

Connector X60003 52-pin black			
Pin	Signal	Component/function	Notes
19	Input	Signal, throttle potentiometer 1	Throttle valve
20	Ground	Ground, throttle position sensor	Throttle valve
21	Ground	Ground, crankshaft position sensor	Crankshaft position sensor
22	Output	Signal, intake air temperature	Intake air temperature sensor
23	Ground	Ground, intake air temperature sensor	Intake air temperature sensor
24	Output	Signal, coolant temperature sensor	Coolant temperature sensor
25	Ground	Ground, coolant temperature sensor	Coolant temperature sensor
26	Input	Signal, oil pressure	Oil pressure switch
27	Output	Signal, engine oil temperature	Oil temperature sensor
28	Ground	Ground, engine oil temperature sensor	Oil temperature sensor
29	Output	Signal, knock sensor	Knock sensor
30	Output	Signal, knock sensor	Knock sensor
31	Output	Signal, knock sensor	Knock sensor
32	Output	Signal, knock sensor	Knock sensor
33	Input	Signal, cylinder 1 fuel injector	Cylinder 1 fuel injector
34	Input	Signal, cylinder 2 fuel injector	Cylinder 2 fuel injector
35	Input	Signal, cylinder 3 fuel injector	Cylinder 3 fuel injector
36	Input	Signal, cylinder 4 fuel injector	Cylinder 4 fuel injector
37	Input	Signal, cylinder 5 fuel injector	Cylinder 5 fuel injector

Connector X60003 52-pin black			
Pin	Signal	Component/function	Notes
38	Input	Signal, cylinder 6 fuel injector	Cylinder 6 fuel injector
39	Input	Signal, oil level sensor	Oil level sensor
40	Input	Signal, VANOS inlet valve	VANOS inlet valve
41	Input	Signal, VANOS outlet valve	VANOS outlet valve
42	Input	Signal, evaporative emissions valve	Evaporative emissions valve
43	Input	Signal, throttle valve drive	Throttle valve
44	Input	Signal, throttle valve drive	Throttle valve
45	Input	Signal, engine coolant thermostat	Engine coolant thermostat (map controlled)
46	Input	Signal, close idle speed control valve	Idle speed control valve
47	Input	Signal, open idle speed control valve	Idle speed control valve
48	Ground	Signal shield, knock sensor	Shield, knock sensor
49	Input	Signal, resonance valve intake system	Resonance valve intake system
50		not used	
51		not used	
52	Input	Signal, secondary air injection pump valve	Secondary air injection valve

Connector X60004 40-pin black			
Pin	Signal	Component/function	Notes
1	Input	Signal, battery charge indicator lamp	Instrument cluster control unit

Connector X60004 40-pin black			
Pin	Signal	Component/function	Notes
2	Input	Feedback signal, engine start	Instrument cluster control module
3	Input	Signal, secondary air injection pump	Secondary air injection pump relay
4	Input	Signal, electric fan	Auxiliary fan motor
5		not used	
6		not used	
7		Pedal position sensor (PWG) (MS 43.0)	Pedal position sensor (PWG) (MS 43.0)
8		Signal, pedal position sensor (PWG) (MS 43.0)	Pedal position sensor (PWG) (MS 43.0)
9		Pedal position sensor (PWG) (MS 43.0)	Pedal position sensor (PWG) (MS 43.0)
10	Input	Signal, fuel pump relay 1	Fuel pump relay 1
11	Input	Signal, oil pressure switch	Instrument cluster control module
12		Pedal position sensor (PWG) (MS 43.0)	Pedal position sensor (PWG) (MS 43.0)
13		Signal, pedal position sensor (PWG) (MS 43.0)	Pedal position sensor (PWG) (MS 43.0)
14		Pedal position sensor (PWG) (MS 43.0)	Pedal position sensor (PWG) (MS 43.0)
15		not used	
16		not used	
17	Input	Speed signal (MS 42.0 up to 6-00)(MS 42.0 from 6-00 and MS 43.0)	Data link connector OBDII 16 pin connector)
18		not used	
19		not used	

Connector X60004 40-pin black			
Pin	Signal	Component/function	Notes
20	Output	Diagnostic module tank leak (DMTL) detection (MS 43.0)	Leak detection (DMTL) (MS 43.0)
21	Input	Signal, oil level sensor	Instrument cluster control module
22	Input	Signal, processed wheel speed, right rear	ABS/ASC module, ABS/DSC module
23	Output	Signal, clutch pedal position switch	Clutch pedal position switch
24	Input	Signal, brake light switch	Light switching center control unit
25		not used	
26	Input	Terminal 15	Fuse F29
27	Output	Voltage supply, multifunction steering wheel	Volute spring
28	Input	Signal, brake light switch	Brake light switch
29	Input	Signal, relay, A/C compressor	A/C compressor relay
30		Signal, leakage diagnosis pump (MS 42.0)Signal diagnostic module (MS43.0)	Leakage diagnosis pumpLeak detection (MS 43.0)
31		not used	
32	Input/output	Transmit diagnosis line (TXD) data link signal	Data link connector (MS 42.0)OBD II connector (MS 43.0)
33	Input	Electronic vehicle immobilization	Electronic immobilizer control module
34		Signal, leakage diagnosis pump (LDP) (MS 42.0)	Leakage diagnosis pump (LDP) (MS 42.0)
35		not used	
36	Input/output	CAN bus signal, high	Connector, CAN bus

Connector X60004 40-pin black			
Pin	Signal	Component/function	Notes
37	Input/output	CAN bus signal, low	Connector, CAN bus
38	Ground	Ground, coolant outlet temperature sensor	Temperature sensor
39	Output	Signal, coolant outlet temperature	Temperature sensor
40		not used	

Connector X60005 9-pin black			
Pin	Signal	Component/function	Notes
1	Input	Signal, ignition coil 3	Ignition coil 3
2	Input	Signal, ignition coil 2	Ignition coil 2
3	Input	Signal, ignition coil 1	Ignition coil 1
4		not used	
5	Ground	Ground	Ground connector
6	Ground	Ground	Ground connector
7	Input	Signal, ignition coil 6	Ignition coil 6
8	Input	Signal, ignition coil 5	Ignition coil 5
9	Input	Signal, ignition coil 4	Ignition coil 4

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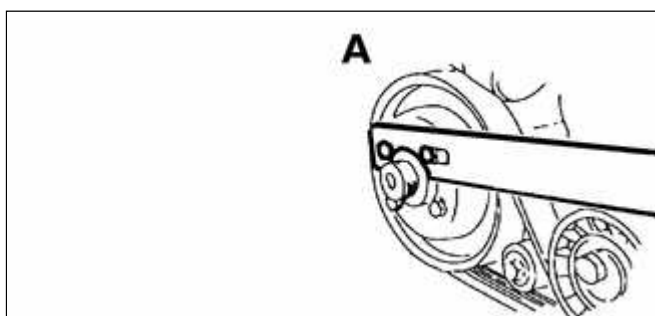
General

This section covers component repair information for the engine cooling system.

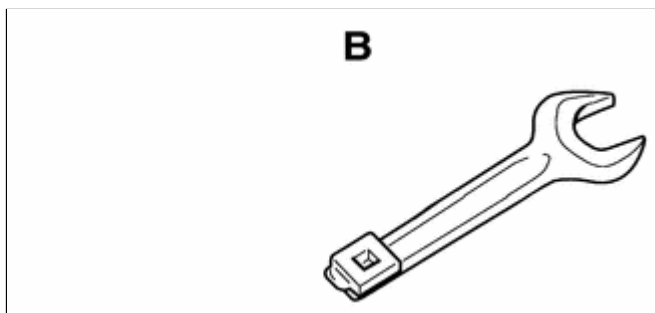
The E46 cooling system uses a centrifugal-type belt-driven coolant pump, an electric primary cooling fan, and an electrically heated thermostat. The cooling system is unique in that the cooling fan and the thermostat are controlled and monitored by the DME engine management system. Therefore, cooling system faults can be diagnosed using an appropriate scan tool.

Special tools

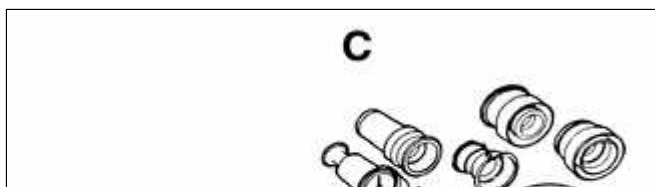
Special tools are necessary for fan clutch removal and pressure testing the cooling system.



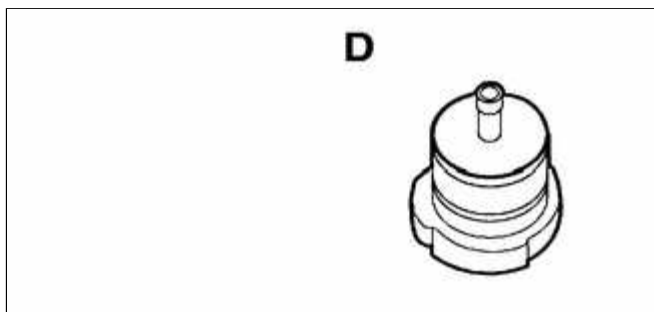
- ◀ Cooling fan counterhold wrench BMW 11 5 030



- ◀ Cooling fan wrench BMW 11 5 040

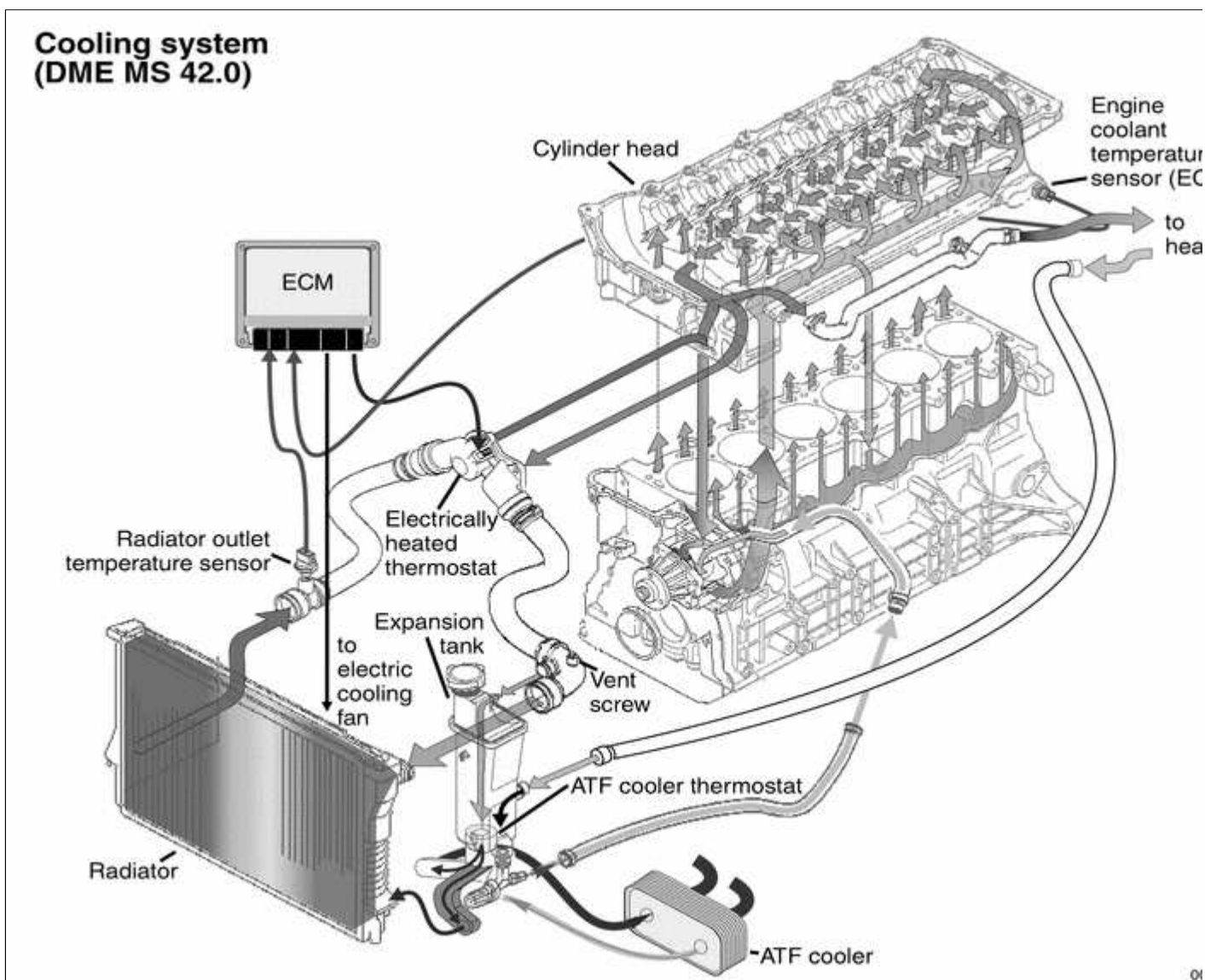


- ◀ Cooling system pressure tester BMW 17 0 002/17 0 005



Expansion tank cap test adapter BMW
17 0 007

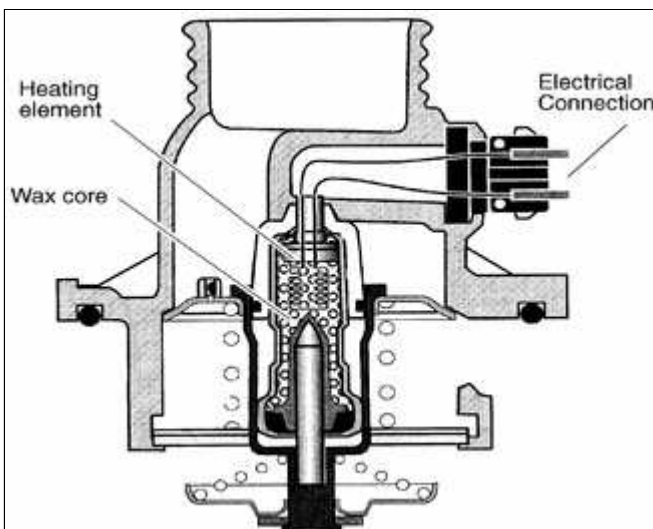
Cooling system (DME MS 42.0)



Coolant pump

A centrifugal-type coolant pump is mounted to the front of the engine. The belt-driven pump circulates coolant through the system whenever the engine is running.

