

# Chapter 3

## Cooling, heating, and air conditioning systems

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### Degrees of difficulty

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

#### Coolant

Mixture type	See Chapter 1
Cooling system capacity	See Chapter 1

#### System pressure

Pressure test	1.2 bars - should hold this pressure for at least 10 seconds
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#### Expansion tank filler cap

Pressure rating	1.2 bars approximately - see cap for actual value
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#### Thermostat

Starts to open	88°C
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#### Radiator electric cooling fan

Switches on at:	
Single-speed fans, two-speed fans - first stage	100°C
Two-speed fans - second stage	103°C
Switches off at:	
Single-speed fans, two-speed fans - first stage	93°C
Two-speed fans - second stage	100°C

#### Coolant temperature sensor

Resistance:	
At -40°C	860.0 to 900.0 kilohms
At 20°C	35.0 to 40.0 kilohms
At 100°C	1.9 to 2.5 kilohms
At 120°C	1.0 to 1.3 kilohms

#### Air conditioning system

Refrigerant	R134a
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### Torque wrench settings

	Nm	lbf ft
Radiator mounting bracket-to-subframe bolts	23	17
Fluid cooler pipe unions - automatic transmission	23	17
Thermostat housing-to-cylinder head bolts	20	15
Water outlet-to-thermostat housing bolts	8 to 11	6 to 8
Coolant temperature sensor	23	17
Coolant temperature gauge sender	8	6
Water pump bolts	18	13
Water pump pulley bolts	See Chapter 2A	
Air conditioning compressor mounting bolts	25	18

## 1 General information

### Engine cooling system

All vehicles covered by this manual employ a pressurised engine cooling system with thermostatically-controlled coolant circulation. A water pump mounted on the drivebelt end of the cylinder block/crankcase pumps coolant through the engine. The coolant flows around each cylinder and toward the transmission end of the engine. Cast-in coolant passages direct coolant around the inlet and exhaust ports, near the spark plug areas and close to the exhaust valve guides.

A wax pellet type thermostat is located in a housing at the transmission end of the engine. During warm-up, the closed thermostat prevents coolant from circulating through the radiator. Instead, it returns through the coolant metal pipe running across the front of the engine to the radiator bottom hose and the water pump. The supply to the heater is made from the rear of the thermostat housing. As the engine nears normal operating temperature, the thermostat opens and allows hot coolant to travel through the radiator, where it is cooled before returning to the engine.

The cooling system is sealed by a pressure-type filler cap in the expansion tank. The pressure in the system raises the boiling point of the coolant, and increases the cooling efficiency of the radiator. When the engine is at normal operating temperature, the coolant expands, and the surplus is displaced into the expansion tank. When the system cools, the surplus coolant is automatically drawn back from the tank into the radiator.



**Warning:** *DO NOT attempt to remove the expansion tank filler cap, or to disturb any part of the cooling system, while it or the engine is hot, as there is a very great risk of scalding. If the expansion tank filler cap must be removed before the engine and radiator have fully cooled down (even though this is not recommended) the pressure in the cooling system must first be released. Cover the cap with a thick layer of cloth, to avoid scalding, and slowly unscrew the filler cap until a hissing sound can be heard. When the hissing has*

*stopped, showing that pressure is released, slowly unscrew the filler cap further until it can be removed; if more hissing sounds are heard, wait until they have stopped before unscrewing the cap completely. At all times, keep well away from the filler opening.*



**Warning:** *Do not allow antifreeze to come in contact with your skin, or with the painted surfaces of the vehicle. Rinse off spills immediately with plenty of water. Never leave antifreeze lying around in an open container, or in a puddle in the driveway or on the garage floor. Children and pets are attracted by its sweet smell, but antifreeze is fatal if ingested.*



**Warning:** *If the engine is hot, the electric cooling fan may start rotating even if the engine is not running, so be careful to keep hands, hair and loose clothing well clear when working in the engine compartment.*

### Heating system

The heating system consists of a blower fan and heater matrix (radiator) located in the heater unit, with hoses connecting the heater matrix to the engine cooling system. Hot engine coolant is circulated through the heater matrix. When the heater temperature control on the fascia is operated, a flap door opens to expose the heater box to the passenger compartment. When the blower control is operated, the blower fan forces air through the unit according to the setting selected.

### Air conditioning system

See Section 11.

## 2 Antifreeze - general information

**Warning:** *Do not allow antifreeze to come in contact with your skin, or with the painted surfaces of the vehicle. Rinse off spills immediately with plenty of water. Antifreeze is highly toxic if ingested. Never leave antifreeze lying around in an open container, or in puddles on the floor; children and pets are attracted by its sweet smell, and may drink it. Check with local authorities about disposing of used antifreeze - many have collection centres which will see that antifreeze is disposed of safely.*

The cooling system should be filled with a water/ethylene glycol-based antifreeze solution, of a strength which will prevent freezing down to at least -25°C, or lower if the local climate requires it. Antifreeze also provides protection against corrosion, and increases the coolant boiling point.

The cooling system should be maintained according to the schedule described in Chapter 1. If antifreeze is used that is not to Ford's specification, old or contaminated coolant mixtures are likely to cause damage, and encourage the formation of corrosion and scale in the system. Use distilled water with the antifreeze, if available - if not, be sure to use only soft water. Clean rainwater is suitable.

