

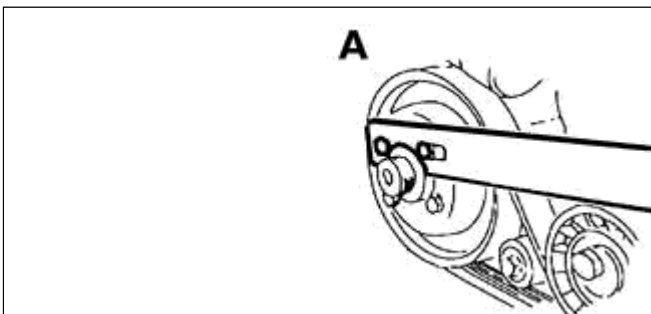
General

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

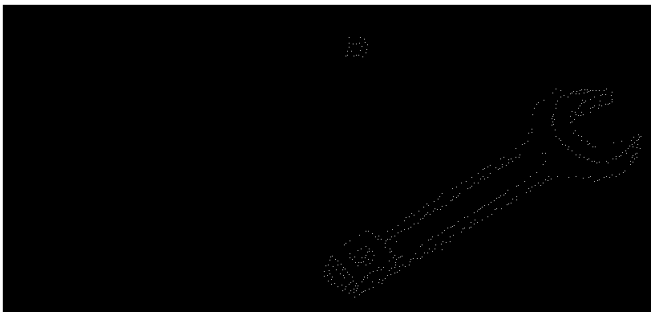
The E46 cooling system uses a centrifugal-type belt-driven coolant pump, an electric primary cooling fan, and an electrically heated thermostat. The cooling system is unique in that the cooling fan and the thermostat are controlled and monitored by the DME engine management system. Therefore, cooling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

Special tools

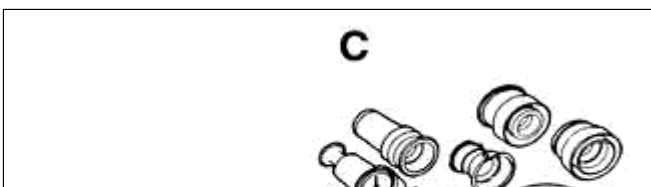
Special tools are necessary for fan clutch removal and pressure testing the cooling system.



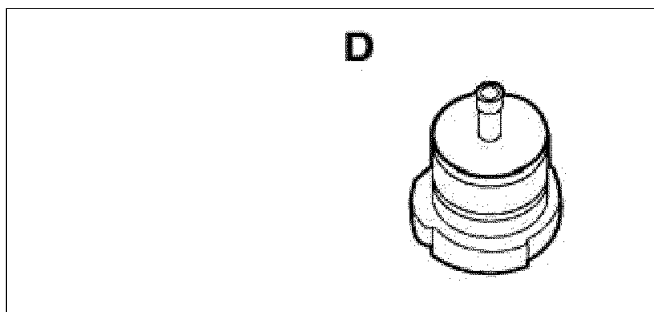
- ◀ Cooling fan counterhold wrench BMW 11 5 030



