Perkins 1100 Series

Models RE, RF, RG, RH, RJ and RK

WORKSHOP MANUAL

4 cylinder diesel engines for industrial, agriculture and construction applications

Publication TPD 1487E, Issue 1.

The information is correct at the time of print.
Published in October 2002 by Technical Publications.
Perkins Engines Company Limited, Peterborough PE1 5NA, England

13 Flywheel and housing

14 Electrical equipment

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 Dealer/Distributor.

POWERPART Antifreeze

Protects the cooling system against frost and corrosion. Part number 21825166.

POWERPART Atomiser thread sealant

To seal the threads of the atomiser into the cylinder head. Part number 21825474.

POWERPART Easy Flush

Cleans the cooling system. Part number 21825001.

POWERPART Gasket and flange sealant

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

POWERPART Gasket remover

An aerosol for the removal of sealants and adhesives. Part number 21820116.

POWERPART Griptite

To improve the grip of worn tools and fasteners. Part number 21820129.

POWERPART Hydraulic threadseal

To retain and seal pipe connections with fine threads. Especially suitable for hydraulic and pneumatic systems. Part number 21820121.

POWERPART Industrial grade super glue

Instant adhesive designed for metals, plastics and rubbers. Part number 21820125.

POWERPART Lay-Up 1

A diesel fuel additive for protection against corrosion. Part number 1772204.

POWERPART Lay-Up 2

Protects the inside of the engine and of other closed systems. Part number 1762811.

POWERPART Lay-Up 3

Protects outside metal parts. Part number 1734115.

POWERPART Metal repair putty

Designed for external repair of metal and plastic. Part number 21820126.

POWERPART Pipe sealant and sealant primer

To retain and seal pipe connections with coarse threads. Pressure systems can be used immediately. Part number 21820122.

Continued

Crankshaft

Diameter of main journals ... ...76,159/76,180 mm (2.9984/2.9992 in)
Maximum wear and ovality on journals and crank pins ... ...0,04 mm (0.0016 in)
Width of centre journal. ... ...44,15/44,22 mm (1.738/1.741 in)
Width of all other journals ... ...39,24/39,34 mm (1.545/1.549 in)
Diameter of crank pins. ... ...63,47/63,49 mm (2.499/2.500 in)
Width of crank pins .. ..40,35/40,42 mm (1.589/1.591 in)
Diameter of flange ... ...135,27/135,32 mm (5.3257/5.3277 in)
Depth of recess for spigot bearing... ... ...20,40/20,60 mm(0.8031/0.8112 in)
Bore of recess for spigot bearing. ... ... .46,96/46,99 mm (1.8488/ 1.8499 in)
Crankshaft end-float ... ...0,05/0,38 mm (0.002/0.015 in)
Maximum permissible end-float... ... ... 0,51 mm (0.020 in)
Fillet radii of journals and crank pins ... ...3,68/3,96 mm (0.145/0.156 in)
Undersize journals and crank pins .. .. -0,25 mm (-0.010 in); -0,51 mm (-0.020 in); -0,76 mm (-0.030 in)

Crankshaft heat treatment

- Induction hardened ... ... Part number 3131D074, 4114A006
- Nitrocarburised .. .. Part number 3131D072, 4112A005

Crankshaft overhaul

Notes:

- Nitrocarburised crankshafts must be hardened again each time they are machined. These crankshafts must be nitrocarburised or, if this process is not available, they can be nitrided for 20 hours. If neither process is available a new crankshaft, or a “new for old” crankshaft, must be fitted.
- Check the crankshaft for cracks before and after it is ground. Demagnetise the crankshaft after it has been checked for cracks.
- After the crankshaft has been machined remove any sharp corners from the lubricating oil holes.
- Surface finish and fillet radii must be maintained and require Ra 0.4 um.

Continued

Thread sealant

When setscrews or studs are fitted into holes which are tapped through the cylinder block, a suitable sealant must be used to prevent leakage.

Micro encapsulated anaerobic sealant (M.E.A.S) fasteners have been introduced instead of jointing compounds or other sealants when the fasteners are fitted in through holes into oil or coolant passages. The identification of these fasteners, as supplied, is by a red, blue, or other colour sealant around the fastener threads.

