Perkins Phaser and 1000 Series

Models AA to AH and YA to YE

WORKSHOP MANUAL

Phaser **4 and 6 cylinder diesel engines for automotive applications**

1000 Series **4 and 6 cylinder diesel engines for agricultural and industrial applications**

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Specifications

Basic engine data

Number of cylinders:

AA, AB, AC, AD, AE, AG, AH ... 4
YA, YB, YC, YD, YE ... 6
Cylinder arrangement ... In-line
Cycle ... Four stroke
Direction of rotation ... Clockwise from the front

Induction system:

AA, AG, YA ... Naturally aspirated
AB, AH, YB ... Turbocharged
AC, YC ... Altitude compensated
AD, AE, YD, YE ... Turbocharged/intercooled
Combustion system ... Direct injection
Nominal bore ... 100 mm (3.937 in)
Stroke ... 127 mm (5.000 in)

Compression ratio:

AA, AG, YA ... 16.5:1
Certain YA engines ... 17.5:1
AB, AC, AD, AH, YB, YC, YD ... 16.0:1
AE, YE ... 17.5:1
Certain AD engines ... 17.25:1 or 17.5:1

Cubic capacity:

- Four cylinder engines ... 4 litres (243 in^3)
- Six cylinder engines ... 6 litres (365 in^3)

Firing order:

- Four cylinder engines ... 1, 3, 4, 2
- Six cylinder engines ... 1, 5, 3, 6, 2, 4

Valve tip clearance (cold):

Inlet ... 0,20 mm (0.008 in)
Exhaust ... 0,45 mm (0.018 in)

Lubricating oil pressure (minimum at maximum engine speed and normal engine temperature):

Engines without piston cooling jets ... 207 kpa (30 lbf/in^2) 2,1 kgf/cm^2
Engines with piston cooling jets ... 280 kpa (40 lbf/in^2) 2,8 kgf/cm^2

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Recommended torque settings

The torque tensions below apply to components lubricated lightly with clean engine oil before they are fitted.

Description	Thread size	Torque		
		Nm	lbf ft	kgf m
Cylinder head assembly				
Setscrews, cylinder head	$^1/_2$ UNF	See Operation 3-10		
Fasteners, rocker shaft brackets:				
Aluminium brackets	M12	40	30	4,1
Cast iron and sintered steel brackets	M12	75	55	7,6
Cap nuts, rocker cover	M12	20	15	2,1
Cap nuts, aluminium rocker cover (with shim washer)	M12	30	22	3,0
Setscrews, inlet manifold to cylinder head	M10	44	33	4,5
Nuts (plated), exhaust manifold to cylinder head	M10	44	33	4,5
Nuts (non-plated), exhaust manifold to cylinder head	M10	50	37	5,1
Setscrews, engine lift bracket	M10	44	33	4,5
Piston and connecting rod assemblies				
Nuts, connecting rods	$^1/_2$ UNF	125	92	12,7
Setscrews, connecting rods	$^1/_2$ UNF	155	114	15,8
Banjo bolts, piston cooling jets	$^3/_8$ UNF	20	15	2,0
Crankshaft assembly				
Setscrews, main bearings	$^5/_8$ UNF	265	196	27,0
Setscrews, crankshaft pulley	$^7/_{16}$ UNF	115	85	11,8
Setscrews, viscous damper to crankshaft pulley	M12	75	55	7,6
Cap screws, viscous damper to crankshaft pulley	M8	35	26	3,6
Cap screws, rubber bonded damper to crankshaft pulley	M8	35	26	3,6
Setscrews, rear oil seal housing to cylinder block	M8	22	16	2,2
Torxscrew, rear oil seal housing to cylinder block	M8	22	16	2,2
Cap screws, bridge piece to cylinder block	M6	16	12	1,6
Cap screws, rear oil seal housing to bridge piece	M8	18	13	1,9
Cap screws, rear oil seal housing to bridge piece	M6	13	10	1,3
Torxscrew, rear oil seal housing to bridge piece	M8	18	13	1,9
Setscrew, idler gear hub of balancer unit	M12	93	68	9,5
Nut, drive gear of balance weight	$^1/_2$ UNF	82	60	8,4
Setscrews, rear cover of balancer frame	M10	54	40	5,5
Setscrews, oil transfer plate (balancer unit)	M10	30	22	3,1
Setscrews, oil pump to balancer frame	M8	27	20	2,8
Setscrews, balancer to cylinder block	M10	54	40	5,5
Timing case and drive assembly				
Setscrews, timing case to cylinder block	M8	22	16	2,2
Setscrews, timing case to cylinder block	M10	44	33	4,5
Setscrews, hub of idler gear	M10	44	33	4,5
Setscrew, camshaft gear	M12	78	58	8,0
Setscrew, camshaft gear (for engines, with 45 mm long setscrew)	M12	100	74	10,0
Setscrews, timing case cover to timing case	M8	22	16	2,2
Nuts, timing case cover to timing case	M8	22	16	2,2

