
Perkins New 1000 Series

Models AJ to AS and YG to YK

WORKSHOP MANUAL

4 and 6 cylinder diesel engines for industrial and agricultural applications

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2

Specifications

Basic engine data

Number of cylinders:

AJ, AK, AM, AP, AQ, AR, AS 4

YG, YH, YJ, YK 6

Cylinder arrangement In line

Cycle Four stroke

Direction of rotation Clockwise from the front

Induction system:

AJ, AP, AR, AS, YG Naturally aspirated

AK, AQ, YH Turbocharged

AM, YJ, YK Turbocharged, intercooled

Combustion system Direct injection

Nominal bore:

AJ, AK, AM, AP, AQ, YG, YH, YJ, YK 100 mm (3.937 in)

AR, AS 103 mm (4.055 in)

Stroke 127 mm (5.00 in)

Compression ratio:

AJ, AK, AM, AP, AQ, YG, YH, YJ, YK 17.25:1

AR, AS 18.5:1

Cubic capacity:

AJ, AK, AM, AP, AQ 4 litres (243 in³)

AR, AS 4,23 litres (258 in³)

YG, YH, YJ, YK 6 litres (365 in³)

Firing order:

AJ, AK, AM, AP, AQ, AR, AS 1, 3, 4, 2

YG, YH, YJ, YK 1, 5, 3, 6, 2, 4

Valve tip clearances (hot or cold):

- Inlet 0,20 mm (0.008 in)

- Exhaust 0,45 mm (0.018 in)

Lubricating oil pressure ⁽¹⁾

AJ, AK, AM, AP, AQ, YG, YH, YJ, YK 280 kPa (40 lbf/in²) 2,5 kgf/cm²

AR, AS 207 kPa (30 lbf/in²) 2,1 kgf/cm²

⁽¹⁾ minimum at maximum engine speed and normal engine temperature

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 torques for 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 torques for studs (metal end)

Thread size	Torque		
	Nm	lbf ft	kgf m
M6 x 1,00	5	4	0,5
M8 x 1,25	11	9	1,1
M10 x 1,50	18	14	1,8
M12 x 1,75	25	19	2,5

Standard torques for pipe unions, plugs, and adaptors

Thread size (Inches)	Torque		
	Nm	lbf ft	kgf m
1/8 PTF	9	7	0,9
1/4 PTF	17	13	1,7
3/8 PTF	30	23	3,0
3/4 PTF	45	35	4,5

Rocker cover

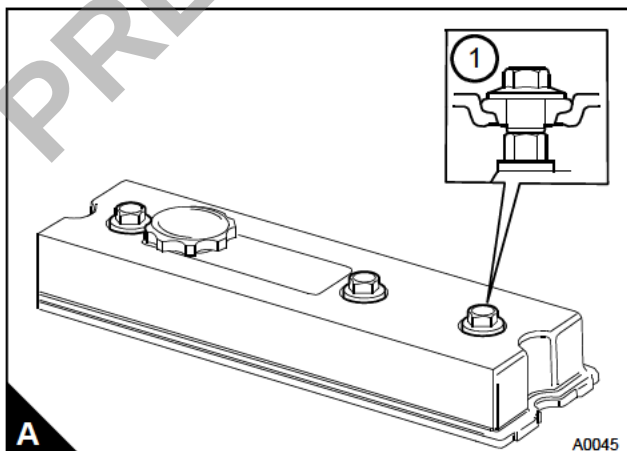
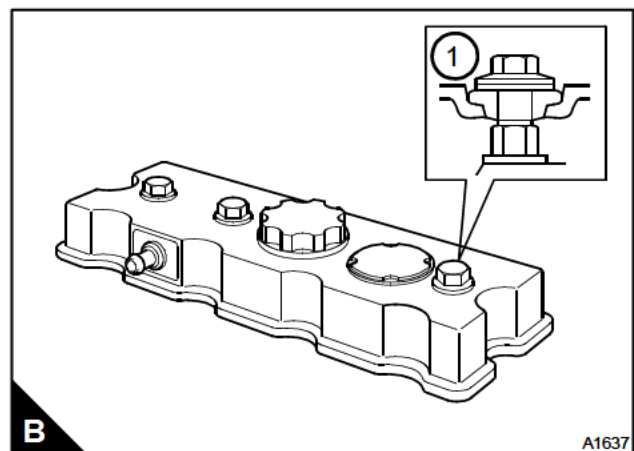
To remove

Operation 3-1

Note: Engines are supplied with rocker covers (A or B) made of a plastic material or aluminum.