With M.E.A.S. sealed studs, the sealed end must be fitted into the cylinder head / cylinder block etc. Ensure that the threaded holes have a 1,59 mm (0.0625 in) 45° chamfer, to ensure that when the new fasteners are fitted the M.E.A.S. sealant is not removed. If the fasteners have to be removed and fitted again, the threads must be cleaned and a suitable sealant used.

Note: New setscrews have sealant applied by the manufacturer to the first 13,0 mm (0.50 in) of the threads. If the setscrews are to be used again, clean the old sealant from the male and female threads and apply new sealant, (POWERPART Threadlock and Nutlock) to the setscrews.

Rocker assembly

To remove and to fit — Operation 3-4

Special requirements

Special tools	
Description	**Part number**
Rocker assembly tools	27610227

To remove

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

2 Remove the rocker cover, see Operation 3-2.

3 Fit the rocker assembly tools between each pair of rocker levers (A1).

4 Release evenly and gradually the Torx screws of the rocker shaft; begin with the end Torx screws and move toward the centre. Remove the Torx screws and lift off the rocker assembly.

To fit

Note: Ensure that the machined square is facing upwards before the rocker assembly is fitted and that the longest Torx screw is fitted in (A2).

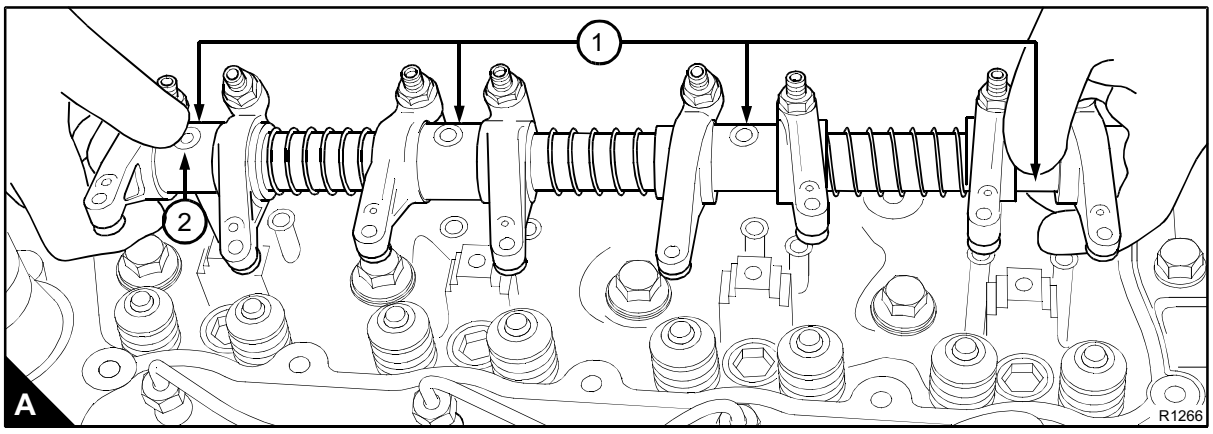
1 Check that the push rods fit correctly in the sockets of the tappets and ensure that the rocker assembly tools are correctly fitted between each pair of rocker levers (A1). Fit the rocker assembly. Check that the ends of the adjustment screws fit correctly in the sockets of the push rods.

2 Fit the Torx screws for the rocker shaft and tighten the Torx screws 35 Nm (26 lbf ft) 3,6 kgf m; begin with the inner Torx screws and work outwards.

3 Set valve tip clearance, see Operation 3-7.

4 Fit the rocker cover, see Operation 3-3.

5 Fit the atomiser cover, see Operation 3-1.



To remove **Operation 3-11**

Special requirements

Special tools			
Description	**Part number**	**Description**	**Part number**
Valve spring compressor	21825666	Setscrew adaptor used with 21825666	27610235

Warning! *Wear eye protection during this operation.*

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.

