

Chapter 3

Cooling, heating and air conditioning systems

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Degrees of difficulty

Easy , suitable for novice with little experience 	Fairly easy , suitable for beginner with some experience 	Fairly difficult , suitable for competent DIY mechanic 	Difficult , suitable for experienced DIY mechanic 	Very difficult , suitable for expert DIY or professional 
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Specifications

General

Coolant capacity	See Chapter 1
Thermostat rating	
Opening temperature	80°C (176°F)
Fully open at	100°C (212°F)
Cooling fan thermo-switch - switching temperatures	
Low-speed	91°C (196°F)
High-speed	99°C (210°F)

Torque wrench settings

	Nm
Mechanical cooling fan clutch-to-water pump securing nut (left-hand thread)	40
Mechanical cooling fan-to-clutch bolts	10
Water pump bolts	
Small bolts (M6)	10
Large bolts (M8)	22
Thermostat housing bolts	10

1 General information

Engine cooling system

All vehicles covered by this manual employ a pressurised engine cooling system, with thermostatically-controlled coolant circulation.

An impeller-type water pump mounted on the front of the block pumps coolant through the engine. The coolant flows around each cylinder, and towards the rear of the engine. Cast-in coolant passages direct coolant

around the intake and exhaust ports, near the spark plug areas, and in close proximity to the exhaust valve guides.

A wax-pellet-type thermostat is located in-line in the bottom hose on M10 engines, in a housing near the front of the engine on M20 and M30 engines, or behind an elbow under the timing belt upper cover (on the front of the cylinder head) on M40 engines. During warm-up, the closed thermostat prevents coolant from circulating through the radiator. As the engine nears normal operating temperature, the thermostat opens and allows hot coolant to travel through the radiator, where it's cooled before returning to the engine.

The pressure in the system raises the boiling point of the coolant, and increases the cooling efficiency of the radiator. The cooling system is sealed by a pressure-type cap. If the system pressure exceeds the cap pressure relief value, the excess pressure in the system forces the spring-loaded valve inside the cap off its seat, and allows the coolant to escape through the overflow tube.

The pressure cap on four-cylinder models is on the top of the radiator; on six-cylinder models, it's on top of a translucent plastic expansion tank. The cap pressure rating is moulded into the top of the cap. The pressure rating is either 1.0 bar (14 psi) or 1.2 bars (17 psi).

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Warning: Do not remove the pressure cap from the radiator or expansion tank until the engine has cooled completely and there's no pressure remaining in the cooling system. Removing the cap from a hot engine risks personal injury by scalding.

Heating system

The heating system consists of a blower fan and heater matrix located in the heater box, with hoses connecting the heater matrix to the engine cooling system, and the heater/air conditioning control head on the dashboard. Hot engine coolant is circulated through the heater matrix passages all the time the engine is running. Switching the heater on opens a flap door to direct air through the heater matrix, and the warmed air enters the passenger compartment. A fan switch on the control head activates the blower motor, which forces more air through the heater matrix, giving additional heater output for demisting, etc.

Air conditioning system

The air conditioning system consists of a condenser mounted in front of the radiator, an evaporator mounted adjacent to the heater matrix, a compressor mounted on the engine, a filter-drier (receiver-drier) which contains a high-pressure relief valve, and the plumbing connecting all of the above components.

A blower fan forces the warmer air of the passenger compartment through the evaporator matrix (a radiator-in-reverse), transferring the heat from the air to the refrigerant. The liquid refrigerant boils off into low-pressure vapour, taking the heat with it when it leaves the evaporator.

Note: Refer to the precautions at the start of Section 12 concerning the potential dangers associated with the air conditioning system.

2 Antifreeze - general information



Warning: Do not allow antifreeze to come in contact with your skin or painted surfaces of the vehicle. Rinse off spills immediately with plenty of water. If consumed, antifreeze can be fatal; children and pets are attracted by its sweet taste, so wipe up garage floor and drip pan coolant spills immediately. Keep antifreeze containers covered, and repair leaks in your cooling system as soon as they are noticed.

The cooling system should be filled with a 60/40% water/ethylene-glycol-based antifreeze solution, which will prevent freezing down to approximately -27°C (-17°F). The antifreeze also raises the boiling point of the

coolant, and (if of good quality) provides protection against corrosion.

The cooling system should be drained, flushed and refilled at the specified intervals (see Chapter 1). Old or contaminated antifreeze solutions are likely to cause damage, and encourage the formation of rust and scale in the system. Use distilled water with the antifreeze, if available, or clean rainwater. Tap water will do, but not if the water in your area is at all "hard".

Before adding antifreeze, check all hose connections, because antifreeze tends to seep out and leak through very minute openings. Engines don't normally consume coolant, so if the level goes down, find the cause and correct it.

The antifreeze mixture should be maintained at its correct proportions; adding too much antifreeze reduces the efficiency of the cooling system. If necessary, consult the mixture ratio chart on the antifreeze container before adding coolant. Hydrometers are available at most car accessory shops to test the coolant. Use antifreeze which meets the vehicle manufacturer's specifications.

3 Thermostat - check and renewal



Warning: Do not remove the radiator cap, drain the coolant, or renew the thermostat until the engine has cooled completely.

