

Chapter L

ENGINE COOLING SYSTEM

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Section L1

GENERAL INFORMATION

Introduction

The cooling system must be filled with a 50% mixture of anti-freeze and water. This should be renewed annually.

A thermostat valve is fitted in the coolant outlet pipe between the engine and radiator header tank. This valve prevents circulation of the coolant through the radiator until the engine has reached normal operating temperature.

Coolant temperature is detected by a transmitter mounted on the thermostat housing and on earlier cars, recorded on a gauge situated on the facia. Later Silver Shadow cars had the gauge deleted and an illuminating warning panel fitted. The Corniche continued to be fitted with the single instrument mounted on the facia.

A coolant level probe situated in the header tank will illuminate the warning panel, (or an amber lamp on earlier cars) if the coolant drops below the required level.

Three drainage points are provided in the system. A tap at the bottom of the radiator (see Fig. L1) and a drain plug on each side of the cylinder block (see Fig. L2).

On cars produced prior to car serial numbers, SRX 3200 (Standard) and CRH 3315 (Coachbuilt), drain taps are fitted to all three positions.

Important

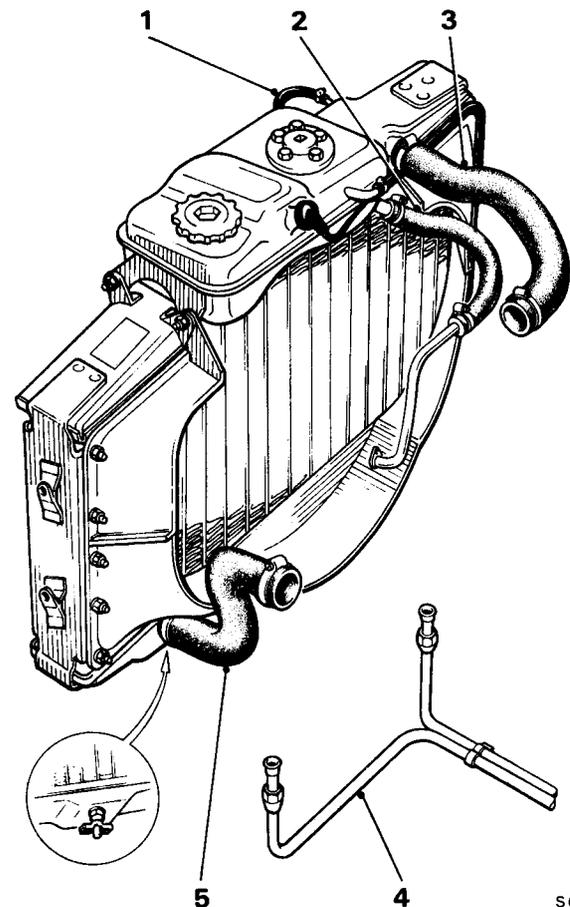
The cooling system is pressurised. **Do not** remove the radiator filler cap while the engine is running or when the engine is hot, otherwise internal pressure will blow out the hot coolant. If it is necessary to check the level of the coolant when the engine is hot, muffle the filler cap with a thick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

Corrosion and freeze protection

For protection against frost and corrosion, the cooling system must be filled with a solution of 50% prescribed anti-freeze and 50% water.

The mixture should be renewed annually.

The trade names of the anti-freezes that may be



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FIG. L1 RADIATOR AND CONNECTING PIPEWORK

- 1 Header tank to radiator
- 2 Pump to header tank
- 3 Radiator to thermostat
- 4 Gearbox oil cooler pipe
- 5 Radiator to pump

used are UT 184 (BP-Hythe Chemicals) or Prestone II. The former is used predominantly in Europe and the latter in North America. Both are summer coolant/anti-freeze solutions and are miscible, but **must not** be mixed with any other brand of anti-freeze.

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As a visual aid to identifying the two types of anti-freeze 'Prestone Anti-freeze and Summer Coolant' UT 184 is coloured turquoise blue and 'Prestone II Winter/Summer Concentrate' is coloured fluorescent green.

Cooling system - To drain

1. Drive the car onto a ramp.
2. Firmly apply the handbrake/parking brake and remove the gear range selector thermal cut-out from the fuseboard.
3. Switch on the ignition but do not start the engine.
4. Move either the UPPER or LOWER air conditioning switch into the fully clockwise position. This will open the heater water tap and assist the draining operation.
5. Switch off the ignition and carefully remove the radiator filler cap.
6. Raise the car to a convenient working height.
7. Place containers under the car to collect the coolant. Attach a length of rubber hose from the radiator drain tap to direct the coolant into the containers.
8. Open the radiator drain tap and drain the coolant from the radiator. When completed, remove the drain plugs to drain the residue from the crank-case.

Radiator - To flush

1. Drain the cooling system as described previously under the heading, Cooling system - To drain.

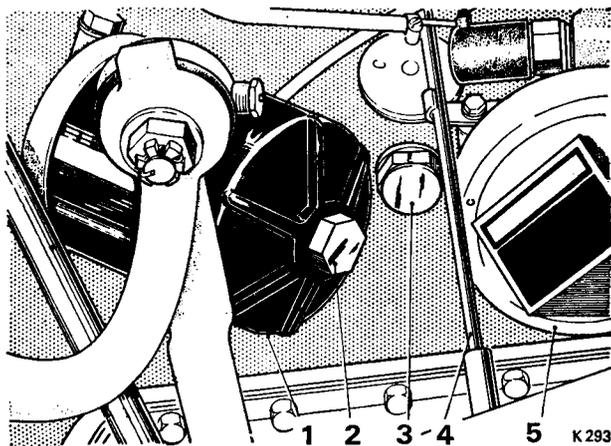


FIG. L2 CYLINDER BLOCK DRAIN

- 1 Oil filter
- 2 Filter bowl securing setscrew
- 3 Cylinder block drain
- 4 Engine dip-stick tube
- 5 Front hydraulic accumulator

2. Remove the inlet and outlet coolant hoses.
3. Fit a waste pipe to the upper (inlet) connection of the radiator.
4. Apply mains water under pressure through the lower (outlet) connection of the radiator. This should remove all loose sediment in approximately 30 minutes.

