forth for so long after loosening plug (1) until oil runs out of plug (1) and resistance can be noticed.
Possible Causes for Unusual Chain Noise:
a) Piston bled incorrectly
b) Piston seized
c) Ventilating slots are clogged
d) Ball valve in piston not working
e) Spring force excessive or insufficient



30 21

11 31 601 REPLACING TENSIONING RAILS/GUIDE RAIL
– Timing Chain Removed –

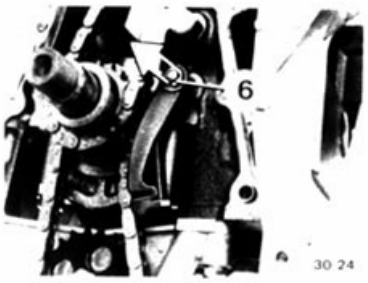
Unscrew water pump (1) and console (2).
Remove lockwashers (3 ... 5).
Installation:
Replace gasket for water pump.


30 22

Swing in and remove tensioning rail.

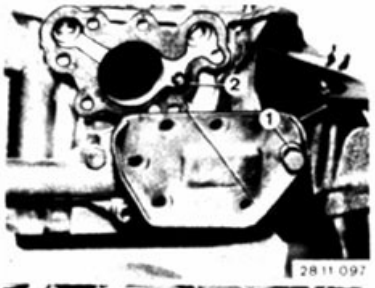

30 23

Pull out guide rail from underneath and swing aside.



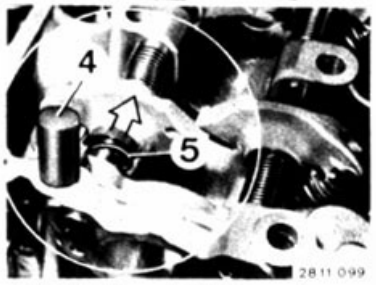
30 24

Remove lockwasher (6) and take out tensioning rail.



11 33 020 REMOVING AND INSTALLING ROCKER ARM SHAFTS

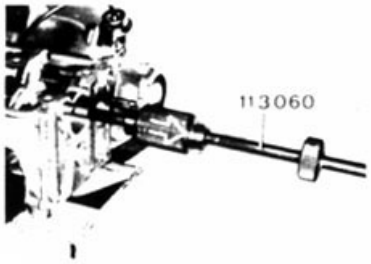
Remove camshaft – see 11 31 000.
Unscrew end cover.
Installation:
Replace seal (1) and gasket (2).



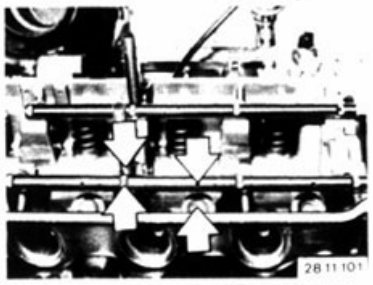
Push back rocker arms and thrust rings.
Lift out snap rings (5).
Remove locating pin (4).



Unscrew plugs (3).
Hold possibly turning rocker arm shafts with locating pin (4).
Installation:
Screw in plugs (3) with Loctite No. 270**.



Screw Special Tool 13 3 060 in the rocker arm shaft.
Drive out rocker arm shafts with the impact sleeve.
Caution!
Springs pop out.



Installation:
Longer rocker arm shafts face the chain.
Openings face bores for cylinder head bolts.
Oil bores face valves.
Plug threads face out.



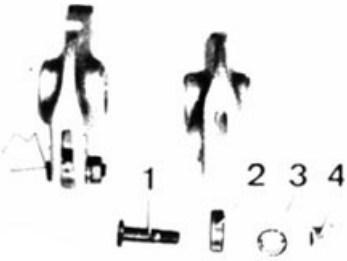
Installed Order:
Spring (9), washer (8), rocker arm (7), thrust ring (6) and snap ring (5).
A = Exhaust
E = Intake
Align rocker arm shafts that cylinder head bolts fit in the openings.
Insert locating pins (4).

** Source: HWB



11 33 031 REPLACING ROCKER ARMS

Remove rocker arms – see 11 33 020.
Replace worn rocker arms or rocker arms with loose slides.
Loose slides will be noticed as excessively loud valve noise.



Transfer bolt (1), eccentric (2), washer (3) and nut (4) to new rocker arm.
Replace a worn eccentric.
Important!
Bolt and nut have M 6 x 0.75 fine threads.
Bore faces out and thick side down.
Bevelled edge of bolt faces tab on rocker arm.



11 34 004 ADJUSTING VALVE CLEARANCE

Remove cylinder head cover see 11 12 000.
Crank engine with Special Tool 11 3 110.

Order of adjustment is same as the firing order (1 5 3 6 2 4) in compression TDC.
Adjust valve clearance between the valve and eccentric after loosening nut (1).
Valve Clearance (Intake and Exhaust):

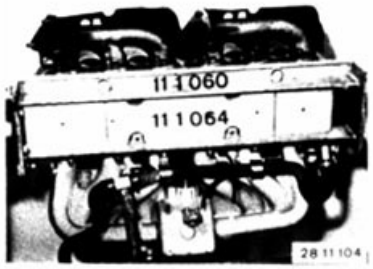
Cold	0.30 mm (0.012")
Operating temperature	0.35 mm (0.014")

Tighten nut (1) with Special Tools 11 1 150 and 00 2 050.
Tightening torque = 10 ± 1 Nm (7 ± 0.5 ft. lbs.).



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.
If gasoline runs past valve heads, valves and valve seats must be inspected.
Remove valves – see 11 34 550.
Machine valve seats – see 11 12 607.



11 34 550 REMOVING AND INSTALLING VALVES
– Rocker Arm Shafts Removed –

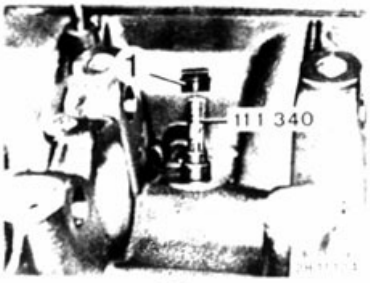
Place Special Tool 11 1 064 (tray) in Special Tool 1 1 060.



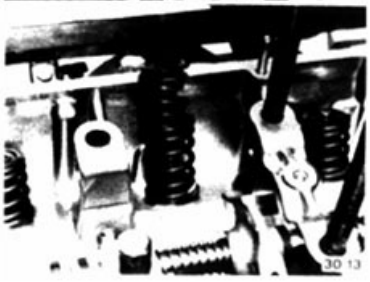
Pull off valve stem seal with Special Tool 11 1 250.



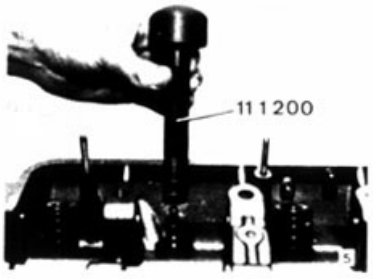
Press down valve springs with Special Tool 11 1 060 and remove valve collets.



Install valve.
Use Special Tool 11 1 340 to avoid damaging the valve stem seal.
Lubricate valve stem seal with oil and install.
Source for Special Tool Sleeves:
CARTOOL
Alfred Brehm-Str. 5
D-8070 Ingolstadt



Remove upper spring retainer, double spring set and lower spring retainer.
Take tray out of assembly stand and pull out valve.
Installation:
Only install valve springs with same color code, wire gage size and length.
Lubricate valve guide and valve stem with oil.



The new, improved valve stem seals (inside rifling) are pressed on by hand with Special Tool 11 1 200.
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

Pull off wires on oil pressure switch.
Unscrew oil pressure switch (1).
Installation:
Check gasket (2), replacing if necessary.
Tightening torque = 35 · 5 Nm (25 · 3.5 ft. lbs.).



Screw in Special Tool 11 4 060.
Connect 10 bar (142 psi) pressure tester of BMW Service Tester.
Measure oil pressure.
At idle speed 0.5 to 2.0 bar (7 to 28 psi)
At max. speed 4.0 to 6.0 bar (57 to 85 psi)

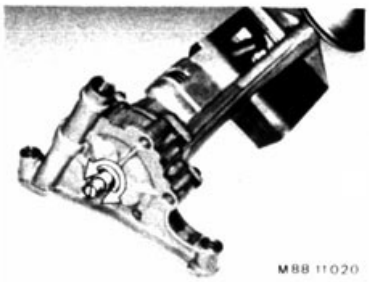


11 41 000 REMOVING AND INSTALLING OIL PUMP

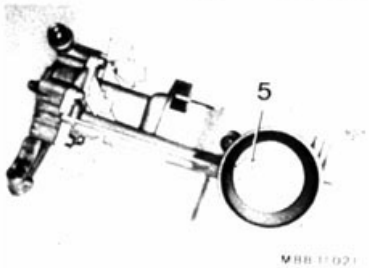
Remove oil pan – see 11 13 000.
Unscrew nut (1) and take off sprocket.
Unscrew bolts (2).
Installation:
Tightening torque for bolts (2) = 22 · 2 Nm (16 · 1.5 ft. lbs.).



Installation:
Slide on sprocket with mounted oil pump.
Tightening torque = 27 · 2 Nm (19.5 · 1.5 ft. lbs.).


M88 11020

Testing and Servicing:
Check whether oil pump runs easily by turning the drive shaft.

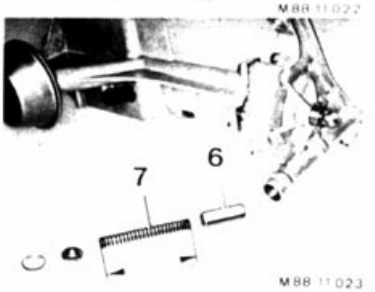


M88 11021

Disassemble oil pump and clean oil filter screen (5).

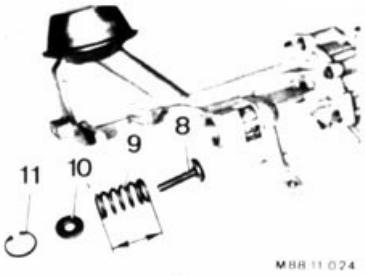

M88 11022

Check oil pump for wear.
– Scoring in body
– Wear of rotors



M88 11023

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").



M88 11024

Pressure safety valve (8 bar = 114 psi) regulates the oil pressure in front of the oil filter and prevents oil filter leakage.
Check piston seat (8).
Check length of spring (9) = 44 ± 0.4 mm (1.732 ± 0.016").


M88 11025

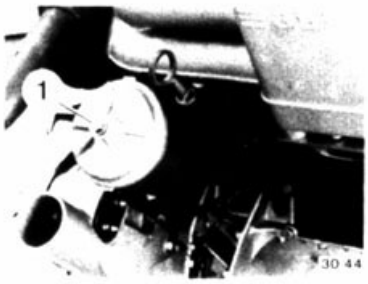
Installation:
Press in spring (9) and washer (10) with a wrench socket and install circlip (11).

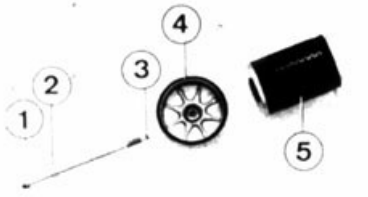


30 35

11 41 151 REPLACING OIL PUMP DRIVE CHAIN

Remove oil pan – 11 13 000.
Remove timing chain – see 11 31 051.
Unscrew nut (1) and take off sprocket.
Installation:
Tightening torque = 27 ± 2 Nm (19.5 ± 1.5 ft. lbs.).

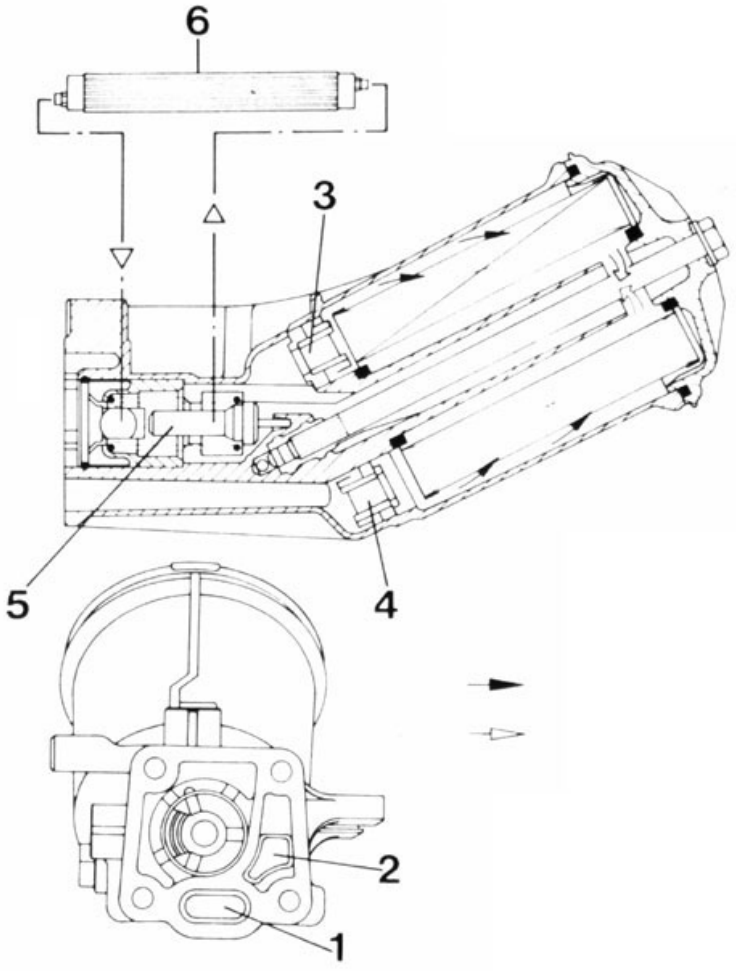




11 42 021 REPLACING FULL FLOW OIL FILTER

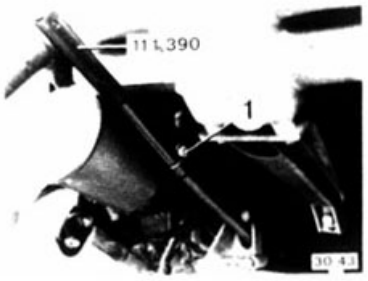
Unscrew bolt (1).
Replace oil filter (5).

Installation
Check seals (2 ... 4), replacing if necessary.
Tightening torque = 30 · 5 Nm (21.5 · 3.5 ft. lbs.).
Pour in engine oil***.



1 Feed from oil pump
2 Return to main oil bore
3 Filter bypass valve – opening pressure 2.2 · 0.4 bar (31 · 5 psi)
4 Return shutoff valve – opening pressure 0.2 · 0.08 bar (3 · 1 psi)
5 Thermostatic regulator for switching on oil cooler
6 Oil cooler

*** See Service Information of Gr. 00



11 43 101 REPLACING GUIDE TUBE FOR OIL DIPSTICK

Loosen clamp (1).
Install guide tube with Loctite No. 270** and drive in against the stop with Special Tool 11 1 390.



11 51 000 REMOVING AND INSTALLING WATER PUMP

Remove fan – see 11 52 000.
Take off drive belt and remove pulley
Installation
Tighten drive belt and check tightness with Special Tool 11 5 020.

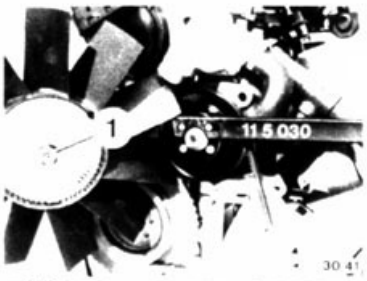


Unscrew suspension eye (1) and disconnect water hose (2).



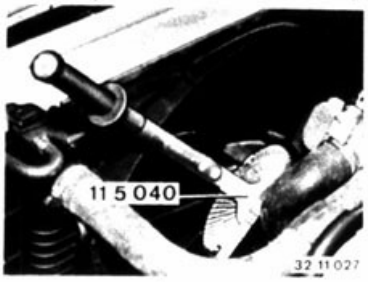
Unscrew water pump.
Installation:
Replace gasket.

** 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 = 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.
Replace fan clutch when
a) hub has seized (fan of stopped 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.
Installation:
Tightening torque = 9 ± 1 Nm (6.5 ± 0.5 ft. lbs.).

* See Specifications
*** See Workshop Equipment Catalog



11 53 000 REMOVING AND INSTALLING COOLANT THERMOSTAT

Drain coolant partially.
Unscrew cover (1).
Installation
Bleed cooling system – see 17 00 039.
Tightening torque = 9 ± 1 Nm (6.5 ± 0.5 ft. lbs.).



Remove thermostat.
Replace seal (2).
Installation
Bar on thermostat faces out.



Testing Thermostat:
Does thermostat begin to open at specified temperature?
Check by placing thermostat in a hot water bath and comparing actual opening temperature against stamped value.

11 Engine M40

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11 00 603	Engine – disassemble and assemble (engine removed)	11- 40 2
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	Engine – mount on assembly stand	11- 40 2
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	Ignition leads distributor – remove	11- 40 3
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	Water pump pulley – remove	11- 40 4
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	Thermostat – remove	11- 40 5
	Adapters for heater hoses – remove	11- 40 5
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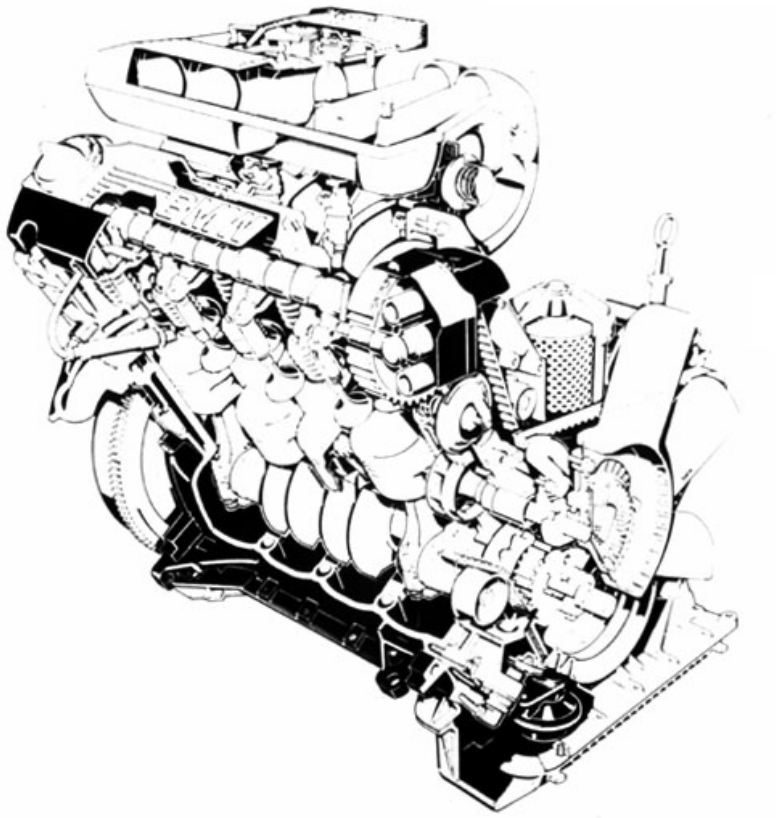
	Main bearing shells – replace	11- 40 24
11 21 501	Crankshaft – replace (crankshaft removed)	11- 40 50

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.



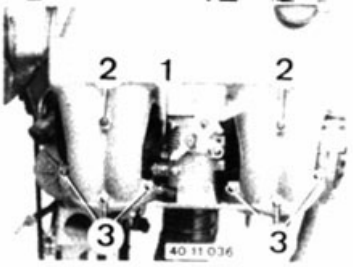
A. Removing, Disassembling and Repairing Cylinder Head

o Removing Air Cleaner:

Loosen clamp and pull hose off.

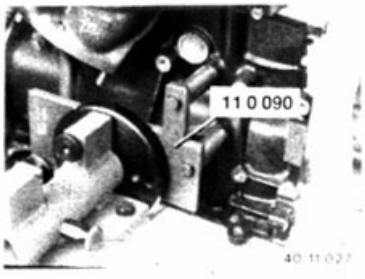


Pull hose (1) off of cylinder head cover.
Loosen clamp and pull hose (2) off of coolant pipe.



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



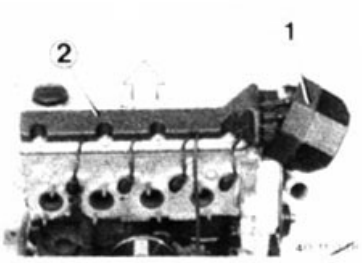
o Mounting Engine on Assembly Stand:

Mount engine on Special Tool 00 1 490 using Special Tool 00 1 490.



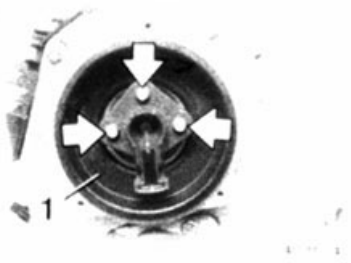
Unscrew nuts and remove lower manifold section.

Installation:
Replace gasket.
Tightening torque: 13 Nm

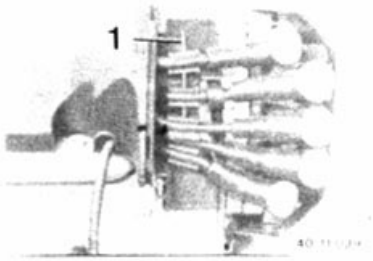


REMOVING IGNITION LEADS DISTRIBUTOR

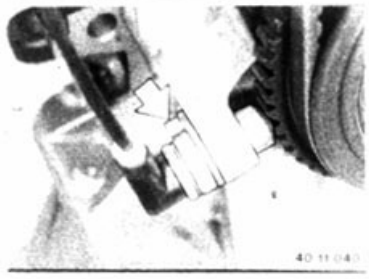
Pull off ignition lead plugs.
Take off cover (1).
Lift out electric lead duct (2) with a screwdriver.



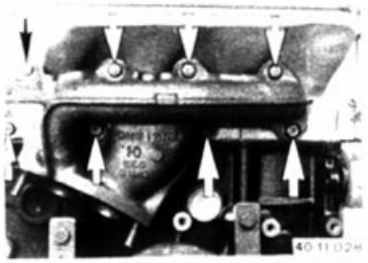
Unscrew screws and take off distributor finger.
Take off cover (1) afterwards.
Installation
Check O-ring on cover, replacing if necessary.



Installation:
Insert ignition leads in guides on insulator (1) in correct order.

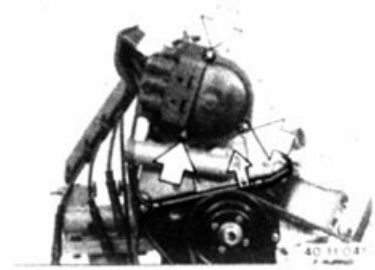


Unscrew reference mark sender.

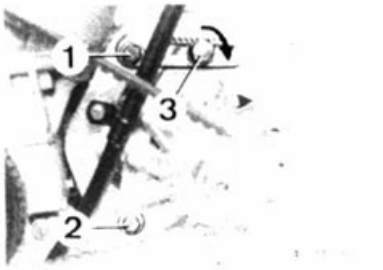


REMOVING EXHAUST MANIFOLD:

Unscrew nuts and take off exhaust manifold.
Installation
Replace self-locking nuts.
Tightening torque = 23 Nm (17 ft. lbs.).

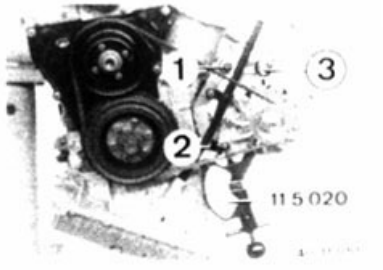


Lift out electric lead duct on face end.
Unscrew screws on distributor cap and take off the ignition tackle.

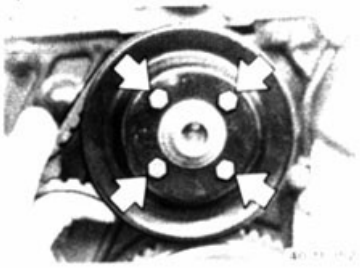


● REMOVING DRIVE BELT:

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.

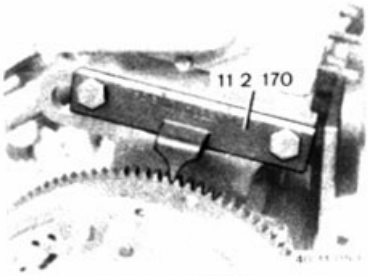


Installation:
Adjust tightness of drive belt with Special Tool 11 5 020 by turning bolt (3) in direction of arrow.
Tighten nuts on bolts (2 and 3) and bolt (1).



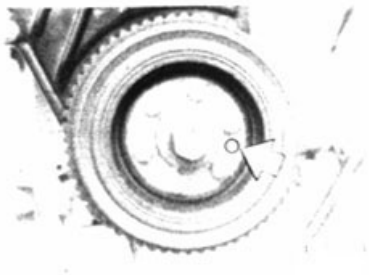
● REMOVING WATER PUMP PULLEY:

Counterhold pulley with drive belt and unscrew bolts



● 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:

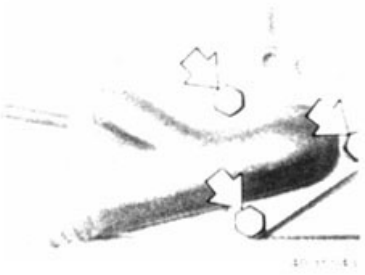
Unscrew bolts and take off thermostat housing and thermostat.



Installation:

Check O ring (1), replacing if necessary.

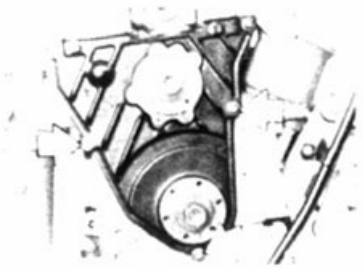
Install thermostat with O ring facing housing.



● REMOVING CONNECTORS FOR HEATER HOSES:

Installation:

Clean sealing surfaces and replace gasket.



o Removing Toothed Belt Cover:

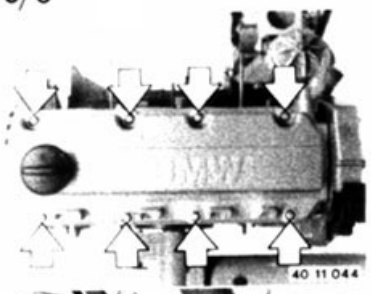
Unscrew screws and remove lower cover.

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.

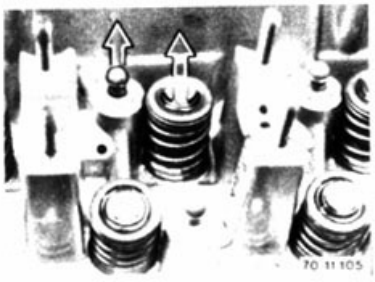
Installation
Check gasket, replacing if necessary.
Tighten bolts diagonally from inside to outside.
Tightening torque: 9 Nm.

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.

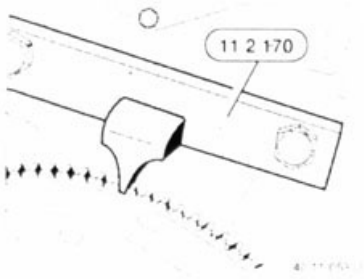
Note
Have each cam facing up perpendicular to the cylinder head.
Special tool must not bear on the cam.
Lay rocker arms aside in order and install in the same positions.



Remove hydraulic valve clearance compensators and guides.

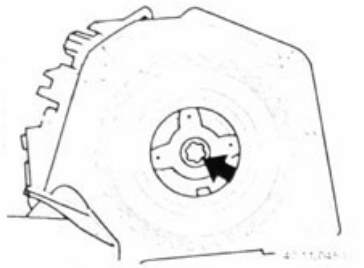
Important!
Keep removed hydraulic valve clearance compensators standing upright to prevent oil from running out.

Cover oil return bores to prevent guides from falling into the crankcase.



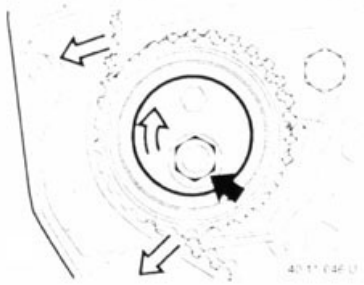
o Removing Toothed Belt:

Turn crankshaft to TDC and hold flywheel with Special Tool 11 2 170.



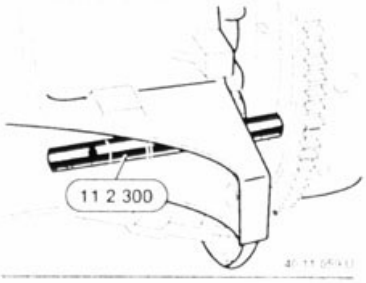
Loosen mounting bolt on camshaft sprocket.

Remove Special Tool 11 2 170.



Loosen nut on tensioning roller and take off toothed belt.

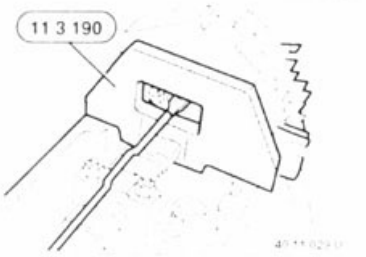
Important!
Regardless of the hours of operation a toothed belt must always be replaced each time the tensioning roller is loosened.



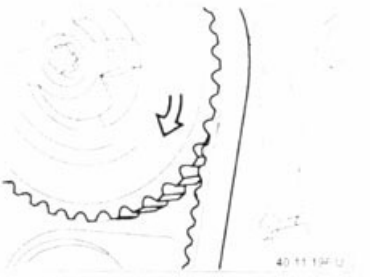
o Installing Toothed Belt and Adjusting Timing:

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

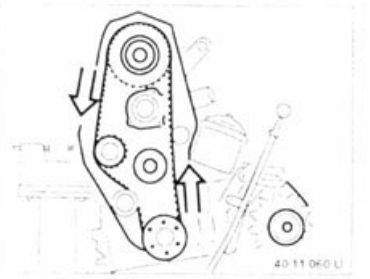
Important!
Remove special tool before operating the engine.



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

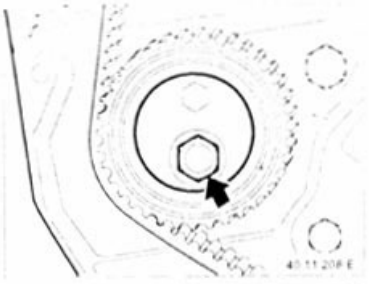


Mount camshaft sprocket with an initial torque of 1 ... 3 Nm (turnable without play) and turn in engine's direction of rotation as far as stop (tab in groove).



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.

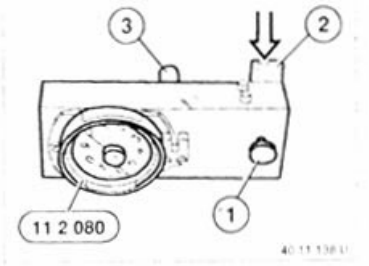


Mount tensioning roller with torque of about 1 Nm that it can be turned easily.



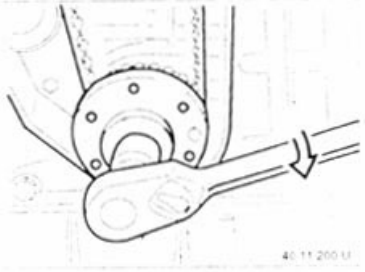
Adjust toothed belt tension to 45 + 5 scale units by turning the tensioning roller.

Tighten tensioning roller with 22 - 3 Nm and camshaft sprocket with 60 + 5 Nm torque.

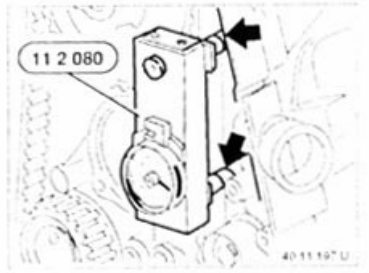


Prepare Special Tool 11 2 080 for the tension test (also refer to operating instructions for 11 2 080):

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.

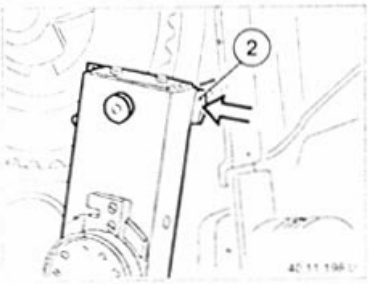


Crank engine on crankshaft at least two full turns in engine's direction of rotation.

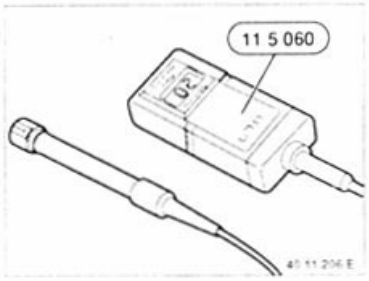


Apply tester between the camshaft and small intermediate roller in such a manner that both rollers of tester bear on the back of the teeth and the center pin is located in a tooth gap.

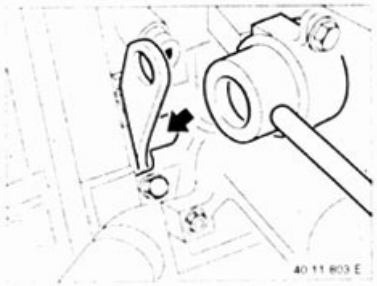
Hold crankshaft with Special Tool 11 2 300 and camshaft with Special Tool 11 3 190.
Loosen camshaft bolt to 1 Nm torque.
Apply Special Tool 11 2 080.
Loosen tensioning roller bolt and tension toothed belt briefly to 45 + 5 scale units.



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.

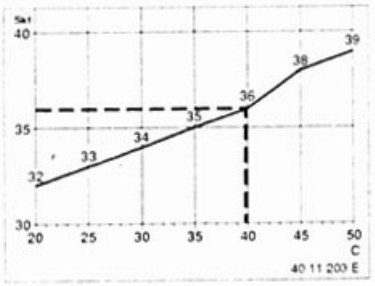
Remove holding tools and tester.

Adjusting Table for Readjustments:

Skt = Scale units on tester

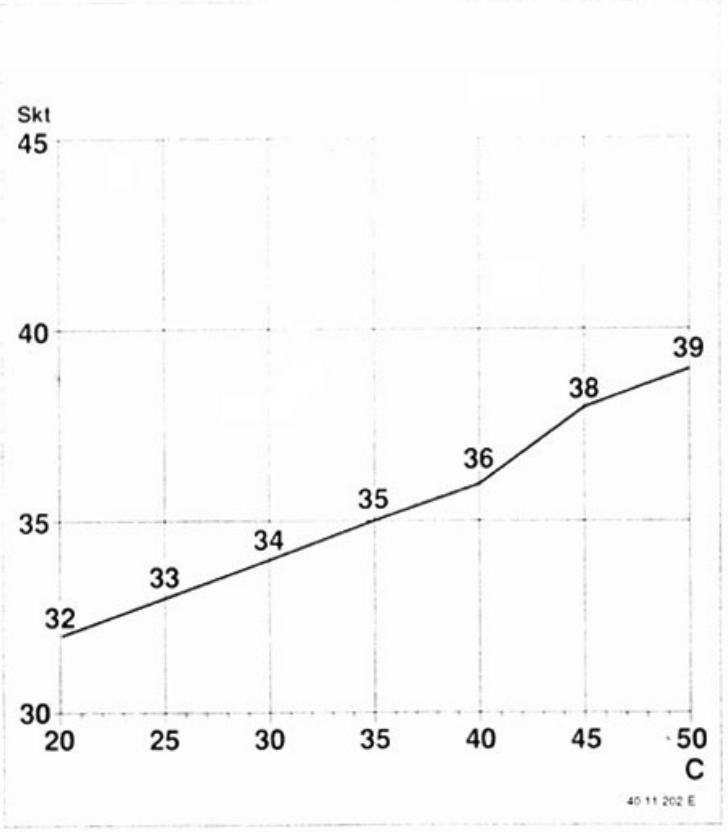
°C = Temperature measured at measuring point on cylinder head

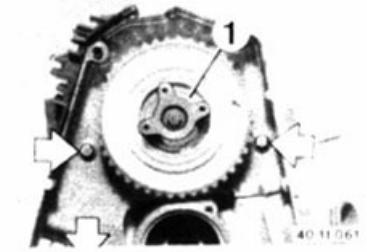
Permissible tolerance: + 2 scale units.



Example:
Engine temperature at measuring point: 40° C.
Adjust toothed belt tension to 36 scale units on the tester.
Round off values.

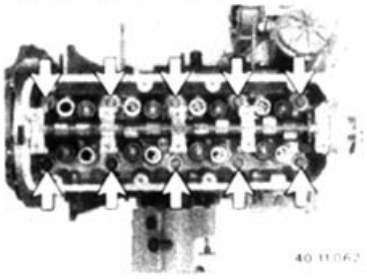
Important!
Toothed belt tension must not be adjusted if the component (cylinder head) temperature is less than 20° C.



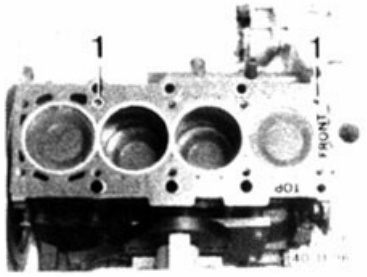


o Removing Cylinder Head:

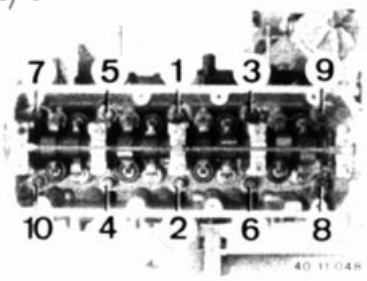
Unscrew camshaft sprocket (1).
Loosen bolts and take off housing.



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.

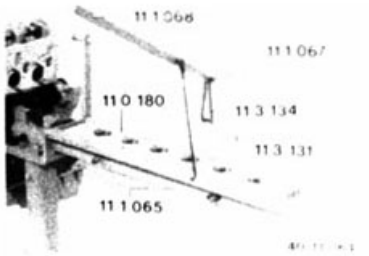


Mount cylinder head and tighten new bolts (lightly lubricated with oil) in three steps in the sequence of 1 through 10.
Step 1: 33 Nm torque
Step 2: 93° torque angle
Step 3: 93° torque angle

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).



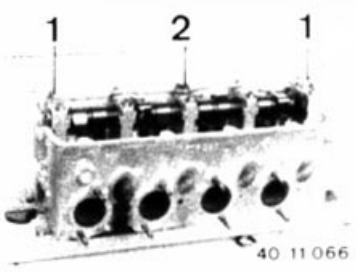
** Source of Supply: HWB



o Mounting Cylinder Head on Assembly Stand Fixture:

Mounting Special Tool 11 1 065 on Special Tool 00 1 490.

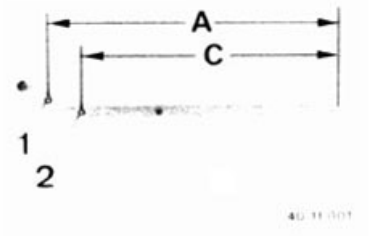
11 0 180 = Tray (opening on valve support faces forward)
11 1 067 = Guide rod
11 1 068 = Thrust lever
11 3 131 = Guide bar
11 3 134 = Thrust cage



o Removing Camshaft:

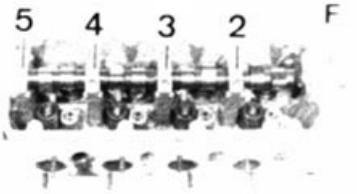
Loosen bolts (1 and 2) and take off oil pipe.

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.

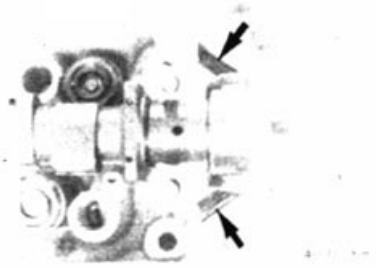
Hole 1 for removal of intake valve.
Hole 2 for removal of exhaust valve.



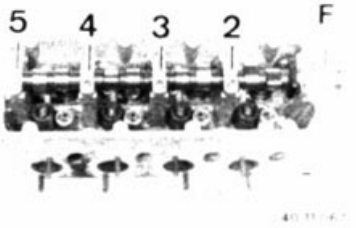
Unscrew and remove camshaft bearing caps (F, 2 .... 5) and take out camshaft.
Pull old radial oil seal off of camshaft.



Place cylinder head on assembly fixture that the exhaust end faces forward, align and secure with one cylinder head bolt (front center).

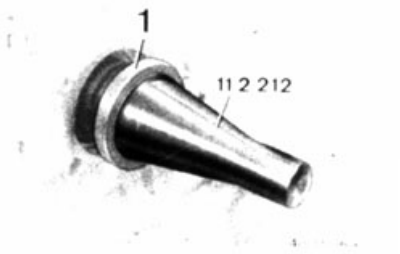


Installation:
Lubricate camshaft bearings with oil and install camshaft.
Apply a thin coat of non-hardening sealing compound** on the bearing surface of bearing cap (F).



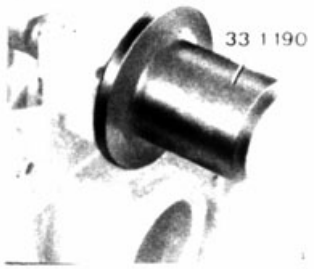
Mount bearing caps (F, 2 .... 5) in the same position and tighten the bolts.
Tightening torque: 11 Nm.

** 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.

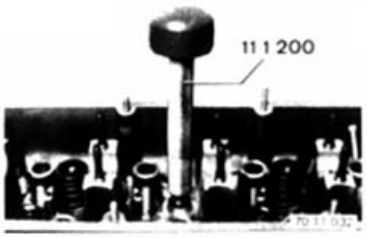


Drive in radial oil seal as far as stop with Special Tool 33 1 190.



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.



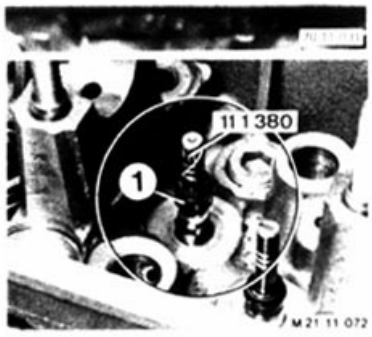
Press on valve stem seal by hand against the stop with help of Special Tool 11 1 200.



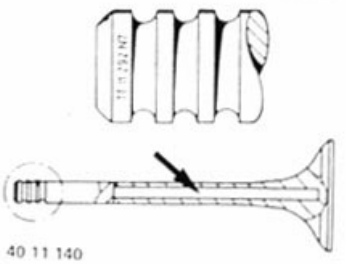
Pull off valve stem seal with Special Tool 11 1 250.



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.

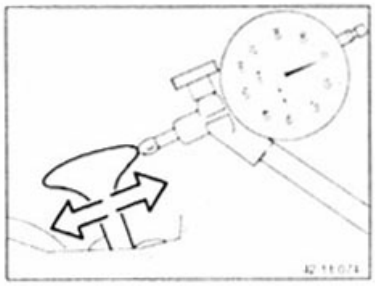


Important Scrapping Information!
Exhaust valves are filled with sodium to improve carrying off heat.

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!

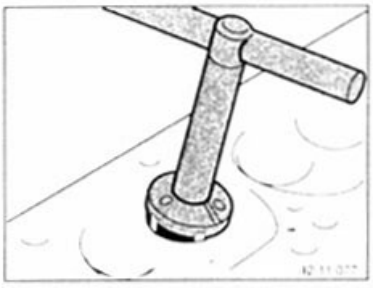
Consequently sodium filled exhaust valves must be collected for scrapping and sent to the Landshut Factory, HT-L-2, for neutralization.

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*.



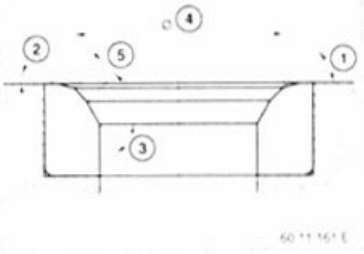
o Machining Valve Seat

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:

o Reaming Valve Guides

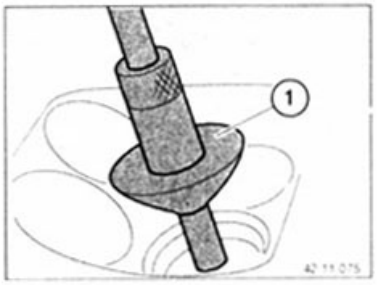
In case of excessive play between the valve stem and valve guide, the valve guide must be reamed out and a repair valve with oversized stem diameter* installed.



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

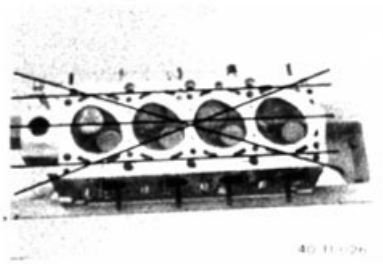
Valve seat dimensions*.



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.

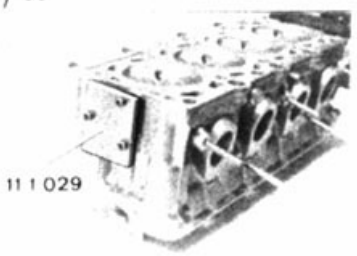
* Refer to Specifications

* 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").

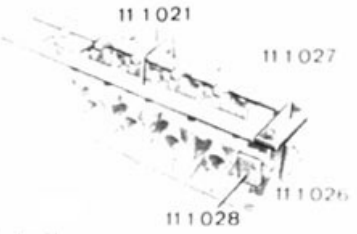


● **CHECKING CYLINDER HEAD FOR CRACKS IN WATER TEST:**
– Cylinder Head Disassembled –

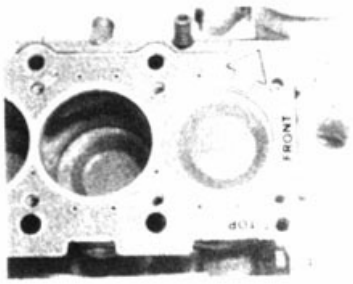
Mount Special Tool 11 1 029.
Note:
Leave the temperature sensor/sender installed.

Remove all attachments on cylinder head to machine the sealing surface.

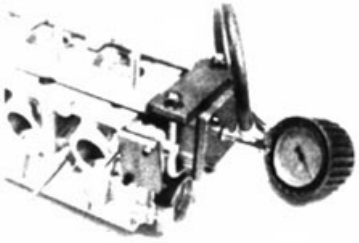
Max. machining:	0.3 ± 0.05 mm (0.012 ± 0.002")
New cyl. head height:	141.0 mm (5.551")
Machining limit:	140.55 mm (5.533")



Mount Special Tools 11 1 021 with cylinder head bolts.
Mount Special Tools 11 1 026 / 027 / 028.

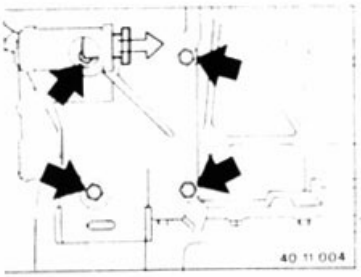


A 0.3 mm (0.012") thicker cylinder head gasket, which must be installed together with an appropriately thicker O-ring for the coolant duct, is available for 0.3 mm (0.012") machining.



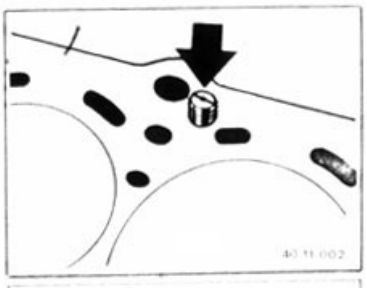
Fill cylinder head with compressed air (testing pressure: 4.5 bar = 64 psi).
If pressure drops, place cylinder head in water bath and check for cracks.
Note:
If necessary, relax water bath with a detergent.

B DISASSEMBLING AND REPAIRING ENGINE BLOCK CRANKSHAFT DRIVE



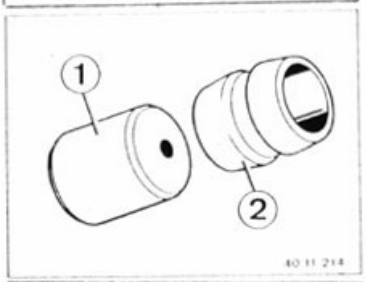
o Removing Alternator Console

Press out sleeve (1)
Unscrew bolts and remove console

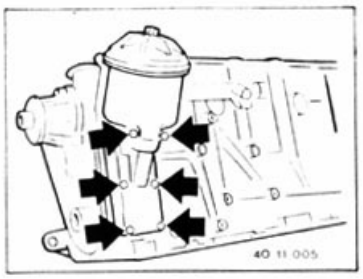


o Checking Orifice for Oil Supply to Hydr Valve Clearance Compensators

Screw orifice out of engine block and check that its bore is not clogged, cleaning the bore if necessary.



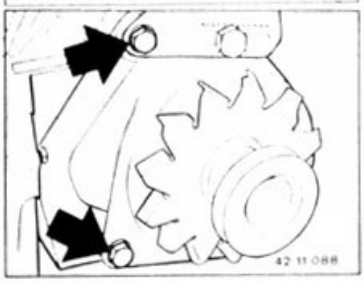
Important:
A reduction jet (1) with rubber-lined spacing sleeve (2) for oil supply to the cylinder head is installed in the engine block of M 40 engines since 9.92.



o Removing Oil Filter Housing

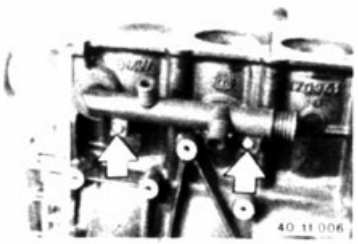
Unscrew bolts and remove oil filter housing.

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:

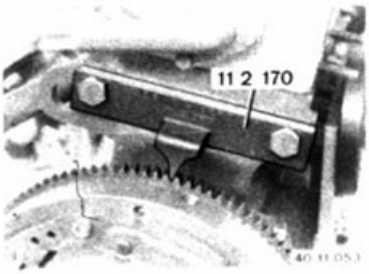
Unscrew bolts.



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.

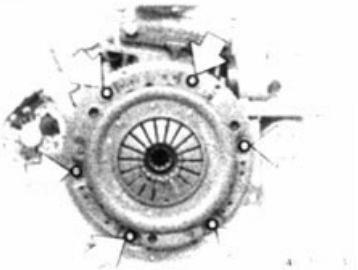


Unscrew bolts and take off flywheel.

Installation:

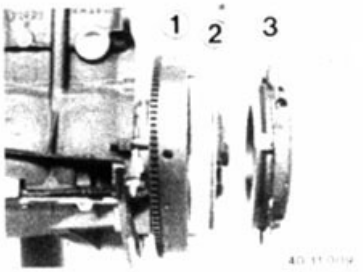
Clean threads and install bolts with a bolt cement**.

Tightening torque: 105 Nm (76 ft. lbs.).



Unscrew bolts uniformly.

Take off pressure plate and drive plate.



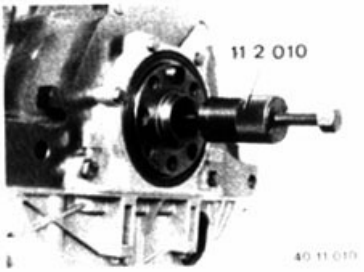
Installation:

1 = Flywheel

2 = Drive plate

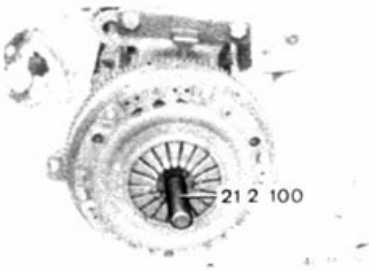
3 = Pressure plate

Install drive plate (2) with flat end facing flywheel (1).



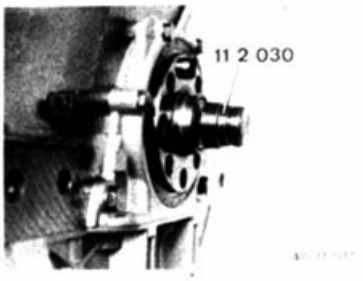
● REPLACING PILOT BEARING IN CRANKSHAFT:

Remove pilot bearing with Special Tool 11 2 010.



Center drive plate with Special Tool 21 2 100 and tighten bolts.

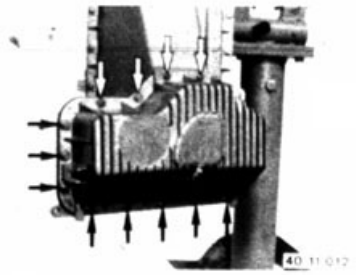
Tightening torque: 23 Nm (17 ft. lbs.).



Installation:

Insert pilot bearing and drive it in against the stop with Special Tool 11 2 030.

** Source: HWB



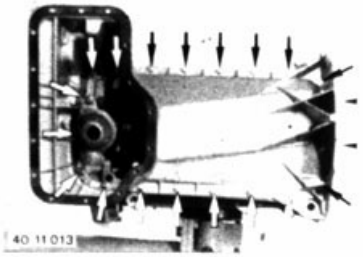
REMOVING OIL PAN:

Unscrew bolts and take off lower oil pan section.

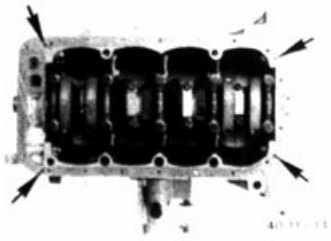
Installation

Replace gasket.

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



Unscrew bolts and take off oil pan.



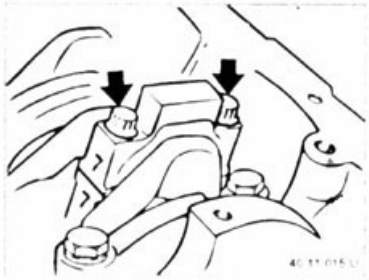
Installation

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



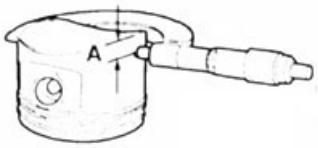
o Removing Piston

Unscrew conrod bearing cap.
Remove piston.

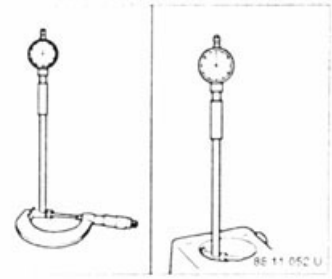
Important!
Mark position of connecting rod to crankshaft, if the bearing shells do not have to be replaced.
Connecting rods and caps are marked with the same pair numbers (1 ... 99) and must not be mixed up.



Mark piston and reinstall it at the same position, if the piston does not have to be replaced.



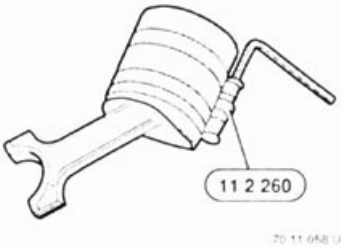
Installation:
Measure the piston installed clearance before installing.
Measure the piston diameter at distance A* from the bottom edge of the piston using a micrometer.



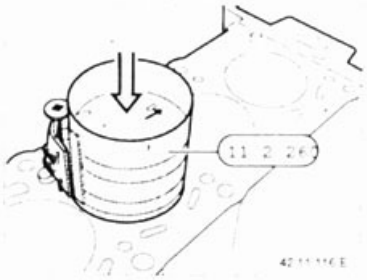
Set internal caliper to zero on micrometer with the measured piston diameter.
Measure cylinder bore at bottom, middle and top diagonally.

New piston installed clearance*.
Max. permissible total wear clearance*.

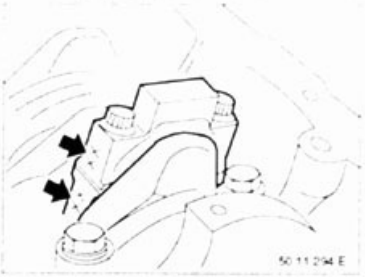
* Refer to Specifications



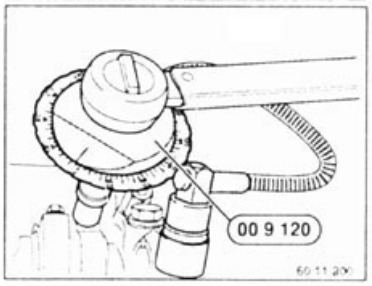
Installation:
Lubricate piston and piston rings lightly with oil.
Align gaps of piston rings (offset approx. 120°, but not above the piston pin eye).
Compress piston rings using Special Tool 11 2 260.
Apply Special Tool 11 2 470 on connecting rod.



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 11 061

o Removing Connecting Rods:

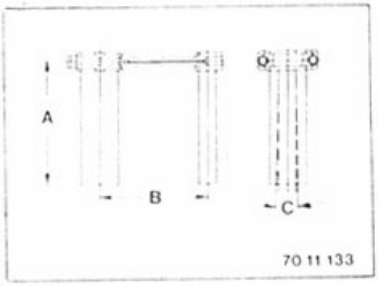
Lift out circlip and press out piston pin.

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:

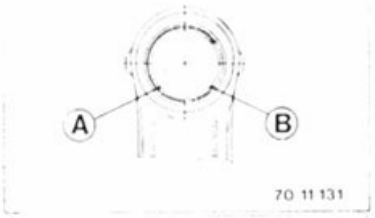
Check connecting rod for deviation from parallel and distortion.

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

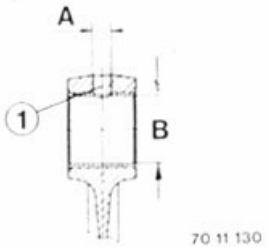
Checking Bush in Conrod:
Press-fit between the bush and piston pin is correct, if the piston pin can be pressed through the bush by hand with only slight force and there is no noticeable play.



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.

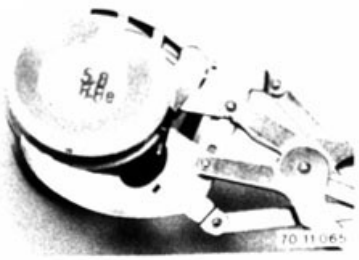


70 11 069

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:

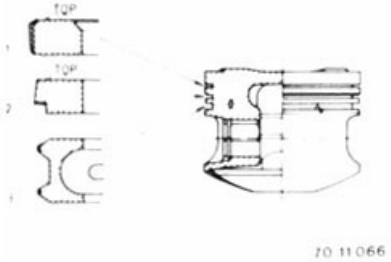
Remove piston rings with a piston ring compressing pliers.

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



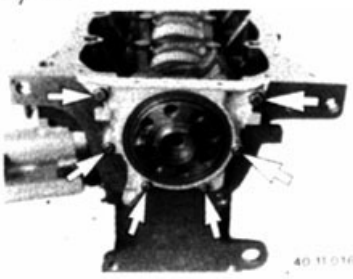
● REPLACING CONNECTING ROD BEARING SHELLS:

Select new bearing shells according to paint mark on connecting rod.
Important!
Check ground size of crankshaft also refer to Replacing Main Bearing Shells).



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.

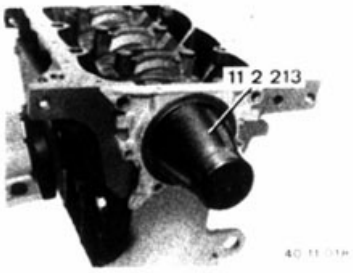


● REMOVING REAR END COVER:

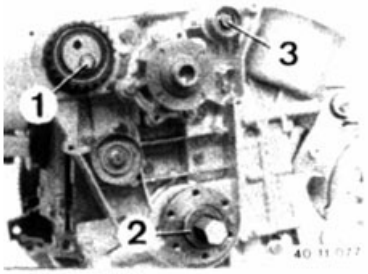
Unscrew bolts and take off cover.



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

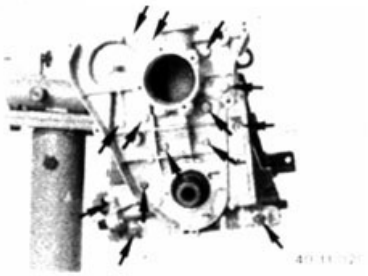


Apply Special Tool 11 2 213 on crankshaft.
– Replace gasket for cover.
– Lubricate sealing lip of radial oil seal with oil.
Slide on and tighten cover.
Tightening torque: M 6 – 9 Nm (6.5 ft. lbs.)
M 8 – 22 Nm (16 ft. lbs.)

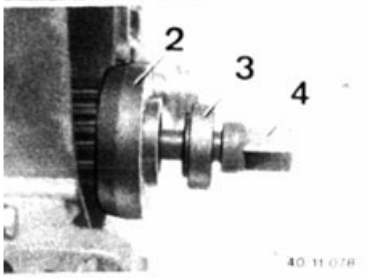


REMOVING FRONT END COVER:

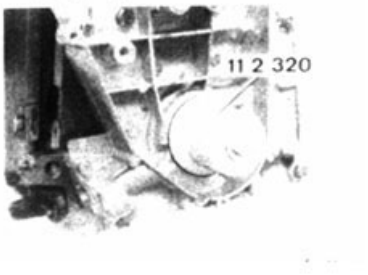
Unscrew tensioning roller (1), drive gear (2) and stabilizing roller (3).



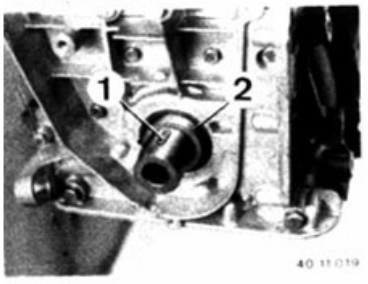
Unscrew all mounting bolts of end cover and take off cover.



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).

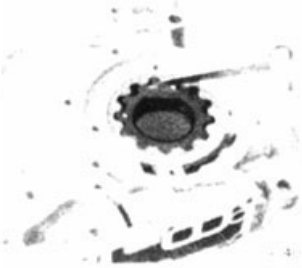


● REMOVING/CHECKING OIL PUMP:

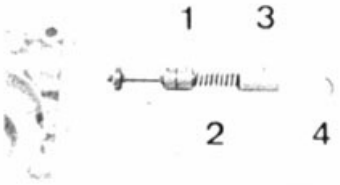
Unscrew bolts and take off cover.
Installation
Tightening torque: 9 Nm (6.5 ft. lbs.).



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.

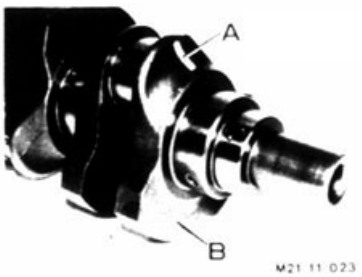


- REPLACING MAIN BEARING SHELLS:

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

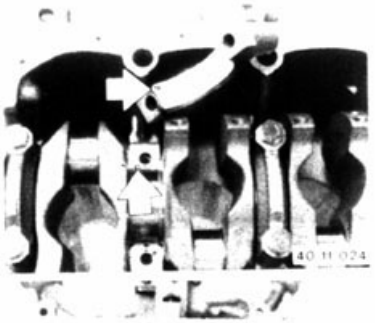
Important!
Check ground size* of the crankshaft.

Conrod Bearing Journal (A)

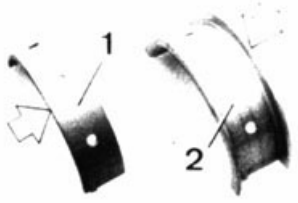
1 paint stripe	Size 1 (0.25 mm)
2 paint stripes	Size 2 (0.50 mm)

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.

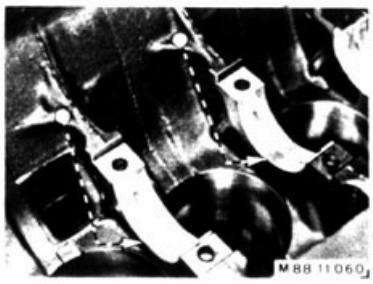
1 Bearing shell 1-2-3-4 (only caps)-5
2 Bearing shell 4 (thrust bearing, only crankshaft)

Check the ground size of main bearing journals!



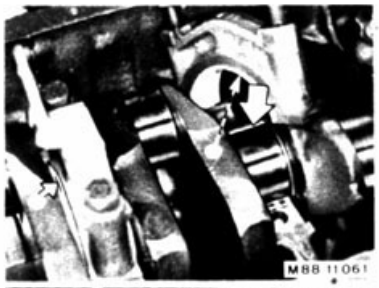
Tighten bolts (washed and lubricated with oil) in two steps.

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

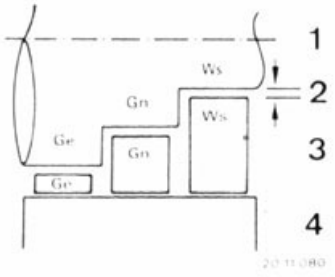


Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps to the specified torqueing procedure*.
Do not turn the crankshaft.

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.



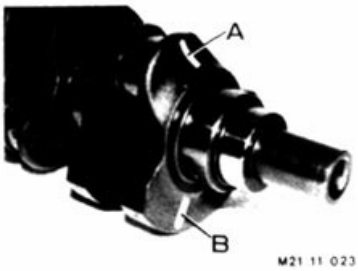
Survey of Color Code/Shaft Diameter/Bearing Shell Thickness*

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





M21 11 023


40 11 142



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
(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 *

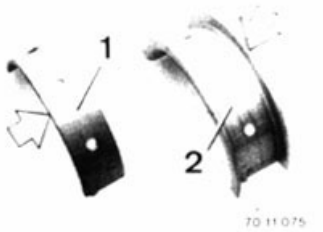
Main Bearing Journal (B)
1 paint stripe Size 1 *
2 paint stripes Size 2 *

Cars with Manual Transmission:
Install pilot bearing for the transmission main shaft.

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.

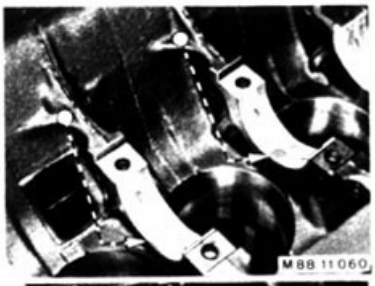


70 11 075

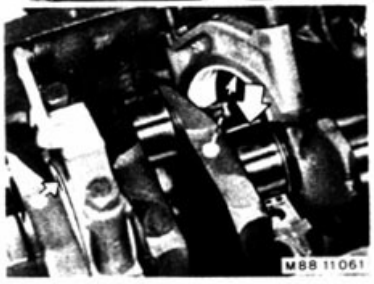
The bearing shells are marked with yellow, green or white paint.

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

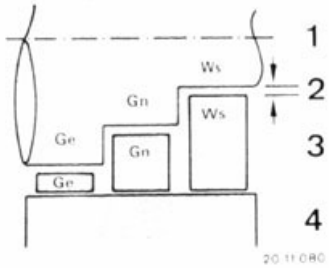
Install crankshaft.
Place Type PG-1 Plastigage on the crankshaft wiped clean of oil and tighten the bearing caps with correct torque*.
Do not turn the crankshaft.

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*

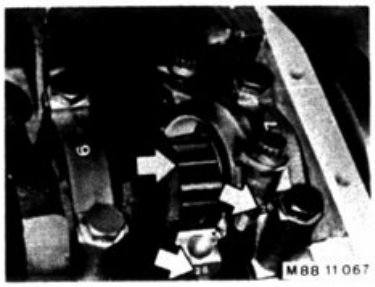
Triple Classification Color Codes:
Ge = yellow
Gn = green
Ws = white

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.

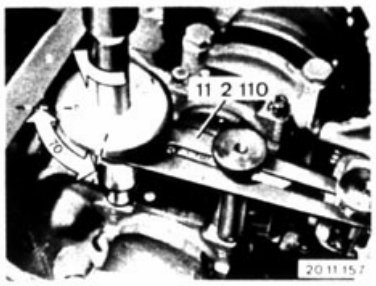
Install only red bearing shells of the pertinent ground size for replacement crankshafts.



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

11 Engine M50

11 00 603 Engine – disassemble and assemble (engine removed) 11- 50/1
Mounting engine on assembly stand 11- 50/1
A. Cylinder head – remove 11- 50/2
Intake manifold with throttle valve assembly – remove 11- 50/2
Thermostat housing - remove 11- 50/2
Cylinder head cover – remove 11- 50/2
Cylinder head – remove 11- 50/3
Camshaft adjusting procedures 11- 50/5
Cylinder head – unscrew 11- 50/7
B. Cylinder head – disassemble and assemble 11- 50/9
Cylinder head – mount on assembly stand 11- 50/9
Camshafts – remove 11- 50/10
Valves – remove 11- 50/12
Non-return valve – remove 11- 50/14
Valve guide – check 11- 50/14
Valve guide – ream 11- 50/14
Valve seat – machine 11- 50/15
Cylinder head mating surface – check/machine 11- 50/16
C. Engine block / crankshaft – disassemble and assemble 11- 50/17
Alternator – remove 11- 50/17
Tensioning roller with console – remove 11- 50/17
Oil filter housing – remove 11- 50/17
Water pump – remove 11- 50/18
Vibration damper – remove 11- 50/18
Vibration damper hub – remove 11- 50/18
Oil pan – remove 11- 50/19
Lower timing case cover – remove 11- 50/19
Timing chain and lower guides – remove 11- 50/20
Oil pump – remove 11- 50/20
Oil pump – disassemble 11- 50/21
Clutch / flywheel – remove 11- 50/22
Pilot bearing in crankshaft – replace 11- 50/22
Rear end cover – remove 11- 50/23
Connecting rods and pistons – remove 11- 50/23
Connecting rods – remove/check/repair 11- 50/24
Conrod bearing shells – replace 11- 50/25
Pistons – replace/check 11- 50/26
Piston rings – replace/check 11- 50/26
Crankshaft – remove 11- 50/27
Main bearing shells – replace 11- 50/27
Spray nozzles in crankshaft journals – replace 11- 50/28
11 21 501 Crankshaft – replace (crankshaft removed) 11- 50/29

11 00 603 DISASSEMBLING AND ASSEMBLING ENGINE (Engine Removed)

General Information for Working on Valve Timing

Attention must be paid to the following if work had been carried out on the cylinder head, for which the camshaft was removed:
Hydraulic valve tappets expand when without load from the camshaft and must be allowed enough time after installation to constrict again. Consequently fast assembly could cause "closed" valves to still be open and have contact with the pistons.

The following waiting times must be allowed between installation of the camshaft and mounting of the cylinder head:

Ambient Temperature:	Time:
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:

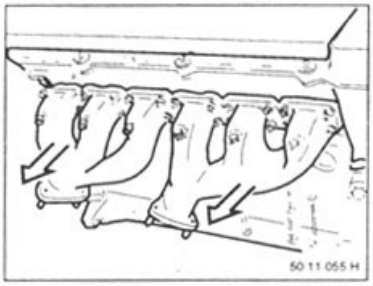
Ambient Temperature:	Time:
20° C	**10 minutes**
10 to 20° C	**30 minutes**
0 to 10° C	**75 minutes**

Working on Valve Train with Mounted Cylinder Head:

Turn crankshaft in engine's direction of rotation to approx. 30° from the TDC mark, so that in this manner no pistons are in TDC.
Install camshaft so that the cam peaks of cylinder no. 1 overlap.
Conform with the above mentioned waiting times.
Turn crankshaft back to TDC position and mount timing chain.
Crank engine not earlier than 10 minutes after installation of the camshaft.

Disassembling and repairing the engine are described in chronological sequence on the following pages. The positions shown in the list of contents will help in taking up work again after an interruption or finding different points more easily. They only describe the direct removal or installation, but not the complete scope of work.

If necessary, drain engine oil and fill engine with new engine oil after completion of engine assembly. Check oil level after installation and road test.

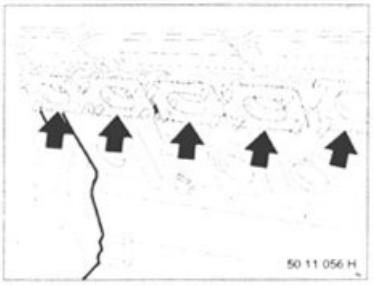


o Mounting Engine on Assembly Stand

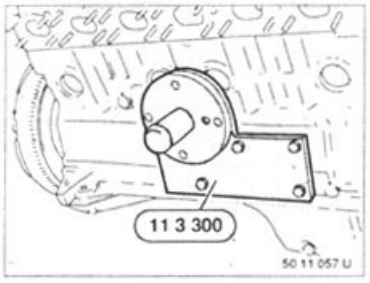
Removing Exhaust Manifold:
Unscrew nuts.
Lift exhaust manifold off.

Installation:
Replace nuts.
Coat threads with copper paste**.
Tightening torque*.

Shorter manifold is at rear.



Installation:
Graphite surfaces of gaskets face the cylinder head.



Mount engine on Special Tool 00 1 490 using Special Tool 11 3 300.

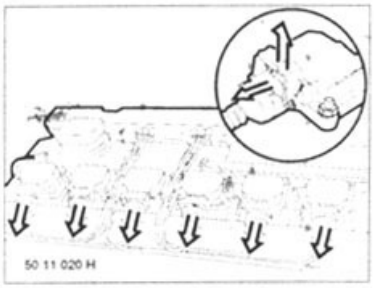
* Refer to Specifications
** Source of Supply: HWB

A. Removing Cylinder Head

o Removing Intake Manifold with Throttle Valve Assembly

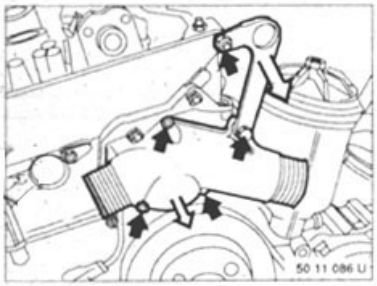
This operation will already have been carried out on an engine which was removed from the car.

Refer to Group 11 in the Model Repair Manual.



o Removing Cylinder Head Cover

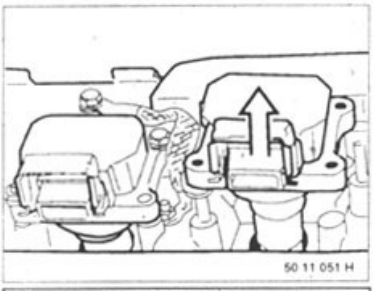
If applicable, disconnect plugs on ignition coils.



o Removing Thermostat Housing

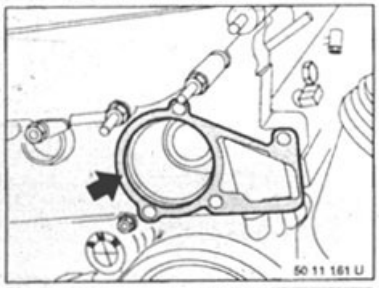
Note:
This operation is necessary to be able to mount the cylinder head on Special Tool 11 1 065.

Unscrew suspension eye.
Unscrew thermostat housing.

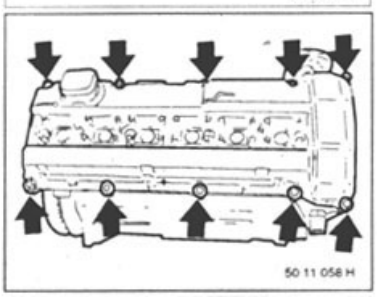


Remove ignition coils.

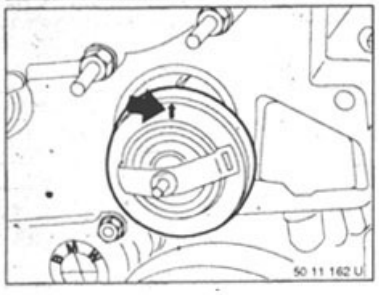
Installation:
Place paper gasket between valve cover and ignition coil (galvanic decoupling).



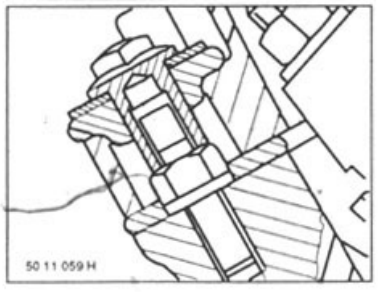
Installation:
Replace gasket.



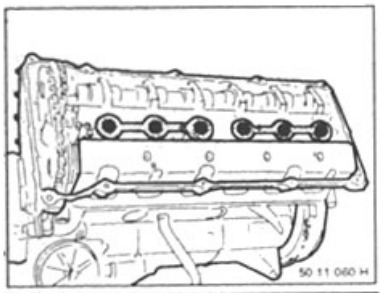
Unscrew cylinder head cover.



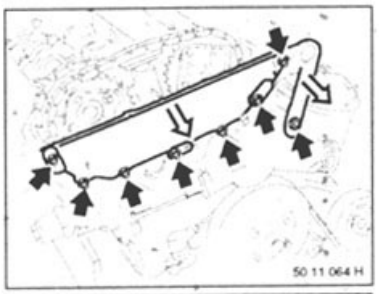
Installation:
Check direction of installation.
Vent hole or arrow faces up.
Replace O-ring.



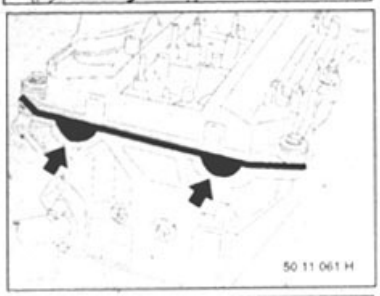
Note:
The cylinder head cover uses rubber mounts and gaskets for vibrational separation from the cylinder head.
Check arrangement of rubber liners.



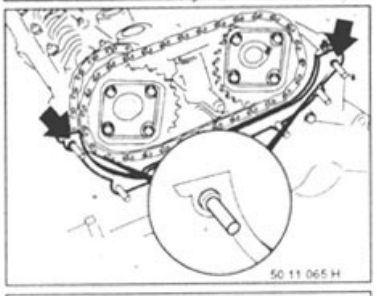
Installation:
Check gaskets, replacing them if necessary.
Place gaskets on cylinder head.



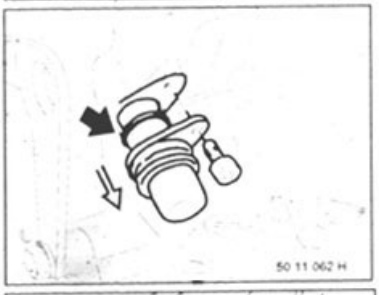
Unscrew suspension eye and upper timing case cover.



Installation:
When mounting the cylinder head cover, check for correct seating of gasket on back of the cylinder head.



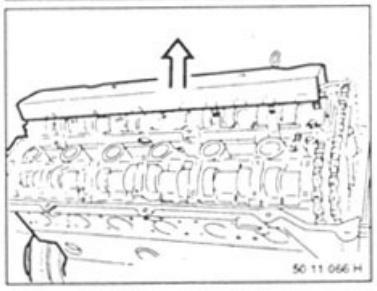
Installation
Replace gasket.
Check dowel sleeves.



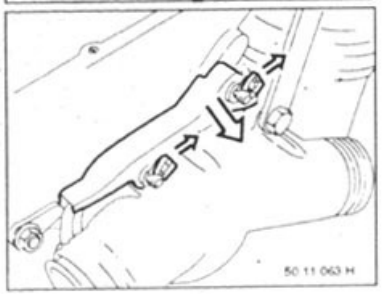
o **Removing Cylinder Head**

Remove sender.

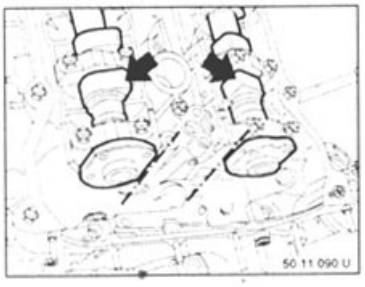
Installation:
Check seal, replacing if necessary.



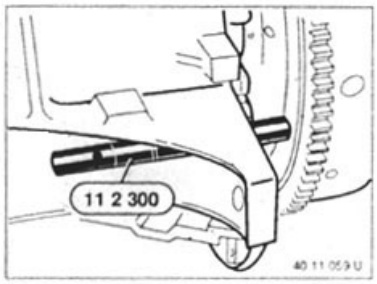
Pull cover off.



Take off electric wiring channel.

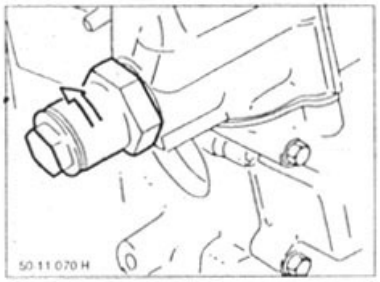


Crank engine in direction of rotation until cam peaks of intake and exhaust cams in cylinder no. 1 face each other.
Arrows on sprockets face up.



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

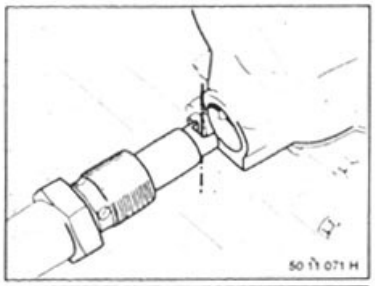
Important!
Remove special tool before operating the engine.



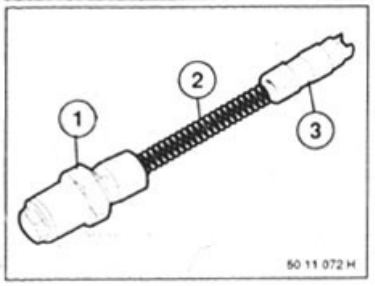
Unscrew chain tensioner.

Caution!
Spring pressure.

Installation:
Replace gasket.
Tightening torque*.



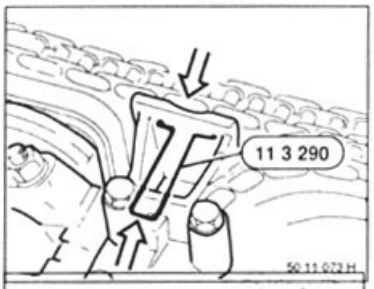
Installation:
Align groove in piston perpendicular to the tensioning rail.



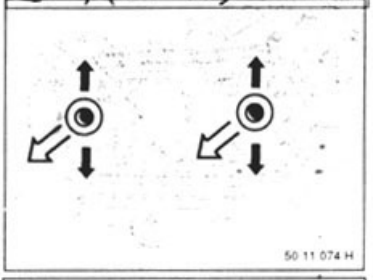
Arrangement of Parts:

1 - Sleeve
2 - Spring
3 - Piston

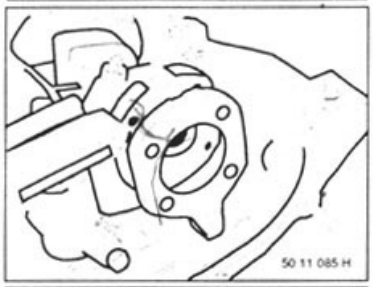
* Refer to Specifications



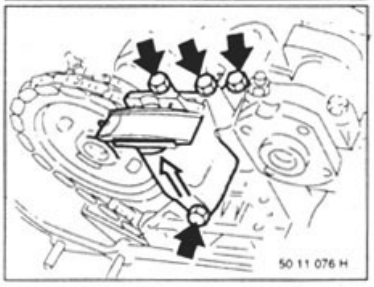
Press upper chain tensioner down and arrest by inserting Special Tool 11 3 290.



Unscrew sprockets.
Lift both sprockets off complete with chain.

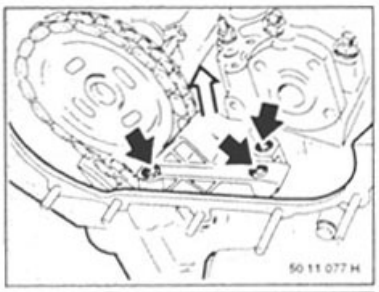


Installation:
Lift pulse sender off of the intake camshaft.

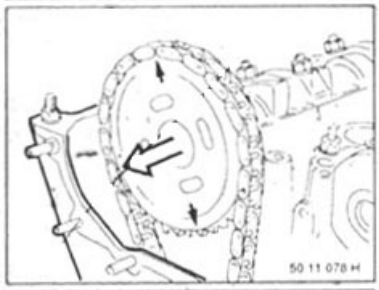


Unscrew console for upper chain tensioner.

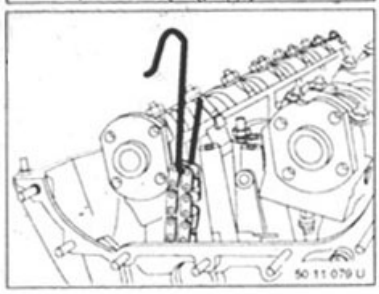
* Refer to Specifications



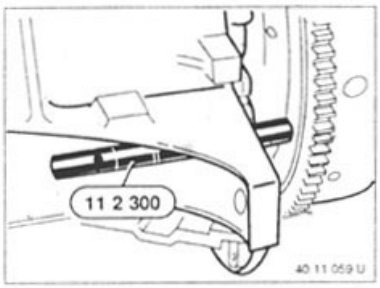
Unscrew chain guide.



Lift sprocket off together with chain.



Important!
Prevent chain from slipping down with a piece of wire.



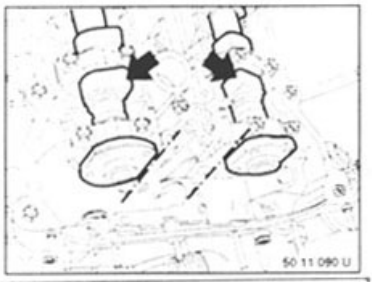
o Camshaft Adjusting Procedures

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

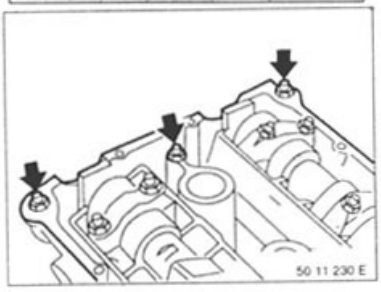
Important!
Remove special tool before operating the engine.



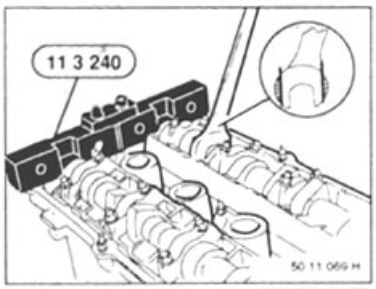
Important!
If it is necessary to correct the camshaft adjustment to such an extent that there is valve movement in cylinders 1 and 6, first turn the crankshaft about 30° away from TDC position in the engine's direction of rotation and return to TDC only after turning the camshaft.
This prevents contact between the valves and pistons.



Turn camshaft until the cam peaks of intake and exhaust cams for cylinder no. 1 face each other.

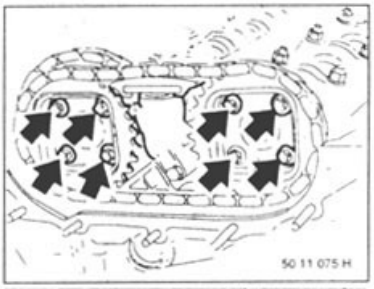


Unscrew the three rear studs for the valve cover.

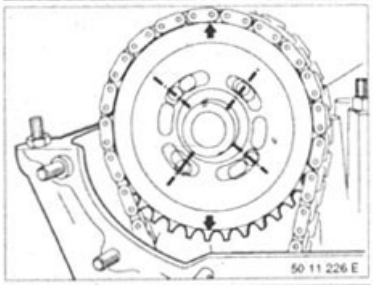


Hold camshaft with Special Tool 11 3 240.
Camshafts may be turned on the hexagon with a 24 mm wrench.

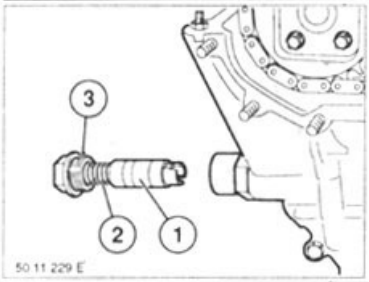
Important!
Be careful that the bearing plate is not damaged.
Machine the fork wrench to size accordingly if necessary.



Install bolts to be turnable without play, but do not tighten at this stage.

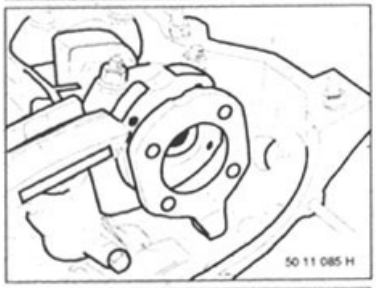


Install primary timing chain on the sprocket and center with the exhaust camshaft.
Arrow on sprocket faces up.
Mount sprocket that the tapped bores are to the left of the slots as the sprocket will be moved to the left when installing the chain tensioner.

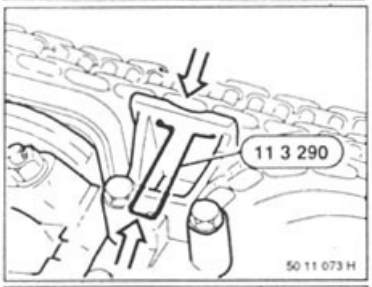


Screw in and tighten chain tensioner sleeve.
Insert chain tensioner pistop (1) that the guides engage in the tensioning rail.
Install spring (2) and bolt (3).

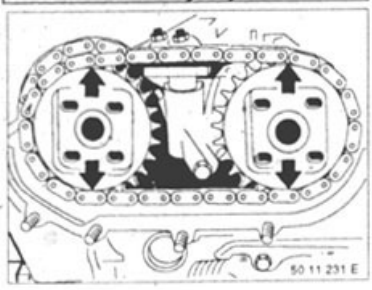
Installation:
Replace seal.
Tightening torque*.



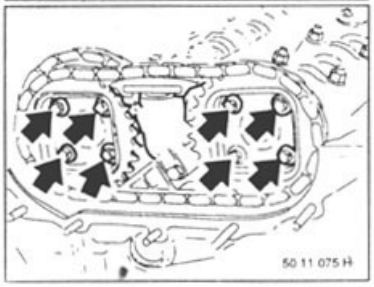
Install pulse sender on the intake camshaft.



Unlock chain tensioner arrest.
Remove Special Tool 11 3 290.



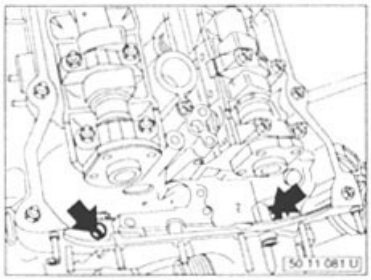
Mount both sprockets complete with chain.
Arrows on sprockets face up.



Tighten both sprockets, beginning at the intake side, with an initial torque of approx. 5 Nm and afterwards in a second step to the specified final torque of 22 Nm.

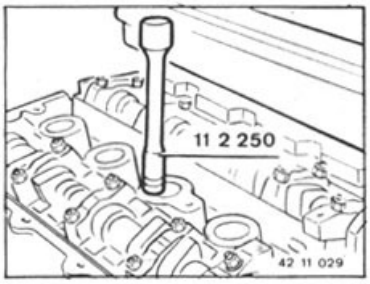
* Refer to Specifications

Remove Special Tools 11 2 300 and 11 3 240.
Crank engine at least twice in direction of rotation.
Check camshaft adjustment.

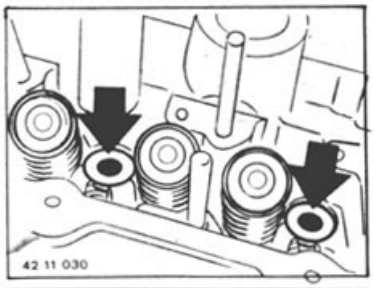


o Unscrewing Cylinder Head

Unscrew timing case cover from cylinder head.



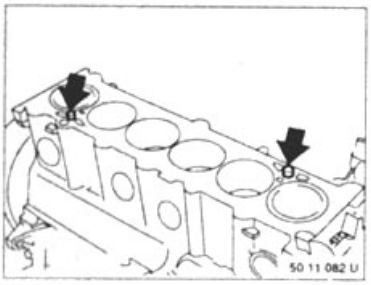
Unscrew cylinder head bolts in several steps from outside to inside using Special Tool 11 2 250.
Lift cylinder head off.



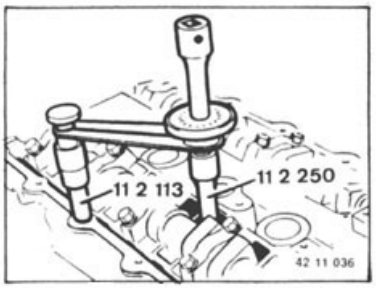
Note:
Some of the washers are locked in the standard cylinder heads to prevent them from being lost.
When installing a new cylinder head, install new washers *without* locking them.
Make sure that no washers are missing.



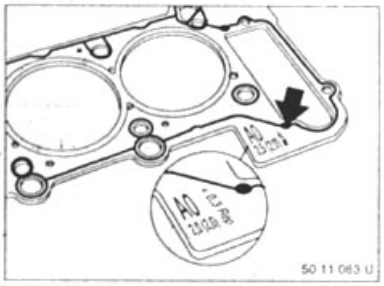
Installation:
When installing the cylinder head, conform with the waiting time for hydraulic valve tappets.
Refer to "General information".



Installation:
Cleaning mating surfaces on cylinder head and crankcase, if necessary removing remainders of gaskets with gasket remover** and a hard wood scraper. Make sure that remainders of gaskets do not fall into oil and coolant bores.
Install new cylinder head gasket.
Check dowel sleeves (1) for damage and correct installed position.

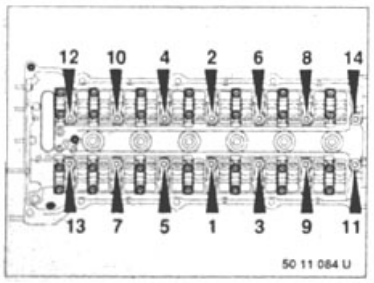


Note:
Use torque angle tester together with Special Tools 11 2 250 and 11 2 113.



Installation:
Gaskets which are 0.3 mm thicker are available for machined (ground) cylinder heads (refer to "Checking/Machining Cylinder Head Mating Surface").

Identification:
2.0 for 2.0 liter
2.5 for 2.5 liter
+ 0.3 for 0.3 mm thicker gasket for repair-machined cylinder head

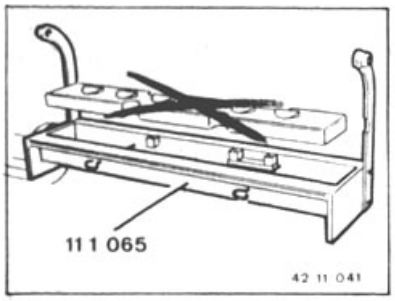


Installation:
Mount cylinder head and tighten new bolts (lightly oiled) in sequence of 1 ... 14 in three steps.

Step 1: Tightening torque	30 ± 2 Nm
Step 2: Torque angle	90 ± 3°
Step 3: Torque angle	90 ± 3°

Important!
Cylinder head bolts may only be used once.
Keep oil out of tapped bores in the engine block (danger of cracking the block, wrong tightening torque values).

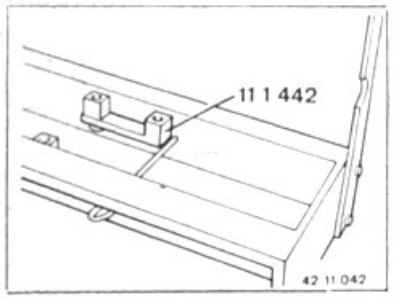
** Source of Supply: BMW Parts



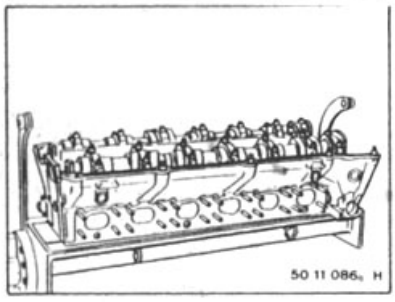
B. **Disassembling and Assembling Cylinder Head**

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 (tray).



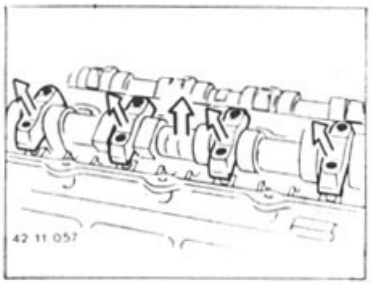
Note:
Bolt Special Tool 11 1 442 on already supplied assembly fixtures (11 1 065).



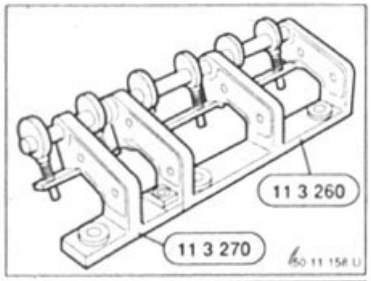
Mount cylinder head on assembly fixture with two cylinder head bolts.

- Removing Camshafts

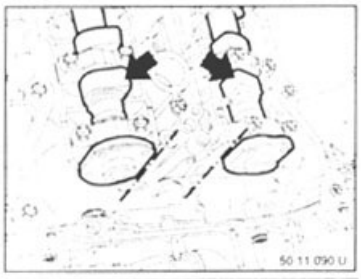
Important!
Camshafts could be damaged or broken in case of improper removal/installation without the fixture.
In addition, valve could be bent through contact with the piston crowns when mounting the cylinder head on the crankcase.
Always conform with instructions and sequence.



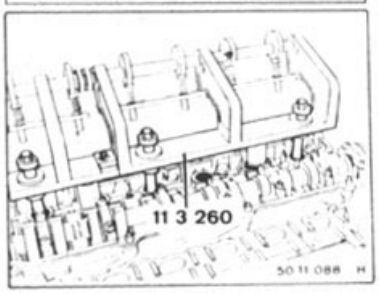
Release and remove fixture.
Lift out bearing caps and camshaft.



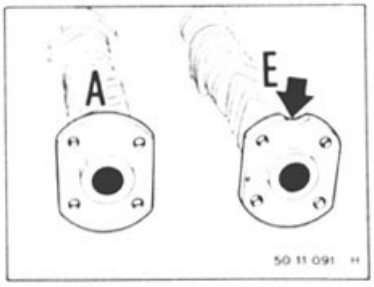
Prepare Special Tool 11 3 260 for a six cylinder engine.



Installation:
Install camshafts that the cam peaks for intake and exhaust valves in cylinder number 1 face each other.

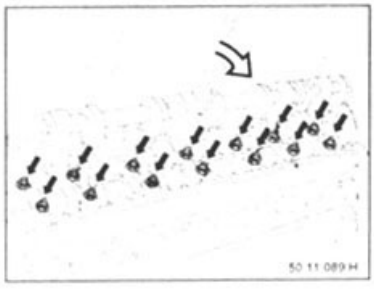


Unscrew spark plugs.
Mount fixture and bolt in the tapped bores for spark plugs.
Tightening torque = 23 Nm (17 ft. lbs.).



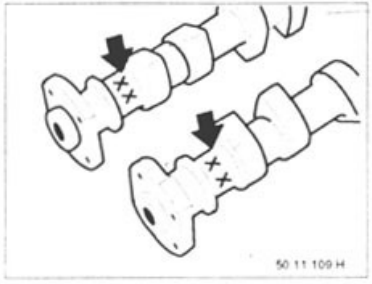
Installation:
Identification of Camshafts on Flange for Sprockets:

E = Intake camshaft
A = Exhaust camshaft



Apply load on bearing caps by turning the eccentric shaft.
Unscrew all bolts for bearing caps.

Installation:
Tightening torque*.



Identification on Front of Camshafts:

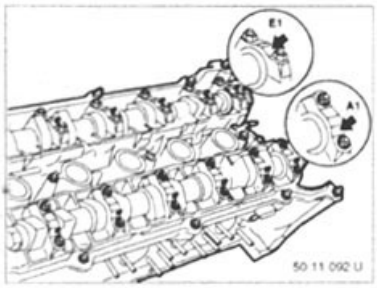
X X

A = 2.5 liters
B = 2.0 liters

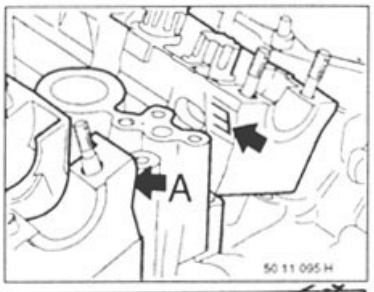
E = Intake
A = Exhaust

Example: EB = Intake 2.0 liters

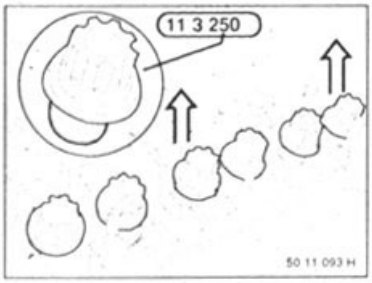
* See Specifications



Installation:
Bearing caps are marked with
A 1 ... A 7 for the exhaust side and
E 1 ... E 7 for the intake side,
and this identification can be read from the exhaust side.

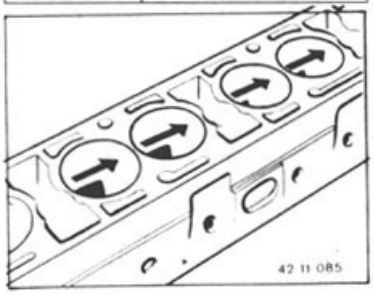


Installation:
Bearing plates are marked with
"A" for exhaust side and
"E" for intake side.

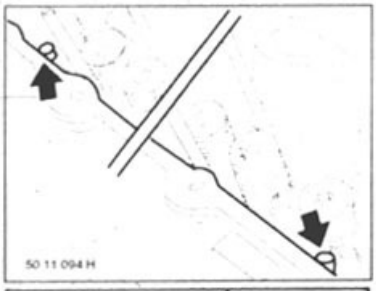


Hold valve clearance compensators tight with Special Tools 11 3 250 (suction cups).

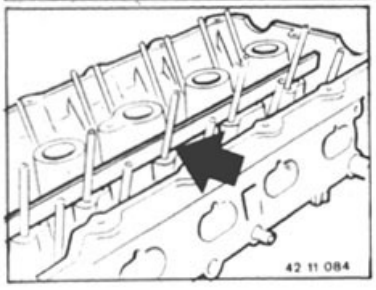
Lift bearing plate out complete with valve tappets.



Installation:
Check bearing surfaces of valve clearance compensators for wear (scoring).



Installation:
Note centering sleeves on mounting bolts for bearing caps 2 and 7.



Note:
If the cylinder head is replaced because of mechanical defects (cracks, distortion), the bearing surfaces of the bearing plates must be checked on the old cylinder head for distortion with a steel ruler.
Max. gap: 0.05 mm.
Also replace the bearing plates if this gap is exceeded.

Installation:
Hydraulic valve tappets expand when without load from the camshaft and must be allowed enough time after installation to constrict again. Consequently fast assembly could cause "closed" valves to still be open and have contact with the pistons.

The following waiting times must be allowed between installation of the camshaft and mounting of the cylinder head:

Ambient Temperature:	Time:
20° C	4 minutes
10 to 20° C	11 minutes
0 to 10° C	30 minutes

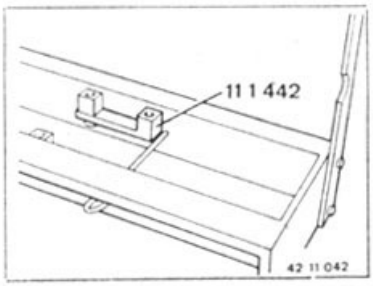
After installation of the camshaft and timing chain the engine may first be cranked after the following waiting times:

Ambient Temperature:	Time:
20° C	10 minutes
10 to 20° C	30 minutes
0 to 10° C	75 minutes

If necessary, proceed as described below.

<u>Working on Valve Train with Mounted Cylinder Head:</u>

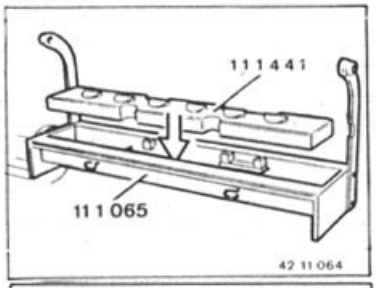
Turn crankshaft in engine's direction of rotation to approx. 30° from the TDC mark, so that in this manner no pistons are in TDC.
Install camshaft so that the cam peaks of cylinder no. 1 overlap.
Conform with the above mentioned waiting times.
Turn crankshaft back to TDC position and mount timing chain.
Crank engine not earlier than 10 minutes after installation of the camshaft.



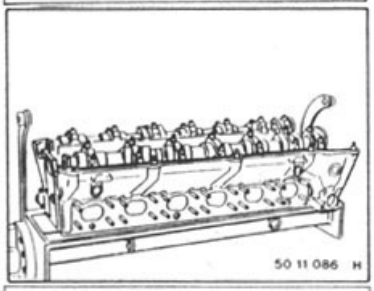
o Removing Valves

Mount Special Tool 11 1 065 on Special Tool 00 1 490.

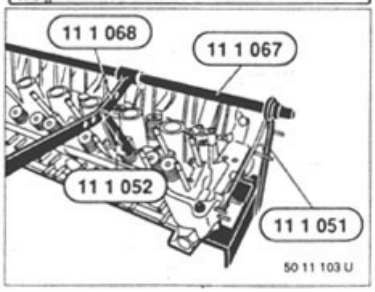
Note:
Bolt Special Tool 11 1 442 on already supplied assembly fixtures (11 1 065).



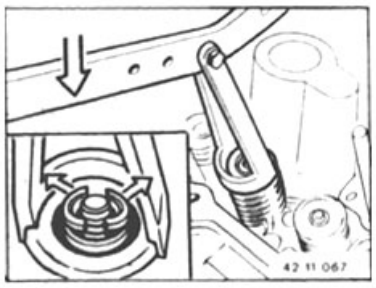
Insert Special Tool 11 1 441 (tray) into assembly fixture.



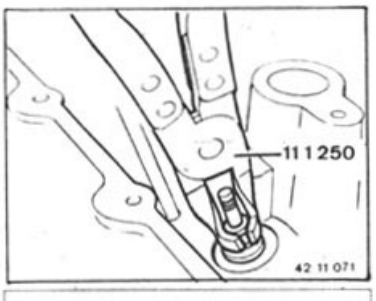
Mount cylinder head on assembly fixture with two cylinder head bolts.



Screw on Special Tool 11 1 051.
Mount Special Tool 11 1 068 together with Special Tools 11 1 052 and 11 1 067.

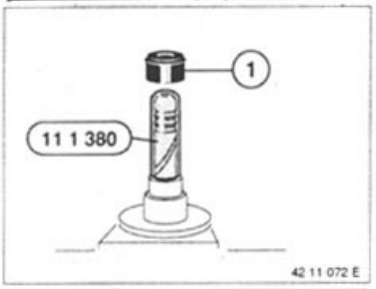


Compress valve springs and take out valve collets.
Remove valve springs and spring retainers.
Take tray out of the assembly fixture from below and pull out valve.

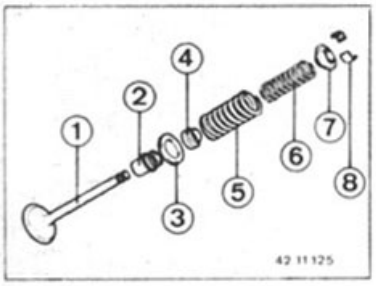


Pull off valve stem seal with Special Tool 11 1 250.

Installation:
If one spring of the spring set (inner or outer spring) is damaged or broken, both springs must be replaced.
Only use inner and outer springs of the same make and with the same color code.

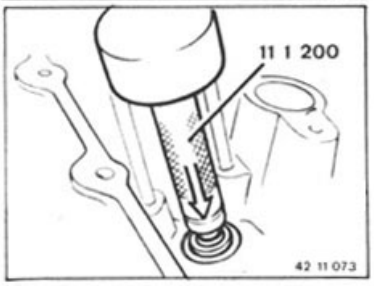


Installation:
Lubricate valve stem with oil and insert valve.
Apply Special Tool 11 1 380.
Lubricate new valve stem seal with oil and install.

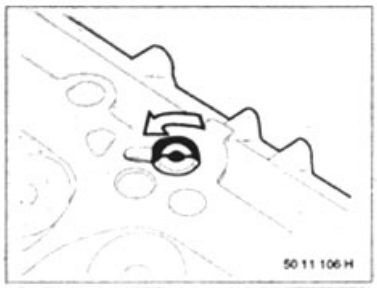


Installed Order:

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

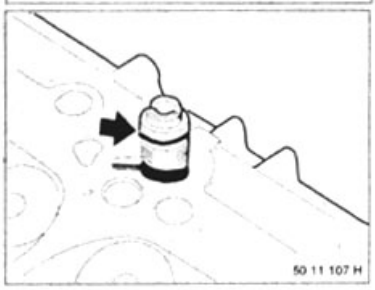


Installation:
Press on valve stem seal against the stop by hand with Special Tool 11 1 200.

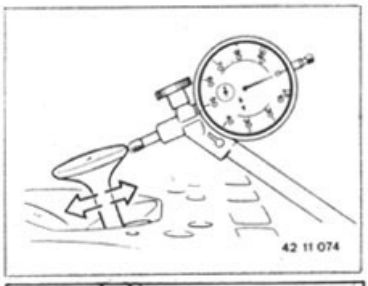


- Remove Check Valve

Unscrew valve.



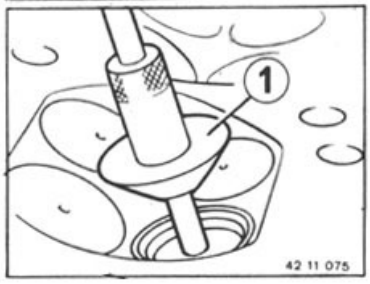
Installation:
Replace O-ring.
Tightening torque*.



- Checking Valve Guide

To check, insert a new valve in such a manner that the valve stem end is flush with the valve guide.
Apply dial gage and measure the tilt clearance.

Max. permissible tilt clearance = 0.5 mm (0.020").



- Reaming Valve Guide

Valve guide must be reamed and a repair valve with oversize stem diameter (+ 0.1 or 0.2 mm / 0.004 or 0.008") installed when there is excessive play between the valve stem and valve guide.
Press guide (1) on valve seat and ream valve guide from the combustion chamber side.
Turn down the reamer once.

Note:
The valve seat must be machined after reaming.

* See Specifications

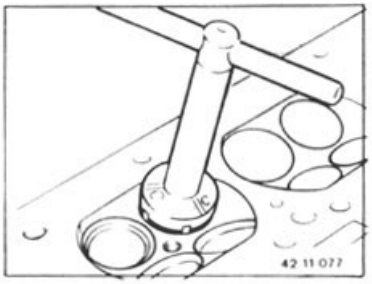
o Machining Valve Seat:

Important!
If more than 0.2 mm has to be machined off the valve seat, a valve with a thicker valve head must be installed (change in compression).
The following valve versions are available in addition to the standard valves:

Stem Oversize	0 mm	0.1 mm	0.2 mm
Valve Head Thickness Oversize	0.2 mm	0.2 mm	0.4 mm
For Machining on Seat Insert Ring More Than mm	0.2 mm	0.2 mm	0.4 mm
Identification on Stem (see picture)	0.0	0.1	0.2

Note for Second Machining:
If size "0,0" is already installed and valve seat machining exceeds 0.2 mm, install size "0.2".

Caution!
Valves with excessively thick valve heads cause engine damage (knock limit is exceeded).



Machining Valve Seat:
Machine valve seat to the instructions of the the tool supplier using Special Tool 00 3 520 or 00 3 580 (dimensions and angles are given below).

Correction Cutters from "Neway":

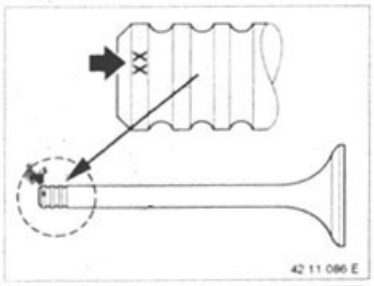
45° = No. 609
60° = No. 694
0° = No. 701

After machining the valve seat angle, produce valve seat diameter "M" and valve seat width "B" by machining correction angle "Y" and correction depth "KT" perpendicularly.
Grind in valve with grinding paste and check for leaks.

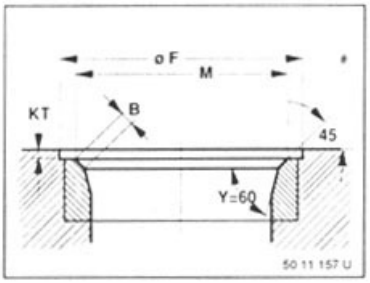
Important!
Keep grinding paste out of the valve guide.

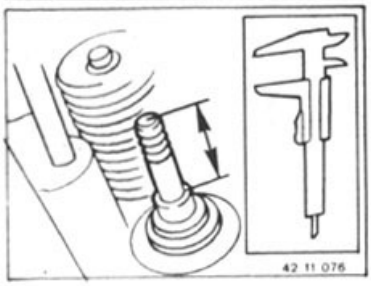
Valve Seat Dimensions*:

M = Valve seat diameter
B = Valve seat width
Y = Correction angle
F = Correction diameter
KT = Correction depth



Location of Valve Identification

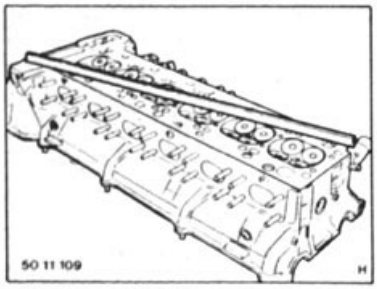




The amount of valve seat machining can be determined as follows.

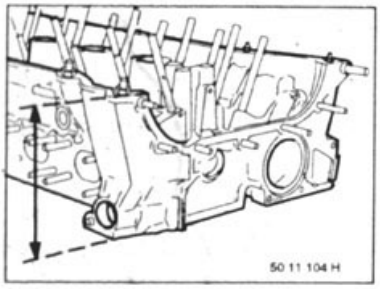
Insert valve, measure protrusion from valve stem to valve guide and note value.
Machine valve seat.
Reinstall the same valve, measure protrusion from valve stem to valve guide and note value.
The difference between both measurements is equal to the amount of machining.

* See Specifications



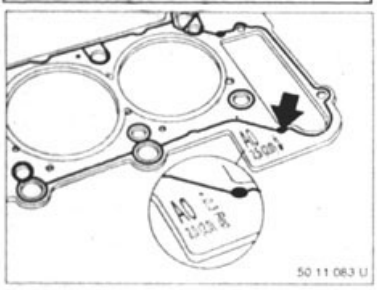
- Checking / Machining Cylinder Head Sealing Surface:

Check levelness of the cylinder head sealing surface with a standard steel ruler. Max. deviation = 0.03 mm (0.0012").



Remove all attachments on the cylinder head to grind the sealing surface.

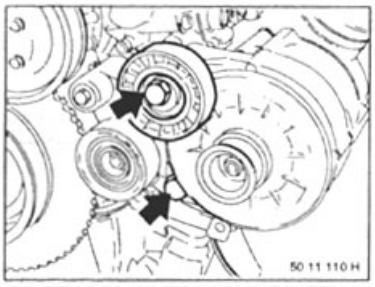
Max. grinding:	0.3 ÷ 0.05 mm (0.012 ÷ 0.002")
New cyl. head height:	140 ÷ 0.1 mm (5.512 ÷ 0.004")
Machining limit:	139.55 mm (5.494")



0.3 mm (0.012") thicker cylinder head gaskets are available for 0.3 mm (0.012") grinding.

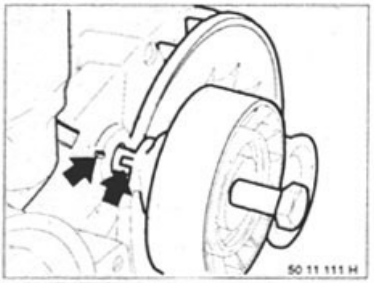
C. **Disassembling and Assembling Engine Block / Crankshaft Drive**

o **Removing Alternator**

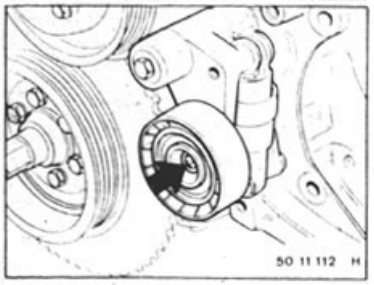


Unscrew bolts and remove alternator.

Installation:
Tightening torque*.



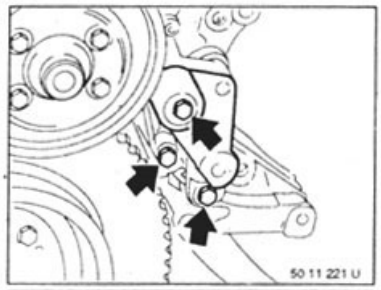
Installation:
Note retainer on bearing of reversing roller.



o **Removing Tensioning Roller with Console**

Unscrew tensioning roller.

* **Refer to Specifications**

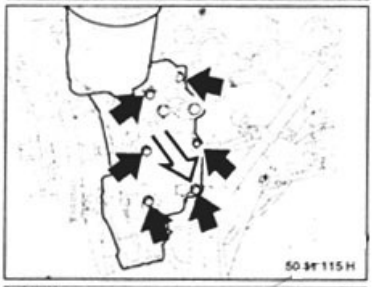


Unscrew console.



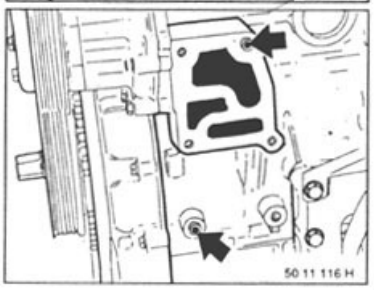
Note:
The hydraulic belt tensioner is filled with oil; a removed unit must only be stored standing upright.
Incorrectly stored units can normally be bled by compressing them several times.

Installation:
Note direction of installation.

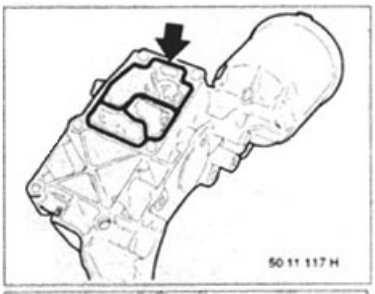


o **Removing Oil Filter Housing**

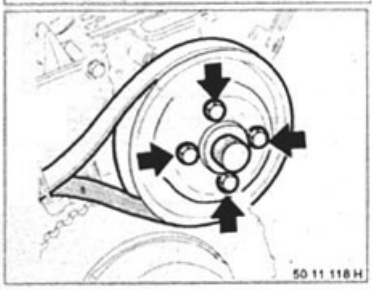
Unscrew bolts and remove oil filter housing.



Installation:
Check dowel sleeves.



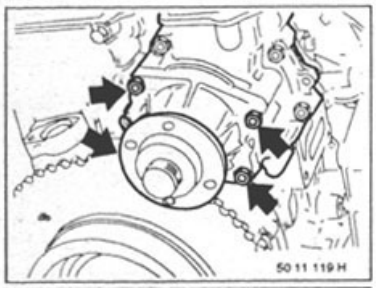
Installation:
Replace gasket.



o Removing Water Pump

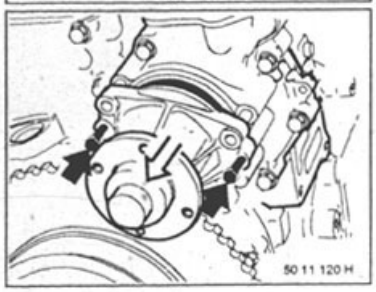
Hold pulley tight on drive belt and unscrew bolts.

Installation:
Tightening torque*.



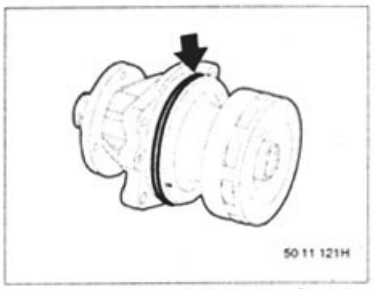
Unscrew bolts.

Installation:
Tightening torque*.

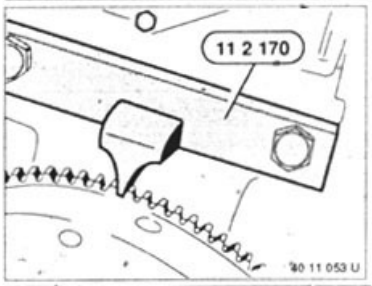


Screw two M 6 screws into tapped bores (1) and press water pump out of end cover uniformly.

