Engine cooling system

Contents

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Introduction

Introduction
The sealed cooling system comprises an expansion bottle (header tank on Corniche cars), a radiator, and a pump. Also various passages and pipes to convey the coolant around the system (see fig. L1-1).

On Corniche cars from approximately mid 1984 an expansion bottle was introduced to provide a means of retaining any overflowing coolant. With the introduction of this expansion bottle the overflow, situated beneath the header tank filler cap, was deleted leaving only the overflow pipe from the pressure valve. The overflow pipe being connected to the expansion bottle on the left-hand front inner wing.

A mixture containing equal amounts of approved anti-freeze/summer coolant and water should be used in the system at all times.

The coolant in the system should always be maintained at the correct level and this must be checked at the intervals specified in the service schedules.

Cars fitted with a coolant expansion bottle
It is not necessary to remove the radiator cap to check the coolant level as the system incorporates a transparent expansion bottle.

Note
If a full check is to be carried out refer to page L5-3.

Cars not fitted with a coolant expansion bottle
The cooling system is pressurized. **Do not remove the radiator filler cap while the engine is running or when the engine is hot, otherwise internal pressure will blow out the hot coolant.** If it is necessary to check the level of coolant when the engine is hot, muffle the filler cap with a thick cloth. Gradually turn the cap anti-clockwise until the pressure is reduced, then remove the cap.

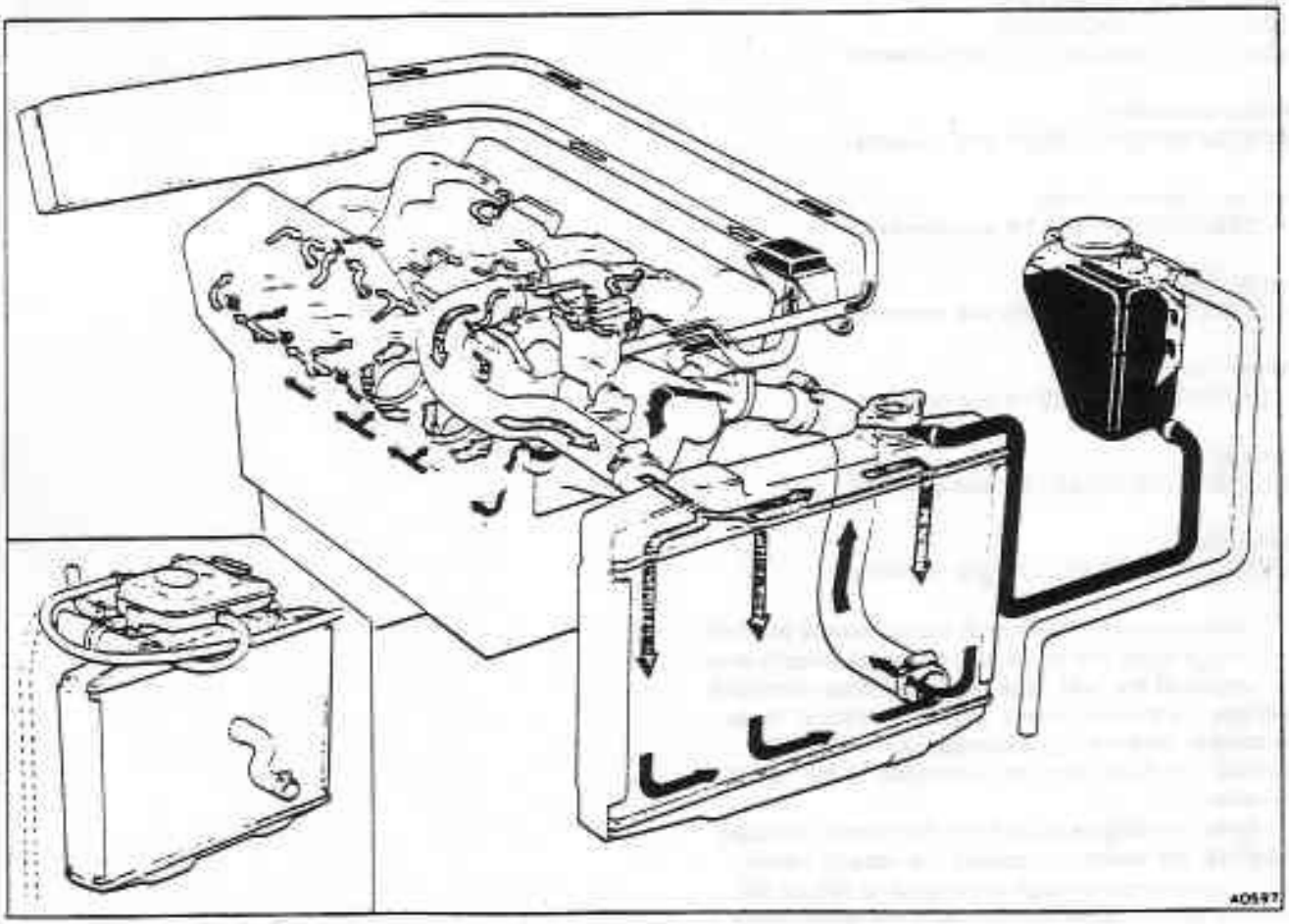


Fig. L1-1 Diagrammatic view of the cooling system
Inset - Corniche radiator and header tank. Dotted line - Cars not fitted with a coolant expansion bottle

The coolant pump is situated at the front of the engine and is driven from the crankshaft by twin matched 'Vee' belts.

Three types of coolant pump and fan coupling have been fitted. For identification purposes throughout this Chapter they are quoted as type A, B, and C.

Type A (see fig. L4-1) was fitted up to early in 1981.

Type B (see fig. L4-2) was then introduced and fitted to cars prior to the vehicle identification numbers (VIN) quoted for type C.

Type C (see fig. L4-3) was fitted to cars from the following vehicle identification numbers (VIN).

Rolls-Royce Silver Spirit
SCAZS42A9ECX08517
SCAZS42A2ECX08519
SCAZS42A6ECX08524
SCAZS42A7ECX08600
SCAZS42A0ECX08602
SCAZS42A4ECX08604
SCAZS42A8ECX08606
SCAZS42A8ECX08685
SCAZS42A1ECX08690 and onwards

Rolls-Royce Silver Spur
SCAZN42A0ECX08641
SCAZN42A6ECX08658
SCAZN42A8ECX08659
SCAZN42A7ECX08667 and onwards

Bentley Mulsanne
SCBZS42A7ECX08608 and onwards

Bentley Mulsanne Turbo
SCBZS0T08ECH08537 and onwards

Bentley Eight
SCBZS8004ECH08862 and onwards

Bentley Turbo R
SCBZS0T0XFCH12834 and onwards

Corniche
SCAZD42A7ECX08879 and onwards

Continental
SCBZD0001FCH09030 and onwards

Coolant from the bottom of the radiator is pumped via transfer pipes and crankcase passages directly onto the outside of the 'wet' type engine cylinder liners and then into the cylinder heads. From the cylinder heads the coolant travels along passages cast in the inlet manifold and flows past the thermostat to the top of the radiator.

When the engine is cold the thermostat is closed. Therefore, the coolant by-passes the radiator matrix and is recirculated through the engine to reduce the warm-up period. Once normal operating temperature is attained, the thermostat opens and the coolant is directed to the radiator.

The temperature of the coolant is registered on the gauge situated on the facia. Whenever the ignition is on, a transmitter situated in the thermostat housing signals the coolant temperature to the gauge.

Radiator assembly and Expansion bottle

The radiator assembly and expansion bottle (header tank only on Corniche cars prior to mid 1984) are mounted in the engine compartment, at the front of the car (see figs. L2-2 and L2-3).

Radiator assembly

This assembly is situated between the front of the engine and the radiator grille. It is attached to the body at four points (two on each side).

All cars other than Corniche

The radiator is fitted with a cap that operates as both a pressure and vacuum relief valve. The valve controls the pressure in the system to between 0,96 bar and 1,24 bar (14 lbf/in² and 18 lbf/in²) by releasing the expanding coolant past a spring-loaded seat and into a pipe that connects to the expansion bottle. Should the expansion bottle overflow, the excess coolant is vented via an overflow pipe. In addition, the reversible seal within the cap acts as a vacuum valve and opens at 0,07 bar (1 lbf/in²) below atmospheric pressure.

Under no circumstances should the radiator pressure cap be removed whilst the engine is hot, otherwise, scalding fluid and steam may be blown out of the radiator.

Rubber hoses connect the inlet and outlet pipes of the radiator with their respective connections on the engine. Worm drive clips are used to retain the hoses.

A brass drain tap with a tapered thread is screwed into the bottom of the radiator.

Radiator assembly - To remove and fit

1. Carry out the usual workshop safety precautions.
2. Remove the bonnet (see Chapter S).
3. Drain the coolant (see Section L5).
4. Unscrew the worm drive clips securing the top hose to the thermostat outlet elbow and to the radiator. Free the joints and withdraw the hose. Blank the open connections.
5. Unscrew the worm drive clips securing the bottom hose to the coolant pump and to the radiator. Free the joints and withdraw the hose. Blank the open connections.
6. Cars fitted with a coolant expansion bottle

Slacken the worm drive clips securing the hose from the expansion bottle. Free the joints and withdraw the hose.

Cars not fitted with a coolant expansion bottle

Slacken the worm drive clips securing the hose from the header tank to the coolant pump. Free the joints and withdraw the hose. Disconnect the electrical connectors on the coolant level indicator switch.

7. Unscrew the two pipe union connections situated on the bottom of the radiator (see fig. L2-1). One pipe conveys oil from the transmission where it is cooled in a separate matrix installed in the base of the radiator and the other pipe returns the cooled oil to the transmission. Blank the open connections.
8. Secure a sheet of foam rubber to the radiator matrix inside the fan cowl. This will afford protection to the matrix when the fan assembly is withdrawn.
9. [Type A (see page L1-2)] Remove the four nuts securing the fan assembly to the coolant pump spigot (see fig. L2-4, A). Collect the washers.

(Type B) Remove the setscrew and dog location washer securing the fan assembly to the coolant pump spindle (see fig. L2-4, B).

(Type C) Unscrew the Eaton type fan coupling from the spindle, noting that it has a left-hand thread (see fig. L2-4, C).

Note

All Turbocharged cars have Type C fan coupling retention.