- ◀ Cooling fan wrench BMW 11 5 040

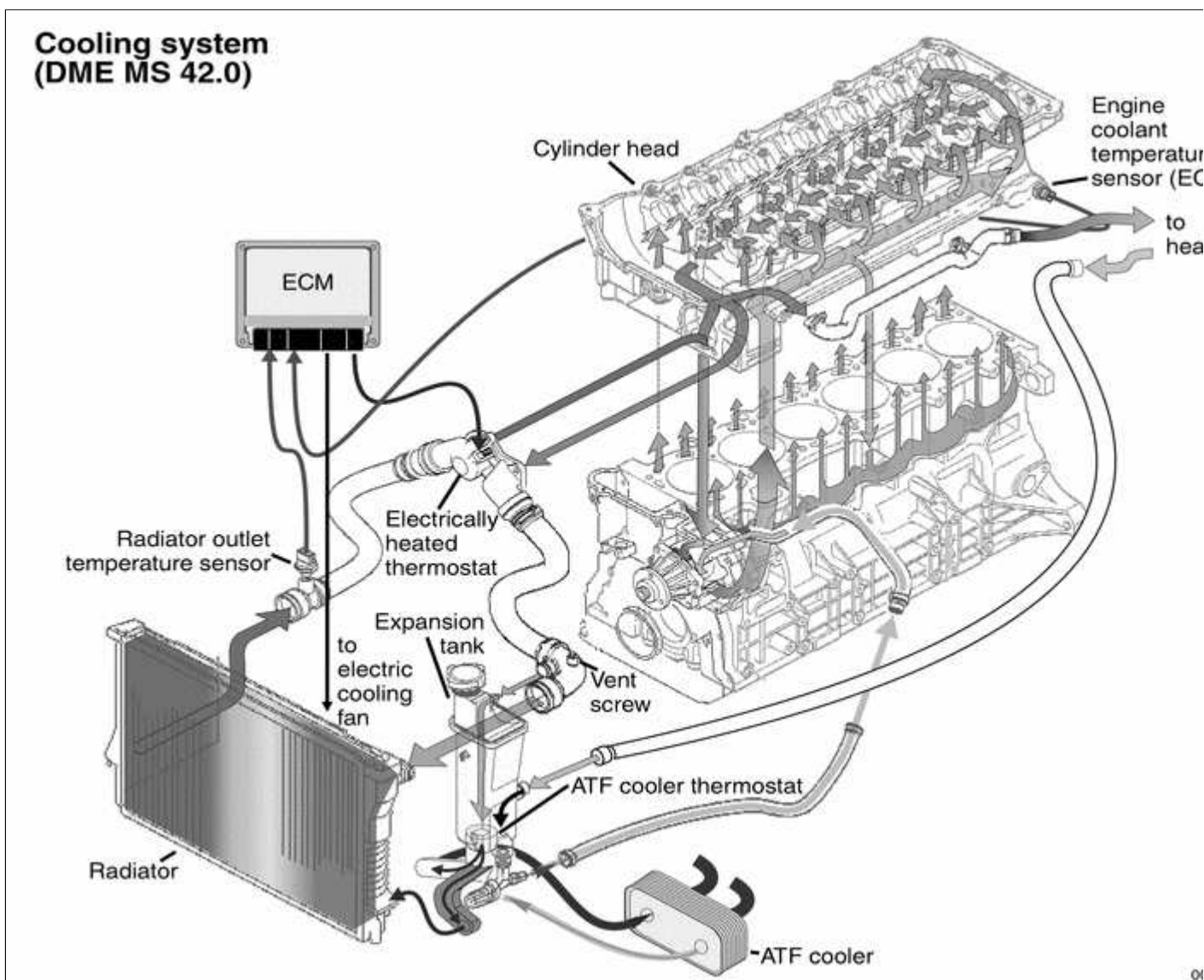


- ◀ Cooling system pressure tester BMW 17 0 002/17 0 005



Expansion tank cap test adapter BMW
17 0 007

Cooling system (DME MS 42.0)

