
Lubrication system

18

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General description

The lubricating oil pump is fitted around the forward end of the crankshaft; the inner rotor of the pump is driven by a key in the crankshaft. The pump has an inner rotor and an outer rotor which are offset to each other. The inner rotor has ten lobes which mesh with the eleven lobes of the outer rotor. When the pump turns, the space between the lobes which are in mesh increase to cause a suction or decreases to cause a pressure increase.

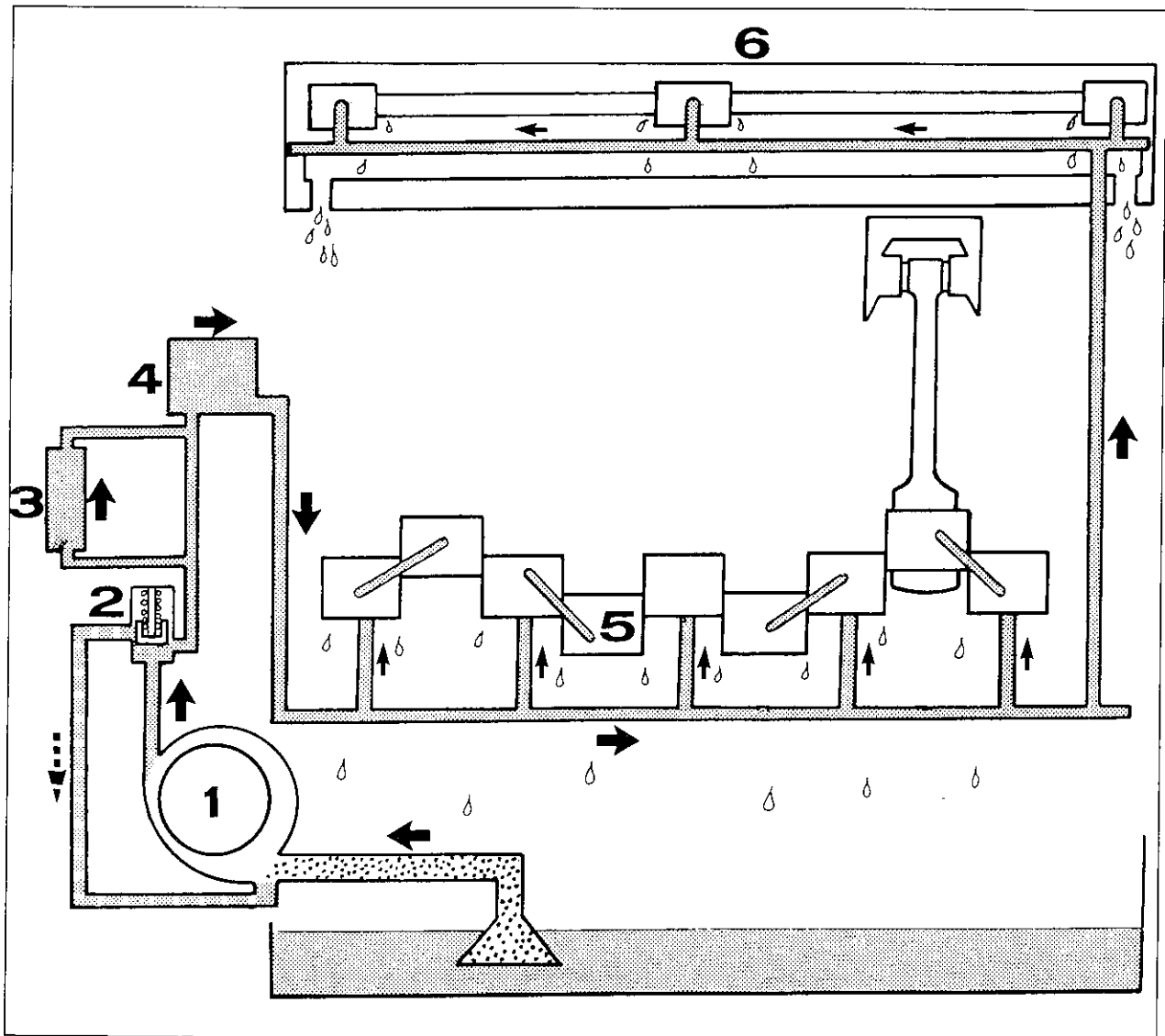
Lubricating oil from the sump passes through a strainer and pipe to a passage in the cylinder block and then to the suction side of the pump.

A relief valve (which is fitted in the pump body) opens if the pressure is too high; this allows some of the oil from the outlet side of the pump to return to the inlet side of the pump.

From the pump the oil passes through a filter which is fitted to the pump body. After the filter the oil passes to the pressure rail which is drilled through the length of the block.

From the pressure rail, lubricating oil passes to the crankshaft main bearings and through passages in the crankshaft to the big end bearings. The pistons and the cylinder bores are lubricated by splash and oil mist.

Oil passes (through passages in the block and the cylinder head) from the rear of the pressure rail in the block to a pressure rail in the head. From the pressure rail in the head, oil passes to each camshaft journal. The valves and the tappets are lubricated by splash and oil mist.



- 1. Oil pump
- 2. Pressure relief valve
- 3. Oil cooler
- 4. Oil filter
- 5. Crankshaft
- 6. Camshaft

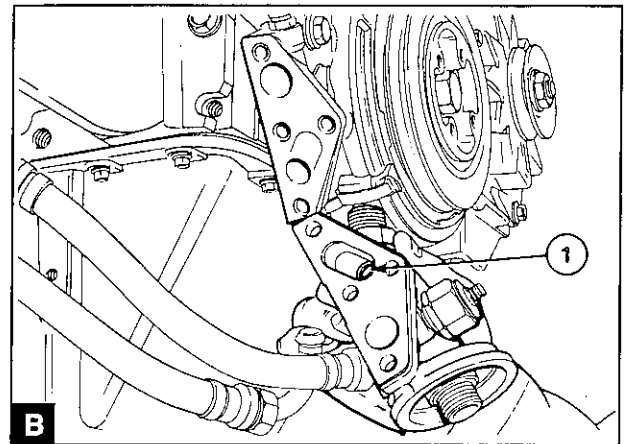
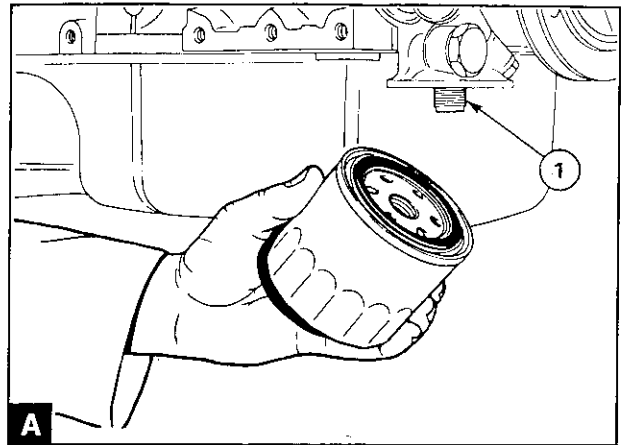
Filter canister

To renew

18A-01

- 1 Put a tray under the filter to contain spilt lubricating oil.
- 2 Remove the filter canister with a strap wrench or a similar tool. Ensure that the adaptor (A1) is secure in the filter head and then discard the canister.
- 3 Clean the filter head.
- 4 Add clean engine lubricating oil to the new canister. Allow time for the oil to fill the canister through the filter element.
- 5 Lubricate the top of the canister seal with clean engine lubricating oil.
- 6 Install the new canister and tighten it by hand only. Do not use a strap wrench.
- 7 Ensure that there is lubricating oil in the sump.
- 8 Operate the engine and check for leakage from the filter. When the engine has cooled, check the oil level on the dipstick and add oil to the sump, as necessary.

Attention: The canister contains a valve and a special tube which ensure that lubricating oil does not drain from the filter. Therefore, ensure that the correct canister is used.



Filter head

To remove and to fit

18A-02

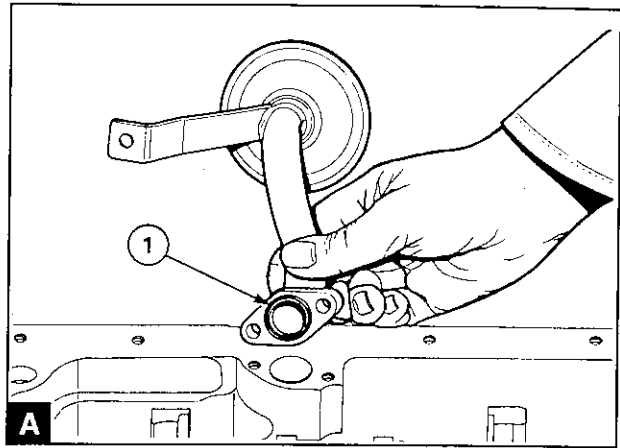
- 1 Put a tray under the filter head to contain spilt lubricating oil.
 - 2 Remove the filter canister, operation 18A-01.
 - 3 If necessary, disconnect the oil cooler pipe.
 - 4 Release the setscrews and remove the filter head from the lubricating oil pump. Discard the joint.
 - 5 Clean the joint faces of the filter head and of the oil pump.
- If an oil cooler is used, ensure that a plug is fitted in the filter head (B1). For some applications, the plug will have a small hole in it to allow some of the oil to pass directly to the filter.
- 6 Fit the filter head and a new joint to the oil pump and tighten the setscrews to 22 Nm (16 lbf ft) 2,2 kgf m.
 - 7 If necessary, connect the oil cooler pipe and/or the turbocharger oil pipe.
 - 8 Fit a new filter canister, operation 18A-01.

Lubricating oil sump

To remove and to fit

18A-03

- 1 Drain the oil. Remove the dipstick. Disconnect the drain pipes of the breather.
- 2 Where necessary, provide a support for the sump. Remove the setscrews which fasten the sump to the cylinder block. Lower the sump and remove the joint.
- 3 Wash the sump with clean kerosene, ensure that all the kerosene is removed. Clean the flange faces of the sump and of the cylinder block.
- 4 If the front or the rear main bearing cap has been removed, apply sealant as instructed in item 14 of operation 14A-08.
- 5 Put a new sump joint in position on the sump or on the cylinder block. If a two piece joint is to be used, apply Sealant to the ends of each half joint and ensure that the ends are fitted together correctly. Fit the sump and ensure the correct location with a setscrew on each side. Fit the remainder of the setscrews and tighten all the setscrews to 22 Nm (16 lbf ft) 2,2 kgf m. If necessary, fit the drain plug and its washer and tighten the plug to 43 Nm (32 lbf ft) 4,4 kgf m.
- 6 Fit the dipstick. Connect the drain pipes of the breather.
- 7 Fill the sump to the "MAX" level on the dipstick with an approved lubricating oil.



Oil strainer and suction pipe

To remove and to fit

18A-04

The oil strainer is an integral part of the suction pipe. No regular service is necessary but wash the strainer when it is removed.

- 1 Remove the sump, operation 18A-03.
- 2 Release the setscrew which holds the bracket to the main bearing cap.
- 3 Release the flange setscrews of the suction pipe and remove the suction pipe and strainer. Remove the "O" ring (A1). Clean the flange face of the cylinder block and of the suction pipe.
- 4 Loosely assemble the suction pipe bracket to the correct main bearing cap. Fit the suction pipe to the oil pump together with a new "O" ring. Tighten the setscrews. Tighten the setscrew of the suction pipe bracket; ensure that there is no stress on the suction pipe.
- 5 Fit the sump, operation 18A-03 and fill it with an approved oil to the "MAX" level on the dipstick.

To inspect and to correct

18A-05

- 1 Wash the assembly in kerosene and dry it thoroughly.
- 2 Check the pipe, the strainer and the welded joints for cracks and other damage. Check that the mounting bracket is secure.
- 3 If the damaged component cannot be welded correctly, renew the assembly.

