

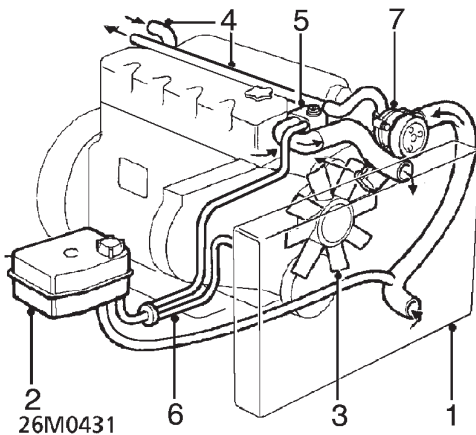


## ENGINE COOLING

### Description

The Tdi engine uses a pressurized cooling system and cross flow radiator which is supplied from a separate header tank. The radiator assembly is in three sections. The largest section is for engine coolant and the other two sections which are cast in aluminium, are the engine oil cooler and the turbo charger intercooler.

A belt driven viscous fan and centrifugal water pump is located in the front of the cylinder block. Hot coolant is supplied to the heater through hoses. Two small diameter air purge hoses connect the top of the radiator and cylinder head water gallery, to the header tank.



### Coolant circulation (engine cold)

1. Cross flow radiator
2. Header tank
3. Viscous fan
4. Heater hoses
5. By pass hose and engine thermostat
6. Air purge hoses
7. Coolant pump

## COOLANT CIRCULATION

### 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 towards the rear of the cylinder block around each of the cylinders. Coolant as it is heated rises through ports in the cylinder block and head gasket, into the cylinder head. The coolant flows forwards to the thermostat, by-pass port and radiator top hose connection.

#### Start from cold (thermostat closed)

While the thermostat is closed, coolant circulates around the cylinder block and cylinder head via the by-pass.

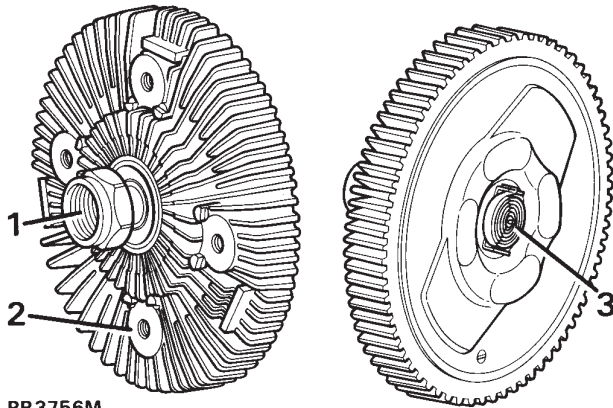
#### Engine warm (thermostat open)

When the engine reaches normal running temperature the thermostat closes off the by-pass and opens the flow to the top of the 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

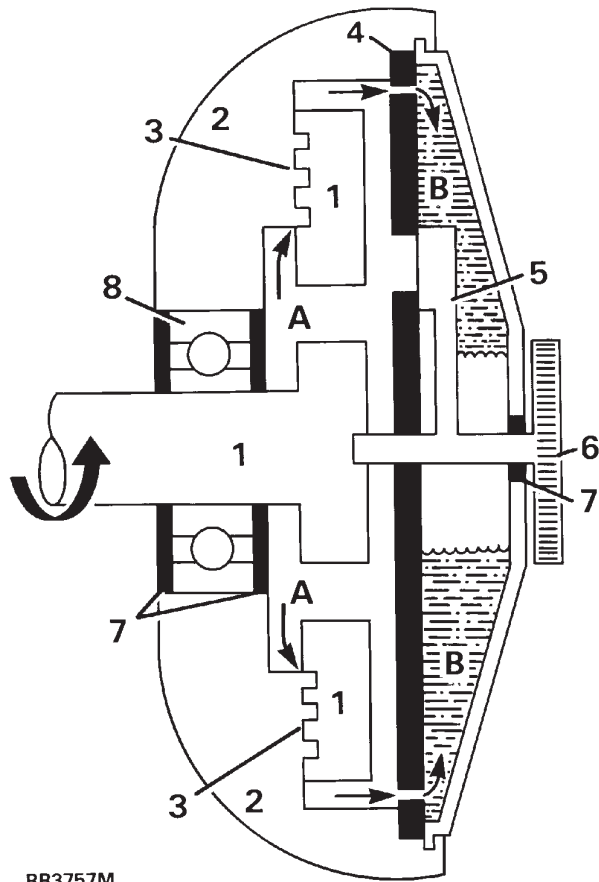
The viscous unit consists of two principal components: An inner member 1 which is secured to water pump spindle and is driven by the fan belt. An outer member 2 which has the fan blades attached, houses the working parts and is driven through the medium of the viscous fluid.