Check

- 1 Before assuming the thermostat is to blame for a cooling system problem, check the coolant level, drivebelt tension (see Chapter 1) and temperature gauge (or warning light) operation.
- 2 If the engine seems to be taking a long time to warm up (based on heater output or temperature gauge operation), the thermostat is probably stuck open. Renew the thermostat.
- 3 If the engine runs hot, use your hand to check the temperature of the upper radiator hose. If the hose isn't hot, but the engine is, the thermostat is probably stuck closed,



3.8 On the M10 (four-cylinder) engine, the thermostat (arrowed) is connected in-line in the radiator hose

preventing the coolant inside the engine from circulating to the radiator. Renew the thermostat.



Caution: Don't drive the vehicle without a thermostat. The engine will be very slow to warm-up in cold conditions, resulting in poor fuel economy and driveability. A new thermostat is normally an inexpensive component anyway.

4 If the upper radiator hose is hot, it means that the coolant is flowing and the thermostat is at least partly open. Consult the "Fault finding" Section at the rear of this manual for cooling system diagnosis.

Renewal

All models

5 Disconnect the negative cable from the battery.



Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

6 Drain the cooling system (see Chapter 1). If the coolant is relatively new or in good condition, save it and re-use it.

M10 engines

7 The thermostat is located in the bottom hose. First remove the cooling fan.

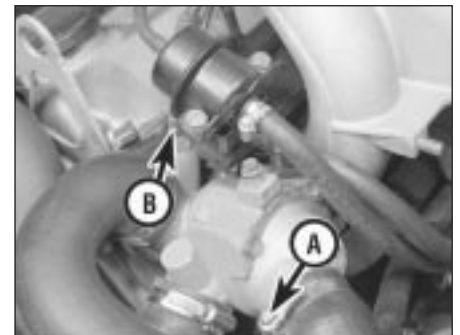
8 Note the fitted position of the thermostat, then unscrew the hose clamps and withdraw the thermostat from the hose connections (see illustration).

9 Refit the thermostat-to-hose connections, and tighten the hose clamps.

10 Refit the cooling fan.

M20 and M30 engines

11 Loosen the hose clamp (see illustration), then detach the hose(s) from the thermostat cover.



3.11 On M20 and M30 engine models, loosen the hose clamp (A) and disconnect the hose from the thermostat housing cover - note that the coolant temperature sender unit (barely visible behind the fuel pressure regulator) is located at the top of the thermostat housing (B)



3.15 On M20 and M30 engine models, after the housing and thermostat have been removed, take the O-ring out of the housing and clean the recess in the housing to be sure of a good seal upon reassembly

12 If the outer surface of the fitting that mates with the hose is deteriorated (corroded, pitted, etc.), it may be damaged further by hose removal. If it is, a new thermostat housing cover will be required.

13 Remove the bolts and detach the housing cover. If the cover is stuck, tap it with a soft-faced hammer to jar it loose. Be prepared for some coolant to spill as the gasket seal is broken.

14 Note how it's fitted, then remove the thermostat.

15 Stuff a rag into the engine opening, then remove all traces of old gasket material (if the gasket is paper type). Otherwise, remove the rubber O-ring (see illustration) and sealant from the housing and cover with a gasket scraper. Remove the rag from the opening and clean the gasket mating surfaces.

16 Fit the new thermostat and gasket in the housing. Make sure the correct end faces out - the spring end is normally directed towards the engine.

17 Refit the cover and bolts. Tighten the bolts to the torque listed in this Chapter's Specifications.

M40 engines

18 Remove the cooling fan and timing belt upper cover.

19 Unscrew the hose clamp and detach the



3.20a Removing the elbow from the cylinder head (M40 engine)

bottom hose from the elbow on the front of the cylinder head.

20 Unbolt the elbow from the cylinder head. Note the fitted position of the thermostat, then remove it (see illustrations). Remove the rubber O-ring; a new one will be needed for reassembly.

21 Locate the thermostat in the cylinder head in the same position as noted during removal (arrow pointing upwards).

22 Press a new O-ring in the groove, and locate the elbow on the cylinder head. Tighten the bolts.

23 Connect the bottom hose to the elbow, and tighten the hose clamp.

24 Refit the upper timing belt cover and cooling fan.

All models

25 Refill the cooling system (see Chapter 1).

26 Connect the battery negative cable.

27 Start the engine and allow it to reach normal operating temperature, then check for leaks and proper thermostat operation (as described earlier in this Section).

4 Radiator - removal and refitting



Warning: Wait until the engine is completely cool before beginning this procedure.



3.20b Removing the thermostat (M40 engine)

Note: If the radiator is being removed because it is leaking, note that minor leaks can often be repaired without removing the radiator, using a radiator sealant.



Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

Removal

1 Disconnect the battery negative cable.

2 Drain the cooling system (see Chapter 1). If the coolant is relatively new, or in good condition, save it and re-use it.

3 Loosen the hose clamps, then detach the hoses from the radiator (see illustrations). If they're stuck, grasp each hose near the end with a pair of water pump pliers, twist gently to break the seal, then pull off - be careful not to distort or break the radiator outlets! If the hoses are old or deteriorated, cut them off and refit new ones.

