



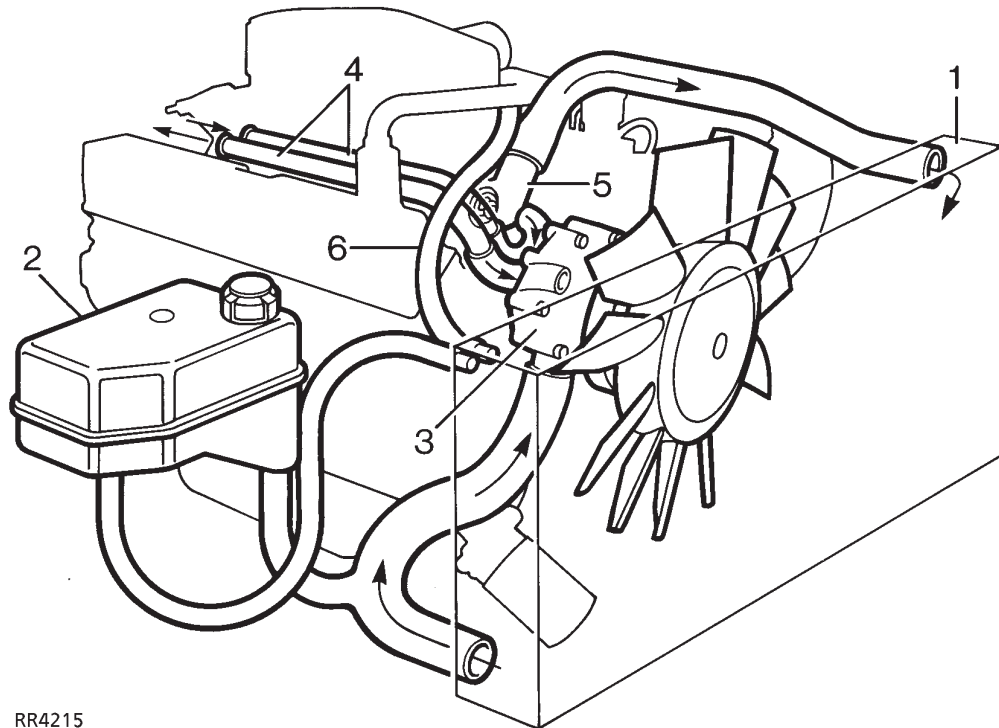
## ENGINE COOLING

### Description

The V8i engine uses a pressurised cooling system and cross flow radiator which is supplied from a separate header tank. The coolant radiator also incorporates a section at the left hand end for cooling the transmission oil and a section at the other end for cooling the engine oil.

The belt driven viscous fan and centrifugal water pump is located in the engine front cover with ports for circulation of coolant to both banks of cylinders and cylinder heads. Coolant returns to the top of the radiator via ports in the inlet manifold where the thermostat is mounted horizontally.

Coolant also circulates through the vehicle heating system and is used to heat air entering the inlet manifold plenum chamber.



RR4215

### Coolant circulation (engine hot)

1. Cross flow radiator
2. Header tank
3. Viscous fan and water pump
4. Heater pipes
5. Plenum chamber connection
6. Thermostat

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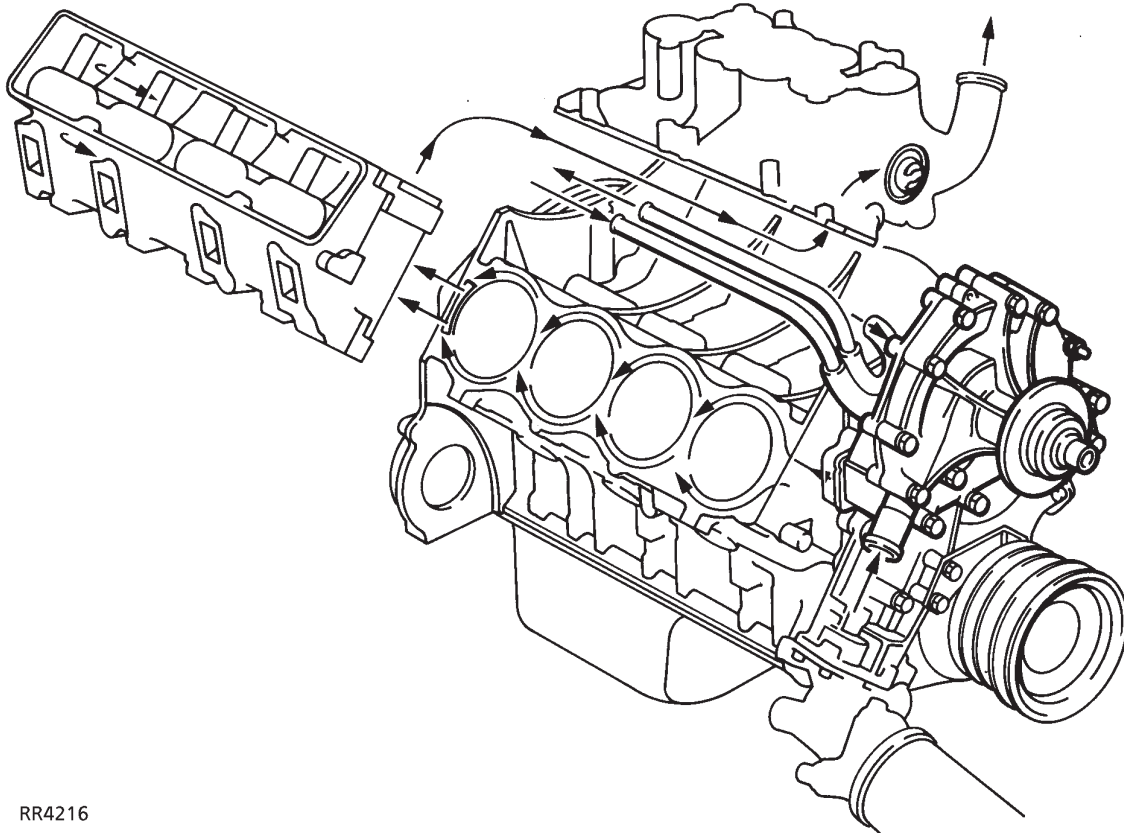
**COOLANT CIRCULATION**