10. Withdraw the fan assembly from the spigot and lift it upwards past the refrigeration and steering pumps.

If it is necessary to prise the fan assembly flange forward off the coolant pump spigot, use extreme care.

11. Unscrew the two nuts retaining the hose clips to the left-hand side of the radiator. Collect the washers and free the clips (not applicable to Corniche cars).

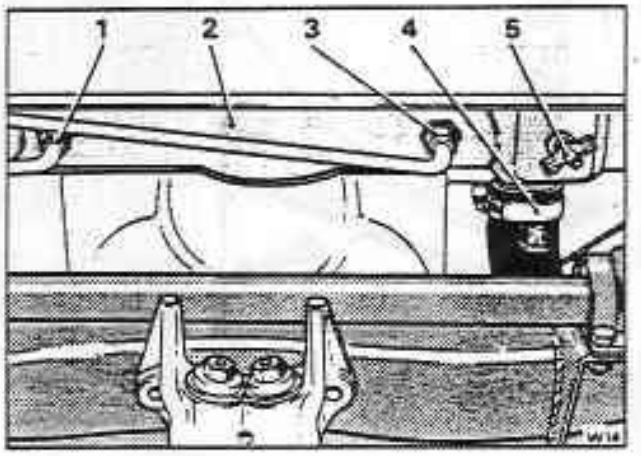


Fig. L2-1 Bottom of radiator assembly

1 Oil connection from transmission
2 Radiator
3 Oil connection to transmission
4 Bottom hose retaining clip
5 Drain tap

12. Temporarily support the weight of the radiator assembly.
13. Unscrew the four mounting setscrews (two on each side) securing the radiator assembly in position (see fig. L2-2). Collect the washers.
14. Withdraw the radiator assembly in an upwards direction.
15. Immediately the radiator is removed, secure

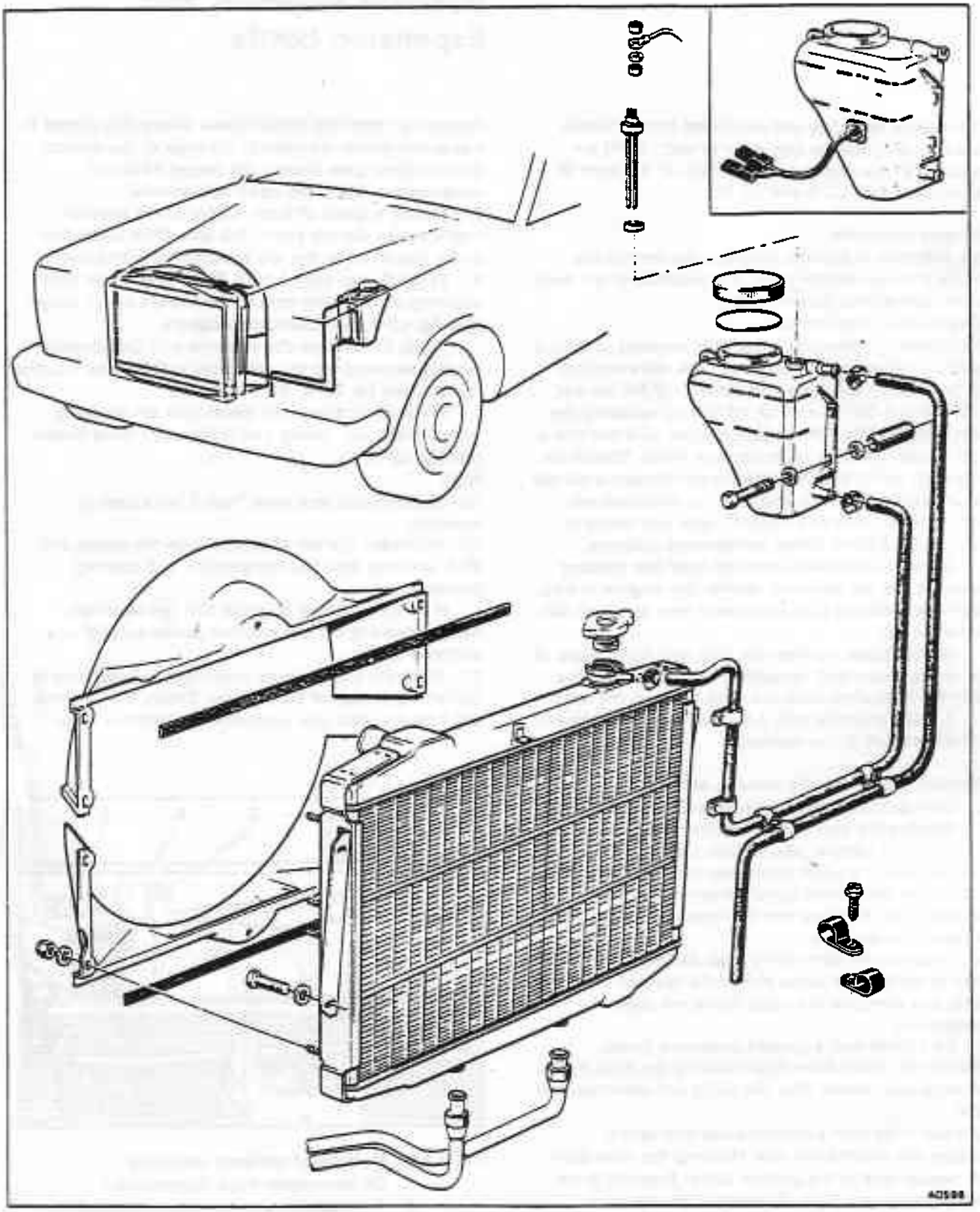


Fig. L2-2 Radiator and expansion bottle All cars other than Corniche
Inset – Updated expansion bottle (1985 and onwards)

blanks to the inlet and outlet connections and half fill with coolant.

16. Fit the radiator assembly by reversing the procedure given for removal. Note the special torque tightening figures (see Section L6), and the torque spanner RH 9747 necessary for securing the Eaton type fan coupling.

Radiator assembly - To dismantle and assemble

1. Unscrew the nuts securing the fan cowl to the radiator. Collect the washers and withdraw both the upper and lower halves of the cowl.
2. Unscrew the drain tap from the bottom of the radiator.
3. Corniche

Unscrew the worm drive clips securing the radiator to header tank pipe. Free the joints and withdraw the hose. Remove the nuts and bolts securing the header tank to the radiator. Remove the header tank.

4. To assemble the radiator, commence by coating the cowl studs with Wellseal.
5. Inspect the condition of the foam rubber strips secured to the edges of the fan cowl.
6. Fit the two halves of the fan cowl as shown in figures L2-5 and L2-6.
7. Fit the washers and cowl retaining nuts. On cars other than Corniche ensure that the two hose securing clips are fitted to the top two studs on the left-hand side (see fig. L2-5).
8. Screw the retaining nuts onto the studs until the nuts and washers just contact the cowl, then tighten each nut a further one and a quarter turns.
9. After tightening the cowl retaining nuts, again coat the nuts and studs with Wellseal.
10. Screw the drain tap into the bottom of the radiator.
11. Corniche

Secure the header tank to the radiator using the nuts and bolts. Fit the radiator to header tank pipe and secure with worm drive clips.

Radiator - To reverse flush

Refer to Section L5, Coolant.

Expansion bottle (if fitted)

The plastic expansion bottle is situated on the left-hand valance in front of the wheel arch.

The bottle has an inlet connection from the radiator and an outlet connection to atmosphere. Situated on top of the assembly is the filler cap.

The coolant level indicator switch (if fitted) may be positioned in the top or the side of the bottle.

Expansion bottle - To remove and fit

1. Unscrew the worm drive clips securing the hoses to the connections on the expansion bottle. Free the joints and withdraw the hoses. The coolant from the bottle should be allowed to drain into a clean container. Blank the open connections.
2. Disconnect the electrical leads from the coolant level indicator switch (if fitted).
3. Hold the expansion bottle and remove the three mounting setscrews.

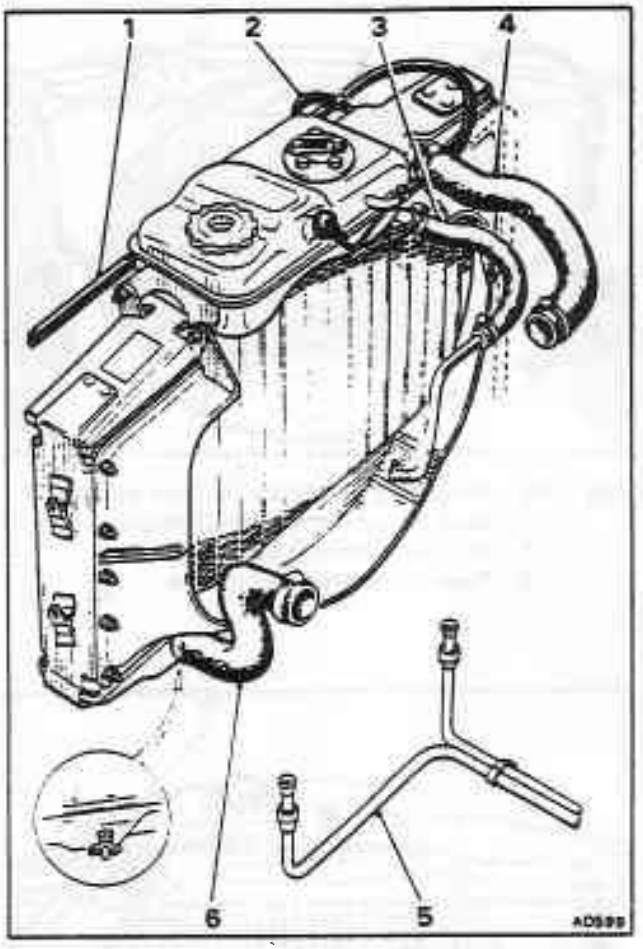


Fig. L2-3 Radiator and connecting pipework

Corniche

1 Overflow to expansion bottle (if fitted)
2 Header tank to radiator
3 Pump to header tank
4 Radiator to thermostat housing
5 Transmission oil cooler pipes
6 Radiator to pump

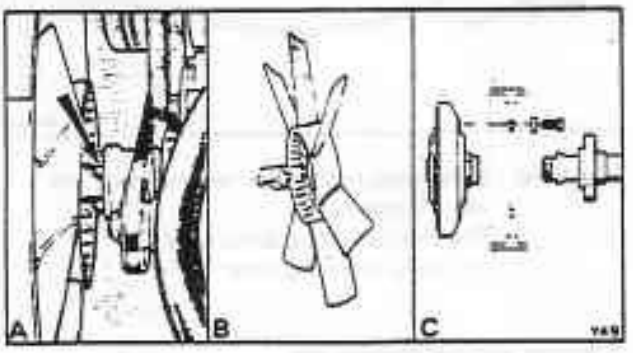


Fig. L2-4 Fan assembly retention

A Original type
B Dog location type
C Eaton type (left-hand thread)

Withdraw the expansion bottle.