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Rocker assembly

To remove and to fit **Operation 3-3**

To remove

1 Remove the rocker cover, see Operation 3-1.

2 Release evenly and gradually the fasteners of the rocker shaft brackets; begin with the end brackets and move toward the centre. Remove the fasteners and the washers and lift off the rocker assembly.

Note: The washers between the fasteners and the rocker brackets have been removed on the latest engines and new flange faced nuts and setscrews have been fitted.

3 Remove the rubber oil seal (A) from the oil supply connection or from the oil supply hole in the cylinder head.

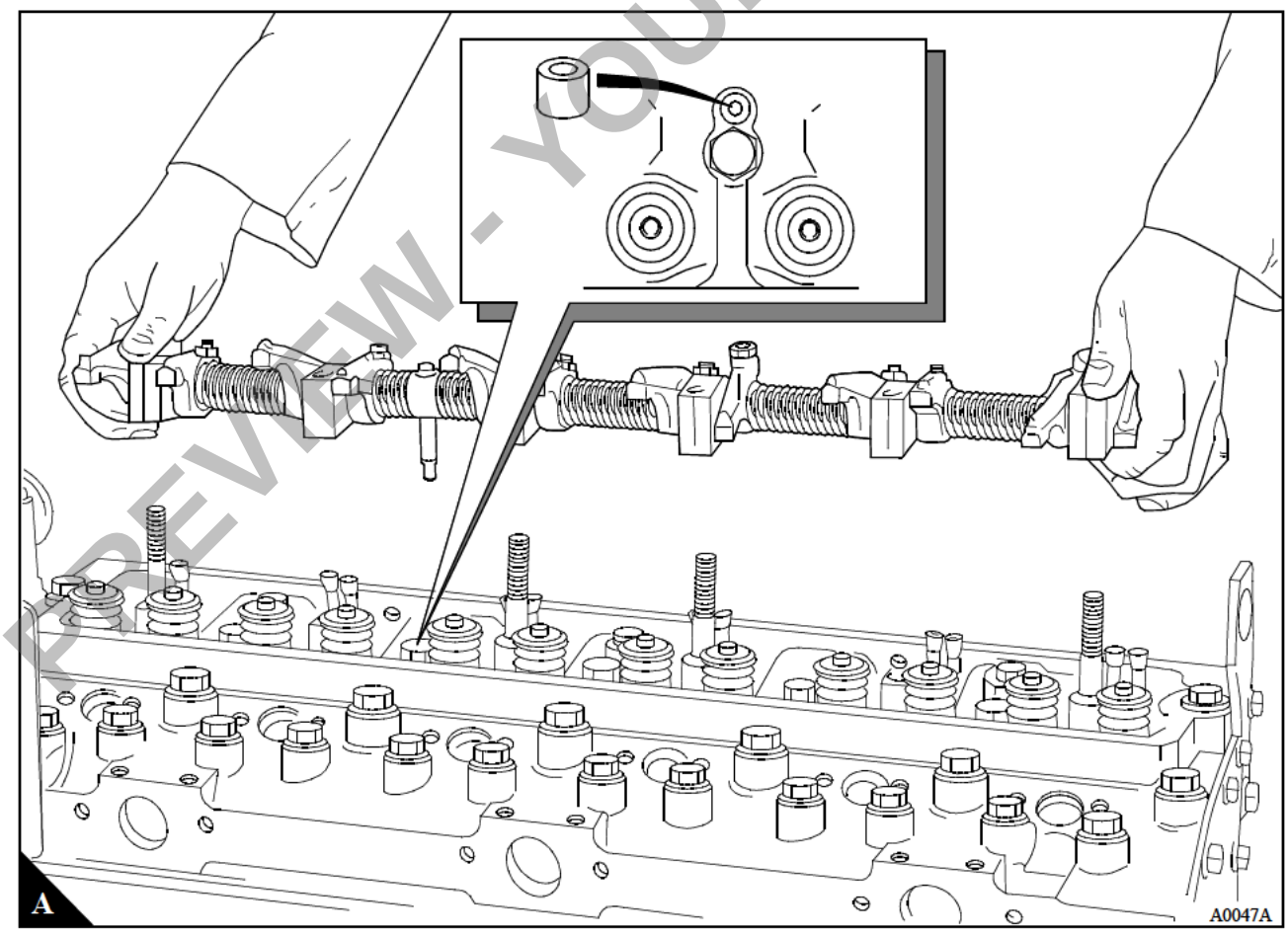
To fit

1 Fit a new rubber oil seal in the oil supply hole in the cylinder head (A).

2 Check that the push rods fit correctly in the sockets of the tappets. Fit the rocker assembly; ensure that the oil supply connection is fitted correctly into the oil seal. Check that the ends of the adjustment screws fit correctly in the sockets of the push rods.