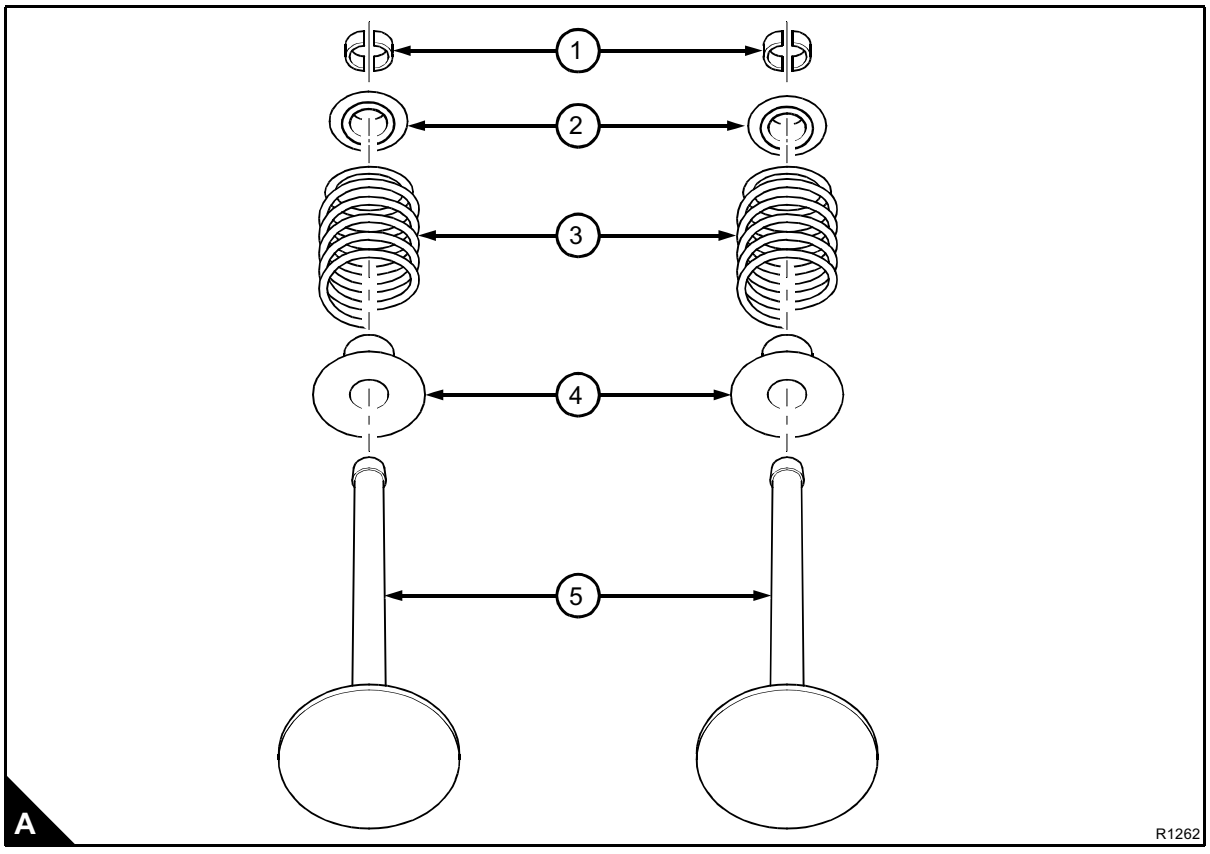
Caution: *Ensure that the valve springs are compressed squarely or the valve stem can be damaged.*

Note: Do not over compress the valve springs so that coils are touching.

4 Use the valve spring compressor and the relevant adaptor to compress the valve spring (A3) and remove the collets (A1).

5 Release the valve spring compressor and remove the valve spring cap (A2), valve spring and valve stem seal (A4).

6 Repeat steps 4 and 5 for the other valves.



To fit valve seat inserts **Operation 3-19**

1 Remove the valve guide, see Operation 3-15, and clean the bore into which the guide is to be fitted.

2 Fit new partially finished valve guides, see Operation 3-16.

3 With the bore of the new partially finished valve guide used as a pilot, machine the recess in the cylinder head to the dimensions shown in "Dimensions of recesses for valve seat inserts" on page 14, or machine out the old insert. Remove all debris and clean the insert recess.

