2

Specifications

Data and dimensions

Note: This information is given as a guide for personnel engaged on engine overhauls. The dimensions that are shown are those that are mainly used in the factory. The information applies to all engines, unless an engine type code is shown.

Basic engine data

Cycle	Four stroke
Number of cylinders	3
Cylinder arrangement	In line
Firing order	1, 2, 3
Direction of rotation	Clockwise from the front
Induction system	Turbocharged / naturally aspirated
Cubic capacity	2,7 litres (164.76 in^3)
Compression ratio	17.25:1
Combustion system	Direct injection
Nominal bore	95,0 mm (3.74 in)
Stroke	127 mm (5.00 in)
Valve tip clearances (hot or cold):	
- Inlet	0,20 mm (0.008 in)
- Exhaust	0,45 mm (0.018 in)
Lubricating oil pressure **(1)**	207 kPa (30 lbf/ in^2) 2,1 kgf/cm^2
Typical dry installed engine weight	305 kg (672 lbs)

(1) Minimum at maximum engine speed and normal engine temperature.

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Rocker cover

To remove and to fit — Operation 3-1

Early engines are supplied with an aluminium rocker cover. The latest engines have a plastic rocker cover. Both of these covers have a seal (B1) fitted in the flange.

To remove

1 Disconnect the breather pipe, if fitted.

2 Remove the two cap nuts (A1). Each cap nut has a steel washer (A2), a shim washer (A3) and a rubber seal (A4).

Note: The shim washers are not used with the plastic rocker covers.

3 Lift off the rocker cover.

To fit

1 Check the condition of the rubber seals (A4), the steel washers (A2) and the shim washers (A3) for the cap nuts (A1). If necessary, the seals for the cap nuts can be renewed.

Note: The shim washers are not used with the plastic rocker covers.

2 Check the condition of the rocker cover seal (B1). If necessary, the seal can be renewed.

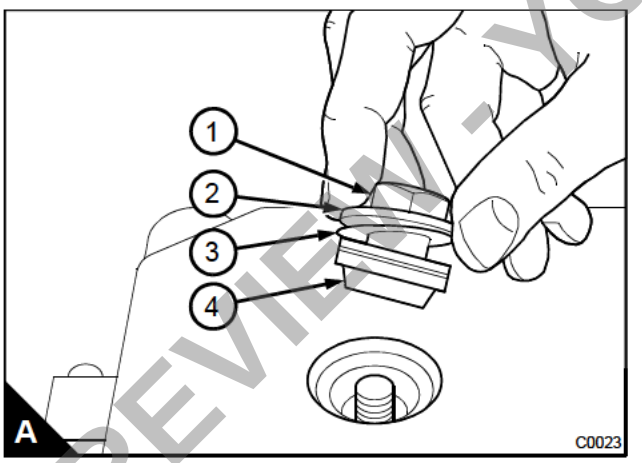
3 Clean the seal face of the cylinder head and fit the rocker cover.

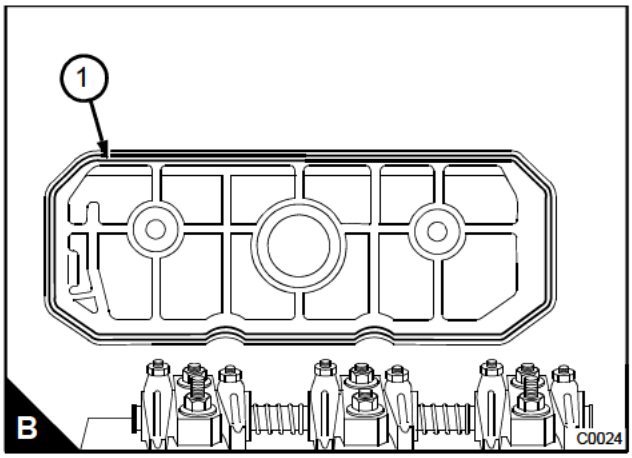
4 Fit the steel washer, the shim and the seal to each cap nut and fit the cap nuts.

Caution: *Damage to the seals can occur if the cap nuts are not tightened centrally through the sealing washer and the rocker cover. If the seals are damaged they must be renewed.*

5 Tighten the cap nuts to 30 Nm (22 lbf ft) 3,1 kgf m for the aluminium rocker cover, or 20 Nm (15 lbf ft) 2,0 kgf m for the plastic rocker cover.