4. Fit the expansion bottle by reversing the removal procedure, noting the coolant topping-up procedure given in Section L5.

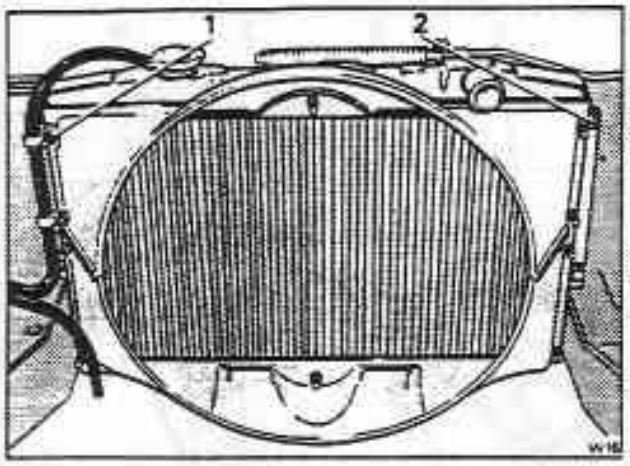


Fig. L2-5 Mounting points for radiator and fan cowl All cars other than Corniche
1 Fan cowl retaining nuts
2 Radiator mounting setscrews

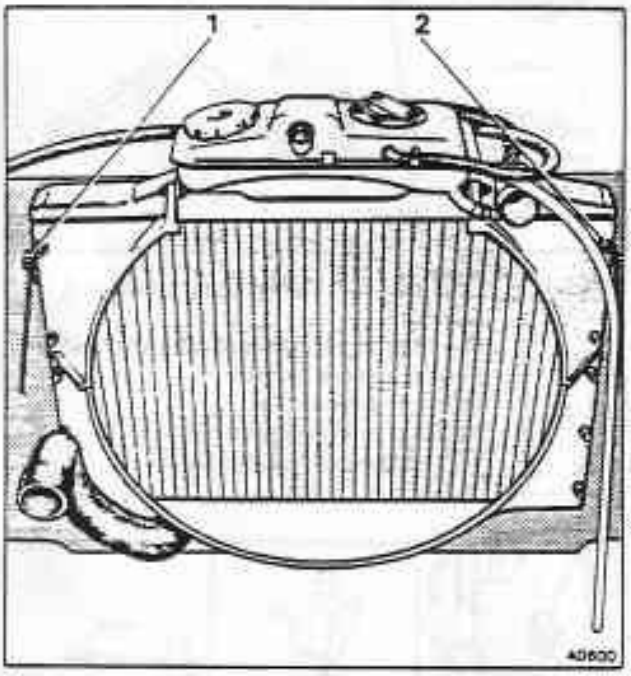


Fig. L2-6 Mounting points for radiator and fan cowl Corniche
1 Radiator mounting setscrews
2 Fan cowl retaining nuts

Cooling system booster fan

A booster fan is located between the radiator grille and the refrigeration condenser and is switched from a temperature sensor located in the thermostat housing.

On cars fitted with a cycling clutch air conditioning unit, either a single fan or twin booster fans are fitted depending upon the cars specification (see Chapter A, Section A3). Both systems are switched from either engine coolant temperature, or from refrigerant pressure.

All booster fans are electrically operated assemblies and the service details are contained in Chapter M.

Thermostat housing assembly

The thermostat housing is situated at the forward end of the induction manifold (see fig. L3-1).

There are four similar types of thermostat housing dependent upon the specification of the vehicle. One is an integral part of the induction manifold casting and the other three are detachable, being connected to the induction manifold by transfer pipes.

A number of electrical switches are fitted into the thermostat housing dependent upon the specification of the vehicle. The service details relating to these switches are contained in either Chapter M, Electrical system or Chapter U, Emission control systems.

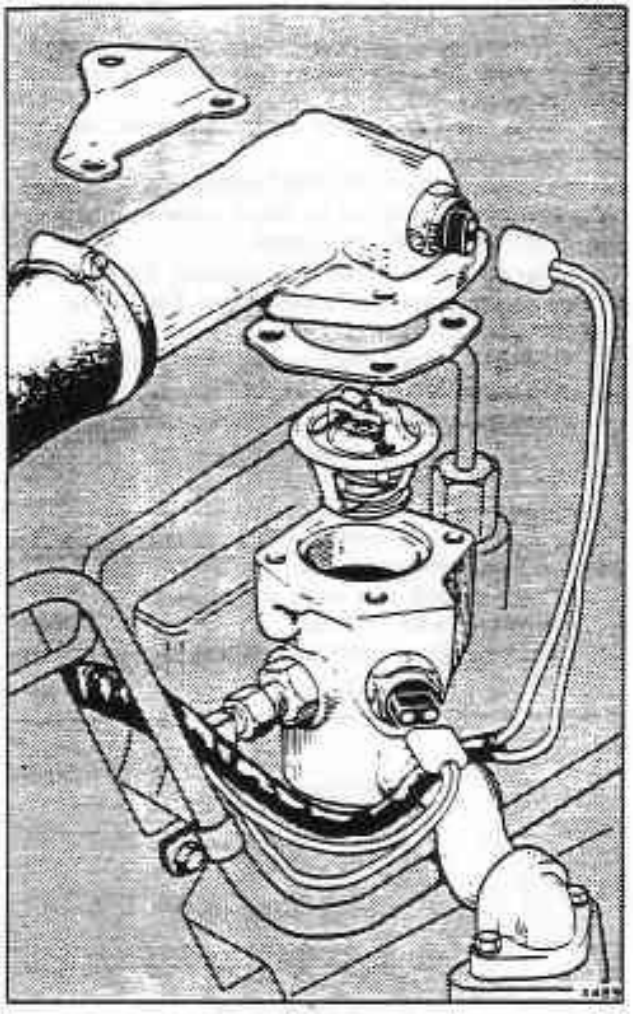


Fig. L3-1 Thermostat housing assembly

Thermostat

The engine cooling system incorporates a wax element thermostat (see fig. L3-2). This reduces the engine warm-up time by recirculating the coolant leaving the engine back to the coolant pump, thus by-passing the radiator. As the coolant approaches its normal working temperature the thermostat opens and allows the engine coolant to flow through the radiator. When the thermostat is in the fully open position it closes the by-pass circuit.

On top of the thermostat is the bridge piece and into this is secured the fixed piston rod.

The valve assembly containing the wax capsule seat, is on the underside of the top flange. It is biased in this position by a spring and retained by a 'U' piece.

A second outer 'U' piece (by-pass valve) loaded by a light poundage spring, is fitted to the bottom of the thermostat to operate the by-pass circuit.

The top flange incorporates a vent hole containing a jiggle pin. This vent allows air to escape when the cooling system is being filled. When the system is operating the jiggle pin rises to close the vent.

Also situated around the top flange are fusible plugs. These plugs melt at approximatley 124°C (255°F) and provide vent holes for the coolant, in the event of the thermostat not opening, to control the coolant temperature.

The thermostat operates when the coolant temperature approaches between 85°C and 89°C (185°F and 192°F). At this point the wax in the capsule changes its state and expands rapidly. The expansion compresses the rubber sleeve forcing it off the end of the tapered piston rod. As the sleeve is an integral part of the main valve assembly, this movement is transmitted to the valve moving it downwards off its seat. A small quantity of warm coolant is then allowed to pass between the valve and its seat to the radiator matrix, where it is cooled.

Further rises in engine coolant temperature cause a progressive opening of the main valve until a temperature of between 99°C and 102°C (210°F and 215°F) is attained. At these temperatures the main valve is fully open [maximum travel 14,27 mm (0.562 in)].

When the main valve assembly has opened 10 mm (0.375 in), the by-pass valve on the base of the thermostat assembly will have moved under spring pressure sufficiently to close the coolant by-pass circuit and all coolant is then directed to the radiator matrix.

A decrease in engine temperature will cause the wax in the capsule to contract and, due to spring pressure, close the main valve and also open the by-pass circuit.

The thermostat main valve assembly, being sensitive to the temperature of the surrounding

coolant, controls the flow of coolant to the radiator matrix to suit the requirements of the engine.

At the service intervals quoted in the Service Schedules Manual a new thermostat should be fitted.

Do not attempt to adjust the thermostat.

Thermostat - To remove

1. Carry out the usual workshop safety precautions.
2. Drain approximately half the radiator coolant into a clean container (see Section L5).
3. If the vehicle is fitted with an air injection system, remove either the relief valve assembly or the air diverter valve.
4. Disconnect the electrical connection from the thermostat outlet elbow.
5. On cars fitted with SU HIF7 carburetters, remove the setscrew securing the air intake elbow to the steady bracket. Collect the washer.

Unscrew the two setscrews securing the steady bracket to the thermostat outlet elbow. Collect the washers and bracket.

6. Unscrew the setscrews securing the outlet elbow to the thermostat housing. Collect the washers.
7. Free the joint and lift off the thermostat cover.
8. Lift the thermostat out of the housing.

Thermostat - To fit

Fit the thermostat by reversing the procedure given for removal, noting the following.

1. Ensure that the joint faces are clean.
2. Always use a new gasket.
3. Fill the cooling system as described in Section L5.