- 1 Disconnect the breather pipe.
- 2 Remove the cap nuts and rubber seal (A1 or B1) from the top of the rocker cover and remove the heat shield, if one is fitted.
- 3 Lift off the rocker cover and the joint.

Caution: When the rocker cover is fitted, the cap nuts are tightened onto the nuts of the rocker brackets. During removal of the cap nuts, it is possible to loosen the nuts of the rocker brackets. The nuts of the rocker brackets should be tightened to the correct torque every time the cover is removed.



Turbocharger faults

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

If the inside of the intake manifold is wet, check that there is not a fuel leak from the fuelled starting aid, if there is one fitted, see Operation 14-11.

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, 35, 36
Black smoke	1, 4, 5, 6, 7, 8, 9, 10, 11, 18, 20, 21, 22, 25, 26, 27, 28, 34, 35, 36
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 intake 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

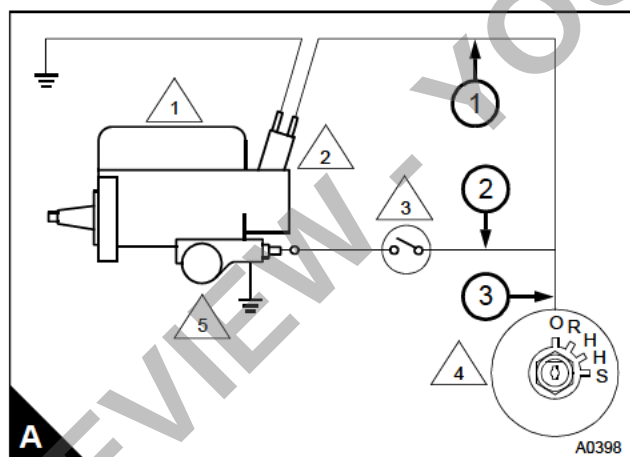
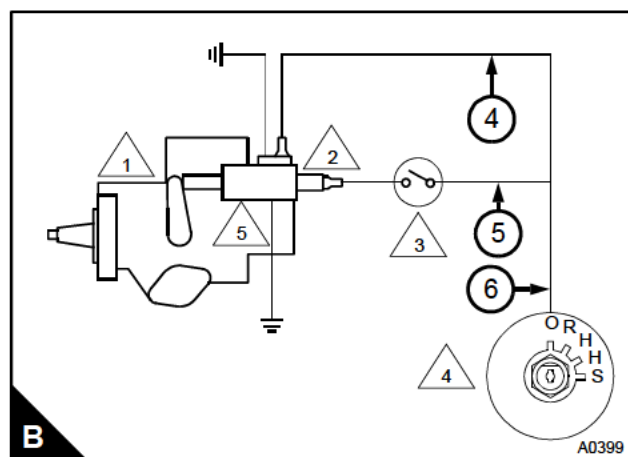
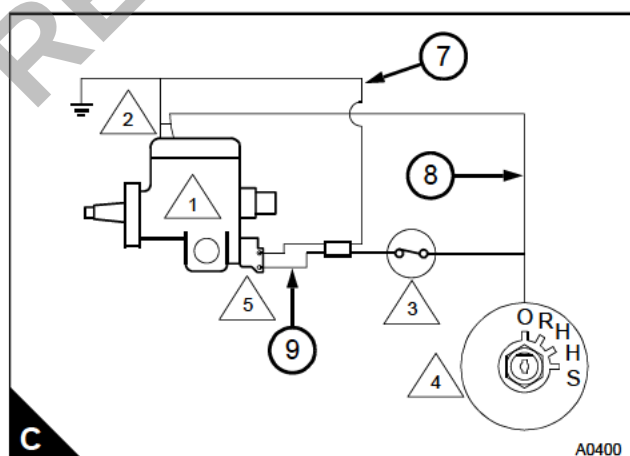
Wiring diagrams for the cold start advance unit fitted to some Lucas/Delphi DP200 Series, Bosch and Stanadyne fuel injection pumps are shown in the illustrations (A), (B) and (C) respectively. For easy identification the cables are shown in circles on the illustrations.