Do not under any circumstances use a strong alkaline compound or detergent to clean the cooling system. Such compounds have a detrimental chemical action on aluminium alloys.

5. Examine all rubber coolant hoses and renew any which show signs of deterioration.

Engine - To flush

1. Remove the outlet hose.
2. Remove the drain plug or drain tap from each cylinder head.
3. Remove the thermostat cover, withdraw the thermostat and replace the cover.
4. Fit a suitable pipe to the drain plug aperture and apply mains water pressure to each aperture in turn.

Flush for approximately 30 minutes, or until the water runs clear.

5. Fit the drain plugs, thermostat and thermostat cover using a new gasket.

If the engine is being flushed as part of the two year scheduled maintenance, the thermostat should be discarded and a new one fitted.

6. Examine all rubber coolant hoses and renew any which show signs of deterioration.

Heater matrix - To flush

1. Detach the matrix hose at the electrically operated water tap and disconnect the return hose at the coolant pump.
2. Fit a waste pipe to the inlet connection of the heater matrix.
3. Flush the matrix for approximately 30 minutes.
4. Examine the cylinder head to heater tap hose and matrix inlet for deterioration. Renew if necessary.

Removal and fitting of heater and matrix

Refer to Chapter C - Air conditioning system.

Cooling system - To fill

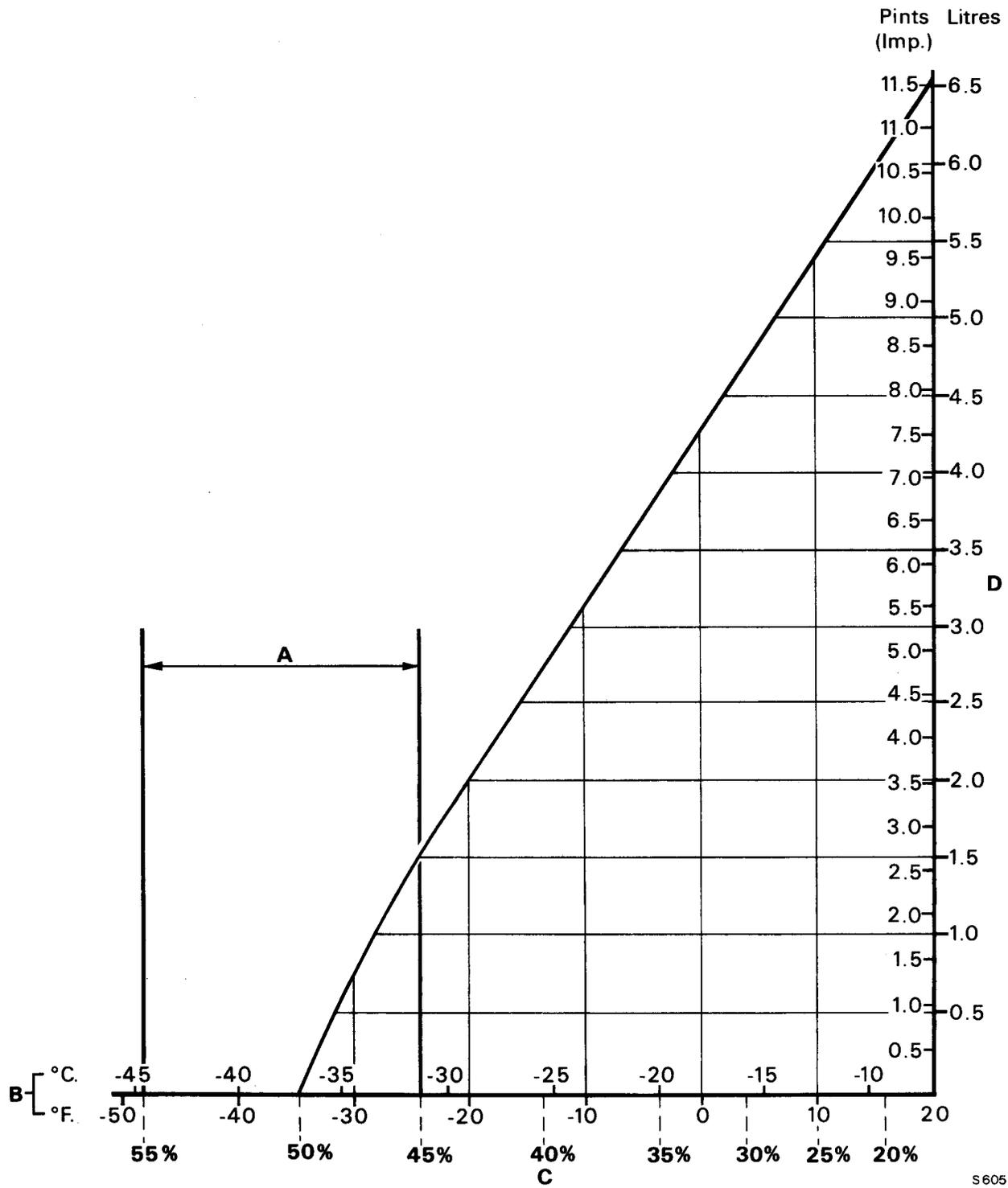
To facilitate filling the cooling system the UPPER or LOWER air conditioning switches on the facia should be in the fully clockwise position.

