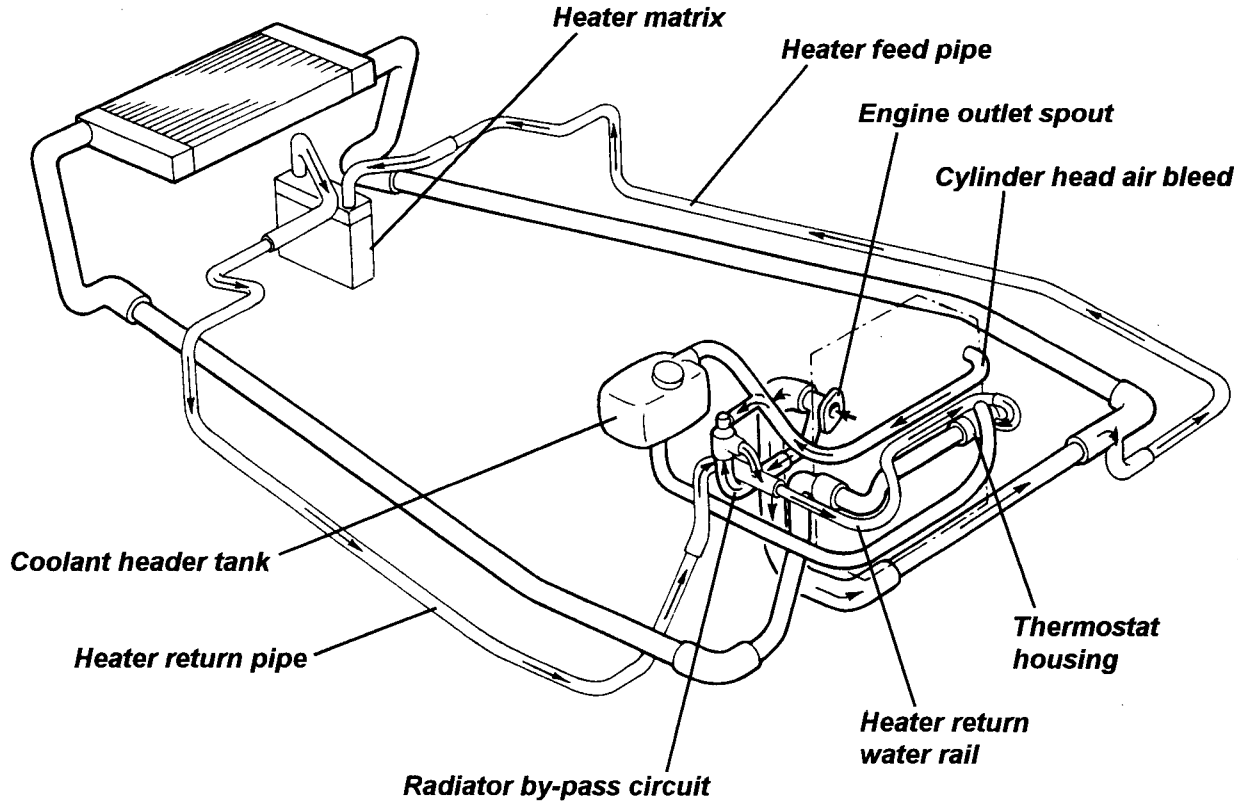
ENGINE COOLING

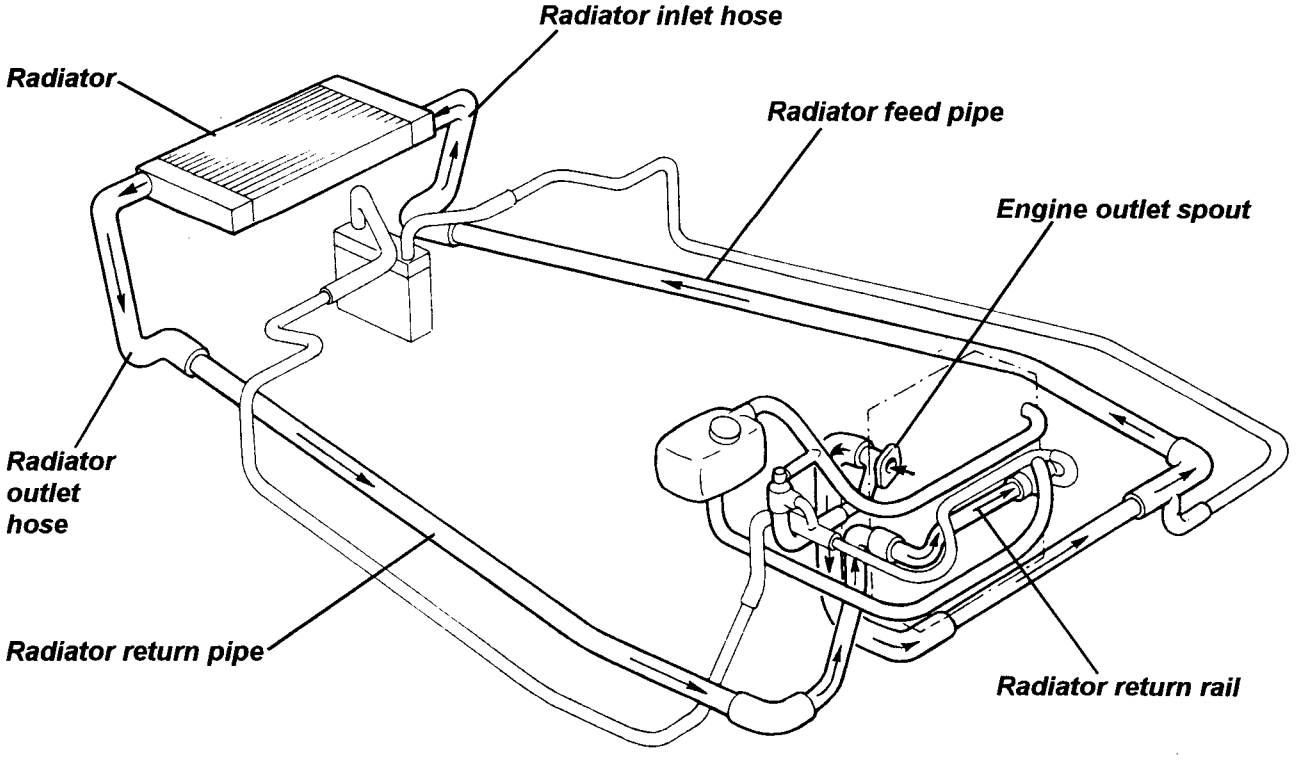
SECTION KG - ELISE 2001 M.Y. Onwards

Thermostat Closed



k59a

Thermostat Open



k58a

KG.1 - GENERAL DESCRIPTION

The engine cooling system comprises an engine driven water pump, a front mounted radiator with electric cooling fan(s), and associated ducting, pipework and controls.

The centrifugal water pump is mounted on the front face of the cylinder block, and is driven by the camshaft toothed belt. Water is discharged from the pump into the front of the cylinder block, around the cylinder liners and up into the cylinder head, before exiting the engine via an outlet elbow at the left hand rear of the head. From the outlet elbow, there are three routes through which water may flow:

- Radiator circuit; The larger of the two spouts on the outlet elbow is connected via an alloy pipe running through the chassis right hand side rail, to the front mounted radiator. Water returns from the radiator via a pipe in the chassis left hand side rail to the engine bay. One of a pair of steel tube water rails fixed to the engine, then directs this water around the back and the right hand side of the engine to a plastic bodied thermostat housing fixed to the back of the water pump.

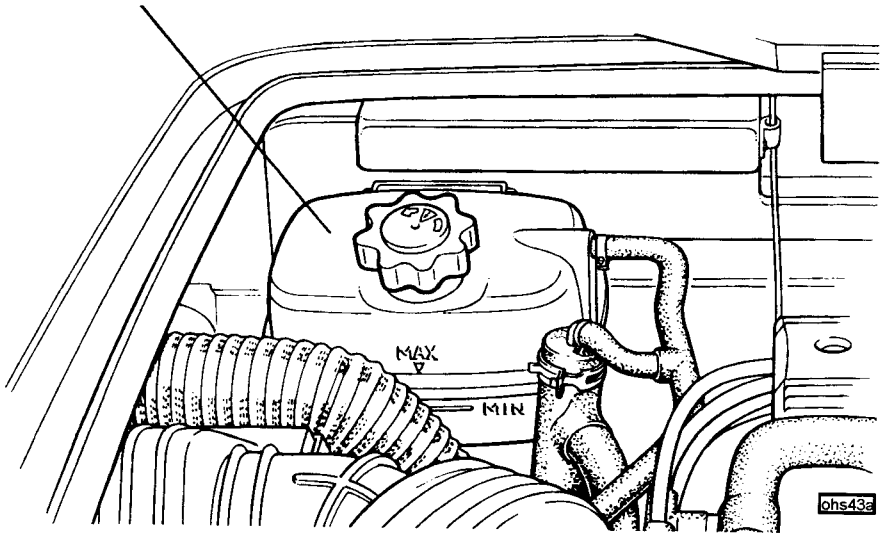
- Heater circuit; A take-off for the heater is provided in the radiator feed circuit at the right hand front of the engine bay, from where it is routed through an alloy pipe fixed to the outside face of the RH chassis side rail, to the heater matrix mounted in the chassis well ahead of the cabin footwell. Water returns from the heater via an alloy pipe routed outside the LH chassis side rail, connecting with a second steel tube engine mounted water rail, to the water pump side of the thermostat housing.