* Refer to Specifications



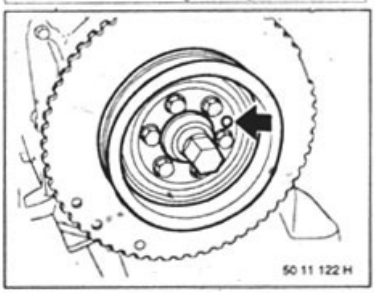
Installation:
Replace O-ring and coat with lubricant**.
Tightening torque*.



o Removing Vibration Damper

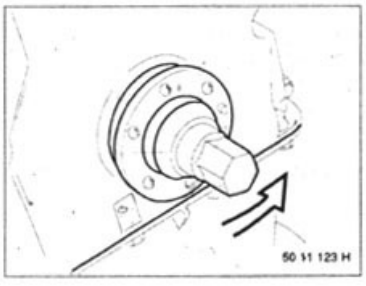
Hold engine with Special Tool 11 2 170.

Important!
Do not use a mandrel to hold the engine.



Unscrew bolts on vibration damper and remove vibration damper.

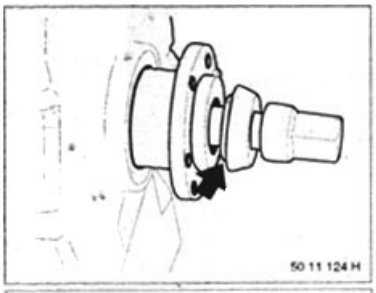
Installation:
Align dowel pin bore in vibration damper with the dowel pin.
Tightening torque*.



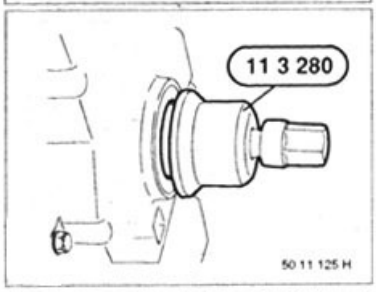
o Removing Vibration Damper Hub

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

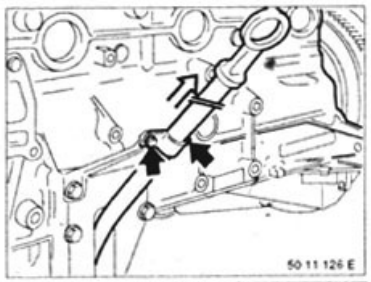
* Refer to Specifications
** Source of Supply: BMW-Parts



Installation:
Align groove of hub with woodruff key.
Collar of washer faces hub.
Tightening torque for central bolt = 410 Nm (296 ft. lbs.).

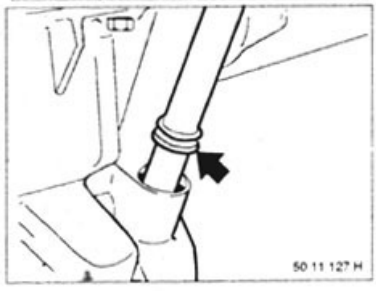


Installation:
Press in new radial oil seal flush with Special Tool 11 3 280 in conjunction with the central bolt and mounted timing case cover.

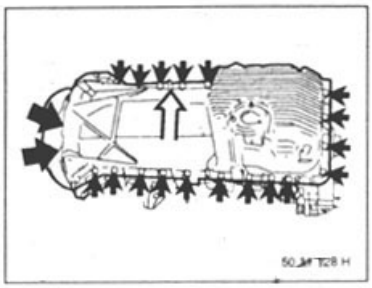


- Removing Oil Pan

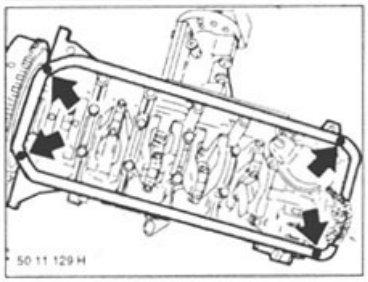
Unscrew and pull out guide pipe for the oil dipstick.



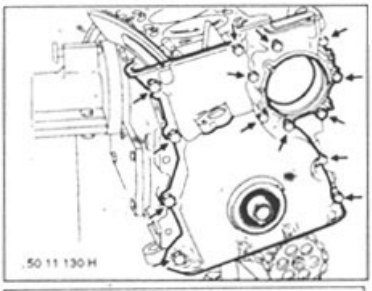
Installation:
Replace seal.



Unscrew all bolts and take off oil pan.



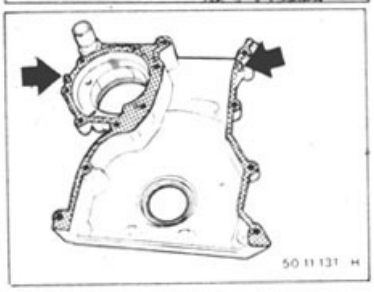
Installation:
Replace gasket.
Fill in joints to the front timing case and rear end cover with permanently elastic black sealing compound 3 Bond 1207 B**.



- Removing Lower Timing Case Cover

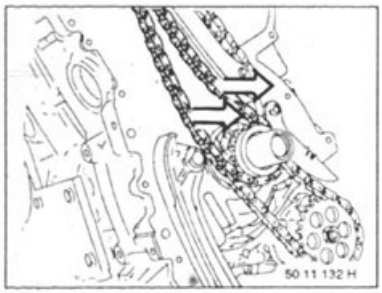
Unscrew bolts.
Lift off timing case cover.

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



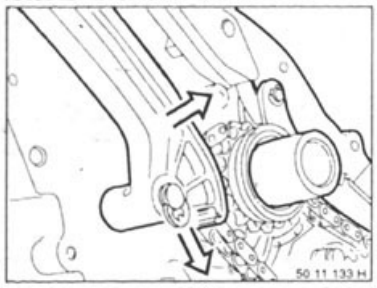
Installation:
Replace gaskets.
Check dowel pins.

** Source of Supply: HWB

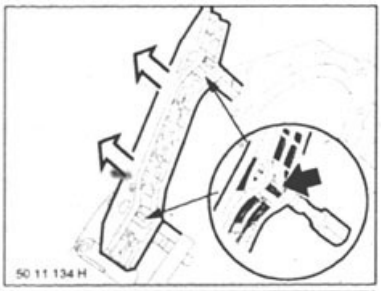


o Removing Lower Timing Chain and Guides

Fold tensioning rail down.
Lift timing chain out.

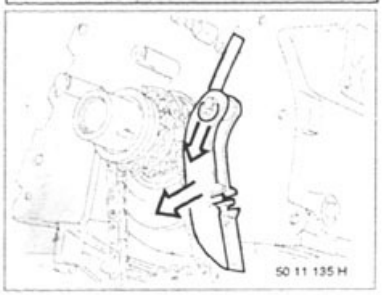


Remove tensioning rail.



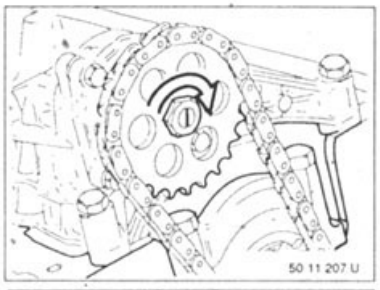
Removing Chain Guide:

Lift upper and lower retainers.
Pull chain guide off.



Remove chain tensioner for oil pump.

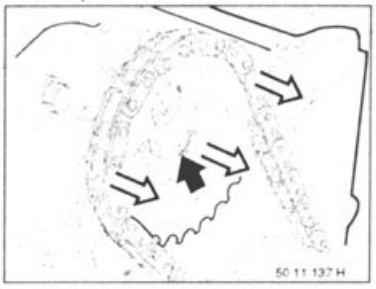
Note:
The chain tensioner is no longer installed.
The chain tensioner may also be omitted in repair work.



o Removing Oil Pump

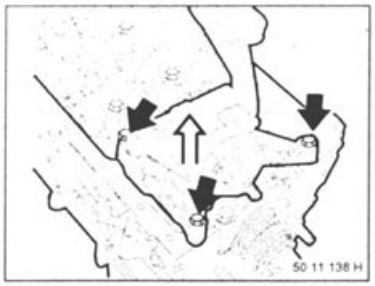
Unscrew sprocket nut.

Important!
Left-hand threads.

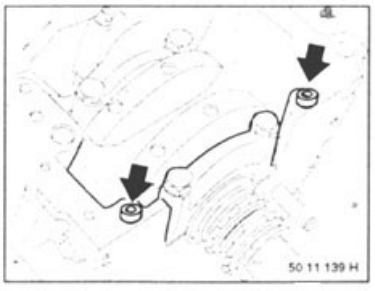


Lift sprocket off together with chain.

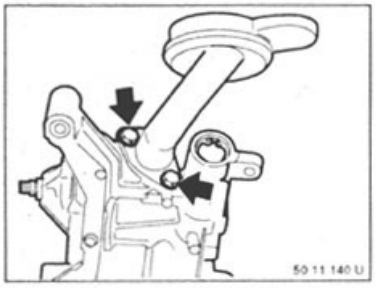
Installation:
Check for tooth engagement.



Unscrew oil pump.

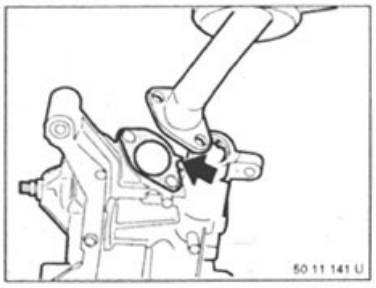


Installation:
Check dowel sleeves.

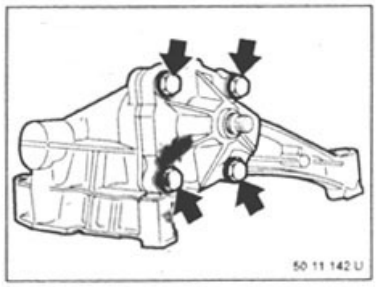


- **Disassembling Oil Pump**

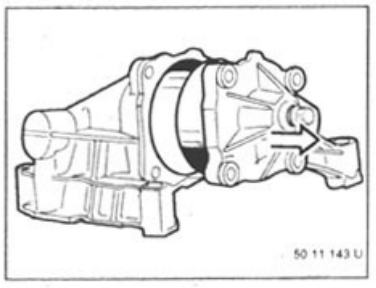
Unscrew intake pipe.



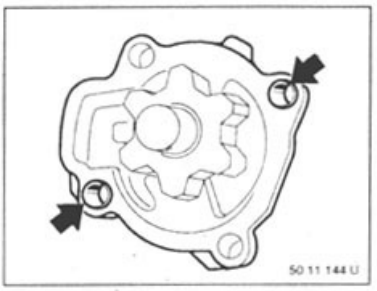
Installation
Tab on gasket faces the suction basket.



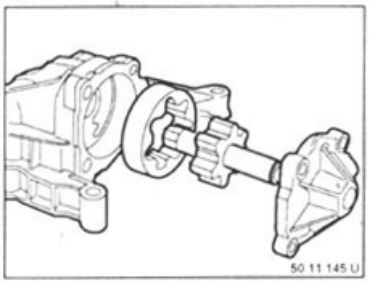
Screw on pump body.



Remove front pump section with shaft and rotor.

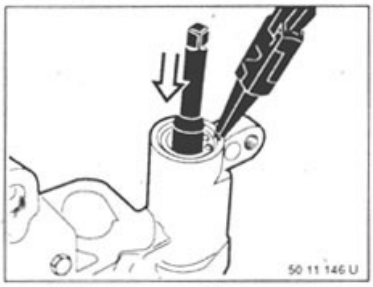


Installation
Check dowel sleeves.



Installation
Check all parts for wear.

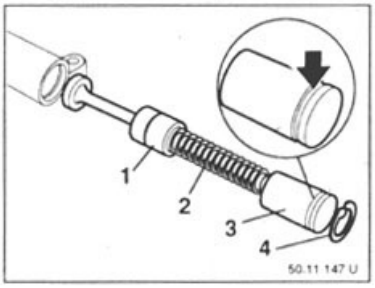
Scoring in body
Wear on rotors
Wear and scoring on bearing surfaces



Removing Safety Valve:

Press down sleeve slightly with a suitable mandrel.
Lift out circlip and remove valve.

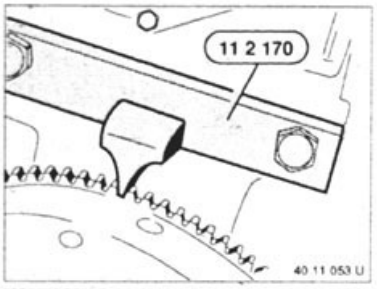
Caution!
Spring force.



Installation:
1 Plunger
2 Spring
3 Sleeve with O-ring
4 Circlip

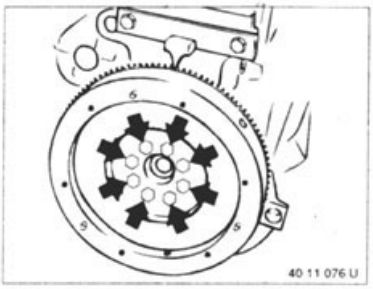
Measure length of unloaded spring (2).
Specification: 84.1 mm (3.311").

Important!
Replace O-ring.
Don't damage the sleeve during installation.



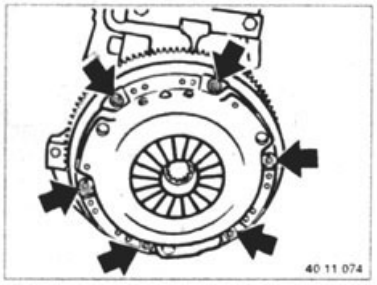
o Removing Clutch / Flywheel

Hold flywheel with Special Tool 11 2 170.



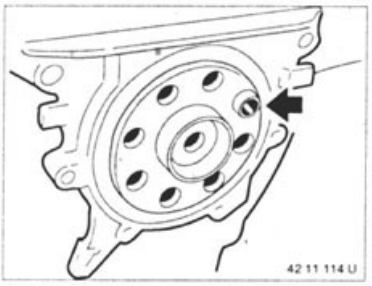
Unscrew bolts and remove flywheel.

Installation:
Clean threads of tapped bores and install new bolts coated with micro-encapsulated cement.
Tightening torque: 121 Nm.

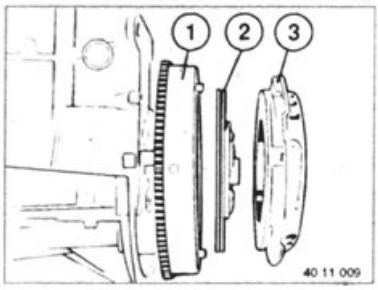


Unscrew bolts uniformly.
Remove pressure plate and drive plate.

Installation:
Check dowel pins.

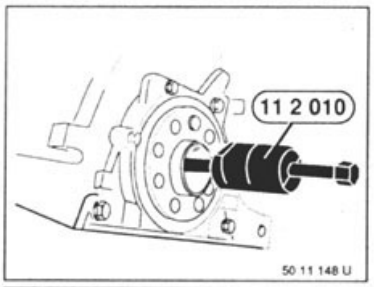


Installation:
Check dowel sleeve.



Installation:
1 = Flywheel
2 = Drive plate
3 = Pressure plate

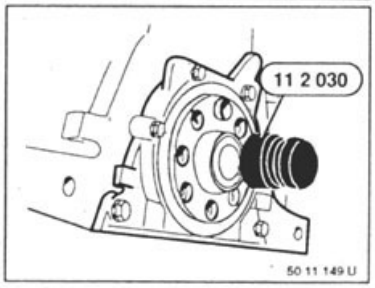
Flatter surface of drive plate (2) points to flywheel (1).



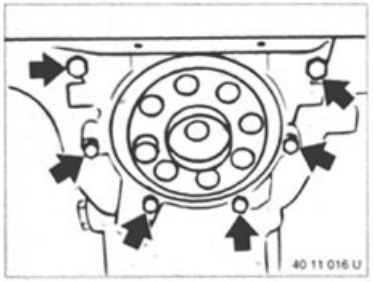
o Replacing Pilot Bearing in Crankshaft

Remove pilot bearing with Special Tool 11 2 010 or 11 2 340.

Center the drive plate using Special Tool 21 2 100 and tighten bolts in several steps.
Tightening torque: 23 Nm.

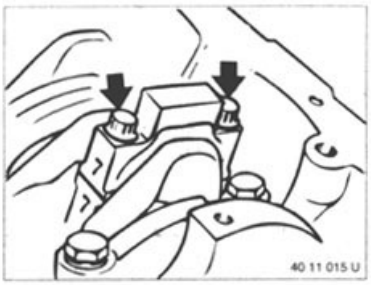


Installation:
Insert pilot bearing and drive it in as far as stop with Special Tool 11 2 030.



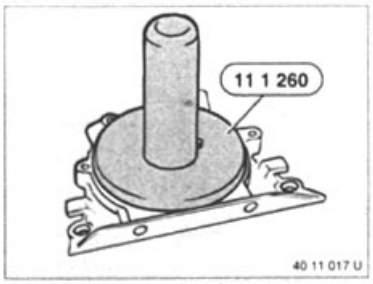
- Removing Rear End Cover

Unscrew bolts and take off cover.



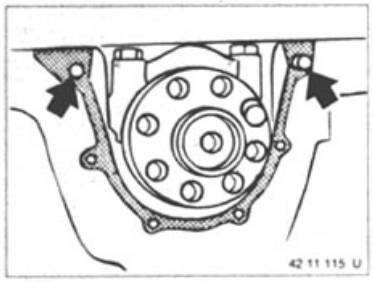
- Removing Connecting Rod and Piston

Unscrew conrod bearing cap.
Lift out connecting rod and piston from the cylinder head end.

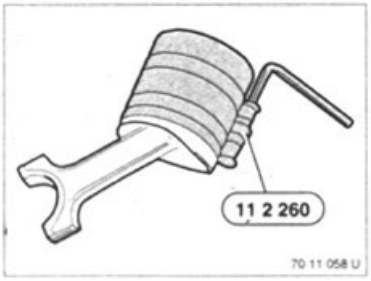


Installation:
Lift out radial oil seal and drive in new seal with Special Tool 11 1 260.

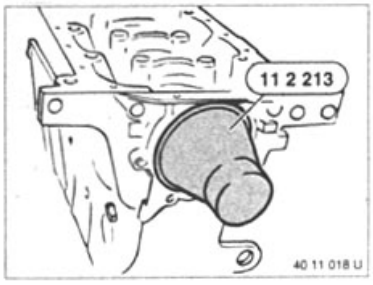
Important!
Insert piston, connecting rod and bearing shells in the same installed position.
Connecting rods and bearing caps are marked with the same pairing number — don't mix them up.



Installation:
Replace gasket.
Check dowel sleeves.

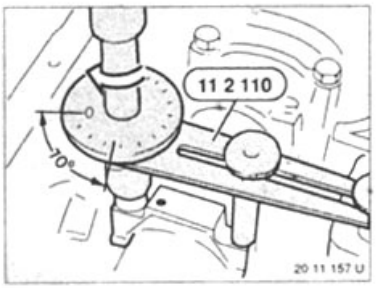


Installation:
Lubricate piston and piston rings lightly with oil.
Align gaps of piston rings (offset approx. 120°, but do not position over piston pin bore).
Compress piston rings with Special Tool 11 2 260.



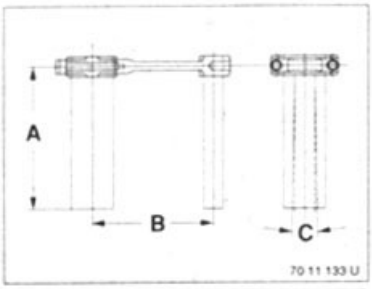
Installation:
Apply Special Tool 11 2 213 on crankshaft.
Lubricate sealing lip of radial oil seal with oil.,
Slide on and tighten cover.

Installation:
Insert piston with arrow facing the camshaft drive.
Compressor must bear firmly on the crankcase all around.
Press in piston with light knocks (e.g. with handle of a hammer).
Guide crankshaft journal and connecting rod together at the same time.



Installation
Conrod Bolt Tightening Procedures:
Lubricate conrod bearing shells with oil.
Mount bearing caps that pairing numbers are matched.
Install new conrod bolts.
Tighten conrod bolts in two steps.

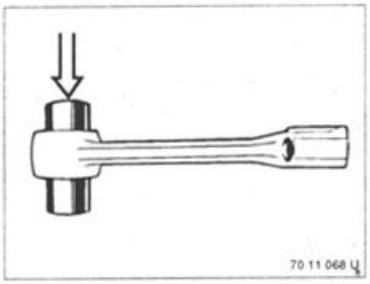
Step 1 = 23 Nm (17 ft. lbs.) torque
Step 2 = 70° torque angle



Checking Connecting Rod:

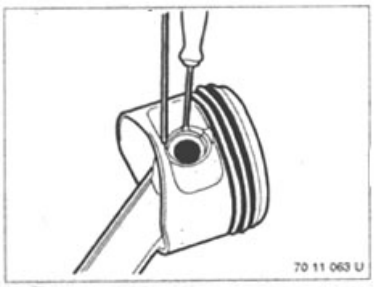
Check connecting rod for deviation from parallel and displacement.

A = Test distance = 150 mm (5.906")
B = Permissible deviation in parallel at distance A = max. 0.04 mm (0.0016")
C = Permissible displacement to either side = max. 0° 30'



Checking Piston Pin Bush:

It should be possible to have the piston pin slide through the bush by hand with slight force and no noticable play.

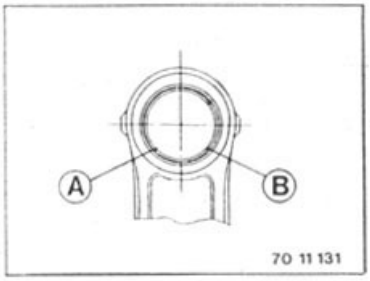


- **Removing / Checking / Repairing Connecting Rods**

Lift out circlip and press out piston pin.

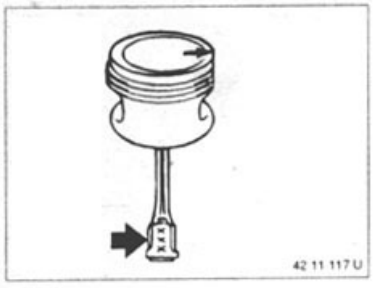
Important!
Pistons and piston pins are matched and must not be mixed up.

Installation:
Insert circlip that its opening is opposite the hole.

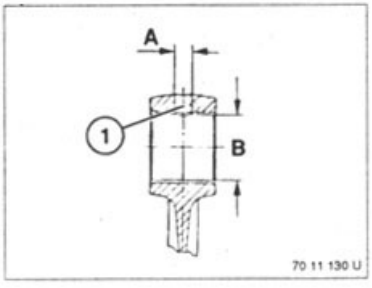


Replacing Piston Pin Bush:

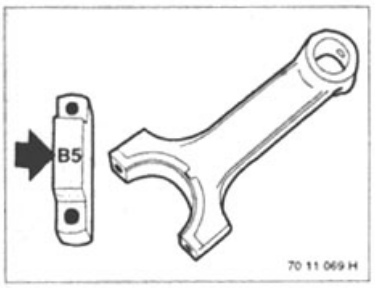
Press out old bush with a suitable mandrel (23.5 mm / 0.925" dia.).
Press in new bush; location of bush gap optionally at point A or B.

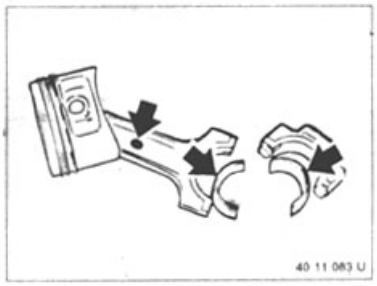


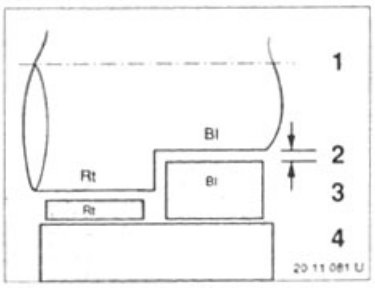
Installation:
Install connecting rod on piston in such a manner that with the pairing number seen the arrow on the piston crown faces to the right.



Drill oil bore (1).
A = 6 mm (0.236") diameter.
Deburr bore at both ends.
Ream out bush with a reamer.
B = 22.005 ... 22.010 mm (0.8663 ... 0.8665")







Replacing Connecting Rods:

Note:
Only connecting rods of the same weight class (die-stamped in bearing cap) may be installed in one engine.

Only connecting rods of weight class B5 are available for replacements. They cover the entire weight tolerance range.

o Replacing Conrod Bearing Shells

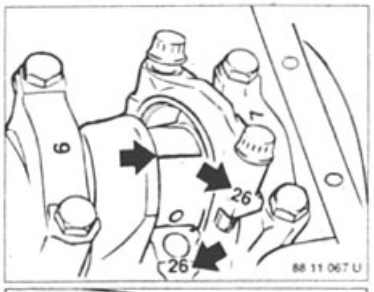
Select new bearing shells to match the color code on the connecting rod.

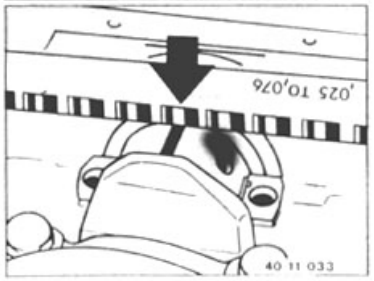
Important!
Check ground size of crankshaft – also refer to "Replacing Crankshaft".

Color Code – Shaft Diameter – Bearing Thickness* – Survey

Double Classification Color Codes:
Rt = Red
Bl = Blue

1 - Crankpin
2 - Bearing play
3 - Bearing shell thickness
4 - Big conrod end





Installation:
Check conrod bearing play (only carried out for control purpose):

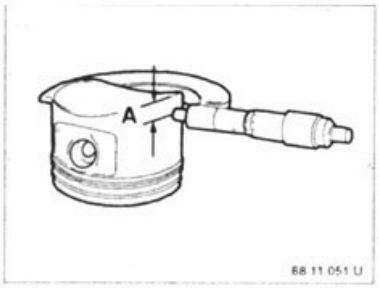
Place Type PG 1 Plastigage** on crankshaft wiped clean of oil with pistons in BDC position.
Mount bearing cap and tighten old conrod bolts to specified torque.

Important!
Do not turn connecting rods or crankshaft.

Remove bearing cap and read bearing play (specification: 0.020 ... 0.055 mm) from supplied scale by measuring width of the flattened Plastigage.
Correct the bearing play by installing new bearing shells or bearing shells with different color code.

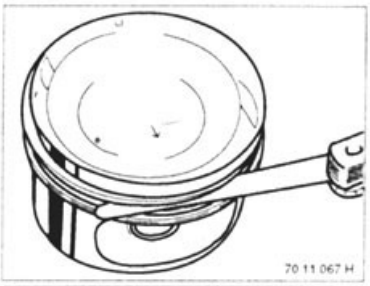
* Refer to Specifications

** Source of Supply: Cartool



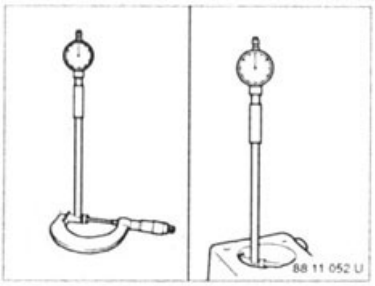
o Checking / Replacing Pistons:

Installation:
Measure installed piston clearance before installing. Measure piston diameter with a micrometer at distance A* from the lower edge of the piston and offset 90° from the piston pin axis.



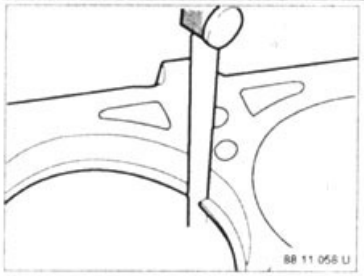
Measure side clearance.

Specifications:
Groove 1 = 0.020 ... 0.052 mm
Groove 2 = 0.020 ... 0.052 mm
Groove 3 = 0.020 ... 0.055 mm



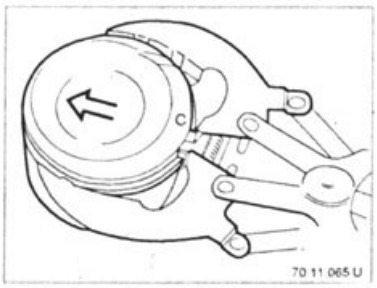
Set internal caliper to zero on the micrometer with the measured piston diameter. Measure cylinder bore diagonally at bottom, middle and top.

New piston clearance: 0.01 ... 0.04 mm
Max. wear clearance: 0.15 mm



Measure end clearance.

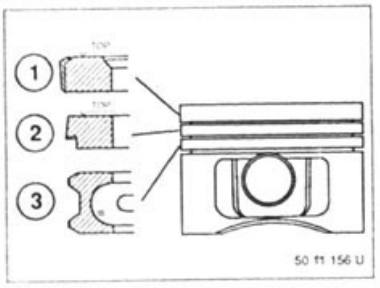
Specifications:
Groove 1 = 0.20 ... 0.40 mm
Groove 2 = 0.20 ... 0.40 mm



o Checking / Replacing Piston Rings:

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.

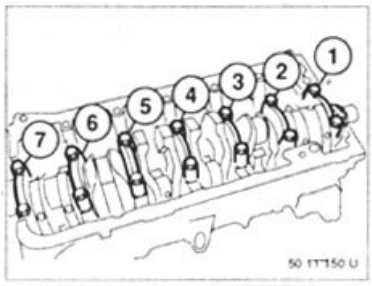


Installation:
Install piston rings with the word "TOP" facing the piston crown.

1 Plain compression ring
2 Tapered face compression ring
3 Oil scraper ring with rubber lined spring

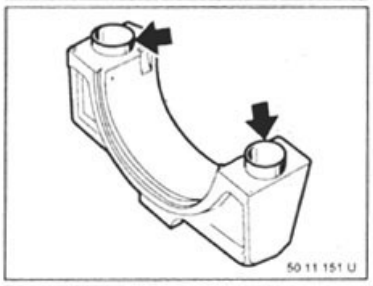
Offset piston ring gaps by approx. 120° to each other, but not above the piston pin bore.

* See Specifications

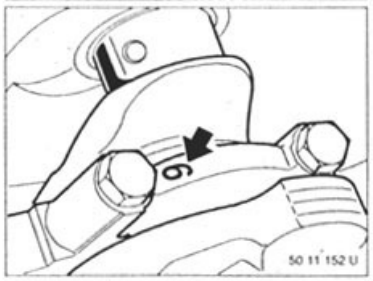


- **Removing Cranshaft**
  (Replacing Cranshaft – see 11 21 501)

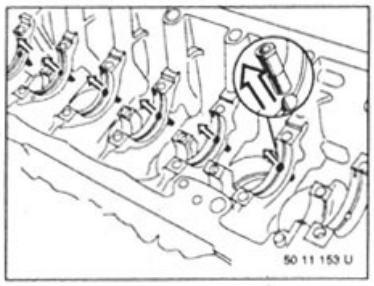
Remove bearing caps (1 ... 7) and lift out crankshaft.



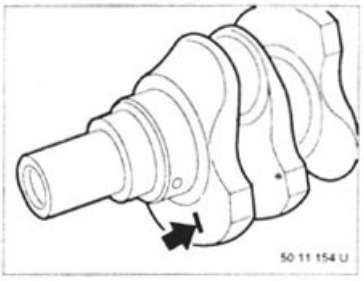
Installation:
Check dowel sleeves.



Installation:
Bearing caps are marked with a cast 1 ... 7 on the "exhaust side".

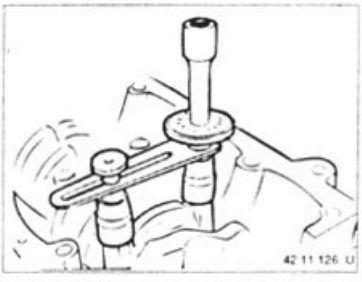


Installation:
Make sure that oil spray jets are inserted in bearings 2 ... 7.



Installation:
Lubricate bearing shells with oil.
Install crankshaft.
Mount bearing caps 1 ... 7 in such a manner that grooves of bearing shell guides are on one side.
Align bearing caps precisely.

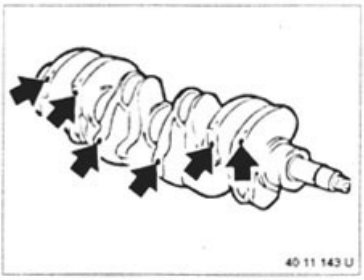
Note
Thrust bearing shells are installed only for bearing no. 6.



Bearing Cap Tightening Procedures:

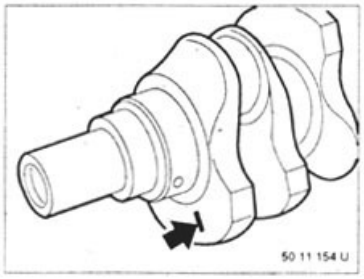
Tighten bolts (washed and lubricated with oil) in two steps.

Step 1 = 23 Nm (17 ft. lbs.) torque
Step 2 = 50° torque angle



- **Replacing Main Bearing Shells**

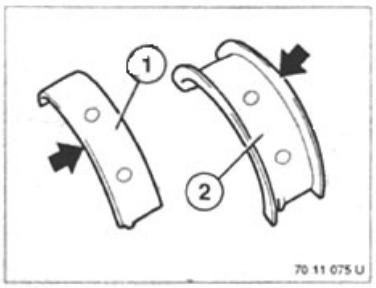
The crankshaft is marked with yellow, green or white paint depending on main bearing journal tolerances.



Important!
Check ground size* of the crankshaft.

1 paint stripe = size 1 (0.25 mm/0.010")
2 paint stripes = size 2 (0.50 mm/0.020")

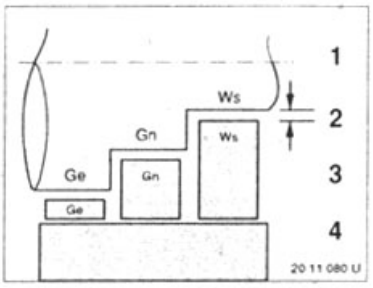
* **See Specifications**



Bearing shells are marked with yellow, green or white paint.

1 = Bearing shell
2 = Thrust bearing shell

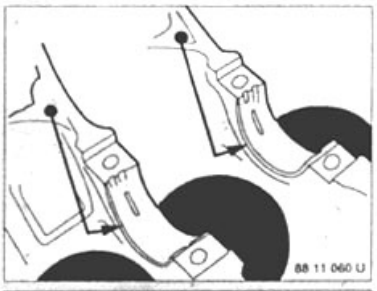
Check ground size of main bearing journals.



Survey of Color Code/Shaft Diameter/Bearing Shell Thickness*

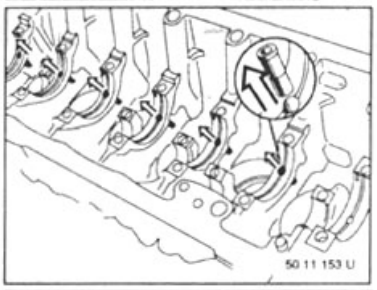
Triple Classification Color Codes:
Ge = Yellow
Gn = Green
Ws = White

1 Crankshaft diameter
2 Bearing play
3 Bearing shell thickness
4 Bearing support diameter



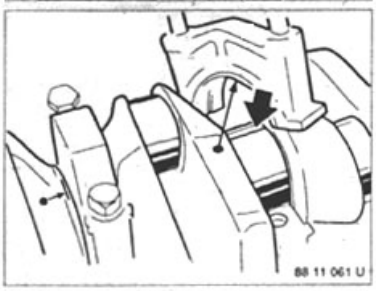
Install bearing shells in crankcase with same color code as dot of paint on the crankcase.
Install bearing shells in bearing caps with same color code as on the crankshaft.

Install both bearing shells with the color code of the crankshaft, if the paint mark has been washed off of the crankcase.

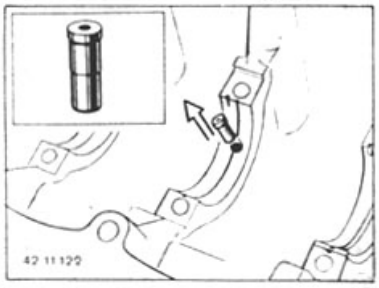


- Replacing Spray Jets in Crankshaft Bearing Supports

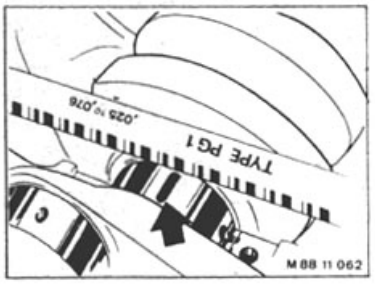
Note:
Spray jets are installed in bores of bearing supports 2 ... 7 and supply oil for lubrication of the piston pins and cooling of pistons.



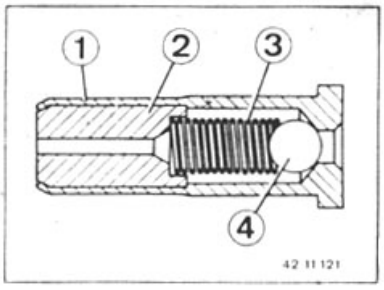
Install crankshaft.
Place Type PG-1 Plastigage** on the crankshaft wiped clean of oil and tighten bearing caps as specified.
Tightening torque*.
Don't turn the crankshaft.



Pull spray jet out of bore.



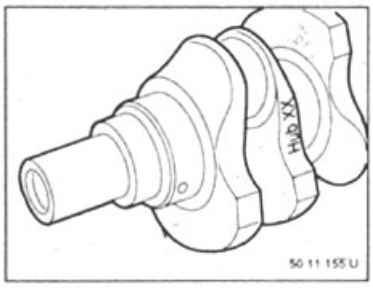
Remove bearing caps and read bearing play* by measuring the width of the flattened Plastigage with help of the supplied scale.
Install new bearing shells or bearing shells with a different color code to correct the bearing play.



Spray Jet Assembly:

1 = Jet body
2 = Jet
3 = Spring
4 = Ball

* See Specifications
** Source of Supply: CARTOOL

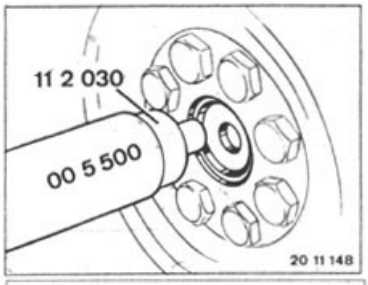


11 21 501 REPLACING CRANKSHAFT
– Crankshaft Removed –

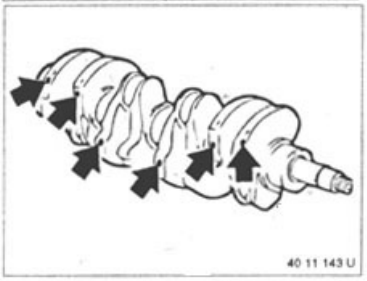
Note:
Replacement crankshafts are supplied complete with corresponding main and conrod bearing shells.

Crankshaft identification (Cast on Crank Cheek):

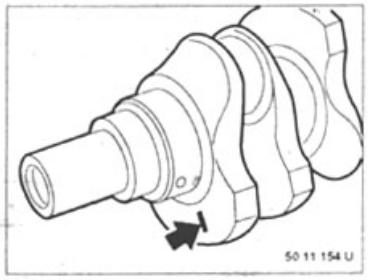
Engine	Stroke
M50 B20	66 mm (2.598")
M50 B25	75 mm (2.953")



Drive in pilot bearing with Special Tools 11 2 030 and 00 5 500.

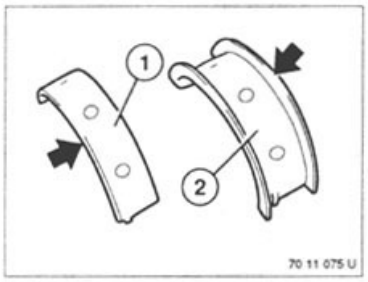


Crankshafts are marked with yellow, green or white paint depending on the main bearing journal tolerances.



Crankshafts are surface treated and may only be reground in the factory. Reground crankshafts are marked with stripes of paint*.

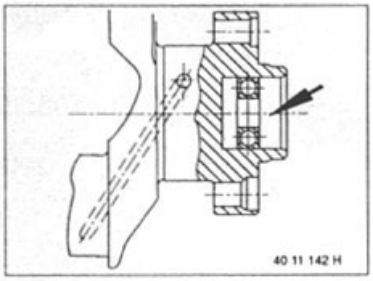
1 paint stripe = size 1 (0.025 mm / 0.010")
2 paint stripes = size 2 (0.50 mm / 0.020")



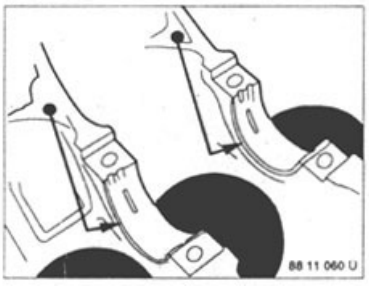
Bearing shells are marked with yellow, green or white paint.

1 = Bearing shell 1-2-3-4-5-7
2 = Bearing shell 6 (thrust bearing)

Check ground size of main bearing journals!

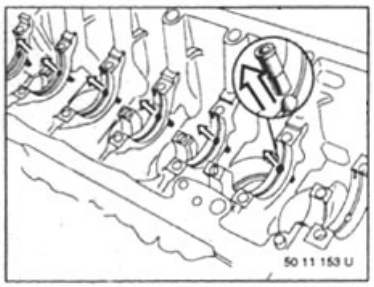


Cars with Manual Transmission:
Install pilot bearing for transmission main shaft.

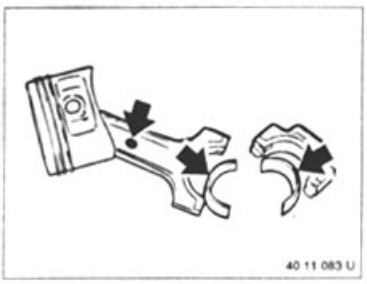


Installing Procedure:
Only place bearing shells with "yellow" color code in the crankcase (regardless of paint mark still on the crankcase).
Install bearing shells in bearing caps depending on color code of crankshaft bearing journal (yellow, green or white).

* **See Specifications**

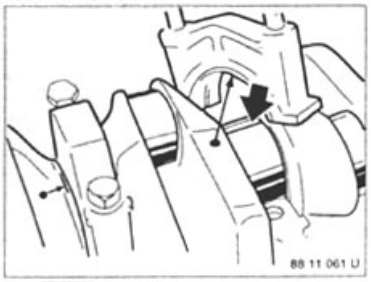


Installation:
Make sure that oil spray jets are inserted for bearings 2 ... 7.

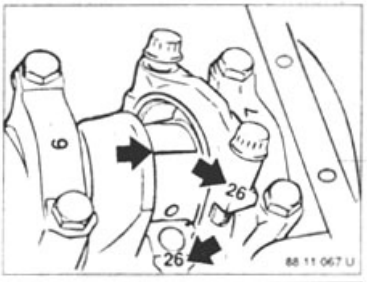


Replacing Conrod Bearing Shells:
Red or blue conrod bearing shells are installed standard depending on the paint mark on the connecting rod for a pertinent crankshaft ground size.

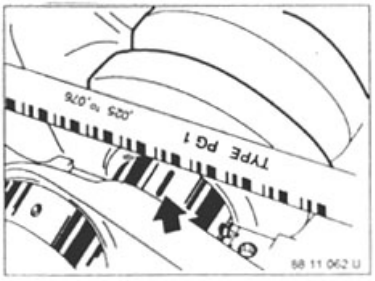
Only install red bearing shells in the pertinent ground size for replacement of the crankshaft.



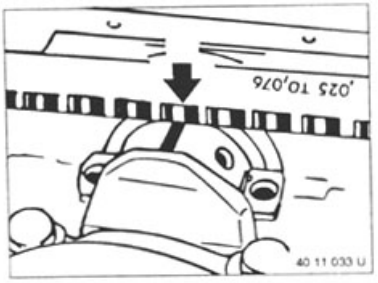
Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps as specified.**
Tightening torque*.
Don't turn the crankshaft.



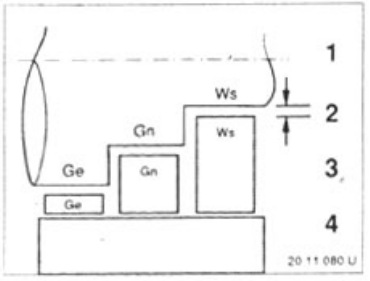
Installation:
Check conrod bearing play.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil in BDC position.**
Mount bearing caps and tighten with old conrod bolts as specified.



Remove bearing caps.
Read bearing play* by measuring width of the flattened Plastigage with help of the supplied scale.
Install new bearing shells, bearing shells of different machined size or bearing shells with a different color code to correct the bearing play.



Important!
Don't turn the connecting rod or crankshaft.
Remove bearing caps and read bearing play by measuring width of the flattened Plastigage with help of the supplied scale.
Specification: 0.020 ... 0.055 mm
(0.0008 ... 0.0022")
Install new bearing shells or bearing shells with a different color code to correct the bearing play.

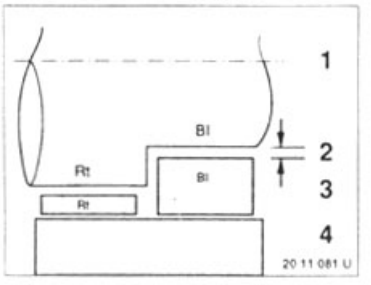


Survey of Color Code/Shaft Diameter/Bearing Shell Thickness*

Triple Classification Color Codes:
Ge = Yellow
Gn = Green
Ws = White

1 Crankshaft
2 Bearing play
3 Bearing shell thickness
4 Bearing support

*** See Specifications**
**** Source of Supply: CARTOOL**

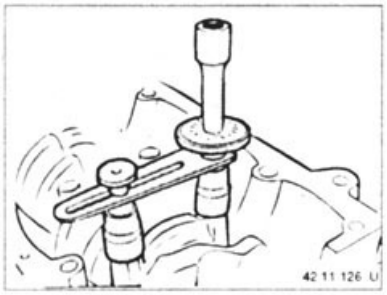


Survey of Color Code/Shaft Diameter/Bearing Shell Thickness*

Double Classification Color Codes:
Rt = Red
Bl = Blue

1 Crankshaft journal
2 Bearing play
3 Bearing shell thickness
4 Conrod end

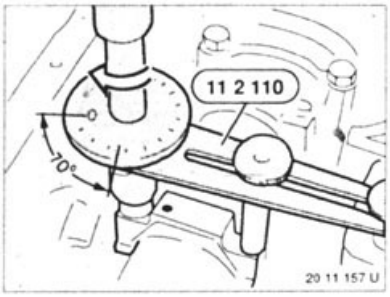
*** See Specifications**
**** Source of Supply: CARTOOL**



Main Bearing Cap Bolt Tightening Procedure:

Tighten bolts (washed and lubricated with oil) in two steps.

Step 1 = 23 Nm (17 ft. lbs.) torque
Step 2 = 50° torque angle



Conrod Bearing Cap Bolt Tightening Procedure:

Lubricate conrod bearing shells with oil and mount bearing caps that pair numbers are opposite each other.
Use new conrod bolts.
Tighten conrod bolts in two steps.

Step 1 = 23 Nm (17 ft. lbs.) torque
Step 2 = 70° torque angle

11 Engine M50 VANOS

11 00 603 **Engine** – disassemble and assemble (engine removed) 11- 50/40
Cylinder head – remove and install 11- 50/40
Engine – mount on assembly stand 11- 50/40
Thermostat housing cover – remove and install 11- 50/41
Cylinder head cover – remove 11- 50/42
VANOS control unit – remove 11- 50/43
Cylinder head – unscrew 11- 50/46
Camshaft adjusting procedures 11- 50/47
VANOS – check function 11- 50/53
Cylinder head – disassemble and assemble 11- 50/54
Cylinder head – mount on assembly stand 11- 50/54
Camshafts – replace 11- 50/55
Valves – remove 11- 50/57
Survey of repair-size valves 11- 50/57
Check valve – remove 11- 50/58
Cylinder head – check for cracks in water test 11- 50/59
Cylinder head – machine sealing surface 11- 50/59
Cylinder head – inspect sealing surface 11- 50/59
Cylinder head – machine 11- 50/59
Valve guide and seat – machine 11- 50/60
Valve guide – ream 11- 50/60
Valve seat – machine 11- 50/60
Crankcase – disassemble and assemble 11- 50/61
Alternator – remove 11- 50/61
Tensioning roller and console – remove 11- 50/61
Oil filter body – remove 11- 50/62
Water pump – remove 11- 50/62
Vibration damper – remove 11- 50/63
Vibration damper hub – remove 11- 50/63
Front end radial oil seal – replace 11- 50/63
Oil pan – remove 11- 50/64
Lower timing case cover – remove 11- 50/64
Timing chain and guides, lower – remove 11- 50/65
Oil pump – remove (E34) 11- 50/65
Oil pump – remove (E36) 11- 50/66
Oil pump – disassemble 11- 50/67
Connecting rod and piston – remove 11- 50/68
Connecting rod – remove 11- 50/69
Connecting rod bearing shells – replace 11- 50/70
Piston – replace 11- 50/70
Piston rings – replace/check 11- 50/71
Clutch / flywheel – remove 11- 50/72
Pilot bearing in crankshaft – replace 11- 50/73
Rear end cover – remove 11- 50/73
Crankshaft – remove 11- 50/74
Piston cooling spray jets – replace 11- 50/75
Main bearing shells – replace 11- 50/76

11 00 603 DISASSEMBLING AND ASSEMBLING ENGINE
– Engine Removed –

General Information on Valve Timing Work:
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 about 30° 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.

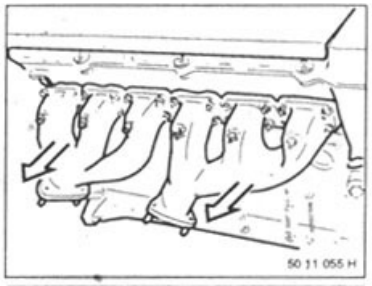
If applicable, drain engine oil and fill the engine with new engine oil after assembling the engine.
Check the engine oil level after installation and trial run.

o Removing Cylinder Head

Remove intake manifold together with throttle valve.

This step will have already been carried out on engines which have been removed from the car.

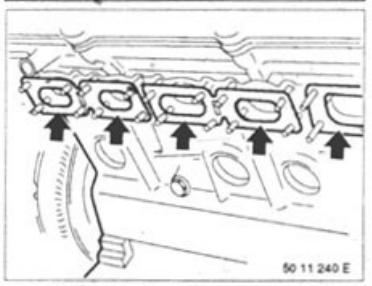
Refer to Group 11 in Model Repair Manual.



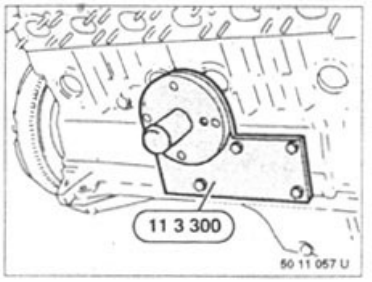
o Mounting Engine on Assembly Stand

Remove exhaust manifolds.
Unscrew nuts.
Lift off exhaust manifolds.

Installation:
Shorter manifold is located at rear.
Replace nuts.
Coat threads with copper paste**.
Tightening torque*.

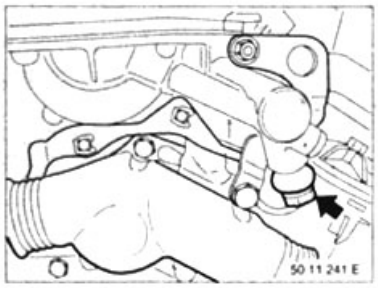


Installation:
Replace gaskets.
Install gaskets that beads face exhaust manifolds.



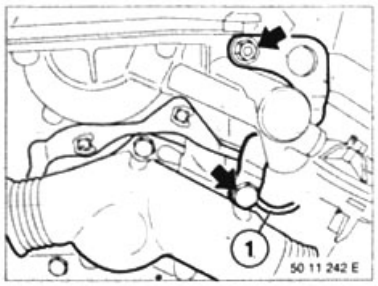
Mount engine on Special Tool 00 1 490 using Special Tool 11 3 300.

* Refer to Specifications
** Source of Supply: BMW Parts



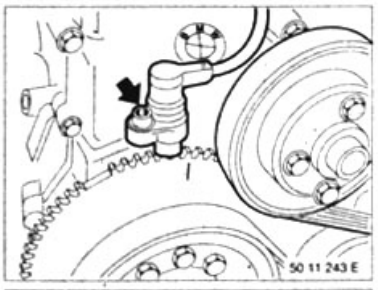
Unscrew oil pipe at VANOS control unit.

Installation:
Check seals, replacing them if necessary.
Tightening torque*.

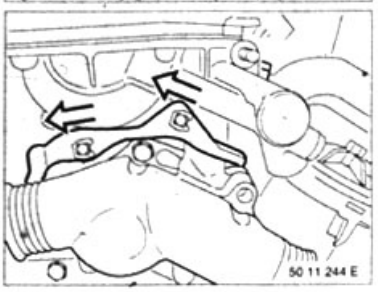


Unscrew suspension eye.

Installation:
Check for ground strap (1).

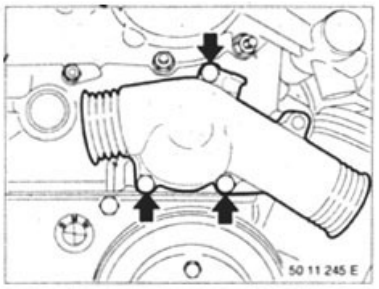


Unscrew pulse sender.



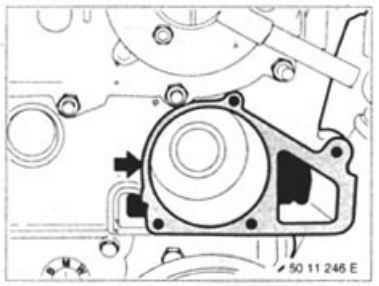
Remove wiring duct for pulse sender.

* Refer to Specifications

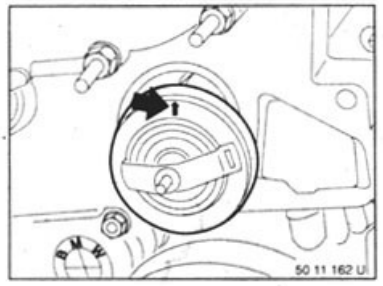


o Removing Thermostat Housing Cover

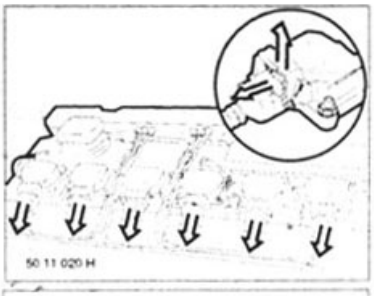
If applicable, unscrew thermostat housing for other work on cylinder head later.



Installation:
Sealing surfaces must be clean and without oil.
Check rubber profile gasket, replacing it if necessary.

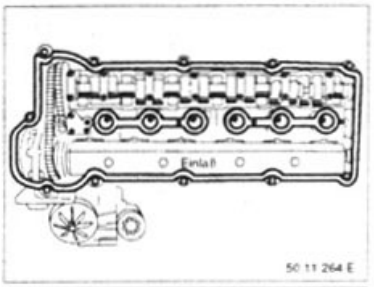


Installation:
Check installed direction.
Vent or arrow faces up.
Replace seal.

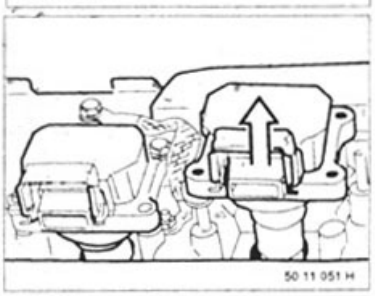


o Removing Cylinder Head Cover

If applicable, pull plugs off of ignition coils.

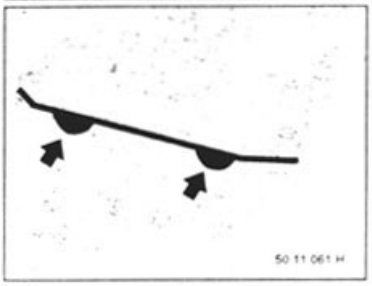


Installation:
Check cover gasket, replacing it if necessary.
Place outer and inner cover gaskets on cylinder head in advance.

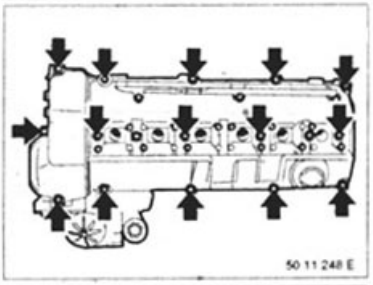


Unscrew nuts.
Remove ignition coils.

Installation:
Check for ground strap of ignition coils at cylinders 3 and 6.

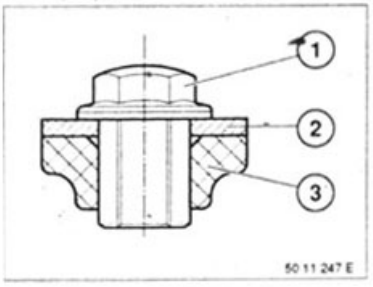


Installation:
Check for correct seating of gasket on back of the cylinder head when mounting the cylinder head cover.



Unscrew cylinder head cover.

Installation:
Install and align cover.
Screw on cover nuts, but do not tighten them.
Tighten cover nuts diagonally from inside to outside.
Tightening torque*.

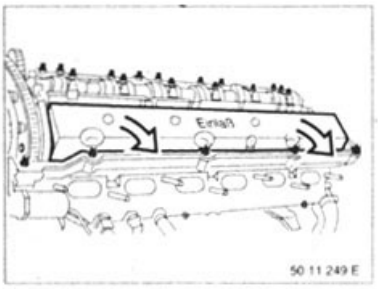


Note:
Cylinder head cover is separated from the cylinder head as far as transmission of oscillation is concerned by employing rubber mounts and gaskets.

Check arrangement of cover installation.

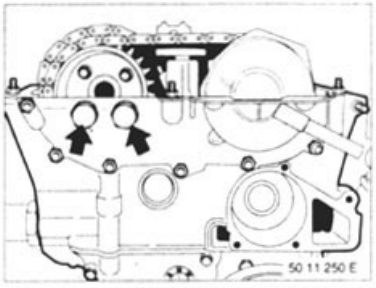
1 Cover nut
2 Washer
3 Rubber mount

* Refer to Specifications

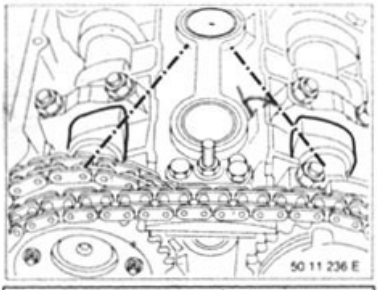


o Removing VANOS Control Unit

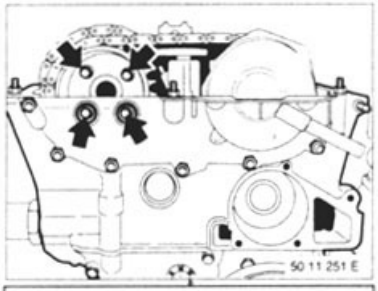
Take off plastic cover.
Lift out lock and remove plastic cover for the intake camshaft.



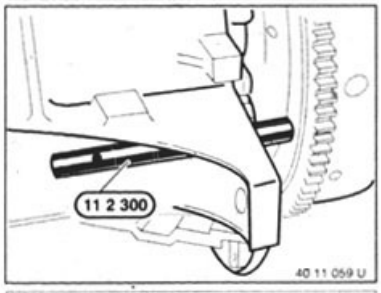
Screw plugs out of control unit.



Turn engine in its direction of rotation until the peaks of cams on intake and exhaust camshafts for cylinder no. 1 point to each other.

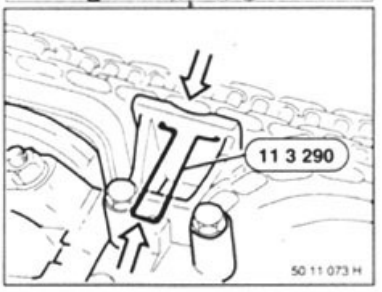


Unscrew bolts of sprocket on the exhaust camshaft.

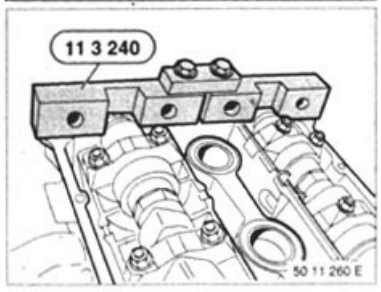


Hold crankshaft in TDC using Special Tool 11 2 300.

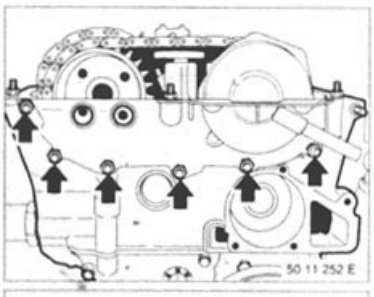
Important!
Remove special tool before operating the engine.



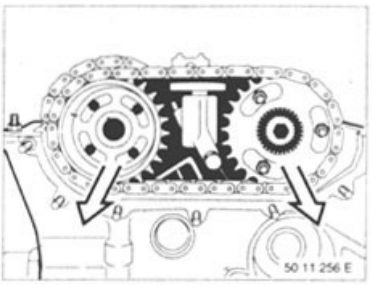
Press down on upper chain tensioner and lock using Special Tool 11 3 290.



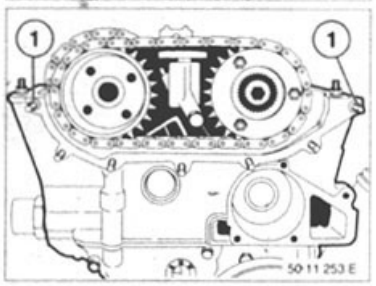
Hold camshafts using Special Tool 11 3 240.



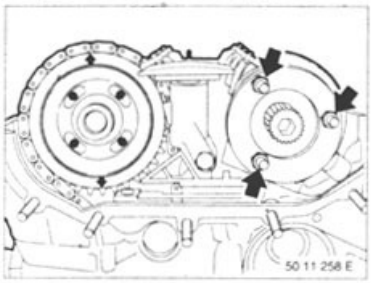
Unscrew nuts.
Remove VANOS control unit.



Remove sprockets together with chain.

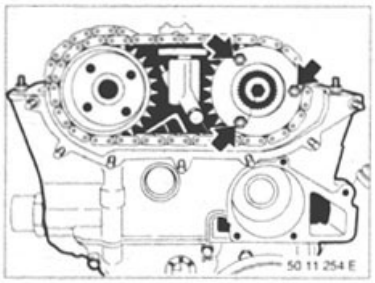


Installation:
Check for dowel sleeves (1).
Apply 3 Bond 1209** liquid sealing compound at the corners of the joint between the cylinder head and VANOS control unit.
Replace gasket.

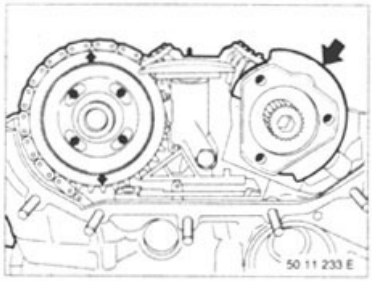


If applicable for other work on cylinder head later, unscrew thrust washer bolts.
Remove thrust washer.

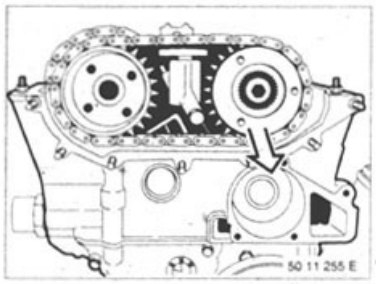
Installation:
Tightening torque*.



Unscrew nuts of intake camshaft.



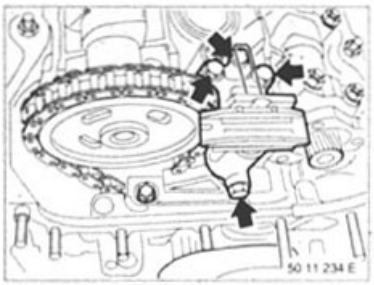
If applicable, remove sender gear.



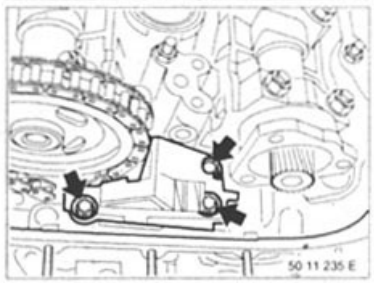
Remove thrust washer.

** Source of Supply: BMW Parts

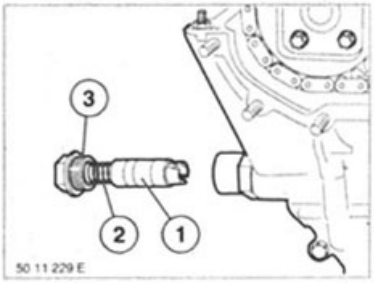
* Refer to Specifications



Unscrew secondary tensioner.



Unscrew chain guide.



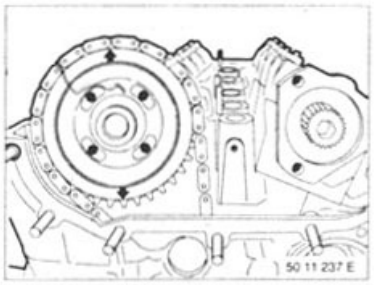
Unscrew bolt (3).

Caution!
Strong spring force.

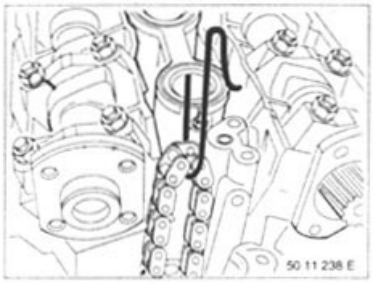
Remove spring (2) and plunger (1).

Installation:
Insert chain tensioner plunger (1) in such a manner that guides engage in the tensioning rail.
Install spring (2) and bolt (3).
Replace seal.
Tightening torque*.

* Refer to Specifications



Lift off sprocket together with chain.

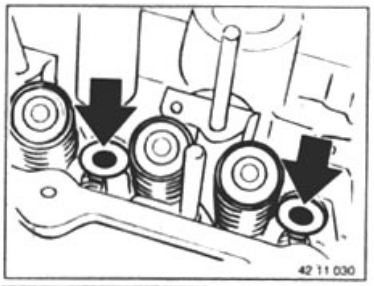


Note:
Secure chain with a piece if wire to keep it from sliding down.

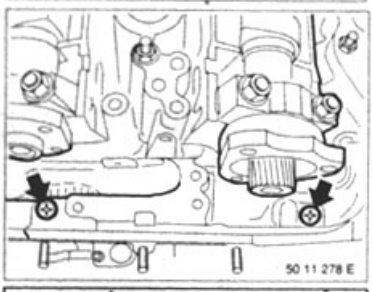


o Unscrewing Cylinder Head

Important!
If applicable, first turn crankshaft in engine's direction of rotation about 30° away from TDC and then back to TDC only after turning the camshaft.
This measure ensures that valves do not contact piston crowns.



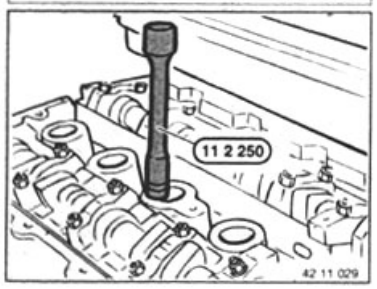
Note:
Washers are sometimes punch-locked in standard production cylinder heads to prevent them from getting lost.
Use new washers *without* punch-locking when installing a new cylinder head.
Ensure that no washers are missing.



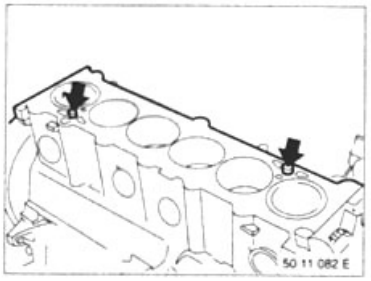
Unscrew timing case cover to cylinder head bolts.



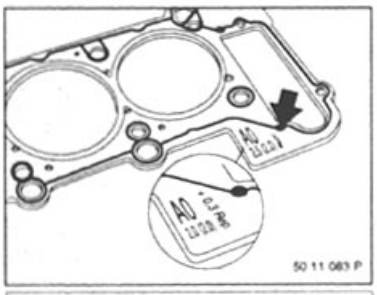
Installation:
Keep to the waiting times for hydraulic valve tappets when installing the cylinder head — refer to "General Information".



Unscrew cylinder head bolts from outside to inside in several steps using Special Tool 11 2 250.
Lift off cylinder head.



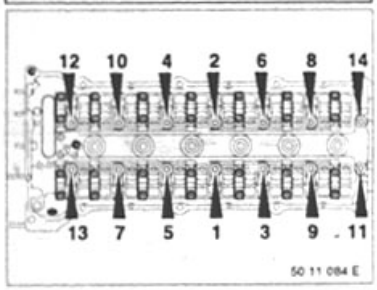
Installation:
Clean sealing surfaces on cylinder head and crankcase, if necessary removing bits of gaskets using a hard wood scraper and watching out that bits of gaskets do not fall into oil and coolant bores.
Install new cylinder head gasket.
Check dowel sleeves for damage and correct installation.



Installation:
A 0.3 mm thicker cylinder head gasket is available for machined (ground) cylinder heads (refer to "Checking / Machining Cylinder Head Sealing Surface").

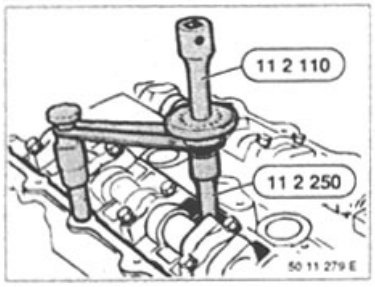
Identification:

2.0	for 2.0 liters
2.5	for 2.5 liters
+ 0.3	for 0.3 mm thicker gasket after grinding cylinder head

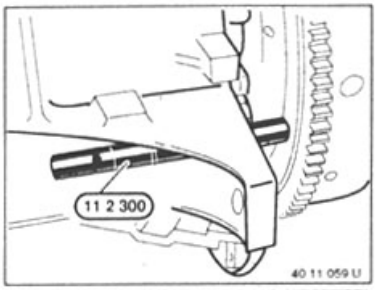


Installation:
Mount cylinder head and tighten new bolts (lightly lubricated with oil) in sequence of 1...14 in three steps.
Check cylinder head bolt tightening specifications*.

Important!
Cylinder head bolts may only be used once. Keep oil out of tapped bores in crankcase and timing case cover (danger of cracking block, falsified torque values).



Note:
Use Special Tools 11 2 250 and 11 2 110 or 00 9 120 to tighten bolts to torque angle*.



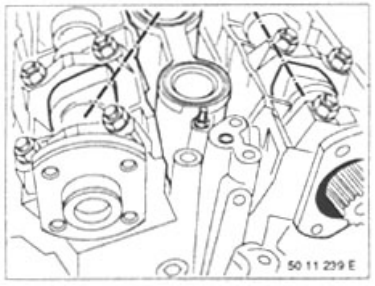
o Camshaft Adjusting Procedures

Hold crankshaft in TDC using Special Tool 11 2 300.

Important!
Remove special tool before operating the engine.

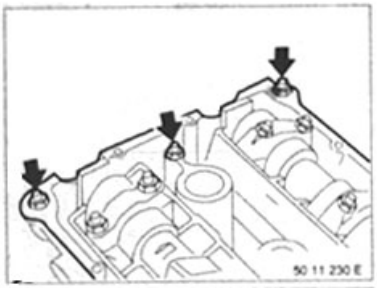


Important!
If the camshaft adjustment has to be corrected so much that valves in cylinders 1 and 6 are moved, first turn the crankshaft in engine's direction of rotation about 30° away from TDC and then back to TDC only after turning the camshaft.
This measure prevents contact between valves and piston crowns.

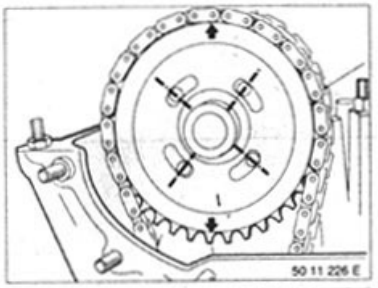


Turn camshaft until peaks of intake and exhaust cams in cylinder no. 1 point to each other.

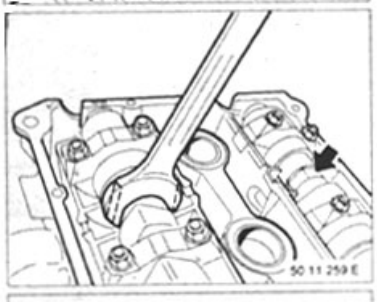
* Refer to Specifications



Unscrew and remove the three rear valve cover mounting studs.

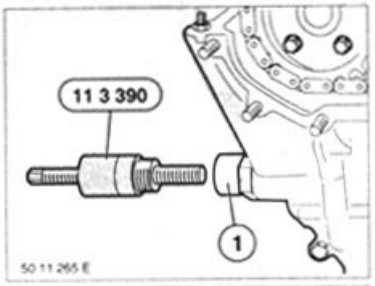


Install primary timing chain on sprocket and center on the exhaust camshaft.
Arrow on sprocket points up.
Mount sprocket in such a manner that tapped bores are on the left-hand side of the slots, as the sprocket will be turned to the left when installing the chain tensioner.

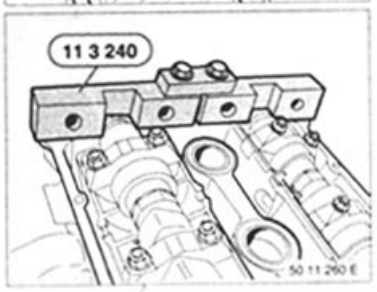


Align camshafts by turning on the hexagon.

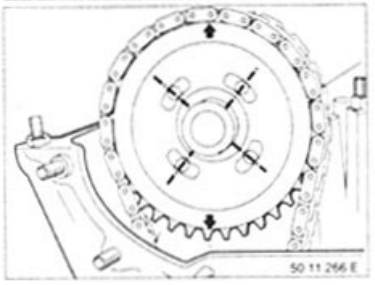
Important!
Don't damage the cylinder head.
If applicable, machine the open-ended wrench accordingly.



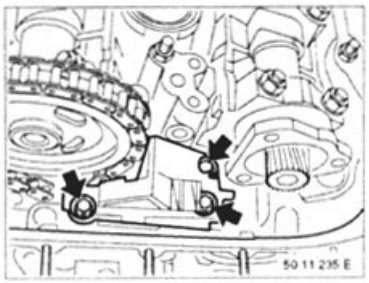
Insert Special Tool 11 3 390 into chain tensioner sleeve (1).
Screw in adjusting screw on tensioning rail as far as stop, but do not tighten.



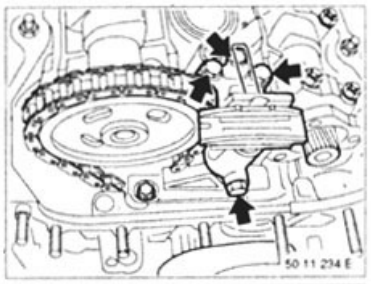
Apply Special Tool 11 3 240 on camshafts at cylinder no. 6.



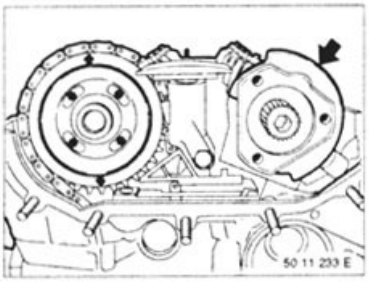
Note
Sprocket slots are now centered.



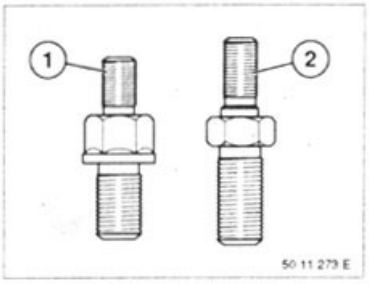
Install chain guide.



Install secondary tensioner.

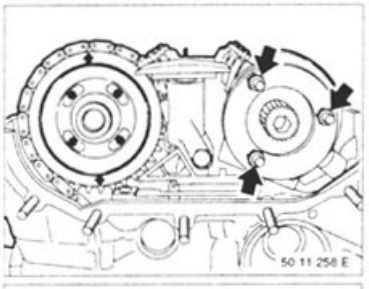


Mount sender gead on the intake camshaft.

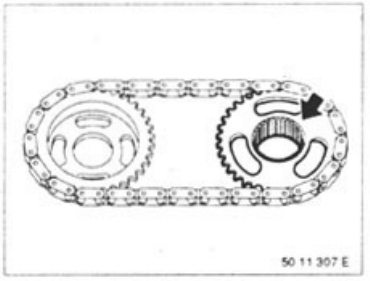


Important!
Don't mix up studs.

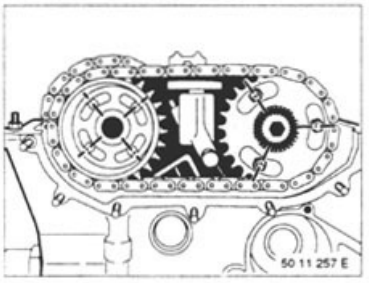
1 Stud for cylinder head cover installation
2 Stud for thrust washer and sprocket installation



Mount thrust washer and secure with studs (2).
Tightening torque*.

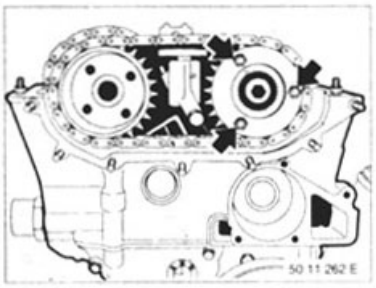


Important!
Mount the intake camshaft sprocket correctly — flat side faces VANOS control unit and collar faces camshaft.

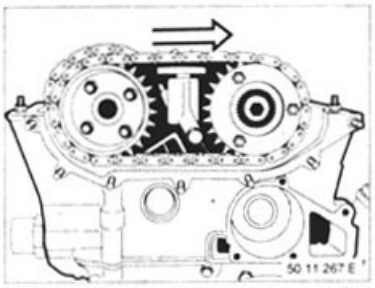


Install both sprockets together with chain.
Arrow on exhaust camshaft sprocket points up.
Slots are then centered.

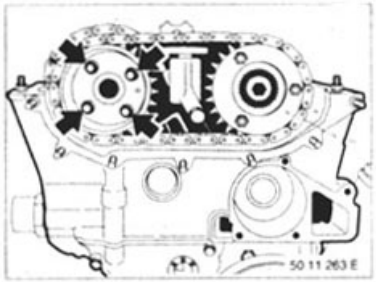
* Refer to Specifications



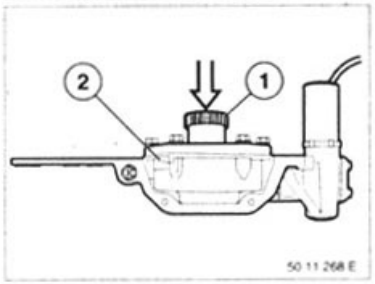
Mount thrust washer on intake camshaft and secure with nuts.
Tightening torque*.



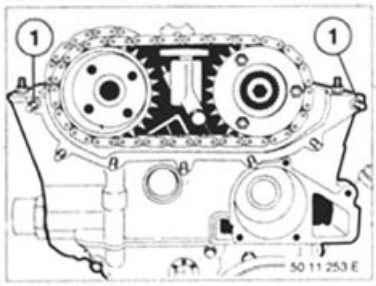
Important!
Before installing the VANOS control unit, turn the sprockets together with secondary chain as far as right-hand stop until slots are aligned with the studs.



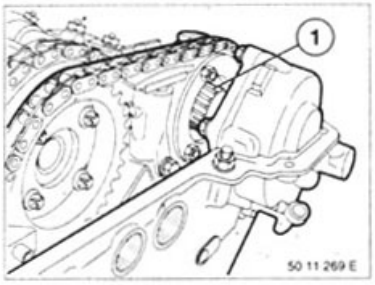
Mount thrust washer on exhaust camshaft using bolts.
Screw in bolts to be free of play, but do not yet tighten them.



Important!
Before mounting the VANOS control unit, push back splined shaft together with hydraulic plunger (1) in direction of housing (2) as far as stop.

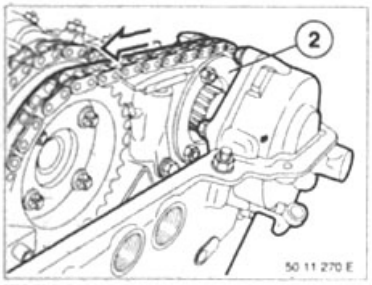


Installation:
Check for dowel sleeves (1).
Apply 3 Bond 1209** liquid sealing compound on corners of joint between cylinder head and VANOS control unit.
Replace gasket.



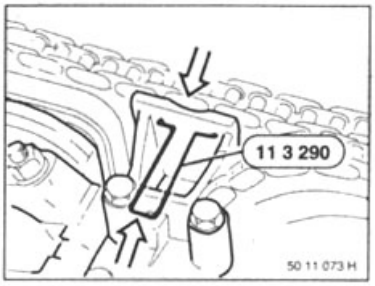
Installation:
Mount VANOS control unit.
Turn splined shaft (1) until splines mesh.

* Refer to Specifications
** Source of Supply: BMW Parts

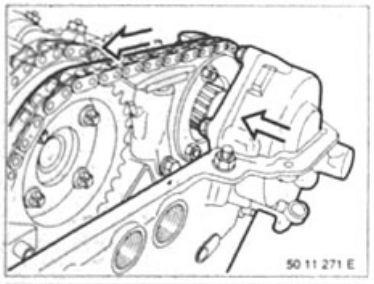


Turn chain together with sprockets counterclockwise by hand until the splined shaft meshes in the splines of sprocket (2).

Important!
It is absolutely essential to ensure that the "FIRST" suitable tooth meshes.

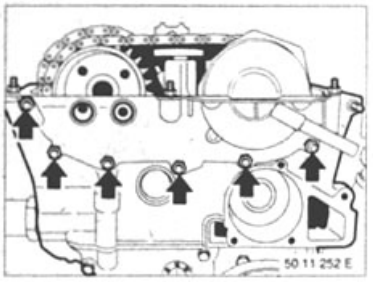


Unlock secondary tensioner.

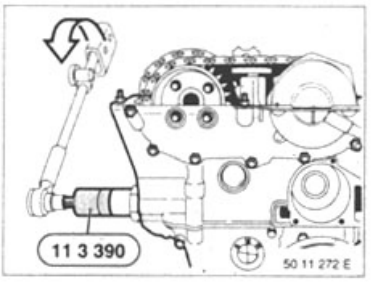


Push VANOS control unit in direction of the cylinder head.
Guiding the bevel splined shaft into the bevel splined sprocket causes the chain together with sprockets to be turned counterclockwise.
Guide chain together with sprockets counterclockwise by hand.

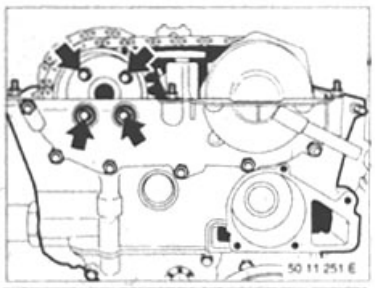
Note:
It is absolutely necessary to pull the chain into the root of teeth on the sprockets for timing diagram adjustments since introduction of rubber-lined sprockets.



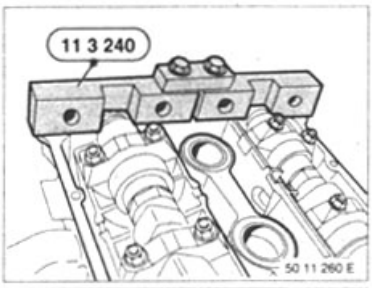
Tighten VANOS control unit.



Preload the tensioning rail with 1.3 Nm torque using Special Tool 11 3 390 by turning the adjusting screw using Special Tool 00 2 050 or a standard torque wrench.



Tighten bolts of exhaust camshaft sprocket in two steps as specified.
Tightening torque*.

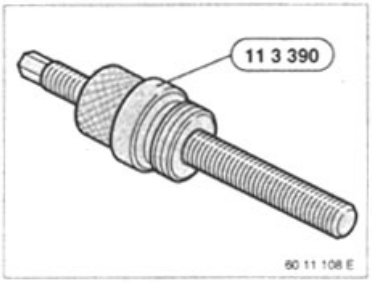


Check adjustment of camshafts.
Apply Special Tool 11 3 240 on camshafts at cylinder no. 6.

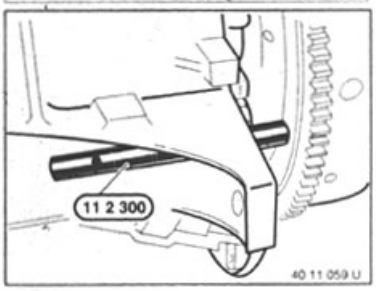
Note:
Special Tool 11 3 240 must bear flat on cylinder head without any gaps.



Remove Special Tools 11 2 300 and 11 3 240.
Crank engine twice in its direction of rotation.



Important!
Always ensure that the timing chain is preloaded with help of Special Tool 11 3 390 when checking the adjustment of camshafts.

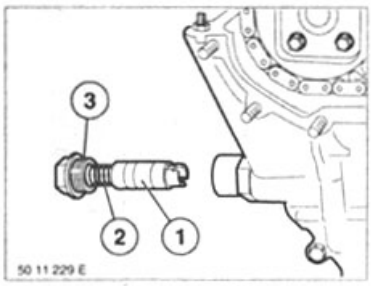


Hold crankshaft in TDC using Special Tool 11 2 300.

Important!
Do not crank engine back again.
Remove special tool before operating the engine.

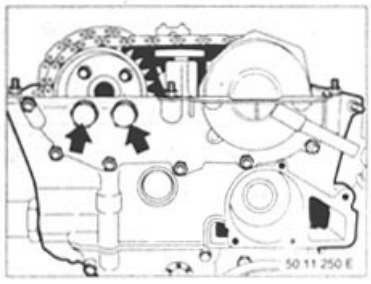
Remove Special Tool 11 3 240 from the cylinder head.
Loosen Special Tool 11 3 390.

* Refer to Specifications



Insert chain tensioner plunger.

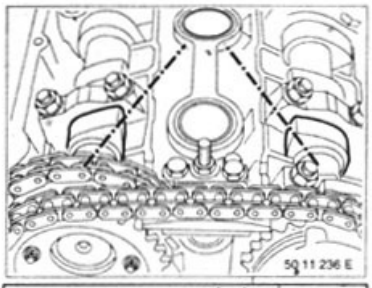
Installation:
Install chain tensioner plunger (1) that guides engage in the tensioning rail.
Install spring (2) and bolt (3).
Replace seal.



Install plugs.

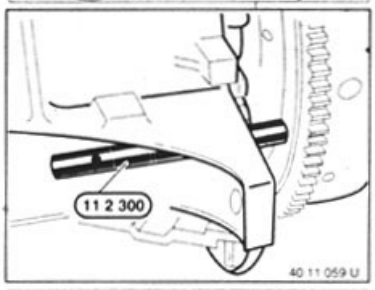
Installation:
Replace seals.
Tightening torque*.

* Refer to Specifications



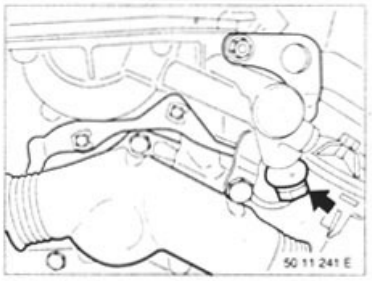
o Checking Function of VANOS

Crank engine in its direction of rotation until the peaks of intake and exhaust cams in cylinder no. 1 point to each other.



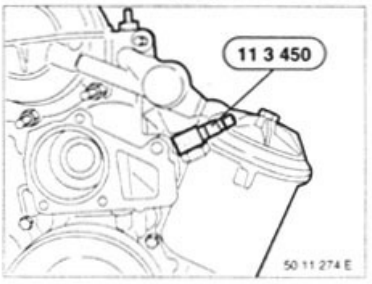
Hold crankshaft in TDC using Special Tool 11 2 300.

Important!
Do not crank engine back again.
Remove special tool before operating the engine.



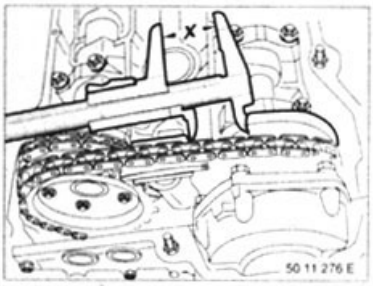
Unscrew oil pipe on VANOS control unit.

Installation:
Check seals, replacing them if necessary.
Tightening torque*.

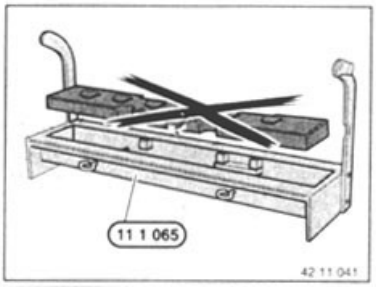


Mount Special Tool 11 3 450 using coupling.
Connect to air pressure supply (2 to 8 bar).

* Refer to Specifications

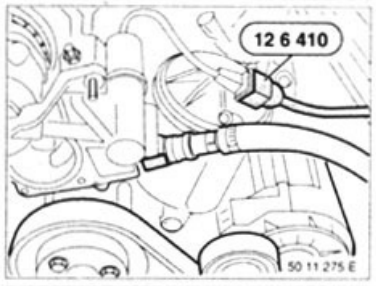


Measure gap between secondary tensioner and edge on the sender gear.
Note the value.

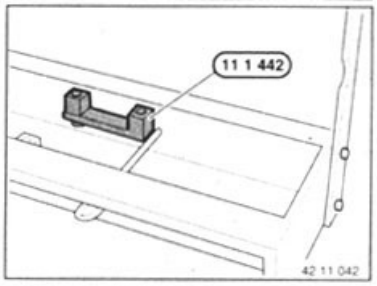


- Dsiassembling and Assembling Cylinder Head
- Mounting Cylinder Head on Assembly Stand

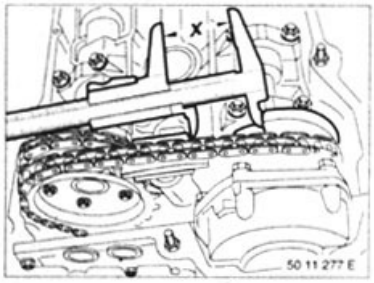
Mount Special Tool 11 1 065 on Special Tool 00 1 490.
Do not insert Special Tool 11 1 441 at this time.



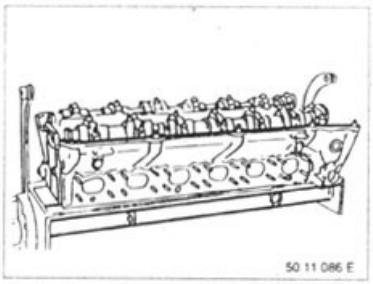
Connect Special Tool 12 6 410 on 4/2-way valve for VANOS.
Connect battery.
Ensure that poles are not mixed up.
Camshaft with be adjusted in advanced direction.



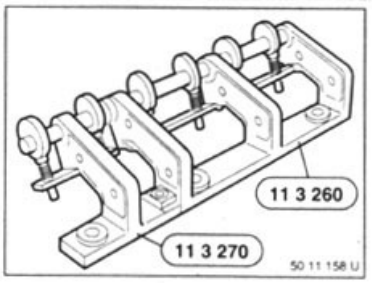
Note:
Screw Special Tool 11 1 442 on already delivered special tool assembly fixtures.



Measure gap between secondary tensioner and edge on the sender gear.
Note the value.
The difference between both measured values must be at least 8.5 mm.



Mount cylinder head on assembly stand fixture using two cylinder head bolts.

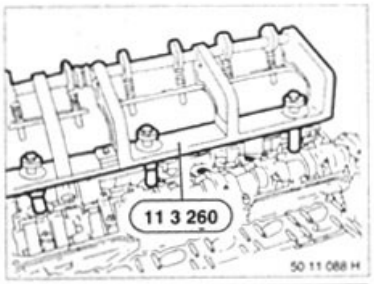


Prepare Special Tool 11 3 260 for a six cylinder engine.

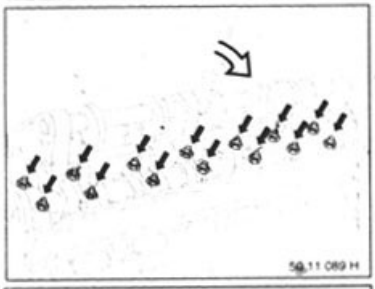
o Replacing Camshafts

Important!

Camshafts could be damaged or broken in case of improper removal / installation without application of special tools.
In addition, the valves could be bent through contact with the piston crowns when mounting the cylinder head on the crankcase.
Always conform with procedures and sequence of installation.

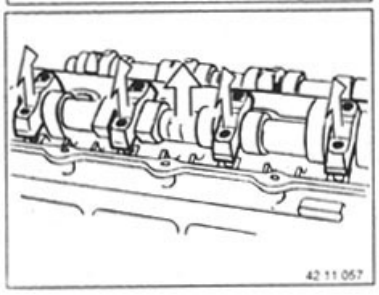


Unscrew spark plugs.
Apply Special Tool 11 3 260 and bolt down in the spark plug tapped bores.
Tightening torque = 23 Nm.



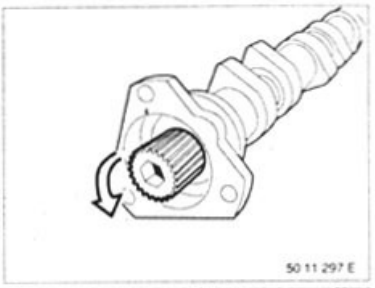
Preload bearing caps by turning the eccentric shaft.
Unscrew all bearing cap bolts.

Installation:
Tightening torque*.



Loosen and remove special tool.
Lift out bearing caps and camshaft.

* Refer to Specifications

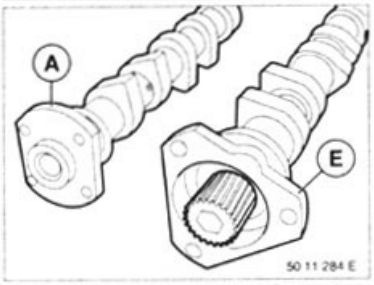


Take splined shaft out of intake camshaft.

Note:
Clamp camshaft in a vise fitted with soft jaws.

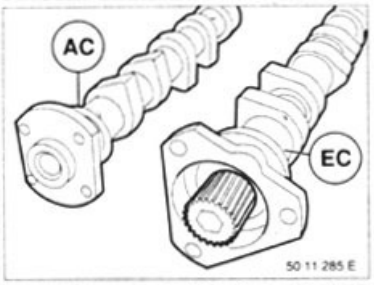
Remove splined shaft.

Installation:
Tightening torque*.



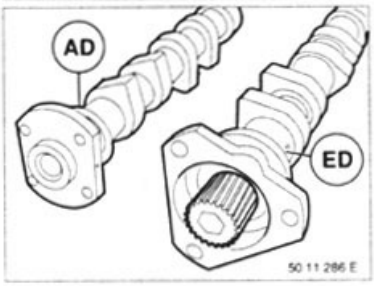
Installation:
Identification of camshafts on flange for timing chain sprocket:

E = Intake camshaft
A = Exhaust camshaft



Note:
Identification of camshafts:

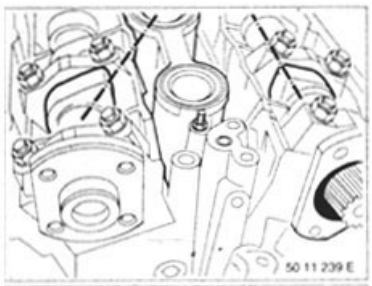
AC =	Exhaust camshaft	2.0 liters
EC =	Intake camshaft	2.0 liters



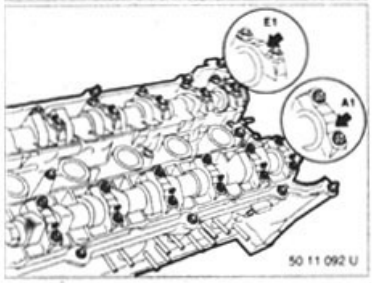
Note:
Identification of camshafts:

AD =	Exhaust camshaft	2.5 liters
ED =	Intake camshaft	2.5 liters

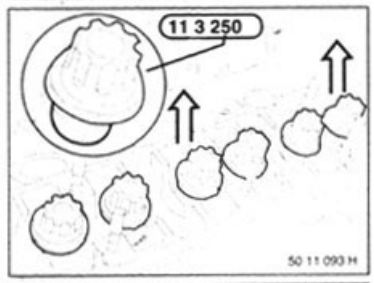
* Refer to Specifications



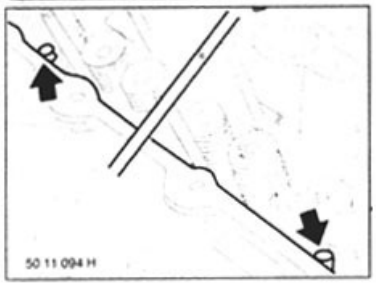
Installation:
Install camshafts in such a manner that the peaks of intake and exhaust cams for cylinder no. 1 point to each other.



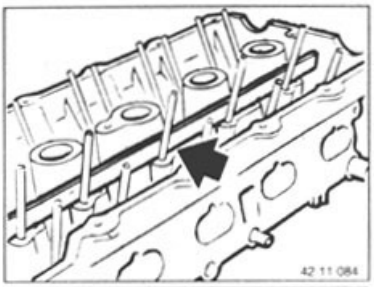
Installation:
Bearing caps are marked with
A1 ... A7 for the exhaust side or
E1 ... E7 for the intake side
and these marks can be read from the exhaust side.



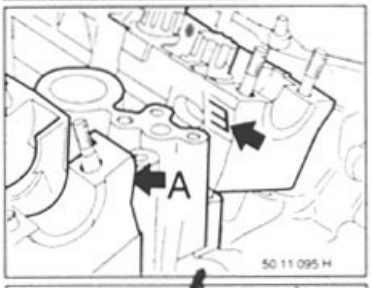
Hold valve clearance compensators tight using Special Tools 11 3 250.
Lift out bearing rail together with valve tappet.



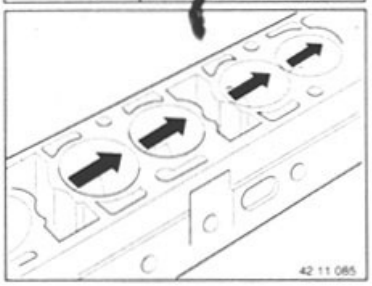
Installation:
Check for centering sleeves and studs at bearings 2 and 7.



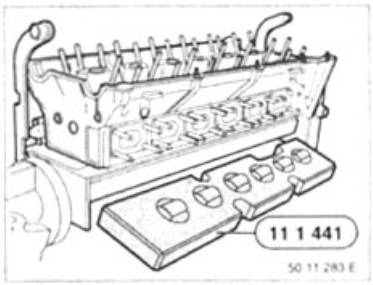
Note:
If a cylinder head is being replaced because of mechanical damage (cracked, distorted), the bearing surfaces of bearing rails on the old cylinder head must be checked for distortion using a steel straightedge.
Max. gap = 0.05 mm.
Also replace the bearing rails in case of greater deviation.



Installation:
Bearing rails are marked with
"A" for exhaust side or
"E" for intake side.

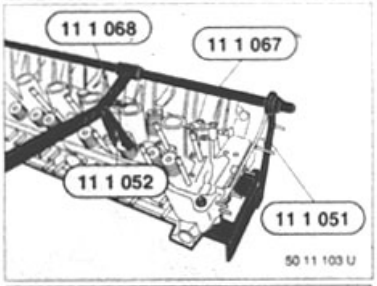


Installation:
Inspect bearing surfaces of valve clearance compensators for wear (scoring).

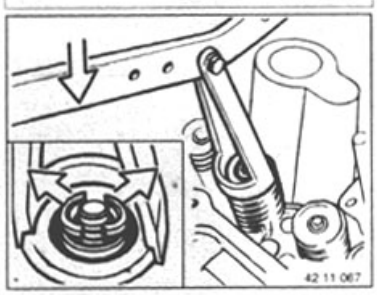


o Removing Valves

Install Special Tool 11 1 441 in Special Tool 11 1 065 from underneath and secure with studs.



Screw on Special Tool 11 1 051 (holder). Mount Special Tool 11 1 068 together with Special Tool 11 1 052 and Special Tool 11 1 067.



Press down on valve springs and remove valve collets.
Remove valve springs and spring retainers.
Take tray out of the assembly stand fixture downwards and pull out valve.

o Survey of Valves for Repairs

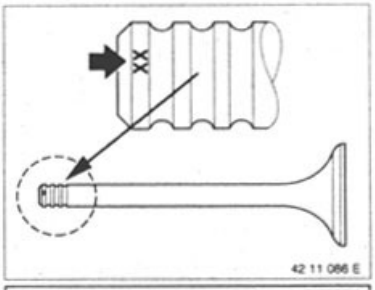
Important!

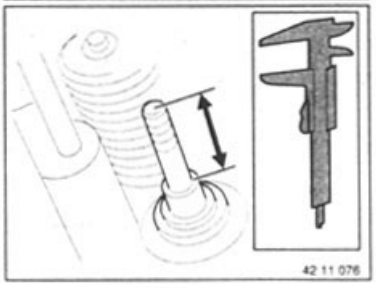
A valve with a thicker valve head must be installed of more than 0.2 mm is machined off of the valve seat (change in compression). The following valve versions are available in addition to standard size valves.

Stem Oversize	0.0 mm Size	0.1 mm Oversize	0.2 mm Oversize
Valve head thickness oversize	0.2 mm	0.2 mm	0.4 mm
For machining on seat insert more than mm	0.2 mm	0.2 mm	0.4 mm
Identification on stem (see Figure)	R 0	R 1	R 2

Note for Second Machining:
If size "R 0" valve is already installed and valve seat grinding is greater than 0.2 mm, install a size "R 2" valve straight off.
Valves with thick valve heads cause engine damage (knock limit is exceeded).

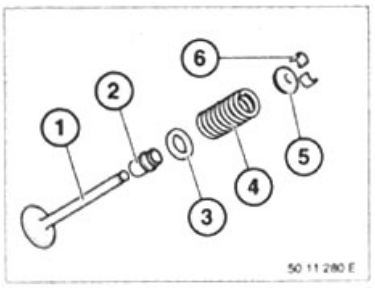
Location of Valve Identification





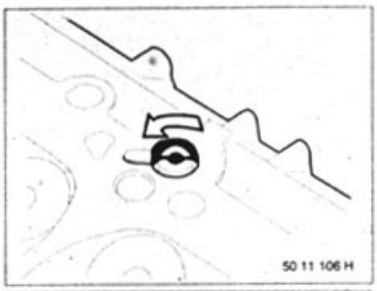
To which extent the valve seat must be machined can be determined as follows.

Insert valve, measure protrusion from valve stem to valve guide and note value.
Machine valve seat.
Insert same valve again, measure protrusion from valve stem to valve guide and note value.
The difference of both measured values is the machining distance.



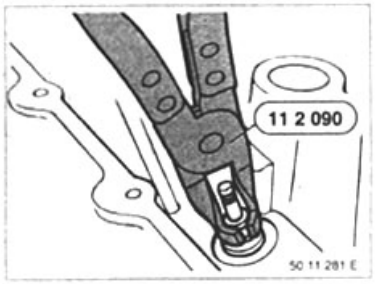
Sequence of installation:

1 Valve
2 Valve stem seal
3 Lower valve spring retainer
4 Valve spring
5 Upper valve spring retianer
6 Valve collets

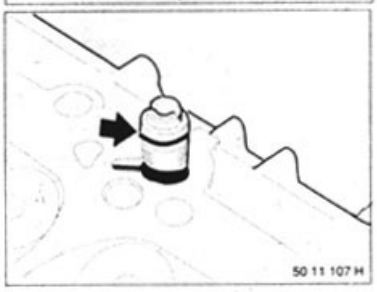


o Removing Check Valve

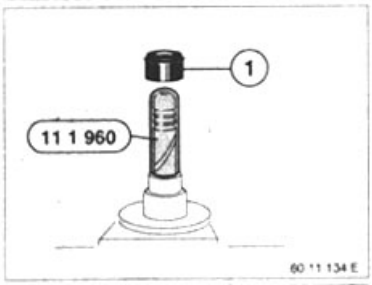
Unscrew valve.



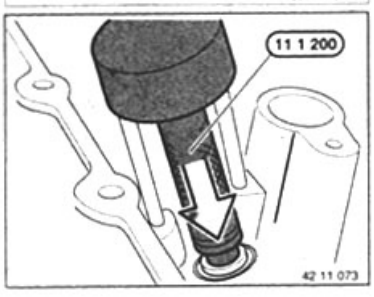
Pull off valve spring seal using Special Tool 11 2 090.



Installation:
Check seal, replacing it if necessary.
Tightening torque*.

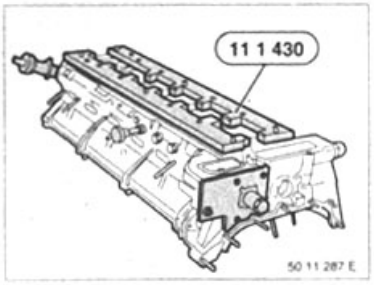


Installation:
Lubricate valve stem with oil and insert valve.
Apply Special Tool 11 1 960.
Lubricate new valve stem seal (1) with oil and install.



Installation:
Press on valve stem seal as far as stop by hand using Special Tool 11 1 200.

* Refer to Specifications

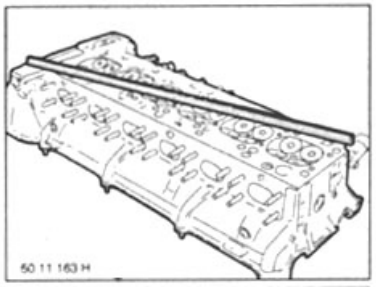


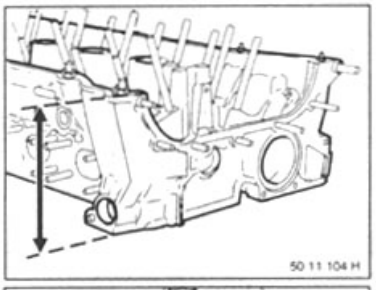
- Checking Cylinder Head for Cracks in Water Test

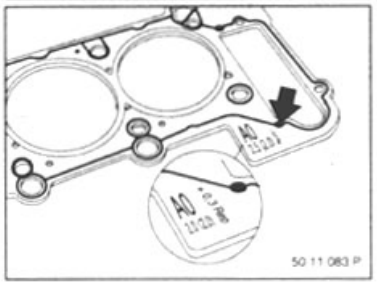
If there is suspicion of leakage in the coolant circuit (cylinder head zone), check the cylinder head as described below. Plug off the coolant circuit using Special Tool 11 1 430.

Supply air pressure to cylinder head.
Testing pressure = 4.5 bar.
Place cylinder head in a water bath and check for cracks.

Note:
If necessary, soften the bath water with a detergent.







- Grinding Cylinder Head Sealing Surface
- Inspecting Cylinder Head Sealing Surface

Check levelness of the cylinder head sealing surface with help of a standard steel straightedge.

Max. levelness deviation = 0.03 mm.

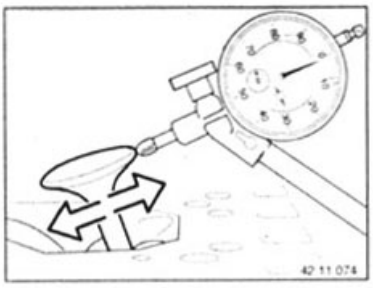
- Machining Cylinder Head

Remove all attachments from the cylinder head to machine the sealing surface.

Maximum machining*.
New cylinder head height*.

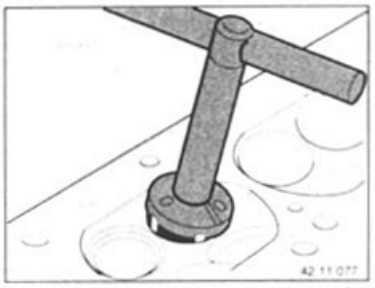
A 0.3 mm thicker cylinder head gasket is available for repairs to compensate for difference in compression.

* Refer to Specifications



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*.



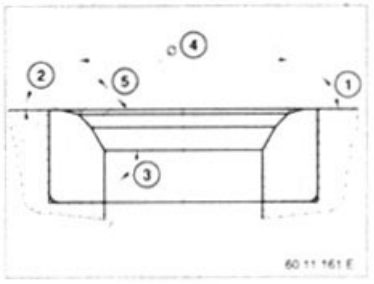
o Machining Valve Seat

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:

o Reaming Valve Guides

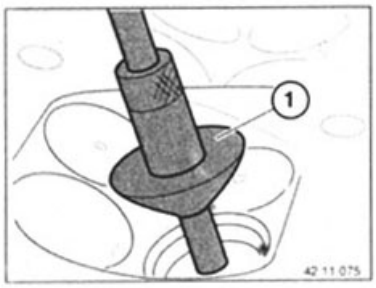
In case of excessive play between the valve stem and valve guide, the valve guide must be reamed out and a repair valve with oversized stem diameter* installed.



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*.

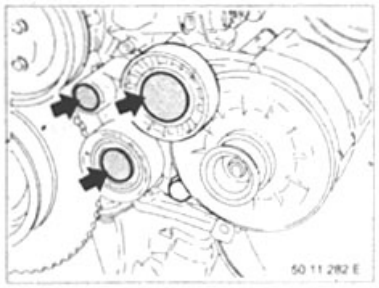


Assemble Special Tool 00 4 200 depending on the stem diameter.
Press mushroom guide (1) against the valve seat and ream out the valve guide dry from the combustion chamber end.
Turn down the reamer once.

Note:
The valve seat must be machined after reaming the valve guide.

* Refer to Specifications

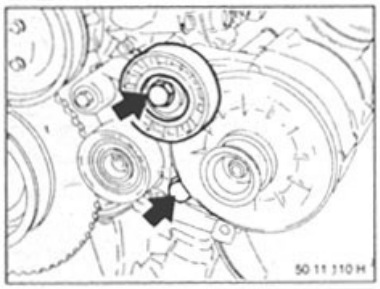
* Refer to Specifications



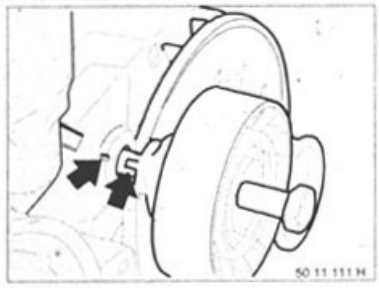
DISASSEMBLING AND ASSEMBLING CRANKCASE

o Removing Alternator

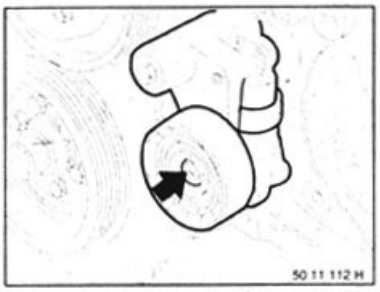
Lift off dust caps.



Unscrew bolts and remove alternator.

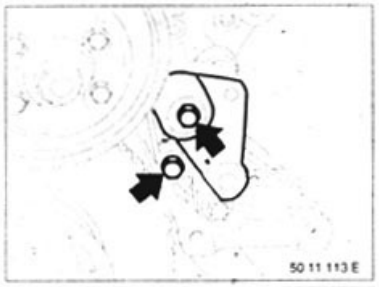


Installation:
Check retaining tab on bearing of the reversing roller.

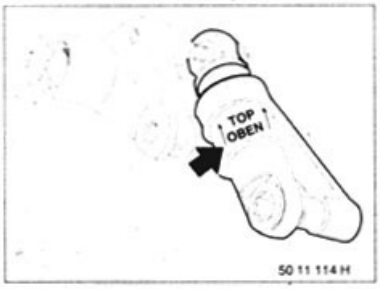


o Removing Tensioning Roller and Console

Unscrew tensioning roller.

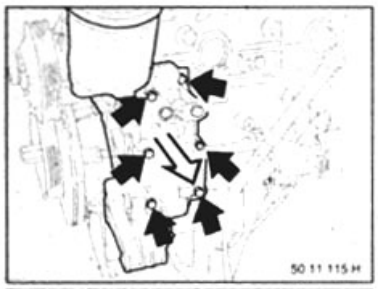


Unscrew console.



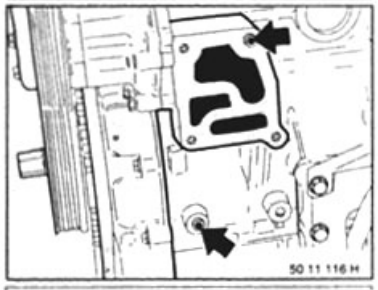
Note:
The hydraulic belt tensioner is filled with oil, so that a removed element must only be stored standing upright.
Incorrectly stored elements can normally be bled by compressing several times.

Installation:
Check installed direction.

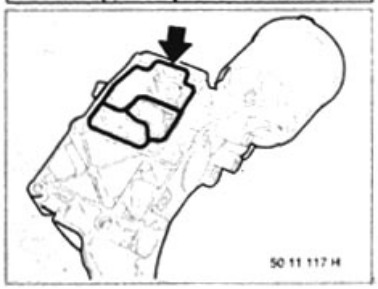


o Removing Oil Filter Housing

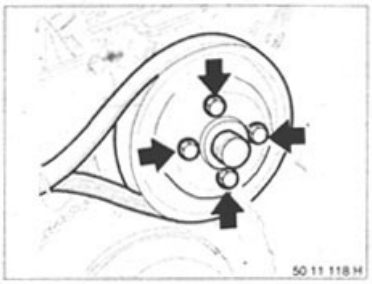
Unscrew screws and remove oil filter housing.



Installation:
Check for dowel sleeves.



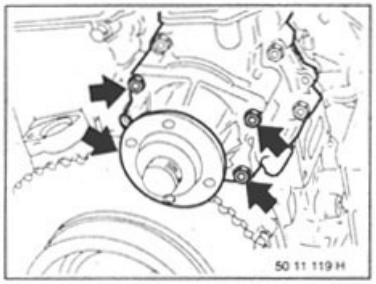
Installation:
Check gasket, replacing it if necessary.



o Removing Water Pump

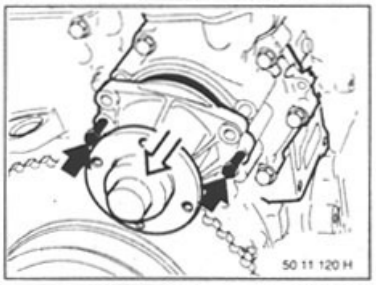
Hold pulley tight on the drive belt and unscrew bolts.

Installation:
Tightening torque*.

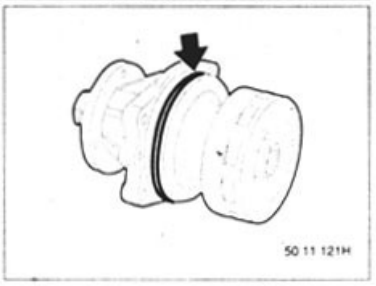


Unscrew bolts.

Installation:
Tightening torque*.

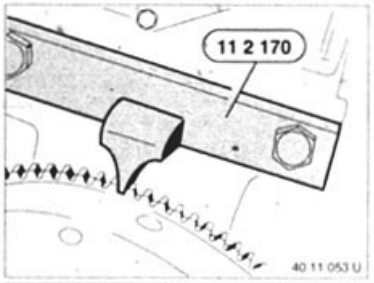


Screw two M6 bolts into tapped bores (1) and press water pump out of the end cover uniformly.



Installation:
Check O-ring, replacing it if necessary, and coat it with lubricant**.
Tightening torque*.

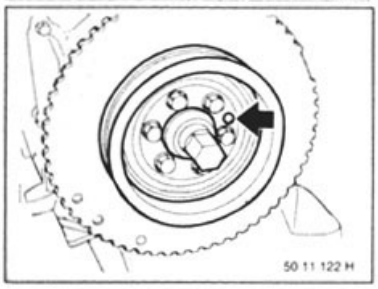
* Refer to Specifications
** Source of Supply: BMW Parts



o Removing Vibration Damper

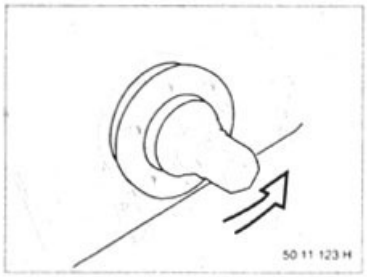
Block engine using Special Tool 11 2 170.

Important!
Do not block the engine with a mandrel.



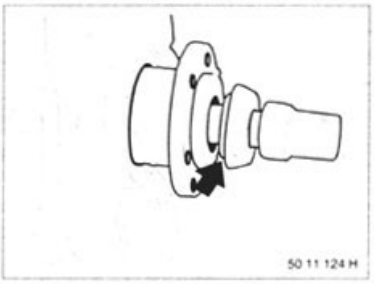
Unscrew bolts on vibration damper and remove vibration damper.

Installation:
Align dowel pin bore in vibration damper with the dowel pin.
Tightening torque*.



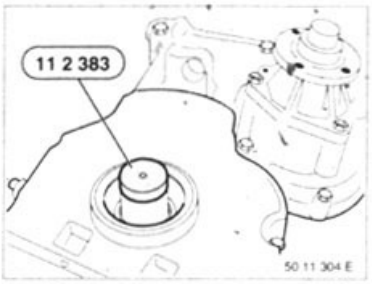
o Removing Vibration Damper Hub

Hold flywheel using Special Tool 11 2 170.
Unscrew central bolt.
Remove washer and hub.



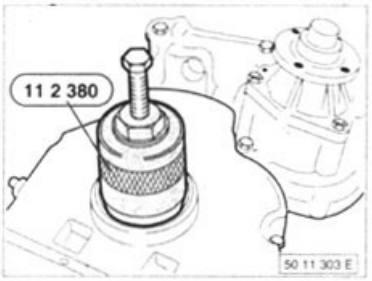
Installation:
Align groove of hub with the woodruff key.
Shoulder of washer faces the hub.
Central bolt tightening torque*.

* Refer to Specifications

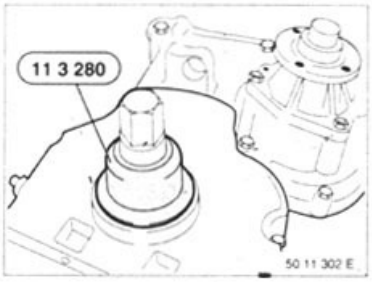


o Replacing Front Radial Oil Seal

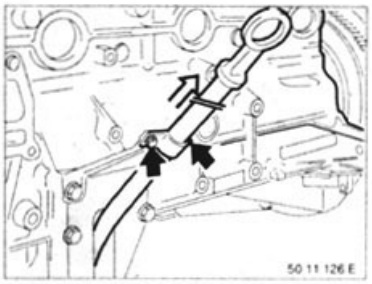
Apply Special Tool 11 2 383 on crankshaft.



Remove radial oil seal.
Screw in Special Tool 11 2 380 far enough that it is firmly connected with the radial oil seal.
Then pull out radial oil seal by screwing in the bolt.

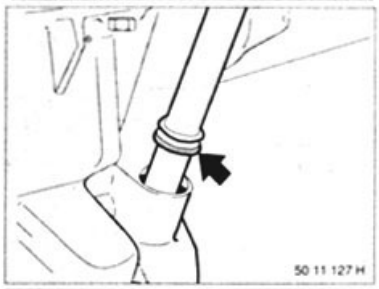


Installation:
Lubricate sealing lips of new radial oil seal with oil.
Install radial oil seal flush with the timing case cover using Special Tool 11 3 280 and the central bolt.