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**Operation**

When the engine is started from cold the thermostat prevents any coolant circulation through the radiator by closing off the top hose. During the engine warm up period, the water pump, pumps coolant around the cylinders to the rear of the cylinder block along the main galleries in both cylinder banks. At the rear of the cylinder block the coolant rises through a large port in each cylinder head/block joint face, and then flows forward to connect with ports at the front of the inlet manifold. From the manifold the coolant is carried by an external pipe to the heater unit and from the heater through another external pipe to the pump inlet.

The coolant circulation through the cylinder block and heads, does not change when normal running temperature is reached and the thermostat opens. But with the thermostat open, coolant flows through the top hose to the radiator where it is cooled and drawn back into the pump via the bottom hose.

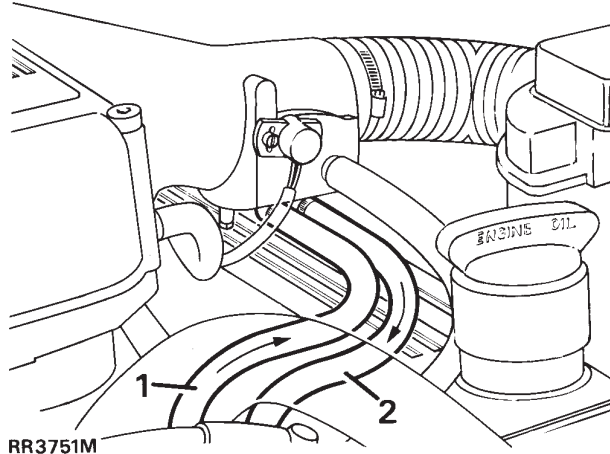


RR4216



### Plenum chamber heating

Air entering the plenum chamber is heated by a flow of coolant from the inlet manifold which returns through a long hose, to the top right corner of the radiator.



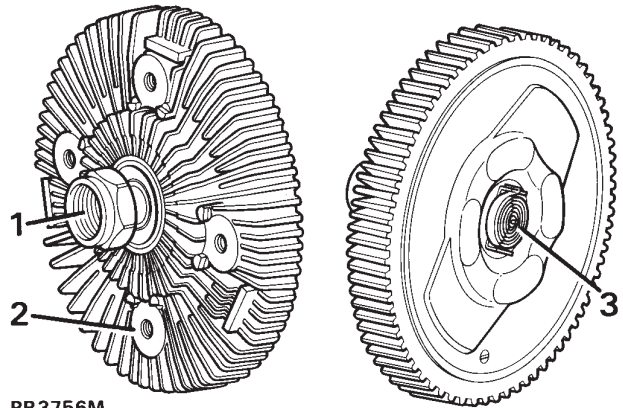
RR3751M

1. Hot water supply
2. Cold return to radiator

### VISCOUS FAN

#### Description

The viscous drive unit for the engine cooling fan, provides a means of controlling the speed of the fan relative to the running temperature of the engine. The viscous unit is a type of fluid coupling, which drives the fan blades through the medium of a special 'silicone fluid' injected into the unit during manufacture.