4 On M20 and M30 engines, disconnect the reservoir hose from the radiator filler neck.

5 Remove the screws or plastic fasteners that attach the shroud to the radiator, and slide the shroud towards the engine (see illustration). On some engines it is possible to completely remove the shroud.

6 If the vehicle has automatic transmission,



4.3a Disconnecting the top hose from the radiator



4.3b Bottom hose connection to the radiator



4.5 Plastic fastener retaining the radiator shroud on some engines

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4.7 Sensors that control the high- and low-speed operation of the auxiliary cooling fan are located in various places in the radiator tanks

disconnect the fluid cooler lines from the radiator. Use a drip tray to catch spilled fluid. Plug the fluid cooler lines and fittings.

7 Disconnect the coolant sensors located on the radiator (**see illustration**). The thermostatically-controlled switches for high- and low-speed operation of the auxiliary fan are located in the radiator tanks, in various locations depending on engine and model.

8 Remove the radiator mounting bolt(s). The mountings are either on the top or sides of the radiator (**see illustration**).

9 Carefully lift out the radiator from the bottom mountings, taking care not to damage the cooling fins. Don't spill coolant on the vehicle, or scratch the paint.

10 With the radiator removed, it can be inspected for leaks and damage. If it needs repair, have a specialist perform the work, as special techniques are required.

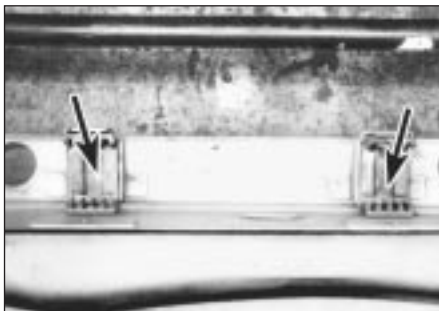
11 Flies and dirt can be removed from the radiator with compressed air and a soft brush. Don't bend the cooling fins as this is done.

12 Check the radiator mountings for deterioration, and renew if necessary (**see illustration**).

Refitting

13 Refitting is the reverse of the removal procedure.

14 After refitting, fill the cooling system with the proper mixture of antifreeze and water. Refer to Chapter 1 if necessary.



4.12 When the radiator is out, the radiator mountings can be inspected - check for signs of deterioration, and renew them, if needed



4.8 The radiator is bolted to the front panel at either the sides or the top of the radiator

15 Start the engine and check for leaks. Allow the engine to reach normal operating temperature, indicated by the upper radiator hose becoming hot. Recheck the coolant level, and add more if required.

16 If you're working on an automatic transmission model, check and add transmission fluid as needed.

5 Engine cooling fan(s) and clutch - check, removal and refitting



Warning: To avoid possible injury or damage, DO NOT operate the engine with a damaged fan. Do not attempt to repair fan blades - fit a new fan. Also, the electric auxiliary fan in front of the radiator or air conditioning condenser can come on without the engine running or ignition being on. It is controlled by the coolant temperature of the thermo-switches located in the radiator.

Check

Electric auxiliary fan

Note : This fan on most models is controlled by two thermo-switches placed in the radiator: one for low-speed/low-temperature operation, and one for high-speed/high-temperature operation. Each switch comes on at a different coolant temperature (refer to the Specifications at the beginning of this Chapter).

1 The thermostatically-controlled switches for high- and low-speed operation of the auxiliary fan are fitted in various locations in the radiator (**see illustration 4.7**), depending on engine or model. Two single switches, or one dual switch, may be fitted.

2 Insert a small screwdriver into the connector to lift the lock tab, and unplug the fan wire harness.

3 To test the fan motor, unplug the electrical connector at the motor, and use jumper wires to connect the fan directly to the battery. If the fan doesn't work when connected directly to the battery, the motor is proved faulty, and must be renewed. If the fan works, there's a

good chance the switch is malfunctioning. To more accurately diagnose the problem, follow the steps that apply to your model. **Note:** Spin the auxiliary fan motor by hand, to check that the motor or fan isn't binding. Make sure, however, that the engine is sufficiently cool that there is no danger of the fan cutting-in on its own when this is done.

4 To test the low-speed and high-speed circuits, disconnect the electrical connector from one of the fan switches, and bridge the terminals of the switch's electrical connector with a short piece of wire. The fan should run at low or high speed, depending on which switch has been disconnected. On some models the ignition must be on before the fan will run.

5 Repeat the test at the other switch so that both high and low speeds are tested.

6 If the low-speed and high-speed circuits are OK, but there has been a problem with the fan not operating correctly in service, renew the switch (or switches). To remove a switch, drain the coolant below the level of the switch (**see Chapter 1**), then unscrew the switch and screw in the new one. Refill the system with coolant.

7 If the switches are satisfactory, but the motor still does not operate, the problem lies in the fuse, the relay, the wiring which connects the components (or the fan motor itself). Carefully check the fuse, relay, all wiring and connections. **See Chapter 12** for more information on how to carry out these checks.

Mechanical fan with viscous clutch

8 Disconnect the battery negative cable, and rock the fan back and forth by hand to check for excessive bearing play.

Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

9 With the engine cold, turn the fan blades by hand. The fan should turn with slight resistance.

10 Visually inspect for substantial fluid leakage from the fan clutch assembly. If problems are noted, renew the fan clutch assembly.