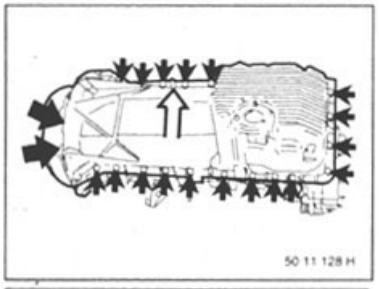


o Removing Oil Pan

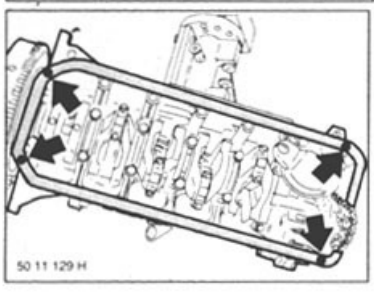
Unscrew and pull out oil dipstick guide tube.



Installation:
Check seal, replacing it if necessary.

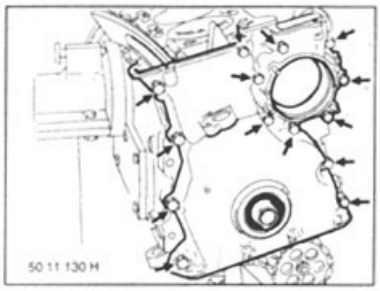


Unscrew all bolts and remove oil pan.



Installation:
Check gasket, replacing it if necessary.
Apply 3 Bond 1209** permanently elastic sealing compound at joints of timing case at front end and rear cover at rear end.

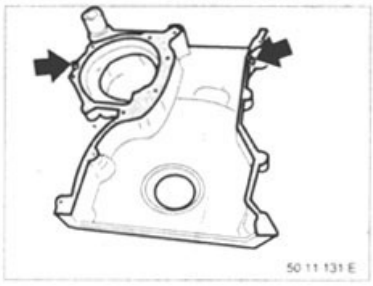
** Source of Supply: BMW Parts



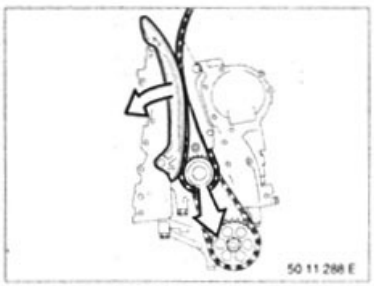
o Removing Lower Timing Case Cover

Unscrew bolts.
Lift off timing case cover.

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

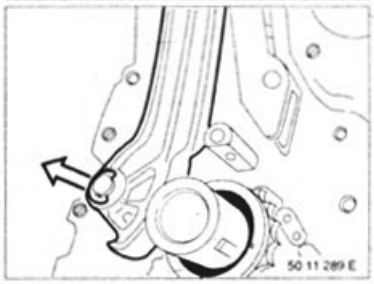


Installation:
Replace gaskets.
Check for dowel pins.

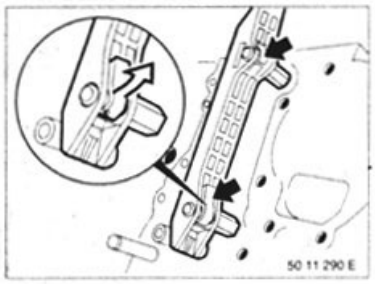


o Removing Lower Timing Chain and Guides

Fold tensioning rail downwards.
Lift out timing chain.

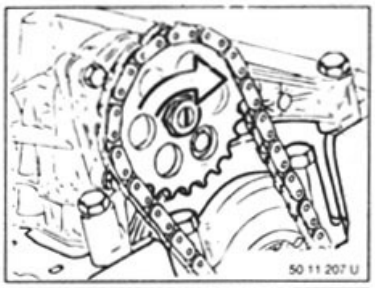


Remove tensioning rail.



Removing Chain Guide:

Lift upper and lower retainers.
Pull off chain guide.

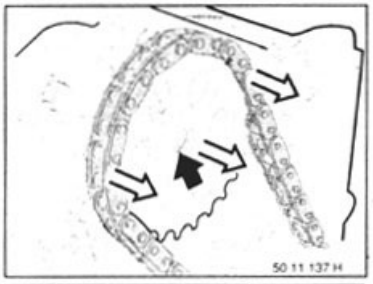


o Removing Oil Pump (E 34)

Unscrew sprocket nut.

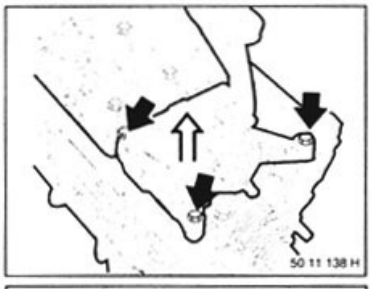
Important!
Left-hand threads.

Installation:
Tightening torque*.

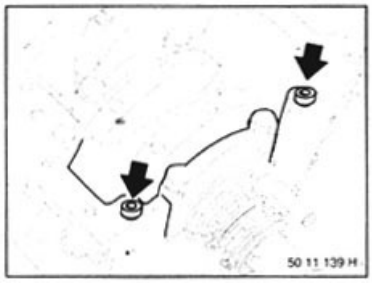


Lift off sprocket together with chain.

Installation:
Check for correct meshing of splines.

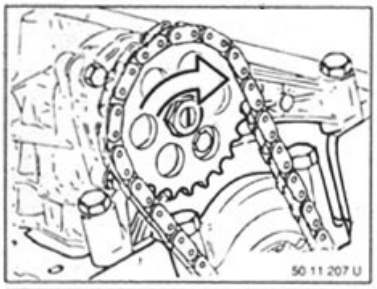


Unscrew oil pump.



Installation:
Check for dowel sleeves.

* Refer to Specifications

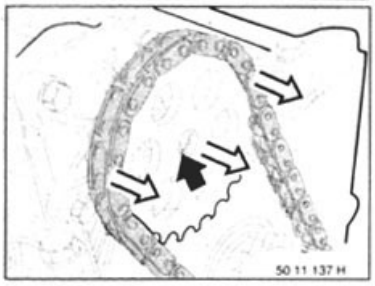


o Removing Oil Pump (E 36)

Unscrew sprocket nut.

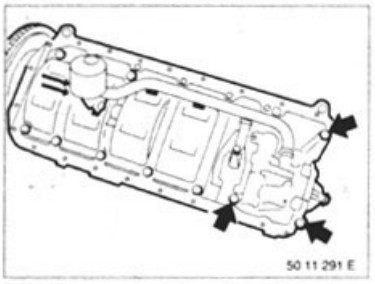
Important!
Left-hand threads.

Installation:
Tightening torque*.

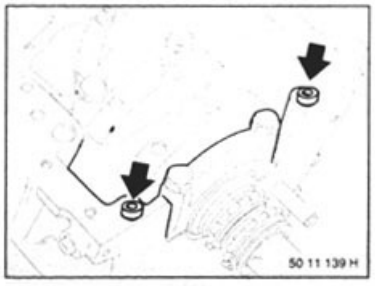


Lift off sprocket together with chain.

Installation:
Check for correct meshing of splines.

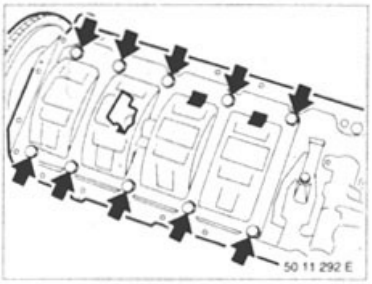


Unscrew oil pump.
Unscrew intake pipe support.

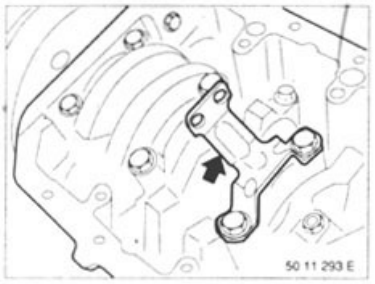


Installation:
Check for dowel sleeves.

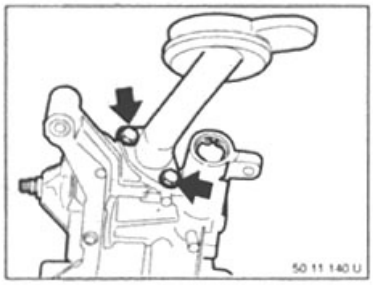
* Refer to Specifications



Unscrew oil baffle plate.

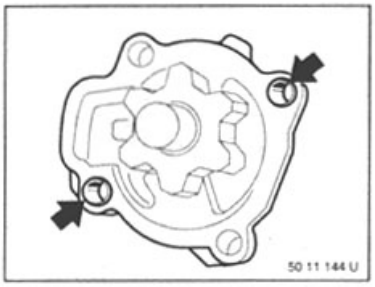


Check for intake pipe support on main bearing no. 5.

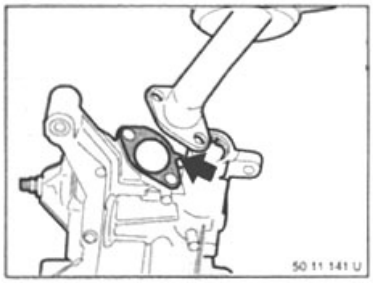


o Disassembling Oil Pump

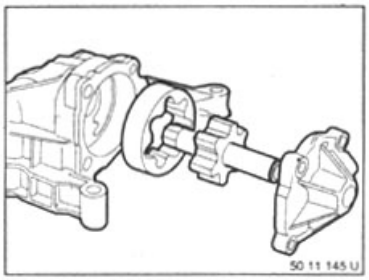
Unscrew intake pipe.



Installation:
Check for dowel sleeves.

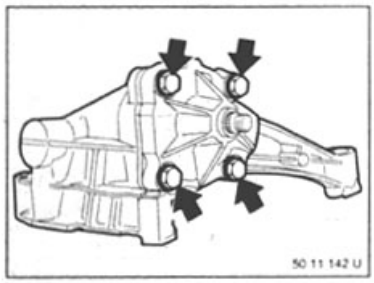


Installation:
Tab on gasket points to the intake basket.

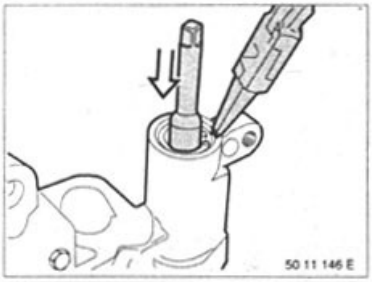


Installation:
Inspect all parts for wear.

Scoring in body
Wear on rotors
Wear and scoring on bearing surfaces



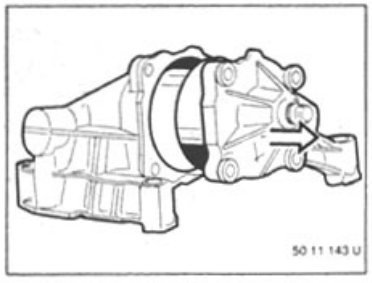
Screw on pump body.



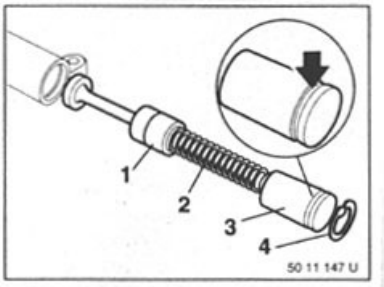
Removing Pressure Relief Valve:

Press down lightly on sleeve using a suitable punch.
Lift out circlip and remove valve.

Caution!
Strong spring force.

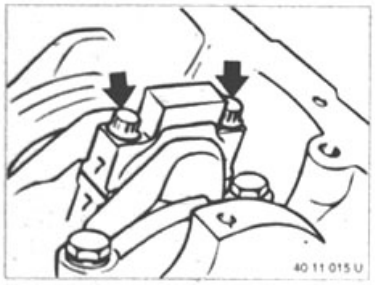


Remove pump front section together with shaft and rotor.



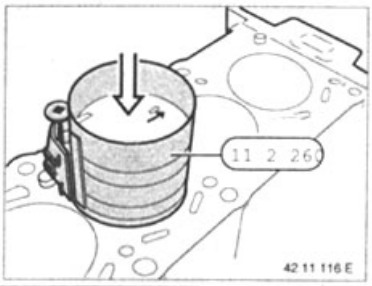
Installation:
1 Plunger
2 Spring
3 Sleeve and O-ring
4 Circlip

Important!
Check seal, replacing it if necessary.
Don't damage the sleeve.



o Removing Connecting Rod and Piston

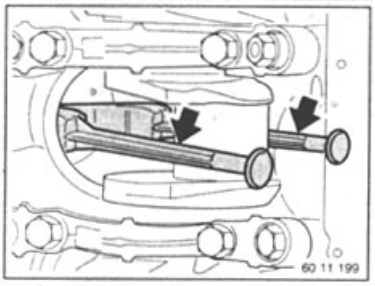
Unscrew conrod bearing cap.
Pull out connecting rod and piston to the cylinder head end.



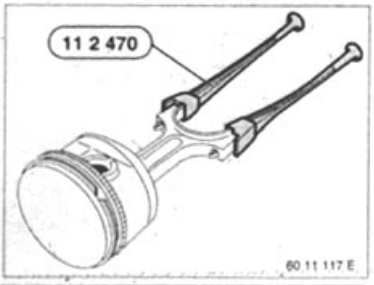
Installation:
Insert piston that arrow points to camshaft drive.
Compressing tool must bear flat on crankcase all around.
Press in piston only with finger force (do not knock in!).



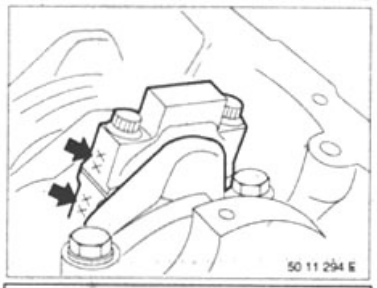
Important!
Reinstall piston, connecting rod and bearing shells in the same installed position.
Connecting rods and bearing caps are marked with the same pair number and must not be mixed up.



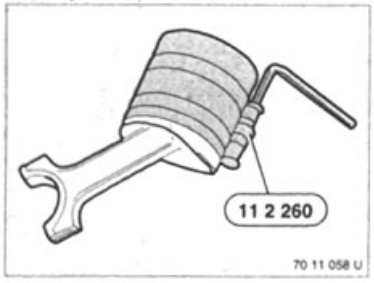
Installation:
Guide crankshaft journal and connecting rod together.



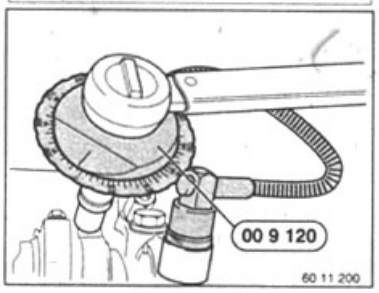
Installation:
Apply Special Tool 11 2 470 in connecting rod.



Installation:
Lubricate conrod bearing shells with oil.
Mount bearing cap that pair numbers are aligned.
Screw in new conrod bolts.

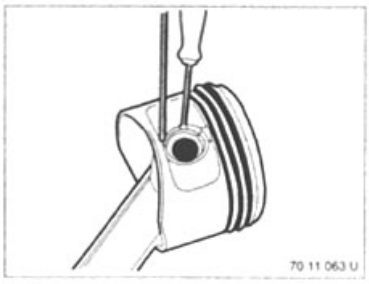


Installation:
Lubricate piston and piston rings lightly with oil.
Align gaps of piston rings (offset approx. 120°, but not above the piston pin eye).
Compress piston rings using Special Tool 11 2 260.



Installation:
Tighten conrod bearing cap bolts using Special Tool 00 9 120 or 11 2 110.
Conrod bolt tightening torque*.

* Refer to Specifications

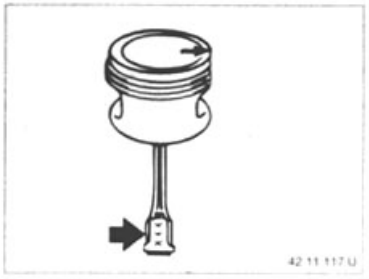


o Removing Connecting Rod

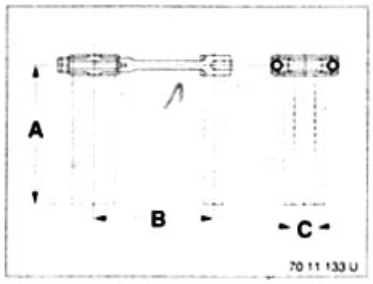
Lift out circlip and press out piston pin.

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:
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.

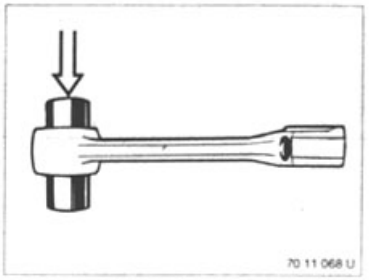


Checking Connecting Rod:

Check connecting rod for deviation in parallelism and distortion.

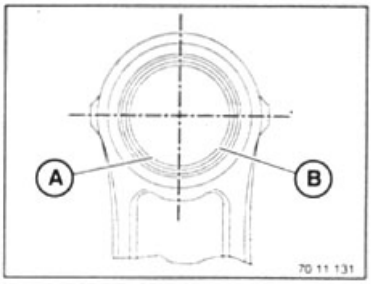
A Testing distance*
B Permissible parallel deviation at distance A*
C Max. permissible distortion to each side*

* Refer to Specifications



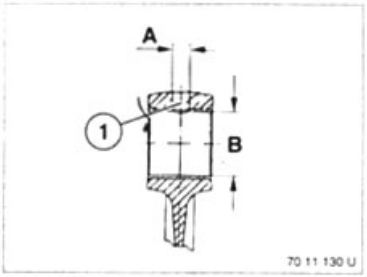
Checking Piston Pin Bush:

It should be possible to push the piston pin through the bush by hand with slight force and there must not be noticeable play.

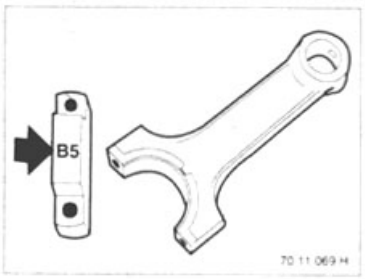


Replacing Piston Pin Bush:

Press out old bush using a suitable punch (23.5 mm dia.).
Press in new bush with bush gap located optionally at A or B.



Drill oil bore (1).
A = 6 mm.
B = Bore diameter*
Remove burrs from both ends of bore.
Ream out bush dry to specified diameter* using a reamer.

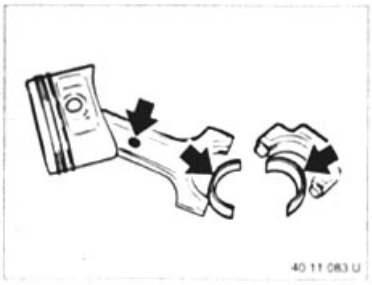


Replace connecting rod.

Note:
Only connecting rods of the same weight class (stamped on bearing cap) may be installed in one engine.

Only connecting rods of weight class B5 are available from Parts for replacements. They cover the entire range of weight tolerances.

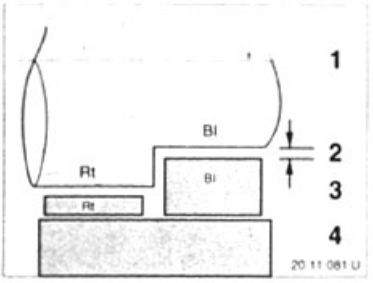
* Refer to Specifications



o Replacing Conrod Bearing Shells

Select new bearing shells to conform with paint mark on connecting rod.

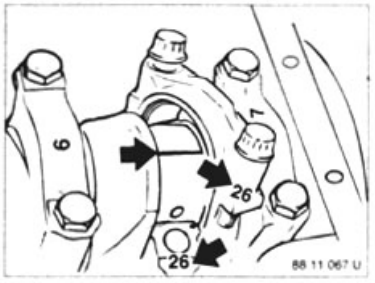
Important!
Check ground size of the crankshaft - also refer to "Replacing Crankshaft".



Color Code Shaft Diameter Bearing Shell Thickness* Survey

Double Classification Color Codes:
Rt = Red
Bl = Blue

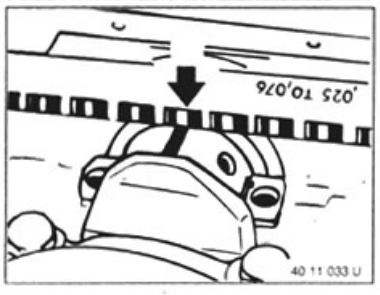
1 = Crankpin
2 = Bearing play
3 = Bearing shell thickness
4 = Conrod eye



Installation:
Checking conrod bearing play.
Only carry out for control purposes.

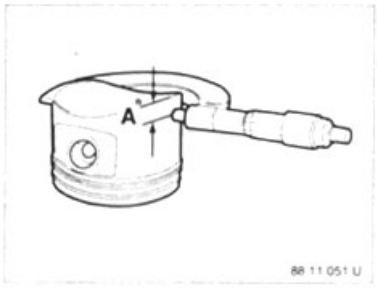
With piston in BDC place Type PG1 Plastigage (Special Tool 00 2 590) on crankshaft wiped clean of oil.
Mount bearing cap and secure with old conrod bolts tightened to specifications.

Important!
Don't turn the connecting rod or crankshaft.



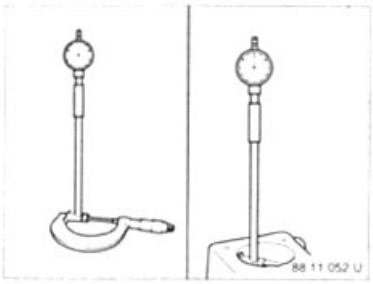
Remove bearing cap and read bearing play* by measuring width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells or bearing shells with a different paint mark.

* Refer to Specifications



o Replacing Piston

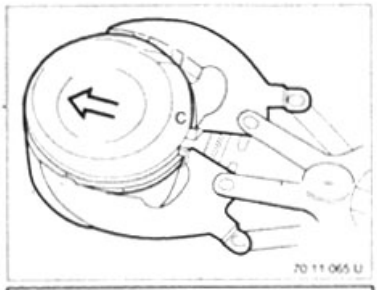
Installation:
Measure the piston installed clearance before installing.
Measure the piston diameter at distance * from the bottom edge of the piston and 90° to the piston pin axis using a micrometer.



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*.

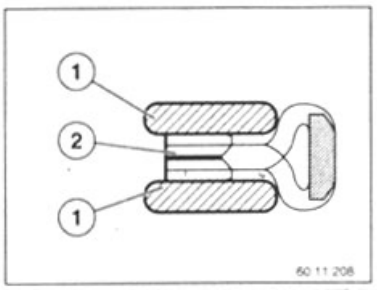
* Refer to Specifications



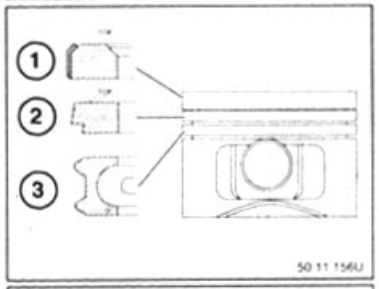
o Replacing / Checking Piston Rings

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.
New pistons may only be installed together with new piston rings.



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°.



Installation:
Insert piston rings with "TOP" facing piston crown.

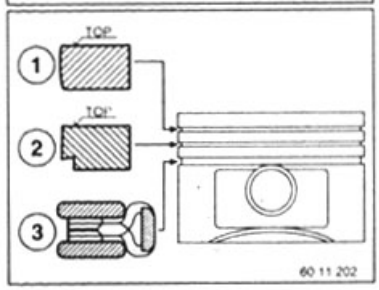
Note:
2.0 Liter Version:

1 Plain compression ring
2 Stepped taper face ring "Top" (check installed position)
3 Slotted oil scraper ring with rubber lined spring



Measure side clearance.

Specification*.
Max. permissible total wear*.

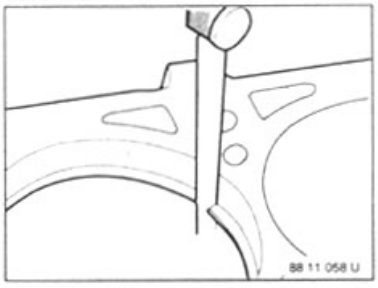


Installation:
Insert piston rings with "TOP" facing piston crown.

Note:
2.5 Liter Version:

1 Plain compression ring
2 Stepped taper face ring "Top" (check installed position)
3 Three-piece steel band ring

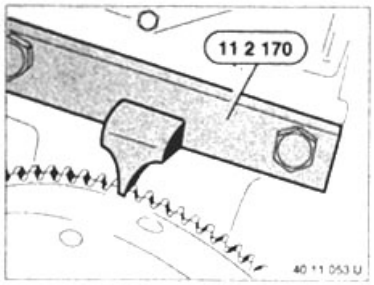
Offset piston ring gaps about 120° to each other, but not above the piston pin eye.



Measure end clearance.

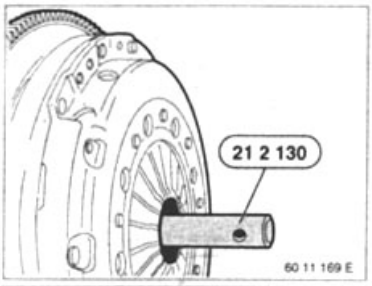
Specification*.
Max. permissible total wear*.

* Refer to Specifications

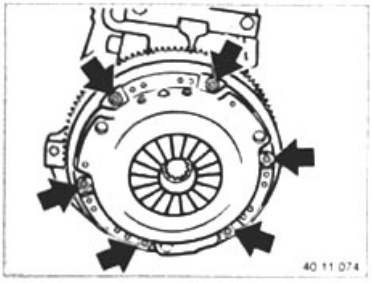


o **Removing Clutch / Flywheel**

Hold flywheel using Special Tool 11 2 170.

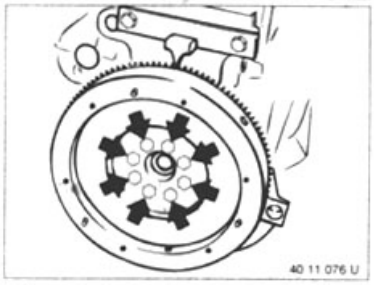


Installation:
Center drive plate using Special Tool 21 2 130 and tighten bolts in several steps. Tightening torque*.



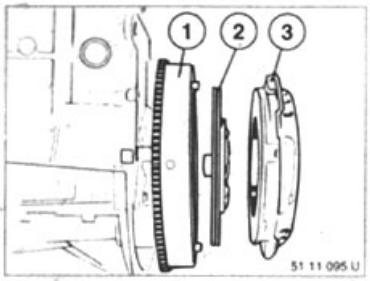
Unscrew bolts uniformly.
Remove pressure plate and drive plate.

Installation:
Check for dowel pins.

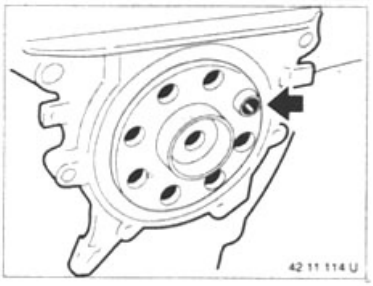


Unscrew bolts and remove flywheel.

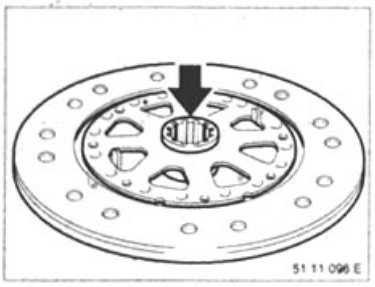
Installation:
Clean threads of tapped bores and install new micro-encapsulated bolts. Tightening torque*.



Installation:
1 Flywheel
2 Drive plate
3 Pressure plate

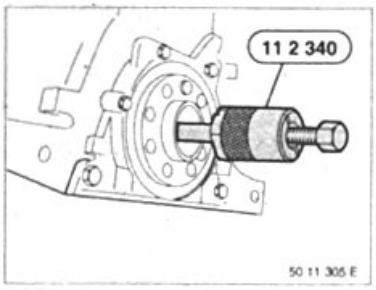


Installation:
Check for dowel sleeve.



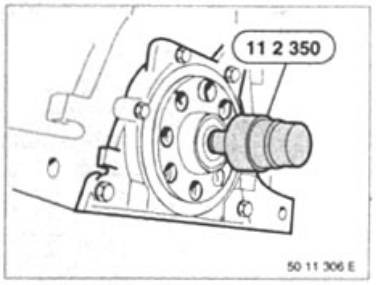
Note:
Flat side of drive plate (2) faces towards the transmission.

* **Refer to Specifications**

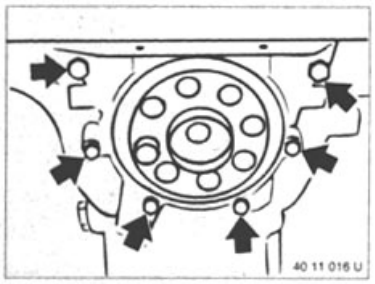


o Replacing Pilot Bearing in Crankshaft

Remove pilot bearing using Special Tool 11 2 340.

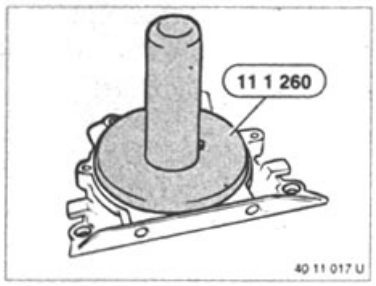


Installation:
Insert and drive in new pilot bearing as far as stop using Special Tools 11 2 350 and 00 5 500.

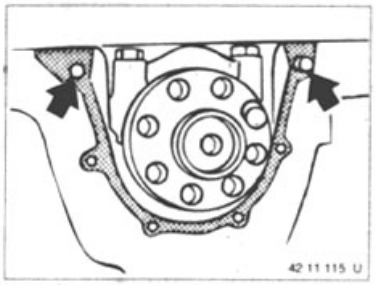


o Removing Rear End Cover

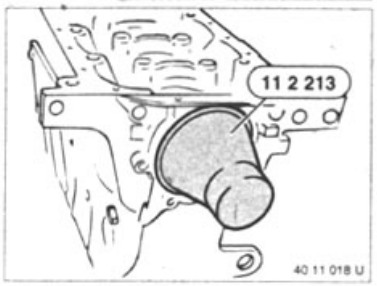
Unscrew bolts and remove cover.



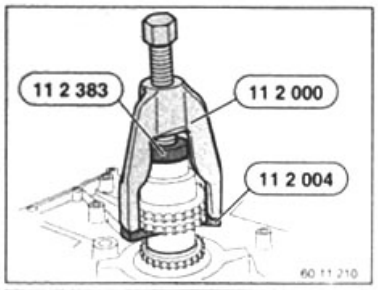
Installation:
Lift out radial oil seal and drive in new seal using Special Tools 11 1 260 and 00 5 500.



Installation:
Check for correct fit of dowel sleeves.
Replace gasket.



Installation:
Apply Special Tool 11 2 213 on crankshaft.
Lubricate sealing lip of radial oil seal with oil.
Install cover and tighten bolts.



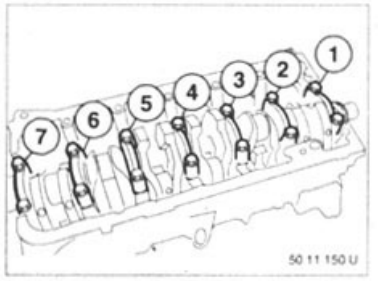
o Removing Crankshaft

Apply Special Tool 11 2 383 on crankshaft.
Pull off sprocket using Special Tools 11 2 000 and 11 2 004 or a standard puller.

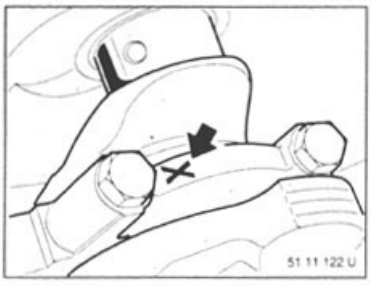


Installation:
Check woodruff key for correct fit.
Heat sprocket to max. 150° C with a hot air blower or on a hotplate.

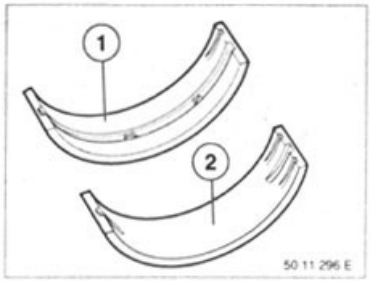
Important!
Do not exceed the specified temperature because of the rubber!



Unscrew main bearing cap bolts.
Remove main bearing caps (1 ... 7).
Lift out crankshaft.

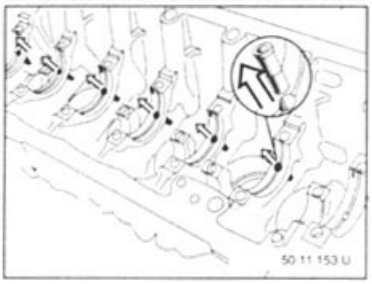


Note:
Bearing caps 1 ... 5 are marked on the exhaust side.
Bearing caps 6 and 7 are not marked.
Bearing cap 6 is the thrust bearing.



Installation:
Install bearing shells (1) with a lubricating groove and one retaining tab in crankcase.

Install bearing shells (2) without a continuous lubricating groove and with two retaining tabs in the bearing caps.

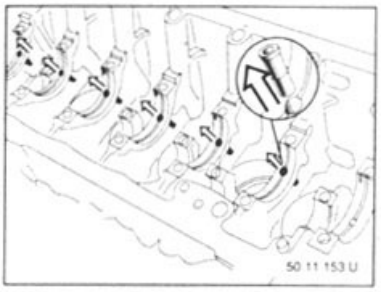


Installation:
Ensure that oil spray jets are used at bearings 2 ... 7.

Installation:
Lubricate bearing shells with oil.
Install crankshaft.
Mount bearing caps 1 ... 7 (bearing no. 1 is at the camshaft drive end) in such a manner that grooves of the bearing shell guide are all on same side.
Align bearing caps precisely.

Note:
Thrust bearing shells are installed at bearing no. 6.

Installation:
Main bearing cap bolts must always be replaced with new bolts.
Keep oil out of tapped bores (danger of cracking the block).
Wash and lubricate bolts with oil.



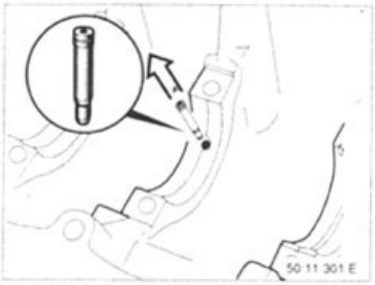
o Replacing Piston Cooling Spray Jets

Note:
Spray jets are installed in bores of bearings 2 ... 7 and serve lubrication of piston pins and cooling of pistons.

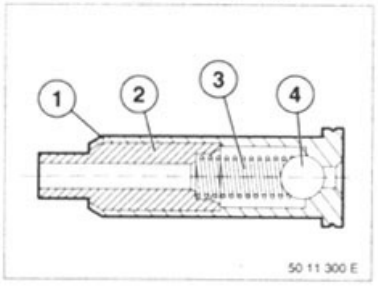


Main Bearing Cap Bolt Tightening Procedures:

1st Step	Tighten bolts to tightening torque in Nm*.
2nd Step	Tighten bolts to torque angle* using Special Tool 11 2 110 or 00 9 120.
	Tightening torque*.



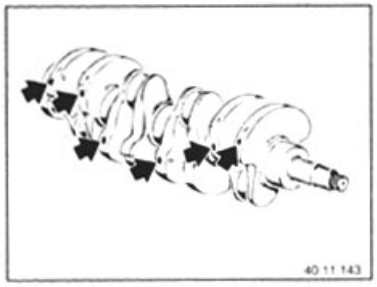
Pull spray jet out of crankcase.



Spray Jet Assembly:

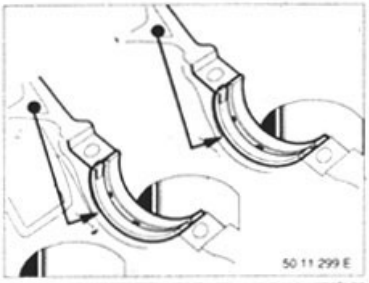
1 Jet body
2 Jet
3 Spring
4 Ball

* Refer to Specifications



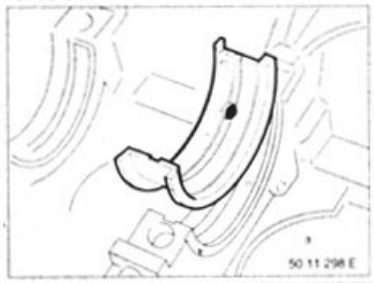
o Replacing Main Bearing Shells

Crankshafts are marked with yellow, green or white paint depending on main bearing tolerances.

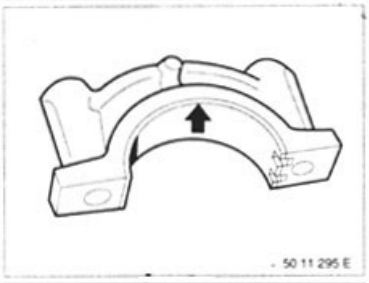


Installation:
When replacing bearing shells (also for exchange crankshafts), classification does not apply for the allocation of bearing shells in the crankcase.
Only install yellow bearing shells in the crankcase.

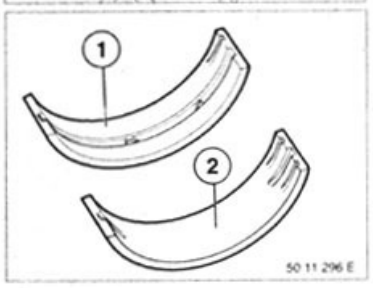
Check ground size of crankshaft!



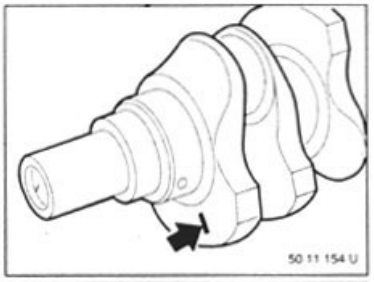
Note:
Thrust bearing shells are installed at bearing no. 6.



Installation:
Bearing shell classification for bearing caps is marked on the crankshaft with yellow, green or white paint.

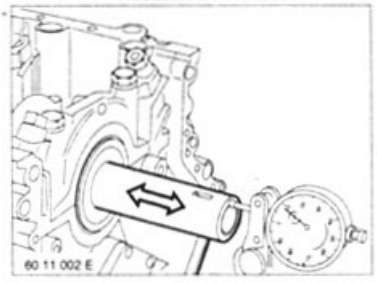


Note:
1 Bearing shells with continuous lubricating groove and one retaining tab (for crankcase)
2 Bearing shells without continuous lubricating groove and with two retaining tabs (for bearing caps)



Important!
Check ground size* of crankshaft.

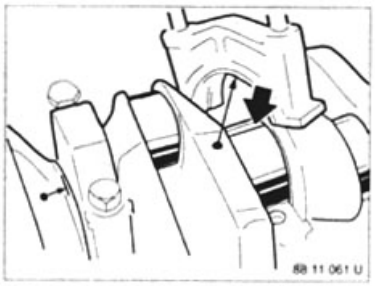
1 paint stripe	Size 1 (0.25 mm)
2 paint stripes	Size 2 (0.50 mm)



Checking Axial Play:

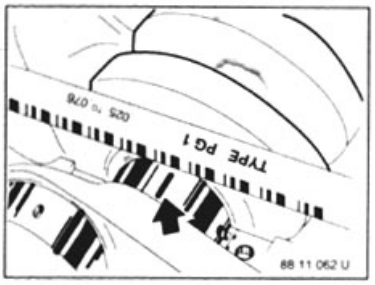
If permissible play* is exceeded, check crankshaft and thrust bearing shells and replace if necessary.

* Refer to Specifications

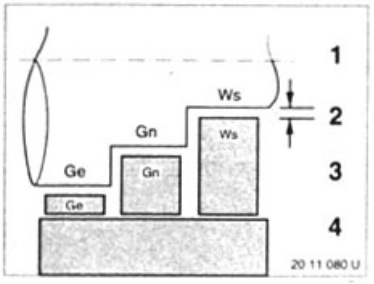


Check bearing clearance.
Only carry out this step for control purposes.

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.



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

11 Engine M51

11 00 . . . Engine – disassemble and assemble (engine removed) 11- 51/1
Engine – mount on assembly stand 11- 51/1
A. Cylinder head – remove 11- 51/3
Intake manifold and intake necks – remove 11- 51/3
Injection pipes – remove 11- 51/3
Ribbed drive belt – remove 11- 51/4
Cylinder head cover – remove 11- 51/4
Belt tensioner – remove 11- 51/4
Vacuum pump – remove 11- 51/5
Valve timing – remove 11- 51/5
Camshaft adjusting procedures 11- 51/6
Cylinder head – unscrew 11- 51/8
Piston protrusion – measure 11- 51/10
B. Cylinder head – disassemble and assemble 11- 51/11
Thermostat housing – remove 11- 51/11
Cylinder head – mount on assembly stand 11- 51/11
Camshaft – remove 11- 51/12
Valves – remove 11- 51/13
Cylinder head – inspect sealing surface 11- 51/14
Cylinder head – check for cracks in water test (cylinder head disassembled) 11- 51/15
Valve guide and seat – machine 11- 51/15
Valves – check for leaks (camshaft removed) 11- 51/17
C. Crankcase – disassemble 11- 51/18
Oil filter housing – unscrew 11- 51/18
Oil dipstick – remove 11- 51/18
Power steering pump – remove 11- 51/18
Alternator – remove 11- 51/19
Console for alternator and power steering pump – remove 11- 51/19
Console for AC compressor – remove 11- 51/19
Wire harness for engine – remove 11- 51/19
Oil pan – remove 11- 51/19
Water pump – remove 11- 51/20
Vibration damper – remove 11- 51/21
Vibration damper hub – remove 11- 51/21
Drive chain – remove 11- 51/21
Engine console – unscrew 11- 51/23
Injection pump drive chain adjusting procedures 11- 51/23
Injection pump – unscrew 11- 51/24
Oil pump – remove 11- 51/25
Oil pump – disassemble and assemble 11- 51/25
Injection pump console – remove 11- 51/26
Clutch / flywheel – remove 11- 51/27
Pilot bearing in crankshaft – replace 11- 51/27
Rear end cover – remove 11- 51/28
Connecting rod and piston – remove 11- 51/29
Connecting rod – remove/inspect/repair 11- 51/30
Connecting rod bearing shells – replace 11- 51/31
Piston – replace/check 11- 51/32
Piston rings – replace/check 11- 51/32
Crankshaft – remove 11- 51/32
Main bearing shells – replace 11- 51/33

11 00 ... DISASSEMBLING AND ASSEMBLING ENGINE
(Engine Removed)

General Information for Working on Valve Timing:
Attention must be paid to the following if work had been carried out on the cylinder head, for which the camshaft was removed:
Hydraulic valve tappets expand when without load from the camshaft and must be allowed enough time after installation to constrict again. Consequently fast assembly could cause "closed" valves to still be open and have contact with the pistons.

The following waiting times must be allowed between installation of the camshaft and mounting of the cylinder head:

Ambient Temperature:	Time:
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:

Ambient Temperature:	Time:
20° C	10 minutes
10 to 20° C	30 minutes
0 to 10° C	75 minutes

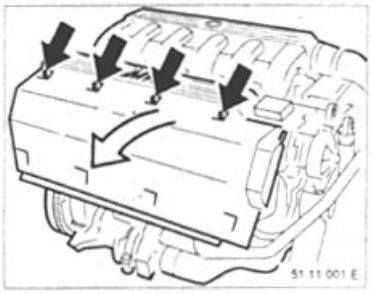
Working on Valve Train with Mounted Cylinder Head:

Turn crankshaft in engine's direction of rotation to approx. 30° from the TDC mark, so that in this manner no pistons are in TDC.
Install camshaft so that the cam peaks of cylinder no. 6 overlap.

Conform with the above mentioned waiting times. Turn crankshaft back to TDC position and mount timing chain.
Crank engine not earlier than 10 minutes after installation of the camshaft.

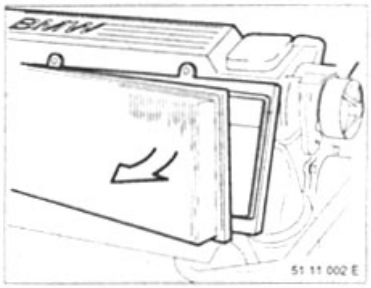
Disassembling and repairing the engine are described in chronological sequence on the following pages. The positions shown in the list of contents will help in taking up work again after an interruption or finding different points more easily. They only describe the direct removal or installation, but not the complete scope of work.

If necessary, drain engine oil and fill engine with new engine oil after completion of engine assembly. Check oil level after installation and road test.

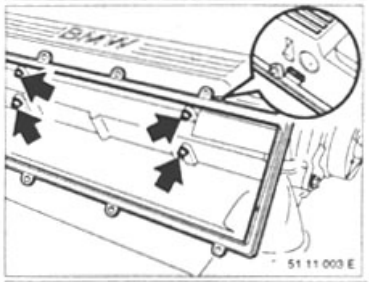


o Mounting Engine on Assembly Stand

Remove air cleaner.
Unscrew upper housing section.

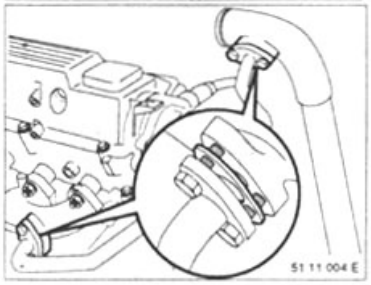


Take air filter element out.



Unscrew air cleaner housing and lift off together with the intake channel.

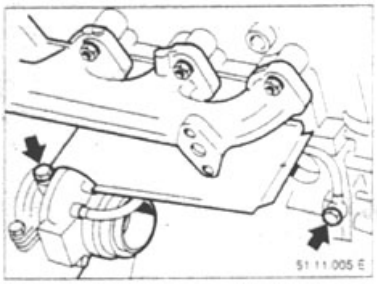
Installation:
Pay attention to O-ring for crankcase breather.



Unscrew EGR pipe.

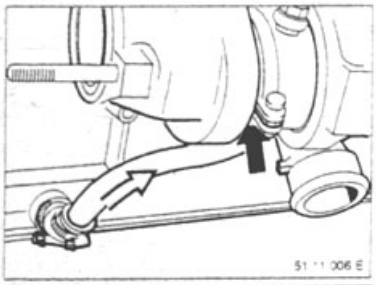
*Installation:**
Tightening torque*.

* Refer to Specifications



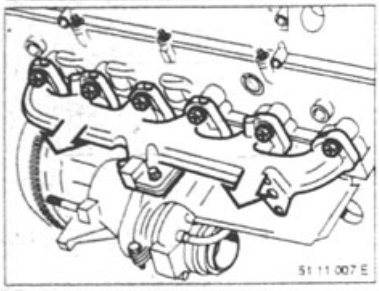
Unscrew oil supply pipe.

Installation:
Replace gaskets (2 each).
Tightening torque*.



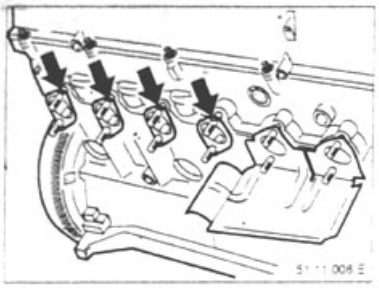
Unscrew oil return pipe.

Installation:
Replace gaskets.
Tightening torque*.



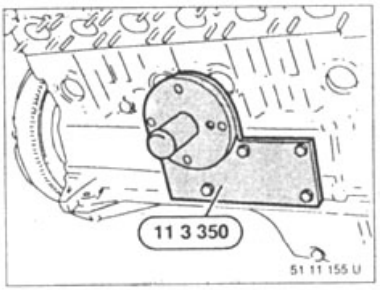
Unscrew exhaust manifold complete with turbocharger.

Important!
Pay attention to shims.

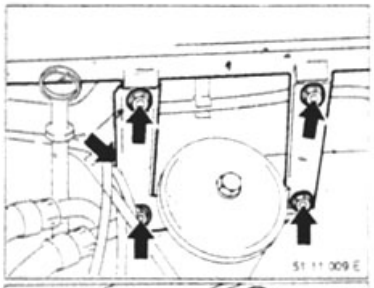


Installation:
Pay attention to arrangement of heat shields and gaskets; pins face out.
Tighten from inside to outside!
Tightening torque*.

* Refer to Specifications



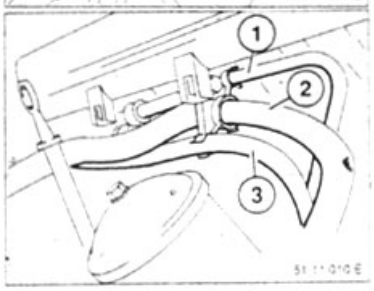
Mount engine on Special Tool 00 1 490 using Special Tool 11 3 350.



A. REMOVING CYLINDER HEAD

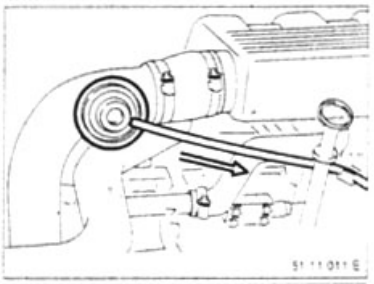
o Removing Intake Manifold with Intake Pipes:

Unscrew supports.
Unclip holders.

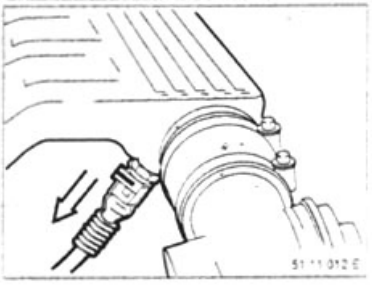


Unclip hoses from holders.

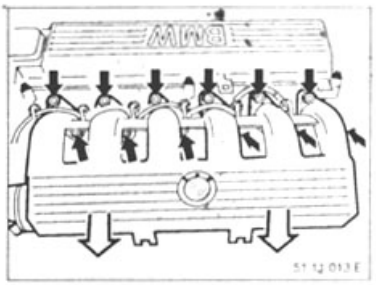
1 = Vacuum hose for brake booster
2 = Coolant hose for heater
3 = Fuel hose for injection pump



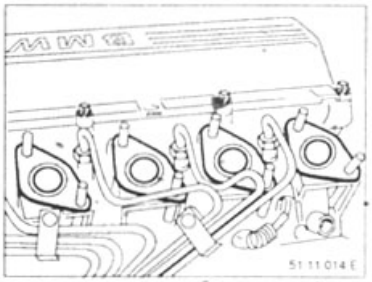
Pull vacuum hose off of EGR vacuum unit.



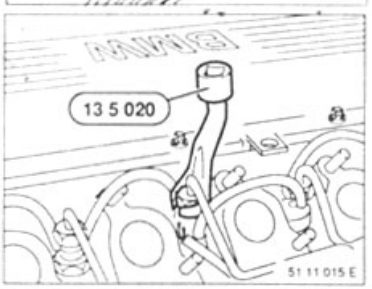
Pull temperature sensor plug off of intake manifold.



Unscrew intake manifold.



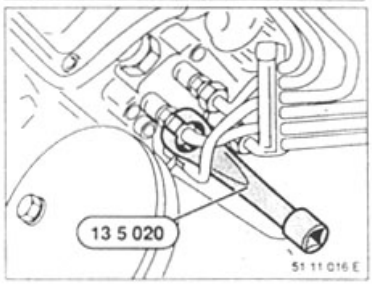
Installation
Replace gaskets.



o Removing Injection Pipes:

Unscrew coupling nuts with Special Tool 13 5 020.

Important!
Reposition tool in good time to avoid bending the pipes.
Plug openings with caps.

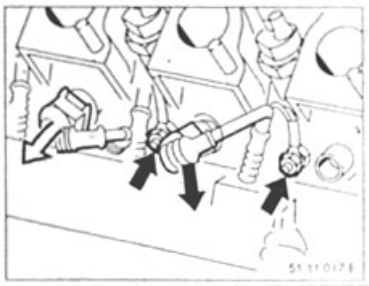


Unscrew coupling nuts on injection pipe.

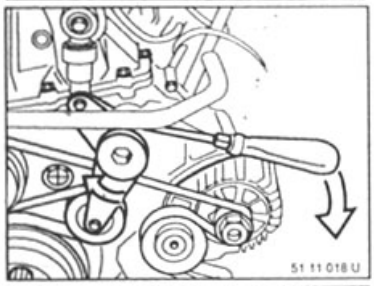
Installation:
Tightening torque*.

Remove complete pipes.

* = Refer to Specifications

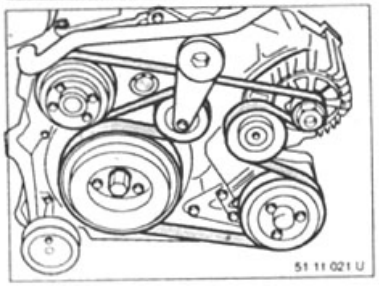


Disconnect plugs and connections for glow plugs.

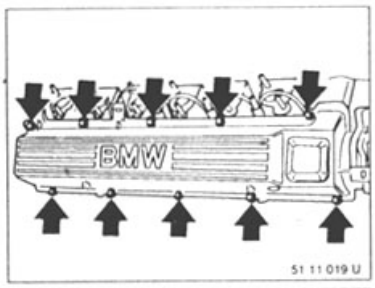


o Removing Ribbed Drive Belt:

Slacken the automatic belt tensioner with a suitable lever (e.g. thick screwdriver) and remove ribbed drive belt.



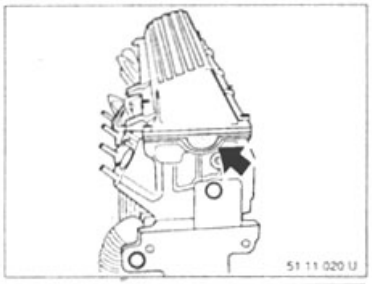
Important!
Pay attention to belt arrangement.
Place multi-tooth belt in grooves correctly.



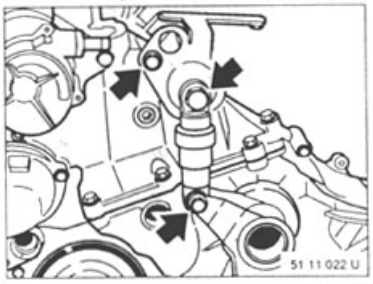
o Removing Cylinder Head Cover:

Unscrew cylinder head cover.

Installation:
Tightening torque*.
Tighten from inside to outside.

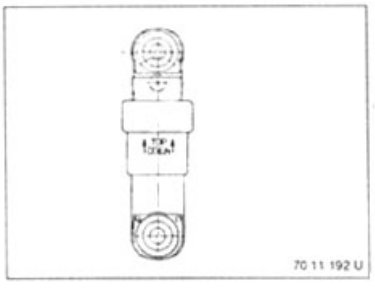


Installation:
Make sure that gasket seats correctly on the pressure side of the cylinder head when mounting the cylinder head cover.



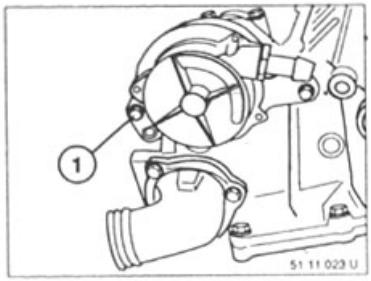
o Removing Belt Tensioner:

Unscrew console for toothed belt tensioner.
Disconnect damper.



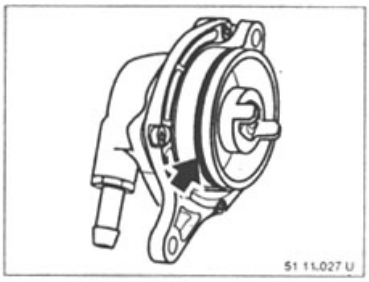
Note:
The hydraulic belt tensioner is filled with oil so that the removed element must be stored standing upright.
Incorrectly stored elements can normally be bled by compressing them several times.

* Refer to Specifications

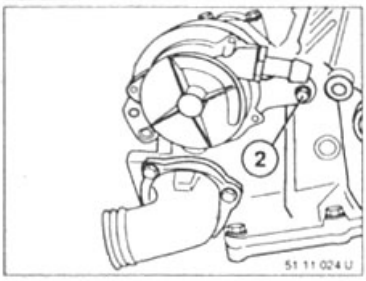


o Removing Vacuum Pump:

Unscrew bolt (1).



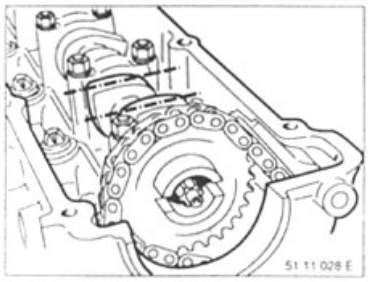
Installation:
Replace O-ring and coat new O-ring with lubricant**.



Remove bolt (2) and lift pump off.

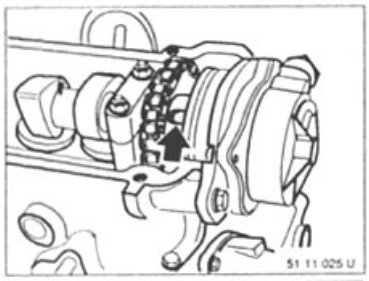
Note:
Bolt is also used to hold the chain guide.

Installation:
Threads are coated with a sealing cement so that a new bolt must be used or a coat of sealing cement** applied.

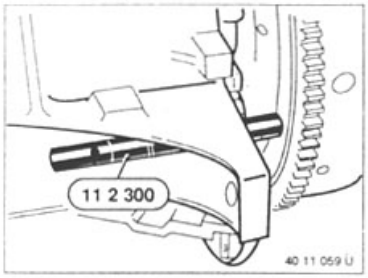


o Removing Valve Timing:

Note:
Turn engine in direction of rotation until valves of cylinder no. 6 overlap.
(Cylinder no. 1 = power stroke.)
Cam position can also be checked through the oil filler bore when the cylinder head cover is mounted.

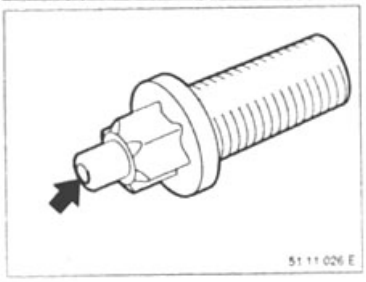


Installation:
Insert drive dog into opening of camshaft sprocket.

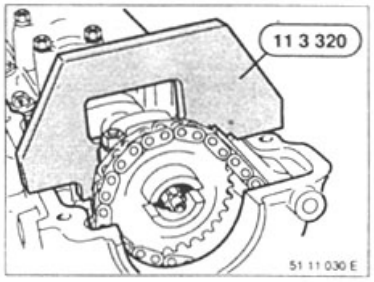


Hold crankshaft in TDC position with Special Tool 11 2 300.

Important!
Remove special tool before operating the engine again.



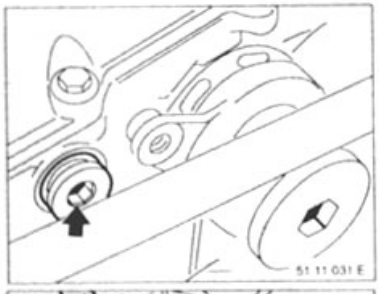
Note:
Torx bolt on the camshaft sprocket is fitted with a nozzle for lubrication of the vacuum pump. Check for dirt.



Hold camshaft with Special Tool 11 3 320.

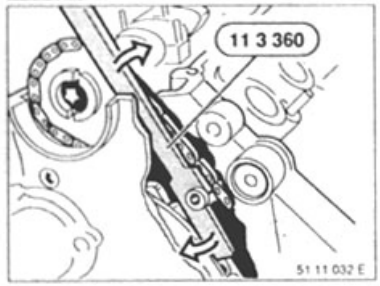
** Source of Supply: BMW Parts

** Source of Supply: BMW Parts

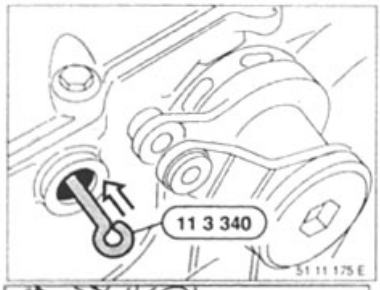


Arresting Chain Tensioner:

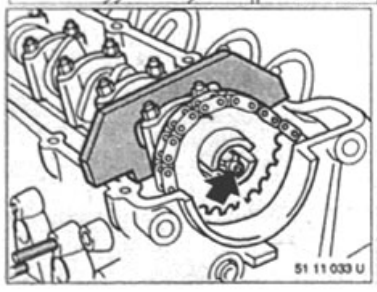
Unscrew plug.



Apply Special Tool 11 3 360 on chain tensioning rail and press chain tensioner in.

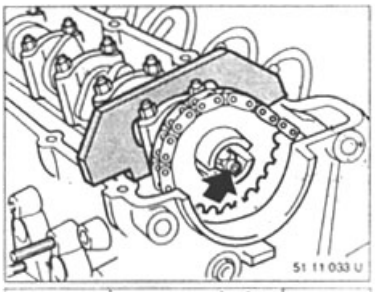


Apply Special Tool 11 3 340.



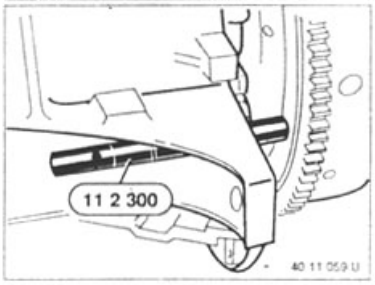
Unscrew and remove sprocket.

Installation:
Bearing surface must be clean and free of grease.



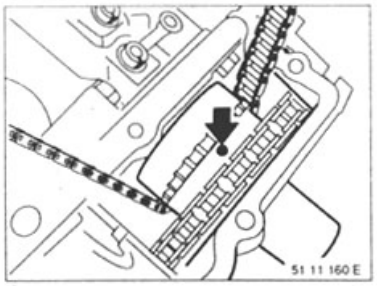
o Camshaft Adjusting Procedures:

Mount sprocket with chain on camshaft loosely.



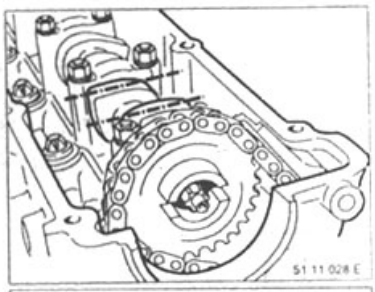
Hold crankshaft in TDC position with Special Tool 11 2 300.

Important!
Remove special tool before operating the engine again.



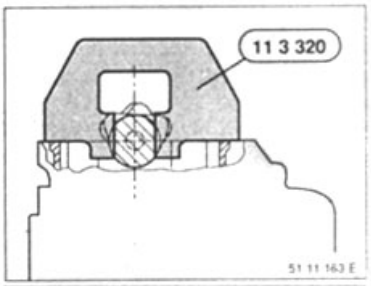
Note:
Mark on injection pump sprocket must face up.
If not, turn crankshaft another full turn.
(Crankshaft : injection pump ratio = 2 : 1.)

Important!
Mark can be seen only before installation of the cylinder head.
First remove the camshaft if the crankshaft has to be turned when the cylinder head is mounted.



Turn camshaft until the valves of cylinder no. 6 overlap.
(Cylinder no. 1 = power stroke.)

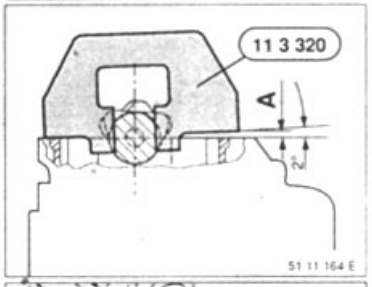
Note:
The camshaft can be turned on the hexagon using a 27 mm wrench.



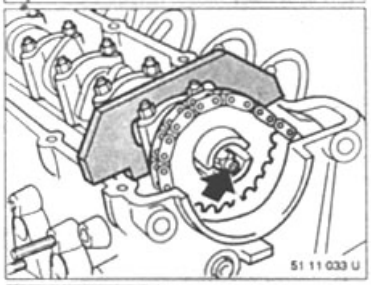
Note:
An empty Special Tool 11 3 320 must be used to adjust the timing of NEW or used chains up to 20,000 km of operation.



Important!
If the camshaft position has to be corrected to such an extent that valves of cylinder no. 1 and 6 are moved, first turn the crankshaft in engine's direction of rotation to about 30° away from TDC position and return to the initial position only after turning the camshaft.
This will prevent contact between valves and pistons.
Install both chain tensioners after assembling has been completed.
Crank engine in engine's direction of rotation several times.
Recheck camshaft adjustment.

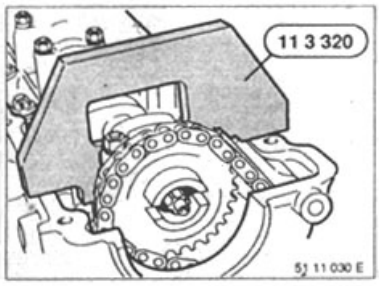


If chains with more than 20,000 km of operation are to be reused, a shim (feeler gage blade) of thickness A = 4.61 mm must be used on the intake side.

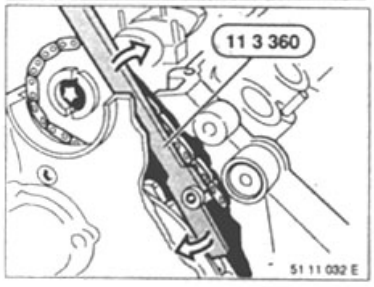


Mount sprocket with chain and tighten loosely.

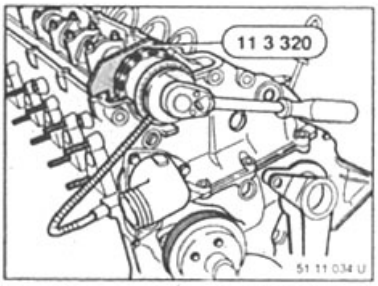
Important!
Bearing surfaces must be clean and free of grease.



Hold camshaft with Special Tool 11 3 320.

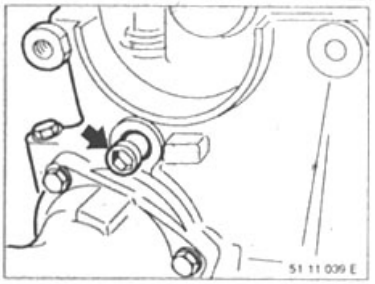


Apply Special Tool 11 3 360 on chain tensioning rail and press chain tensioner in.
Pull Special Tool 11 3 340 out.



Tighten camshaft sprocket to final torque.

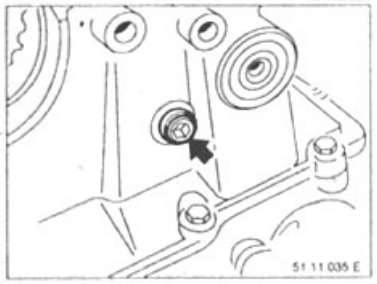
Tightening Procedures:
Step 1 20 Nm torque
Step 2 35 ± 3° torque angle



o Unscrewing Cylinder Head:

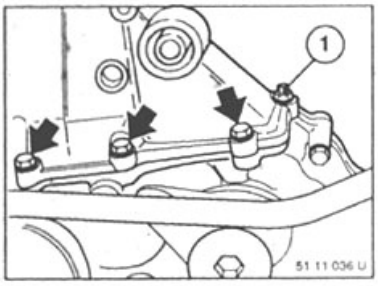
Unscrew retaining pin for tensioning rail.

Installation:
Check O-ring.



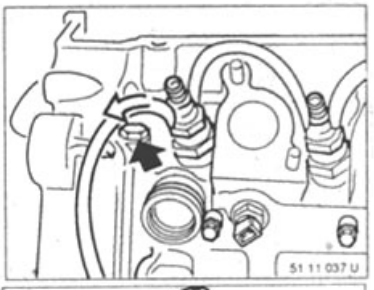
Unscrew retaining pin for chain guide.

Installation:
Check O-ring.

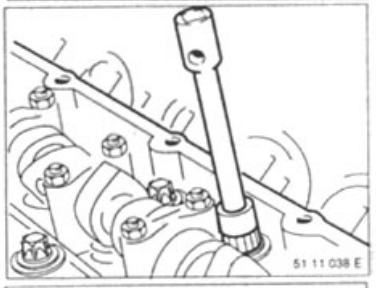


Unscrew bolts on timing case cover.

Note:
Position (1) is a stud with nut.



Unscrew bolt and pull pipe for injection valve leak oil off.



Unscrew cylinder head bolts from outside to inside in several steps.
Lift cylinder head off.

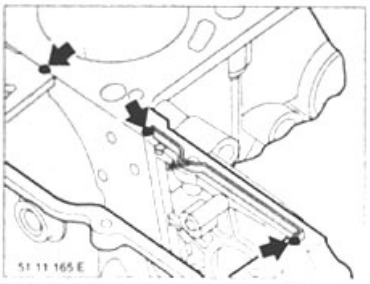


Important!
Conform with waiting time for hydraulic valve tappets when installing the cylinder head – refer to general information.
The gasket thickness must be determined after working on the crankshaft/pistons (refer to "Measuring Piston Protrusion").

Installation:
Clean mating surfaces on cylinder head and crankcase; if necessary remove pieces of gasket with gasket remover** and a hard wood scraper. Be careful that pieces of gasket do not fall into oil and coolant bores.

Tapped bores in crankcase must be free of dirt and oil.

** Source of Supply: BMW Parts

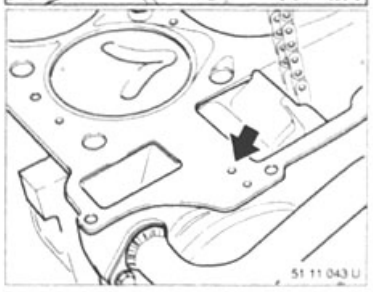


Installation:
Replace sealing strip on console for the injection pump.

Apply coat of 3 Bond 1209** permanently elastic sealing compound on joint surfaces to the timing case cover.

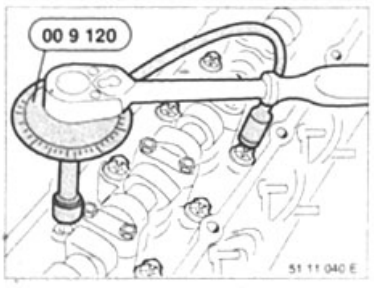


Installation:
Install new cylinder head gasket.
Check dowel sleeves (1) for damage and correct installation.



Installation:
Use a gasket with same thickness mark (number of holes).

Exception:
Work on crankcase which changes piston protrusion (refer to "Measuring Piston Protrusion").

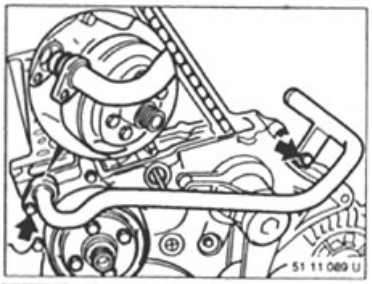


Installation:
Mount cylinder head and install new bolts (lubricated lightly with oil).
Keep oil out of tapped bores.
Use Special Tool 11 2 110 or 00 9 120 to tighten bolts to torque angle.

Installation:
Bolt tightening procedures:
Tighten bolts diagonally from middle to outside in four steps.
Loosen bolts in reverse sequence.
Tightening torque*.

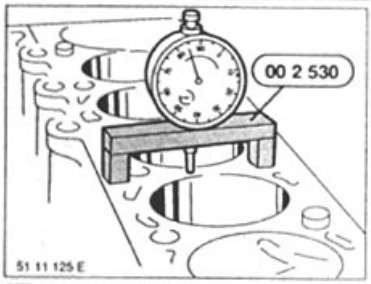
** Source of Supply: BMW Parts

* Refer to Specifications



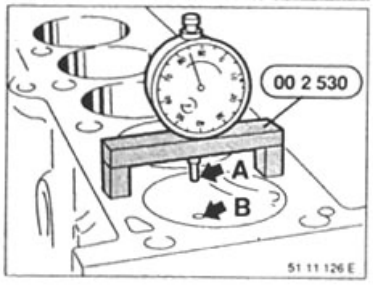
Unscrew coolant pipe.

Installation:
Check O-ring.
Belt tensioner must have been installed first.



o Measuring Piston Protrusion:

Thickness of the cylinder head gasket to be installed depends on the highest piston protrusion of all six pistons.
Procedures:
Apply dial gage with Special Tool 00 2 530 on cleaned cylinder head sealing surface and set to zero with preload.



Apply dial gage at measuring point "A" on cleaned piston and find the highest point by turning the crankshaft.
Note the displayed "piston protrusion A" value.
Apply dial gage at measuring point "B" and note "piston protrusion B".
The mean value of dimensions "A" + "B" results in the "piston protrusion" of a piston.
Carry out these measurements on all six pistons.

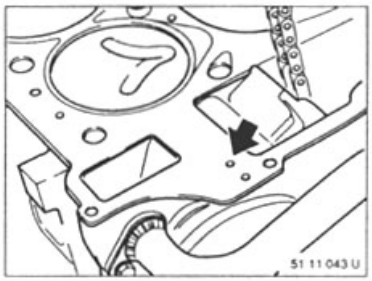
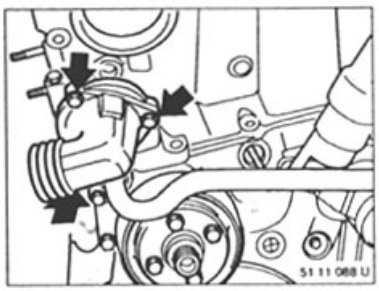


Figure out the mean value from the six determined values.

Cylinder Head Gaksets:

Piston Protrusion of All Six Pistons (Mean Value in mm)	Identification of Cyl. Head Gasket (Number of Holes)
0.54 ... 0.76	2
0.76 ... 0.99	3

Note
A gasket with three-hole identification must be used if, however, one or more cylinders have piston protrusion of more than 0.81 mm.



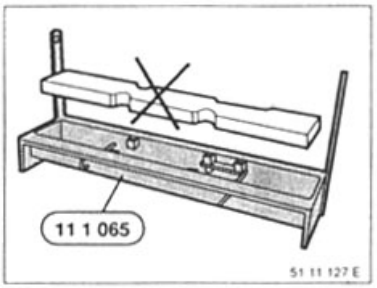
B. DISASSEMBLING AND ASSEMBLING CYLINDER HEAD

o Removing Thermostat Housing:

(This operation is only necessary when disassembling the complete cylinder head.)

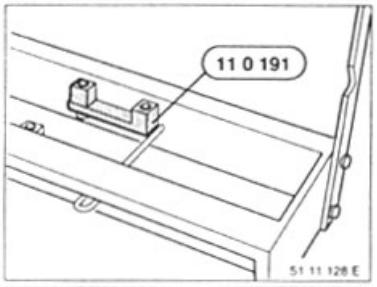
Loosen bolts and remove housing and thermostat.

Installation:
Vent bore faces up.

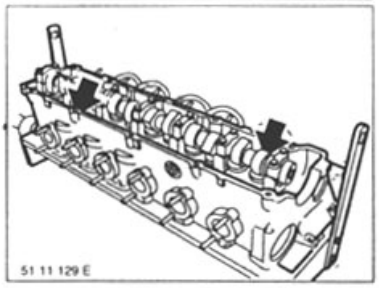


o Mounting Cylinder Head on Assembly Stand:

Mount Special Tool 11 1 065 on Special Tool 00 1 490.
Do not insert Special Tool 11 3 132 (tray).



Note:
Screw Special Tool 11 0 191 on already supplied assembly stands.

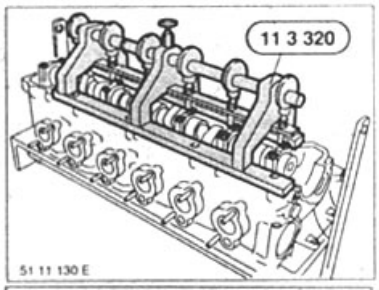


Mount cylinder head on assembly stand with supplied bolts.

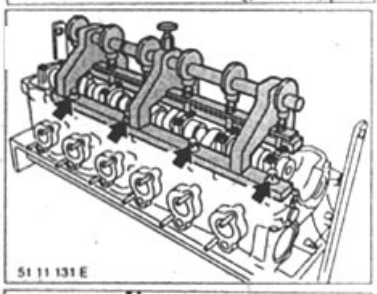


o **Removing Camshaft:**

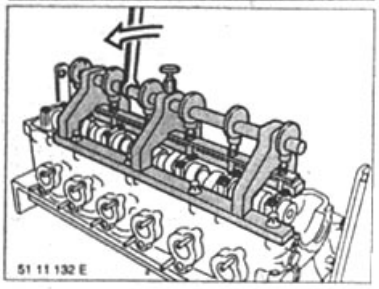
Caution!
The camshaft could be damaged or broken when cylinder head would be incorrectly disassembled/assembled without use of an assembly stand.
In addition, valves could be bent through contact with piston crowns when mounting the cylinder head on the crankcase.
Always conform with assembly procedures and sequence.



Place Special Tool 11 3 320 on cylinder head.



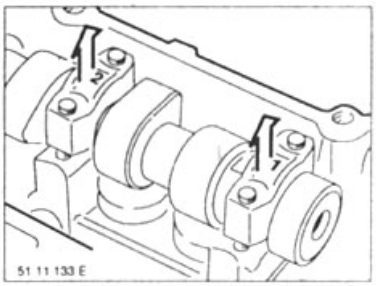
Secure special tool with valve cover bolts.



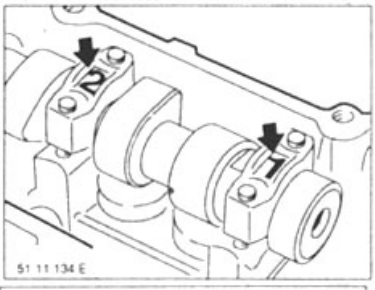
Preload bearing caps by turning the eccentric shaft.
Loosen all bolts for bearing caps.

Installation:
Tightening torque*.

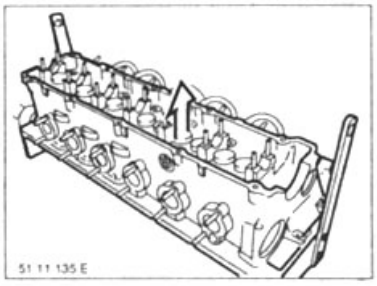
* **Refer to Specifications**



Release and remove special tool.
Lift bearing caps and camshaft out.



Installation:
Bearing caps are marked with numbers from 1 to 7, which can be read from the exhaust side.



Lift hydraulic valve clearance compensators out.

Note:
Pay special attention to damage of hydraulic valve clearance compensator guides.

o **Removing Valves:**

Installation:
Hydraulic valve clearance compensators expand when without load from the camshaft and must be allowed enough time after installation to constrict again. Consequently fast assembly could cause "closed" valves to still be open and have contact with the pistons.

The following waiting times must be allowed between installation of the camshaft and mounting of the cylinder head:

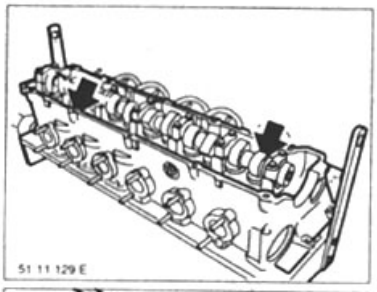
Ambient Temperature:	**Time:**
20° C	**4 minutes**
10 to 20° C	**11 minutes**
0 to 10° C	**30 minutes**

After installation of the camshaft and timing chain the engine may first be cranked after the following waiting times:

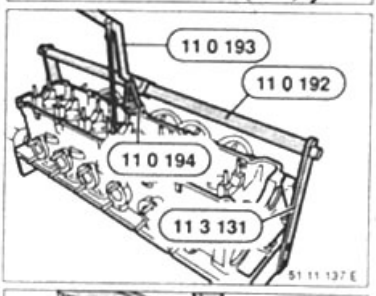
Ambient Temperature:	**Time:**
20° C	**10 minutes**
10 to 20° C	**30 minutes**
0 to 10° C	**75 minutes**

If necessary, proceed as described below.

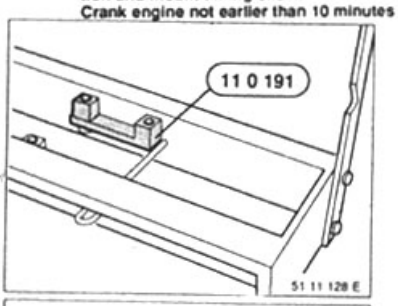
Working on Valve Train with Mounted Cylinder Head:
Turn crankshaft in engine's direction of rotation to approx. 30° from the TDC mark, so that in this manner no pistons are in TDC.
Install camshaft so that the cam peaks of cylinder no. 1 face each other.
Conform with the above mentioned waiting times. Turn crankshaft back to TDC position and mount timing chain.
Crank engine not earlier than 10 minutes after installation of the camshaft.



Mount cylinder head on assembly stand with supplied bolts.

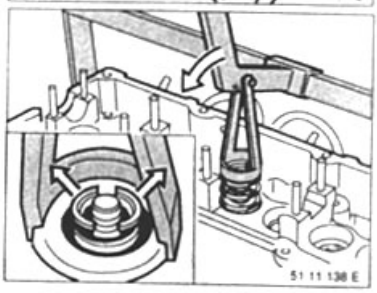


Screw on Special Tool 11 3 131.
Slide Special Tool 11 0 192 onto Special Tool 11 1 067 and mount together with Special Tools 11 0 193 and 11 0 194.

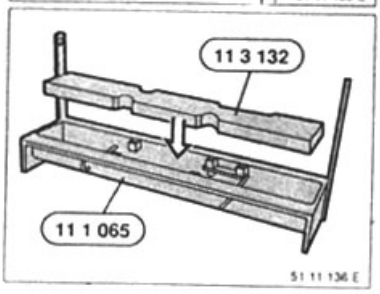


Mount Special Tool 11 1 065 on Special Tool 00 1 490.

Note:
Screw Special Tool 11 0 191 on already supplied assembly stands.

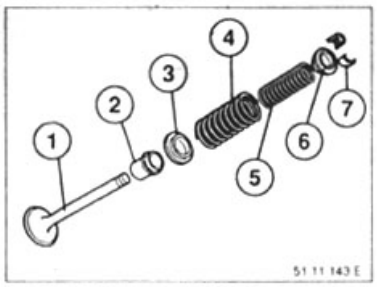


Press valve springs down and remove valve collets.
Remove valve springs and spring retainers.
Take tray out of assembly stand from underneath and pull valve out.



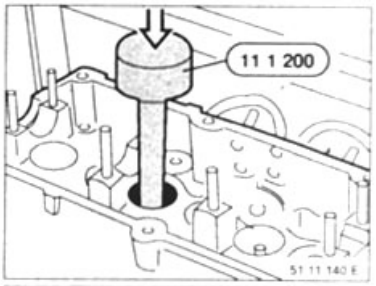
Insert Special Tool 11 3 132 (tray) into assembly stand.

Installation:
If one spring of the spring set (inner or outer spring) is damaged or broken, both springs must be replaced.
Only use inner and outer springs of the same make and with the same color code.

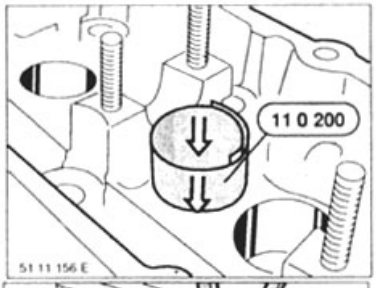


Sequence of installation:

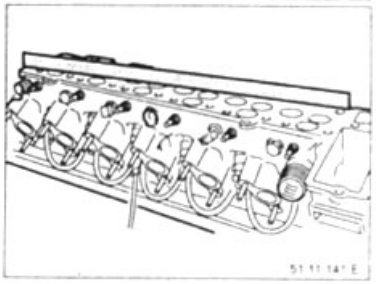
1 - Valve
2 - Valve stem seal
3 - Lower valve retainer
4 - Outer spring
5 - Inner spring
6 - Upper spring retainer
7 - Valve collets



Installation:
Press valve stem seal on by hand as far as stop using Special Tool 11 1 200.

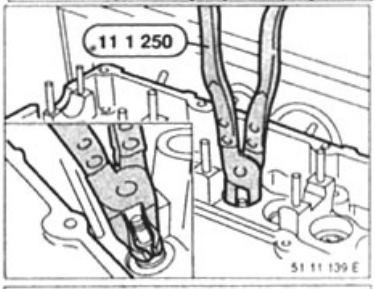


Caution!
Be careful that bearing surfaces of hydraulic valve clearance compensators are not damaged.
Use Special Tool 11 0 200.

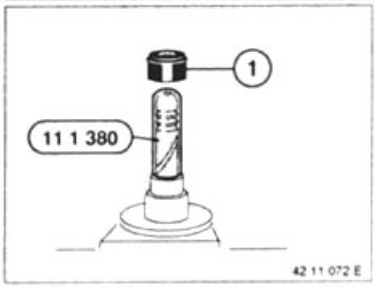


o **Checking Cylinder Head Mating Surface:**

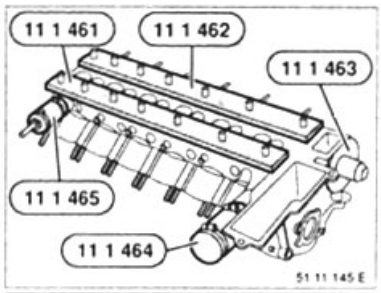
Check levelness of cylinder head mating surface with a (standard) ruler.
Max. deviation: 0.03 mm.



Pull valve stem seal off with Special Tool 11 1 250.



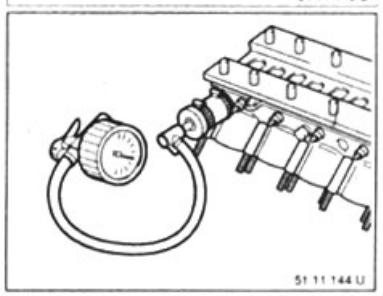
Installation:
Lubricate valve stem with oil and install valve.
Apply Special Tool 11 1 380.
Lubricate new valve stem seal with oil and install.



o Checking Cylinder Head for Cracks in Water Test:
(Cylinder Head Disassembled)

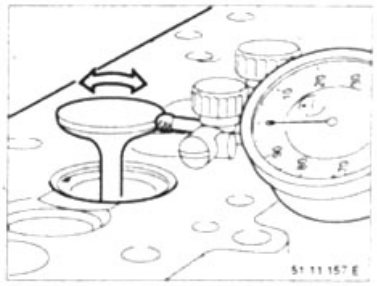
Inspect cylinder head as follows if there is suspicion of leakage in the water circuit (area of cylinder head).
Seal off water circuit with following special tools:

1. Sealing plates 11 1 461 / 11 1 462
2. Water pump connection plug 11 1 463
3. Plug 11 1 464
4. Plug with valve 11 1 465



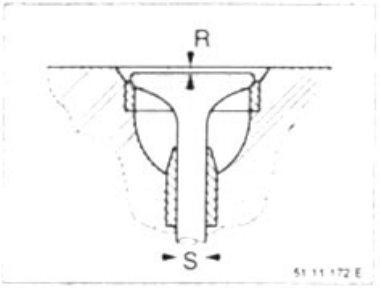
Fill cylinder head with compressed air.
Test pressure = 4.5 bar.
Place cylinder head in water bath and check for leaks.

Note:
Add detergent to water bath if necessary



o Machining Valve Guides and Seats:

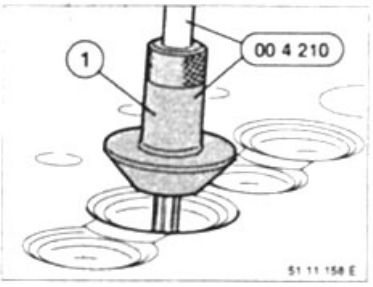
To measure, insert a new valve in such a manner that the valve stem end is flush with the valve guide.
Apply dial gage and measure tilt play.
Max. permissible tilt play = 0.8 mm.



<u>Reaming Valve Guide:</u>

In case of excessive play between the valve stem and valve guide, the valve guide must be reamed out and a repair valve with larger stem diameter (S = + 0.1 mm) must be installed.

Note:
The valve seat must be machined after reaming out.
Check valve retrusion "R".



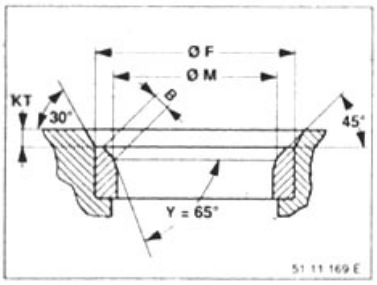
Assemble Special Tool 00 4 210 depending on the stem diameter.
Push guide pad (1) down onto valve seat and ream valve seat out dry from the combustion side.

Turn reamer down once.



Machining Valve Seat:

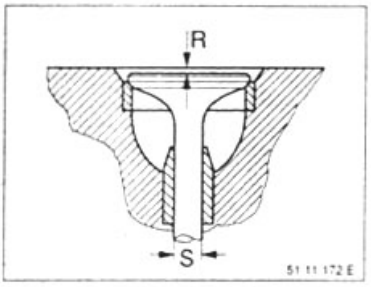
Valve seat machining tool from
Hunger
and five-cutter cutting tool from
New Way
are approved for the machining of valve seat inserts.



After machining the valve seat angle, produce valve seat diameter "M" and valve seat width "B" by machining correction angle "Y" and cutting "KT" vertically.

Valve seat dimensions*.

M = Valve seat diameter
B = Valve seat width
Y = Correction angle
F = Correction diameter
KT = Correction depth

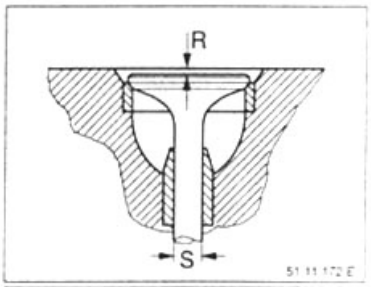


A repair valve with thicker valve head must be used after machining the valve seat.

Machine valve seat inserts until specified valve retrusion "R" is reached.

Important!
Valves may not be ground in.

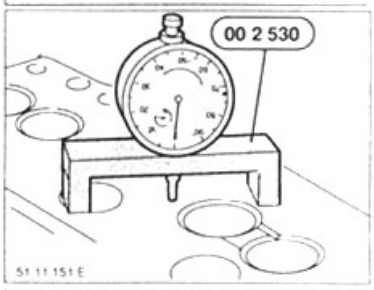
* Refer to Specifications



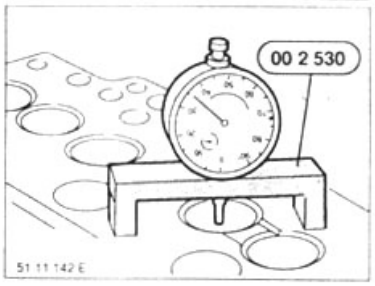
Measuring Valve Retrusion "R":

The valve head thickness must be selected to conform with specified valve retrusion "R".

Caution!
Valves with incorrect valve head thickness will cause engine damage.



Apply dial gage in Special Tool 00 2 530 on cleaned cylinder head mating surface and set to zero with preload.



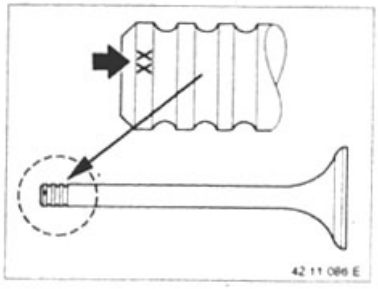
Apply dial gage on valve head and measure valve retrusion distance "R".

Specified distance "R":

Intake valve	0.65 ... 0.85 mm
Exhaust valve	0.85 ... 1.05 mm

Valves with thicker valve heads are available in addition to the standard valves to reach distance "R":

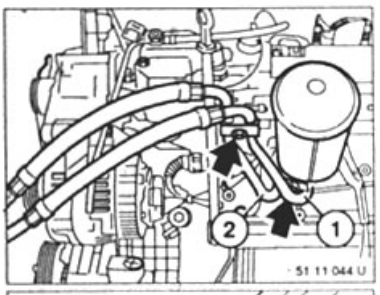
Stem oversize	0 mm	0.1 mm	0.1 mm	0.2 mm
Valve head thickness oversize	0.25 mm	0.25 mm	0.50 mm	0.50 mm
For machining on seat insert	0.25 mm	0.25 mm	0.50 mm	0.50 mm
Identification on stem (see figure)	TRWT 11485 R0	TRWT 11485 R1	TRWT 11485 R2	TRWT 11485 R3



Location of valve identification

o Checking Valve for Leaks:
(Camshaft Removed)

Fill intake and exhaust ports with gasoline outdoors or indoors in conformance with fire prevention regulations.
Valves and valve seats must be inspected if gasoline runs out of valve heads.

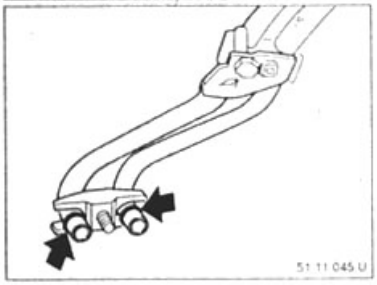


C. DISASSEMBLING CRANKCASE

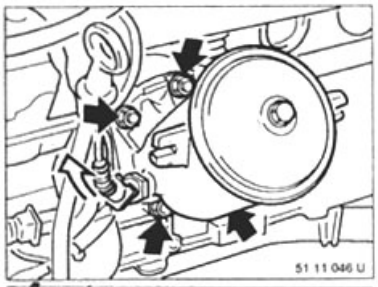
o Unscrewing Oil Filter Housing:

Unscrew oil cooler pipes.

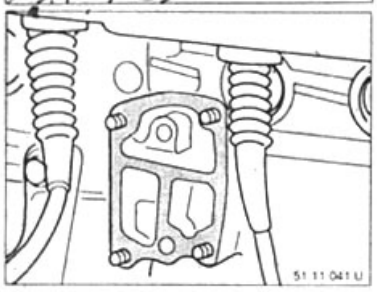
Installation:
Check arrangement of pipes.
1 = Supply
2 = Return



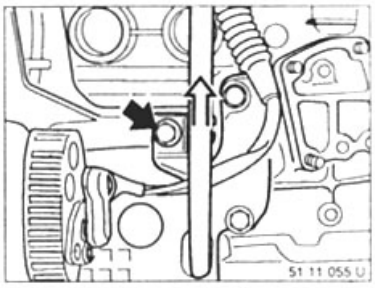
Installation:
Replace O-rings.



Disconnect plug.
Unscrew oil filter housing.

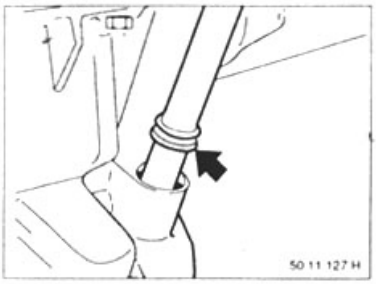


Installation:
Replace gasket.

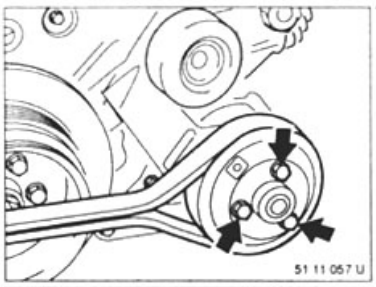


o Removing Oil Dipstick:

Unscrew oil dipstick holder and pull oil dipstick out of oil pan.

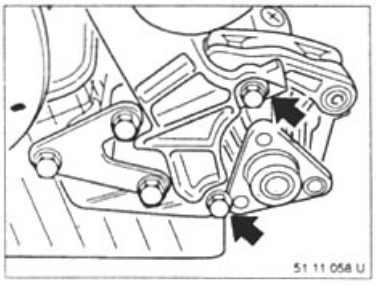


Installation
Check O-ring.

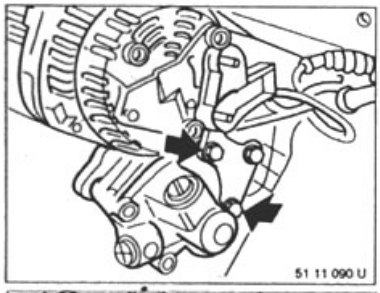


o Removing Power Steering Pump:

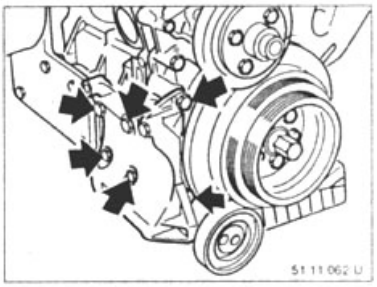
Hold pulley tight with help of ribbed drive belt.
Unscrew bolts.



Unscrew bolts on face.

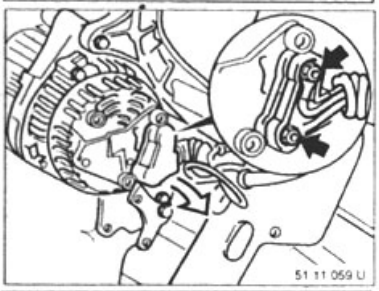


Unscrew bolts on back.



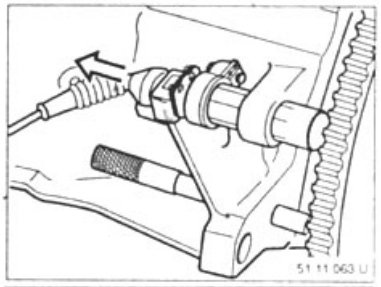
o Removing Console for A/C Pump:

Unscrew bolts.



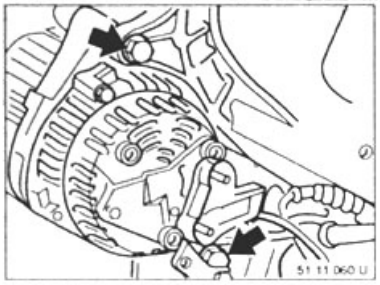
o Removing Alternator:

Pull cap off and disconnect wire harness connections.

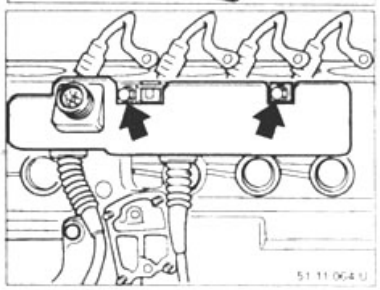


o Removing Wire Harness from Engine:

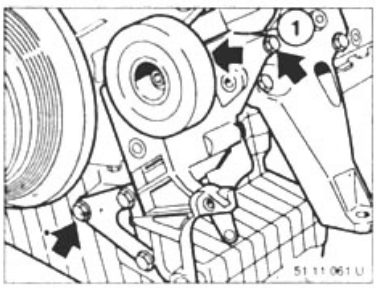
Disconnect plug for speed sender.



Unscrew alternator.



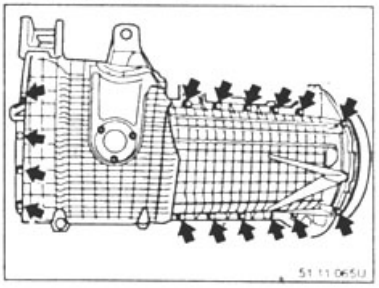
Unscrew wire harness from engine.



o Removing Console for Alternator and Power Steering Pump:

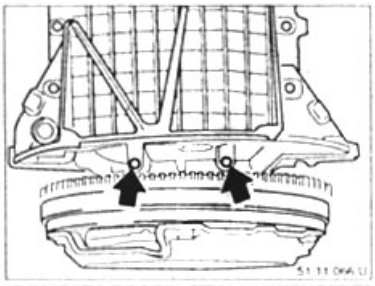
Unscrew bolts and remove console.

Installation:
Check dowel sleeve (1).

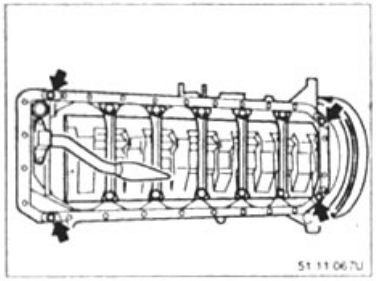


o Removing Oil Pan:

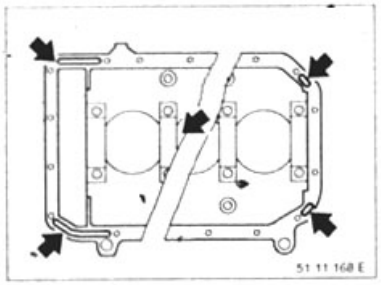
Unscrew bolts.



Unscrew bolts on transmission end and lift oil pan out.

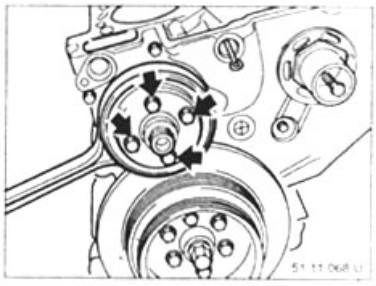


Installation:
Replace gasket.
Place gasket on oil pan or engine block and fill front and rear openings with a bead of permanently elastic sealing compound "black 3 Bond 1207B" ** approx. 3 mm wide and 2 mm high.



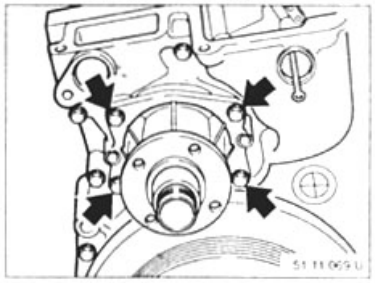
Versions of front and rear openings

** Source of Supply: BMW Parts

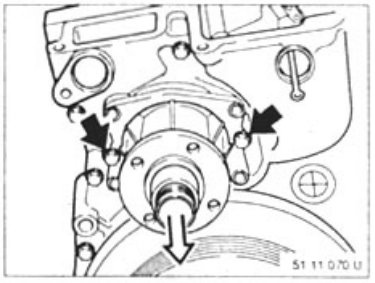


o Removing Water Pump:

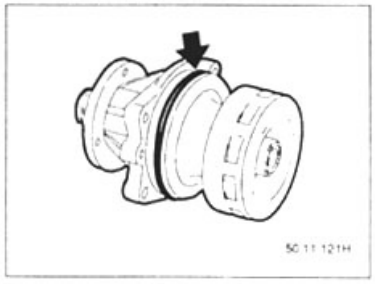
Hold pulley tight with ribbed drive belt and unscrew bolts.



Unscrew bolts.

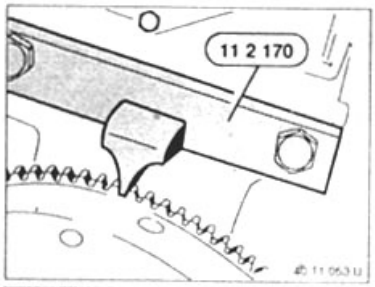


Screw two M 6 bolts into tapped bores and press water pump out of end cover with uniform pressure.



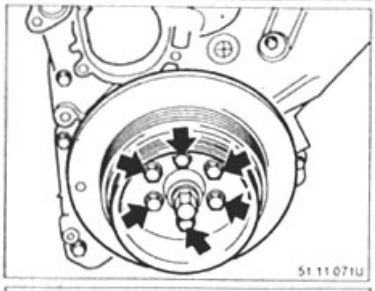
Installation:
Replace O-ring and coat it with lubricant**.

** Source of Supply: BMW Parts



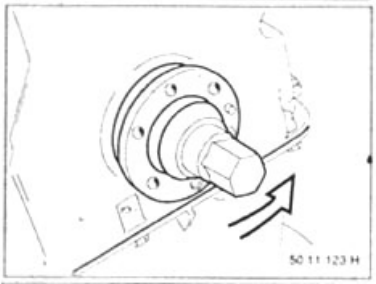
o **Removing Vibration Damper:**

Block engine with Special Tool 11 2 170.



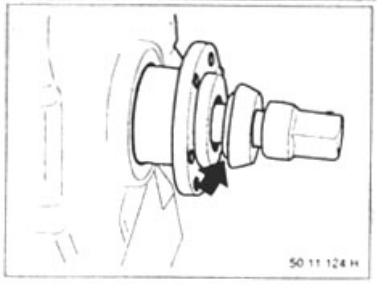
Unscrew bolts on vibration damper and remove vibration damper.

Installation:
Align dowel pin bore in vibration damper with dowel pin.

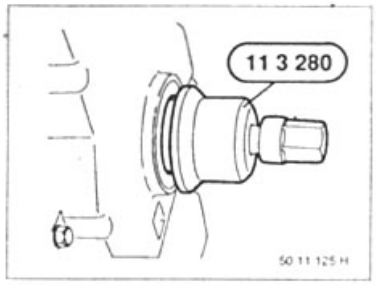


o **Removing Vibration Damper Hub:**

Block flywheel with Special Tool 11 2 170.
Unscrew central bolt.
Remove washer and hub.



Installation:
Align groove of hub with woodruff key.
Shoulder of washer faces hub.
Tightening torque of central bolt:
1. **100 Nm torque force**
2. **150° torque angle**



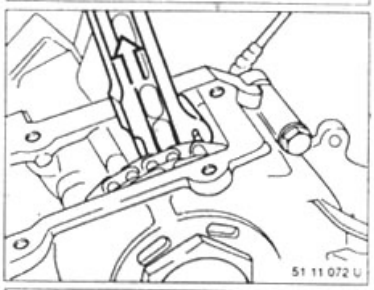
Installation:
Press new radial oil seal in flush with Special Tool 11 3 280 in conjunction with the central bolt, with attached timing case cover.

Note:
The central bolt could be too short in case of unfavorable tolerances. If necessary, use central bolt from a M50 engine.

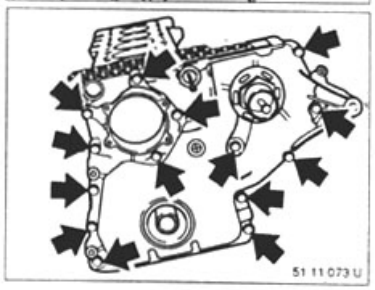


o **Removing Chain Drive:**

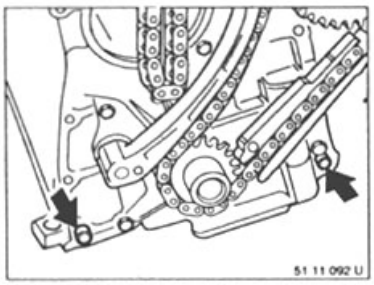
Important!
The injection pump or adapter for injection pump must be installed when working on the chain drive (the adapter is supplied with exchange engines as replacement for the pump).



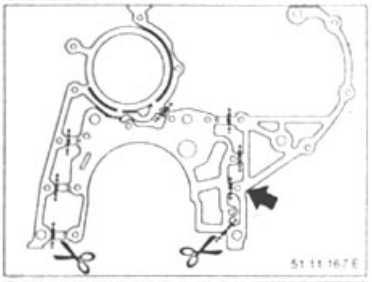
Pull upper guide rails upwards off of shaft bolts on the injection pump console.



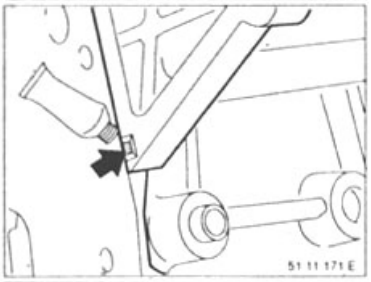
Unscrew timing case cover.



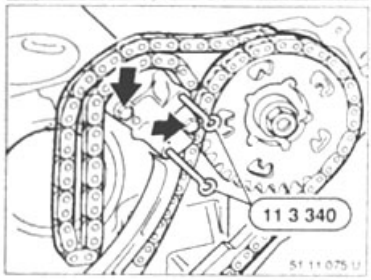
Installation:
Check dowel sleeves.



Installation:
The gasket is only available for the timing case cover and oil pump together.
Cut gasket off at the marked points for repairs on the timing case cover.



Important!
Fill the V-shaped recess in the seal for injection pump console with permanently elastic sealing compound ** prior to installation of the gasket.



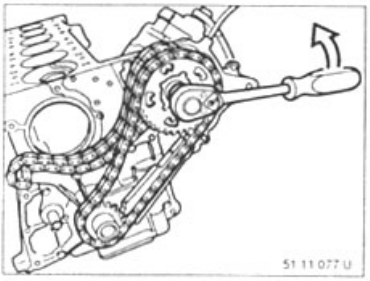
Press tensioning piston in downwards and lock with Special Tool 11 3 340.
Unscrew chain tensioner.

Installation:
Tightening torque*.

* Refer to Specifications
** Source of Supply: BMW Parts

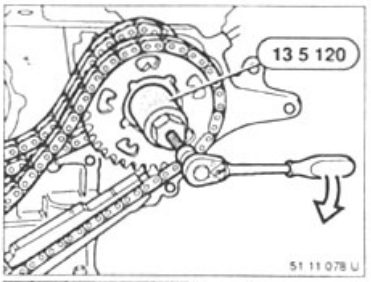


Caution!
Tensioning piston has strong spring force. Danger of injury while removing the special tool pins.

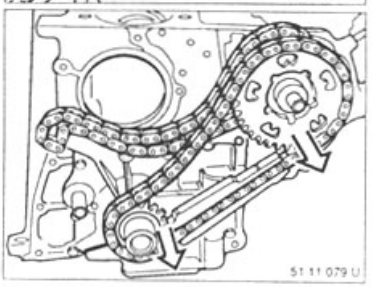


Remove sprocket bolt.

Installation:
Tightening torque*.

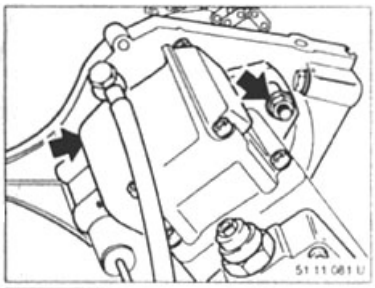


Screw Special Tool 13 5 120 with pressing-out bolt onto injection pump sprocket and press sprocket off.

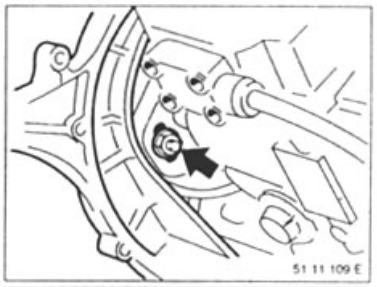


Remove both sprockets with mounted chain.

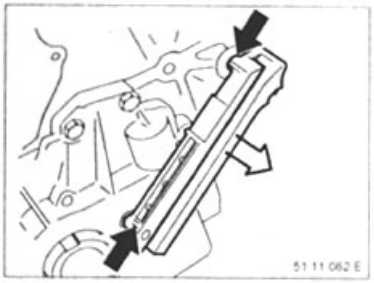
* Refer to Specifications



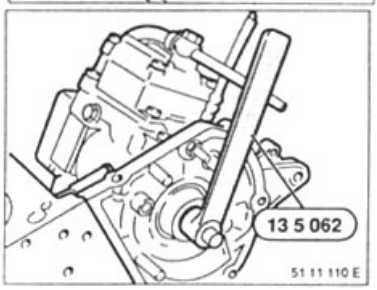
Unscrew injection pump bolts and remove injection pump.



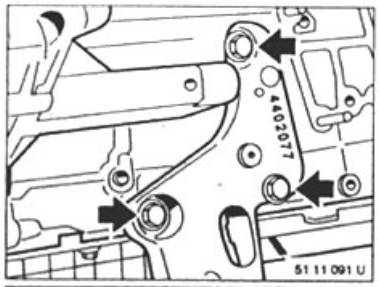
Secure injection pump in center of slot.



Unclip lower chain guide.



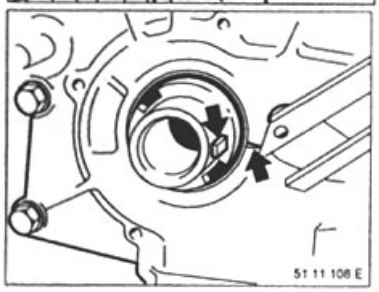
Set injection pump shaft to beginning of stroke in cylinder no. 1 using Special Tool 13 5 062 (the lever must point up vertically in front of the felt cam).



o Unscrewing Engine Mount Console:

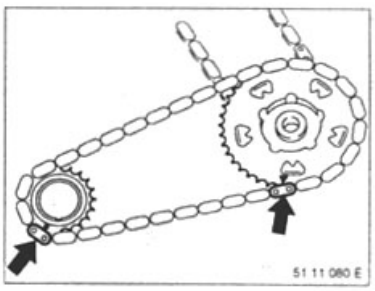
Unscrew bolts.

Place 80-link chain on the small toothed diameter of the injection pump sprocket. Place 74-link chain on the large toothed diameter of the injection pump sprocket and on the crankshaft sprocket.



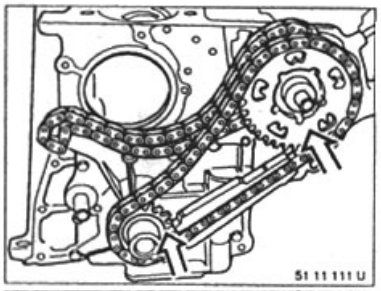
o **Injection Pump Drive Chain Adjusting Procedures:**

Turn crankshaft to position cylinder no. 1 to 26° before TDC (woodruff key on crankshaft points to mark on oil pump).

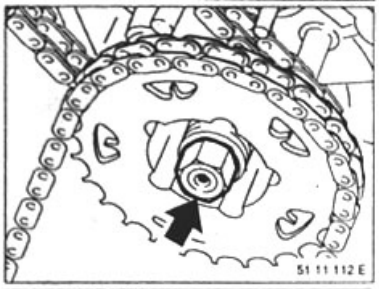


Important!

The 74-link chain has copper outside links at two points, which must be aligned with the tooth center marks on crankshaft and injection pump sprockets.

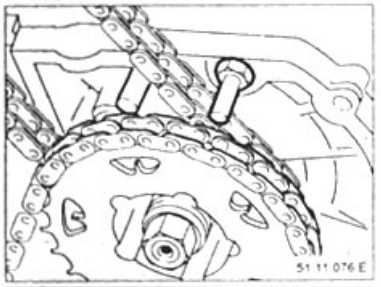


Push both sprockets with mounted chains mutually onto crankshaft and injection pump shaft.

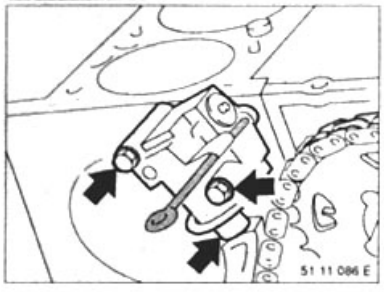


Bolt sprocket to injection pump shaft.

Tightening torque*.

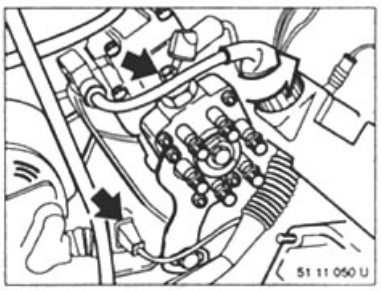


Note:
Pay attention to arrangement of camshaft chain between pins.



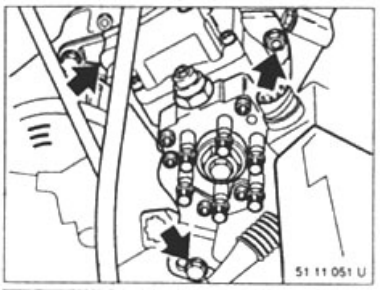
Bolt chain tensioner and remove lower special tool pin.

* Refer to Specifications



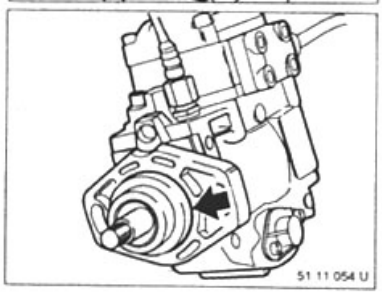
o Unscrewing Injection Pump:

Disconnect plugs.

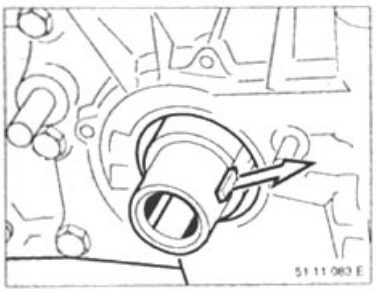


Unscrew pump.

Installation:
Pay attention to shims.

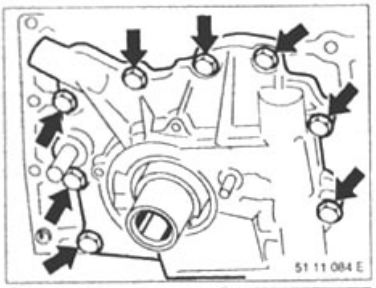


Installation:
Replace O-ring.

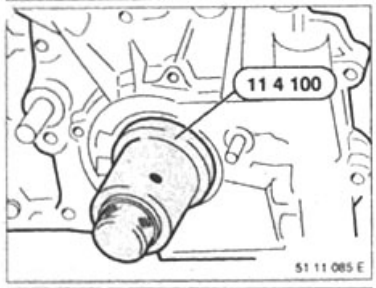


o **Removing Oil Pump:**

Lift woodruff key out.



Unscrew oil pump bolts and lift oil pump off together with intake pipe.

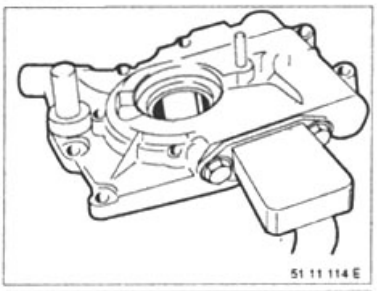


Installation:
Screw in bolts loosely.

Center oil pump to crankshaft with Special Tool 11 4 100:
Screw special tool in as far as stop and then tighten bolts.



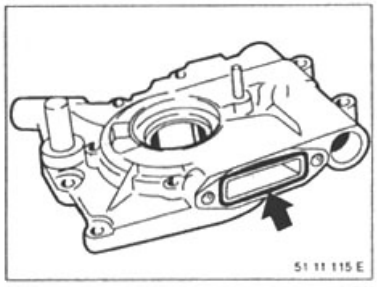
Caution!
Non-conformance will lead to pump rotor damage during operation.



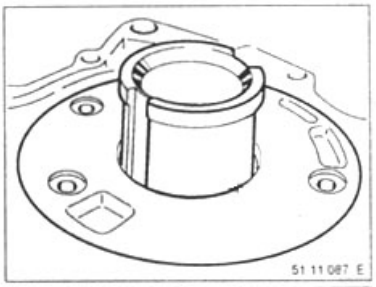
o **Disassembling and Assembling Oil Pump:**

Unscrew intake.

Important!
Intake is secured with self-tapping screws so that new pump bodies do not have tapped bores.
The threads can be cut with the available screws.

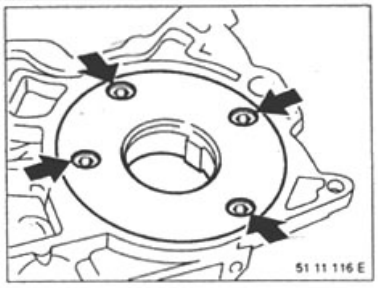


Installation:
Replace gasket.
Side with sealing bead points to intake.



Press bushing out.

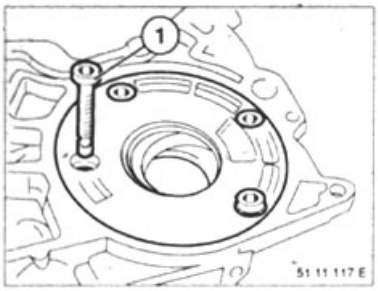
Installation:
Collar of bushing faces crankcase.



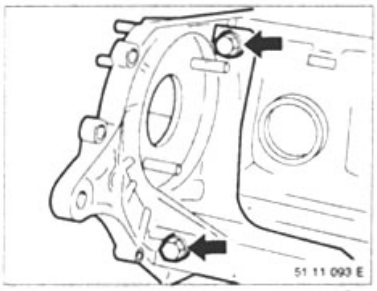
Unscrew screws and lift cover off.