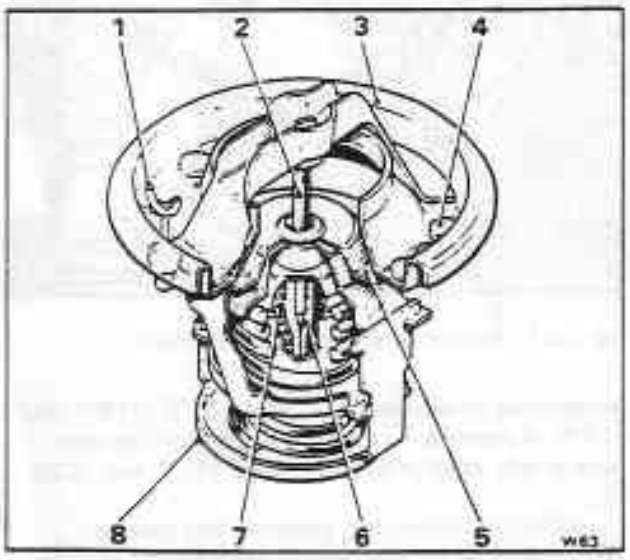


Fig. L3-2 Thermostat

1 Jiggle pin
2 Tapered piston rod
3 Top flange
4 Fusible plug
5 Main valve
6 Rubber sleeve
7 Wax filled element
8 By-pass valve

Thermostat - To test

1. Remove the thermostat from the engine.
2. Suspend the thermostat and a thermometer in a container filled with engine coolant.
3. Ensure that neither the thermostat nor the thermometer are touching the container.
4. Slowly heat the coolant, stirring continuously to ensure a uniform temperature.
5. Note when the thermostat opens and compare the temperature with the information contained in the following table.

Thermostat starts to open between 80°C and 89°C (176°F and 192°F)
Thermostat fully open [maximum travel 14,27 mm (0.562 in)] between 99°C and 102°C (210°F and 215°F).

Do not attempt to adjust the thermostat setting. If its operation is suspect, fit a new unit.

6. Allow the test equipment to cool and remove the thermostat.
7. Examine the condition of the fusible plugs situated around the top of the thermostat body (see fig. L3-2). Ensure that they are intact and in good condition.

Thermostat housing - To remove and fit

On cars other than those fitted with SU HIF7 carburetters, the thermostat housing is detachable from the induction manifold and can be removed as follows.

1. Carry out the usual workshop safety precautions.
2. Drain the engine coolant (see Section L5).
3. Disconnect the electrical connections from the various switches in the thermostat housing and outlet elbow. Label each connection to facilitate assembly.
4. If the vehicle is fitted with an air injection system, remove either the relief valve assembly or the air diverter valve (refer to the appropriate section of Chapter U).
5. Slacken the worm drive clip securing the rubber outlet hose, free the joint and withdraw the hose.
6. Unscrew the three setscrews retaining the thermostat by-pass pipe to the coolant pump.
7. Free the joint and remove the thermostat housing. Discard the gasket. Slight resistance may be encountered when withdrawing the housing due to the rubber sealing rings situated on the transfer pipes.
8. Fit the thermostat housing by reversing the procedure given for removal, noting that the rubber sealing rings are in good condition.
9. Fill the cooling system as described in Section L5.

Coolant pump

The coolant pump is situated at the front of the engine and is belt driven from the crankshaft pulley (see page L1-1).

The pump draws coolant from the bottom tank of the radiator assembly and pumps it via the coolant galleries in the crankcase to circulate directly onto the outside of the cylinder liners. From this point, the coolant circulates through galleries in the top of the crankcase, via the cylinder head and induction manifold to the thermostat housing.

Dependent upon the temperature in the thermostat housing, the coolant either by-passes the radiator (because the thermostat is closed) and is recirculated through the engine or it passes through the thermostat to be cooled in the radiator assembly.

The coolant pump is fitted to the engine as an individual component. When either overhaul or maintenance work becomes necessary it is not essential to remove the complete assembly, the pump body can remain fitted to the engine and all moving parts withdrawn as a sub-assembly (see figs. L4-1, L4-2, and L4-3).

If the coolant pump requires overhaul it is recommended that a service replacement unit is fitted.

However, if this is not possible for any reason the existing assembly can be overhauled.

Impeller and bearing assembly - To remove (see figs. L4-1, L4-2, and L4-3)

1. Drive the car onto a ramp and carry out the usual workshop safety precautions.
2. Raise the ramp to a convenient working height.
3. Drain the coolant (see Section L5).
4. Secure a piece of foam rubber inside the fan cowl to protect the radiator matrix.
5. (Type A) Remove the four nuts securing the fan assembly to the coolant pump spigot (see fig. L2-4,A). Collect the washers.

(Type B) Remove the setscrew and dog location washer securing the fan assembly to the coolant pump spindle (see fig. L2-4,B).

(Type C) Unscrew the Eaton type fan coupling from

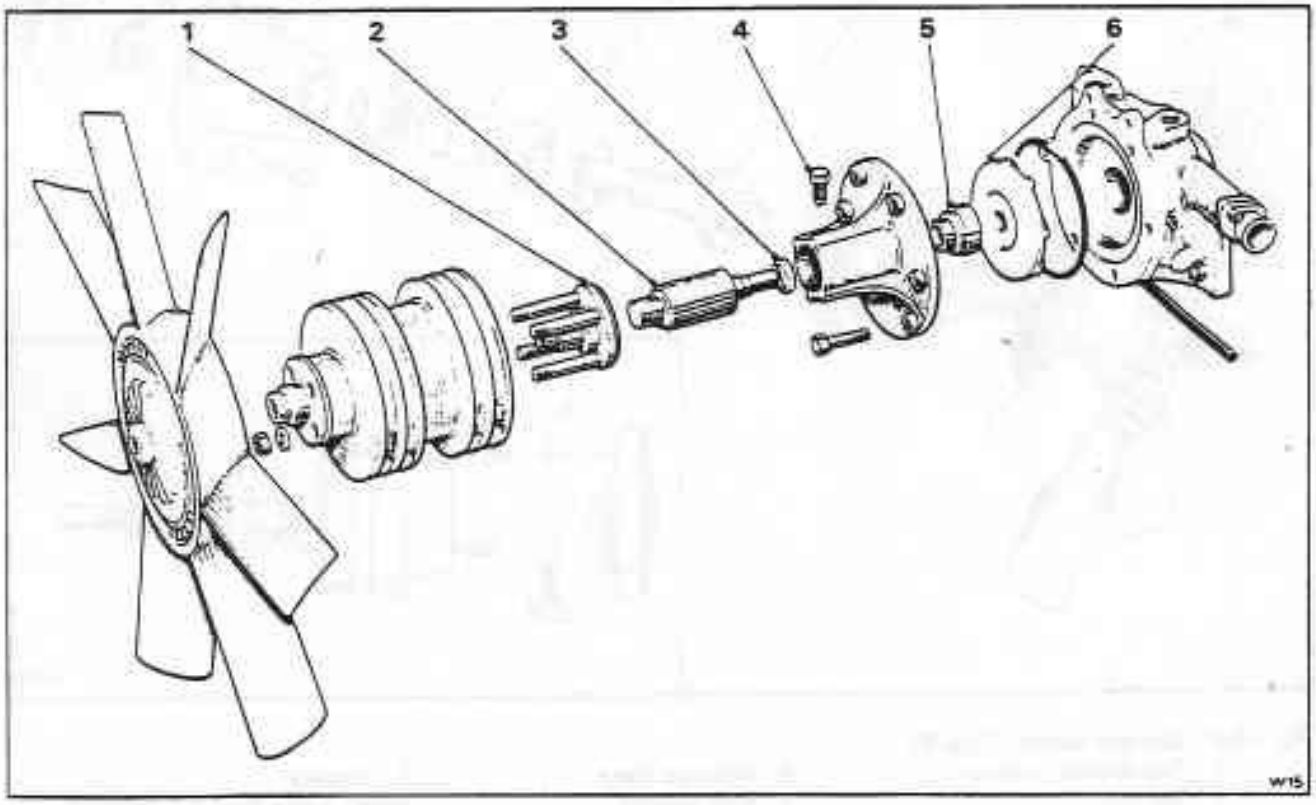


Fig. L4-1 Coolant pump (Type A)

1 Pulley mounting flange
2 Shaft and bearing assembly
3 Sealing gland counterface
4 Bearing locating screw
5 Sealing gland
6 Impeller

the spindle, noting that it is has a left-hand thread (see fig. L2-4, C).

Note

All Turbocharged cars have Type C fan coupling retention.

6. Withdraw the fan assembly from the spigot and lift it upwards past the refrigeration and steering pumps.

If it is necessary to prise the fan assembly flange forward off the coolant pump spigot, use extreme care.

On Corniche and Turbocharged cars from approximately mid 1984, a modified cooling fan and coupling were introduced. In addition, Corniche cars have a spacing washer fitted between the fan and coupling (see fig. L4-3, inset).

From 1986 model year, the modified metal fan and coupling were introduced onto all cars, with the exception of cars built to a United Kingdom specification, which retain the plastic fan assembly.

7. Release the tension of the drive belts. Remove the belts.
8. Carefully slide the coolant pulley forward to reveal the bearing housing setscrews.
9. Unscrew the setscrews that secure the bearing housing to the coolant pump casing.
10. Withdraw the bearing housing containing all the moving parts.

At this stage of the removal procedure it is possible to manoeuvre the pulley assembly off the spigot.

11. Remove and discard the rubber 'O' ring from the pump casing.
12. If the casing is to be removed, refer to Coolant pump casing - To remove.