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.



RR3757M

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

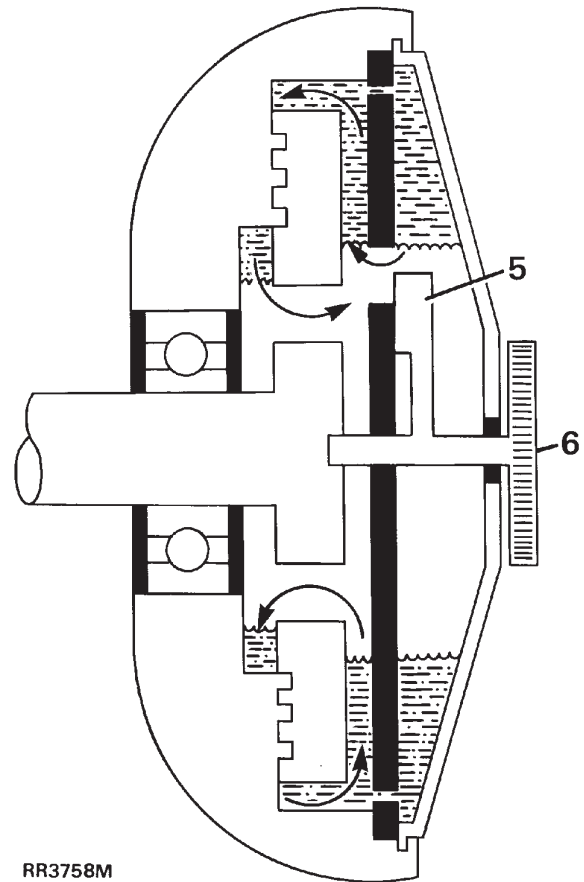
1. Inner member (drive in fast)
2. Outer member (drive out slow)
3. Running clearance
4. Valve plate
5. Valve (closed)
6. Bi-metal
7. Fluid seals
8. Ball race
- A Fluid chamber
- B Fluid chamber

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.



RR3758M

#### 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, Compressor Drive Belt**  
YES - Continue.
3. Is coolant in radiator frozen?  
YES - Slowly thaw and drain system. **See Adjustment, Coolant**  
NO - Continue.
4. Is air flow through radiator restricted or blocked?  
YES - Apply air pressure from engine side of radiator to clear obstruction.  
NO - Continue.
5. Are there any external leaks, from water pump, engine gaskets, fast idle thermostat or the heater unit?  
YES - Investigate and rectify. **See Adjustment, Coolant**  
NO - Continue.
6. Are fan blades fitted correct way round, concave side towards engine?  
NO - Rectify.  
YES - Continue
7. 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 10, otherwise: Continue.

8. Are the air conditioning fans operating correctly?  
**See Electrical Trouble Shooting Manual.**  
NO - Rectify.  
YES - Continue.
9. Is temperature sender and gauge giving accurate readings?  
NO - Substitute parts and compare readings.  
YES - Continue.
10. 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 only the coolant system is contaminated suspect a cylinder head gasket.

If both systems are contaminated, suspect the radiator.

If only the lubrication system is contaminated with coolant, suspect leakage past cylinder liner seals or cylinder head gasket.

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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.




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**COOLANT**


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Service repair no - 26.10.01

**Draining**



**WARNING:** Do not remove any caps or plugs when the engine is hot. The cooling system is pressurised and personal scalding could result.

1. Remove expansion tank filler cap.
2. Disconnect bottom hose from radiator and allow coolant to drain into a container. Ensure container is clean if reusing coolant.



**NOTE:** When expansion tank has emptied, remove thermostat housing plug to assist drainage. Similarly when coolant level is below top of radiator, remove radiator plug.