The amperage of each of the cables is listed in the cable identification table below. The identification numbers for the electrical components are shown in triangles. Refer to the component identification list to find a component.

Cable identification ⁽¹⁾		Component identification ⁽²⁾	
Cable (Number)	Current (Amperes)	Component	Description
1	3	1	Fuel injection pump
2	3	2	Engine stop solenoid
3	6	3	Sender unit
4	3	4	Start switch
5	3	5	Cold start advance unit
6	6		
7	3		
8	6		
9	3		

(1) For numbers shown in circles

(2) For numbers shown in triangles



3 Cylinder head assembly

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Crankshaft thrust washers

Type. Steel back, lead bronze bearing material

Position. Each side of centre main bearing

Thickness:

- Standard. 2,26/2,31 mm (0.089/0.091 in)

- Oversize. 2,45/2,50 mm (0.096/0.098 in)

Balancer unit

Diameter of drive shaft for front bearing. 28,562/28,575 mm (1.1245/1.1250 in)

Diameter of drive shaft for rear bearing. 23,787/23,800 mm (0.9365/0.9370 in)

Number of teeth on gear of drive shaft. 21

Backlash from gear of drive shaft to idler gear. 0,17/0,29 mm (0.007/0.011 in)

End-float of drive shaft. 0,13/0,30 mm (0.005/0.012 in)

Diameter of bore for front bearing of drive shaft. 34,912/34,937 mm (1.3745/1.3755 in)

Diameter of bore for rear bearing of drive shaft. 29,972/29,993 mm (1.1800/1.1808 in)

Diameter of bore for idler gear. 47,64/47,65 mm (1.8755/1.8760 in)

Diameter of hub of idler gear. 38,09/38,10 mm (1.4996/1.5000 in)

End-float of idler gear. 0,07/0,23 mm (0.003/0.009 in)

Thickness of thrust washer for idler gear. 4,14/4,29 mm (0.163/0.169 in)

Number of teeth on idler gear. 37

Inside diameter of bushes in balancer frame and end cover (fitted). 38,133/38,174 mm (1.5013/1.5029 in)

Diameter of spigots for balance weights. 38,054/38,069 mm (1.4982/1.4988 in)

Fit of spigot in bush. 0,064/0,120 mm (0.0025/0.0047 in)

End-float of balance weights. 0,19/0,40 mm (0.007/0.016 in)

Backlash of gears on balance weights. 0,10/0,27 mm (0.004/0.011 in)

Backlash of drive gear to spline on balance weight. 0,05/0,20 mm (0.002/0.008 in)

Number of teeth on drive gear. 24

Number of teeth on spline on balance weight. 16

Cylinder head assembly

To remove

Operation 3-12

- 1 Drain the cooling system.
- 2 Disconnect the battery terminals.
- 3 For engines fitted with turbochargers: Disconnect all connections to the turbocharger and remove the turbocharger, see Operation 9-1.
- 4 Remove the intake manifold, see Operation 3-9.
- 5 Remove the exhaust manifold, see Operation 3-10 or Operation 3-11.
- 6 Remove the low-pressure fuel pipes which are fitted between the fuel injection pump and the fuel filter.
Note: Where a Bosch fuel injection pump is fitted, keep the fuel outlet banjo bolt with the fuel injection pump.
Remove the fuel pipe fitted between the fuel lift pump and the fuel filter. Remove the fuel filter bracket together with the fuel filter.
Caution: Where access to the fuel injection pump outlet unions is possible, ensure that a separate spanner is used to prevent movement of the fuel injection pump outlets when the connections of the high-pressure pipes are released. Fit suitable covers to all open connections on the fuel injection pump.
- 7 Remove the high-pressure fuel pipes.
- 8 Remove the atomiser leak-off pipe.
- 9 Remove the atomisers, see Operation 11-4. Fit suitable covers to the nozzles and the open connections.
- 10 If a compressor is fitted: Remove the coolant pipe which is fitted between the cylinder head and the compressor. Then remove the coolant pipe which is fitted between the by-pass connection and the compressor.