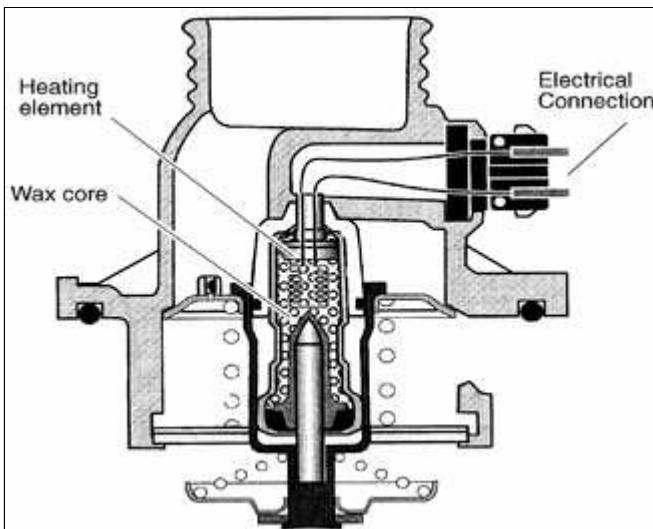


Coolant pump

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

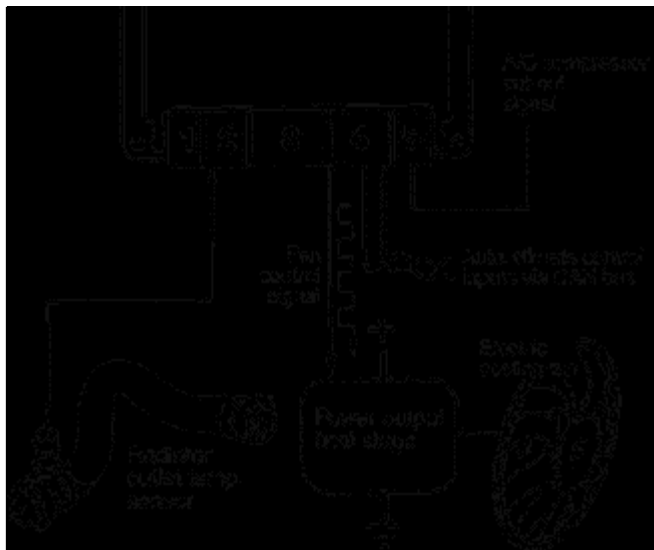
The radiator is a crossflow design. An expansion tank provides for coolant expansion at higher temperatures and easy monitoring of the coolant level.

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

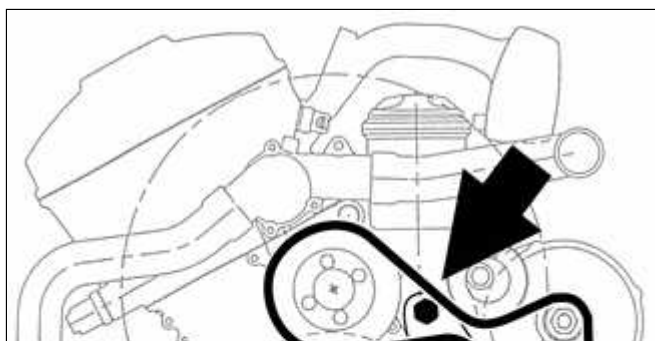
Begin the diagnosis of cooling system problems with a thorough visual inspection. If no visual faults are found, it is recommend that the DME system be checked for stored diagnostic fault codes (DTCs) using BMW scan tools DIS (Diagnostic Information System) or MoDiC (Mobile Diagnostic Computer) or an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

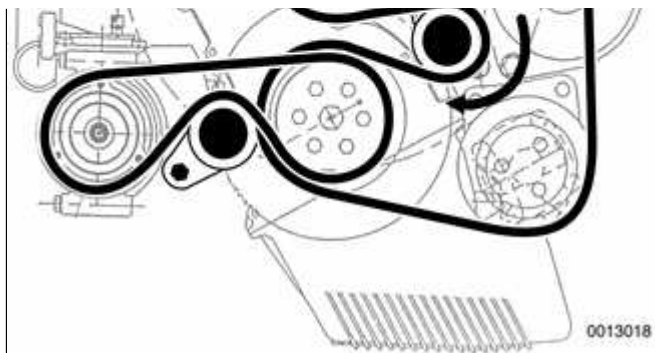
Be sure to check the condition and tension of the coolant pump drive belt. Check hoses for cracks or softness. Check clamps for looseness. Check the coolant level and check for evidence of coolant leaks from the engine.

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.

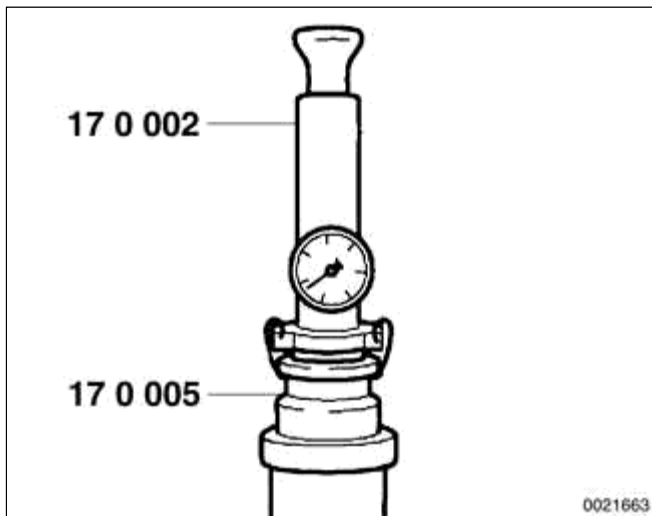
Cooling system pressure test

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.

