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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21 Cooling system

POWERPART recommended consumable products

Perkins have made available the products recommended below in order to assist in the correct operation, service and maintenance of your engine and your machine. The instructions for the use of each product are given on the outside of each container. These products are available from your Perkins distributor.

POWERPART Antifreeze

Protects the cooling system against frost and corrosion. Part number 1 litre 21825166 or 5 litres 21825167, refer to the User's Handbook.

POWERPART Easy Flush

Cleans the cooling system. Part number 2182501

POWERPART Jointing compound

Universal jointing compound which seals joints. Currently Hylomar. Part number 1861155 or 1861117.

POWERPART Silicone rubber sealant

Silicone rubber sealant which prevents leakage through gaps.Currently Hylosil. Part number 1861108.

POWERPART Lay-Up 1

A diesel fuel additive for protection against corrosion. Part number 1772204, refer to the User's Handbook.

POWERPART Lay-Up 2

Protects the inside of the engine and of other closed systems. Part number 1762811, refer to the User's Handbook.

POWERPART Lay-Up 3

Protects outside metal parts. Part number 1734115, refer to the User's Handbook.

POWERPART Chisel

Allows easy removal of old gaskets and joints. Currently Loctite chisel. Part number 21825163.

POWERPART Repel

Dries damp equipment and gives protection against corrosion. Passes through dirt and corrosion to lubricate and to assist removal of components. Currently Loctite repel. Part number 21825164.

POWERPART Threadlock

To retain small fasteners where easy removal is necessary. Currently Loctite 222e. Part number 21820222.

POWERPART Studlock

To permanently retain large fasteners and studs. Currently Loctite 270. Part number 21820270.

POWERPART Nutlock

To retain and seal threaded fasteners and cup plugs where easy removal is necessary. Currently Loctite 242e. Part number 21820242

POWERPART Liquid gasket

To seal flat faces of components where no joint is used. Especially suitable for aluminium components. Currently Loctite 518. Part number 21820518

POWERPART Threadlock (hydraulic/pnuematic)

To retain and seal pipe connections with fine threads. Especially suitable for hydraulic and pneumatic systems. Currently Loctite 542. Part number 21820542

POWERPART Threadlock (pipe)

To retain and seal pipe connections with coarse threads. Pressure systems can be used immediately. Currently Loctite 575. Part number 21820575.

POWERPART Retainer (oil tolerant)

To retain components which have a transition fit. Currently Loctite 603. Part number 21820603.

POWERPART Retainer (high strength)

To retain components which have an interference fit. Currently Loctite 638. Part number 21820638.

POWERPART Atomiser thread sealant

To seal the threads of the atomiser into the cylinder head. Currently Hylomar Advance Formulation. Part number 21825474.

Continued

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Cylinder head assembly

General description

In a diesel engine there is little carbon deposit and for this reason the number of hours run is no indication of when to overhaul a cylinder head assembly. The factors which indicate when an overhaul is necessary are how easily the engine starts and its general performance.

The cylinder head assembly has two valves fitted for each cylinder, each fitted with single valve springs.

The ports for the inlet and exhaust are on the right side of the cylinder head.

The face angle of the valves is either 45° or 30°. The angle of the valve seats in the cylinder head is either 46° or 31°.

The valves move in phosphated steel guides which can be renewed. The exhaust valve guide has a counterbore to prevent seizure of the valve stem caused by a build up of carbon under the head of the valve.

Both valve stems are fitted with oil seals that fit over the top of the valve guides.

The engines have steel valve seat inserts fitted in the cylinder head for both inlet and exhaust valves.

To fit

(Engine types AJ to AQ and YG to YK)

See page 45 for AR and AS engine types

Special tools:

Angle gauge, to tighten cylinder head setscrews, MS.1531

1 Clean the bottom face of the cylinder head and the top face of the cylinder block. Ensure that there is no debris in the cylinder bores.

Note: The engines have two location pins (A3), one at each end of the cylinder head, pressed into the cylinder block to hold the cylinder head and cylinder head gasket in the correct position when the cylinder head is fitted.

***Cautions*:**

- *To prevent damage to the cylinder head gasket, ensure that the location pins are pressed in the cylinder block before the cylinder head is fitted.*
- *The cylinder head gasket must be fitted without jointing compound.*

2 Put the cylinder head gasket in position; It is stamped "FRONT TOP" (A2) for correct assembly.

3 To ensure the cylinder head is fitted into the correct position, fit two suitable 1/2 UNF guide studs (A1) or (B1) in positions 16 and 21 (page 40/B) or positions 25 and 30 (page 40/A). Put the cylinder head in position. Ensure that the two location pins are fully engaged in the cylinder head.

4 Lightly lubricate the threads of the cylinder head setscrews and the thrust faces of the setscrew heads. Engage some of the setscrews in their correct positions and remove the guide studs. Engage the remainder of the setscrews in their correct positions.

5 Gradually and evenly tighten the setscrews to 110 Nm (80 lbf ft) 11,1 kgf m in the sequence shown in (page 40/A or B).

6 Repeat paragraph 5 to ensure that all the setscrews are tightened to the correct torque.

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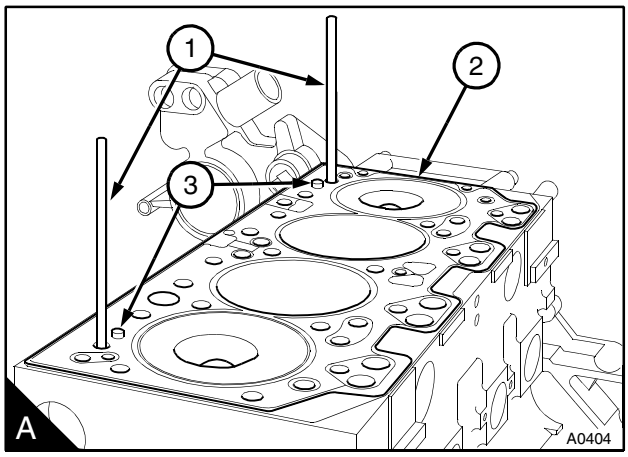
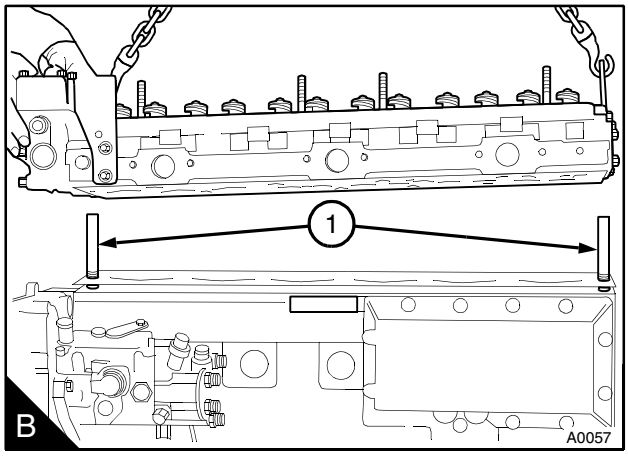




Valve guides

To inspect 12-10

To check the valve guides for wear: The maximum permissible clearance (A5) with a valve lift of 15,0 mm (0.6 in), between the valve stem and the bore of the guide is 0,100 mm (0.008 in) for inlet valves and 0,121 mm (0.011 in) for exhaust valves. If the clearance, with a new valve fitted, is more than the limit, then a new valve guide (A4) must be fitted.

It is recommended that the procedure given below is used to check the valve guide clearance:

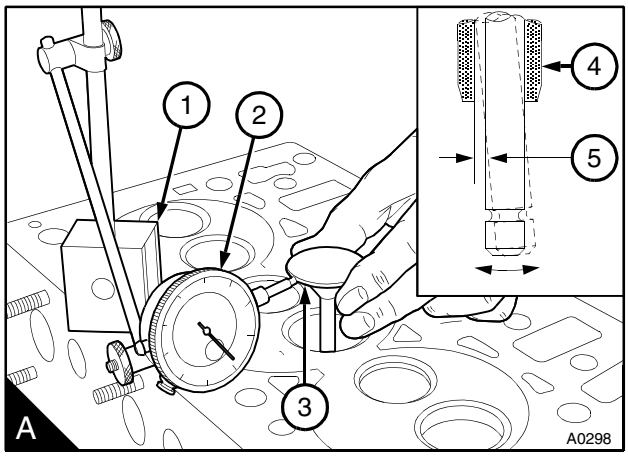
1 Put a new valve in the valve guide.

2 Put a dial test indicator with a magnetic base (A1) onto the face of the cylinder head.

3 With the valve lifted 15,0 mm (0.6 in) and the gauge (A2) in contact with the edge of the valve head (A3), move the valve radially away from the gauge. With the valve held in this position, set the gauge to zero.

4 Move the valve radially across the axis of the cylinder head towards the gauge. Make a note of the reading on the gauge. If the reading is equal to or greater than the data given below, a new valve guide (A4) must be fitted.

Note: The partially finished valve guides are reamed and the valve seats are cut in one operation with a special tool. The valve seat and the guide are cut in one operation to ensure the concentricity of the valve seat to the valve guide. This will ensure a good seal between the guide and its seat. New valves and new valve seat inserts must be fitted each time a new valve guide is fitted. Valves must not be lapped, see operation 12-13. If all or most of the original valve guides need to be renewed it may be cost effective to overhaul or exchange the cylinder head.