1. Ensure all hose connections and drain plugs are fitted and secure. Check that the radiator drain tap is closed.

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FIG. L3 ANTI - FREEZE CONCENTRATION 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

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2. Using the correct anti-freeze/water mixture, fill the system by pouring slowly to avoid the possibility of air locks.
3. Start the engine and allow time for the system to reach normal operating temperature ensuring uniform distribution of the coolant.
4. Stop the engine and check the coolant level. Top-up if necessary. The correct level is when the coolant reaches the rubber seal in the filler neck.
5. Fit the radiator filler cap.
6. Check the tightness of all hose clips.
7. Examine all disturbed hoses and joints for leaks.

Coolant - To check

In the majority of cases hydrometers, used for checking anti-freeze concentrations, are inaccurate above a 40% figure.

As the acceptable range of concentration is between 45% and 55%, a refractometer, similar to the 'AO Duo-check' instrument, is more suitable for measuring a 50% solution.

The graph (*see Fig. L3*) shows the degrees of frost protection converted to a percentage concentration. Should the system be less than the acceptable limit, the graph indicates the necessary amount of coolant to be drained from a full system before replacing with 100% anti-freeze.

1. After pouring into the system the correct amount of 100% anti-freeze, replace the filler cap, then run the engine on fast idle for approximately five minutes to enable a complete mix with the existing solution. Failure to circulate the new anti-freeze will result in an incorrect reading.
2. Remove the filler cap and check that the solution now measures within the range shown on the graph (*see Fig. L3*). Rectify if necessary.

Section L2

RADIATOR

Radiator - To remove

1. Drive the car onto a ramp.
 2. Firmly apply the handbrake/parking brake and remove the gear range thermal cut-out from the fuseboard.
 3. Drain the coolant as described in Cooling system - To drain, Section L1.
 4. Slacken the worm drive clips and remove the two top hoses and one bottom hose at the radiator.
 5. Disconnect the cables from the coolant probe in the header tank.
 6. Disconnect the two heat exchange pipes, if fitted, from the underside of the radiator. Fit blanking plugs to prevent the ingress of dirt.
 7. Disconnect the header tank steam escape pipe and bleed hose from the header tank to the radiator.
 8. Remove the four setscrews securing the fan, or the four nuts holding the fan and viscious coupling to the water pump pulley extension cone.
 9. Slacken the tension on the drive belts.
 10. Carefully withdraw the fan or, in the case of the fan and viscous coupling, place these inside the radiator cowl.
- Take care not to damage the radiator matrix.**
11. Support the radiator then remove the four setscrews securing the assembly to the bonnet hinge panels.
 12. Carefully withdraw the radiator and header tank.
 13. Remove the fan or fan and viscous coupling from the cowl.

Radiator - To fit

To fit the radiator, reverse the procedure given for removal noting the following points.

1. Examine all hoses for deterioration and renew any found to be unserviceable.
2. Fill the system with a clean coolant solution.
3. Check the level of concentration as shown in Section L1 - Coolant - To check. Correct the level of concentration as necessary.

Important - Cars with radiator cowlings

After replacement of the radiator a check must be made for possible fouling of the fan blades on the radiator cowling, using the following procedures.

4. Check that a minimum clearance of 16 mm. (0.630 in.) exists between the tip of the fan blades and around most of the cowling. A clearance of 9,5 mm. (0.370 in.) is acceptable at the lower section of the cowling.
5. To check that engine torque does not cause the fan to foul the cowling, apply the handbrake/parking brake, set the engine onto fast idle by pressing the accelerator and then start the engine.
6. Select (D) Drive and (R) Reverse. Listen for any catching of the blades on the radiator cowling. No attempt must be made to increase engine speed above that of fast idle.
7. Choose an open stretch of dry road. When the road is free from any potential danger, accelerate the car sharply from a stand still position and listen for fouling of the blades on the cowling.

Radiator header tank - To remove (radiator in the car)

The header tank is supported on three brackets attached to the top face of the radiator.

1. Remove the radiator filler cap, open the drain tap and drain sufficient coolant to empty the header tank; approximately 2 litres (3.5 pints) into a clean container.
2. Slacken the worm drive clips and remove the hose between the header tank and the radiator.
3. Remove the header tank steam escape pipe at the header tank connection.
4. Disconnect the cables from the coolant probe.
5. Remove the three nuts, bolts and washers from the supporting brackets and remove the header tank.

Radiator header tank - To fit

To fit the header tank, reverse the procedure given for removal noting the following points.

1. Examine hoses for deterioration and ensure

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all worm drive clips are secure. Renew any hoses that appear to be unserviceable.

2. Replace the clean fluid drained from the system.

3. Check the concentration level of the coolant and if below the acceptable level of between 45% and 55% bring the coolant up to the acceptable level (*see Section L1 Coolant - To check*).

Booster fan - To remove (late cars)

1. Disconnect the battery.

2. Remove the radiator grille. For details refer to Chapter S - Body.

3. Release the wiring loom attached along the upper mounting bar of the fan and unwind the adhesive tape to expose two Lucar connectors; disconnect the Lucars.