Coolant pump casing - To remove

1. Refer to Impeller and bearing assembly - To remove and carry out Operations 1 to 8 inclusive.
2. Slacken the worm drive clips securing both ends of the radiator bottom hose. Free the joints and withdraw the hose.
3. If the car is fitted with an air diverter valve and/or air injection pump it should be removed as described in the appropriate section of Chapter U.
4. Locate the jockey pulley and unscrew the setscrew from the adjustment slot. Collect the washer.
5. Remove the nut and washer from the jockey

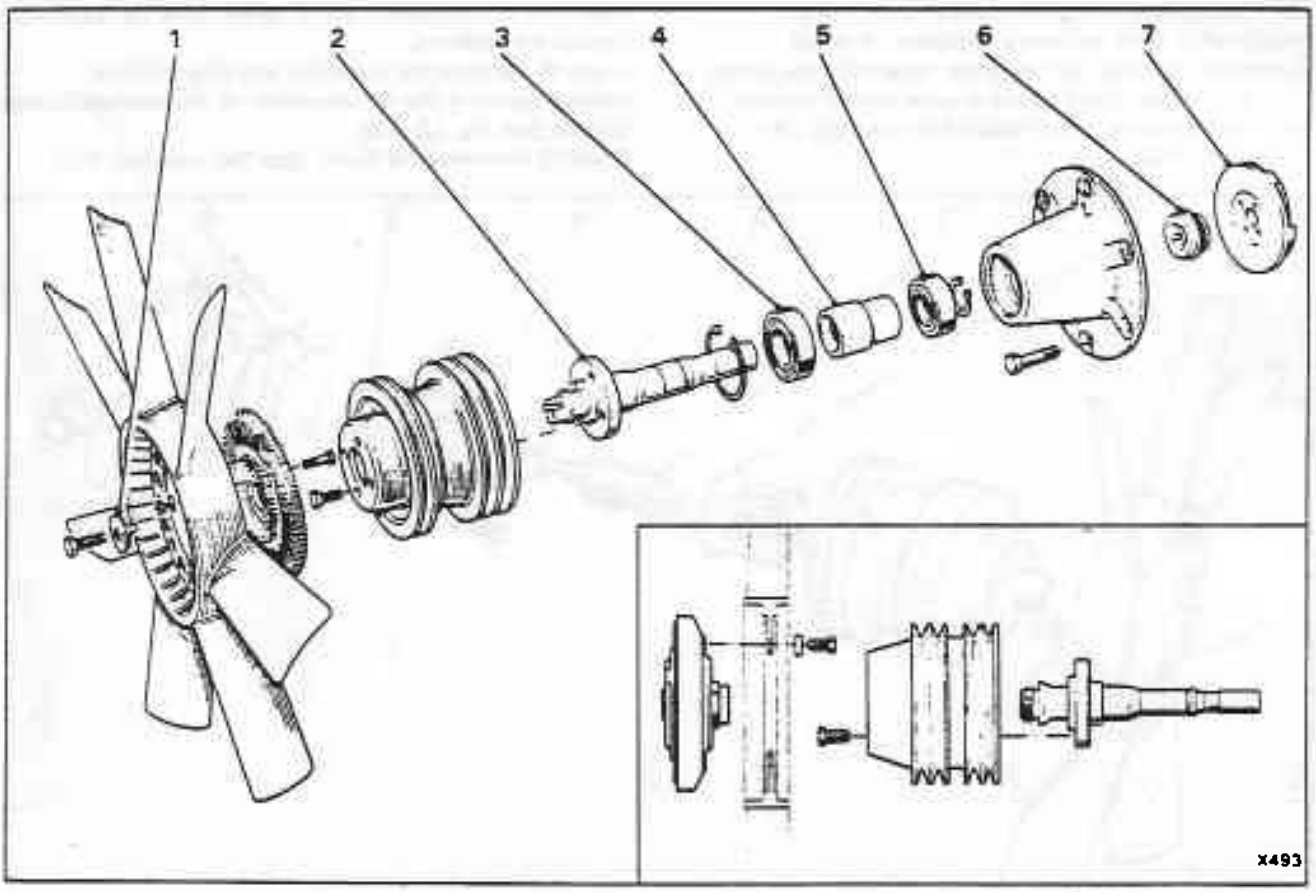


Fig. L4-2 Coolant pump (Type B)

1 Dog location washer
2 Spindle
3 Front bearing
4 Distance piece
5 Rear bearing
6 Pump seal
7 Impeller
Inset - Eaton type fan coupling (All Mulsanne Turbocharged cars prior to mid 1984)

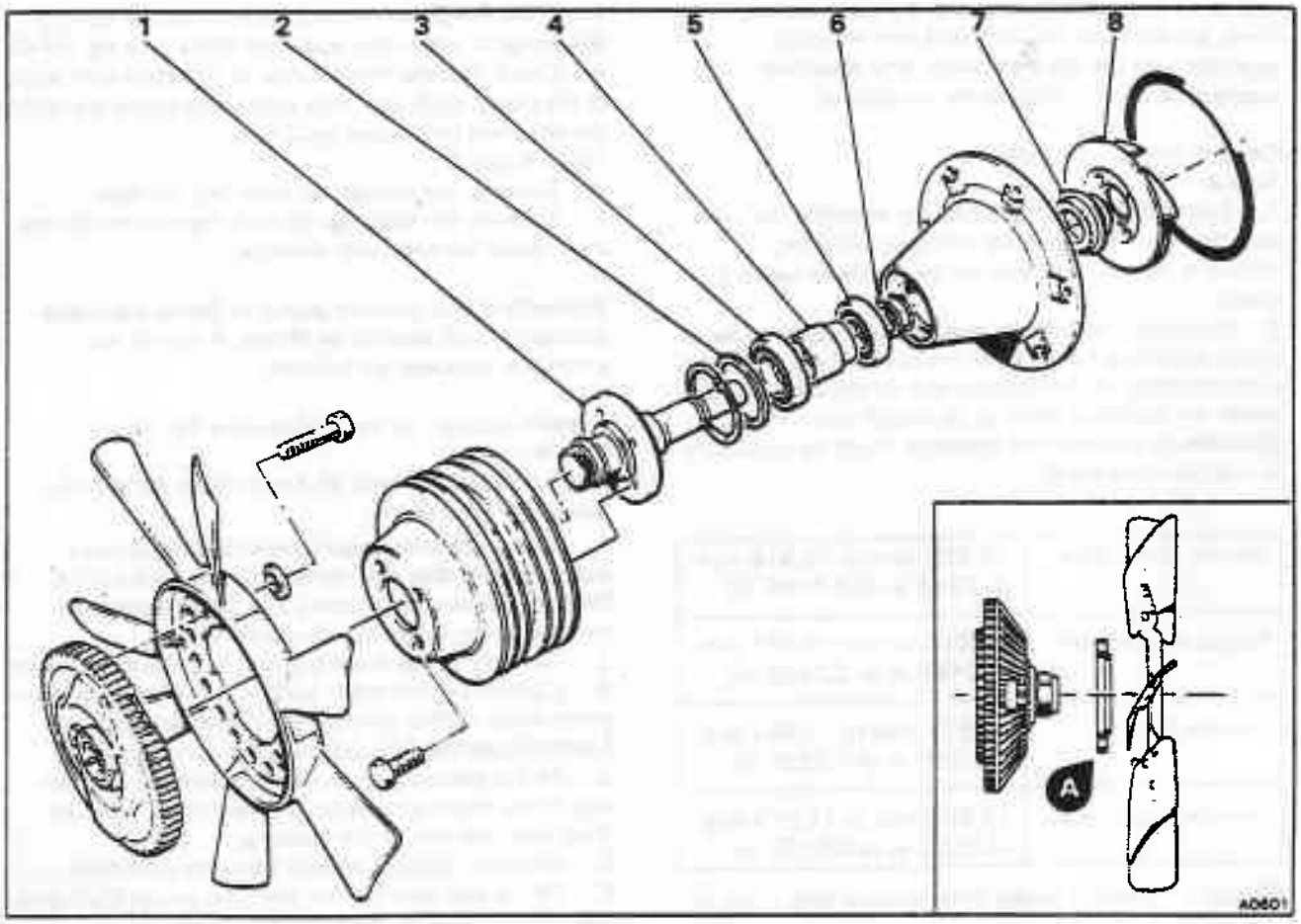


Fig. L4-3 Coolant pump (Type C)

1 Spindle
2 Abutment washer (outer)
3 Front bearing
4 Distance piece
5 Rear bearing
6 Abutment washer (inner)
7 Pump seal
8 Impeller

Inset - Modified fan and coupling assembly
A Spacing washer (Corniche cars only)

pulley pivot pin and withdraw the jockey pulley.

6. Remove the steering pump lower mounting (see Chapter N).

7. Remove the alternator and mounting bracket (see Chapter M).

8. Remove the refrigeration compressor and mounting bracket (see Chapter C). It is not necessary to disturb the refrigerant pipes as the purpose of this operation is to move the compressor from the vicinity of the coolant pump casing. Take care not to either damage or scratch other components if the compressor is lodged on the engine.

9. Unscrew the setscrew securing the heater return pipe into the rear face of the pump casing, withdraw the pipe.

10. Unscrew the setscrews retaining the thermostat by-pass elbow, either withdraw the elbow or lift it upwards when the pump casing is withdrawn.

11. Unscrew and remove the two lower setscrews that secure the pump casing to the crankcase, collect the washers.

12. Unscrew the two remaining setscrews situated at the top of the pump casing that are fitted from the crankcase side, collect the washers.

13. Withdraw the coolant pump casing and the neoprene sealing strip fitted to the lower edge.

14. Using a sharp knife, cut the paper gasket across the upper edge of the crankshaft front cover and discard this portion of the gasket.

Coolant pump - To dismantle

1. Remove the impeller and bearing assembly from the coolant pump casing (refer to Impeller and bearing assembly - To remove).

2. Withdraw the impeller from the pump shaft using the special extractor RH 7098.

3. (Type A) Remove the peg screw that retains the bearing assembly in the housing. Support the bearing housing and using a mallet, drive the bearing assembly forward out of the casting. Discard the seal and counterface.

(Types B and C) Remove the rear circlip from the spindle and tap out the spindle from the housing using a mallet and aluminium drift. Turn the housing over

and remove the circlip retaining the front bearing. Then, tap out both the front and rear bearings, together with the distance piece, and abutment washers (if fitted). Discard the pump seal.

Coolant pump - To inspect
Type A
1. Examine the shaft and bearing assembly for wear and damage. The assembly contains lubricant, therefore, **no attempt should be made to wash it clean.**
2. Normally it will not be necessary to remove the pulley mounting flange from the pump shaft. However, if the diameter of the impeller end of the shaft is either below the specified limits or damaged and a service replacement pump is not available, it will be necessary to withdraw the flange.