Lubricating oil pump

To remove and to fit

18A-06

To remove

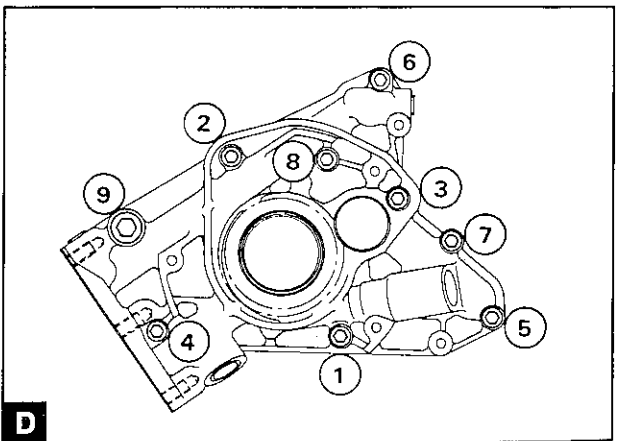
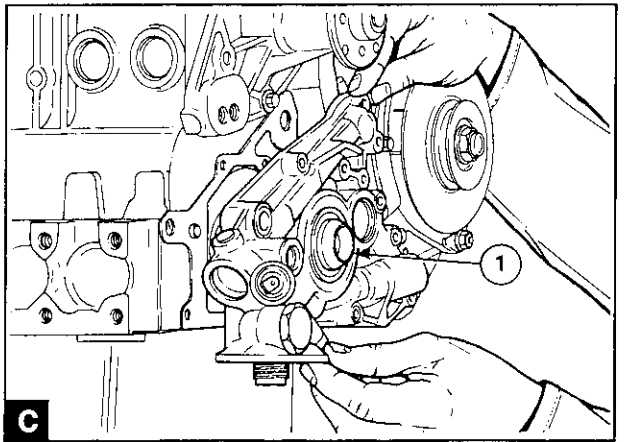
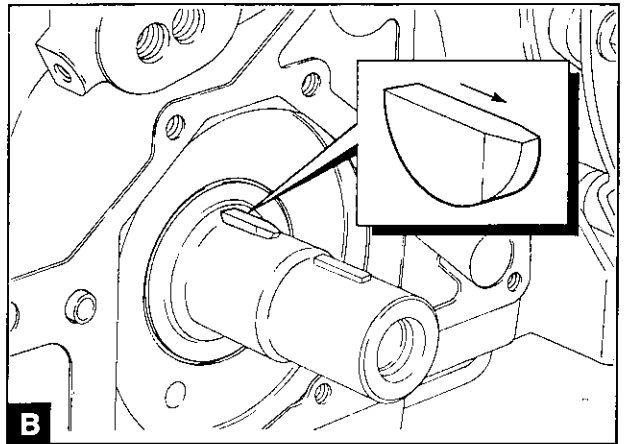
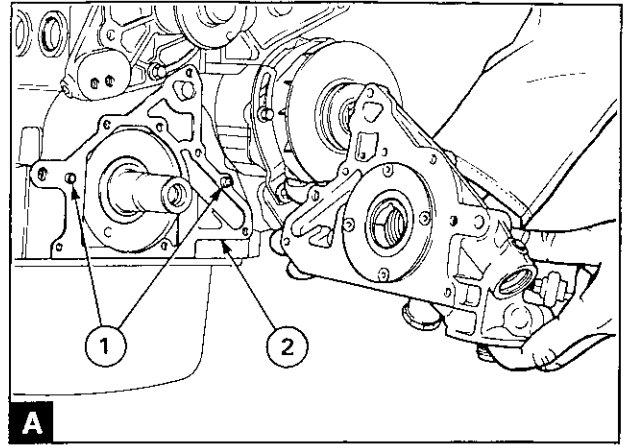
- 1 Disconnect the battery.
- 2 Remove the setscrew from the timing hole in the top front of the camshaft cover. Turn the crankshaft until the timing hole in the front journal of the camshaft aligns with the hole in the cover.
- 3 Fit the timing pins to the camshaft and to the flywheel, see section 17.
- 4 Remove the drive belt of the alternator, operation 22A-03 and remove the pulley of the water pump.
- 5 Remove the crankshaft pulley, operation 14A-01A.
- 6 Remove the timing case cover, operation 15A-01.
- 7 Remove the timing belt, the toothed pulleys and the timing case, see section 15.
- 8 Remove the front key of the crankshaft.
- 9 Release gradually and evenly the setscrews of the oil pump in the reverse sequence to that shown in figure D.
- 10 Remove the oil pump (A).

To fit

Special tool:

Protection sleeve, 885032-3

- 1 Ensure that the joint faces of the oil pump, the cylinder block and the main bearing cap are clean. Ensure that the two dowels (A1) are in position and put a new joint into position (A2).
 - 2 Ensure that the rear key is in position and that the chamfered end of the key is towards the front (B). If the front key is still in position, remove it from the crankshaft.
 - 3 Clean the crankshaft and the protection sleeve 885032-3 and lightly lubricate them with clean engine oil. Fit the protection sleeve (C1) to the crankshaft.
 - 4 Turn the rotors of the oil pump until the keyway in the inner rotor will align with the key in the crankshaft. If the seal is fitted in the front of the pump, lightly lubricate it with clean engine oil. Carefully put the pump into position with the keyway over the key and with the dowels fitted into the pump housing. Remove the protection sleeve.
 - 5 Put the pump setscrews in position with a suitable sealant applied to the setscrew which fits into the main bearing cap (D1). Sealant is already applied to new setscrews. Tighten the setscrews gradually and evenly to the correct torque, see section 11C, in the correct sequence (D).
 - 6 Where necessary, fit the front oil seal into the pump, see operation 14A-02.
 - 7 Fit a new front key to the crankshaft.
 - 8 Fit the timing case, operation 15A-08.
 - 9 Fit the toothed pulleys and the timing belt, see section 15.
- Check the timing of the fuel injection pump, operation 17A-03.
- 10 Fit the timing case cover, operation 15A-01.
 - 11 Fit the crankshaft pulley, operation 14A-01A.
 - 12 Fit the pulley of the water pump and the drive belt of the alternator, operation 22A-03.



- 13 Ensure that the timing pins have been removed and fit the setscrew in the timing hole in the top front of the camshaft cover.
- 14 Connect the battery.
- 15 Ensure that the engine will not start and operate the starter motor until there is a reading on the oil pressure gauge or the oil warning light is extinguished.
- 16 Start the engine and check for leaks.

To inspect

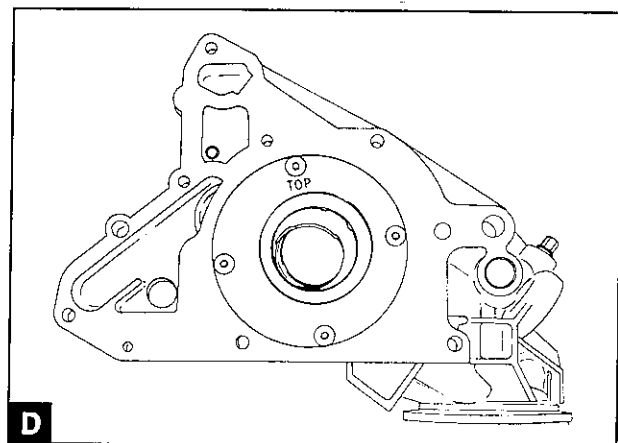
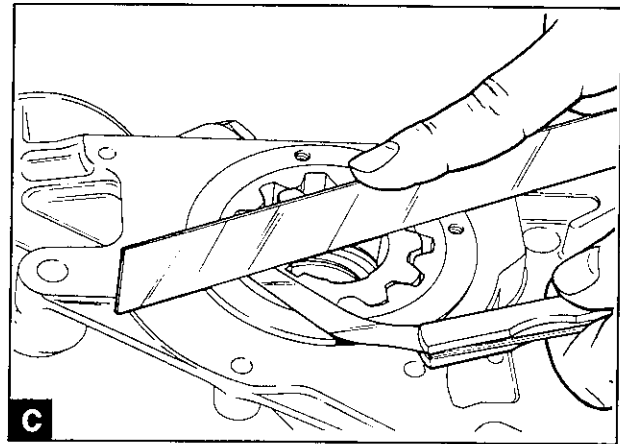
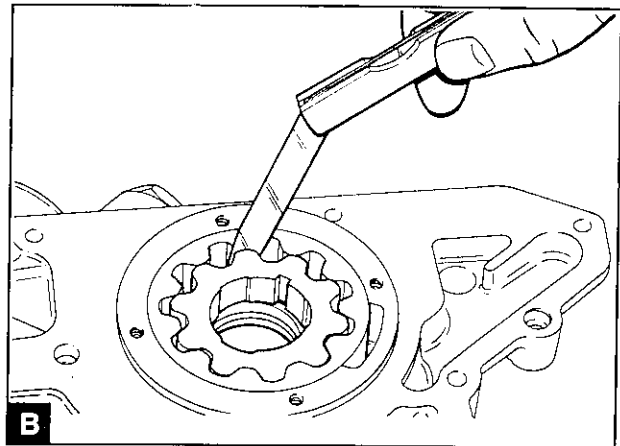
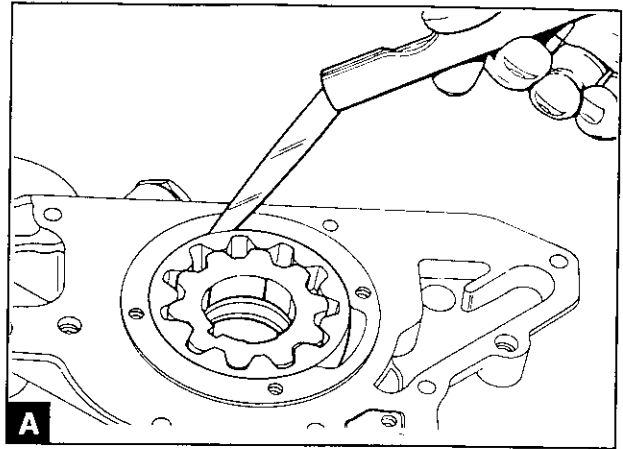
18A-07

If the rotors are worn enough to have an effect on the performance of the oil pump, the complete oil pump must be renewed.

- 1 Release the screws and remove the backplate of the oil pump.
- 2 Remove the rotors and clean thoroughly all the components. Check for cracks and other damage.
- 3 Fit the rotors inside the pump and check the outer rotor to body clearance (A).
- 4 Check the inner rotor to outer rotor clearance (B).
- 5 Check the rotor end-float with a straight edge and a feeler gauge (C). For all the above clearances, see section 11C.
- 6 If the oil seal is to be renewed, remove the rotors and press the seal from the body. The pump is easier to fit to the engine without the seal in position and the seal can be fitted with the pump on the engine, see operation 14A-02.

If necessary, the seal can be fitted with the pump off the engine. Ensure that the lip seal is to the inside of the pump and that the seal is fitted squarely in the pump. Use a suitable adaptor and press the seal into the pump until the front face of the seal is 0,5 mm (0.02 in) below the front face of the housing.

- 7 Lightly lubricate the rotors with clean engine oil and fit them to the pump. The inner rotor has a spigot on one end and this spigot must be fitted towards the seal housing. Fit the backplate with the word "TOP" away from the straight edge of the pump body (D). Fit and tighten the backplate screws to 4 Nm (3 lbf ft) 0,4 kgf m.



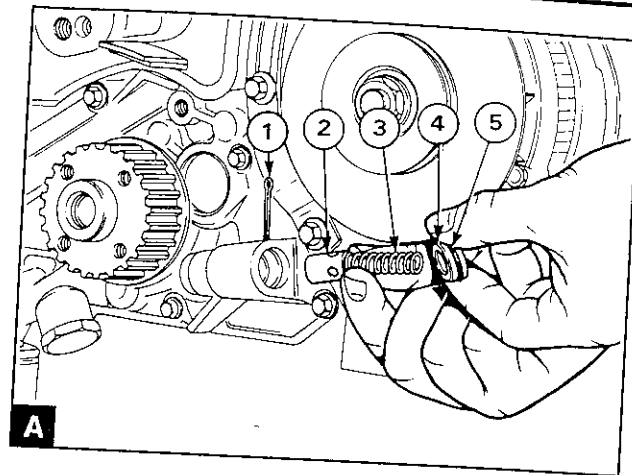
Relief valve

To remove and to fit

18A-08

The relief valve is fitted inside the left side of the pump body and cannot be removed as an assembly. The pressure setting is not adjustable except by the installation of new parts.

- 1 Straighten the open ends of the split pin (A1). Apply pressure to the end plug (A4) and remove the split pin from the pump body.
- 2 Release the pressure from the end plug and, if possible, remove the plug and the spring (A3). If the plug does not come out, lightly hit it inwards to see if the spring pressure will push it out of the housing. If the plug will still not come out, drill a small hole in the centre of the plug; use a self-tapping screw to remove the plug.
- 3 Remove the spring and the plunger (A2). A small magnet can be used to remove the plunger.
- 4 Renew the split pin, the "O" ring (A5) and the end plug (if the plug has been drilled).
- 5 Ensure that all the components are clean and lubricate them with clean engine oil. Fit the new "O" ring to the end plug.
- 6 Fit the plunger into the sleeve in the housing with the open end of the plunger towards the inside. Fit the spring over the boss on the end of the plunger. Fit the end plug with the end of the spring fitted inside the recess in the plug.
- 7 Press in the end plug and fit the split pin through the top hole in the housing and then through the bottom hole. Bend over the ends of the split pin.



To inspect

18A-09

- 1 Check the spring for wear and other damage and, if possible, check the load necessary to compress the spring to its fitted length, see section 11C.
- 2 Check the plunger for wear and other damage and ensure that it slides easily in the sleeve of the housing.
- 3 Check the body and the end plug for wear and other damage.
- 4 Renew worn or damaged components.

Fuel system

19

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	Fuel system	
19A-08	To eliminate air from the fuel system	19A.08

General description

All engines are fitted with a Bosch fuel injection pump. These pumps have mechanical governors to control the engine speed.

The atomisers receive high pressure fuel from the fuel injection pump and inject this fuel into the combustion chambers as a very fine spray. The pressure at which atomisers operate can be corrected by a change of shims fitted above the spring.