RR3756M

1. Drive in from water pump spindle
2. Drive out to fan blades
3. Bi-metal

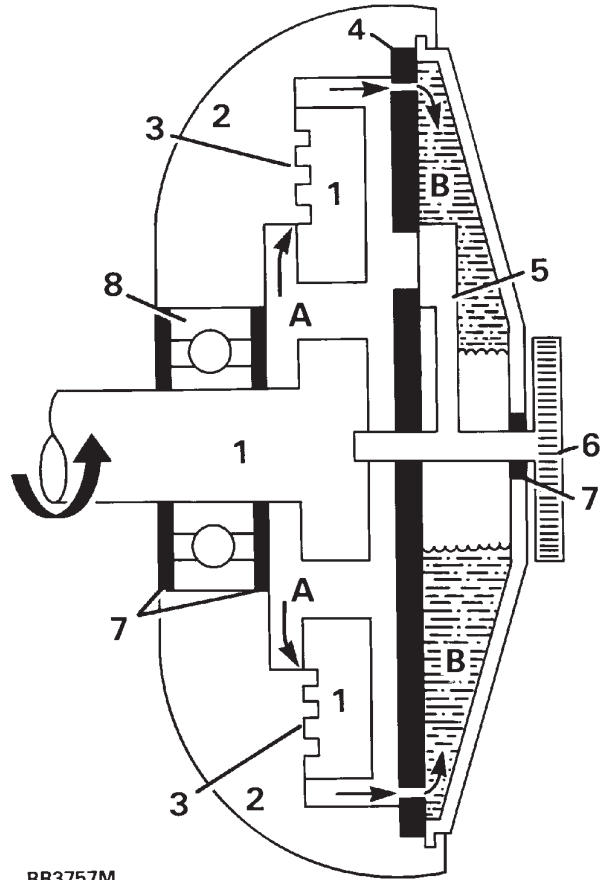
## Operation

The viscous unit consists of two principal components:  
 An inner member 1 which is secured to water pump spindle and is driven by the fan belt.  
 An outer member 2 which has the fan blades attached, houses the working parts and is driven through the medium of the viscous fluid.

The inner and outer members have interlocking annular grooves machined in each, with a small running clearance 3 to allow the silicone fluid to circulate through the valve plate 4.  
 The unit also contains a valve 5 which is controlled by an external bi-metal thermostat 6.

## Starting engine from cold

During the time the engine is at rest the silicone fluid drains down, half filling chambers A and B. Thus when the engine is first started sufficient fluid is present in chamber A to provide a positive drive between the members, as is evident by the initial noise of the fan. However within a very short period of time, after starting the engine, the fan speed and noise will decline indicating that the fluid is being centrifuged into chamber B (as seen in RR3757M) causing the drive to slip.



## Viscous unit slipping (Engine at normal running temperature)

1. Inner member (drive in fast)
2. Outer member (drive out slow)
3. Running clearance
4. Valve plate
5. Valve (closed)
6. Bi-metal
7. Fluid seals
8. Ball race
- A. Fluid chamber
- B. Fluid chamber

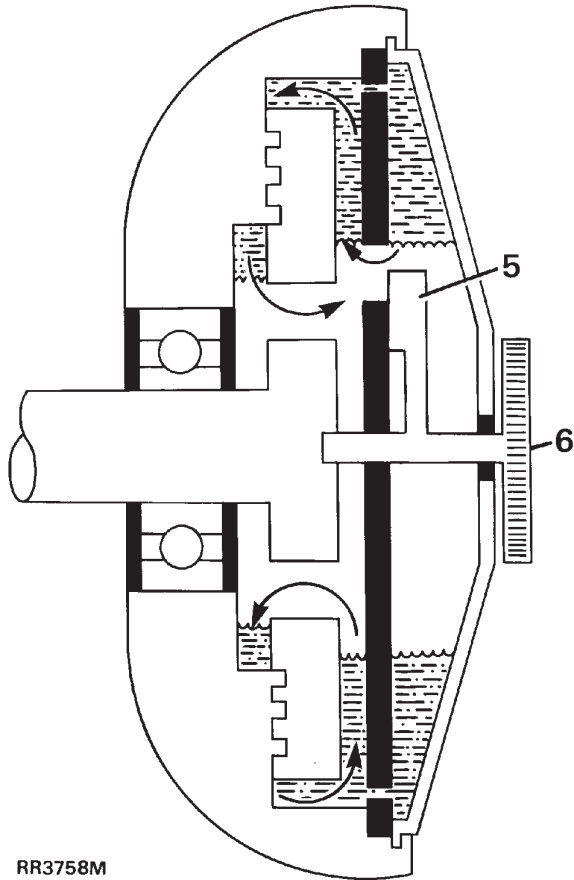
If the engine speed is increased the degree of slip will also increase to limit the maximum fan speed.



### Hot conditions

When operating in high ambient temperatures or when stationary in traffic, the bi-metal thermostat will operate and open the valve port between chambers A and B.

Opening the valve (as shown in RR3758M) allows the fluid to circulate between the two members, causing the unit to couple, thus increasing the fan speed and cooling effect.