11 With the engine completely warmed up, turn off the ignition switch and disconnect the battery negative cable. Turn the fan by hand. Heavier resistance should be evident. If the fan turns easily, a new fan clutch may be needed.

Removal and refitting

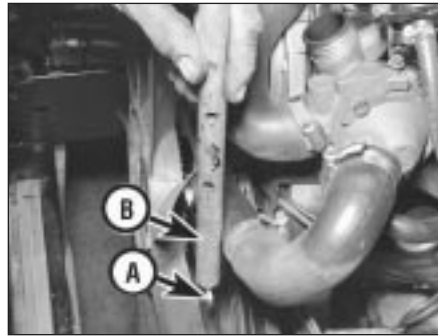
Electric auxiliary fan

12 Disconnect the battery negative cable.

13 To remove the auxiliary fan follow the procedure that applies to your vehicle.



5.27a The cooling fan on the water pump is attached to the shaft by a left-hand-threaded nut located directly behind the fan . . .



5.27b . . . to loosen the nut, place a 32 mm open-ended spanner on the nut, and sharply strike the spanner (A) with a metal drift (B) and hammer; this will loosen the nut and allow it to be turned easily so the fan can be removed



5.29 Removing the water pump pulley (M40 engine)

3-Series models

- 14 Remove the radiator grille assembly (see Chapter 11).
- 15 Unbolt and remove the fan bracket and shroud assembly from the radiator (see Section 5).
- 16 Remove the radiator (see Section 4).
- 17 Unbolt the air conditioning condenser mounting bolts, where applicable. Do not remove the condenser or disconnect any refrigerant lines from the condenser.
- 18 Carefully pull the condenser back towards the engine, slightly, to gain access to lift the auxiliary fan.
- 19 Disconnect the fan motor electrical connection and remove the auxiliary fan.
- 20 Refitting is the reverse of removal.

5-Series models

- 21 Remove the screws and trim panel in front of the radiator.
- 22 Unbolt the fan assembly from the condenser mounting points.
- 23 Disconnect the fan electrical connector.
- 24 Remove the fan and housing from the car, being careful not to damage the air conditioning condenser (when applicable) while removing the fan.
- 25 Refitting is the reverse of removal.

Mechanical fan with viscous clutch

- 26 Disconnect the battery negative cable. Remove the fan shroud mounting screws or plastic fasteners, and detach the shroud (see Section 4).
- 27 Use a 32 mm open-ended spanner to remove the fan/clutch assembly. Place the spanner on the large nut ahead of the pulley (see illustrations), and tap the end of the spanner to loosen the nut.



Caution: The nut has left-handed threads, so it loosens by being turned clockwise, as viewed from the front of the vehicle.

- 28 Lift the fan/clutch assembly (and shroud, if necessary) out of the engine compartment.
- 29 If necessary, remove the four bolts attaching the pulley to the water pump hub. The pulley can then be removed after removing the drivebelt(s) (see illustration).

- 30 Carefully inspect the fan blades for damage and defects. Renew it if necessary.

- 31 At this point, the fan may be unbolted from the clutch, if necessary. If the fan clutch is stored, position it with the radiator side facing down.

- 32 Refitting is the reverse of removal.

6 Water pump - check



- 1 A failure in the water pump can cause serious engine damage due to overheating.
- 2 There are two ways to check the operation of the water pump while it's fitted on the engine. If either of the following checks suggest that the pump is defective, a new one should be fitted.
- 3 Water pumps are equipped with "weep" or "vent" holes. If a failure occurs in the pump seal, coolant will leak from the hole. In most cases, you'll need a torch to find the hole on the water pump from underneath to check for leaks.
- 4 If the water pump shaft bearings fail, there may be a howling sound at the front of the engine while it's running. Shaft wear can be felt if the water pump pulley is rocked up and down (with the drivebelt removed). Don't mistake drivebelt slippage, which causes a squealing sound, for water pump bearing failure. Alternator bearing failure can also cause a howling sound, but after removing the drivebelt(s) it should be easy enough to tell which component is responsible.

7 Water pump - removal and refitting



Warning: Wait until the engine is completely cool before beginning this procedure.



Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

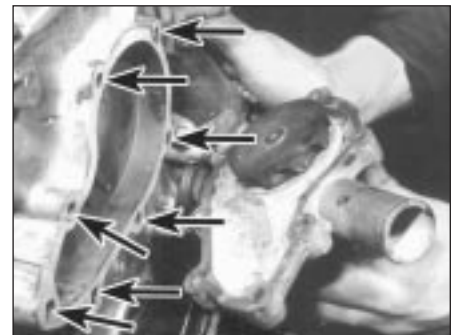
Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

Removal

- 1 Disconnect the battery negative cable.
- 2 Drain the cooling system (see Chapter 1). If the coolant is relatively new, or in good condition, save it and re-use it.
- 3 Remove the cooling fan shroud (see Section 5).
- 4 Remove the drivebelts (see Chapter 1).
- 5 Where applicable, loosen the clamps and detach the hoses from the water pump. If they're stuck, grasp each hose near the end with a pair of water pump pliers and gently twist it to break the seal, then pull it off. If the hoses are deteriorated, cut them off and refit new ones.
- 6 Remove the fan and clutch assembly and the pulley at the end of the water pump shaft (see Section 5).
- 7 To remove the water pump, follow the specific steps that apply to your engine.