Driving flange bore	18,905 mm to 18,918 mm (0.7443 in to 0.7448 in)
Flange end of shaft	18,948 mm to 18,961 mm (0.7460 in to 0.7465 in)
Impeller bore	15,875 mm to 15,887 mm (0.6250 in to 0.6255 in)
Impeller end of shaft	15,905 mm to 15,918 mm (0.6262 in to 0.6267 in)

Fig. L4-4 Coolant pump dimensional data (Type A)

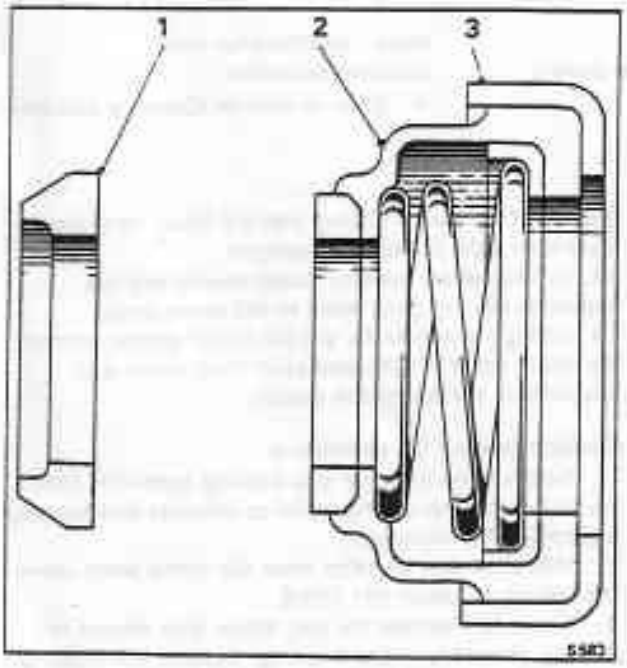


Fig. L4-5 Pump shaft seal and counterface (Type A)
1 Counterface
2 Sealing gland
3 Metal cover (outer surface to be coated with waterproofing solution)

3. If the flange is removed, check that the bore of the flange is within the specified limits (see fig. L4-4).
4. Check that the interference fit between both ends of the pump shaft and their respective bores are within the specified limits (see fig. L4-4).
Types B and C
1. Examine the spindle for wear and damage.
2. Examine the bearings for free movement and the inner bores for wear and damage.

Normally if the coolant pump is faulty a service exchange unit should be fitted. If this is not available, proceed as follows.

Coolant pump - To assemble (see fig. L4-1)
Type A
It is essential to keep all parts clean during the assembly procedure.
1. Before commencing to assemble the coolant pump, ensure that any damage marks on the joint faces of the bearing housing and pump casing are rectified using a fine carborundum stone.
2. Carefully fit the sealing gland into the metal cover.
3. Lightly coat the outer surface of the metal sealing gland cover with a waterproofing solution such as Loctite Superfast 572 pipe sealant (see fig. L4-5).
4. Fit the sealing gland assembly into the impeller end of the bearing housing. The assembly must be flush with the end of the housing.
5. Wipe any surplus sealant from the assembly.
6. Fit the seal counterface onto the pump shaft until the chamfered face abuts the shoulder.
7. Insert the impeller end of the shaft into the front end of the bearing housing. Align the locating screw holes then, using a mallet tap the bearing assembly into the bore of the housing until the locating screw can be fitted.
8. Fit the locating screw.
9. Ensure that the impeller end of the shaft and the bore of the impeller are clean and free from burrs.
10. Lightly smear Retinax A grease or its equivalent onto the mating surfaces of both the impeller and shaft.
11. Press the impeller into position on the shaft, noting that a load of at least 363 kgf (800 lbf) should be required. This ensures that the correct interference fit exists between the mating faces.
12. Using feeler gauges, ensure that the gap between the face of the bearing housing and impeller is between 1,143 mm and 1,219 mm (0.045 in and 0.048 in).
13. Spin the assembly to ensure that the shaft rotates freely.
14. If the pulley mounting flange has been removed, smear both the flange and shaft mating surfaces with Retinax A grease or its equivalent. Press the flange onto the shaft to the dimension given in figure L4-6.
A load of at least 612 kgf (1350 lbf) should be required to press the flange onto the shaft to ensure the correct interference fit.
15. Check the pulley mounting flange run out (see fig. L4-7); this must not exceed 0,05 mm (0.002 in).

16. Check that the pulley mounting flange is square on the pump shaft: this must not exceed 0.025 mm (0.001 in) out of square (see fig. L4-7).
17. Lightly coat the flange studs with either Loctite Studlock or Loctite 270 and screw them into the flange to a length of 52,07 mm (2.050 in). Allow the Loctite to harden before attempting to fit the coolant pump assembly to the engine.

Types B and C

It is essential to keep all parts clean during the assembly procedure.

1. Before commencing to assemble the coolant pump, ensure that any damage marks on the joint faces of the bearing housing and pump casing are rectified using a fine carborundum stone.
2. Insert the rear bearing into the housing and tap down using a mallet and suitable aluminium drift until the bearing is approximately flush with the front inner face of the housing.
3. Fit the front bearing onto the spindle together with the distance piece and insert the assembly into the bearing housing. Tap the spindle gently with a mallet until the bearing starts squarely into its bore. Then, remove the spindle and using a mallet and aluminium drift, drive the bearing into the housing until against the shoulder. This operation will also drive the rear bearing the correct distance into the housing.
4. (Type C) Fit the outer abutment washer into the housing.
5. Fit the front bearing retaining circlip, ensuring that the chamfered side is fitted away from the bearing.
6. Fit the spindle into the housing and invert the housing onto the spindle front face.
7. (Type C) Fit the inner abutment washer onto the spindle.
8. Fit the rear circlip securing the spindle into the housing.
9. Wipe clean the end of the spindle and the counterbore in the housing with a clean cloth. Lubricate the end of the spindle with clean engine oil. Then, tap the pressure balance seal onto the spindle and into the counterbore.
10. Again lubricate the end of the spindle with clean engine oil and press on the impeller, noting that a minimum load of at least 363 kgf (800 lbf) should be required. This ensures that the correct interference fit exists between the mating faces.
11. Using feeler gauges, ensure that the gap between the face of the bearing housing and the impeller is between 1,143 mm and 1,219 mm (0.045 in and 0.048 in).
12. Spin the assembly to ensure that the shaft rotates freely.

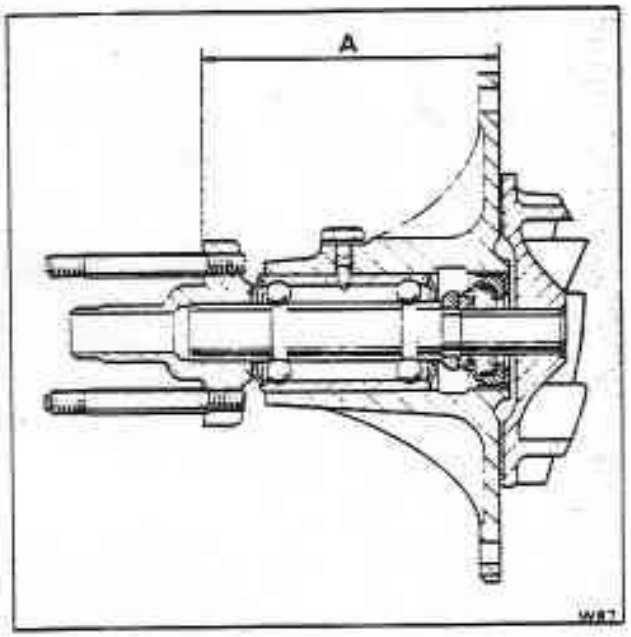


Fig. L4-6 Pulley flange pressed onto shaft (Type A)
A 94,97 mm to 95,22 mm (3.739 in to 3.749 in)

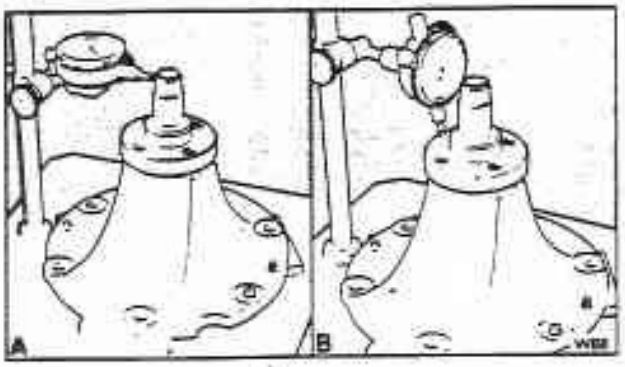


Fig. L4-7 Checking the pulley flange
A Checking run-out
B Checking out-of-square

Coolant pump - To fit

Fit the coolant pump to the engine by reversing the removal procedure, noting the following.

1. If the casing has been removed from the crankcase, ensure that the joint faces are free from burrs. Any burrs should be removed using a fine carborundum stone.
2. Obtain a new gasket and modify it to suit the crankcase to coolant pump joint faces.
3. Tighten all bolts to the standard torque figures given in Chapter P.
4. Tighten the drive belts as detailed in Chapter E.
5. Fill the system with coolant as described in Section L5.
6. Upon completion of the assembly procedure start the engine and immediately check for coolant system leaks. If satisfactory, run the engine until normal operating temperature is attained and again, check the coolant system for leaks.

Coolant

The cooling system should contain a 50% mixture of an approved anti-freeze and water. This mixture not only provides frost protection down to a temperature of -37°C (-35°F) but it also prevents corrosion of the coolant passages.

Refer to the Service Schedules Manual to obtain the specified service intervals for draining and replenishing the cooling system or for the fitting of a new thermostat and reverse flushing the system.