Valve guides

Inside diameter of partially finished guide . . . . . 8,600/8,700 mm (0.3386/0.3425 in)
Inside diameter of finished guide. . . . . 9,000/9,022 mm (0.3543/0.3552 in)
Outside diameter:
Inlet . . . . . 13,034/13,047 mm (0.5131/0.5137 in)
Exhaust . . . . . 14,034/14,047 mm (0.5525/0.5530 in)
Interference fit of valve guide in cylinder head . . . . . 0,047/0,007 mm (0.0003/0.0019 in)
Full length . . . . . 51,25 mm (2.018 in)
Protrusion from bottom of recess for valve spring. . . . . 14,85/15,15 mm (0.585/0.596 in)

Valve springs

Fitted length. . . . . 39,0 mm (1.54 in)
Load at fitted length:
- Engine types, AJ, AK, AM, AP, AQ, YG, YH, YK . . . . . 246/277,5 N (55.3/62.4 lbf) 25,1/28,3 kgf
- Engine types AR and AS. . . . . 136,3/153,7 N (30.6/34.5 lbf) 13,9/15,7 kgf
Number of active coils 3.3
Number of damper coils 0
Direction of coils . . . . . Left hand

Tappets

Diameter of tappet stem . . . . . 18,99/19,01 mm (0.7475/0.7485 in)
Diameter of tappet bore in cylinder block . . . . . 19,05/19,08 mm (0.7500/0.7512 in)
Clearance of tappet in cylinder block. . . . . 0,04/0,09 mm (0.0015/0.0037 in

Rocker shaft

Outside diameter . . . . . 19,01/19,04 mm (0.7485/0.7495 in)

Rocker levers and bushes

Diameter of parent bore for bush. . . . . 22,23/22,26 mm (0.8750/0.8762 in)
Outside diameter of bush . . . . . 22,28/22,31 mm (0.8770/0.8785 in)
Interference fit of bush in rocker lever . . . . . 0,020/0,089 mm (0.0008/0.0035 in)
Internal diameter of fitted bush when reamed . . . . . 19,06/19,10 mm (0.7505/0.7520 in)
Clearance between rocker lever bush and rocker shaft . . . . . 0,03/0,09 mm (0.001/0.0035 in)
Maximum permissible clearance between
rocker lever bush and rocker shaft . . . . . 0,13 mm (0.005 in)

Piston rings

To remove and to fit 13-5

The pistons have two compression rings and an oil control ring. All the piston rings are above the gudgeon pin. To ensure that the correct type is obtained always use the engine identification number to order new parts.

Caution: *Only expand the ring gaps enough to ensure that the ends of the rings do not damage the piston when the ring is removed or put into position.*

To remove

Remove the piston rings with a suitable ring expander. Keep the rings with their relevant piston.

To fit

Use a suitable piston ring expander to fit the piston rings.

1 Fit the spring of the oil control ring in the bottom groove with the latch pin (A1) inside both ends of the spring (A). Fit the oil control ring over the spring (B3) or (C3). Ensure that the ring gap is at 180° to the latch pin.

2 Fit the cast iron ring with the taper face into the second groove, with the word "TOP" towards the top of the piston.

New second rings have a green identification mark which must be on the left of the ring gap when the ring is fitted and the piston is upright.

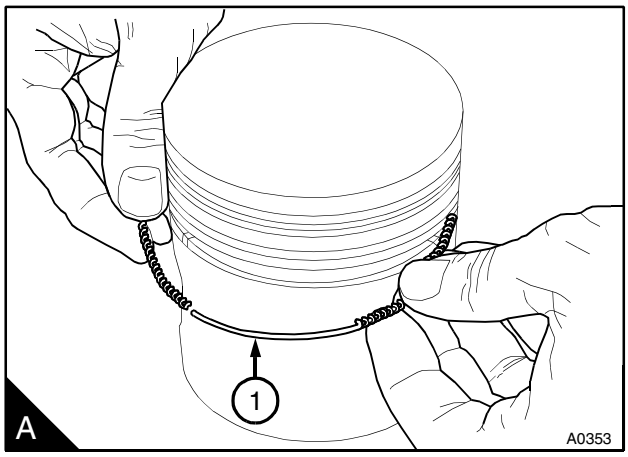
The second ring has a step (B2) or (C2) at the bottom of the tapered face.

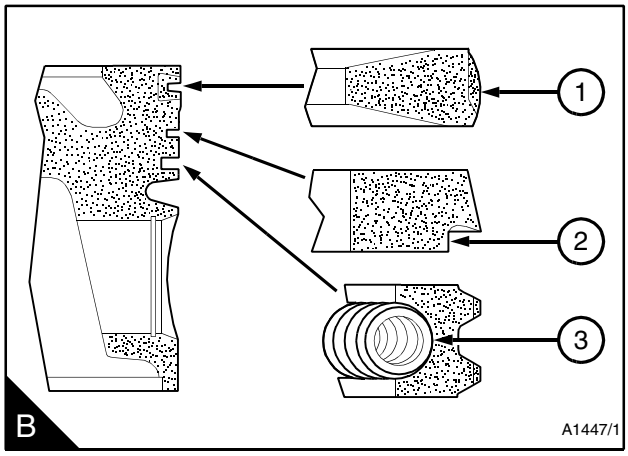
3 Fit the tapered, top ring (B1) or (C1) with the word 'TOP' towards the top of the piston.

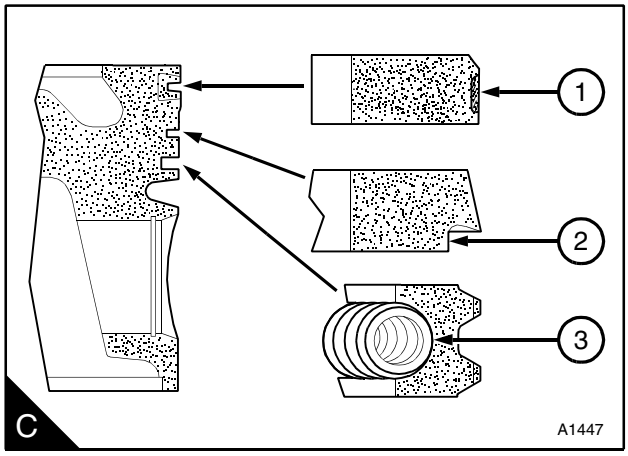
Note: The top ring (C1) of engine types AR and AS is parallel.

New top rings have a red identification mark which must be on the left of the ring gap when the ring is fitted and the piston is upright.

4 Ensure that the ring gaps are 120° apart.







Crankshaft pulley and damper

Consumable products:

POWERPART Retainer (oil tolerant)

Caution: *A viscous damper (C1) should be renewed if there is impact damage to the outer casing or if there is leakage of the viscous fluid from the cover plate. Check the area around the holes for the damper fasteners for damage.*

To remove

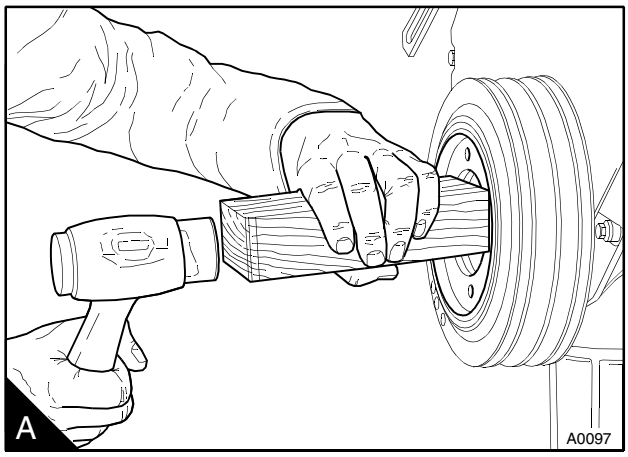
1 Remove the drive belts, see operation 23-3.

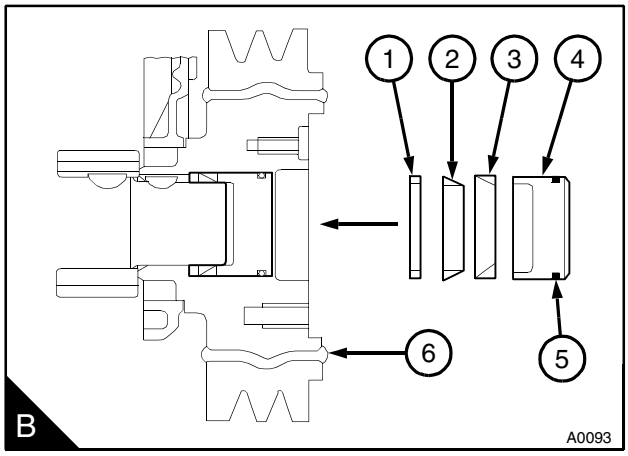
Warning! *The crankshaft pulley and damper assembly is heavy and must be given support before removal.*

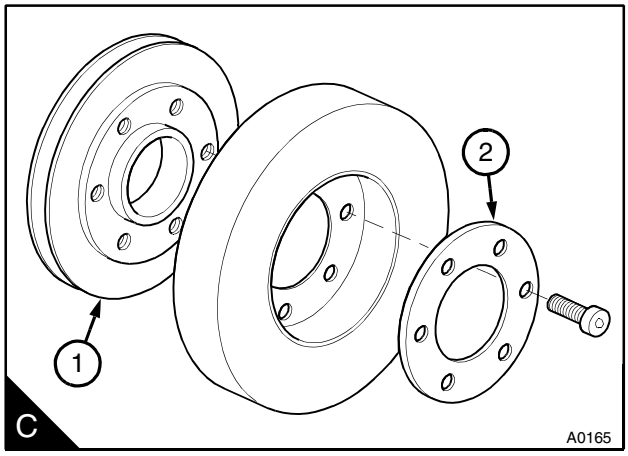
2 Release the fasteners which secure the clamp ring (C2) for the damper to the pulley, if one is fitted, and remove the damper.

Caution: *Do not use an extractor to remove the pulley.*

3 Remove the three setscrews and the thrust block (B4). If the pulley is not free. Hold a wooden block against the inner hub of the pulley and with a hammer, lightly hit the wooden block towards the rear (A) to loosen the tapered rings (B2 and B3).