Installation:
Tightening torque*.

* **Refer to Specifications**

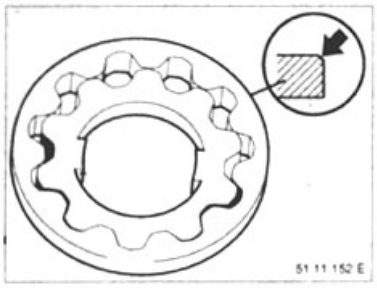


Installation:
Bolt (1) with M 7 threads is fitted with a journal and is simultaneously used to take the timing chain guide.



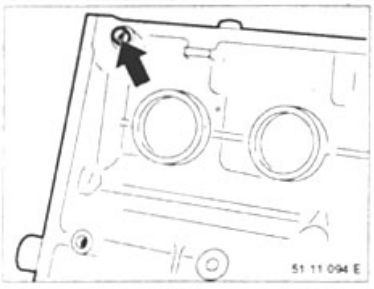
o **Removing Injection Pump Console:**

Unscrew bolts.

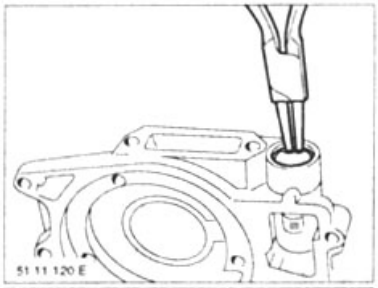


Inspect body and cover for wear and signs of scoring.

Installation:
Chamfer on outer rotor faces the body.

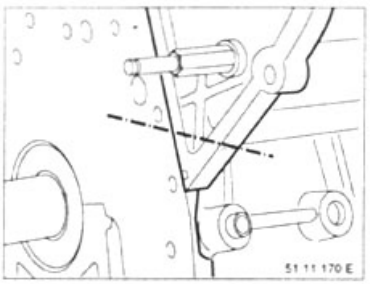


Installation:
Pay attention to dowel sleeve.

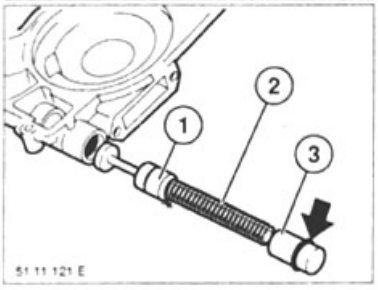


Press sleeve down lightly with help of a suitable mandrel.
Lift circlip out and remove pressure valve.

Caution!
Strong spring force.

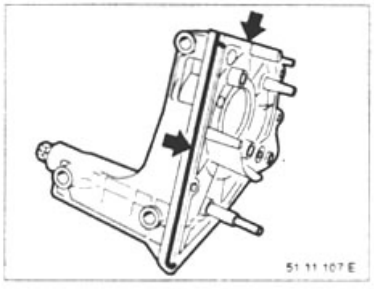


Align bottom of console to be flush on timing case cover gasket bearing surface with face of engine block.

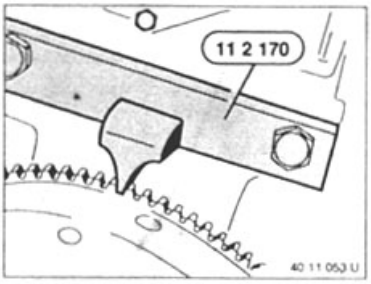


Installation:
1 = Piston
2 = Spring
3 = Sleeve

Note:
Check O-ring.
Measure length of relaxed spring (2).
Specified length = 84.1 mm.

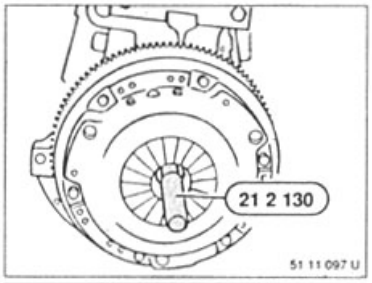


Installation:
Pay attention to gaskets.



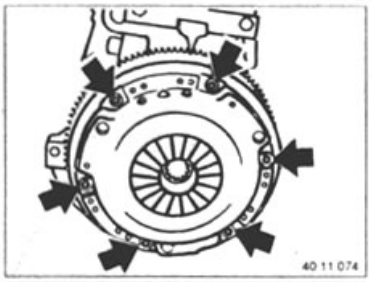
o **Removing Clutch/Flywheel:**

Block flywheel with Special Tool 11 2 170.



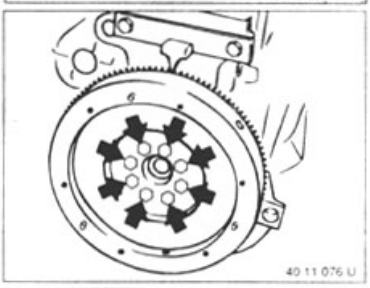
Center drive plate with Special Tool 21 2 130 and tighten bolts in several steps.

Tightening torque*.



Unscrew bolts uniformly.
Remove pressure plate and drive plate.

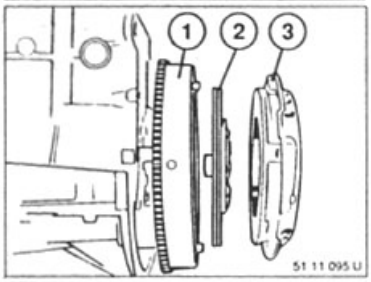
Installation:
Pay attention to dowel pins.



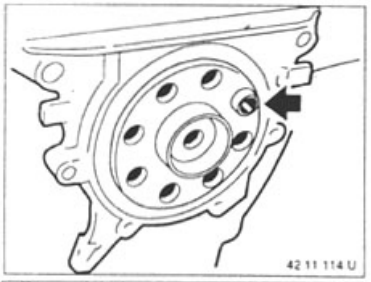
Unscrew bolts and remove flywheel.

Installation:
Clean tapped bores and install new bolts coated with micro-encapsulated cement.

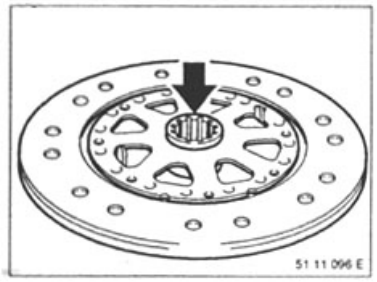
Tightening torque*.



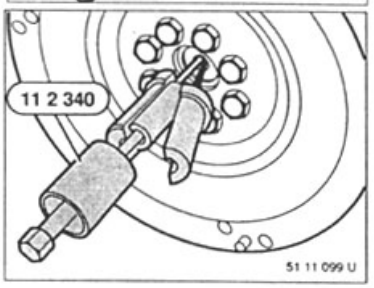
Installation:
1 = Flywheel
2 = Drive plate
3 = Pressure plate



Installation:
Pay attention to dowel sleeve.



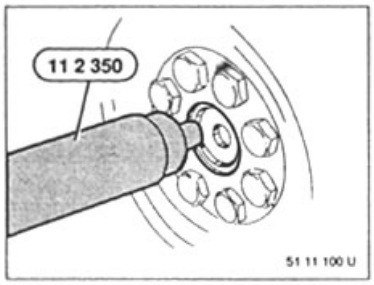
Note:
Flat side of drive plate (2) faces transmission.



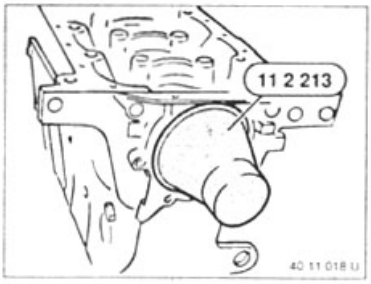
o **Replacing Pilot Bearing in Crankshaft:**

Remove pilot bearing using Special Tool 11 2 340.

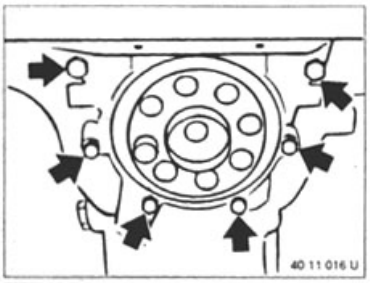
* **Refer to Specifications**



Installation:
Insert pilot bearing and drive it in as far as stop using Special Tool 11 2 350.

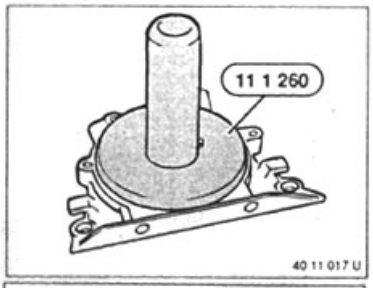


Installation:
Apply Special Tool 11 2 213 on crankshaft.
Lubricate sealing lip of radial oil seal with oil.
Push cover on and tighten bolts.

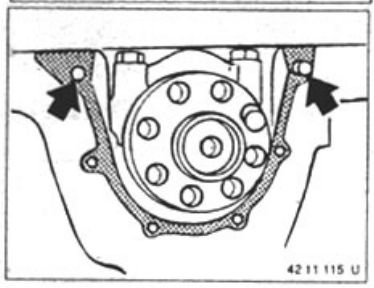


o **Removing Rear End Cover:**

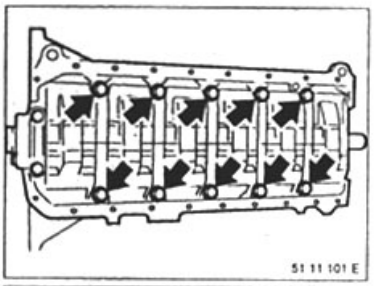
Unscrew bolts and remove cover.



Installation:
Lift radial oil seal out and drive new seal in using Special Tool 11 1 260.

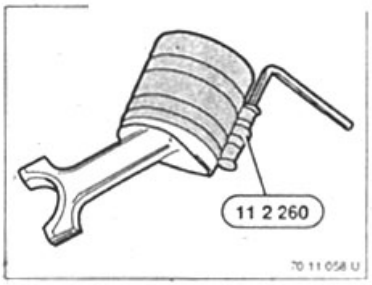


Installation:
Replace gasket.
Pay attention to dowel sleeves.

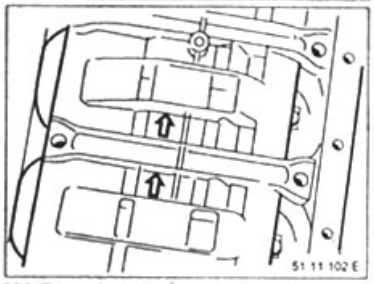


o **Removing Conrod with Piston:**

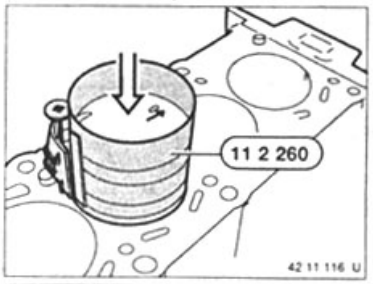
Unscrew oil splash plate.



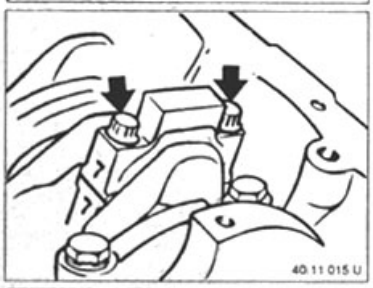
Installation:
Lubricate piston and piston rings lightly with oil.
Align gaps of piston rings (approx. 120° offset, but not above piston pin bore).
Compress piston rings using Special Tool 11 2 260.



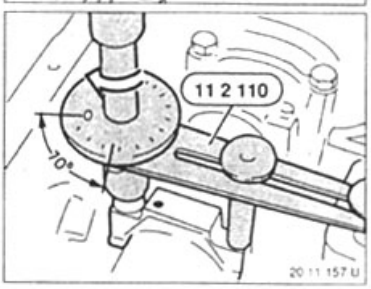
Installation:
Arrows point towards front end.



Installation:
Install piston that arrow points to camshaft drive.
Compressing tool must bear firmly on crankcase all around.
Press piston in with help of light knocks (e.g. from handle of hammer).
Bring crankshaft journal and connecting rod together at same time.



Unscrew conrod bearing cap.
Pull conrod with piston out to cylinder head side.

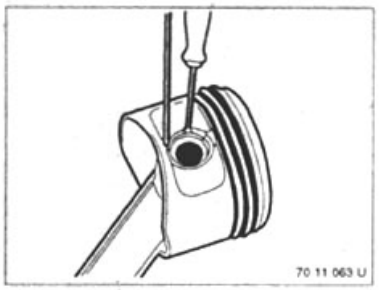


Installation:
Conrod bolt tightening procedures:
Lubricate conrod bearing shells with oil.
Mount bearing cap that pair numbers are matched.
Install new conrod bolts.
Tighten conrod bolts in two steps.

Step 1: **20 Nm torque force**
Step 2: **70° torque angle**



Important!
Reinstall piston, conrod and bearing shells in same position.
Conrods and bearing caps are marked with the same pair number — don't mix them up.

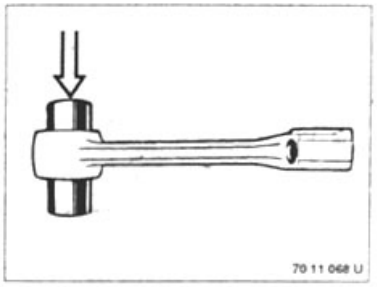


o **Removing / Checking / Repairing Connecting Rods:**

Lift circlip out and press piston pin out.

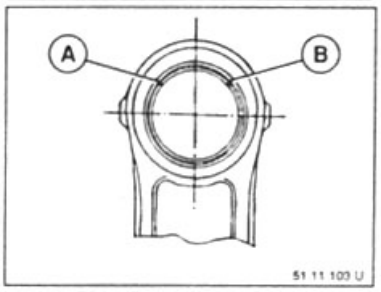
Important!
Pistons and piston pins are matched and must not be mixed up.

Installation:
Insert circlip in such a manner that gap is opposite the opening.



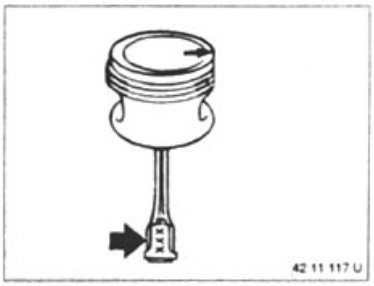
Checking Piston Pin Bush:

It must be possible to pass the piston pin through the bush by hand with slight force and no play should be noticed.

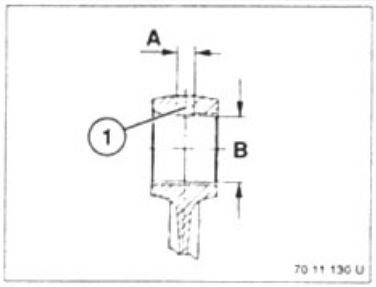


Replacing Piston Pin Bush:

Press old bush out using a suitable mandrel (28.5 mm dia.).
Press new bush in with bush gap optionally at point A or B.

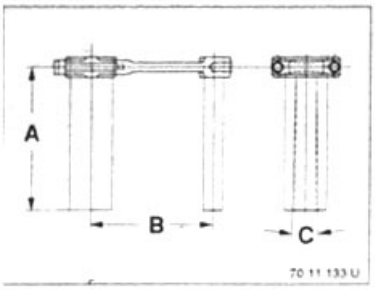


Installation:
Install connecting rod on piston in such a manner that installed direction arrow on the piston points to the right when the pair number is visible.



Drill oil bore (1)
(A = same bore diameter as in conrod).
Remove burrs from both ends of bore.
Ream bush dry to diameter B = 27.008 ... 27.014 mm with a reamer.

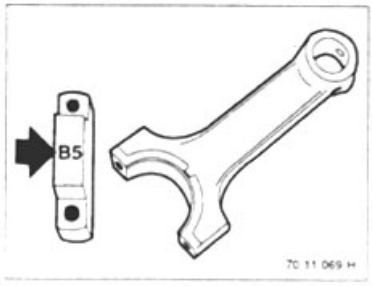
Note:
Break of lubricating groove points in direction of conrod gap.



Checking Connecting Rod:

Inspect connecting rod for parallel deviation and distortion.

A = Test distance: 150 mm
B = Max. permissible parallel deviation at distance A: 0.04 mm
C = Max. permissible distortion to one side: 0° 30'



Replacing Connecting Rod:

Note:
Only connecting rods of the same weight class (die-stamped in bearing cap) may be installed in one engine.

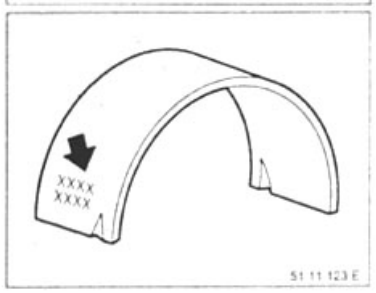
Connecting rods are only supplied in sets by Parts.



o Replacing Conrod Bearing Shells:

Different version bearing shells are used in standard production for "Low Version" and "High Version" engines.

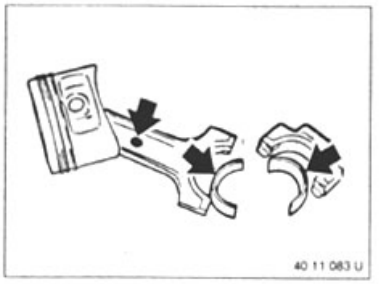
"Low Version" (85 kW):
Normal bearing shells.



"High Version" (105 kW):
Conrod bearing caps – normal bearing shells.
Conrods – wear-proof bearing shells (sputter bearing shells).

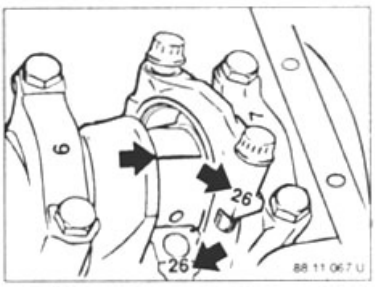
The wear-proof bearing shell is also marked with a die-stamped "S" on the outside of the bearing shell.

Only "High Version" bearing shells are available from Parts.
They must be installed in both engine versions for replacements.



Install one each red and blue bearing shell for each connecting rod regardless of the color code on the conrod shank.

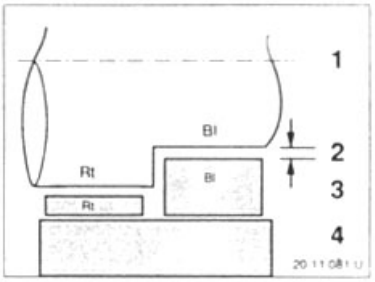
Important!
Pay attention to ground size.
Refer to "Replacing Crankshaft Bearing Shells".



Installation:
Check conrod bearing play.
– This work need only be carried out for controlling purposes when necessary. –

Place Type PG 1 Plastigage** on crankshaft wiped clean of oil with piston in BDC.
Mount bearing cap and secure with old conrod bolts tightened to specified torque.

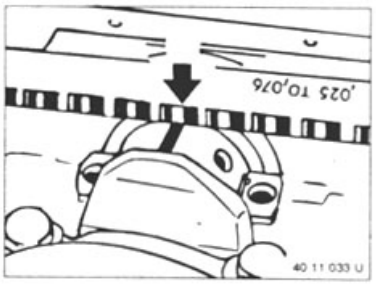
Important!
Don't turn conrod or crankshaft.



Survey of Color Code / Shaft Diameter / Bearing Shell Thickness*

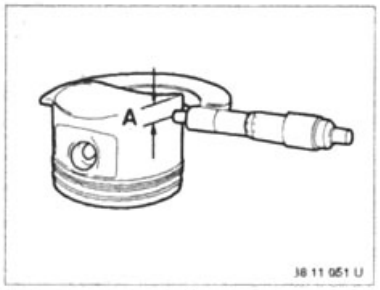
Double Classification Color Codes:
Rt = Red
Bl = Blue

1 - Crankpin
2 - Bearing play
3 - Bearing shell thickness
4 - Conrod end



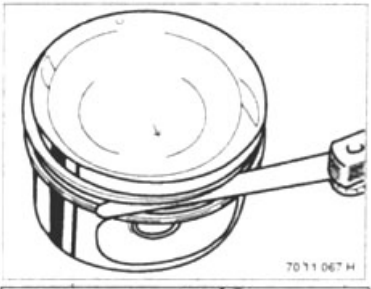
Remove bearing cap and read bearing play (specification: 0.020 ... 0.055 mm) by measuring width of flattened Plastigage with help of supplied scale.
Correct the bearing play by installing either new bearing shells or bearing shells with a different color code.

* Refer to Specifications
** Source of Supply: Cartool



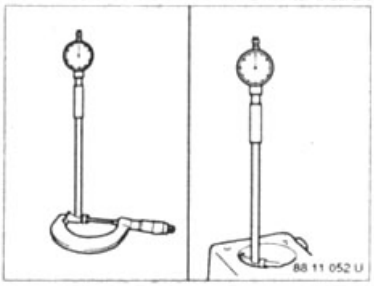
o **Replacing / Checking Pistons:**

Installation:
Measure piston installed clearance before installing.
Measure piston diameter at distance A = 7 mm from lower edge of piston and offset 90° from piston pin axis using a micrometer.



Measuring side clearance:

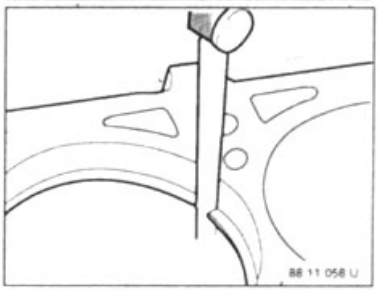
Specifications:
Groove 1 = measuring not necessary
Groove 2 = 0.040 ... 0.087 mm
Groove 3 = 0.05 ... 0.065 mm
Max. permissible total wear = 0.025 mm



Set internal calipers to zero with measured piston diameter on the micrometer.
Measure cylinder bore diameter at bottom, middle and top diagonally.

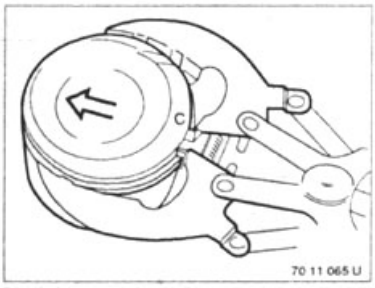
New piston installed clearance:
0.031 ... 0.063 mm

Max. total wear clearance:
0.15 mm



Measuring end clearance:

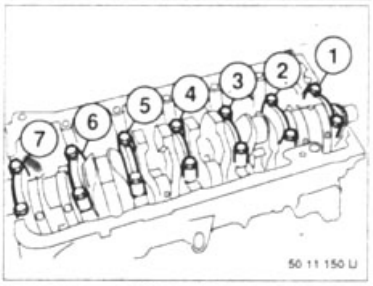
Specifications:
Groove 1 = 0.2 ... 0.4 mm
Groove 2 = 0.2 ... 0.4 mm
Max. permissible total wear = 0.05 mm



o **Replacing / Checking Piston Rings:**

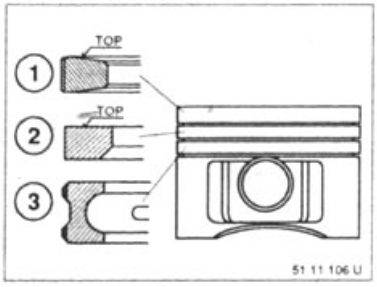
Remove piston rings using piston ring compressing pliers.

Note:
It might not be possible to read the identification of used piston rings. Consequently lay piston rings aside in correct sequence and installed location.



o **Removing Crankshaft:**
(refer to 11 21 501 for replacing crankshaft)

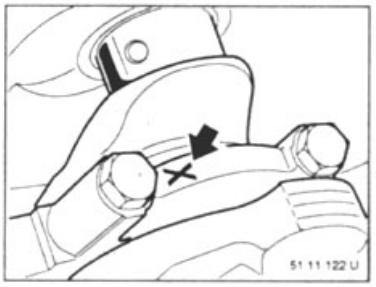
Unscrew and remove main bearing caps (1 ... 7) and lift crankshaft out.



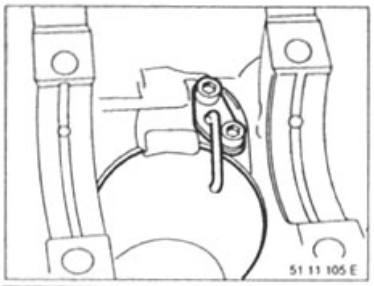
Installation:
Install piston rings with "TOP" facing the piston crown.

1 - Double-sided keystone ring
2 - Taper face ring
3 - Bevelled ring with hose-lined spring

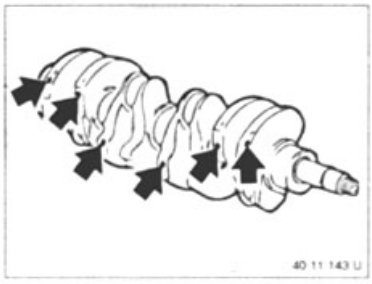
Offset piston ring gaps by about 120° to each other, but do not position them above the piston pin bore.



Installation:
The bearing caps are marked with die-stamped numbers from 1 to 5 on the "exhaust side".
Bearing caps 6 (thrust bearing) and 7 are not marked.

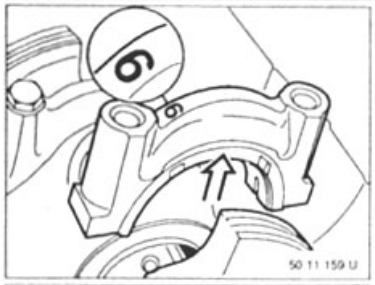


The oil spray nozzles are mounted on the crankcase without gaskets.
If necessary, check flow and sprayed direction.



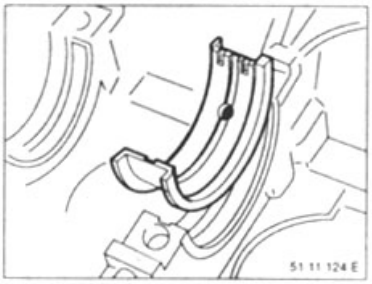
o Replacing Main Bearing Shells:

The crankshaft is marked with yellow, green or white paint depending on main bearing journal tolerances.



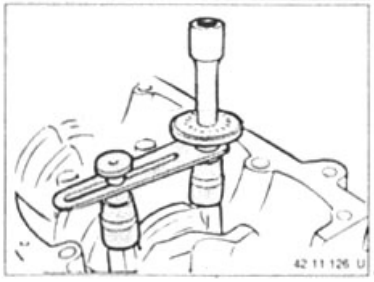
Installation:
Lubricate bearing shells with oil.
Install crankshaft.
Mount bearing caps (1 ... 7) in such a manner that grooves of bearing shell guides are on one side.
Align bearing caps precisely.

Installation:
The thrust bearing shells are installed at bearing (6).



In standard production the thrust bearing only uses a shell on the case end.

For repairs thrust bearing shells must be used in the cap and case similar to the M21 engine.

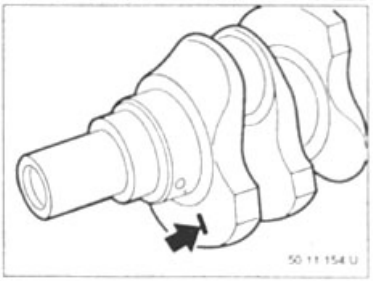


Main bearing cap tightening procedures:

Tighten bolts (washed and oiled) in two steps.

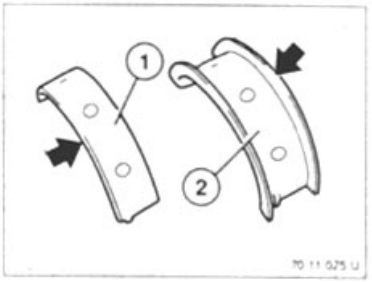
Step 1 = 23 Nm torque force
Step 2 = 50° torque angle

Note:
Make sure that oil is kept out of tapped bores.



Important!
Pay attention to ground size* of crankshaft.

1 paint stripe	Size 1 (0.25 mm)
2 paint stripes	Size 2 (0.50 mm)

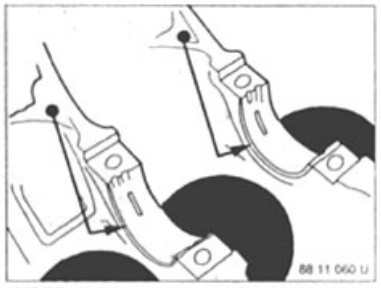


The bearing shells are marked with yellow, green or white paint.

1 = Bearing shell
2 = Thrust bearing shell

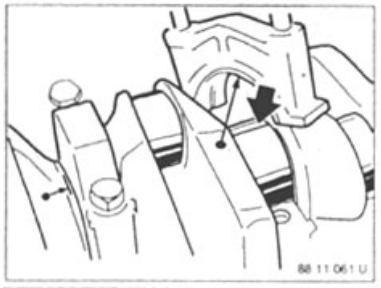
Pay attention to ground size of main bearing journal.

* Refer to Specifications



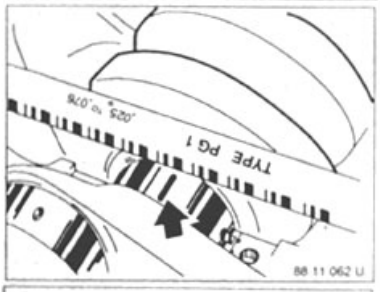
Install bearing shell with yellow paint mark in crankcase.

Install bearing shell with same color paint mark as that of crankshaft in bearing cap.

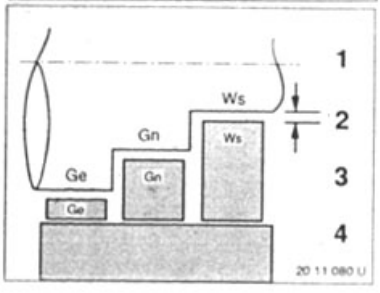


Check conrod bearing play.
– This work need only be carried out for controlling purposes when necessary. –

Install crankshaft.
Place Type PG-1 Plastigage** on crankshaft wiped clean of oil and tighten bearing cap bolts to specified torque*.
Don't turn the crankshaft.



Remove bearing cap and read bearing play* by measuring width of flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing either new bearing shells or bearing shells with a different color paint mark.



Survey of Color Codes / Shaft Diameters / Bearing Shell Thickness*
Triple Classification Color Codes:
Ge = Yellow
Gn = Green
Ws = White

1 = Crankshaft diameter
2 = Bearing play
3 = Bearing shell thickness
4 = Bearing support diameter

* Refer to Specifications
** Source of Supply: Cartool

11 Engine M60

11 00 603 **Engine** – disassemble and assemble 11- 60/1
General information 11- 60/1
Engine – mount on assembly stand 11- 60/1
Exhaust manifolds – remove 11- 60/1
Cylinder head – remove 11- 60/3
Engine wire harness – remove 11- 60/3
Ribbed belt – remove 11- 60/4
Belt tensioner – remove 11- 60/4
Intake manifolds – remove 11- 60/4
Cylinder head covers – remove 11- 60/5
Oil filter – remove 11- 60/6
Oil dipstick guide tube – remove 11- 60/7
Upper timing case cover (bank of cylinders 1-4) – remove 11- 60/7
Upper timing case cover (bank of cylinders 5-8) – remove 11- 60/9
Timing chain sprockets – remove 11- 60/10
Camshaft adjusting procedures 11- 60/11
Cylinder head (bank of cylinders 1-4) – remove 11- 60/14
Cylinder head (bank of cylinders 5-8) – remove 11- 60/15
Cylinder head gasket – replace 11- 60/16
Cylinder head – disassemble and assemble 11- 60/17
Cylinder head – mount on assembly stand 11- 60/17
Camshafts (bank of cylinders 1-4) – remove 11- 60/17
Camshafts (bank of cylinders 5-8) – remove 11- 60/20
Bucket tappets with hydraulic valve clearance compensators – remove 11- 60/22
Intake and exhaust valves – remove 11- 60/22
Cylinder head – check for cracks in water test 11- 60/24
Cylinder head sealing surface – inspect 11- 60/24
Valve guides and seats – machine 11- 60/24
Valve guides – ream 11- 60/24
Valve seats – machine 11- 60/25
Crankcase – disassemble and assemble 11- 60/26
Oil pan lower section – remove 11- 60/26
Oil pan upper section – remove 11- 60/26
Alternator – remove 11- 60/27
Vibration damper – remove 11- 60/27
Front radial oil seal – replace 11- 60/28
Water pump – remove 11- 60/28
Lower timing case cover – remove 11- 60/29
Timing chain guide – remove 11- 60/29
Oil pump – remove 11- 60/31
Oil pressure regulating piston – remove 11- 60/32
Connecting rods and pistons – remove 11- 60/33
Connecting rods – remove 11- 60/34
Conrod bearing shells – replace 11- 60/35
Pistons – replace 11- 60/35
Piston rings – replace/check 11- 60/35
Clutch / flywheel – remove 11- 60/36
Pilot bearing in crankshaft – replace 11- 60/38
Rear end cover – remove 11- 60/38
Crankshaft – remove 11- 60/39
Main bearing shells – replace 11- 60/41

11 00 603 DISASSEMBLING AND ASSEMBLING ENGINE
- Engine Removed -

o General Information

- Cylinder Arrangement:

Looking forward in the car cylinders 1 ... 4 are located on the right-hand side (beginning with cylinder no. 1 at the front end).

Looking forward in the car cylinders 5 ... 8 are located on the left-hand side (beginning with cylinder no. 5 at the front end).

General information for Valve Timing Work:
If work had been carried out on the cylinder head, for which the camshaft was removed, the must be compliance with the following.
The 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 installation of the camshaft and mounting cylinder head:

Room temp. (20° C)	4 minutes
10 to 20° C	11 minutes
0 to 10° C	30 minutes

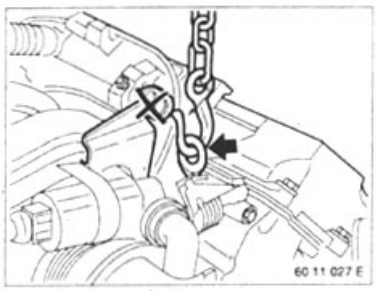
After installation of the camshaft and timing chain the engine may first be cranked after the following waiting times:

Room temp. (20° C)	10 minutes
10 to 20° C	30 minutes
0 to 10° C	75 minutes

Always pay attention to the camshaft adjusting procedures when working on the valve train with mounted cylinder heads.

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.

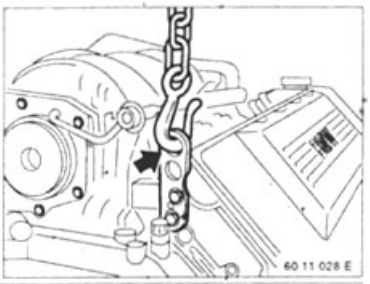
If applicable, drain the engine oil and fill the engine with new oil after assembling the engine.
Check the engine oil level after installation and trial run.



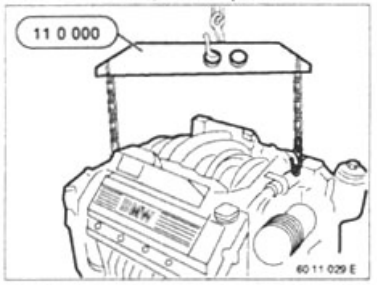
o Mounting Engine on Assembly Stand

Important!
Only lift engine on the suspension eyes provided for this purpose.

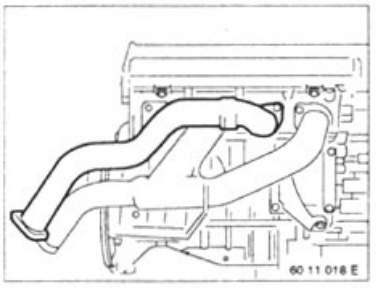
Front Engine Suspension



Rear Engine Suspension

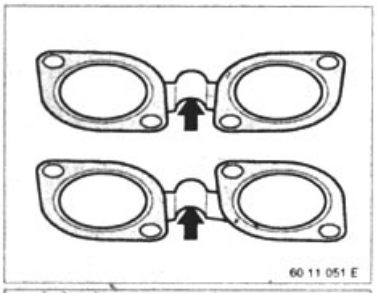


Lift engine using Special Tool 11 0 000.

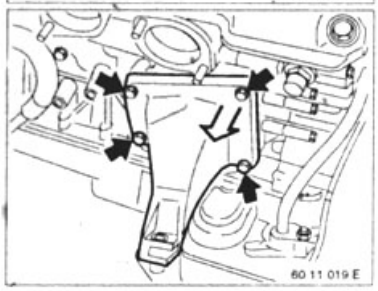


o Removing Exhaust Manifolds

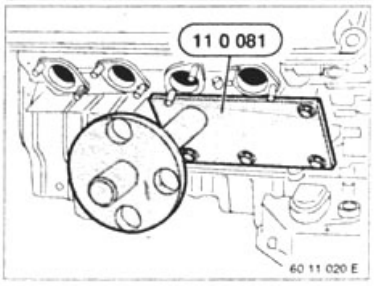
Installation:
The exhaust manifold for cylinders 1 and 3 has to be mounted first because of accessibility to exhaust manifold bolts.



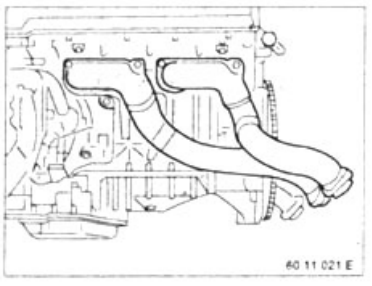
Installation:
Replace gasket — the gasket bead points to the exhaust manifold.



Unscrew engine carrier at cylinder bank 1...4 side.

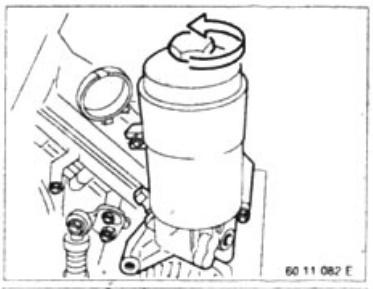


Mount Special Tool 11 0 081 on cylinder bank 1...4 side.



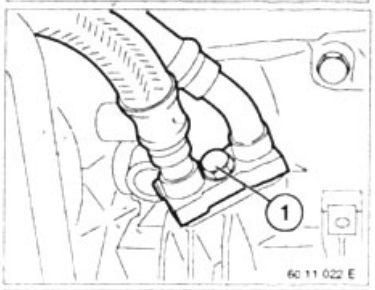
Unscrew exhaust manifold for cylinder bank 5...8.

Installation:
Replace gasket — the gasket bead points to the exhaust manifold.



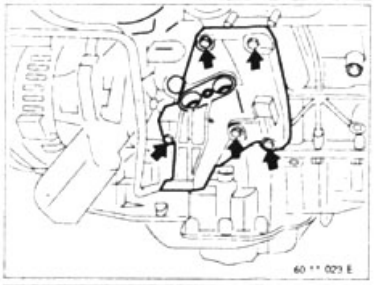
Loosen oil filter cover to let the oil run out of the oil filter housing into the oil pan.

Installation:
Always use a socket for loosening and tightening to prevent damage to the hexagon on the oil filter cover.
Tightening torque*.

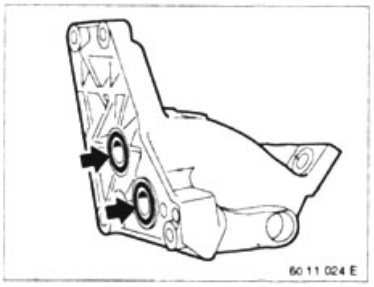


Remove oil filter pipes.
Unscrew bolt (1) and lift out pipes upwards.

Installation
Check seals, replacing if necessary.

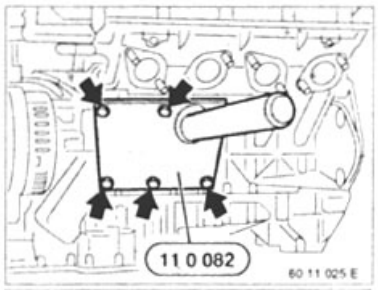


Unscrew engine carrier with oil connectors.

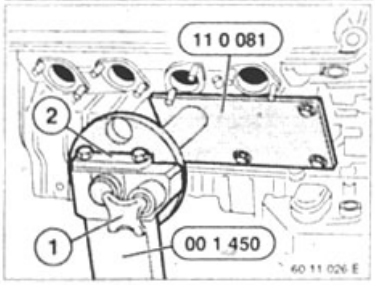


Installation:
Replace seals.
Check for correct seating of seals and, if necessary, hold them in position with grease.

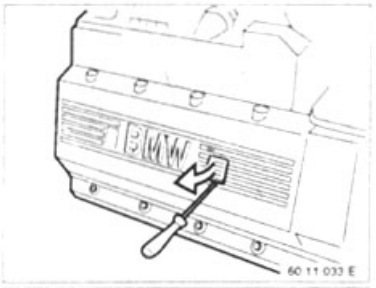
* Refer to Specifications



Mount Special Tool 11 0 082.



Place engine with attached Special Tools 11 0 081 and 11 0 082 in Special Tool 00 1 450 (assembly stand) in such a manner that arrest (1) engages.
Lock left and right arrests (2) and bolt.



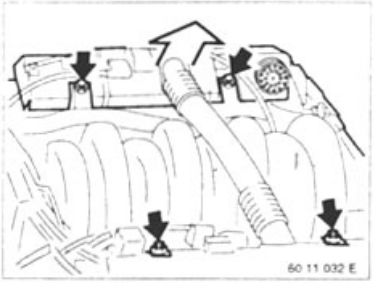
REMOVING CYLINDER HEAD

o Removing Engine Wire Harness

Lift out cover and unscrew nuts.
Remove cover for ignition coils.

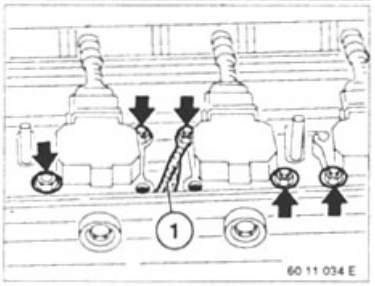


Disconnect plugs on ignition coils.



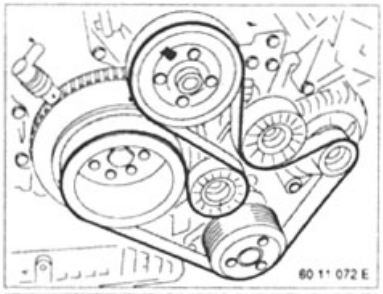
Unscrew nuts from left and right wire duct.
Disconnect all plugs.
Lift off wire harness.

Refer to Group 12 for plug pin connections.



Unscrew nuts.
Remove ignition coils.

Installation:
Secure ground strap (1) at the ignition coils for cylinders 3 and 7.

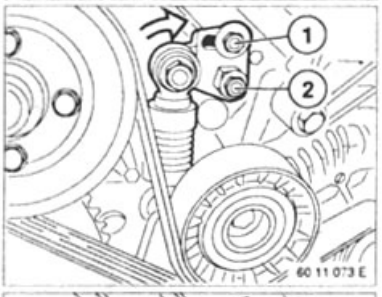


o **Removing Ribbed Drive Belt**

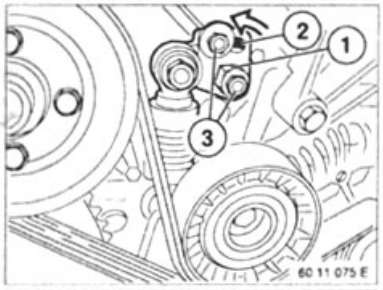
Ribbed Drive Belt Layout

Installation:
Check the ribbed drive belt for traces of coolant and oil, replacing if necessary.

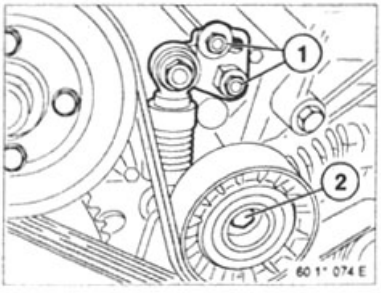
Important!
It is absolutely necessary to replace a ribbed drive belt dirtied with hydraulic oil.



Loosen nuts (1 and 2) to remove tension from the drive belt.

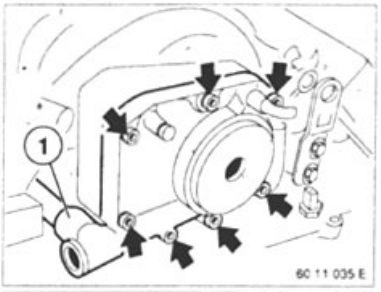


Installation:
Install the ribbed drive belt and check for correct position on the pulleys.
Pre-tesnion the adjusting plate up to the end of slot (2) on hexagon (1).
Tighten nuts (3).



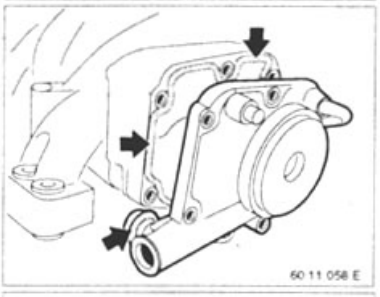
o **Removing Drive Belt Tensioner**

Unscrew nuts (1) and bolt (2).
Remove complete belt tensioner.

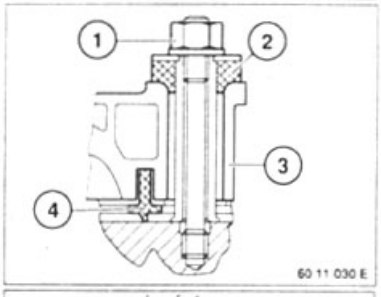


o **Removing Intake Manifolds**

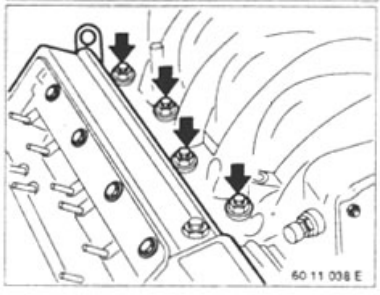
Important!
First unscrew the cover with pressure regulating valve as otherwise vent pipe (1) would be damaged.



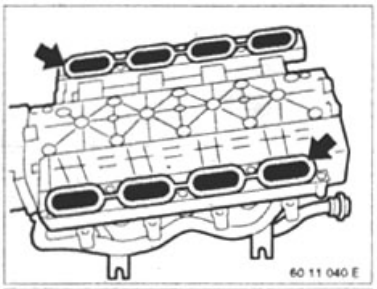
Installation:
Check seal and gasket, replacing if necessary.



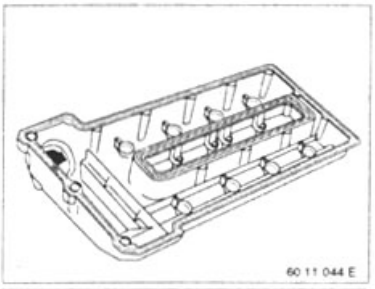
Note:
Rubber mounts and gaskets separate the intake manifold from the cylinder head in regards to oscillation.
Arrangement:
1 Nut
2 Decoupling element (rubber mount)
3 Intake manifold
4 Gasket



Unscrew left and right nuts.
Lift off intake manifold.

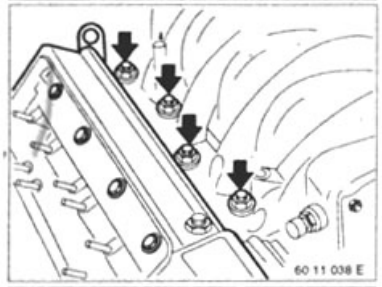


Installation:
Check gaskets, replacing if necessary.
Check for correct seating of gaskets.

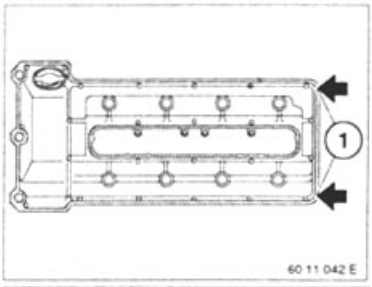


Installation:
Check gasket, replacing if necessary.

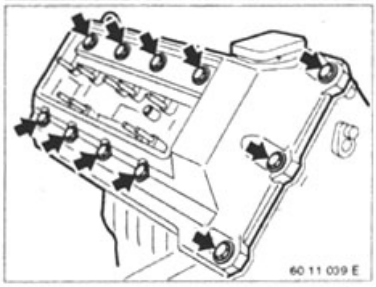
Coat the outer and inner grooves as well as sealing surface of the cylinder head cover all around with a rubber lubricant, e.g. glycerine** or something similar.
Press the inner gasket into the cover groove free of distortion, beginning at the four corners.



Installation:
Screw in two mounting elements still without pre-load on left and right sides and align the intake manifold.
Screw in all other mounting elements and tighten diagonally from inside to outside.
Tightening torque*.

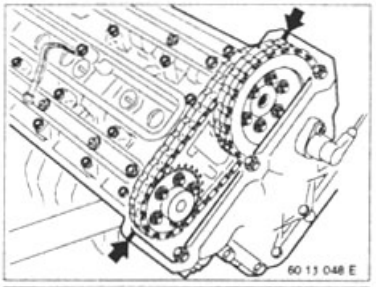


Installation:
Line up the outer gasket loose on the cover groove.
Press the gasket into the cover groove free of distortion, beginning at the rear corner radii (1).

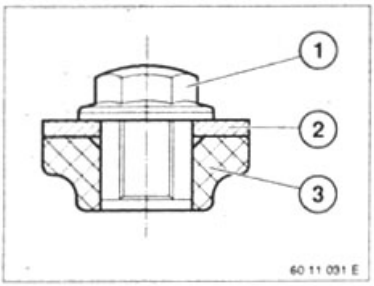


o Removing Cylinder Head Covers

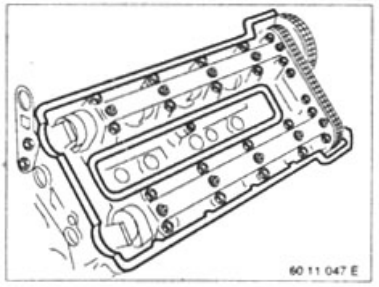
Unscrew cover nuts.
Lift off covers.



Installation:
Coat the butt joint surfaces with fluid sealing compound - Hylomar SQ32 Special**.



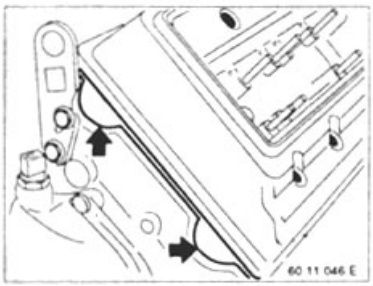
Note:
Rubber mounts and gaskets separate the cylinder head cover from the cylinder head in regards to oscillation.
Arrangement:
1 Nut
2 Washer
3 Rubber mount



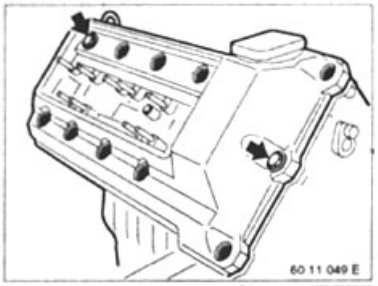
Installation:
Coat the sealing surface on the cylinder head over the entire rear face side including both half-moons with rubber lubricant, e.g. glycerine** or something similar.
Mount the cylinder head cover with gasket on the cylinder head.

* Refer to Specifications

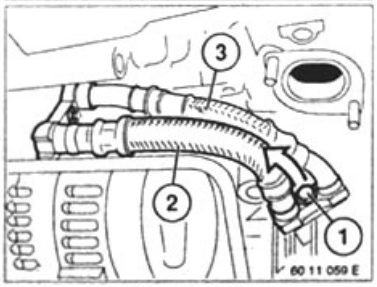
** Source of Supply: BMW Parts



Installation:
Check for correct seating of the gasket on the cylinder head when mounting the cylinder head cover – pay attention to the back.



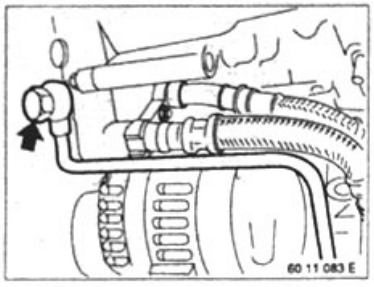
Installation:
Screw in two mounting elements at points of location still without pre-load and align the cover.
Screw in all other mounting elements and tighten diagonally to 10 Nm from inside to outside.



o **Removing Oil Filter**

Unscrew oil pipes from carrier.
Unscrew bolt (1) and lift out pipes upwards.

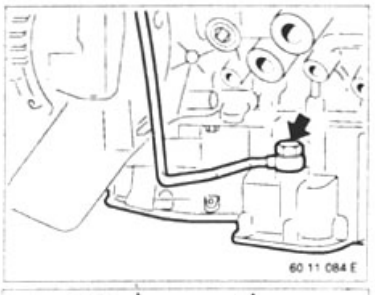
Installation:
Check seals, replacing if necessary.
Note arrangement of oil hoses.
2 Used oil
3 Fresh oil



Unscrew oil drain pipe at oil filter.

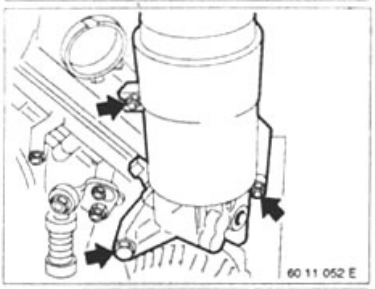
Installation:
Check seal, replacing if necessary.
Tightening torque*.

* **Refer to Specifications**

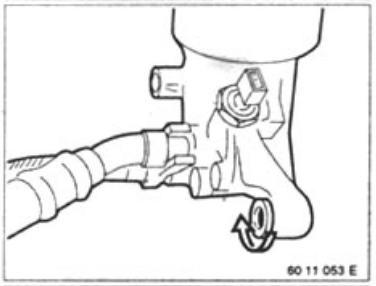


Unscrew oil drain pipe at oil pan.

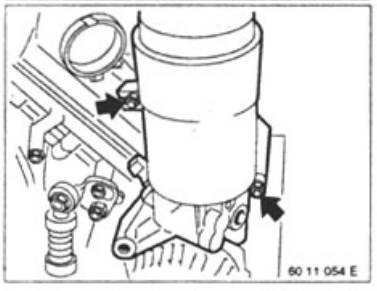
Installation:
Check seal, replacing if necessary.
Tightening torque*.



Unscrew bolt and nuts.
Remove oil filter.

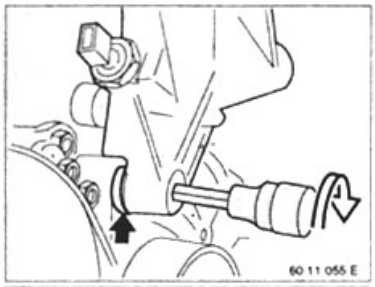


Installation:
Turn back hexagon into oil filter completely using a hexagon key.

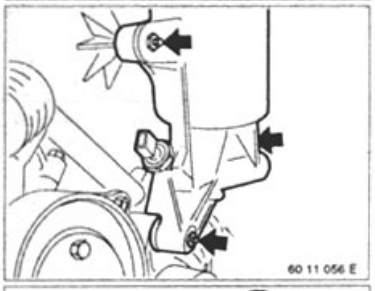


Installation:
Secure with both nuts on the upper timing case cover.

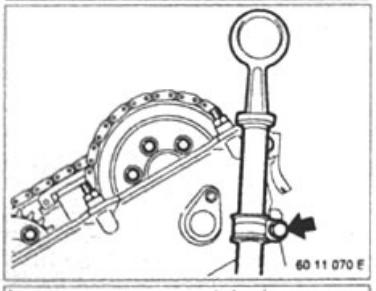
* **Refer to Specifications**



Installation:
Turn the adjusting hexagon against the alternator free of play using a hexagon key, but "do not pre-load".

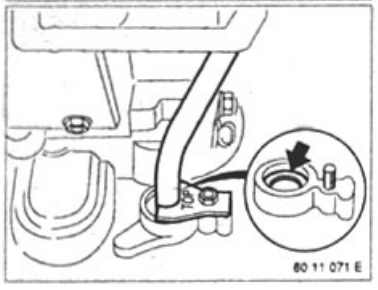


Installation:
Install bolts and tighten all mounting elements.



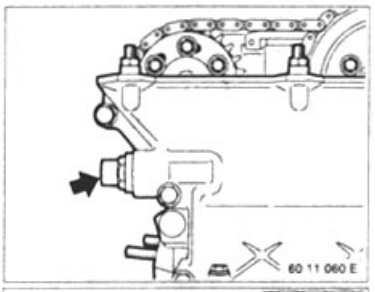
o **Removing Oil Dipstick Guide Tube**

Unscrew clamp.



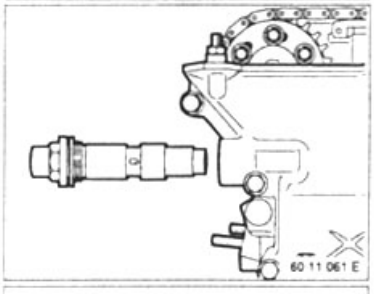
Unscrew nut.

Installation:
Check seal.

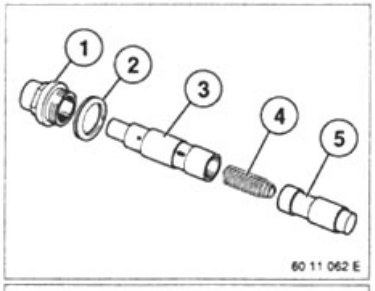


o **Removing Upper Timing Case Cover Cylinder Bank 1...4**

Unscrew chain tensioner mounting element.

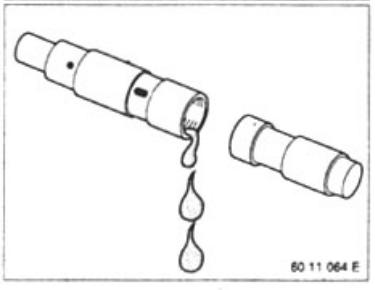


Remove complete mounting element and hydraulic tensioner.



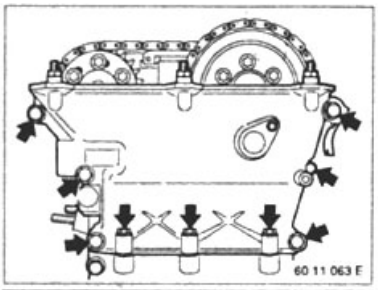
Arrangement of Parts:
1 Plug
2 Seal
3 Cylinder
4 Return spring
5 Hydraulic plunger

Installation:
Conical end of return spring (4) points to hydraulic plunger (5).

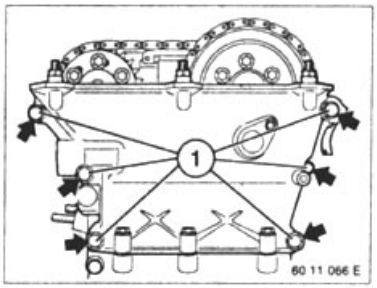


Installation:
Empty the oil chamber between the cylinder and hydraulic plunger to make installation easier.
Replace gasket.
Tightening torque*.

* **Refer to Specifications**

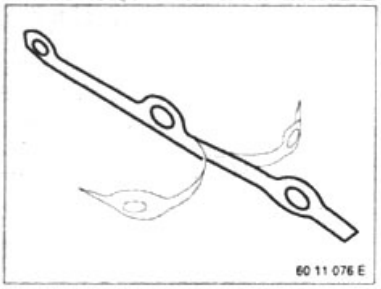


Unscrew mounting elements on timing case cover.



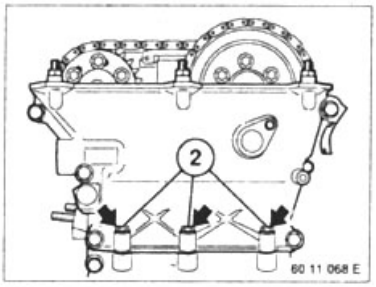
Installation:
Check for correct seating of gaskets.
Press tensioning rail inwards firmly.
Mount timing case cover.
Screw in all bolts.

Bolt Tightening Sequence:
Screw in bolts (1) for securing to cylinder head free of play, but do not tighten!

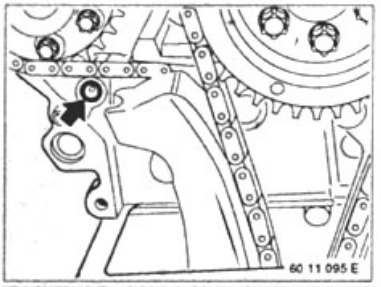


Installation:
Clean sealing surfaces to remove dirt and oil.
Replace gasket.

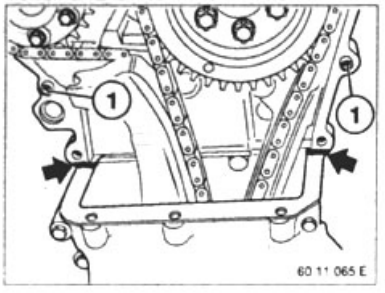
Important!
Pull off protective sheet.



Installation:
Tighten bolts (2) to timing case cover in two steps.
Afterwards tighten bolts (1) in two steps.

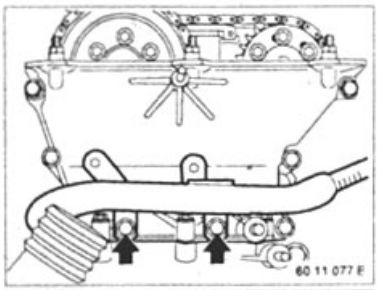


Important!
Supply of oil for hydraulic tensioner in the timing case cover.
Check seal.
Only replace with a genuine BMW part.



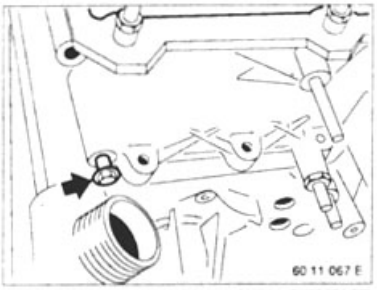
Installation:
Check for correct seating of dowel sleeves (1).
Coat the butt joint corners of the plane between the cylinder head and cylinder head gasket with fluid sealing compound - Hylomar SQ32 Special**.

** Source of Supply: BMW Parts

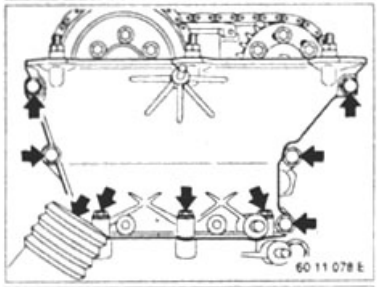


o **Removing Upper Timing Case Cover Cylinder Bank 5...8**

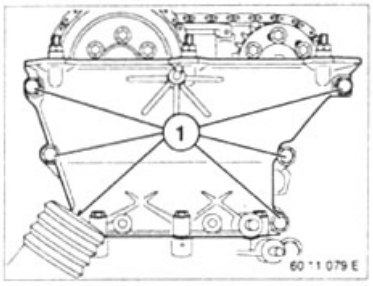
Disconnect battery positive wire at alternator.
Unscrew protective pipe mounting screws.
Place pipe aside.



Installation:
Check for correct seating of gaskets.
Mount timing case cover with inserted bolt, which cannot be inserted afterwards.

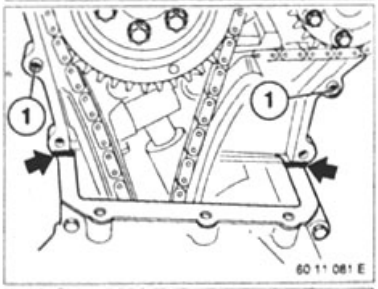


Unscrew mounting elements on timing case cover.

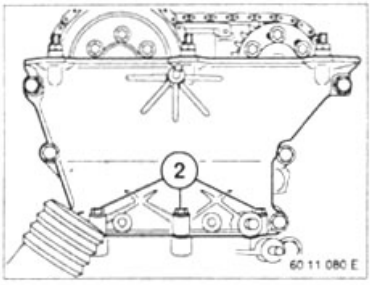


Installation:
Screw in all bolts.

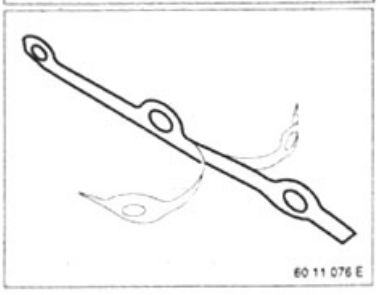
Bolt Tightening Sequence:
Screw in bolts (1) for securing to cylinder head free of play, but do not tighten!



Installation:
Check for correct seating of dowel sleeves (1).
Coat the butt joint corners of the plane between the cylinder head and cylinder head gasket with fluid sealing compound - Hylomar SQ32 Special.**



Installation:
Tighten bolts (2) to timing case cover in two steps.
Afterwards tighten bolts (1) in two steps.

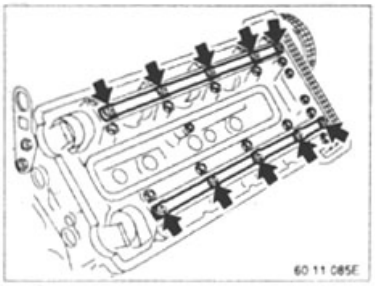


Installation:
Clean sealing surfaces to remove dirt and oil.
Replace gasket.

Important!
Pull off protective sheet.

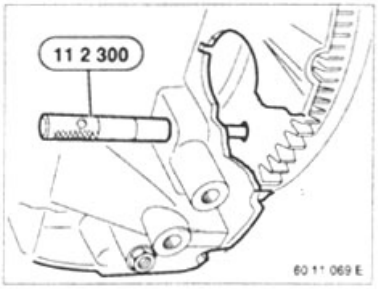
** **Source of Supply: BMW Parts**

** **Source of Supply: BMW Parts**



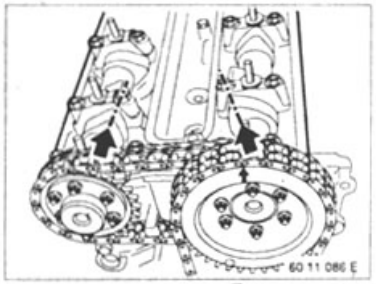
o Removing Sprockets

If applicable, unscrew oil pipes for bearing and cam lubrication.

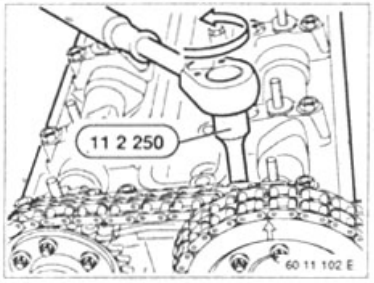


Hold crankshaft in TDC position using Special Tool 11 2 300.

Important!
Remove special tool before operating the engine.

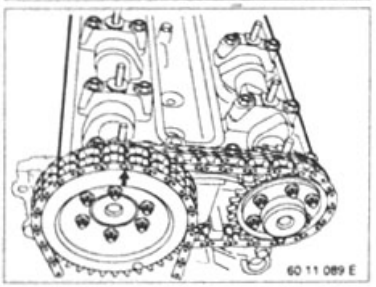


Note:
Crank engine in turning direction until peaks of cams on intake and exhaust camshafts of cylinder no. 1 point to each other.

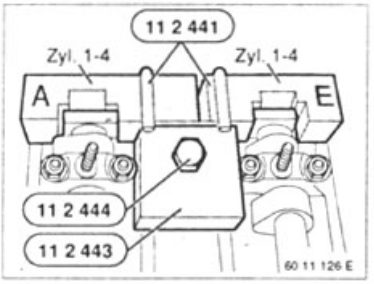


Note:
Easier installation for later cylinder head removal.
Loosen cylinder head bolts from outside to inside in several steps using Special Tool 11 2 250.
Remove rear cylinder head bolts from cylinders 4 and 8.

Installation:
Cylinder head bolt tightening procedures*.

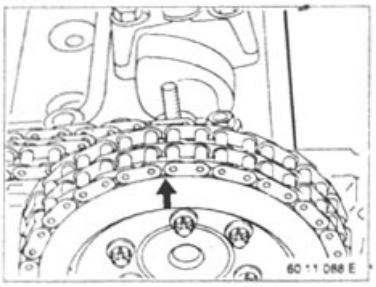


Camshaft Position - Cylinder No. 5

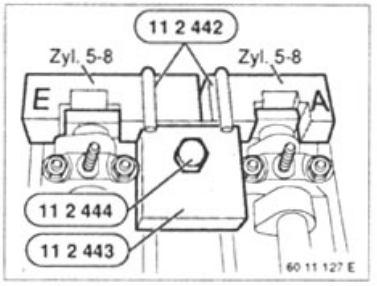


Apply Special Tool 11 2 441 on camshafts at cylinder no. 4.

Installation:
Mount Special Tool 11 2 441 on exhaust and intake camshafts separately.
Mount Special Tool 11 2 443 and locate above spark plug's tapped bore with help of Special Tool 11 2 444.



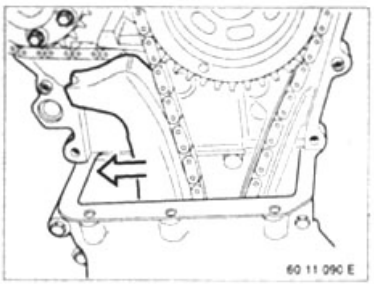
Arrows on sprockets face up in cylinder axis.



Apply Special Tool 11 2 442 on camshafts at cylinder no. 8.

Installation:
Mount Special Tool 11 2 442 on exhaust and intake camshafts separately.
Mount Special Tool 11 2 443 and locate above spark plug's tapped bore with help of Special Tool 11 2 444.

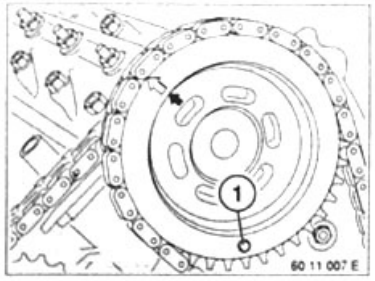
* Refer to Specifications



Unscrew sprocket bolts from both banks of cylinders.
Remove sprockets.

Important!
Prevent the chain from slipping down.

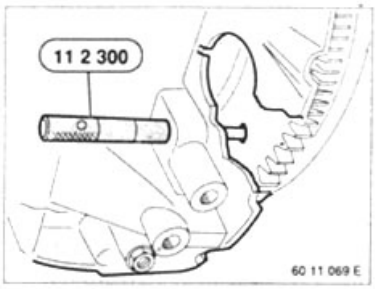
Installation:
Sprockets can only be installed when the timing case cover for cylinder bank 1...4 is removed.



Installation:
Sprocket on intake camshaft for cylinder bank 1...4 has a sender pin (1).
Arrow points up; align in middle of slots.

Tightening torque* for sprocket bolts.

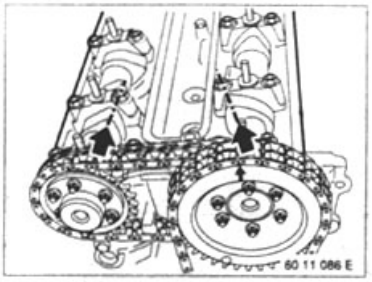
* Refer to Specifications



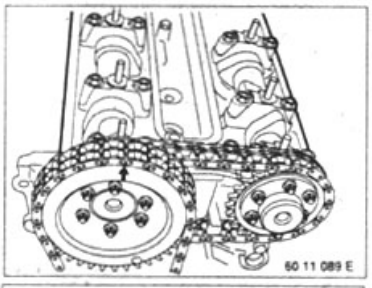
o „Camshaft Adjusting Procedures

Hold crankshaft in TDC position using Special Tool 11 2 300.

Important!
Remove special tool before operating the engine.



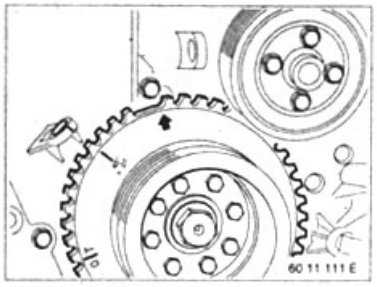
Note:
Camshaft position - cylinder no. 1



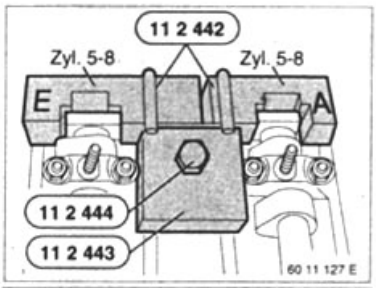
Note:
Camshaft position - cylinder no. 5



Important!
If the camshaft position has to be corrected so much to have valve movement at cylinders 1 and 4 or 5 and 8, the crankshaft must be turned to approx. 45° before TDC. This will prevent contact between the valves and pistons.

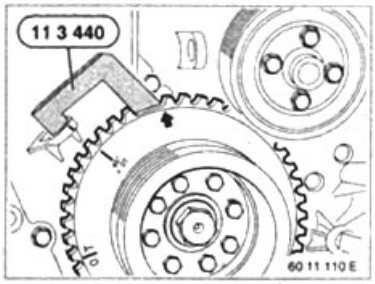


Note:
The vibration damper has a mark for 45° before TDC.
In this position the camshafts can be turned without contact between the valves and pistons.
If applicable, crank the engine to this position.

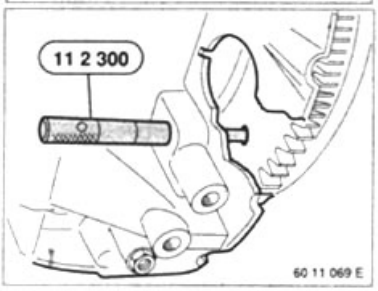


Apply Special Tool 11 2 442 on camshafts at cylinder no. 8.

Installation:
Mount Special Tool 11 2 442 on exhaust and intake camshafts separately.
Mount Special Tool 11 2 443 and locate above spark plug's tapped bore with help of Special Tool 11 2 444.

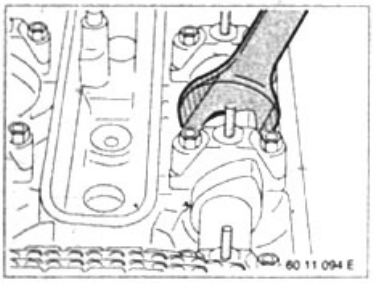


Note:
Vibration Dampers Without Mark for 45° Before TDC:
Apply Special Tool 11 3 440.
Crank the engine on the vibration damper opposite its turning direction until the gap of the increment gear fits in Special Tool 11 3 440.



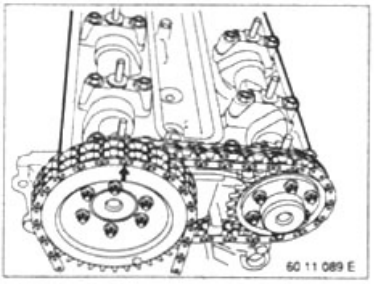
If the engine is cranked to 45° before TDC, crank it in turning direction to TDC position.
Hold crankshaft in TDC position using Special Tool 11 2 300.

Important!
Remove special tool before operating the engine.

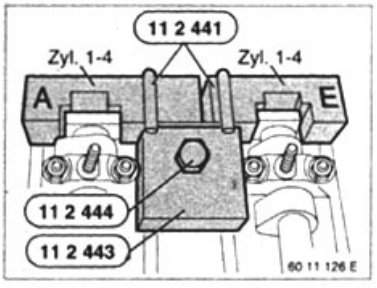


Adjust camshafts on the hexagon using a 27 mm fork wrench.

Important!
Don't damage the cylinder head.
Machine the fork wrench accordingly if necessary.

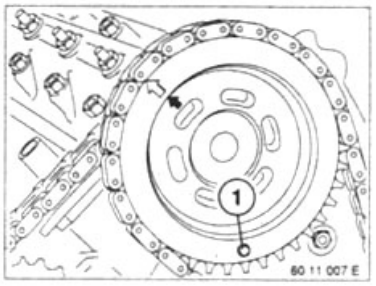


Installation:
First mount sprocket on intake camshaft for cylinder bank 5...8.
Arrow points up; align in middle of slots.
Install and screw in sprocket bolts to remove play, but "do not tighten".



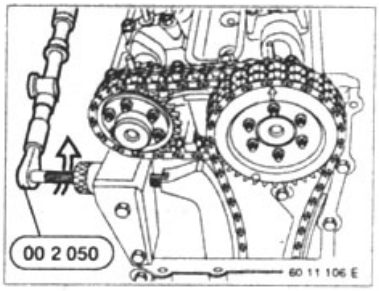
Apply Special Tool 11 2 441 on camshafts at cylinder no. 4.

Installation:
Mount Special Tool 11 2 441 on exhaust and intake camshafts separately.
Mount Special Tool 11 2 443 and locate above spark plug's tapped bore with help of Special Tool 11 2 444.

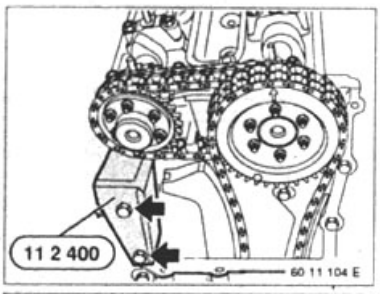


Installation:
Mount sprocket on intake camshaft for cylinder bank 1...4 with sender pin (1).
Arrow points up; align in middle of slots.
Install and screw in sprocket bolts to remove play, but "do not tighten".

Note:
Since introduction of rubber-coated timing chain sprockets it is absolutely necessary to pull the chain into the tooth root of timing chain sprocket for the control diagram adjustment.



Preload the tensioning rail to 1.3 Nm using Special Tool 11 3 390 by turning the adjusting screw with Special Tool 00 2 050 or a standard torque wrench.



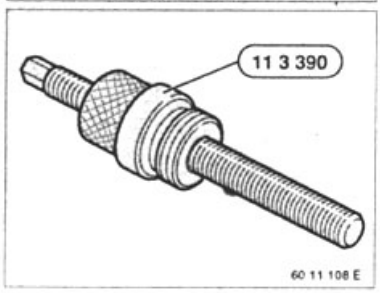
Mount Special Tool 11 2 400 on cylinder head,1...4.

Tighten bolts of all sprockets.

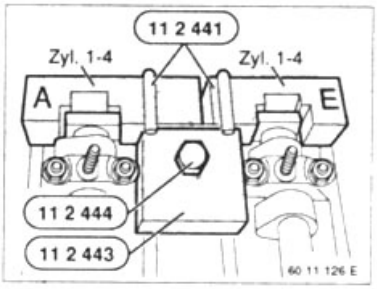
Important!
Pay attention to the tightening sequence for sprockets on camshafts.

1	Exhaust camshaft	5...8
2	Exhaust camshaft	1...4
3	Intake camshaft	5...8
4	Intake camshaft	1...4

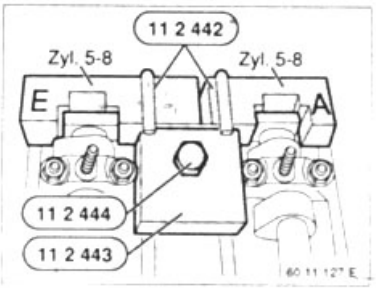
Tightening torque*.



Install Special Tool 11 3 390 in Special Tool 11 2 400.

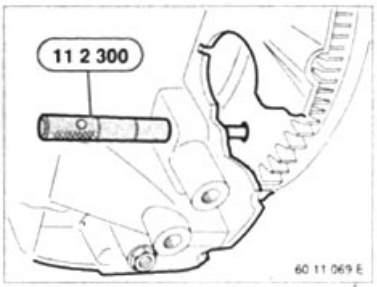


Remove Special Tool 11 2 300 and Special Tool 11 2 441 from cylinder no. 4.



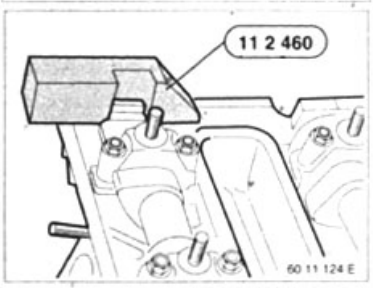
Remove Special Tool 11 2 442 from cylinder no. 8.
Crank engine twice in turning direction.

* Refer to Specifications

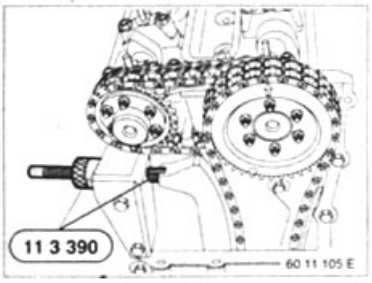


Hold crankshaft in TDC position using Special Tool 11 2 300.

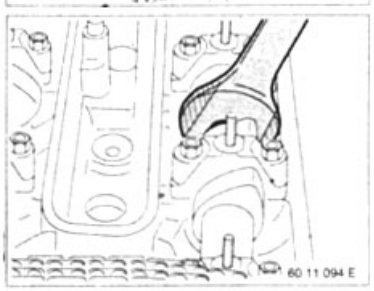
Important!
Don't turn the engine back.
Remove special tool before operating the engine.



Check the camshaft adjustment using Special Tool 11 2 460.



Important!
When checking the camshaft adjustment it is essential to ensure that the timing chain is pre-tensioned with Special Tool 11 3 390.

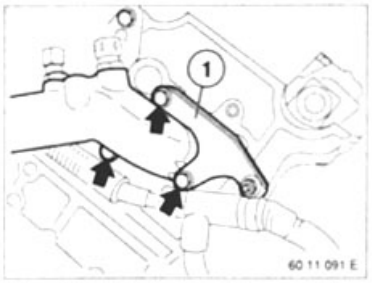


If applicable, unscrew the sprocket of an incorrectly adjusted camshaft and align the camshaft on the hexagon using a 27 mm fork wrench.

Important!
Don't damage the cylinder head.
If necessary, machine the fork wrench accordingly.

Tightening torque* for sprocket bolts.
Loosen Special Tool 11 3 390.
Remove Special Tool 11 2 400 from the cylinder head.

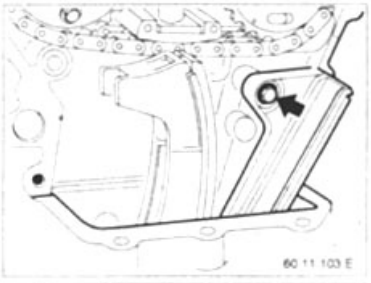
* Refer to Specifications



o Removing Cylinder Head
Cylinder Bank 1...4

Unscrew battery positive wire holder (1).
Unscrew water box on back cylinder wall at left and right sides.

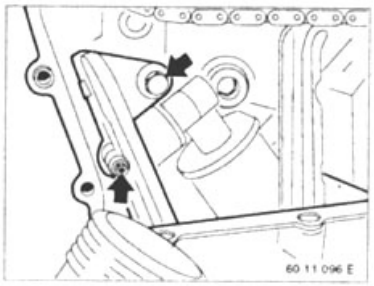
Installation:
Clean the sealing surfaces.
Replace gaskets.
Check seals in water box, replacing if necessary.



Unscrew sliding rail from cylinder head.



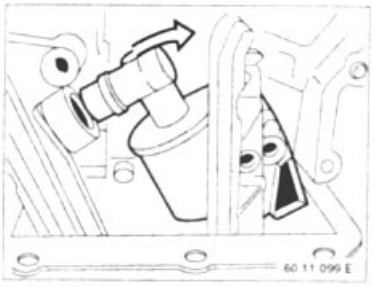
Unscrew cylinder head bolts from outside to inside using Special Tool 11 2 250.
Lift off cylinder head.



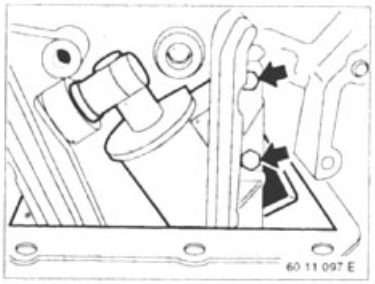
o Removing Cylinder Head
Cylinder Bank 5...8

Loosen the headless screw.

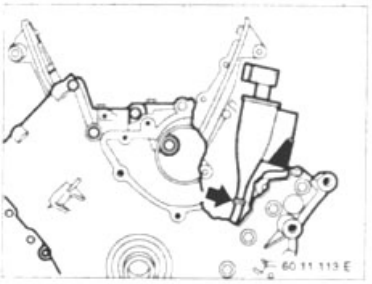
Installation:
Replace only with a genuine BMW part.
The headless screw locates the elbow in the cylinder head.
Tightening torque: 2 to 3 Nm.
Unscrew sliding rail from cylinder head.



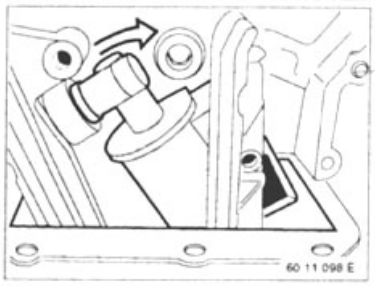
Important!
Push the oil separator inwards when removing and installing the cylinder head.



Unscrew sliding rail bolts and oil separator mounting screw.

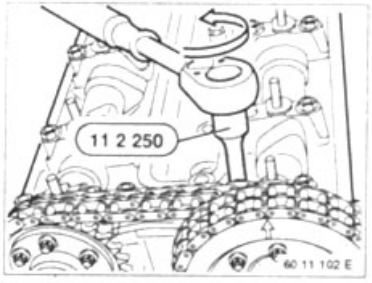


Installation:
Check for correct seating of the oil return pipe in the oil separator.
Align the return pipe using a screwdriver.



Pry oil separator out of the elbow using a screwdriver.

Installation:
Check seal in elbow, replacing it if necessary.



Unscrew cylinder head bolts from outside to inside using Special Tool 11 2 250.
Lift off cylinder head.



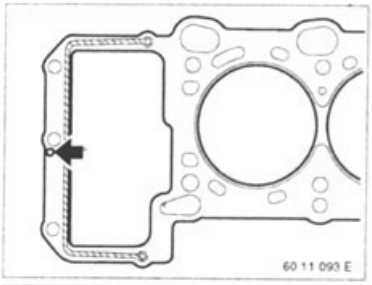
Installation:
Comply with the waiting times for the hydraulic valve tappets when installing the cylinder head.
Refer to "General Information".

o Replacing Cylinder Head Gasket

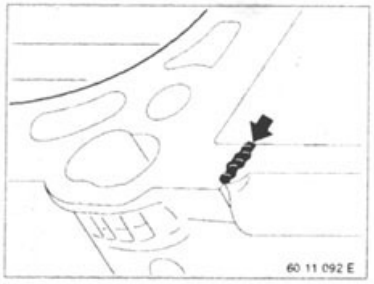
Installation:
Clean the sealing surfaces on cylinder head and crankcase; if necessary remove bits of gaskets with gasket remover** and a wood scraper.
Ensure that bits of gaskets do not fall into oil and coolant bores.

Tapped bores in the crankcase must be free of dirt and oil (danger of cracking the head).

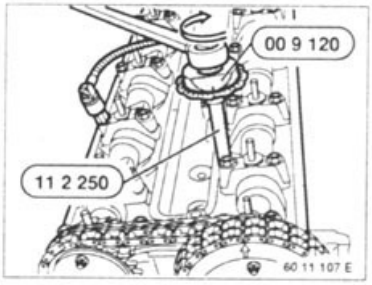
Important!
Maximum 0.3 mm may be machined off of the cylinder head thickness.
A repair gasket is available for compensation of compression.



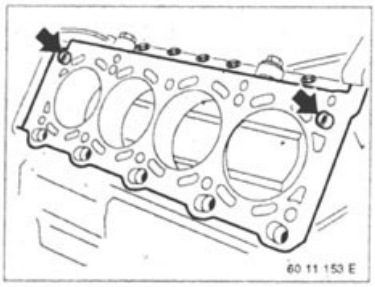
Installation:
Repair gaskets are marked with a hole in the front area.



Coat the butt joint between crankcase and timing case cover with Hylomar SQ 32 Special**.



Installation:
Mount the cylinder head together with new bolts (don't remove coat from bolts)!
Keep oil out of the tapped bores (danger of cracking the head).
Use Special Tools 11 2 250 and 11 2 110 or 00 9 120 to tighten bolts to torque angle.

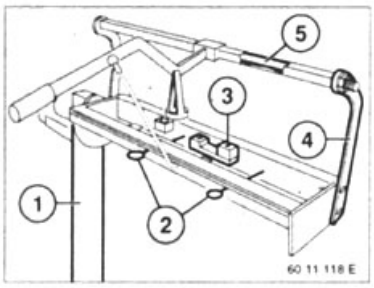


Installation:
Check dowel sleeves for damage and correct installed position.
Install new cylinder head gasket.

Installation:
Install all cylinder head bolts.
Comply with cylinder head bolt tightening procedures*.
Tighten bolts diagonally from the center to the outside in three steps.

** Source of Supply: BMW Parts

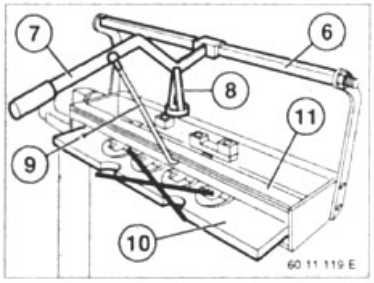
* Refer to Specifications



DISASSEMBLING AND ASSEMBLY CYLINDER HEAD

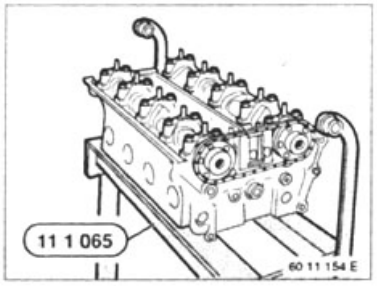
- Setting Up Cylinder Head on Assembly Stand

1 Special Tool 00 1 490
2 Special Tool 11 0 214
3 Special Tool 11 0 213
4 Special Tool 11 1 071
5 Special Tool 11 1 067

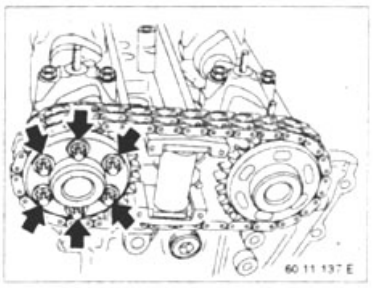


6 Special Tool 11 0 192
7 Special Tool 11 0 193
8 Special Tool 11 0 212
9 Special Tool 11 0 244
10 Special Tool 11 0 211
11 Special Tool 11 1 065

Do not yet mount Special Tool 11 0 211 (tray).

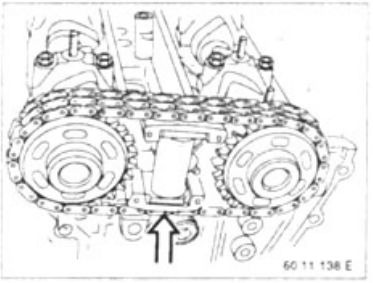


Secure cylinder head to Special Tool 11 1 065 using cylinder head bolts.

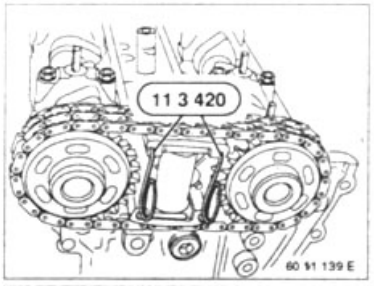


- Removing Camshafts Cylinder Bank 1.. 4

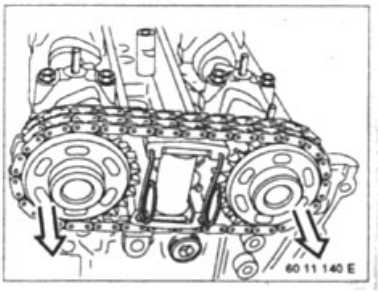
Unscrew sprocket bolts.



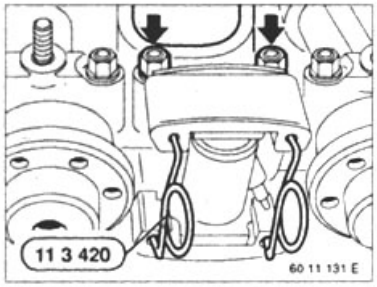
Compress the hydraulic tensioning element to loosen the timing chain.



Lock the hydraulic tensioning element using Special Tool 11 3 420.



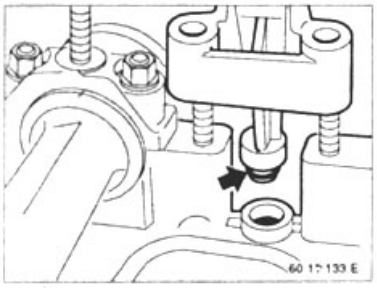
Lift off both sprockets together with the timing chain.



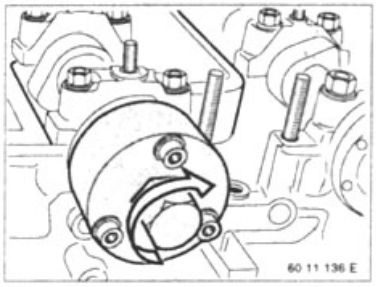
Remove the hydraulic tensioning element for cylinder bank 1...4.



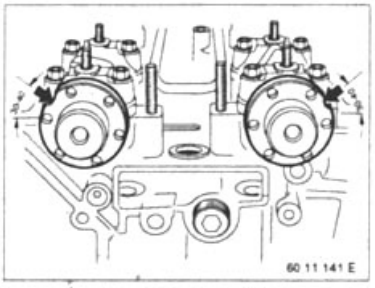
Caution!
The camshaft could be pre-damaged or broken when installation or removal is incorrect.
In addition, the valves could be bent through contact with the piston crowns when mounting the cylinder head on the crankcase.
Always comply with installing procedures and sequence.



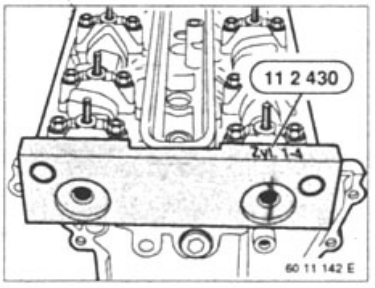
Installation:
Check seal, replacing if necessary.



Cylinder Bank 1...4:
Turn camshafts to insertion position.
Turn exhaust and intake camshafts for cylinder bank 1...4 using Special Tool 11 3 430.

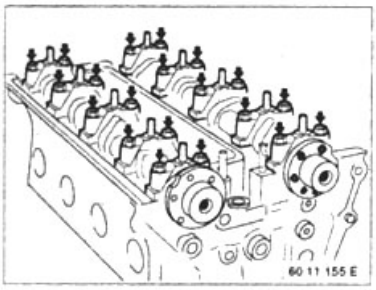


Openings of the camshafts point up at an angle of approx. 30 to 40° from the cylinder head plane.

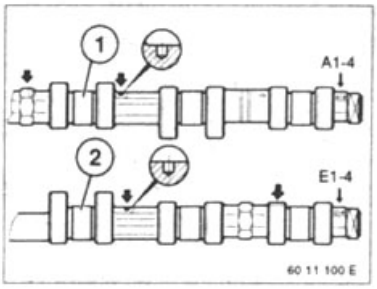


Check the insertion position using Special Tool 11 2 430.

Note:
Lettering "cyl. 1-4" on Special Tool 11 2 430 faces up.

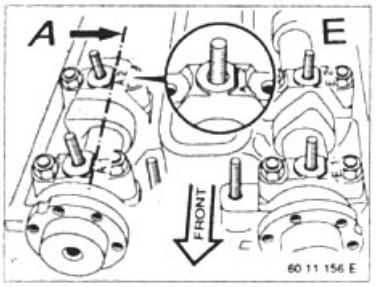


Unscrew bearing caps of camshafts for cylinder bank 1...4 uniformly from outside to inside in 1/2-turn steps.



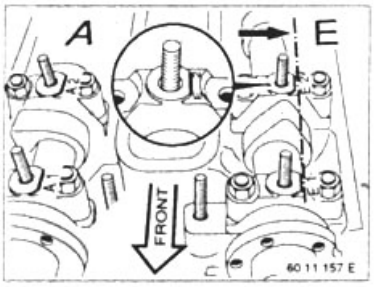
Note:
Camshaft identification:
1 Exhaust camshaft 1...4
2 Intake camshaft 1...4

Marks face up in ignition TDC.
Additional identification:
Exhaust camshaft =
hexagon between cylinders 1 and 2.
Intake camshaft =
hexagon between cylinders 3 and 4.

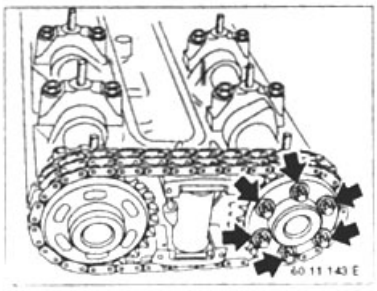


Important!
Don't mix up camshaft bearing caps of cylinder banks 1...4 and 5...8.

Exhaust camshaft bearing caps are marked with A1 through A5 and can be read from the intake side.

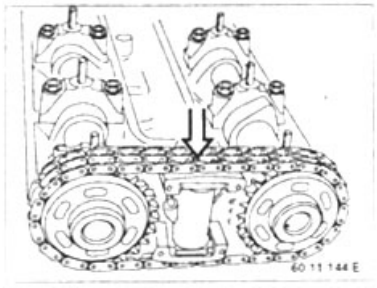


Intake camshaft bearing caps are marked with E1 through E5 and can be read from the intake side.

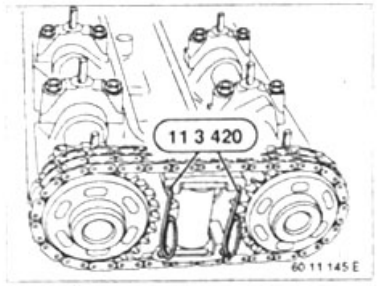


o **Removing Camshafts Cylinder Bank 5...8**

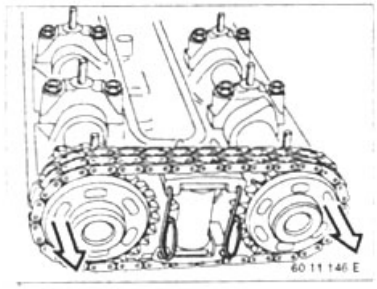
Unscrew sprocket bolts.



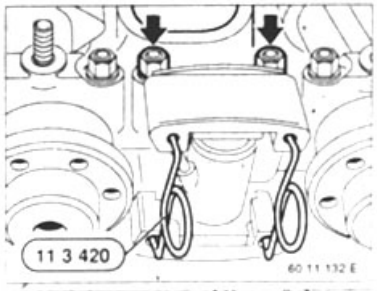
Compress the hydraulic tensioning element to loosen the timing chain.



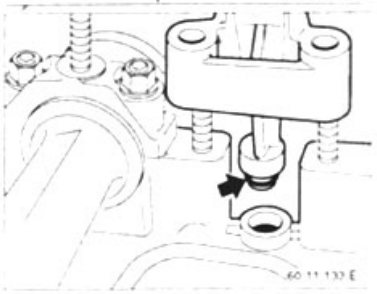
Lock the hydraulic tensioning element using Special Tool 11 3 420.



Lift off both sprockets together with the timing chain.



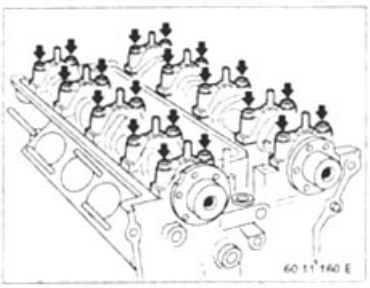
Remove the hydraulic tensioning element for cylinder bank 5...8.



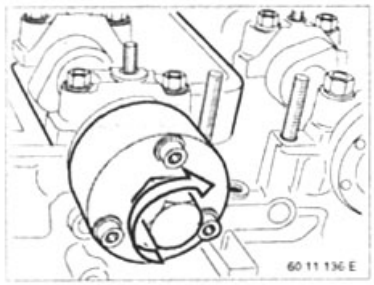
Installation
Check seal, replacing if necessary.



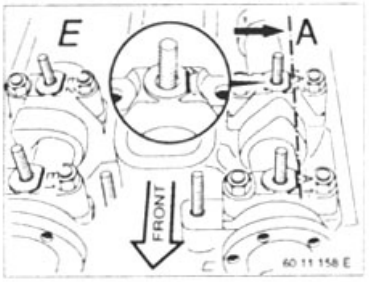
Caution!
The camshaft could be pre-damaged or broken when installation or removal is incorrect.
In addition, the valves could be bent through contact with the piston crowns when mounting the cylinder head on the crankcase.
Always comply with installing procedures and sequence.



Unscrew bearing caps of camshafts for cylinder bank 5...8 uniformly from outside to inside in 1/2-turn steps.

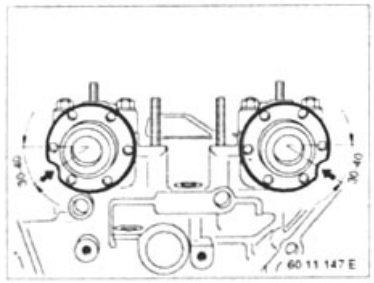


Cylinder Bank 5...8:
Turn camshafts to insertion position.
Turn exhaust and intake camshafts for cylinder bank 5...8 using Special Tool 11 3 430.

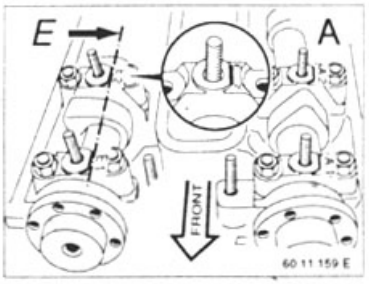


Important!
Don't mix up camshaft bearing caps of cylinder banks 1...4 and 5...8.

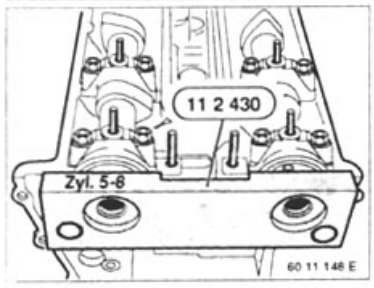
Exhaust camshaft bearing caps are marked with A1 through A5 and can be read from the intake side.



Openings of the camshafts point down at an angle of approx. 30 to 40° from the cylinder head plane.

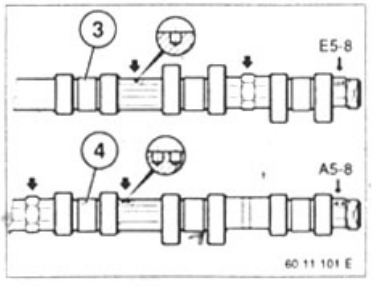


Intake camshaft bearing caps are marked with E1 through E5 and can be read from the intake side.



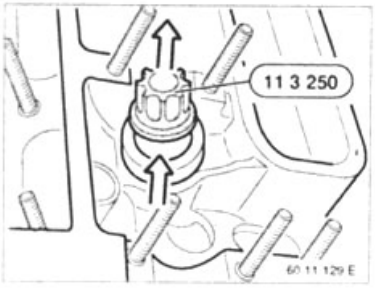
Check the insertion position using Special Tool 11 2 430.

Note:
Lettering "cyl. 5-8" on Special Tool 11 2 430 faces up.



Note:
Camshaft identification:
3 Exhaust camshaft 5...8
4 Intake camshaft 5...8

Marks face up in ignition TDC.
Additional identification:
Intake camshaft =
hexagon between cylinders 7 and 8.
Exhaust camshaft =
hexagon between cylinders 5 and 6.



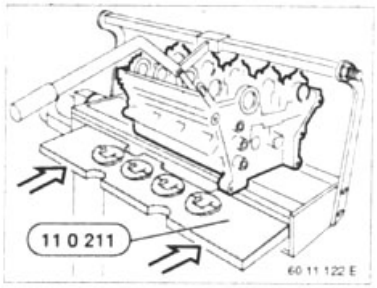
o Removing Bucket Tappets with Hydr. Valve Clearance Compensators

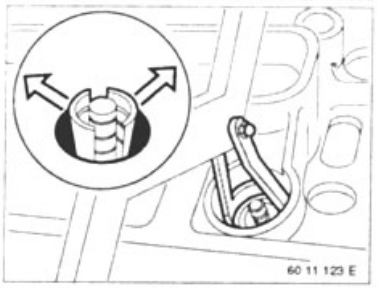
Note:
Always only use Special Tool 11 3 250 to remove hydraulic valve clearance compensator bucket tappets.

Note:
Pay particular attention to damage of the hydraulic valve clearance compensator guides in the cylinder head.

Installation:
Inspect bearing surfaces of hydraulic valve clearance compensator bucket tappets for wear and scoring.

Installation:
Used hydraulic valve clearance compensator bucket tappets may only be reinstalled in the same tappet bores.



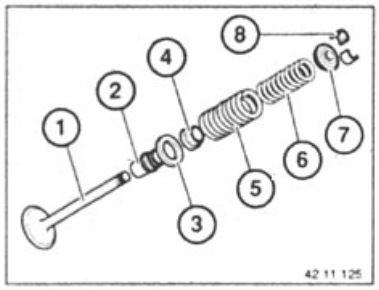


o Removing Intake and Exhaust Valves

Insert Special Tool 11 0 211 (tray) into Special Tool 11 1 065 at bottom.
Secure with dowel pins.

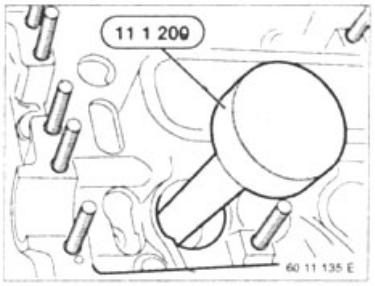
Press down valve springs on spring retainer and remove the valve collets.
Remove valve springs and spring retainer.
Take tray out of assembly stand downward and pull out valve.

Installation:
Both valve springs must be replaced, if one inner or outer valve spring is damaged or broken.
Only use inner and outer valve springs of the same make with the same color code.

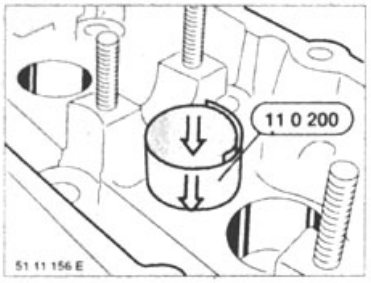


Installed Sequence:

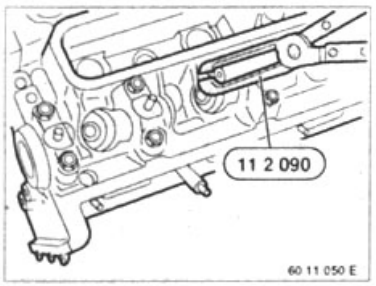
1 Valve
2 Valve stem seal
3 Outer valve spring retainer
4 Inner valve spring retainer
5 Outer valve spring
6 Inner valve spring
7 Upper valve spring retainer
8 Valve collets



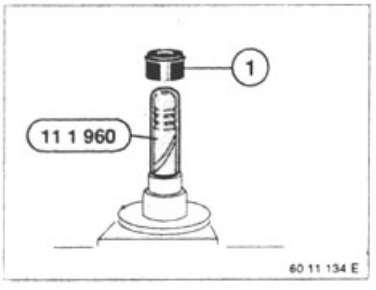
Installation:
Press on valve stem seal as far as stop by hand using Special Tool 11 1 200.
Remove Special Tool 11 1 960.



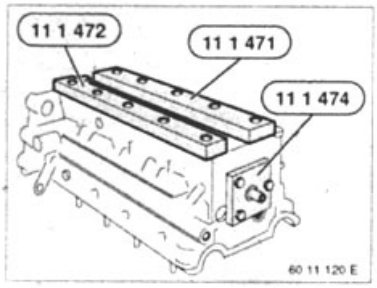
Important!
Bearing surfaces of the hydraulic valve clearance compensator bucket tappets must not be damaged.
Protect them by inserting Special Tool 11 0 200.



Pull off valve stem seal using Special Tool 11 2 090.



Installation:
Lubricate valve stem with oil and insert valve.
Apply Special Tool 11 1 960.
Lubricate new valve stem seal (1) with oil and install.



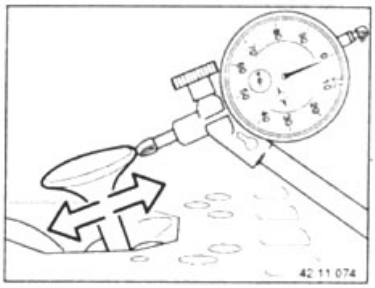
o Checking Cylinder Head for Cracks in Water Test

Check the cylinder head to the following instructions if there is suspicion of leaks in the coolant circuit (cylinder head area).

Plug off the coolant circuit with
Special Tool 11 1 471,
Special Tool 11 1 472 and
Special Tool 11 1 474.

Supply air pressure to cylinder head.
Test pressure = 4.5 bar.
Place cylinder head in a water bath and check for cracks.

Note:
Possibly soften the water bath with a detergent.

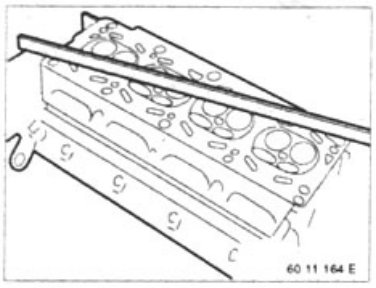


o Machining Valve Guides and Seats

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*.

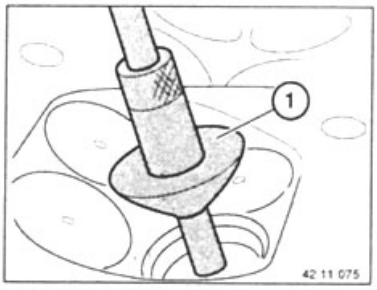
o Reaming Valve Guides

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.



o Checking Cylinder Head Sealing Surface

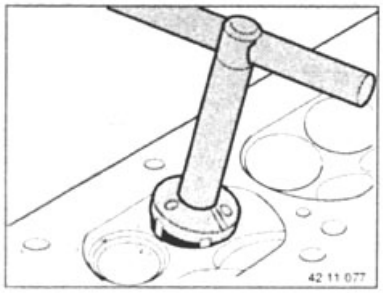
Check levelness of the cylinder head sealing surface with a standard straightedge (steel ruler).
Max. deviation = 0.03 mm.



Assemble Special Tool 00 4 200 depending on the stem diameter.
Press guide mushroom (1) against the valve seat and ream out the valve guide dry from the combustion chamber end.
Turn down the reamer once.

Note:
The valve seat must be machined after reaming.

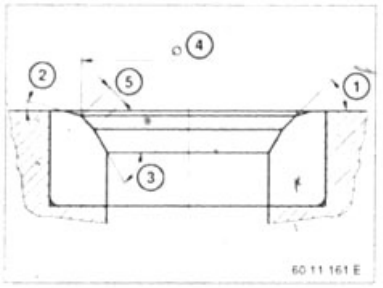
* Refer to Specifications



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:

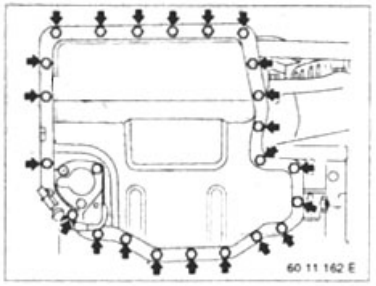


After Machining Valve Seat:
Machine valve seat outside and inside diameters to specified size using a correction cutter* in such a manner that the specified valve seat width* is produced.

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

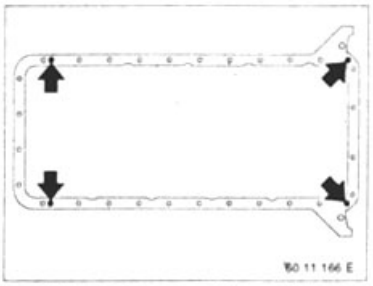


DISASSEMBLING AND ASSEMBLING CRANKCASE

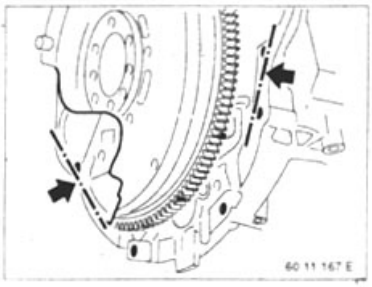
o Removing Oil Pan Low Section

Unscrew bolts.

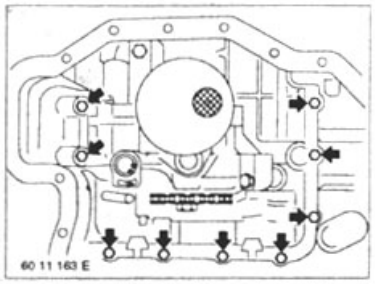
Installation:
Replace gasket.



Installation:
Clean sealing surfaces and remove bits of gasket.
Coat butt joint edges with fluid sealing compound Hylomar SQ32 Special**.
Replace gasket.



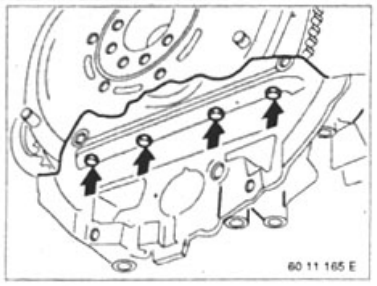
Installation:
Align the oil pan at the transmission end with the crankcase in order to exclude stress when mounting the transmission later.



o Removing Oil Pan Upper Section

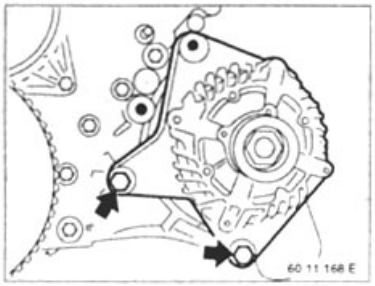
Unscrew bolts.

Note:
Note bolts inside oil pan.



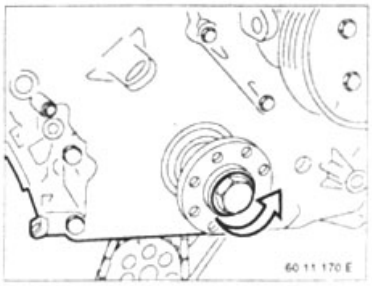
Note:
Note bolts for end cover.

** Source of Supply: BMW Parts

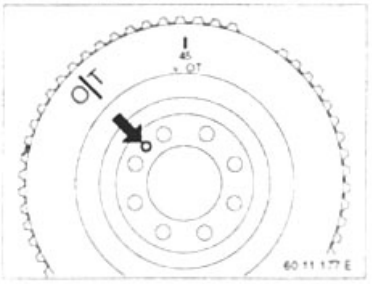


o Removing Alternator

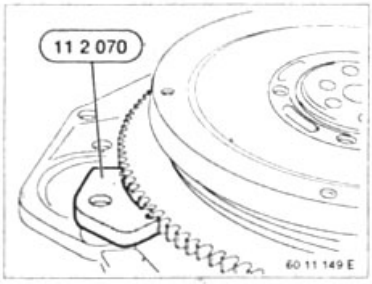
Unscrew bolts.
Refer to Group 12 for electric connections.
Remove alternator.



Unscrew central bolt.
Remove hub.

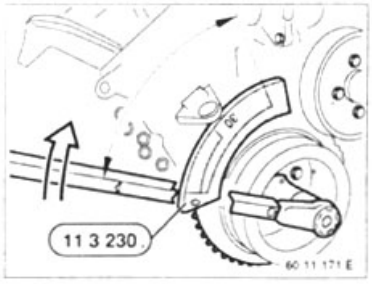


Installation
Align hub with groove for woodruff key.
Install central bolt.
Align dowel pin bore in the vibration damper with the dowel pin.
Mount vibration damper.

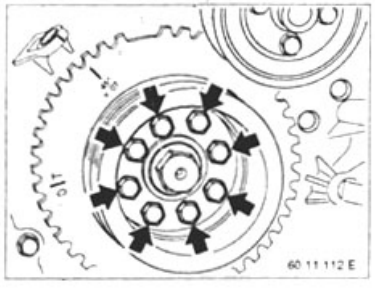


o Removing Vibration Damper

Arrest flywheel using Special Tool 11 2 070.

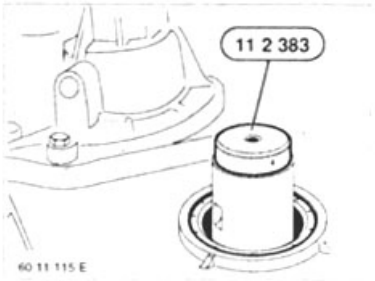


Installation
Mount Special Tool 11 3 230 on the vibration damper.
Tighten the central bolt to specified tightening torque* and torque angle*.



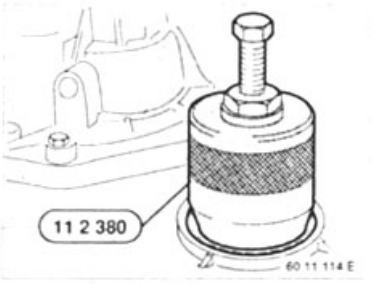
Unscrew vibration damper.

Refer to Specifications

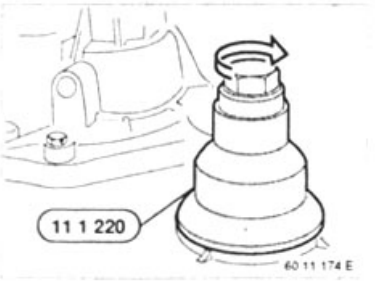


o Replacing Front Radial Oil Seal

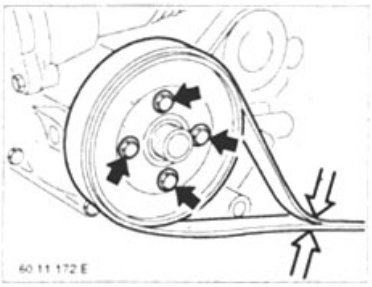
Apply Special Tool 11 2 383 on crankshaft.



Remove radial oil seal:
Apply Special Tool 11 2 380.
Screw in special tool far enough that it is securely connected with the radial oil seal.
Pull out radial oil seal by screwing in the bolt.

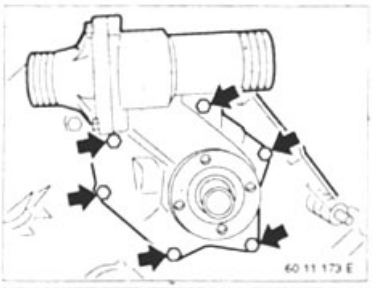


Installation:
Lubricate sealing lips of new radial oil seal with oil.
Apply Special Tool 11 1 220 and central bolt flush with the timing case cover.

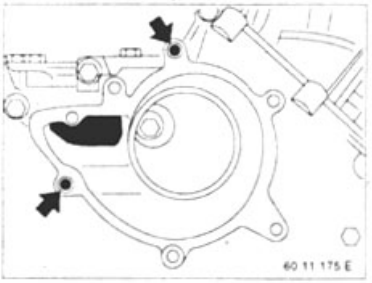


o Removing Water Pump

Counterhold the water pump pulley on the ribbed drive belt and unscrew bolts.

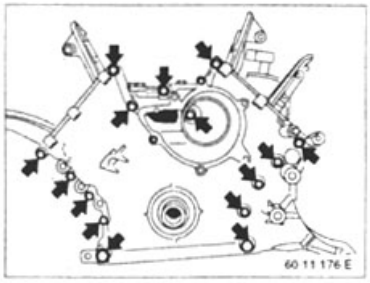


Unscrew bolts.
Remove water pump.



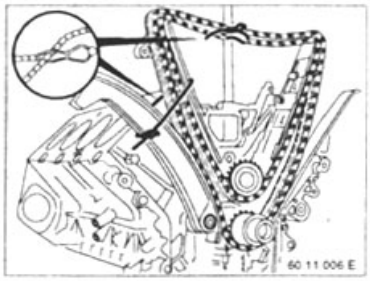
Installation:
Check for correct seating of dowel sleeves.
Clean sealing surfaces and remove bits of gasket.
Replace gasket.