M10 engine

- 8 Unscrew the mounting bolts and remove the water pump (see illustration).



- 7.8 On M10 engines, there are seven bolts (locations arrowed) that hold the water pump to the block



7.12 Water pump bolt locations on the M20 engine



7.18a With the water pump mounting bolts removed, screw two bolts into the special lugs (one top and one bottom) . . .



7.18b . . . and remove the water pump (M40 engine)

M20 engine

- 9 Remove the distributor cap and HT leads, ignition rotor and dust shield (see Chapter 1).
- 10 Where applicable, remove the timing sensor (see Chapter 5).
- 11 Remove the timing belt upper cover (see Chapter 2A).
- 12 Loosen all three water pump mounting bolts. Remove the top and right-hand side bolts, but DON'T remove the lower bolt (see illustration).
- 13 Rotate the pump downwards, and remove the drivebelt tensioner spring and pin.
- 14 Remove the final water pump bolt, and remove the pump.



Caution: Leave the tensioner bolt tight. Be careful to not move the camshaft gear, as damage can occur if the valves are moved.

M30 engine

- 15 Remove the engine lifting bracket.
- 16 Remove the bolts that mount the water pump to the engine block.
- 17 Remove the water pump, and recover the gasket.

M40 engine

- 18 Unscrew the mounting bolts and remove the water pump. If the pump is tight in the cylinder head, insert two bolts in the special lugs at the top and bottom of the pump, and tighten them evenly to press the pump out of the head (see illustrations).



7.23 Fit a new O-ring on the M40 engine water pump



7.24 New outer gasket on the M40 engine water pump

Refitting

- 19 Clean the bolt threads and the threaded holes in the engine to remove corrosion and sealant.
- 20 Compare the new pump to the old one, to make sure they're identical.
- 21 Remove all traces of old gasket material from the engine with a gasket scraper.
- 22 Clean the water pump mating surfaces.
- 23 On the M40 engine, locate a new O-ring on the pump (see illustration).
- 24 Locate the gasket on the pump, and offer the pump up to the engine (see illustration). Slip a couple of bolts through the pump mounting holes to hold the gasket in place.
- 25 Carefully attach the pump and gasket to the engine, threading the bolts into the holes finger-tight. **Note:** On the M20 engine, refit the lower bolt finger-tight, then rotate the water pump into position with the drivebelt tensioner spring and pin in position.
- 26 Refit the remaining bolts (if they also hold an accessory bracket in place, be sure to reposition the bracket at this time). Tighten them to the torque listed in this Chapter's Specifications, in quarter-turn increments. Don't overtighten them, or the pump may be distorted.
- 27 Refit all parts removed for access to the pump.
- 28 Refill the cooling system and check the drivebelt tension (see Chapter 1). Run the engine and check for leaks.

8 Coolant temperature sender unit - check and renewal



Warning: Wait until the engine is completely cool before beginning this procedure.

- 1 The coolant temperature indicator system is composed of a temperature gauge mounted in the instrument panel, and a coolant temperature sender unit that's normally mounted on the thermostat housing (see illustration 3.11). Some vehicles have more than one sender unit, but only one is used for the temperature gauge. On the M40 engine, the sender unit is mounted on the left-hand side of the cylinder head, towards the rear.
- 2 If the gauge reading is suspect, first check the coolant level in the system. Make sure the wiring between the gauge and the sending unit is secure, and that all fuses are intact. (If the fuel gauge reading is suspect as well, the problem is almost certainly in the instrument panel or its wiring.)
- 3 Before testing the circuit, refer to the relevant wiring diagrams (see Chapter 12). Where the sender unit simply earths out the circuit, test by earthing the wire connected to the sending unit while the ignition is on (but without the engine running, for safety). If the gauge now deflects to the end of the scale, renew the sender unit. If the gauge does not respond satisfactorily, the gauge, or the wiring to the gauge, is faulty. Where the sender unit has two terminals, test the circuit by checking the resistance of the unit. No figures were available at the time of writing, but typically readings of several hundred or several thousand ohms (depending on temperature) would be expected. A reading of zero (short-circuit) or infinity (open-circuit) would indicate a faulty sender unit.



Caution: Do not earth the wire for more than a second or two, or damage to the gauge could occur.

4 If a new sender unit is to be fitted, make sure the engine is completely cool. There will be some coolant loss when the unit is unscrewed, so be prepared to catch it, or have the new unit ready to fit immediately the old one is removed. Disconnect the wiring, then unscrew the old unit from the engine, and fit the new one. Use sealant on the threads. Reconnect the wiring, and check the coolant level on completion.

9 Heater and air conditioning blower motor - removal, testing and refitting



Removal

Note: The 3-Series models covered by this manual have always used a single blower motor for ventilation, heating and air conditioning. "Old-shape" (E28) 5-Series models use two separate blower motors: one for ventilation and heating, and another for air conditioning. "New-shape" (E34) 5-Series models have a single blower motor, like the 3-Series. The removal and refitting of the single blower motor, and the old-shape 5-Series vent/heat motor, is described below. The removal and refitting of the old-shape 5-Series air conditioning blower motor is described in Section 14 of this Chapter.