4 If the bottom face of the cylinder head has been machined, the insert will have to be surface ground on the back face to ensure that there is no protrusion of the insert above the bottom face of the cylinder head. After the back of the insert has been ground, ensure that the outer edge of the back face has a 0,9/1,3 mm (0.035/0.051 in) chamfer at 30° to the vertical.

5 With the bore of the new, partially finished, valve guide used as a pilot, and with the rear face of the insert towards the cylinder head, press in the insert with the valve seat insert tool, see "Valve seat insert tool" on page 15.

Caution: *Do not use a hammer on the insert and do not use lubrication.*

Use a hydraulic press or a hand press in one continuous movement. Ensure that the bottom of the insert is in contact with the bottom of the recess.

6 Ream the valve guide and cut the valve seat at an included angle of 120° for 30° valve seats, see Operation 3-18.

Ensure that the depth of the valve head below the face of the cylinder head is within the production limits, refer to the relevant Data and dimensions for the "Intake and exhaust valves" on page 13.

Note: Work as near as possible to the minimum value to allow for future wear on the valve seat.

Piston rings

To remove — Operation 4-7

Note: 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.*

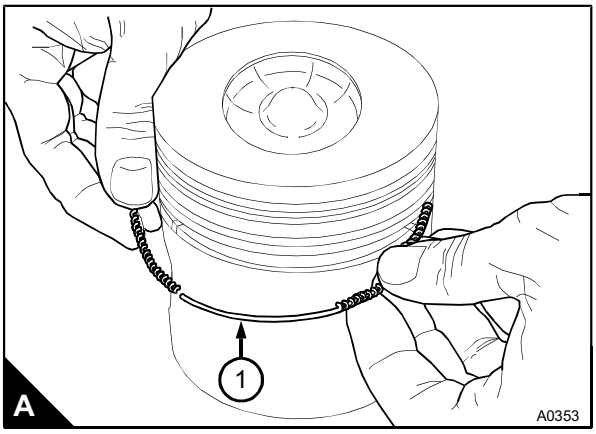
1 Remove the piston rings with a suitable ring expander. Keep the rings with their relevant piston.

To fit — Operation 4-8

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

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.*

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. 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.

3 The second ring has a green identification mark which must be on the left of the ring gap when the ring is fitted and the piston is upright, with the word "TOP" towards the top of the piston.

4 The first ring has a red identification mark which must be on the left of the ring gap when the ring is fitted and the piston is upright.

5 Ensure that the ring gaps are 120° apart.

Rear end oil seal assembly

To remove and to fit the rear end oil seal assembly — Operation 5-2

Caution: *The new rear end oil seal assembly includes a plastic protection sleeve (A2) that is fitted to the inside of the seal. This sleeve is to protect the oil seal from damage when it is fitted to the crankshaft palm (A1). The plastic sleeve must remain inside the seal until the assembly is fitted. When the assembly is fitted, the plastic sleeve will be pushed out of the oil seal and the assembly. The plastic sleeve must be discarded after the assembly is fitted. The seal of the new rear end oil seal assembly is pre-waxed, there is no need to lubricate the palm or the seal before it is fitted.*

Notes:

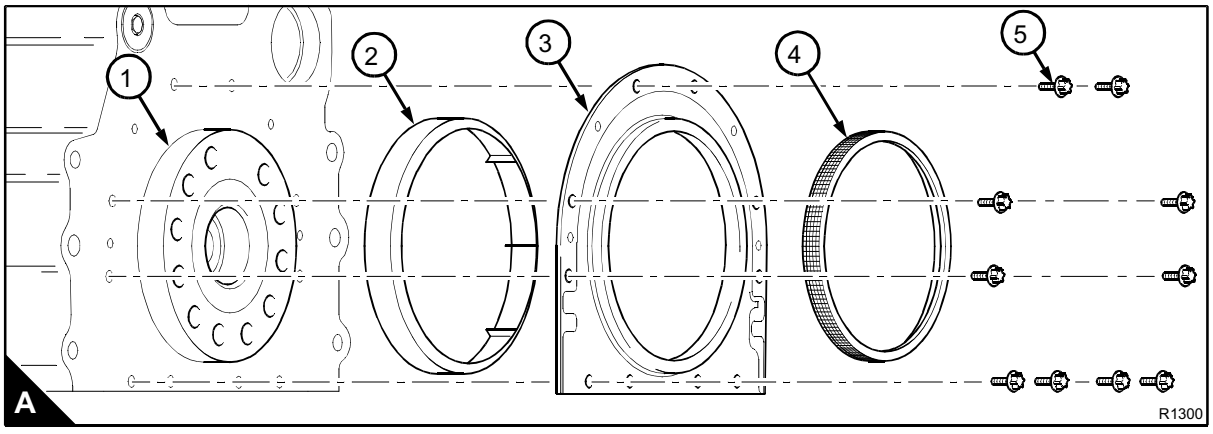
- The oil seal for the rear end oil seal assembly cannot be renewed, if the seal is faulty, the complete assembly must be renewed.
- If the crankshaft palm has a wear groove caused by the old oil seal assembly, a wear sleeve must be fitted to the crankshaft palm before the new assembly is fitted, see Operation 5-3.
- An alignment tool is needed to fit the rear end oil seal assembly, see page 82.
- The rear end oil seal cannot be used again and must be replaced if removed.

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 Torx screws from the rear end oil seal housing and remove the assembly.



Crankshaft

To remove — Operation 5-10

Note: If the crankshaft is to be renewed, it may be necessary to change the grade of the connecting rods, see Operation 4-11. 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 4-6.

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

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 10-4.

3 Remove the fan, see Operation 12-8, the drive belts, see Operation 14-3, the fan drive pulley and housing, see Operation 12-9 and the coolant pump, see Operation 12-4.

4 Remove the fuel injection pump:

- For Bosch VP30 fuel injection pumps, see Operation 11-9.
- For Bosch EPVE fuel injection pumps, see Operation 11-11.
- For Delphi DP210 fuel injection pumps, see Operation 11-13.

5 Remove the crankshaft pulley, see Operation 5-1.

6 Remove the alternator and its mounting bracket, see Operation 14-4.

7 Remove the exhauster if fitted, see Operation 15-5.

8 Remove the timing case cover, see Operation 6-1.

9 Remove the timing gears and the timing case, see Chapter 6, Timing case and drive assembly.

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

11 Remove the rear end oil seal housing, see Operation 5-2.

12 Remove the lubricating oil pump, see Operation 10-9, or remove the balancer unit, see Operation 5-15.

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, see Operation 4-4.

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, see Operation 5-5 and Operation 5-7.

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

Caution: *If a timing ring is fitted to the crankshaft ensure that is protected from damage and is correctly stored.*

To assemble (oil pump) Operation 5-17

Special requirements

Consumable products	
Description	**Part number**
POWERPART Threadlock and nutlock	21820117

1 Assemble the lubricating oil relief valve, see Operation 10-12.

2 Fit the four setscrews (A1) to the lubricating oil pump cover plate and tighten to 26 Nm (19 lbf ft) 2,6 kgf m.

3 Fit the lubricating oil pump gear and nut, gradually tighten to 95 Nm (70 lbf ft) 9,7 kgf m.

Note: Ensure that the flats on the thrust washer (B2) are aligned.

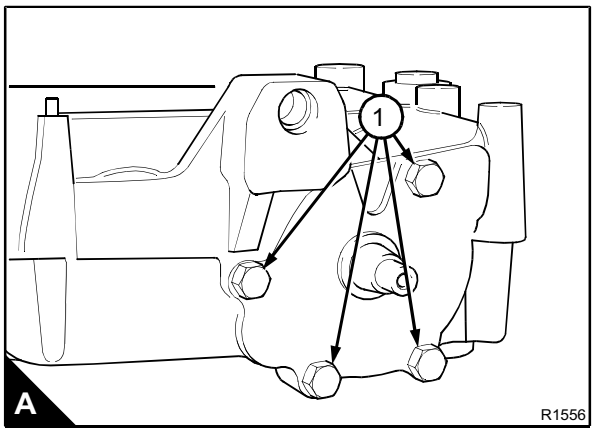
4 If necessary, renew the idler gear. Lubricate the bush with clean engine lubricating oil. Fit the hub into the bush and fit the thrust washer onto the rear of the hub. Ensure that the threads of the setscrew are clean and dry. Fit the setscrew through the assembly and apply a small amount of POWERPART Threadlock and nutlock to the thread. Fit the assembly to the front of the balancer unit . Tighten the setscrew to 26 Nm (19 lbf ft) 2,6 kgf m.