3. Reconnect hose after draining and tighten hose clamp.

**Refit**



**CAUTION:** In order to expel ALL air from the cooling system, follow the procedures carefully.

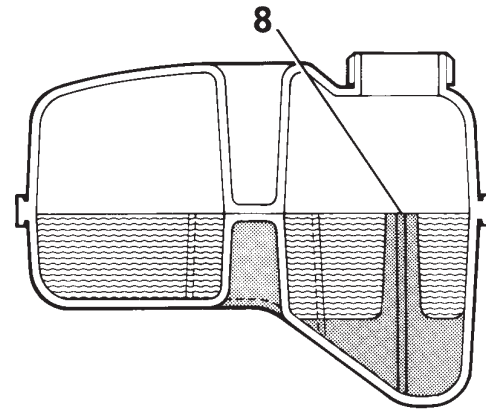


**NOTE:** Refill procedure is slow but can be accelerated by squeezing hoses to assist removal of air from the system.

4. Add correct mix of coolant into expansion tank until radiator is full (as seen through plug hole on top of radiator). **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Anti-Freeze**



**CAUTION:** Take care to avoid excess coolant spillage from radiator.



RR2897A

5. Fit radiator plug.
6. Continue adding coolant into expansion tank until coolant appears in thermostat housing.



**CAUTION:** Take care to avoid excess coolant spillage from thermostat housing.

7. Fit thermostat housing plug.
8. Check coolant in expansion tank is level with indicator post. Add more coolant if necessary.
9. Start engine and run for 5 minutes.
10. Allow engine to cool, check coolant level in expansion tank; top up to level indicator post if necessary.
11. Fit expansion tank filler cap.



## VISCOUS COUPLING, FAN BLADES, PULLEY AND FAN COWL

Service repair no - 26.25.03/05

Viscous coupling	- Remove 1 to 3
Fan blades	- Remove 1 to 4
Fan cowl	- Remove 1 to 3
Fan pulley	- Remove 1 to 6

### Remove



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

1. Slacken nut securing viscous coupling/fan blade assembly to pulley.



**NOTE: Nut securing viscous unit to pulley has a left hand thread. Release by turning clockwise when viewed from front of viscous unit.**

2. Drop viscous unit and fan assembly into bottom of cowl
3. Remove two fixings clips from top of cowling and lift cowling complete with viscous unit and fan out of lower mountings.
4. Remove fan blades from viscous coupling if necessary.
5. Remove serpentine drive belt and, if fitted, air conditioning compressor belt.
6. Remove pulley fixings, remove pulley.



**NOTE: The serpentine belt is removed by using a hexagonal socket and tommy bar on the auto-tensioning pulley nut. Whilst tensioning the device the belt can be removed.**

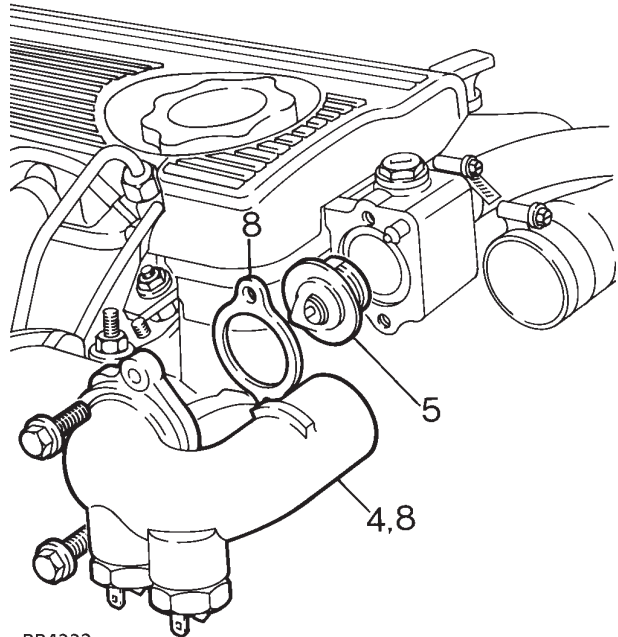
7. Reverse removal procedure. Ensure fan blades are fitted correctly. Fan is marked 'front' and should be fitted with word 'front' closest to radiator. Tighten to **30 Nm**.
8. Refit drive belt. **See ENGINE, Repair, Drive Belt**

## 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.

### 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 begins to open. Thermostat is satisfactory if its open between 85°C and 89°C.