The fuel injection equipment must only be checked and adjusted by personnel who have had the correct training.

The lift pump is a diaphragm type pump and is mechanically driven. It is fitted on the right side of the camshaft cover and is driven by an eccentric on the camshaft. The pump is fitted with a priming lever.

It is very important that dirt does not enter the fuel system. Before a connection is disconnected, clean thoroughly the area around the connection. After a component has been disconnected, fit a suitable cover to all open connections.

Fuel filter canister

To renew

19A-01

- 1 Thoroughly clean the outside surfaces of the fuel filter assembly. Loosen, by two or three turns, the vent screw (A1) which is fitted in the top of the filter. Loosen the drain device (A2) at the bottom of the canister and drain the fuel into a suitable container.
- 2 Use a strap wrench or similar tool to loosen the filter canister and remove the canister (B).
- 3 Ensure that the threaded adaptor (B1) is secure in the filter head and that the inside of the head is clean.
- 4 Lubricate lightly the top seal of the new canister with clean fuel. Fit the new canister to the filter head and tighten, by hand only.
- 5 Eliminate the air from the fuel filter, see operation 19A-10.

Attention: It is important that only the genuine Volvo Penta fuel filter canister is used. The use of a wrong canister can damage the fuel injection pump.

Atomisers

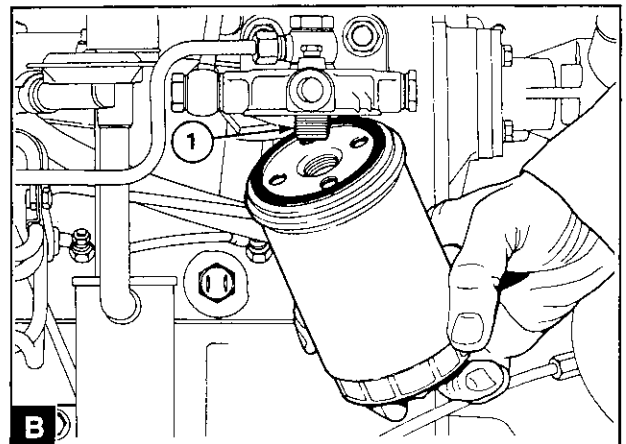
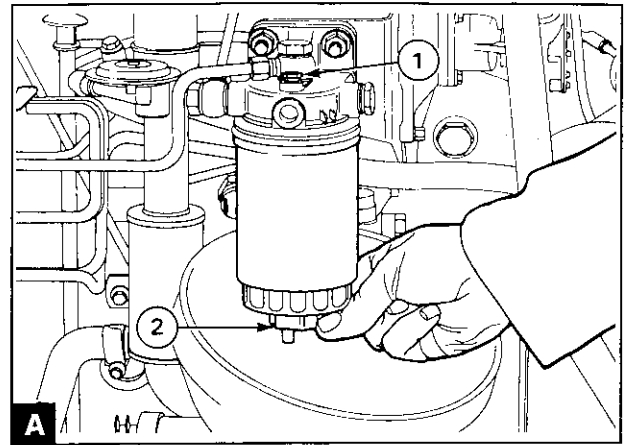
Atomiser fault

An atomisers fault can cause an engine misfire.

To find which atomiser is defective, operate the engine at a fast idle speed. Loosen and tighten the union nut of the high-pressure fuel pipe at each atomiser. When the union nut of the defective atomiser is loosened, it has little or no effect on the engine speed.



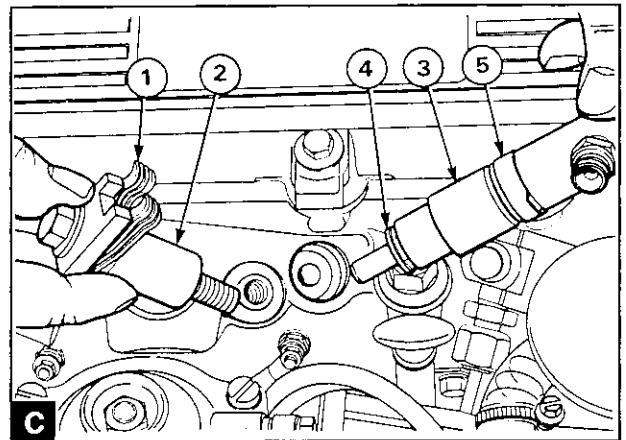
Ensure that the fuel does not spray onto your skin.



To remove and to fit

19A-02

- 1 Remove the fuel leak-off pipe.
- 2 Remove the union nuts of the high-pressure pipe from the atomiser and from the fuel injection pump. Hold the pump outlet with a spanner to prevent movement while the union is released at the pump. Do not bend the pipe. If necessary, remove the pipe clamps.
- 3 Release the clamp setscrew of the atomiser. The spacer (C2) will be either 31,5 mm (1.2 in) or 7 mm (0.3 in) long, according to the type of atomiser used. If a short spacer is used, lift the spring assembly during the setscrew removal operation. This will ensure that the thread of the setscrew does not enter the hole in the bottom spring. Remove the clamp assembly (C1) and the spacer. Remove the atomiser (C3) and its seat washer (A4).
- 4 Check the clamp assembly for damage or distortion and, if necessary, renew the assembly. Renew the atomiser seat washer.
- 5 Ensure that the atomiser location ring (C5) is in position in the cylinder head and put the new atomiser and seat washer into position. Ensure that the atomiser is not tilted. Fit the clamp assembly and the spacer with the arms of the clamp fitted squarely on the shoulders of the atomiser. Tighten the clamp setscrew to 43 Nm (32 lbf ft) 4,4 kgf m.



6 Fit the high-pressure fuel pipe and tighten the union nuts to 18 Nm (13 lbf ft) 1,8 kgf m. Hold the pump outlet with a spanner to prevent movement while the union nut is tightened at the pump. If necessary, fit the pipe clamps.

7 Fit the leak-off pipe.

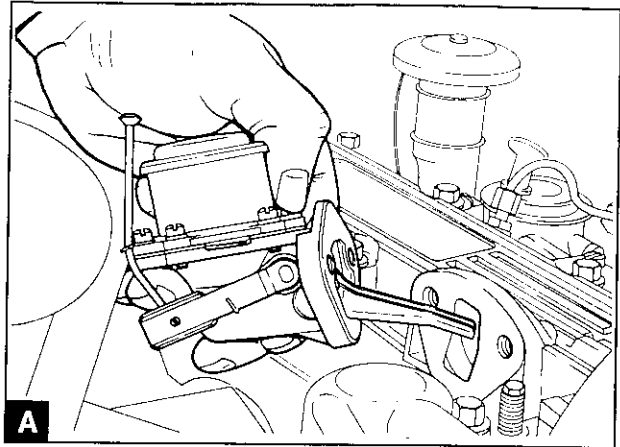
8 Operate the engine and check for leakage of fuel and air.

Lift pump

To remove and to fit

19A-03

- 1 Disconnect the fuel pipes from the lift pump.
- 2 Remove the setscrew from the timing hole in the top front of the camshaft cover. Turn the crankshaft until the timing hole in the front journal of the camshaft aligns with the hole in the cover. This will ensure that the highest point of the drive eccentric is away from the pump lever.
- 3 Release the setscrews and remove the lift pump (A).
- 4 Clean the joint faces of the lift pump and of the camshaft cover and fit the lift pump together with a new joint. Fit the setscrews and tighten them gradually and evenly to 22 Nm (16 lbf ft) 2,2 kgf m.
- 5 Connect the fuel pipes.
- 6 Release the vent screw on the fuel filter head. Operate the priming lever of the lift pump to eliminate any air between the lift pump and the fuel filter. Operate the lever until fuel, free of air, comes from the vent screw. Tighten the vent screw.
- 7 Operate the engine and check for any fuel or air leakage.



To dismantle and to assemble

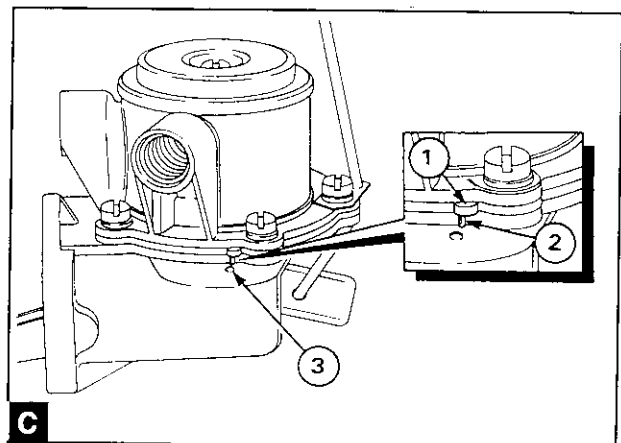
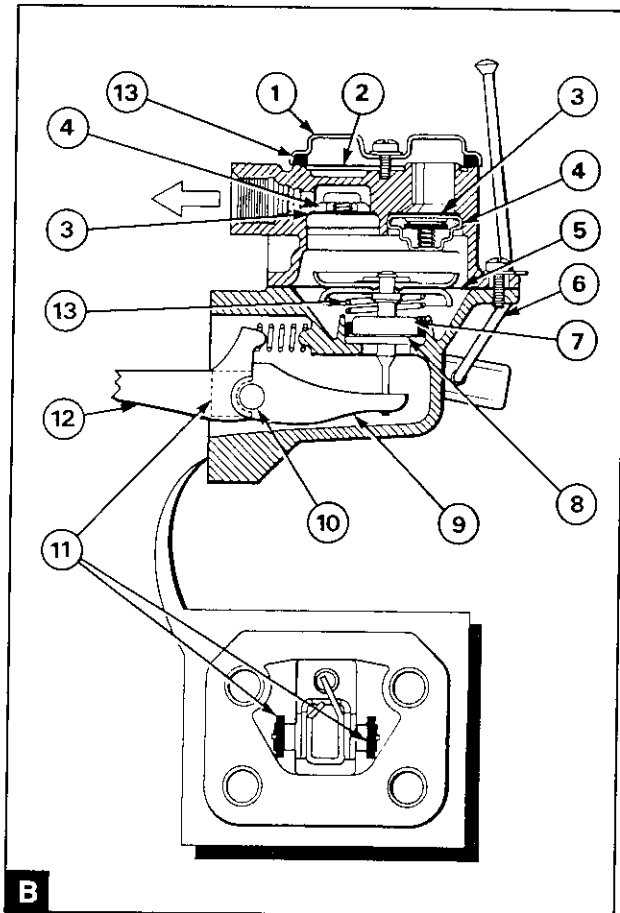
19A-04

To dismantle

- 1 Clean the outside surfaces of the lift pump.
- 2 Make a mark across the flanges of the two halves of the pump to ensure correct relationship when the pump is assembled.
- 3 Remove the lift pump cover (B1) and the gauze strainer (B2). Release the screws and separate the two halves of the pump.
- 4 Turn the diaphragm assembly (B5) 90° to release the diaphragm pull rod from the link arm (B9) and remove the diaphragm assembly. Remove the stem seal (B7), the spring seat washer (B8) and the spring (B13) from the pull rod. The diaphragm and pull rod assembly is renewed as an assembly and no service is possible on the diaphragm.
- 5 The valves (B4) are peened in and can be removed with a suitable lever. Some of the peened metal will have to be removed before the valves can be removed.
- 6 To remove the link arm: Hold the rocker lever (B12) in a vice and hit the body of the lift pump with a soft face hammer to release the two retainers (B11). Be careful not to damage the joint face of the pump body. Remove the rocker lever, the pin (B10), the link arm and the return spring. Check the components for wear and other damage.

To assemble

- 1 Thoroughly clean the valve housings. Fit new seat washers (B3) and push the new valves (B4) into position. As the valves are the same, but one valve is fitted in reverse of the other, it is possible to fit the valves upside down. To ensure that the valves are correctly fitted, fit them as shown in B. When the valves are correctly fitted, peen the edge of the valve housings in six evenly divided places to keep the valves in position.
- 2 Keep the rocker lever (B12), pin (B10) and link arm assembly (B9) into the bottom half of the lift pump. Fit the return spring and ensure that the ends of the spring are in their correct locations.



3 With a light hammer and a suitable adaptor, fit two new retainers (19A.04/B11) in their grooves in the casing until they fasten the pin. Peen the open ends of the grooves to fasten the retainers in position.

4 Fit the diaphragm spring (19A.04/B13) into its location under the diaphragm (19A.04/B5). Put the spring seat washer (19A.04/B8) and a new stem seal (19A.04/B7) into position on the pull rod. Ensure that the small diameter at the top of the seal is on the round section of the pull rod.

5 Put the diaphragm assembly in position over the lower half body with the blade of the pull rod aligned with the slot in the link arm. Ensure that the small protrusion on the edge of the diaphragm (19A.04/C1) is at 90° to the similar protrusion on the body (19A.04/C2). Press lightly down on the diaphragm until the notch in the pull rod is in the slot in the link arm. Turn the diaphragm 90° to ensure that the protrusion on the edge of the diaphragm aligns with the protrusion on the body. This action will engage and retain the pull rod in the slot of the link arm.