### Viscous unit coupled (Hot running conditions)

Bi-metal expanded, valve (open)



## ENGINE OVERHEATING

Before conducting any cooling system diagnosis: **See Description and operation, Engine Cooling**

1. Is coolant level correct?  
NO - Allow engine to cool, top up level to expansion tank seam.  
YES - Continue.
2. Is drive belt tension correct?  
NO - **See ENGINE, Repair, Drive Belt - Check Tension**  
YES - Continue.
3. Is ignition timing correct?  
NO - **See ELECTRICAL, Adjustment, Ignition Timing**  
YES - Continue.
4. Is coolant in radiator frozen?  
YES - Slowly thaw and drain system. **See Adjustment, Coolant Requirements**  
NO - Continue.
5. Is air flow through radiator restricted or blocked?  
YES - Apply air pressure from engine side of radiator to clear obstruction.  
NO - Continue.
6. Are there any external leaks, from water pump, engine gaskets or the heater unit?  
YES - Investigate and rectify. **See Adjustment, Coolant Requirements**  
NO - Continue.
7. Are fan blades fitted correct way round, concave side towards engine?  
NO - Rectify.  
YES - Continue.
8. Is viscous unit operating correctly? **See Description and operation, Viscous Fan**  
NO - Renew. **See Repair, Viscous Coupling, Fan Blades, Pulley and Fan Cowl**  
YES - Carry out a pressure test on radiator cap and system. Check thermostat type, operation and correct fitting **See Repair, Thermostat**  
If pressure test leads you to suspect coolant leakage across gaskets, go to check 11, otherwise: Continue.
9. Are the air conditioning fans operating correctly? **See Electrical Trouble Shooting Manual.K5**  
NO - Rectify.  
YES - Continue.
10. Is temperature sender and gauge giving accurate readings?  
NO - Substitute parts and compare readings.  
YES - Continue.
11. Carry out cylinder pressure test to determine if pressure is leaking into cooling system causing over pressurising and loss of coolant.  
  
If problem is not diagnosed, check the coolant system for engine oil contamination and engine lubrication system for coolant contamination.  
  
If the coolant only, or both systems are contaminated, suspect cylinder head gaskets or radiator.  
  
If only the lubrication system is contaminated with coolant, suspect inlet manifold or front cover gaskets.

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## ENGINE RUNS COLD

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Before conducting any cooling system diagnosis: **See Description and operation, Engine cooling**

1. Check operation of viscous unit. **See Description and operation, Viscous Fan**  
Is viscous unit operating correctly?  
NO - **See Repair, Viscous coupling, fan blades, pulley and fan cowl**  
YES - Continue.
2. Is thermostat correct type and operating? **See Repair, Thermostat**  
If problem is not diagnosed: Continue.
3. Are the air conditioning fans operating continuously?  
YES - **See Electrical Trouble Shooting Manual.**  
NO - Continue.
4. Is temperature sender and gauge giving accurate readings? Substitute parts and compare readings. If problem is not diagnosed repeat tests, starting at 1.



## COOLANT REQUIREMENTS

### Frost precautions and engine protection.

Cooling system **MUST ALWAYS** be filled and topped-up with solution of water and anti-freeze, winter and summer. **NEVER** use water alone, this may corrode aluminium alloy.



**CAUTION:** Do not use salt water otherwise corrosion will occur. In certain territories where only available natural water supply has some salt content use only rain or distilled water.

### Recommended solutions

**Anti-freeze:** Universal anti-freeze or permanent type ethylene base, without methanol, containing a suitable inhibitor for aluminium engines and engine parts.

Use one part of anti-freeze to one part of water.

Anti-freeze can remain in the cooling system and will provide adequate protection for two years provided that specific gravity of coolant is checked before onset of second winter and topped-up with new anti-freeze as required.

Vehicles leaving factory have cooling system filled with 50% solution of anti-freeze and water. This gives protection against frost down to minus 36°C (minus 33°F). Vehicles so filled are identified by a label affixed to radiator.



**NOTE:** Should ambient temperatures be below that stated above refer to **Anti-Freeze Data in Recommended Lubricants, Fluids and Capacities in Section 09. Instructions in chart must be strictly adhered to before driving vehicle.**

After the second winter the system should be drained and thoroughly flushed. Before adding new anti-freeze examine all joints and replace defective hoses to make sure that the system is leakproof.

See the 'Recommended Lubricants Fluids and Capacities' for protection quantities. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**

## COOLANT

Service repair no - 26.10.01

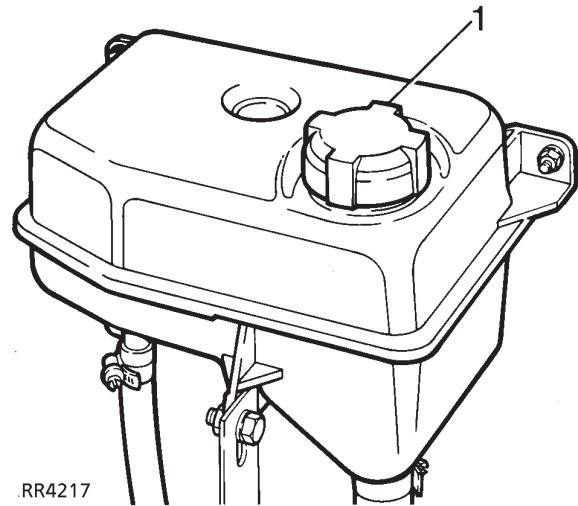
### Draining



**WARNING:** Do not remove expansion tank filler cap when engine is hot. The cooling system is pressurised and personal scalding could result.