4. Remove the four setscrews attaching the mounting bars to the condenser end plates and withdraw the unit.

5. To remove the booster fan, unscrew the four bolts and self-locking nuts to dismantle the unit from the mounting bars.

Booster fan - To fit (late cars)

To fit the booster fan reverse the procedure given for removal noting the following points.

1. When assembling the booster fan to the mounting bars ensure new self-locking nuts are used.

2. After connecting the wiring loom, cut away the unwrapped portion of adhesive tape. Completely cover the Lucar connections with new tape.

3. Touch in any black paint chipped or scratched from the area of the fan during removal.

4. Switch on the ignition, then test the fan by shorting the two wires from the switch of the thermostat outlet elbow to the engine casing.

Section L3

THERMOSTAT

Thermostat - To remove (see Fig. L4)

1. Drive the car onto a ramp.
2. Firmly apply the handbrake/parking brake and remove the gear range selector thermal cut-out from the fuseboard.
3. Drain the coolant as described in Cooling system - To drain, Section L1.
4. On cars fitted with exhaust emission control equipment it will be necessary to disconnect the cable to the primary valve lock-out switch and, dependent on the car's domicile, to remove the air diverter valve. Refer to Chapter U - Emission systems, for removal and fitting of exhaust emission control components.
5. Remove the setscrew to the air intake elbow bracket then the two setscrews securing the bracket to the thermostat cover and release the bracket.
6. Unscrew the remaining two setscrews securing the thermostat cover to the housing and move the cover to one side; the hose being sufficiently flexible to allow the desired movement without having to be removed.
7. Remove the heat exchanger water connection, if fitted.
8. Lift the thermostat from the housing.

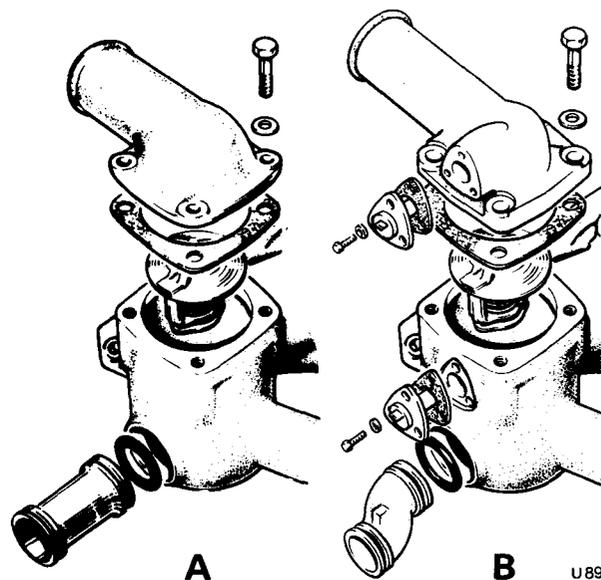
Thermostat - To test

If the thermostat is suspected of being faulty, it can be tested as follows.

1. Suspend the thermostat and the bulb of an accurate thermometer into a container of water so that they are completely immersed. They must not be allowed to touch the sides or bottom of the container as this would cause a false reading.
2. Gradually heat the water, stirring continuously to ensure that the water and thermostat are at a uniform temperature.
3. Note the temperature at the point when the thermostat valve begins to open.

If the water is heated too quickly, or if it is not adequately stirred, a false reading may result.

The thermostat has its opening temperature

**FIG. L4 THERMOSTAT AND HOUSING**

- A** Early cars
B Late cars

stamped on the base of the unit, for example, 80°C. (190°F.).

When fully open, the valve should have travelled a minimum of 9,5 mm. (0.375 in.).

No attempt must be made to adjust the thermostat.

4. Check that the fusible plugs are intact.

Thermostat - To fit

1. Remove the old gasket material from the thermostat housing and cover, ensuring that no material enters the thermostat housing.

Check that the two faces are wiped clean.

2. Fit a new gasket and insert the thermostat into its housing.
3. Replace the cover and secure in position by progressively tightening the four setscrews.
4. Examine hoses for deterioration and ensure all worm drive clips are secured. Renew any hoses that are unserviceable.

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5. Replace exhaust emission control components, or heat exchanger water connection, if fitted.

6. Fill the system, using the correct anti-freeze/water mixture, verifying and adjusting the concentration level using the method described in Section L1 Coolant - To check.

Section L4

COOLANT PUMP

Coolant pump - To remove

For normal service and maintenance, including reconditioning, it is not necessary to remove the pump casing from the engine.

All moving parts can be withdrawn, complete with the bearing housing (see Figs. L5 and L6)

1. Drive the car onto a ramp, chock the rear wheels and remove the gear range selector thermal cut-out. Raise to a convenient working height.

2. Place a clean container under the car to collect the coolant. Attach a length of rubber hose from the radiator drain tap to direct coolant into the container.

3. Open the radiator drain tap (see Fig. L1) and drain the coolant from the radiator (see *Cooling system - To drain, Section L1*). Close the drain tap, cover the container to prevent contamination of the fluid then lower the car.

4. Remove the header tank from the radiator.

5. Remove the fan from the extension cone, or if a fan and viscous coupling are fitted, dismantle the upper half of the fan cowl to facilitate removal of the fan and coupling assembly. Take care not to damage the matrix fins.

6. Remove the four nuts and washers securing the viscous coupling, fan and pulley to the driving flange.

When removed, it is not necessary to separate the fan and coupling unless one of them is to be replaced.

Note

When the viscous coupling is removed, it should be stored with the bi-metal strip downwards.