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

The exact mixture of antifreeze-to-water which you should use depends on the relative weather conditions. The mixture should contain at least 40% antifreeze, but not more than 70%. Consult the mixture ratio chart on the antifreeze container before adding coolant. Hydrometers are available at most automotive accessory shops to test the coolant. Use antifreeze which meets the vehicle manufacturer's specifications.

## 3 Cooling system hoses - disconnection and renewal



**Note:** *Refer to the warnings given in Section 1 of this Chapter before starting work.*

**1** If the checks described in Chapter 1 reveal a faulty hose, it must be renewed as follows (see illustration).

**2** First drain the cooling system (see Chapter 1); if the antifreeze is not due for renewal, the drained coolant may be re-used, if it is collected in a clean container.

**3** To disconnect any hose, use a pair of pliers to release the spring clamps (or a screwdriver to slacken screw-type clamps), then move them along the hose clear of the union. Carefully work the hose off its stubs. The hoses can be removed with relative ease when new - on an older car, they may have stuck.



4.5 Unbolt water outlet to withdraw thermostat

#### 4 Thermostat - removal, testing and refitting



**Note:** Refer to the warnings given in Section 1 of this Chapter before starting work.

##### Removal

1 Disconnect the battery negative (earth) lead (see Chapter 5, Section 1).

2 Unbolt the resonator support bracket from the engine compartment front crossmember. Slacken the two clamp screws securing the resonator to the air mass meter and plenum chamber hoses, then swing the resonator up clear of the thermostat housing (see Chapter 4).

3 Drain the cooling system (see Chapter 1). If the coolant is relatively new or in good condition, drain it into a clean container and re-use it.

4 Disconnect the expansion tank coolant hose and the radiator top hose from the thermostat housing's water outlet.

5 Unbolt the water outlet and withdraw the thermostat (see illustration). Note the position of the air bleed valve, and how the thermostat is installed (which end is facing outwards).

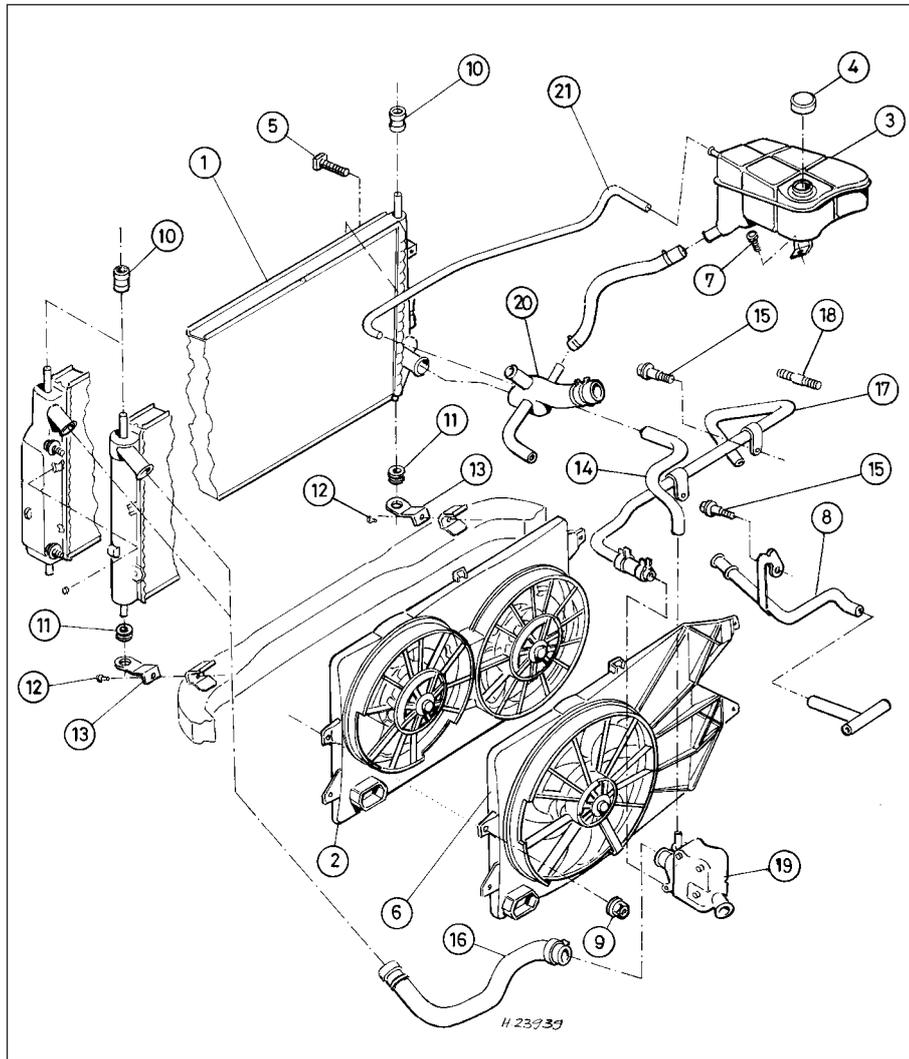
##### Testing

##### General check

6 Before assuming the thermostat is to blame for a cooling system problem, check the coolant level, auxiliary drivebelt tension and condition (see Chapter 1) and temperature gauge operation.

7 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.

8 If the engine runs hot, use your hand to check the temperature of the radiator top hose. If the hose isn't hot, but the engine is, the thermostat is probably stuck closed, preventing the coolant inside the engine from escaping to the radiator - renew the thermostat.