Thermostat



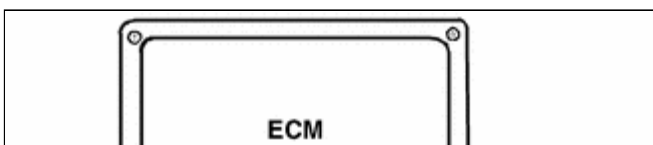
⚡ An electrically heated thermostat regulates the engine coolant temperature and is controlled by the DME control module. The heated thermostat allows the engine to be operated at higher temperatures at idle and at part throttle. Having the ability to control the engine coolant temperature electronically results in improved emissions and performance. Problems with the heated thermostat can be diagnosed using a compatible scan tool.

Radiator and expansion tank

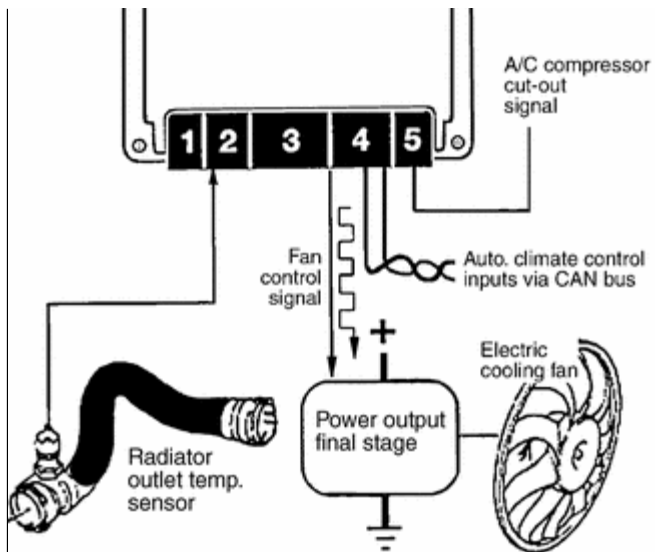
The radiator is a crossflow design. An expansion tank provides for coolant expansion at higher temperatures and easy monitoring of the coolant level.

On cars with automatic transmission, ATF is circulated through an additional heat exchanger (ATF cooler).

Cooling fan (primary)



⚡ There are two cooling fan configurations used on the cars covered by this manual, depending on transmission



application.

On cars with automatic transmissions, the main fan is electric and mounted on the bumper side of the radiator. The fan is controlled by the DME control module via the output final stage. Additionally a belt-driven fan via a viscous fluid coupling (clutch) is attached to the front of the coolant pump. The fan clutch controls the speed of the fan based on engine compartment temperature.

On cars with manual transmissions, a single multi-speed electric cooling fan is used. The fan is mounted on the engine side of the radiator and controlled by the DME control module via the output final stage.

On both configurations, the output final stage is mounted on the fan housing, next to the fan motor. The fan is operated using a pulse width modulated (PWM) signal and is protected by a 50-amp fuse. Electric fan activation is based on the following inputs to the ECM:

- ◆ Radiator outlet temperature
- ◆ Catalyst temperature (calculated temperature)
- ◆ Vehicle speed
- ◆ Battery voltage
- ◆ A/C pressure (calculated pressure)

When the vehicle is first started, The ECM activates the electric fan briefly at 20% of its maximum speed, then switches off. This is for diagnostic monitoring. The voltage generated by the fan when it slows down (acting as a generator) must match the stored 'rpm'

values in the fan power output stage to confirm that the fan is operating correctly.

Note:

- ◆ *If the ECM stored a cooling fan fault, check that the fan is not seized and that it spins freely.*
- ◆ *When A/C is switched ON, the electric fan is not immediately turned on.*
- ◆ *After the engine is switched OFF, the fan may continue to run at varying speeds for up to 10 minutes, based on calculated catalyst temperature.*

Warnings and cautions

The following warnings and cautions should be observed when working on the cooling system.

WARNING!

- ◆ *At normal operating temperature the cooling system is pressurized. Allow the system to cool as long as possible before opening-a minimum of an hour-then release the cap slowly to allow safe release of pressure.*
- ◆ *Releasing the cooling system pressure lowers the coolant boiling point and the coolant may boil suddenly. Use heavy gloves and wear eye and face protection to guard against scalding.*
- ◆ *Use extreme care when draining*

and disposing of engine coolant. Coolant is poisonous and lethal to humans and pets. Pets are attracted to coolant because of its sweet smell and taste. Consult a veterinarian immediately if coolant is ingested by an animal.

CAUTION!

- ♦ ***Avoid adding cold water to the coolant while the engine is hot or overheated. If it is necessary to add coolant to a hot system, do so only with the engine running and coolant pump turning.***
- ♦ ***To avoid excess silicate gel precipitation in the cooling system and loss of cooling capacity, use BMW coolant or equivalent low silicate antifreeze.***
- ♦ ***If oil enters the cooling system, the radiator, expansion tank and heating circuit must be flushed with cleaning agent. BMW recommends removal of the radiator and expansion tank to flush.***
- ♦ ***When working on the cooling system, cover the alternator to protect it against coolant drips.***
- ♦ ***Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.***

Troubleshooting

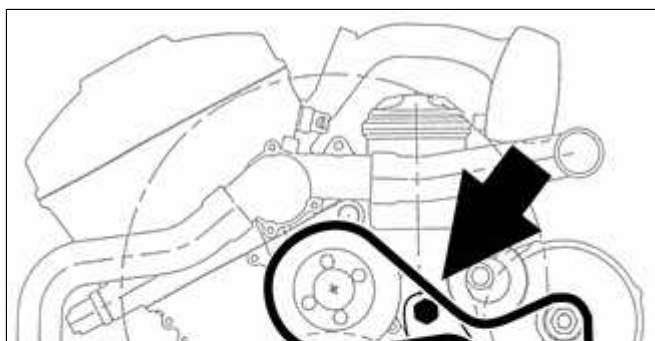
Begin the diagnosis of cooling system problems with a thorough visual inspection. If no visual faults are found, it is recommend that the DME system be checked for stored diagnostic fault codes (DTCs) using BMW scan tools DIS (Diagnostic Information System) or MoDiC (Mobile Diagnostic Computer) or an aftermarket equivalent.

Common cooling system faults can be grouped into one of four categories:

- ◆ Cooling system leaks
- ◆ Poor coolant circulation
- ◆ Radiator cooling fan faults
- ◆ Electrical/electronic faults

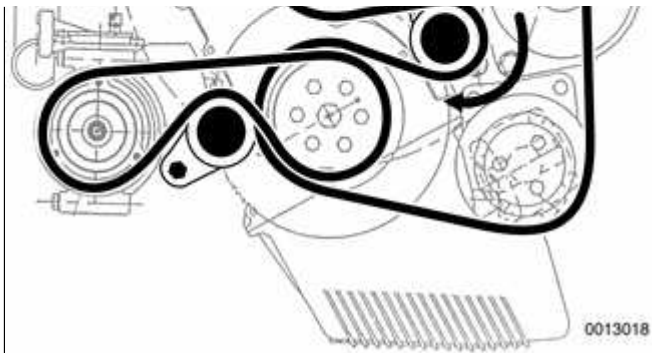
Be sure to check the condition and tension of the coolant pump drive belt. Check hoses for cracks or softness. Check clamps for looseness. Check the coolant level and check for evidence of coolant leaks from the engine.

Check that the radiator fins are not blocked with dirt or debris. Clean the radiator using low-pressure water or compressed air. Blow outward, from the engine side out.



To check coolant pump:

- ◆ Lever tensioner clockwise using wrench on hex (large arrow) and slip belt off pulley.
- ◆ Firmly grasp opposite sides of



pulley and check for play in all directions.

- ◆ Spin pulley and check that shaft runs smoothly without play.

Note:

The coolant provides lubrication for the pump shaft, so an occasional drop of coolant leaking from the pump is acceptable. If coolant drips steadily from the vent hole, the pump should be replaced.

The cooling system becomes pressurized at normal operating temperature, which raises the boiling point of the coolant. Leaks may prevent the system from becoming pressurized, allowing the coolant to boil at a lower temperature. If visual evidence is inconclusive, a cooling system pressure test can help to pinpoint hard-to-find leaks.

If the cooling system is full of coolant and holds pressure, the next most probable causes of overheating are:

- ◆ Faulty radiator fan or DME control circuit. Use an appropriate scan tool to interrogate the DME control module for faults.
- ◆ Loose or worn drive belt.
- ◆ Failed thermostat or coolant pump impeller. Some pumps may be fitted with plastic impellers.
- ◆ Clogged/plugged radiator or coolant passages.

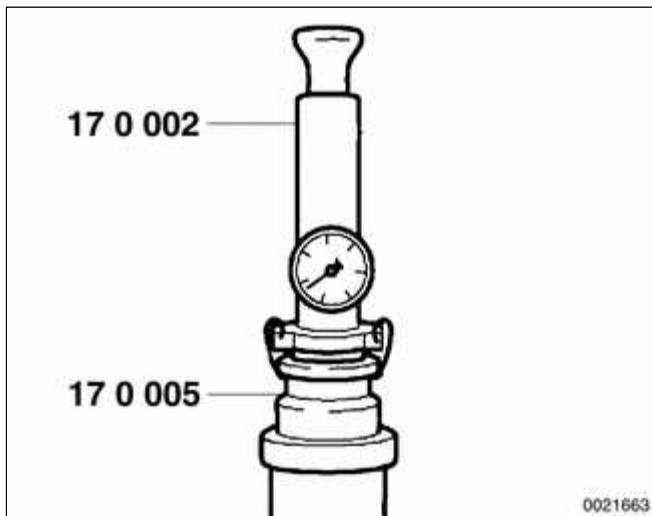
Cooling system pressure test

A cooling system pressure test is used to check for internal leaks. Some of the common sources of internal leaks are a faulty cylinder head gasket, a cracked cylinder head, or a cracked cylinder block.

To do a cooling system pressure test, a special pressure tester is needed.

WARNING!

At normal operating temperature the cooling system is pressurized. Allow the system to cool before opening. Release the cap slowly to allow safe release of pressure.



With engine cold, install pressure tester (BMW special tools 17 0 002/17 0 005 or equivalent) to expansion tank. Pressurize system to specification listed in ⇒ [Table a](#).

- ◆ Pressure should not drop more than 0.1 bar (1.45 psi) for at least two minutes.
- ◆ If pressure drops rapidly and there is no sign of external leakage, cylinder head gasket may be faulty. Perform compression and leak-down tests as described in ⇒ [100 Engine-General](#)
- ◆ Also test expansion tank cap using pressure tester and correct adapter (BMW special tool 17 0 007 or equivalent). Replace faulty cap or cap gasket.

Table a. Cooling system test pressures

Component	Test pressure
Radiator	1.5 bar (21.75

Table a. Cooling system test pressures

Component	Test pressure
	psi)
Radiator cap	2 bar (29 psi)

CAUTION!

Exceeding the specified test pressure could damage the radiator or other system components.

Combustion chamber leak test

- If you suspect that combustion chamber pressure is leaking into the cooling system past the cylinder head gasket, use an exhaust gas analyzer to test the vapors rising from the coolant at the expansion tank.

CAUTION!

- ♦ ***Use an extension tube above the reservoir neck to maintain distance between the top of the coolant and the gas analyzer nozzle. The gas analyzer is easily damaged if it is allowed to inhale liquid coolant.***
- ♦ ***While running engine to check for causes of overheating, observe coolant temperature carefully in order to avoid engine damage.***

Thermostat, checking

If the engine overheats or runs too cool and no other cooling system tests

indicate trouble, the electrically heated thermostat may be faulty.

Check for thermostat diagnostic fault codes (DTCs) using BMW scan tools DIS or MoDiC or equivalent. DTCs pertaining to cooling system malfunctions are listed in ⇒ [Table b.](#) See also ⇒ [OBD On Board Diagnostics](#) at the back of this manual.

Table b. Cooling system fault codes		
BMW fault code	Explanation	Possible cause(s)
10	Engine coolant temperature out of predefined range	Faulty thermostat or cooling fan. Faulty wiring to cooling fan or thermostat.
222	Insufficient coolant temperature signal to permit closed loop operation	Faulty thermostat. Faulty thermostat electrical circuit.

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Cooling System Service

Coolant, draining and filling

WARNING!

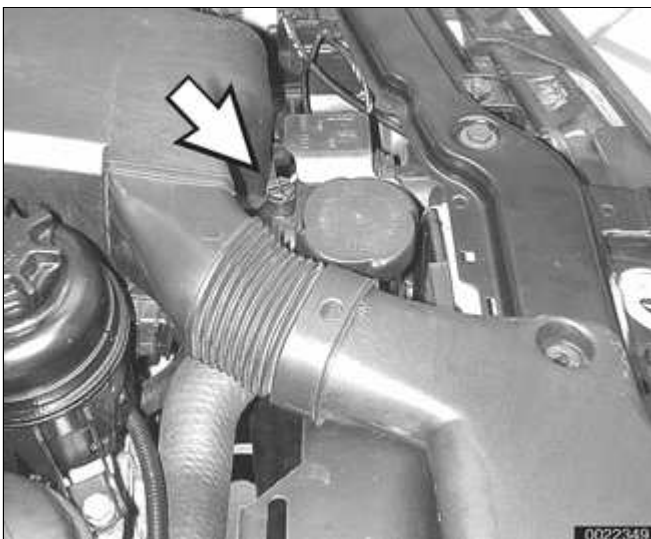
Allow the cooling system to cool before opening or draining the cooling system.

- Raise front of car and support safely.

CAUTION!

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove splash shield from under engine.



- ✦ Loosen radiator bleed screw at top radiator fitting (**arrow**).

- Remove cap from radiator expansion tank. Set temperature controls to full warm.
- Place 3-gallon pail underneath radiator.