- Radiator by-pass circuit; The smaller of the two spouts on the cylinder head outlet elbow connects directly with the heater return pipework. When the thermostat is closed, the radiator return circuit is shut off, so that water is forced to flow through the heater and by-pass circuits, thus ensuring optimum heater performance.

The header tank is mounted at the left hand front of the engine bay, with a hose from its underside connecting with the heater return rail near the thermostat housing. An air bleed hose connects the header tank air space with the radiator by-pass circuit and a cylinder head spigot at the front end of the inlet manifold. The tank is fitted with a 110 kPa (15 lb/in²) pressure cap to raise the boiling point of the coolant to over 120°C.

The engine cooling radiator is of aluminium construction with plastic end tanks and is horizontally mounted at the front of the vehicle, on top of the glass fibre composite 'crash structure' which also serves as a duct to direct airflow from the body nose air intake, to the underside of the radiator. A single 100 mm diameter electric cooling fan is fitted to the underside of the radiator to supplement, when required, the ram air flow, and a moulded duct directs air exhausting from the top of the radiator through outlets incorporated into the front bonnet. On cars equipped with air conditioning, the condenser is sandwiched between the radiator and crash structure, with two cooling fans attached to its underside. Separate coolant temperature sensors for the engine management system (which also controls the radiator fan), and the temperature gauge are fitted in the cylinder head outlet elbow.

Coolant header tank



KG.2 - MAINTENANCE

Under normal operating conditions, the engine cooling system, being a closed circuit, should not require any topping up between services. As a precaution however, every week, the level of coolant in the engine cooling header tank should be checked. The transluscent header tank is marked with both cold and hot level indicators. The level of coolant will rise as the engine warms up and the coolant expands, and will fall again

as it cools down.

WARNING: Do NOT remove the cap from the engine cooling header tank when the engine is warm, as serious scalding could result from boiling water and/or steam.

When fully cold, the level of coolant should be up to the 'cold' mark moulded on the header tank. If overfilled, the excess coolant will be ejected when the engine is warm, and if the level is allowed to fall too low, overheating may result. If necessary, top up the system using an approved coolant mixture (see below) to maintain full protection from freezing damage and corrosion.

Anti-Freeze/Corrosion Inhibitor

It is necessary that the coolant contains an anti-freeze with corrosion inhibitor to protect the engine and heat exchangers from both frost damage, and corrosion of the metallic elements. A good quality mono-ethylene glycol anti-freeze, provides protection against these dangers as well as raising the boiling point of the coolant. The car is factory filled, for all markets, with a 50% concentration of 'Unipart Superplus Antifreeze & Summer Coolant', which is the only recommended coolant product, and provides freezing protection down to approximately - 35°C. In warm climates it is recommended that the concentration is not allowed to fall below 25%, in order to maintain full corrosion protection.

The simplest means of checking the antifreeze concentration is to measure the specific gravity (density) of the coolant at a known temperature, using a hydrometer. The following table provides a general guide:

	Density @	
Concentration	***20°C***	***60°C***
25%	1.039	1.020
33%	1.057	1.034
50%	1.080	1.057

The coolant density reflects the effective level of mono-ethylene glycol, and not the level of corrosion inhibitors present, whose effectiveness diminishes over a period of time. The coolant should therefore be renewed every 24 months to ensure optimum corrosion protection.

In areas where the tap water is extremely hard (exceeding 250 parts per million), use of this water will lead to 'furring up' of the system over a period of time. In such areas, distilled, de-ionised or filtered rain water should be used.

Radiator Fin Cleaning

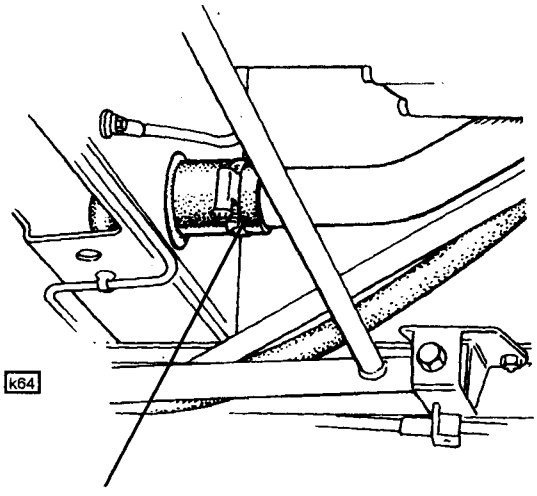
At service intervals, the matrix of the engine cooling radiator should be checked for clogging by insects, leaves and other debris. If necessary, use a water jet from both above and below to clean the fins, taking care not to damage the fragile tubes or distort the finning. At the same time, check the integrity of all cooling system joints, and the condition of all flexible hoses. In snowy conditions, ensure the radiator air exit is cleared of snow before driving the car.