3.1 Cooling system components

- |  |                              |                         |
|--|------------------------------|-------------------------|
| 1 Radiator                                 | 7 Bolt                       | 14 Coolant hose         |
| 2 (Twin) electric cooling fan and shroud   | 8 Coolant pipe               | 15 Bolt                 |
| 3 Expansion tank                           | 9 Nut                        | 16 Radiator top hose    |
| 4 Filler/pressure cap                      | 10 Top mounting rubber       | 17 Coolant pipe/hose    |
| 5 Bolt                                     | 11 Bottom mounting rubber    | 18 Stud                 |
| 6 (Single) electric cooling fan and shroud | 12 Bolt                      | 19 Thermostat housing   |
|  | 13 Radiator mounting bracket | 20 Radiator bottom hose |

4 If a hose proves stubborn, try to release it by rotating it on its unions before attempting to work it off. Gently prise the end of the hose with a blunt instrument (such as a flat-bladed screwdriver), but do not apply too much force, and take care not to damage the pipe stubs or hoses. Note in particular that the radiator hose unions are fragile; do not use excessive force when attempting to remove the hoses. If all else fails, cut the hose with a sharp knife, then slit it so that it can be peeled off in two pieces. While expensive, this is preferable to buying a new radiator. Check first, however, that a new hose is readily available.

5 When refitting a hose, first slide the clamps

onto the hose, then work the hose onto its unions. If the hose is stiff, use soap (or washing-up liquid) as a lubricant, or soften it by soaking it in boiling water, but take care to prevent scalding.

6 Work each hose end fully onto its union, then check that the hose is settled correctly and is properly routed. Slide each clip along the hose until it is behind the union flared end, before tightening it securely.

7 Refill the system with coolant (see Chapter 1).

8 Check carefully for leaks as soon as possible after disturbing any part of the cooling system.



4.14 Ensure thermostat is refitted as shown



**Caution:** Don't drive the vehicle without a thermostat. The lack of a thermostat will slow warm-up time. The engine management system's ECU will then stay in warm-up mode for longer than necessary, causing emissions and fuel economy to suffer.

9 If the radiator top hose is hot, it means that the coolant is flowing and the thermostat is open. Consult the "Fault diagnosis" section at the front of this manual to assist in tracing possible cooling system faults.

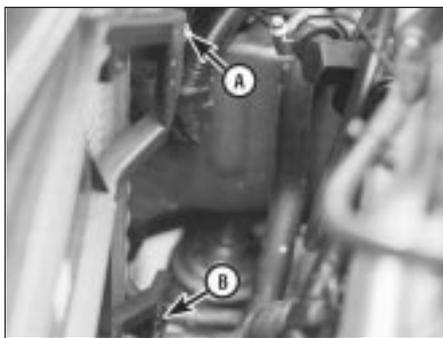
#### Thermostat test

10 If the thermostat remains in the open position at room temperature, it is faulty, and must be renewed as a matter of course.

11 To test it fully, suspend the (closed) thermostat on a length of string in a container of cold water, with a thermometer beside it; ensure that neither touches the side of the container.

12 Heat the water, and check the temperature at which the thermostat begins to open; compare this value with that specified. Continue to heat the water until the thermostat is fully open; the temperature at which this should happen is stamped in the unit's end. Remove the thermostat and allow it to cool down; check that it closes fully.

13 If the thermostat does not open and close as described, if it sticks in either position, or if it does not open at the specified temperature, it must be renewed.



5.10A Fan shroud is secured at top by mounting nut (A), at bottom by clip (B) . . .

#### Refitting

14 Refitting is the reverse of the removal procedure. Clean the mating surfaces carefully, renew the thermostat's sealing ring if it is worn or damaged, then refit the thermostat with its air bleed valve uppermost (see illustration). Tighten the water outlet bolts to the specified torque wrench setting.

15 Refill the cooling system (see Chapter 1).

16 Start the engine and allow it to reach normal operating temperature, then check for leaks and proper thermostat operation.

#### 5 Radiator electric cooling fan(s) - testing, removal and refitting



**Note:** Refer to the warnings given in Section 1 of this Chapter before starting work.

#### Testing

1 The radiator cooling fan is controlled by the engine management system's ECU, acting on the information received from the coolant temperature sensor. Where twin fans or two-speed fans are fitted, control is through a resistor assembly, secured to the bottom left-hand corner of the fan shroud - this can be renewed separately if faulty.

2 First, check the relevant fuses and relays (see Chapter 12).

3 To test the fan motor, unplug the electrical connector, and use fused jumper wires to connect the fan directly to the battery. If the fan still does not work, renew the motor.

4 If the motor proved sound, the fault lies in the coolant temperature sensor (see Section 6 for testing details), in the wiring loom (see Chapter 12 for testing details) or in the engine management system (see Chapter 6).

#### Removal and refitting

5 Disconnect the battery negative (earth) lead (see Chapter 5, Section 1).

6 Unbolt the resonator support bracket from the engine compartment front crossmember. Slacken the two clamp screws securing the resonator to the air mass meter and plenum chamber hoses, then swing the resonator up clear of the thermostat housing (see Chapter 4).



5.10B . . . and is hooked over radiator top edge (one point arrowed)

7 Drain the cooling system (see Chapter 1).

8 Remove the radiator top hose completely. Disconnect the metal coolant pipe/hose from the thermostat, and unbolt the coolant pipe from the exhaust manifold heat shield.

9 Unplug the cooling fan electrical connector(s), then release all wiring and hoses from the fan shroud.

10 Unscrew the two nuts securing the fan shroud, then lift the assembly to disengage it from its bottom mountings and from the radiator top edge (see illustrations).