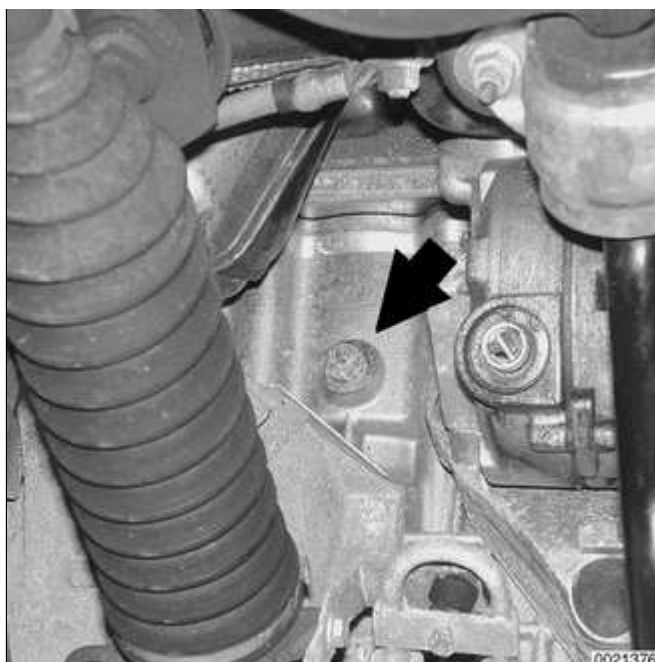


- ✦ Remove drain plug (**arrow**) on bottom of radiator.

WARNING!



Coolant is poisonous. It is especially lethal to pets. Clean up spills immediately and rinse the area with water.



- ✦ Place empty 3-gallon pail underneath exhaust side of engine block. Loosen and remove engine block coolant drain plug (**arrow**).

Note:

The block drain plug is located on the exhaust side of the engine block at cylinder 2.

- Reinstall radiator and engine block drain plugs using new sealing washers.
 - Before refilling radiator:
 - ◆ Switch ignition to ON.
 - ◆ Set temperature controls to full warm.
 - ◆ Set blower control to low.
 - Using a coolant mixture of 50% antifreeze and 50% distilled water, fill expansion tank slowly. Continue until coolant emerges from bleed screw. Cooling system capacity is listed in ⇒ [Table c](#).
- Note:**
- ◆ *Be sure radiator bleed screw is loose when filling cooling system.*

- ◆ *Tap water may cause corrosion of radiator, engine and coolant hoses.*
- ◆ *Coolant can often be reused provided it is clean and less than two years old. Do not reuse coolant when replacing damaged engine parts. Contaminated coolant may damage the engine or cooling system.*

Table c. Cooling system capacity

Engine	Capacity
M52 TU/M54	8.4 liters (8.8 qt.)

Tightening torques

Engine block drain plug to block	25 Nm (18 ft-lb)
Radiator drain plug to radiator	2 - 3 Nm (18 - 27 in-lb)

Cooling system, bleeding

Air may become trapped in the system during cooling system service. Trapped air can prevent proper coolant circulation. Whenever the coolant is drained and filled, the system should be bled of trapped air.

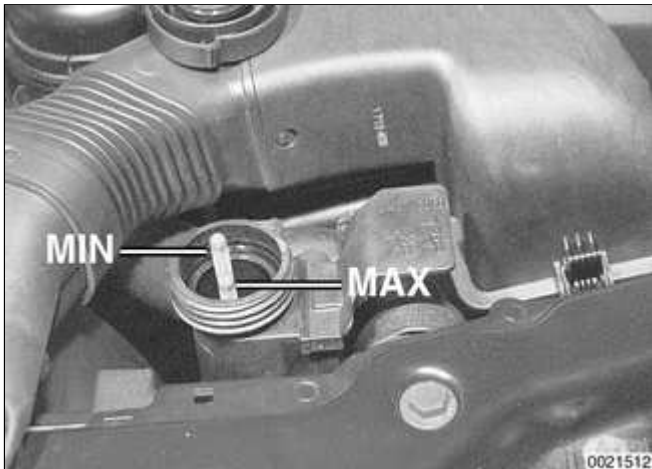
- ✦ Loosen bleed screw (**arrow**) on radiator expansion tank.

- Set temperature controls in passenger compartment to full warm, set blower to low setting and turn ignition to ON position (do not start engine).





- Slowly add coolant until it spills from bleed screw. When coolant spilling from bleed screws is free of air bubbles, tighten screw.



- Run engine until it reaches operating temperature.
- ◆ After engine has cooled, recheck coolant level.
- ◆ Top up so that coolant level indicator is at MAX.

CAUTION!

Always use genuine BMW coolant or its equivalent to avoid the formation of harmful, clogging deposits in the cooling system. Use of other antifreeze solutions may be harmful to the cooling system.

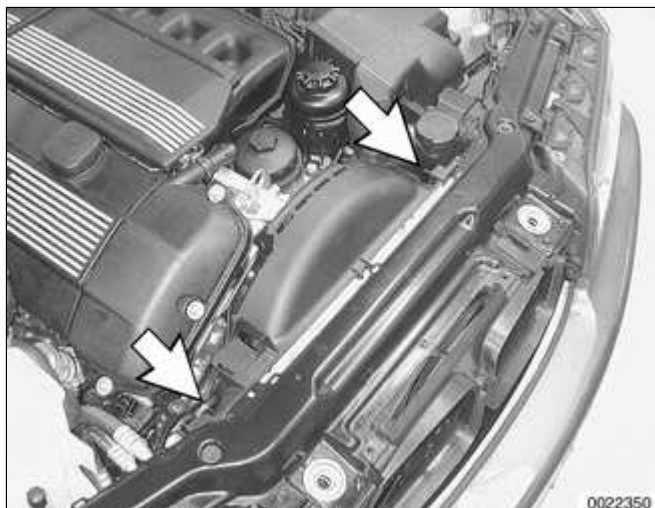
Tightening torque

Radiator bleed screw	2.5 Nm (22 in-lb)
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Viscous clutch cooling fan, replacing (models with automatic transmission)

- To gain access to viscous clutch fan or electric fan at front of the engine:
 - ◆ Remove expansion rivets (**arrows**) and remove intake duct.

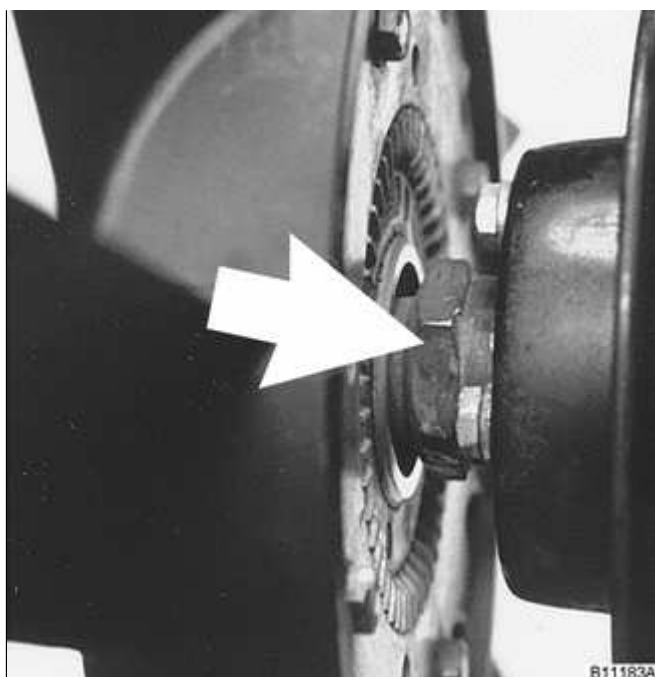




- ✦ Working at top of fan shroud, remove screw and expansion rivet (**arrows**) holding fan shroud to radiator. Unclip or disconnect electrical connector(s) from right side of shroud.

Note:

Shroud is detached from radiator at this point but can only be removed later when fan and clutch assembly is removed.



- ✦ Using 32 mm wrench (BMW special tool 11 5 040) on fan clutch nut (**arrow**), turn wrench quickly in a clockwise direction (working from front of car) to loosen. Spin fan off coolant pump.

Note:

- ◆ *The radiator cooling fan nut (32 mm wrench) has left-hand threads.*
- ◆ *If fan nut is difficult to loosen, use BMW special tool 11 5 030 to counterhold coolant pump pulley.*
- Lift fan and shroud together out of engine compartment.
- To replace fan clutch, remove fan mounting bolts and separate viscous clutch from fan.
- Installation is reverse of removal.

Tightening torques	
Clutch nut to coolant pump (left-hand threads)	
without BMW tool 11 5 040	40 Nm (29 ft-lb)

Tightening torques

with BMW tool 11

5 040

30 Nm (22 ft-lb)

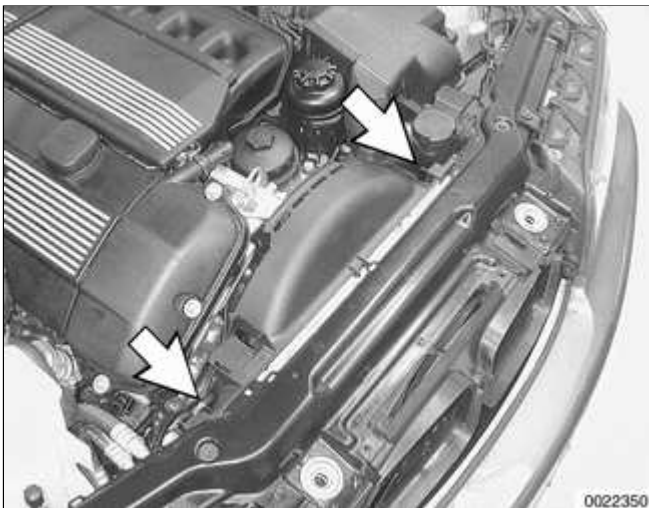
Fan to viscous
clutch

10 Nm (89 in-lb)

**Electric cooling fan, replacing
(models with manual
transmission)**

On models with manual transmission, the primary cooling fan is electrically operated and is mounted on the engine side of the radiator.

- Remove air intake duct as described above.



- ✦ Working at top of fan shroud, remove screw and expansion rivet (**arrows**) holding fan shroud to radiator. Unclip or disconnect electrical connector(s) from right side of shroud.

- Lift fan assembly straight up and off radiator. If necessary, push center top area of fan shroud toward engine to unhook shroud from radiator crossmember.
- Fan can be separated from shroud on bench.

CAUTION!

Do not carry fan by the blades; it may disturb the balance.

- Installation is reverse of removal.

**Electric cooling fan, replacing
(models with automatic**

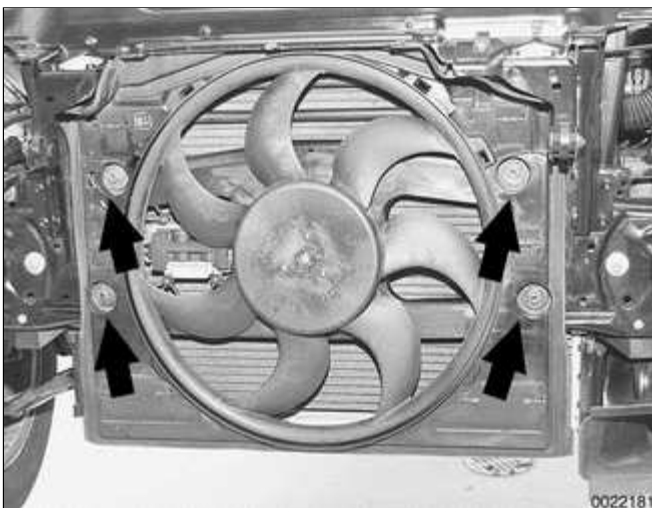
transmission)

The electric cooling fan on cars with automatic transmission is mounted behind the front bumper, in front of the A/C condenser.

- Remove air intake duct as described above.
- Remove front bumper. See ⇒ [510 Exterior Trim, Bumpers](#).
- Disconnect fan electrical connector (**arrow**) on right side of radiator shroud

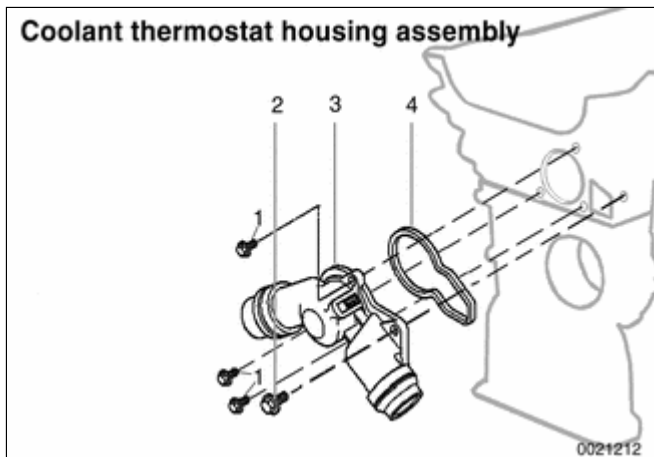


- ✦ Pull out plastic expansion rivets (**arrows**) and remove cover from front of fan.



- ✦ Remove fan mounting nuts (**arrows**) and lift out fan.
- Installation is reverse of removal. Install front bumper. See ⇒ [510 Exterior Trim, Bumpers](#).

Thermostat, replacing



- ✦ The electrically-heated thermostat is an integral part of the thermostat housing. The operation of the thermostat is monitored by the DME control module. If a faulty thermostat is suspected, the DME control module should be interrogated for stored fault codes using an appropriate scan tool.

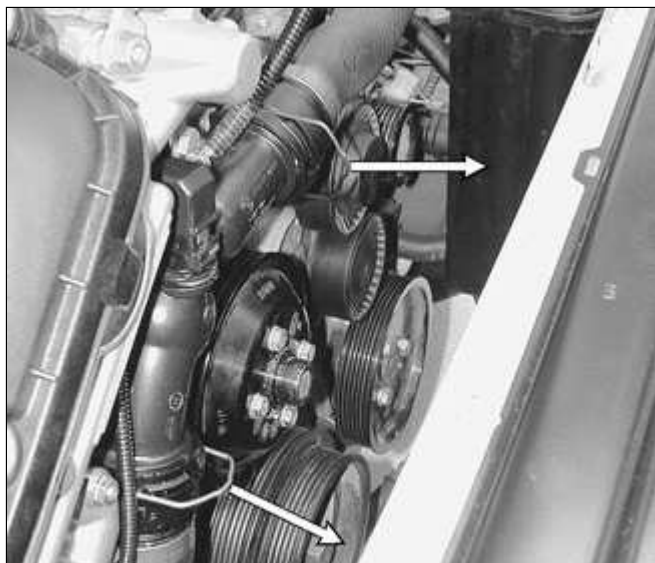
- 1 - Bolt M6
- 2 - Bolt M8
- 3 - Housing with heated thermostat
- 4 - Gasket

- Drain radiator and engine block as described above under ⇒ [Coolant, draining and filling.](#)

WARNING!