KG.3 - DRAIN/REFILL PROCEDURE

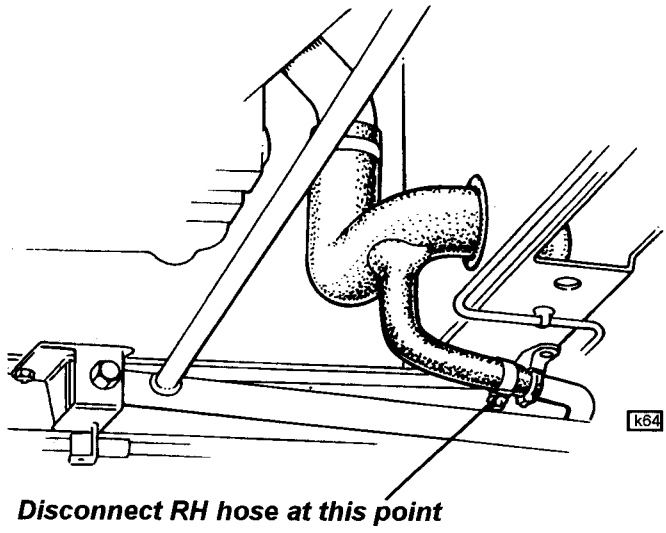
To drain the engine cooling system, remove the header tank cap, and disconnect the radiator feed and return hoses from the rear ends of the water rails running down each sill. If necessary, raise the front of the car to aid draining. Note that draining of the heater matrix is not easily possible with the unit 'in situ', and that if draining for the purpose of coolant change, this volume should be disregarded.

To refill the system:

1 Refit the hoses, and fill with the recommended coolant mix via the header tank.

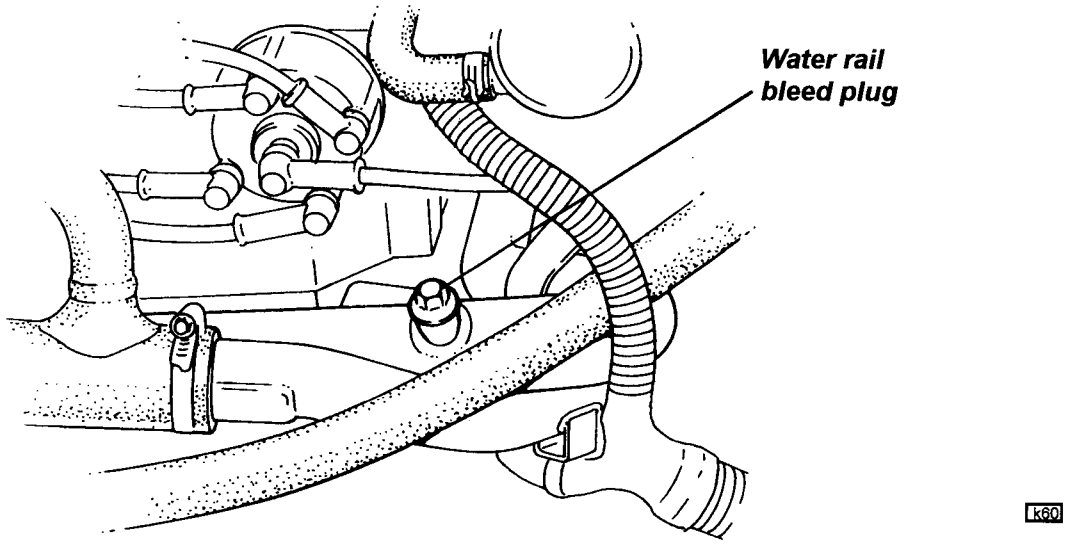


Disconnect LH return hose at this point

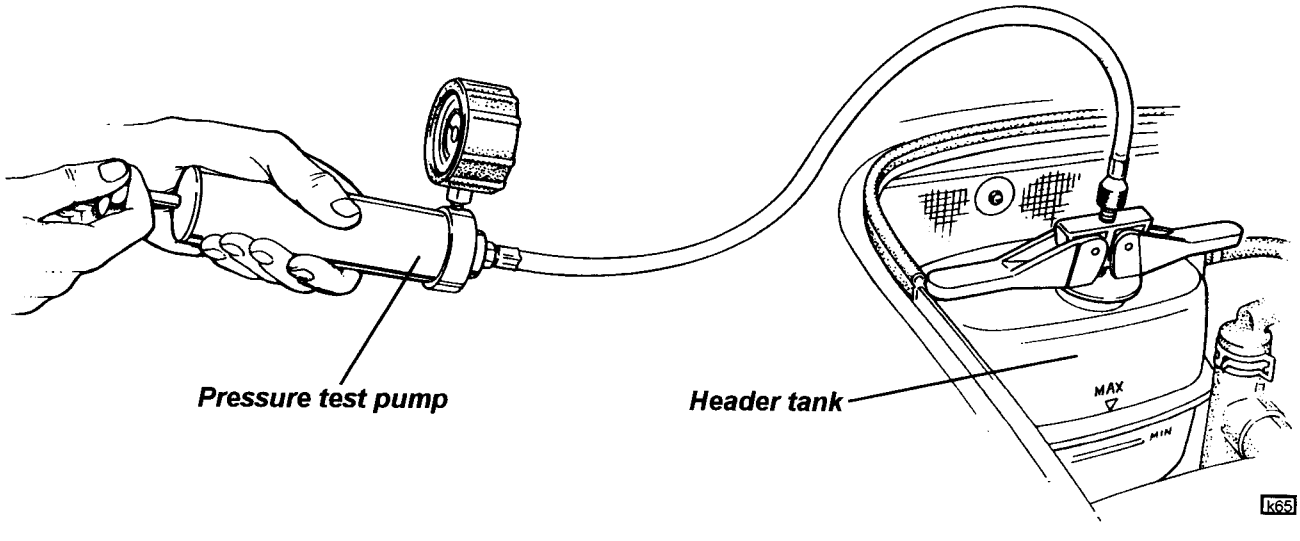


Disconnect RH hose at this point

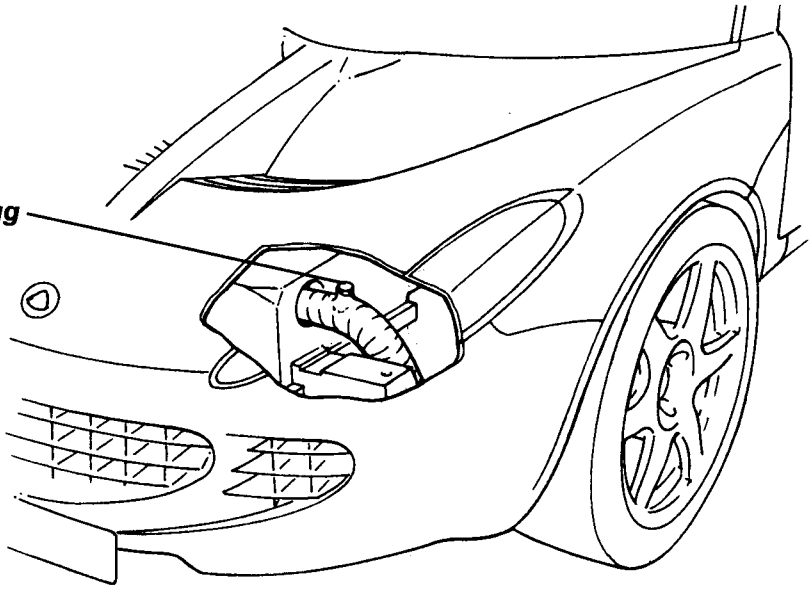
2. Remove the bleed screw in the return water rail at the left hand side of the engine, taking care not to misplace the sealing washer.



3. Using radiator pressure test equipment, pressurise the header tank to circulate the coolant. When necessary, refill the header tank and repeat. When a steady stream of coolant flows from the bleed port, replace the screw and washer and tighten.



4. Release the front end of the LH front wheelarch liner, to provide access to the radiator outlet hose bleed screw. Pressurise the system to 35 kPa (5 lbf/in²) and open the radiator hose bleed screw until a steady stream of coolant flows. Tighten the bleed screw.



5. Remove the pressure test equipment and top up the header tank to the cold level. With the header tank cap removed, start and run the engine at idle until the water temperature gauge reads 60 - 65°C. Increase engine speed to 2000 rpm and observe the temperature gauge which should indicate 93 - 98°C before dropping to 90°C due to the action of the thermostat and the circulation of air pockets. After a further rise and fall of indicated temperature, re-bleed at the radiator hose with the engine running.

6. Continue to run the engine at 2000 rpm until the radiator return pipe at the engine feels hot, at which time the header tank cap should be replaced. Check that the radiator fan cuts in at 103 - 105°C and brings down the temperature to 90 - 95°C, before the cycle repeats.