* Refer to Specifications

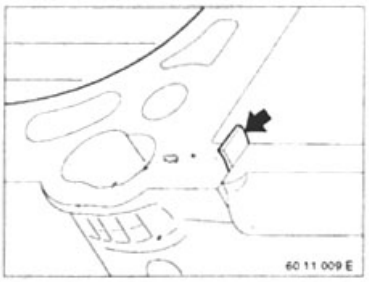


o **Removing Lower Timing Case Cover**

Unscrew bolts.

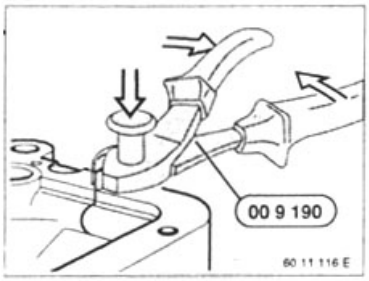


Installation:
Secure timing chain and rails with plastic straps.



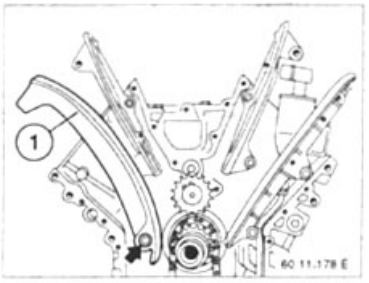
Installation:
Check for correct seating of dowel sleeves.
Clean sealing surfaces and remove bits of gasket.
Replace gasket.

Note:
Timing case cover gaskets are designed as coated metal gaskets.



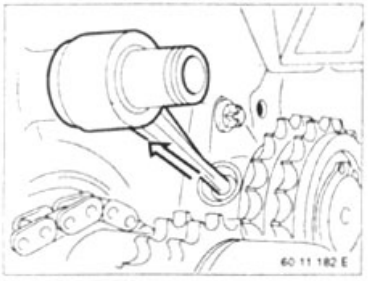
Installation:
Cut off protruding ends of gasket using Special Tool 00 9 190.

Important!
Apply the special tool level.
Cut off pieces of gasket must not fall into the engine.

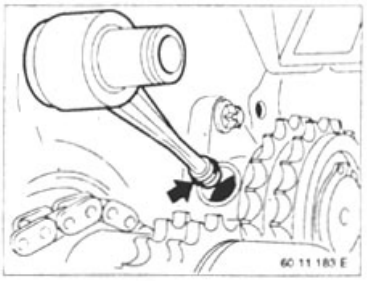


o **Removing Timing Chain Guide**

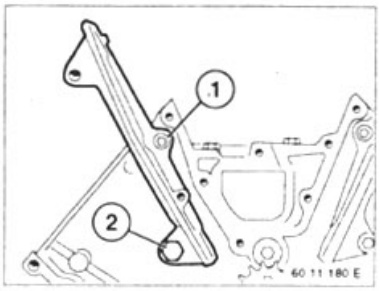
Unscrew socket head bolt.
Remove tensioning rail (1).



Pull off spacer with oil supply for the tensioning rail.

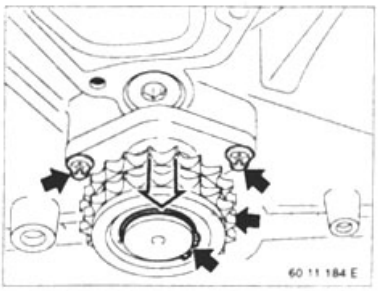


Installation:
Check seal, replacing it if necessary.

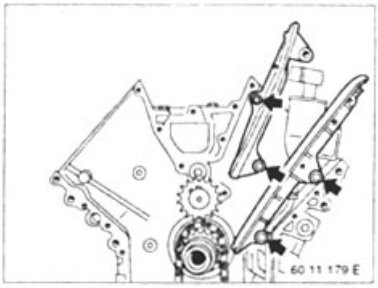


Unscrew sliding rail for cylinder bank 1...4.

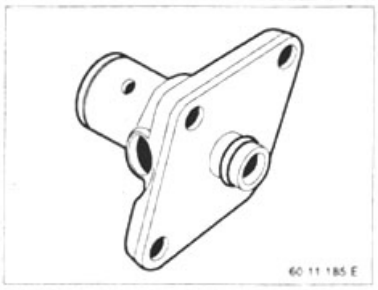
Installation:
1 Socket head bolt
2 Hexagon head bolt
These bolts must not be mixed up to guarantee clearance with the tensioning rail.



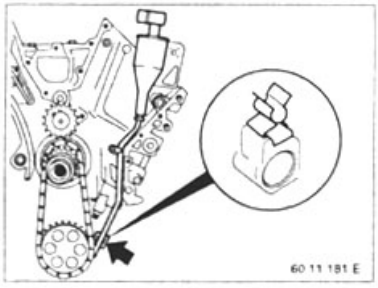
Unscrew deflection wheel:
Remove circlip.
Remove deflection wheel together with shim.
Unscrew the three console mounting bolts.



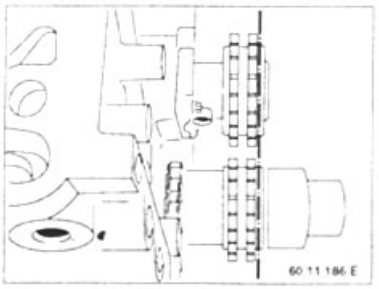
Unscrew sliding rails for cylinder bank 5...8.



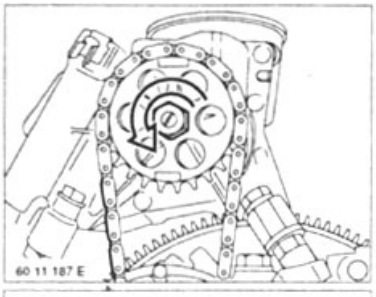
Installation
Check seal, replacing if necessary.



Remove oil separator with return pipe.

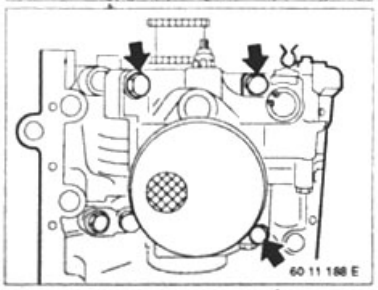


Installation:
Check installed position of the deflection wheel.
If the deflection wheel is installed inversed, the chain will be misaligned.

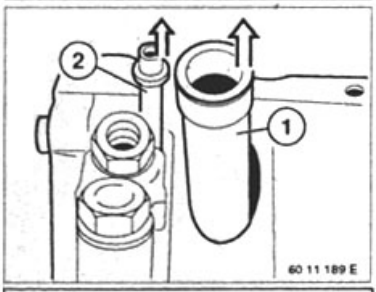


o Removing Oil Pump

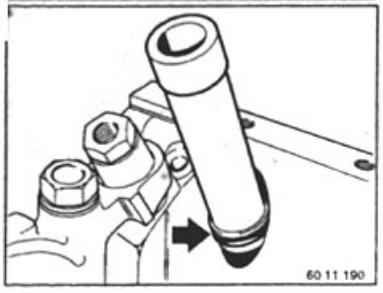
Unscrew sprocket bolt.
Remove sprocket together with chain.



Unscrew oil pump bolts.
Remove oil pump.

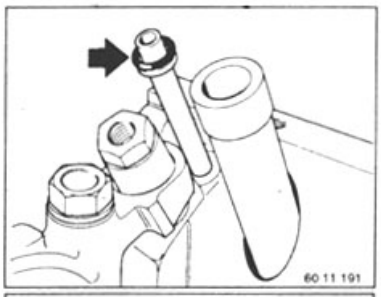


Pull used oil pipe (1) and fresh oil pipe (2) out of the crankcase.



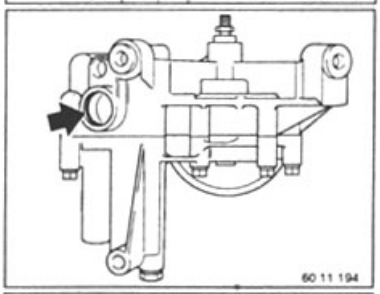
Installation:
Check seal, replacing it if necessary.
Lubricate seal lightly with oil.

Important!
Ensure that seal is not damaged on edge of crankcase.

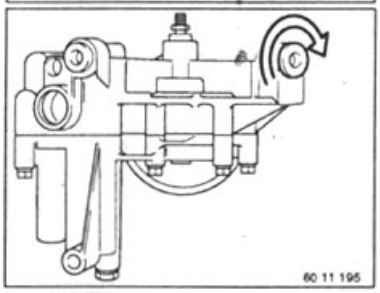


Installation:
Install fresh oil pipe in crankcase.

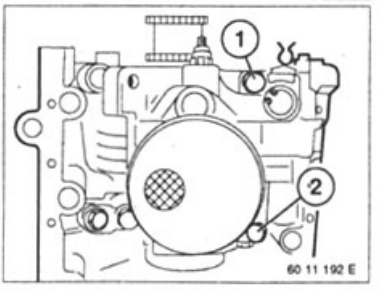
Note:
Check seal, replacing it if necessary.



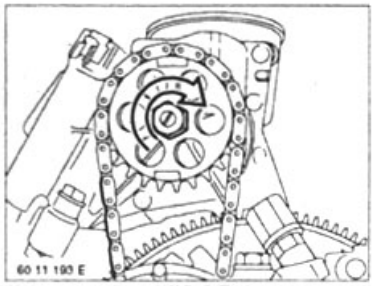
Installation:
Check seal in oil pump, replacing it if necessary.



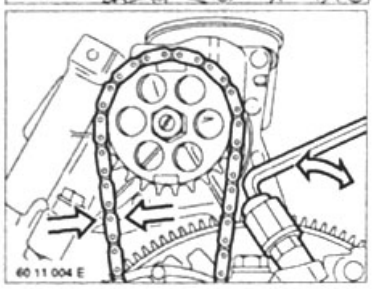
Installation:
Turn back hexagon socket into the oil pump as far as the stop.



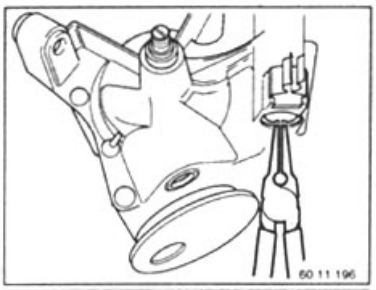
Installation:
Mount oil pump and secure with bolts (1 and 2).



Installation:
Mount sprocket together with timing chain and tighten central nut to specified tightening torque*.



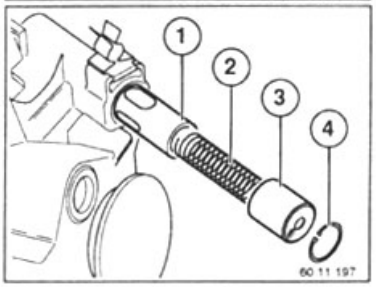
Installation:
Adjust chain deflection (10 ± 2 mm) by turning the hexagon socket in the oil pump. Install and tighten bolt.



o **Removing Oil Pressure Regulating Plunger**

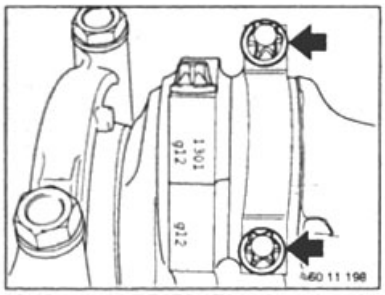
Press down cylinder using a suitable mandrel.
Remove circlip.

Caution!
High spring pressure.



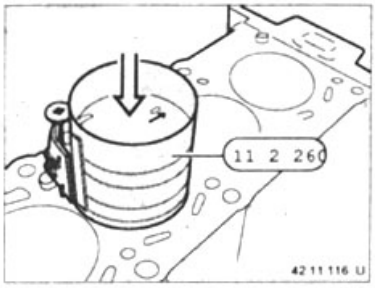
Installation:
1 = Regulating plunger
2 = Spring
3 = Cylinder
4 = Circlip

* **Refer to Specifications**



o **Removing Connecting Rod with Piston**

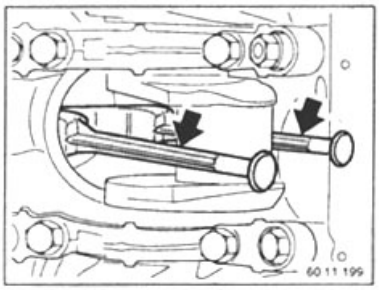
Unscrew conrod bearing cap.
Pull out connecting rod and piston from the cylinder head end.



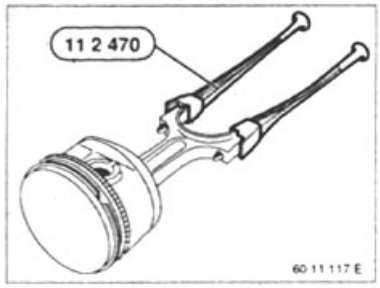
Installation:
Insert piston that arrow points to camshaft drive.
The piston ring compressor must bear firmly on the crankcase all around.
Press in piston only with finger pressure; don't knock it in!
Danger of breaking the piston rings.



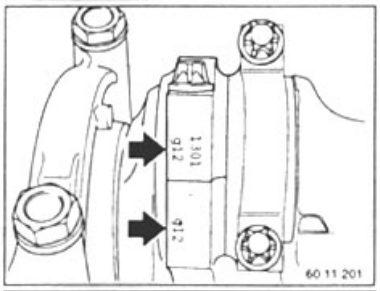
Important!
Reinstall pistons, connecting rods and bearing shells in the same installed position.
Connecting rods and bearing caps are marked with the same pair code and must not be mixed up.



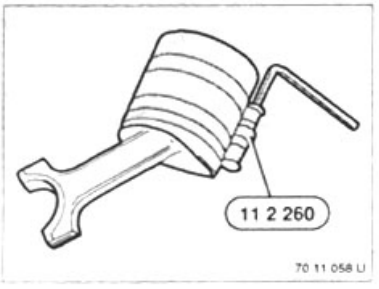
Installation:
Guide crankpin and connecting rod together.



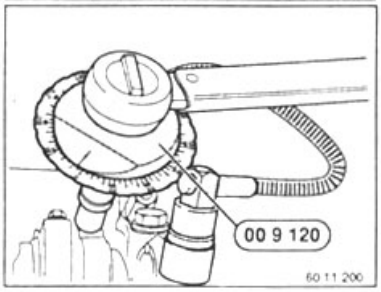
Installation:
Apply Special Tool 11 2 470 in the connecting rod.



Installation:
Lubricate conrod bearing shells with oil.
Mount bearing cap that pair codes match.
Install new conrod bolts.

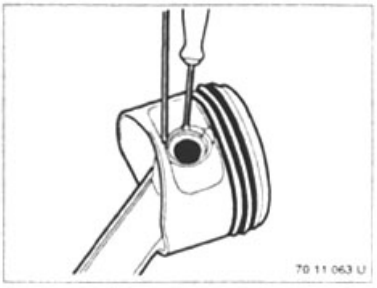


Installation:
Lubricate piston and piston rings lightly with oil.
Align end gaps of piston rings (offset approx. 120°, however, not above the piston pin eye).
Compress piston rings with Special Tool 11 2 260.



Installation:
Tighten conrod bolts to specified torque* using Special Tool 00 9 120 or 11 2 110.
Pay attention to conrod bolt tightening procedures*.

* **Refer to Specifications**

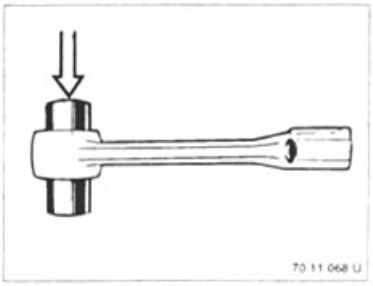


o Removing Connecting Rod

Remove circlip and press out piston pin.

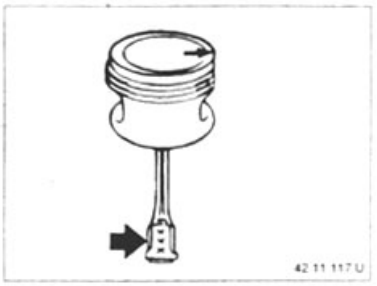
Important!
Pistons and piston pins are matched and must not be mixed up.

Installation:
Install circlip that its gap is opposite the opening.

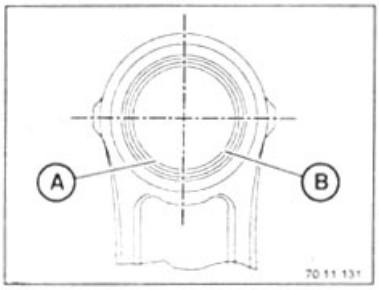


Checking Piston Pin Bush:

It should be able to push the piston pin through the bush by hand with slight force and without noticeable play.

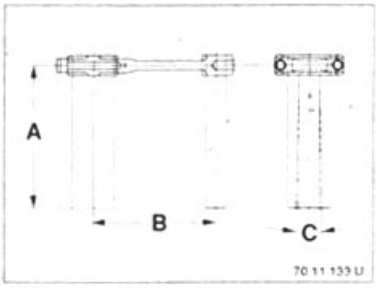


Installation:
Install connecting rod in the piston in such a manner that the installed direction arrow on the piston crown points to the right when the code number is visible.



Replacing Piston Pin Bush:

Press out old bush using a suitable mandrel (23.5 mm dia.).
Press in new bush with bush gap positioned optionally at point A or B.



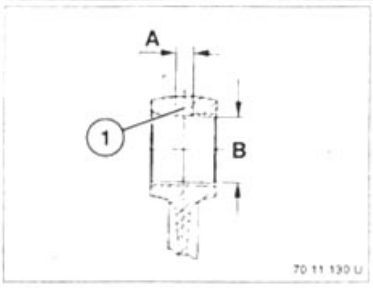
Checking Connecting Rod:

Check the connecting rod for deviation in parallelism and displacement.

A Testing distance*

B Max. permissible parallel deviation in distance A*

C Max. permissible displacement to each side*



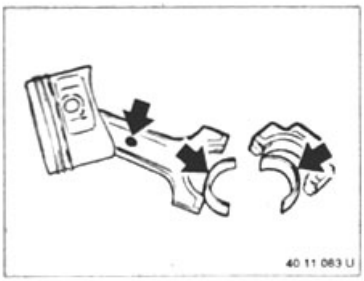
Drill oil bore (1).

A 6 mm
B Bore diameter*

Deburr edges on both sides of bore.
Ream out bush dry with a reamer*.

* Refer to Specifications

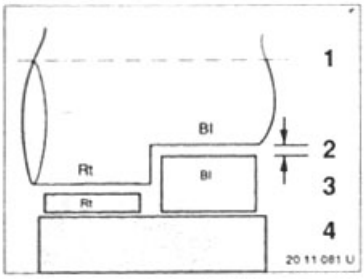
* Refer to Specifications



o Replacing Conrod Bearing Shells

Select new bearing shells to conform with paint mark on connecting rod.

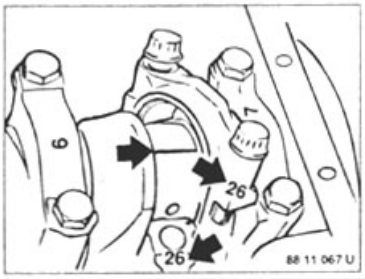
Important!
Check ground size of the crankshaft - also refer to "Replacing Crankshaft".



Color Code Shaft Diameter Bearing Shell Thickness* Survey

Double Classification Color Codes:
Rt = Red
Bl = Blue

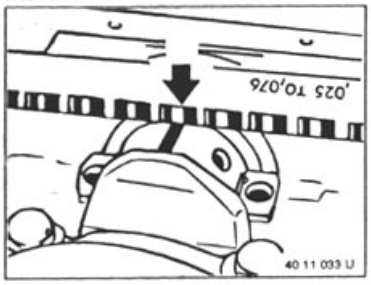
1 = Crankpin
2 = Bearing play
3 = Bearing shell thickness
4 = Conrod eye



Installation:
Checking conrod bearing play.
Only carry out for control purposes.

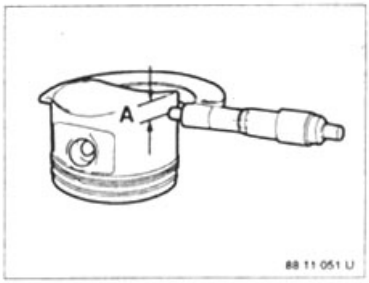
With piston in BDC place Type PG1 Plastigage (Special Tool 00 2 590) on crankshaft wiped clean of oil.
Mount bearing cap and secure with old conrod bolts tightened to specifications.

Important!
Don't turn the connecting rod or crankshaft.



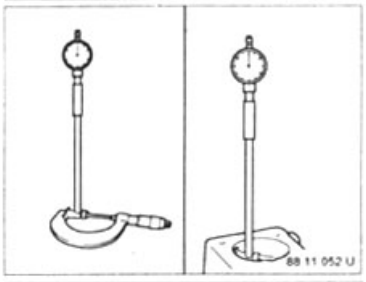
Remove bearing cap and read bearing play* by measuring width of the flattened Plastigage with help of the supplied scale.
Correct the bearing play by installing new bearing shells or bearing shells with a different paint mark.

Refer to Specifications



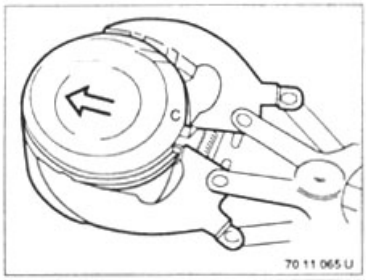
o Replacing Piston

Installation:
Measure the piston installed clearance before installing.
Measure the piston diameter at distance
A in mm* for M60 3 liter engine or
A in mm* for M60 4 liter engine
from the bottom edge of the piston and 90° to the piston pin axis using a micrometer.



Set internal caliper to zero on micrometer with the measured piston diameter.
Measure cylinder bore at bottom, middle and top diagonally.

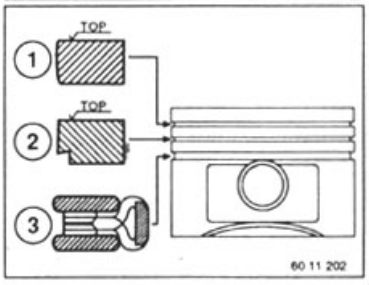
New piston installed clearance*.
Max. permissible total wear clearance*.



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.
New pistons may only be installed together with new piston rings.

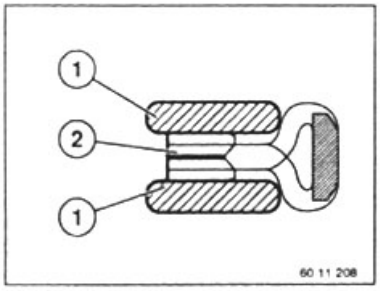


Installation:
Insert piston rings with "TOP" facing piston crown.

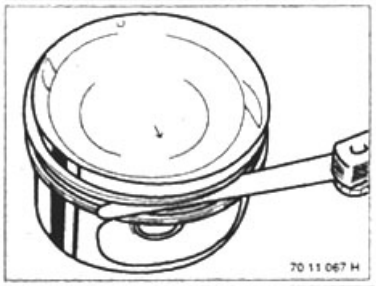
1 Plain compression ring
2 Stepped taper face ring "Top" (check installed position)
3 Three-piece steel band ring

Offset piston ring gaps about 120° to each other, but not above the piston pin eye.

* Refer to Specifications

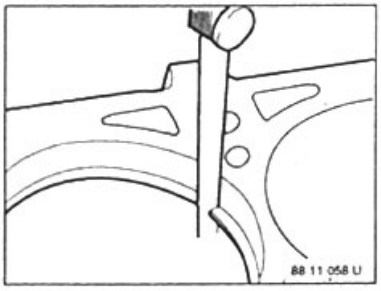


Installation:
The oil scraper ring consists of two steel band rings (1) and one spring ring (2).
Install all parts separately.
Offset gaps approx. 120°.



Measure side clearance:

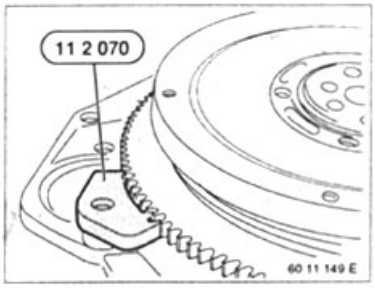
Nominal values*
Max. permissible total wear*



Measure end clearance:

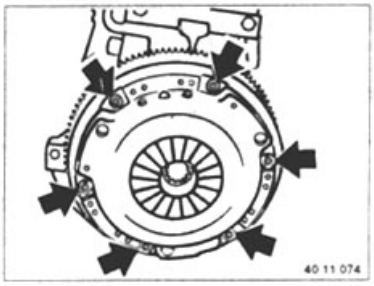
Nominal values*
Max. permissible total wear*

* Refer to Specifications



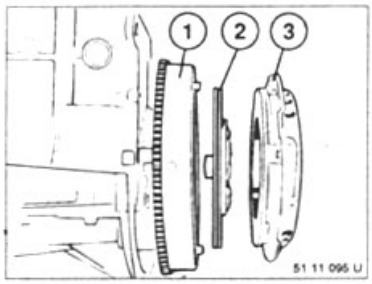
o Removing Clutch / Flywheel

Arrest flywheel using Special Tool 11 2 070.

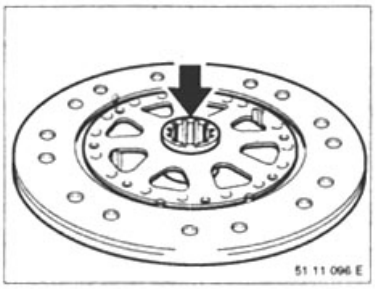


Unscrew bolts uniformly.
Remove pressure plate and drive plate.

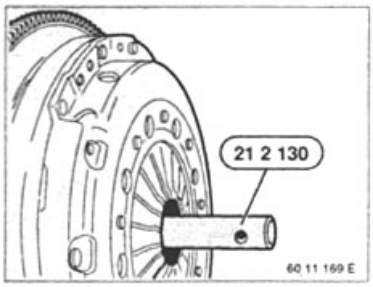
Installation:
Check dowel pins.



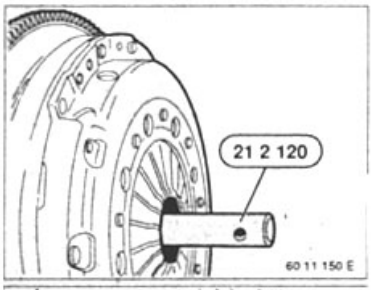
Installation:
1 Flywheel
2 Drive plate
3 Pressure plate



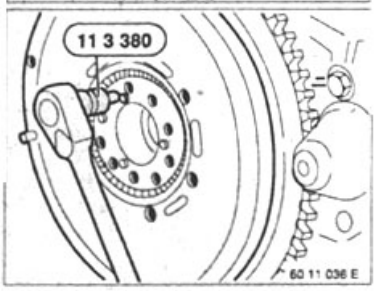
Note:
Flatter side of drive plate (2) faces the transmission.



Installation:
M60 / 3.0 Liter Engine:
Center drive plate using Special Tool 21 2 130 and tighten bolts in several steps. Tightening torque*.

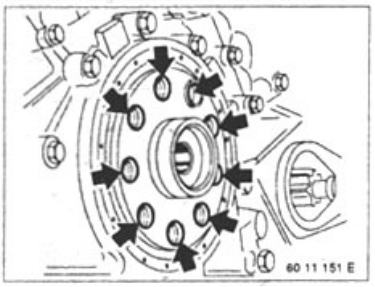


Installation:
M60 / 4.0 Liter Engine:
Center drive plate using Special Tool 21 2 120 and tighten bolts in several steps. Tightening torque*.



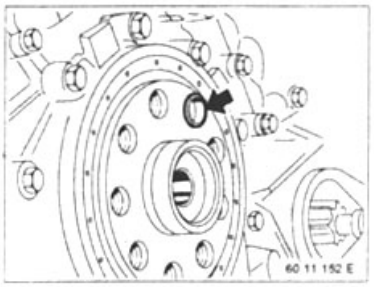
Unscrew double-mass flywheel.

Important!
Always use Special Tool 11 3 380 to unscrew and tighten a double-mass flywheel.



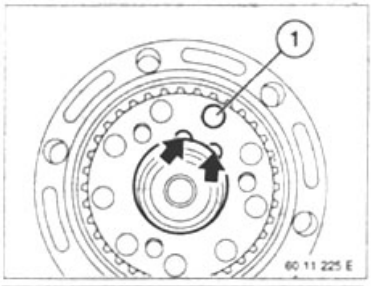
Installation:
Clean tapped bores in crankshaft for flywheel bolts.

* Refer to Specifications



Installation:
The double-mass flywheel has a special (shorter) dowel sleeve.

Important!
Only replace with original BMW parts.

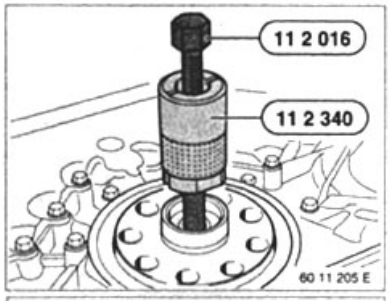


Installation:
The location of dowel sleeve (1) in the double-mass flywheel is indicated by two notches next to the concerned bolt bore.



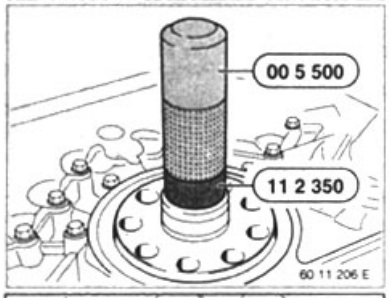
Important!
Flywheel bolts are component parts of a flywheel.
Do not install flywheel bolts with a bolt cement.
Lubricate threads of bolts lightly with oil.
Always keep to tightening torque.
Excessively tightened flywheel bolts will cause the special tool to break when removed later.
Tightening torque*.

* Refer to Specifications

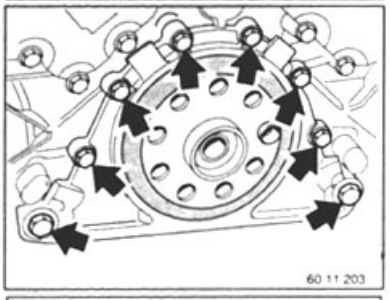


o Replacing Pilot Bearing in Crankshaft

Remove pilot bearing using Special Tools 11 2 340 and 11 2 016.

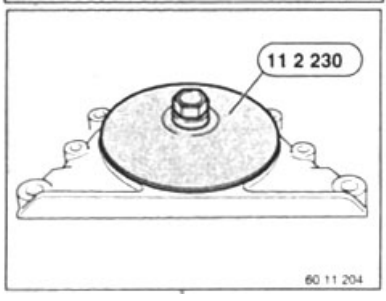


Installation:
Insert and drive in new pilot bearing as far as stop using Special Tools 11 2 350 and 00 5 500.

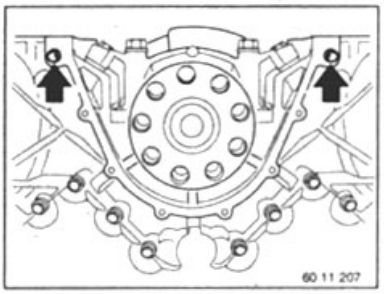


o Removing Rear End Cover

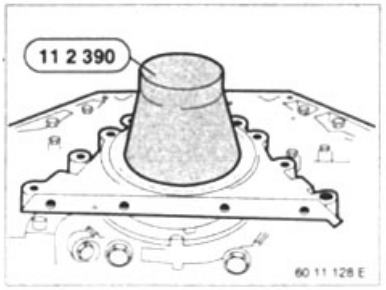
Unscrew bolts and remove cover.



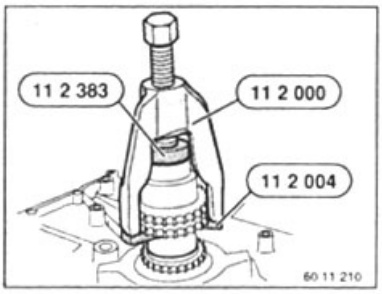
Installation:
Lift out radial oil seal and drive in new seal using Special Tools 11 2 230 and 00 5 500.



Installation:
Replace gasket.
Check dowel sleeves for correct fit.

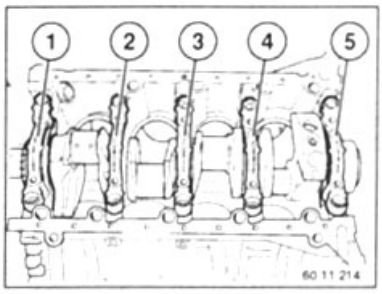


Installation:
Apply Special Tool 11 2 390 on crankshaft.
Lubricate sealing lip of radial oil seal with oil.
Install cover and tighten bolts.



o Removing Crankshaft

Apply Special Tool 11 2 383 on crankshaft.
Pull off sprocket using Special Tools 11 2 000 and 11 2 004.

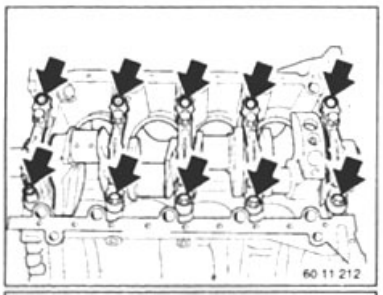


Remove main bearing caps (1 ... 5).
Lift out crankshaft.

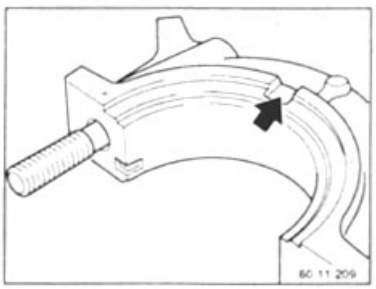
Installation:
Check key for correct seating.
Heat sprocket to max. 150° C with a hot air blower or on a hotplate.

Important!
Do not exceed this temperature because of the rubber coating.

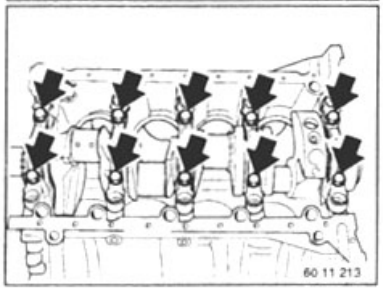
Note
Bearing caps (1 ... 3) are marked with die-stamped numbers.
Bearing caps (4 and 5) are not marked.



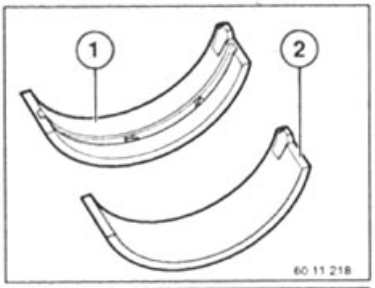
Unscrew inclined bolts and hexagon for oil pump.



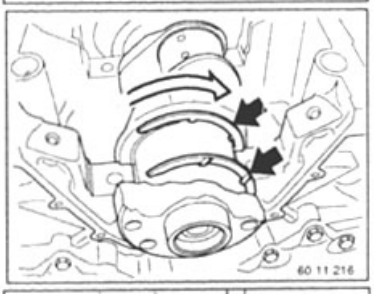
Note
Bearing cap (5) can be recognized on the openings for thrust washers of the thrust bearing.



Unscrew main bearing caps.



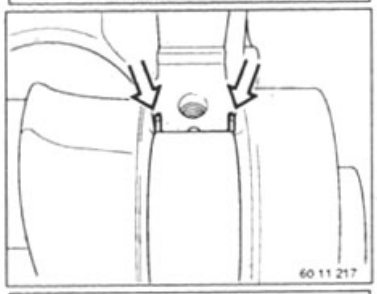
Installation:
Install bearing shells (1) with a lubricating groove in the crankcase.
Install bearing shells (2) without a lubricating groove in the bearing caps.



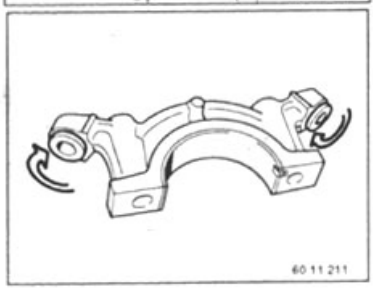
Lubricate bearing shells with oil.
Install crankshaft.

Insert thrust washers for the thrust bearing between the crankshaft and crankcase at bearing no. 5 on both sides.

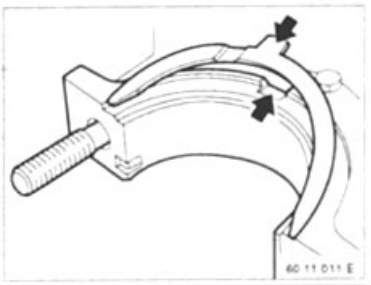
Note the installed direction:
lubricating groove faces crankshaft.



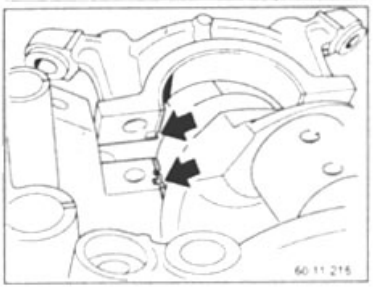
Installation:
Align thrust washers level to bearing surface of the bearing cap.



Installation:
Turn back socket hexagons in bearing cap.



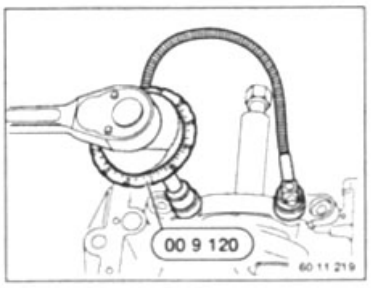
Installation
Insert thrust washers into grooves of bearing cap no. 5 on both sides.



Installation
Mount bearing caps (1 ... 5) in such a manner that retaining grooves of the bearing shells are all on one side.
Align bearing caps precisely.

Main Bearing Cap Tightening Procedures:

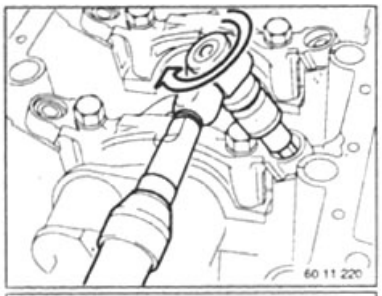
Always replace the main bearing cap shouldered bolts.
Don't wash off bolt coating.
Keep oil out of the tapped bores (danger of cracking the crankcase)!



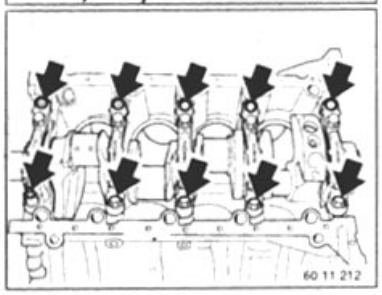
Step 1: Tighten bolts to specified Nm*

Step 2: Tighten bolts to specified torque angle* using Special Tool 11 2 110 or 00 9 120.

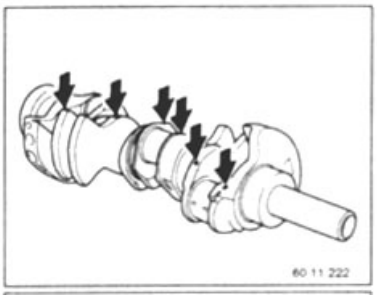
* Refer to Specifications



Installation:
Move threaded support bush to correct position and tighten to specified torque*.

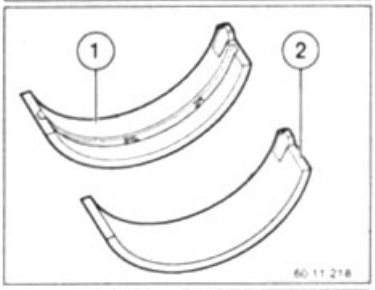


Installation:
Install inclined bolts and hexagon bolts for oil pump.
Tighten to specified torque*.



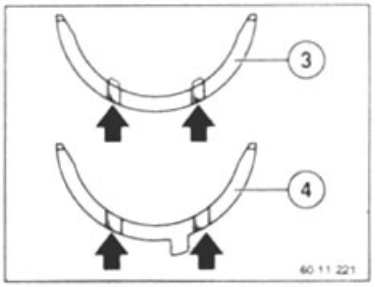
o **Replacing Main Bearing Shells**

The crankshaft is marked with yellow, green or white paint depending on main bearing journal tolerances.



1 **Bearing shell with lubricating groove (for crankcase)**

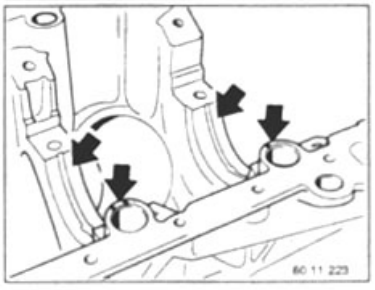
2 **Bearing shell without lubricating groove (for bearing caps)**



3 **Thrust washer for thrust bearing (in crankcase)**

4 **Thrust washer for thrust bearing (in bearing cap)**

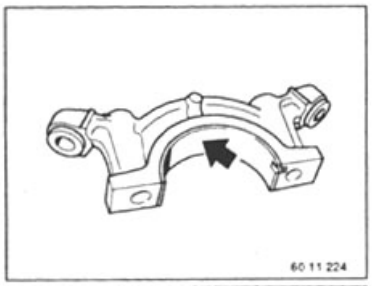
Note
Lubricating groove faces crankshaft.

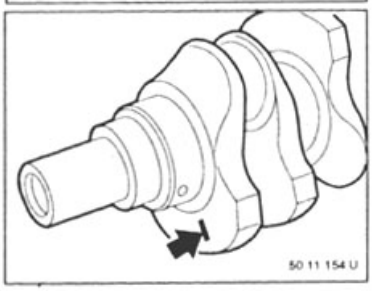


Installation
Bearing shell classification for the crankcase is no longer marked with paint dots, but instead with notches.

1 notch = yellow bearing shell code
2 notches = green bearing shell code
3 notches = white bearing shell code

* **Refer to Specifications**





Installation:
Bearing shell classification for bearing caps is marked on the crankshaft with yellow, green or white paint.

Important!
Check ground size* of crankshaft.

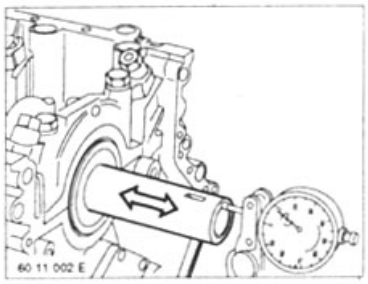
1 paint stripe	Size 1 (0.25 mm)
2 paint stripes	Size 2 (0.50 mm)
3 paint stripes	Size 3 (0.75 mm)

Note:
When installing exchange crankshafts, classification does not apply for the allocation of bearing shells in the crankcase. Only install yellow bearing shells in the crankcase.

Check ground size of crankshaft!

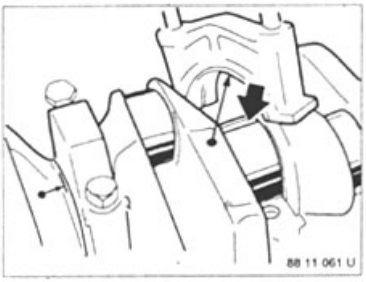
Note:
Install bearing shells in bearing caps according to paint mark on the crankshaft (yellow, green or white).

* Refer to Specifications



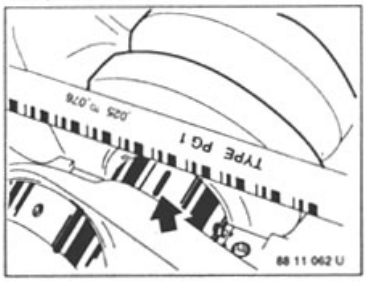
Checking Axial Play:

If permissible play* is exceeded, check crankshaft and thrust washers and replace if necessary.

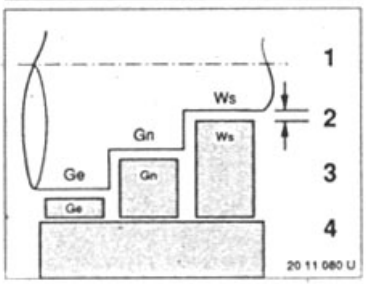


Check bearing clearance.
Only carry out this step for control purposes.

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 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

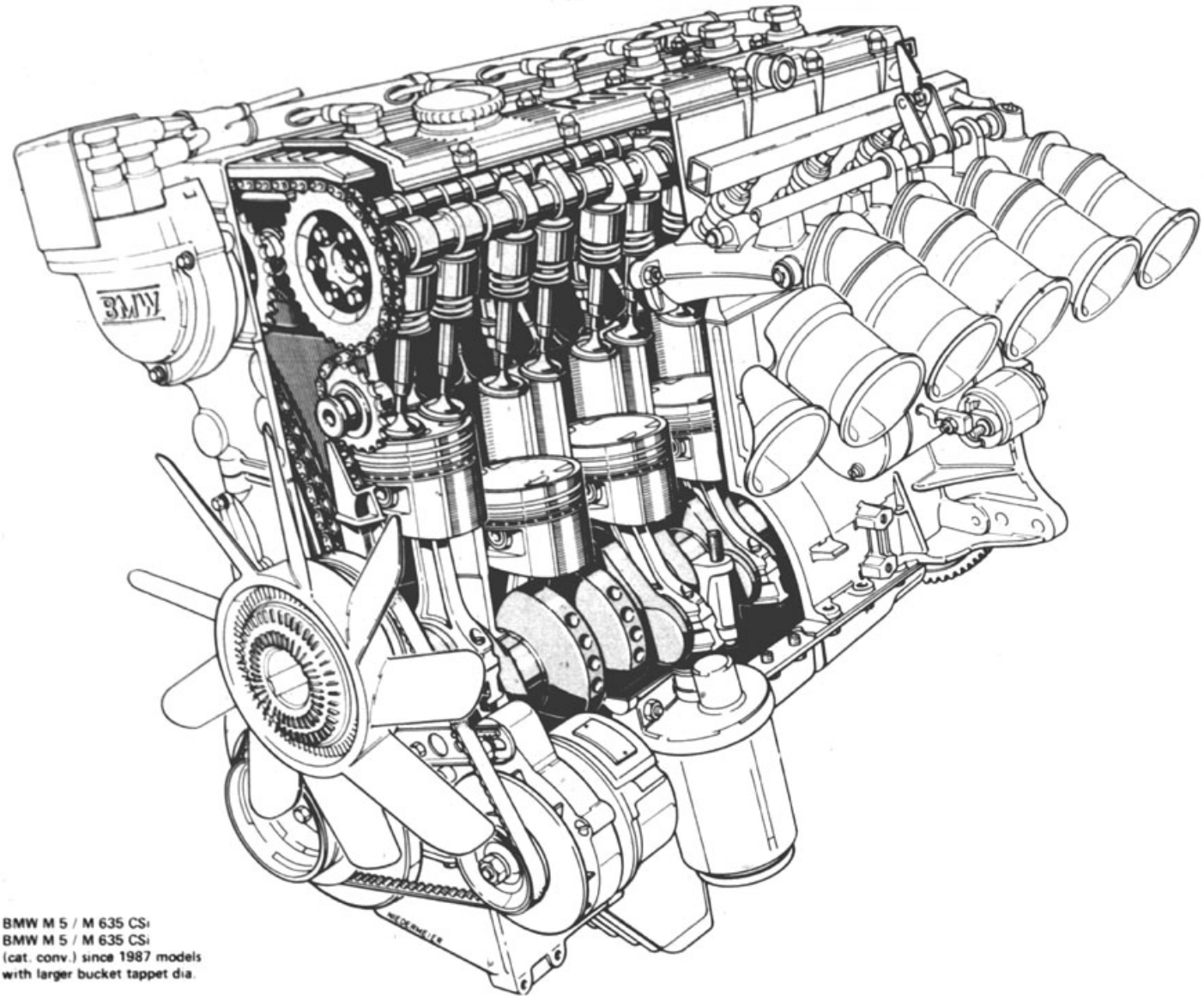
* Refer to Specifications

11 Engine M88-3 / S38 Z

M88-3 = 6 Cylinder M-Power Engine
S38 Z = 6 Cylinder M-Power Engine

11 12 000	Cylinder head cover – remove and install	11- 801
101	Cylinder head gasket – replace	11- 801
500	Cylinder head – remove and install (engine removed)	11- 802
595	Valve guide – inspect for wear (valve removed)	11- 804
600	Valve guide – ream (valve removed)	11- 804
607	Valve seats and valves – machine (valves removed)	11- 804
719	Cylinder head sealing surface – grind (cylinder head disassembled) This job is not approved for these engines.	
729	Cylinder head – inspect for cracks in water test (cylinder head disassembled)	11- 805
11 14 105	Radial oil seal in distributor housing – replace	11- 806
110	Lower timing case cover – remove and install/seal	11- 806
141	Radial oil seal in lower timing case cover – replace	11- 808
605	Radial oil seal in clutch end cover	11- 808
11 21 000	Crankshaft – remove and install	11- 809
501	Crankshaft – replace (crankshaft removed)	11- 810
531	Crankshaft main bearing shells – replace (engine disassembled)	11- 810
571	Pilot bearing in crankshaft – replace	11- 811
11 22 000	Flywheel – remove and install	11- 812
541	Starter gear ring – replace	11- 812
11 23 000	Vibration damper with hub – remove and install	11- 813
010	Vibration damper – replace	11- 813
031	Vibration damper hub – replace	11- 813
11 24 521	Connecting rods – replace (pistons removed)	11- 814
571	Conrod bearing shells – replace (disassemble engine)	11- 814
11 25 000	Pistons – remove and install (engine removed)	11- 815
651	Piston rings of one piston – replace	11- 816
11 31 000	Camshaft – remove and install (cylinder head removed)	11- 817
051	Timing chain – replace	11- 820
061	Timing chain sprocket set – replace (timing chain removed)	11- 821
090	Timing chain tensioner piston – remove and install	11- 822
11 34 004	Valve clearance – adjust	11- 823
509	Valves – check for leaks	11- 823
550	Valves – remove and install (cylinder head removed)	11- 824
11 40 000	Engine oil pressure – check	11- 825
11 41 000	Oil pump – remove and install	11- 825
151	Oil pump drive chain – replace	11- 826
11 42 021	Full flow oil filter – replace	11- 827
11 43 101	Oil dipstick guide tube – replace	11- 828
11 51 000	Water pump – remove and install	11- 828
11 52 000	Fan – remove and install	11- 829
020	Fan clutch – replace	11- 829
11 53 000	Coolant thermostat – remove and install	11- 829
000	Coolant thermostat – remove and install (S38 B36)	11- 830
11 62 . . .	Exhaust manifold – remove and install/seal or replace	11- 831

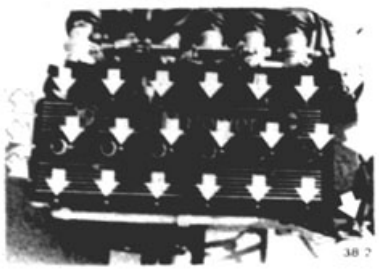
11-800



M 88 3 = BMW M 5 / M 635 CSi
S 38 Z = BMW M 5 / M 635 CSi
(cat. conv.) since 1987 models
with larger bucket tappet dia.



38 1



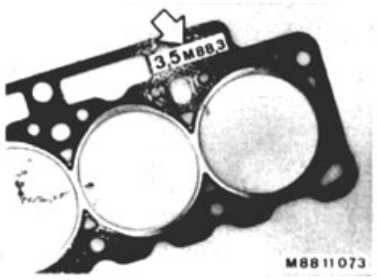
38 2

11 12 000 REMOVING CYLINDER HEAD COVER

Unscrew ignition lead pipe (1)*.
Disconnect hose (2) and pull out spark plug connectors.

Unscrew cylinder head cover.

Installation
Check gaskets, replacing if necessary.



M88 11 073

11 12 101 REPLACING CYLINDER HEAD GASKET

Remove cylinder head - see 11 12 100.
Clean sealing surfaces on cylinder head and crankcase thoroughly with a gasket remover** and hard wood scraper.
Check levelness with a standard steel ruler.

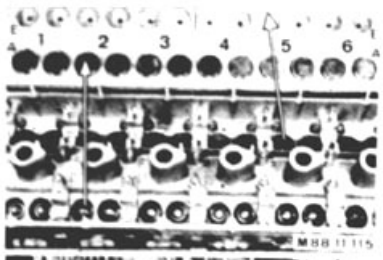
Installation:
Only use original cylinder head gaskets, in which the holes match those for the coolant system precisely.

Stamped Identification:

Type	Code	Bore Dia.
M 635 CSi/ M 5	3.5 M 88.3	93.4 mm * (3.677")

* See Specifications
** Source of Supply: HWB

11 3 030

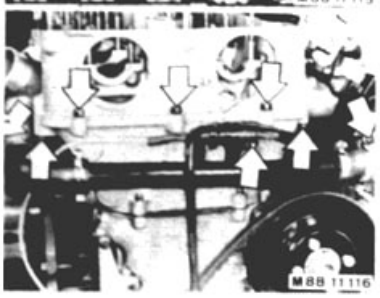


11 12 500 REMOVING AND INSTALLING CYLINDER HEAD
- Engine Removed -

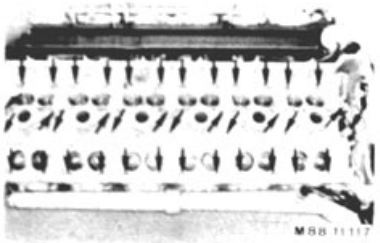
Remove camshaft - see 11 31 000.
Pull out and place tappets in tray, Special Tool 11 3 030.

Installation

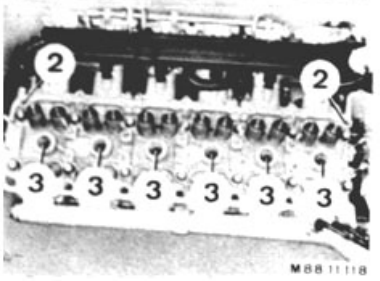
Reinstall tappets in same position.



Unscrew pipe.
Unscrew bolts.



Unscrew timing case.



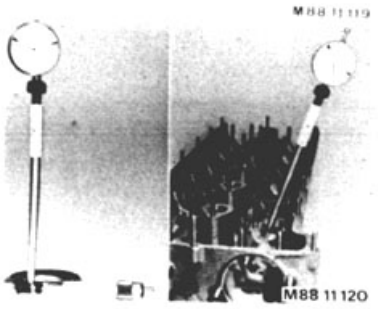
Installation

Replace O-rings (2) in oil bore.
Check O-rings (3), replacing if necessary.
Coat sealing surfaces with Three Bond 1207**.
Tighten bolts uniformly.
Tightening torque*.

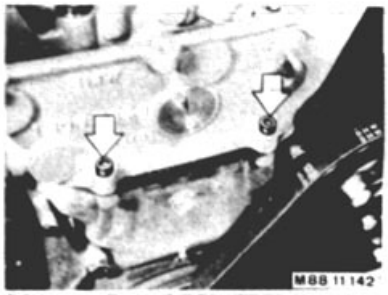
* See Specifications
** Source of Supply: HWB



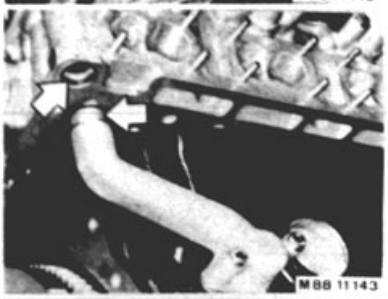
Measuring Tappet Clearance:
Measure tappet diameter with a micrometer.



Set internal calipers to zero on the micrometer with the measured tappet diameter.
Measure tappet bore diameter.
Compare the measured tappet clearance with the specified clearance.
Tappet Clearance / Installed Clearane: 0.025 to 0.066 mm (0.0010 to 0.0026").



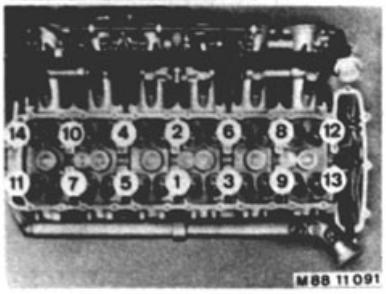
Unscrew bolts.



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

Installation

Check O-ring, replacing if necessary.
Coat pipe with Three Bond 1207**.
Clean cavities in crankcase and cylinder head bolts.
Lubricate cylinder head bolts with oil.
Replace cylinder head gasket - see 11 12 101.
Check while mounting cylinder head:
-Pull out timing chain upward.
-Press in tensioning rail.
-Place timing chain on sprocket for reversing.

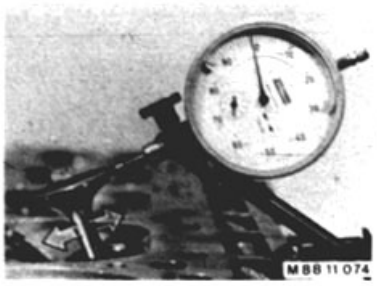


Tighten bolts in order of 1 through 14 in three steps.

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 +/-2 Nm (72 +/- 1.5 ft. lbs.)

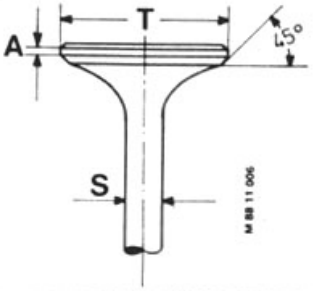
Check and adjust engine idle speed - see 13 00 054.

** Source fo Supply: HWB



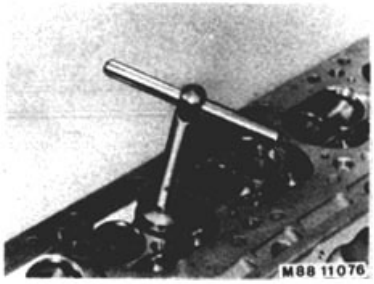
11 12 595 CHECKING VALVE GUIDE FOR WEAR
– Valve Removed –

To check wear, install 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*.

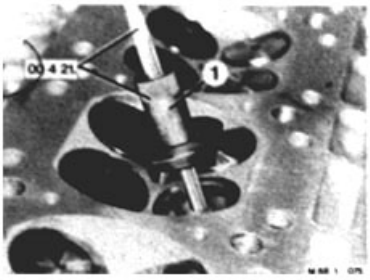


11 12 607 MACHINING VALVE SEATS AND VALVES
– Valves Removed –

Replace valve, if edge thickness A* is less than the specified minimum.

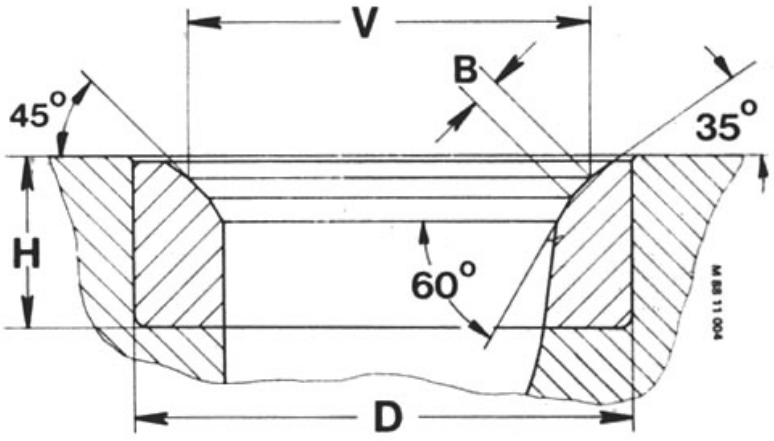


Machine correction angles* to produce valve seat diameter V* and valve seat width B* after machining the valve seat angle*.
Grind in valves with grinding paste and check valves for leaks – 11 34 509.



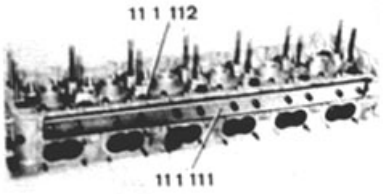
11 12 600 REAMING OUT VALVE GUIDE
– Valve Removed –

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 – turning down reamer once.



* See Specifications

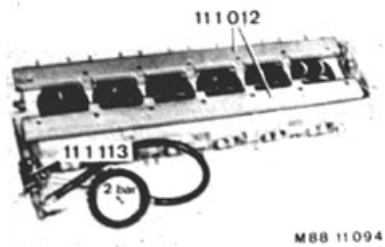
* See Specifications



M88 11093

11 12 729 CHECKING CYLINDER HEAD FOR CRACKS IN WATER TEST
- Cylinder Head Disassembled -

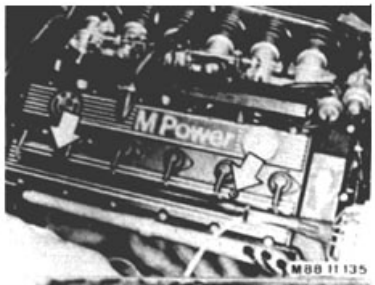
Screw on Special Tools 11 1 111 using Special Tools 11 1 112.



M88 11094

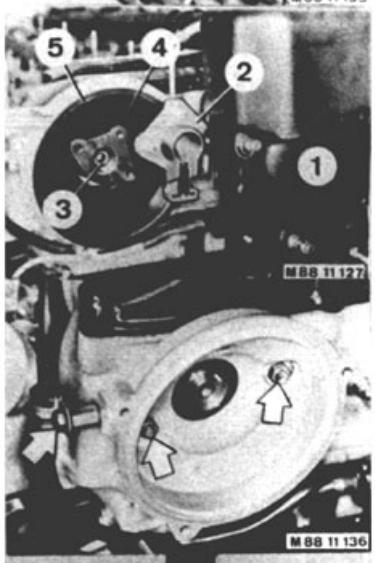
Screw on Special Tools 11 1 012.
Mount Special Tool 11 1 113.
Fill cylinder head with compressed air (2 bar testing pressure).
Place cylinder head in a water bath and check for leaks.

Note:
Water bath may be relaxed with a detergent if necessary.



11 14 105 REPLACING RADIAL OIL SEAL IN DISTRIBUTOR HOUSING

Unscrew ignition lead tube.



Remove distrbutor cap (1).
Unscrew distributor rotor (2).
Unscrew adapter (3).
Remove cover (4).
Installation:
Check O-ring (5), replacing if necessary.
Tightening torque*.

Unscrew distributor housing.
Installation:
Check O-ring, replacing if necessary.



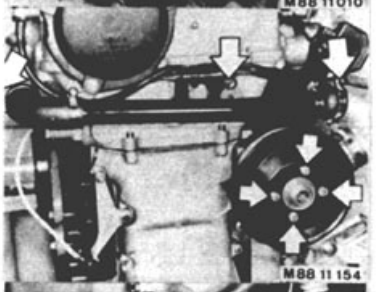
Lift out radial oil seal.
Drive in new radial oil seal with Special Tool 00 5 550.
Lubricate sealing lip with oil.

* See Specifications

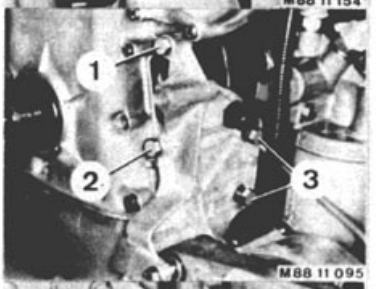


11 14 110 REMOVING AND INSTALLING/ SEALING LOWER TIMING CASE COVER

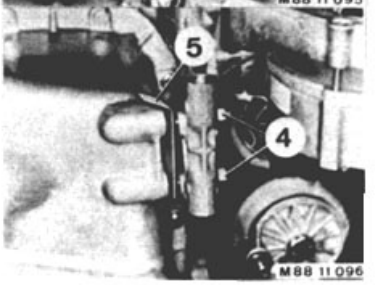
Disconnect battery ground lead.
Pull off plug (1) and lift out wires.
Unscrew hose clamp (2).
Unscrew nut (3) and remove air cleaner with air flow sensor.
Remove vibration damper with hub 11 23 000.



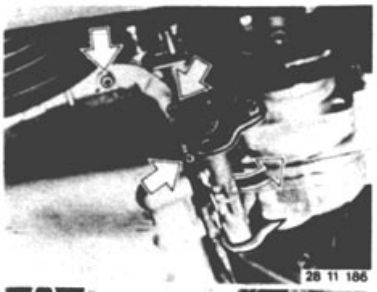
Unscrew pipe.
Remove water pump pulley.



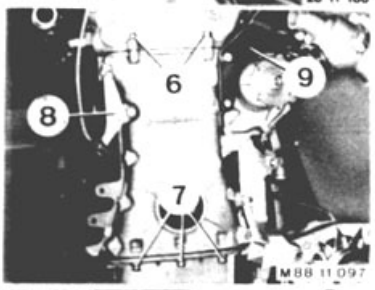
Loosen and swing alternator aside.
Loosen bolt (1).
Unscrew bolt (2).
Unscrew bolts (3) partially.



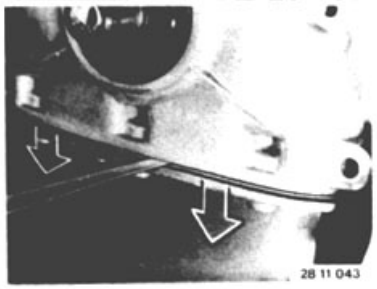
Unscrew power steering pump and remove bolts (4).
Installation:
Do not tension console when installing pump – use spacer (5) underneath (see 32 41 131).



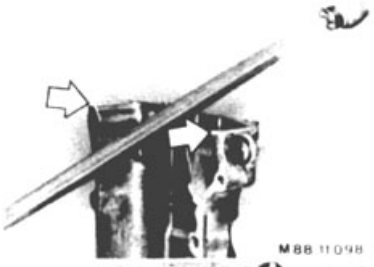
Swing away and tie down console.
Drain engine oil.
Unscrew oil pan bolts.
Installation:
Add engine oil***.



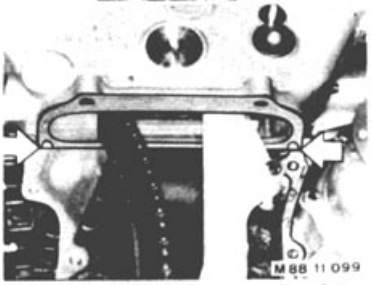
Unscrew bolts (6 and 7).
Loosen remaining oil pan bolts.
Unscrew timing case cover bolts.
Installation:
Mount TDC transmitter (8) and suspension eye (9).
Check length of bolts.
Tighten first bolts (6).



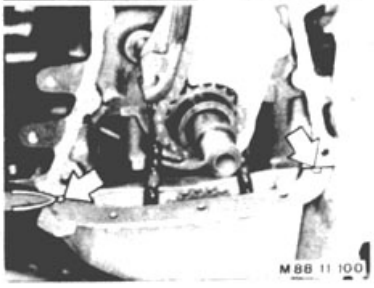
Pry oil pan gasket off of timing case cover carefully with a knife.
If oil pan gasket is damaged, remove oil pan and replace gasket – see 11 13 000.



Remove timing case cover.
Installation:
Break upper edges with a file.
Coat sealing surfaces with Three Bond Silicone 1207**.

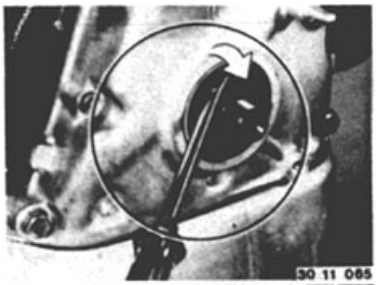


Installation:
Replace gaskets, coat with Three Bond Silicone 1207** and cut off ends.
Coat mating surfaces with Three Bond Silicone 1207**.
Guide in cover uniformly.



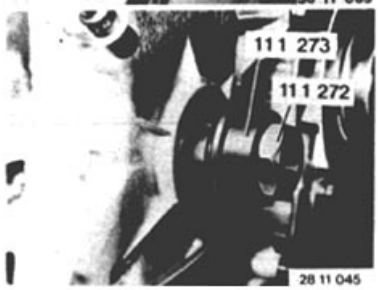
*** See Service Information of Gr. 00

** Source: HWB



11 14 141 REPLACING RADIAL OIL SEAL IN TIMING CASE COVER

Remove vibration damper with hub – 11 23 000.
Lift out radial oil seal with a screwdriver.

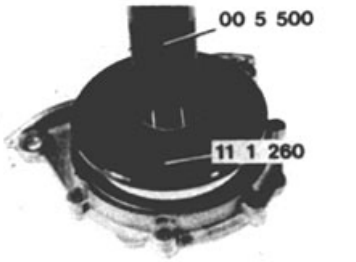


Lubricate sealing lip of radial oil seal with oil.
Press in radial oil seal with Special Tools 11 1 273 and 11 1 272.



11 14 605 REPLACING RADIAL OIL SEAL IN CLUTCH END COVER – Transmission Removed –

Remove flywheel 11 22 000.
Drain engine oil.
Loosen oil pan.
Pry off gasket carefully with a knife in area of end cover/oil pan joint.
Remove 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.
Coat end cover/oil pan joint with a brush-on universal sealing compound / Three Bond Silicone 1207**.
Use Special Tool 11 2 213 to avoid damaging the radial oil seal.
Add engine oil***.



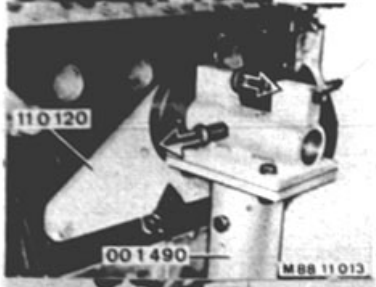
Press in radial oil seal with Special Tools 11 1 260 and 00 5 500.
Install new radial oil seal with about 1 to 2 mm (0.039 to 0.079") offset toward the inside in contradiction to the standard radial oil seal, which had been installed flush.
Lubricate sealing lip with oil.

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



11 21 000 REMOVING AND INSTALLING CRANKSHAFT

Remove engine 11 00 050.
First unscrew rear and then front exhaust manifolds.
Installation:
Replace gaskets.
Tightening torque*.



Unscrew right engine bracket and mount engine on Special Tool 00 1 490 with help of Special Tool 11 0 120.
Installation:
Tightening torque*.



Remove clutch disc 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 crankshaft.
Check/replace thrust bearing, if maximum permissible play is exceeded.

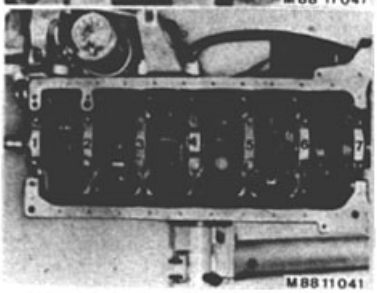


Remove flywheel 11 22 000.
Unscrew end cover.
Installation:
Replace gasket.
Use Special Tool 11 2 213 to avoid damaging radial oil seal.
Cut off gasket on oil pan sealing surface.

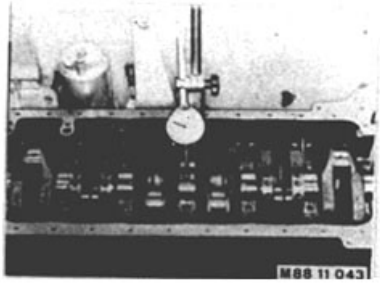
* See Specifications



Unscrew conrod bearing caps.
Installation:
Replace conrod bearings and check conrod bearing play, see 11 24 571.



Unscrew crankshaft bearing caps and lift out crankshaft.
Installation:
Bearing cap no. 1 is on sprocket end.
Mount oil pump console together with thrust bearing cap (4).
Install bearing shells and check bearing play, see 11 21 531.
Installation:
Check axial play with crankshaft installed – unscrew thrust bearing cap no. 4 again.
Center thrust bearing by applying knocks on rear and front ends of crankshaft with a plastic hammer.
Tighten thrust bearing cap as specified.
Check axial play*.
If crankcase had to be replaced, clean oil and water bores or passages again thoroughly to remove cast sand.



Check runout deviation:
Insert bearing shells 1 and 7.
Apply dial gauge on center bearing and measure runout* while turning crankshaft.

* See Specifications

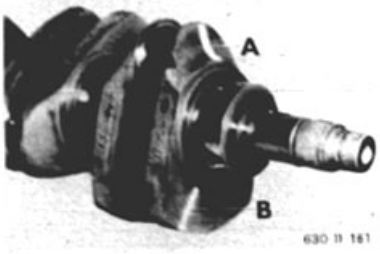


11 21 501 REPLACING CRANKSHAFT
– Crankshaft Removed –

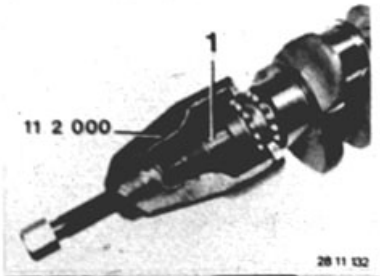
Note:
A replacement crankshaft is supplied complete with corresponding bearing shells for main and conrod bearings.

Crankshaft identification:

Engine	Stroke (mm)	Code
M 88/3	84 (3.307")	M
S 38 Z	84 (3.307")	M
S 38 B 36	86 (3.386")	D

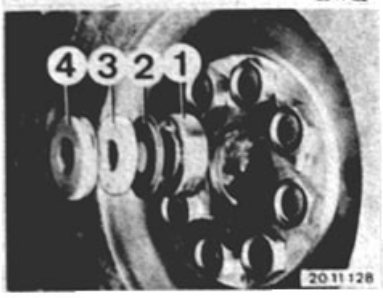


The crankshaft is surface treated and may only be reground in the factory. Reground crankshafts are marked with stripes of paint.
Conrod Bearing Journal (A) (not applicable for S 38 B 36):
1 paint stripe Size 1 *
2 paint stripes Size 2 *
Main Bearing Journal (B) (conrod and main bearings for S 38 B 36):
1 paint stripe Size 1 *
2 paint stripes Size 2 *
3 paint stripes Size 3 *



Transferring Sprocket:
Lift out woodruff key (1).
Pull off sprocket with Special Tool 11 2 000.

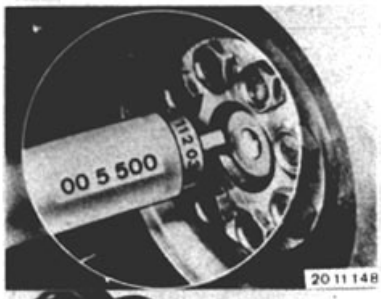
Installation:
Heat sprocket to max. 200° C (390° F) for installation.



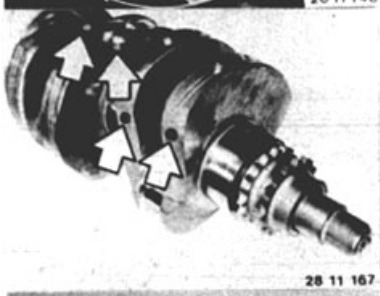
Installing Pilot Bearing for Transmission Main Shaft:

Installed Order:
Ball bearing (1), cover (2), felt ring (3) and capsule (4).
Insert cover (2) with the embossment facing out.

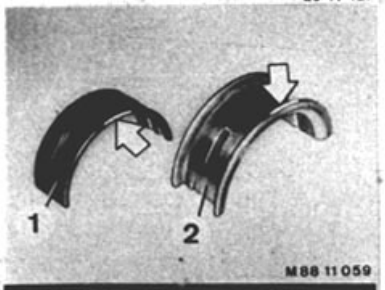
*** See Specifications**



Fill bore in the 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.



The crankshaft is marked with red or blue paint depending on the main bearing journal tolerances.



1 = Bearing shell 1–2–3–5–6–7
2 = Bearing shell 4 (pilot bearing)

The color code mark is located on the side of a bearing shell.

Check the ground size of main bearing journals!



Installing instructions:
Install only "red" bearing shells in the crankcase (regardless of the old color code marks on the crankcase).
Install "red" or "blue" bearing shells in the bearing caps depending on the color code of the crankshaft bearing journals.

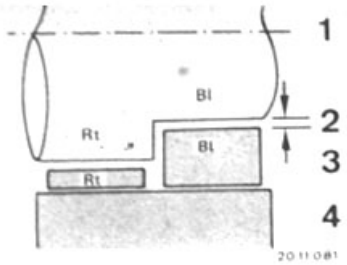


Install crankshaft.
Place Type PG-1 Plastigage on crankshaft wiped clean of oil and tighten bearing caps with correct torque*.
Do not turn the crankshaft.

Source of Supply for Plastigage:
CARTOOL
Alfred-Brehm-Str. 5
D-8070 Ingolstadt



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*

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 ground size of the crankshaft.

Install only yellow bearing shells of the 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 with pair numbers and bearing shell grooves on the exhaust manifold side.

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.

Conrod Bolt Tightening Torque:
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 the width of the flattened Plastigage with help of the supplied scale.





28 11 167

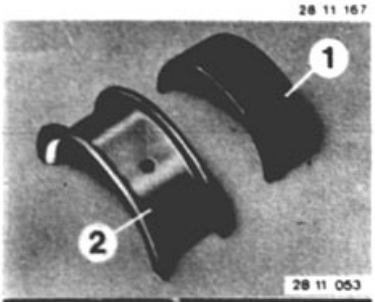
11 21 531 REPLACING CRANKSHAFT MAIN BEARING SHELLS
– Engine Disassembled –

The crankshaft is marked with red or blue paint depending on the main bearing journal tolerances.



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.

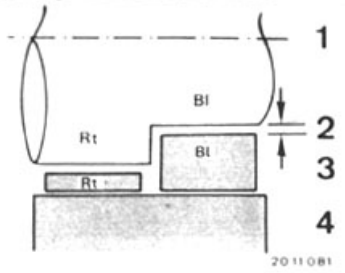


28 11 053

1 = Bearing shell 1–2–3–5–6–7
2 = Bearing shell 4 (pilot bearing)

The color code mark is located on the side of a bearing shell.

Check the ground size of main bearing journals.



20 11 081

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



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.



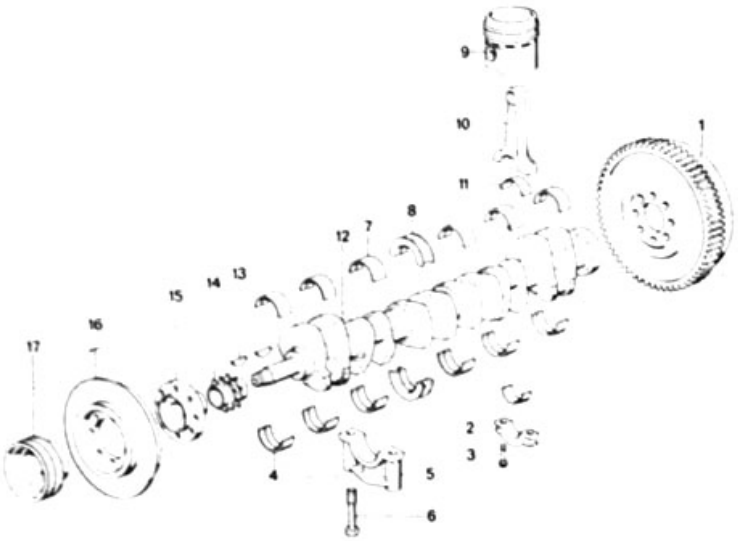
M88 11 061

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

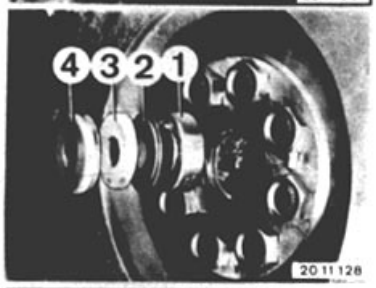
* See Specifications

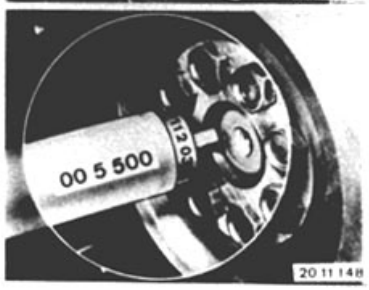


Crankshaft Assembly:

1 Flywheel
2 Conrod bearing cap
3 Conrod bolt
4 Main bearing shell
5 Main bearing cap
6 Main bearing cap bolt
7 Main bearing shell
8 Thrust bearing
9 Piston
10 Connecting rod
11 Conrod bearing shell
12 Crankshaft
13 Woodruff key
14 Sprocket set
15 Vibration damper hub
16 Vibration damper
17 Pulley







11 21 571 REPLACING PILOT BEARING IN CRANKSHAFT

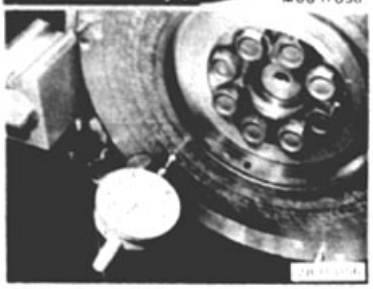
Remove clutch disc 21 21 000.
Pull out ball bearing with Special Tool 11 2 010.

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.



M 88 11 036



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.

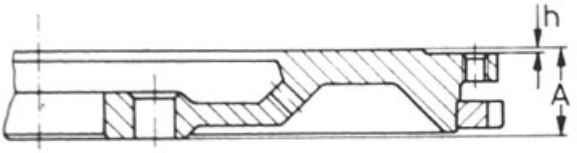
Installation

Clean tapped bores.
Install disc (1).
Replace and install expansion bolts with Loctite No. 270**.
Tightening torque*

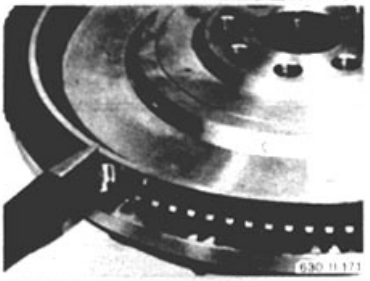
Check axial runout* of flywheel.

Friction surface may be machined to minimum thickness A*.
If machining the friction surface reduces distance "h" to zero, flange surface (distance "h") has to be machined.

M 88 11 072









11 22 541 REPLACING STARTER GEAR RING

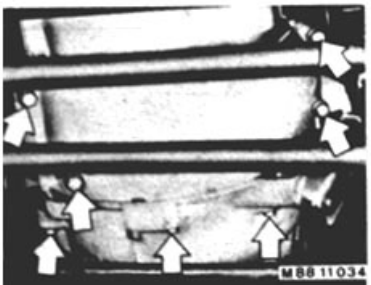
Drill a 6 mm (0.236") dia. hole approx. 8 mm (0.315") deep below a tooth gap to make breaking the ring easier.

Break gear ring at drilled point with a chisel.

Installation:

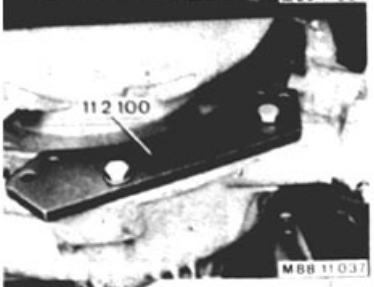
Heat new gear ring to 200 ... 230° C (395 to 445° F), checking temperature with a thermochrome pencil.
Tooth bevel faces engine.
Install starter gear ring to fit snugly all around with a brass mandrel.

* See Specifications
** Source: HWB



11 23 000 REMOVING AND INSTALLING VIBRATION DAMPER WITH HUB

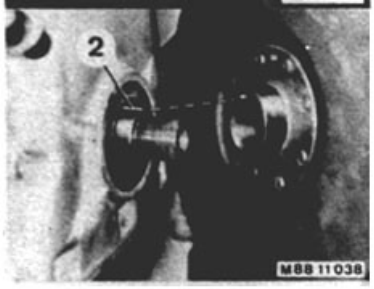
Remove radiator 17 11 000.
Remove fan 11 52 000.
Unscrew brace.



Hold flywheel with Special Tool 11 2 100.

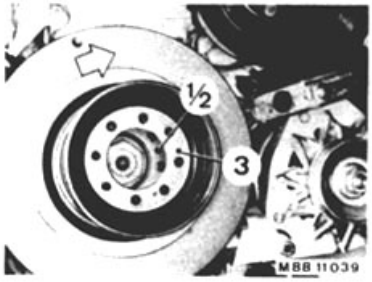


Take off drive belts on alternator, power steering pump and, if applicable, compressor for air conditioner.
Unscrew nut (1) with Special Tool 11 2 180.
Installation:
Tightening torque*.
Tighten drive belts and check tightness with Special Tool 11 5 020.



Pull off vibration damper with hub.
Installation:
Check for correct installed position of key (2).
Check seal, replacing if necessary.
If hub is worn, install seal approx. 1 to 2 mm (0.039 to 0.079") deep.

* See Specifications



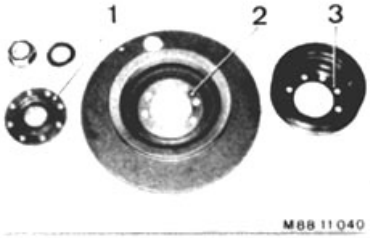
11 23 010 REPLACING VIBRATION DAMPER

Remove fan cowl.
Take off drive belts on alternator, power steering pump and, if applicable, compressor for air conditioner.
Unscrew pulley and remove vibration damper.
Installation:
– Dowel pin (1) to bore (2)
– Bore (3) to bore (2)

Vibration Damper Identification:

Type	Dia.(mm)	BMW Number	Color Code
M 88/3	245	1 305 802	white
S 38 Z	245	1 309 236	blue

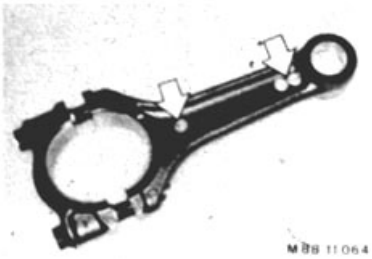
Tightening torque*.
Tighten drive belts and check tightness with Special Tool 11 5 020.



11 23 031 REPLACING HUB OF VIBRATION DAMPER

Remove vibration damper with hub 11 23 000.
Unscrew pulley and remove vibration damper.
Installation:
– Dowel pin (1) to bore (2)
– Bore (3) to bore (2)
Tightening torque*.

* See Specifications



M88 11 064



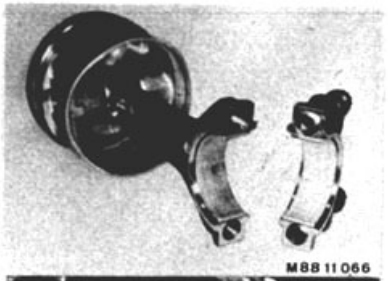
M88 11 065

11 24 521 REPLACING CONNECTING RODS
– Pistons Removed –

Note:
Only install connecting rods of same weight class (die-stamped in bearing caps) in one engine.

Consequently only sets of connecting rods are available from Parts.

The piston pin must slide through the conrod bush under light pressure.
Install conrod bearing shells – see 11 24 571.



M88 11 066



M88 11 067



M88 11 068



M88 11 069

11 24 571 REPLACING CONROD BEARING SHELLS
– Engine Disassembled –

Place conrod bearing shells in connecting rods and conrod bearing caps.
Check the machined size (conrod bearing diameter).

Place Plastigage (Type PG - 1) on conrod bearing journals wiped clean of oil in BDC position.
Mount conrod bearing caps — pair codes and grooves of bearing shells must be on the exhaust side.

Source of Supply for Plastigage:
Cartool
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

Tighten bolts (use old conrod bolts).
Tightening torque*.
Don't turn the crankshaft.
Remove conrod bearing caps.
Read the conrod bearing play* from the supplied scale by measuring the width of the flattened Plastigage.

Use new bearing shells or shells of different machined size or with different color code to correct the bearing play.
Use new conrod bolts for final installation.

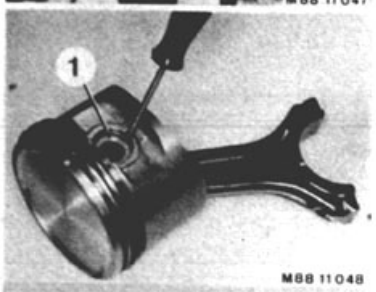
* See Specifications



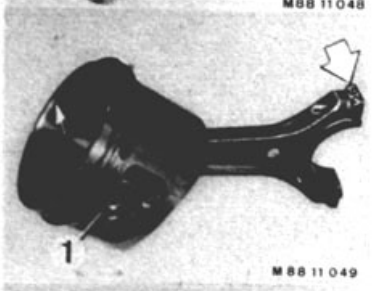
11 25 000 REMOVING AND INSTALLING PISTON

– Engine Removed –

Remove cylinder head 11 12 100.
Remove oil pump 11 41 000.
Take off connecting rod bearing cap and press out piston with connecting rod upwards.
Installation:
Install connecting rod 11 24 571.



Remove circlip (1).
Press out piston pin.
Installation:
Piston pins and pistons are matched and must not be mixed up.



Installation:
Pairing codes and grooves of bearing shells are on exhaust side.
Install circlip (1) with gap facing down.



Only install a piston of same make and same weight class.
Weight class is stamped with "+" or "–" in piston crown.
Identification:

Engine	E*	Dia. in mm
M 88/3	10.5	93.4
S 38 Z	9.8	93.4

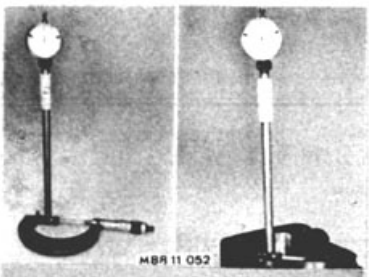
Check machined size (piston diameter)*.

* See Specifications

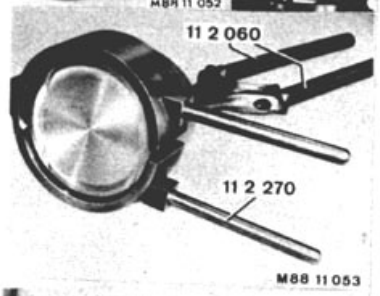


Measuring Piston Installed Clearance:
Measure piston diameter* at measuring point "A" with a micrometer.

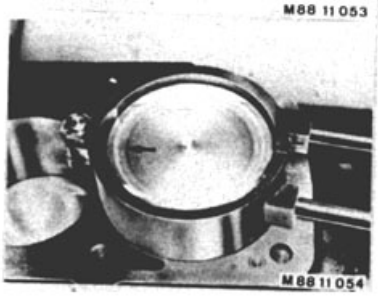
Engine	Make	Measuring Point "A" in mm
M 88/3	Mahle	11 (0.433")
S 38 Z	Mahle	6 (0.236")



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.
Compare measured piston installed clearance with specified piston installed clearance*.
Max. permissible wear clearance*.

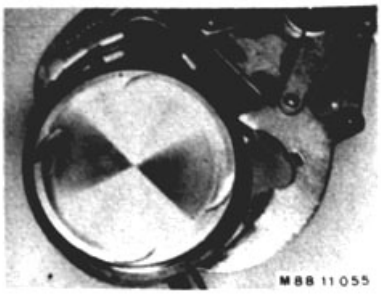


Bolt Special Tool 11 2 060 on connecting rod.
Lubricate piston and piston rings with oil.
Offset piston ring end gaps by 120°.
Compress piston rings with Special Tool 11 2 270.



Install piston that arrow faces timing chain.
Turn pertinent connecting rod bearing journal to BDC to install piston.

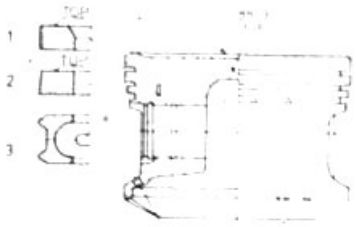
* See Specifications



11 25 651 REPLACING PISTON RINGS OF ONE PISTON
– Piston Removed –

Remove piston rings with a piston ring compressing pliers.

Note:
It might no be possible to find the identification on used piston rings.
Lay piston rings aside in correct sequence and installed position.

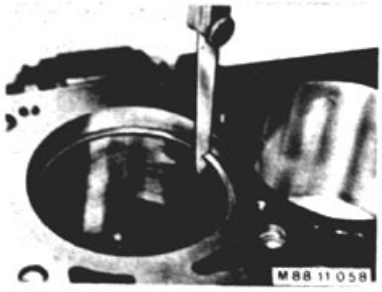


Installation:
Install piston rings with the word "TOP" facing the piston crown.

1 Plain compression ring
2 Bevelled compression ring
3 Oil scraper ring with rubber lined spring

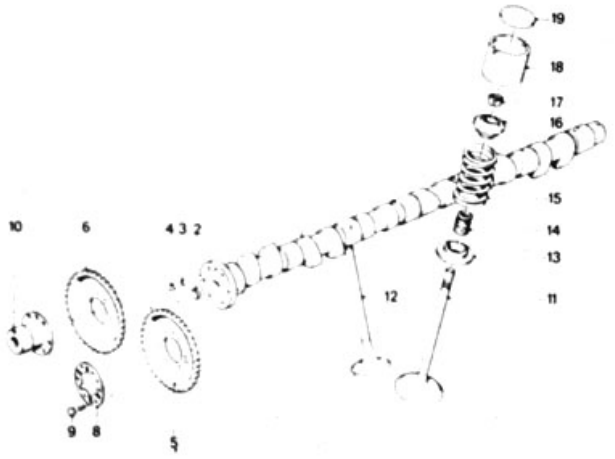


Measure side clearance*.



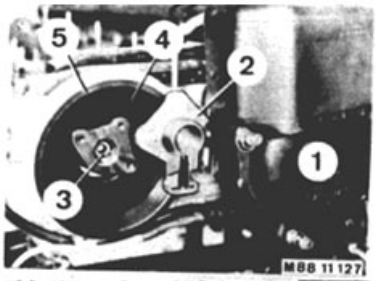
Measure end clearance*.

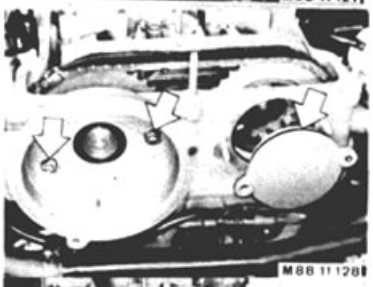
* **See Specifications-**

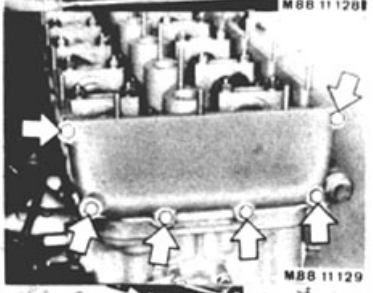


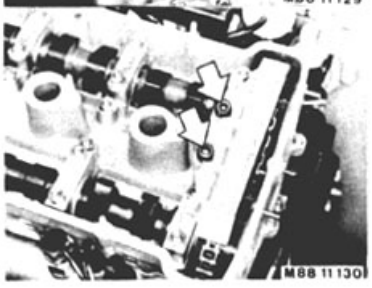
Valve Timing

1 Camshaft 264° – M 88 - 3
Camshaft 248° – S 38 Z
2 Camshaft oil bore plug
3 Circlip
4 Cylindrical pin – different for intake and exhaust sprockets. New uniform pin for intake and exhaust is retroactively interchangeable.
5 Sprocket - intake "E"
6 Sprocket - exhaust "A"
8 Lockplate
9 Hex. head screw M 6 x 16
10 Adapter for distributor rotor
11 Intake valve - 37 mm dia. (larger stem diameter valves available for repairs)
12 Exhaust valve - 32 mm dia. (larger stem diameter valves available for repairs)
13 Lower valve retainer
14 Valve stem seal
15 Valve spring - 42.5 mm long (double spring set can be installed retroactively with new spring retainers)
16 Upper spring retainer
17 Valve collets
18 Plunger (larger plunger dia. for S 38 Z)
19 Shims from 3.00 to 4.25 mm









11 31 000 REMOVING AND INSTALLING CAMSHAFT

Remove cylinder head cover – see 11 12 000.
Remove fan cowl and fan – see 11 52 000.
Remove distributor cap (1).
Unscrew distributor rotor (2).
Unscrew adapter (3).
Remove cover (4).

Installation:
Check O-ring (5), replacing if necessary.
Tightening torque*.

Unscrew distributor housing and end cover.

Installation:
Check O-ring, replacing if necessary.

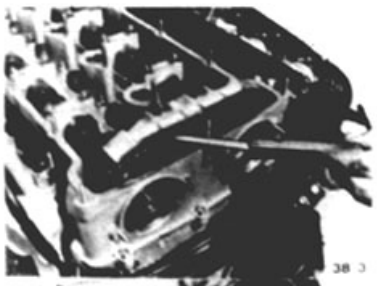
Unscrew end cover.

Installation:
Replace gasket.

Important!
Use new bolts coated with microencapsulated cement to prevent oil leakage.

Unscrew guide rail.

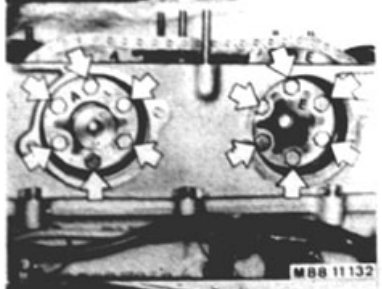
* See Specifications



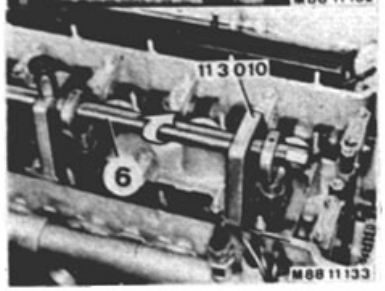
Installation
Center guide rail with a feeler gage blade.



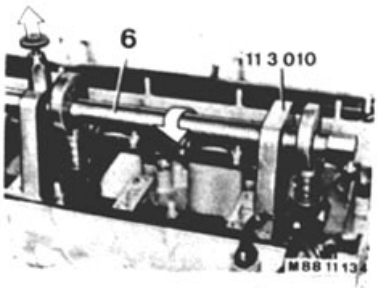
Turn crankshaft with Special Tool 11 3 020 to set cylinder 1 to TDC – cyl. 6 overlaps.
Caution!
Never crank the engine after removing the timing chain.



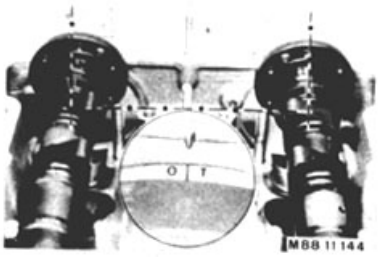
Remove chain tensioner – see 11 31 090.
Open lockplates and unscrew sprockets.



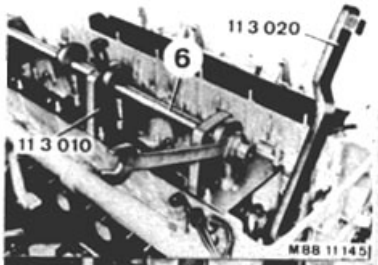
Mount Special Tool 11 3 010 on timing case. Turn shaft (6) up to the stop – camshaft is held down for removal of bearing caps. Unscrew camshaft bearing caps.



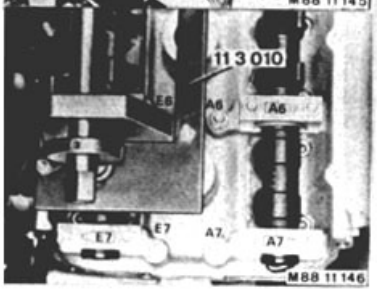
Release arrest and relax the camshaft, Remove Special Tool 11 3 010.
Mark camshafts "E" / "A" and remove.
Installation:
Intake and exhaust camshafts are identical. Used camshafts must be installed in the same position.



Installation:
Turn crankshaft to TDC.
Install camshaft that one each groove faces up and in – TDC position.

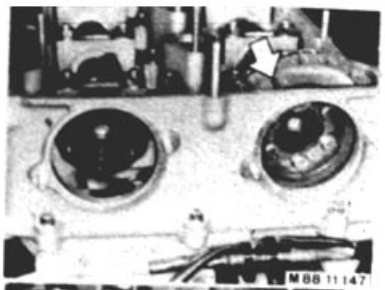


Mount Special Tool 11 3 010 on timing case. Hold camshaft in TDC position with Special Tool 11 3 020 and turn shaft (6) up to the stop – camshaft is held down for installation of bearing caps.



Install camshaft bearing caps on timing case according to the lettering.
Tightening torque*.

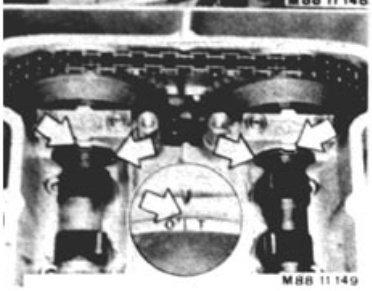
* See Specifications



Tighten the timing chain in opposite direction of engine rotation and place on the intake sprocket "E" first.
Install lockplate and tighten sprocket.
Tightening torque*.



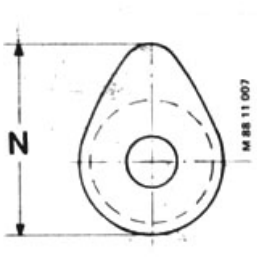
Installation
Install exhaust sprocket "A".
Insert adapter (7).
Install lockplate and tighten sprocket.
Tightening torque*.



Install chain tensioner – see 11 31 090.
Crank engine once in direction of rotation and recheck the timing.
- Crankshaft in TDC
- One each camshaft groove faces in
- One each camshaft groove faces cast boss on bearing cap

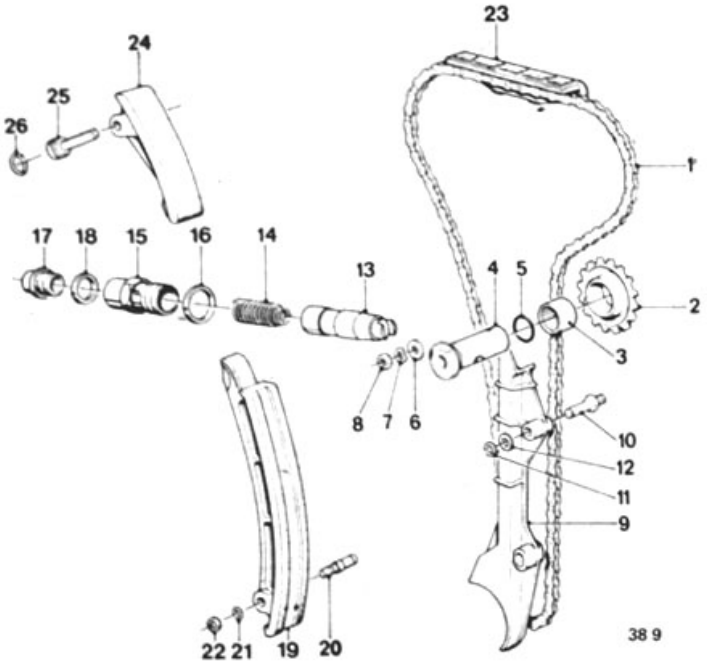
Lock sprocket mounting bolts with the lockplates.
Adjust valve clearance – see 11 34 004.

* See Specifications



Cam distance "N"*.

* See Specifications

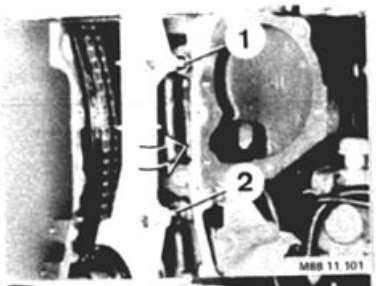


Valve Timing

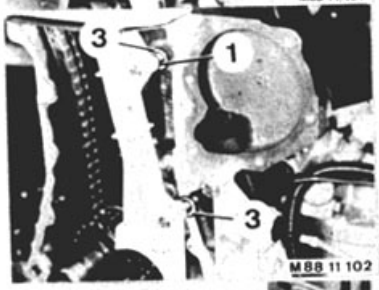
1	Timing chain	14	Spring
2	Sprocket (guide wheel)	15	Cylinder
3	Needle sleeve	16	Seal
4	Shaft	17	Plug
5	O-ring	18	Seal
6	Shim	19	Tensioning rail (lower)
7	Spring washer	20	Bearing pin (hollow)
8	Nut	21	Lock washer
9	Guide rail	22	Retainer
10	Bearing pin	23	Guide rail
11	Lock washer	24	Tensioning rail (upper)
12	Shim	25	Bearing pin
13	Piston	26	O-ring

11 31 051 REPLACING TIMING CHAIN

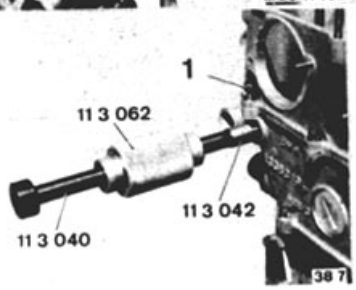
Remove lower timing case cover 11 14 110
Remove sprockets on camshafts, see 11 31 000.
Remove water pump 11 51 000.



Unscrew bolts (1 and 2).
Unscrew screw (2) and swing guide rail aside.
Installation:
Place timing chain on crankshaft sprocket and reversing wheel before swinging in the guide rail.

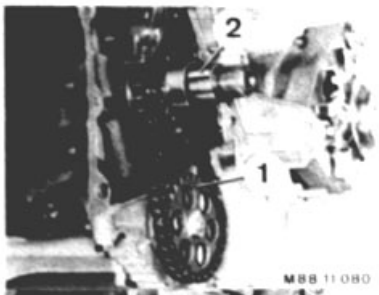


Unscrew bolt (1) and take off guide rail.
Remove timing chain.
Installation:
Timing chain is pre-stretched.
Use washers (3).



11 31 ... REMOVING AND INSTALLING UPPER TENSIONING RAIL

Remove timing chain – see 11 31 051.
Loosen bolt (1) and screw in Special Tools 11 3 040, 11 3 062 and 11 3 042.
Knock out shaft.
Installation:
Check O-ring, replacing if necessary.



M88 11 080

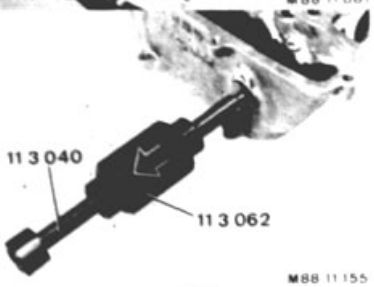
11 31 061 REPLACING SPROCKET SET
– Timing Chain Removed –

Remove oil pan 11 13 000.
Remove sprocket (1) on oil pump.
Take off chain.
Lift out woodruff key (2).



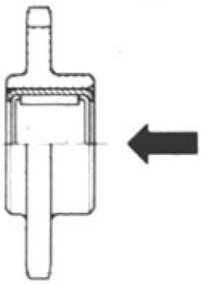
M88 11 081

Pull off sprocket with Special Tool 11 2 000.
Installation:
Heat sprocket to max. 200° C (390° F) for installation.
Tighten oil pump chain, see 11 41 000.



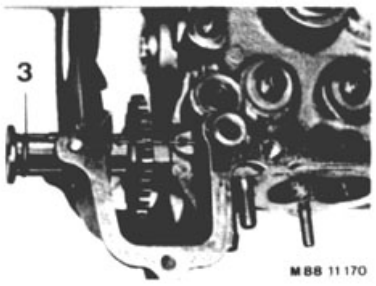
M88 11 155

Apply Special Tools 11 3 040 and 11 3 062 on shaft of chain guide wheel.
Knock out shaft.



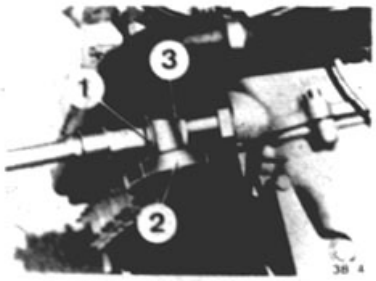
Installation:
Check needle sleeve in sprocket, replacing if necessary.

Forward direction and pressing in direction for needle sleeve.



M88 11 170

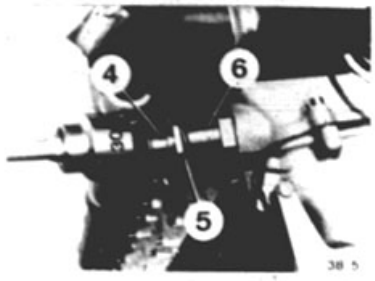
Installation:
Replace O-ring (3).
Drive in shaft (with bore facing up) partially.
Push on guide wheel sprocket.
Drive in shaft against stop.



38 4

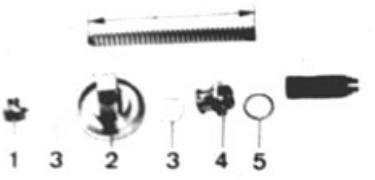
11 31 090 REMOVING AND INSTALLING PISTON FOR CHAIN TENSIONER

Unscrew plug (1).
Take off damper housing (2).
Installation
Replace seal (3).
Tightening torque = 25 · 3 Nm (18 · 2 ft. lbs.).



38 5

Unscrew connector (4).
Caution!
Strong spring pressure.
Remove spring and piston.
Installation
Replace seal (5).
Tightening torque for connector (4) = 40 · 3 Nm (29 · 2 ft. lbs.).



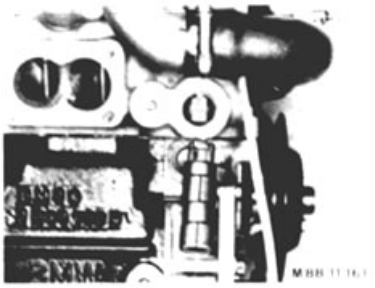
38 8

Tightening torque for cylinder (6) = 50 · 3 Nm (36 · 2 ft. lbs.).
Installation
Check length of spring.
Nominal value: 159 · 0.5 mm (6.260 · 0.020").
Conically wound end of spring faces the connector.

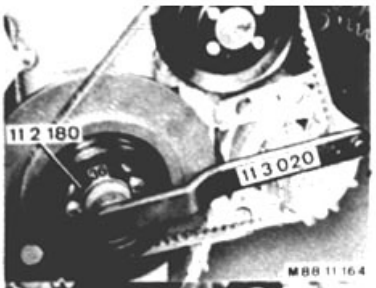

38 6

Piston and cylinder are matched* with each other – marked 1 or 2.
Only install parts with same marks.
Install cylinder with groove facing back (as seen looking forward in car) and piston with groove facing up.

* See Specifications

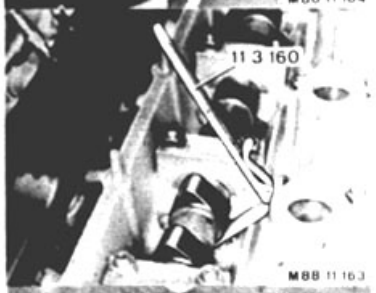


Guide piston opening into tensioning rail.
Piston is operated by engine oil pressure.

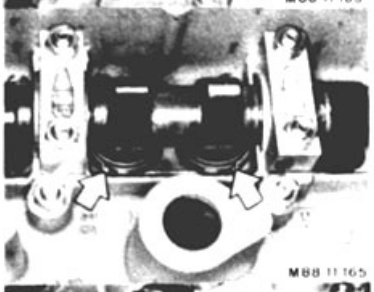


11 34 004 ADJUSTING VALVE CLEARANCE

Remove fan cowl and fan – see 11 52 000.
Remove cylinder head cover – see 11 12 000.
Crank engine with Special Tool 11 3 020.



Measure valve clearance with cams facing up. Compare measured valve clearance with the specified valve clearance*.

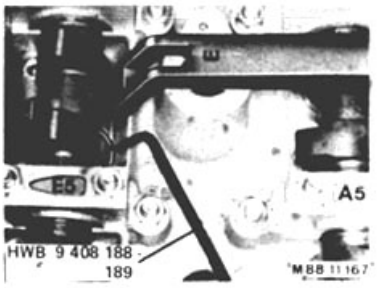


Turn openings of tappets as shown in the picture, if the measured valve clearance is not within specified valve clearance tolerances.



Guide in Special Tool 11 3 150 for M 88 · 3 engines or 11 3 170 for S 38 engines in accordance with camshaft "A" or "E" and press tappets down.

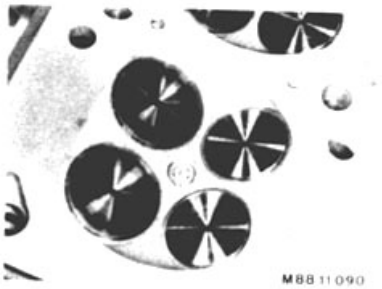
* See Specifications



Blow out the valve shim with compressed air.

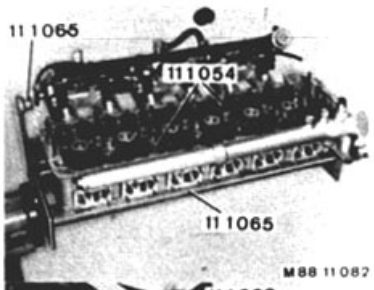


Measure thickness of removed valve shim. Install shim of required thickness with the lettering facing down.



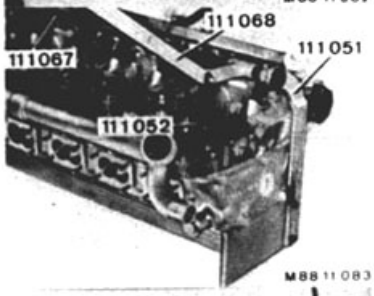
11 34 509 CHECKING VALVES FOR LEAKS – Cylinder Head Removed

Spark plugs remain screwed in.
Fill combustion chamber with gasoline outdoors or indoors with conformance of fire prevention regulations.
If gasoline runs past valve heads, valves and valve seats must be inspected.
Remove valves – see 11 34 550.
Machine valve seats – see 11 12 607.

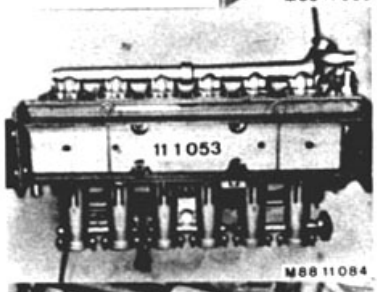


11 34 550 REMOVING AND INSTALLING VALVES
– Cylinder Head Removed –

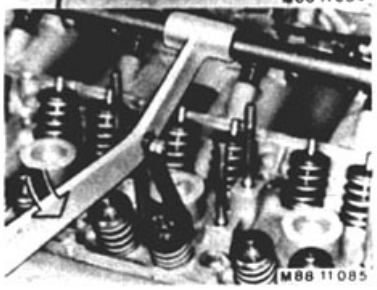
Mount cylinder head on Special Tool 11 1 065 with Special Tool 11 1 054.
Bolt down Special Tool 11 1 065



and 11 1 051.
Mount Special Tool 11 1 068 with Special Tools 11 1 052 and 11 1 067.
Unscrew spark plugs.
Installation
Tightening torque*.



Place Special Tool 11 1 053 (tray) in assembly fixture.

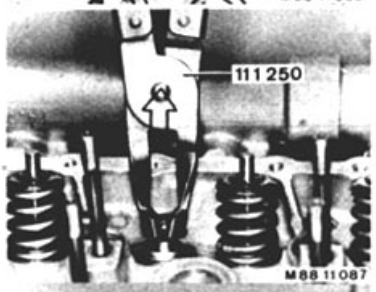


Compress valve springs and remove valve collets.

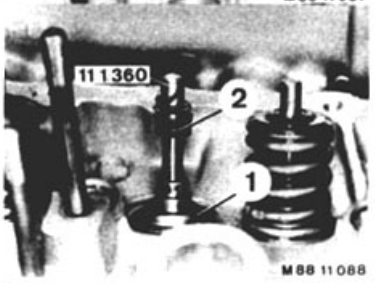
* See Specifications of Group 12



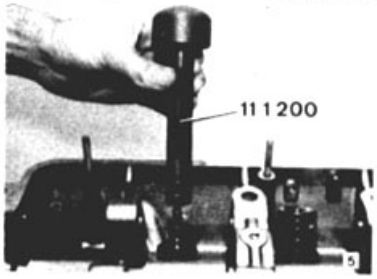
Remove upper spring retainer and valve springs.
Take tray out of assembly stand and pull out valve.
Installation
Lubricate valve guide and valve stem with oil.
Double spring set can be installed retroactively together with the new spring retainers.



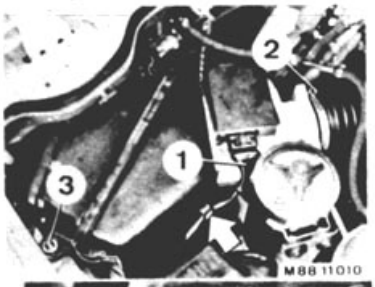
Pull off valve stem seal with Special Tool 11 1 250.
Check valve guide for wear – 11 12 595.



Install valves and place Special Tool 11 1 053 (tray) in fixture.
Use Special Tools 11 1 360 (sleeves) to avoid damaging the valve stem seals.
Lubricate valve stem seals (2) with oil and install.
Source for Sleeves:
Cartool
Alfred-Brehm-Str. 5
D-8070 Ingolstadt

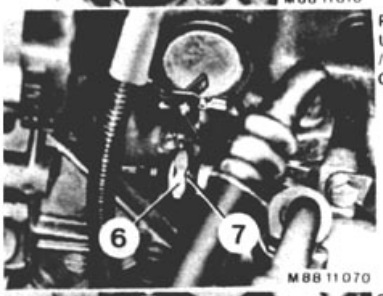


Press on valve stem seal against stop with Special Tool 11 1 190.
New, improved valve stem seals with grooves on the inside are pressed on by hand with Special Tool 11 1 200.
Special Tool 11 1 200 has two diameters – for 7 mm (0.276") and 8 mm (0.315") valve stem seals.

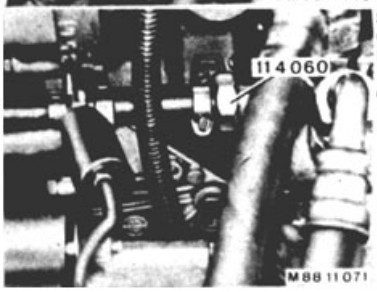


11 40 000 CHECKING ENGINE OIL PRESSURE

Pull off plug (1) and lift out wires.
Unscrew hose clamp (2).
Unscrew nut (3) and remove air cleaner with air flow sensor.

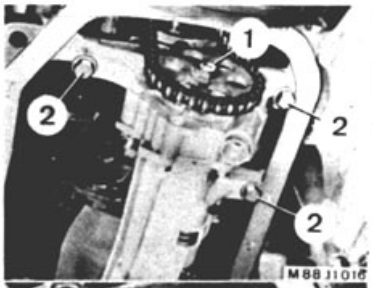


Pull off plug on oil pressure switch.
Unscrew oil pressure switch (6).
Installation:
Check seal (7), replacing if necessary.



Screw in Special Tool 11 4 060.
Connect 10 bar (142 psi) pressure tester of BMW service test unit.
Install manifold.
Check oil pressure*.

* See Specifications



11 41 000 REMOVING AND INSTALLING OIL PUMP

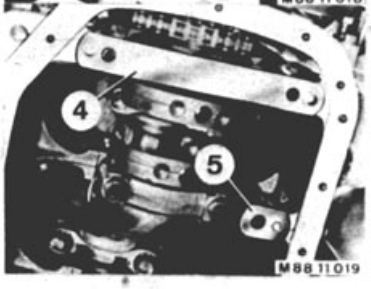
Pull out oil dipstick.
Remove oil pan 11 13 000.
Unscrew nut (1) and take off sprocket.
Unscrew bolts (2).



Unscrew bracket (3) and remove oil pump.
Installation:
Mount bracket without tension.



Installation:
Push on sprocket with oil pump mounted.
Tightening torque* for nut.

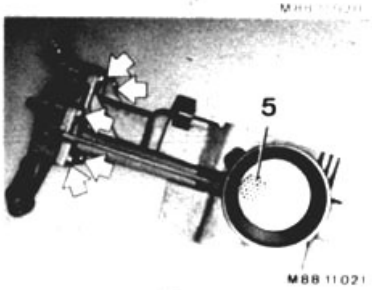


Installation:
Adjust chain tightness with shims (4 and 5) that chain gives under light thumb pressure.
Shims (4) and (5) must have the same thickness.

* See Specifications



Testing and Servicing:
Check movement of oil pump by turning on the drive shaft.

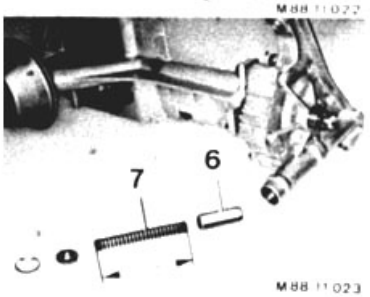


M88 11 021

Disassemble oil pump and clean oil filter screen (5).