Allow cooling system to cool before opening or draining the system.

- Remove air intake duct, cooling fan and fan shroud as described earlier.
- Disconnect electrical harness connector from thermostat housing.



- ✦ Lever out retaining clips (**arrows**) and pull hose fittings off housing.
- Unbolt and remove thermostat housing from front of engine. Loosen nut at top of engine lifting eye to facilitate removal.
 - Installation is reverse of removal, noting the following:
 - ◆ Keep sealing faces free of oil.

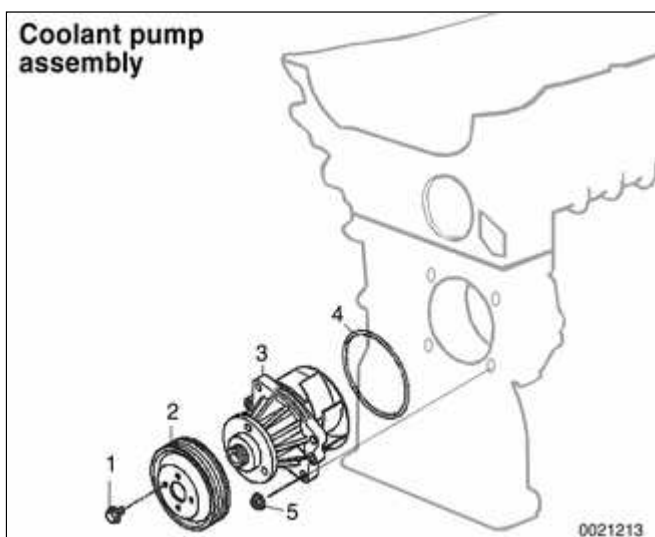


- ◆ Use new sealing gasket.
- ◆ Fill system with coolant as described under ⇒ [Coolant, draining and filling](#)

Tightening torques

Engine block drain plug to block	25 Nm (18 ft-lb)
Radiator drain plug to radiator	2 - 3 Nm (18 - 27 in-lb)

Coolant pump, replacing

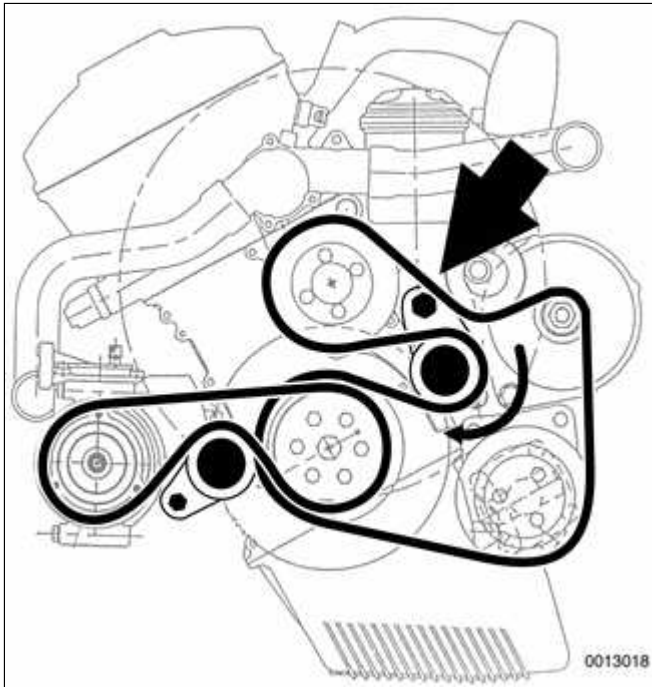


- ✦ The engine coolant pump is mounted in the front of the engine in the timing chain cover.
- 1 - Bolt M6 -tighten to 10 Nm (89 in-lb)
- 2 - Drive pulley
- 3 - Coolant pump
- 4 - O-ring seal
- 5 - Nut M6 -tighten to 10 Nm (89 in-lb)
- Drain cooling system as described earlier.

WARNING!

Allow cooling system to cool before opening or draining system.

- Remove air intake duct, cooling fan and fan shroud as described earlier.



- ✦ Remove engine drive belt: Lever tensioner hex (**large arrow**) in clockwise direction (facing engine) and slip belt off coolant pump pulley.

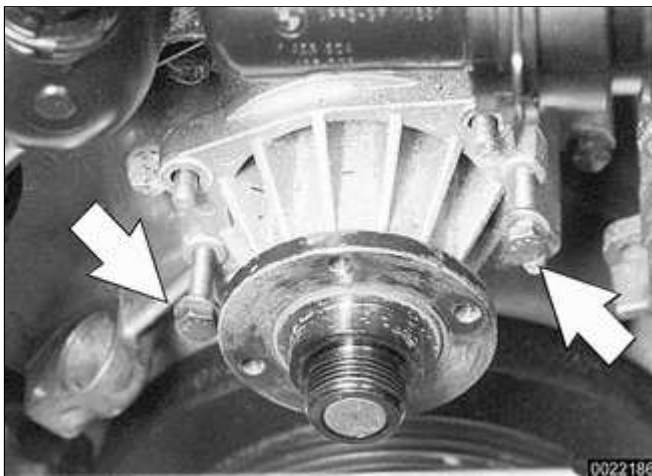
Note:

Mark direction of drive belt rotation if reusing belt.

- Remove coolant pump pulley bolts and remove pulley from pump.
- Remove pump mounting nuts (qty. 4).

Note:

The coolant pump is mounted on studs and retained by nuts.



- ✦ Insert two M6 screws (**arrows**) in tapped bores and tighten uniformly until pump is free from timing chain cover. (Thermostat and hoses have been removed for visual access.)
- Installation is reverse of removal, noting the following:
 - ◆ Be sure to replace sealing O-ring and gaskets.
 - ◆ Coat O-ring with lubricant during installation.

Tightening torques

Coolant pump to timing chain cover	10 Nm (89 in-lb)
Coolant pump pulley to coolant pump	10 Nm (89 in-lb)
Engine block drain plug to block	25 Nm (18 ft-lb)

Tightening torques	
Radiator drain plug to radiator	2-3 Nm (18-27 in-lb)

Radiator, removing and installing

- Raise front of car and support safely.

CAUTION!

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.

- Remove splash shield from under engine.
- Drain radiator and engine block as described earlier.

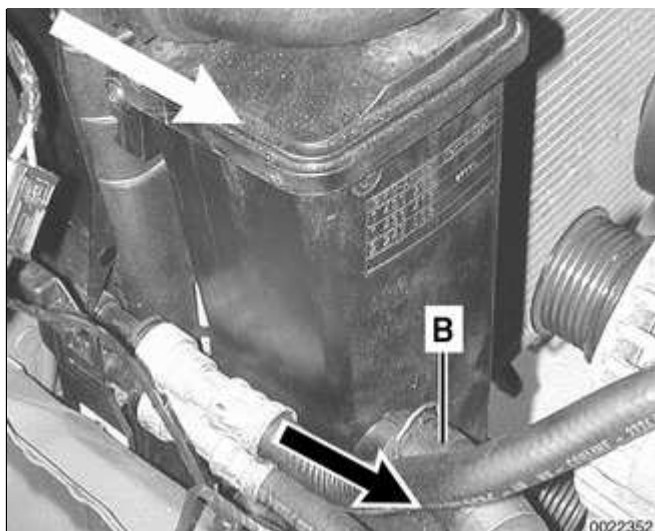
WARNING!

Allow cooling system to cool before opening or draining system.

- Remove complete air filter housing.
- Remove air intake duct, cooling fan and fan shroud as described earlier.

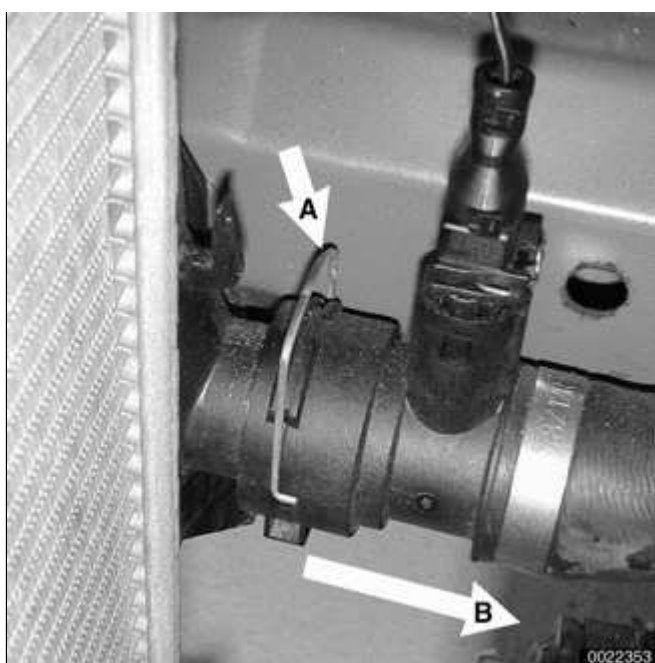


Working on left side of radiator, lever out hose retaining clips and disconnect coolant hose fittings from radiator (A) and radiator expansion tank (B).



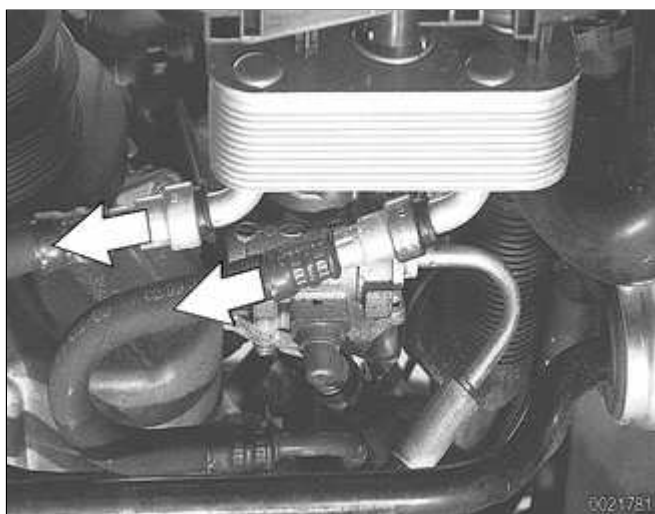
- ◀ Working on ride side of radiator, release hose retaining clips (**A**) and disconnect lower coolant hose fitting from radiator (**B**).

- Working underneath radiator, disconnect harness connector from coolant level sensor.



- ◀ Where applicable, disconnect automatic transmission fluid (ATF) cooler lines from ATF cooler at quick disconnect unions (**arrows**) as follows:

- ◆ Push hose toward oil cooler.
- ◆ Press black locking ring into hose fitting while pulling hose off cooler.

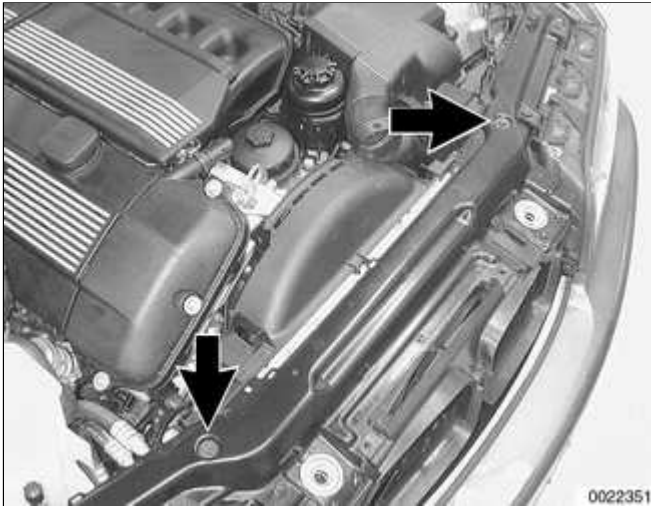


CAUTION!

Be sure to have a drain pan ready to catch spilled ATF.

Note:

Alternatively, detach ATF cooler from radiator by pulling up on quick release clips and pulling cooler from radiator tank.



- ✦ Remove plastic bolts at top of radiator (**arrows**). Pull radiator up and out of car.

- Installation is reverse of removal, noting the following:
- ◆ Do not coat sealing O-rings with anti-seize paste.
- ◆ Fill radiator and cooling system as described under ⇒ [Coolant, draining and filling](#)
- ◆ Check ATF level and, if necessary, top up. See ⇒ [240 Automatic Transmission](#).

Tightening torques	
Engine block drain plug to block	25 Nm (18 ft-lb)
Radiator drain plug to radiator	2 - 3 Nm (18 - 27 in-lb)

Coolant expansion tank, removing and installing

- Raise front of car and support safely.

CAUTION!

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack

stands designed for the purpose. A floor jack is not adequate support.

- Remove splash shield from under engine.
- Drain radiator and engine block as described earlier.

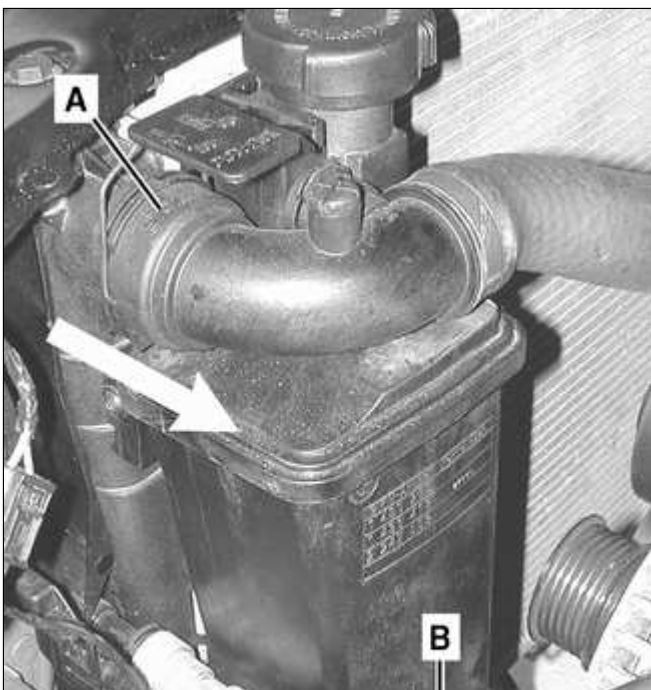
WARNING!