Continued

Piston and piston rings

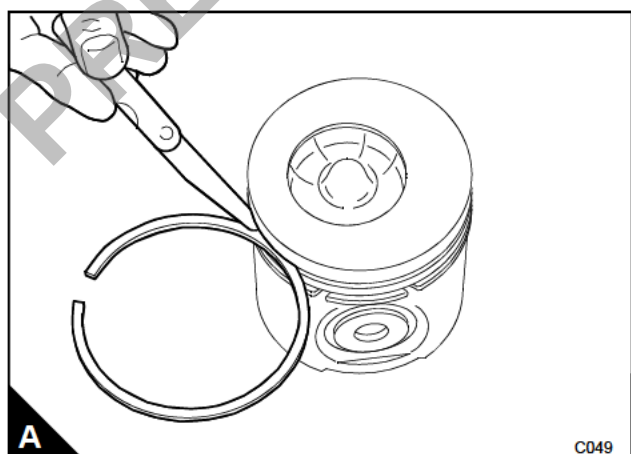
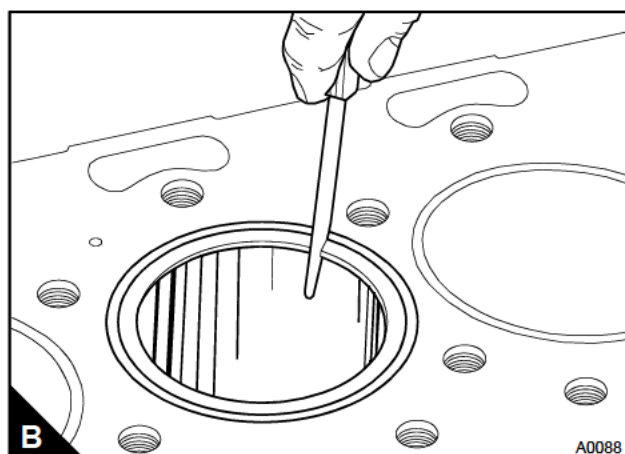
To inspect

Operation 4-12

- 1 Check the piston for wear and other damage.
- 2 Check that the piston rings are free to move in their grooves and that the rings are not broken.
- 3 Remove the piston rings, see Operation 4-7, and clean the piston ring grooves and the piston rings.
- 4 Fit new piston rings in the grooves and check for wear of the grooves with feeler gauges (A). Compare the piston ring clearance in the groove to that given for new components, refer to the Data and dimensions for "Pistons and piston cooling jets" on page 18, and renew the piston, if necessary.

Note: The pistons have a tapered top groove and the piston ring is wedge shaped, refer to Operation 4-8 (B). The top piston ring clearance cannot be checked by this method.

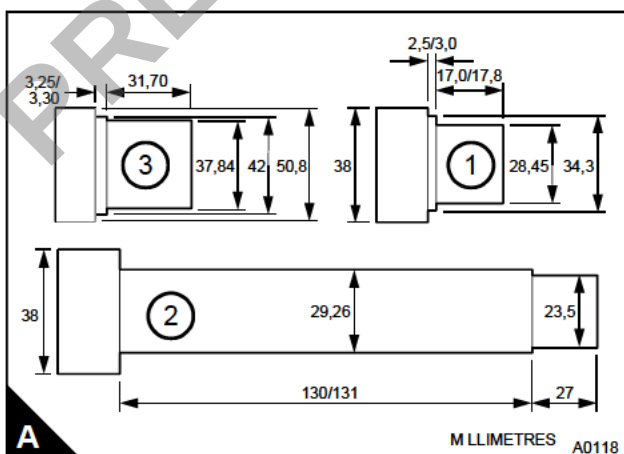
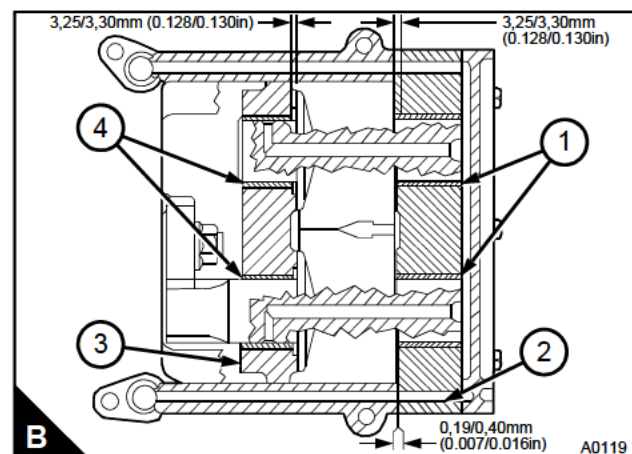
- 5 Clean all carbon from the top of the cylinder liners. Fit each piston ring in the top part of the cylinder liner and measure the ring gap with feeler gauges (B). The coil spring must be removed from the oil control ring when the gap of this piston ring is measured. For piston ring gaps on new components, refer to the Data and dimensions for "Piston rings" on page 18.