Except in an emergency water must not be used to either fill or top-up the cooling system. If a situation does arise where water is used, **the coolant must be corrected as soon as possible, otherwise corrosion damage will occur to the engine coolant passages.**

Anti-freeze

The trade names of the anti-freezes that may be used are UT 184 (BP - Hythe Chemicals) or Prestone II. The

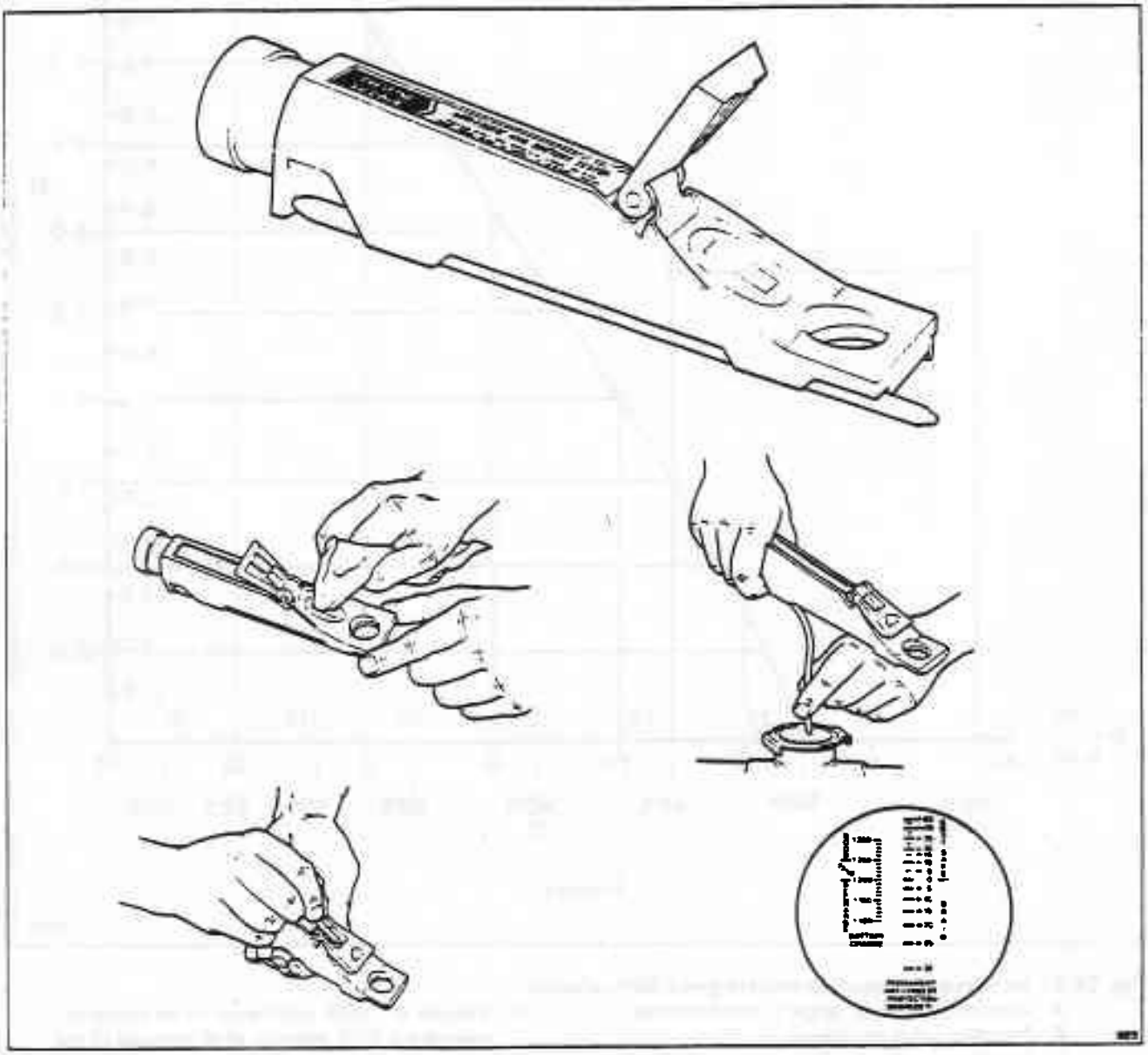


Fig. L5-1 Checking the anti-freeze concentration

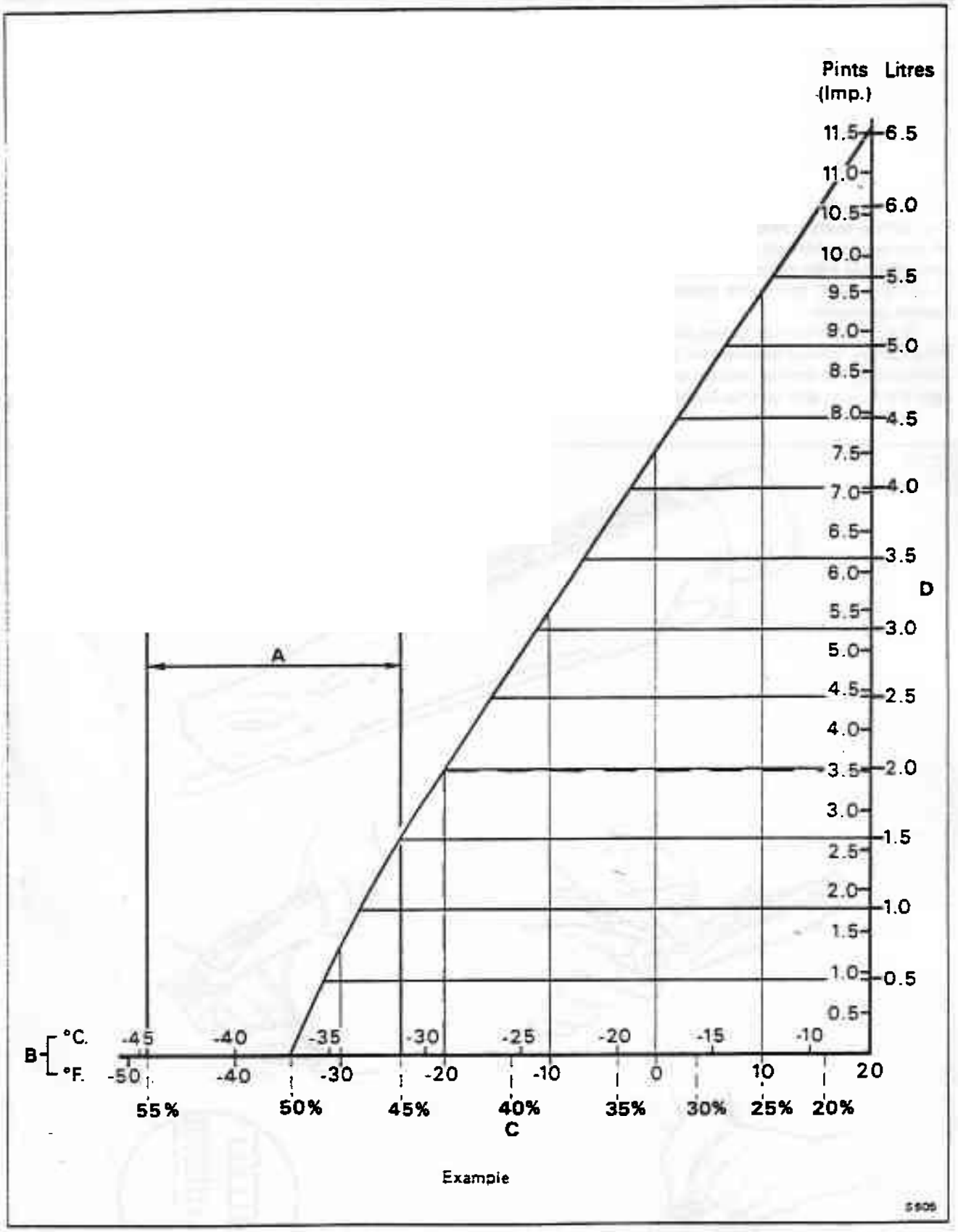


Fig. L5-2 Anti-freeze correction chart to give a 50% solution

A Acceptable service range of concentration
B Freezing point of coolant
C Percentage concentration
D Volume of 100% anti-freeze to be added to maintain a 50% solution after removal of the same volume of old coolant first

former is used predominantly in Europe and the latter in North America. Both are summer coolant/anti-freeze solutions and are miscible, however, they must not be mixed with any other brand of anti-freeze.

Anti-freeze concentration - To check

If the strength of the coolant requires increasing, sufficient coolant should be drained from the radiator and replaced with undiluted anti-freeze. Afterwards run the engine until normal operating temperature is attained and the anti-freeze has become thoroughly mixed with the coolant. Stop the engine and again check the concentration in the radiator.

An acceptable level of anti-freeze concentration is between 45% and 50%. Therefore, as a hydrometer may be inaccurate where readings above 40% are expected, it is suggested that a refractometer (see fig. L5-1) is used in the following manner.

1. Lift the plastic cover on the refractometer (tester) to expose both the measuring window and bottom of the plastic cover.
2. Thoroughly clean both exposed surfaces (A) with clean water and then wipe them dry with a clean soft cloth.
3. Carry out the usual workshop safety precautions.
4. Raise the bonnet and remove the radiator cap.
5. Release the tip of the clear plastic tube from the tester (B) and insert it into the coolant in the radiator.
6. Press and then release the bulb on the end of the plastic tube. This will draw a small quantity of coolant into the tube.
7. Withdraw the test equipment and bend the end of the plastic tube around the tester so that the tip of the tube can be inserted into the cover plate opening.
8. Press the bulb on the end of the plastic tube and eject a few drops of coolant onto the measuring surface (C).
9. Point the tester towards the light and look into the eye piece.

Do not open the plastic cover when taking a reading. Evaporation of water from the fluid sample being tested can affect the reading.

10. The anti-freeze protection reading is at the point where the dividing line between light and dark (edge of shadow) crosses the scale. The anti-freeze reading is on the right-hand scale (D).

Note

The tester temperature scale is **reversed** from a standard thermometer. Below zero readings are on the upper half of the scale.

11. If the temperature reading is higher than -31°C (-24°F) (further down on the scale) it will be necessary to refer to figure L5-2 and add the appropriate amount of anti-freeze to the system.

Example

A tester reading of -29°C (-20°F) is equal to an anti-freeze concentration of 43% and is outside the service limits. Follow the line upwards until the angled line is reached, then trace the horizontal line to the scale on the right-hand side of the graph to find that 2 litres (3.5 Imp pt, 4.2 US pt) of coolant should be removed from a full system and replaced with undiluted anti-freeze.

Once the additional concentrated anti-freeze has mixed with the existing coolant the percentage concentration will be 50%.

12. After adding undiluted anti-freeze, allow the engine to operate normally for a few days before carrying out further checks to determine the percentage of anti-freeze concentration. This will allow time for the anti-freeze to be thoroughly mixed with the existing coolant.

Cars fitted with a coolant expansion bottle

The anti-freeze concentration should be checked in both the expansion bottle and the radiator as approximately 0.28 litres (0.5 Imp pt, 0.6 US pt) is transferred to and from the expansion bottle each time the engine is warmed-up and then left to cool.

Failure to allow the new anti-freeze to circulate properly will result in a false reading.

Note

If a refractometer is not available and a hydrometer has to be used a scale reading of between 1.06 and 1.07 should be obtained, with the coolant at room temperature, for the mixture to be correct.

Coolant level - To check and top-up

Warning

Both types of cooling system become pressurized during engine running, therefore, extreme care should be taken when removing the radiator cap from a warm or hot radiator.

Cars fitted with a coolant expansion bottle

Routine check

To check the coolant level outside a normal service schedule and when no cooling/heating system fault is reported or suspected, proceed as follows.