Allow cooling system to cool before opening or draining system.

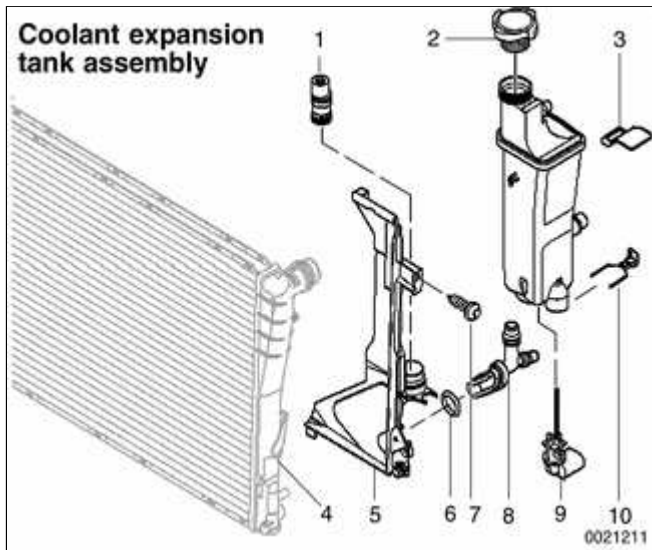
- Remove complete air intake filter housing.



- ✦ Working at front of engine compartment, remove expansion rivets (**arrows**) retaining air intake duct to radiator support and remove intake duct.



- ✦ Release hose retaining clips and disconnect coolant hose fittings (**A** and **B**) from expansion tank.
- Working underneath radiator, disconnect harness connector from coolant level sensor.



- Remove coolant level sensor (9) by twisting counterclockwise and pulling out of bottom of tank.
- 1 - Thermostat (ATF heat exchanger)
 - 2 - Expansion tank cap
 - 3 - Label
 - 4 - Radiator
 - 5 - Mounting bracket
 - 6 - Sealing O-ring
 - 7 - Self-tapping screw
 - 8 - Connector (ATF heat exchanger)
 - 9 - Coolant level sensor
 - 10 - Locking clip
- Pull out expansion tank by detaching from radiator at top. Then pull up from mounting bracket at bottom.
 - Installation is reverse of removal.
 - ◆ Do not coat O-rings with anti-seize paste.
 - ◆ Fill radiator and cooling system as described under ⇒ [Coolant, draining and filling](#)

Tightening torques

Engine block drain plug to block	25 Nm (18 ft-lb)
----------------------------------	------------------

Tightening torques	
Radiator drain plug to radiator	2 - 3 Nm (18 - 27 in-lb)

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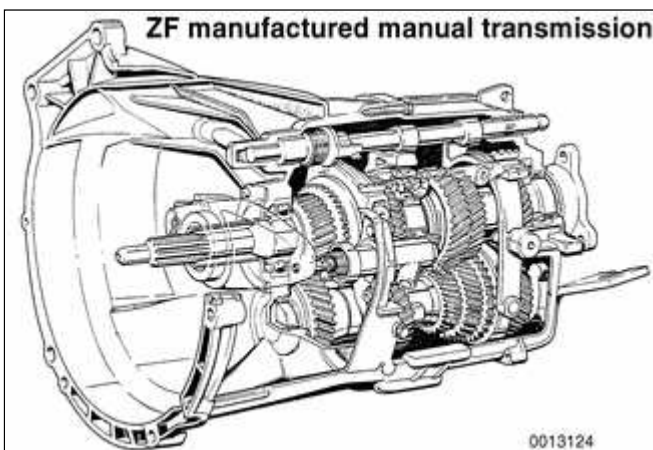
General

This section covers the repairs related to the clutch, manual and automatic transmissions, shift linkages, driveshafts, and transfer case (all wheel drive vehicles only). For repairs related to drive axles and front and rear final drive differentials, see ⇒ [311 Front Axle Final Drive](#) and ⇒ [331 Rear Axle Final Drive](#).

Drivetrain

E46 models are equipped with a longitudinal drivetrain. The transmission is bolted directly to the rear of the engine. In rear wheel drive models, a driveshaft connects the output shaft of the transmission to the rear final drive. On all wheel drive models, a transfer case is mounted to the rear of the transmission, with drive shafts leading to front and rear final drive assemblies. Individual drive axles with integrated constant velocity joints transfer rotational power from the final drive units to the drive wheels.

Manual transmission



Due to different power characteristics and performance requirements, three different manual transmissions are used in models covered by this manual. Manual transmission applications are given in ⇒ [Table a. Manual transmission applications](#).

Note:

For transmission gear ratio information and repair information, see ⇒ [230 Manual Transmission](#).

The manual transmissions use a single clutch disc with dual-mass flywheel. For further information, see ⇒ [210 Clutch](#).

Manual transmissions have a metal ID plate mounted on the side of the transmission. Do not rely on numbers cast on the transmission case for identification.

Table a. Manual transmission applications

Model	Year	Engine	Transmission
323i/Ci 325i/Ci	1999 - 2000 2000 - 2001	M52 TU M54	Getrag S5D 250G
328i/Ci 330i/Ci	1999 - 2000 2000 - 2001	M52 TU M54	ZF S5D 320Z
325xi330xi	2000 -2001	M54	ZF S5D 280Z

Automatic transmission

Two different automatic transmissions are used, depending on model and model year and/or production date. All of the automatic transmissions are electrohydraulically controlled with five forward speeds. Automatic transmission applications are given in ⇒ [Table b. Automatic transmission applications](#).

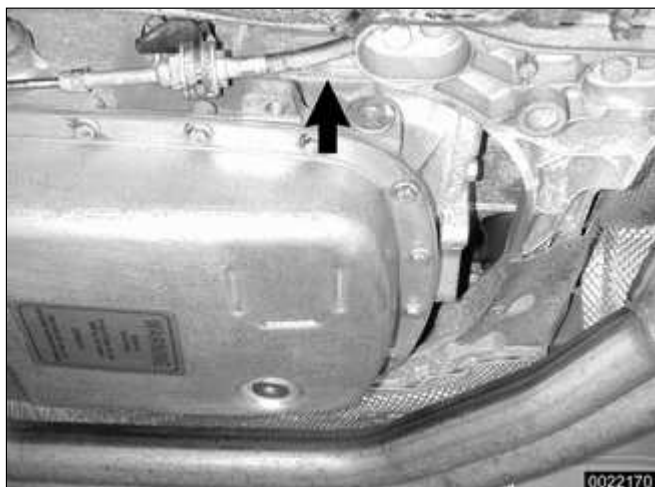
For automatic transmission repair information, see ⇒ [240 Automatic Transmission](#).

Transmission Identification codes for automatic transmissions are located on metal ID tags mounted to the body of the transmission.

Note:

323 i/Ci and 328 i/Ci models

manufactured from 08/98 to 03/00 are equipped with the A5S 360R automatic transmission. Vehicles produced after 03/00 use the A5S 325Z transmission.



- ◀ GM manufactured transmissions have the ID tag located on the left hand side of the transmission housing, behind the transmission selector cable, just above the transmission pan (**arrow**).



- ◀ ZF manufactured transmissions have the ID tags mounted on the left side of the rear of the transmissions, just above the automatic transmission pan (**arrow**).

Table b. Automatic transmission applications

Model	Year	Engine	Transmission
323i/Ci 328i/Ci	1999 - 2000 2000 - 2001	M52TU	GM A5S 360R ZF A5S 325 Z
325i/Ci 330i/Ci	2000 - 2001	M54	ZF A5S 325 Z
325xi 330xi	2000 - 2001	M54	GM A5S 390R

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Transmission lubricants

General

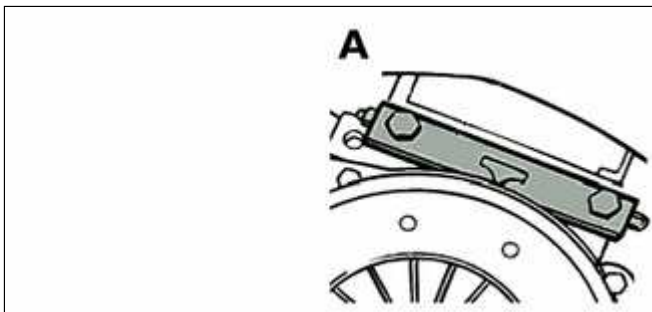
This repair group covers replacement of the clutch mechanical and hydraulic components. Read the procedure through before beginning a job.

Note:

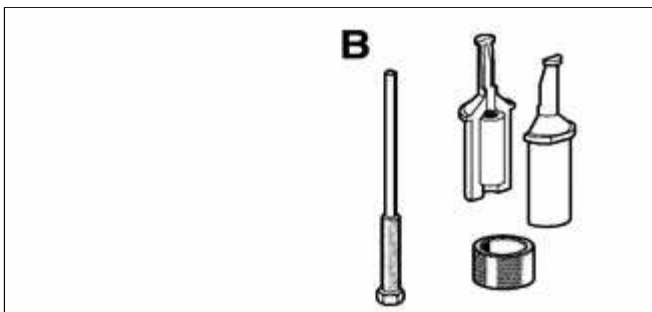
See ⇒ [200 Transmission-General](#) for transmission application information.

Special tools

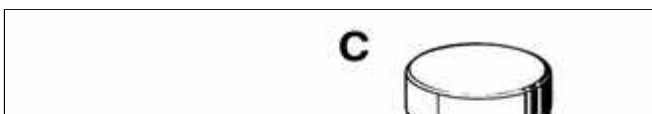
The 3 Series BMW employs a traditional style clutch layout with a self adjusting clutch for manual transmission cars. BMW suggests some specific tools for fitting and removing the self adjusting clutch (SAC) assembly. These tools are required for aligning and assembling the clutch disk, as well as locking the flywheel in place and aligning the SAC assembly to the dual mass flywheel.



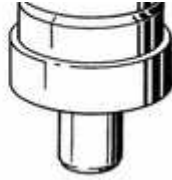
◀ Flywheel locking tool BMW 11 2 170



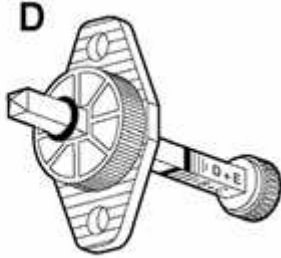
◀ Pilot bearing removal tool BMW 11 2 340



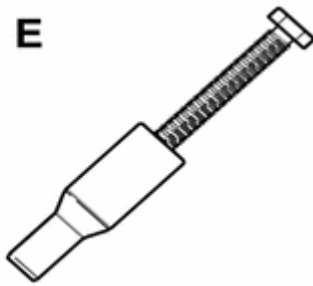
◀ Pilot bearing installation tool BMW 11 2 350



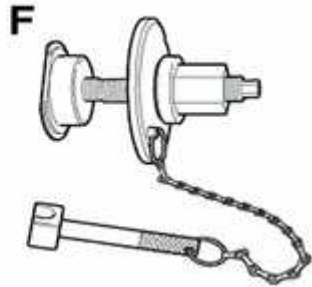
➤ Clutch lining gauge BMW 21 2 080



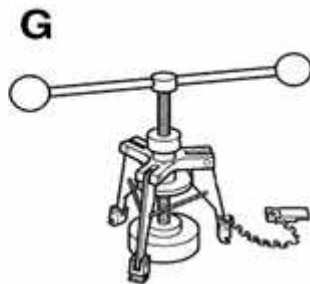
➤ Clutch centering mandrel BMW 21 2 142



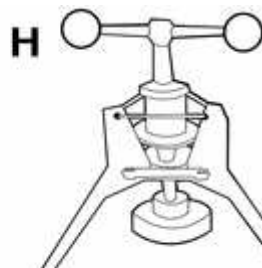
➤ SAC clutch lock tool BMW 21 2 150

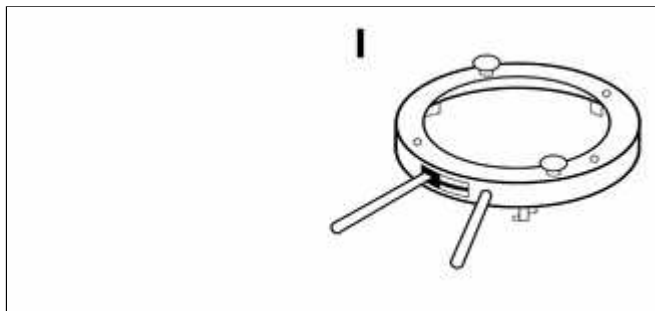


➤ Clutch diaphragm tensioning tool BMW 21 2 160



➤ SAC tensioning tool BMW 21 2 170





✦ SAC locating ring BMW 21 2 180

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Clutch Hydraulics

The clutch is hydraulically actuated by the master and slave cylinders. Clutch disc wear is automatically taken up through the self adjusting pressure plate springs, making periodic adjustments unnecessary.

A soft or spongy feel to the clutch pedal, long pedal free-play, or grinding noises from the gears while shifting can all indicate problems with the clutch hydraulics. In these circumstances it is best to start with a clutch fluid flush, followed, if necessary, by replacement of the hydraulic parts.

Note:

The clutch hydraulic system shares the fluid reservoir and fluid with the brake hydraulic system.

Clutch hydraulic system, bleeding and flushing

If the clutch/brake fluid is murky or muddy, or has not been changed within the last two years, the system should be flushed. Flushing the old fluid from the clutch lines is done using a brake system pressure bleeder.