11 Withdraw the fan and shroud as an assembly (see illustration).

12 At the time of writing, the fan, motor and shroud are available only as a complete assembly, and must be renewed together if faulty.

13 Refitting is the reverse of the removal procedure. Ensure that the shroud is settled correctly at all four mounting points before refitting and tightening the nuts.

#### 6 Cooling system electrical switches and sensors - testing, removal and refitting



**Note:** Refer to the warnings given in Section 1 of this Chapter before starting work.

#### Coolant temperature gauge sender

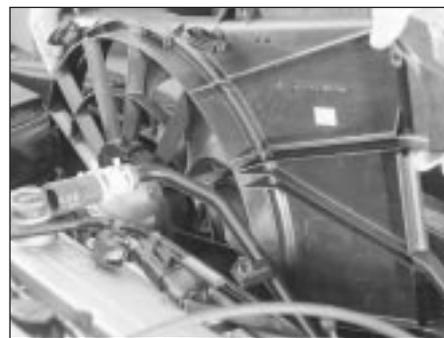
#### Testing

1 If the coolant temperature gauge is inoperative, check the fuses first (see Chapter 12).

2 If the gauge indicates Hot at any time, consult the "Fault finding" section at the end of this manual, to assist in tracing possible cooling system faults.

3 If the gauge indicates Hot shortly after the engine is started from cold, unplug the coolant temperature sender's electrical connector. If the gauge reading now drops, the wire to the gauge may be shorted to earth, or the gauge is faulty.

4 If the gauge fails to indicate after the engine has been warmed up (approximately 10 minutes) and the fuses are known to be sound, switch off the engine. Unplug the



5.11 Removing radiator electric cooling fan and shroud assembly

sender's electrical connector, and use a jumper wire to connect the white/red wire to a clean earth point (bare metal) on the engine. Switch on the ignition without starting the engine. If the gauge now indicates Hot, renew the sender.

5 If the gauge still does not work, the circuit may be open, or the gauge may be faulty. See Chapter 12 for additional information.

### Removal

6 Unbolt the resonator support bracket from the engine compartment front crossmember. Slacken the two clamp screws securing the resonator to the air mass meter and plenum chamber hoses, then swing the resonator up clear of the thermostat housing (see Chapter 4).

7 Drain the cooling system (see Chapter 1).

8 Disconnect the expansion tank coolant hose and the radiator top hose from the thermostat housing's water outlet, then disconnect the metal coolant pipe/hose from the thermostat.

9 Unplug the electrical connector from the sender (see illustration).

10 Unscrew the sender and withdraw it.

### Refitting

11 Clean as thoroughly as possible the opening in the thermostat housing, then apply a light coat of sealant to the sender's threads. Screw in the sender and tighten it to the specified torque wrench setting, and plug in its electrical connector.

12 Reconnect the hoses and refit the resonator, top-up the cooling system (see Chapter 1) and run the engine. Check for leaks and proper gauge operation.

## Coolant temperature sensor

### Testing

13 Disconnect the battery negative (earth) lead (see Chapter 5, Section 1).

14 Unbolt the resonator support bracket from the engine compartment front crossmember. Slacken the two clamp screws securing the resonator to the air mass meter and plenum chamber hoses, then swing the resonator up clear of the thermostat housing (see Chapter 4).

15 Unplug the electrical connector from the sensor (see illustration).

16 Using an ohmmeter, measure the resistance between the sensor terminals. Depending on the temperature of the sensor tip, the resistance measured will vary, but should be within the broad limits given in the Specifications Section of this Chapter. If the sensor's temperature is varied - by removing it (see below) and placing it in a freezer for a while, or by warming it gently - its resistance should alter accordingly.

17 If the results obtained show the sensor to be faulty, renew it.

18 On completion, plug in the connector and refit the resonator.



6.9 Location (arrowed) of coolant temperature gauge sender

### Removal

19 Disconnect the battery negative (earth) lead (see Chapter 5, Section 1).

20 Unbolt the resonator support bracket from the engine compartment front crossmember. Slacken the two clamp screws securing the resonator to the air mass meter and plenum chamber hoses, then swing the resonator up clear of the thermostat housing (see Chapter 4).

21 With the engine *completely cool*, remove the expansion tank filler cap to release any pressure, then refit the cap. Provided you work swiftly and plug the opening as soon as the sensor is unscrewed, coolant loss will thus be minimised; this will avoid the draining of the complete cooling system which would otherwise be necessary (see Chapter 1).

22 Unplug the electrical connector from the sensor.

23 Unscrew the sensor and withdraw it. If the cooling system has not been drained, plug the opening as quickly as possible.

### Refitting

24 Clean as thoroughly as possible the opening in the thermostat housing, then apply a light coat of sealant to the sensor's threads. Remove the material used to plug the sensor hole (where applicable), and quickly install the sensor to prevent coolant loss. Tighten the sensor to the specified torque wrench setting, and plug in its electrical connector.

25 Refit the resonator, top-up the cooling system (see Chapter 1) and run the engine, checking for leaks.

## Coolant low level switch

### Testing

26 The switch is a reed-type unit mounted in the bottom of the cooling system expansion tank, activated by a magnetic float. If the coolant level falls to the "MIN" level or less, the appropriate bulb lights in the warning display.

27 If the bulb fails to light during the 5-second bulb test, check the bulb, and renew if necessary as described in Chapter 12.