3 Fit the washers (if fitted) and fasteners of the rocker shaft brackets and tighten the fasteners evenly and gradually; begin with the inner fasteners and work towards the end fasteners. Tighten the fasteners evenly to the correct torque according to the material of the rocker shaft brackets:

- Aluminium: 40 Nm (30 lbf ft) 4,1 kgf m.
- Cast iron: 75 Nm (55 lbf ft) 7,6 kgf m.
- Sintered steel: 75 Nm (55 lbf ft) 7,6 kgf m.



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To renew the filter element of the separate element type — Operation 11-2

Warning! *Discard the used canister and fuel oil in a safe place and in accordance with local regulations.*

***Cautions*:**

- *It is important that only the genuine Perkins parts are used. The use of a wrong canister or element can damage the fuel injection pump.*
- *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.*

The filter can have one or two elements (A) or (B). When twin elements are fitted, both of the elements must be renewed at the same time.

1 Clean the outside surfaces of the fuel filter assembly. If a drain tap (A4) or (B1) is fitted to the bottom cover of the filter, drain the fuel from the filter.

2 Hold the bottom cover of the filter element and release the setscrew (A3) which is fitted through the filter head above the centre of each element.

3 Lower the bottom cover of the filter.

4 Remove the element (A5) and discard it.

5 Clean the inside surfaces of the filter head (A1) and bottom filter cover.

6 Fit the new sealing rings (A6) and (A2).

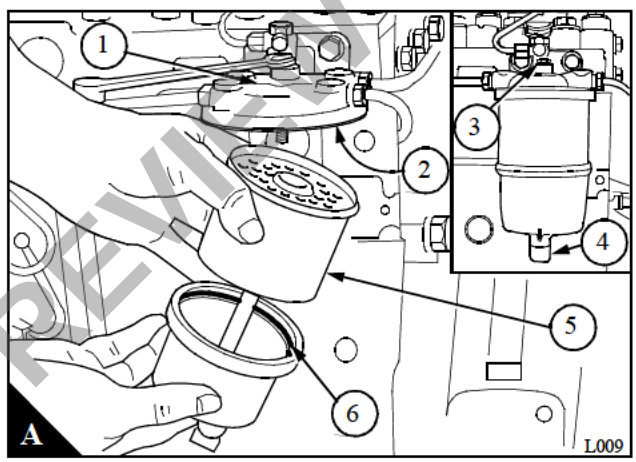
Note: Replace “O” ring on centre mounting stub if fitted.

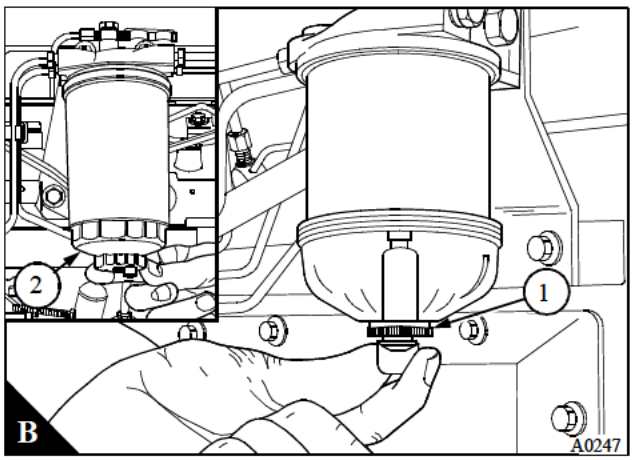
7 Put the bottom cover on the bottom of the new element (A5) and assemble it squarely to the filter head to ensure that the element is fitted in the centre against the joint in the filter head.

8 Hold the assembly in this position and engage and tighten the setscrew.

9 Eliminate all air from the fuel system:

- Bosch EPVE fuel injection pumps, see Operation 11-25
- Lucas/Delphi DPA and DPS fuel injection pumps, see Operation 11-35
- Lucas/Delphi DP 200 fuel injection pumps, see Operation 11-46
- Stanadyne fuel injection pumps, Operation 11-54.