Cooling System Service

Coolant, draining and filling

WARNING!

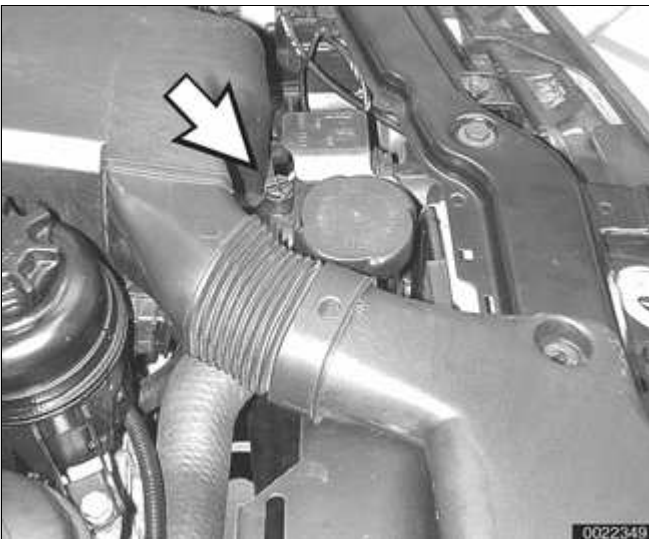
Allow the cooling system to cool before opening or draining the cooling system.

- 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.



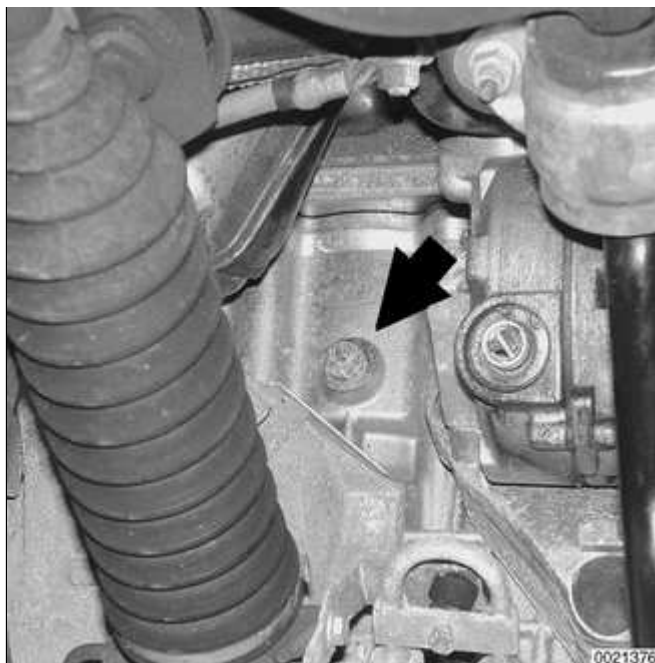
- ✦ Loosen radiator bleed screw at top radiator fitting (**arrow**).

- 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.

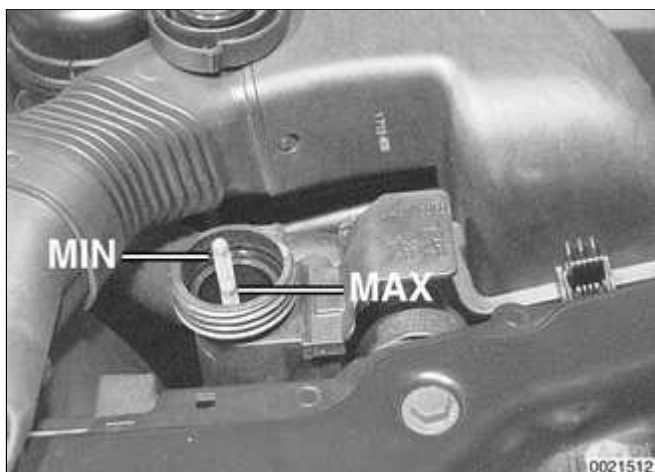
- ✦ Loosen bleed screw (**arrow**) on radiator expansion tank.

- 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.