M88 11 022

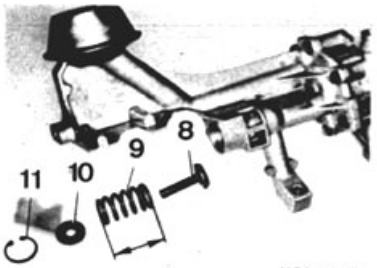
Check oil pump for wear:
- scoring in body
- wear of rotors



M88 11 023

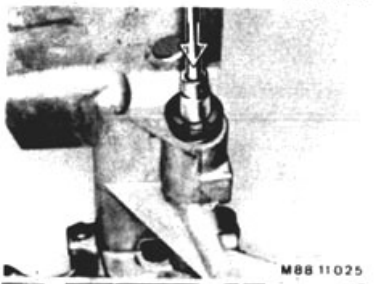
Pressure relief valve is installed in main bore and regulates the engine oil pressure*, see 11 40 000.
Check movement of piston (6).
Check length of spring (7) = 68 mm (2.677").

* See Specifications



M88 11 024

The 8 bar (114 psi) pressure relief valve regulates 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").


M88 11 025

Installation:
Push in spring (9) and washer (10) with a wrench socket and install circlip (11).

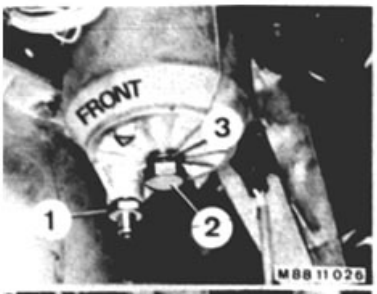


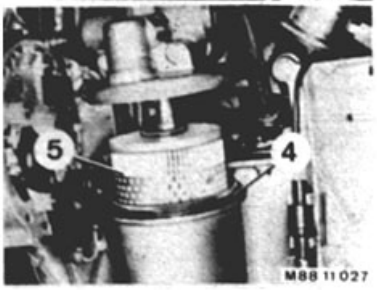
M88 11 063

11 41 151 REPLACING OIL PUMP DRIVE CHAIN

Remove oil pan 11 13 000.
Remove timing chain 11 31 051.
Unscrew nut (1) and remove sprocket.
Installation:
Adjust chain tightness, see 11 41 000.
Chains with green color code are longer than chains with red color code.
Tightening torque*.

* See Specifications



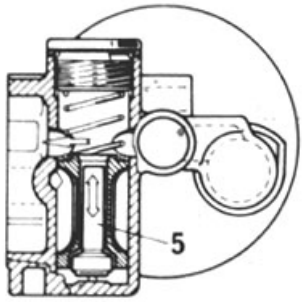


11 42 021 REPLACING FULL FLOW OIL FILTER

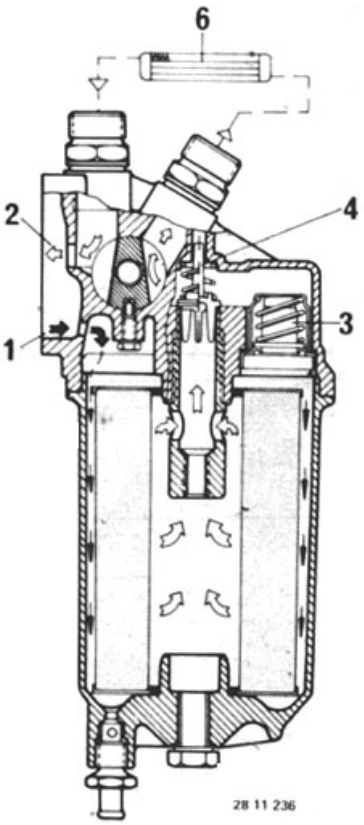
Unscrew oil drain plug (1) and drain oil.
Unscrew bolt (2).
Replace oil filter (5).

Installation

Check seals (3 and 4), replacing if necessary.
Mount oil filter housing that arrow faces forward (FRONT).
Tightening torque*.
Add engine oil***.

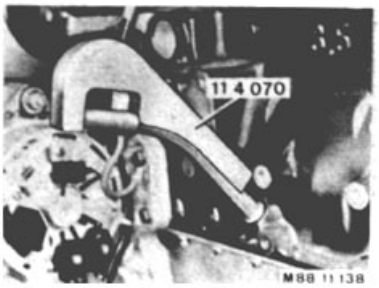


Unfiltered oil
Filtered oil



1 Feed from oil pump
2 Return to main oil bore
3 Bypass valve – opening pressure 2.5 ± 0.25 bar (35 ± 3.5 psi)
4 Return inhibiting valve – opening pressure 0.1 ± 0.05 bar (1.4 ± 0.7 psi)
5 Thermostatic activator for switching oil cooler
6 Oil cooler

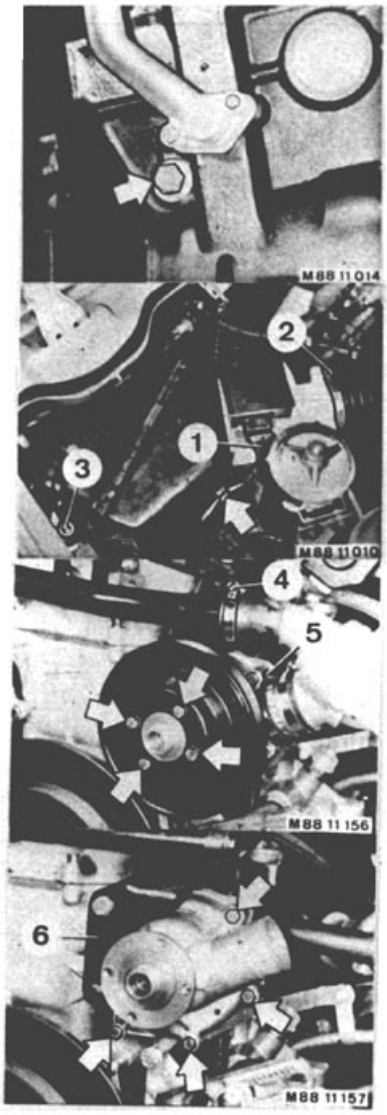
* See Specifications
*** See Service Information of Gr. 00



11 43 101 REPLACING GUIDE TUBE FOR OIL DIPSTICK

Install guide tube with Loctite No. 270** and drive in against stop.

** Source: HWB



11 51 000 REMOVING AND INSTALLING REPLACING WATER PUMP

Unscrew bolt and drain coolant.
Remove fan cowl and fan 11 52 000.
Installation:
Add coolant***.

Pull off plug (1) and lift out wires.
Unscrew hose clamp (2).
Unscrew nut (3) and remove air cleaner with air flow sensor.

Take off drive belt and remove pulley.
Pull off hoses (4 and 5).
Installation:
Tighten drive belt and check tightness with Special Tool 11 5 020.

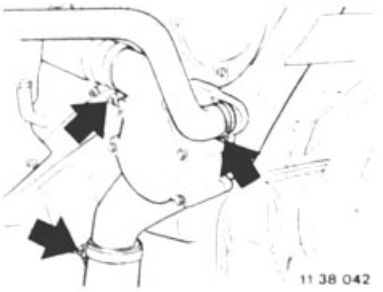
Unscrew suspension eye (6) and water pump.
Installation:
Replace gasket.

*** See Service Information of Gr. 00

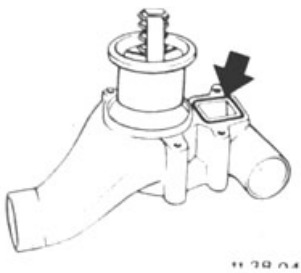


11 53 000 REMOVING AND INSTALLING OR REPLACING COOLANT THERMOSTAT

Disconnect coolant hoses on thermostat housing to the coolant pipe.

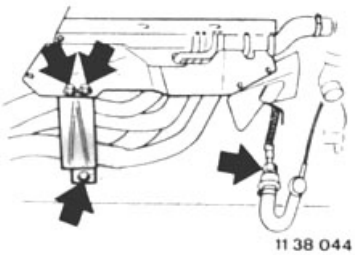


Unscrew bolts.
Lift off thermostat housing.



Pull thermostat out of the housing.

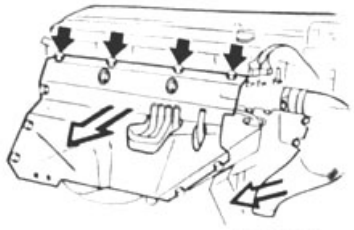
Installation:
Replace rubber seal on the coolant port.
Check installed direction of the thermostat.



11 38 044

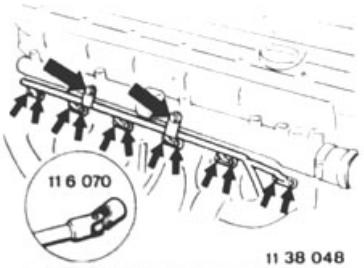
11 62 . . . REMOVING AND INSTALLING/ SEALING OR REPLACING BOTH EXHAUST MANIFOLDS (S 38 B 36 Engine) – Engine Removed –

Unscrew air injection.
Unscrew holder for heat shield.



11 38 047

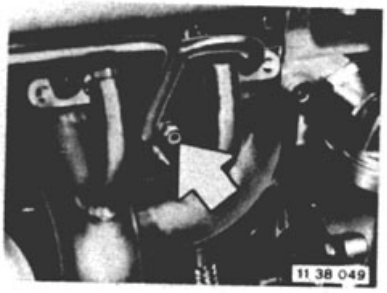
Unscrew and remove heat shield.



11 38 048

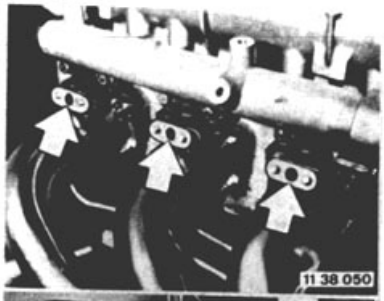
Unscrew air injection pipe.

Note:
Use Special Tool 11 6 070.



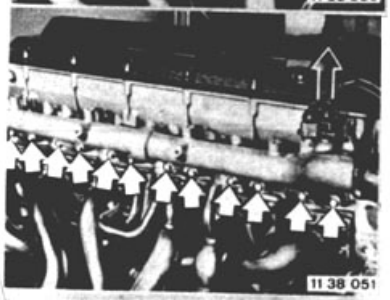
11 38 049

Important!
Unscrew holder on exhaust manifold at cylinder no. 1.



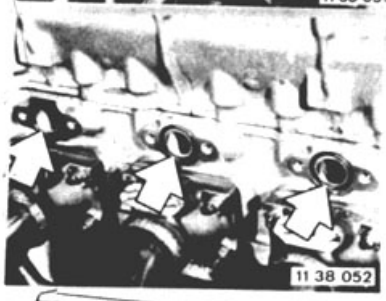
11 38 050

Installation:
Replace gaskets.



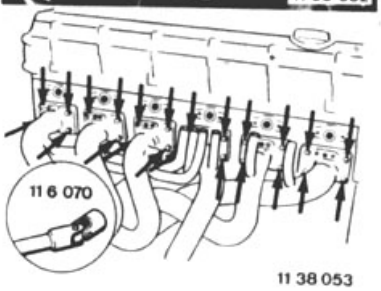
11 38 051

Unscrew coolant pipes.



11 38 052

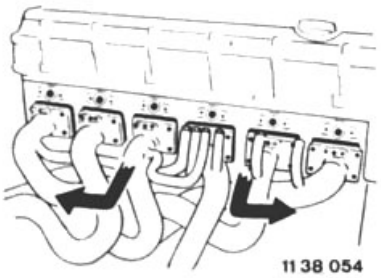
Installation:
Replace seals.



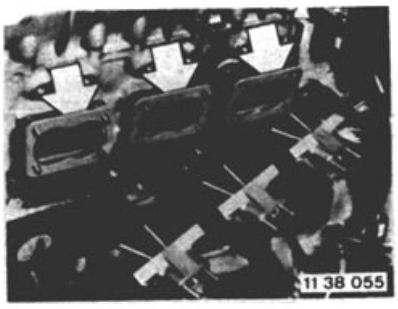
11 38 053

Unscrew both exhaust manifolds on the cylinder head.

Note:
Use Special Tool 11 6 070.


11 38 054

Lift both manifolds off of the staybolts.


11 38 055

Installation:
The graphite surface of gaskets faces the cylinder head.
Use new self-locking nuts.
Tightening torque = 10 ± 1 Nm (7.2 ± 0.7 ft. lbs.).

Oil grade, refer to Operating Fluids		
Oil fill quantity for transmission type M (188) a)	approx. ltr.	1.7
Oil fill quantity for transmission type G b)	approx. ltr.	1.9

a) side cover with 6 screws

b) side cover with 8 screws

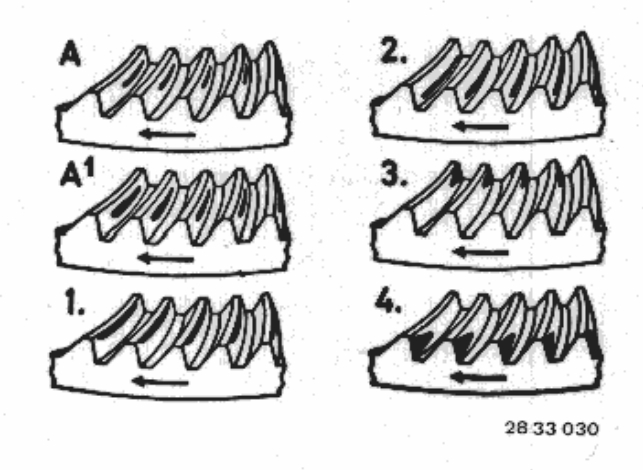
33 12 Crown wheel with pinion and bearing (Type K, M, G)

	Type	Thread	Tightening specification	Measure
1AZ Crown wheel on final drive housing Always replace screws, ensuring screws are free of oil and grease, then secure screws with Loctite 270	All	M10	Jointing torque Torque angle	50 + 3 Nm 40 + 3 °
	All	M12 x 1.5	Jointing torque Torque angle	100 + 10 Nm 50 + 5 °
	All	M14 x 1.5	Jointing torque Torque angle	100 + 10 Nm 30 + 4 °
2AZ Input flange to drive pinion				
Type K (Side cover with 4 bolts); min.		M20		175 Nm
Type M (Side cover with 6 bolts); min.		M20		185 Nm
Type G (Side cover with 8 bolts); min.		M22		210 Nm

		thread	tightening specification	
Designations				
Type K = Side cover with 4 screws				
Type M = Side cover with 6 screws				
Type G = Side cover with 8 screws				
168 / 168 / 215 / 220 compact = without side cover				

	Type	Thread	Tightening specification	Measure
1AZ Output shaft to final drive unit and drive flange				
Fillister head bolt	All	M10		83 Nm
with locking teeth	All	M10	Replace bolts and washers	96 Nm
	All	M12		110 Nm
Torx bolt	All	M10		83 Nm
with ribbed teeth Color: BLACK	All	M10		100 Nm
	All	M8		64 Nm
with ribbed teeth Color: SILVER	All	M10	Replace screws	80 Nm
	All	M8		52 Nm
with ribbed teeth	All	M12		135 Nm

	Type	Thread	Tightening specification	Measure
1AZ Case Covers	All	M10 8.8		45 Nm
	All	M10 10.9		90 Nm
	E60 / E65 / E66	M10x75 10.9		110 Nm
	E63 / E64	M10x75 10.9		90 Nm
	E60 / E63 / E64 / E65 / E66	M10x25 10.9		90 Nm
	E85	M10 8.8		55 Nm
	E83	M10 10.9		55 Nm
2AZ Side bearing cap (insert into through bore-holes only new coated screws or screws with Loctite 270) Differential designations	Type M, G	M8		22 Nm
	Type K	M8	Jointing torque Torque angle	10 + 2 Nm 40 + 5 °
3AZ Oil fill and drain plug with sealing ring	All			65 Nm
4AZ Drive flange, right	E34 / Four Wheel Drive	M10		59 Nm
5AZ Drive flange, left (always replace screws)	E34 / Four Wheel Drive	M14 x 1.5	Jointing torque Torque angle	90 Nm 100 + 4 °
6AZ Oil cooler connection to rear differential	E31			35 Nm
7AZ Union nuts pipe oil cooler	E31			17 Nm
8AZ Vibration damper on bracket	All			77 Nm
9AZ Oil filler and drain plugs with O-ring	All			60 Nm



A Correct tooth pattern without load

A1 Under load, the contact pattern moves slightly outwards.

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.

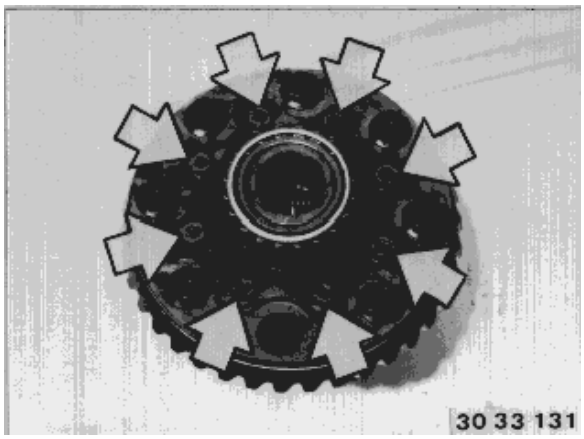
   Move ring gear away from drive pinion. Maybe move pinion closer to ring gear shaft.

4. Short contact pattern on large tooth end (heel contact) of ring gear.

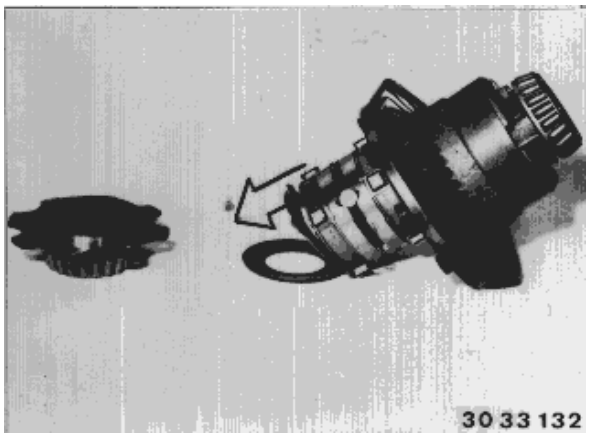
   Move ring gear toward drive pinion. Perhaps back drive pinion away from ring gear shaft.

33 14 593 Dismantling and assembling limited slip differential (Type K) - final drive removed -

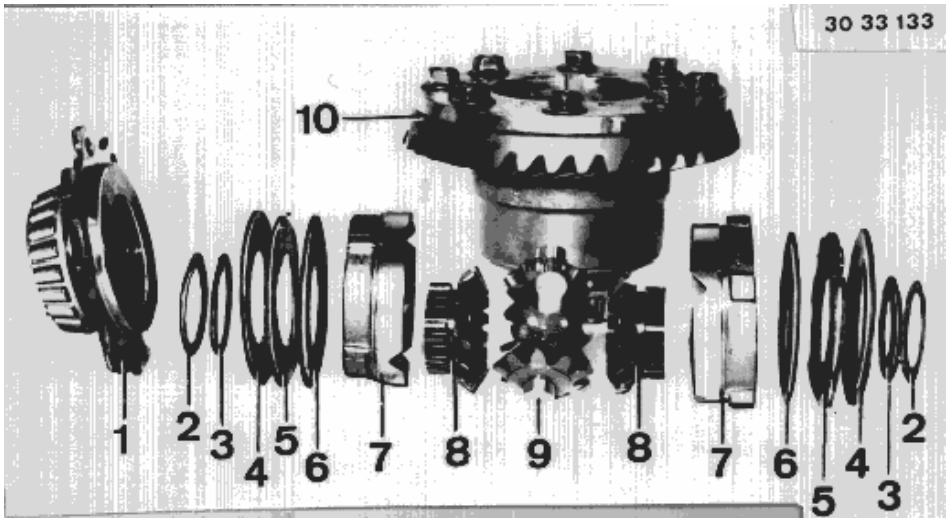
Removing limited-slip differential,
refer to 33 14 520



Unscrew case cover mounting bolts.
Take off case cover.



Carefully allow the components to slide out of the housing.



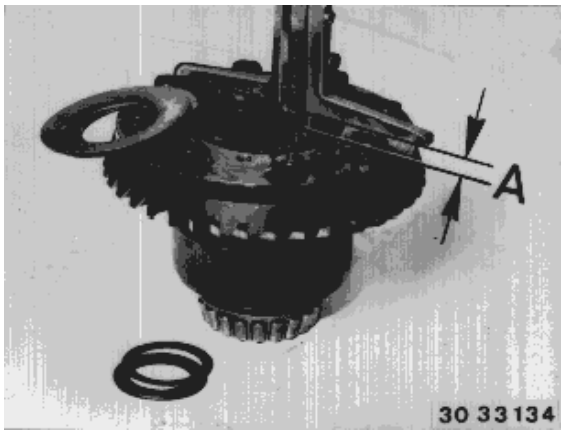
1) Housing cover	6) Inner disc
2) Plate spring	7) Compression ring
3) Thrust washer	8) Differential side gear
4) Plate spring	9) Final drive gears with differential shafts
5) Outer disc	10) Final drive housing

Check all parts for wear,

e.g. molybdenum coating, gears.

Installation:

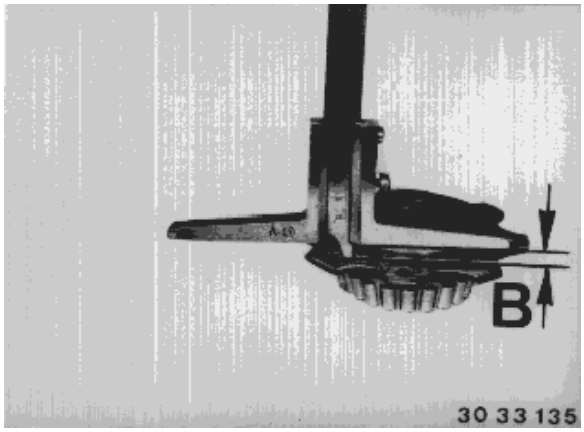
Lubricate all parts with approved final drive oil before assembling.



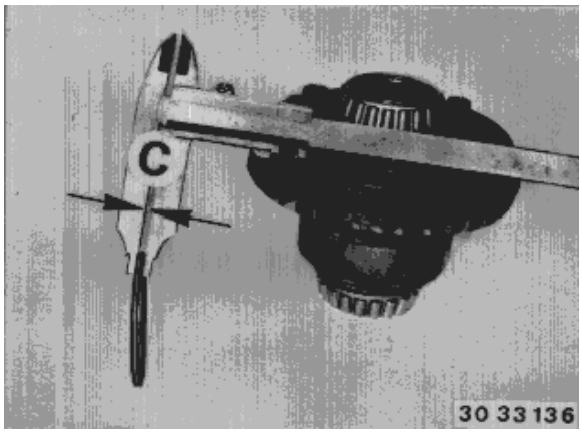
Install following parts in correct installed order to measure the preload:

Outer plates (5), inner plates (6), thrust rings (7), differential side gears (8) and differential gears with differential shafts (9).

Measure dimension A from edge of housing to outer disc, e.g. A = 10.8 mm.

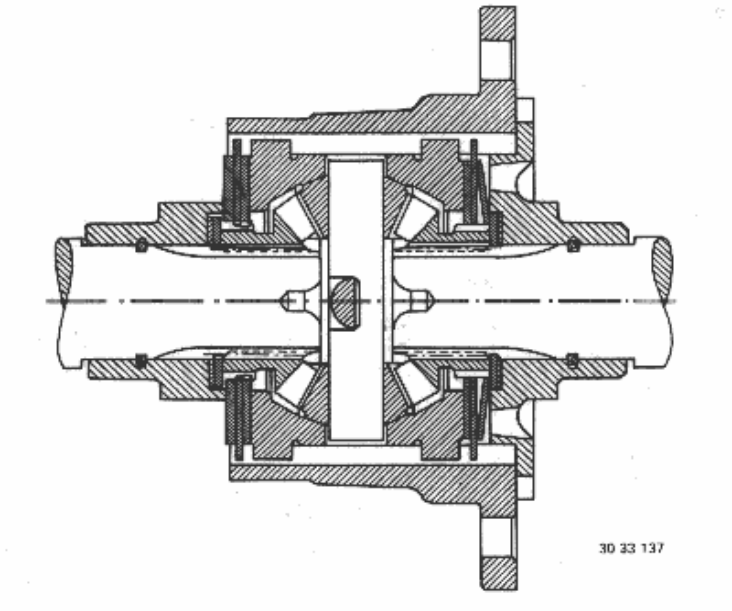


Measure dimension B on cover, e.g. B = 6.8 mm.



Place both diaphragm spring curved surfaces together.

Measure dimension C on the plate springs, e.g. C = 3.6 mm.



To ensure that the plate springs are not block-preloaded, installation clearance of 0.1 ... 0.4 mm is required.

Example:

B (cover) 6.8 mm

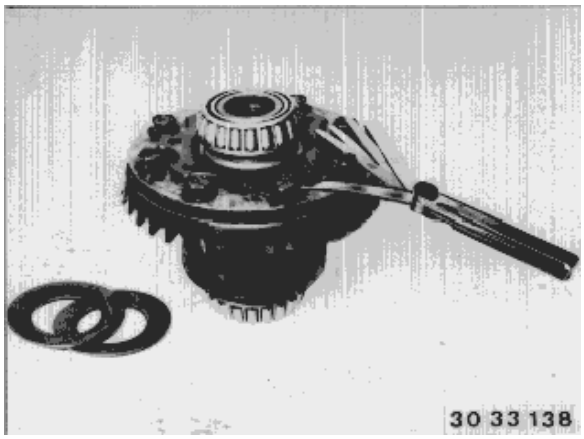
C (plate spring) 3.6 mm

A (housing) 10.8 mm

Sum total of B + C 10.4 mm

Installation clearance D 0.4 mm

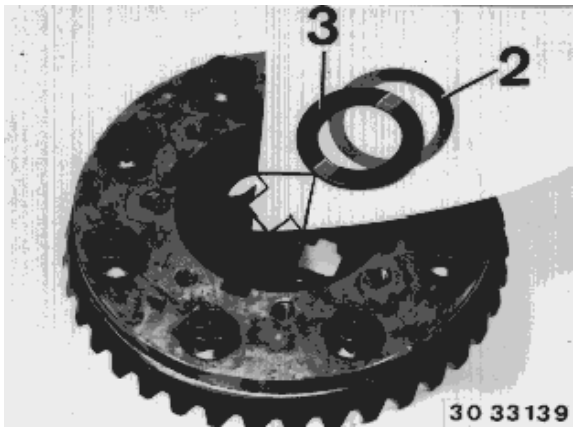
Correct any deviation in installed clearance D by installing outer plates of correct thickness.



Remove all parts from case and insert with the additional parts, diaphragm springs (2) and thrust washers (3). Mount case cover (1) and press on firmly, but do not bolt.

The preload of small diaphragm springs (2) should produce an uniform gap all around (check with feeler gage blade).

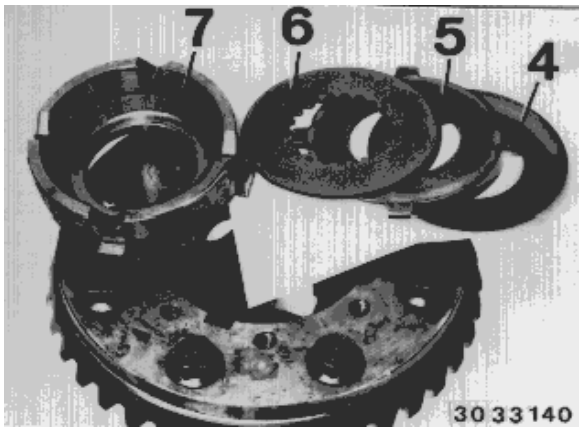
If there is no clearance between cover and case, check diaphragm springs (2) and thrust washers (3).



Installation:

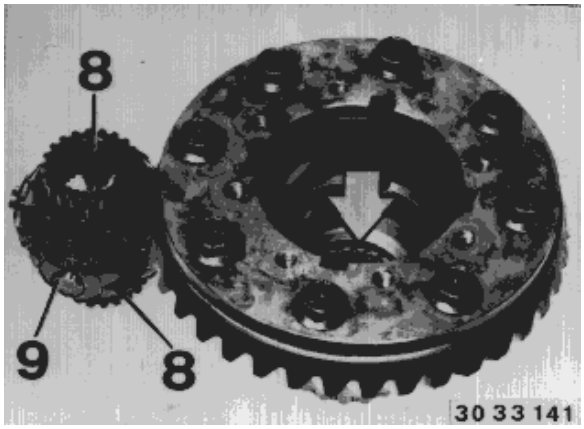
Diaphragm spring (2) with inside curved surface facing differential shaft (up).

Insert thrust washer (3) with oil pockets facing up to differential shaft.



Installation:

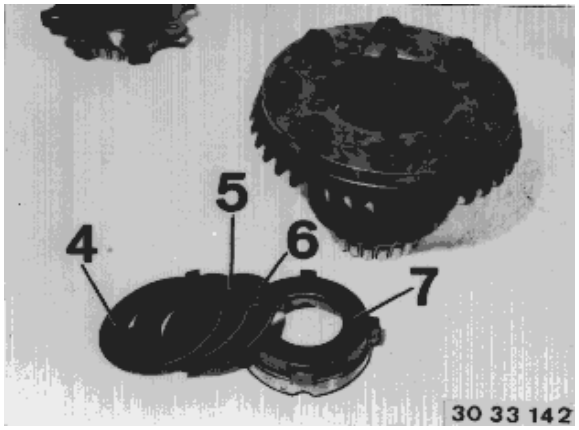
Insert diaphragm spring (4) with inside curved surface facing differential shaft and outer plate (5) with four tabs. Insert moybdenum coated inner plate (6) and thrust ring (7).



Installation:

Install differential side gear (8) by turning into guides or splines of inner plate.

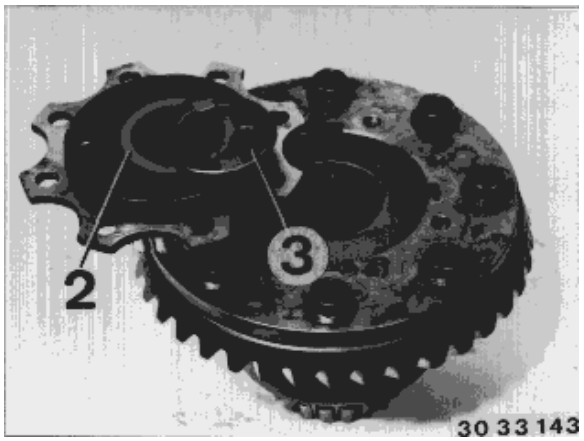
Install differential gears with shafts (9) and a second differential side gear (8).



Installation:

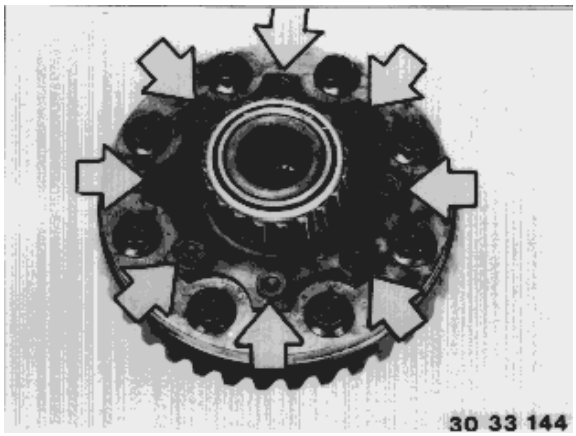
Install thrust ring (7), molybdenum coated inner plate (6) and outer plate (5).

Insert diaphragm spring (4) with inside curved surface facing differential shaft (down).



Installation:

Install diaphragm spring (2) with inside curved surface facing up and thrust washer (3) with oil pockets facing up in case cover, using grease.

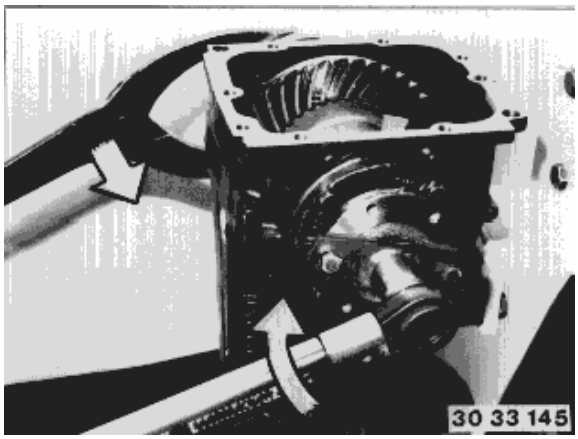


Installation:

Mount case cover with washers (being careful that washers do not slide out).

Install bolts with Loctite No. 270 and tighten cover uniformly.

Tightening torque, refer to Technical Data



Check slip torque of limited slip differential, refer to Technical Data,

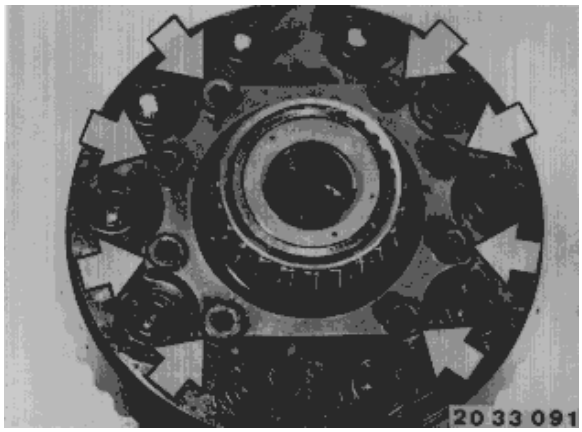
with one secured rear wheel and one driven rear wheel.

Make up tool locally for this purpose by, for example, welding a nut on a drive flange which is no longer required.

33 14 593 Dismantling and reassembling limited slip differential (Type M) - rear axle removed -

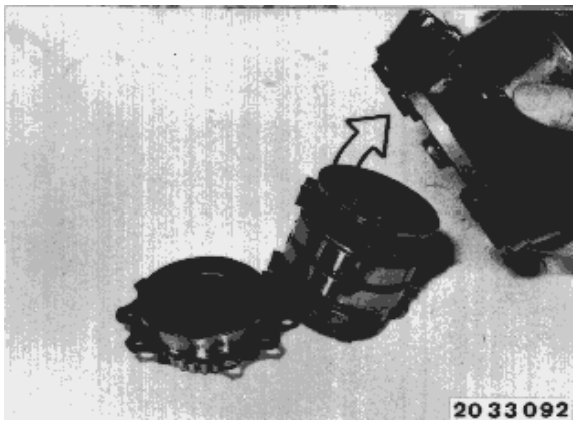
Removing limited-slip differential,

refer to Replacing complete limited-slip differential 33 14 520



Unscrew case cover mounting bolts.

Take off case cover.



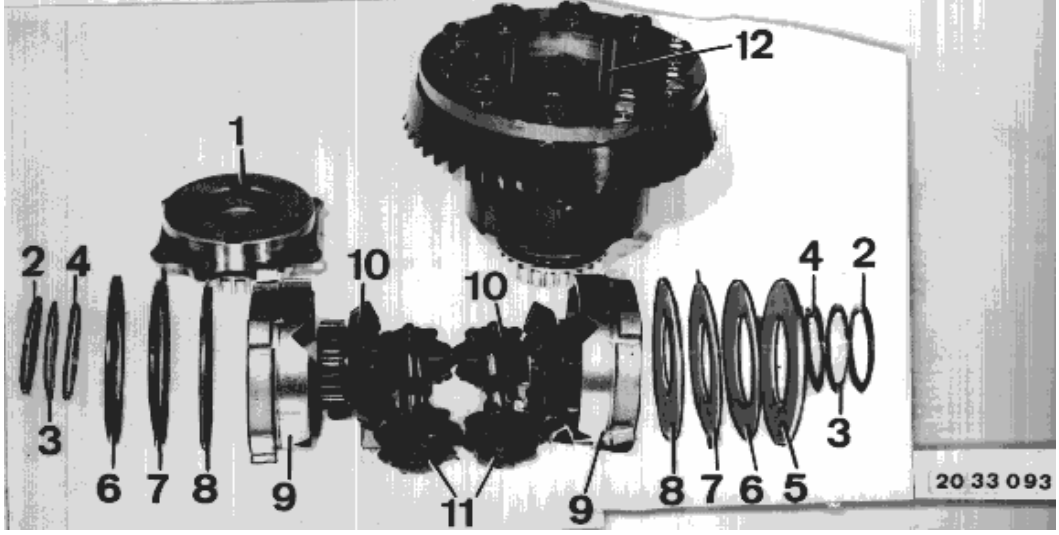
Carefully allow components to slide out of housing.

Installation:

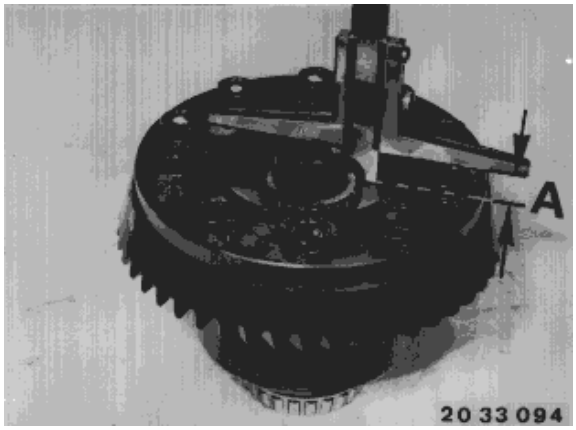
Check all parts for wear, e.g. molybdenum coating, gear and spline teeth.

Installation:

Lubricating all parts before assembly with approved grade of final drive oil.



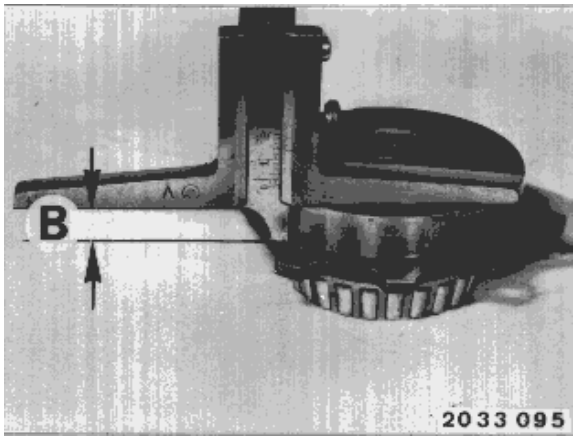
1	Housing cover	7	Outer disc
2	Thrust washer	8	Inner disc
3	Plate spring	9	Compression ring
4	Lug disc	10	Differential side gear
5	Spacer	11	Differential gears with differential shafts
6	Plate spring	12	Differential housing



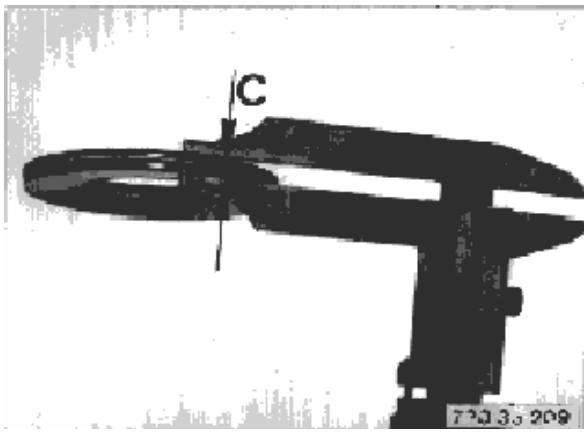
Install following parts in correct installed order to measure the preload:

Spacer disc (5), outer discs (7), inner discs (8), compression rings (9), rear axle shaft gears (10) and differential bevel gears and differential shafts (11).

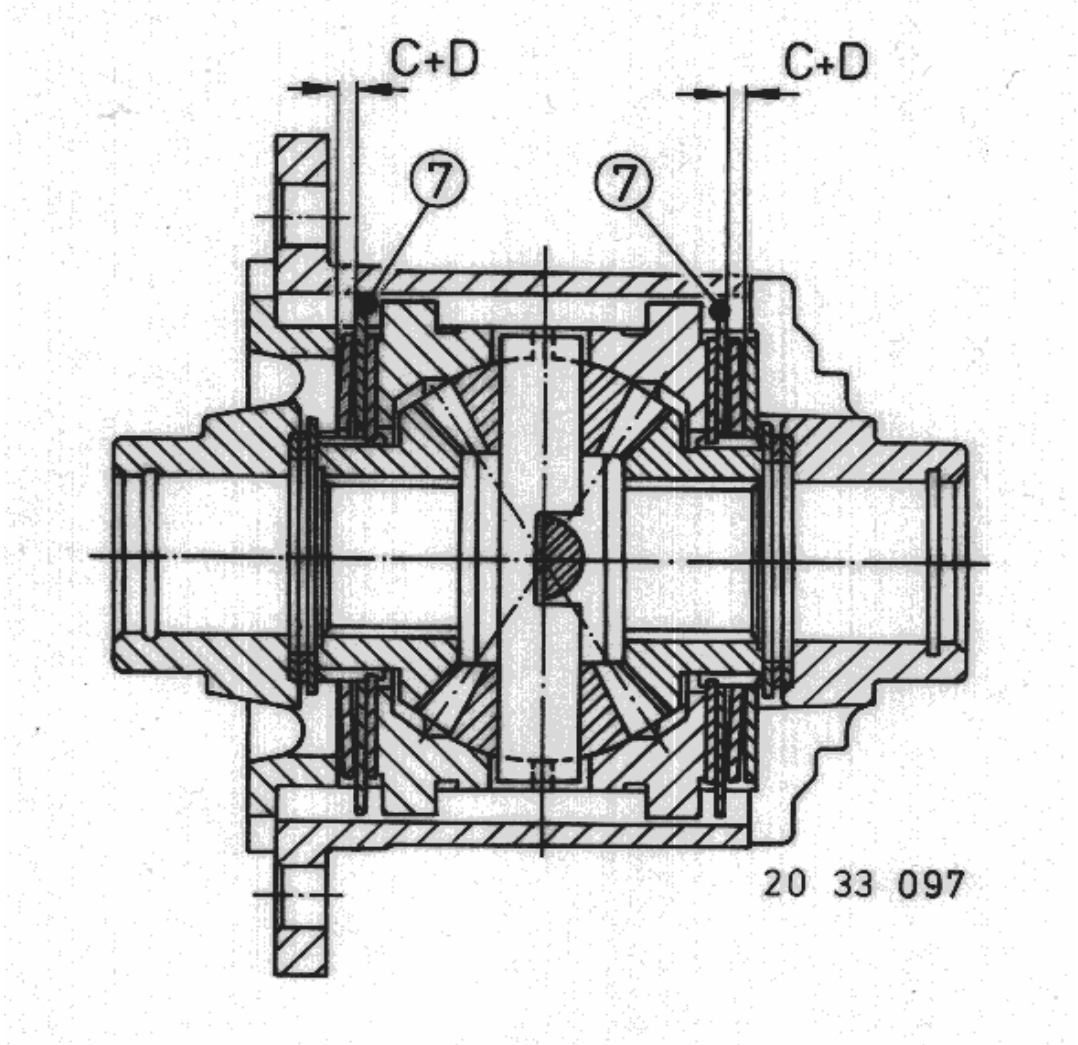
Measure dimension A from edge of housing to outer disc, e.g. A = 19.5 mm.



Measure dimension B on cover, e.g. B = 14.4 mm.



Place both diaphragm spring curved surfaces together.
Measure dimension C on the plate springs, e.g. C = 4.8 mm.

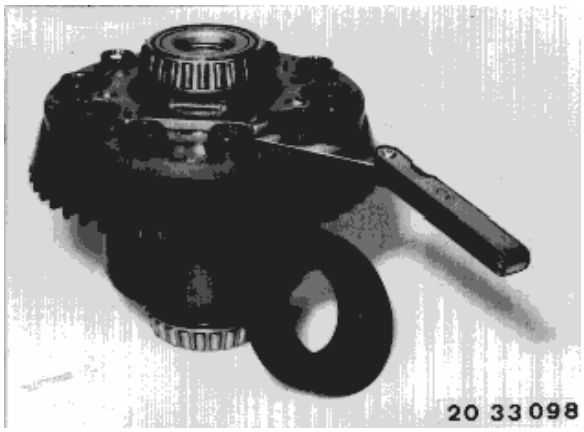


To ensure that the plate springs are not block-preloaded, installation clearance of 0.1 ... 0.4 mm is required.

B (cover)	14.4 mm
C (plate spring)	4.8 mm

A (housing)	19.2 mm
Total of B + C	19.2 mm
Installation clearance D	0.3 mm

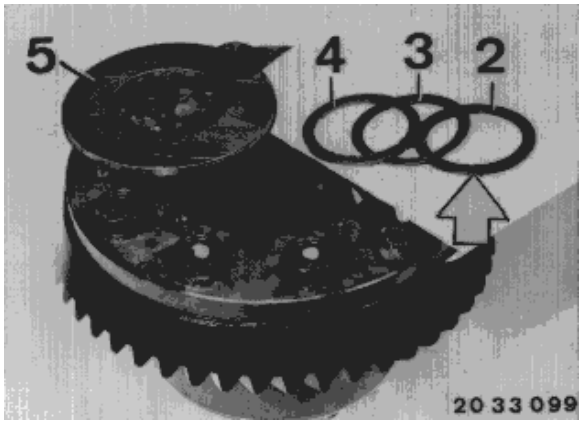
Correct any deviation in installed clearance D by installing outer plates of correct thickness.



Remove all parts from the housing and install with additional parts: thrust washers (2), plate springs (3) and lug discs (4). Mount case cover (12) and press on firmly, but do not bolt.

The preload on the small plate spring (3) should create an even gap all round (check with feeler gauge).

If there is no gap between cover and housing, check plate springs (3), thrust washers (2) and lug discs (4).

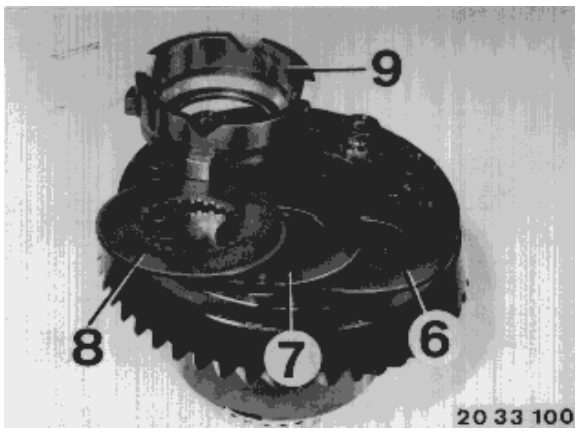


Installation:

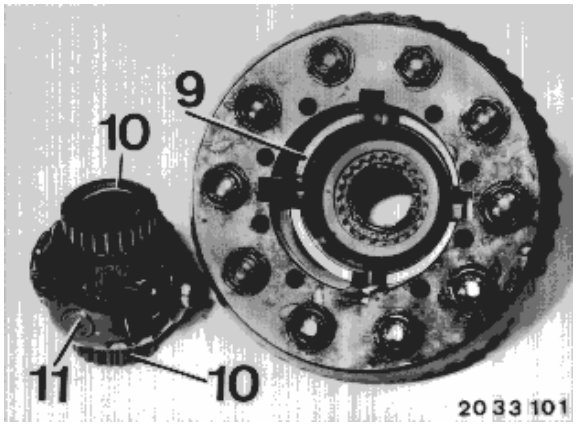
Thrust washer (2), with oil pockets facing the housing (downwards).

Diaphragm spring (3) with inside curved surface facing differential shaft (up).

The smooth side of the lug disc (4) faces the plate spring (downwards), the lug engages in the guide in the housing.

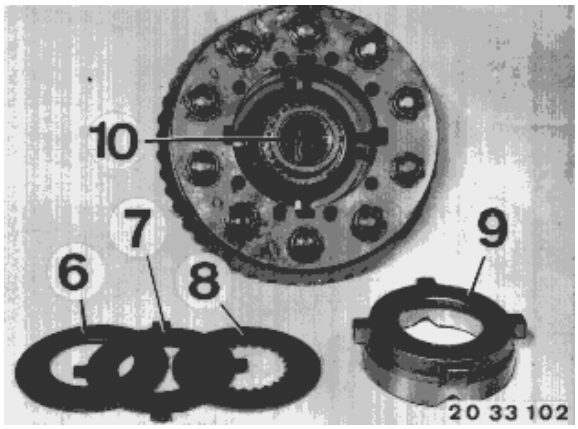


Install spacer disc (5), plate spring (6) with internal bulge facing differential shaft, outer disc (7) with the 4 lugs, then insert molybdenum-coated inner disc (8).



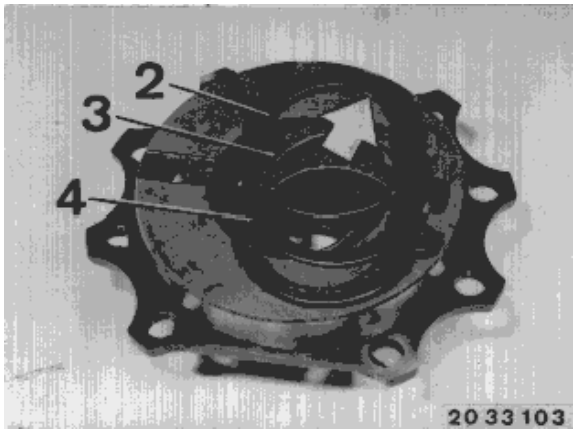
Install compression ring (9) and differential side gear (10) by twisting into the guide and/or spline of the inner disc.

Installing differential gears with shafts (11), second differential side gear (10) and compression ring (9).

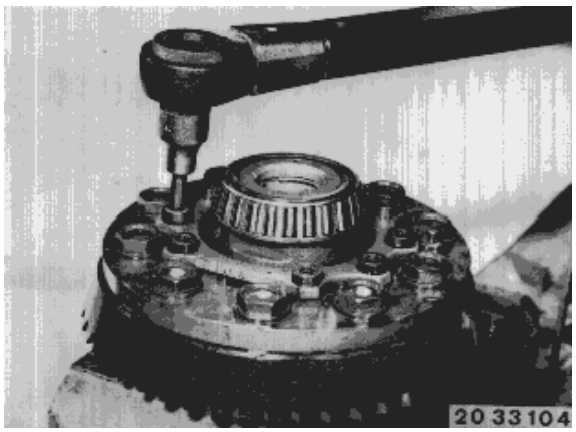


Installing molybdenum-coated inner disc (8) and outer disc (7).

Insert diaphragm spring (6) with inside curved surface facing differential shaft (down).



Install thrust washer (2) with oil packet facing cover, plate spring (3) with inner bulge facing outwards and lug disc (4) with smooth side facing plate spring and lug in groover of housing cover with grease in housing cover.

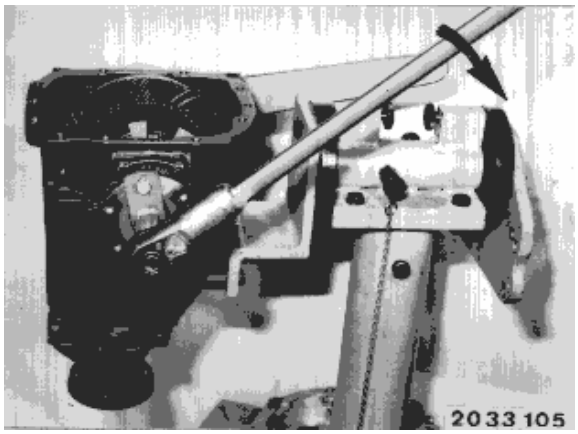


Fit housing cover with washers (do not allow lug disc to slide out of groove).

Install screws with Loctite No. 270 and tighten down cover evenly.

Installation:

For tightening torque, refer to Technical Data



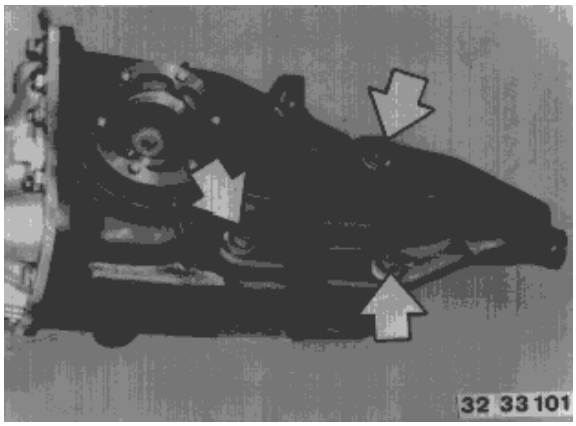
Check slip torque, refer to Technical Data

of limited slip differential at (a) stationary and (b) driven differential side gear.

Make up tool locally for this purpose by, for example, welding a nut on a drive flange which is no longer required.

Note:

Replacement/repair



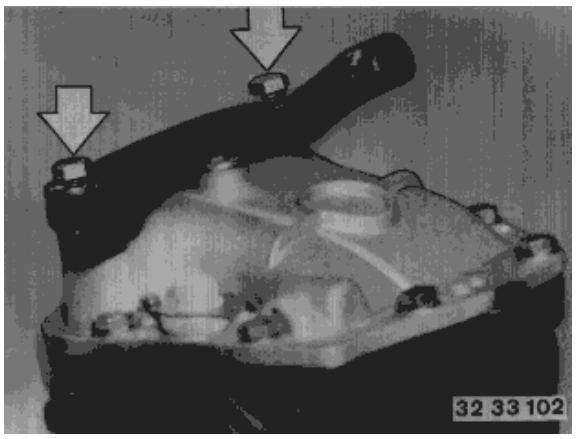
Unscrew front transmission suspension carrier plate.

Installation:

Mount carrier plate again after repairing.

Tightening Torque,

refer to Technical Data 33 17 5AZ.



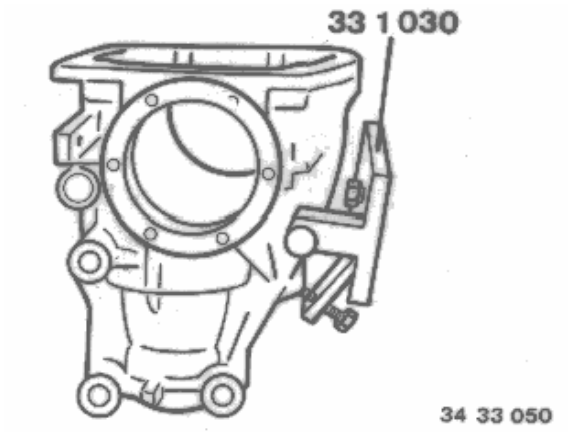
Bracket for rear transmission suspension is mounted in the transmission cover with both long bolts.

Installation:

Secure bracket to cover.

Tightening Torque,

refer to Technical Data 33 17 5AZ.



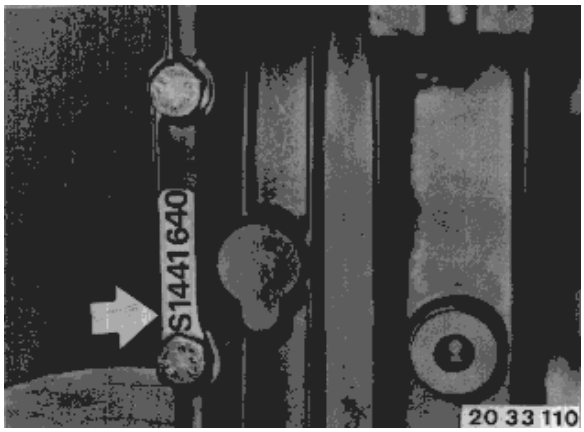
Locate final drive in assembly frame with special tool 33 1 010/030 (locating bracket).

Model series	Engine/displacement	Final drive	Remark
E36	M41, M42, M43, M44, M50 B20, M52 B20, CNG (gas)	168N	
E36/7	M43 B18/B19, M44 B19, M52 B20	168N	From 1.04.98 these cars with sports suspension are equipped with the 188N final drive with Torsen differential lock
E36	M50 B25, M51, M52 B23/B28	188N	
	S50	210	with differential lock
E36/7	M52 B25/B28, M54	188N	
E36/7	S54	188	with differential lock
E38	M52, M51, M62 B35	188K	
	M62 B40, M57, M67, M73	220K	
E39	M52, M57 B25, M62 B35	188K	
	S62	215	with differential lock
	M57 B30, M62 B40	220K	
E46	M43, M52 B20, M54 B22 A	168K	
	M52 B23/B28, M54 B22/B30, M47, M57 B25	188K	
	S54	210	with variable M differential lock
	M57 B30	215K	
E46/16	M54, M57	188K	
E52	S62	220K	
E53	M54, M57, M62	188K	

N => normal drive

K => compact drive

The limited-slip differential is designated on the housing or on the type plate with an "S".



A limited-slip differential has the following advantages:

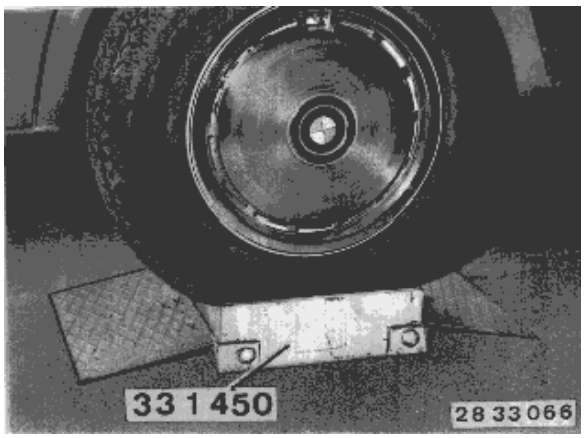
a) Wheel slip when leaving the ground while driving over uneven ground is prevented.

b) With varying levels of traction / grip, wheel slip is prevented when setting off.

c) When cornering at high speed, the nearside wheel does not spin.

d) The wheels do not spin on wet surfaces and at high roadspeeds.

e) The risk of slipping at high speed on variable road surfaces is reduced substantially.



Function check while installed:

a) Flat workshop floor.

b) Drive left wheel of vehicle onto special tool 33 1 450.

c) Fully release handbrake.

d) Engage 1st gear and run engine up to speed.

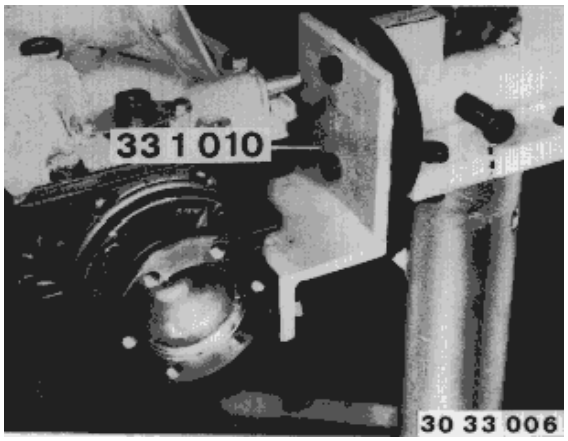
e) The limited-slip differential is functioning correctly if the vehicle can be driven off the special tool 33 1 450.

Caution!

Slowly drive out of the fixture.

33 12 526 Replacing bearing for drive pinion (Type K) - final drive removed -

Remove final drive,
refer to 33 10 010.

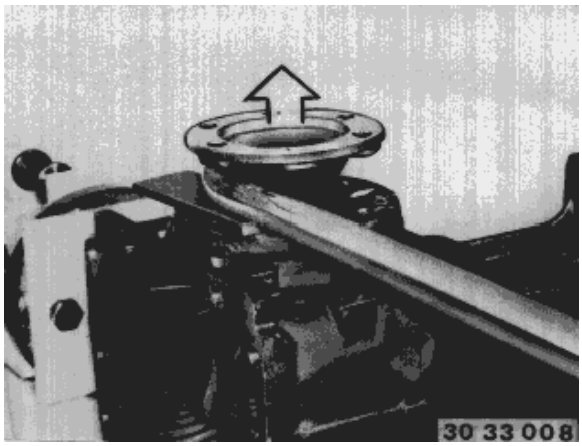


Secure final drive to special tool 33 1 010.
Drain off fluid.
Take off case cover.

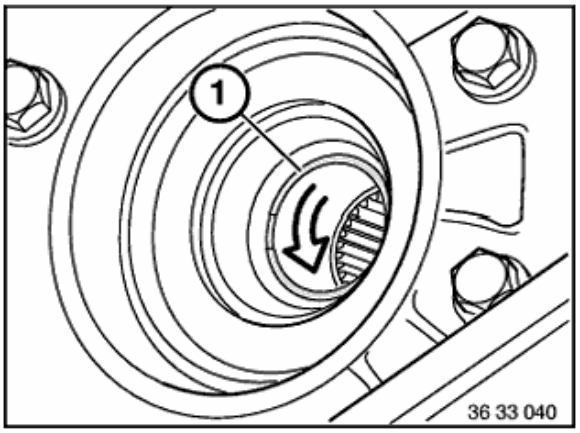
Installation:

Replace seal. Tightening Torque,
refer to Technical Data 33 11 1AZ.

Topping up oil. Oil fill quantity,
refer to Technical Data.
Oil grades,
refer to BMW Service Operating Fluids.



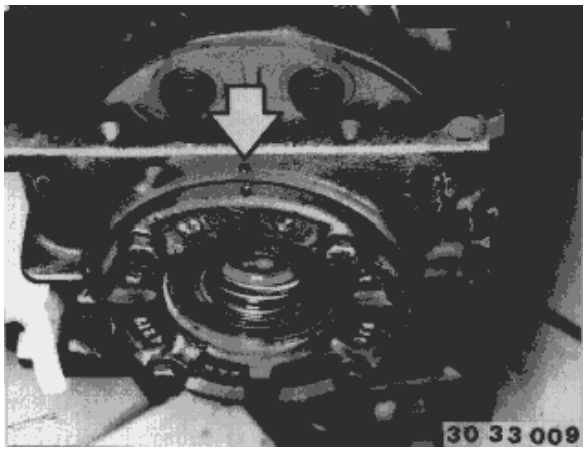
Press off drive flange with pry bar.



Installation:

Before fitting the drive flange, the round wire circlip (1) must be placed in the groove of the differential housing in such a way that both ends of the round wire circlip are recessed.

This prevents lateral bending of the ring.
Press in drive flange by hand and turn slightly until wire snap ring is heard to engage.
Replace stretched snap rings.



Punch mark both bearing caps.

Unfasten screws on both bearing covers and remove bearing covers (turn if necessary, because the sealing ring grips firmly - suction).

Caution!

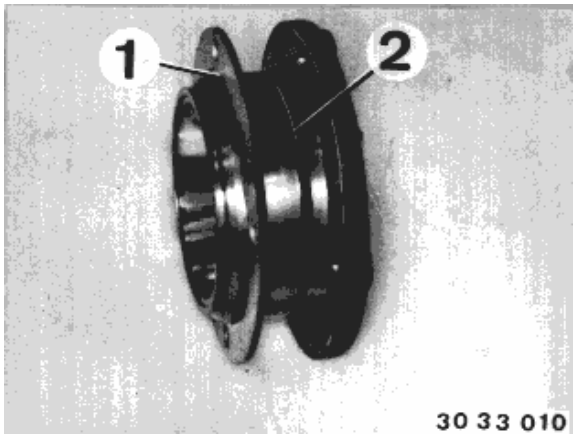
Do not mix up bearing caps and spacers.

Secure spacers on bearing cap with a piece of wire, if necessary.

Installation:

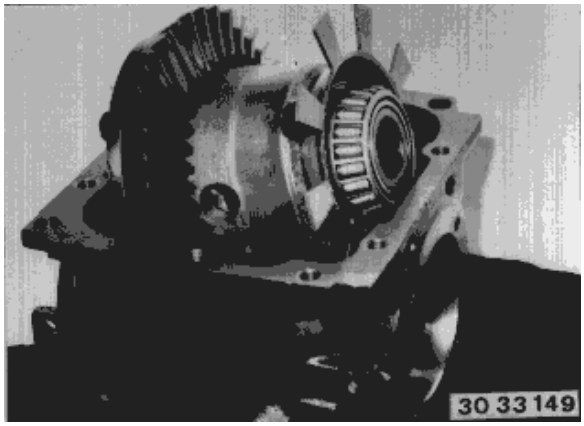
Tightening Torque,

refer to Technical Data 33 11 2AZ.



With shims (1), the axial preload of the differential bearing (4000 N) and the torsional face runout of the crown and bevel gear is set.

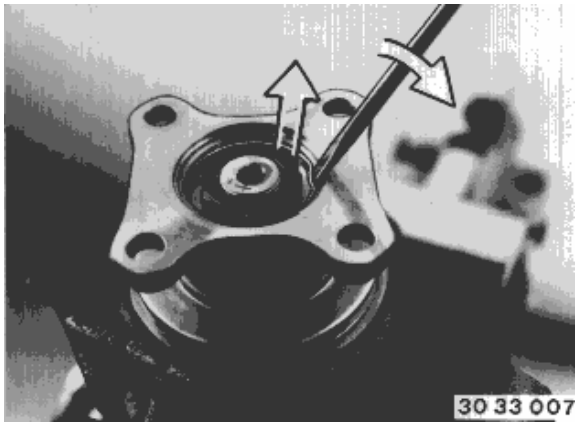
(2) = O-ring



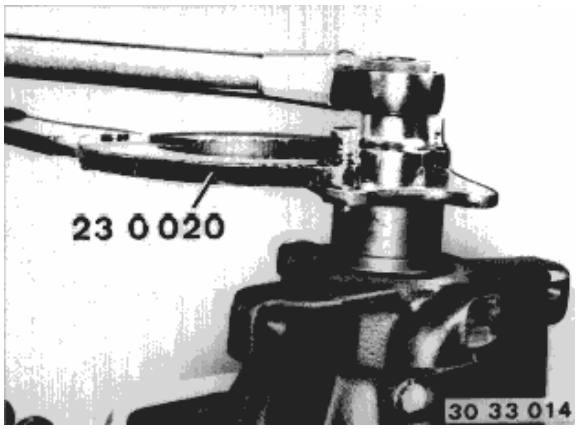
Remove complete differential case.

Caution!

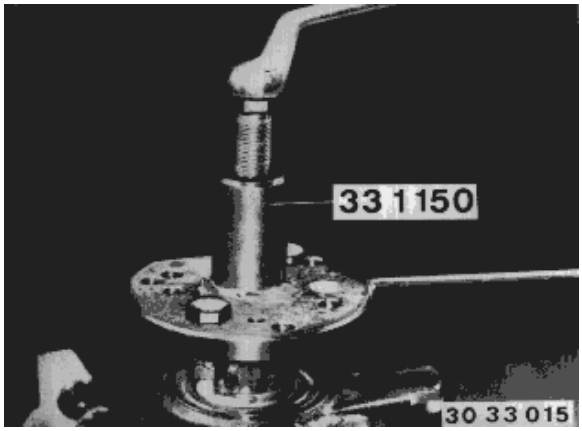
Do not bend the pulse generator wheel.



Remove lockplate.



Brace input flange with special tool 23 0 020 and unfasten collar nut.

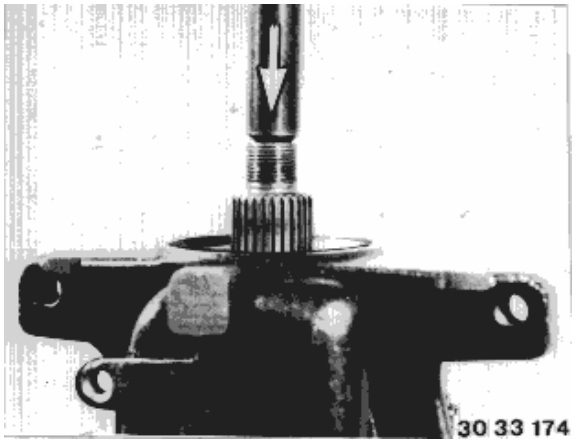


Remove input flange with special tool 33 1 150.

The specified friction torque level is indicated for the new bearing,

refer to Technical Data.

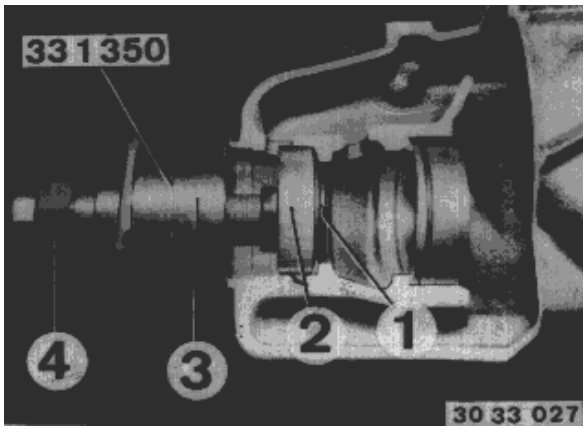
The friction torque of the old bearings no longer needs to be measured.



Press out drive pinion.

Caution!

Be careful not to damage threads.



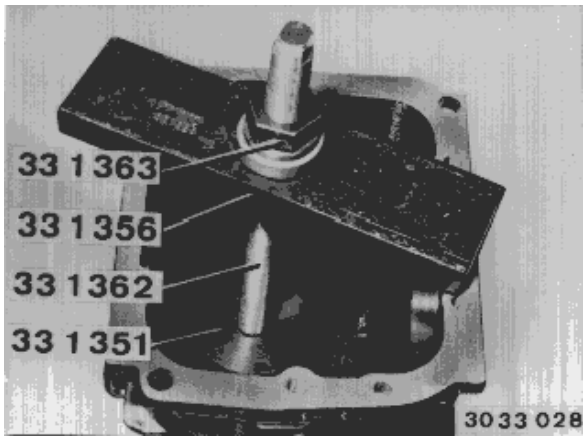
Extract front outer bearing race with special tool 33 1 350.

(1) = Spreader

(2) = Outer bearing race front

(3) = Puller bell housing

(4) = Pressure bolt



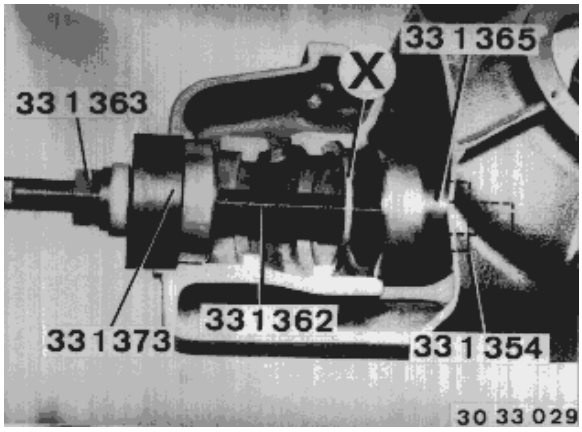
Remove rear outer bearing race with special tool 33 1 351 / 356 / 362 / 363.

Caution!

The shim (X) is located below the rear outer bearing race.

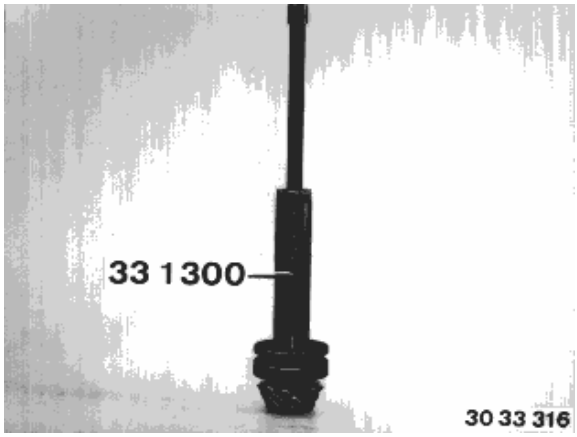
This is needed again to adjust the block dimension.

Measure and note down thickness of shim (X) e.g. X = 4.10 mm.

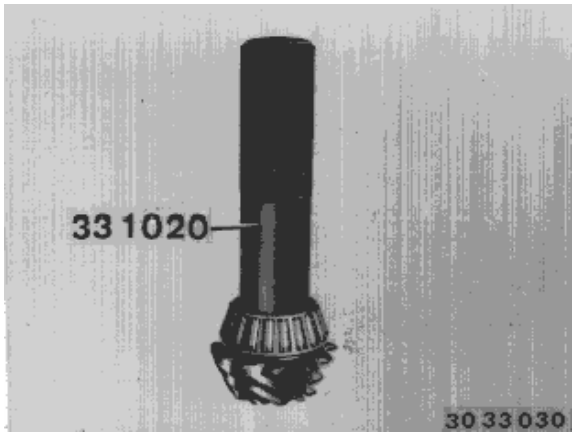


Install old shim (X) in front of rear outer bearing race.

Draw in new outer bearing races with special tool 33 1 373 / 365 / 362 / 363 / 354.



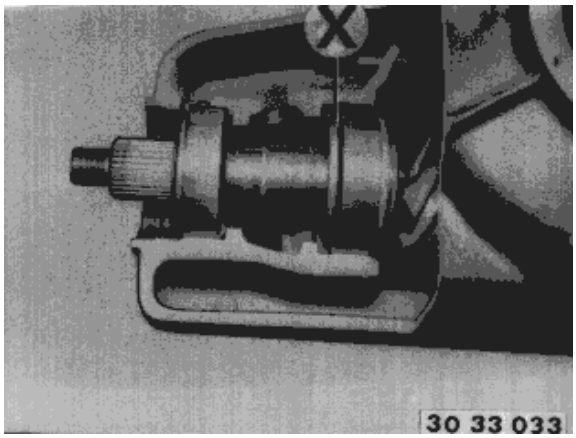
Pull bevel gear roller bearings off drive pinion with special tool 33 1 300.



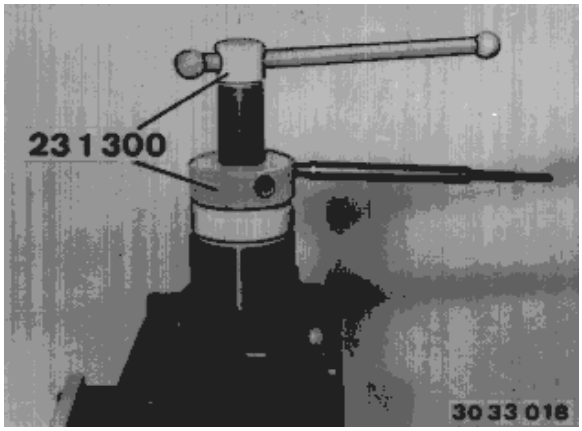
Press new taper roller bearing onto drive pinion using special tool 33 1 020.

Caution!

Always only use same make bearings for both.

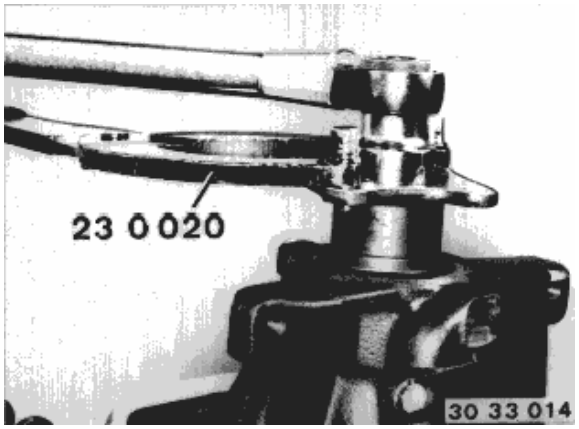


To determine the correct shim (X), the drive pinion is installed with new taper roller bearings and no clamping bush.



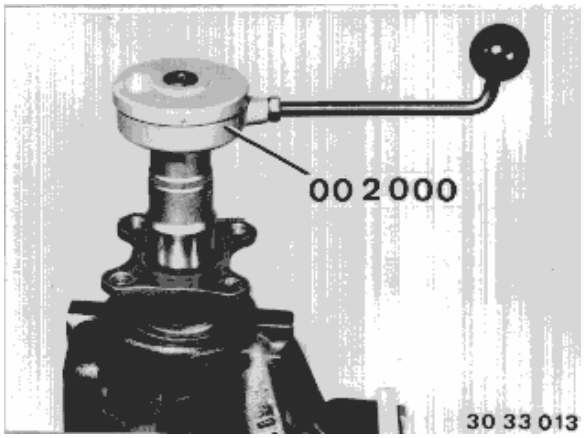
Install drive pinion in the rear bearing outer race.

Draw front taper roller bearing onto drive pinion with special tool 23 1 300 in conjunction with a spacer bush.



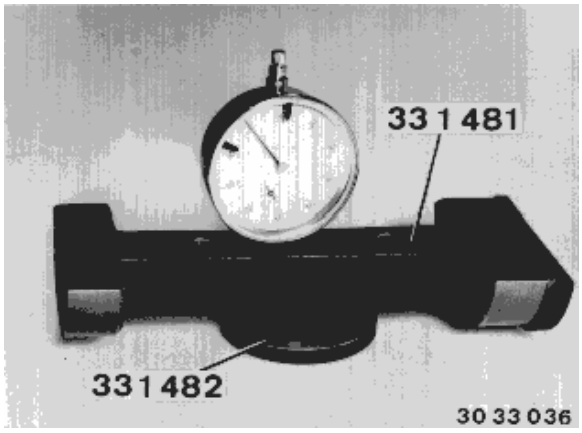
Mount input flange.

By carefully tightening down the collar nut, adjust friction torque of input taper roller bearing to 250 Ncm.



Caution!

When tightening down, keep checking friction torque with special tool 00 2 000 at regular intervals.



Secure dial gauge in special tool 33 1 481.

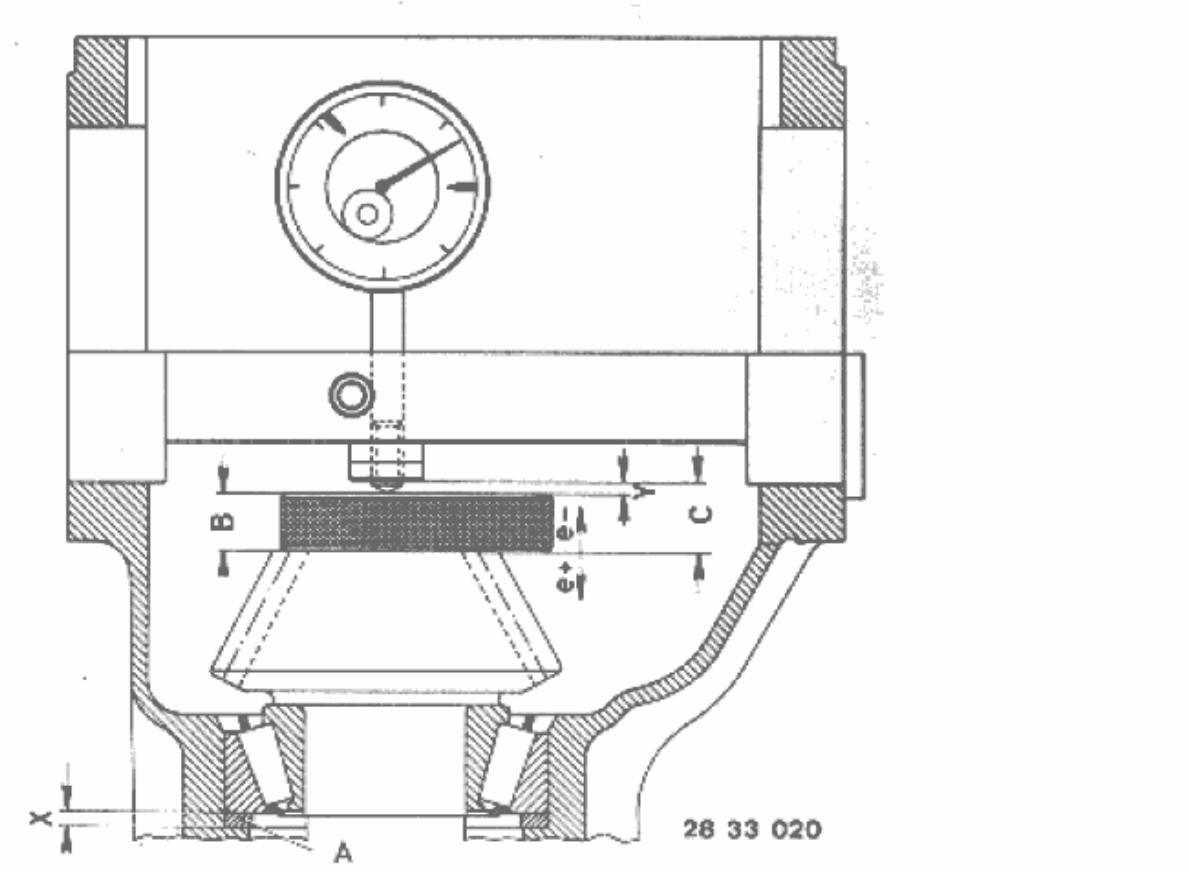
Fit special tool 33 1 481 with dial gauge on special tool 33 1 482 and set dial gauge preload to zero.

Fitting special tool 33 1 482 to drive pinion.

Install special tool 33 1 481 in housing.

Read value (Y) and note down e.g. Y = 1.92 mm.

Example:



C = 9.02 mm (basic adjustment dimension for all Type K final drives)

B = 7.00 mm (special tool 33 1 482)

- / +e = number from taper e.g. +e 10

Y = measured distance e.g. 1.92 mm

X = old shim e.g. 4.10 mm

A = Thickness of correct shim

Determination of correct shim:

C nominal = C + e = 9.02 mm + 0.10 mm = 9.12 mm

C actual = B + Y = 7.00 mm + 1.92 mm = 8.92 mm

D (difference) = C nominal - C actual = 9.02 mm - 8.92 mm = +0.20 mm

A = X - D = 4.10 mm - (+0.20 mm) = 3.90 mm

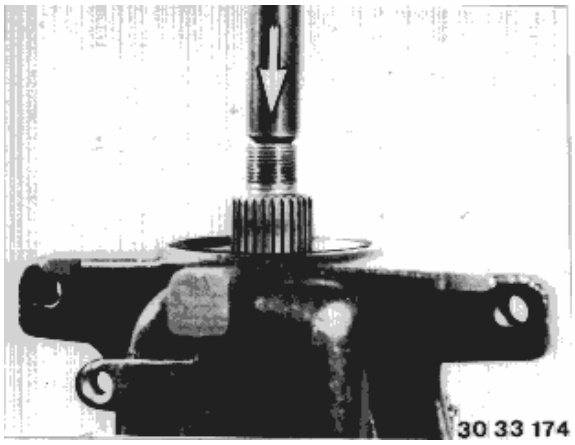
The correct thickness for the shim is 3.90 mm.

Caution!

If the difference (D) is positive, the old shim was this much too thick.

If the difference (D) is negative, the old shim was this much too thin.

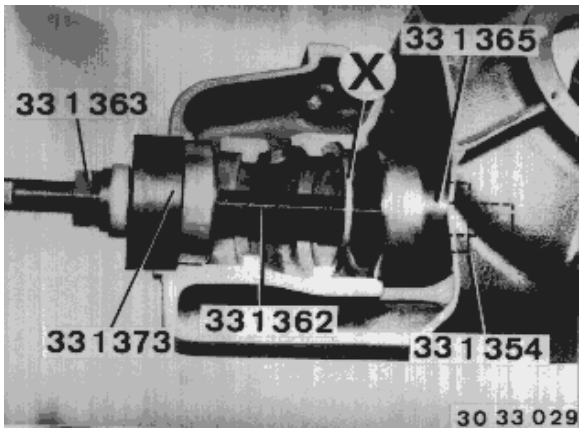
The permitted tolerance for the shim (A) is derived from the available shim gauges which range from 0.01 ... 0.03 mm.



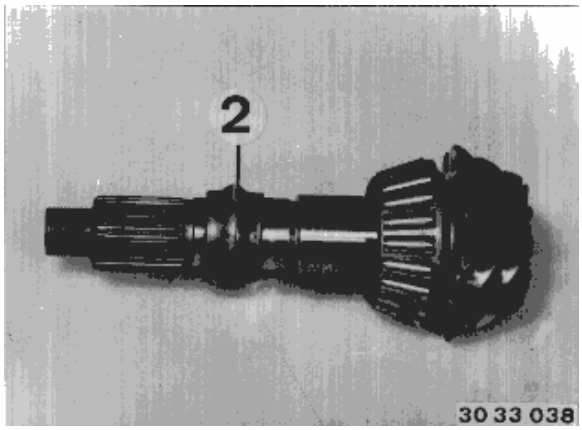
After determining the shim thickness (x), remove drive pinion.

Caution!

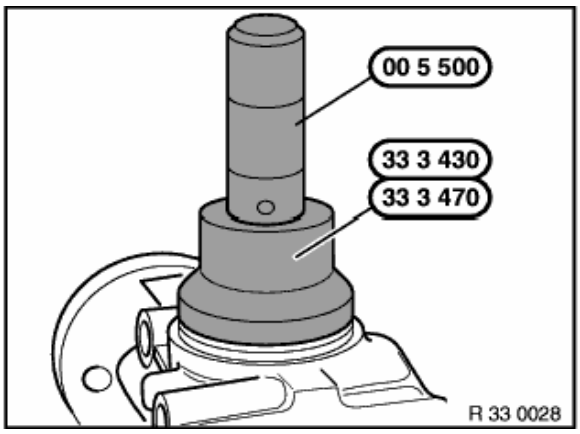
Note make of bearings - this is required to determine the friction torque.



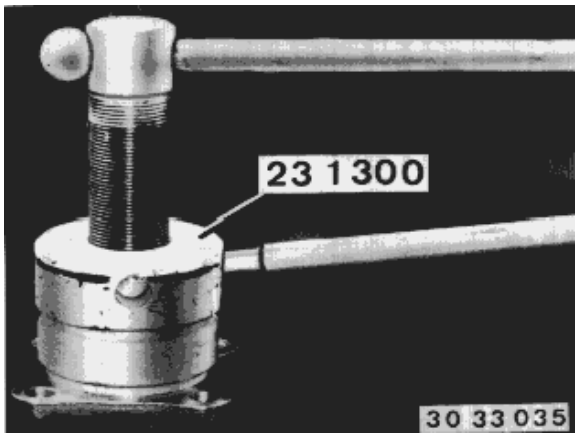
Remove rear outer bearing race and install with a shim (x) of the appropriate thickness.



Install drive pinion with a new clamping sleeve (2).

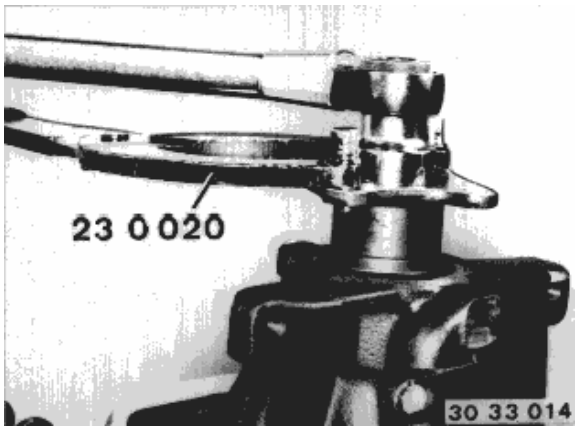


Immerse shaft seal in final drive oil and drive in flush with special tool 33 1 430 in conjunction with special tool 00 5 500.

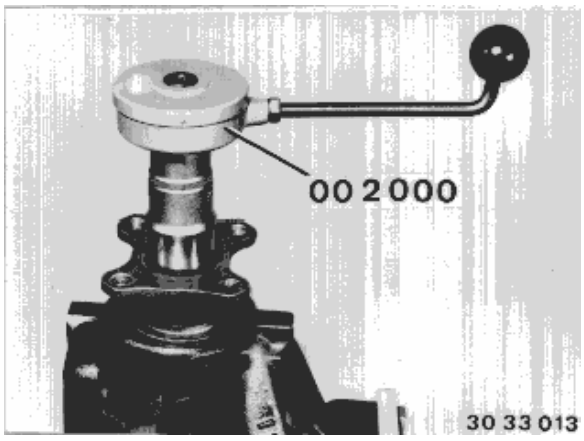


Press-fit input flange to the input shaft using special tool 23 1 300 but do not tighten down.

The axial preload force of drive pinion bearings (5000 N) can be determined with help of the friction torque.



Gradually tighten down input flange with collar nut, measuring friction torque at regular intervals.



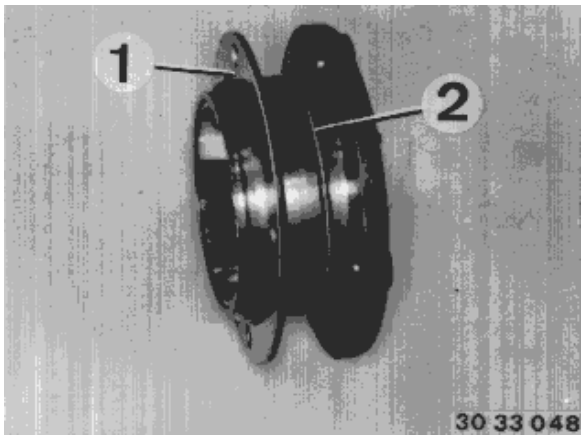
Measure friction torque with special tool 00 2 000 and suitable socket adapter.

refer to Technical Data.

Caution!

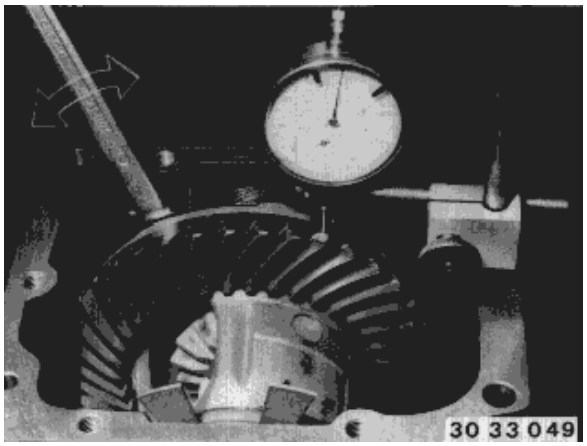
The relation between friction torque and preload force differs depending on the make of bearings.

Refer to pinion bearing table for specified friction torque, refer to Technical Data, and add 20 Ncm for the new shaft seal.



Install final drive, install side cover after marking with the appropriate washers (1) and install new 0-rings (2). Tighten screws down evenly. Tightening Torque,

refer to Technical Data 33 11 2AZ.



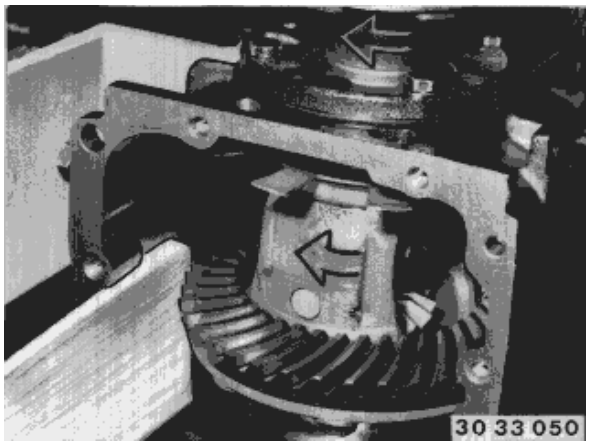
Backlash/Tooth Contact Pattern Adjustment

Secure special tool 00 2 500 (dial gauge holder) and measure torsional face runout,

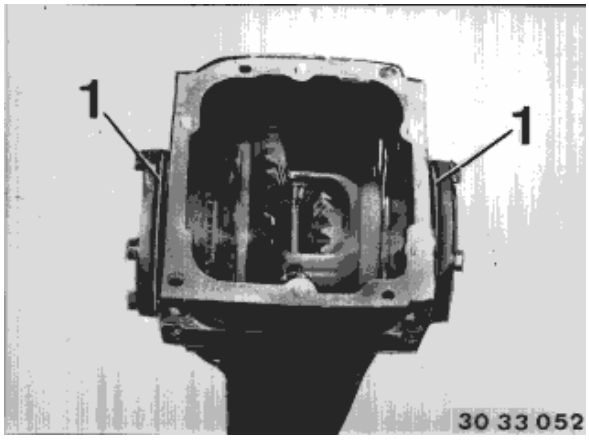
refer to Technical Data.

Caution!

The tooth contact pattern is always most important for a perfectly adjusted pinion/crown wheel.



To check the tooth contact pattern, coat the crown wheel teeth with printer's ink, turn in both directions several times and stop crown wheel suddenly with a piece of hard wood.



Correction to torsional face runout and contact pattern is performed by altering the thicknesses of both shims (1).

If backlash is too great, install a thinner shim on the crown wheel end.

If backlash is too small, use a thicker shim on the crown wheel end.

Axial displacement of the crown wheel of 0.01 mm signifies a change in tooth flank clearance of 0.0076 mm.

Caution!

The total of both shim thicknesses must not be altered.

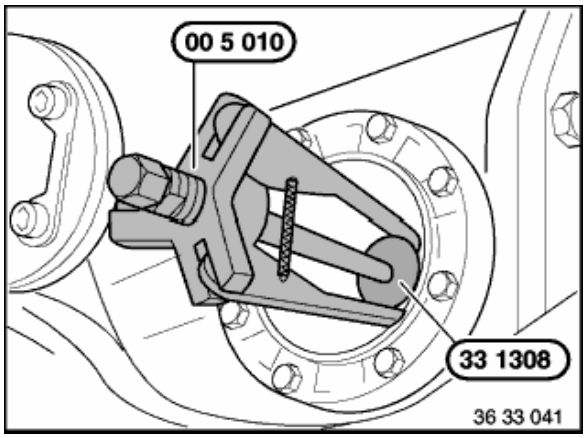
If a thicker or thinner shim to those fitted is required to adjust the contact pattern, the overall thickness must be re-established with a second shim. Failure to do this would alter the friction torque of the bearing.

Determining friction torque of differential bearings, refer to Replacing differential bearings,

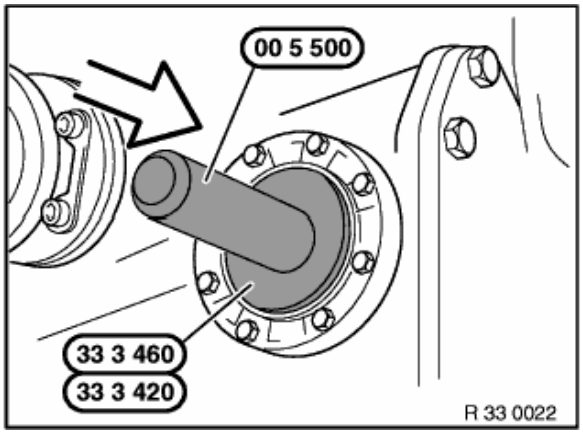
refer to 33 11 731.

Tooth contact pattern adjustment,

refer to 33 12 ... Basic rules for tooth contact pattern adjustment.



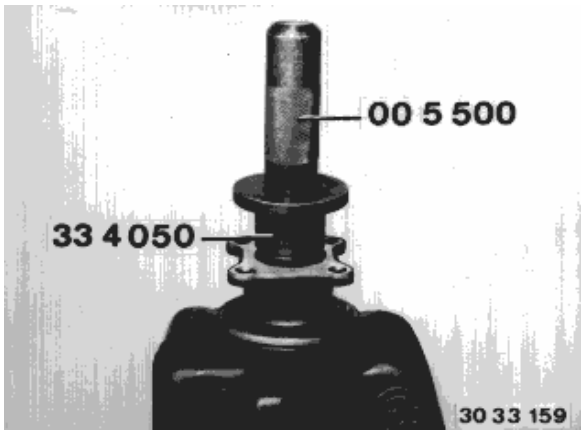
Extract old shaft seal with special tool 00 5 010 in conjunction with pressure piece.



Dip new shaft seals in final drive gear lube.

Drive in shaft seals with special tool 33 3 460 (impact bush) in conjunction with special tool 00 5 500 up to stop.

Replace drive flange if the bearing surface is seriously scored.



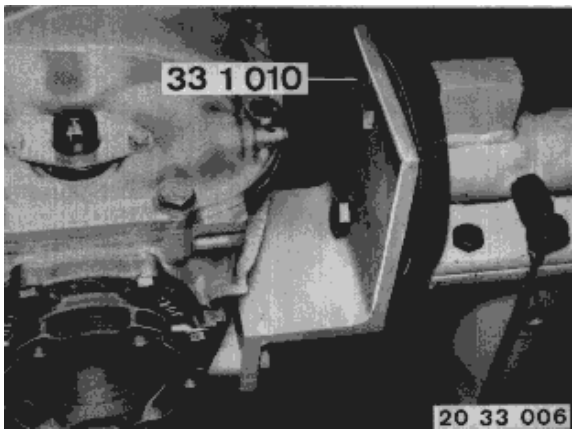
Installation:

Drive in new retaining plate with special tool 33 4 050 and special tool 00 5 500 (handle).

33 12 526 Replacing bearing for input bevel gear (Type M) - final drive removed -

Removing final drive, included in MF (microfiche) Repair Instructions, model-dependent, from '85,

refer to 33 10 010.



Secure final drive to special tool 33 1 010.

Drain off fluid. Take off case cover.

Installation:

Replace seal.

Tightening Torque,

refer to Technical Data 33 11 1AZ.

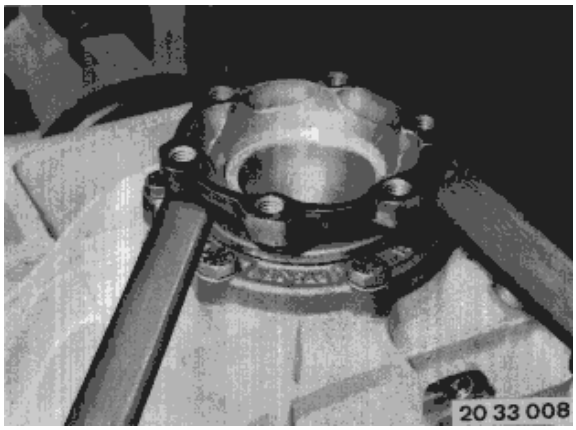
Topping up oil,

Oil quantity,

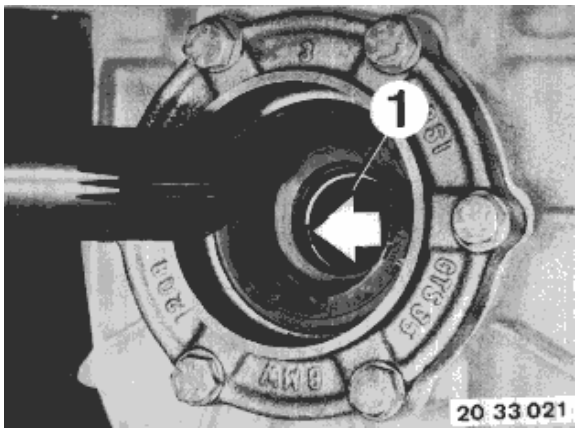
refer to Technical Data.

Oil grades,

refer to Operating Fluids specifications.



Press off drive flange with pry bar.



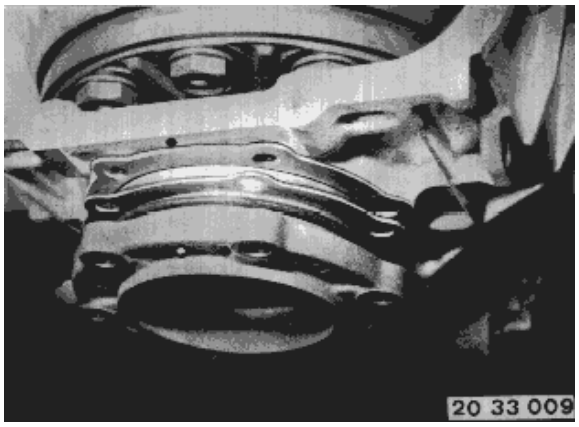
Installation:

Before fitting the drive flange, the round wire circlip (1) must be placed in the groove of the differential housing in such a way that both ends of the round wire circlip are recessed.

This prevents lateral bending of the ring.

Press in drive flange by hand and turn slightly until wire snap ring is heard to engage.

Replace stretched snap rings.



Punch mark both bearing caps.

Unfasten screws on both bearing covers and remove bearing covers (turn if necessary, because the sealing ring grips firmly - suction).

Caution!

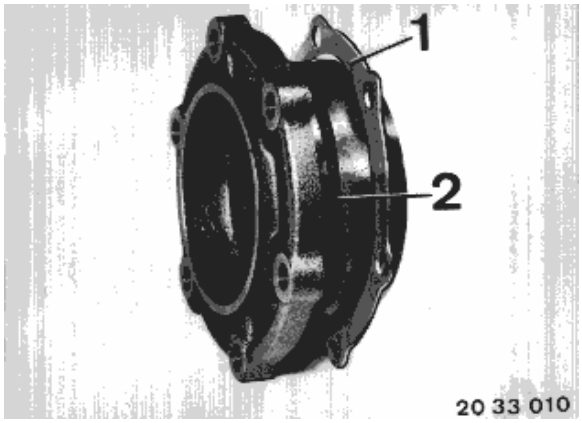
Do not mix up bearing caps and spacers.

Secure spacers on bearing cap with a piece of wire, if necessary.

Installation:

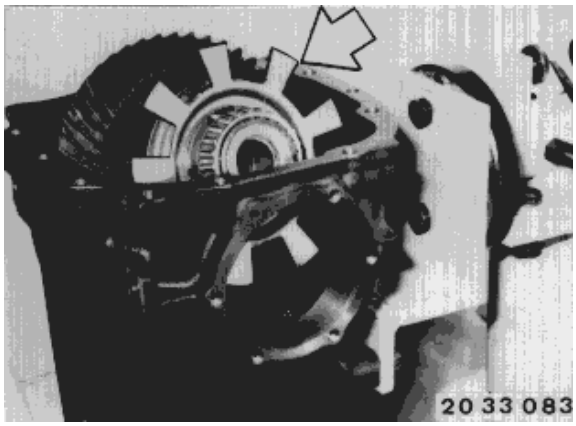
Tightening Torque,

refer to Technical Data 33 11 2AZ.



Shims (1) are used to adjust axial preload force of final drive mounting (4000 N) and torsional face runout of crown wheel and bevel gear.

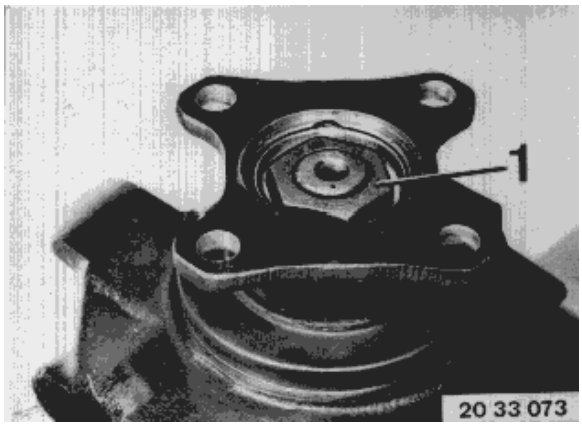
(2) O-ring



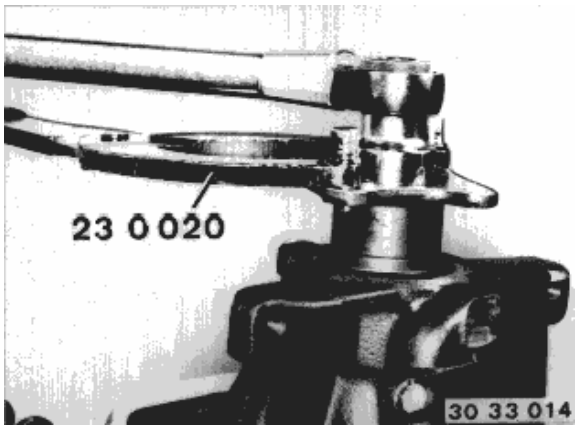
Remove complete differential case.

Caution!

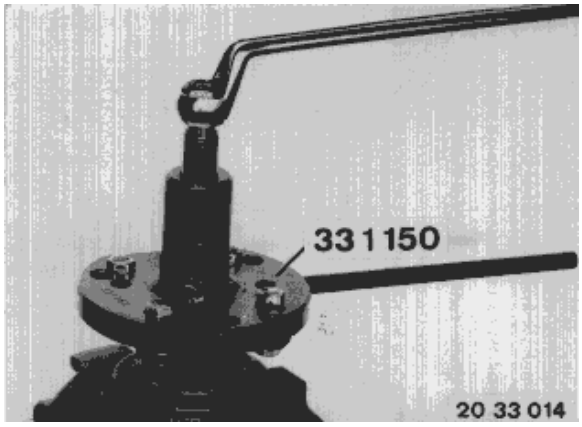
Do not bend the pulse generator wheel.



Lift out lockplate (1).



Brace input flange with special tool 23 0 020 and unfasten collar nut.

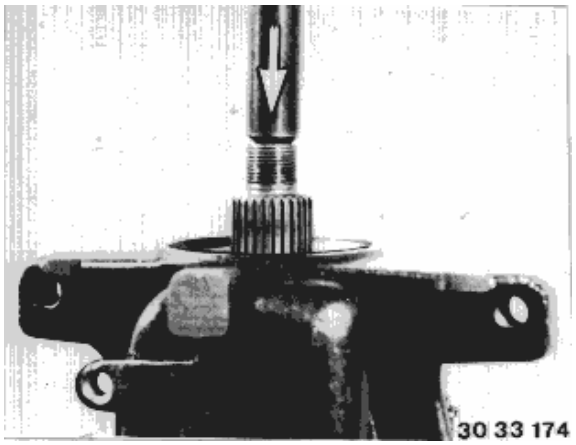


Remove input flange with special tool 33 1 150.

The specified friction torque level is indicated for the new bearings,

refer to Technical Data.

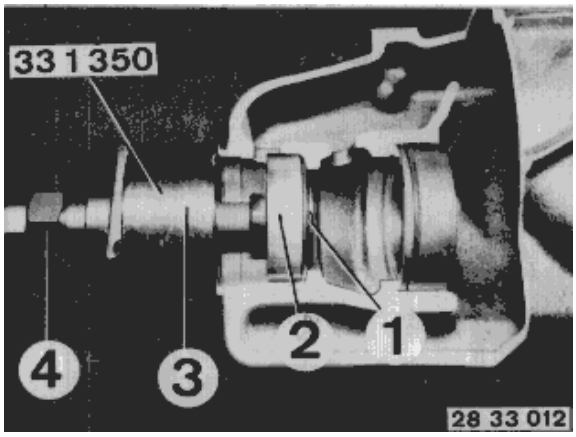
The friction torque of the old bearings no longer needs to be measured.



Press out drive pinion.

Caution!

Be careful not to damage threads.



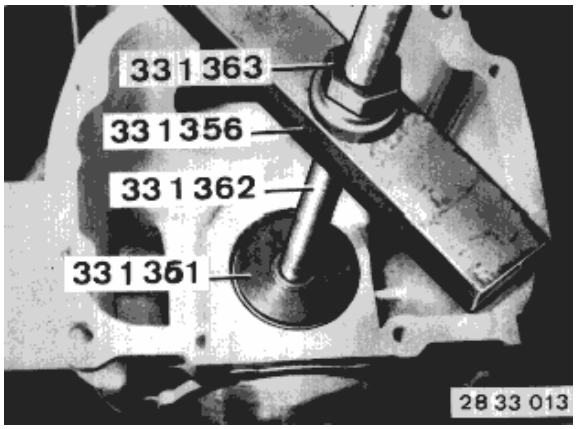
Extract front outer bearing race with special tool 33 1 350.

(1) Spreader

(2) Front bearing outer race

(3) Puller bell housing

(4) Pressure bolt

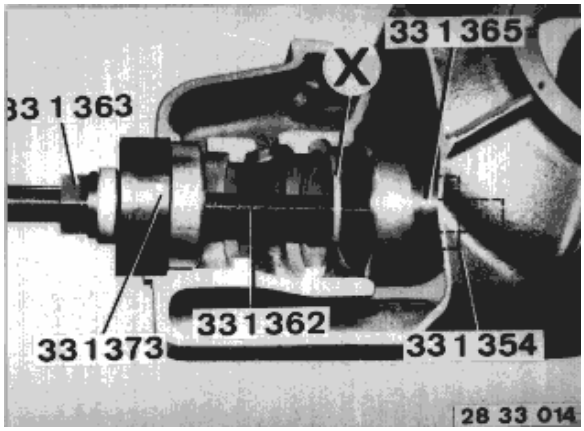


Remove rear outer bearing race with special tool 33 1 360 / 361 / 362 / 363 / 356.

Caution!

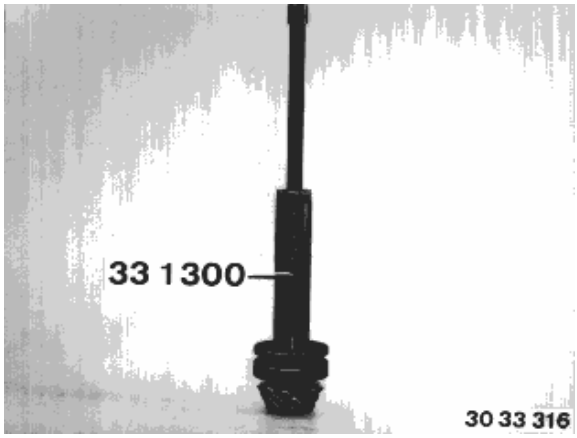
Shim (X) is located underneath the rear bearing outer race.

This is needed again to adjust the block dimension.



Install old shim (X) in front of the rear bearing outer race.

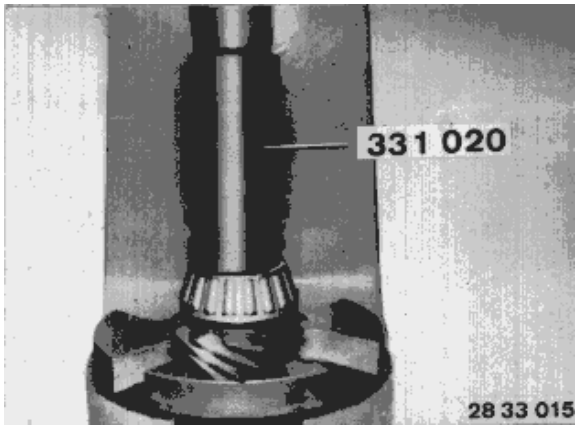
Draw in outer bearing races with special tool 33 1 360 / 362 / 363 / 365 / 354 / 373.



Pull bevel gear roller bearings off drive pinion with special tool 33 1 300.

Caution!

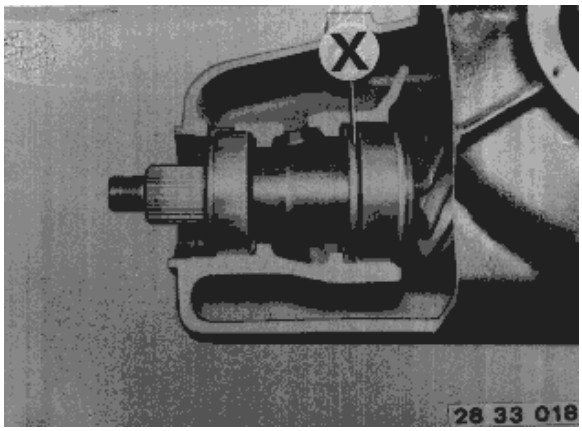
Do not damage taper: Insert aluminium jaws or wooden blocks.



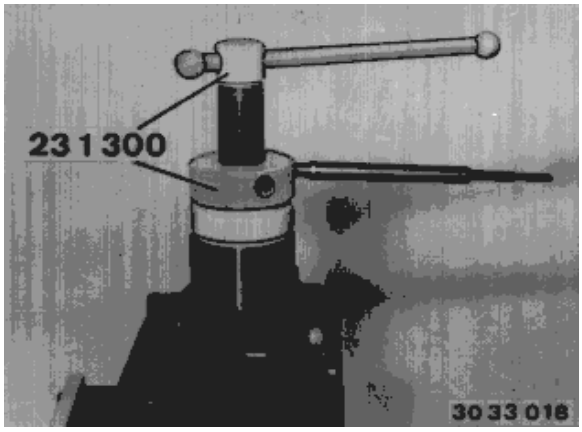
Press-fit new taper roller bearing to the drive pinion with special tool 33 1 020 (sleeve).

Caution!

Always only use same make bearings for both.

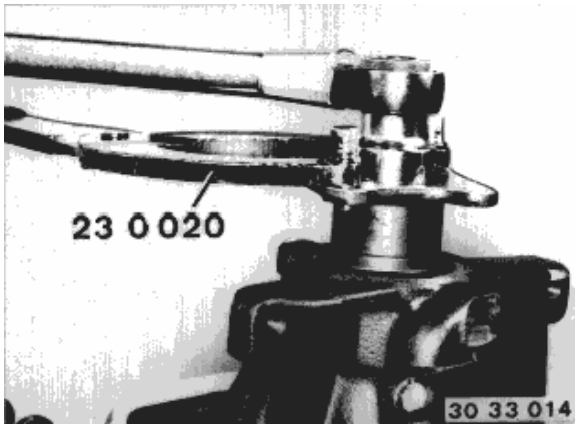


Install the drive pinion with new tapered roller bearings, but without a clamping sleeve, to determine the correct thickness of shim (X).



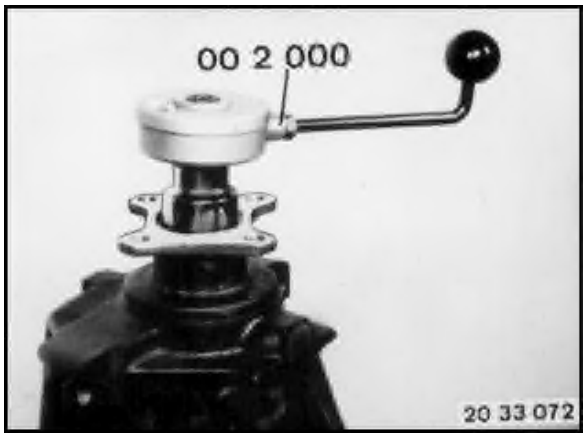
Install drive pinion in the rear bearing outer race.

Pull front taper roller bearing onto the drive pinion with special tool 23 1 300 in conjunction with a spacer bush.



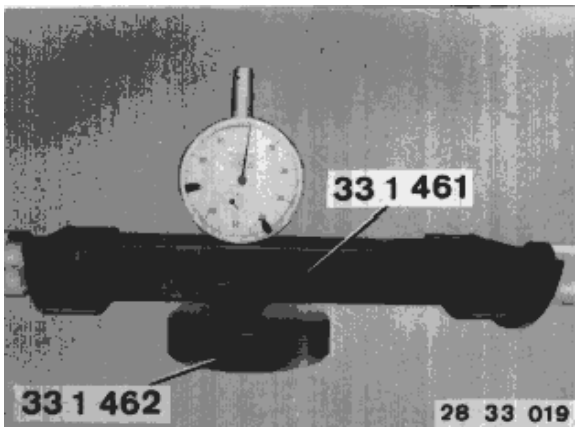
Mount input flange.

By carefully tightening down the collar nut, adjust friction torque of input taper roller bearing to 250 Ncm.



Caution!

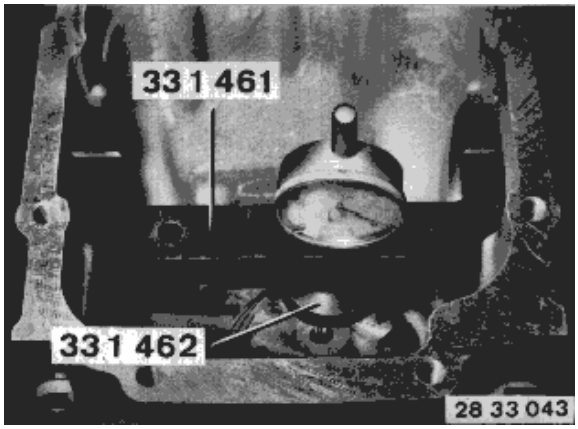
When tightening down, keep checking friction torque with special tool 00 2 000 at regular intervals.



Block Distance of Drive Pinion

Secure dial gauge in special tool 33 1 461.

Fit special tool 33 1 461 with dial gauge on special tool 33 1 462 and set dial gauge preload to zero.



Fit special tool 33 1 462 to drive pinion.

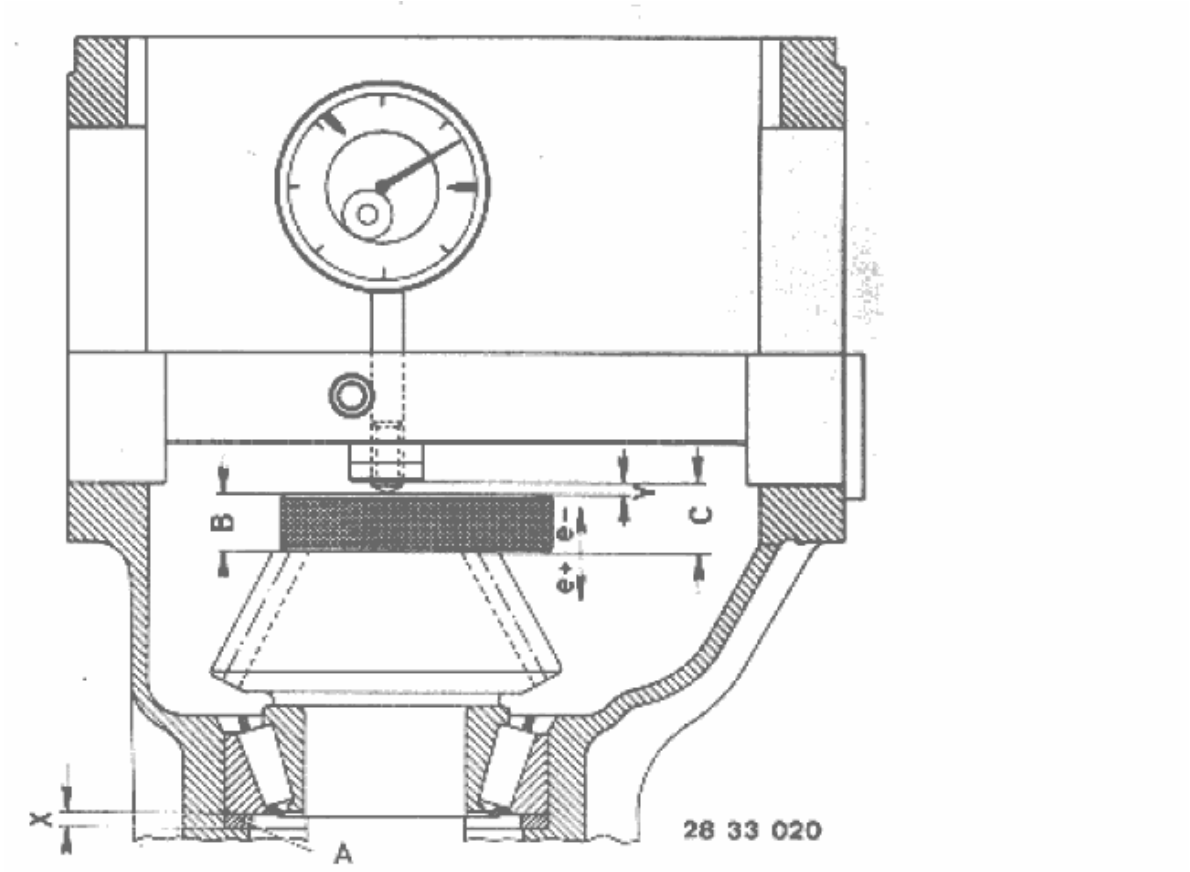
Install special tool 33 1 461 in housing.

Determine value Y:

Basic distance C = 11.50 mm

Gage thickness B = 9.50 mm

Examples for Determination of Correct Shim Thickness (X)



Example I:

C	11.50 mm
e +	0.10 mm
C nominal	11.60 mm

Y measured on dial gage	1.90 mm
+ gage thickness B	9.50 mm
C actual	11.40 mm

C nominal	11.60 mm
C actual	- 11.40 mm
a	0.20 mm
Master disc A	4.10 mm
- a	0.20 mm
Thickness of shim (X)	3.90 mm

If C nominal is greater than C actual, "a" is subtracted from

thickness of shim (X).

Example II:

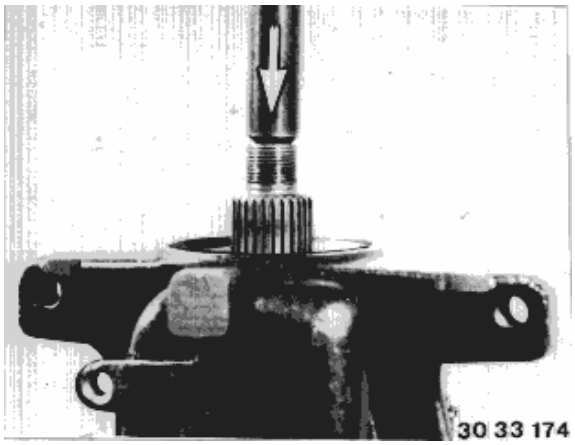
C	11.50 mm
e -	0.10 mm
C nominal	11.40 mm

Y measured on dial gage	2.20 mm
+ master disc thickness	9.50 mm
C actual	11.70 mm

C nominal	11.70 mm
C actual	- 11.50 mm
a	0.20 mm
Master disc A	3.90 mm
- a	0.20 mm
Thickness of shim (X)	4.10 mm

If C nominal is less than C actual, "a" on the shim ring (x) is added to the value.