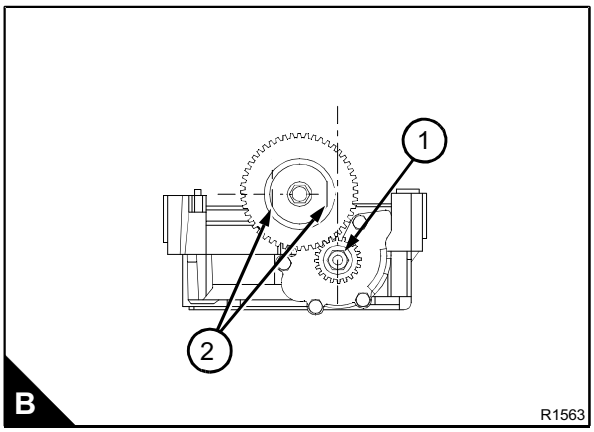
5 Check the end-float of the idler gear with a feeler gauge between the front face of the idler gear and the hub. Check the backlash between the idler gear and the drive shaft gear. Refer to the Data and dimensions for "Balancer unit" on page 21.

6 Fit the suction tube and the joint and tighten the setscrews, if removed.

7 Remove the distance piece from the balancer weights.

8 Fit the balancer to the engine, see Operation 5-15.





To fit **Operation 6-6**

***Cautions*:**

- *These procedures must only be carried out by a person with the correct training.*
- *The engine is pin timed at TDC, do not use the pins as a locking device when repairs are carried out on the engine.*

Note: The fuel pump gear will only fit correctly in one position.

1 Clean and check the fuel pump gear (A1) for damage and renew if necessary. Clean the fuel injection pump hub (A3).

2 If the timing pin (A2) has been removed, rotate the hub (A3) until the slot in the hub is aligned with the hole in the pump body. Insert the timing pin through the slot into the hub (A3) and fully into the body of the fuel injection pump.

3 With all three timing pins fitted, fit the fuel pump gear (A1) over the timing pin (A2) and onto the hub (A3).

4 Loosely fit the flat hardened washers and setscrews (B3).

Caution: *To ensure that the engine is correctly timed, backlash must be removed from all the gears.*

5 Apply pressure counter clockwise by hand (B1) to the fuel pump gear (B2), to remove the backlash.

6 Tighten the setscrews (B3) to 22 Nm (16 lbf ft) 2,2 kgf m.

7 Remove the timing pins.

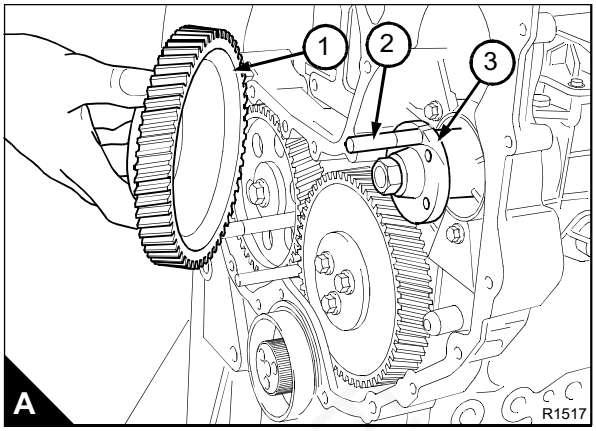
8 Check the fuel pump gear end-float and backlash, see "Timing case and drive assembly" on page 22.