6 Fit breather pipes as necessary.





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Standard torque tensions

Most of the torque tensions on the engine are standard. Special torque tensions are listed in the separate special torque tables. The standard torque tensions listed in the tables below can be used when a special torque is not necessary.The torque tensions below apply to components lubricated lightly with clean engine oil before they are fitted.

Standard torque for UNF/UNC setscrews and nuts

Thread size	Torque		
	Nm	lbf ft	kgf m
1/4	11	8	1,1
5/16	21	15	2,1
3/8	37	27	3,8
7/16	60	44	6,1
1/2	92	68	9,4
9/16	130	96	13,3
3/4	186	137	19,0

Standard torque for metric setscrews and nuts

Thread size	Torque		
	Nm	lbf ft	kgf m
M6 x 1,00	9	7	0,9
M8 x 1,25	22	16	2,2
M10 x 1,50	44	33	4,5
M12 x 1,75	78	58	8,0
M14 x 2,00	124	91	12,6
M16 x 2,00	190	140	19,3

Standard torque for pipe threaded parts

Thread size	Torque		
	Nm	lbf ft	kgf m
1/8 PTF	9,5	7	0,97
1/4 PTF	17	13	1,73
3/8 PTF	30	22	3,1
1/2 PTF	30	22	3,1
3/4 PTF	45	33	4,6
3/4 - 16 UNF	45	33	4,6

Standard torque for studs (metal end)

Thread size	Torque		
	Nm	lbf ft	kgf m
M8 x 1,00	11	9	1,1
M10 x 1,25	18	14	1,8
M12 x 1,50	25	19	2,5

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Turbocharger faults

Problems and possible causes

The chart below is given to assist in the correct diagnosis of turbocharger faults.

If the inside of the induction manifold is wet, check that there is not a fuel leak from the fuelled starting aid, if there is one fitted, see Operation 14-9.

Problems	Possible causes code numbers
Not enough power	1, 4, 5, 6, 7, 8, 9, 10, 11, 18, 20, 21, 22, 25, 26, 27, 28, 34
Black smoke	1, 4, 5, 6, 7, 8, 9, 10, 11, 18, 20, 21, 22, 25, 26, 27, 28, 34
Blue smoke	1, 2, 4, 6, 8, 9, 17, 19, 20, 21, 22, 30, 31, 32, 34
High lubricating oil consumption	2, 8, 15, 17, 19, 20, 28, 29, 31, 32, 34
Too much lubricating oil at turbine end	2, 7, 8, 17, 19, 20, 22, 28, 30, 31, 32
Too much lubricating oil at compressor end	1, 2, 4, 5, 6, 8, 19, 20, 21, 28, 31, 32
Not enough lubrication	8, 12, 14, 15, 16, 23, 24, 29, 32, 33, 37, 38
Lubricating oil in the exhaust manifold	2, 7, 17, 18, 19, 20, 22, 28, 31, 32
Inside of the induction manifold wet	1, 2, 3, 4, 5, 6, 8, 10, 11, 17, 18, 19, 20, 21, 28, 32, 34, 39, 40
Damaged compressor impeller	3, 4, 6, 8, 12, 15, 16, 20, 21, 23, 24, 29, 32, 33, 37, 38
Damaged turbine rotor	7, 8, 12, 13, 14, 15, 16, 18, 20, 22, 23, 24, 25, 27, 29, 32, 33, 37, 38
Rotating assembly does not turn freely	3, 6, 7, 8, 12, 13, 14, 15, 16, 18, 20, 21, 22, 23, 24, 29, 32, 33, 37, 38
Worn bearings, bearing bores, journals	6, 7, 8, 12, 13, 14, 15, 16, 23, 24, 29, 33, 37, 38
Noise from turbocharger	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 20, 21, 22, 23, 24, 29, 32, 33, 34, 37, 38
Sludge or carbon deposit in bearing housing	2, 11, 13, 14, 15, 17, 18, 24, 29, 33, 37, 38