6 Push the rocker arm upwards until the diaphragm is level with the body flange. Fit the top half of the body in position with the marks on the flanges aligned. Keep the pressure on the rocker arm and fit the spring washers and the screws. Release the pressure on the rocker arm and tighten the screws evenly. When fitted, the edge of the diaphragm should be approximately level with the edge of the body.

7 Fit the gauze strainer (19A.04/B2) and the cover (19A.04/B1) with the rubber seal (19A.04/B14) correctly fitted. Fit the cover screw and its sealing washer and tighten the screw.

To test

19A-05

If there is a leakage of fuel through the hole in the pump body (19A.04/C3), this will indicate that the diaphragm is damaged. If there is a leakage of lubricating oil, the seal is damaged.

1 Disconnect the fuel outlet pipe from the fuel lift pump. Fit a 0—70 kPa (0—10 lbf/in² (0—0,7 kgf/cm²) pressure gauge to the outlet of the lift pump. Release the connection at the gauge and operate the priming lever of the lift pump to eliminate air from the pipe. When fuel, free of air, flows from the pipe tighten the connection. Ensure that there are no leaks at the connections between the pump and the gauge.

2 Operate the starter motor for 10 seconds and note the maximum pressure indicated on the gauge. If the pressure indicated is less than 75% of the minimum production static pressure shown in section 11C, correct or renew the pump. Also, after the crankshaft rotation has stopped, check the rate at which the pressure reduces to half the maximum pressure obtained. If this is less than 30 seconds, correct or renew the pump.

3 Remove the gauge and connect the outlet pipe to the lift pump. Release the vent screw on the fuel filter head and operate the priming lever until fuel, free of air, flows from the vent screw. Tighten the vent screw.

Fuel injection pump

To remove and to fit

19A-06

Special tools:

Timing pins, 885037-2

Pulley remover, 885027-3

Adaptors for use with 885029-9

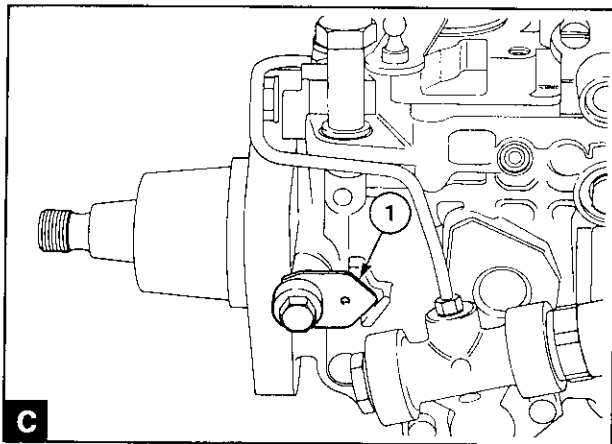
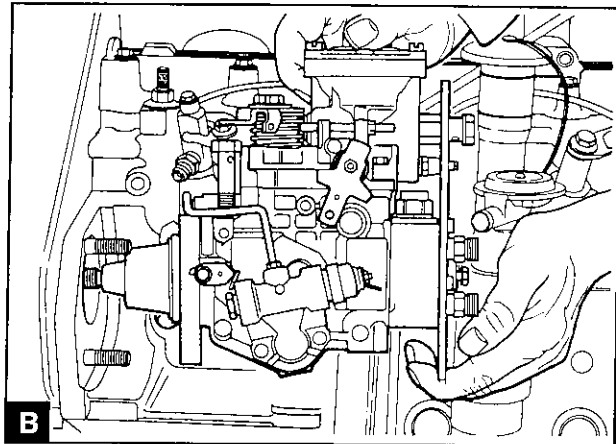
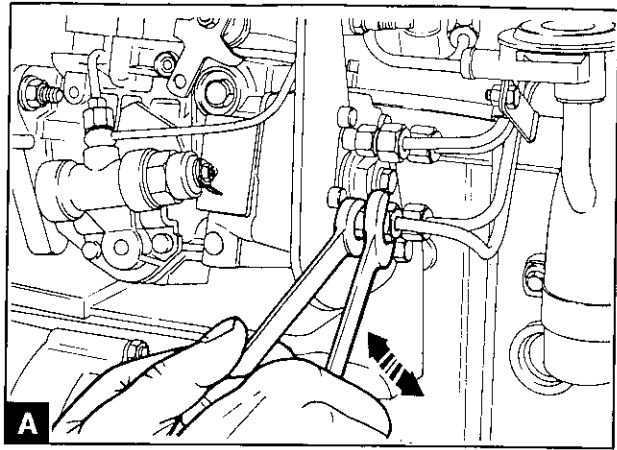
Anti-rotation tool, 885055-4

- 1 Disconnect the battery.
- 2 Set number 1 piston to TDC compression stroke, operation 17A-01 and fit the timing pins 885037-2. Remove the starter motor, operation 22B-01 and fit anti-rotation tool 885055-4 to the flywheel.
- 3 Remove the timing case cover, the timing belt and the toothed pulley for the fuel injection pump, see section 15.
- 4 Disconnect the speed control of the fuel pump and, if necessary disconnect the stop control. Disconnect the cable from the stop solenoid on the pump. Ensure that the cables are suitably marked to ensure that they can be connected correctly.
- 5 Remove all necessary pipes from the pump. Ensure that a spanner is used to prevent movement of the fuel pump outlets (A) when the nuts of the high-pressure pipes are released.
- 6 Remove the setscrews which fasten the support bracket at the rear of the pump to the mounting bracket.
- 7 Remove the flange nuts and remove the pump (B) — ensure that they key does not fall from the drive shaft.

To fit

Attention: If a new or reconditioned pump is to be fitted, the pump shaft may be fastened in the equivalent position to the engine at number 1 piston at TDC compression stroke. If it is, the spacer in the shape of a pointer (C1) will be removed from under the setscrew which is fitted to the front left side of the pump. The spacer will be fastened loosely to the pump by a piece of wire. The pump can be fitted and the tension of the timing belt adjusted with the pump in this condition but **the pump shaft or the crankshaft must not be turned without the spacer in position under the setscrew.**

- 1 Ensure that the timing pins are fitted into the camshaft and into the flywheel. Ensure that the anti-rotation tool is fitted.
- 2 Ensure that the key is correctly fitted to the pump shaft. Put the fuel pump in position with the flange nuts tightened enough to hold the pump; but not enough to prevent radial movement of the pump body. Fit the setscrews which fasten the support bracket at the rear of the pump and tighten them finger tight.
- 3 Put the toothed pulley on the shaft with the key engaged in the correct keyway, see operation 15A-05. Hold the pulley to prevent movement, fit the pulley nut and washer and tighten the nut to press the pulley onto the shaft; do not tighten the nut to its final torque.
- 4 If the shaft of the pump is fastened into the TDC position (see "Attention" above): Ensure that the correct marked tooth is towards the arrow on the timing case and fit the timing belt, see operation 15A-04. Check the position of the studs within the slots of the pump mounting flange; ensure that the fuel pump can move in a clockwise direction from the rear while the belt tension is adjusted. If there is not enough movement, change the belt position on the pulley. Adjust the tension of the timing belt, operation 15A-03. Ensure that the studs are not at the ends of the slots in the mounting flange of the pump and tighten the flange nuts. Loosen the setscrew on the side of the pump and fit the spacer



underneath. Tighten the setscrew to 12 Nm (9 lbf ft) 1,2 kgf m. Tighten the nut of the pump pulley to 60 Nm (44 lbf ft) 6,1 kgf m. Check the timing of the pump, operation 17A-03.

If the pump shaft is not fastened: Ensure that the correct marked tooth is towards the arrow on the timing case and fit the location pins through the plain holes in the pump pulley. Fit the timing belt, see operation 15A-04 and remove the location pins. Adjust the belt tension, operation 15A-03. Tighten the nut of the pump pulley to 60 Nm (44 lbf ft) 6,1 kgf m. Adjust the timing of the pump, operation 17A-03 and tighten the flange nuts of the pump.

5 Tighten the setscrews which fasten the support bracket at the rear of the pump to the mounting bracket.

6 Ensure that the timing pins are removed. Remove the anti-rotation tool and fit the starter motor, operation 22A-01.

7 Fit the timing case cover, operation 15A-01.

8 Fit the low-pressure pipes. Some pumps are fitted with a banjo connection bolt which is marked "OUT" and this must be fitted at the fuel return to tank connection.

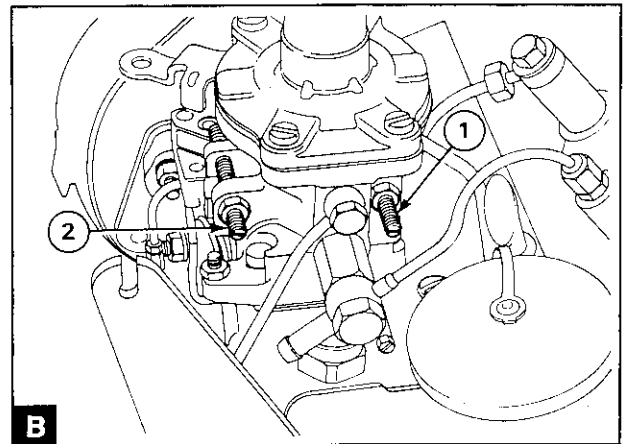
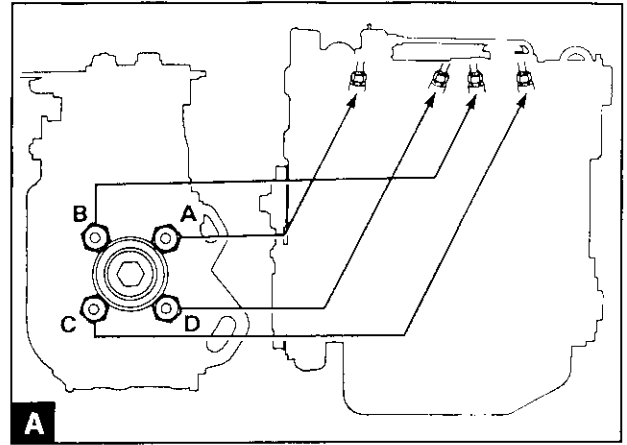
9 Fit the high-pressure pipes to the pump. Ensure that a spanner is used to prevent movement of the fuel pump outless when the high-pressure pipes are fitted. The relevant cylinders to which the pump outlets are to be connected are given in figure A. Do not tighten the connections at the atomisers until the air has been eliminated from the system.

10 Connect the speed control of the fuel pump and, if necessary, connect the stop control. Connect the cables from the stop solenoid on the pump. Connect the battery.

11 Eliminate air from the fuel system, operation 19A-8.

12 Operate the engine and check for leakage. Check that the idle speed is correct, operation 19A-07.

13 If a new fuel pump has been fitted, check the maximum no load speed, operation 19A-07.



To adjust

19A-07

1 Operate the engine until it reaches its normal temperature of operation and check the idle speed. If necessary, adjustment can be made by the inner adjustment screw (B1). Release the locknut and turn the screw clockwise to increase or counter-clockwise to decrease the speed. When the speed is correct, tighten the locknut.

2 With the engine at its normal temperature of operation, check the maximum no load speed. The maximum no load speed is indicated by the last section of the fuel pump setting code. The setting code can be found on the data plate on side of the fuel pump. A typical setting code is 2643H000CE/1/3200. In this example, the maximum no load speed is 3200 rev/min. If necessary, this speed can be adjusted by the outer adjustment screw (B2). Release the locknut and turn the screw counter-clockwise to increase or clockwise to decrease the speed. When the speed is correct, tighten the locknut and seal the screw. The person who fits the pump must ensure that the adjustment screw is suitably sealed against interference after it has been set initially.

The adjustment screw on original fuel pumps is set and sealed by the manufacturer. The setting must not be changed as this could affect the engine warranty.

Fuel system

To eliminate air from the fuel system **19A-08**

If air enters the fuel system, it must be eliminated before the engine can be started.

Air can enter the system if:

- The fuel tank is drained during normal operation.
- The low-pressure fuel pipes are disconnected.
- A part of the low-pressure fuel system leaks during engine operation.

To eliminate air from the fuel system, proceed as follows:

1 Loosen, by two or three turns, the vent screw (A1) on the top of the fuel filter.

2 Operate the priming lever (B) on the fuel lift pump until fuel, free from air, comes from the filter vent point. Tighten the vent screw of the filter. If the drive cam of the fuel lift pump is at the point of maximum cam lift, it will not be possible to operate the priming lever. In this situation, the crankshaft must be turned one revolution.