Crankshaft

Consumable products:

POWERPART Silicone rubber sealant

POWERPART liquid gasket

Note: If the crankshaft is to be renewed, it may be necessary to change the grade of the connecting rods, see operation 13-7. This will occur if the correct piston height above the block face cannot be maintained with the original piston and connecting rod assemblies, see operation 13-4.

Warning! *Use lift equipment or obtain assistance to lift heavy engine components such as the flywheel, flywheel housing and the crankshaft.*

To remove

1 Before the engine is removed from the vehicle or from the machine, drain the lubricating oil and the coolant.

2 Remove the lubricating oil sump, see operation 19-3.

3 Remove the fan, the drive belts, the fan drive pulley and housing and the coolant pump, see section 21.

4 Remove the fuel injection pump, see section 20.

5 Remove the crankshaft pulley, see operation 14-1 or operation 14-2.

6 Remove the alternator and its mounting bracket, see section 23.

7 Remove the compressor and its drive assembly or remove the exhauster, see section 24.

8 Remove the timing case cover, see operation 15-1.

9 Remove the timing gears and the timing case, see section 15.

10 Remove the flywheel and the flywheel housing, see section 22.

11 Remove the rear oil seal housing, see operation 14-4.

12 If a balancer unit is fitted, remove it, see operation 14-12. If a balancer unit is not fitted, remove the lubricating oil suction pipe and strainer, the lubricating oil pump, the delivery pipe and the relief valve (four cylinder engines) and the lubricating oil crossover pipe, if fitted, see section 19.

13 Remove the bridge piece.

Warning! *The engine should be upside down before the fasteners for the crankshaft are removed. If the engine cannot be turned upside down support the crankshaft before the fasteners are removed.*

14 Remove the caps of the connecting rods. Keep the bearings and caps together. Remove the bolts of the connecting rods and carefully push the pistons towards the top their bores.

15 Ensure that the tops of the main bearing caps are stamped with their relevant position number. Remove the main bearing caps, the lower half of the shell bearings and the upper and lower thrust washers. Keep the bearings with their relevant caps.

16 Lift out the crankshaft. Remove the upper half of the bearings and keep each bearing with its relevant lower half and cap.

1 Clean all the components before inspection.

2 Check the gear teeth and the splines of the drive shaft for wear or other damage. Renew the drive shaft if necessary.

3 Check the idler gear, needle roller bearing, hub and thrust washer for wear or other damage. Renew the components if necessary.

4 Check the drive gear for the balance weights for wear or other damage. Renew the gear if necessary.

5 Check the balance weights for wear or other damage. If either balance weight is worn or damaged, both balance weights must be renewed.

6 Check the needle roller bearings for the drive shaft for wear or other damage. Renew the bearings, see operation 14-15, if necessary.

7 Check the bushes for the balance weights for wear or other damage. Renew the bushes, see operation 14-16, if necessary.

8 To inspect the lubricating oil pump, see operation 19-8.

Front oil seal

Special tools:

Replacer tool for front oil seal (main tool), PD170

Pressure plate for use with PD.170, PD.170-1

Sleeve for use with PD.170, PD.170-2

Fastener plate for use with PD.170, PD.170-3

Adaptor for use with PD.170 **(1)**

(1) Refer to your nearest Perkins distributor.

To remove

1 Remove the fan, see operation 21-9. and the drive belts, see operation 23-3.

2 Remove the crankshaft pulley, see operation 14-1 or operation 14-2.

3 Remove the oil seal with a suitable lever behind the main lip of the oil seal. Do not damage the edge of the oil seal housing.

To fit

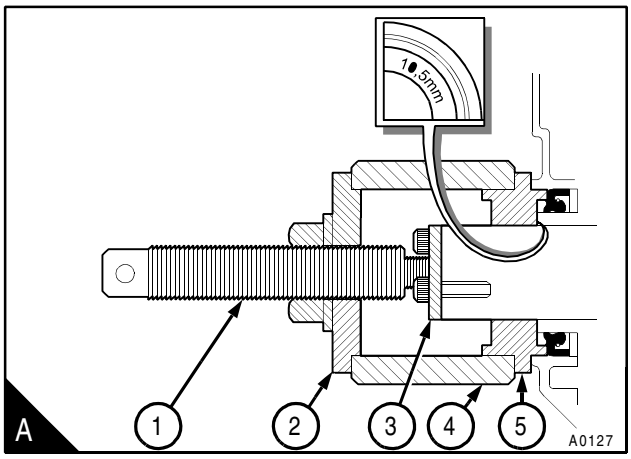
Note: The seal is fitted to a depth of 10,20/10,70 mm (0.402/0.421 in) from the front face of the oil seal housing to the flat front face of the oil seal. If, in service, there is wear in the seal location area of the crankshaft pulley, oil will continue to leak after a new oil seal is fitted. To renew a worn crankshaft pulley, see operation 15-3.

1 Clean the oil seal housing. Inspect the new seal for damage. If a scratch can be seen across the lip of the seal, do not fit the seal.

2 Lubricate the outer circumference of the oil seal with clean engine lubricating oil and enter the seal into the housing. Ensure that the spring loaded lip of the oil seal is towards the inside of the timing case cover and that the oil seal is square to the bore of the seal housing.

3 Assemble the oil seal replacer tool (A). Fit the fastener plate, PD.170-3, (A3) to the front of the crankshaft. Put the adaptor, (A5) on the nose of the crankshaft and against the seal. Ensure that the adaptor has the side stamped 10,5 mm towards the seal.

Assemble the pressure plate, PD.170-1, (A2) together with the sleeve, PD.170-2, (A4) onto the threaded bar, PD.170, (A1). Put the tool assembly in position on the adaptor, and tighten the threaded bar onto the stud of PD.170-3 (A3).



Fit a rod through the hole in the end of the threaded bar to prevent movement of the bar when the nut is tightened. Tighten the nut to push the seal into the housing to the correct depth.

4 Remove the replacer tool and lightly lubricate the seal location area of the crankshaft pulley with clean engine lubricating oil. Fit the crankshaft pulley, see operation 14-1 or operation 14-2.

5 Fit the drive belts, see operation 23-3 and adjust the belt tension, see operation 23-2.

6 Fit the fan, see operation 21-12.

Crankshaft gear

To remove

1 Remove the timing case cover, see operation 15-1.

2 Rotate the crankshaft until the marked teeth of the crankshaft gear and the camshaft gear are in mesh with the idler gear. The marked teeth of the idler gear will not necessarily be in mesh with the marked teeth of the other gears because of the different speed of rotation of the idler gear.

3 Remove the idler gear, see operation 15-4.

4 The crankshaft gear is a transition fit on the crankshaft. It may slide off easily or, if it is a tight fit and the gear is to be renewed, it may be necessary to remove the crankshaft, see operation 14-10, to remove the gear safely.

To fit

1 The gear can fit easily, or it may be necessary to heat the gear before it will fit onto the crankshaft. If the gear is to be heated, heat it in an oven to not more than 180 °C (226 °F). If an oven is not available, heat it in coolant which is at its boiling point. Do not use a flame as this can cause local damage. Fit the gear with the timing marks to the front.

2 Fit the idler gear, see operation 15-4 and ensure that all the timing marks are correctly aligned.

3 Fit the timing case cover, see operation 15-1.

To remove and to fit 16-4

Special tools:

Remover/replacer for cylinder liner (main tool), PD.150B

Adaptors for use with PD.150B, PD.150B-17A

Depth gauge, liner flange, PD.41D

Dial gauge for use with PD.41D, PD.208

Consumable products: (See Section 10)

POWERPART Retainer (oil tolerant)

Loctite Safety Solvent or a similar product

Where several liners are to be removed or a very tight production liner is fitted, a press should be used. Where a single liner is to be removed or the crankshaft is to remain in position, a tool for hand operation is available.

To remove

1 Drain the lubricating oil and remove the lubricating oil sump, see operation 19-3.

2 Remove the cylinder head assembly, see operation 12-7.

3 Remove the piston and connecting rod assembly, see operation 13-3.

4 Carefully remove the piston cooling jet, where fitted, see operation 13-11.

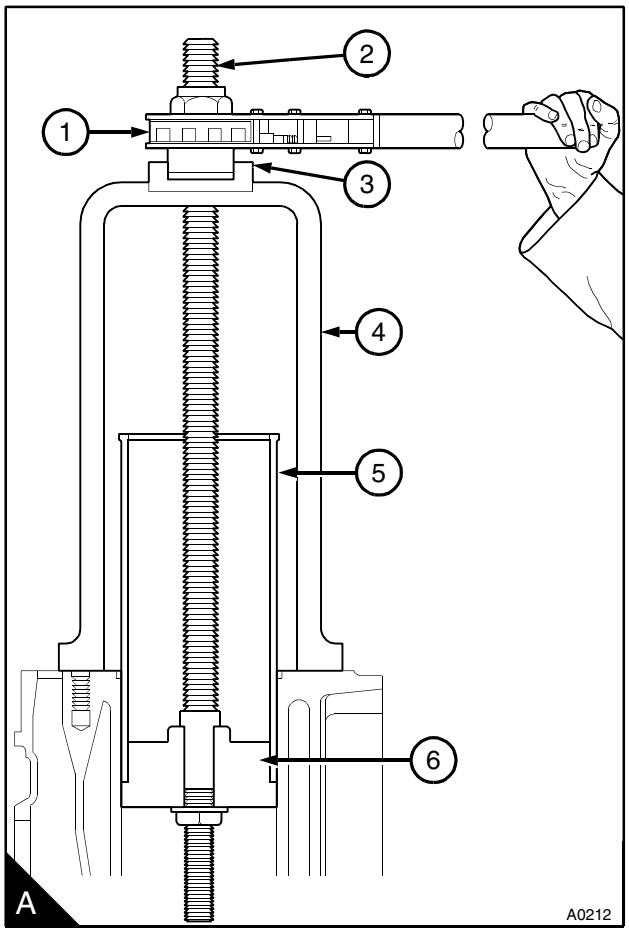
5 Rotate the crankshaft to give access to the cylinder liner. Protect the crank pin.