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Cylinder block assembly

Cylinder block

Height between top and bottom faces ... ... 441,12/441,33 mm (17.367/17.375 in)
Diameter of parent bore for cylinder liner... ... ... 104,20/104,23 mm (4.103/4.104 in)
Depth of recess for flange of cylinder liner. ... ... 3,81/3,91 mm (0.150/0.154 in)
Diameter of recess for flange of cylinder liner ... ... 107,82/107,95 mm (4.245/4.250 in)
Diameter of parent bore for main bearing.. ... ... 80,416/80,442 mm (3.1660/3.1670 in)

Camshaft bore diameter

Four cylinder engines:

Number 1 (for bush)... ... ... 55,56/55,59 mm (2.188/2.189 in)
Number 2 ... ... 50,55/50,60 mm (1.990/1.992 in)
Number 3 ... ... 50,04/50,09 mm (1.970/1.972 in)

Six cylinder engines:

Number 1 (for bush)... ... ... 55,56/55,59 mm (2.188/2.189 in)
Number 2 ... ... 50,55/50,60 mm (1.990/1.992 in)
Number 3 ... ... 50,29/50,34 mm (1.980.1.982 in)
Number 4 ... ... 50,04/50,09 mm (1.970/1.972 in)
Bore of bush for number 1 camshaft journal.. ... ... 50,79/50,85 mm (2.000/2.002 in)

Cylinder liners

Type:

Production.. ... ... Dry, interference fit, flanged
Service ... ... Dry, transition fit, flanged
Service ... ...Dry, transition fit, flanged, with flame ring
Partially finished liner. ... ... Dry, interference fit, flanged, with flame ring

AE, YE, 110Ti and 135Ti AD lists:

Production.. ... ... Dry, interference fit, flanged, with flame ring
Outside diameter of production liner.. ... ... 104,25/104,28 mm (4.105/4.106 in)
Interference fit of production liner .. .. 0,03/0,08 mm (0.001/0.003 in)
Inside diameter of production liner. ... ... 100,00/100,03 mm (3.937/3.938 in)
Transition fit of service liner ... ... +/- 0,03 mm (+/- 0.001 in)
Inside diameter of service liner (fitted) .. ..100,04/100,063 mm (3.9385/3.9395 in)
Inside diameter of service liner with a flame ring (fitted) ... ...100,00/100,063 mm (3.937/3.939 in)
Maximum permissible wear of liner bore ... ... 0,25 mm (0.010 in)
Thickness of flange ... ... 3,81/3,86 mm (0.150/0.152 in)
Relative position of top of liner flange to top face of cylinder block ... ... 0,10 mm (0.004 in) above
... ... 0,10 mm (0.004 in) below

Partially finished liner

Inside diameter of partially finished liner ... ... 99,162/99,415 mm (3.9040/3.9139 in)
Interference fit of partially finished liner in parent bore .. .. 0,025/0,076 mm (0.003/0.001 in)
Hone angle (cross hatch)... ... ... 30°/35°
Final finish grade, silicon carbide (Plateau hone) .. .. 0,65/1,3 micrometers
Inside diameter of finished liner . ... 100,00/100,03 mm (3.937/3.938 in)

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Valves and valve springs

To remove **Operation 3-11**

Special requirements

Special tools			
Description	**Part number**	**Description**	**Part number**
Valve spring compressor	21825932	Setscrew adaptor	21825673
Stud adaptor	21825672		

1 Remove the cylinder head, see Operation 3-9.

2 Clean the bottom face of the cylinder head and check the depth of the heads of the valves below the face of the cylinder head, see Operation 3-13.

3 Make a suitable mark on the heads of the valves to ensure that the valves can be fitted in their original positions, if they are to be used again.