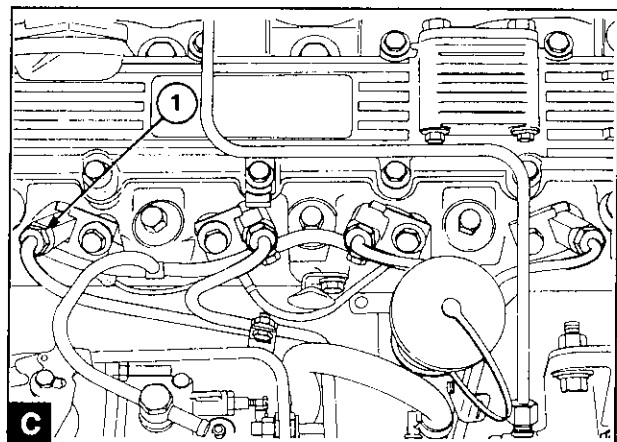
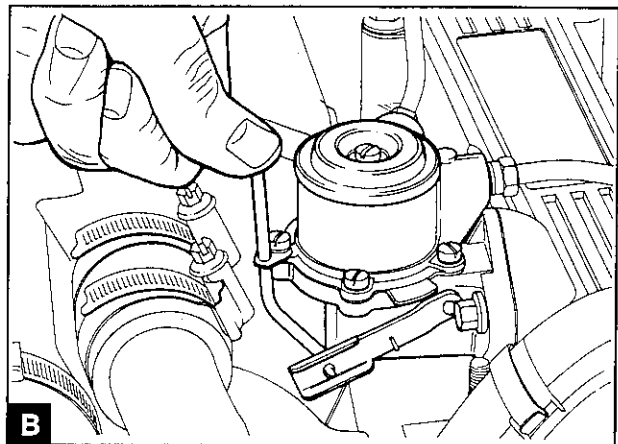
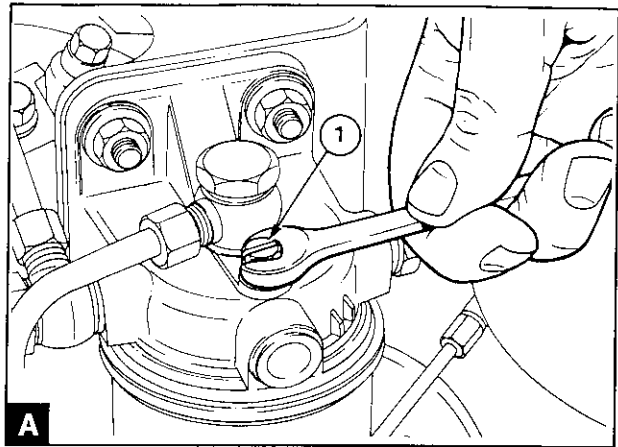
3 Loosen the union nuts of the high-pressure pipes at the atomisers (C). According to the type of atomiser fitted, the union nuts will be connected at the top or at the side of the atomiser.

4 Operate the starter motor until fuel, free from air, comes from the pipe connections. If a separate starter switch is used, ensure that the switch for the engine electrical system is in the "on" position for this operation.

5 Tighten the high-pressure pipe connections.

6 The engine is now ready to start.

If the engine runs correctly for a short time and then stops or runs roughly, check for air in the fuel system. If there is air in the fuel system, there is probably a leakage in the low pressure system.



Cooling system

20

	General description	20A.02
	Coolant circuit	
20A-01	To drain	20A.03
20A-02	To fill	20A.03
	Raw water circuit	
20A-03	To drain	20A.03
	Thermostat	
20A-04	To remove and to fit	20A.04
	To test	20A.04
	Water pump	
20A-05	To remove and to fit	20A.05
	Raw water pump	
20A-06	To remove and to fit	20A.06
20A-07	To dismantle and to assemble	20A.06
	Mounting bracket and plate for the raw water pump	
20A-08	To remove and fit	20A.07
	Lubrication oil cooler	
20A.09	To remove and to fit	20A.08
	Heat exchanger/manifold/header tank assembly	
20A-10	To remove and to fit	20A.09
20A-11	To remove the tube stack of the heat exchanger	20A.10

General description

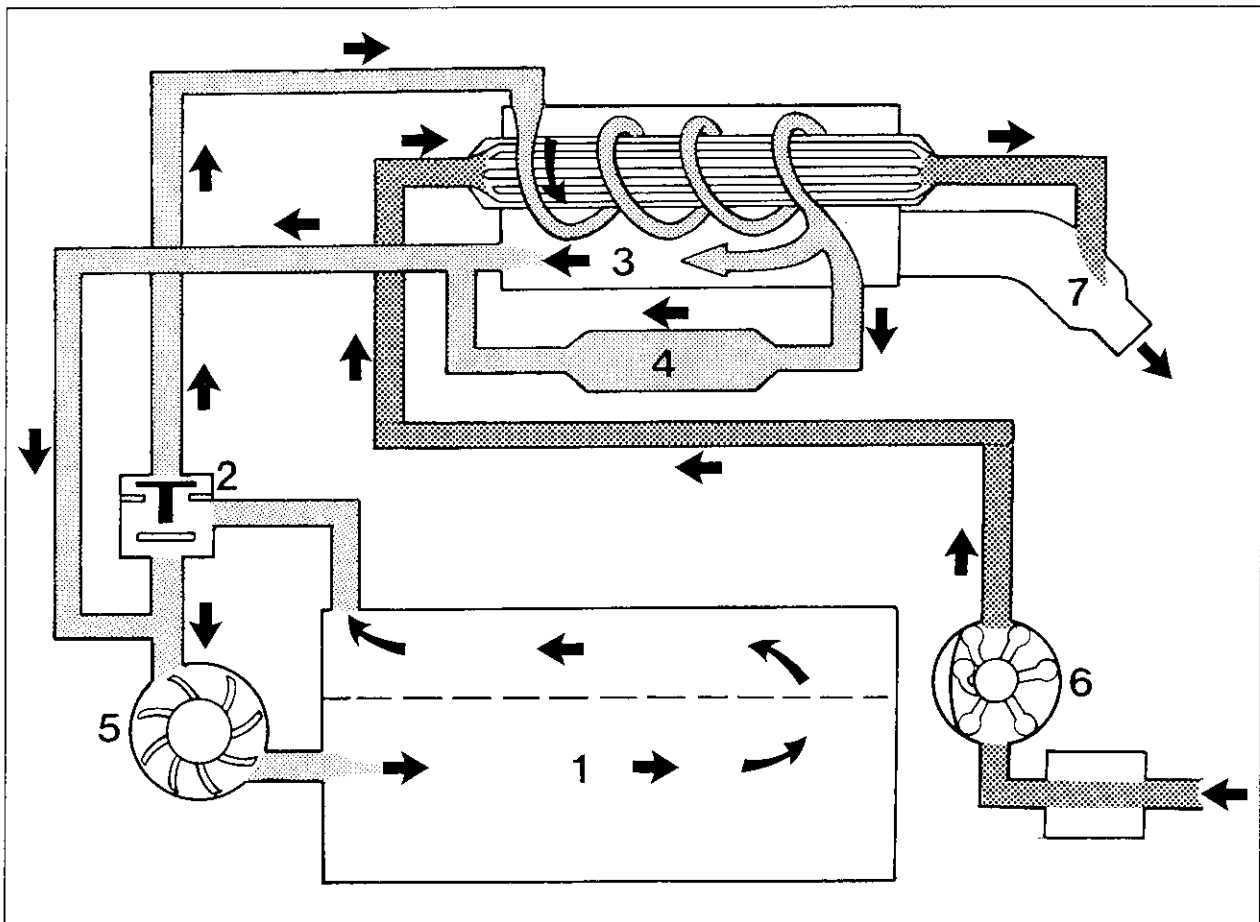
The engine has two cooling circuits. The closed circuit is filled with coolant which is used to cool the cylinder block and the cylinder head. This coolant is used also to cool the exhaust manifold. The raw water circuit uses raw water from outside the boat to cool the coolant of the closed circuit and to cool also the lubricating oil.

The heat exchanger, the exhaust manifold and the header tank for the closed circuit coolant are all together in one assembly. This is fitted to the right side of the engine.

The coolant in the closed circuit passes from the header tank to the inlet of the water pump. From the pump the coolant passes through the cylinder block and the cylinder head to the thermostat housing. If the coolant is cold, it passes through the by-pass, directly to the inlet of the water pump. As the temperature of the

coolant increases, the thermostat valve will open, the by-pass will close and the coolant will pass to the heat exchanger. In the heat exchanger, the coolant passes around the tubes and is cooled by the raw water in the tubes. The coolant leaves the exchanger tubestack and enters the tank assembly where it cools the exhaust manifold which is an intergral part of the assembly. The coolant then passes to the inlet of the water pump. Some coolant passes through an outlet at the rear of the assembly to an oil cooler and then to the pump inlet.

The raw water is circulated by the raw water pump which is fitted at the rear of the cylinder head and is driven from the rear end of the camshaft. From the pump, the raw water passes through the tubes of the heat exchanger and is then discharged into the exhaust.



- | | |
|---|----------------------|
| 1. Cylinder block | 4. Engine oil cooler |
| 2. Thermostat | 5. Fresh water pump |
| 3. Combined header tank
heat exchanger inlet and
exhaust manifold | 6. Raw water pump |
| | 7. Exhaust elbow |

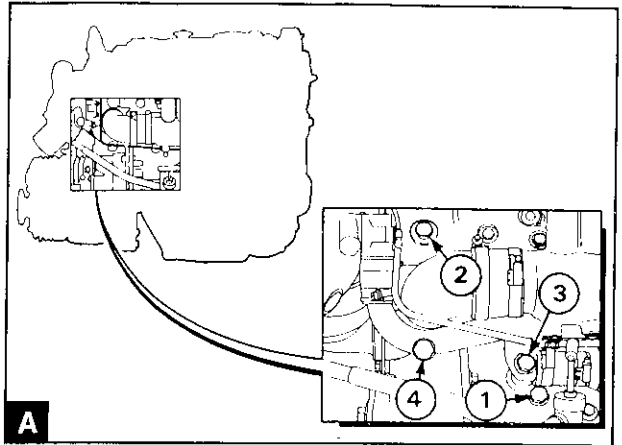
Coolant circuit

To drain

20A-01

Attention: Do not drain the coolant while the engine is still hot and the system is under pressure because dangerous hot coolant can be discharged.

- 1 Remove the filler cap from the coolant header tank.
- 2 Remove the drain plug (A1) from the right side of the cylinder block to drain the engine. Ensure that the drain hole is not restricted.
- 3 Remove the drain plug (A2) at the bottom of the heat exchanger/manifold/header tank assembly to drain the assembly. Ensure that the drain hole is not restricted.
- 4 Remove the drain plug (A3) from the inlet of the engine oil cooler. Ensure that the drain hole is not restricted.
- 5 Fit the drain plugs and the filler cap.
- 6 Fasten a suitable label to the engine control panel to indicate that the coolant has been drained.

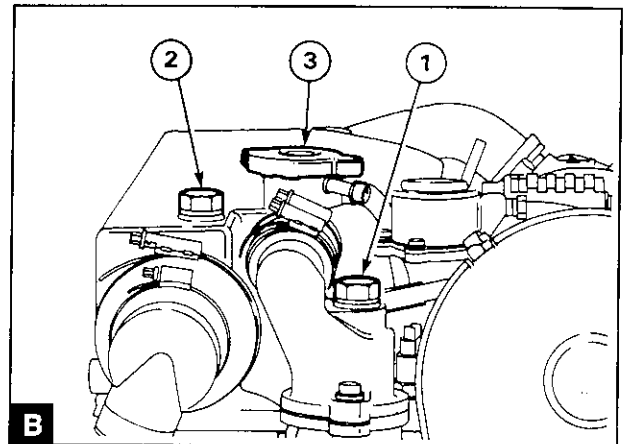


To fill

20A-02

- 1 Remove the vent plug from the water outlet connection (B1) or from the top of the heat exchanger/manifold assembly (B2).
- 2 Remove the filler cap (B3) of the header tank and fill the tank until the coolant level reaches the filler tube.
- 3 Fit the vent plug and the filler cap.
- 4 Start the engine and, when it has reached its normal temperature of operation, stop it and let it cool.
- 5 Remove the filler cap of the header tank and add coolant until the level of the coolant reaches the filler tube. Fit the filler cap.

Attention: If coolant is added to the circuit during service, it must consist of the same original mixture as used to fill the system.



Raw water circuit

To drain

20A-03

- 1 Ensure that the seacock is closed.
- 2 Disconnect both hoses at the raw water pump.
- 3 Remove the drain plug (A4) from the outlet pipe of the heat exchanger. Ensure that the drain hole is not restricted.
- 4 Turn the engine to ensure that the raw water pump is empty.
- 5 Connect the pipes and fit the drain plug.

Thermostat

To remove and to fit

20A-04**To remove**

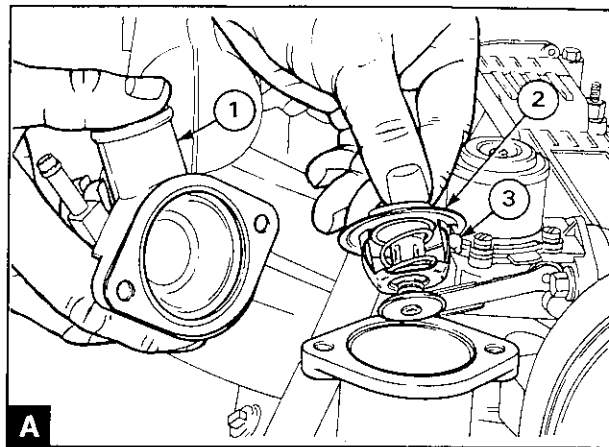
- 1 Drain the cooling system so that the coolant level is below the thermostat position and disconnect the top hose from the coolant outlet connection.
- 2 Release the setscrews and remove the coolant outlet connection (A1).
- 3 Remove the thermostat (A2).