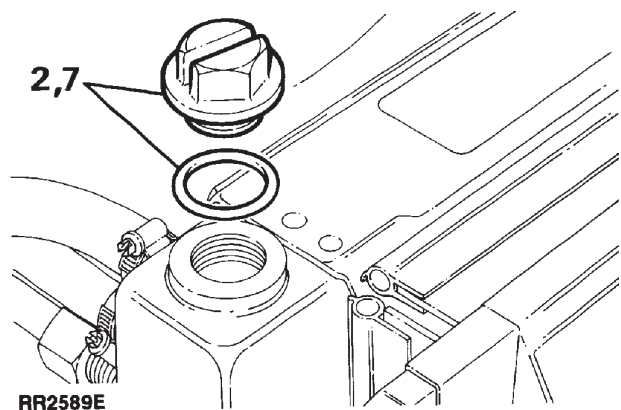
See coolant requirements before refilling system.

1. Remove expansion tank filler cap by slowly turning it anti-clockwise, pause to allow pressure to escape. Continue turning it in same direction and remove.



RR4217

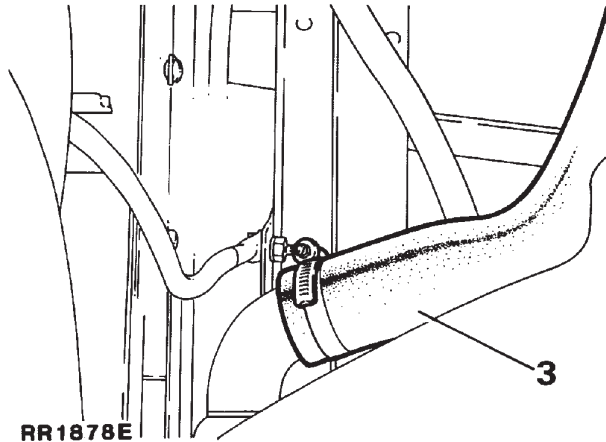
2. Remove radiator filler plug and 'O' ring to assist drainage.



RR2589E



3. Disconnect bottom hose from radiator. Drain coolant into a clean container. Reconnect bottom hose, re-tighten hose clamp.

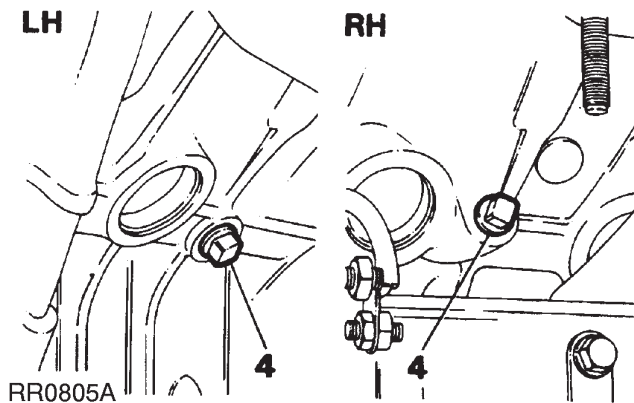


5. Pour correct solution of water and anti-freeze into expansion tank until radiator is full.
6. Start engine, run it until normal operating temperature is attained, topping up as necessary.
7. Refit radiator filler plug and 'O' ring, with new 'O' ring if required. Tighten to **6 Nm**.
8. Fit expansion tank filler cap.
9. Allow engine to cool, check coolant level. Finally top up expansion tank until level reaches seam of expansion tank.



**NOTE:** It is not possible to drain all coolant retained in heater system. It is not desirable to flush through system, after draining.

4. Remove engine drain plugs, one each side of cylinder block, beneath exhaust manifolds. Drain coolant, refit and tighten plugs.





## EXPANSION TANK

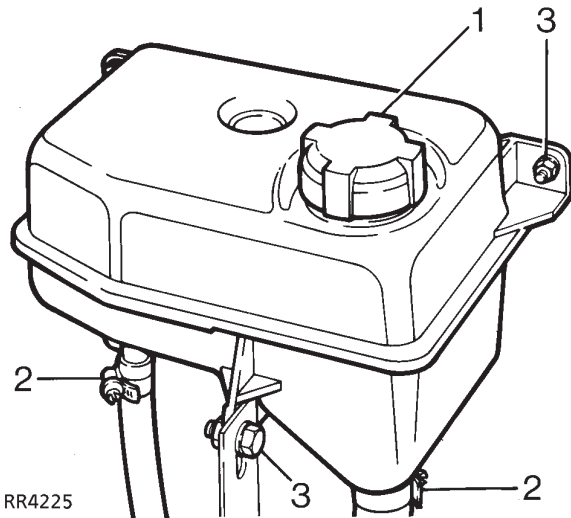
Service repair no - 26.15.01

### Remove



**WARNING:** Do not remove expansion tank filler cap when engine is hot. The cooling system is pressurised and personal scalding could result.

1. Remove expansion tank filler cap by first turning it slowly anti-clockwise, pause to allow pressure to escape. Continue turning in same direction and lift off.
2. Disconnect two hoses from bottom of expansion tank, allowing coolant to drain into a suitable container.
3. Remove three fixing bolts, remove expansion tank.