To remove and to fit the bushes for the balance weights

Operation 5-23

- 1 Press the bushes out of the balancer frame and the rear cover with a suitable adaptor.
- 2 Clean the parent bores and lubricate them with clean engine lubricating oil.
- 3 Make a suitable adaptor to the dimensions given in (A3). Fit a bush onto the adaptor. Press the bush (B4) into the parent bore in the rear of the balancer frame (B3), in a continuous movement, until the shoulder of the adaptor is against the rear face of the balancer frame. In this position the rear face of the bush should be 3,25/3,30 mm (0.128/0.130 in) from the rear face of the balancer frame (B). Repeat this operation for the other bush.
- 4 Fit a bush (B1) onto the adaptor and put it into position at the front end of one of the parent bores in the rear cover (B2). Press in the bush, in a continuous movement, until the shoulder of the adaptor is against the front face of the rear cover. In this position the front face of the bush should be 3,25/3,30 mm (0.128/0.130 in) from the front face of the rear cover (B). Repeat this operation for the other bush.



Cylinder liner

To inspect**Operation 7-5**

To ensure the best performance during the life of the engine it is important that worn or damaged cylinder liners are renewed. If a change of liner becomes necessary in service, transition fit liners and partially finished liners are available.

The condition of a cylinder liner is decided by:

- The amount and location of any polished areas
- Wear
- Damage to the liner wall.

Note: It will not be necessary to renew the liners if:

- The honed finish can still be clearly seen.
- The engine performance and oil consumption is acceptable.

To check the condition of a cylinder liner

1 Inspect the liner surface for cracks and deep scratches.

2 Check the liner wall for areas where the honed finish has been polished away. Check especially the area around the top of the liner bore just below the carbon ring. In this area, thrust from the top piston ring is at its maximum.

Cautions:

- *Do not use "Flex-hone" to repair cylinder liners.*
- *Damaged or worn liners must be discarded.*
- *New piston rings must be fitted when the cylinder liner is renewed.*
- *An engine can have high oil consumption with very little wear of the liner bores, if the surfaces of the liners are glazed.*
- *Specialist training and equipment is needed to machine the finish of a partially finished liner.*

Partially finished cylinder liners must be bored and then diamond honed, silicon carbide base honed and silicon carbide plateau honed to the finished size. Refer to the Data and dimensions for a "Partially finished liner" on page 26. Specialist training and equipment is needed to machine a partially finished liner. For further information contact your nearest Perkins Distributor.

10

Lubrication system

General description - four cylinder engine lubrication system

Pressure lubrication is supplied by a rotor type pump which is driven through an idler gear from the crankshaft gear. The pump has an inner rotor and an outer rotor which are off-centre to each other. There is a key between the inner rotor and the drive shaft. The inner rotor has six lobes which mesh with the seven lobes of the outer rotor. When the pump rotates, the space between the lobes of the outer rotor which are in mesh increases to cause a suction or decreases to cause a pressure increase. If a balancer unit (page 190 illustration B) is fitted, the oil pump is fitted to the balancer frame and is driven by the balancer drive shaft.

Lubricating oil (page 189 illustration A1) from the sump passes through a strainer and pipe to the suction side of the pump.

The lubricating oil (page 189 illustration A2) passes from the outlet side of the pump through a pipe to a relief valve, which is fitted to the bottom of the left side of the cylinder block. If a balancer unit is fitted, the relief valve is fitted in the frame of the balancer. The relief valve opens if the oil pressure is too high and allows some of the lubricating oil to return to the sump.

From the relief valve, lubricating oil passes to a plate type oil cooler (some naturally aspirated engines do not have an oil cooler). The oil cooler is either fitted to the left side of the cylinder block and has seven plates, or it is fitted between the oil filter head and the filter canister and has ten plates. Some oil coolers are fitted with a by-pass valve. If cold oil increases the restriction in the cooler, the by-pass valve opens and the oil passes directly from the inlet side to the outlet side of the cooler.