7. Release the tension on all drive belts. Remove the belts.

8. Slide the coolant pump pulley forward **carefully** to reveal the bearing housing setscrews.

9. Unscrew the six setscrews which secure the bearing housing to the coolant pump casing.

10. Detach the bearing housing containing all the moving parts of the pump. It will be possible to manoeuvre the pulley off the assembly at this stage.

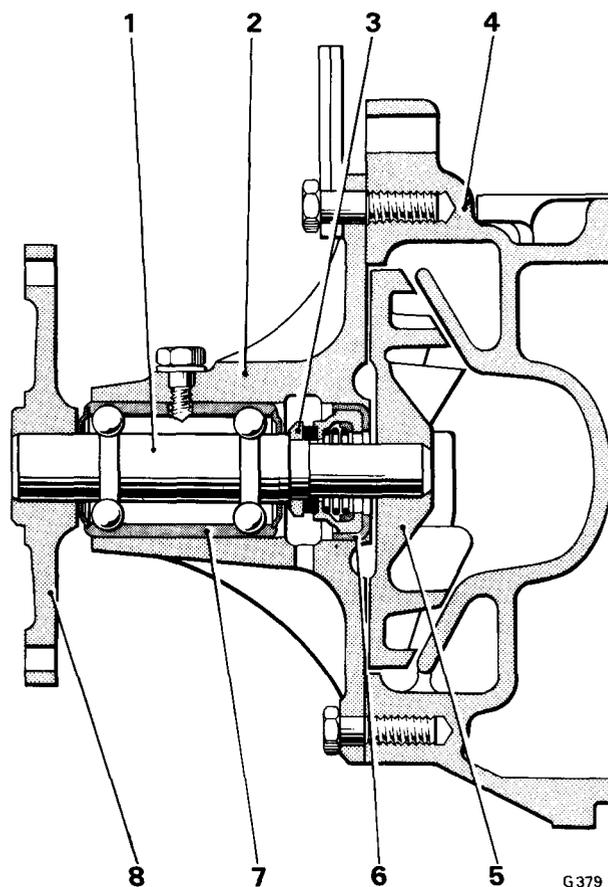


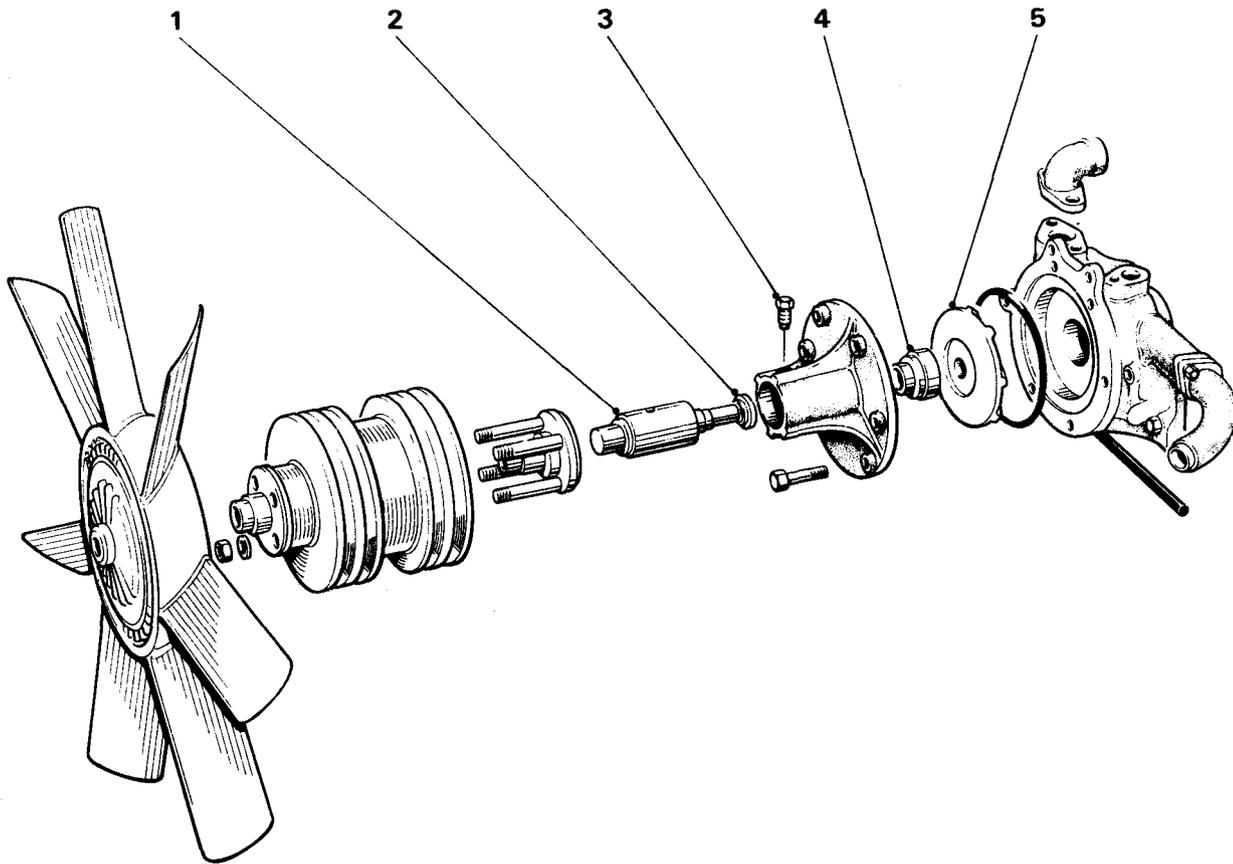
FIG. L5 COOLANT PUMP (EARLY CARS)

- 1 Driving shaft
- 2 Bearing housing
- 3 Thrust collar
- 4 Coolant pump casing
- 5 Impeller
- 6 Sealing gland
- 7 Bearing housing
- 8 Driving spider

11. Remove and discard the 'O' ring from the pump casing.

If it is necessary to remove the pump casing from the engine, carry out the following operations.