7. Stop the engine and allow to cool fully before topping up the header tank to the 'low' mark.

KG.4 - RADIATOR & COOLING FAN

The aluminium cored radiator is positioned horizontally on top of the composite 'crash structure' in the front services compartment. A composite moulding is used to mount the radiator, and also, via extensions at each side, to provide a mounting point for the inside front of the clamshell wheelarch. The radiator must be removed for access to the cooling fan(s).

To Remove Radiator

1. Remove the front clamshell (see sub-section BP.5).

2. Drain the coolant and disconnect the feed and return hoses from the radiator.

3. Release the two fixings securing each water shield to the top rear edge of the radiator mounting panel, and withdraw both shields.

4. Release the tie wraps, and unplug the rad. fan harness connector(s).

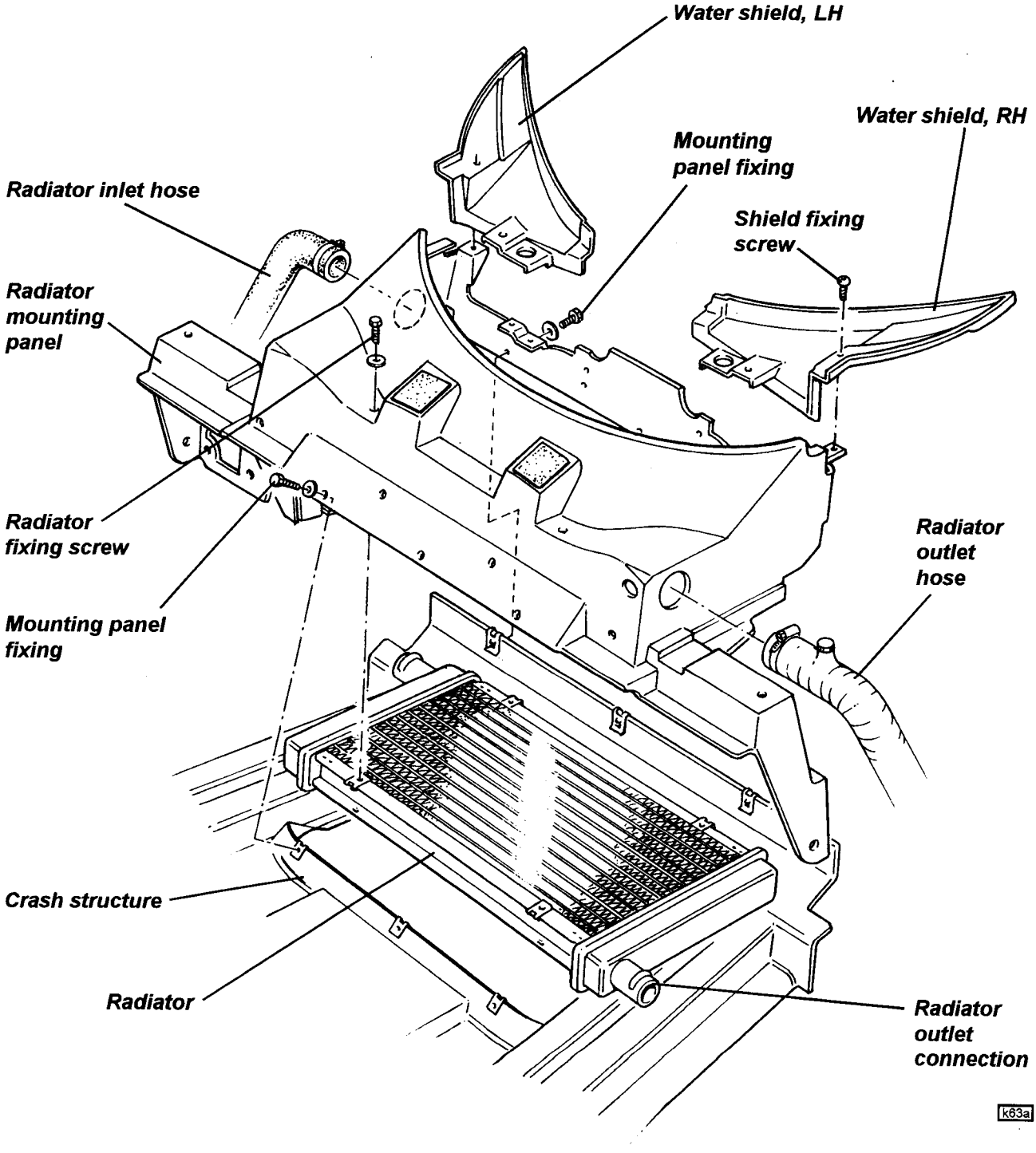
5. Release the single fixing at the bottom of each side extension securing the mounting panel to the bottom flange of the crash structure.