Lubricating oil from the oil cooler, passes to an oil filter. The oil filter can be fitted to the left or right side of the engine. If the filter is fitted to the right side (page 190 illustration B) of the engine, the oil passes through a pipe connected between the relief valve and the right side of the cylinder block. The oil passes from the pipe through a passage in the right side of the cylinder block to an oil cooler and then to the oil filter. When the oil filter is on the right side of the engine, and an oil cooler is fitted, the oil cooler will be between the oil filter head and the oil filter canister.

The lubricating oil passes from the filter to the pressure rail which is drilled the complete length of the left side of the cylinder block. If the oil filter is on the right side of the engine, the oil passes through a passage drilled across the cylinder block to the pressure rail.

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

Lubricating oil (page 189 illustration A3) passes from the main bearings through passages in the cylinder block to the journals of the camshaft. Lubricating oil passes from the centre journal of the camshaft through a passage in the cylinder block and cylinder head to a restriction in the pedestal of the rocker shaft, at a reduced pressure (page 189 illustration A4), to the rocker bushes. The oil passes through a passage in the rocker shaft to the bearings of the rocker levers. The valve stems, valve springs and the tappets are lubricated by splash and oil mist.

The hub of the idler gear is lubricated by oil from the pressure rail and the timing gears are splash lubricated.

The turbocharger is lubricated by oil after the filter. Oil is supplied from a connection on the right side of the cylinder block through an external pipe to the turbocharger. The oil passes through the turbocharger and returns through a pipe to the sump.

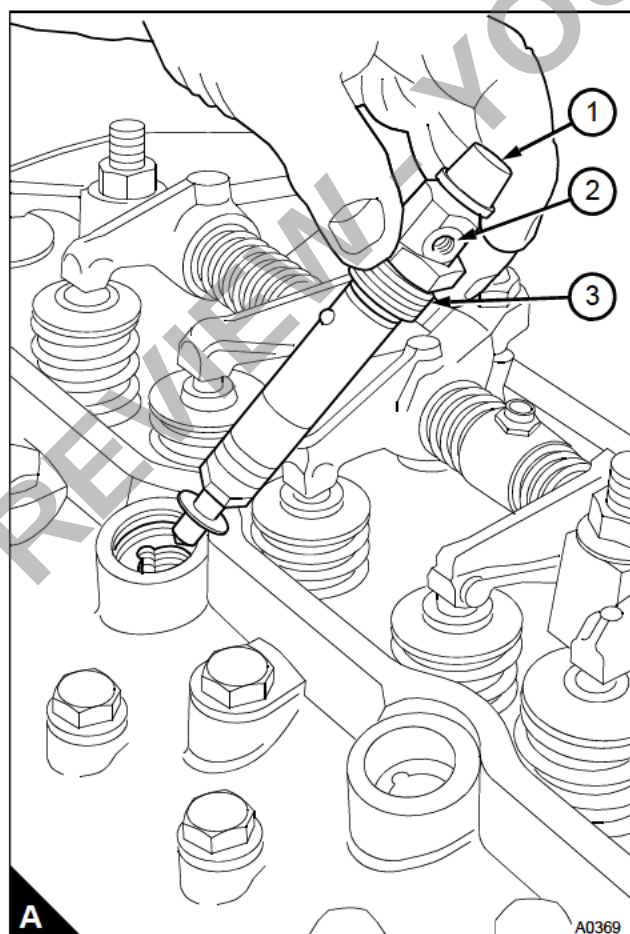
Turbocharged engines have piston cooling jets fitted. These jets are connected to the oil pressure rail and spray lubricating oil inside the pistons to keep them cool. Naturally aspirated engine types AR and AS have one piston cooling jet fitted to the number one cylinder position.

To remove

Operation 11-4

Caution: Do not allow dirt to 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.

- 1 Remove the fuel leak-off pipe from the connection (A2).
- 2 Remove the union nuts of the high-pressure pipe from the atomiser and from the fuel injection pump. Do not bend the pipe. If necessary, remove the pipe clamp. Fit a plastic cap (A1) to cover the fuel inlet connection and the nozzle.
- 3 Release the gland nut (A3) and remove the atomiser and its seat washer from the recess in the cylinder head.



Air in the fuel system

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.