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FIG. L6 COOLANT PUMP (LATE CARS)

- | | |
|---|--|
| <ul style="list-style-type: none"> 1 Shaft and bearing assembly 2 Counterface 3 Locating screw | <ul style="list-style-type: none"> 4 Sealing gland assembly 5 Impeller |
|---|--|

- 12. Slacken the worm drive clips and disconnect the pump casing to radiator bottom tank hose.
- 13. If the car is fitted with an exhaust emission control system, remove the air injection pump as described in Chapter U - Emission Systems.
- 14. Remove the nut and washer from the jockey pulley pivot pin and withdraw the jockey pulley assembly.
- 15. Remove the adjusting setscrew to the pivot plate of the steering pump (see Chapter N - Steering System Fig. N15). Swing the steering pump away from the engine.
- 16. Remove the nuts and bolts securing the refrigeration compressor (if fitted) but do not disconnect the pipework. Lift bodily away from the working area placing carefully onto a protective cover to ensure that no damage is caused to other engine components.
- 17. Remove the alternator as described in Chapter M - Electrical System.
- 18. Unscrew and remove the setscrews and

- plain washers from the by-pass elbow.
- Remove the elbow and bobbin. Discard the 'O' rings and gasket.
- 19. Slacken the worm drive clips and disconnect the hose from the expansion tank to coolant pump pipe and from the heater return pipe. Remove the setscrew and washer securing each pipe to the coolant pump casing, detach the pipes and discard the 'O' rings.
- 20. Unscrew and remove the two lower setscrews securing the coolant pump casing to the crankcase, and the two setscrews and plain washers entering the top of the coolant pump casing from the crankcase side with the air injection pump bracket attached.
- 21. Detach the coolant pump casing, together with the Neoprene sealing strip, fitted to its lower edge.
- 22. With 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

For normal service operation, the bearing housing will have already been separated from the pump casing.

1. Draw the impeller off the shaft using the special tool (RH 7098).

2. Remove the peg screw which retains the bearing in the housing.

3. Support the bearing housing to enable the bearing assembly to be lightly driven out with a mallet.

4. Remove and discard the seal and counter face.

5. Examine the shaft and bearing for wear and damage. The assembly contains lubricant therefore no attempt must be made to wash any of the components.

6. If the *spider* (early cars), *flange* (later cars) or the shaft has been damaged, draw the component off the shaft using the following special tool.

Spider - (RH 7099)

Flange - (RH 8615)

Discard the damaged component.

If no damage has occurred and the diameter of the shaft is within the specified limits it will not be necessary to withdraw the flange.

7. With the flange or spider withdrawn, check that the bore conforms to the limits specified (see Section L5 Dimensional Data). If satisfactory, the component may be used for further service.

8. Measure the diameter of a new shaft to ensure that the tolerances required for the flange/spider and impeller are within the limits shown (see Section L5 Dimensional Data).

Coolant pump - To assemble

1. Before assembly, any damage marks on the joint faces of the bearing housing and pump casing should be removed using a fine carborundum stone.

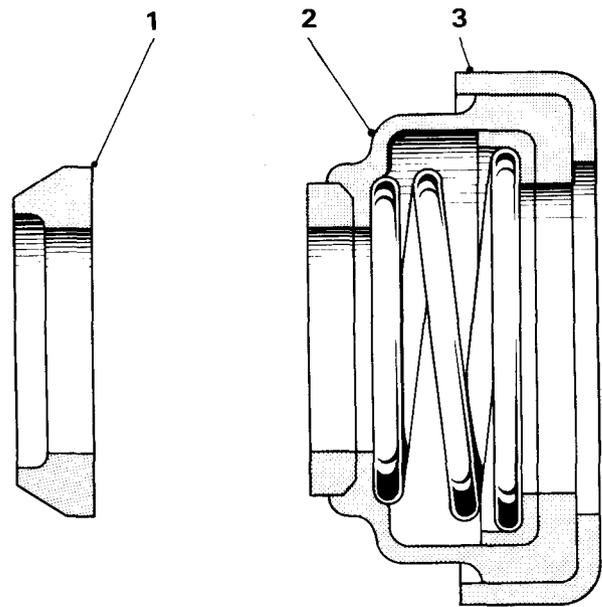
2. Lightly coat the inside surface of the gland cover with a waterproofing solution such as 'Seelastik' then fit the sealing gland assembly into the gland cover (see Fig. L7).

3. Fit the sealing gland assembly into the impeller end of the bearing housing. The assembly must lie flush with the end of the housing (see Figs. L5 and L6).

4. If the driving *spider* (early cars) or *flange* (later cars), is not fitted at this stage press this component onto the shaft. Check that the run out is less than 0,05 mm. (0.002 in.) total indicator reading.