### Refit

4. Reverse removal procedure.
5. Replenish cooling system.
6. Check for leaks around all hose connections.

## VISCOUS COUPLING, FAN BLADES, PULLEY AND COWL

Service repair no - 26.25.19 - Viscous coupling and fan assembly  
 Service repair no - 26.25.03 - Water pump pulley  
 Service repair no - 26.25.05 - Fan blades

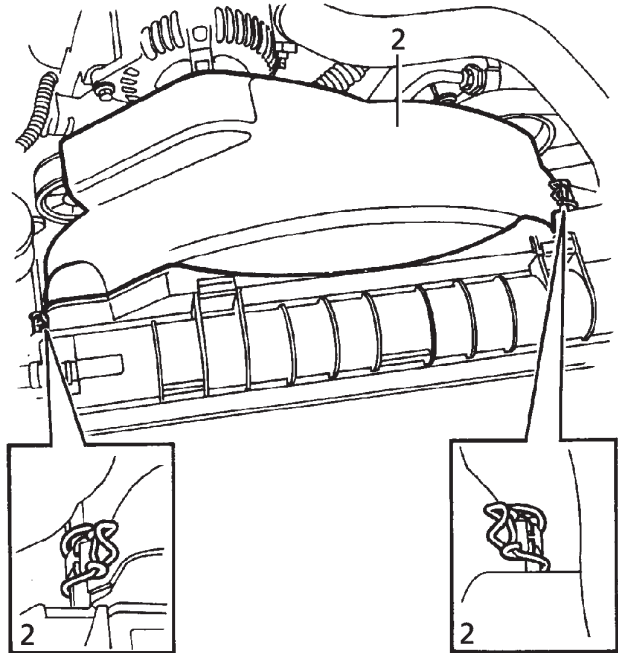
### Special tools:

LRT-12-093

LRT-12-094 - Viscous coupling removal

### Remove

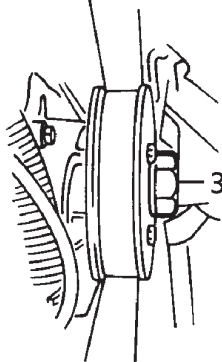
1. Disconnect battery negative lead.



### NOTE: 4.0 V8 only:

Release coolant hose from cooling fan upper cowl.

2. Release 2 clips securing cooling fan upper cowl. Remove cowl.



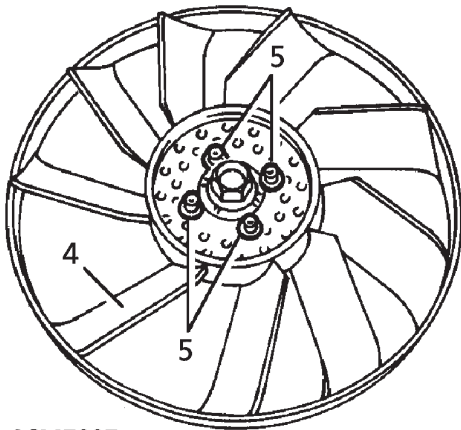
26M7006

3. Use LRT-12-093 to prevent coolant pump pulley from turning and using LRT-12-094, unscrew viscous coupling from water pump.



**NOTE:** Nut securing viscous unit to water pump has a right hand thread. Release by turning anti-clockwise when viewed from front of viscous unit.

4. Remove fan and coupling assembly.



26M7007

**Do not carry out further dismantling if component is removed for access only.**



**NOTE:** Mark fan with reference to assist refitting.

5. Remove 4 Allen screws securing blades to coupling. Remove coupling.
6. Remove serpentine drive belt.
7. Remove pulley fixings, remove pulley.

#### Refit

8. Clean fan blades and mating faces.
9. Fit fan blades to coupling. Secure with screws. Tighten to **24 Nm**.
10. Using LRT-12-093 and LRT-12-094, fit fan assembly to pump. Tighten to **56 Nm**.
11. Fit cooling fan upper cowl. Secure with clips.
12. **4.0 V8 only:** Fit coolant hose to cooling fan upper cowl.
13. Fit serpentine drive belt.
14. Fit pulley fixings, remove pulley.
15. Reconnect battery negative lead.