6 Put the tool (A4) on the top face of the cylinder block and over the centre of the liner (A5). Ensure that the base of the tool is not on top of the liner flange of the next cylinder.

7 Put the bearing (A3) in the recess in the top of the tool with the flat face of the bearing to the bottom of the recess.

8 Fit the threaded rod (A2) through the bearing and the top of the tool until the handle (A1) is in the recess in the top of the bearing. In this position adjust the threaded rod until the end is below the bottom of the cylinder liner. Fit the adaptor PD.150B-17/1 (A6) onto the threaded rod and against the bottom of the cylinder liner. Ensure that the two lugs on the top of the adaptor engage with the flats on the threaded rod. Fit the washer and nut and tighten the nut onto the adaptor.

9 Lubricate the ratchet of the handle and the threaded rod with Shell Spirax oil or an equivalent oil. Operate the handle and pull the cylinder liner out of the top of the cylinder block.



17

Engine timing

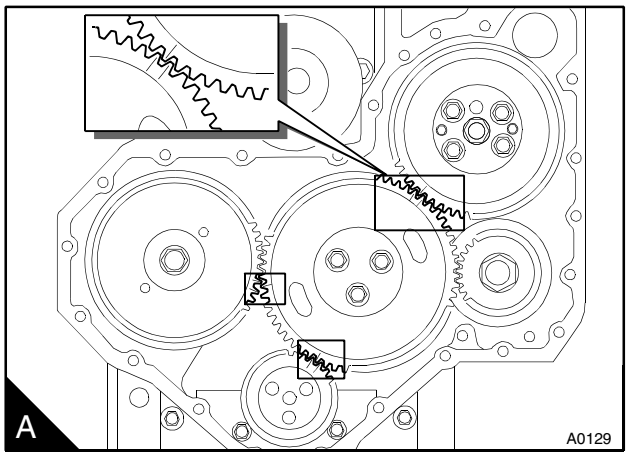
General description

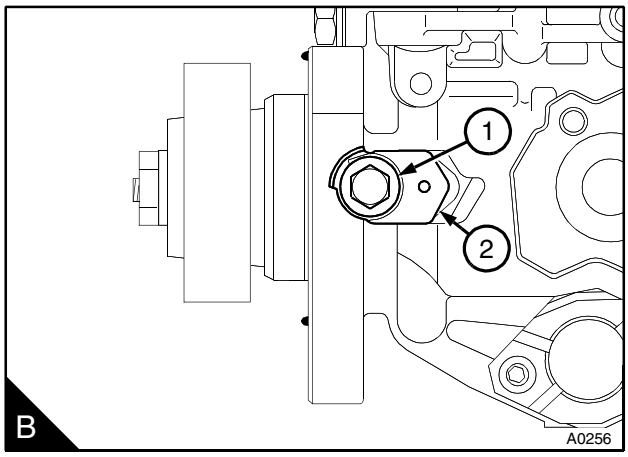
To reach the accurate fuel injection needed for engines to conform to emissions legislation, the latest fuel injection pumps operate at a static timing very close to TDC.

The timing gears are stamped with timing marks to ensure that they are assembled correctly (A). The marked teeth of the crankshaft, the camshaft and the fuel pump gears will be in mesh with the idler gear when number 1 piston is close to top dead centre (TDC) on the compression stroke. The marked teeth of the idler gear may not necessarily be in mesh in this position, because of the different speeds at which the gears rotate.

The fuel injection pump is timed at TDC on the compression stroke of number 1 cylinder. It is important that fuel injection timing is accurate to conform to emissions legislation. Always use operation 17-1 or operation 17-2 to obtain TDC on the compression stroke of number 1 cylinder accurately.

Caution: *The fuel injection pump has a lock screw (B1) which locks the shaft.* ***It is important that the lock screw is released*** *and the pump shaft is free to turn. The drive shaft of the pump must not be rotated without the spacer (B2) in position under the locking screw. If the drive shaft is rotated with the locking screw tightened on to the shaft, the drive shaft will be damaged.*





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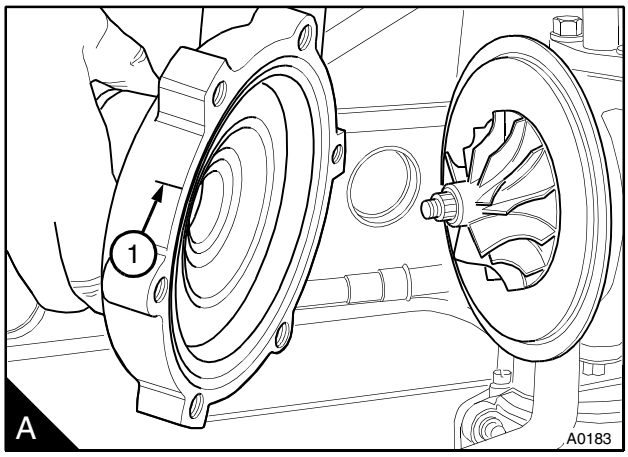
To clean the impeller and the compressor casing 18-2



Generally, it is not necessary to remove the turbocharger to remove the compressor casing, except on some engines where the compressor casing is held by a circlip and access to the circlip is not always possible. This type of turbocharger is usually fitted to engines used in vehicle applications.

1 Release the clip and remove the hose from the compressor inlet. Release the clips and push the hose on the compressor outlet up the elbow of the induction manifold.

2 Make a reference mark on the compressor casing (A1) and on the bearing housing to ensure correct assembly later.

3 Release the setscrews and remove the lock plates. If the compressor casing is retained by a circlip, remove the circlip. It may be necessary to remove the turbocharger if access to the circlip is not possible. If the turbocharger has a waste-gate unit, remove the actuator and bracket assembly, see operation 18-3.

Caution: *Be careful not to damage the impeller blades. If the impeller is damaged, the turbocharger must be renewed.*

4 Remove carefully the compressor casing from the turbocharger (A). If the casing is tight, lightly hit it with a soft faced hammer.

5 Put the compressor casing in a suitable container that contains a non-caustic solution. Allow the dirt to become soft and then clean the casing with a hard brush and/or a soft scraper. Dry the casing with clean, compressed air at low pressure.

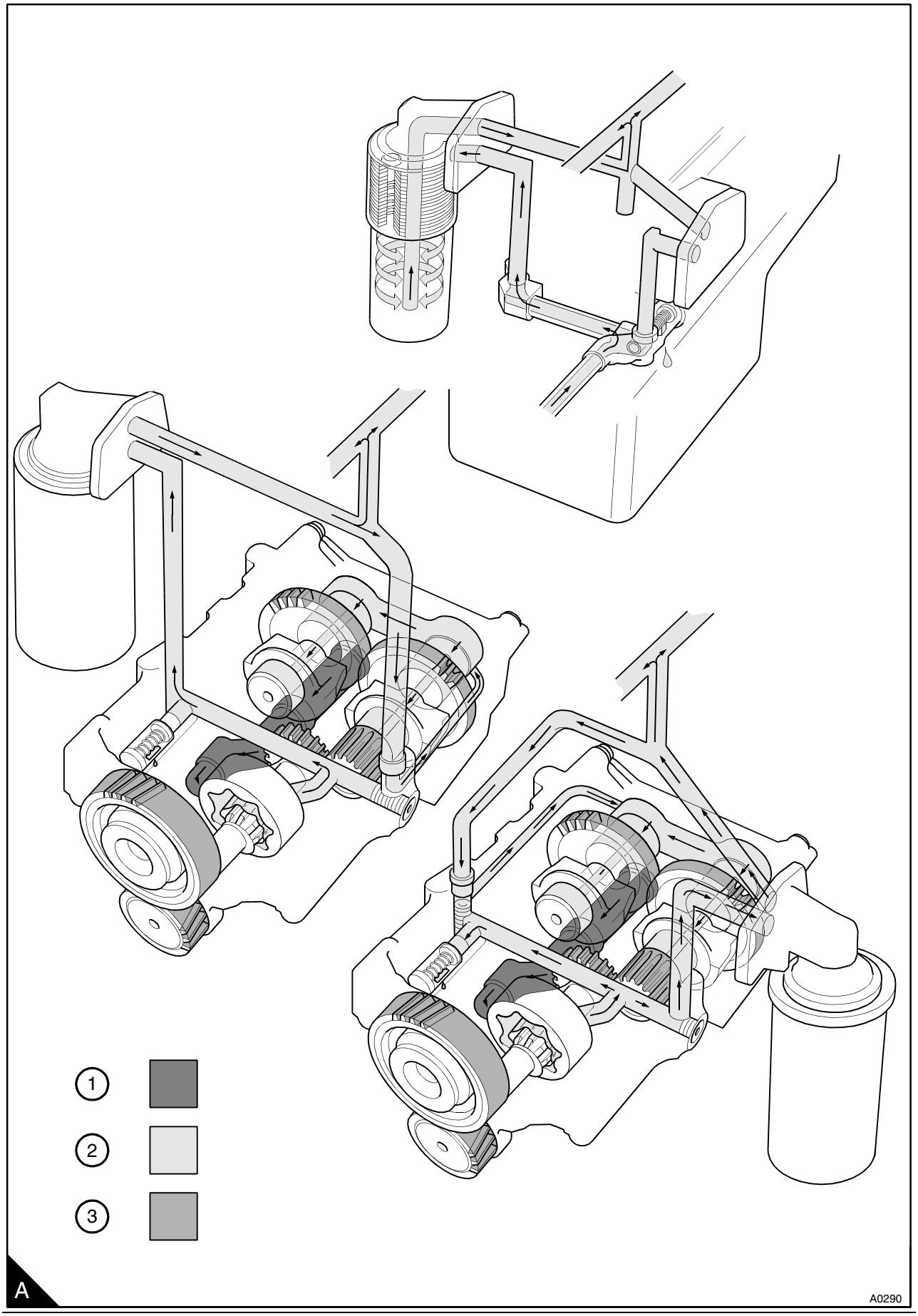
6 Clean the impeller with a soft brush.