5. Fit a new seal counterface onto the shaft until the chamfered face abuts the shoulder.

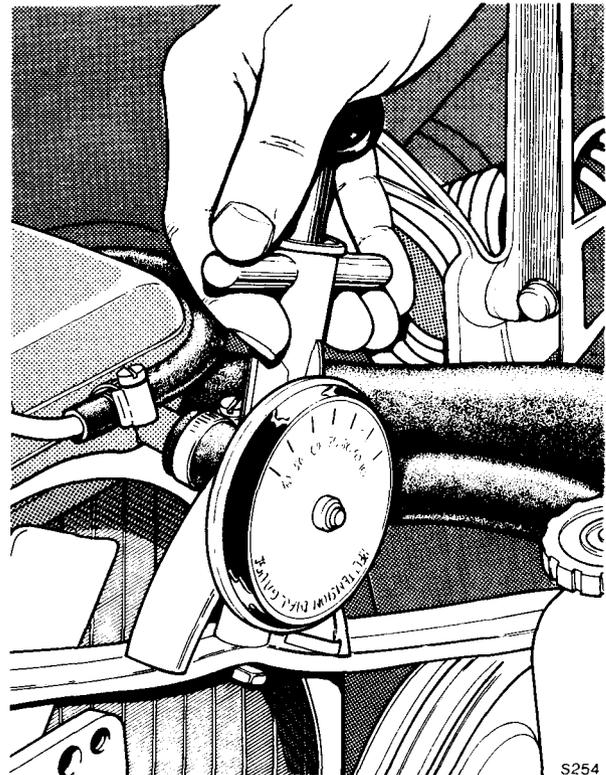
6. Insert the impeller end of the shaft into the outer end of the bearing housing. Using a soft headed mallet, tap the bearing into the bore until



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FIG. L7 SHAFT SEAL AND COUNTERFACE

- 1 Counterface
- 2 Sealing gland assembly
- 3 Gland cover



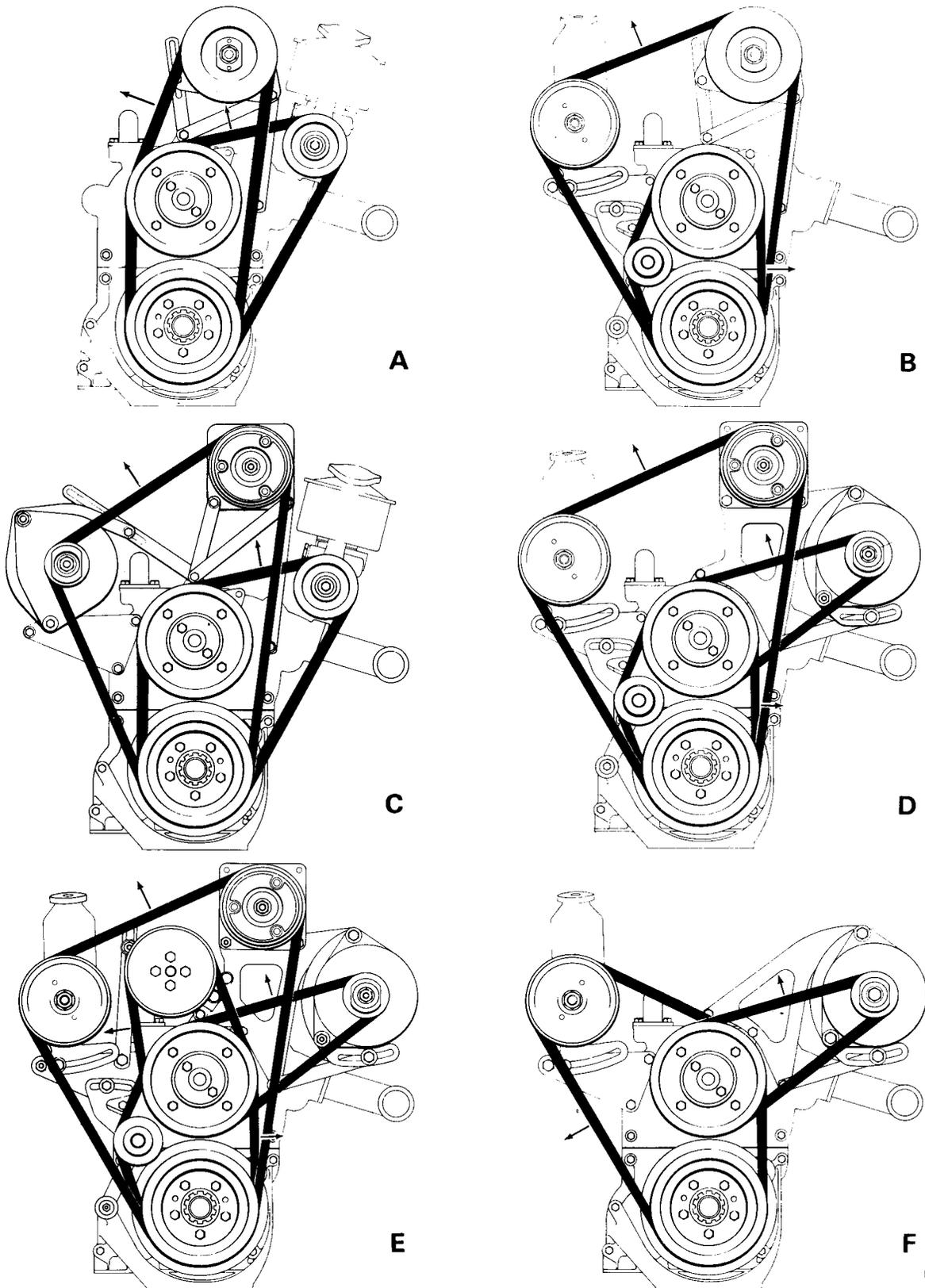
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FIG. L8 BELT TENSION METER

the locating holes are aligned. Fit the locating screw.