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Electrical equipment

Alternator

Make ... ... Magneti Marelli A127-65
Rating 12V/65A

Starter motor

Make ... ... Magneti Marelli M127
Voltage 12V
Number of teeth on pinion 10
Maximum starter cable resistance at 20 °C (68 °F). ... ... 0.0012 ohm

Starting aid

Type. ... ... Electrically operated heater, with a fuel supply
Voltage 12V
Flow rate of fuel through starting aid ... ... 3,5/5,9 ml/min

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Cylinder head

To inspect and to correct — Operation 3-18

1 Remove the cylinder head assembly, see Operation 3-8.

2 Inspect the cylinder head for signs of gas or coolant leakage.

3 Remove the valve springs and the valves, see Operation 3-12.

4 Clean the face of the cylinder head and the passages for coolant and for lubricating oil. The water jacket can be cleaned with a special solvent, which must be used in accordance with the manufacturer's instructions.

5 Test the cylinder head for leaks at the pressure given in the Data and dimensions for the "Cylinder head" on page 12.

6 When the cylinder head is thoroughly clean, check it for cracks. Check carefully the areas around the valve seats and around the holes for the atomiser nozzles.

7 The bottom face of the cylinder head can be machined if: there is distortion; there are deep scratches; the valve depths are below the service limit.

8 Use a straight edge and feeler gauges to check the cylinder head for distortion across and along its bottom face and refer to "Maximum permissible cylinder head distortion" on page 12. If the distortion is more than the limit given, the bottom face can be machined.

***Cautions*:**

- *Remove only the minimum material and then not more than 0,40 mm (0.016 in).*
- *The nozzle protrusion for the engine must be measured with the nozzle seat washer fitted, after the head has been machined. See "Maximum protrusion of the atomiser nozzle" on page 12.*
- *After the cylinder head has been machined the valve seats must be corrected to give the correct valve head depth. It is better to work to the minimum limit to allow for later wear.*
- *If a new valve seat insert is to be fitted, the back face must be surface ground to ensure that there is no protrusion above the bottom face of the cylinder head, see Operation 3-20.*

9 Check the valve seats for wear and for damage.

10 Before any work is done on the valve seats, new valve guides must be fitted, see Operation 3-16 and Operation 3-17.

11 Where there is little damage, the valve and valve seat can be lapped. When the valve seats are lapped keep the seat as narrow as possible and ensure that all the compound used to lap the valve and the seat is removed.

12 More badly damaged valve seats can be corrected by use of the cutter tool, see Operation 3-19, or new inserts can be fitted to the inlet and exhaust valves, see Operation 3-20.

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To fit **Operation 6-2**

Special requirements

Special tools	
Description	**Part number**
Centralising tool	21825571

1 Clean the faces of the timing case cover and of the timing case. Fit a new joint (A1) to the cover, a sealant is not necessary.

2 Put the cover together with the new joint in position on the timing case and loosely retain the cover, in balance, with two setscrews. Tighten the setscrews finger tight.

3 Fit the centralising tool (B4) to the nose of the crankshaft. Loosely fit the large washer (B1) and the large setscrew (B2) for the crankshaft pulley. Engage the tool with the seal housing (B3) and tighten the setscrew finger tight to centre the cover.

4 Fit the remainder of the setscrews for the cover in their correct positions and fully tighten the M8 setscrews to 22 Nm (16 lbf ft) 2,2 kgf m and the M6 setscrews to 9 Nm (7 lbf ft) 0,9 kgf m. Remove the setscrew and the large washer and remove the centralising tool.

5 Fit the coolant pump, see Operation 12-5.

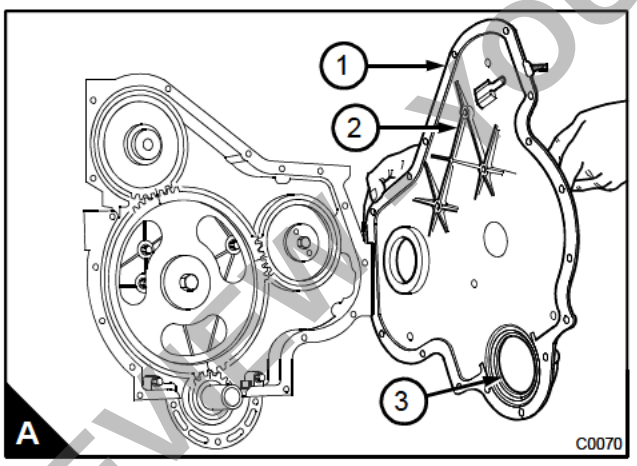
6 Fit the crankshaft pulley, see Operation 5-1.