To fit

- 1 Ensure that the joint faces of the housing and the outlet are clean and the jiggle pin (A3) in the thermostat is free to move.
- 2 Put the new thermostat in position in the housing.
- 3 Fit a new joint and the coolant outlet connection and tighten the setscrews.
- 4 Connect the top hose and fill the cooling system with the correct coolant, see the relevant handbook.

To test

- 1 Hang the thermostat in a suitable container filled with water.
- 2 Heat the water gradually. Use a thermometer to check the temperature at which the valve starts to open and at which it is fully open. The correct temperatures are given in section 11C.
- 3 If the thermostat does not operate correctly, it must be renewed. Do not try to adjust the settings.



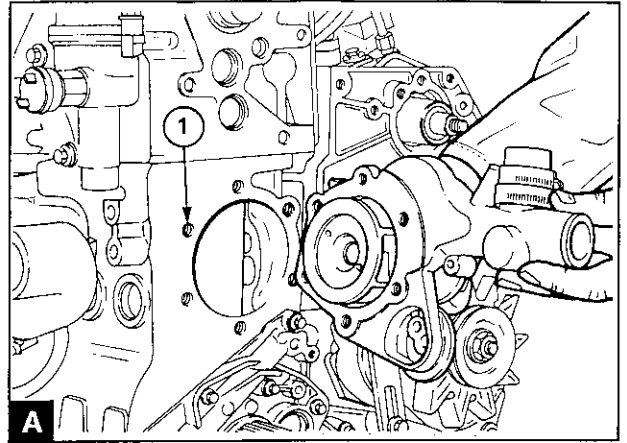
Water pump

To remove and to fit

20A-05

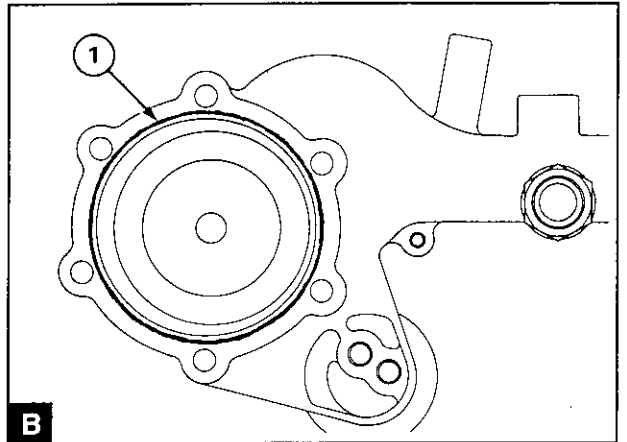
To remove

- 1 Disconnect the battery.
- 2 Drain the coolant circuit, operation 20A-01.
- 3 Disconnect the inlet pipe at the water pump and, if necessary, disconnect the by-pass connection.
- 4 Set number 1 piston to TDC compression stroke, operation 17A-01 and fit the timing pins.
- 5 Remove the timing case cover, operation 15A-01 and the timing belt, operation 15A-04.
- 6 Remove the timing case, operation 15A-08. Remove the pump setscrews and remove the pump (A).



To fit

- 1 Check the pump for wear and other damage. If there is a fault, the pump must be renewed as an assembly.
 - 2 Ensure that the contact faces of the water pump and of the cylinder block are clean.
 - 3 Apply a 1,0/1,5 mm (0.04/0.06 in) continuous bead of Sealant to the contact face of the pump, on the impeller side of the fastener holes (B1). If the old setscrews are to be used, clean the thread of the setscrew which will be fitted in the 10 o'clock position (A1) and apply sealant to the thread. Immediately after the sealant has been applied to the pump, put the pump in position and fit the setscrews. Tighten the setscrews gradually and evenly to the correct torque, see section 11B.
 - 4 Fit the timing belt, operation 15A-04, and adjust the belt tension, operation 15A-03. Check the timing of the fuel injection pump, operation 17A-03.
 - 5 **Ensure that the timing pins are removed** and fit the setscrew in the timing hole in the top of the camshaft cover.
 - 6 Connect the hose to the pump inlet connection and, if necessary, connect the by-pass connection. Fill the cooling system with the correct coolant: see the relevant handbook.
- Fill the coolant circuit, operation 20A-02.
- 7 Connect the battery. Operate the engine and check for leakage.



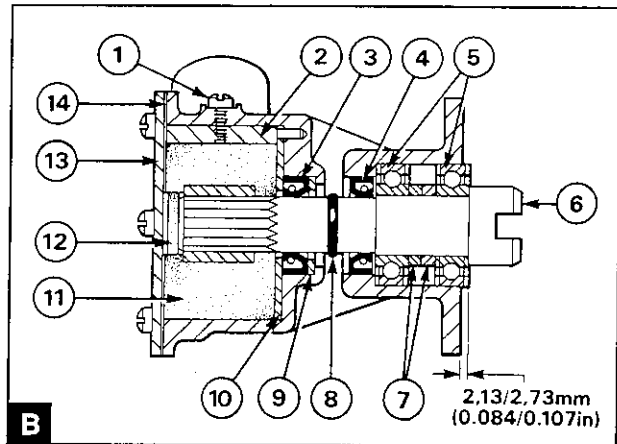
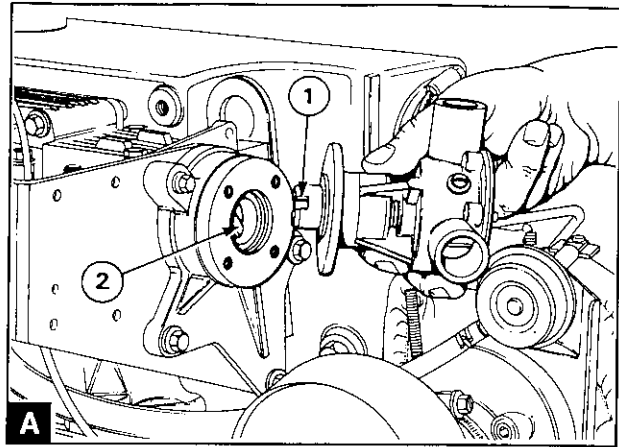
Raw water pump

To remove and to fit

20A-06

Attention: If the mounting bracket and the mounting plate for the raw water pump are released, they must be aligned correctly (with the use of an alignment tool) before the pump is fitted, see operation 20A-08.

- 1 Drain the raw water circuit, operation 20A-03.
- 2 Disconnect the hose connections at the pump.
- 3 Release the four setscrews which fasten the pump to its drive housing and remove the pump (A).
- 4 Clean the contact surfaces of the pump body and the adaptor plate.
- 5 Clean and inspect for wear the drive components of the pump. If necessary, renew the worn components or the pump. If the drive adaptor is removed from the end of the camshaft, tighten the adaptor cap screws to 9 Nm (7 lbf ft) 0,9 kgf m when the adaptor is fitted.
- 6 Apply a high melting point grease (for example Shell Alvania R2) to the drive components and to fill the inside of the drive housing.
- 7 Align the slot in the pump shaft (A1) with the projection on the drive shaft (A2). Fit the pump to the engine with a new joint between the pump and the adaptor plate. Fit the setscrews and tighten them to 9 Nm (6 lbf ft) 0,9 kgf m.
- 8 Connect the hose connections at the pump.
- 9 If necessary, open the seacock.



To dismantle and to assemble

20A-07

To dismantle

- 1 Remove the pump, operation 20A-06.
- 2 Remove the end cover (B13) and its joint (B14).
- 3 Remove the rubber plug (B12) from the end of the impeller (B11).
- 4 Remove carefully the impeller from the shaft (B6) with suitable levers or with long nose pliers.
- 5 Press out the shaft and bearing assembly through the drive end of the housing with the use of a suitable adaptor. If the bearings (B5) and their spacers (B7) do not come out with the shaft, they can be pressed out later when the impeller seal (B3) has been removed. Do not lose the "O" ring (B8) when the shaft is removed.
- 6 Release the cam plate screw (B1) by two or three turns and lightly hit the top of the screw to separate the cam plate (B2) from the body. Remove the screw and the cam plate.
- 7 Remove the wear ring (B10), the seal (B3) and the seal spacer (B9) from the impeller housing.
- 8 Remove the seal (B4) from the bearing housing.
- 9 Check the components for wear and other damage and renew the, if necessary. Renew the seals and the joint.

To assemble

- 1 Ensure that all the components are clean.
- 2 Press one of the bearings (B5) on the shaft (B6), fit the spacers (B7) and then press on the other bearing. Use an adaptor that will contact the inner flange of the bearing to press on the bearings. The bearings are lubricated for life.
- 3 Press one of the seals (B4) into position in the bearing housing with the lip towards the drive end. Lightly lubricate the lip of the seal.

4 Support the pump on the cover end and press the shaft and bearing assembly into the bearing housing. When the assembly has been correctly pressed in, the outside bearing will have a protrusion of 2,13/2,73 mm (0.084/0.107 in) from the mounting face.

5 Slide the "O" ring (B8) along the shaft until it is in the centre of the space between the bearing housing and the impeller housing.

6 Fit the seal spacer (B9) into the seal housing. Lightly lubricate the lip of the other seal (B3) and press it into position in the impeller housing with the lip towards the impeller position.

7 Put the wear plate (B10) in position in the impeller housing with the dowel in its location. If the plate is worn on one face, fit it with the face which is not worn towards the impeller.

8 Apply a suitable jointing compound to the top face and to the front (wear plate) face of the cam plate (B2). Also apply jointing compound to the thread of the screw (B1) for the cam plate. Fit the cam plate and tighten the screw.

9 Apply Marfak 2HD grease to the blades of the impeller (B11) and fit it on the shaft with the blades bent clockwise (as seen from the cover end). If the blades are slightly worn, the impeller can be fitted with its original front end to the rear. Fit the rubber plug (B12) in the end of the impeller.

10 Apply jointing compound to a new joint (B14). Fit the joint, the end cover (B13) and the screws. Tighten the screws gradually and evenly.

Mounting bracket and plate for the raw water pump

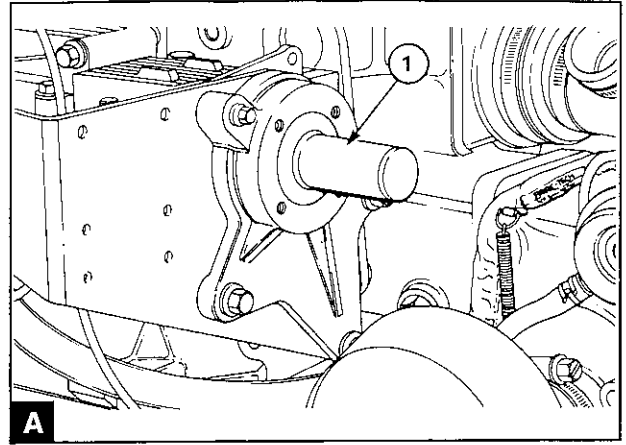
To remove and to fit

20A-08

Special tool:

Alignment adaptor for raw water pump mounting, 885038-0

- 1 Remove the raw water pump, operation 20A-06 and remove the adaptor plate.
- 2 Disconnect the fuel pipes at the fuel filter and, if necessary, remove the filter.
- 3 Release the four setscrews and remove the mounting plate and the bracket.
- 4 Check the bracket and the plate for cracks and other damage.
- 5 Release the cap screws and remove the drive adaptor from the end of the camshaft.
- 6 Put the mounting bracket and plate in position, engage the setscrews and tighten them finger tight only.
- 7 Engage the small diameter of the alignment tool (A1) into the end of the camshaft and the larger diameter into the bore of the mounting plate. Tighten the setscrews gradually and evenly and remove the alignment tool.
- 8 Fit the drive adaptor in the end of the camshaft and tighten the cap screws to 9 Nm (7 lbf ft) 0,9 kgf m.
- 9 Fit the raw water pump, operation 20A-06.



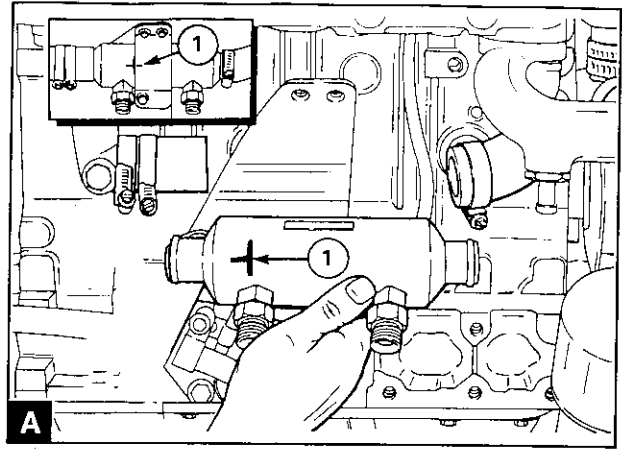
Lubricating oil cooler

To remove and to fit

20A-09

The tubes in the cooler will not normally need to be cleaned as the coolant which goes through them is from the closed coolant circuit.