6. Release the three fixings securing the back edge of the mounting panel to the vertical flange on the crash structure, and the three fixings along the front edge of the panel.

7. Release the four fixings securing the radiator to the mounting panel, and withdraw the panel from the radiator.

8. Withdraw the radiator and cooling fan assembly. On a.c. cars, lift the radiator/condenser assembly only sufficiently to release the cooling fans or radiator as required, without disconnecting the refrigerant circuit.

Lift away the panel complete with the radiator and fan.



6. Release the fan motor from the radiator by removing the four nuts securing the fan shroud to the mounting brackets rivetted to the radiator frame. Withdraw the fan harness through the mounting panel grommet.

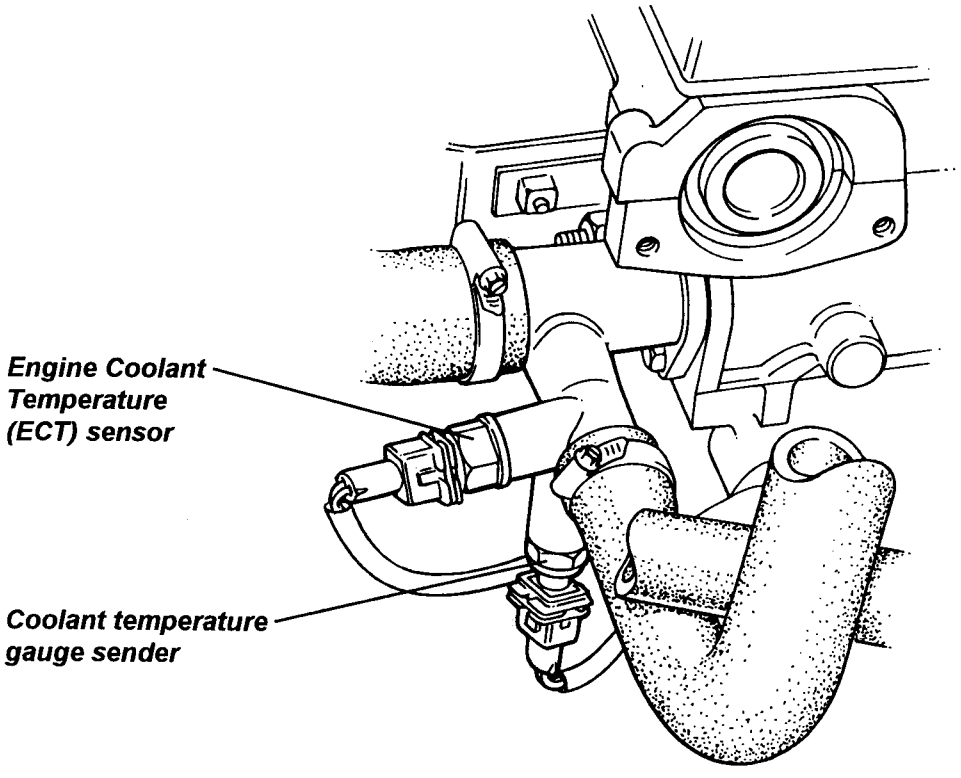
7. Remove the four screws securing the radiator to the mounting panel.

8. Refit the radiator in reverse order to removal and refill with coolant and bleed as detailed in sub-section KG.3.

KG.5 - RADIATOR FAN CONTROL

The engine management ECM requires a coolant temperature input signal in order to increase fuel delivery and maintain driveability during the cold running and warm-up phase. The Engine Coolant Temperature (ECT) sensor supplies this signal, which is also used by the ECM to control the radiator cooling fan. The fan is switched on at a rising coolant temperature of 102°C, and switched off on falling temperature at 96°C. Note that during a 15 minute period following ignition switch off, the cooling fan will operate if coolant temperature rises above 112°C, switching off again at 106°C. This feature helps prevent heat soak boiling.

The sensor is a thermistor (a resistor which changes value with temperature) mounted in the outlet junction pipe at the flywheel end front side of the engine. Note that the ECT sensor is mounted horizontally, and should not be confused with the water temperature gauge sender which is fitted in the same pipe, but vertically from below. Low coolant temperature produces a high resistance, whereas high temperature causes low resistance. At normal running temperature, the resistance will be approximately 300 - 400 ohms.



If the ECM receives a signal voltage outside of the acceptable range, a default setting equating to 60°C will be substituted, and the cooling fan energised.