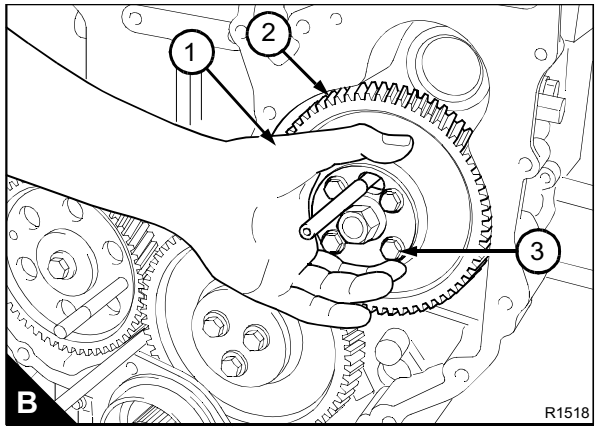
9 Lightly lubricate each gear with clean engine lubricating oil.

10 Fit the timing case cover, see Operation 6-2.

11 Fit the glow plugs, see Operation 14-10.

12 Fit the rocker cover, see Operation 3-3.





To fit the oil seal with the timing case removed

1 Clean the oil seal housing and check for damage, renew if necessary.

2 Check the crankshaft pulley for damaged. To repair the pulley, see Operation 6-15.

3 Check that the new oil seal has the sleeve protector fitted.

4 Align the oil seal to the oil seal housing. Do not lubricate the oil seal or the housing.

5 With a suitable tool, press the oil seal into the housing until contact is made with the bottom face of the housing.

6 Fit the timing case, see Operation 6-17.

7 When the front timing case cover is fitted, turn and pull the sleeve protector counter clockwise, to remove the sleeve from the seal.

8 Fit the crankshaft pulley immediately, see Operation 5-1.

7

Cylinder block assembly

General description

The cylinder block is made of high duty cast iron with an integral crankcase. The sides of the cylinder block extend below the crankshaft centre line to give added strength. The cylinder block provides full length support for the cylinder bores.

All bores are honed with silicon carbide tools to a controlled finish to ensure long life and low oil consumption. A bush is fitted in the cylinder block for the front camshaft journal and the other camshaft journals run directly in the block.

Note: Your Perkins Dealer/Distributor has specialist equipment and personnel with the correct training to repair worn cylinder bores.

To adjust the timing of the Bosch EPVE fuel injection pump **Operation 8-4**

Special requirements

Special tools	
Description	**Part number**
Bosch EPVE fuel pump timing adaptor	27610248

***Cautions*:**

- *This procedure must only be carried out by a person with the correct training.*
- *Do not turn the fuel injection pump with the pump shaft locked.*

1 Rotate the crankshaft to obtain TDC, see Operation 8-1.

2 Remove the rocker assembly, see Operation 3-4.

3 Remove the high-pressure fuel pipes from the fuel injection pump.

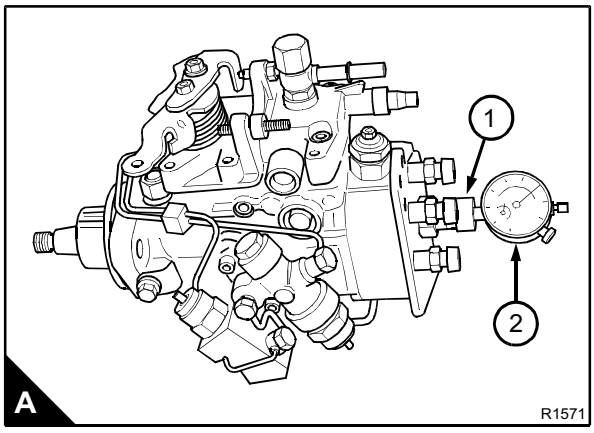
4 Remove the plug and washer from the rear of the fuel pump and fit the Bosch EPVE fuel pump timing adaptor (A1) and a suitable dial gauge (A2). Set the dial gauge to indicate approximately 3,0 mm.