### Refit

7. Insert thermostat with jiggle pin/vent hole upper most (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.

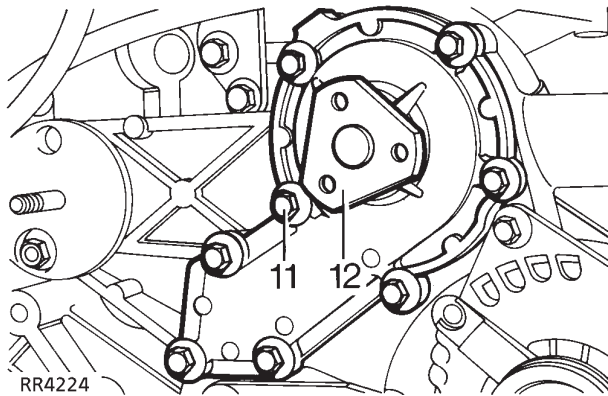
**WATER PUMP**

Service repair no - 26.50.01

**Remove**

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

1. Drain engine cooling system. *See Adjustment, Coolant*
2. Remove top hose radiator to thermostat.
3. Remove top hose intercooler to induction manifold.
4. Slacken water pump and power steering pump pulley retaining bolts.
5. Remove drive belt.
6. Remove centre nut from belt tensioner.
7. Manoeuvre pulley upwards and withdraw tensioner from retaining stud.
8. Disconnect hose thermostat to bottom hose, release hose from clip on water pump and move aside.
9. Remove water pump pulley.
10. Remove power steering pump pulley.



11. Remove 8 bolts securing water pump, noting location of 3 through bolts.
12. Withdraw pump and gasket, clean all gasket material from mating surfaces.

**Refit**

13. Refit water pump in reverse order to removal using new gasket.

**RADIATOR**

Service repair no - 26.40.01

**Remove**

1. Drain cooling system. *See Adjustment, Coolant*
2. Disconnect radiator top hose.
3. Remove fan blade assembly.
4. Remove cowl.
5. Disconnect engine oil cooler connections and turbo intercooler connections from radiator ends.



**NOTE: Oil spillage will occur when connections are loosened. Blank off exposed oil connections.**

6. Disconnect expansion tank bleed hose from radiator.
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. Check radiator sealing strips are securely located.
10. Transfer oil cooler adaptors if fitting new radiator.
11. Reverse removal procedure. Tighten oil cooler connections to **30 Nm** before fitting fan blades and cowl.
12. Check all connections for leaks.



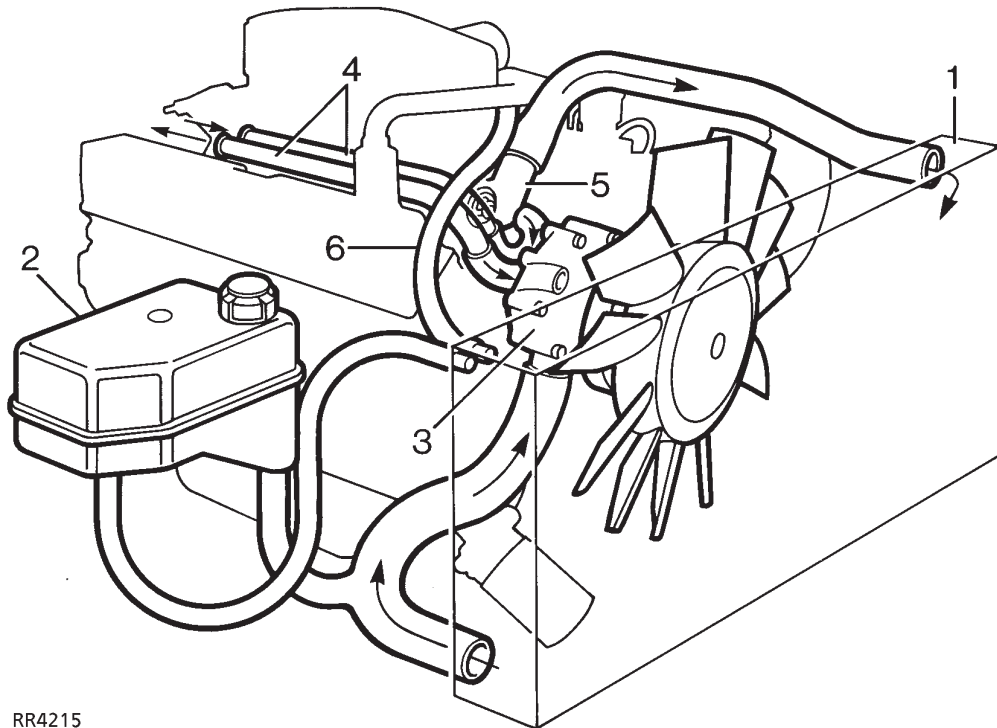
## ENGINE COOLING

### 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