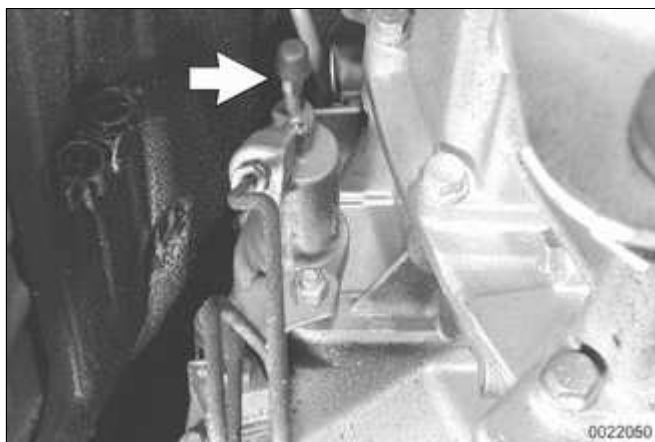
- Raise and safely support vehicle.
- Remove under transmission splash guard if applicable.
- Remove brake fluid reservoir cap. Using a clean syringe, remove brake fluid from reservoir. Refill reservoir with clean DOT 4 brake fluid.



- ✦ Attach pressure brake bleeder to fluid reservoir and pump bleeder a few times to pressurize hydraulic fluid system.

CAUTION!

- ✦ ***Do not exceed 2 bar (29 psi) pressure at the fluid reservoir when bleeding or flushing the hydraulic system.***
- ✦ ***Brake fluid is poisonous, highly corrosive and dangerous to the environment. Wear safety glasses and rubber gloves when working with brake fluid. Do not siphon brake fluid with your mouth. Immediately clean away any fluid spilled on painted surfaces and wash with water, as brake fluid will remove paint.***
- ✦ ***Always use new brake fluid from a fresh, unopened container. Brake fluid will absorb moisture from the air. This can lead to corrosion problems in the hydraulic systems, and will also lower the brake fluid's boiling point. Dispose of brake fluid properly.***



- ✦ Connect a length of hose from clutch slave cylinder bleeder valve (**arrow**) to a container.
 - Open bleeder valve and allow brake fluid to expel until clean fluid comes out free of air bubbles.
 - Close bleeder valve and disconnect pressure bleeding equipment from fluid reservoir. Hose on bleeder valve remains connected.

- Slowly operate clutch pedal about 10 times. Fill reservoir with clean fluid as necessary.
- Unbolt slave cylinder from transmission. Fit BMW special tool 21 5 030. Press slave cylinder pushrod completely into slave cylinder.
- Hold slave cylinder so that bleeder valve is at the highest point.
- Open bleeder valve.
- ◆ Once brake fluid appears with out air bubbles, withdraw pushrod completely.
- ◆ Press slave cylinder pushrod all the way in.
- ◆ If brake fluid appears without air bubbles close bleeder valve and slowly release pushrod. Repeat procedure until fluid runs out clear and without bubbles.
- Disconnect bleeder hose. Install slave cylinder to transmission. Add clean brake fluid to reservoir as necessary. Check clutch operation.

Tightening torque	
Clutch slave cylinder to transmission	22 Nm (16 ft-lb)

Clutch master cylinder,

replacing

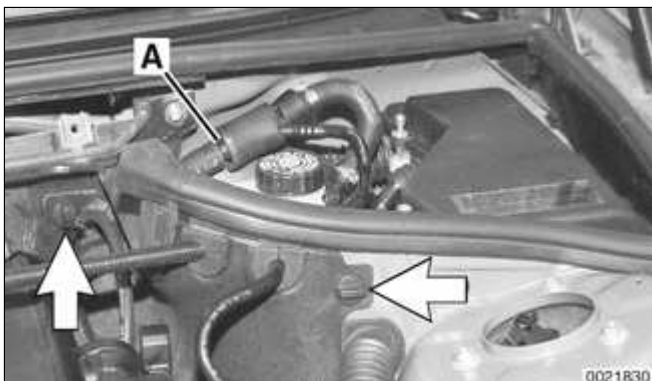
The clutch master cylinder is mounted to the pedal assembly directly above the clutch pedal.

- Disconnect negative (-) cable from battery.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Raise and safely support vehicle.
- Remove under transmission splash guard if applicable.
- Remove brake fluid reservoir cap. Using a clean syringe, remove brake fluid from reservoir.
- Disconnect fluid supply hose from brake master cylinder. Place a pan under hose to catch any excess fluid.
- Working in engine compartment, disconnect fluid line fitting from master cylinder.



◀ Working at left rear of engine compartment:

- ◆ Peel rubber edge seal off top of panel.
- ◆ Twist plastic panel retainers (**arrows**) 90° and pull out to remove.

- ◆ Disengage panel from hoses and wiring harnesses and remove from engine compartment.
- ◆ Separate brake booster vacuum hose at one way valve (**A**). Plug hose ends.
- Disconnect clutch pedal from clutch master cylinder push rod by removing securing pin.



- ✦ Remove master cylinder mounting bolts (**arrows**).



- ✦ Remove clip (**arrow**) retaining hydraulic line to master cylinder. Be prepared to catch any excess brake fluid remaining in hydraulic line.

Note:

Wrap clutch master cylinder with shop rags when removing hydraulic fluid lines from master cylinder to prevent brake fluid spill.

- Pull hydraulic line from master cylinder. Remove master cylinder with supply hose.
- Installation is reverse of removal. Fill fluid reservoir with clean fluid.

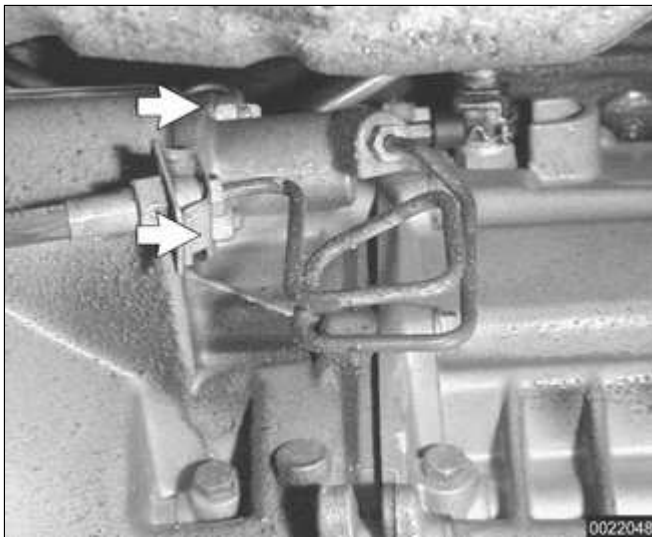
Bleed clutch hydraulics as described earlier. Connect negative cable to battery last.

Tightening torques

Clutch master cylinder to pedal cluster	22 Nm (16 ft-lb)
Fluid line to master cylinder or slave cylinder	20 + 5 Nm (15 + 4 ft-lb)

Clutch slave cylinder, replacing

- Pinch off brake fluid supply hose to clutch master cylinder using BMW special tool 13 3 010 or equivalent fuel line clamp tool.
- Remove transmission splash guard if applicable.
- Disconnect fluid hose from slave cylinder. Place a pan under hose to catch any excess fluid.



➤ Remove mounting nuts (**arrows**) from slave cylinder on left side of transmission.

- Installation is reverse of removal, noting the following:
- ◆ Check for wear on slave cylinder. Any other wear except on tip is caused by misalignment of clutch components.
- ◆ Lightly coat pushrod tip with molybdenum disulfide grease (Molykote® Longterm 2 or

equivalent).

- ◆ During installation be sure pushrod tip engages recess in clutch release lever.
- ◆ Fill fluid reservoir with clean fluid.
- ◆ Bleed clutch hydraulics as described earlier.

Tightening torques	
Clutch slave cylinder to transmission	22 Nm (16 ft-lb)
Fluid line to slave cylinder	20 + 5 Nm (15 + 4 ft-lb)

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Clutch Mechanical

The transmission must be removed from the engine to access the clutch mechanical components. It is recommended that the clutch disc, pressure plate and release bearing be replaced during a clutch overhaul. Be sure to check the bottom of the bellhousing for oil. If engine oil is found, check for a faulty rear crankshaft oil seal.

Due to the construction of the self adjusting clutch (SAC) disc special tools must be used when removing the SAC style clutch. The pressure plate of the SAC clutch uses a wedge ring which rotates against the diaphragm springs to accommodate for clutch disc wear. The wedge ring adjusts by means of spring tension, so special tools must be used to apply and relieve spring tension as the clutch pressure plate is removed and installed. For special tools needed for clutch replacement procedures refer to the ⇒ [Special tools](#)

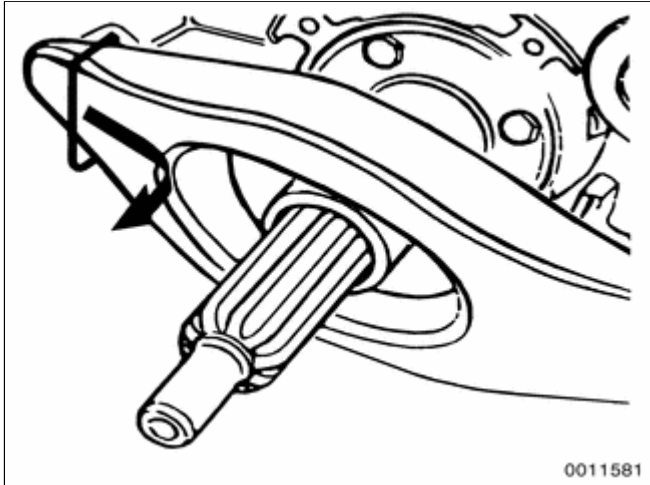
Table a. Clutch disc diameter	
Model	Diameter
323i/Ci 325i/Ci/xi	228 mm (8.98 in.)
328i/Ci 330i/Ci/xi	240 mm (9.45 in.)

Clutch, removing

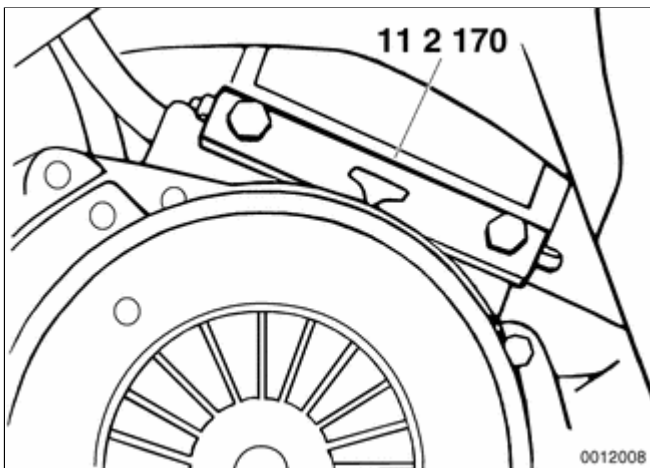
- On all wheel drive vehicles:
Remove transfer case. See ⇒ [270 Transfer Case](#).

- Remove transmission from engine.
See ⇒ [230 Manual Transmission](#).

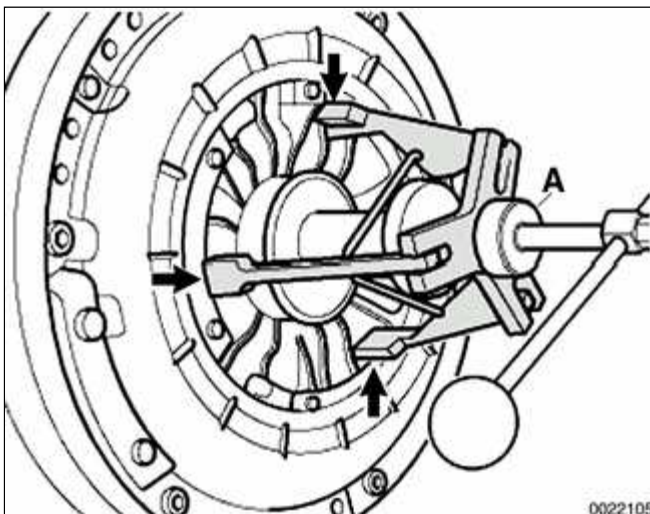
- Remove release bearing from transmission input shaft.



- Remove clutch release lever by pulling away from spring clip in direction of **arrow**.



- Lock flywheel in position using BMW special tool 11 2 170 or equivalent.



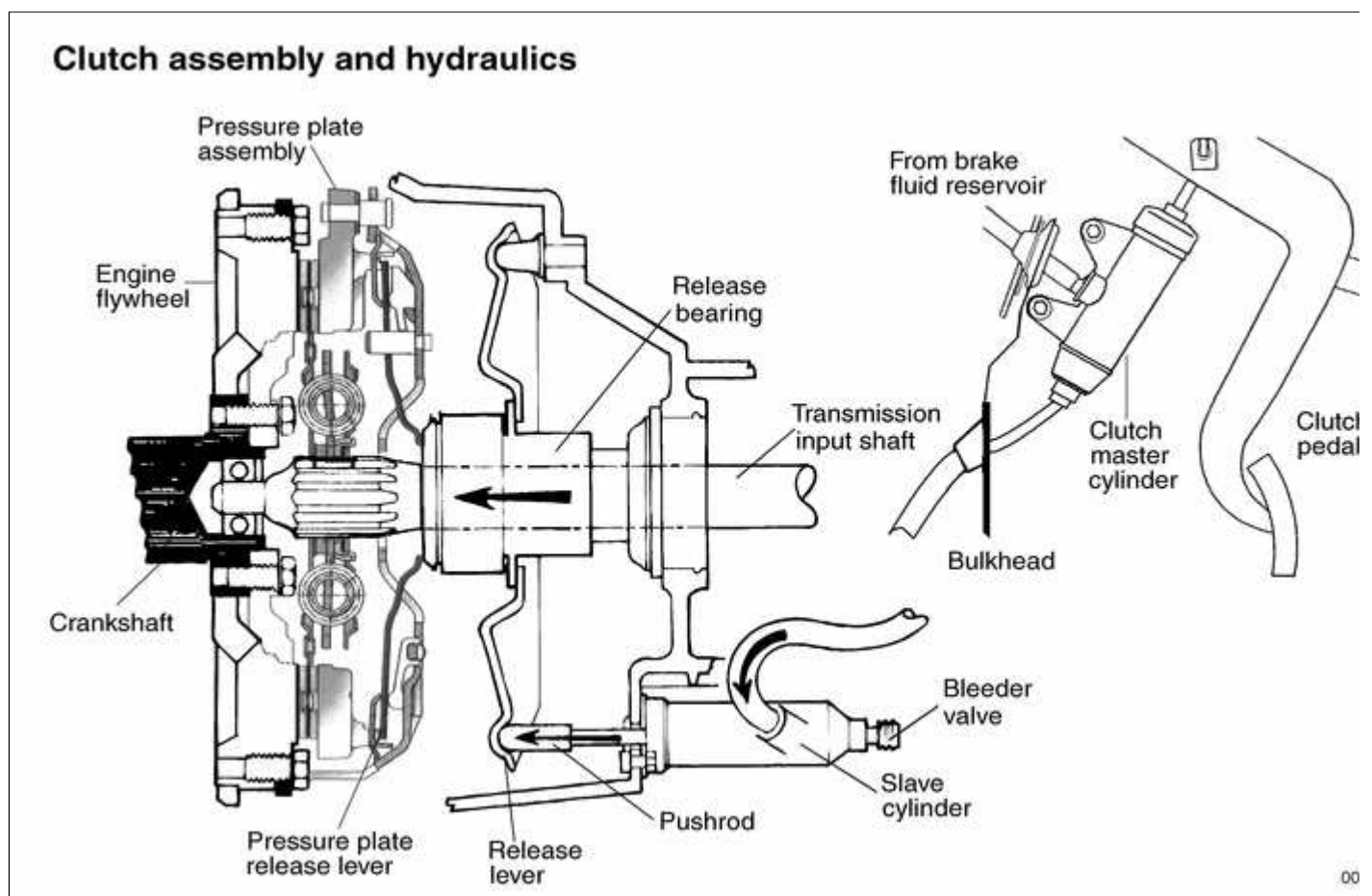
- Install BMW special tool 21 2 160 or 21 2 170 with feet (**arrows**) clamping on to pressure plate at openings for self-adjusting springs. Tighten down head nut (**A**) to lock feet into position.