7 Push carefully the compressor impeller towards the bearing housing and turn the impeller by hand. Check that there is no restriction of movement and that there is no noise which can indicate a fault. If there is a fault, remove the turbocharger for inspection by a specialist.

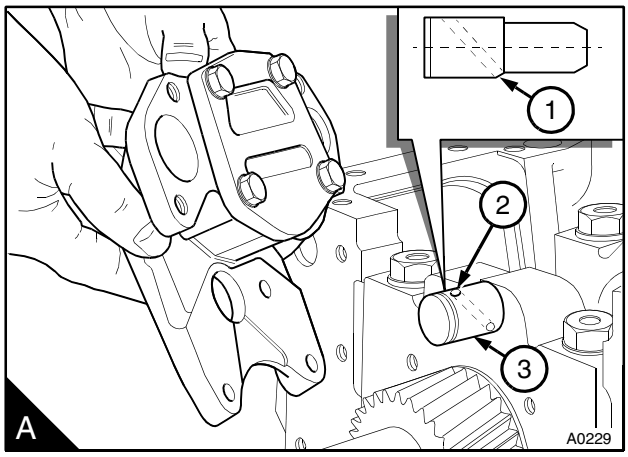
8 Fit the casing to the turbocharger and align the mark on the casing with the mark on the bearing housing. Fit the lock plates and the setscrews and tighten the setscrews.If the compressor casing of the turbocharger is retained by a circlip, fit the circlip loosely to the bearing housing. Ensure that the flat face of the circlip is toward the compressor casing. Fit the casing to the turbocharger and align the marks on the casing and on the bearing housing. Fit the circlip in its groove. If the turbocharger has a waste-gate unit, fit the actuator and bracket assembly, see operation 18-3.

9 Fit the hoses to the compressor inlet and outlet and tighten the clips.

10 If necessary, fit the turbocharger to the engine, see operation 18-1.


1
2
3
A
A0290

To fit the idler shaft



1 Check that the new idler shaft, part number 3271H002 or 3271H004 and the hole for the idler shaft in the bearing cap are clean and free from oil or grease. Remove any rough edges from the hole of the bearing cap.

2 Support the rear of the bearing cap and ensure that the cap will not move when the idler shaft is pressed in. Apply only enough POWERPART Retainer (oil tolerant) around the chamfer of the shaft to fully cover the surface of the hole when the shaft is pressed into position. Enter the chamfer of the idler shaft into the hole.

If the idler shaft (A3) has an oil hole ensure that the hole (A2) in the idler shaft is at the top and that the flat (A1) is at the bottom before the shaft is pressed into the bearing cap.

Ensure that the idler shaft is square to the bearing cap and press the shaft in onto its shoulder. Remove the surplus POWERPART Retainer from the idler shaft, the oil hole and the bearing cap before the oil pump is fitted.

3 Use the original hole for the pin in the bearing cap as a guide and drill a 6,35 mm (0.25 in) diameter hole in the idler shaft 9,5 mm (0.37 in) deep.

4 Fit a new pin, part number 2116087, into the bearing cap and idler shaft.

20

Fuel system

General description.

***Cautions*:**

- *The fuel injection equipment must only be checked and adjusted by personnel who have had the correct training.*
- *Do not clean an engine while it runs. If cold cleaning fluids are applied to a hot engine, certain components on the engine may be damaged.*

New 1000 Series engines are used for industrial and agricultural applications and use various fuel injection pumps. Either Bosch (A), Lucas (B) or Stanadyne (C) pumps may be fitted.

All of the fuel pumps conform to emissions legislation. Both the pump timing and the speed adjustment are tamper proof.

All of the fuel injection pumps have mechanical governors to control the engine speed.

Bosch and Lucas fuel injection pumps have locking screws (A2) and (B1) which lock the shaft. ***It is important that the lock screw is released*** and the pump shaft is free to turn when the pump is fitted to the engine. Stanadyne pumps do not have a locking screw fitted.

All of the fuel injection pumps have a pin timing hole (A1), refer to section 17 for the correct method to time the pump.

Turbocharged engines have pumps with a boost control (B2). The boost control is a device which is affected by boost pressure (from the turbocharger) and reduces the maximum fuel delivery at lower engine speeds to match the reduced air supply to the cylinders.

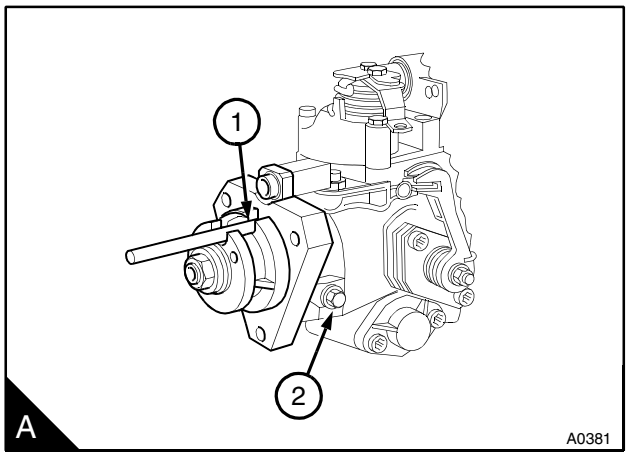
A data plate is fitted to the bracket of the fuel injection pump. The data plate information is shown below:

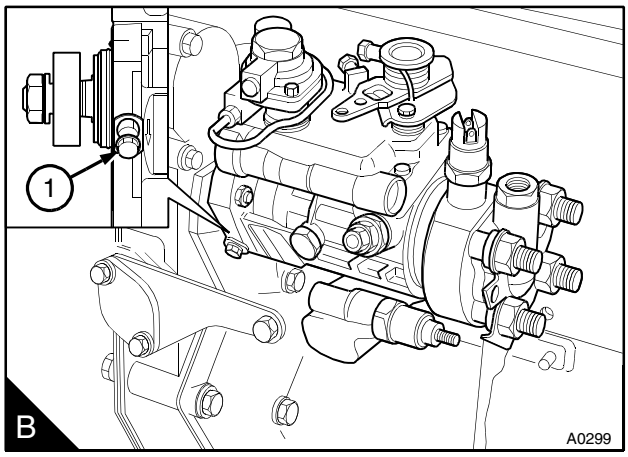
Perkins part number

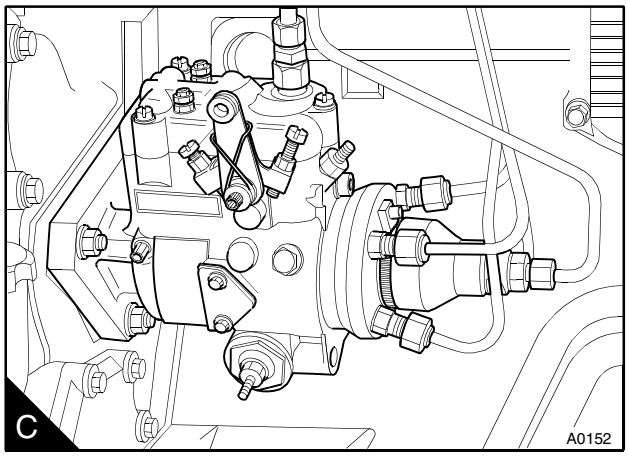
Fuel pump serial number

Manufacturers model number

The maximum no-load speed is shown on the emissions data plate fitted to the left side of the cylinder block.







Continued

Atomisers

Atomiser fault 20-2

Regular maintenance of the atomisers is not necessary. The atomiser nozzles should be renewed and not cleaned, and renewed only if an atomiser fault occurs. The major problems that may indicate that new nozzles are needed are listed below:

Engine will not start or is difficult to start

Not enough power

Engine misfires or runs erratically

High fuel consumption

Black exhaust smoke

Engine knocks or vibration

Excessive engine temperature

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 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. Do not loosen the union nut more than half a turn. When the union nut of the defective atomiser is loosened, there is little or no effect on the engine speed.

To remove and to fit 20-3

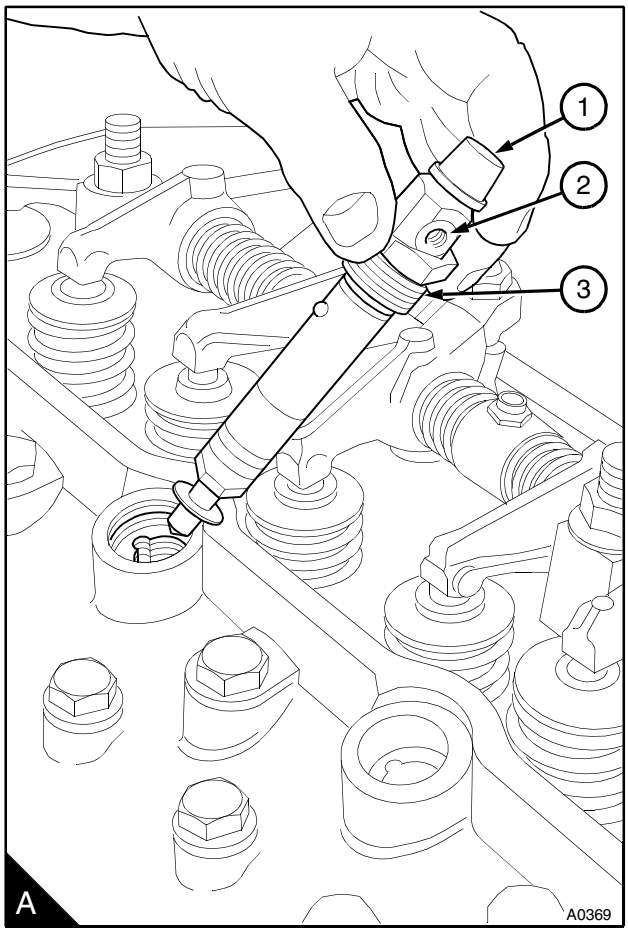
Consumable products:

POWERPART atomiser thread sealant

To remove

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 connection. 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.