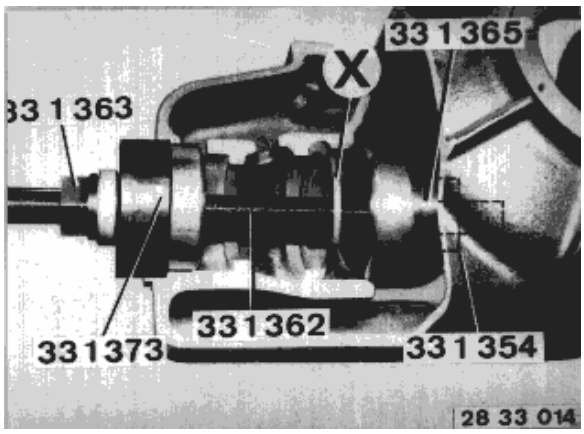
The permitted tolerance for dimension (x) is derived from the gage steps available for shim rings (0.01 ... 0.03 mm).



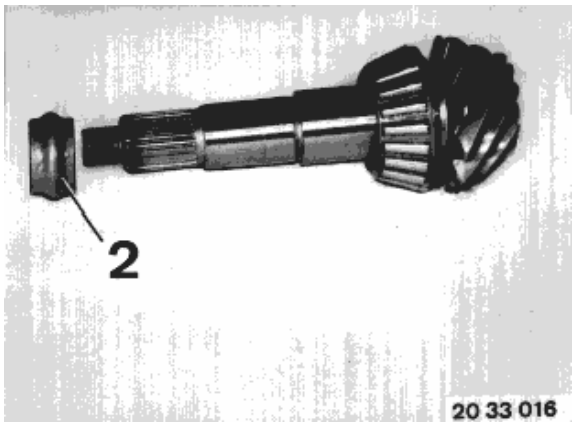
After determining the shim thickness (x), remove drive pinion.

Caution!

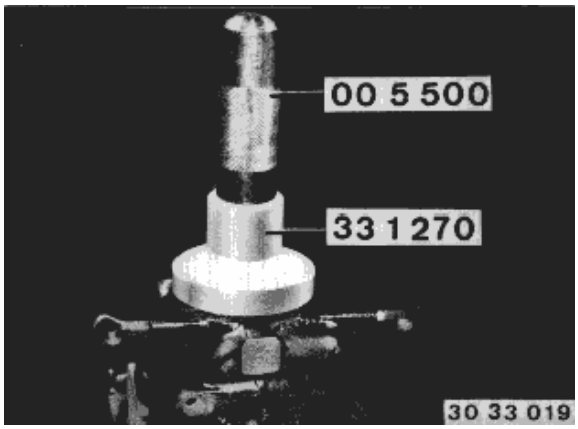
Note make of bearings - this is required to determine the friction torque.



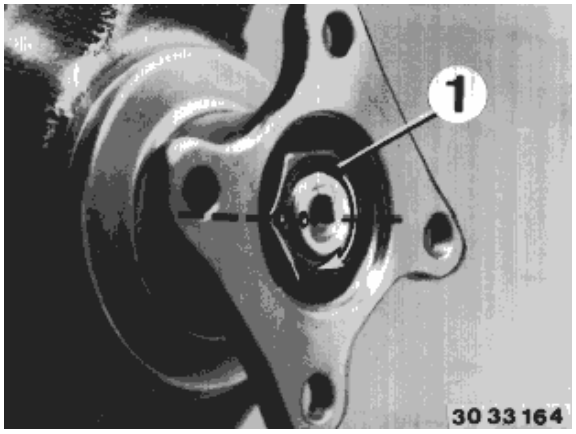
Remove rear outer bearing race and install with a shim (x) of the appropriate thickness.



Install drive pinion with a new clamping sleeve (2).

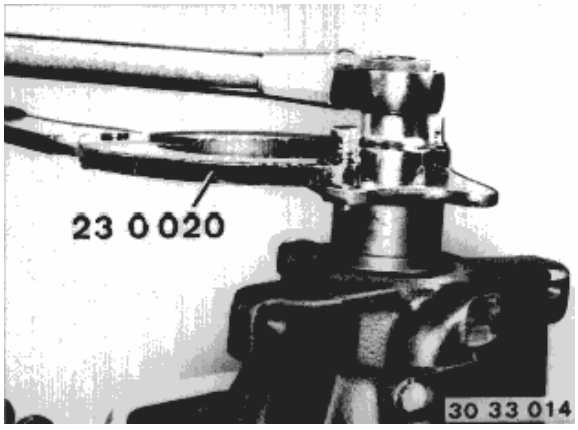


Immerse shaft seal in final drive oil and drive in flush with special tool 33 1 270 in conjunction with special tool 00 5 500.

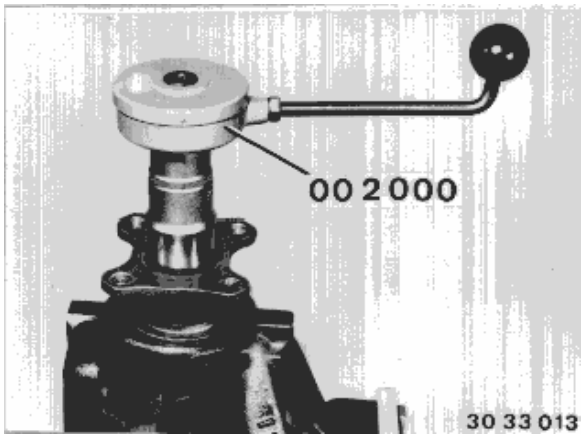


Press-fit input flange to the input shaft using special tool 23 1 300 but do not tighten down.

The axial preload force of drive pinion bearings (5000 N) can be determined with help of the friction torque.



Gradually tighten down input flange with collar nut, measuring friction torque at regular intervals.



Measure friction torque with special tool 00 2 000 and suitable socket adapter,

refer to Technical Data.

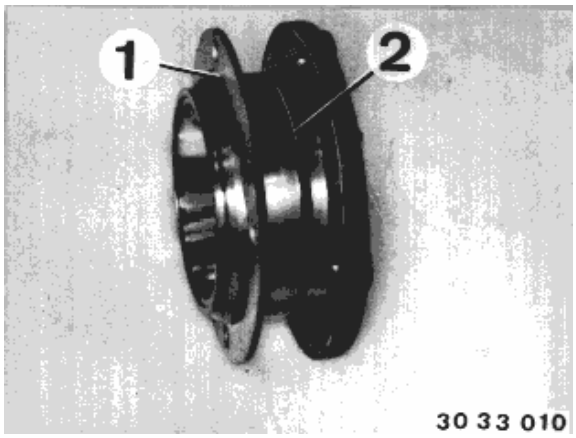
Caution!

The relation between friction torque and preload force differs depending on the make of bearings.

Refer to pinion bearing table for specified friction torque,

refer to Technical Data,

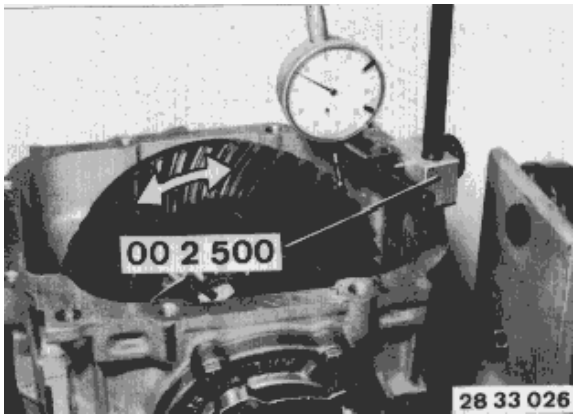
and add 20 Ncm for the new shaft seal.



Install final drive, install side cover after marking with the appropriate washers (1) and install new O-rings (2). Tighten screws down evenly.

Tightening Torque,

refer to Technical Data.



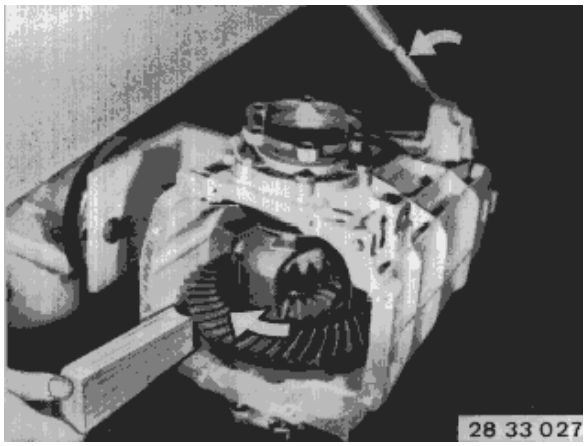
Backlash/tooth contact pattern adjustments

Secure special tool 00 2 500 (dial gauge holder) and measure torsional face runout,

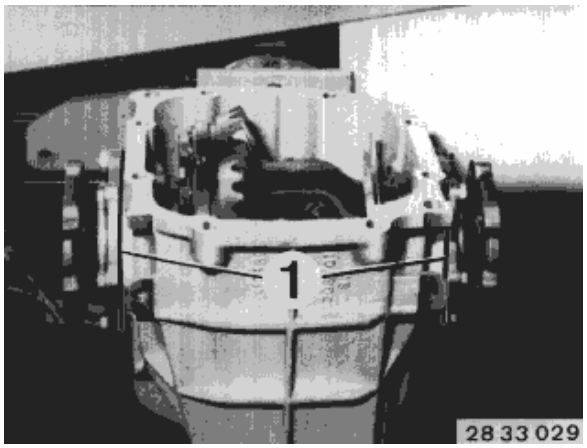
refer to Technical Data.

Caution!

The tooth contact pattern is always most important for a perfectly adjusted pinion/crown wheel.



To check the tooth contact pattern, coat the crown wheel teeth with printer's ink, turn in both directions several times and stop crown wheel suddenly with a piece of hard wood.



A correction to torsional face runout,

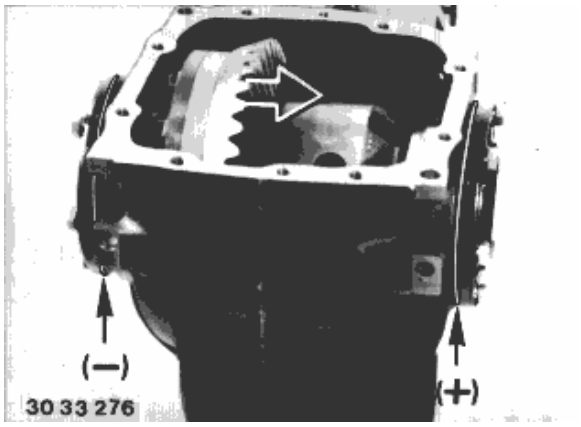
refer to Technical Data,

and contact pattern is performed by changing the thickness of both shims (1).

If backlash is too great, install a thinner shim on the crown wheel end.

If backlash is too small, use a thicker shim on the crown wheel end.

Axial displacement of the crown wheel of 0.01 mm signifies a change in tooth flank clearance of 0.0076 mm.



Caution!

The total of both shim thicknesses must not be altered.

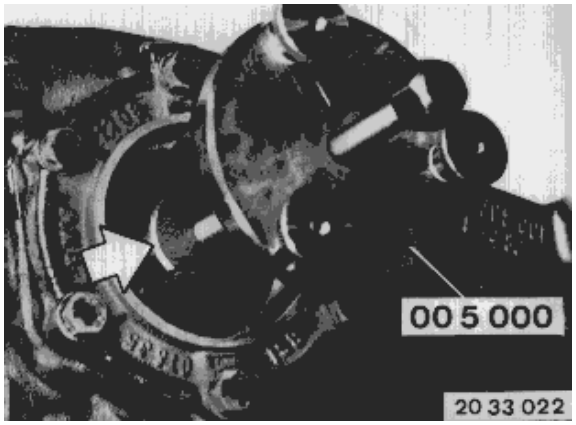
If a thicker or thinner shim is required on the one side to correct the tooth contact pattern, the other shim must also be changed again to have the original total thickness - if not, the friction torque of the bearings would be changed.

Determine friction torque differential bearings, described in Replace bearings for final drive housing,

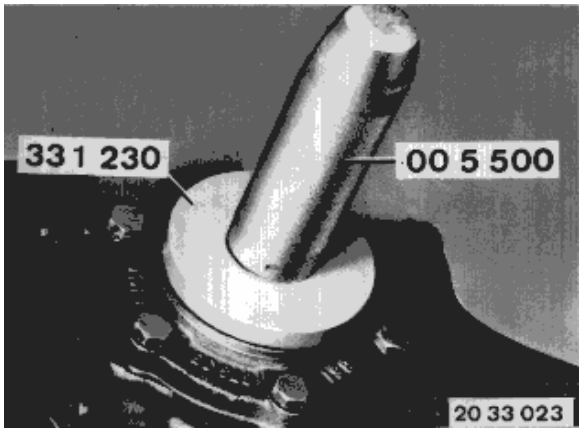
refer to 33 11 731.

Basic rules for contact pattern adjustment, as Replace drive pinion with crown wheel,

refer to 33 12 ...



Extract old shaft seals with special tool 00 5 000 in conjunction with pressure piece.



Installation:

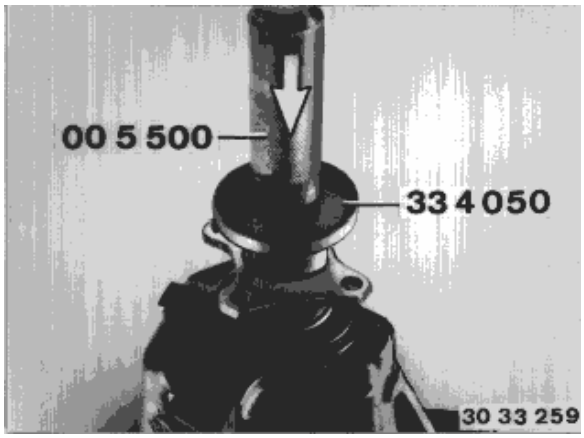
Dip new shaft seals in final drive gear lube.

Drive in shaft seals with special tool 33 1 230 in conjunction with special tool 00 5 500 up to stop.

Replace drive flange if the bearing surface is seriously scored.

Note:

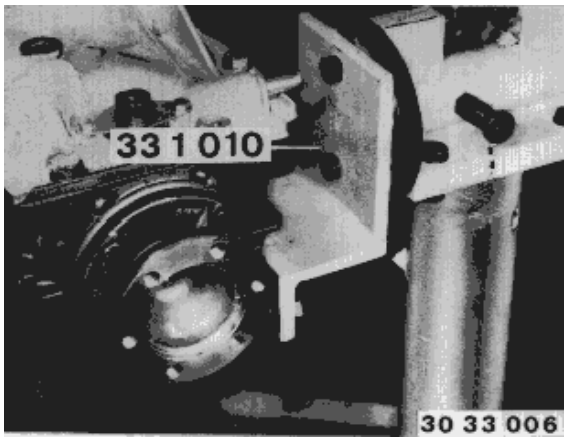
The special tool 33 1 230 may have to be remachined on account of the casting tolerances.



Drive in new retaining plate with special tool 33 4 050 and special tool 00 5 500.

33 11 731 Replacing both bearings in final drive case (Type K) - final drive removed -

Remove final drive,
refer to 33 10 010.

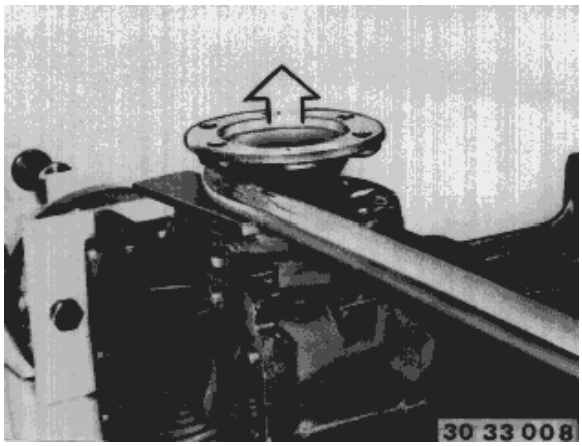


Secure final drive to special tool 33 1 010.
Drain off fluid.
Take off case cover.

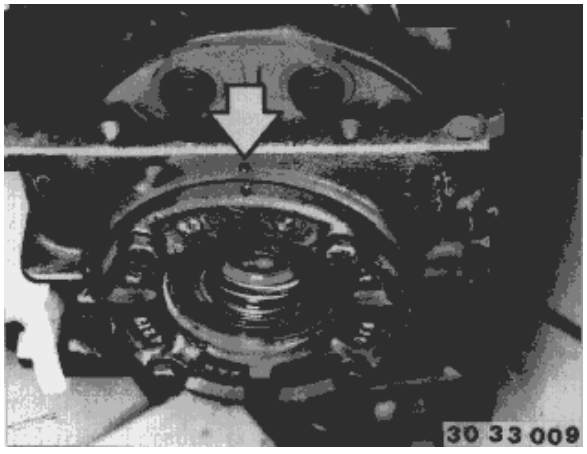
Installation:

Replace seal. Tightening Torque,
refer to Technical Data 33 11 1AZ.

Topping up oil. Oil quantity,
refer to Technical Data.
Oil grades,
refer to BMW Service Operating Fluids.



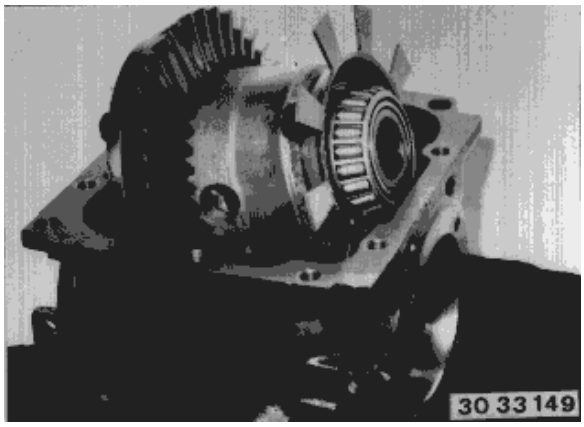
Press off drive flange with pry bar.



Mark bearing cap with punch marks and remove.

Caution!

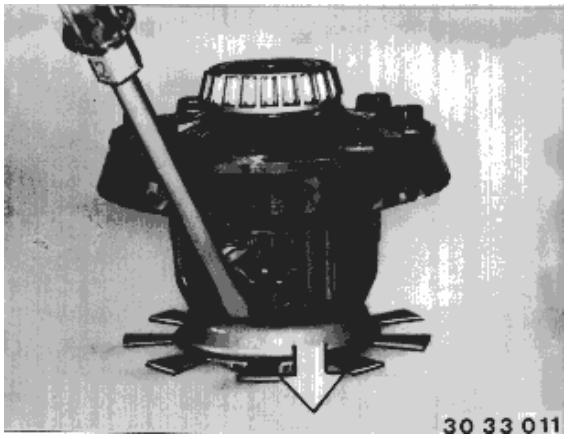
In order to make friction torque adjustments easier, ensure that the bearing caps and spacer discs are not mixed up.



Remove complete differential case.

Caution!

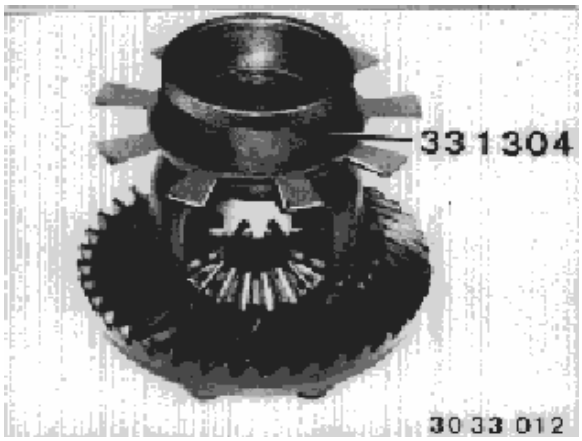
Do not bend the pulse generator wheel.



Press pulse generator wheel off of differential case.

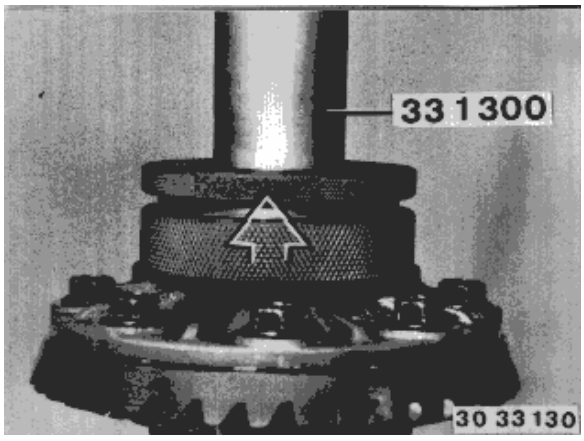
Caution!

Do not bend the pulse generator wheel.

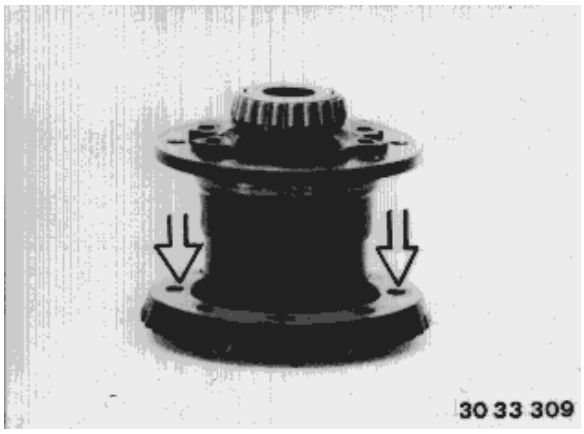


Installation:

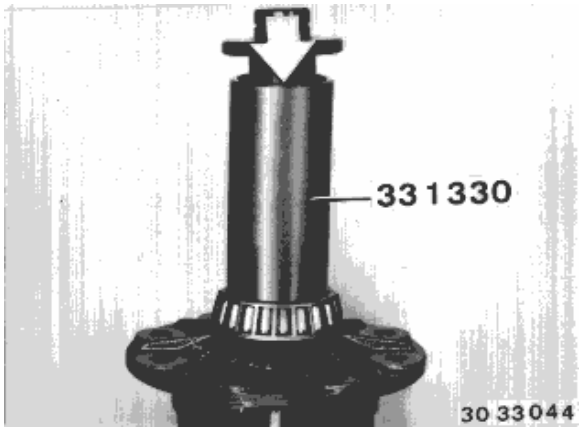
Press fit pulse alternator wheel using special tool 33 1 304.



Pull taper roller bearing off differential housing with special tool 33 1 300.



Remove crown wheel (cold).

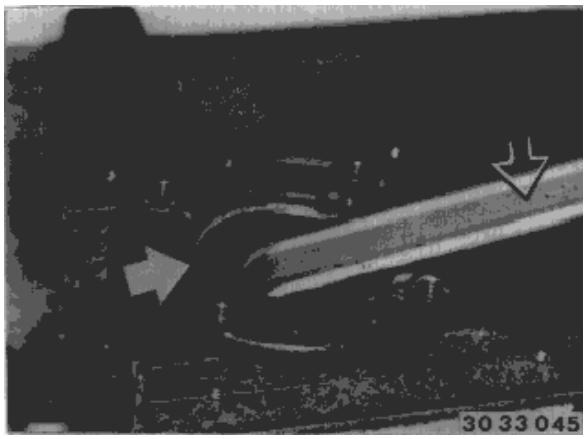


Installation:

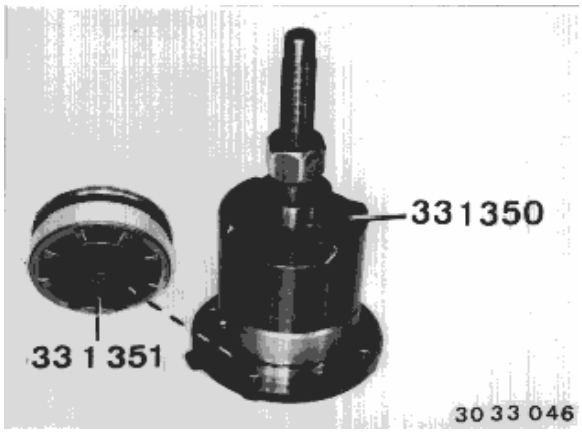
Cold-press new taper roller bearing on using special tool 33 1 330.

Caution!

Always only use same make bearings for both.



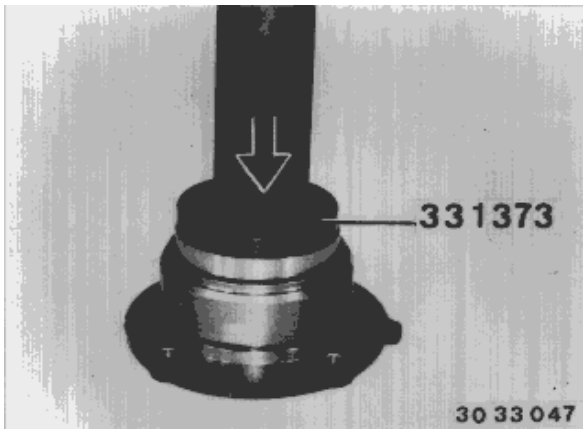
Lift shaft seals out of both bearing caps.



Press off outer bearing race with special tool 33 1 350 and special tool 33 1 351.

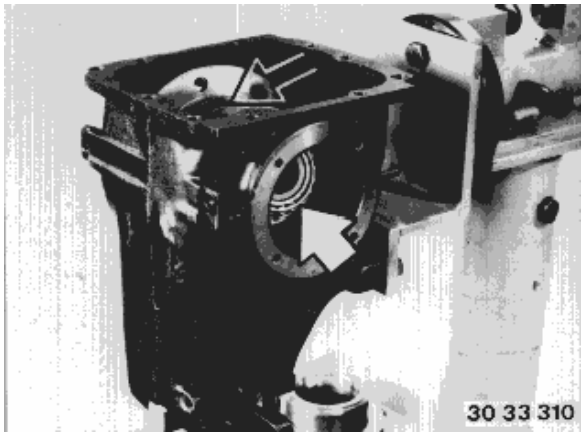
Caution!

Special tool 33 1 351 must engage in outer bearing race.



Installation:

Press new outer bearing race in 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.

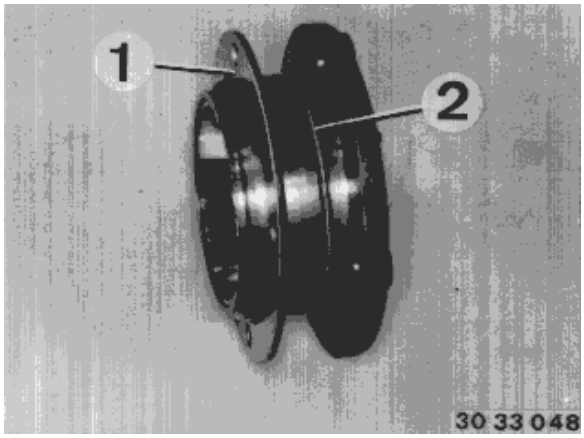
Caution!

Note make of bearings - this is required to determine the friction torque.

Oil the new bearings well with differential oil,

refer to BMW Service Operating Fluids,

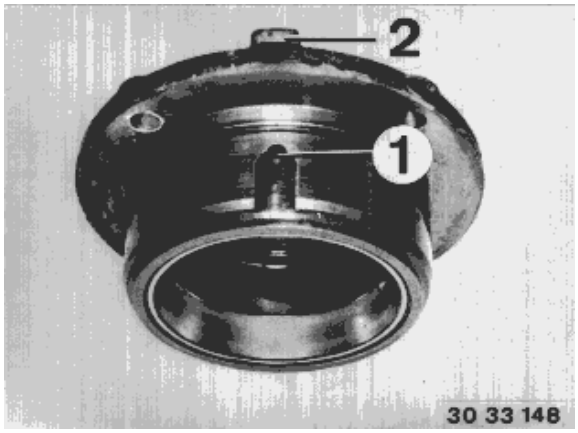
and allow to drip-drain.



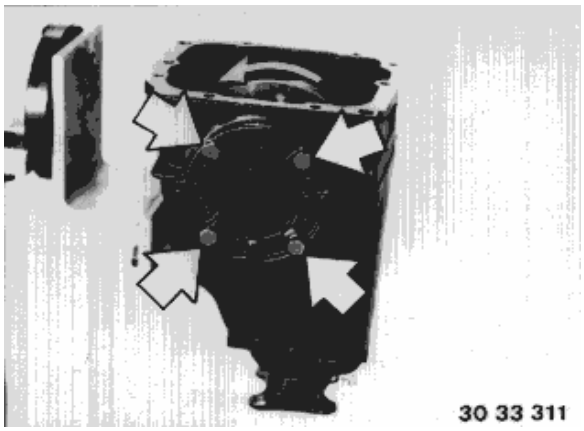
Install side bearing caps marked with belonging shims (1), but at first without O-rings (2).

Tighten down bearing cover screws on bevel gear end evenly. Tightening Torque,

refer to Technical Data 33 11 2AZ.



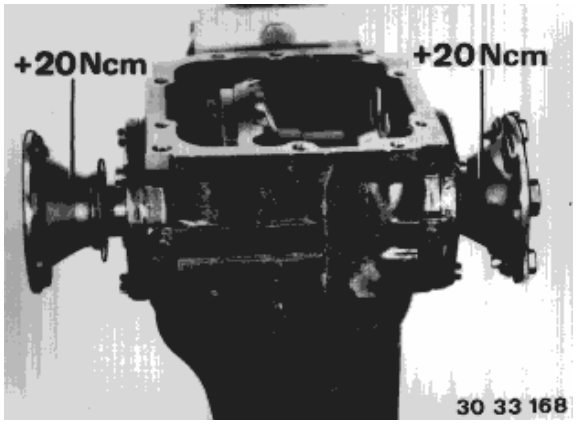
The lubricant bores (1) always face up when the transmission is installed correctly and this can be seen on the outside by way of tab (2).



The axial preload force of the differential housing bearing (4000 N) can be determined from the friction torque,

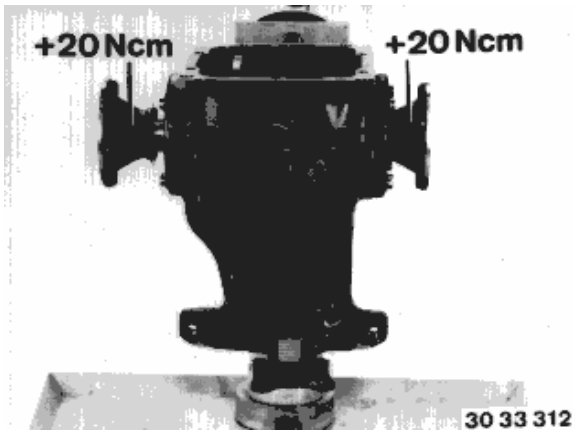
refer to Technical Data 33 11 2AZ.

Tighten bolts of second bearing cap uniformly only enough, that the differential can still be turned easily.



On the side tightened down to Tightening Torque, install an output flange and determine friction torque by means of a bracket with welded nut (in-house manufacture) and special tool 00 2 000.

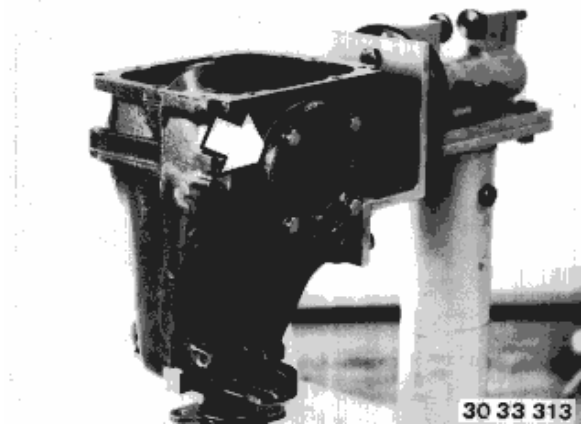
Turn friction torque meter at speed of approx. 50 rpm.



The friction torque level indicated in the final drive bearing table should be achieved, but should not be exceeded,

refer to Technical Data.

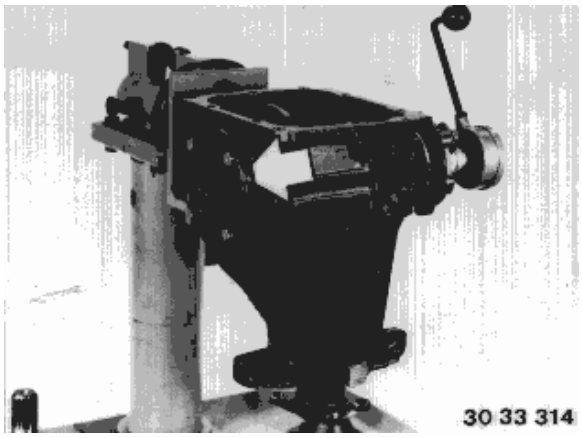
If new shaft seals have already been installed, 20 Ncm must be added for each seal in which an output shaft runs while measuring.



If the specified friction torque is not achieved, although both bearing covers are tightened down to specified Tightening Torque,

refer to Technical Data 33 11 2AZ.

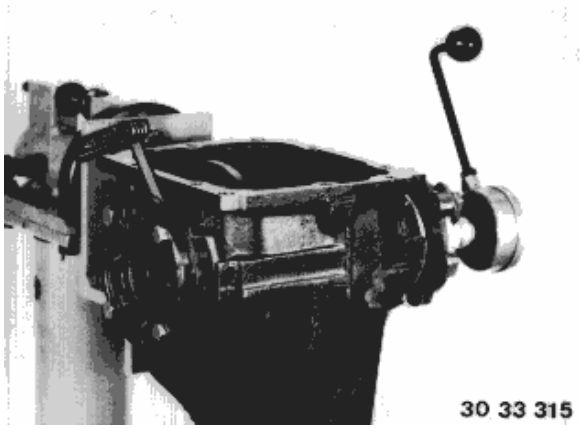
a thinner shim must be installed on the side facing the crown wheel and the measurement must be repeated.



If the friction torque is reached, although the second bearing cover has not yet been tightened to the specified torque,

refer to Technical Data

a thicker shim must be installed beside the crown wheel and the measurement must be repeated.



To make it easier to discover the shim thickness, the gap between shim and transmission case can be measured with a feeler gauge and then added to the thickness used for the shim.

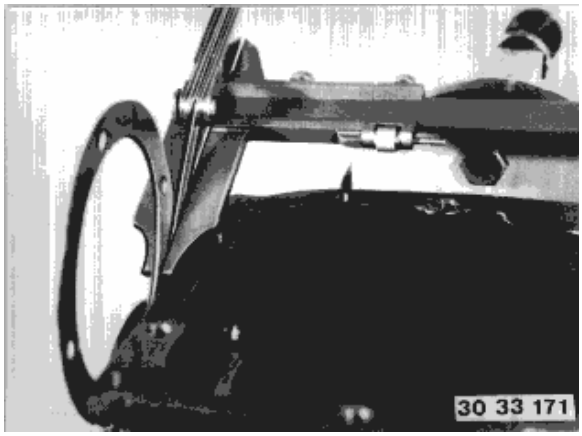
Example:

Second bearing cap not tightened (bolts screwed in uniformly).

Specified friction torque,

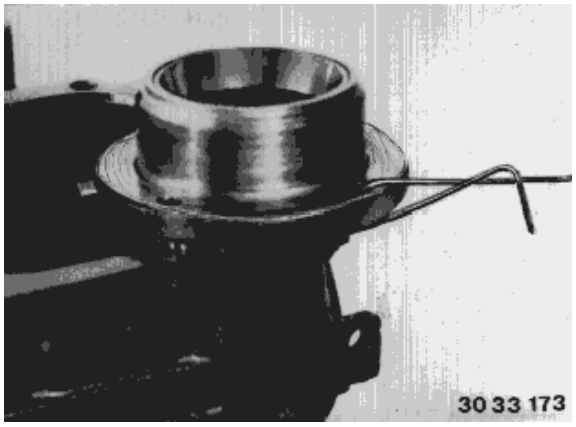
refer to Technical Data,

(e.g. 190 Ncm without shaft seal) achieved.



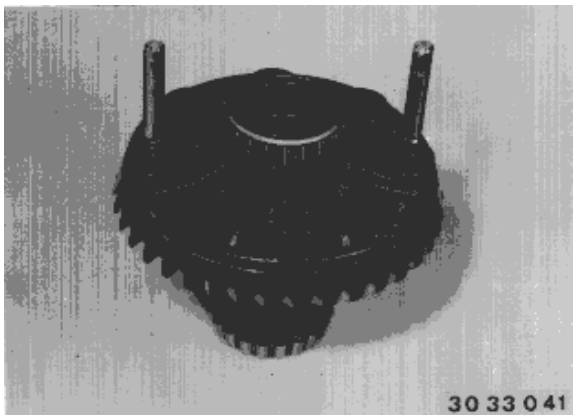
Gap measured with blade	0.20 mm
Used shim	1.40 mm
Install shim of thickness	1.60 mm

Install 1.60 mm thickness of shim and repeat measurement.



Remove differential.

Match side covers and shim of determined thickness, and do not mix them up.

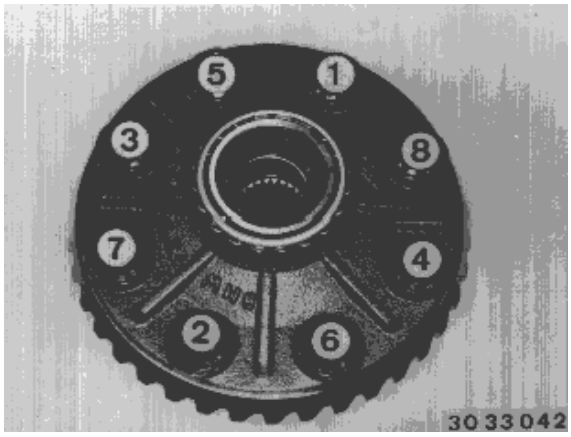


Installation:

Clean tapped bores thoroughly (tapper).

Heat plate spring to max. 100 °C (thermo-chrome pin).

Mount crown wheel with two locally manufactured staybolts for guiding.

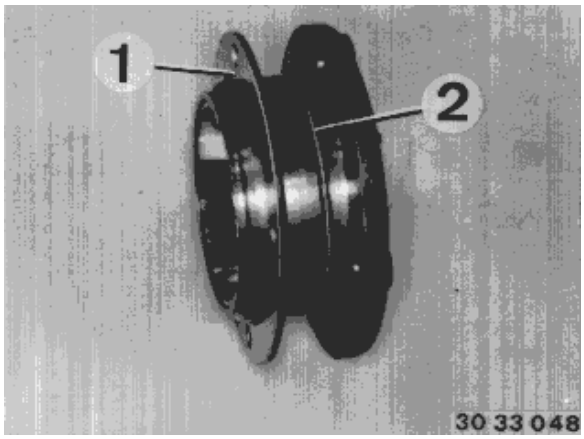


Installation:

Install new bolts with Loctite No. 270. Tighten bolts in order of 1 ... 8.

Note Tightening Torque and torsion angle,

refer to Technical Data 33 12 1AZ.

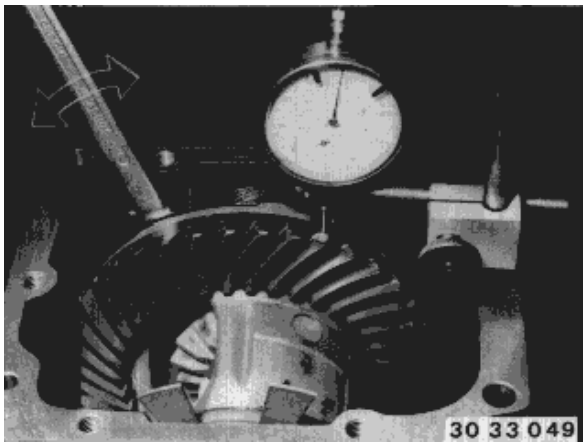


Installation:

Install differential with ring gear and pulse gear.

Install side cover after marking with the appropriate washers (1) and new O-ring (2). Tightening Torque,

refer to Technical Data 33 11 2AZ.



Adjusting torsional face runout/contact pattern:

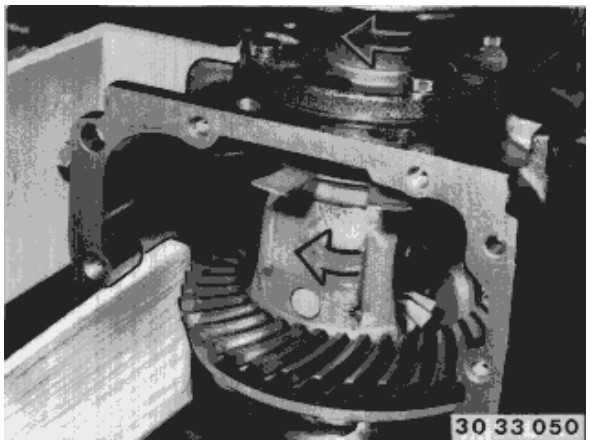
Secure special tool 00 2 500 (dial gauge holder) and measure torsional face runout,

refer to Technical Data.

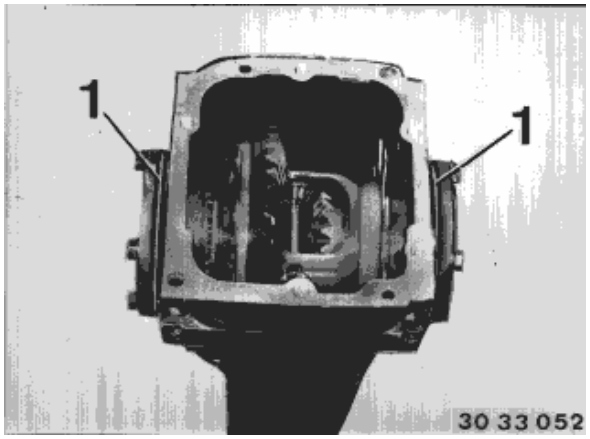
Caution!

The contact pattern is always the key to perfect adjustment of a gear train,

refer to Basic Rules of Contact Pattern Adjustment.



To check the tooth contact pattern, coat the crown wheel teeth with printer's ink, turn in both directions several times and stop crown wheel suddenly with a piece of hard wood.



Correction of torsional face runout and contact pattern is performed by altering the thicknesses of both shims (1).

If backlash is too great, install a thinner shim on the crown wheel end.

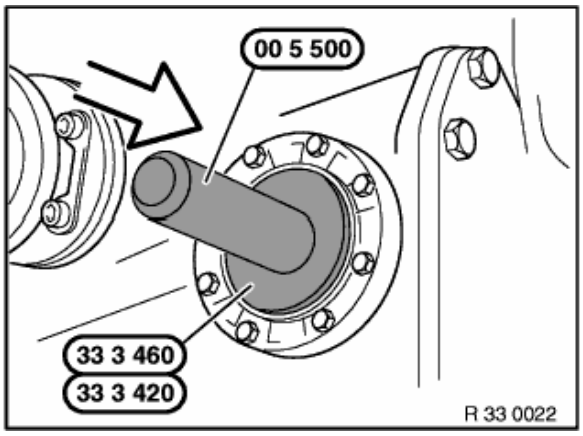
If backlash is too small, use a thicker shim on the crown wheel end.

Axial displacement of the crown wheel of 0.01 mm signifies a change in tooth flank clearance of 0.0076 mm.

Caution!

The total thickness of both shims may no longer 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.

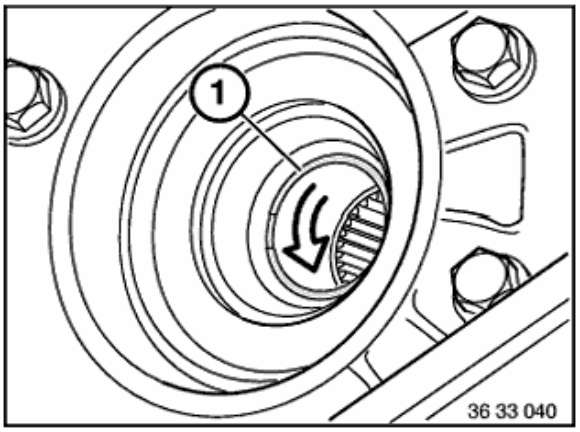


Installation:

Dip shaft seal in final drive oil.

Drive shaft seal firmly home with special tool 33 3 460 in conjunction with special tool 00 5 500.

Replace drive flange if the bearing surface is seriously scored.



Installation:

Before fitting the drive flange, the round wire circlip (1) must be placed in the groove of the differential housing in such a way that both ends of the round wire circlip are recessed.

This prevents lateral bending of the ring.

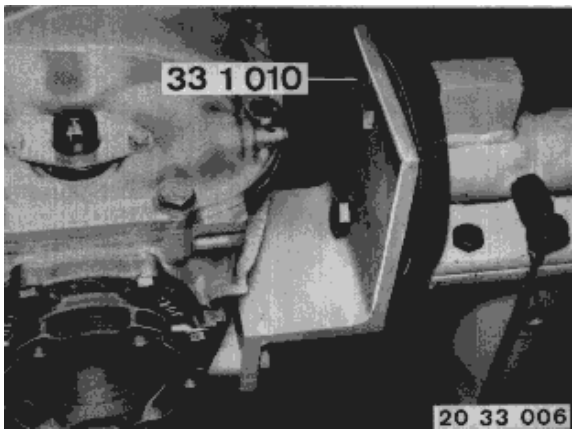
Press in drive flange by hand and turn slightly until wire snap ring is heard to engage.

Replace stretched round wire snap rings.

33 11 731 Replacing both bearings on final drive housing (Type M) - final drive removed -

Remove final drive, refer to pertinent model Repair Instructions microfiche beginning with 1985 models,

refer to 33 10 010



Secure final drive to special tool 33 1 010.

Drain oil and remove housing cover.

Installation:

Replace seal.

Tightening Torque,

refer to Technical Data 33 11 1AZ.

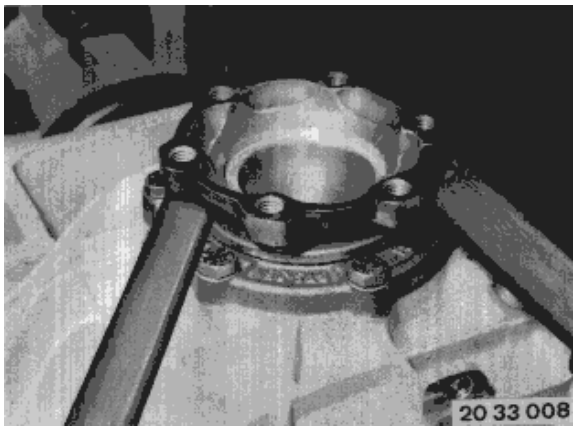
Topping up oil.

Oil quantity,

refer to Technical Data.

Oil grade,

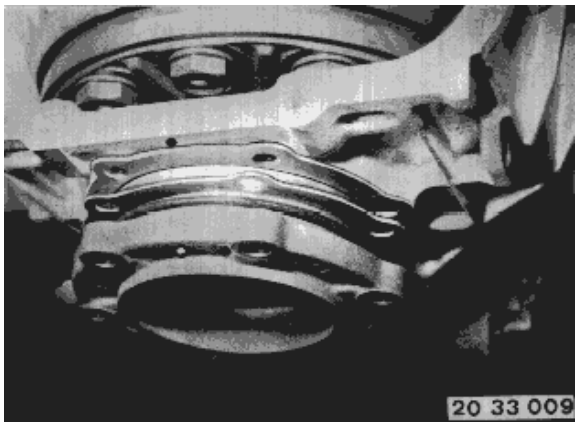
refer to BMW Service Operating Fluids.



Remove complete final drive housing,

refer to 33 12 526.

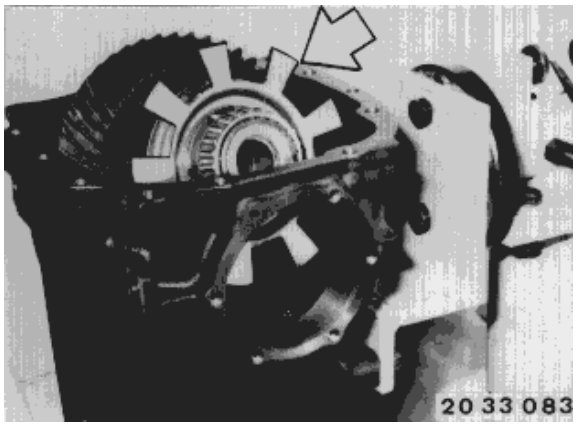
Pry off drive flanges with a tire iron for this purpose.



Mark bearing cap with punch marks and remove.

Caution!

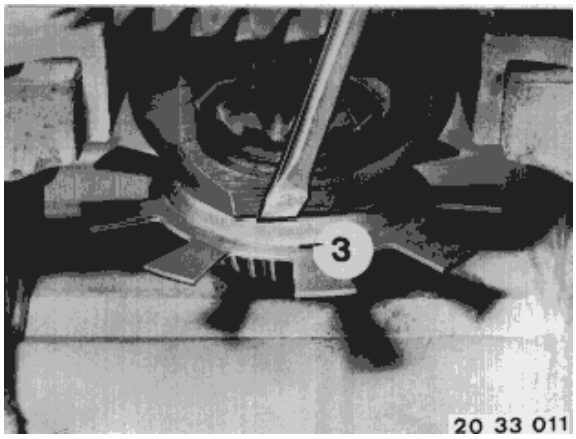
In order to make friction torque adjustments easier, ensure that the bearing caps and spacer discs are not mixed up.



Remove complete differential case.

Caution!

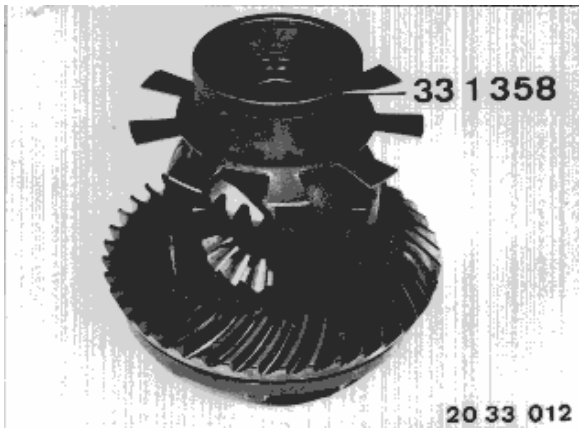
Do not bend the pulse generator wheel.



Press pulse generator wheel off of differential case.

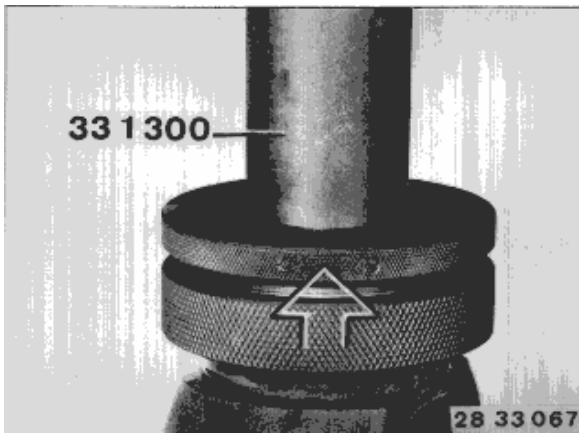
Caution!

Do not bend pulse generator wheel (3).

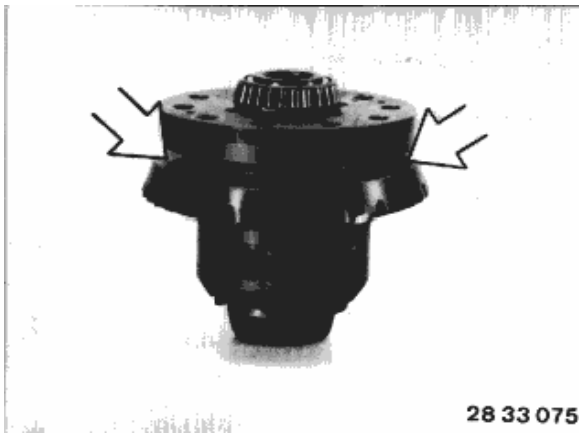


Installation:

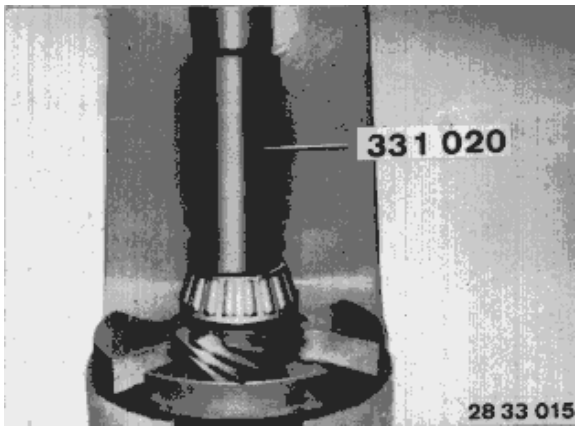
Press fit pulse generator wheel using special tool 33 1 358.



Pull taper roller bearing off differential housing with special tool 33 1 300.



Remove crown wheel (cold).

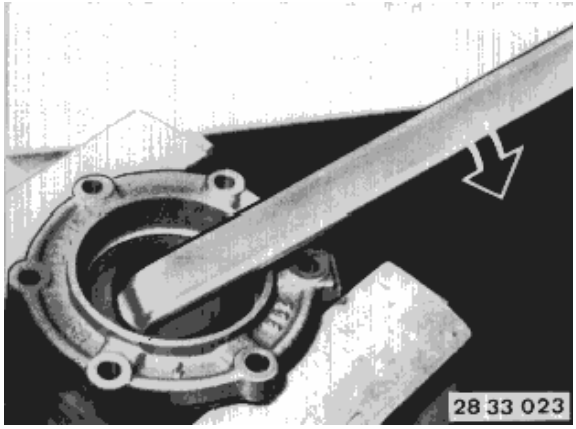


Installation:

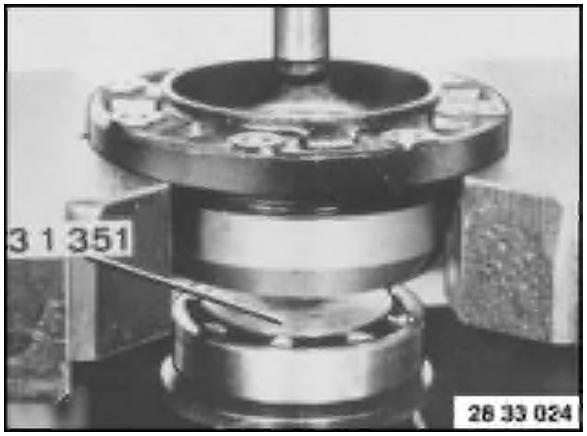
Cold-press new taper roller bearing on using special tool 33 1 020.

Caution!

Always only use same make bearings for both.



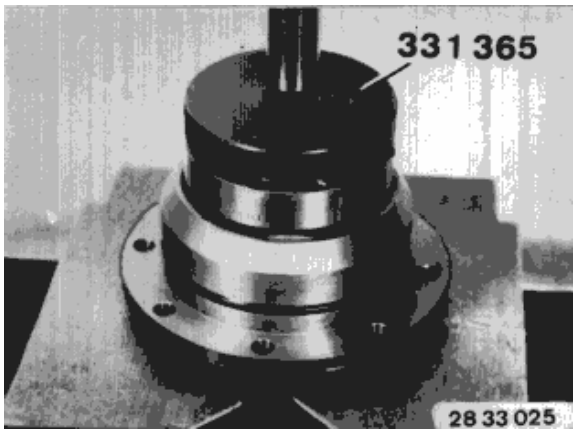
Lift shaft seals out of both bearing caps.



Press outer bearing race out with special tool 33 1 350 / 351.

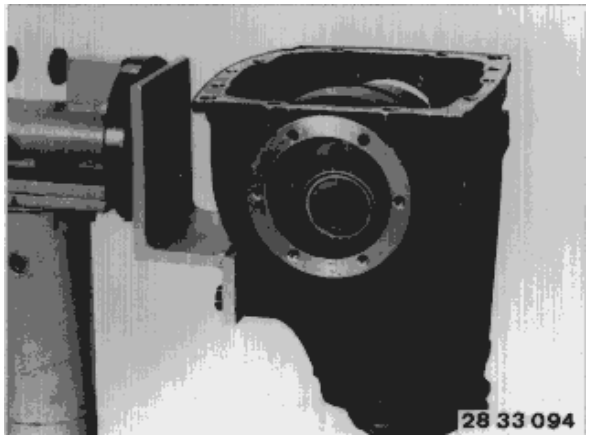
Caution!

Special tool must engage in the bearing outer race.



Installation:

Press in new outer bearing races in with special tool 33 1 365.

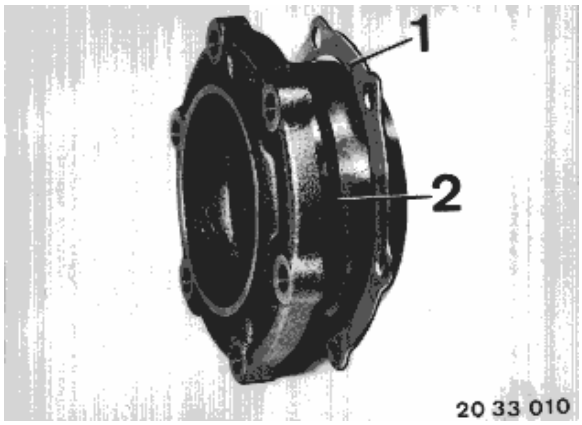


If only the differential bearings are being replaced, the drive pinion can remain installed and the differential case is installed without the ring gear to determine thickness of shims.

Caution!

Note make of bearings - this is required to determine the friction torque.

Lubricate new bearings with approved final drive gear lube thoroughly (refer to Operating Fluids) and let them drip dry.

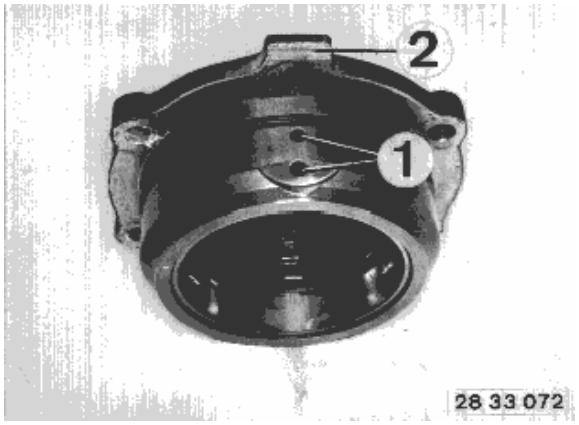


Install side bearing caps as marked with corresponding shims (1), but without O-rings (2) at first.

Uniformly tighten bearing cover screw on sides facing the crown wheel side.

Tightening Torque,

refer to Technical Data 33 11 2AZ.



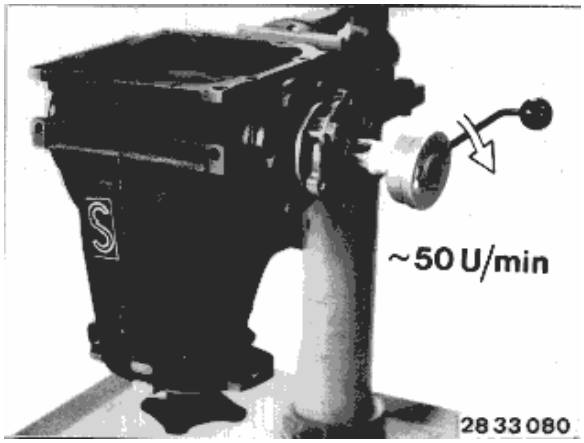
The differential bores (1) always face up when the differential is installed correctly and this can be seen on the outside by way of tab (2).



The axial preload force of the differential housing bearing (4000 N) can be determined from the friction torque,

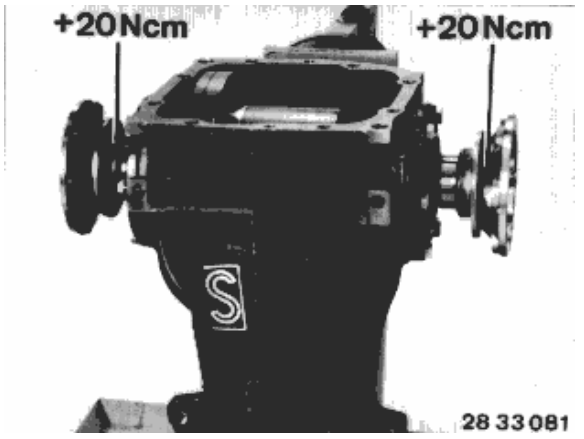
refer to Technical Data.

Tighten bolts of second bearing cap uniformly only enough, that the differential can still be turned easily.



On the side tightened down to Tightening Torque, install an output flange and determine friction torque by means of a bracket with welded nut (in-house manufacture) and special tool 00 2 000.

Turn special tool at approx. 50/min.



The friction torque specified in the table for the final drive housing mount should be achieved, but do not exceed this value,

refer to Technical Data.

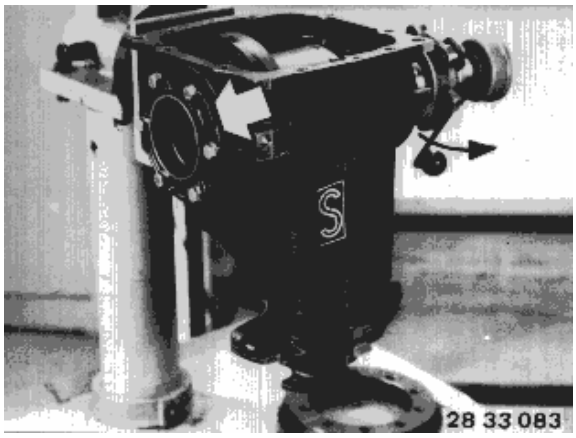
If new shaft seals have already been installed, 20 Ncm must be added for each seal in which an output shaft runs while measuring.



If the specified friction torque is not achieved, although both bearing covers are tightened down to specified Tightening Torque,

refer to Technical Data,

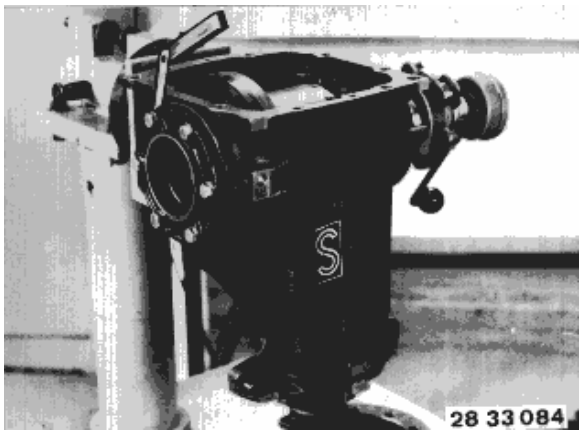
a thinner shim must be installed on the side facing the crown wheel and the measurement must be repeated.



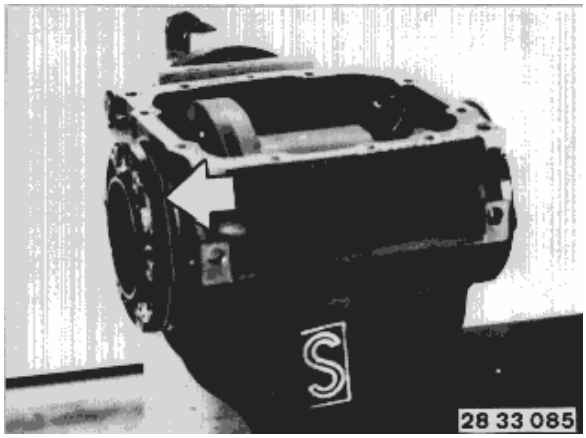
If the friction torque is reached, although the second bearing cover has not yet been tightened to the specified torque,

refer to Technical Data

a thicker shim must be installed beside the crown wheel and the measurement must be repeated.



To make it easier to discover the shim thickness, the gap between shim and transmission case can be measured with a feeler gauge and then added to the thickness used for the shim.



Example:

Second bearing cover not tightened (screws evenly hand-tightened).

Friction torque, refer to Technical Data

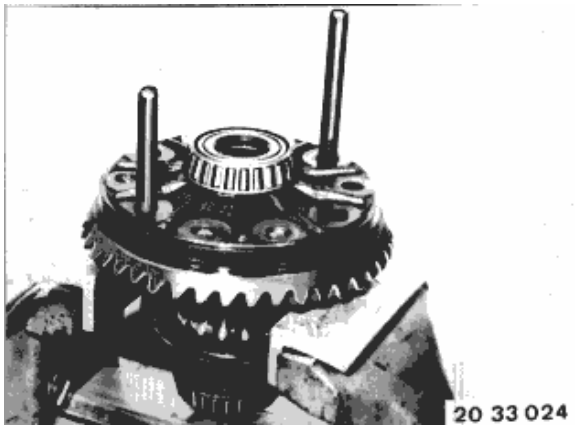
Gap measured with blade	0.20 mm
Used shim	1.40 mm
Install shim of thickness	1.60 mm

and measure again.



Remove differential.

Match side covers and shim of determined thickness, and do not mix them up.

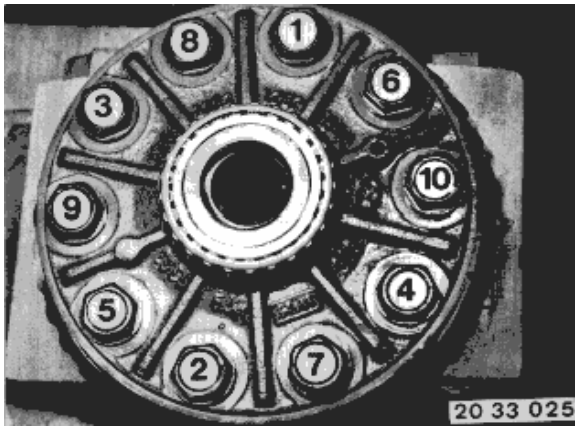


Installation:

Clean tapped bores thoroughly (tapper).

Heat plate spring to max. 100 °C (thermo-chrome pin).

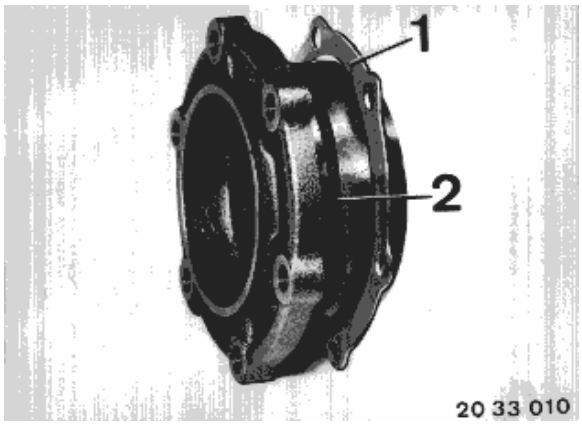
Mount crown wheel with two locally manufactured staybolts for guiding.



Install new bolts with Loctite No. 270. Tighten bolts in order of 1 ... 10).

Tightening Torque and torsion angle,

refer to Technical Data 33 12 1AZ.

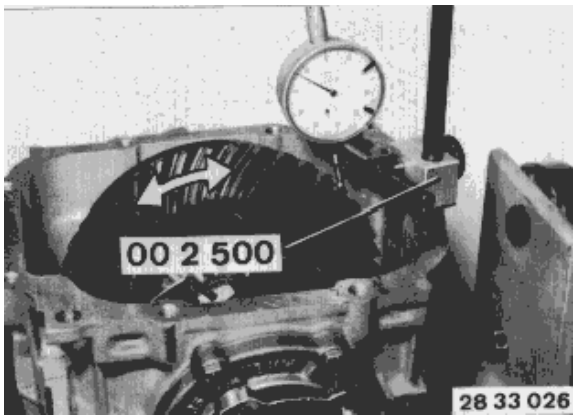


Install differential with crown wheel and pulse gear.

Install side cover after marking with the appropriate washers (1) and new O-rings (2).

Tightening Torque,

refer to Technical Data.



Backlash/tooth contact pattern adjustments

Secure special tool 00 2 500 (dial gauge holder) and measure torsional face runout,

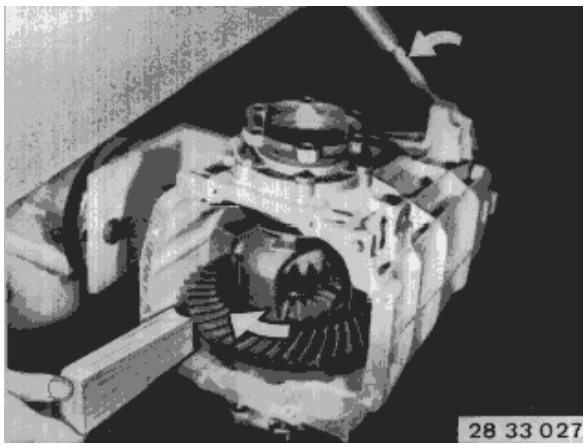
refer to Technical Data.

Caution!

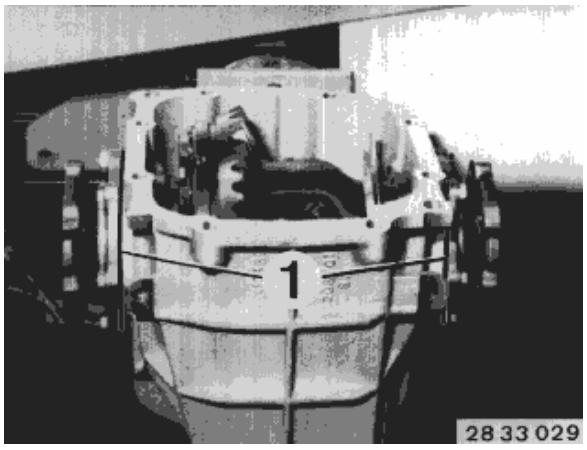
The tooth contact pattern is always most important for a perfectly adjusted pinion/crown wheel.

Basic rules for contact pattern adjustment,

refer to 33 12 ...



To check the tooth contact pattern, coat the crown wheel teeth with printer's ink, turn in both directions several times and stop crown wheel suddenly with a piece of hard wood.



A correction to torsional face runout,

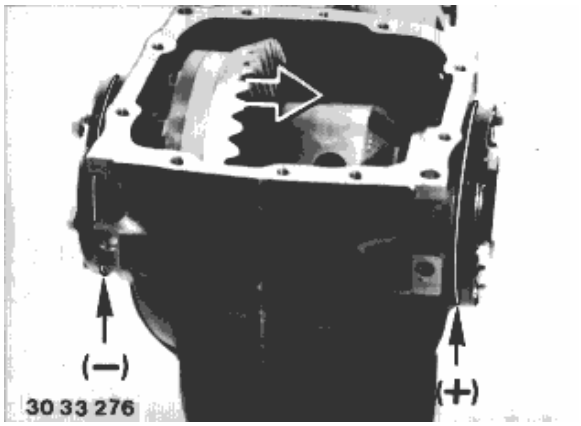
refer to Technical Data,

and contact pattern is performed by changing the thickness of both shims (1).

If backlash is too great, install a thinner shim on the crown wheel end.

If backlash is too small, use a thicker shim on the crown wheel end.

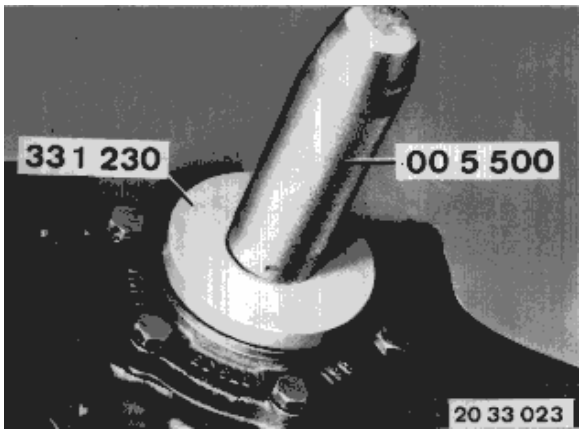
Axial displacement of the crown wheel of 0.01 mm signifies a change in tooth flank clearance of 0.0076 mm.



Caution!

The total thickness of both shims may no longer 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.



Installation:

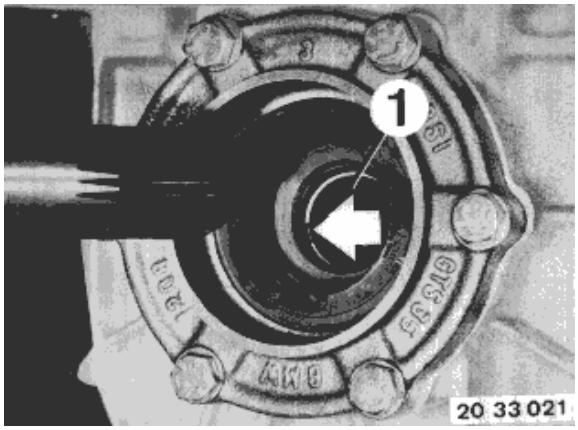
Dip shaft seal in final drive oil.

Drive shaft seal firmly home with special tool 33 1 230 in conjunction with special tool 00 5 500.

Replace drive flange if the bearing surface is seriously scored.

Note:

The special tool 33 1 230 may have to be remachined on account of the casting tolerances.



Installation:

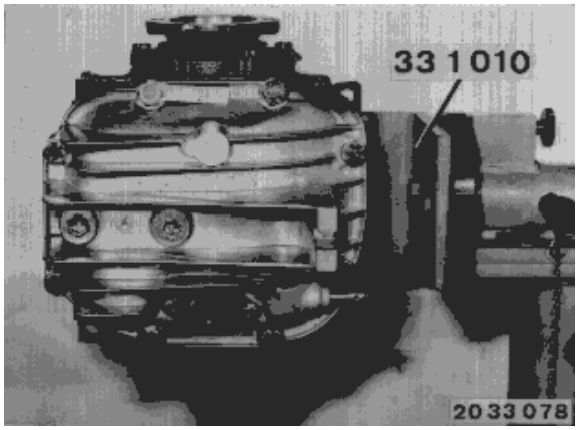
Place round wire snap ring (1) in the groove of the differential case in such a manner that both ends of the round wire snap ring are recessed in the groove, before installing the drive flange.

This prevents lateral bending of the ring.

Press in drive flange by hand and turn slightly until wire snap ring is heard to engage.

Replace stretched snap rings.

33 14 520 Replacing complete locking differential (Type M) - final drive removed -



Removing and installing final drive, included in Repair Manual MF, model-dependent, from '85,

refer to 33 10 010.

Drain ATF.

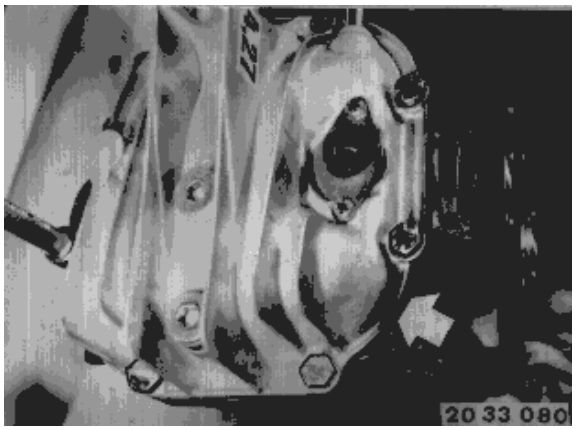
Secure final drive to special tool 33 1 010 (retaining bracket).

Installation:

Add oil.

Oil volume, refer to Technical Data

Refer to Fluids and Lubricants for approved oil.

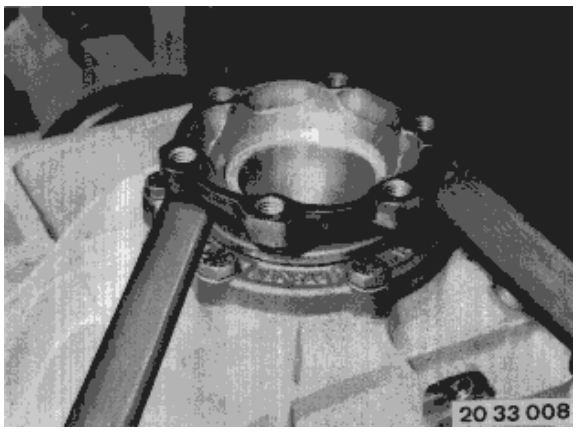


Take off case cover.

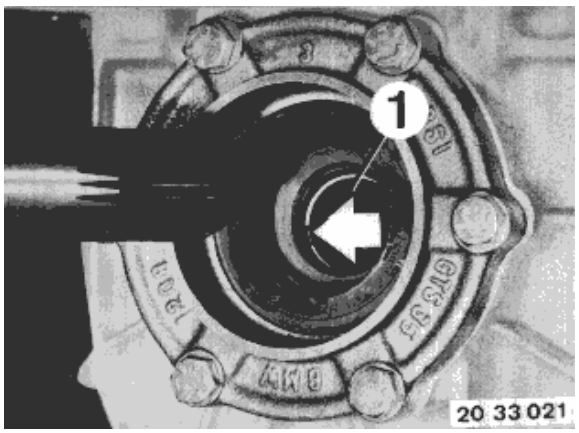
Installation:

Replace gasket.

Tightening torque, refer to Technical Data



Press off both drive flanges with a tire iron.

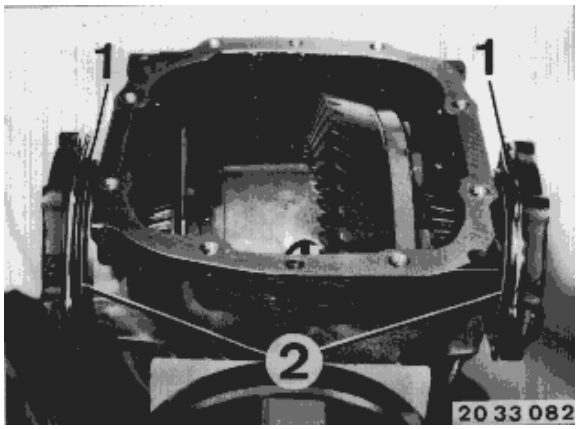


Installation:

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 turn slightly until wire snap ring is heard to engage.

Replace stretched snap rings.



Installation:

Differential case bearings and backlash are adjusted with shims (1).

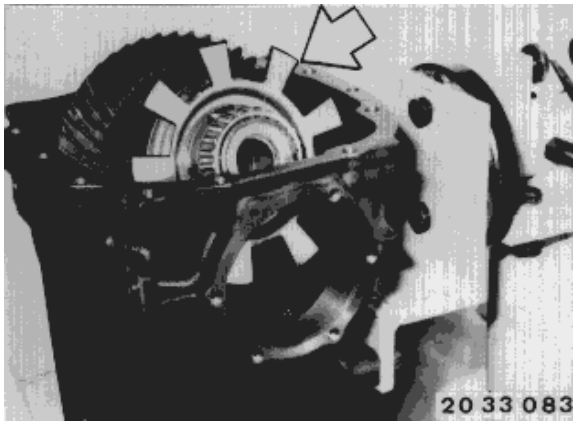
Check O-ring (2), replace if necessary.

Caution!

Changing the total thickness of shims (1) will change the friction torque value.

After adjustment of the friction torque, torsion face runout and contact pattern must be readjusted,

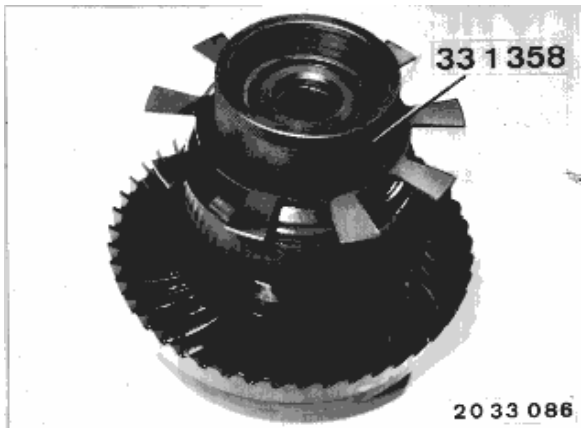
refer to 33 12 551



Remove complete limited slip differential.

Installation:

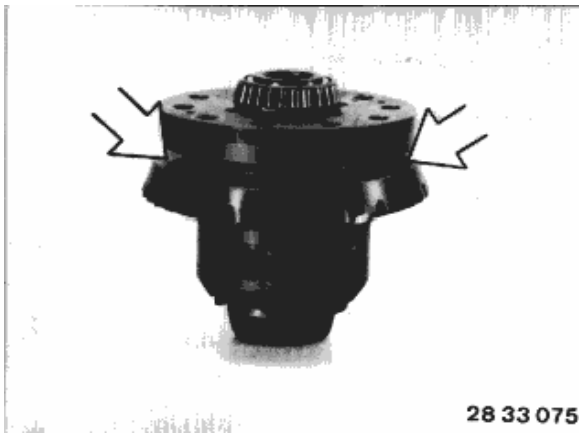
Don't bend the pulse spider.



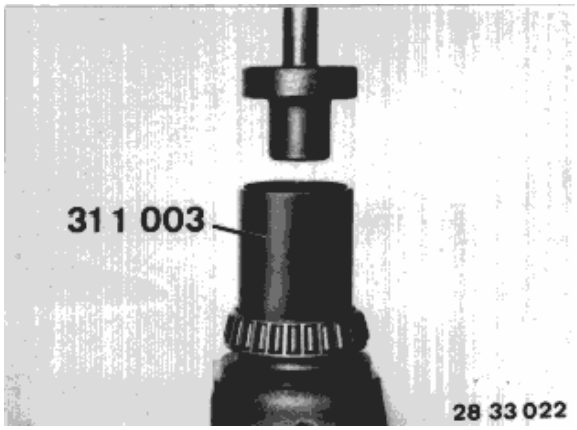
Press off pulse spider.

Installation:

Press fit pulse generator wheel with special tool 33 1 358 (union ring).



Remove crown wheel (cold).

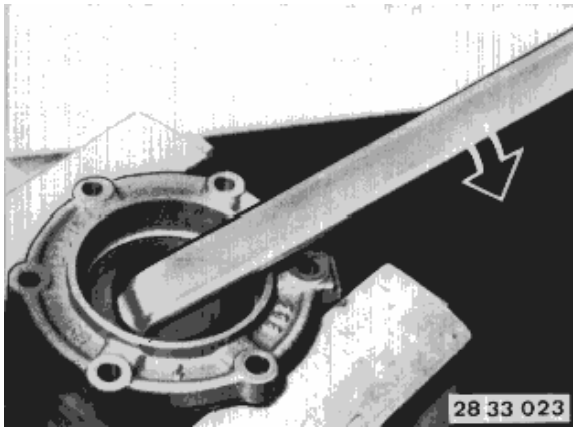


Press-fit new taper roller bearing to new final drive case with limited-slip differential cold using special tool 33 1 003.

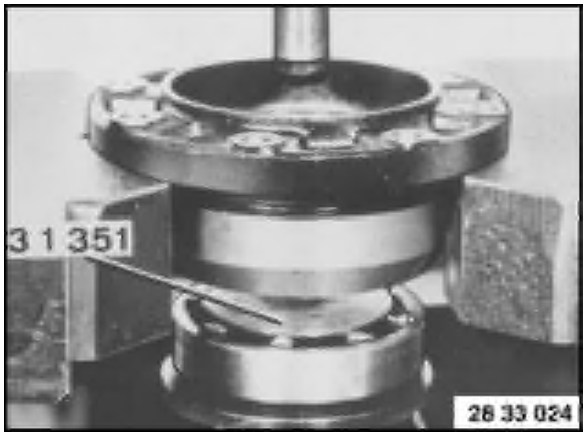
Caution!

Only use same make bearings for both bearings.

Note make - this information is required later to determine the friction torque.



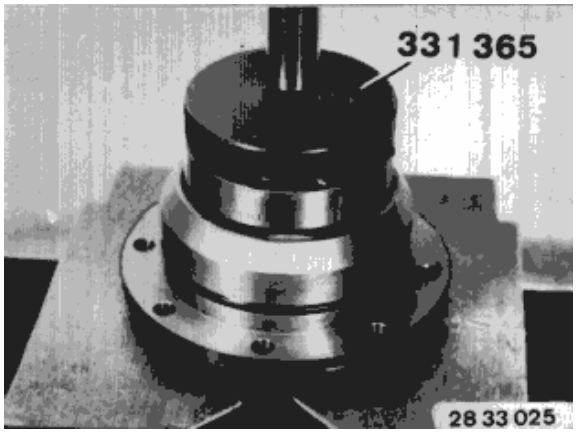
Lift shaft seals out of both bearing caps.



Press out outer bearing race with special tool 33 1 350 (extractor fixture) and special tool 33 1 351 (extractor star tool).

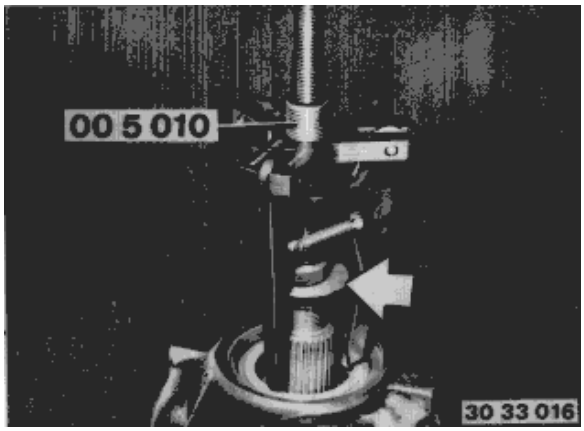
Caution!

Special tool must engage in the bearing outer race.

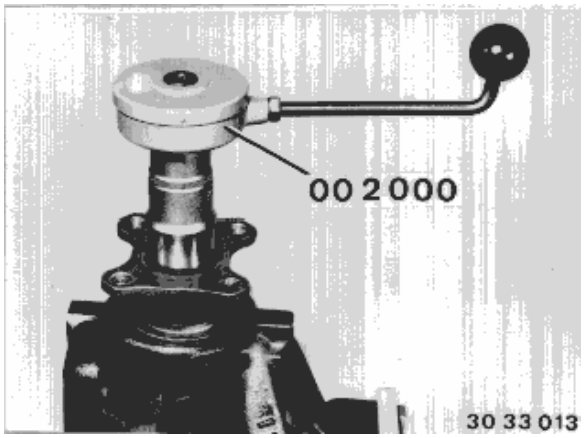


Installation:

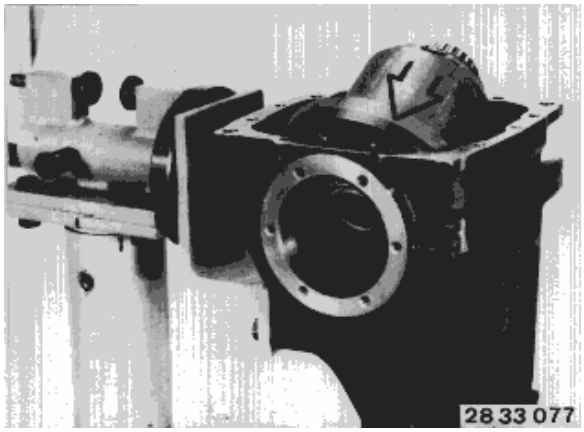
Press-fit new bearing outer races with special tool 33 1 365 (pressure plate).



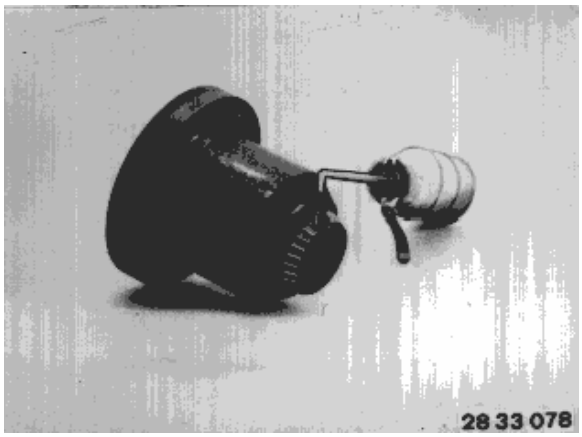
If necessary, replace shaft seal for input flange,
refer to 33 11 021



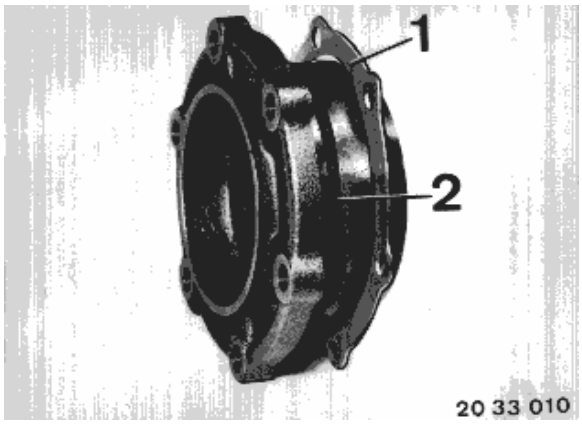
If necessary input bevel gear,
refer to 33 12 551



Install new limited slip differential with new bearings.
Use both bearings of same make. Note make.



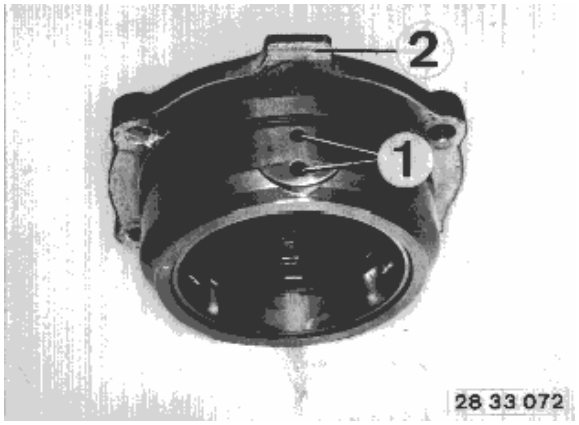
Lubricate new bearings with approved final drive gear lube thoroughly (refer to Fluids and Lubricants) and let them drip dry.



Install side bearing caps marked with belonging shims (1), but at first without O-rings (2).

Evenly tighten bearing cover screws opposite the crown wheel,

Tightening torque, refer to Technical Data.



Installation:

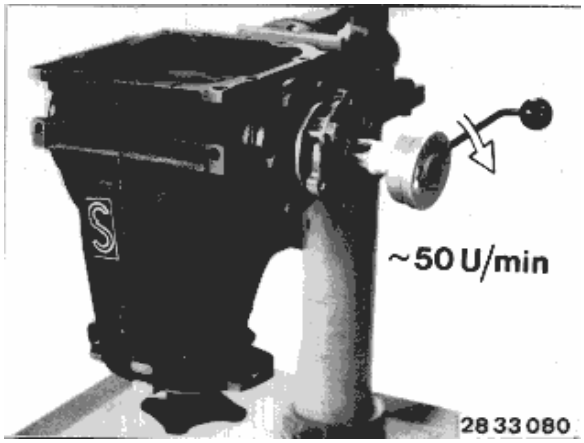
Compensating bores (1), recognized on the outside tab (2), always face up in installed position of transmission.



The axial preload force of the final drive mount (4000 N) can be determined from the friction torque,

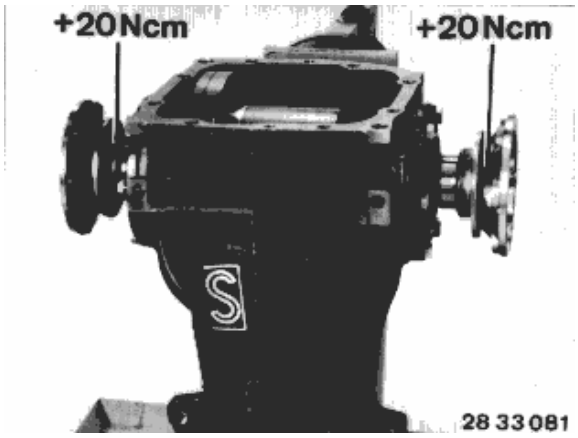
refer to Technical Data

Tighten bolts of second bearing cap uniformly only enough, that the differential can still be turned easily.



On side opposite crown wheel, fit an output flange and determine friction torque using a bracket with welded on nut (in-house manufacture) and special tool 00 2 000 (friction torque gauge).

Turn friction torque meter at speed of approx. 50 rpm.



The friction torque specified in the final drive mount table should be achieved but not exceeded,

refer to Technical Data

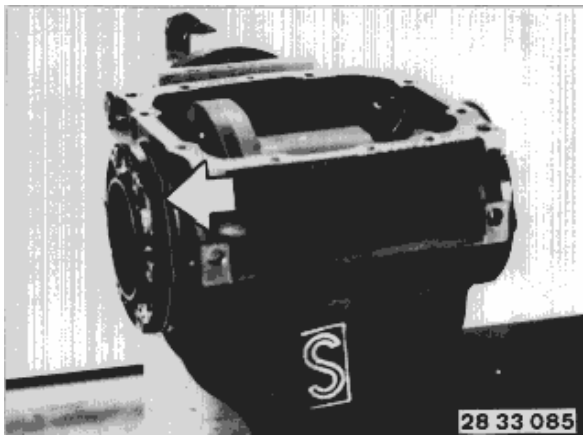
If new shaft seals have already been fitted, 20 Ncm must be added to each seal in which an output shaft rotates during the measurement process.



If the specified friction torque is not achieved although both bearing covers are at specified tightening torque,

refer to Technical Data

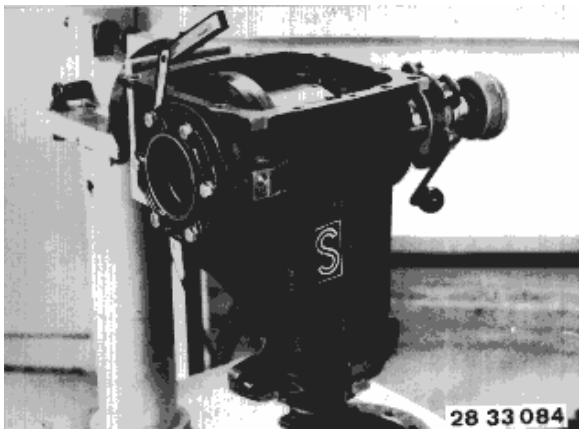
a thinner shim must be installed opposite the crown wheel and the measurement must be repeated.



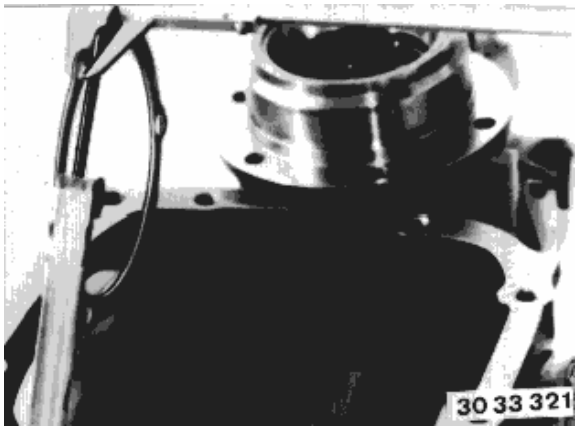
If the specified friction torque is reached although both bearing covers are tightened to the specified tightening torque,

refer to Technical Data

a thicker shim must be installed opposite the crown wheel and the measurement must be repeated.



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.



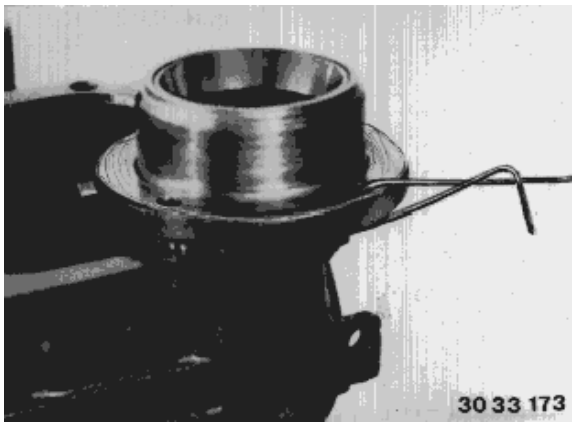
Example:

Second bearing cover not tightened down (screws tightened evenly).

Friction torque, refer to Technical Data

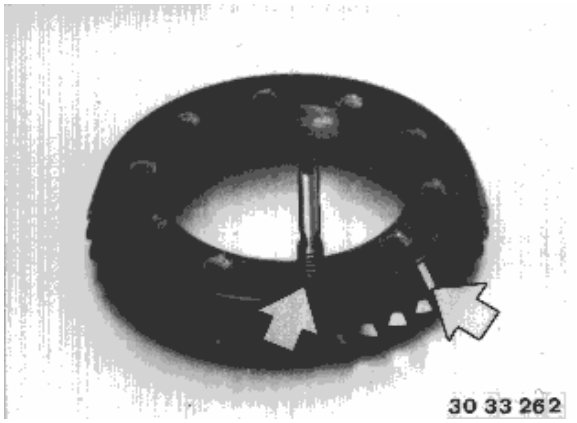
Gap measured with blade	0.20 mm
Used shim	1.40 mm
Install shim of thickness	1.60 mm

Measure again.



Remove differential case.

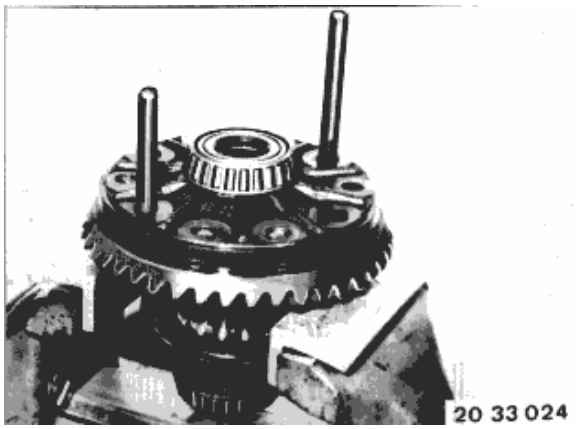
Arrange side covers and shims of determined thickness - don't mix them up.



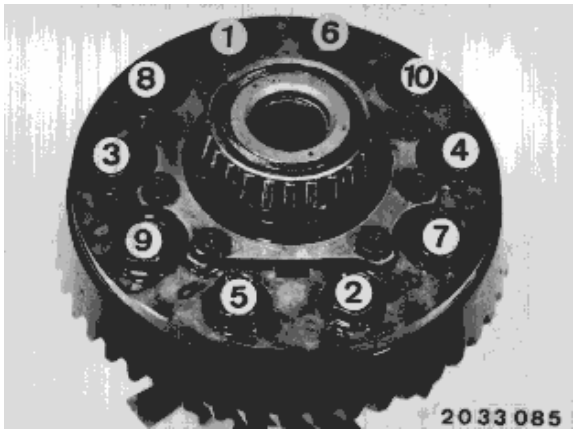
Installation:

Clean tapped bores thoroughly (tapper).

Heat plate spring to max. 100° C (thermo-chrome pin).



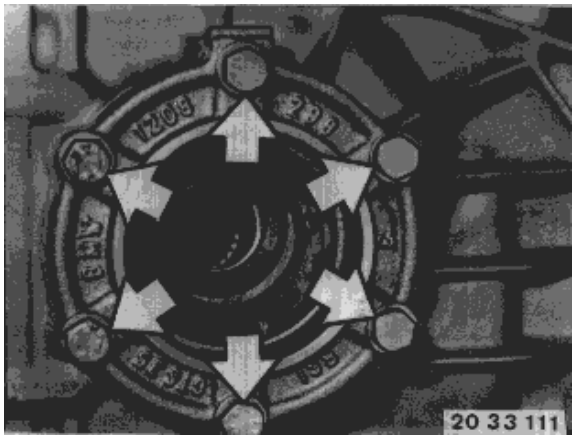
Mount crown wheel with two locally manufactured staybolts for guiding.



Install new bolts with Loctite No. 270. Tighten bolts in order of 1 ... 10.

Tightening torque and torsion angle,

refer to Technical Data

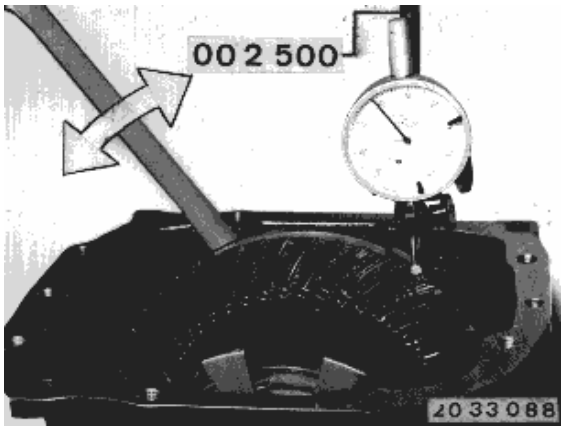


Install new limited slip differential with crown wheel and pulse sender.

Install marked side bearing covers with corresponding washers and new O-rings.

Tighten bearing cover screws evenly.

Tightening torque, refer to Technical Data



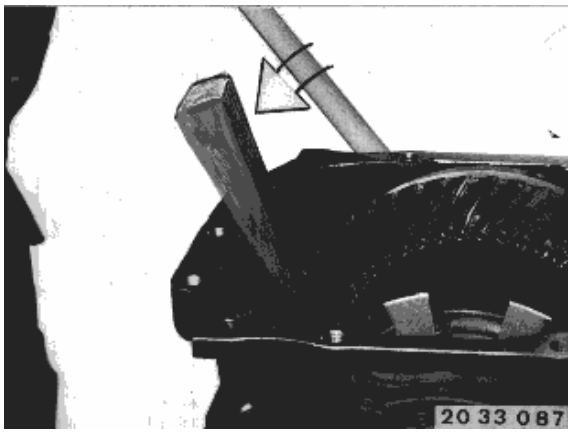
Secure special tool 00 2 500 (dial gauge holder) and measure torsion flank clearance,

refer to Technical Data

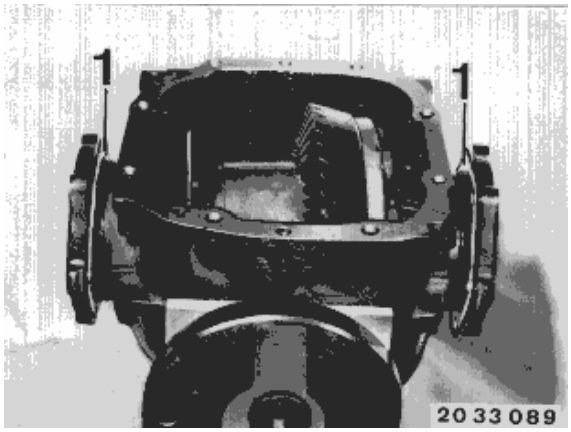
Caution!

The contact pattern is always the indicator for perfect gear adjustment,

refer to33 12 551



To check the tooth contact pattern, coat the crown wheel teeth with printer's ink, turn in both directions several times and stop crown wheel suddenly with a piece of hard wood.



Correction of torsion clearance,

refer to Technical Data

and contact pattern is performed by altering the thickness of both shims (1).

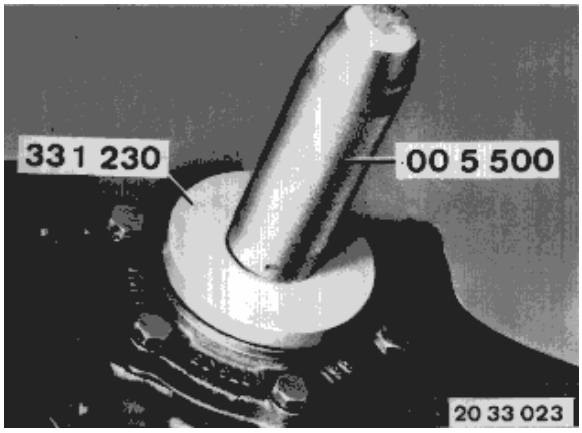
If backlash is too great, install a thinner shim on the crown wheel end.

If backlash is too small, use a thicker shim on the crown wheel end.

Axial displacement of the crown wheel of 0.01 mm signifies a change in tooth flank clearance of 0.0076 mm.

Caution!

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 new shaft seals in final drive gear lube.

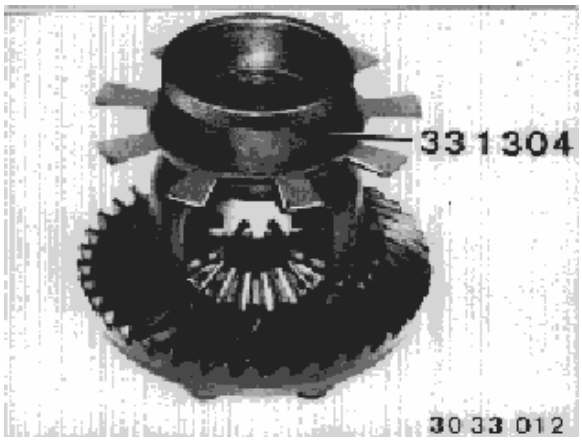
Drive in shaft seal firmly with special tool 33 1 230 (impact bush) in conjunction with special tool 00 5 500 (handle).

Note:

It is possible that the special tool 33 1 230 might have to be reworked to compensate for casting tolerances on the side cover.

Remove final drive housing, contained in Replace drive pinion with crown wheel,

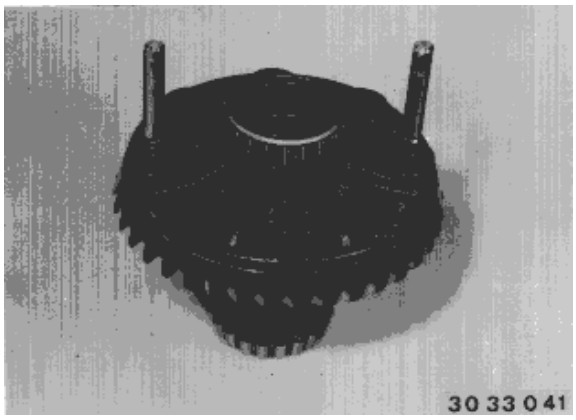
refer to 33 12 551.



Press off pulse spider.

Installation:

Press on pulse alternator wheel with special tool 33 1 304 (union ring).



Remove crown wheel (cold).

Caution!

If the bearings are also replace, first install crown wheel after determining friction torque determination - replace bearings for differential,

refer to 33 11 731.

Installation:

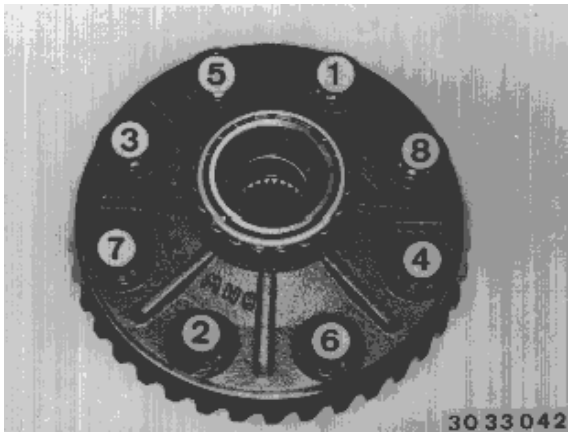
Clean tapped bores thoroughly (tapper).

Heat plate spring to max. 100 °C (thermo-chrome pin).

Mount crown wheel with two locally manufactured staybolts for guiding.

Caution!

Use new ring gear bolts.

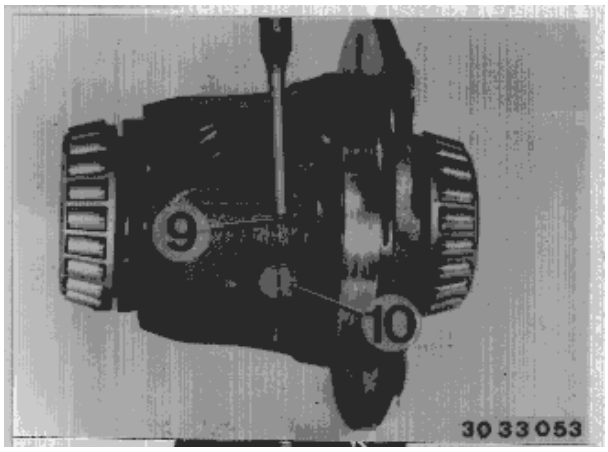


Installation:

Tighten new bolts in order of 1 ... 8.

Tightening Torque,

refer to Technical Data 33 12 1AZ.

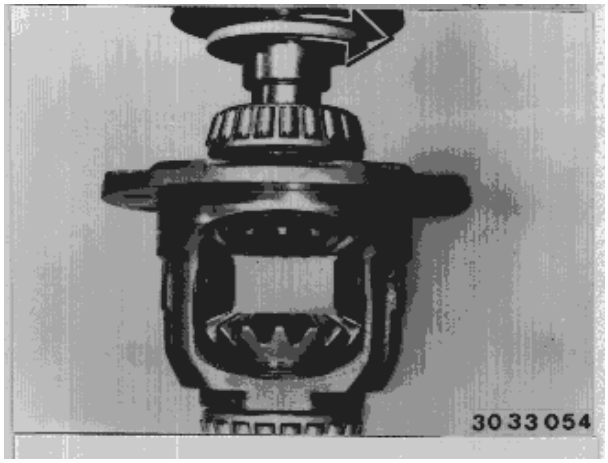


Drive out key (9) and differential shaft (10).

Installation:

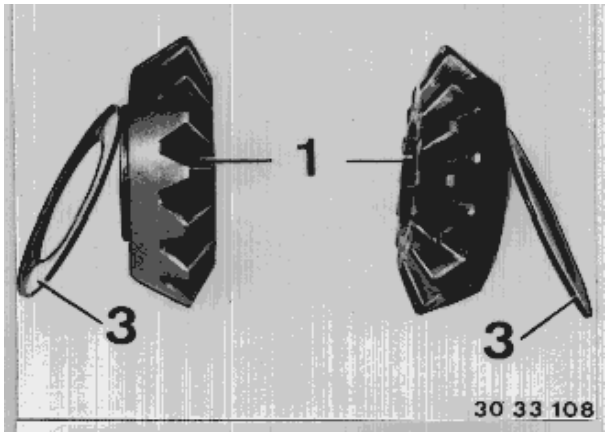
The bore in differential shaft (10) is countersunk on one end.

Drive in key (9) from this end.



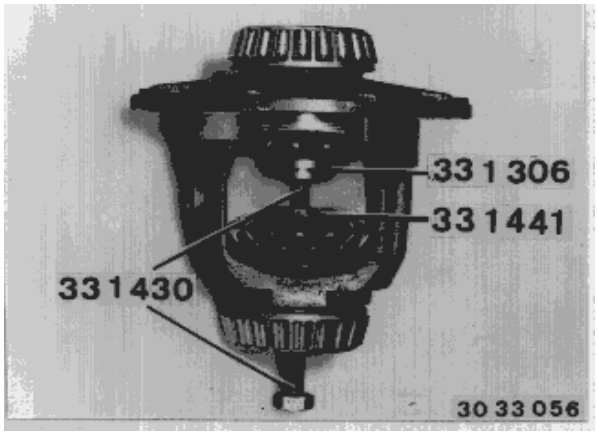
Turn out differential pinion gears with drive flange.

Remove differential side gears with shims.



To gauge the shims, install both new differential side gears (1) with disk springs (3) without shims (2).

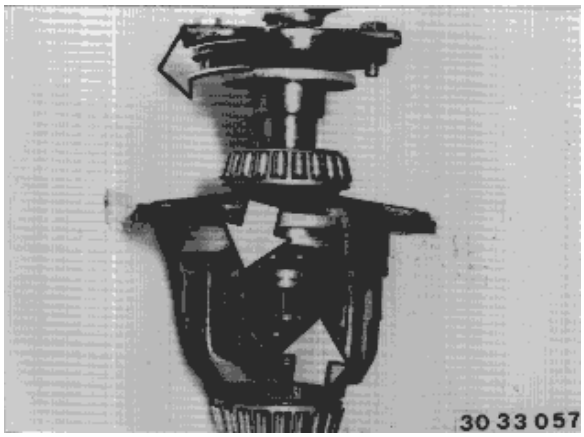
Center differential side gears with the drive flange.



Install special tool 33 1 306 (pressure piece) on one side.

Screw in special tool 33 1 441 (threaded plate) with special tool 33 1 430 (screw).

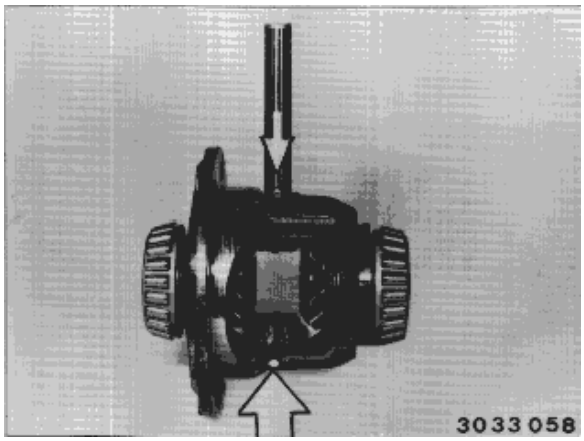
Tighten special tool bolt to spread differential side gears so far apart, that the drive flange can just barely be turned.



Install differential pinion gears exactly opposite each other.

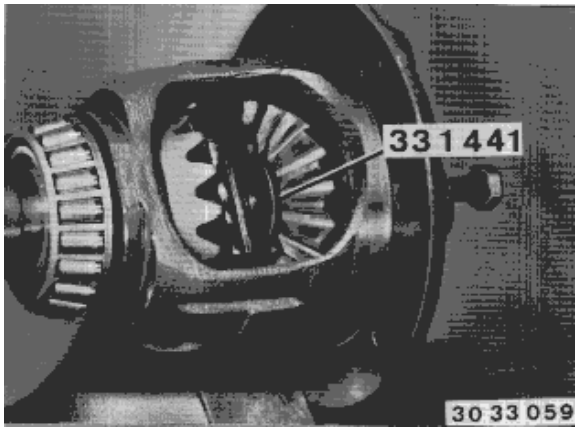
Move differential gears to installed position by turning drive flange.

Remove special tools.



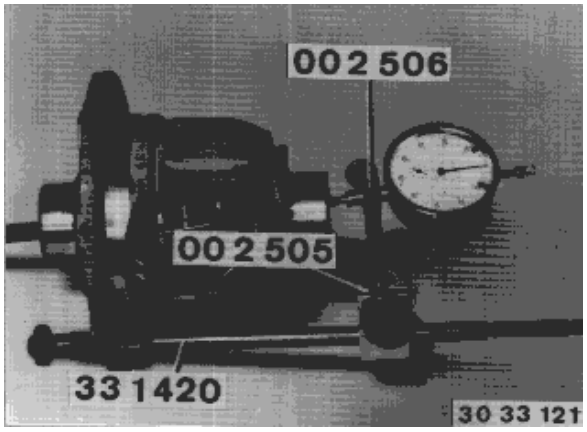
Drive in differential gear shaft.

Turn differential pinion gears with the drive flange and stop them at the highest point of tooth mesh (hardest to turn).



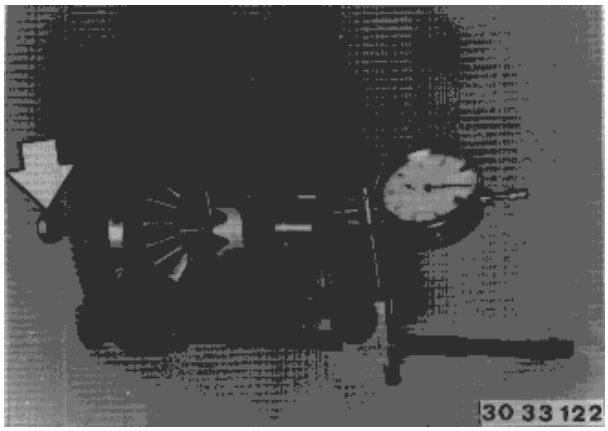
For measurement operation, install special tool 33 1 441 (threaded plate) and special tool 33 1 431 (screw).

If applicable, open up thread plate slightly to make it easier to insert the dial gage. Screw in bolt far enough, that the shaft gear is on "block".



Secure special tool 33 1 420, 00 2 505 and 00 2 506 to final drive housing.

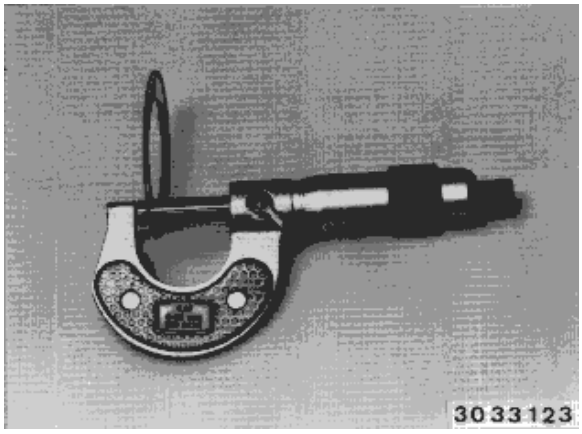
Set dial gage on blocked shaft gear to zero with preload.



Unfasten special tool 33 1 431 (screw).

Read off dial gauge, record value and allocate to one side, e.g. side of crown wheel 0.36 mm.

Repeat measurement on opposite differential side gear and note down value, e.g. 0.28 mm.



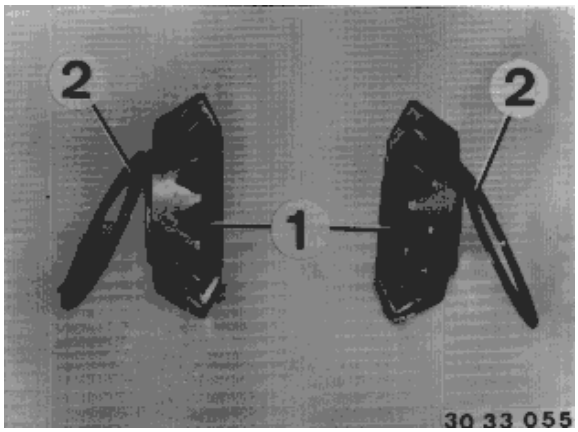
Remove differential side gears and diaphragm springs.

Caution!

Don't mix up differential side gears and diaphragm springs.

Measure plate spring with micrometer, record values and allocate, e.g. crown wheel 1.16 mm, other side 1.18 mm.

Determine correct thickness of shim taking into account the clearance of 0.02 ... 0.07 mm.



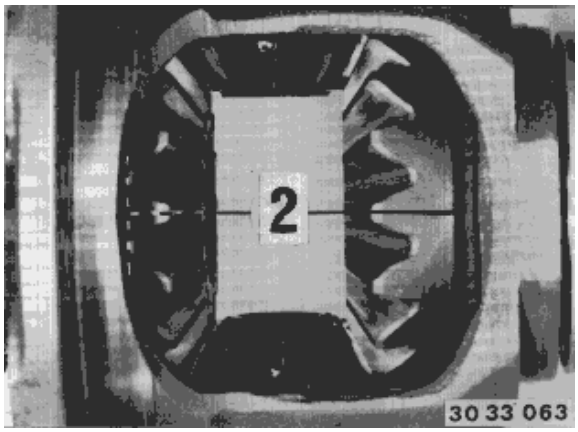
Example:

Ring gear end	Opposite end
Plate spring thicknesses	1.16 mm
+ measured value	0.36 mm
Total	1.52 mm
- play	0.02 mm
	1.50 mm

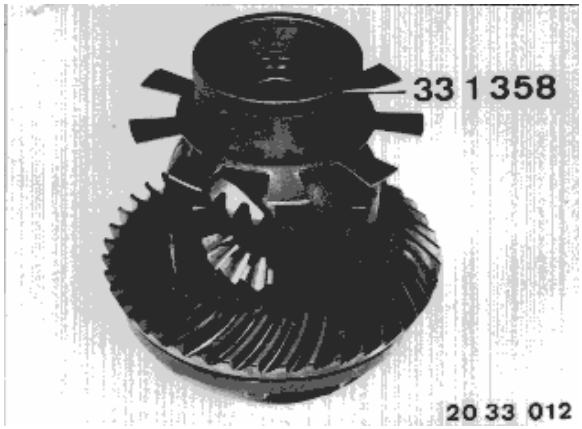
Thickness of shim:

1.50 mm - 1.44 mm = 0.06 mm

Shims (2) are available in gage steps of 0.05 mm.