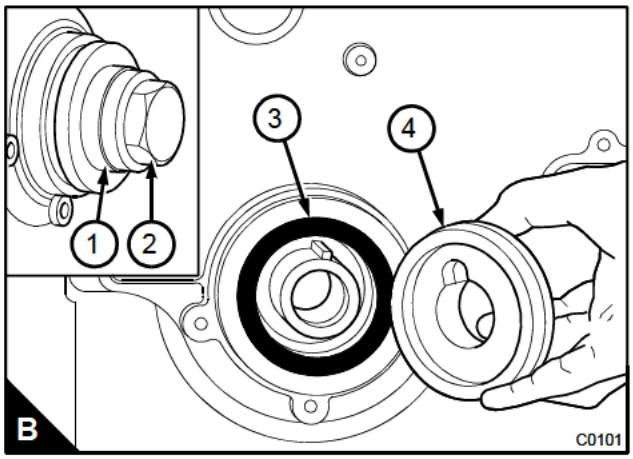
7 Fit the alternator, see Operation 14-4.

8 Fit the drive belt, see Operation 14-3, and adjust the belt tension, see Operation 14-2.

9 Fill the cooling system with antifreeze of the correct specification, see Operation 12-3.

Note: See "Coolant specification" in Chapter 5 of the User's handbook for details of the correct coolant to be used in the cooling system.





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Aspiration system

General description

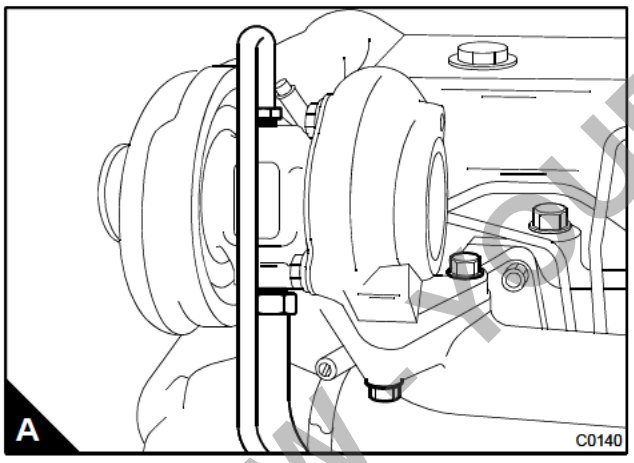
Warning! *Turbochargers operate at high speeds and at high temperatures. Keep fingers, tools and debris away from the inlet and outlet ports of the turbocharger. Do not touch hot surfaces.*

The Schwitzer S1B turbocharger (A), is fitted between the exhaust and the induction manifolds and is driven by exhaust gases. Air is supplied to the engine at more than atmospheric pressure. The turbocharger is lubricated by oil from the filter head. The oil passes through the bearing housing of the turbocharger and returns to the lubricating oil sump.

Some engines have the turbochargers mounted towards the front of the engine or centrally according to the application it is fitted to.

Always use the manufacturer's instructions and specialist assistance to fit the service kit for the turbocharger.

Caution: *Do not use a caustic solution to clean the components of the turbocharger because the turbocharger will be damaged.*



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Relief valve

The relief valve (A) is fitted in the lubricating oil pump body and prevents too much pressure in the lubricating oil system.