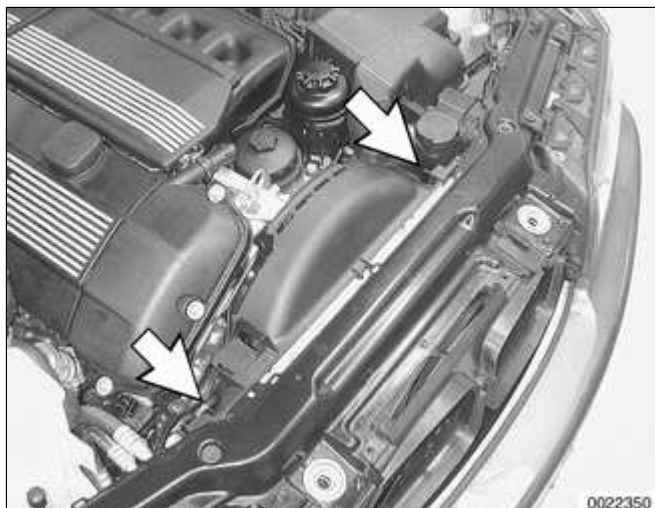
Tightening torque

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.

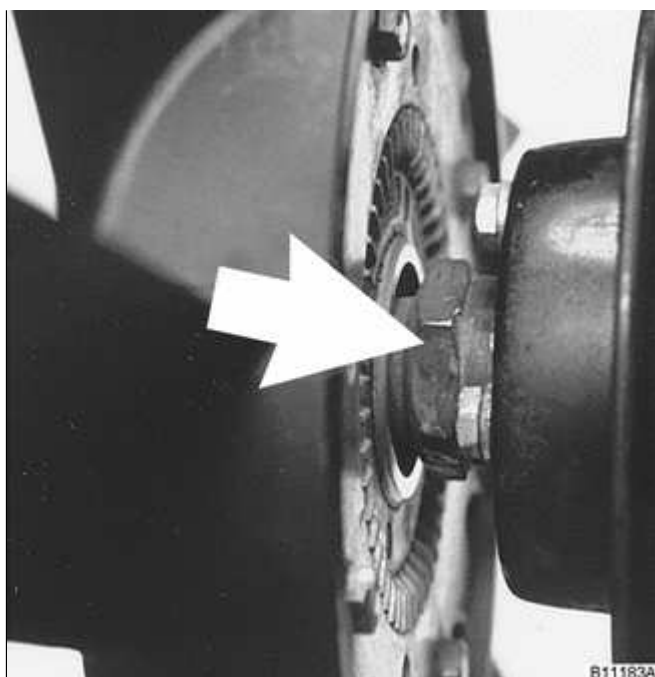




- ✦ Working at top of fan shroud, remove screw and expansion rivet (**arrows**) holding fan shroud to radiator. Unclip or disconnect electrical connector(s) from right side of shroud.

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.

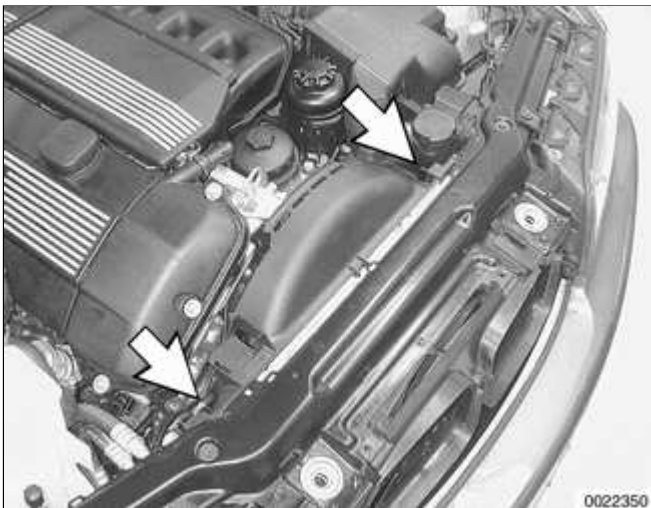
Tightening torques	
Clutch nut to coolant pump (left-hand threads)	
without BMW tool 11 5 040	40 Nm (29 ft-lb)