1a. If the **engine is hot** ensure that the coolant level in the translucent expansion bottle is at the MAX mark. Top-up if necessary and replace the expansion bottle cap.

b. If the **engine is cold** ensure that the coolant level in the translucent expansion bottle is half-way between the MIN and MAX marks. Top-up if necessary and replace the expansion bottle cap.

2. If the coolant level in the expansion bottle is either below the MIN mark or there is no coolant in the expansion bottle, carry out the Full check procedure.

Full check

To check the coolant level during a service schedule and /or when a cooling/heating system fault is reported or suspected, proceed as follows.

1. Carry out the usual workshop safety precautions.
2. Check the coolant level in the translucent expansion bottle and if the level is low or the bottle is empty, add coolant to bring the level up to the MIN mark.
3. Ensure that the engine is not hot (to allow safe removal of the radiator cap).
4. Remove the radiator cap in three stages as follows.

Turn the cap slowly anti-clockwise until a check position is reached. Wait until any pressure in the system has been released. Press down on the cap and continue to turn it anti-clockwise until the cap is released.

5. Check the coolant level in the radiator. This should be half-way up the filler neck.

If the coolant level in the radiator is correct proceed to Operation 14.

If the coolant level in the radiator is low but visible and no cooling/heating system fault is reported or suspected proceed to Operation 7.

If the coolant level in the radiator is not visible or a cooling/heating system fault is reported or suspected, proceed as follows.

6. Check all system components. Rectify any faults, then pressure test the system.
7. Top-up the radiator until the coolant level is half-way up the filler neck.
8. Start and run the engine.
9. Turn the air conditioning system function control fully clockwise to the defrost position.
10. Ensure the air conditioning upper system mode override switch is in the AUTO position.
11. Allow at least one minute for the air conditioning system to stabilize and then check to ensure that all air is being directed towards the windscreen (i.e. no air is delivered from the lower system and the facia outlets). This procedure opens the heater system water tap.
12. Run the engine, without the radiator pressure cap fitted until normal operating temperature is attained. Top-up the coolant level in the radiator during this time.
13. Switch off the engine.
14. Fit the radiator pressure cap by pressing it firmly down and turning fully clockwise.
15. Top-up the coolant level in the expansion bottle in accordance with the Routine check procedure.

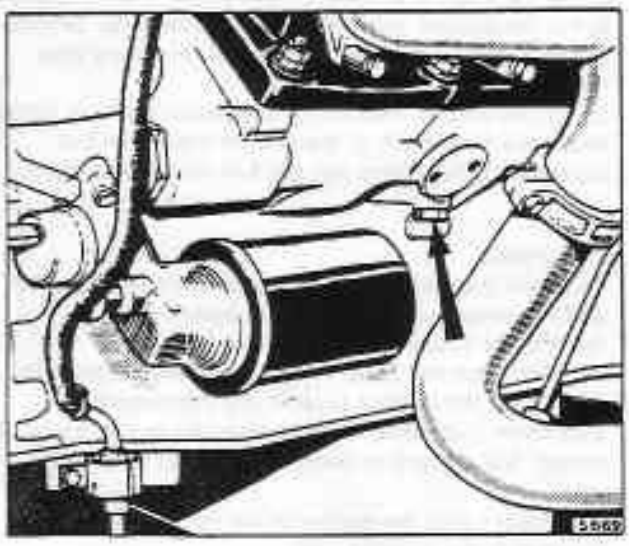


Fig. L5-3 Crankcase coolant drain plug

Cars not fitted with a coolant expansion bottle

1. Carry out the usual workshop safety precautions.
2. Start the engine and turn the air conditioning function control fully clockwise to the defrost position and the upper system mode override switch to the AUTO position.

Allow approximately one minute for the system to attain the required setting, then check that all air is being directed towards the windscreen (i.e. no air is delivered from the lower system and the facia outlets).

This procedure opens the heater water tap and ensures that the cooling system can be checked correctly.

3. Switch off the ignition.
4. Remove the radiator cap. If the engine is hot, muffle the cap with a thick cloth and gradually turn the cap anti-clockwise until the pressure is reduced, then remove the cap.
5. If the coolant level is low, top-up the radiator header tank with the correct anti-freeze/water mixture. The correct level is when the coolant reaches the rubber seal in the filler neck. Fit the radiator cap.

Cooling system - To drain

1. Carry out the usual workshop safety precautions.
2. Place a clean container beneath the radiator drain tap.
3. Open the radiator drain tap.
4. Raise the bonnet and remove the radiator pressure cap.
5. Detach the white/brown cable from the oil pressure switch situated adjacent to the engine oil filter (this switch inhibits the air conditioning system until the engine is running).
6. Switch on the ignition and turn the air conditioning system function switch to the defrost position.
7. Ensure the air conditioning upper system mode override switch is in the AUTO position.
8. Allow at least one minute for the air conditioning system to stabilize and then check to ensure that all air is being directed towards the windscreen (i.e. no air is delivered from the lower system and the facia outlets). This procedure opens the heater system water tap.
9. Switch off the ignition, connect the white/brown cable (see Operation 5) and allow the coolant system to drain.
10. To complete the exercise, unscrew the drain plug situated on both sides of the crankcase (see fig. L5-3).

Cooling system - To fill

1. Carry out the usual workshop safety precautions.
2. Ensure that the crankcase drain plugs are correctly fitted and tightened.
3. Ensure that the radiator drain tap is closed.
4. Disconnect the white/brown cable from the oil pressure switch situated adjacent to the engine oil filter (this switch inhibits the operation of the air conditioning system until the engine is running).
5. Switch on the ignition and turn the air

conditioning system function switch to the defrost position.
6. Ensure the air conditioning upper system mode override switch is in the AUTO position.
7. Allow at least one minute for the air conditioning system to stabilize and then check to ensure that all air is being directed towards the windscreen (i.e. no air is delivered from the lower system and the facia outlets). This procedure opens the heater system water tap.
8. Switch off the ignition and connect the white/brown cable (see Operation 4).
9. Raise the bonnet and remove the radiator cap.
10. Fill the system using the correct anti-freeze/water mixture. Pour the mixture into the system slowly to avoid air locks.
11. Start and run the engine for at least 10 minutes with the pressure cap still removed. Top-up the radiator as necessary to ensure that there is always coolant in the radiator top tank. Ensure that the thermostat has opened: indicated by a rapid warming of the top radiator hose.

Cars not fitted with a coolant expansion bottle
The correct level is when the coolant reaches the rubber seal in the filler neck. Fit the radiator cap.

12. Cars fitted with a coolant expansion bottle
Switch off the ignition and top-up the radiator to half-way up the filler neck. Fit the radiator cap.
13. Using an approved anti-freeze mixture fill the expansion bottle up to the maximum level mark.
14. **Allow the engine to cool down completely.**
Remove the radiator filler cap and check that the coolant level is half-way up the filler neck, add coolant if necessary. Fit the radiator cap.
15. Check the level in the expansion bottle and correct if necessary.

Note
For the coolant system to operate correctly, i.e. for coolant to pass into the expansion bottle when hot and be drawn back into the radiator during cooling, the top of the radiator must not contain an air pocket.

Cooling system - To flush
Under no circumstances should a strong alkaline compound or detergent be used to clean the cooling system. Such compounds have a detrimental chemical action on aluminium alloys.
1. Drain the coolant (see Cooling system - To drain).

Radiator
2. Remove the radiator top and bottom hoses.
3. Connect a waste pipe to the top connection on the radiator.
4. Apply mains water through the bottom connection to reverse flush the radiator until the water runs clear.
5. Examine the top and bottom radiator hoses and renew any that show signs of deterioration.
6. Turn off the water supply, disconnect the connections to the radiator and fit the top and bottom hoses.

Engine
7. Remove the top and bottom hoses connecting the radiator to the engine.
8. Unscrew and remove the drain plug from each bank of engine cylinders (see fig. L5-3).
9. Remove the thermostat (see Section L3) and again fit the outlet cover.
10. Produce a suitable adapter to fit into the cylinder block drain plug aperture and connect via a hose to the mains water supply.
11. Turn on the water and reverse flush the coolant passages until the water runs clear.
12. Repeat the operation to the drain plug aperture on the other side of the crankcase.
13. Remove the flushing equipment.
14. Fit the drain plugs, thermostat, and cover. Use a new thermostat cover gasket.
15. Examine all coolant hoses and renew any that show signs of deterioration.

Heater matrix
16. To flush the heater system, detach the matrix feed hose at the water tap and the return hose at the coolant pump connection.
17. Connect a waste pipe to the feed hose connection and a water main connection to the return connection.
18. Turn on the water and reverse flush the matrix until the water runs clear.
19. Turn off the water and remove the flushing equipment.
20. Examine all heater system hoses and renew any that show signs of deterioration.

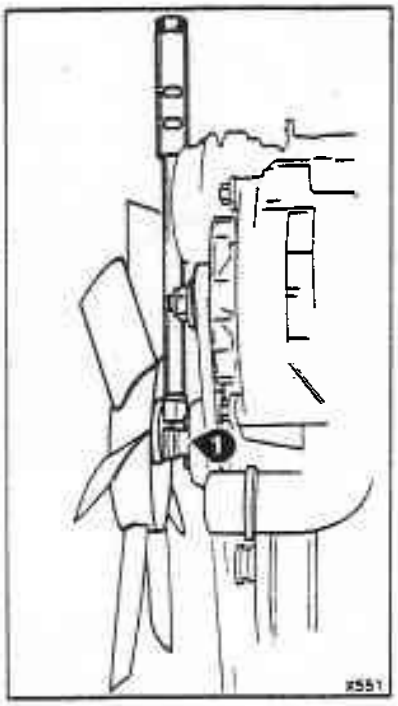
Special torque tightening figures

Introduction

This section contains the special torque tightening figures applicable to Chapter L.

For standard torque tightening figures refer to Chapter P.

Components used during manufacture of the vehicle have different thread formations (Metric, UNF, UNC, etc.). Therefore, when fitting nuts, bolts, and setscrews it is important to ensure that the correct type and size of thread formation is used.

Section L2	Ref.	Component	Nm	kgf m	lbf ft
	1	Eaton type fan coupling (L.H. thread)	48 – 54	5 – 5.5	35 – 40

Workshop tools

RH 7098	Extractor - coolant pump impeller
RH 9747	Torque spanner - Eaton type fan coupling