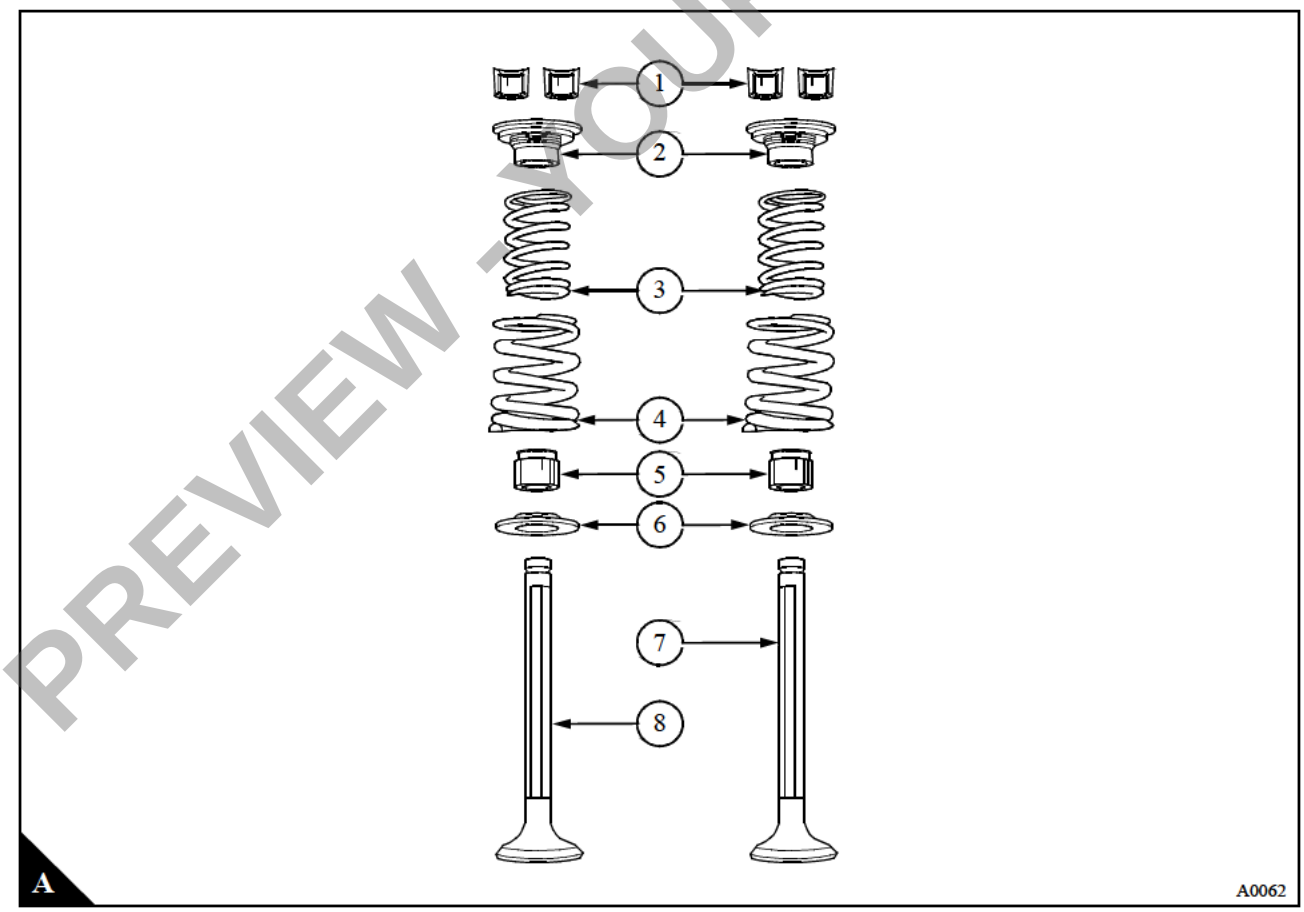
Warning! *Wear eye protection during this operation.*

Caution: *Ensure that the valve springs are compressed squarely or the valve stem can be damaged.*

4 Use the valve spring compressor and the relevant adaptor to compress the valve spring(s) and remove the collets (A1).

5 Release the valve spring compressor and remove the valve spring cap (A2), valve spring(s) (A3/A4), valve stem seal (A5) and the valve seat washer (A6).

6 Repeat steps 4 and 5 for the other valves.



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To remove and to fit (two-piece assembly) **Operation 5-6**

Special requirements

Special tools		Consumable products	
Description	**Part number**	**Description**	**Part number**
Crankshaft rear oil seal adaptor	21825540	POWERPART Threadlock and nutlock	21820117 or 21820118
		POWERPART Silicone rubber sealant	1861108

To remove

1 Remove the drive components from the rear end of the engine.

2 Remove the flywheel, see Operation 13-1 and the flywheel housing, see Operation 13-3.

3 Remove the setscrews and the cap screws from the housing and remove the housing and seal assembly.

4 Inspect the seal for wear or for damage to the main lip and renew the seal, if necessary. If there is only a small scratch across the lip, renew the seal.

Continued

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5 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. If the standard seal is to be pushed in to the service position, turn the nut until the face of 21825581 is against the face of the seal housing. If a water immersion seal is to be fitted, the adaptor, 21825946, should also be pushed fully onto the face of the seal housing.