To eliminate air from the fuel system

Operation 11-20

Warnings!

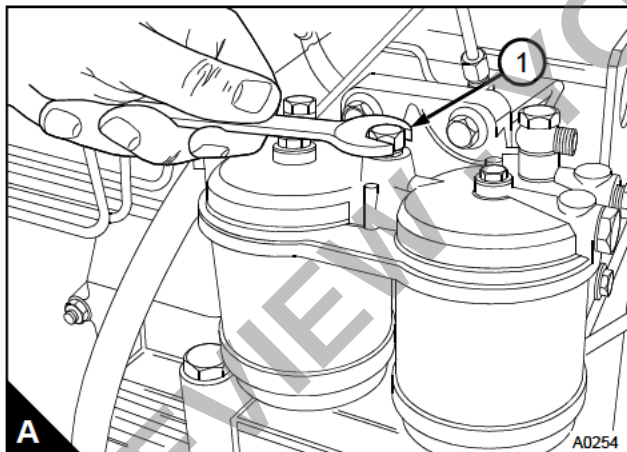
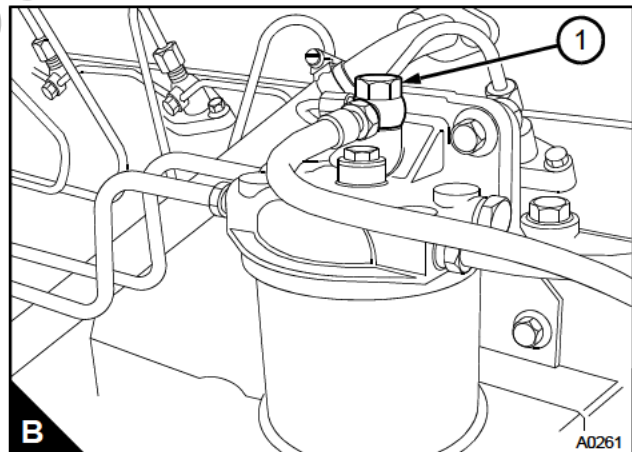
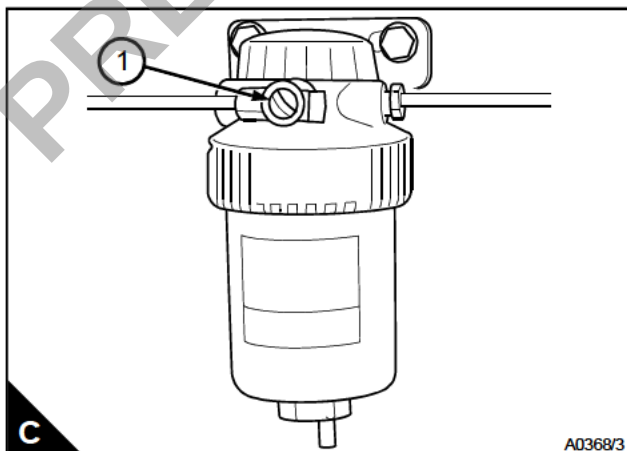
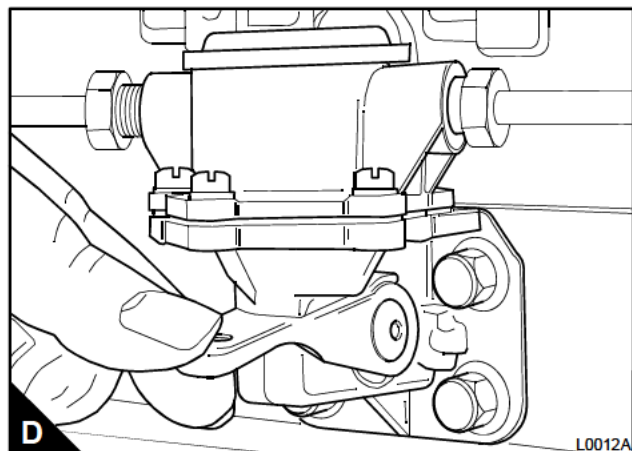
- If your skin comes into contact with high pressure fuel, obtain medical assistance immediately.
- Keep away from moving parts during engine operation. Some moving parts cannot be seen clearly while the engine runs.