28 To check the switch itself, unplug its electrical connector, and use an ohmmeter to measure the resistance across the switch



6.15 Location (arrowed) of coolant temperature sensor

terminals. With the float up, a resistance of 90 ohms should be measured; when it is down, the resistance should increase to approximately 150 kilohms.

29 If the results obtained from the check are significantly different from those expected, the switch is faulty, and must be renewed.

30 If the switch and bulb are proven to be sound, the fault must be in the wiring or in the auxiliary warning control assembly (see Chapter 12).

### Removal

31 Disconnect the battery negative (earth) lead (see Chapter 5, Section 1).

32 Remove the expansion tank (see Section 7).

33 Unplug the switch electrical connector.

34 Release the switch by twisting its retainer anti-clockwise, then withdraw it.

### Refitting

35 Refitting is the reverse of the removal procedure. Refill the cooling system (see Chapter 1). Start the engine, and check for coolant leaks when it is fully warmed-up.

## 7 Radiator and expansion tank - removal, inspection and refitting



**Note:** Refer to the warnings given in Section 1 of this Chapter before starting work.

### Radiator

#### Removal

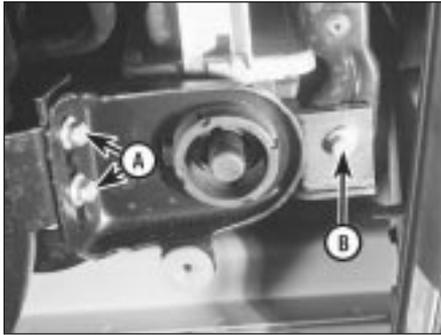
**Note:** If leakage is the reason for removing the radiator, bear in mind that minor leaks can often be cured using a radiator sealant with the radiator *in situ*.

1 Remove the radiator fan and shroud assembly (see Section 5).

2 Disconnect the bottom hose from the radiator.

3 If the vehicle has automatic transmission, disconnect the fluid cooler lines, and plug the lines and fittings.

4 If the vehicle has air conditioning, unscrew the condenser mounting nuts or bolts, detach the condenser from the radiator, and tie it to the engine compartment front crossmember.



**7.5 Radiator mounting bracket-to-subframe bolts (A), air conditioning system condenser mounting bolt (B)**



**Warning:** Do not disconnect any of the refrigerant hoses.

5 Unbolt the radiator mounting brackets from the subframe; note that they are handed, and are marked to ensure correct refitting (see illustration). Collect the bottom mounting rubbers, noting which way up they are fitted, and store them carefully.

6 Carefully lower the radiator from the vehicle, and withdraw it.

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

8 Insects and dirt can be removed from the radiator with a garden hose or a soft brush. Don't bend the cooling fins as this is done.

### Refitting

9 Refitting is the reverse of the removal procedure. Be sure the mounting rubbers are seated properly at the base of the radiator.

10 After refitting, refill the cooling system with the proper mixture of antifreeze and water (see Chapter 1).

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



**8.8 Power steering system pump should be removed to reach water pump hose union (arrowed)**

12 If working on an vehicle with automatic transmission, check and add transmission fluid as needed (see Chapter 1).

### Expansion tank

13 With the engine *completely cool*, remove the expansion tank filler cap to release any pressure, then refit the cap.

14 Disconnect the hoses from the tank, upper hose first. As each hose is disconnected, drain the tank's contents into a clean container. If the antifreeze is not due for renewal, the drained coolant may be re-used, if it is kept clean.

15 Unscrew the tank's two mounting bolts and withdraw it, unplugging the coolant low level switch electrical connector (where fitted).

16 Wash out the tank, and inspect it for cracks and chafing - renew it if damaged.

17 Refitting is the reverse of the removal procedure. Refill the cooling system with the proper mixture of antifreeze and water (see Chapter 1), then start the engine and allow it to reach normal operating temperature, indicated by the radiator top hose becoming hot. Recheck the coolant level and add more if required, then check for leaks.

### 8 Water pump - check, removal and refitting



**Note:** Refer to the warnings given in Section 1 of this Chapter before starting work.

### Check

1 A failure in the water pump can cause serious engine damage due to overheating.

2 There are three ways to check the operation of the water pump while it's installed on the engine. If the pump is defective, it should be replaced with a new or rebuilt unit.

3 With the engine running at normal operating temperature, squeeze the radiator top hose. If the water pump is working properly, a pressure surge should be felt as the hose is released.



**Warning:** Keep your hands away from the radiator electric cooling fan blades!

4 Remove the timing belt covers (see Chapter 2, Part A). 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 an electric torch to find the hole on the water pump from underneath to check for leaks.

5 If the water pump shaft bearings fail, there may be a howling sound at the drivebelt end of the engine while it's running. Shaft wear can be felt if the water pump pulley is rocked up and down. Don't mistake drivebelt slippage, which causes a squealing sound, for water pump bearing failure.

### Removal and refitting

6 Remove the timing belt and tensioner (see Chapter 2, Part A). As noted in Chapter 2, if the belt is fouled with coolant, it must be renewed as a matter of course.

7 Drain the cooling system (see Chapter 1).

8 Disconnect the radiator bottom hose from the pump union. It is easier to reach this union if the power steering pump is unbolted and moved aside as described in Chapter 10 (see illustration). There is no need to disconnect any of the power steering system hoses.

9 Unbolt and remove the water pump (see illustration). If the pump is to be renewed, unbolt the timing belt guide pulleys, and transfer them to the new pump.