6 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 5-1 or Operation 5-3. If a water immersion seal has been fitted, either leave the adaptor in position or fit the plastic mandrel until the crankshaft pulley can be fitted.

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

8 Fit the fan, see Operation 12-18.

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To clean the impeller and the compressor casing **Operation 9-3**

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 9-4.

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.

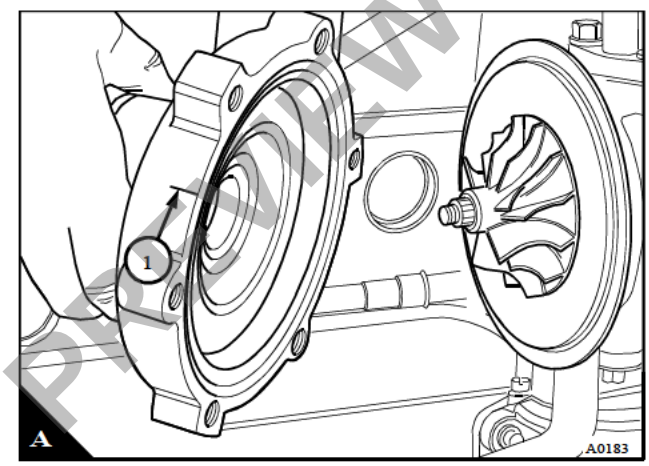
6 Clean the impeller with a soft brush.

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 9-4.

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 9-2.



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To Inspect **Operation 10-18**

1 Remove any old pieces of the joint and clean the flange faces of the oil pipes.

2 Thoroughly clean the oil pipes in an approved detergent cleaning solution.

3 Check the outer cover of the pipes for signs of leakage, cracks or splits. If the outer cover or the flanges are damaged the pipe must be renewed.

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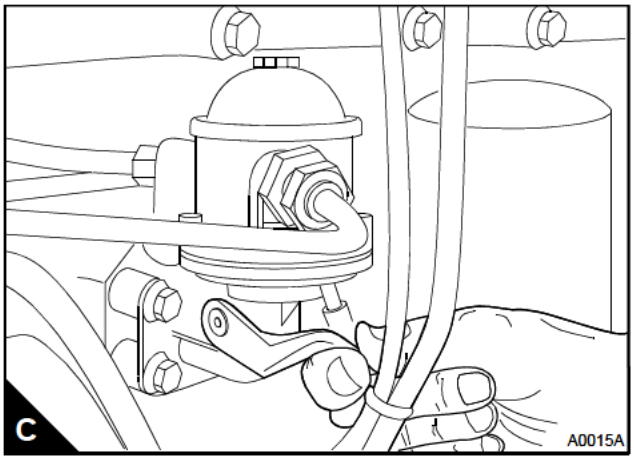
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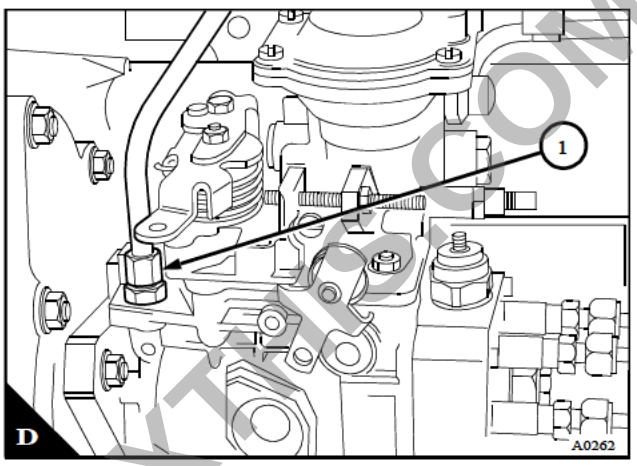
2 Operate the priming lever on the fuel lift pump (C) until fuel, free of air, comes from the filter vent point. Tighten the vent plug or the banjo connection bolt.

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

3 Ensure that the manual stop is in the "run" position. If an electrical stop control is used, turn the key of the start switch to the "R" position.