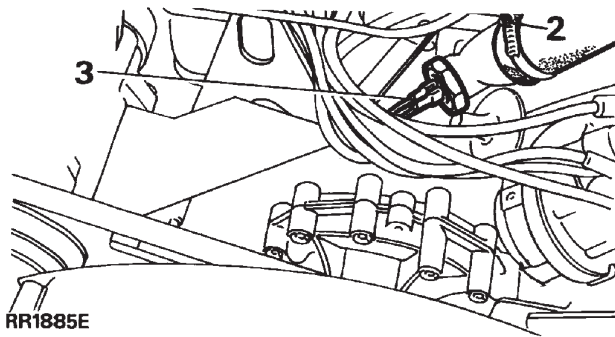


## THERMOSTAT

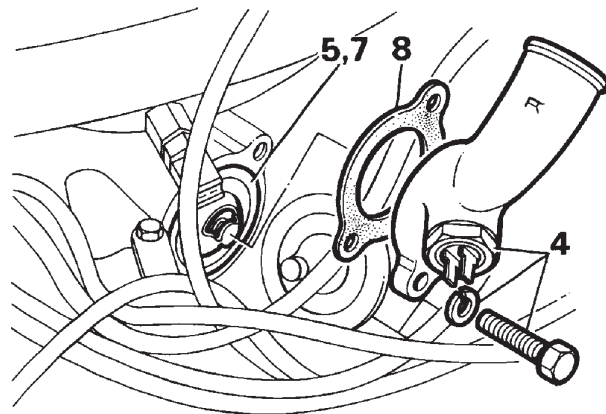
Service repair no - 26.45.01

### Remove

1. Partially drain cooling system, until coolant level is below thermostat housing.
2. Disconnect hose from thermostat housing.
3. Disconnect electrical connections to water temperature switch.



4. Remove outlet elbow.
5. Withdraw thermostat.



RR1792E

### Test

6. Note rating of thermostat is 88°C. Place thermostat in a container half full of water. Heat water, observe temperature at which thermostat opens. Thermostat is satisfactory if it opens between 85°C and 89°C.

### Refit

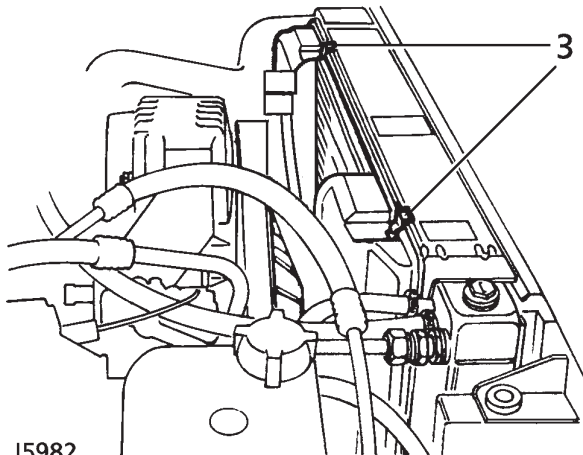
7. Insert thermostat with jiggle pin/vent hole uppermost (12 o'clock position).
8. Fit the outlet elbow and new joint washer. Tighten to **28 Nm**.
9. Reverse removal procedure. 1 to 3.
10. Check for coolant leaks around all connections and joint faces.

**RADIATOR**

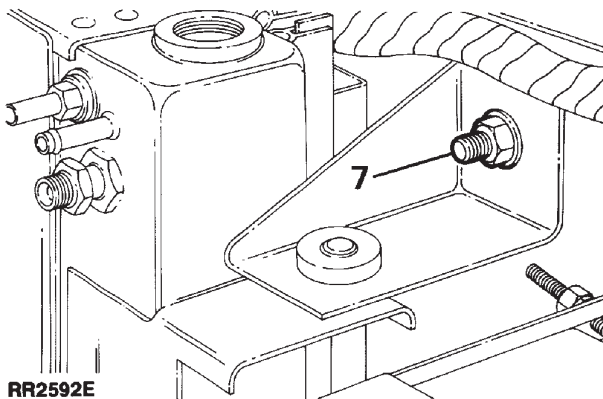
Service repair no - 26.40.01

**Remove**

1. Drain cooling system. *See Adjustment, Coolant*
2. Remove viscous coupling and fan assembly. *See Viscous Coupling, Fan Blades, Pulley and Fan Cowl*