10 Clean the mating surfaces carefully; the gasket must be renewed whenever it is disturbed (see illustration).

11 On refitting, use grease to stick the new gasket in place, refit the pump, and tighten the pump bolts to the specified torque wrench setting.

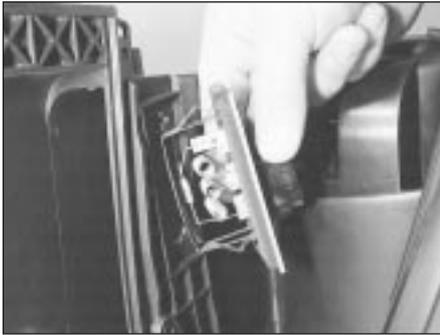
12 The remainder of the reassembly procedure is the reverse of dismantling. Note that a new tensioner spring and retaining pin must be fitted if the timing belt has been removed for the first time. Tighten all fasteners to the specified torque wrench settings, and refill the system with coolant as described in Chapter 1.



**8.9 Unscrew bolts (arrowed) . . .**



**8.10 . . . to remove water pump - always renew gasket and clean all mating surfaces carefully**



9.5 Heater blower motor control resistor can be prised out of heater unit



9.6 Ensure blower motor retaining lug (arrowed) engages securely in heater unit on reassembly



9.9A Coolant pipes to heater matrix must be disconnected . . .

## 9 Heater/ventilation components - removal and refitting



### Heater blower motor

#### Removal

- 1 Disconnect the battery negative (earth) lead (see Chapter 5, Section 1).
- 2 Release the four clips (by pulling them out) securing the passenger side footwell upper trim panel, then withdraw the panel.
- 3 Unplug the motor's electrical connector.
- 4 Lift the motor's retaining lug slightly, twist the motor anti-clockwise (seen from beneath) through approximately 30°, then withdraw the assembly.
- 5 The motor's control resistor can be removed by sliding a slim screwdriver into the slot provided in one end. Press the screwdriver in approximately 5 mm against spring pressure, and prise the resistor out (see illustration).

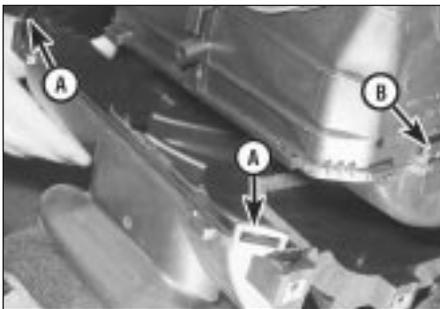
#### Refitting

- 6 Refitting is the reverse of the removal procedure. Refit the motor, and twist it clockwise until the retaining lug engages securely (see illustration).

### Heater matrix

#### Removal

- 7 Disconnect the battery negative (earth) lead (see Chapter 5, Section 1).



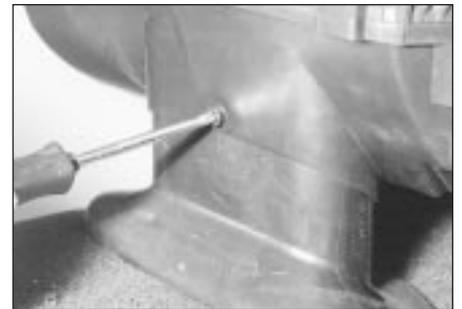
9.12 . . . release clips (A) to free air distributor from base of heater unit - note clips (B) securing . . .



9.9B . . . but can be reached best from beneath vehicle (arrowed)



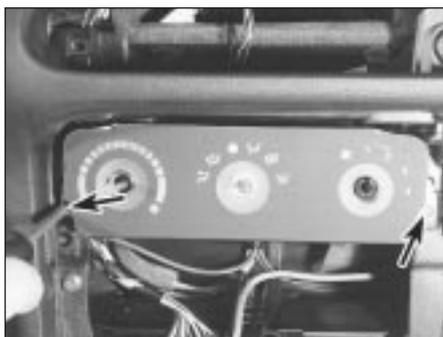
9.13 . . . heater unit's bottom cover, complete with matrix



9.11 Remove screw to allow air duct to be retracted into air distributor at base of heater unit . . .



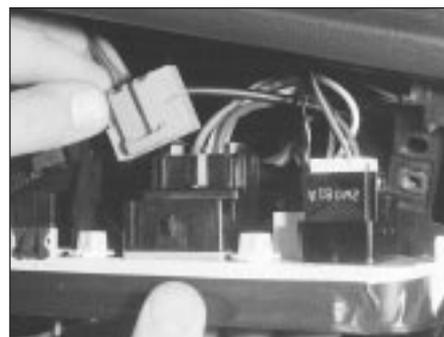
9.14 Remove clamp (one screw) to separate matrix from heater unit's bottom cover



10.4 Remove screws (arrowed) securing each end of heater control unit



10.8 Unhooking operating cable from temperature control - note retaining screw (arrowed)



10.10 Unplugging electrical connectors from rear of heater control unit

duct is lowered from the air distributor and secured with its screw.

16 Refill the cooling system with the proper mixture of antifreeze and water (see Chapter 1). Start the engine and allow it to reach normal operating temperature, indicated by the radiator top hose becoming hot. Recheck the coolant level and add more if required, then check for leaks. Check the operation of the heater.