Continued

To eliminate air from the fuel system 20-9

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:

Caution: *If the fuel system is empty or if the canister 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 banjo bolt (A1) on the top of the filter head. If a vent plug is fitted, loosen the vent plug instead.

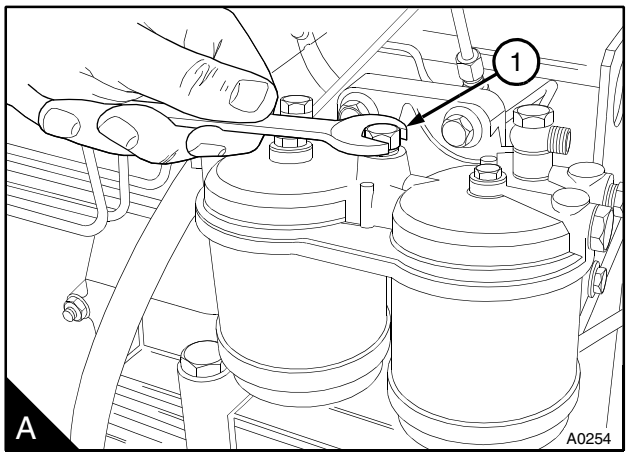
2 Operate the priming lever of the fuel lift pump (B) until fuel, free from air, comes from the banjo bolt. Tighten the banjo bolt. If the drive cam of the fuel lift pump is at the point of maximum lift, it will not be possible to operate the priming lever. In this situation, the crankshaft must be rotated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

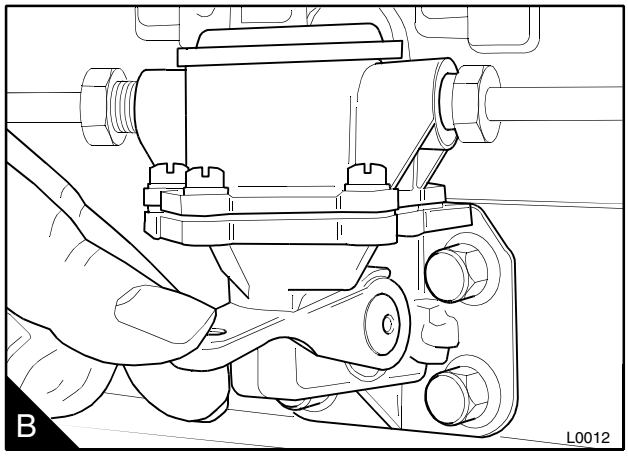
Caution: *Use a spanner to prevent movement of the fuelled starting aid (C1) when the union nut (C2) is loosened or tightened.*

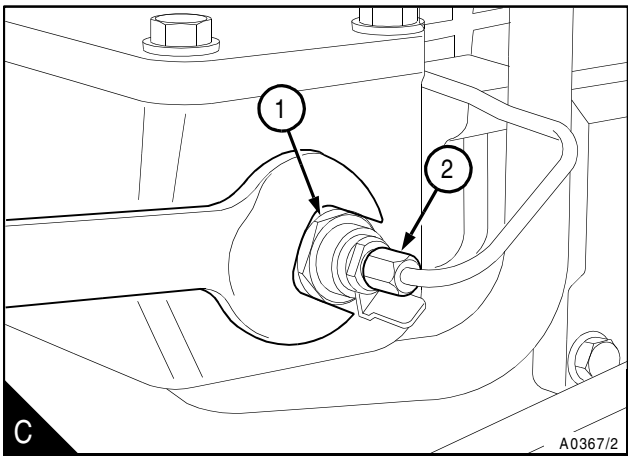
3 Loosen the union nut (C2) at the fuelled starting aid and operate the priming lever of the fuel lift pump until fuel, free of air, comes from the connection. Tighten the union nut at the starting aid.

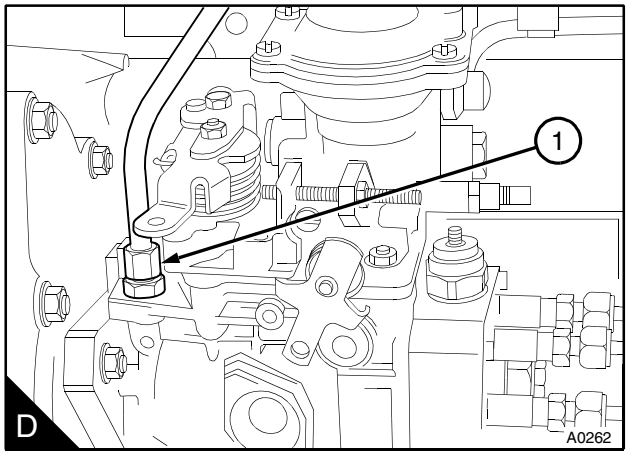
4 Loosen the union nut of the fuel inlet pipe (D1). Operate the priming lever of the fuel lift pump until fuel, free from air, comes from the loose connection. Tighten the union nut.

Continued









To remove

1 Disconnect the battery before the fuel injection pump is removed from the engine.

2 Set the engine to TDC on the number 1 cylinder on the compression stroke, see operation 17-1 or , see operation 17-2.

3 Remove the gear cover from the cover of the timing case. For gear driven coolant pumps: Remove the coolant pump, see operation 21-3.

4 Insert the timing pin (A1) through the hole (A5) in the fuel pump gear and the slot of the hub (A4). Push the pin fully into the hole (A3) in the body of the fuel pump. If the pin can be fully inserted then the pump timing is correct. There should be no resistance when the pin is inserted.

Caution: *Use a second spanner to prevent movement of the high-pressure outlet when the union nut for each high-pressure pipe is released.*

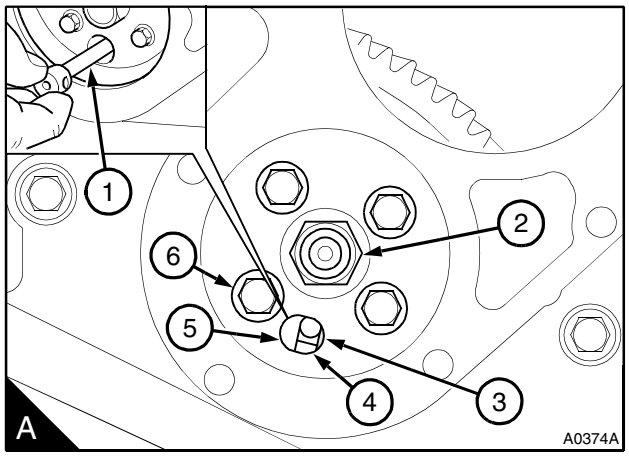
5 Remove the pipes, the cables and the connections for the cold start device (B2) and the electrical stop solenoid (B1) from the fuel pump.

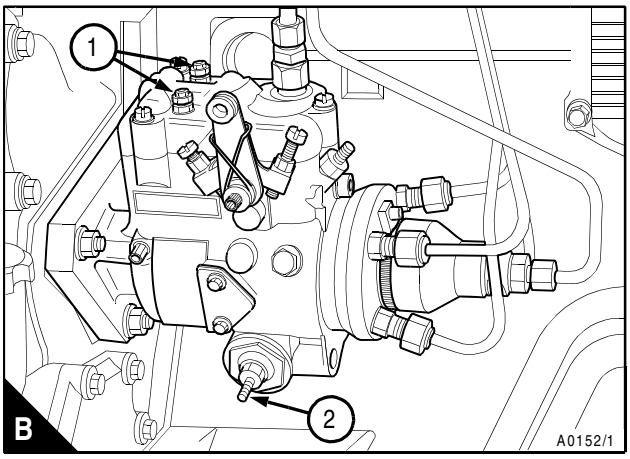
***Cautions*:**

- *Do not rotate the crankshaft when the pump is not on the engine; the loose fuel pump gear may damage the timing case. If it is necessary to rotate the crankshaft, fit the fuel pump temporarily to ensure that the gear is in the correct position. If the fuel pump is fitted temporarily in order to rotate the crankshaft.*
- *Do not release the nut (A2) from the fuel injection pump. The fuel pump hub is fitted to the shaft in the factory to ensure that the fuel pump is in the correct position for timing. If the hub is removed, the hub will need to be accurately fitted to the pump by use of special equipment available to Perkins distributors.*

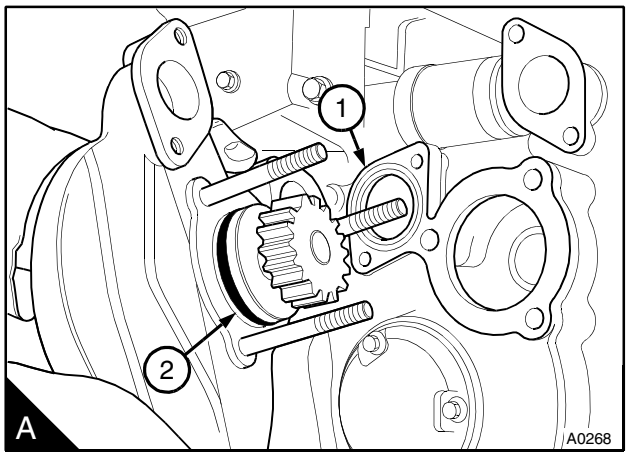
6 Remove the four fasteners (A6) and release the fuel pump gear from the hub of the fuel injection pump.