Install shims (2) of determined thickness.



Removing final drive housing: operation included in "Replacing drive pinion with crown wheel",

refer to 33 12 551

Press off pulse spider.

Installation:

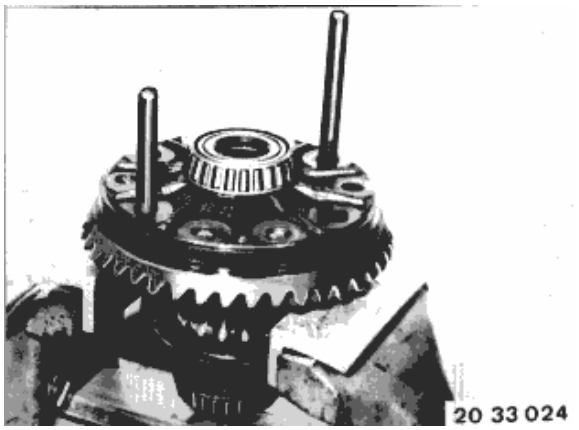
Press fit pulse generator wheel with special tool 33 1 358 (union ring).

Remove ring gear (cold).

Caution!

If bearings were replaced, do not install crown wheel until after friction torque has been determined, similar to replacing bearings on final drive housing,

refer to33 11 731.

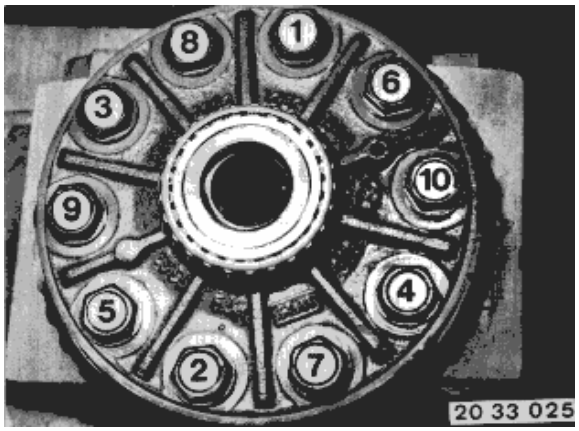


Installation:

Clean tapped bores thoroughly (tapper).

Heat plate spring to max. 100° C (thermo-chrome pin).

Mount ring gear with two locally manufactured staybolts for guiding.

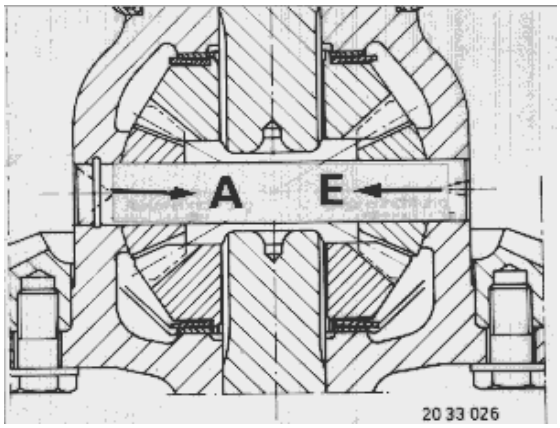


Installation:

Install new screws with Loctite No. 270 and tighten down in sequence (1 ... 10).

Tightening torque and torque angle,

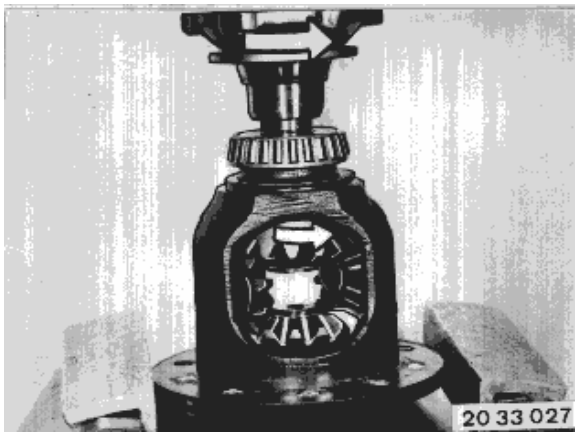
refer to Technical Data



Press out final drive shaft with special tool 33 1 470 (feed mandrel) from countersunk side.

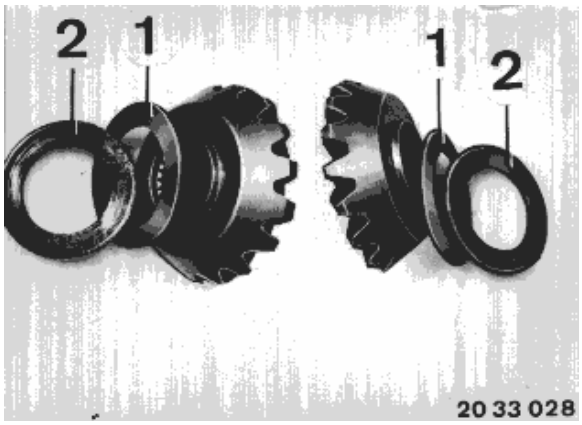
A = Pressing out direction

E = Pressing in direction



Turn out differential bevel gears with drive flange.

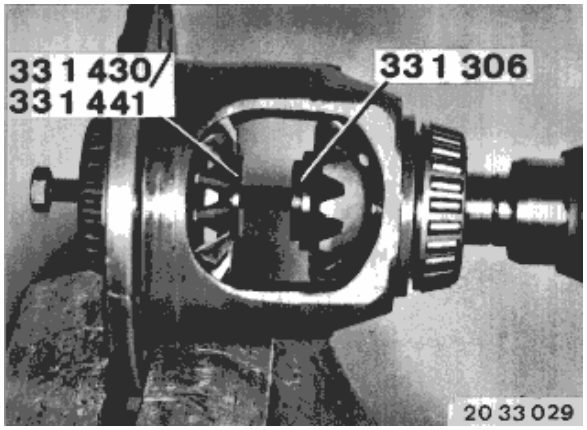
Remove differential side gears with diaphragm springs and shims.



Install both differential side gears with diaphragm springs (1) and shims (2).

Curved surface of diaphragm springs (1) faces differential case.

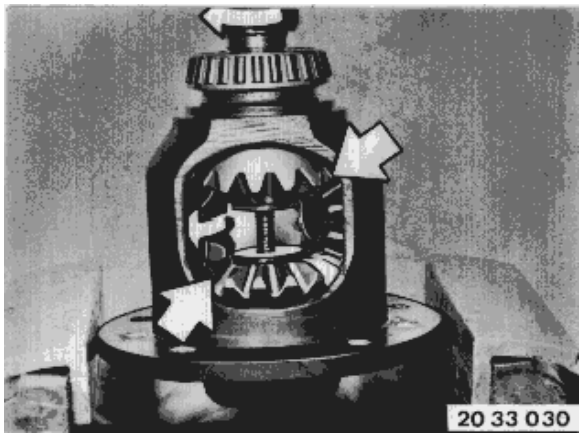
Center differential side gears with the drive flange.



Install special tool 33 1 306 (pressure piece) on one side.

Screw in special tool 33 1 441 (threaded plate) with special tool 33 1 430 (spindle).

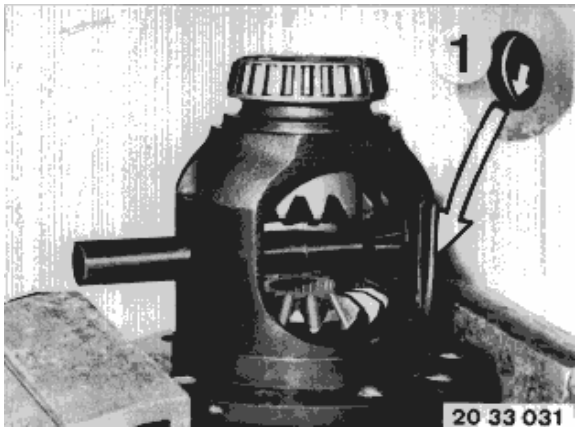
Tighten special tool bolt to spread differential side gears so far apart, that the drive flange can just barely be turned.



Install differential pinion gears exactly opposite each other.

Move differential gears to installed position by turning drive flange.

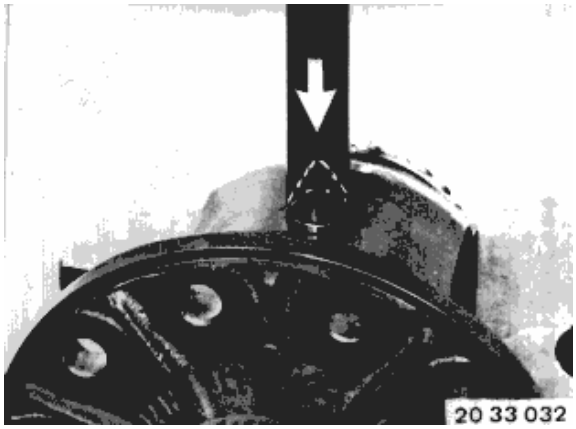
Remove special tools.



Procedure with Hydraulic Press:

Check that circlip (1) is in correct installed position.

Slide in feed mandrel from side without a circlip.



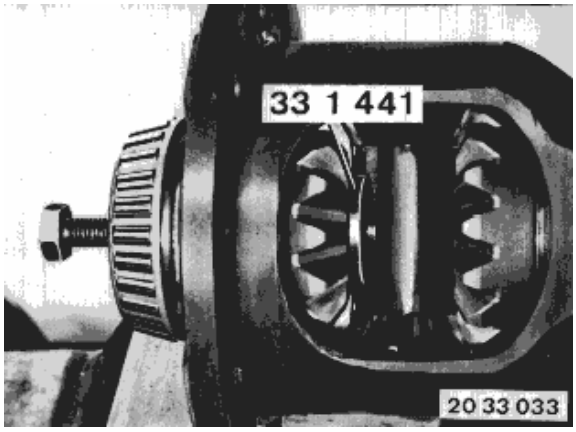
Place differential shaft with large opening on the feed mandrel and press in.

The pressing-in force will increase strongle, when the circlip has engaged.

Caution!

Stop the pressing-in step as soon as the force increases - danger of shearing off the circlip.

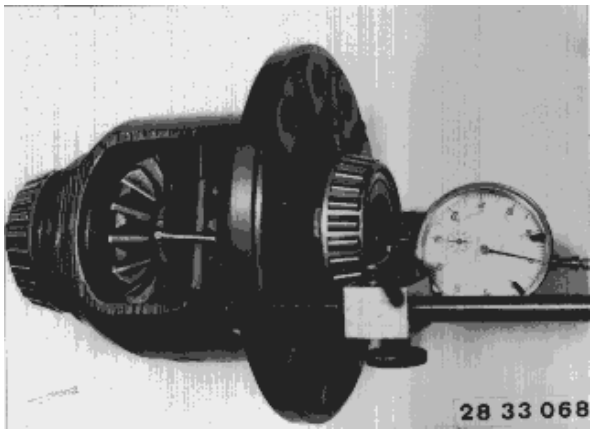
Do not push back the differential shaft after installation.



Measuring Preload of Diaphragm Springs:

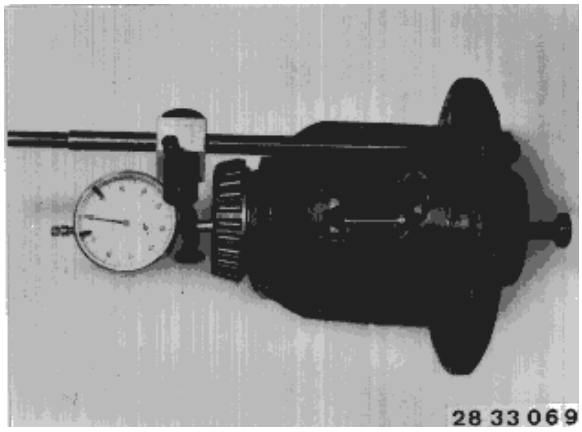
Install special tool 33 1 441 (threaded plate) and special tool 33 1 431 (screw).

Tighten bolt by hand.



Secure dial gauge to final drive housing with special tool 33 1 420, 00 2 505 and 00 2 506.

Set dial gage on blocked shaft gear to zero with preload.



Tighten spindle until diaphragm springs are pressed flat.

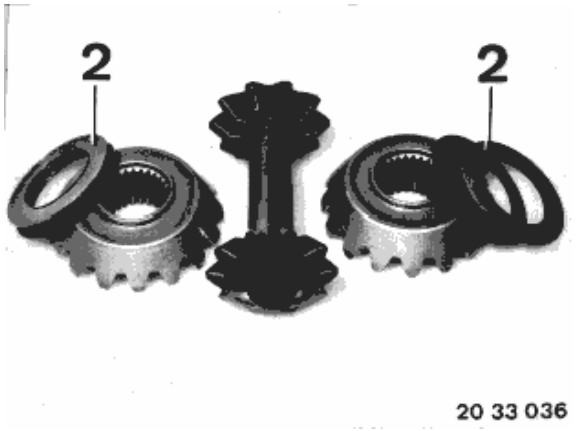
Read dial gage. Loosen spindle.

Turn shaft gear and measure again at several points.

To ensure that the plate spring is not block-preloaded, clearance of 0.03 ... 0.1 mm must be available.

The lower value would be ideal.

Repeat measurements on opposite shaft gear.



Excessive Clearance:

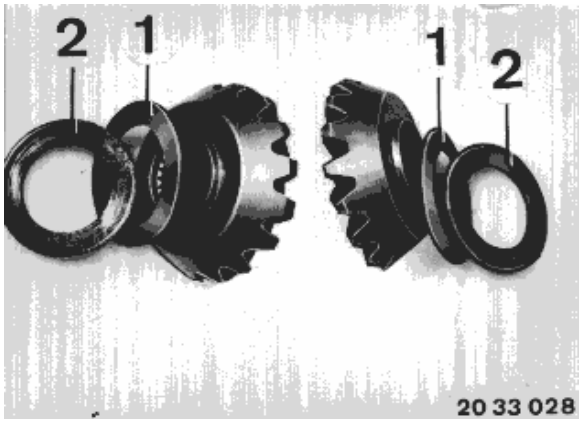
Install thicker shim.

Insufficient Clearance:

Install thinner shim.

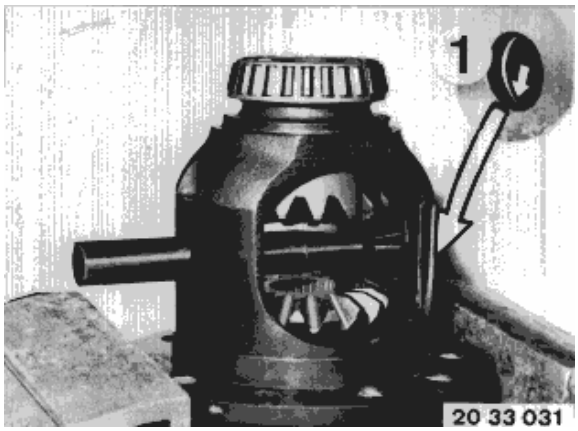
Shims (2) are available in gage steps of 0.05 mm.

The opposite end is determined in the same manner.



Install shims (2) of determined thickness and diaphragm springs (1).

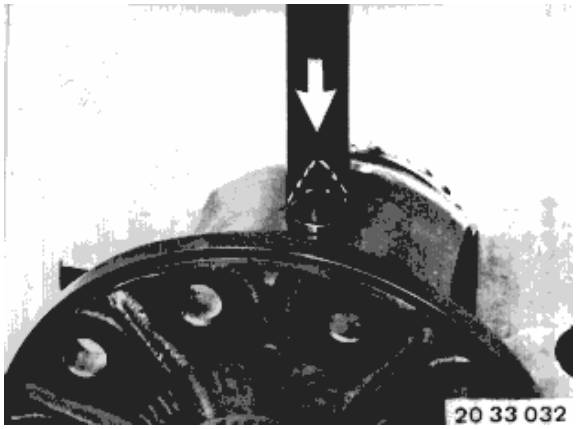
Inside curved surfaces of diaphragm springs (1) face differential case.



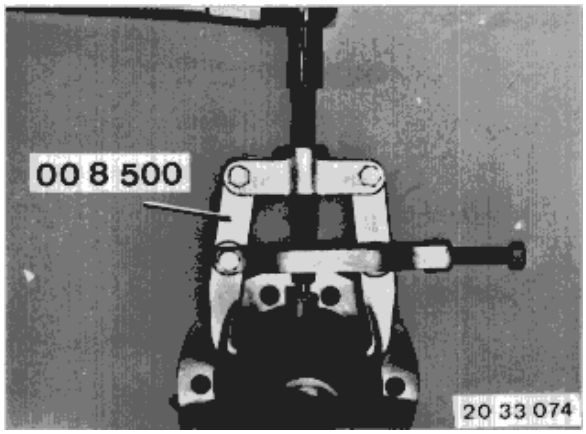
Operation with special tool 00 8 500 (extractor fixture)

Check that circlip (1) is in correct installed position.

Slide in special tool 33 1 470 (feed mandrel) on the side without circlip.



Place differential gear shaft with large opening on special tool and press in until 1 to 2 cm of shaft is visible.



Fit special tool 00 8 500 (extractor fixture) to final drive basket.

Torque = 22 Nm

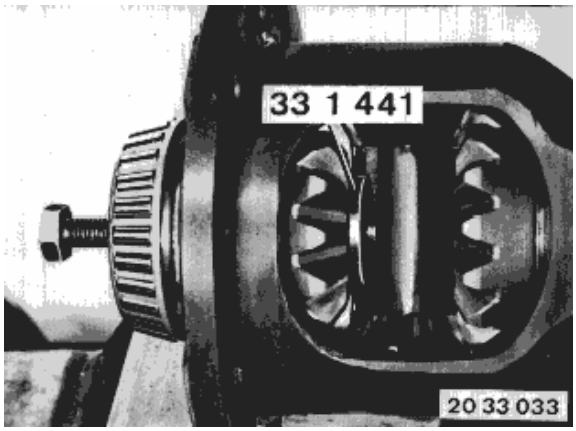
(threaded spindle diameters 18 mm and 20 mm)

Caution!

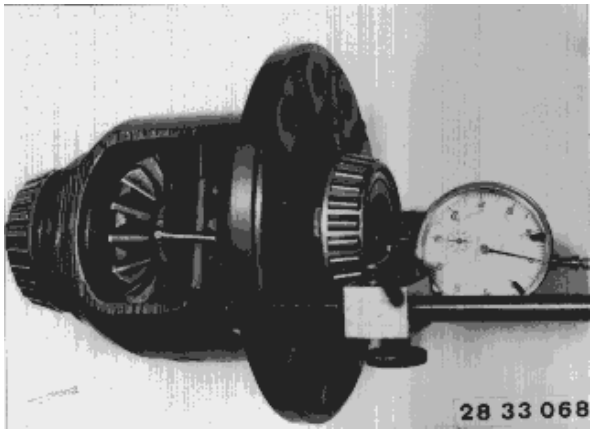
Lubricate center on differential gear shaft with oil before application of the special tool.

Differential gear shaft must no longer be pushed back after installation.

Always ensure that the last quarter of the torque (from approx. 17 Nm) is tightened at a uniform speed (i.e. smoothly and evenly).

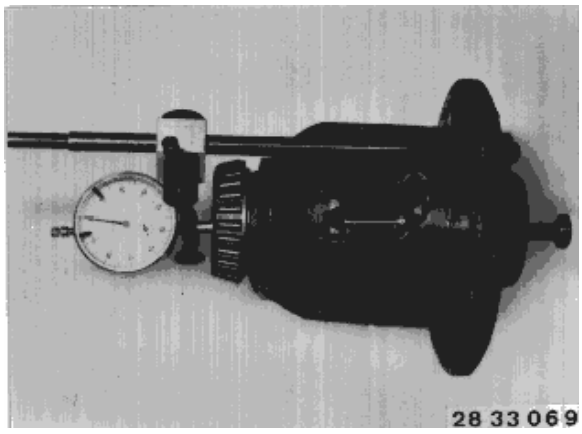


To measure preload of plate springs, install special tool 33 1 441 (threaded plate) and spindle. Tighten spindle by hand.



Mount holder with dial gage.

Set dial gage to zero with preload.



Tighten spindle until diaphragm springs are pressed flat.

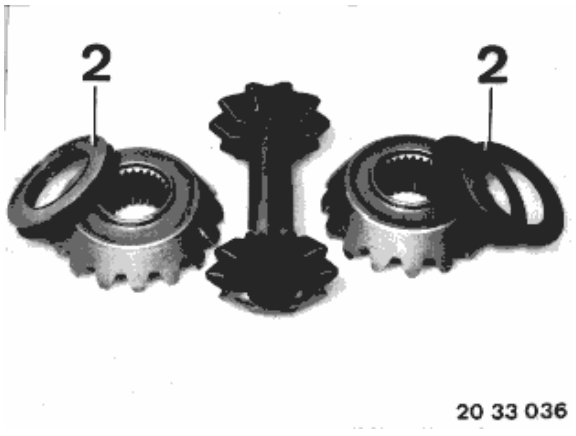
Read dial gage. Loosen spindle.

Turn shaft gear and measure again at several points.

To ensure that the plate spring is not block-preloaded, clearance of 0.03 ... 0.1 mm must be available.

The lower value would be ideal.

Repeat measurements on opposite shaft gear.



Excessive Clearance:

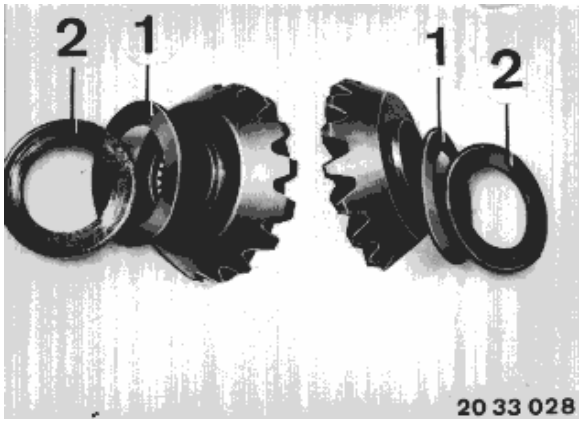
Install thicker shim.

Insufficient Clearance:

Install thinner shim.

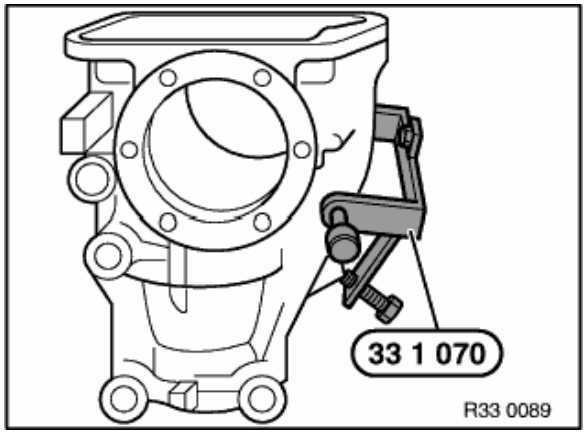
Shims (2) are available in gage steps of 0.05 mm.

The opposite end is determined in the same manner.



Install shims (2) of determined thickness and diaphragm springs (1).

Inside curved surfaces of diaphragm springs (1) face differential case.



Remove final drive,

refer to 33 10 010.

Secure final drive to assembly frame with special tool 33 1 070.

Drain off fluid. Take off case cover.

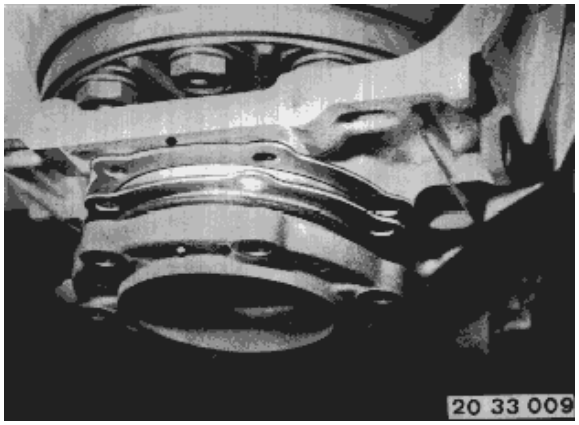
Installation:

Tightening torque,

refer to Technical Data 33 11 1AZ.

Top up oil level,

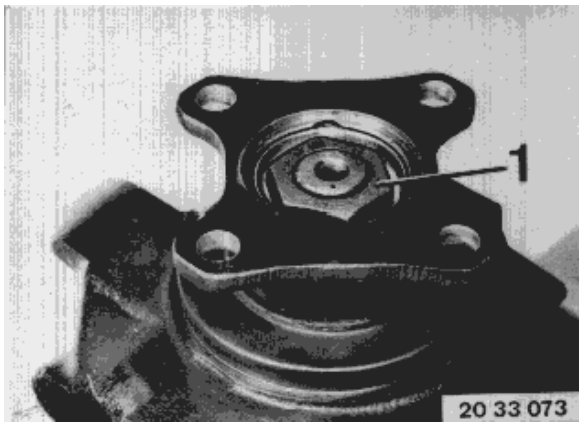
refer to Technical Data.



Remove complete final drive housing.

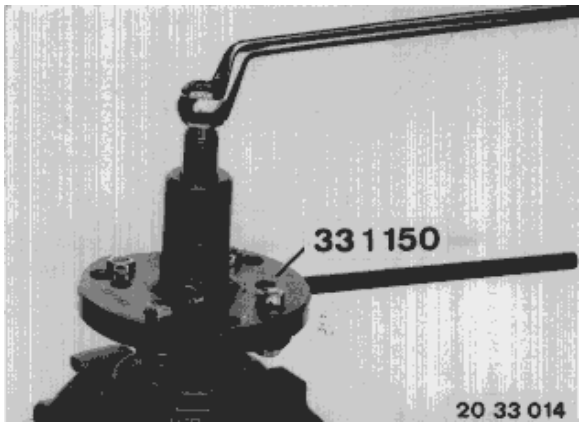
Caution!

Mark out bearing cover: do not confuse shims.



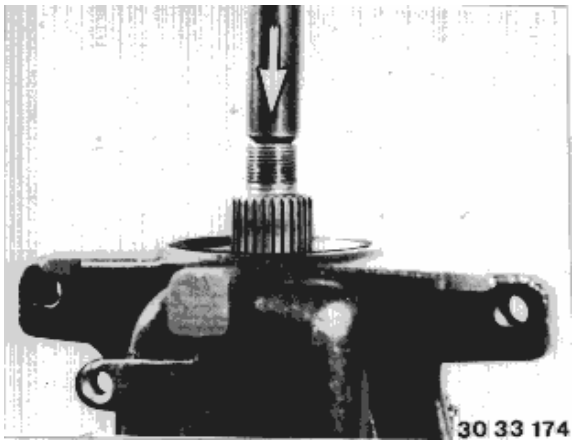
Remove lockplate.

Unfasten nut (1) and brace with special tool 23 0 020.



Remove input flange with special tool 33 1 150.

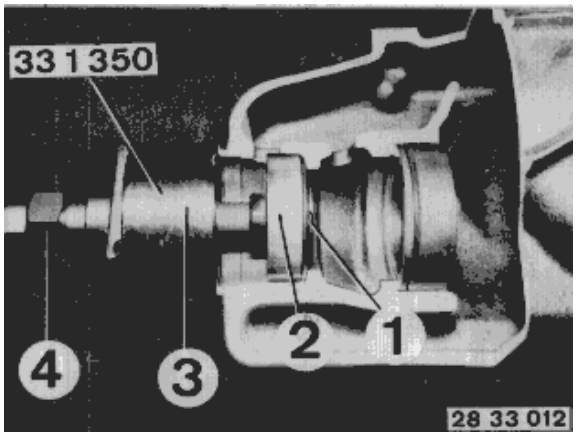
Specified friction torque is indicated on the new drive pinion bearing and friction torque of old bearing does not have to be measured.



Press out drive pinion.

Caution!

Be careful not to damage threads.



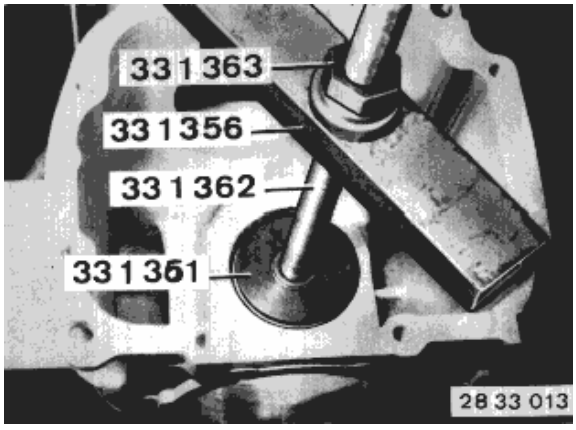
Extract front outer bearing race with special tool 33 1 350.

(1) Spreader

(2) Front bearing outer race

(3) Puller bell housing

(4) Bolt

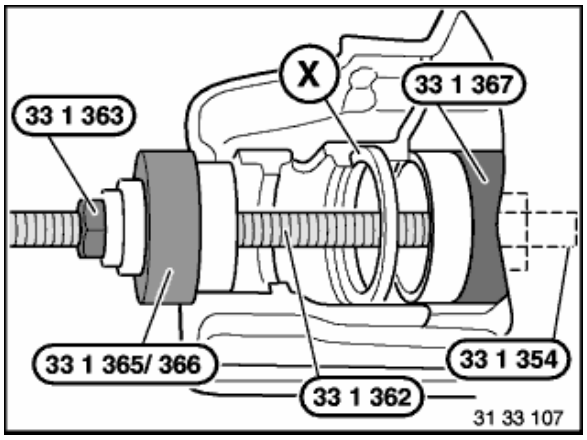


Remove rear outer bearing race with special tool 33 1 360/351/362/356/363.

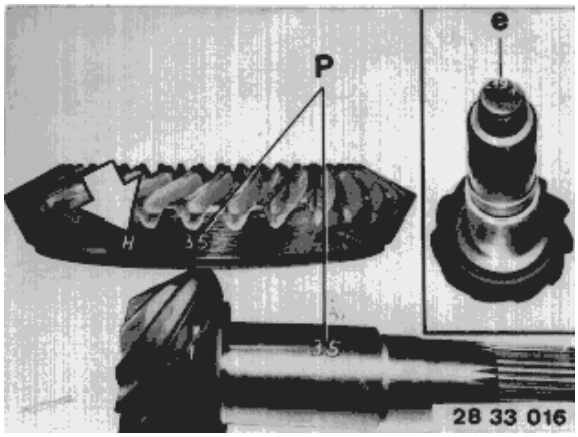
Caution!

The shim (X) is located below the rear outer bearing race. It will be needed again for pinion/crown wheel adjustments.

Measure and note down thickness of shim (X), e.g. X = 4.14 mm.



Install old shim (X) in front of rear outer bearing race. Fit new outer bearing race with special tool 33 1 354 / 362 / 363 / 360 / 365 / 366 / 367.

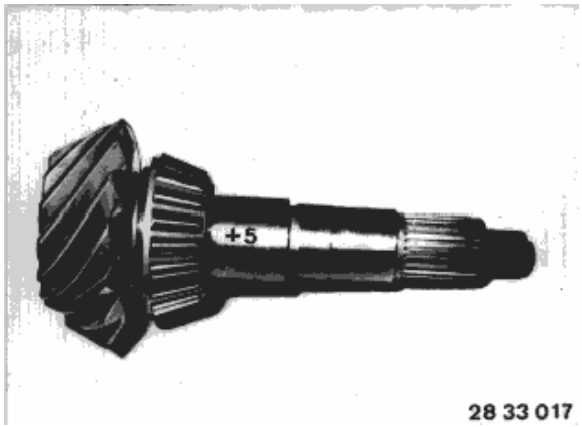


Caution!

Drive pinions and crown wheels are paired for optimal smooth running in special machines.

The pairing code (P) is inscribed electrically on the drive pinion and crown wheel.

Never install crown wheel and drive pinion with different pairing codes (P) together.

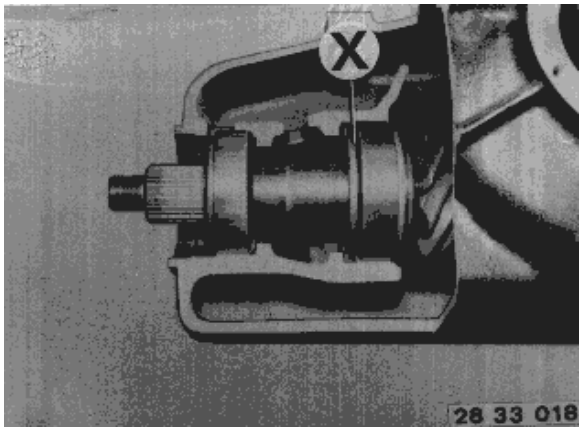


Press taper roller bearing onto new drive pinion with special tool 33 1 330.

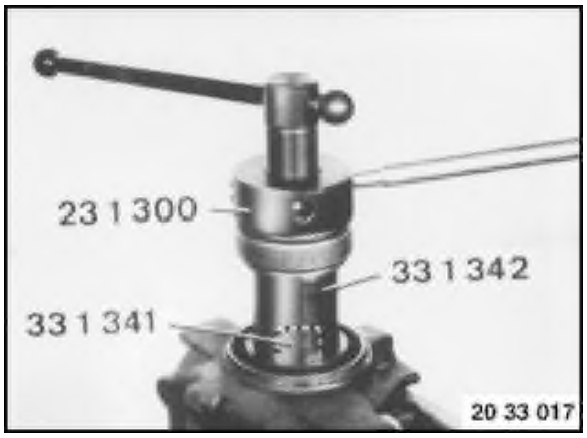
The number applied with "+" or "-" is the deviation from basic adjustment dimension C in hundredths of a millimetre and is used for determining the correct thickness of shims.

Note number with prefix (add + e to C or subtract - e from C, refer to example).

H = designation for Gleason gear

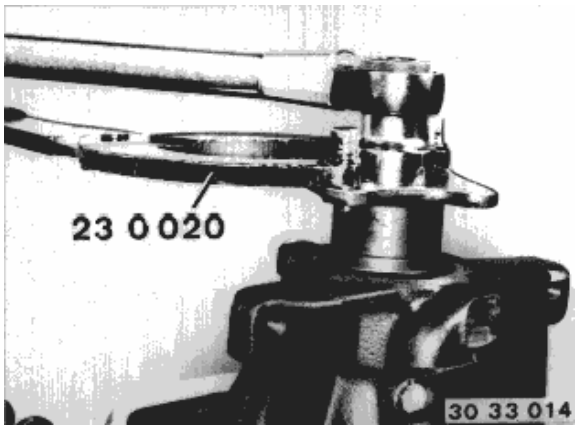


To calculate the correct shim (X), drive pinion is installed with new taper roller bearings but without a clamping bush.



Install drive pinion in the rear bearing outer race.

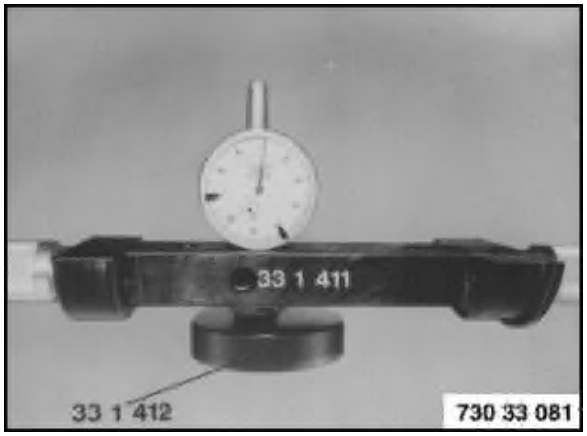
Twist special tool 33 1 341 (reducer) onto drive pinion and pull front taper roller bearing onto drive pinion with special tool 23 1 300 in conjunction with special tool 33 1 342 (spacer bush).



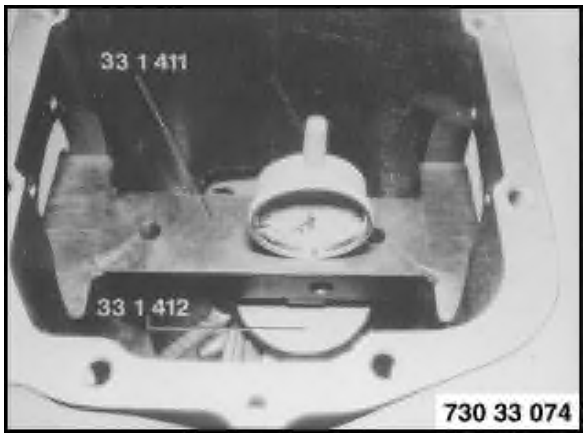
Mount input flange.

By tightening the collar nut, adjust friction torque of input taper roller bearing to 250 Ncm.

Calculate thickness of shim (A).



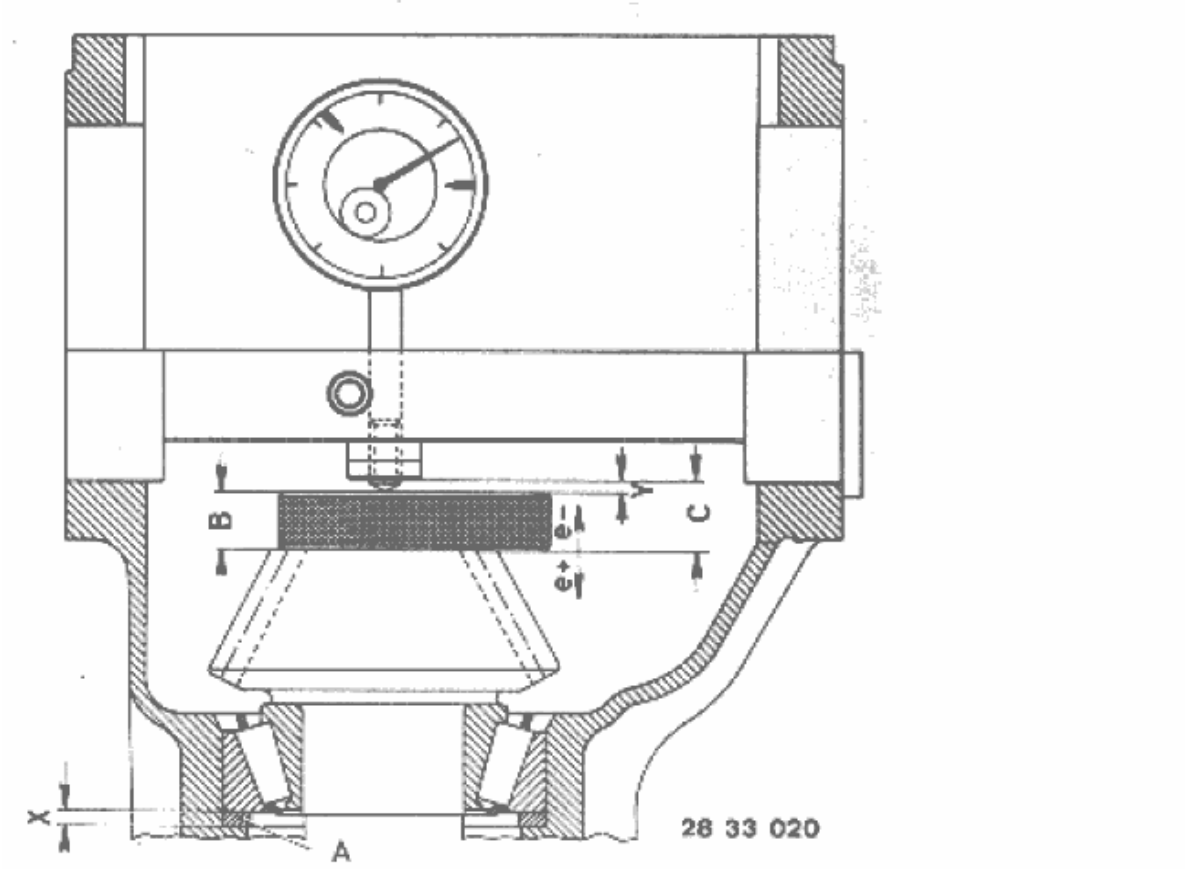
Secure dial gauge to special tool 33 1 411, place on special tool 33 1 412 and adjust dial gauge preload to 0 (zero).



Fitting special tool 33 1 412 to drive pinion. Install special tool 33 1 411 in housing.

Read value (Y) and note down e.g. Y = 0.60 mm.

Example:



C = 18.50 mm (basic adjustment dimension for all Type G final drives)

B = 17.50 mm (special tool 33 1 412)

- / +e = coefficient of bevel gear e.g. - e 30

Y = measured distance e.g. 0.60 mm

X = old shim e.g 4.14 mm

A = thickness of correct shim

Establishing correct thickness of shim:

C nominal = C - e = 18.50 mm - 0.30 mm = 18.20 mm

C actual = B + Y = 17.50 mm + 0.60 mm = 18.10 mm

D (difference) = C nominal - C actual = 18.20 mm - 18.10 mm = +0.10 mm

A = X - D = 4.14 mm - (+0.10 mm) = 4.04 mm

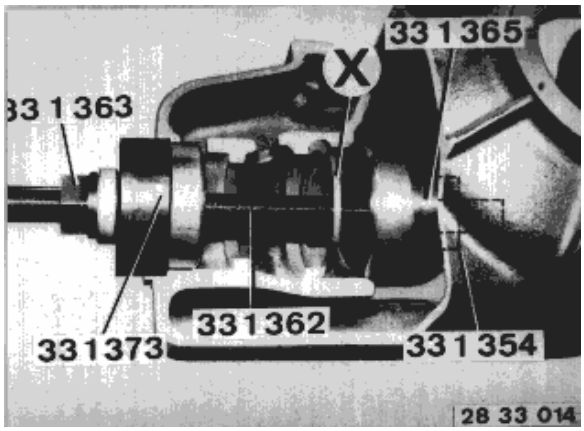
The correct thickness for the shim is 4.04 mm.

Caution!

If the difference (D) is positive, the old shim was this much too thick.

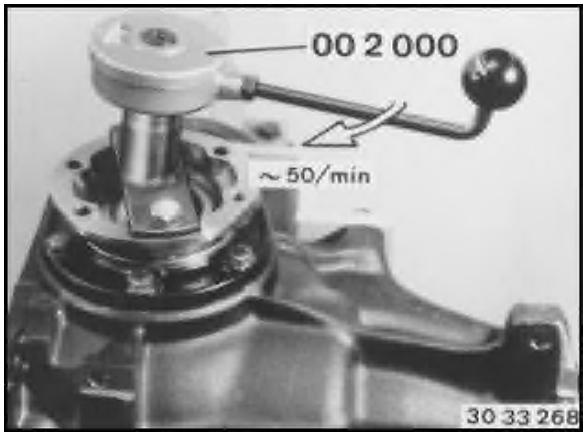
If the difference (D) is negative, the old shim was this much too thin.

The permitted tolerance for the shim (A) is derived from the available shim gauges which range from 0.01 ... 0.03 mm.



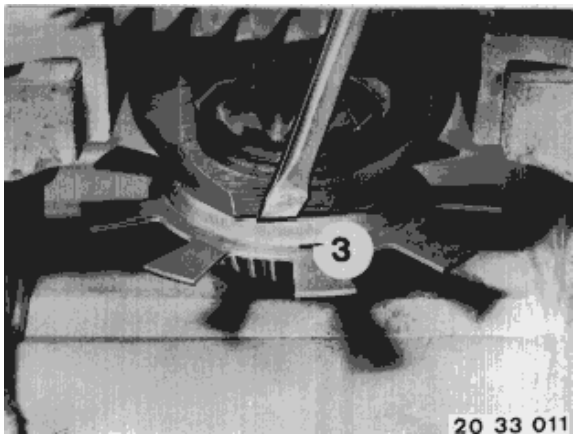
Remove drive pinion and rear bearing outer race.

Press-fit correct thickness of shim (A) and outer bearing race.



Caution!

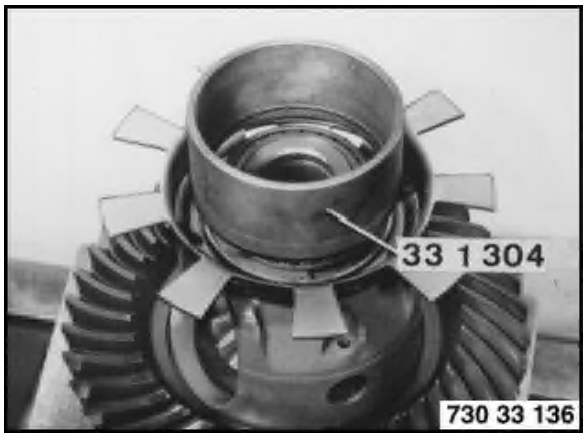
Do not install the drive pinion at this point, since it is first necessary to measure and adjust the friction torque of the new final drive housing bearing.



Press pulse generator wheel (3) off final drive housing.

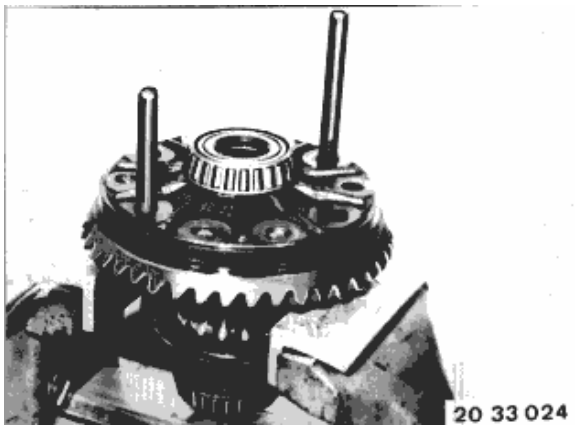
Caution!

Do not bend the pulse generator wheel.



Installation:

Press on pulse alternator wheel with special tool 33 1 304 (union ring).



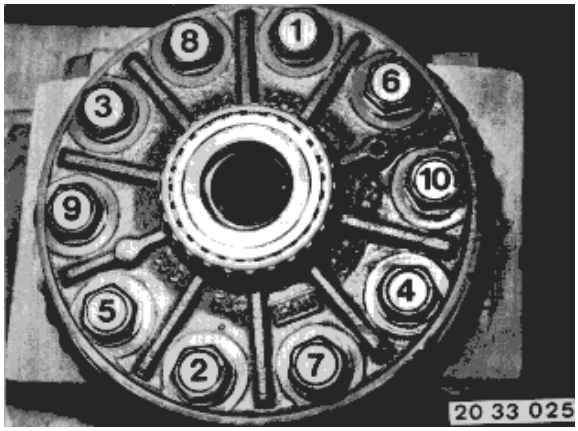
Remove crown wheel (cold).

Installation:

Clean tapped bores thoroughly (tapper).

Heat plate spring to max. 100 °C (thermo-chrome pin).

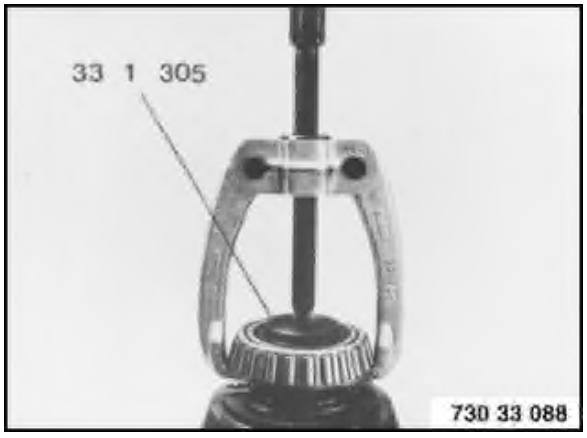
Mount crown wheel with two locally manufactured staybolts for guiding.



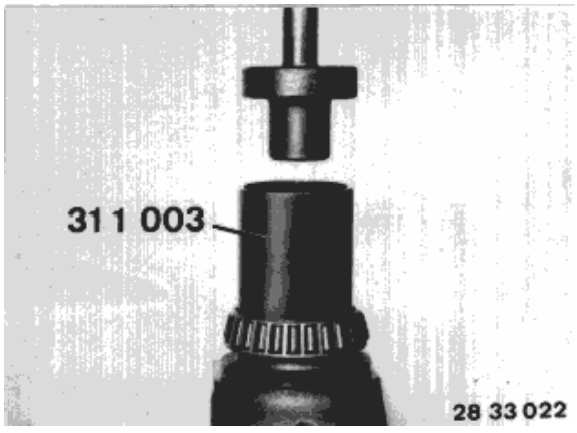
Install new screws with Loctite No. 270 and tighten down in sequence (1 ... 10).

Tightening torque,

refer to Technical Data 33 12 1AZ.

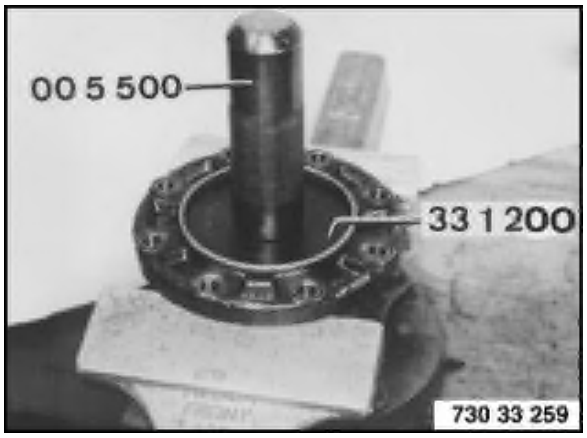


Remove taper roller bearing from recesses on final drive housing with standard extractor tool in conjunction with special tool 33 1 305 (pressure piece).



Installation:

Press-fit new taper roller bearing inner races cold with special tool 33 1 003 (sleeve).

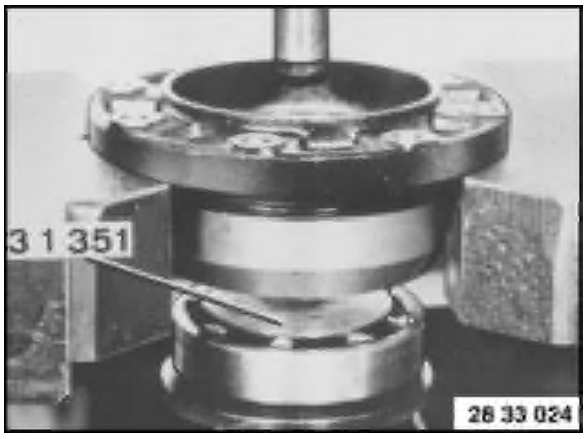


Lift shaft seals out of both bearing caps.

Installation:

Dip new shaft seal in final drive oil.

Drive shaft seals firmly home with special tools 33 1 200 and 00 5 500.



Press out outer bearing race with special tool 33 1 350 / 351.

Caution!

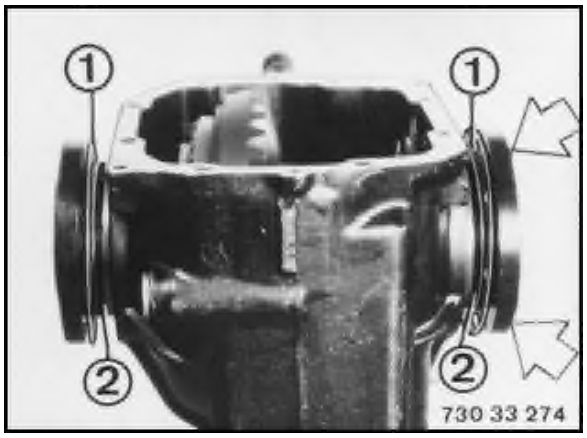
Special tool must engage in the bearing outer race.



Installation:

Press in new outer bearing races with special tool 33 1 365 or 33 1 368 (pressure plate).

The following operations for determining friction torque of the final drive housing bearing are only required if the bearing IS BEING REPLACED.



Determine friction torque of final drive housing bearing:

Install final drive housing with new crown wheel and new bearings.

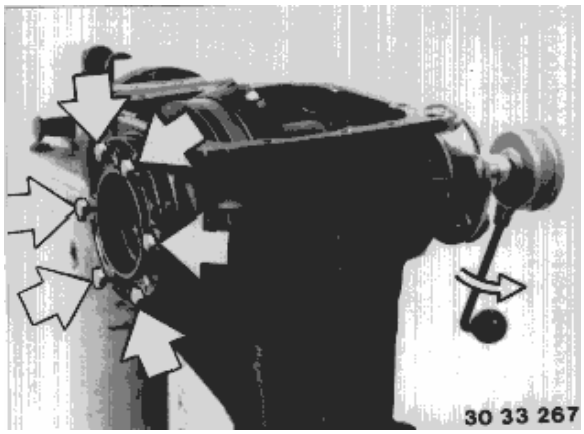
Coat bearing with approved final drive oil, refer to BMW Service Operating Fluids.

Note designation on side bearing cover, and install with appropriate shims (1), but without O-rings (2).

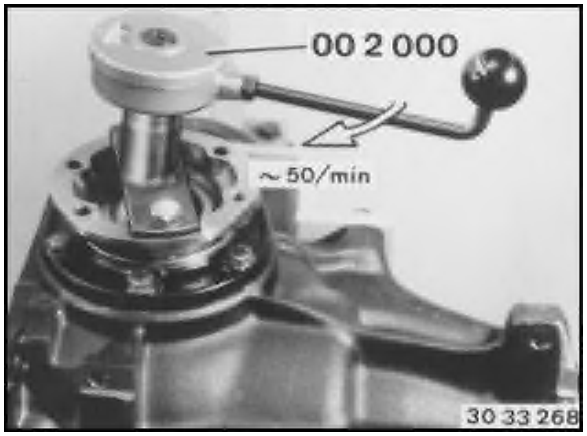
Tighten down screws on bearing cover beside bevel gear.

Tightening torque,

refer to Technical Data 33 11 2AZ.



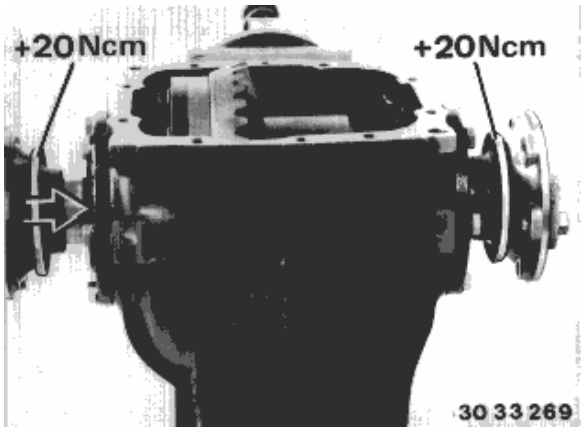
Tighten screws on bearing cover beside bevel gear uniformly to the point where the final drive is still just able to rotate.



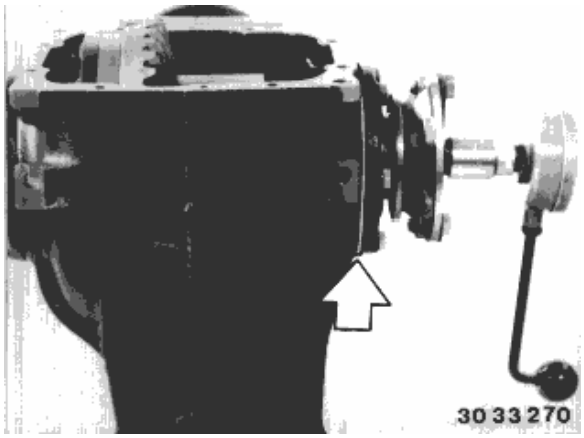
Install an input flange on the bevel gear end.

Using a bracket with welded nut (in-house manufacture) and special tool 00 2 000, calculate the friction torque.

Turn friction torque meter at speed of approx. 50 rpm.



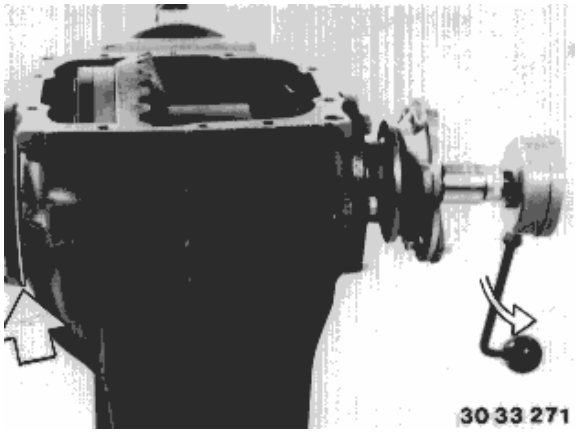
The friction torque specified for the new final drive bearing kit (+20 Ncm for every new shaft seal in which a shaft is rotating during measurement) should be achieved but not exceeded.



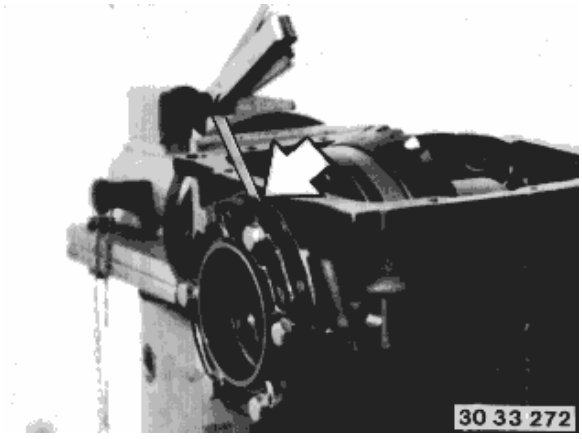
If the specified friction torque is not achieved although both bearing covers have been tightened to the specified tightening torque,

refer to Technical Data 33 11 2AZ,

a thinner shim must be installed at the crown wheel end and the measurement must be repeated.



If the friction torque level is achieved even though the second bearing cover has not been tightened to the specified tightening torque, a thicker shim must be installed at the crown wheel end and the measurement must be repeated.



To simplify calculation of the shim thickness, the distance between shim and transmission case must be measured with a feeler gauge and added to the shim thickness fitted.



Example:

Bearing cover at crown wheel end not tightened down (screws tightened uniformly). Friction torque specified on bearing set packaging 180 Ncm.

1 output flange fitted

New shaft seal = 20 Ncm

Measured friction torque = 200 Ncm

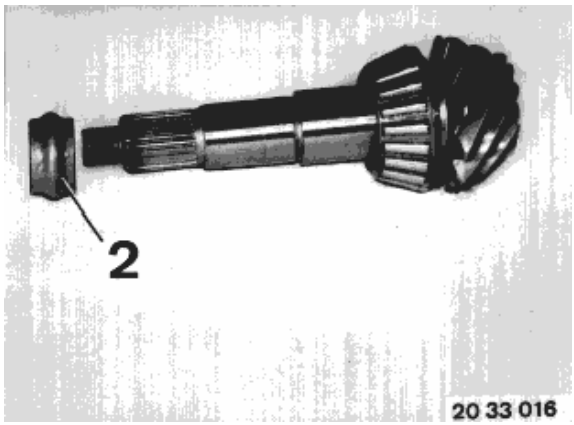
Gap measured with feeler gauge = 0.20 mm

Shim used = 1.40 mm

New shim = 1.60 mm

Install new shims, 1.60 mm gage, and repeat measurement.

Once the friction torque has been established, remove final drive and mark shims used in bearing cover and transmission.



Install bevel gear and shim:

Install drive pinion with a new clamping sleeve (2).

Drive in shaft seal and fit input flange.

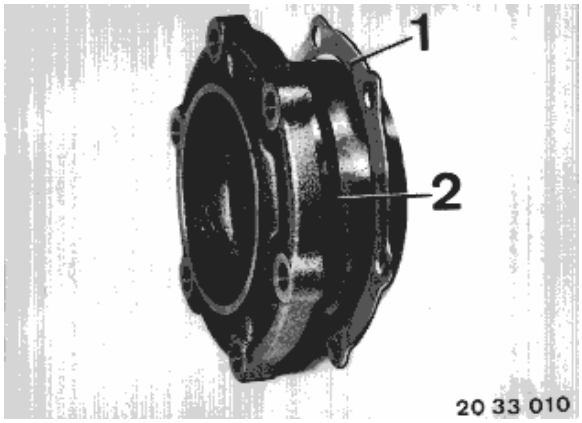


Caution!

Gradually tighten the collar nut (1), measuring the friction torque at regular intervals with special tool 00 2 000 (friction torque gauge). Tighten down the collar nut until the friction torque value specified for the new taper roller bearing plus 20 Ncm for the new shaft seal is reached.

The friction torque level should be reached but must not be exceeded.

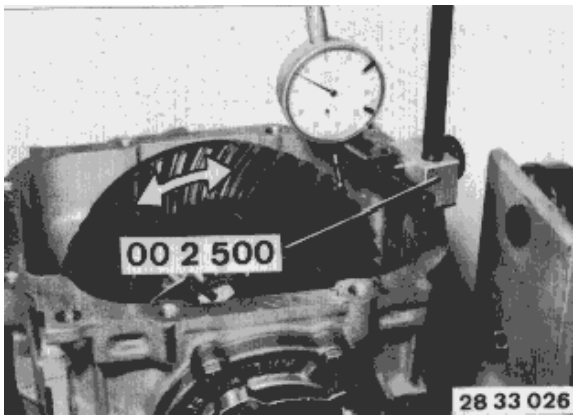
If friction torque value is exceeded, replace bushing (2) and repeat measuring procedures.



Install final drive and bearing cover after marking the appropriate shims (1) and installing new O-rings (2): then tighten screws down evenly.

Tightening torque,

refer to Technical Data 33 11 2AZ.



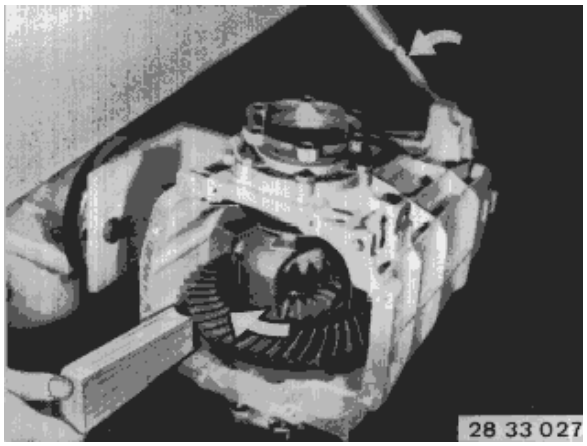
Backlash/Tooth Contact Pattern Adjustment

Secure special tool 00 2 500 and measure torsional face runout,

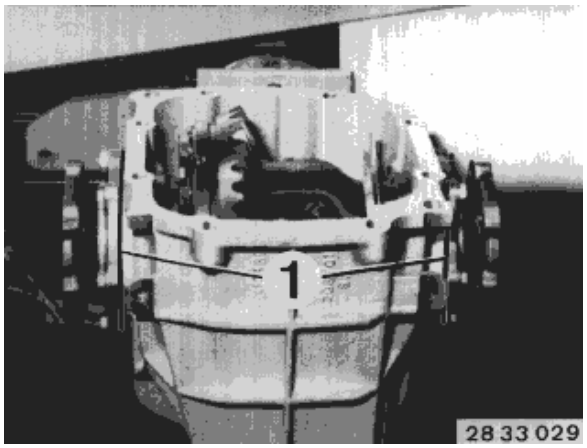
refer to Technical Data.

Caution!

The tooth contact pattern is always most important for a perfectly adjusted pinion/crown wheel.



To check the tooth contact pattern, coat the crown wheel teeth with printer's ink, turn in both directions several times and stop crown wheel suddenly with a piece of hard wood.



Correction of torsional face runout and contact pattern is performed by altering the thicknesses of both shims (1).

If backlash is too great, install a thinner shim on the crown wheel end.

If backlash is too small, use a thicker shim on the crown wheel end.

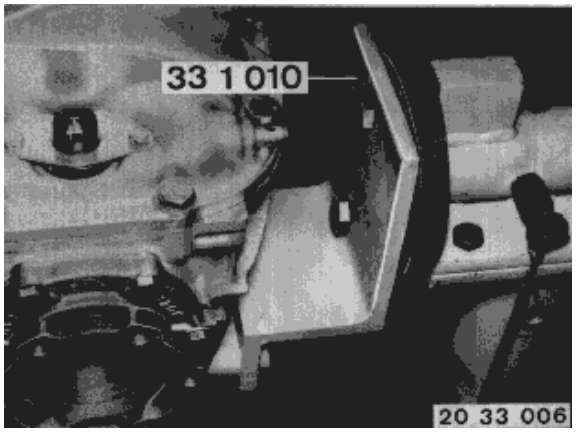
Axial displacement of the crown wheel of 0.01 mm signifies a change in tooth flank clearance of 0.0076 mm.

Caution!

The total thickness of both shims must not be altered.

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.

33 12 551 Replacing input bevel gear and crown wheel (Type M) - final drive housing removed -



Removing and installing final drive, included in MF Workshop Manual, model-dependent, from '85,

refer to 33 10 010.

Securing final drive to special tool 33 1 010 (retaining bracket).

Drain ATF. Take off case cover.

Installation:

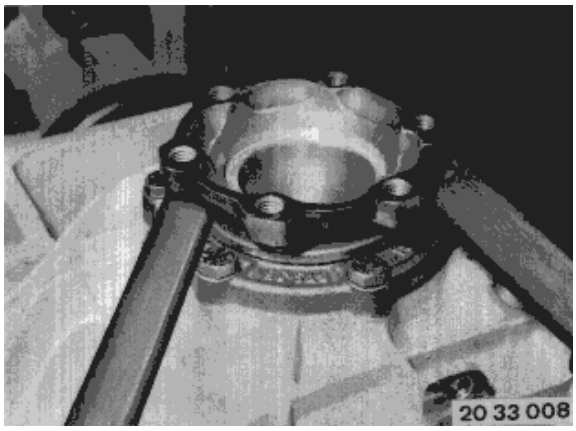
Replace gasket.

Tightening torque, refer to Technical Data

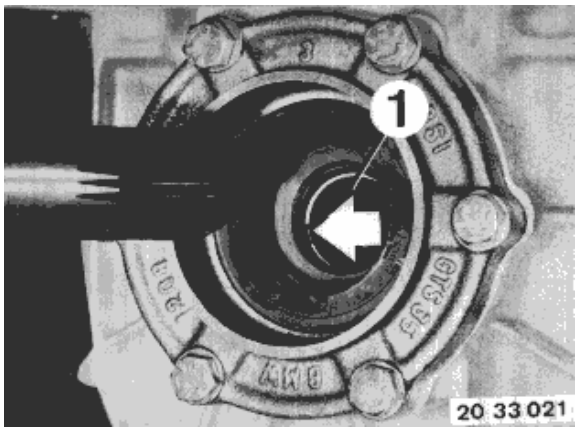
Add oil.

Oil volume, refer to Technical Data

Refer to Fluids and Lubricants for approved oil.



Press off both drive flanges with a tire iron.



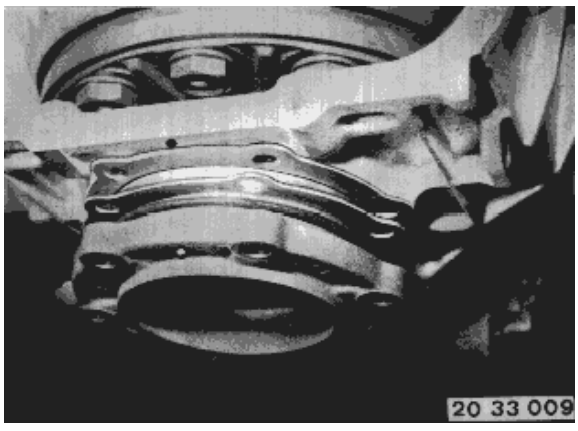
Installation:

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 turn slightly until wire snap ring is heard to engage.

Replace stretched snap rings.



Punch mark both bearing caps.

Unscrew and remove both bearing caps.

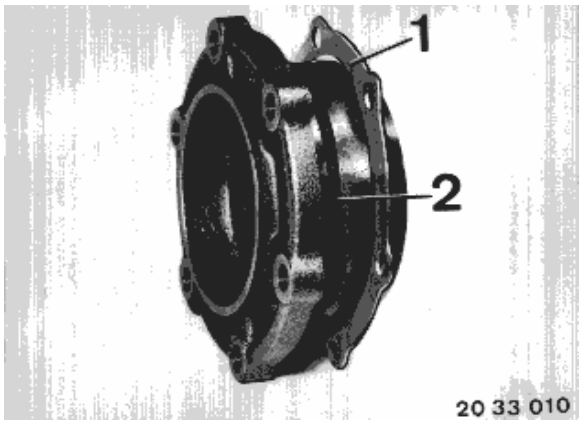
Caution!

Don't mix up bearing caps and spacers.

Secure spacers on bearing cap with a piece of wire, if necessary.

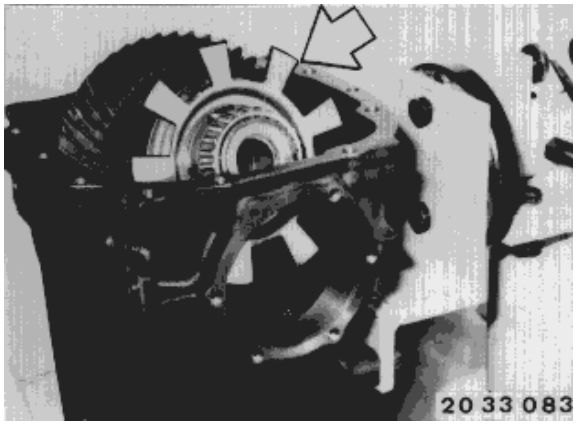
Installation:

Tightening torque, refer to Technical Data



Final drive housing bearings and backlash are adjusted with shims (1).

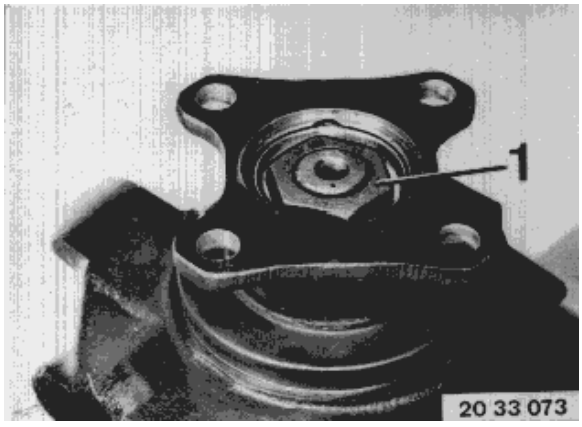
Check O-ring (2), replacing if necessary.



Remove complete final drive housing.

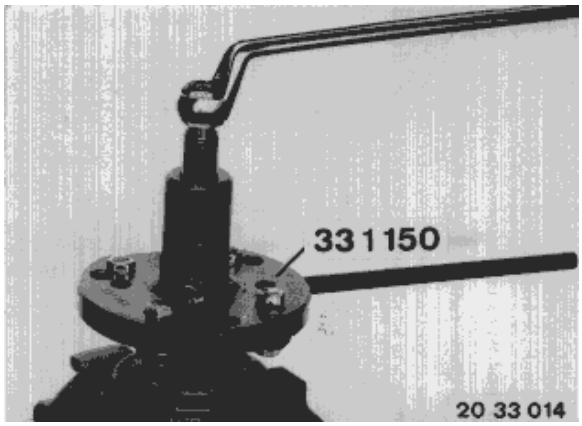
Caution!

Don't bend the pulse spider.



Remove lockplate.

Unfasten nut (1) and brace with special tool 23 0 020.

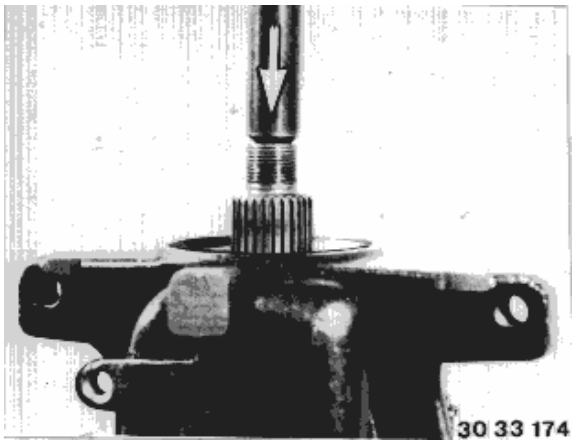


Remove input flange with special tool 33 1 150.

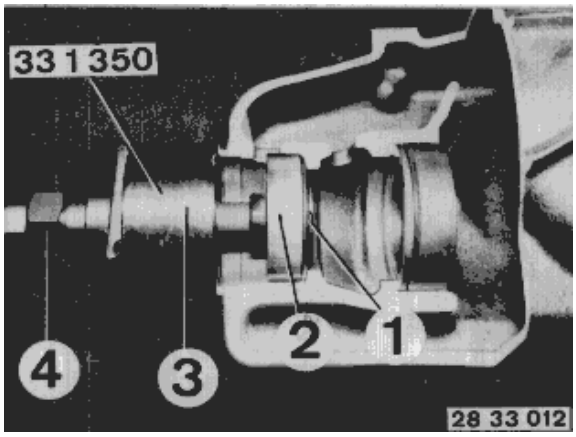
The specified friction torque for the new input bevel gear bearing is indicated,

refer to Technical Data

The friction torque of old bearings does not have to be measured.



Press out drive pinion.



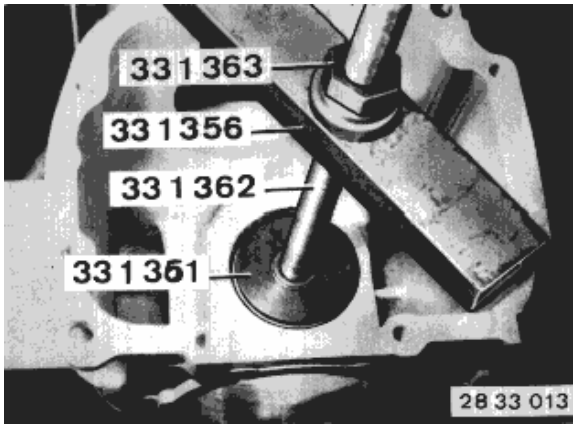
Extract front bearing outer race with special tool 33 1 350 (fixture).

(1) Spreader

(2) Front bearing outer race

(3) Puller bell housing

(4) Pressure bolt



Extract rear outer bearing race with special tool 33 1 360 (fixture).

Puller consists of:

Special tool 33 1 351 (extractor head)

Special tool 33 1 362 (threaded spindle)

special tool 33 1 356 (support bridge)

Special tool 33 1 363 (pressure nut)

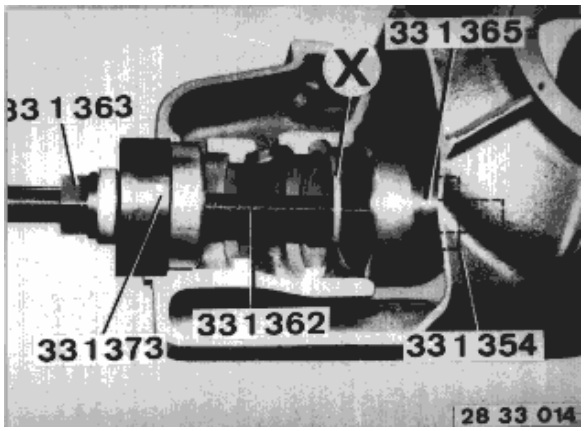
Caution!

Shim (X) is located underneath the rear bearing outer rac.

It will be needed again for pinion/crown wheel adjustments.

Caution!

Replace both drive pinion bearings, using only one make.



Install old shim (X) in front of the rear bearing outer race.

Install new bearing outer races with special tool 33 1 360 (installation fixtur).

Puller consists of:

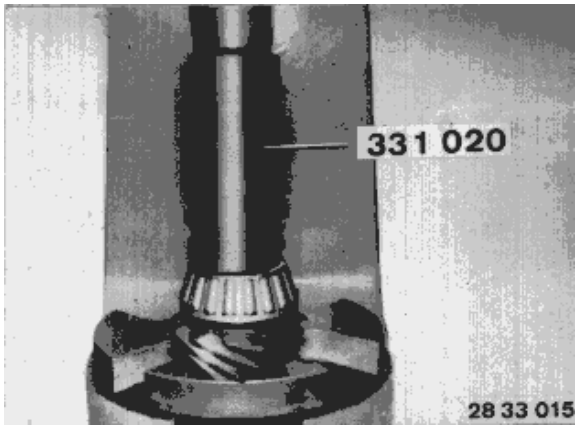
Special tool 33 1 373 (puller disc for front outer race)

Special tool 33 1 365 (puller disc for rear outer race)

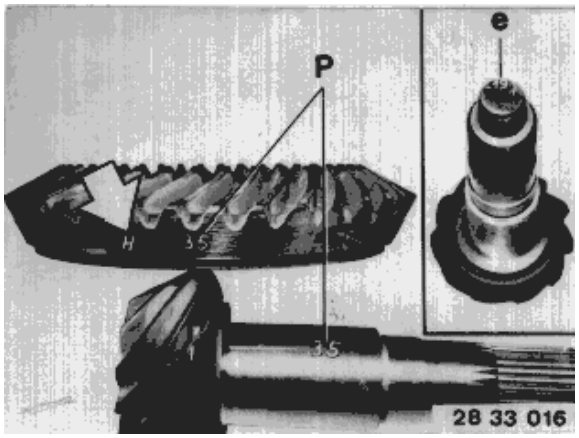
Special tool 33 1 362 (threaded spindle)

Special tool 33 1 363 (pressure nut)

Special tool 33 1 354 (nut)



Press-fit new taper roller bearing inner race to new drive pinion using special tool 33 1 020 (sleeve).



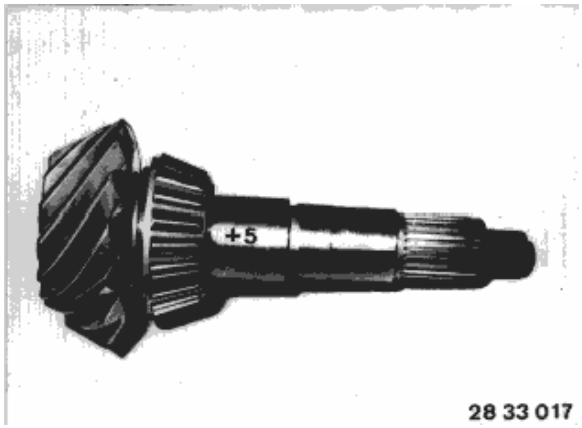
Caution!

Drive pinions and crown wheels are paired for optimal smooth running in special machines.

The pairing code (P) is inscribed electrically on the drive pinion and crown wheel.

Never install crown wheel and drive pinione with different pairing codes (P) together.

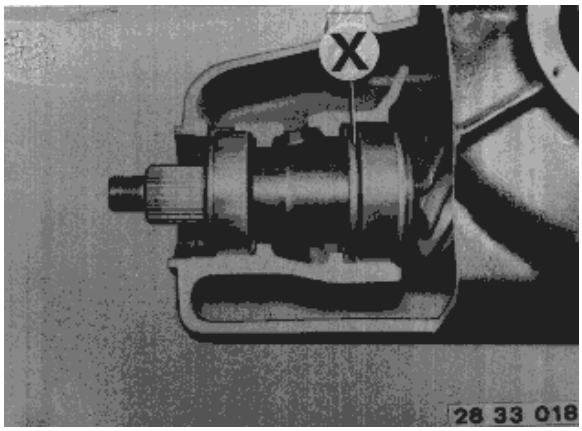
H = Gleason hypoid teeth (helical shape).



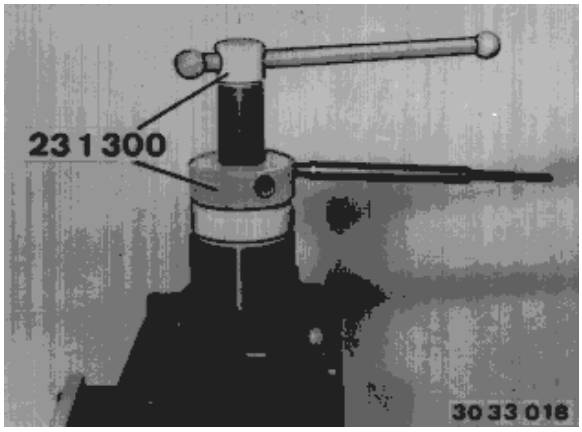
The inscribed number with "+" or "-" is the deviation from basic distance C in hundreths of millimeters and is required for adjustment of the tooth contact pattern with shims.

+ e is added to C.

- e is subtracted from C.

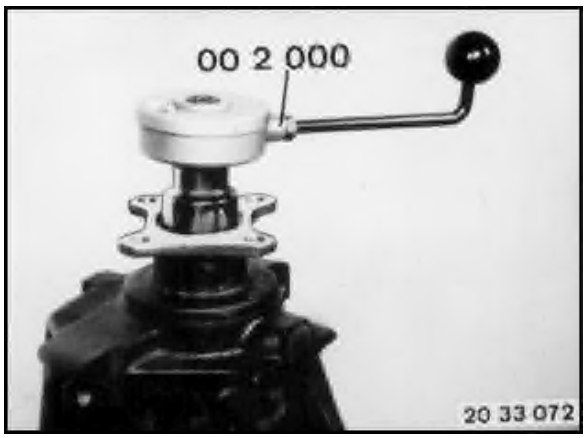


To determine the thickness of shim (X), install drive pinion with new tapered roller bearings, but without bush.



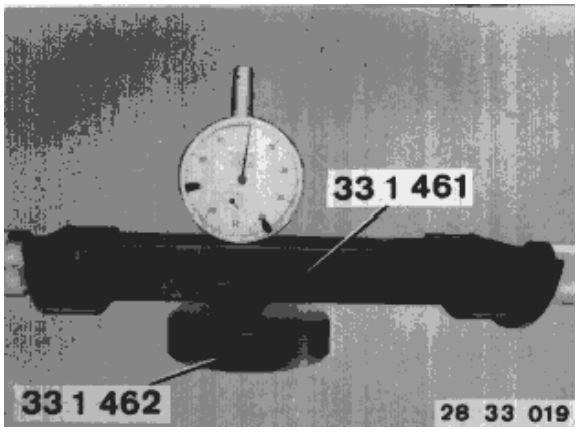
Install drive pinion in the rear bearing outer race.

Press-fit front taper roller bearing to the drive pinion with special tool 23 1 300 in conjunction with a spacer bush but do not tighten down.



Mount input flange.

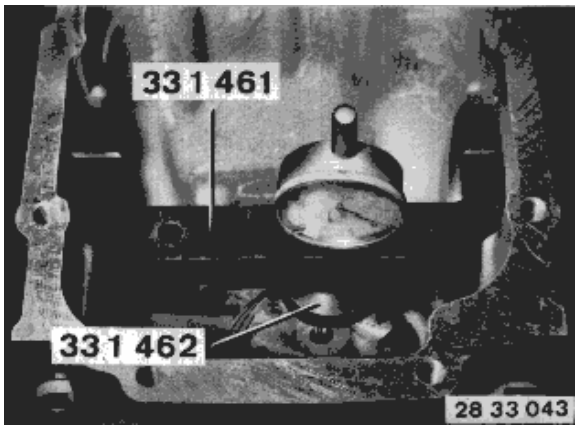
Gradually tighten collar nut, occasionally measuring friction torque with special tool 00 2 000 (friction torque gauge) and adjust with collar nut to 250 Ncm.



Block Distance of Drive Pinion

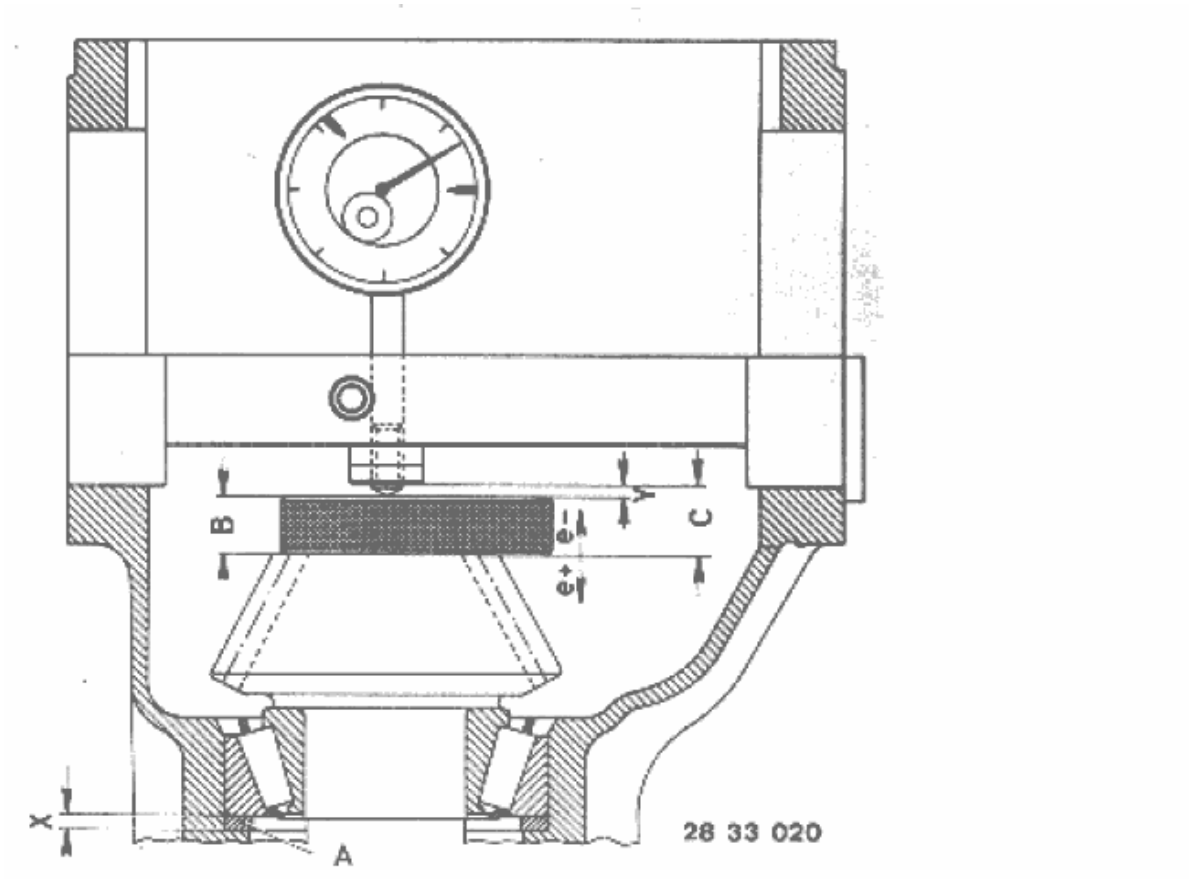
Secure dial gauge in special tool 33 1 481 (measuring fixture).

Place special tool 33 1 461 (measuring fixture) with dial gauge on special tool 33 1 462 (measuring dics) and set dial gauge with preload at zero.



Fit special tool 33 1 462 (measuring disc) to drive pinion.
Install special tool 33 1 461 (measuring fixture) in housing.
Determine value Y.
Basic distance C = 11.50 mm
Gage thickness B = 9.50 mm

Examples for Determination of Correct Shim Thickness (X)



Example I:

C	11,50 mm
e +	0,10 mm
C nominal	11,60 mm

Y measured on dial gage	1,90 mm
+ gage thickness B	9,50 mm
C actual	11,40 mm

C nominal	11,60 mm
C actual	- 11.40 mm
a	0,20 mm
Master disc A	4,10 mm
- a	0,20 mm
Thickness of shim (X)	3,90 mm

If C nominal is greater than C actual, "a" is subtracted from thickness of shim (X).

Example II:

C	11,50 mm
e -	0,10 mm

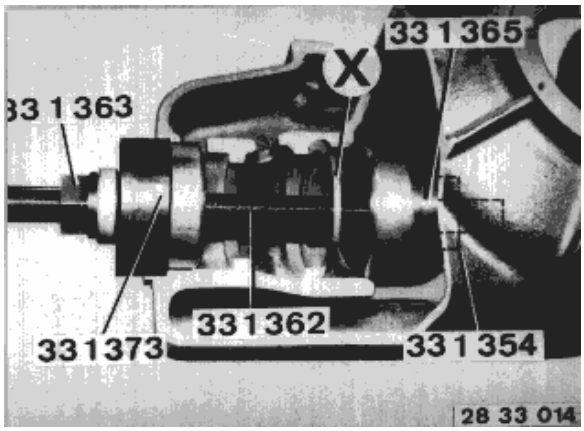
C nominal	11,40 mm

Y measured on dial gage	2,20 mm
+ master disc thickness	9,50 mm
C actual	11,70 mm

C nominal	11,70 mm
C actual	- 11,50 mm
a	0,20 mm
Master disc A	3,90 mm
- a	0,20 mm
Thickness of shim (X)	4,10 mm

If C Nominal is less than C Actual, "a" on the shim ring (x) is added to the value.

The permitted tolerance for dimension (x) is derived from the gage steps available for shim rings (0.01 ... 0.03 mm)

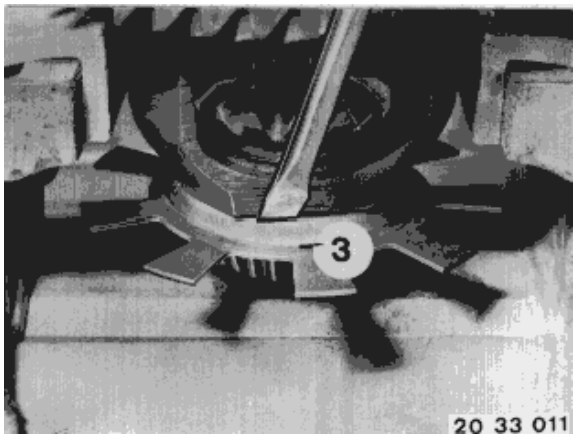


Remove drive pinion and rear bearing outer race.

Press in shim (X) of determined thickness and bearing outer race.

Caution!

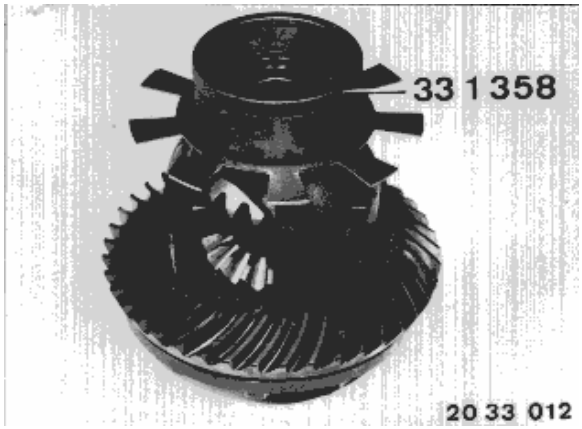
Do not install the drive pinion at this point, since it is first necessary to measure and adjust the friction torque of the new final drive housing bearing.



Press pulse spider (3) off of final drive housing.

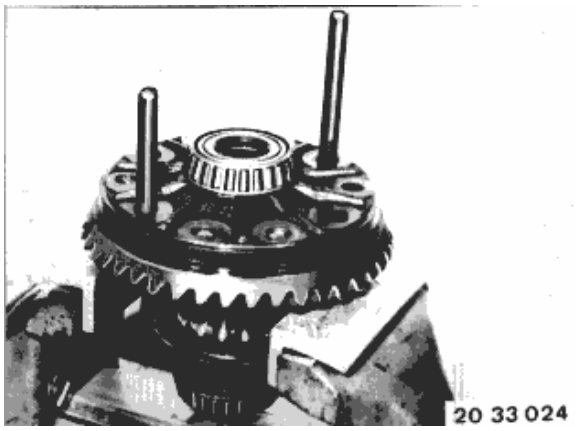
Caution!

Don't bend the pulse spider.



Installation:

Press fit pulse generator wheel with special tool 33 1 358 (pressure sleeve).



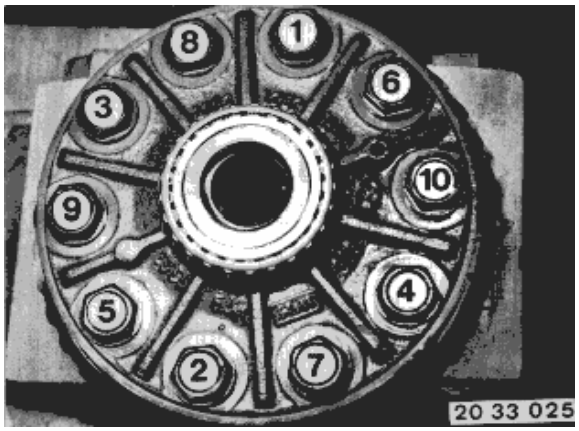
Remove crown wheel (cold).

Installation:

Clean tapped bores thoroughly (tapper).

Heat plate spring to max. 100° C (thermo-chrome pin).

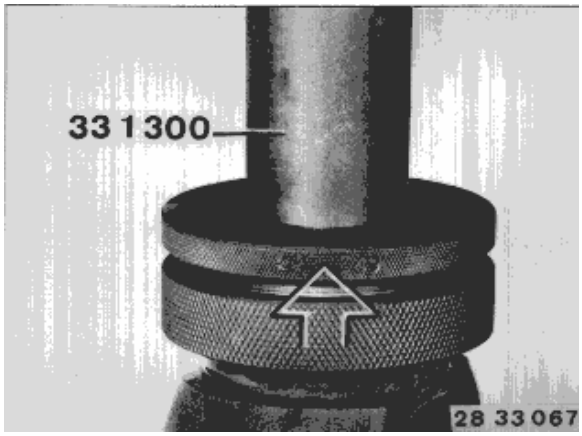
Mount crown wheel with two locally manufactured staybolts for guiding.



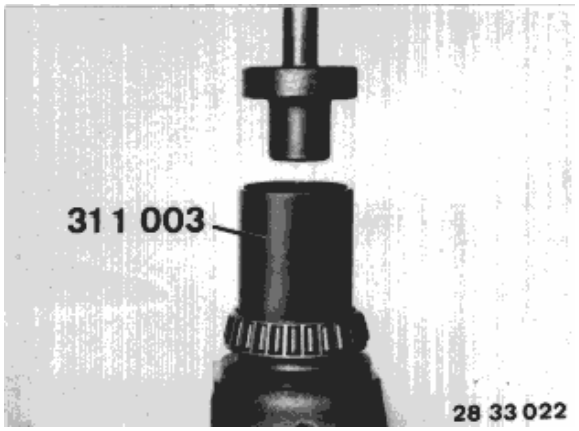
Install new bolts with Loctite No. 270 and tighten in order of (1 ... 10)

Tightening torque and torque angle,

refer to Technical Data

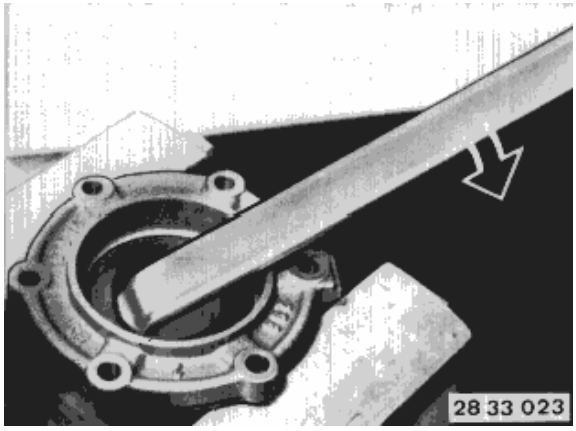


Extract taper roller bearing on final drive housing with special tool 33 1 300 (extractor).

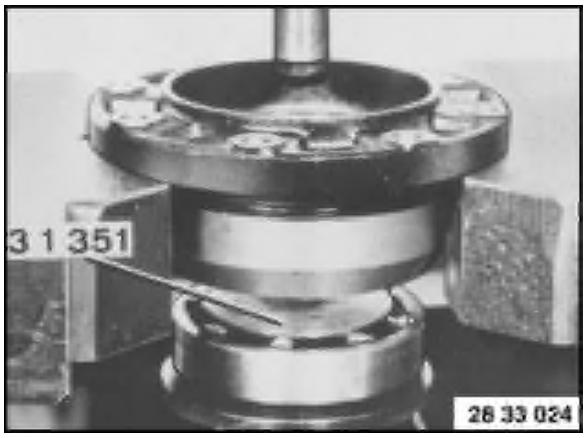


Installation:

Press-fit new taper roller bearing inner races cold with special tool 33 1 003 (sleeve).



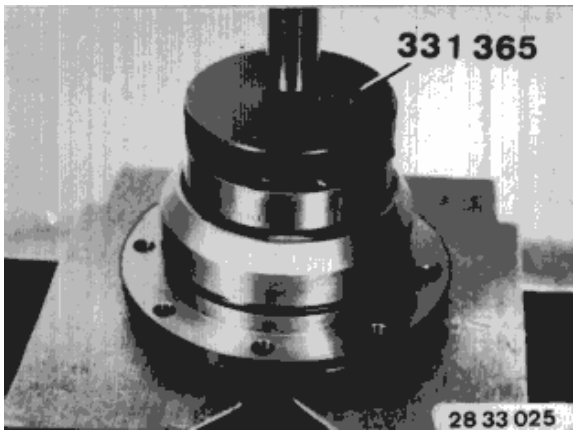
Lift shaft seals out of both bearing caps.



Press out outer bearing race with special tool 33 1 350 (extractor fixture) and special tool 33 1 351 (extractor star tool).

Caution!

Special Tool must engage in the bearing outer race.



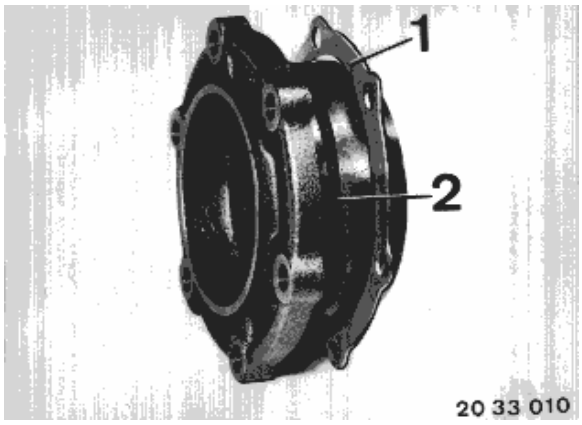
Installation:

Press-fit new bearing outer races with special tool 33 1 365 (pressure plate).

The following 12 steps can only be omitted, if the final drive housing bearings were not replaced.

Install final drive housing with new crown wheel and new bearings.

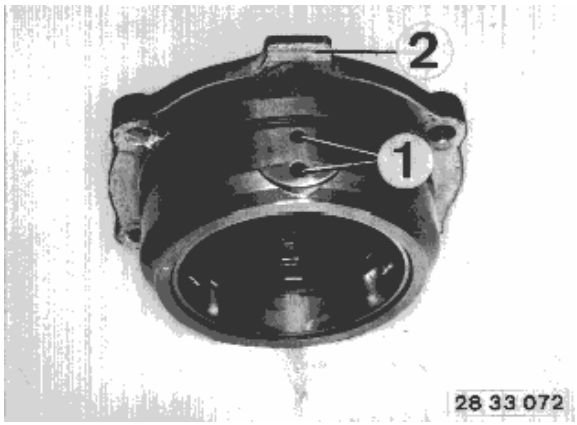
Lubricate bearings thoroughly with approved final drive gear lube (refer to Fluids and Lubricants) and let them drip dry.



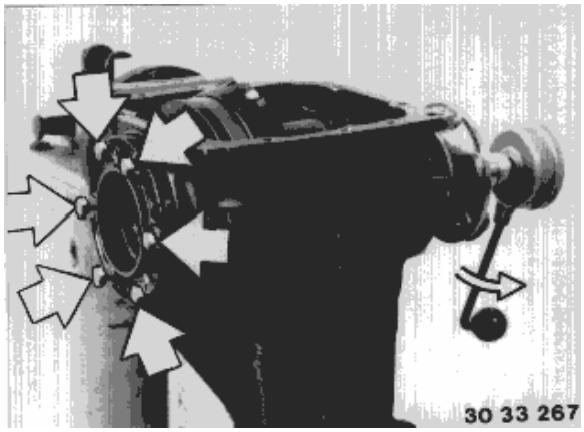
Install side bearing caps marked with belonging shims (1), but at first without O-rings (2).

Evenly tighten bearing cover screws opposite the crown wheel.

Tightening torque, refer to Technical Data



The compensating bore (1), recognized on the outside by tab (2), always faces up in installed position of the transmission.

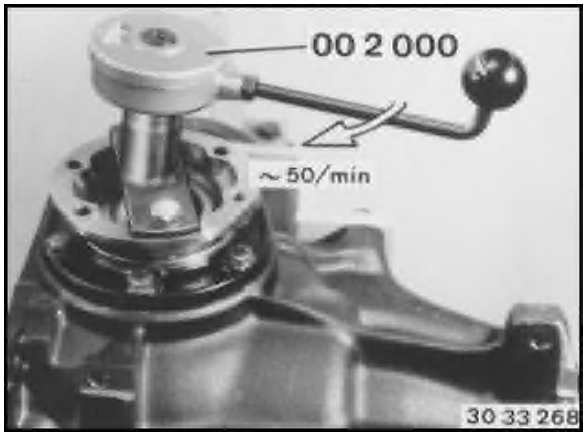


Determining Friction Torque of New final drive housing Bearings

Axial preload force of final drive housing bearings (4000 N) can be determined with help of the friction torque,

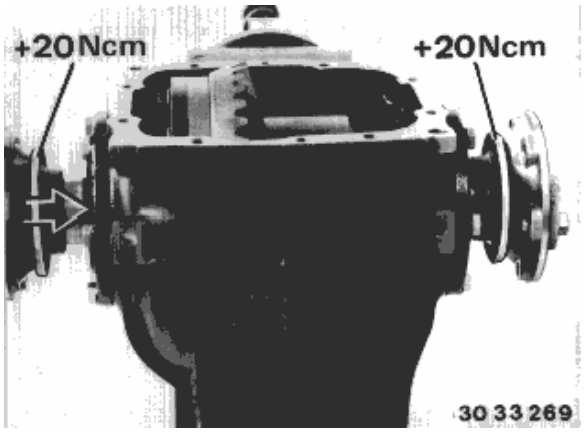
refer to Technical Data

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 crown wheel. Determine friction torque using a bracket with welded on nut (in-house manufacture) and special tool 00 2 000 (friction torque gauge).

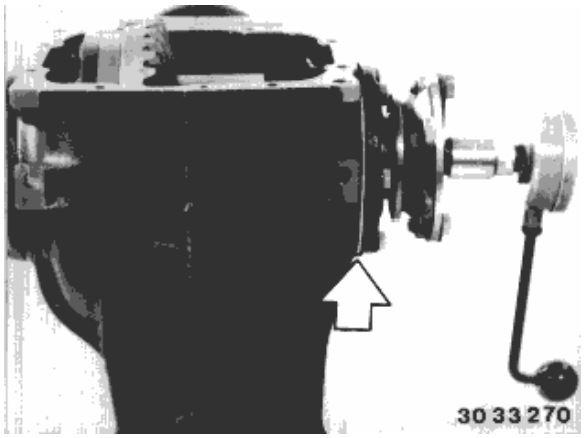
Turn friction torque meter at speed of approx. 50 rpm.



The friction torque specified in the final drive housing bearing table should be reached, but not exceeded (refer to Technical Data).

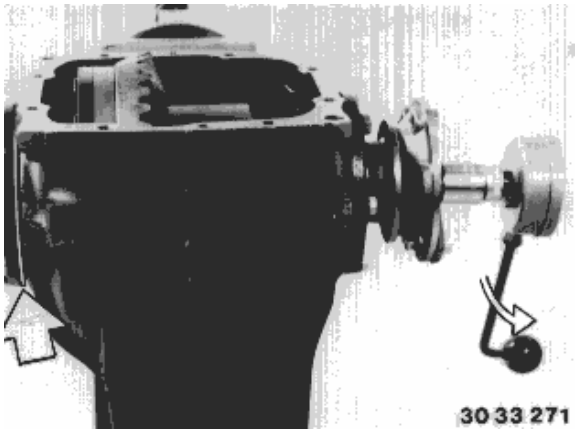
If new shaft seals have already been fitted, 20 Ncm must be added to each seal in which an output shaft rotates during the measurement process.

refer to Technical Data



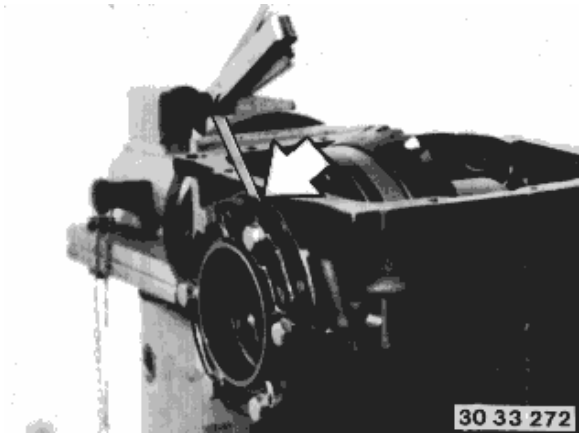
If the given friction torque is not reached, even though both bearing caps are tightened to the correct tightening torque (refer to Technical Data),

install a thinner shim opposite the crown wheel and repeat the measuring procedures.



If the friction torque is reached, even though the second bearing cap has not yet been tightened to the correct thightening torque (refer to Technical Data),

a thicker shim must be used on the crown wheel 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 and added to the thickness of the used shim.



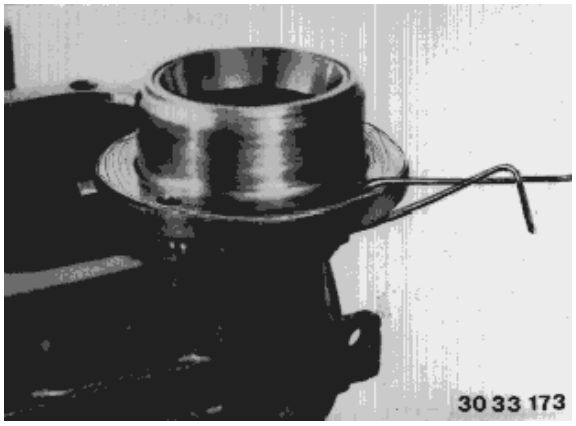
Example:

Second bearing cap not tightened (bolts screwed in uniformly)

Specified friction torque reached and shaft seals not yet installed, refer to Technical Data.

Gap measured with blade	0,20 mm
Used shim	1,40 mm
Install shim of thickness	1,60 mm

Install new shims, 1.60 mm gage, and repeat measurement.

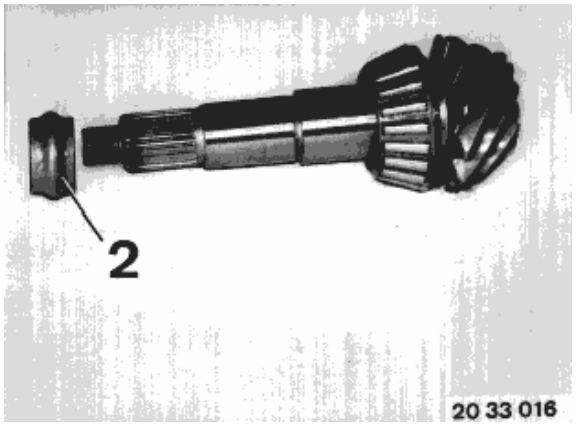


Remove differential for installation of the drive pinion.

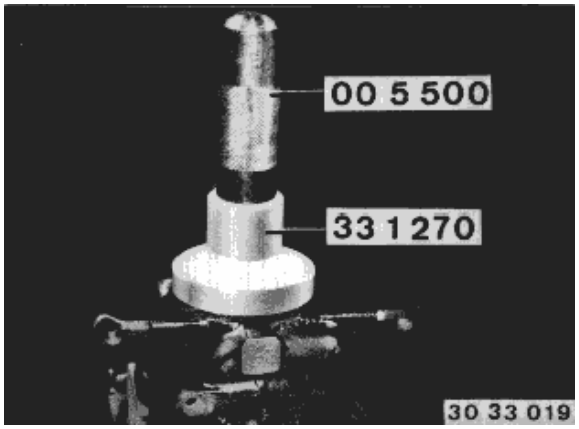
(If final drive housing bearings were not replaced, procedures can be continued from this point.)

Caution!

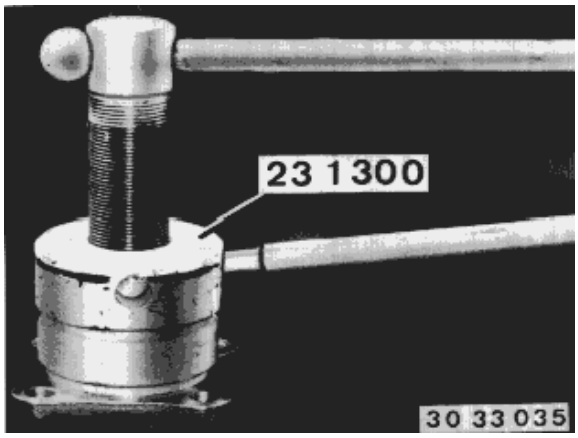
Match side covers ad corresponding shims of determined thickness; don't mix them up.



Install drive pinion with a new clamping sleeve (2).

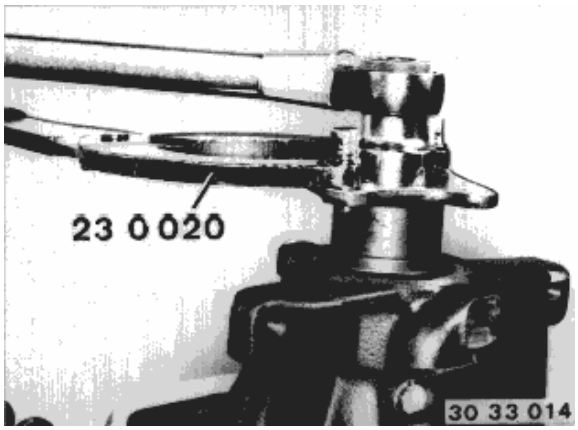


Immerse shaft seal in final drive oil and drive home flush with special tool 33 1 270 in conjunction with special tool 00 5 500 (handle).

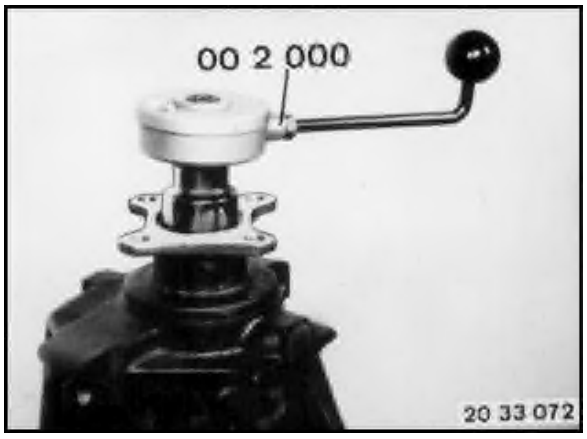


Press-fit input flange to the input shaft using special tool 23 1 300 but do not tighten down.

The axial preload force of drive pinion bearings (5000 N) can be determined with help of the friction torque.



Tighten input flange with the collar nut in steps, measuring the friction torque after each step.



Measure friction torque with special tool 00 2 000 and suitable socket head,

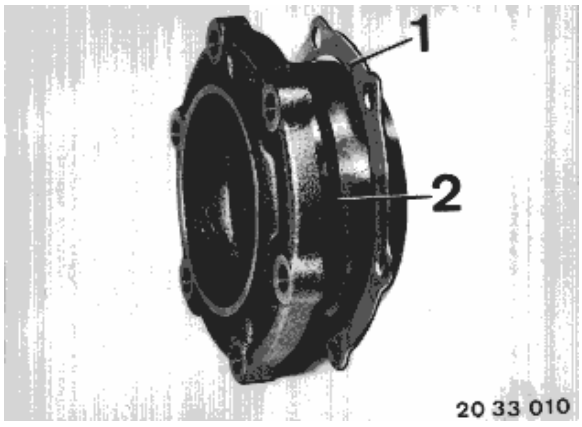
refer to Technical Data.

Caution!

The relation between friction torque and preload force differs depending on the make of bearings.

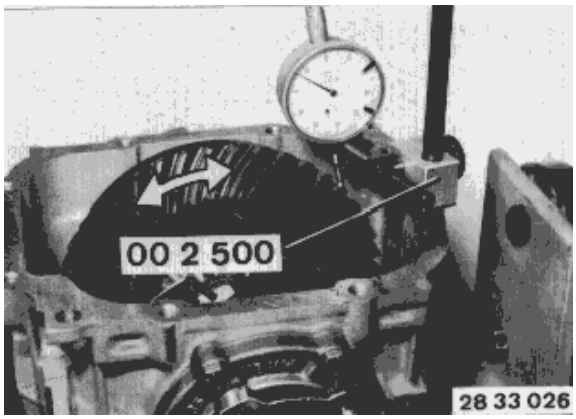
Take specified friction torque from the pinion bearing table and add 20 Ncm,

refer to Technical Data.



Install differential. Install side covers as marked with corresponding washers (1) and new O-rings (2). Tighten bolts uniformly.

Tightening torque, refer to Technical Data



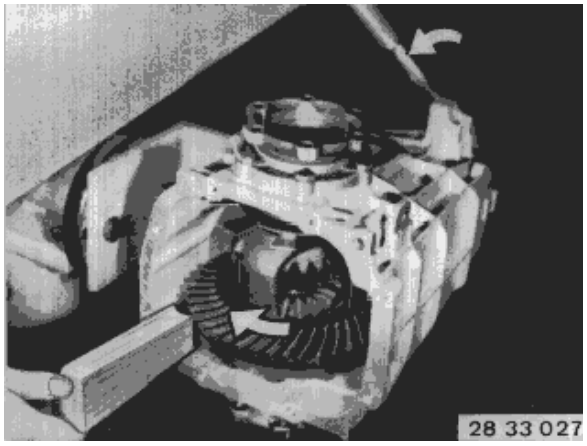
Backlash/Tooth Contact Pattern Adjustment

Attach special tool 00 2 500 (dial gauge holder) and measure torsional face runout,

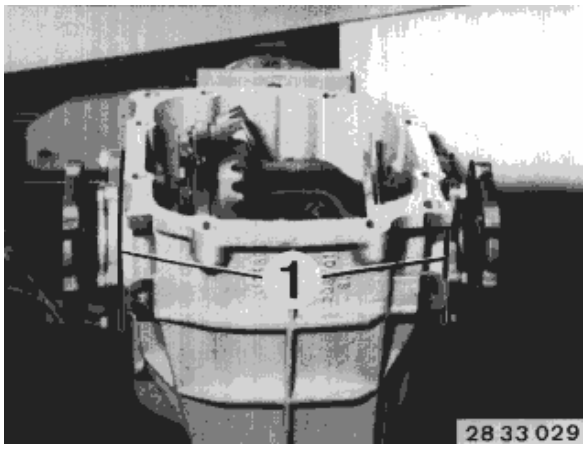
refer to Technical Data

Caution!

The tooth contact pattern is always most important for a perfectly adjusted pinion/crown wheel.



To check the tooth contact pattern, coat the crown wheel teeth with printer's ink, turn in both directions several times and stop crown wheel suddenly with a piece of hard wood.



Correction of torsion clearance,

refer to Technical Data

and contact pattern is performed by altering the thickness of both shims (1).

If the backlash is too large, install a thinner shim on the crown wheel end.

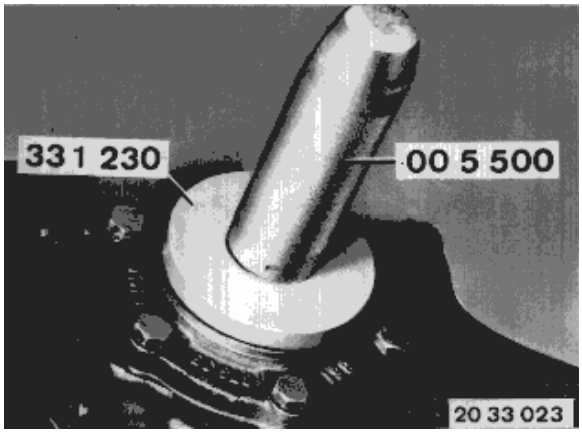
If backlash is too small, use a thicker shim on the crown wheel end.

Axial displacement of the crown wheel of 0.01 mm signifies a change in tooth flank clearance of 0.0076 mm.

Caution!

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.



Installation:

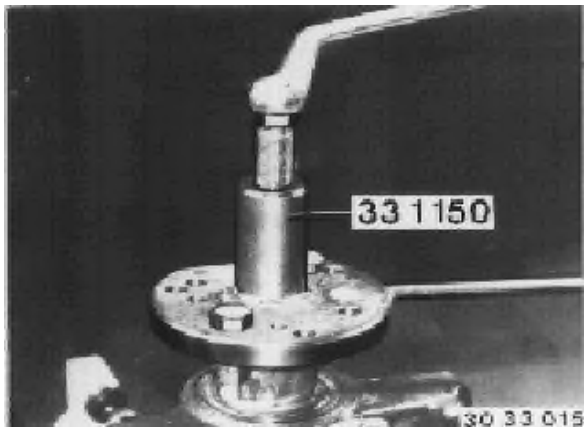
Dip new shaft seals in final drive gear lube.

Drive shaft seal firmly home with special tool 33 1 230 (impact bush) in conjunction with special tool 00 5 500 (handle).

Replace drive flange if the bearing surface is seriously scored.

Note:

It is possible that the special tool 33 1 230 might have to be reworked to compensate for casting tolerances on the side cover.



Drive in new retaining plate with special tool 33 4 050 and special tool 00 5 500 (handle).

Final drive fluids changeover

All models with option 209

Subject: A new approved fluid is being made available for all final drives with limited-slip differential (option 209) in connection with the introduction of the Z3 Roadster. The new fluid is called "BMW Hinterachsgetriebeöl Synthetik
MSP/A" (BMW final drive fluid synthetic MSP/A) and it will replace "BMW Hinterachsgetriebeöl MSP" (BMW final drive fluid MSP).

Effect: It is not permitted under any circumstances to fill up the final drive on a Z3 Roadster with limited-slip differential with MSP fluid. It is **imperative** that MSP/A is used in this instance, as if the wrong type of fluid is used, creaking noises can be heard when the vehicle is in motion.

Procedure: The final drives should be filled with the prescribed fluid.

Any MSP fluid dealers may still have can be used up on any model except for the Z3 Roadster.

Parts: **Hypoid fluids for final drives with plate-design self-locking limited-slip differential**

- BMW final drive fluid synthetic MSP/A

55 l barrel	83 22 9 407 870
205 l barrel	83 22 9 407 871

- Castrol SAF-XJ
- Veedol SAF 44

Friction torque on differential casing bearings (both), according to differential type (see front) and bearing manufacturer. Note: Thouroughly lubricate bearings with differential lubricant, allow excess to drip off.		
Type K FAG	Nm	1.18 - 2.62
Type K SKF	Nm	1.20 - 2.40
Type K Timken	Nm	1.28 - 2.60
Type K Koyo	Nm	1.20 - 2.62
Type M FAG	Nm	1.10 - 2.44
Type M SKF	Nm	1.00 - 2.00
Type M Timken	Nm	0.70 - 2.56
Type M Koyo	Nm	1.40 - 2.60
Type G Timken	Nm	1.80 - 3.80
Type G Koyo	Nm	1.40 - 3.40

Backlash	mm	0.06 to 0.14 (0.0024 to 0.0055)
Backlash Vehicles with M60 B40	mm	0.04 ... 0.10
Ring gear installing temperature	°C	80 ... 100
Max. input flange radial runout	max. mm	0.07
Approx. shaft seal friction torque	approx. Nm	0.20

Slip torque with one differential side gear held tight and one driven (plates lubricated with approved final drive gear lube)	Nm	50 ... 75
Optional outer plate thickness	mm	1.9 / 2.0 / 2.1
Inner plates	mm	2.0

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.

Threads	Max. Tightening Torque Msp (Nm) 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

11-1 Engine

			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

17 - 1	COOLING SYSTEM	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.

21- 1 Clutch

			Type	Nm
21 11	**Bellhousing**			
1AZ	Bellhousing to engine block	M 8	all	27
		M 10	all	51
		M 12	all	86

21- 2 Clutch

				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

24-9 Automatic transmission

			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

24-10 Automatic transmission

			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

24-14 Automatic transmission

			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

24-15 Automatic transmission

			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

25 - 1	GEAR SHIFT MECHANISM	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.

27 - 1	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

31 - 1	FRONT AXLE	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 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

33-3 Final drive and rear suspension

			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.

33-4 Final drive and rear suspension

			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

33-5 Final drive and rear suspension

			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

33-9 Final drive and rear suspension

			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

33-13 Final drive and rear suspension

			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

35 - 1	PEDALS	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

36 - 1	WHEEL RIMS AND TIRES	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

51 - 5	BODY EQUIPMENT	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

64-3 Heating and air conditioning

		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