#### Pollen filter

17 Refer to Chapter 1.

### 10 Heater/air conditioning controls - removal and refitting

#### Blower/air conditioning control

##### Removal

1 Disconnect the battery negative (earth) lead (see Chapter 5, Section 1).

2 Remove the ashtray. Referring to the relevant Sections of Chapter 11, undo the two upper screws from the centre console and pull out the cassette storage compartment, then remove the radio/cassette player.

3 Pull the heater control/radio bezel out of the three clips securing its top edge, pull it forwards and unplug the switch electrical connector (where fitted).

4 Pull off the heater control knobs, and remove the screw securing each end of the heater control unit (see illustration). Pull the control unit out of the facia.

5 Unplug the two electrical connectors from the blower/air conditioning control. Remove the retaining screw and withdraw the control, twisting it to release it from the panel.

##### Refitting

6 Refitting is the reverse of the removal procedure. Check the operation of the control on completion.

#### Temperature control

##### Removal

7 Remove the heater control unit as described in paragraphs 1 to 4 above.

8 On vehicles without air conditioning,

unhook the operating cable from the temperature control (see illustration); where air conditioning is fitted, unplug the control's electrical connector. Undo the retaining screw, and withdraw the control.

##### Refitting

9 Refitting is the reverse of the removal procedure; check the operation of the control on completion.

#### Air distribution control

##### Removal

10 Remove the heater control unit as described in paragraphs 1 to 4 above. Unplug the electrical connectors, and unhook the operating cable (where fitted) to withdraw the unit (see illustration).

11 Use a pair of slim screwdrivers to release the clips on each side of the control, then withdraw the control from the unit.

##### Refitting

12 Refitting is the reverse of the removal

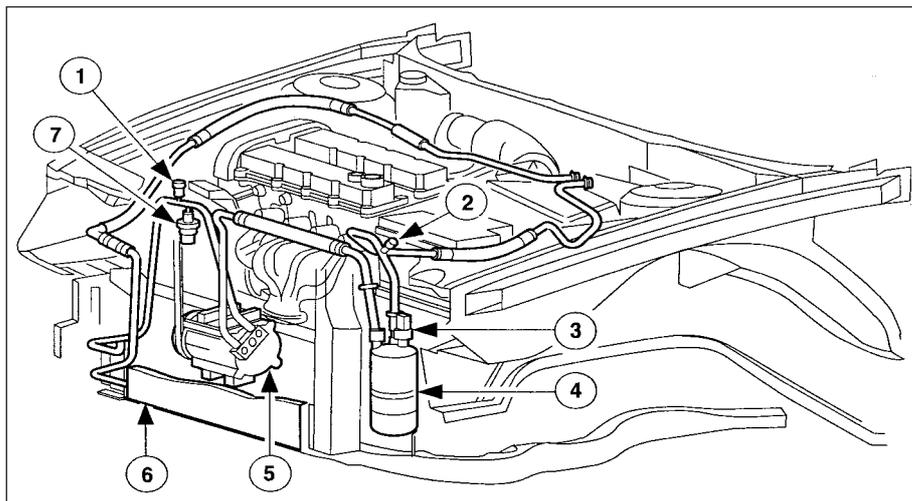
procedure. Check the operation of the controls on completion.

### 11 Air conditioning system - general information and precautions

#### General information

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, an accumulator/dehydrator, and the plumbing connecting all of the above components - this contains a choke (or "venturi") mounted in the inlet to the evaporator, which creates the drop in pressure required to produce the cooling effect (see illustration).

A blower fan forces the warmer air of the passenger compartment through the evaporator core (rather like a radiator in reverse), transferring the heat from the air to



11.1 Air conditioning system components

- |   |   |
|---|---|
| 1 Quick-release Schrader valve-type coupling - high-pressure side | 4 Accumulator/dehydrator                          |
| 2 Quick-release Schrader valve-type coupling - low-pressure side  | 5 Compressor                                      |
| 3 Pressure-cycling switch - low-pressure side                     | 6 Condenser                                       |
|   | 7 Pressure-regulating switch - high-pressure side |

the refrigerant. The liquid refrigerant boils off into low-pressure vapour, taking the heat with it when it leaves the evaporator.

### Precautions



**Warning:** The air conditioning system is under high pressure. Do not loosen any fittings or remove any components until

after the system has been discharged. Air conditioning refrigerant should be properly discharged into an approved type of container, at a dealer service department or an automotive air conditioning repair facility capable of handling R134a refrigerant. Always wear eye protection when disconnecting air conditioning system fittings.

When an air conditioning system is fitted, it is necessary to observe the following special precautions whenever dealing with any part of the system, its associated components, and any items which necessitate disconnection of the system:

- (a) While the refrigerant used - R134a - is less damaging to the environment than the previously-used R12, it is still a very dangerous substance. It must not be allowed into contact with the skin or eyes, or there is a risk of frostbite. It must also not be discharged in an enclosed space - while it is not toxic, there is a risk of suffocation. The refrigerant is heavier than air, and so must never be discharged over a pit.
- (b) The refrigerant must not be allowed to come in contact with a naked flame, otherwise a poisonous gas will be created - under certain circumstances, this can form an explosive mixture with air. For similar reasons, smoking in the presence of refrigerant is highly dangerous, particularly if the vapour is inhaled through a lighted cigarette.
- (c) Never discharge the system to the atmosphere - R134a is not an ozone-depleting ChloroFluoroCarbon (CFC) as is R12, but is instead a hydrofluorocarbon, which causes environmental damage by contributing to the "greenhouse effect" if released into the atmosphere.
- (d) R134a refrigerant must **not** be mixed with R12; the system uses different seals (now green-coloured, previously black) and has different fittings requiring different tools, so that there is no chance of the two types of refrigerant becoming mixed accidentally.
- (e) If for any reason the system must be disconnected, entrust this task to your Ford dealer or a refrigeration engineer.
- (f) It is essential that the system be professionally discharged prior to using any form of heat - welding, soldering, brazing, etc - in the vicinity of the system, before having the vehicle oven-dried at a temperature exceeding 70°C after repainting, and before disconnecting any part of the system.