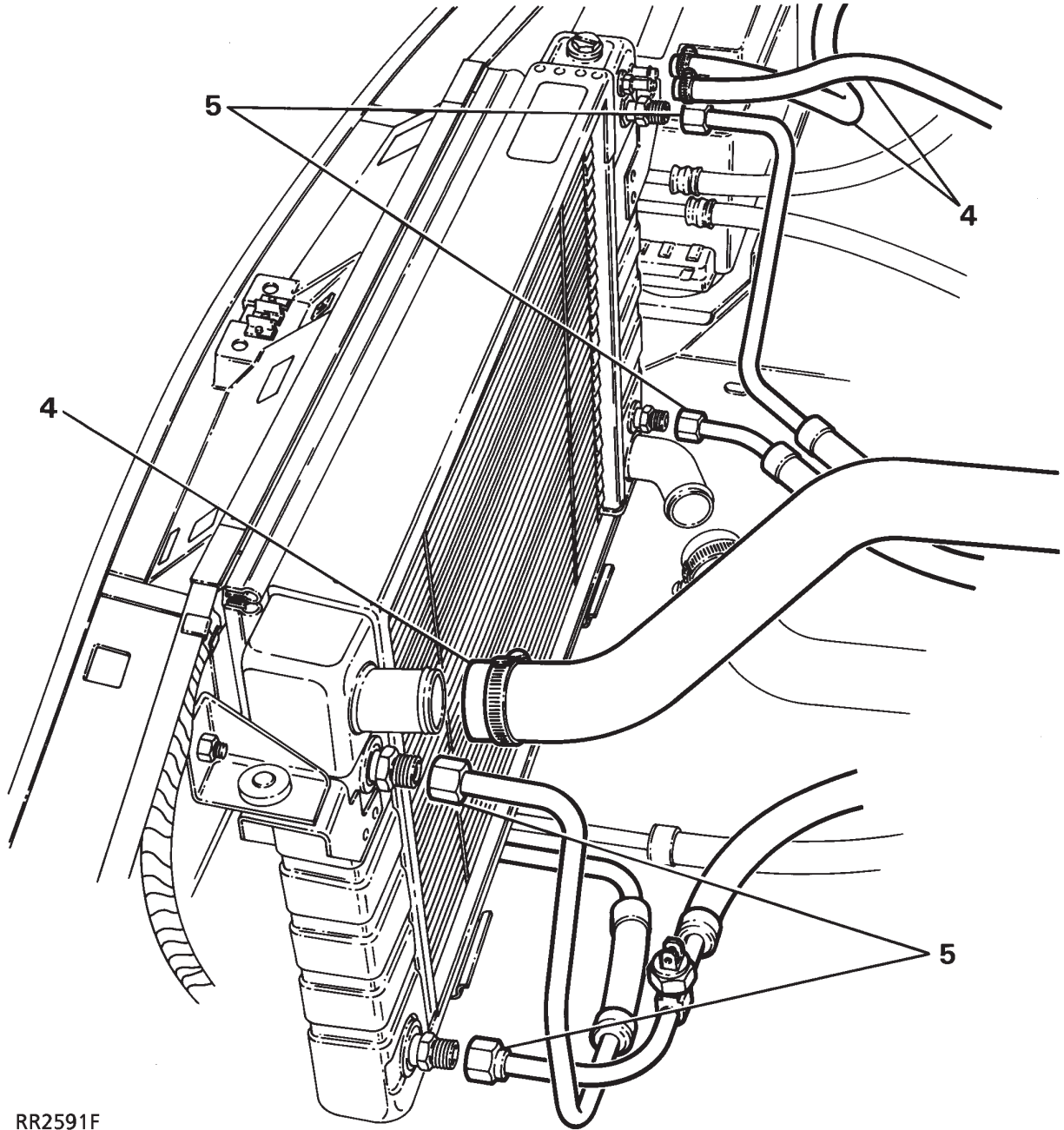
3. Release 2 clips and remove fan cowl.
4. Disconnect radiator top hoses.
5. Disconnect four transmission and engine oil cooler connections to radiator end tanks. Note oil spillage will occur when connections are loosened. Blank off exposed oil connections.
6. Disconnect transmission oil temperature sensor.



7. Remove radiator securing brackets from each side.
8. Remove radiator unit by lifting from its location. Check condition of rubber mounting pads.

**Refit**

9. Reverse removal procedure.
10. Clean unions and apply sealant.
11. Lubricate new 'O' rings before fitting.
12. Check radiator sealing strips are securely located.
13. Transfer oil cooler adaptors if fitting new radiator.
14. Ensure that oil cooler connections are tightened to **30 Nm**. before fitting fan blades and cowl.
15. Clean coolant/oil spillage from vehicle.
16. Check all connections for coolant/oil leaks.



RR2591F

## WATER PUMP

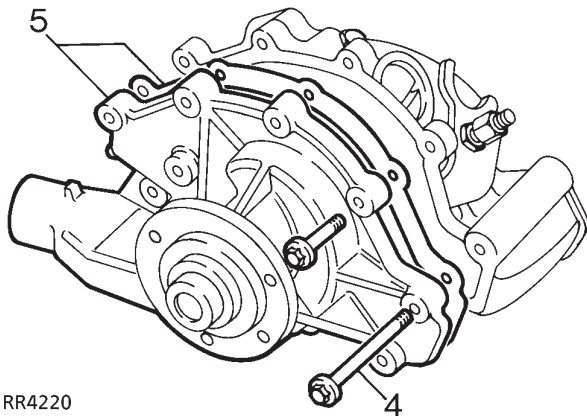
Service repair no - 26.50.01

Remove



**WARNING:** Disconnect battery negative terminal to prevent engine being started before removing or adjusting drive belts.

1. Drain engine cooling system. *See Adjustment, Coolant*
2. Remove fan blades and pulley. *See Viscous Coupling, Fan Blades, Pulley and Fan Cowl*
3. Disconnect inlet hose from water pump.
4. Remove water pump bolts.
5. Remove water pump and joint washer.



RR4220

Refit

6. Lightly grease new joint washer, position on timing cover.
7. Clean threads of all long bolts and coat with Loctite 572 thread lubricant-sealant.
8. Locate water pump in position. Tighten remaining water pump housing bolts evenly to **28 Nm**.
9. Reverse removal procedure. 1 to 3.
10. Check for coolant leaks around all hose connections and joint faces.



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**TORQUE VALUES**

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**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	<b>Nm</b>
Oil cooler pipes .....	30
Radiator filler plug (plastic) .....	6