7. Ensure the inner end of the shaft and the

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FIG. L9 BELT LAYOUT AND TENSION CHECKING POINTS

- | | |
|--|--|
| <p>A Standard cars</p> <p>C Early refrigerated cars</p> <p>E Cars fitted with the exhaust emission control system</p> | <p>B Standard car - Saginaw steering pump</p> <p>D Later refrigerated cars</p> <p>F Standard car - Alternator and Saginaw steering pump</p> |
|--|--|

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impeller bore are free from burrs.

8. Lightly smear the contact surfaces with Retinax 'A' grease.

9. Press the impeller into position on the shaft. The inner face of the impeller must be flush with the end of the shaft.

10. Spin the assembly to ensure the shaft rotates freely.

Coolant pump - To fit

If the coolant pump casing was detached from the engine it should be fitted by reversing the procedure given for its removal. A new Neoprene sealing strip should be fitted to the bottom edge of the casing.

1. Remove any burrs which may exist on the joint face of the pump casing by lightly stoning with a fine carborundum stone.

2. Modify a new coolant pump casing gasket to suit the coolant pump casing.

3. All bolts should be tightened to the standard torque tightness figures, relative to size, shown in Chapter P.

4. Fit the belt driven auxiliaries as described in Chapter U for the air injection pump, Chapter N for the steering pump, Chapter C for the refrigeration compressor and Chapter M for the alternator.

5. Ensure a new strip of polyether foam is fitted between the upper quadrants of the fan cowl and radiator, before securing.

6. Examine all hoses for deterioration and renew any that are unserviceable. Check the security of all worm drive clips.

7. Fill the cooling system with the correct anti-freeze/water mixture as shown in Section L1 Cooling system - To fill, pouring slowly to avoid air locks.

8. Carefully examine all joints and hoses for leaks.

Belt tensioning (see Figs. L8 and L9)

The belt tensioning recommended for the various engine driven external auxiliaries must be checked at a point midway between the two pulleys by the use of a belt tension meter (see Fig. L8), or by applying a spring balance to give a 9,5 mm. ($\frac{3}{8}$ in.) belt deflection.

In a pair of belts, if the tension of one belt differs markedly from the other, a new matched pair must be fitted.

Belt dressing must not be applied to prevent slip.

Early cars - Holbourn Eaton steering pump (see Fig. L9 diagram A)

Spring balance load applied between -

Steering pump and coolant pump 3,6 kg. (8 lb.)

Crankshaft and generator 2,7 kg. (6 lb.)

Early cars - Saginaw steering pump (see Fig. L9, diagram B)

Spring balance load applied between -

Crankshaft and coolant pump 7,26 kg. (16 lb.)

Steering pump and generator 3,60 kg. (8 lb.)

Early refrigerated cars - Holbourn Eaton steering pump (see Fig. L9, diagram C)

Spring balance load applied between -

Steering pump and coolant pump 3,6 kg. (8 lb.)

Refrigeration compressor and alternator 2,7 kg. (6 lb.)

Later refrigerated cars - Saginaw steering pump (see Fig. L9, diagram D)

Spring balance load applied between -

Crankshaft and coolant pump 7,26 kg. (16 lb.)

Coolant pump and alternator 3,6 kg. (8 lb.)

Steering pump and refrigeration compressor 4,1 kg. (9 lb.)

Later refrigerated cars - Saginaw steering pump and fitted with air injection pump for exhaust emission control (see Fig. L9, diagram E)

Crankshaft to cooling pump

Load may be applied on either side of the belt run.

Belt tension meter 23 kg. (50 lb.)

Spring balance 4,1 kg. (9 lb.)

Coolant pump to alternator

Load may be applied on either side of the belt run.

Belt tension meter 23 kg. (50 lb.)

Spring balance 3,6 kg. (8 lb.)

Steering pump to refrigeration compressor

Load must be applied on the top run of the belts.

Each belt to be checked individually.

Belt tension meter 32 kg. (70 lb.)

Spring balance 4,1 kg. (9 lb.)

Coolant pump to air injection pump (car fitted with exhaust emission control system)

Load may be applied on either side of the belt run.

Belt tension meter 18 kg. (40 lb.)

Spring balance 5,44 kg. (12 lb.)

The difference between the spring balance loads for similar belt tension meter loads is due to the varying lengths of belt between the individual pulley centres.

Later standard cars - Alternator and Saginaw steering pump (see Fig. L9, diagram F)

Spring balance load applied between -

Coolant pump and alternator 4,1 kg. (9 lb.)

Crankshaft and coolant pump 3,6 kg. (8 lb.)

Section L5

DIMENSIONAL DATA

Spider bore	18,910 mm. to 18,923 mm. (0.7445 in. to 0.7450 in.)
Impeller end of shaft	16,185 mm. to 16,198 mm. (0.6372 in. to 0.6377 in.)
Spider/flange end of shaft	18,948 mm. to 18,961 mm. (0.7460 in. to 0.7465 in.)
Impeller bore	15,88 mm. to 15,893 mm. (0.625 in. to 0.6255 in.)
Flange bore	18,905 mm. to 18,923 mm. (0.7443 in. to 0.7450 in.)

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WORKSHOP TOOLS

Tool Number	Description
RH 7098	Extractor - Coolant Pump Impeller
RH 7099	Extractor - Coolant Pump Driving Spider
RH 8615	Extractor - Coolant Pump Driving Flange