## 12 Air conditioning system components - removal and refitting



**Warning:** The air conditioning system is under high pressure. Do not loosen any fittings or

remove any components until after the system has been discharged. Air conditioning refrigerant should be properly discharged into an approved type of container, at a dealer service department or an automotive air conditioning repair facility capable of handling R134a refrigerant. Cap or plug the pipe lines as soon as they are disconnected, to prevent the entry of moisture. Always wear eye protection when disconnecting air conditioning system fittings.

Note: This Section refers to the components of the air conditioning system itself - refer to Sections 9 and 10 for details of components common to the heating/ventilation system.

### Condenser

- 1 Have the refrigerant discharged at a dealer service department or an automotive air conditioning repair facility.
- 2 Disconnect the battery negative (earth) lead (see Chapter 5, Section 1).
- 3 Remove the radiator undershield (see Chapter 1).
- 4 Using the Ford service tool 34-001, disconnect the refrigerant lines from the condenser. Immediately cap the open fittings, to prevent the entry of dirt and moisture.
- 5 Unbolt the condenser (see illustration 7.5) and lift it out of the vehicle. Store it upright, to prevent oil loss.
- 6 Refitting is the reverse of removal.
- 7 If a new condenser was installed, add 20 cc of refrigerant oil to the system.
- 8 Have the system evacuated, charged and leak-tested by the specialist who discharged it.

### Evaporator

- 9 The evaporator is mounted with the heater matrix. Apart from the need to have the refrigerant discharged, and to use Ford service tools 34-001 and 34-003 to disconnect the lines, the procedure is as described in Section 9 of this Chapter.
- 10 On reassembly, if a new evaporator was installed, add 20 cc of refrigerant oil to the system.
- 11 Have the system evacuated, charged and leak-tested by the specialist who discharged it.

### Compressor

- 12 Have the refrigerant discharged at a dealer service department or an automotive air conditioning repair facility.
- 13 Disconnect the battery negative (earth) lead (see Chapter 5, Section 1).
- 14 Remove the radiator undershield (see Chapter 1).

15 Remove the auxiliary drivebelt (see Chapter 1).

16 Unbolt the compressor from the cylinder block/crankcase, press it to one side, and unscrew the clamping bolt to disconnect the refrigerant lines. Plug the line connections, swing the compressor upright, unplug its electrical connector, then withdraw the compressor from the vehicle. **Note:** Keep the compressor level during handling and storage. If the compressor has seized, or if you find metal particles in the refrigerant lines, the system must be flushed out by an air conditioning technician, and the accumulator/dehydrator must be renewed.

17 Prior to installation, turn the compressor clutch centre six times, to disperse any oil that has collected in the head.

18 Refit the compressor in the reverse order of removal; renew all seals disturbed.

19 If you are installing a new compressor, refer to the compressor manufacturer's instructions for adding refrigerant oil to the system.

20 Have the system evacuated, charged and leak-tested by the specialist that discharged it.

### Accumulator/dehydrator

- 21 Have the refrigerant discharged at a dealer service department or an automotive air conditioning repair facility.
- 22 Disconnect the battery negative (earth) lead (see Chapter 5, Section 1).
- 23 The accumulator/dehydrator, which acts as a reservoir and filter for the refrigerant, is located in the left-hand front corner of the engine compartment. Using the Ford service tool 34-003, disconnect the refrigerant line next to the accumulator/dehydrator from the compressor. Immediately cap the open fittings, to prevent the entry of dirt and moisture, then unplug the pressure-cycling switch electrical connector (see illustration).
- 24 Remove the radiator undershield (see Chapter 1).
- 25 Unbolt the accumulator/dehydrator from the front suspension subframe.
- 26 Using the Ford service tool 34-003, disconnect the lower refrigerant line from the accumulator/dehydrator. It may be necessary



12.23 Unplug pressure-cycling switch electrical connector (arrowed)

### 3•10 Cooling, heating and air conditioning systems

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to unscrew the pressure-cycling switch to allow the use of the tool. Immediately cap the open fittings, to prevent the entry of dirt and moisture.

**27** Withdraw the accumulator/dehydrator.

**28** Refit the accumulator/dehydrator in the reverse order of removal; renew all seals disturbed.

**29** If you are installing a new accumulator/dehydrator, refer to the manufacturer's instructions for adding refrigerant oil to the system.

**30** Have the system evacuated, charged and leak-tested by the specialist that discharged it.

#### ***Pressure-cycling and pressure-regulating switches***

**31** Have the refrigerant discharged at a dealer service department or an automotive air conditioning repair facility.

**32** Disconnect the battery negative (earth) lead (see Chapter 5, Section 1).

**33** Unplug the switch electrical connector, and unscrew it (**see illustration**).

**34** Refitting is the reverse of the removal procedure; there is no need to top-up the refrigerant oil.

**35** Have the system evacuated, charged and leak-tested by the specialist that discharged it.



**12.33** Unplug pressure-regulating switch electrical connector (arrowed)