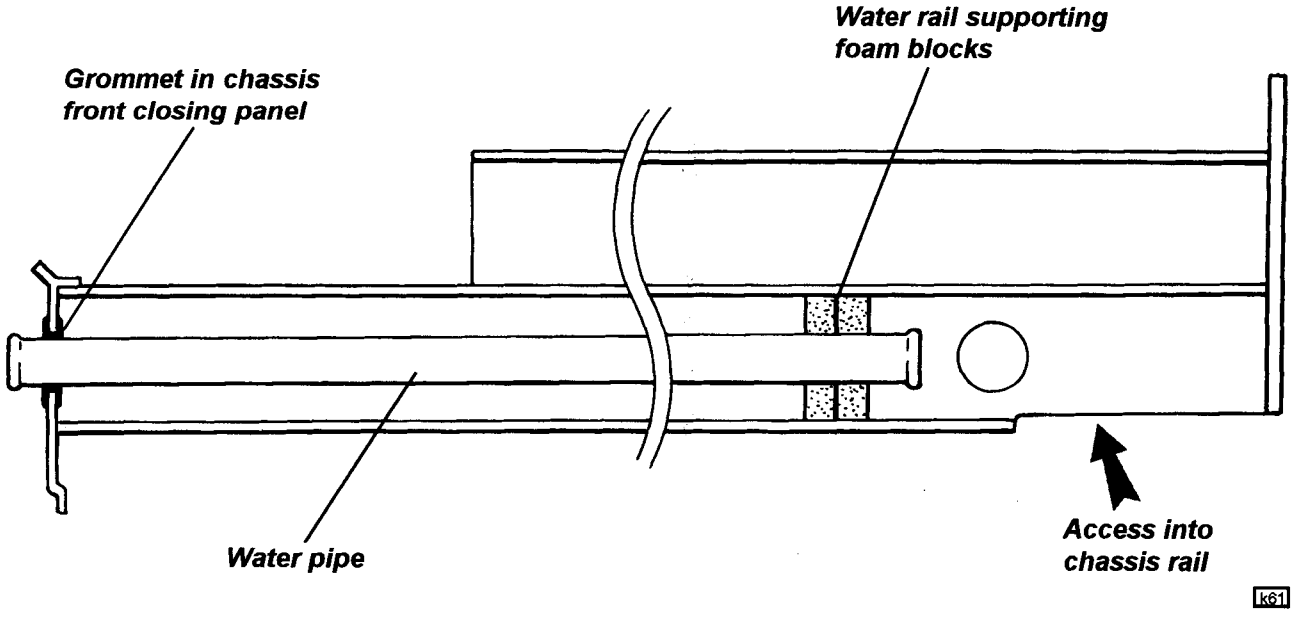
To replace the sensor, disconnect the harness plug, and position a container to catch the escaping coolant when the sensor is removed. Unscrew the sensor from the junction pipe. Clean the threads of the pipe and sensor before applying Teflon tape to the sensor thread and screwing into the pipe. Tighten to 6 Nm. Refit the harness plug, and top up with coolant.

For further information on engine management, see Section EMO.

KG.6 - RADIATOR FEED & RETURN PIPES

The radiator feed and return pipes are routed through the chassis main side rails, feed on the right, and return on the left. Each pipe is located by a grommet in the chassis front closing panel, and by a pair of shaped foam blocks inserted into the rear end of each chassis rail.

On initial build, the water pipes are fitted before the crash structure is bonded to the front of the chassis. A new chassis assembly is supplied with both water pipes and the crash structure pre-fitted. If a pipe is to be replaced in service without the crash structure being removed:



1. Drain the coolant and remove the front clamshell (see sub-section BP.5).

2. **WARNING: The machined edges of the chassis extrusions and the ends of the drive fasteners can present sharp edges and points representing a potentially serious hazard. It is strongly recommended that industrial gloves are worn, and other suitable precautions taken to provide protection from cuts and abrasions.**
   Release the hoses from the front and rear end of the water pipe.

3. Using the access provided from the open underside of the rear end of the chassis side rail, push the water pipe forwards until obstructed by the crash structure. It is recommended that a suitable hole be cut in the flat vertical face of the crash structure, adjacent to the fog lamp harness grommet, in order to allow the pipe to be withdrawn forwards.

4. Retrieve the two support foams from inside the chassis rail. Fit the grommet into the hole in the chassis front closing plate, and smear with rubber grease. Feed the pipe through the access hole and grommet, and position with 35 - 40 mm of pipe protruding.

5. At the rear end of the pipe, fit two foam support blocks onto the pipe, and push into the chassis rail to expose approximately 35 - 40 mm of pipe. After fitting the hoses, manipulate the pipe to check for absence of chassis contact 'knock'.

6. Blank off the access hole in the crash structure with a suitable grommet.