7 Remove the nuts from the flange of the fuel pump and remove the pump.





Coolant pump - early gear driven pumps



Identification of the coolant pump is by the last four digits of the part number, for example 4131**E011**, stamped on the front of the pump body.

To remove and to fit 21-2

To remove

1 Drain the cooling system and disconnect the hose at the inlet connection of the coolant pump.

2 Release the setscrews from the flange of the coolant by-pass.

3 Release the three setscrews which retain the coolant pump to the cover of the timing case - two from the front and one from the rear.

4 Release the setscrews from the rear face of the timing case, which fasten the pump to the timing case, and remove the coolant pump (A). Ensure that the "O" ring (A1) on the cover of the timing case is not lost.

To fit

1 Check the "O" rings on the pump body (A2) and on the cover of the timing case (A1) for damage. If either of the "O" rings are damaged, they must be renewed. Ensure that all joint faces are clean.

2 Check the drive gear of the coolant pump for wear or other damage. If the gear is damaged, it must be renewed.

3 Lightly lubricate the "O" ring on the pump body with clean engine lubricating oil. Fit the pump to the timing case cover with its gear in mesh with the gear of the fuel injection pump. The pump is a tight fit in the cover, but can be pulled into position if the nuts for the pump studs are gradually and evenly tightened. Ensure that the "O" ring in the cover remains in position while the pump is fitted.

Note: The setscrews have a sealant applied to the threads by the manufacturer. If the original setscrews are to be used again, the threads of the setscrews and the threads in which they will be engaged must be cleaned. A suitable sealant must then be applied to the threads of the setscrews.

4 Fit and tighten the three setscrews which retain the pump to the cover of the timing case - two from the front and one from the rear.

5 Fit a new joint to the flange of the coolant bypass. Fit the by-pass and tighten the setscrews.

6 Connect the hose to the inlet connection of the coolant pump and fill the cooling system. Operate the engine and check for leakage.

5 A tool (A) can be made to press the coolant seal into position. The tool should be made of a suitable material to the dimensions listed below:

A 44,0 mm (1.73 in)

B 40,0 mm (1.57 in)

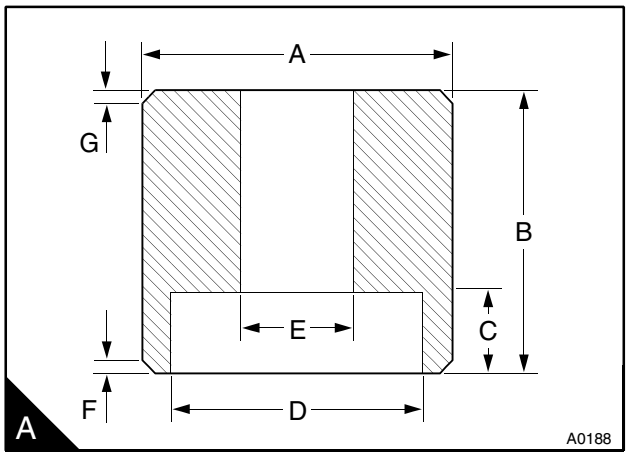
C 11,6 mm (0.46 in)

D 35,8 mm (1.41 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°



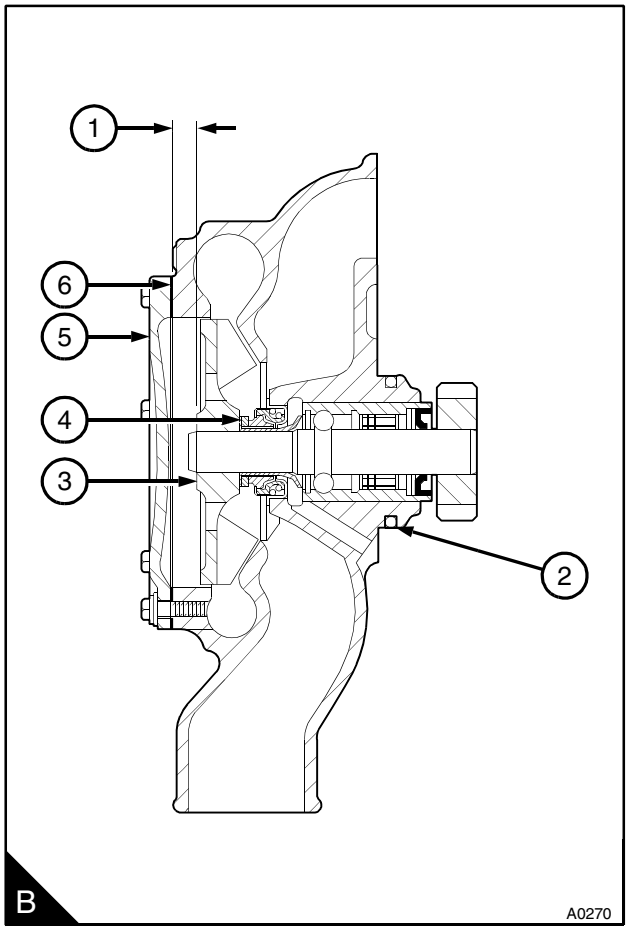
The dimensions of the tool to fit the coolant seal, will ensure that the seal is the correct length after it is installed. It will also prevent axial distortion of the seal when it is pressed onto the shaft.

6 Turn the pump over and support the drive end of the body. Do not lubricate the coolant seal (B4). 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. Put the seal into position on the end of the shaft. Ensure that the ring of sealant is towards the bearing. 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.

7 Hold the pump with the drive end of the shaft on a suitable support. With the use of a suitable distance piece and a flat bar, press the new impeller (B3) onto the shaft until the front face of the impeller is 6,7/7,0 mm (0.26/0.28 in) below the front face of the pump body (B1). Remove the flat bar and distance piece and ensure that the shaft is free to rotate.

8 Clean the threads in the front face of the pump body. Fit a new joint (B6) and the cover (B5). Fit the setscrews and tighten them to 9 Nm (6 lbf ft) 0,9 kgf m. If the setscrews are new, a sealant will have been applied to the threads by the manufacturer. If the original setscrews are to be used again, the threads should be cleaned and a POWERPART Nutlock applied.

9 Fit a new "O" ring (B2) to the body of the pump.



Lubricating oil cooler

To remove and to fit - four cylinder turbocharged engines 21-11

To remove

1 Drain the cooling system.

2 Release the support bracket at the cooler (A3).

3 Release the setscrew and nut (A2) which fasten the low-pressure fuel pipes to the top of the cooler.

4 Release the hose clip at the top rear of the cooler (A1).

5 Release the six setscrews (A4) which are fitted below the cover and the setscrew (A4) to the left of the cover. Remove the cooler.

To fit

1 Renew the "O" rings on the inlet connection for the coolant (B3) and the outlet flange for the coolant (B5). Ensure that the joint faces are clean. Renew the joint (B4) for the oil pipe flange.

2 Lightly lubricate the bore of the vent connection (B2) and the "O" ring on the coolant inlet connection with engine lubricating oil.

3 Loosely fit the hose clip to the vent connection.

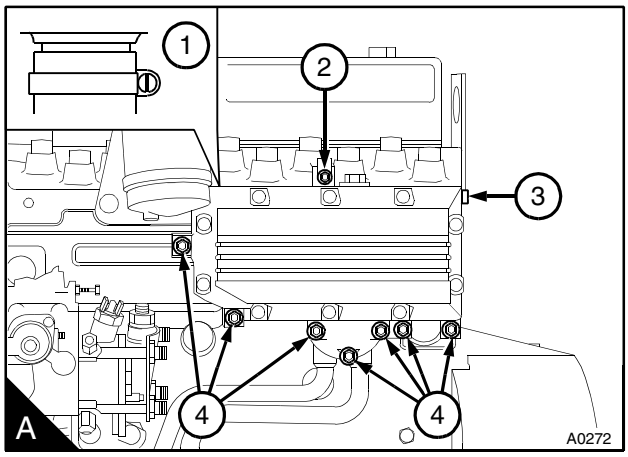
4 Fit the cooler to the engine with the vent (B1) fitted correctly in its connection. Tighten the setscrews and the hose clip of the vent connection.

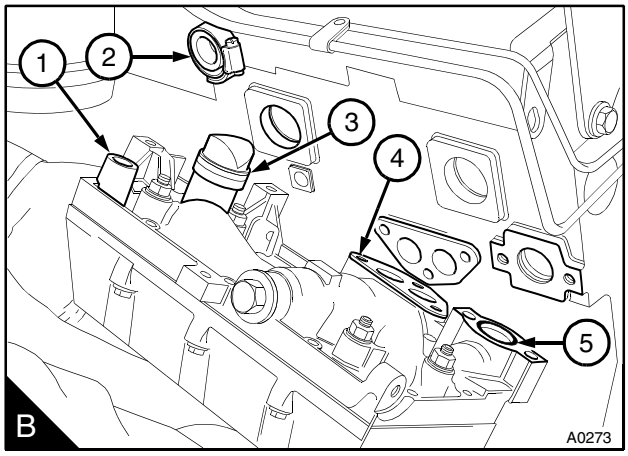
5 Fit and tighten the setscrew of the support bracket.