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

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

- 1 Loosen the vent plug, (A1) (C1) or the banjo bolt on the filter head (B1). If a separate pre-fuel filter is fitted, air must be eliminated from this filter first using the same procedure as described for the main fuel filter.
- 2 Operate the priming lever of the fuel lift pump (D) until fuel, free from air, comes from the vent plug or the banjo bolt. Tighten the vent plug or the banjo bolt.

Continued



Caution: It is important that only the tool, shown in (B), is used to fit the new coolant seal.

The coolant seal is an interference fit on the shaft and a tool will be necessary to fit the seal correctly.

The tool should be made of mild steel bar to the dimensions shown in (B), as follows:

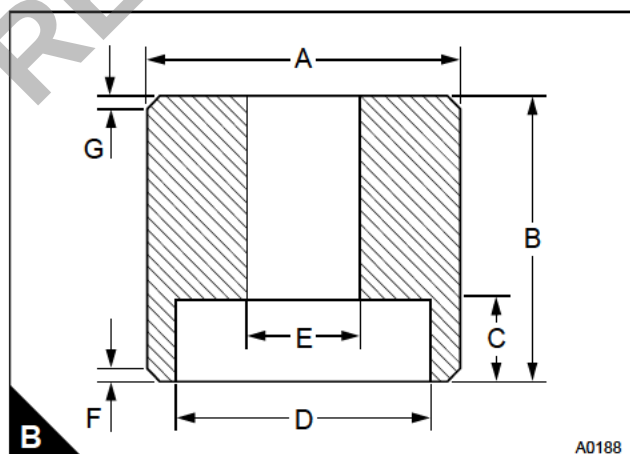
A	44,0 mm (1.73 in)
B	40,0 mm (1.57 in)
C	10,7 mm (0.42 in)
D	37,3 mm (1.47 in)
E	16,1 mm (0.63 in)
F	1,00 mm (0.04 in) at 45°
G	2,00 mm (0.08 in) at 45°

The dimensions of the tool to fit the coolant seal, will ensure that the seal is the correct length after it is installed. It will also prevent axial distortion of the seal when it is pressed onto the shaft.

Caution: Do not lubricate the seal. It is important that the seal is not contaminated by oil or grease and if it is held in the hand, it should be held by the edge of the flange. Do not damage the ring of green sealant applied to the body of the coolant seal just behind the flange of the seal.

Support the pulley end of the shaft, ensure that there are no sharp edges on the edge of the shaft and put the seal into position on the end of the shaft. Ensure that the ring of sealant is towards the bearings. Use the tool to press the seal onto the shaft until the bottom of the seal flange is in complete contact with the pump body. Continue to apply force for approximately ten seconds to ensure that the seal remains in position when the force is released.

Continued



Fault diagnosis

Operation 14-6

The alternator is designed in such a way that a flow of current (indicated by no light at the warning light or a reading shown on an ammeter) 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 ammeter
- 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 fully charged.
- 2 Connect a moving-coil voltmeter of good quality, with a range of 0-50 volts, across the positive and negative terminals of the alternator. If an ammeter is not fitted in the electrical circuit, fit a moving-coil 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); the warning light should be illuminated.
- 4 Switch on a 10-15 ampere load, for example, lights, fans, etc.
- 5 Start the engine and operate it at a fast idle speed; either the warning light should be extinguished or the ammeter indicates a small change in the current in relationship to the engine speed.
- 6 Increase the engine speed for a moment to near maximum speed, when the charge current should be approximately equal to the rating for the alternator, refer to the Data and dimensions for "Alternators" on page 34.
- 7 Operate the alternator at approximately half speed (engine speed approximately 1500 rev/min) and remove the electrical load. The voltage should go up to 14 volts for a 12 volt system or 28 volts for a 24 volt system and then remain constant. At the same time the current reading should show a reduction.

Any change in the above data can indicate a fault and the procedure that follows should be used before any components are disconnected. This procedure is not suitable for A127 alternators and, if a fault is found, 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.

If the warning light is not illuminated when the switch is in the "ON" position:

Check the bulb. If no fault:

Check all the connections at the regulator, at the alternator and at the battery.

If no fault:

Turn the switch to the "OFF" position. Disconnect the wire from the "F" terminal on the alternator and connect a wire between the "F" terminal and the negative terminal on the alternator. Turn the switch to the "ON" position.

If the warning light shows, the fault is in the regulator.

If the warning light does not show, the fault is in the alternator.

Continued

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