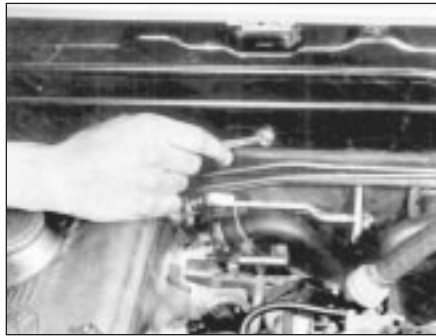
Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

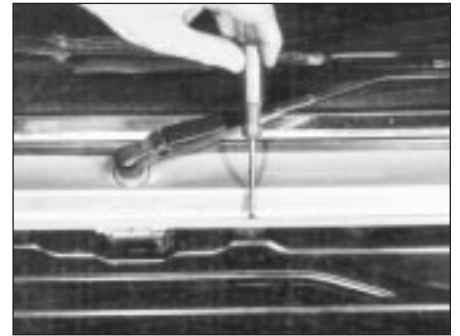
- 1 Disconnect the battery negative cable.
- 2 The blower motor is located behind the bulkhead, under an access panel. Remove the panel securing screws (see illustrations).
- 3 Disconnect or cut the plastic ties holding the wiring harness to the panel, and move the wiring out of the way.
- 4 Remove the panel.
- 5 Unclip the blower housing retaining clip, and the clip securing the blower motor (see illustrations).



9.5a Unclip the retaining strap to remove the blower housing . . .



9.2a To get to the heater blower motor, the access panel must be removed - a fastener from the front and . . .



9.2b . . . a fastener from the top secure the panel

- 6 Disconnect the wiring and remove the blower motor (see illustration).

Testing

7 You can test the blower motor by applying battery voltage to the blower motor's terminals with fused jumper wires (be sure the fan blades won't hit anything when they rotate). If the blower motor spins the fan blades rapidly (this test simulates high-speed operation), the blower motor is OK. If the blower motor does not operate, or operates slowly or noisily, renew it.

Note: If the fan blade assemblies need to be removed, mark their relationship to the shaft. The assemblies are balanced during production, and excessive noise or shortened bearing life could result if they are not refitted in exactly the same position in relation to the shaft.

Refitting

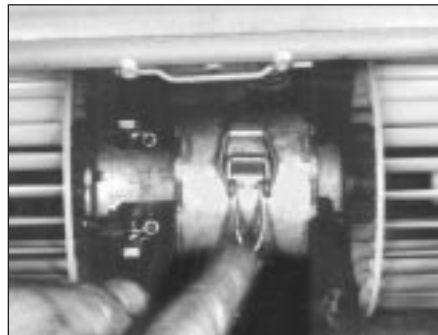
8 Refitting is the reverse of removal. **Note:** The blower motor may have to be rotated to allow the retaining clip to line up correctly.

10 Heater and air conditioner control assembly - removal and refitting



Removal

- 1 Disconnect the battery negative cable.



9.5b . . . and unclip the centre strap that secures the blower motor assembly



Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

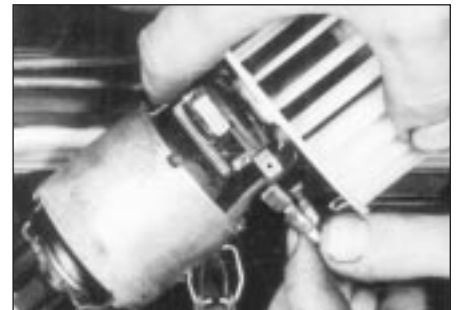
Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

3-Series models

- 2 Remove the centre console and side trim pieces.
- 3 Remove the radio (see Chapter 12), then pull the knobs off the heater/air conditioning control levers.
- 4 Remove the heater trim panel to gain access to the control cables.
- 5 Disconnect the cables, marking them for accurate refitting.
- 6 Disconnect the electrical connector.
- 7 Remove the lever assembly.
- 8 Each lever assembly can be removed separately.

5-Series models

- 9 Remove the centre console (see Chapter 11).
- 10 Remove the radio (see Chapter 12), then pull the knobs off the heater/air conditioning control levers.
- 11 Remove the trim bezel, and pull the control unit from the dash. This will allow you to disconnect the control cables from the lever assembly.



9.6 Lift out the assembly, and disconnect the electrical connection from the blower motor

3•8 Cooling, heating and air conditioning systems

12 Disconnect the cables from the clips securing them to the lever assembly, marking them for accurate refitting.

13 Disconnect the electrical connection from the control assembly.

14 Remove the screws attaching the bezel to the control assembly, and remove the control assembly.

Refitting

15 Refitting is the reverse of the removal procedure.

11 Heater matrix - removal and refitting



Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

- 1 Disconnect the battery negative cable.
- 2 Drain the cooling system (see Chapter 1).
- 3 Remove the centre console (see Chapter 11). Spread an old blanket over the front carpeting; this will prevent stains if any residual coolant spills.