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

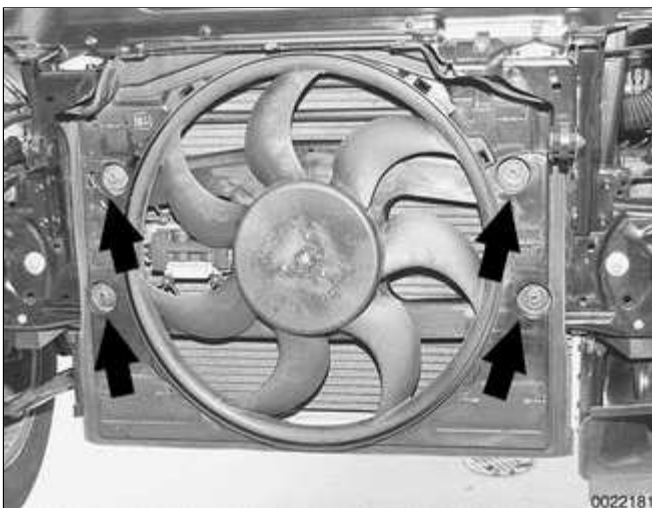
transmission)

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.

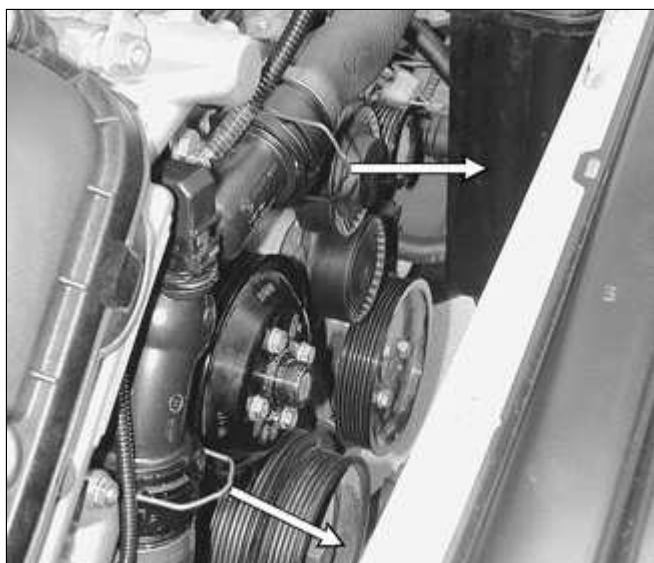
- 1 - Bolt M6
- 2 - Bolt M8
- 3 - Housing with heated thermostat
- 4 - Gasket

- 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.

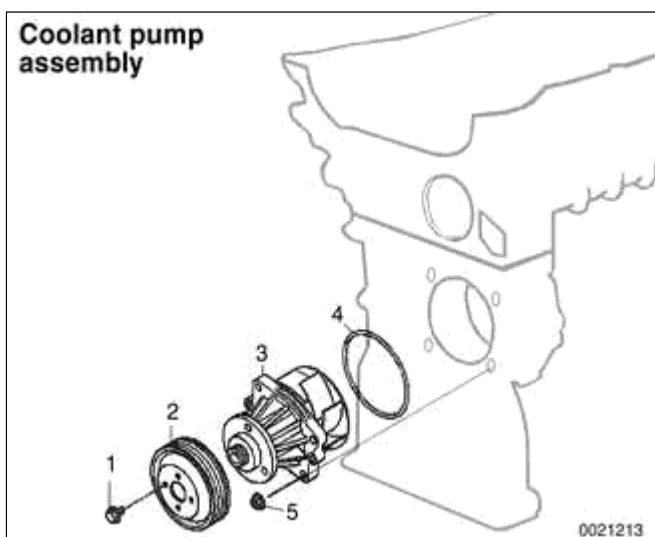


- ◆ Use new sealing gasket.
- ◆ Fill system with coolant as described under ⇒ [Coolant, draining and filling](#)

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.