- 1 Drain the coolant circuit, operation 20A-01.
 - 2 Disconnect the coolant pipes at the cooler.
 - 3 Disconnect the lubricating oil pipes at the cooler.
 - 4 Make a suitable mark on the body and on the strap (A1) to indicate the correct position for the strap.
 - 5 If the cooler only is to be removed: Release the three setscrews which fasten the strap to the cooler and remove the strap and the cooler (A) from the bracket.
 - 6 Check the components for damage and renew them, if necessary.
 - 7 If the cooler and bracket assembly have been removed: Put it in position and engage the two front setscrews. Engage the rear setscrew through the bracket of the drain pump and the spacer and into the cylinder block. Ensure that the cooler body is in the correct position. Tighten the front setscrews to 22 Nm (16 lbf ft) 2,2 kgf m and the rear setscrew to 43 Nm (32 lbf ft) 4,3 kgf m.
- If the cooler only has been removed: Put it into its correct position, fit the strap and tighten the three setscrews for the strap to 22 Nm (16 lbf ft) 2,2 kgf m.
- 8 Connect the coolant hoses and the oil pipes.
 - 9 Fill the coolant system, operation 20A-02.
 - 10 Operate the engine and check for leakage of coolant and lubricating oil.

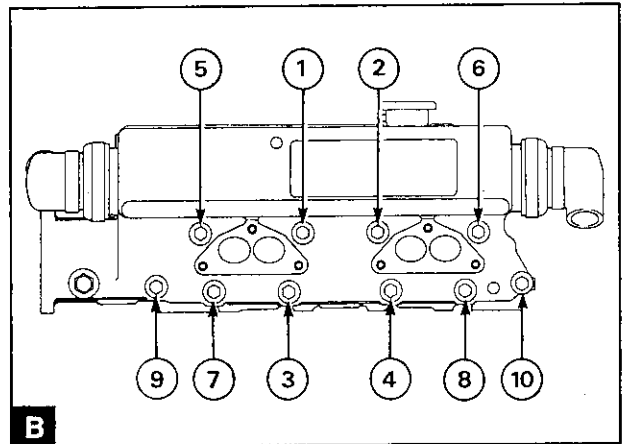
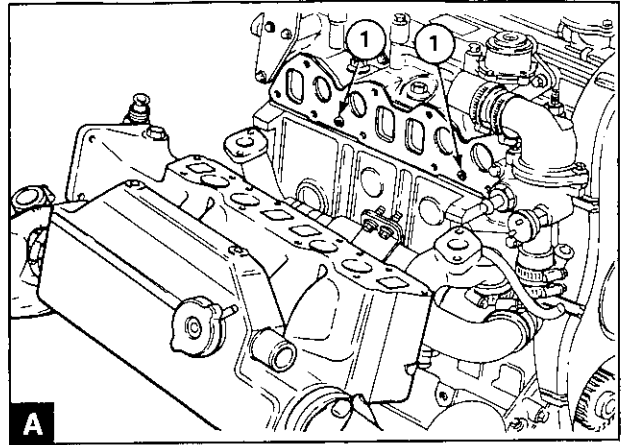


Heat exchanger/manifold/header tank exchanger

To remove and to fit

20A-10

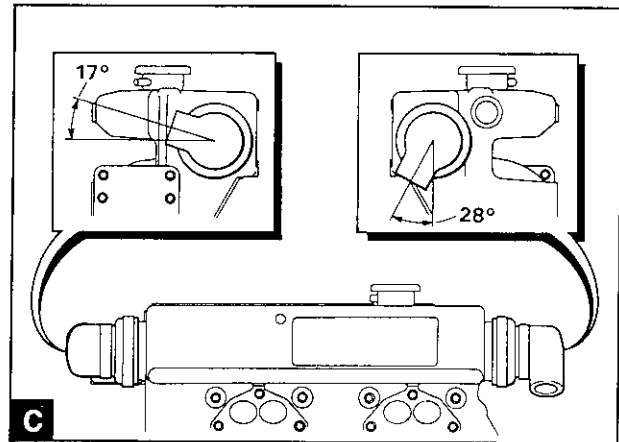
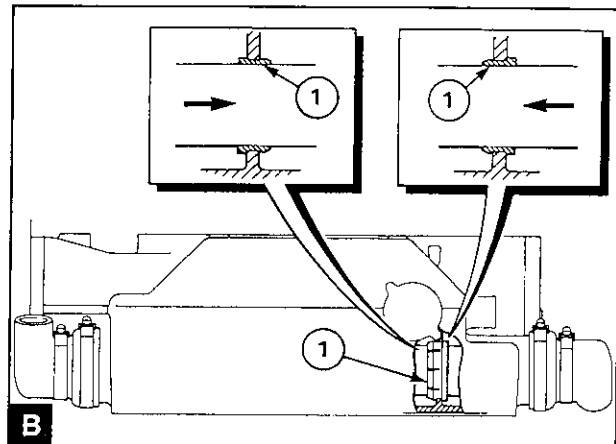
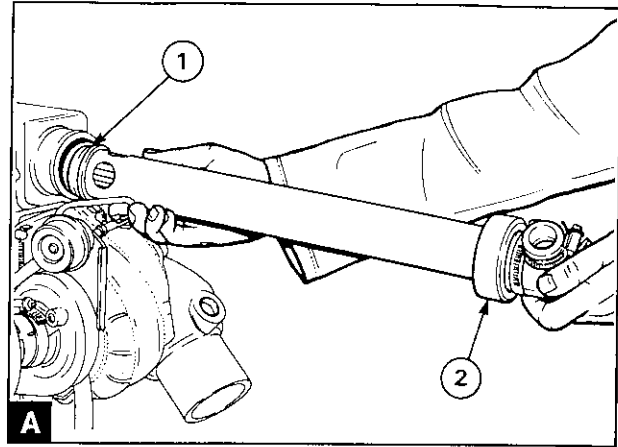
- 1 Drain the coolant circuit, operation 20A-01 and the raw water circuit, operation 20A-03.
- 2 Release the support clips which fasten the outlet pipe of the heat exchanger to the bottom of the inlet manifold. Remove the induction manifold.
- 3 Disconnect the inlet and the outlet pipes for the raw water of the heat exchanger.
- 4 Release the flange setscrews of the coolant pipes which are fitted to the bottom of the assembly and release the pipes from the assembly.
- 5 Remove the support bracket which is fitted between the rear of the assembly and the adaptor housing for the reverse gearbox.
- 6 Release evenly and gradually the setscrews which fasten the assembly to the cylinder head, in the reverse sequence to that shown in B. Remove the assembly (A).
- 7 Remove the joints and clean the contact faces of the assembly, the cylinder head and the flanges of the coolant pipes. Check the components for damage and renew them, if necessary. If the tube stack is to be removed, see operation 20A-11.
- 8 Put a new manifold joint in position over the dowels in the cylinder head (A1). It is not necessary to use a jointing compound. Ensure that the joint is fitted correctly, as shown in 18A.03/B.
- 9 Put the assembly in position on the cylinder head and engage the setscrews. Tighten the setscrews evenly and gradually to 22 Nm (16 lbf ft) 2,2 kgf m, in the sequence shown in B.
- 10 Fit the support bracket between the rear of the assembly and the flywheel housing.
- 11 Fit the coolant pipes to the bottom of the assembly, together with new joints.
- 12 Connect the inlet and the outlet pipes for the raw water of the heat exchanger. The end of the outlet pipe should reach the centre of the end cap.
- 13 Fit the induction manifold, together with new joints and tighten the setscrews to 22 Nm (16 lbf ft) 2,2 kgf m.
- 14 Fit the support clips which fasten the outlet pipe of the heat exchanger.
- 15 Fill the coolant circuit, operation 20A-02 and open the seacock.
- 16 Operate the engine and check for leaks.



To remove and to fit the tube stack of the heat exchanger **20A-11**

The tube stack can be removed (with the heat exchanger in position) if there is 555 mm (22 in) clearance directly to the front or the rear of the face of the header tank.

- 1 Drain the coolant circuit, operation 20A-01 and the raw water circuit, operation 20A-03.
- 2 Release the support clips which fasten the outlet pipe of the heat exchanger to the bottom of the inlet manifold. Disconnect the outlet pipe.
- 3 Loosen the clips of the neoprene end caps and remove the caps.
- 4 Press the tube stack out through either end of the heat exchanger. Ensure that the sleeve (A1) is removed from the body.
- 5 Ensure that the bores of the tubes are clean. If there are hard deposits or debris in the tubes, the best method to clean them is to use a non-caustic solution which is approved by the manufacturer. If the deposits or the debris are soft, the tubes can be cleaned with a steel rod of 3 mm (1/8 in) diameter. Push the rod through the tubes in the opposite direction to the water flow. Ensure that the rod does not damage the tubes.
- 6 Check the components for damage and renew them, if necessary.
- 7 Slide the sleeve (A1) onto one end of the tube stack until the end of the tube stack is in contact with the reduced diameter in the sleeve.
- 8 Push an end cap (A2) over the other end of the tube stack until the protrusion on the inside of the cap is in contact with the end of the tube stack.
- 9 If a rubber sleeve is used, lubricate it with a little soft soap. Put the sleeve end of the assembly into the housing and carefully enter the sleeve into the hole in the baffle plate. Carefully push the tube end of the housing until the spigot of the housing is correctly fitted inside the end cap. Do not pull the tube stack backward during the assembly operation as this will remove the sleeve from the baffle plate. Check through the filler cap aperture to ensure that the sleeve is correctly fitted in the baffle plate (B).
- 10 Fit the other end cap, ensure that the pipe connections of the end caps are in their correct positions and tighten the clips. If the assembly has been removed from the engine, put the caps in the positions shown in C.
- 11 Fit the inlet and outlet pipes and tighten the hose clips. The end of the outlet pipe should reach to the centre of the cap. Tighten the support clips of the outlet pipe.
- 12 Fill the coolant circuit, operation 20A-02 and open the seacock.
- 13 Operate the engine and check for leaks.



Flywheel, flywheel housing

21

	General description	21A.02
	Flywheel	
21A-01	To remove and to fit	21A.03
	Ring gear	
21A-02	To remove and to fit	21A.03
	Flywheel housing	
21A-03	To remove and to fit	21A.04

General description

The engine may be fitted with an aluminium or mild steel backplate or a cast iron flywheel housing. Marine engines have an aluminium adaptor housing fitted between the backplate and the reverse gearbox.

The steel flywheel has a hardened starter ring which is expansion fitted. The starter ring has 104 teeth.

Flywheel

To remove and to fit

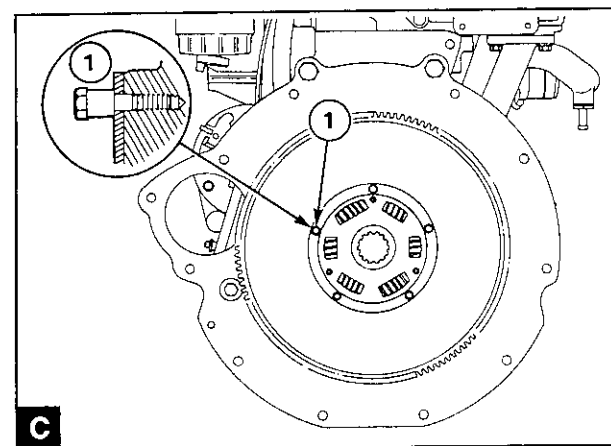
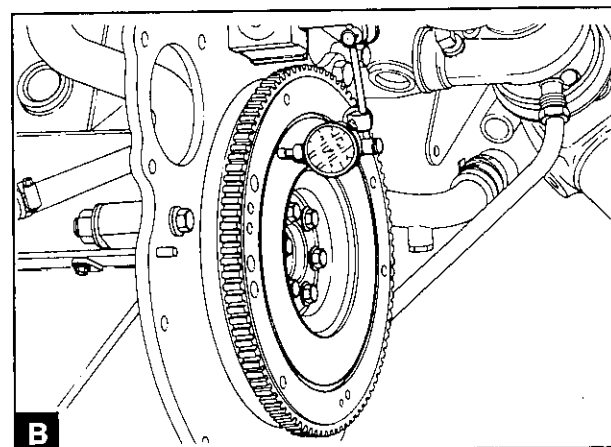
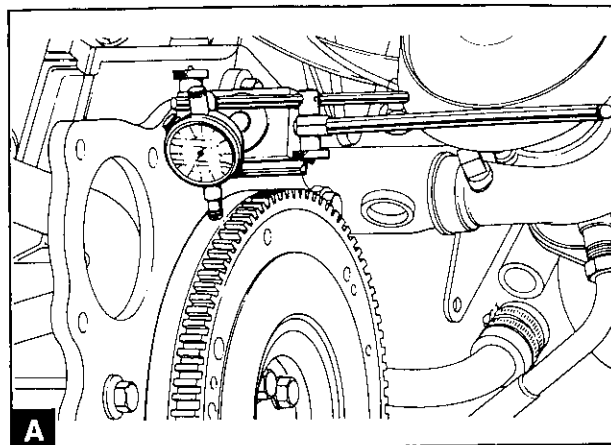
21A-01

To remove

- 1 Remove the drive components from the rear of the engine.
Remove the gearbox adaptor housing and remove the flexible drive plate from the flywheel.
- 2 Remove two opposite setscrews from the flywheel and fit temporarily two guide studs to ensure safety when the flywheel is removed and fitted.
- 3 Remove the remainder of the setscrews and remove the flywheel.
- 4 Check the flywheel and the ring gear for damage and renew, if necessary.