Removal

3-Series models

- 4 Remove the left-hand side heater ducting, and set it aside.
- 5 Remove the heater valve clamp.
- 6 Remove the screws and detach the flange where the two coolant lines enter the heater matrix case. Be careful; some coolant may spill.
- 7 Remove the two screws holding the heater matrix case to the heater main assembly.
- 8 Slide the heater matrix out of the mounting. Be careful not to spill any of the remaining coolant in the heater matrix when removing it.

5-Series models

- 9 Disconnect the temperature sensor electrical connectors.
- 10 Disconnect the straps holding the wiring to the case, and set the wiring out of the way.
- 11 Unfasten the cover fasteners.
- 12 Remove the screws holding the cover in place, then remove the cover.
- 13 Disconnect all heater pipe connections attached to the heater matrix. Be careful; some coolant may spill.
- 14 Lifting on the right side of the heater matrix first, remove the heater matrix.

Refitting

Note: Always use new O-rings when attaching the coolant lines to the heater matrix.

15 Refitting is the reverse of removal. Refill the cooling system (see Chapter 1), then run the engine with the heater on, and check for correct operation and leaks.

12 Air conditioning system - precautions and maintenance



Precautions



Warning: The air conditioning system is under high pressure. DO NOT loosen any hose or line fittings, or remove any components, until after the system has been discharged. Air conditioning refrigerant should be properly discharged by a qualified refrigeration engineer. The refrigerant used in the system must not be allowed into contact with your skin or eyes, or there is a risk of frostbite. Should the refrigerant come into contact with a naked flame, a poisonous gas will be produced. Smoking in the presence of refrigerant is therefore highly dangerous, particularly if refrigerant vapour is inhaled through a lighted cigarette. The refrigerant is heavier than air, and it may cause suffocation if discharged in an enclosed space such as a domestic garage. Finally, uncontrolled release of the refrigerant causes environmental damage, by contributing to the "greenhouse effect".

Maintenance

- 1 The following maintenance checks should be performed on a regular basis to ensure the air conditioner continues to operate at peak efficiency:
 - a) Check the drivebelt. If it's worn or deteriorated, renew it (see Chapter 1).
 - b) Check the system hoses. Look for cracks, bubbles, hard spots and deterioration. Inspect the hoses and all fittings for oil bubbles and seepage. If there's any evidence of wear, damage or leaks, have new hose(s) fitted.
 - c) Inspect the condenser fins for leaves, flies and other debris. Use a "fin comb" or compressed air to clean the condenser.
 - d) Make sure the system has the correct refrigerant charge, as described below.
- 2 It's a good idea to operate the system for about 10 minutes at least once a month, particularly during the winter. Long-term non-use can cause hardening, and subsequent failure, of the seals.
- 3 Because of the complexity of the air conditioning system and the special equipment necessary to service it, in-depth fault diagnosis and repair procedures are not included in this manual. However, simple checks and component renewal procedures are provided in this Chapter.
- 4 The most common cause of poor cooling is

simply a low system refrigerant charge. If a noticeable loss of cool air output occurs, the following quick check may help you determine if the refrigerant level is low.

5 Warm the engine up to normal operating temperature.

6 Set the air conditioning temperature selector at the coldest setting, and put the blower at the highest setting. Open the doors (to make sure the air conditioning system doesn't switch off as soon as it cools the passenger compartment).

7 With the compressor engaged - the compressor clutch will make an audible click, and the centre of the clutch will rotate - feel the tube located adjacent to the right front frame rail, near the radiator.

8 If a significant temperature drop is noticed, the refrigerant level is probably OK.

9 If the inlet line has frost accumulation, or feels cooler than the receiver-drier surface, the refrigerant charge is low. Recharging the system should be carried out by a qualified refrigeration engineer.

13 Air conditioning compressor - removal and refitting



Warning: Due to the potential dangers associated with the system, you are strongly advised to have any work on the air conditioning system carried out by a BMW dealer or air conditioning specialist. At the very least, DO NOT dismantle any part of the system (hoses, compressor, line fittings, etc.) until after the system has been discharged by a qualified engineer. Refer to the precautions given at the start of Section 12.

Note: If a new compressor is fitted, the receiver-drier (see Section 16) should also be renewed.

Removal

- 1 Have the air conditioning system discharged (see Warning above).
- 2 Disconnect the battery negative cable.



Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

- 3 Disconnect the compressor clutch wiring harness.
- 4 Remove the drivebelt (see Chapter 1).
- 5 Disconnect the refrigerant lines from the rear of the compressor. Plug the open fittings to prevent entry of dirt and moisture.
- 6 Unbolt the compressor from the mounting



13.6 From under the vehicle, remove the bolt from the lower air conditioning compressor mounting

brackets, and lift it up and out of the vehicle (see illustration).

Refitting

7 If a new compressor is being fitted, follow any instructions supplied with the compressor regarding the draining of excess oil prior to fitting.

8 The clutch may have to be transferred to the new compressor.

9 Refitting is the reverse of removal. All O-rings should be replaced with new ones specifically made for use in air conditioning systems. Lubricate them with refrigerant oil when fitting.

10 Have the system evacuated, recharged and leak-tested by the qualified engineer who discharged it.

14 Air conditioning blower motor (E28/"old-shape" 5-series models) - removal and refitting



Note: Refer to Section 9 for information on "new-shape" (E34) 5-Series models.



Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

Removal

- 1 Disconnect the battery negative cable.
- 2 Remove the centre console (see Chapter 11).
- 3 Disconnect the blower motor electrical connector from the motor.
- 4 Unbolt the blower motor mountings from the main case.
- 5 Remove the air conditioning blower motor assembly. You can check the motor by following the procedure described in Section 9.

Refitting

- 6 Refitting is the reverse of removal.

15 Air conditioning condenser - removal and refitting



Warning: Due to the potential dangers associated with the system, you are strongly advised to have any work on the air conditioning system carried out by a BMW dealer or air conditioning specialist. At the very least, DO NOT dismantle any part of the system (hoses, compressor, line fittings, etc.) until after the system has been discharged by a qualified engineer. Refer to the precautions given at the start of Section 12.

Note: If a new condenser is fitted, the receiver-drier (see Section 16) should also be renewed.

Removal

- 1 Have the air conditioning system discharged (see Warning above).
- 2 Remove the radiator (see Section 4) except on "new-shape" (E34) 5-series models. On the latter, remove the front bumper (see Chapter 11).
- 3 Remove the radiator grille (see Chapter 11).
- 4 Unbolt the auxiliary fan from the air conditioning condenser mounting brackets.
- 5 Disconnect the refrigerant lines from the condenser.
- 6 Remove the mounting bolts from the condenser brackets.
- 7 Lift the condenser out of the vehicle, and plug the lines to keep dirt and moisture out.
- 8 If the original condenser is being refitted, store it with the line fittings uppermost, to prevent oil from draining out.

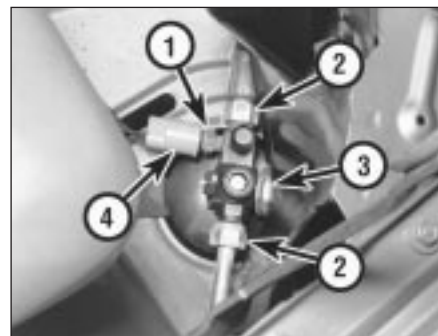
Refitting

- 9 Refit the components in the reverse order of removal. Be sure the rubber pads are in place under the condenser.
- 10 Have the system evacuated, recharged and leak-tested by the qualified engineer who discharged it.

16 Air conditioner receiver-drier - removal and refitting



Warning: Due to the potential dangers associated with the system, you are strongly advised to have any work on the air conditioning system carried out by a BMW dealer or air conditioning specialist. At the very least, DO NOT dismantle any part of the system (hoses, compressor, line fittings, etc.) until after the system has been discharged by a qualified engineer. Refer to the precautions given at the start of Section 12.



16.4 All models have the receiver-drier located behind the right headlight, although the configuration of lines and switches may vary

- 1 High-pressure switch
- 2 Refrigerant lines
- 3 Low-pressure switch
- 4 Electrical connector

Removal

1 Have the system discharged (see Warning above).

2 Disconnect the battery negative cable.

Caution: If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.

Note: If, after connecting the battery, the wrong language appears on the instrument panel display, refer to page 0-7 for the language resetting procedure.

3 Remove the windscreen washer fluid reservoir.

4 Disconnect the electrical connector(s) from the receiver-drier - note that not all models have both the high- and low-pressure switches (see illustration).

5 Disconnect the refrigerant lines from the receiver-drier.

6 Plug the open line fittings, to prevent the entry of dirt and moisture.

7 Remove the mounting screws and remove the receiver-drier.

Refitting

8 If a new receiver-drier is being fitted, it may be necessary to add a quantity of refrigerant oil - follow the instructions supplied with the new unit.

9 Remove the old refrigerant line O-rings, and fit new ones. This should be done regardless of whether a new receiver-drier is being fitted.

10 If a new receiver-drier is being fitted, unscrew the pressure switches and transfer them to the new unit before fitting (see illustration 16.4). Not all models have both the high- and low-pressure switches.

11 Lubricate the O-rings with refrigerant oil before assembly.

Refitting

12 Refitting is the reverse of removal, but be sure to lubricate the O-rings with refrigerant oil before connecting the fittings.

3•10 Cooling, heating and air conditioning systems

13 Have the system evacuated, recharged and leak-tested by the qualified engineer who discharged it.

17 Evaporator matrix - removal and refitting



Warning: Due to the potential dangers associated with the system, you are strongly advised to have any work on the air conditioning system carried out by a BMW dealer or air

conditioning specialist. At the very least, DO NOT dismantle any part of the system (hoses, compressor, line fittings, etc.) until after the system has been discharged by a qualified engineer. Refer to the precautions given at the start of Section 12.

Removal

- 1 Have the air conditioning system discharged (see Warning above).
- 2 Remove the trim panel on the sides of the centre console (see Chapter 11)
- 3 Disconnect the electrical lead and remove the evaporator sensor.

4 Remove the evaporator cover, exposing the refrigerant lines.

5 Disconnect the refrigerant lines from the evaporator matrix.

6 Remove the evaporator matrix from the case.

Refitting

7 Refitting is the reverse procedure of the removal.

8 Have the system evacuated, recharged and leak-tested by the qualified engineer who discharged it.