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





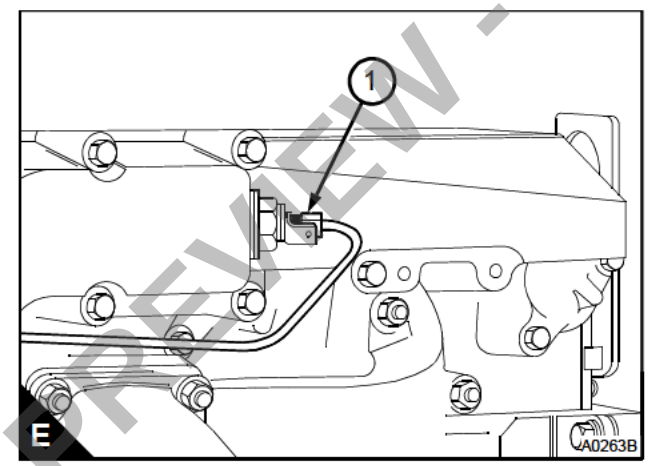
Caution: *spanner to prevent movement of the fuelled starting aid (E1) when the union nut is loosened or tightened.*

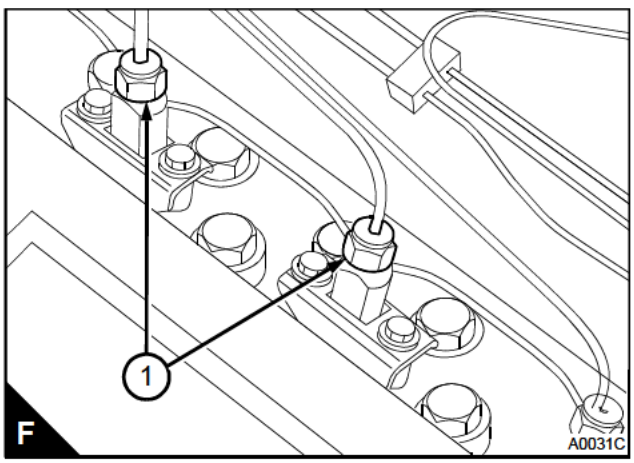
5 Loosen the union nut (E1) at the fuelled starting aid, if one is fitted, and operate the priming lever of the fuel lift pump until fuel, free of air, comes from the connection. Tighten the union nut at the starting aid.

6 Loosen the high-pressure pipe connections (F1) at two of the atomisers.

Warning! *When the starter motor is operated to eliminate air from the high pressure pipes, the engine may run.*

Caution: *Damage to the fuel injection pump, battery and starter motor can occur if the starter motor is used excessively to eliminate air from the fuel system.*





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Pump conversions

Pump conversions that change a pump from one Stanadyne number to another will need both a new Stanadyne number and a new Perkins customer part number. These conversions need major pump component changes or calibration changes and should only be done when a Stanadyne specification suitable for conversion is available.

When the conversions of this type are made in the Perkins factory the original Stanadyne data plate will remain in position. A modification data plate (B1), etched with the new Perkins customer part number, the new Stanadyne model number, and the high idle speed will be fitted.

If an approved Stanadyne service distributor make this type of conversion, they will fit a new Stanadyne data plate. The new data plate will show a new Stanadyne model number, a new Perkins customer part number and the original pump serial number and data code. When this occurs, modification data plates fitted by Perkins should be removed.

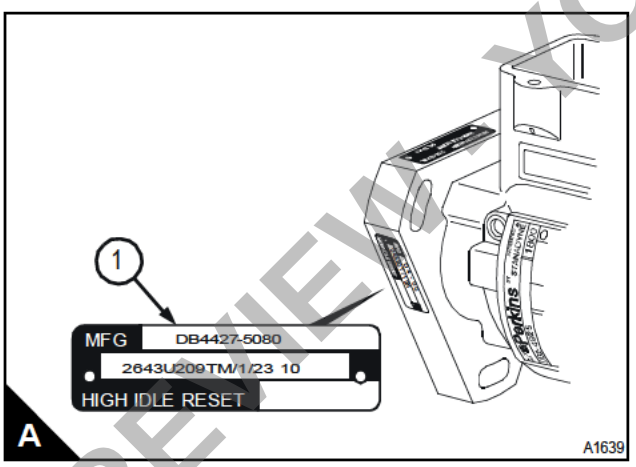
Warranty

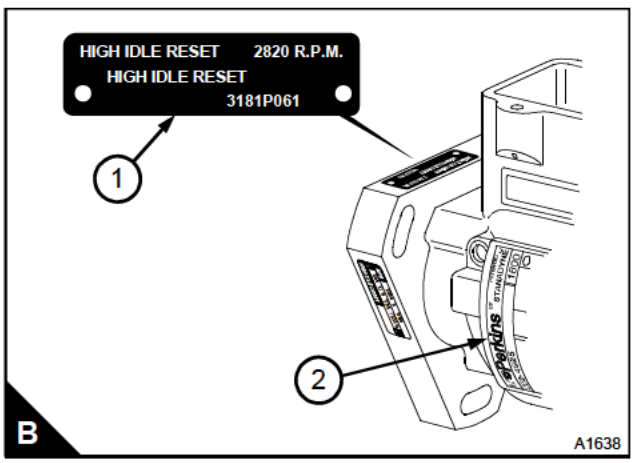
Pump modifications or conversions done by Perkins and “Range Pumps” which have their high idle reset by approved Perkins distributors or O.E.M. customers are protected by Stanadyne’s warranty in accordance with the Stanadyne Service Policies and Procedures Manual. Any failures which occur as a direct result of the Perkins conversion is not protected by the Stanadyne warranty, for example: pump modifications and conversions.