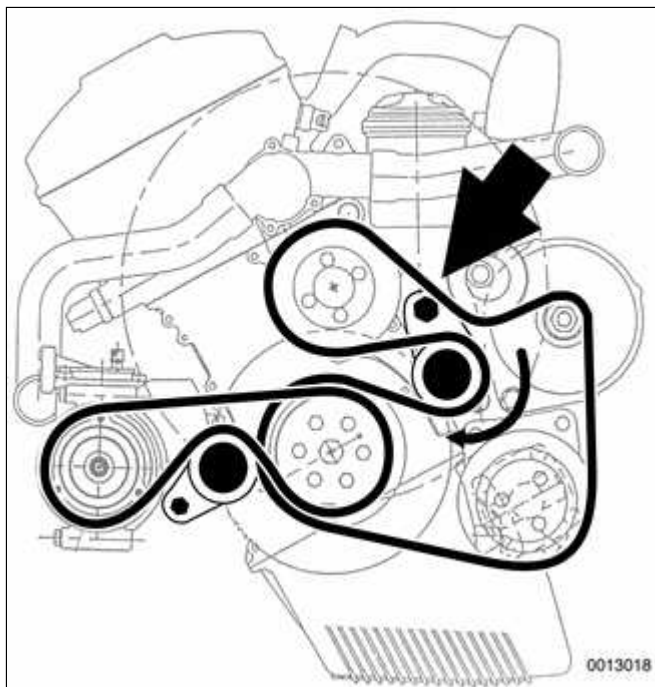
- 1 - Bolt M6 -tighten to 10 Nm (89 in-lb)
- 2 - Drive pulley
- 3 - Coolant pump
- 4 - O-ring seal
- 5 - Nut M6 -tighten to 10 Nm (89 in-lb)

- 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.

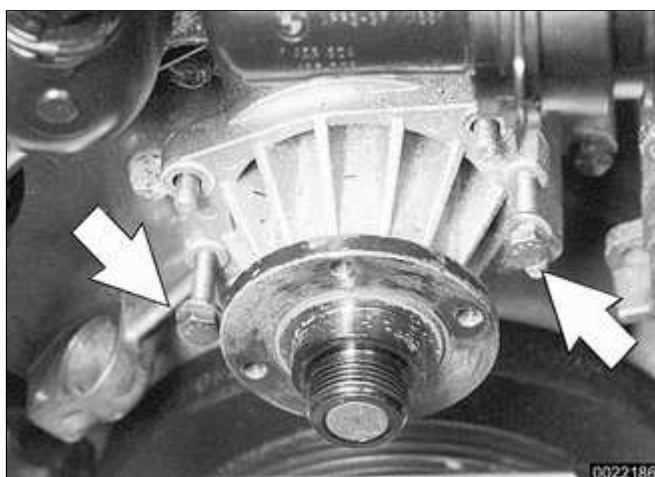
Note:

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)
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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.

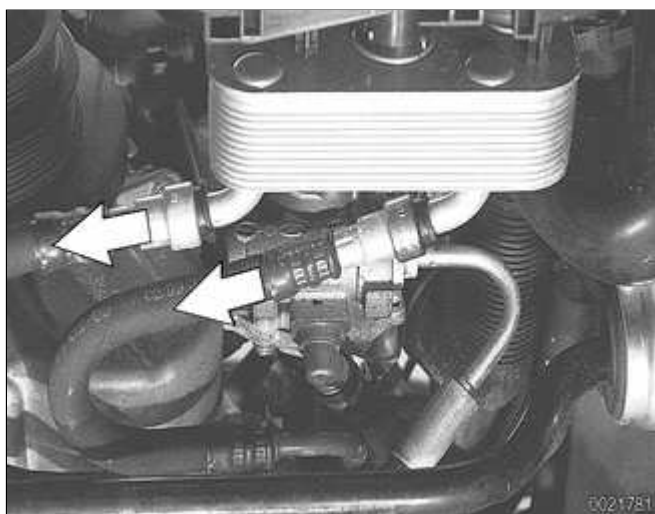
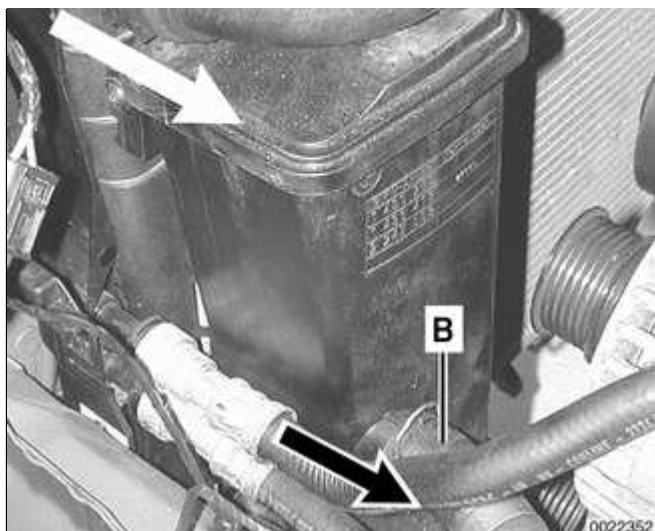
WARNING!