CAUTION!

Self adjusting clutch tool feet must engage in the openings for adjusting springs to safely remove the SAC pressure plate.

- Turn tool handle in until clutch diaphragm spring is fully tensioned.
- Remove six bolts from perimeter of pressure plate. Remove self adjusting clutch unit and clutch disk.

Clutch assembly and hydraulics



Clutch, inspecting

- Inspect clutch disc for wear, cracks, loose rivets, contamination or

excessive runout (warping).
Replace if necessary.

Note:

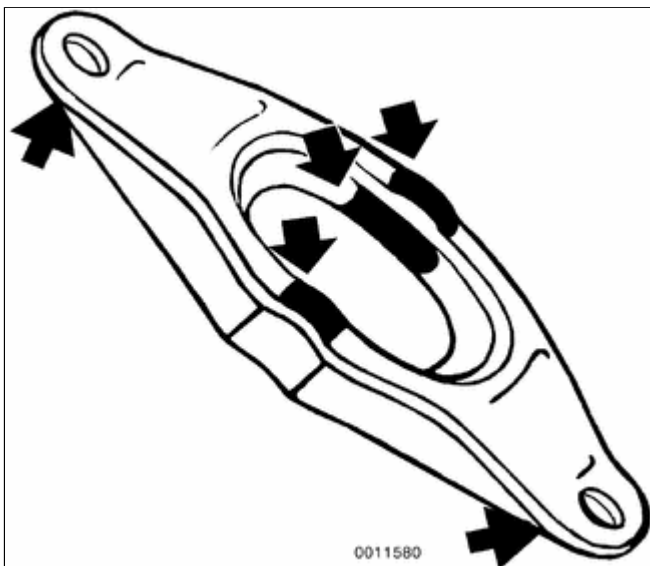
Measure the depth of clutch lining at lining rivets. If shallowest rivet depth is less than 1 mm (0.04 in.), replace clutch disk.

- Inspect flywheel for scoring, hot spots, cracks or loose or worn guide pins. Replace flywheel if any faults are found.

WARNING!

If flywheel is removed from vehicle, use new bolts during installation. The old stretch-type bolts should not be reused.

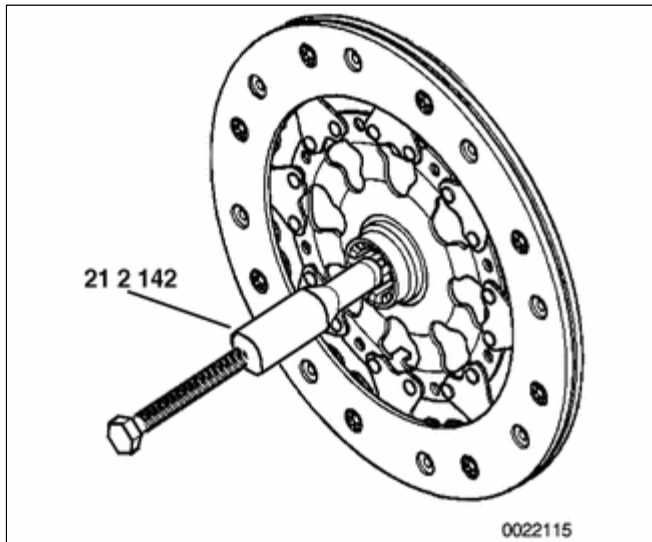
- Inspect transmission pilot bearing in end of crankshaft. The bearing should rotate smoothly without play. If necessary, replace as described later.



- ◀ Inspect and clean release bearing lever. Apply a thin coat of grease to release bearing lever lubrication points (**arrows**). Also, lightly lubricate clutch disc splines and transmission input shaft splines.

Clutch, installing new pressure plate

New self adjusting clutch (SAC) pressure plates come with a locking plate installed that maintains spring tension on the self adjusting springs. This locking ring must not be removed until the pressure plate is securely installed on the flywheel with the clutch disk in place.



- Center clutch disk on flywheel using BMW special tool 21 2 142, or an equivalent clutch alignment tool.

Note:

The sides of a replacement clutch disk are labelled engine side and transmission side. Be sure to install clutch disk orientated in the proper direction.

- Install self adjusting clutch pressure plate onto dowel pins at flywheel. Tighten each bolt one turn at a time until pressure plate is fully seated, and then torque to specification

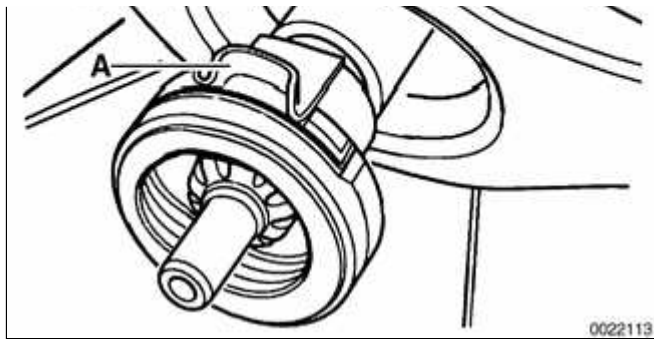
Tightening torque	
Clutch to flywheel	
M8 (8.8 grade)	24 Nm (18 ft-lb)
M8 (10.9 grade)	34 Nm (25 ft-lb)

- Using a 14 mm allen wrench, carefully screw out locking plate in a clockwise direction.

- Remove BMW special tool 21 2 142 with bolt or screw enclosed with replacement clutch disk.



- Clean and inspect release bearing guide sleeve on transmission. Install release lever and release bearing. Bearing tabs (A) align with contact points (B) on



release lever.

- Install transmission. See ⇒ [230 Manual Transmission](#).

Tightening torques

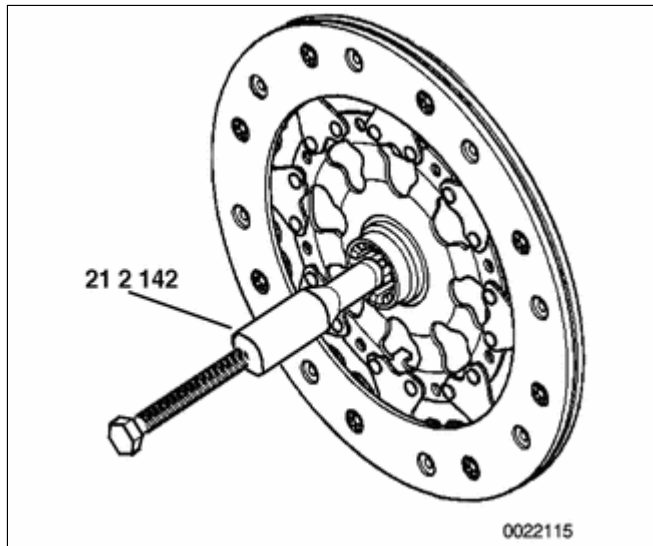
Transmission to engine (Torx bolts)

M8	22 Nm (16 ft-lb)
M10	43 Nm (32 ft-lb)
M12	72 Nm (53 ft-lb)

Clutch, installing used pressure plate

Note:

- ◆ *Before installing a used Self Adjusting Clutch (SAC) pressure plate, be sure to reset self adjusting ring to the new position*
- ◆ *Locating hooks of BMW special tool 21 2 180 must engage in openings of SAC pressure plate*
- Place self adjusting clutch pressure plate on clean work surface. Install special tool 21 2 180 onto pressure plate.
- Squeeze handles of 21 2 180 together. Tighten down knurled knobs of 21 2 180. SAC adjustment ring is now in installation position.
- Install special tool 21 2 170 over 21 2 180 on SAC pressure plate. Screw in handle of 21 2 170 until diaphragm spring of SAC pressure plate is pretensioned.



- ◀ Center clutch disk with BMW special tool 21 2 142. A comparable clutch alignment tool may be used. Remove threaded handle of clutch alignment tool

WARNING!

Be sure clutch disc is facing the correct way. The disc should be marked engine side or transmission side.

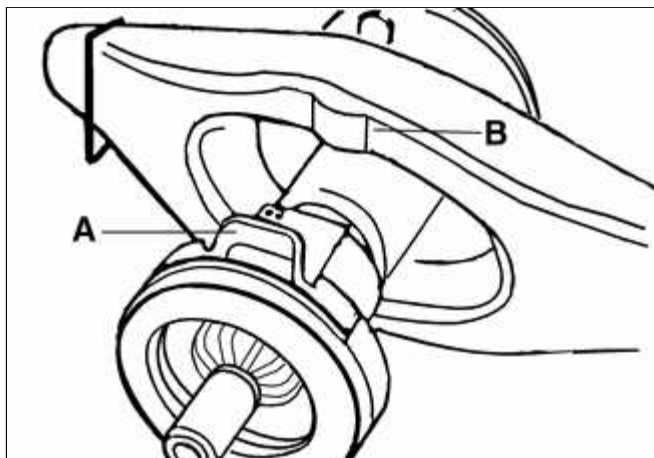
- Mount self adjusting clutch assembly on flywheel, noting location of alignment pins.
- Tighten each bolt one turn at a time until pressure plate is fully seated, and then torque to specification.

Tightening torque

Clutch to flywheel

M8 (8.8 grade)	24 Nm (17-ft-lb)
M8 (10.9 grade)	34 Nm (25 ft-lb)

- Unscrew handle of special tool until load is removed from diaphragm. Remove BMW special tool 21 2 180 from pressure plate.
- Remove clutch alignment tool from disk.



- ◀ Clean and inspect release bearing guide sleeve on transmission. Install release lever and release bearing. Make sure bearing tabs (A) align with contact points (B) on release lever.

- Install transmission. See ⇒ [230 Manual Transmission](#).

Tightening torques



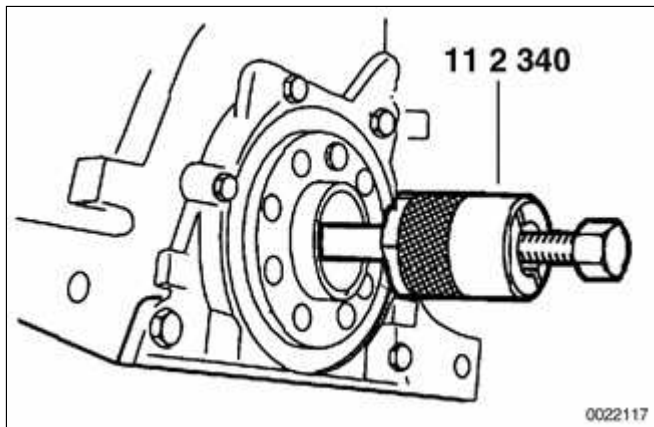
Tightening torques

Transmission to engine (Torx bolts)

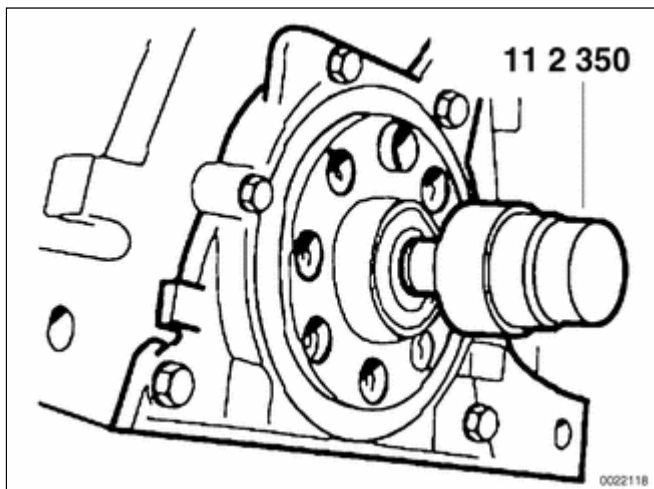
M8	22 Nm (16 ft-lb)
M10	43 Nm (32 ft-lb)
M12	72 Nm (53 ft-lb)

Transmission pilot bearing, replacing

- Remove clutch as described earlier.



- Remove transmission pilot bearing from end of crankshaft using BMW special tool 11 2 340 or equivalent puller.