Electric shut off solenoid (E.S.O.S) changes

Perkins has the option to change the electric shut off solenoid to conform with the voltage or shut off requirements of an application.

Perkins can change the voltage of operation from 12V to 24V or from 24V to 12V DC or from “Energised - Run” (ETR) to “Energised - Shut off” (ETOS). A new Perkins customer part number for the pump must be etched on the modification data plate shown in (B1). An E.S.O.S change will not normally need a new Stanadyne model number, therefore the new Perkins customer part number will be added to the “Special notes”, section of the Stanadyne pump specification together with the identification of the new solenoid.





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Coolant pump (auxiliary)

An auxiliary coolant pump (A) is used on some high rated engines which have a water-to-air intercooler. The pump which is belt driven from the crankshaft pulley, circulates coolant through the intercooler. The pump is fitted to a mounting bracket on the right side of the engine.

Note: A small amount of leakage of coolant across the surface of the face seal in the coolant pump is normal. It's purpose is to provide lubrication for the seal. There is a hole in the coolant pump body to allow coolant to drain. Small amounts of coolant might be seen to leak intermittently from the drain hole during the engine operation cycle.
Signs of a small leakage through the drain hole are not an indication that the pump is faulty. Coolant stains or intermittent drops of coolant from the hole, indicate normal operation of the pump.

To remove and to fit — Operation 12-15

To remove

1 Drain the cooling system.

2 Release the hose clips and disconnect the hoses from the inlet (A1) and outlet (A3) of the coolant pump.

3 Loosen the two nuts (A5 and A6) at the rear of the pump which secure the coolant pump to the mounting bracket (A4).

4 Push the pump towards the cylinder block and remove the belt (A2) from the pump pulley. Support the pump, remove the two nuts for the mounting bracket and remove the pump from the engine.

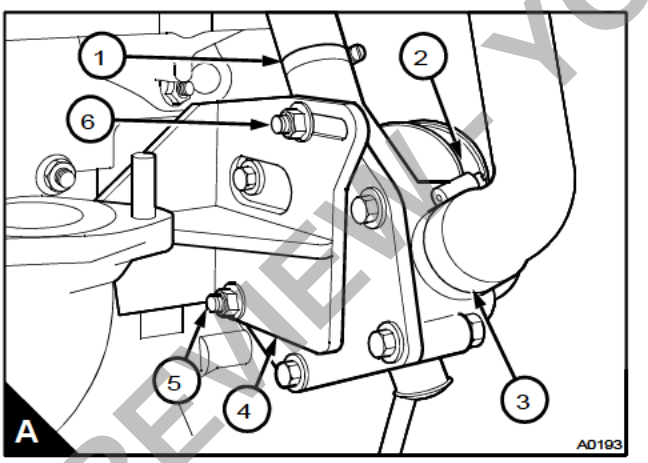
To fit

1 Fit the pump to the mounting bracket and fit loosely the two nuts. Fit the belt to the pump pulley.

2 Check and adjust the belt tension, see Operation 14-2, and fully tighten the two nuts (A5 and A6).

3 Connect the hoses to the inlet and outlet of the coolant pump and tighten the hose clips.

4 Fill the cooling system, start the engine and check for leakage.



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To test on the engine **Operation 14-8**

Ensure that the battery is fully charged.

Turn on the lights and operate the starter switch. If no lights are fitted to the machine, connect a voltmeter across the battery terminals and operate the starter switch.

If the starter does not operate but the lights keep their power or there is no voltage drop across the battery, check the switch and all the connections and wires. Slow action of the starter can be caused by faulty connections.

Failure to engage smoothly between the starter and the flywheel can be caused, on some types of starter motor, by dirt on the helical grooves of the starter motor drive, which can prevent free pinion movement. Clean the shaft thoroughly with gasolene, or a fluid made especially for the purpose, and apply a small quantity of Aero Shell 6B or its equal.

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