To fit

- 1 Ensure that the location faces of the crankshaft and of the flywheel are clean and free from damage.
- 2 Ensure that the dowel is fitted in the flange of the crankshaft. Fit the flywheel over the guide studs. Fit four setscrews, remove the guide studs and fit the other two setscrews. Tighten the setscrews gradually and evenly to 65 Nm (48 lbf ft) 6,6 kgf m.
- 3 Check the flywheel run-out with a dial test indicator (A). This must be less than 0,30 mm (0.012 in) total indicator reading.
- 4 Check the alignment of the flywheel face (B). The alignment error must be not more than 0,03 mm (0.001 in) total indicator reading for every 25 mm (1.0 in) of the flywheel radius (from the crankshaft axis to the indicator plunger). During this check, keep the crankshaft pressed towards the front to remove the effect of crankshaft end-float.
- 5 Fit the flexible plate for the gearbox drive (C). Apply Locktite to the threads of the plate setscrews. Ensure that the small location diameter of each setscrew enters the flywheel (C1). Tighten the setscrews gradually and evenly to 9 Nm (7 lbf ft) 0,9 kgf m. Do not start the engine until the locking agent has had time to harden.
- 6 Fit the drive components to the rear of the engine.

**Ring gear**

To remove and to fit

21A-02

To remove

For this operation eye protection must be used.

Before the ring gear is removed, check the position of the chamfer on the teeth.

The ring gear can be removed with a hammer and a chisel to break the ring. Ensure that the flywheel is not damaged during this operation.

To fit

The ring gear is heated onto the flywheel. When a new gear is to be fitted, ensure that it is not heated to more than 250°C (480°F). Ensure that the chamfer on the teeth of the gear is in the correct direction.

Flywheel housing

To remove and to fit

21A-03

To remove

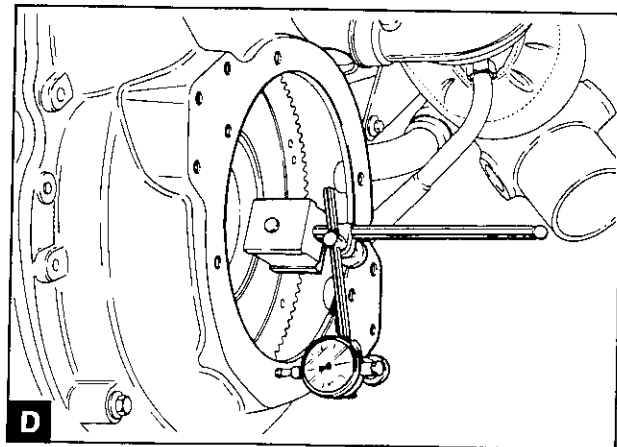
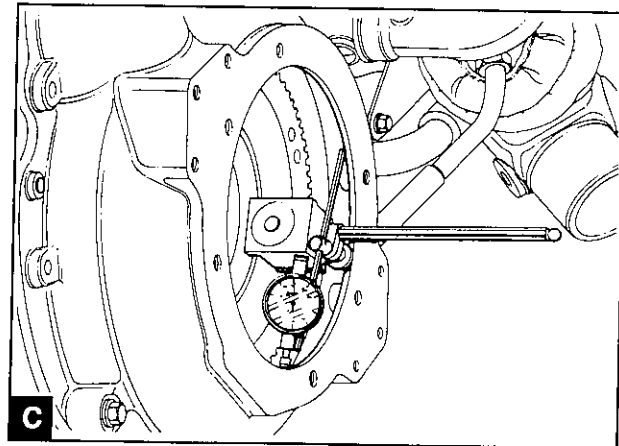
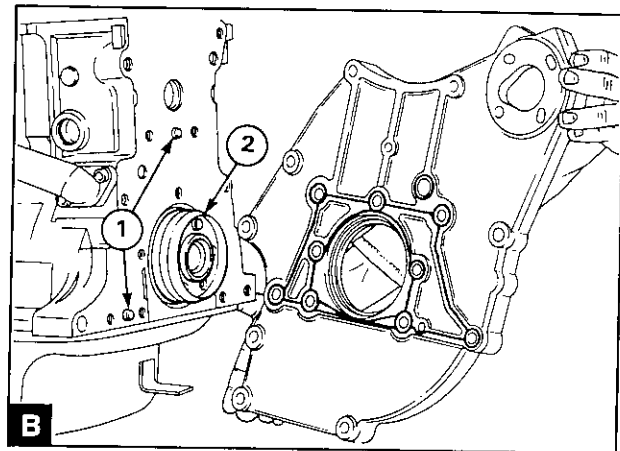
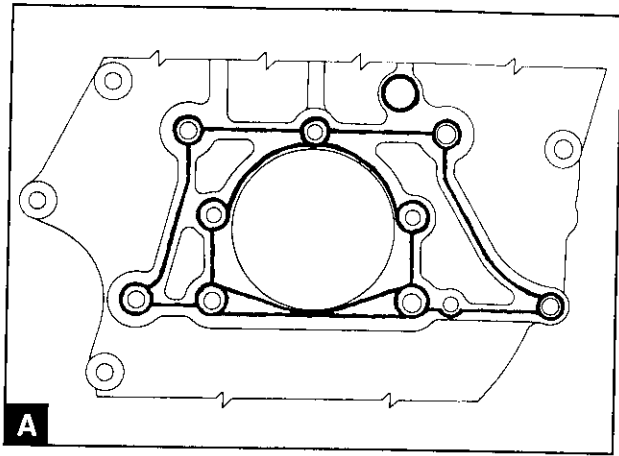
- 1 Remove the drive components from the rear of the engine.
- 2 Remove the starter motor, operation 22B-01. Remove the adaptor housing for the gearbox.
- 3 Remove the flywheel, operation 21A-01.
- 4 Release the setscrews of the flywheel housing. Use a soft face hammer to remove it from the dowels.

To fit

Special tool:

Protection sleeve 885030-7

- 1 Ensure that the rear face of the cylinder block and the faces of the flywheel housing are clean and free from damage.
- 2 Ensure that the location dowels (B1) are fitted correctly. Ensure that the outside diameter of the crankshaft flange is clean. Put the seal protection sleeve (B2) in position on the crankshaft flange. Lubricate lightly, with clean engine lubricating oil, the outside diameter of the crankshaft flange and the protection sleeve.
- 3 Apply a 1,5 mm (0.06 in) continuous bead of Sealant to the front face of the housing as shown in figure A. This operation is not necessary where a separate seal housing is fitted.
- 4 Fit the housing onto the dowels and engage the setscrews.
- 5 Check the concentricity of the housing with a dial test indicator. The maximum permissible total indicator reading is 0,15 mm (0.006 in). If any adjustment is necessary, it must be made on the housing and the concentricity checked again.
- 6 Tighten the setscrews gradually and evenly to the relevant torques given in section 11B, in the relevant sequence shown in figure 21A.05/A.
- 7 Check the alignment of the rear face of the housing. The maximum permissible total indicator reading is 0,15 mm (0.006 in). All adjustments must be made on the housing and not on the cylinder block.
- 8 Fit the flywheel and the gearbox drive adaptor, operation 21A.01. Ensure that the dowels are correctly fitted in the housing. Fit the adaptor housing for the gearbox, tighten the setscrews to 43 Nm (32 lbf ft) 4,4 kgf m. Check the housing concentricity (C) and the alignment (D) as in paragraphs 5 and 7 above. Fit the support plate for the manifold.
- 9 Fit the flywheel, operation 22A-01 and the starter motor, operation 22B-01. Fit the drive components to the rear of the engine.



Electrical equipment

22

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Starting aid	22C
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Alternators

22A

	General description	22A.02
	Precautions	22A.02
	Alternator	
22A-01	To remove and to fit	22A.03
	To maintain	22A.03
	Fault diagnosis	22A.03

General description

The Valeo A13N 147M alternator is driven from the crankshaft pulley by a single drive belt. The rating of the alternator is 50A.

Precautions

To prevent damage to the diodes and to the resistors, the precautions given below must be followed.

- Do not disconnect the battery while the engine is in operation. This will cause a voltage surge in the alternator charge system which can cause damage to the diodes or to the transistors.
- Do not disconnect an electrical wire before the engine is stopped and all electrical switches are in the off position.
- Do not cause a short circuit by the connection of electrical wires to the wrong terminals. The correct identification of the electrical wire to the correct terminal must be made. A short circuit or wrong connection which gives reverse polarity can cause permanent damage to the diodes and to the transistors.
- Do not connect a battery into the system until its has been checked for correct polarity and voltage.
- Do not check for current flow with a spark contact as damage can be caused to the transistors.

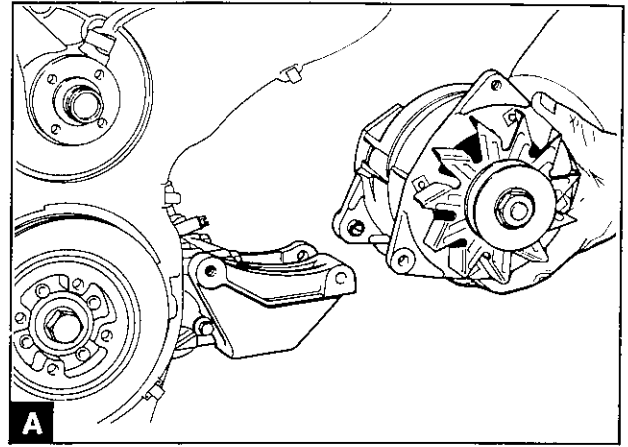
Alternator

To remove and to fit

22A-01

To remove

- 1 Disconnect the electrical connections at the alternator.
- 2 Loosen the pivot fasteners of the alternator and the adjustment link fasteners.
- 3 Release all the belt tension and remove the belt.
- 4 Remove the adjustment link from the alternator and remove the pivot bolt. Make a note of the position of the washer to ensure that it is fitted correctly. Remove the alternator (A).



To fit

- 1 Put the alternator in position and assemble loosely the pivot fasteners and the adjustment link and its fasteners. Ensure that the washer is fitted in its correct position and that the alternator pulley is aligned to the crankshaft pulley.
- 2 Fit the drive belt and adjust the drive belt tension. Tighten the adjustment link fasteners and then the pivot fasteners and check the tension again.
- 3 Connect the electrical connections at the alternator.

5 Start the engine and operate it at a fast idle speed when either: the warning light should be extinguished or the ammeter indicates a small current charge in relationship to the engine speed.

6 Increase the engine speed for a moment to near maximum speed; the charge current should be approximately 50 amperes.

7 Operate the engine at approximately half speed and remove the electrical load. The voltage should go up to 14 volts for a 12 volt system and then remain constant. At the same time the current heading should show a reduction.

Any change in the above data can indicate a fault and the alternator should be removed for test by a specialist.

The regulator is a sealed unit and a repair is not possible. If there is a regulator fault, the regulator must be renewed.

To maintain

- 1 Ensure that the drive belt is not worn and that the belt tension is correct.
- 2 Keep the alternator clean. To clean the alternator, use a material which is damp with kerosene or a special fluid used for this purpose. Ensure that the fluid does not enter the alternator.
- 3 Ensure that air can pass easily over the casing to keep it cool.

Fault diagnosis

The alternator is designed so that a flow of current (indicated by no light at the warning light or by a reading shown on an voltmeter) shows that the system is in correct operation. If the system is in correct operation, no open circuit, voltage or current output checks need to be done on the installation unless:

- The warning light does not show when the alternator is stationary and the switch is in the "on" position or it shows a light when the alternator is in operation.
- No charge current is shown on the voltmeter.
- The battery is discharged.
- The battery is hotter than normal which is an indication of loss of voltage control.

If one or more of the above symptoms occur, the procedure indicated below should be applied.

- 1 Ensure that the battery is in a fully charged condition.
- 2 Connect a voltmeter of good quality, with a range of 0—50 volts, across the alternator and negative terminals.

If an ammeter is not fitted in the electrical circuit: Fit an ammeter of good quality, with a range of 0—100 ampere, in the wire between the alternator and the positive terminal of the battery.

- 3 Turn the warning light switch to the "on" position (main switch on instrument panel) then the warning light should be illuminated.
- 4 Switch on a 10—15 ampere load, for example, lights, etc.