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**).

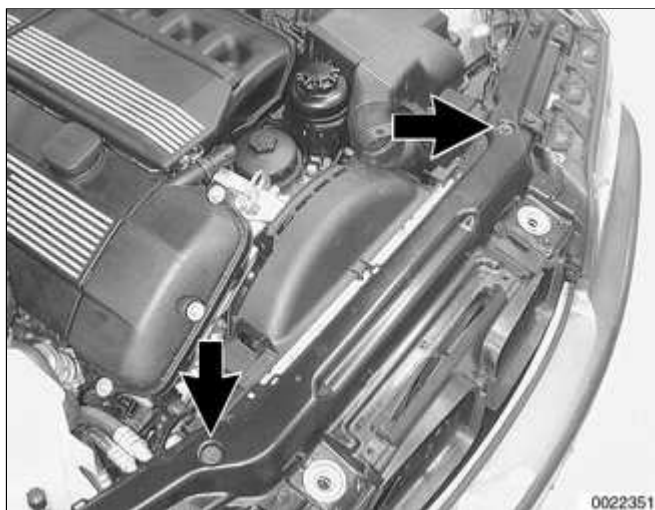
- Working underneath radiator, disconnect harness connector from coolant level sensor.

- 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.

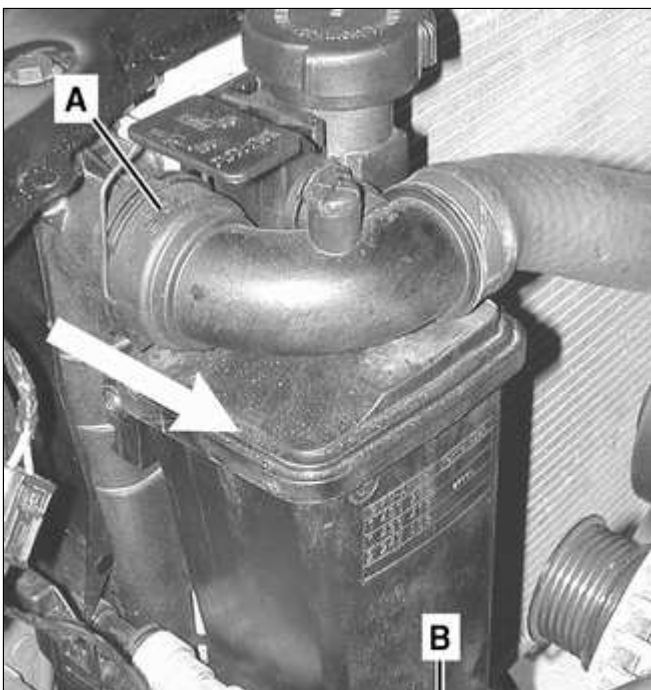
WARNING!

Allow cooling system to cool before opening or draining system.

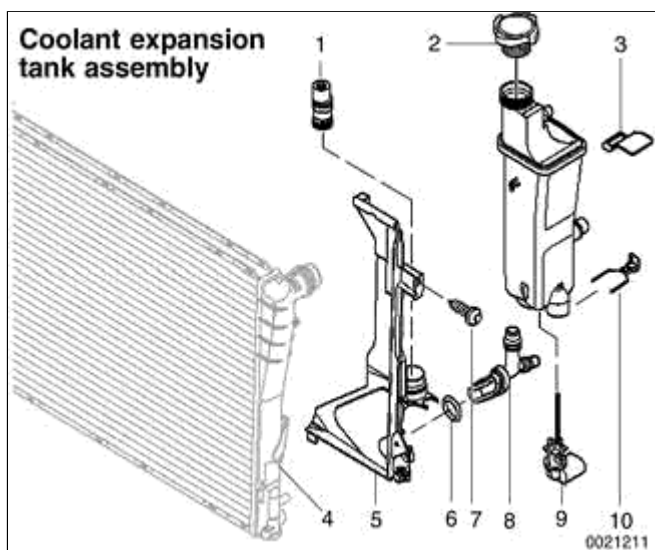
- Remove complete air intake filter housing.



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