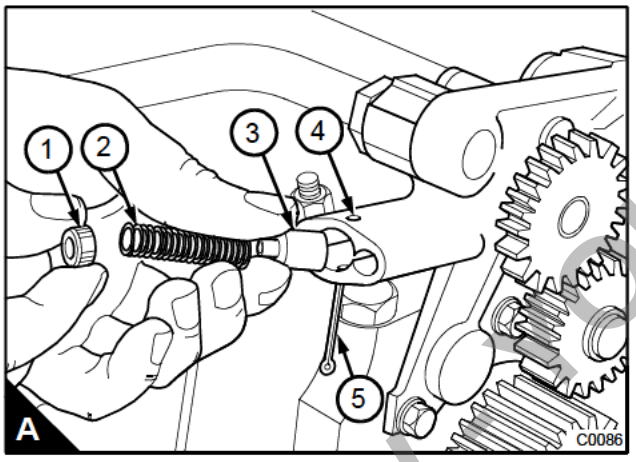
As engine speed increases the output of the oil pump increases, and more oil flows into the system. The increase in flow causes an increase in pressure in the system. When the oil pressure on the plunger of the relief valve is greater than the spring pressure, the valve will open. When the valve opens, surplus oil is returned to the sump. This action will reduce the oil pressure and the valve will close. Oil that passes the relief valve reaches the oil filter.

To dismantle and to assemble **Operation 10-13**

1 Apply pressure to the end plate (A1) of the spring assembly, release and discard the split pin (A5). Carefully release the pressure to remove the end plate and the spring (A2) from the valve body (A4). Remove the plunger (A3) from the bore of the body.

2 Ensure that all the components are cleaned and then lubricated lightly with clean engine lubricating oil.

3 Fit the plunger into the bore with its hollow end to the inside. Fit the spring and the end cap into the bore with the ends of the spring fitted around the bosses of the plunger and the end plate. Apply pressure to the end plate and fit a new split pin into its hole.



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To eliminate air from the fuel system — Operation 11-22

If air enters the fuel system, it must be removed 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.

In order to eliminate air from the fuel system, proceed as follows:

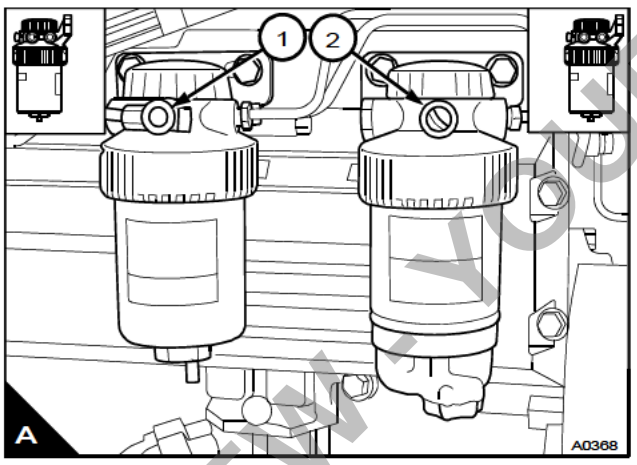
Vent screws are not fitted to the fuel injection pump. Air will usually be removed from the fuel pump automatically.

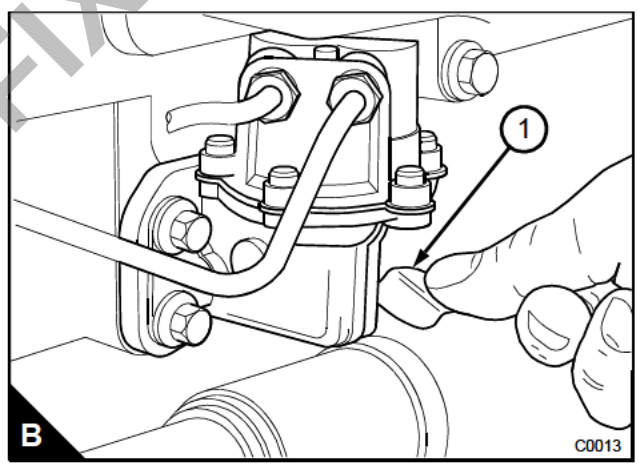
Caution: *If the fuel system is empty or if the canister(s) of the fuel filter have been renewed, it will be necessary to eliminate air from the fuel system, especially the fuel injection pump.*

1 Loosen the vent plug on the filter head of the pre-filter (A2). Operate the priming lever of the fuel lift pump (B1) until fuel, free of air, comes from the vent plug. Tighten the vent plug.

Note: If the drive cam of the fuel lift pump is at the point of maximum lift, it will not be possible to operate the priming lever. In this situation, the crankshaft must be rotated one revolution.

2 Loosen the vent plug (A1) on the top of the filter head. Operate the priming lever (B1) of the fuel lift pump until fuel, free of air, comes from the vent plug. Tighten the vent plug.





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