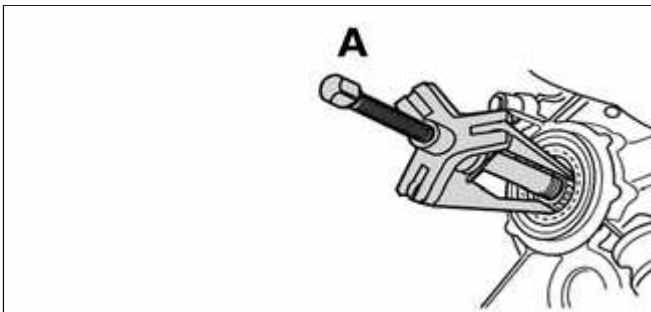
- Press new bearing into place using BMW special tool 11 2 350 or equivalent driver.

General

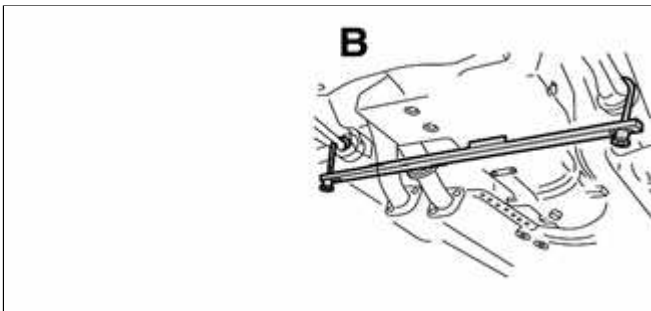
This repair group covers external transmission service, including removal and installation of the transmission unit. Internal transmission repair is not covered. Special press tools and procedures are required to disassemble and service the internal geartrain.

Special tools

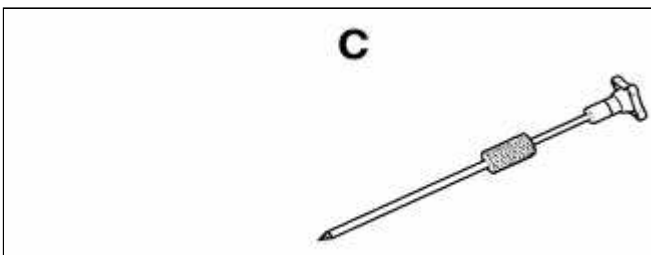
BMW specified tools are required for removal and installation of the manual transmission, as well as the removal and installation of seals at the transmission input, output, and selector shafts. If these tools are unavailable, equivalent tools may be substituted.



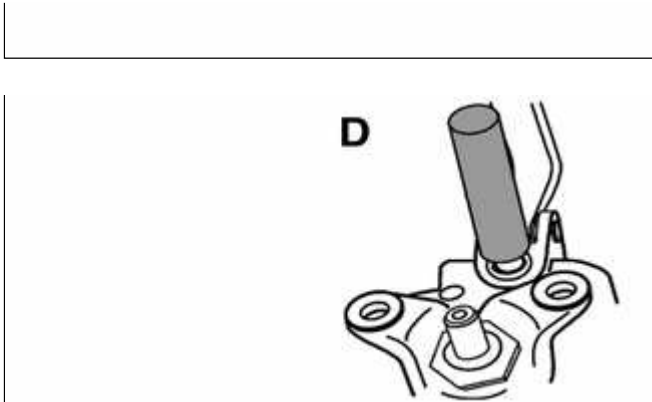
- ◀ Seal puller BMW 00 5 010



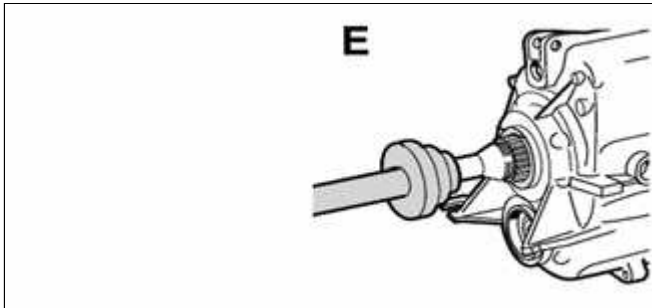
- ◀ Engine support bracket (lower) BMW 11 8 022



- ◀ Input shaft seal puller (slide hammer) BMW 23 0 490



◀ Selector seal drift BMW 23 0 22



◀ Output seal drift BMW 23 2 300

Manual transmissions used are based on engine application. Consult ⇒ [200 Transmission-General](#) for transmission application information. ⇒ [Table a. Manual transmission gear ratios](#) lists gear ratio specifications.

Note:

Do not rely on forged casting numbers for transmission code identification.

Table a. Manual transmission gear ratios

Transmission	Getrag S5D 250G	ZF S5D 280Z	ZF S5D 320Z
Gear Ratios:			
1st	4.23	4.21	4.21
2nd	2.52	2.49	2.49
3rd	1.66	1.66	1.66
4th	1.22	1.24	1.24
5th	1.00	1.00	1.00
reverse	4.04	3.85	3.85

Transmission Fluid Service

Manual transmissions installed in the 3 Series are normally filled with a "Lifetime" manual transmission fluid (BMW MTF LT-1) and do not require periodic fluid changes. Transmissions filled with MTF LT-1 lifetime oil are identified with a yellow label near the transmission fill plug labeled "Lifetime Oil MTF-LT-1".

Transmission fluid level, checking

Checking the transmission fluid level involves simply removing the side fill plug and inserting a finger into the hole to check the fluid level. If the fluid level is up to the bottom of the fill hole (finger is wetted by transmission fluid), the level is correct.

Transmission fluid, replacing

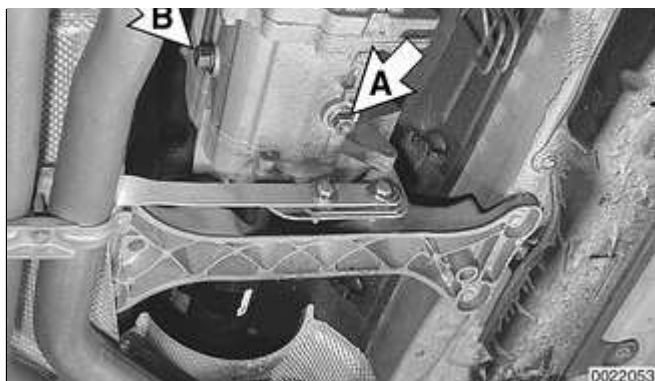
- Drive vehicle for a few miles to warm transmission.
- Raise and safely support vehicle to access drain plug.

CAUTION!

Make sure the car is stable and well supported at all times. Use a professional automotive lift or jack stands designed for the purpose. A floor jack is not adequate support.



Place a drain pan under transmission and remove drain plug (A) at bottom of transmission.



- ◆ Install and torque drain plug.
- ◆ Remove fill plug (**B**) from side of transmission.
- ◆ Slowly fill transmission with fluid until fluid overflows fill hole.
- ◆ Install and torque fluid fill plug.nothing

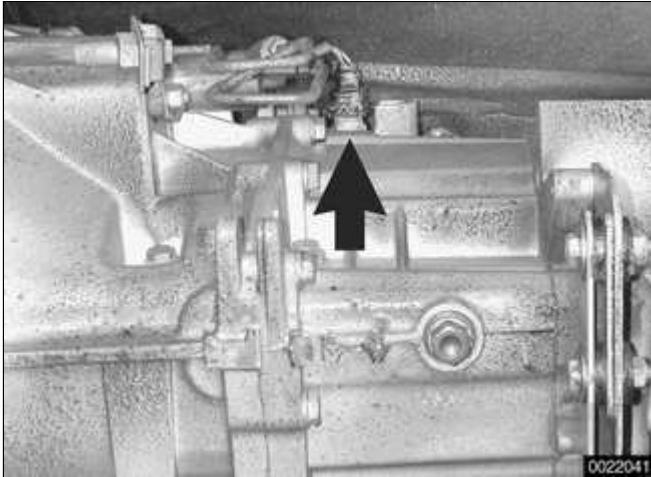
Fluid capacity	
Getrag transmission	1.0 liter (1.1 US qts)
ZF transmission	1.2 liters (1.3 US qts)

Tightening torque	
Transmission drain or fill plug	50 Nm (37 ft-lb)

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Transmission Service

Back-up light switch, replacing



- Raise and safely support vehicle to access back-up light switch. Unscrew switch from transmission.

Note:

- ◆ *The back-up light switch (arrow) on Getrag transmissions is in the left side of the transmission.*
- ◆ *The back-up light switch on ZF transmission is in the right front of the transmission.*

- Install new switch.

Tightening torque	
Back-up light switch to transmission	20 Nm (15 ft-lb)

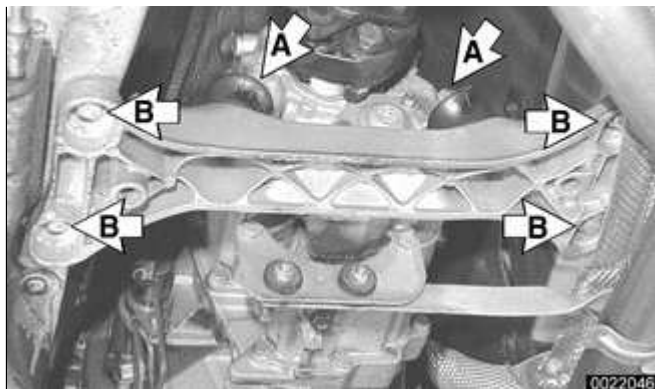
- Check transmission fluid level before lowering vehicle.

Selector shaft seal, replacing (transmission installed)

- Raise and safely support vehicle.
- Support transmission with transmission jack.



- On rear wheel drive cars:



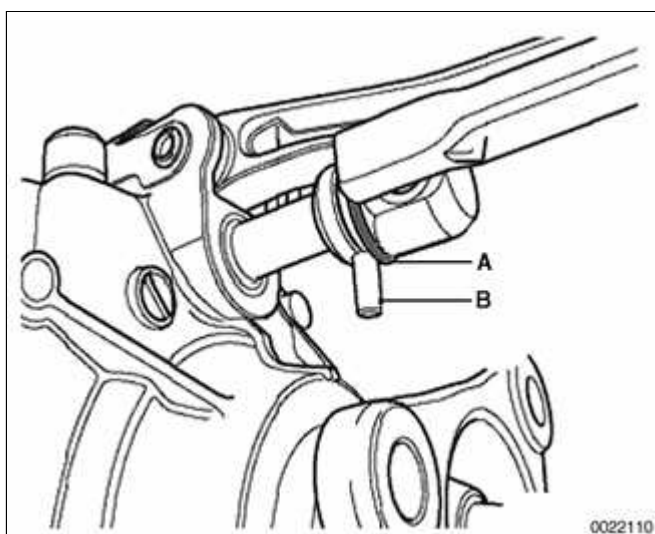
- ◆ Remove driveshaft. See ⇒ [260 Driveshaft](#).
- ◆ Remove transmission mount bolts (A).
- ◆ Remove transmission crossmember bolts (B) and tilt down rear of transmission.



- ✦ On all wheel drive cars:
 - ◆ Remove front and rear driveshafts. See ⇒ [260 Driveshaft](#)
 - ◆ Remove transfer case crossmember bolts (arrows) and remove transfer case. See ⇒ [270 Transfer Case](#).

CAUTION!

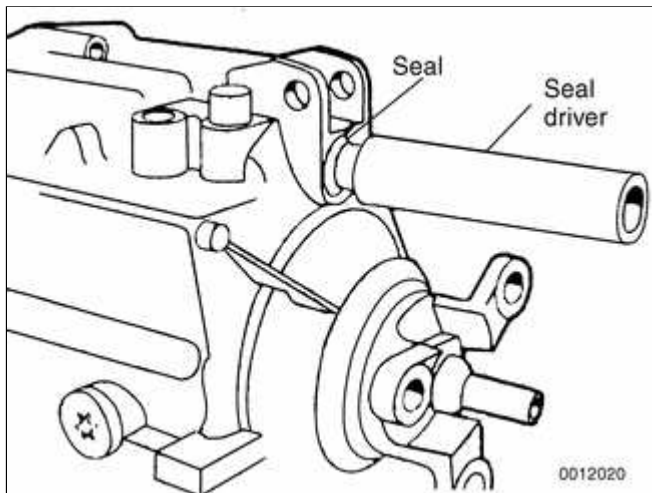
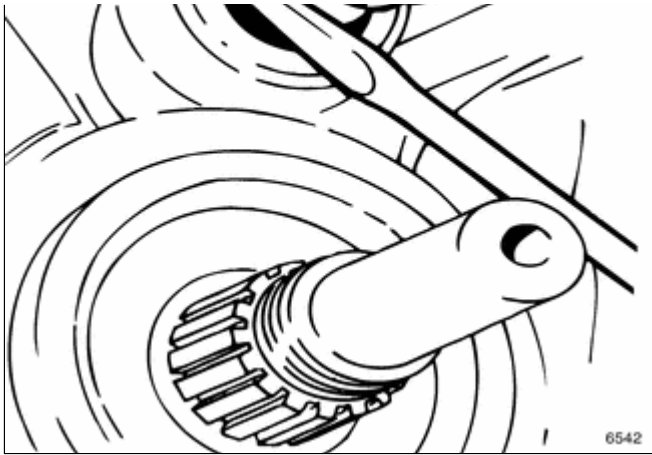
Tilting the engine to lower the transmission can lead to damage to various components due to lack of clearance.



- ✦ Working at rear of selector shaft, pry snap ring (A) out of groove with a small screwdriver. Push snap ring towards gear selector rod joint and drive out pin (B).



- ✦ Carefully pry out selector shaft oil seal with a narrow seal remover or small screwdriver.



✦ Coat new selector shaft seal with transmission fluid. Drive new seal in flush with housing. Use BMW special seal installation tool 23 1 140 or equivalent and a soft-faced (plastic) hammer.

- Installation is reverse of removal, noting the following;
- ◆ Install driveshaft using new lock nuts.
- ◆ Check transmission oil level, topping up as necessary.

Tightening torques

Center bearing (driveshaft) to body	21 Nm (15 ft-lb)
Clamping sleeve (driveshaft)	10 Nm (89 in-lb)
Driveshaft to final drive flange	
With U-joint (M10 ribbed nut)	80 Nm (59 ft-lb)
With U-joint (M10 compressed nut)	64 Nm (47 ft-lb)
Flex-disc to driveshaft or transmission flange	
M10 (8.8 grade)	48 Nm (35 ft-lb)