6 Fit the setscrew and nut which fasten the low-pressure fuel pipes to the top of the oil cooler.

7 Fill the coolant system.

8 Operate the engine and check for leakage of coolant or oil.





To fit

Adhesive sealing strips are fitted to the top cover and the induction manifold to seal the external surfaces of the tubestack. This is necessary to ensure that all of the air which enters the intercooler passes through the fins of the tubestack.

1 Renew the adhesive sealing strips (A1) that fitted to the bottom of the induction manifold and the top cover:

Remove the tape from the adhesive strip. Ensure that the sealing strip is fitted in a straight line, onto the flat machined surface on the cover and the cast surface of the manifold. Ensure that the ends are aligned with the vertical machined surface (A3) on each side of the manifold.

Note: Be careful with the tubestack when it is removed and fitted, be especially careful not to damage the fins.

2 Put the "O" rings (A2) into position against the large shoulder, on the inlet and outlet connections of the tubestack. Carefully position the tubestack in the induction manifold, ensure that the inlet and outlet connections are centred as they enter the holes in the manifold.

The tubestack will be in contact with the bottom of the manifold, if the "O" rings are fitted correctly.

3 Fit the setscrews which retain the tubestack to the induction manifold and tighten them gradually and evenly to 22 Nm (16 lb ft) 2,2 kgf m.

4 Renew the joint between the flange face of the top cover and induction manifold. The joint is fitted without sealant.

5 Put the top cover into position and fit the setscrews which retain the top cover to the induction manifold and tighten them gradually and evenly to 22 Nm (16 lb ft) 2,2 kgf m. Work from the centre of the flange to the outside.

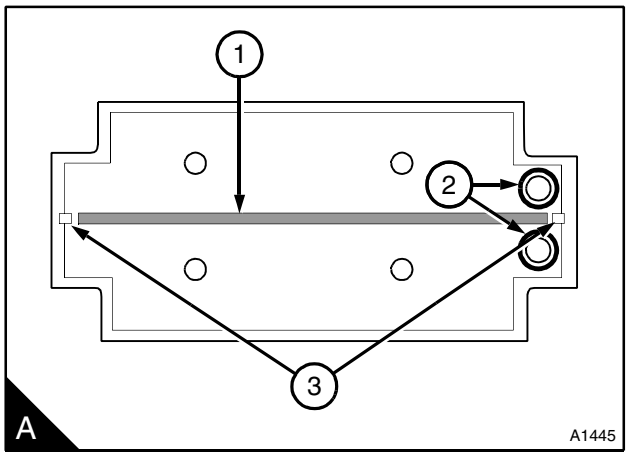
6 Connect the fuel pipe to the connection of the fuelled starting aid and fit the electrical connection. Eliminate air from the fuelled starting aid, see operation 20-9.

7 Fit the hoses and the hose clips to the coolant inlet and the outlet connections of the tube stack and tighten the clips. Fill the coolant system.

8 Fit the air hose from the turbocharger to the intercooler assembly and tighten the hose clips.

Note: If a hose that has a heat shield is renewed, ensure that the new part is of the correct type and it is fitted in the correct position.

9 Operate the engine and check for coolant and air leaks.



23

Electrical equipment

Alternators

General description

The alternator is driven from the crankshaft pulley by single or double belt(s).

The Lucas AC5RS, Magneti Marelli A127 and the Bosch KI 12 volt and NI 24 volt alternators have solid state regulators fitted at the rear. The regulator of the Magneti Marelli A127 alternator includes the brush box as a part of the unit. The regulators of both alternators are sealed and repair is not possible.

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 will immediately 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 electrical wire must be connected to the correct terminal. A short circuit or wrong connection which gives reverse polarity will immediately cause permanent damage to the diodes and to the transistors.
- Do not connect a battery into the system until it 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.

Starting aid

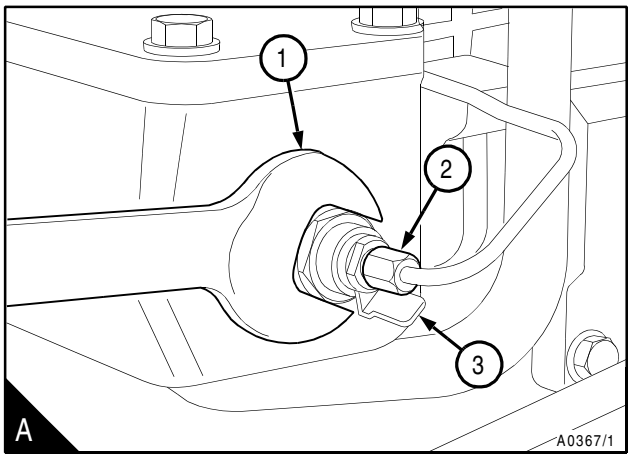
General description

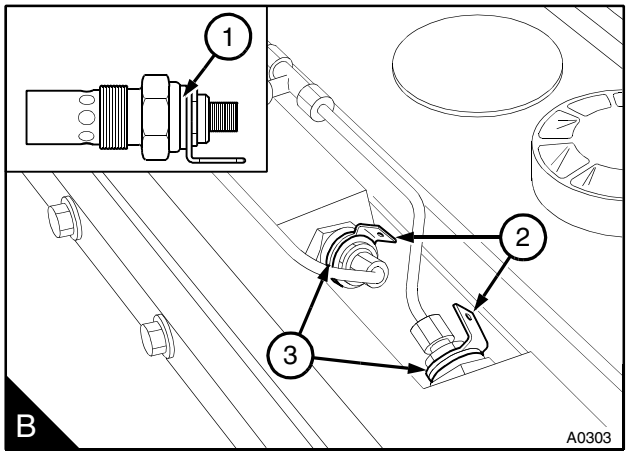
There are two types of electrical starting aid in use: The fuelled starting aid and the port heater.

The fuelled starting aid (B1) is a device which is operated electrically and ignites a controlled amount of diesel fuel in the induction manifold to heat the induction air. A heater coil in the body expands a valve holder to allow fuel to flow into the device. The fuel is ignited by the hot coil and heats the air which passes through the induction manifold when the starter motor is operated.

The port heater has an electrically heated coil that heats the air as it enters the induction manifold. Port heaters are used in a group of two or three.

Starting aid





To remove

1 Disconnect the fuel pipe (A2) and the electrical connection (A3).

2 Turn the spanner (A1) counter-clockwise and remove the starting aid.

To fit

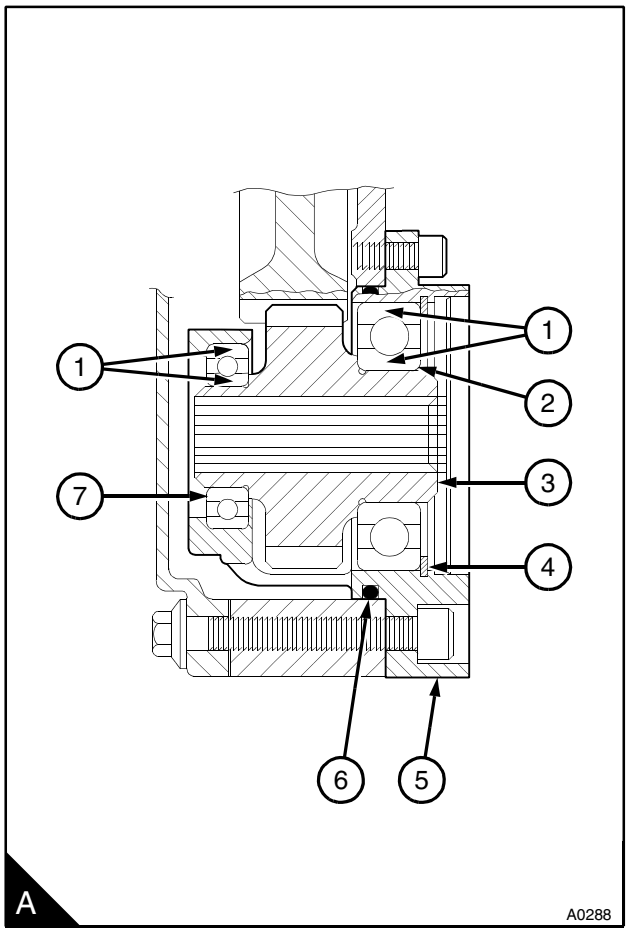
1 Ensure that the contact faces of the manifold and the starting aid are clean. Put the sealing washer into position and fit the starting aid. Tighten the starting aid to 31 Nm (23 lbf ft) 3,2 kgf m.

2 Check the fuel pipe and, if it is still full of fuel, connect it to the starting aid. If the fuel has drained from the pipe, eliminate the air from the pipe as shown in paragraph 3 of operation 20-9.

3 Connect the electrical connection (A2).

Some engines which have water-to-air intercoolers are fitted with twin fuelled starting aids (B3). These starting aids are in a recess on top of the induction manifold. In this situation, access to the electrical terminals (B2) can be restricted if the starting aids are not fitted correctly, see page 272.

Adaptor for a hydraulic pump or a steering pump with a splined drive



To remove

1 Release the cap screws and remove the adaptor assembly from the rear of the timing case.

2 Check the gear, the spline and the bearings for wear and other damage and renew the components as necessary.

To fit

1 Fit a new "O" ring (A6) in its recess in the housing (A5) and lightly lubricate it with clean engine lubricating oil. Lubricate the bearings (A2) and (A7) with clean engine lubricating oil. Fit the adaptor assembly to the timing case and tighten the cap screws.

Consumable products:

POWERPART retainer (oil tolerant)

To dismantle

1 Remove the hydraulic pump or steering pump.

2 Remove the adaptor assembly, see operation 24-3.

3 Remove the circlip (A4). Provide a support for the flange face of the housing (A5). Use a suitable adaptor on the front bearing (A7) to press the gear and bearings out of the housing.

4 Remove the bearings from the gear (A3) with a suitable gear puller.