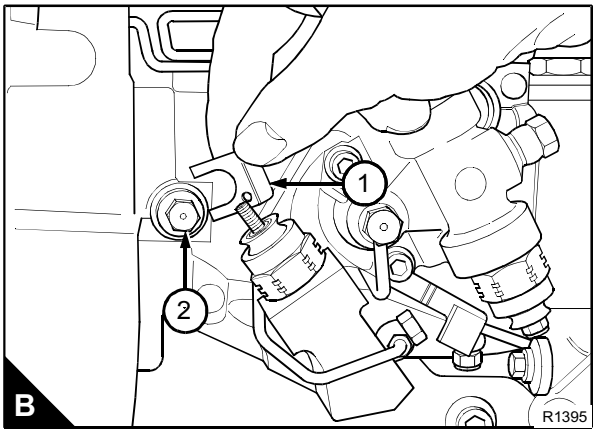
5 Remove the timing pins.

6 Rotate the crankshaft slowly counter-clockwise and then clockwise, until the needle of the dial gauge indicates that the plunger of the fuel injection pump is at the bottom of its stroke. Set the dial to zero.

7 Rotate the crankshaft slowly clockwise, until the needle of the dial gauge indicates the required plunger lift, see Operation 8-3.

8 To lock the Bosch EPVE pump shaft, loosen the locking screw (B2) and remove the washer (B1). Tighten the locking screw (B2) to 31 Nm (23 lbf ft) 3,1 kgf m. Ensure that the needle of the dial gauge has not moved.





Continued

To check the operation of the waste-gate **Operation 9-4**

If the waste-gate valve does not operate at the correct pressure, it can affect the engine performance.

If the valve opens at a low pressure, this can cause black exhaust smoke and loss of power at lower engine speeds.

1 Disconnect the actuator hose (A2) at the actuator. Connect to the actuator an air supply which can be adjusted accurately and is fitted with an accurate gauge.

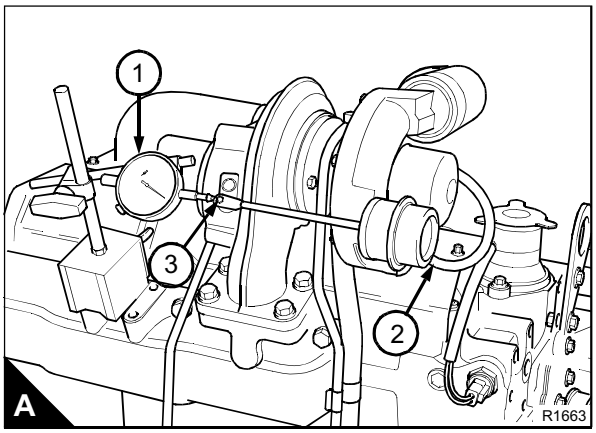
2 Fasten a dial test indicator (A1) to the turbocharger with its plunger in contact with the end of the actuator rod (A3) to measure the axial movement of the rod.

Caution: *Do not apply an air pressure of more than 205 kPa (30 lbf/in^2) 2,1 kgf/cm^2 to the actuator. Higher pressures may damage the actuator.*

3 Slowly apply air pressure. Check that the pressure necessary to move the rod 1,00 mm (0.039 in), is within limits, refer to the Data and dimensions for "Turbocharger" on page 24. Ensure that the pointer returns to zero when the pressure is released. Repeat the test several times to ensure that an accurate reading is obtained. It may be necessary to lightly hit the turbine housing with a soft hammer during the test operation.

4 Consult your nearest Perkins Dealer/Distributor if the operation of the waste-gate is not correct.

5 If the air pressure is correct, release the air pressure, remove the test equipment and connect the actuator hose.



Filter canister

To renew (canister type oil filter) — Operation 10-1

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

***Cautions*:**

- *The canister contains a valve and a special tube to ensure that lubricating oil does not drain from the filter, when the lubricating oil is changed. Ensure that the correct perkins POWERPART canister is used.*
- *Ensure that the application is on a level surface to ensure an accurate reading on the dipstick.*

1 Put a suitable container below the lubricating oil filter.

2 Remove the filter canister with a strap wrench. Ensure that the adaptor is secure in the filter head. Discard the canister.

3 Clean the filter head.

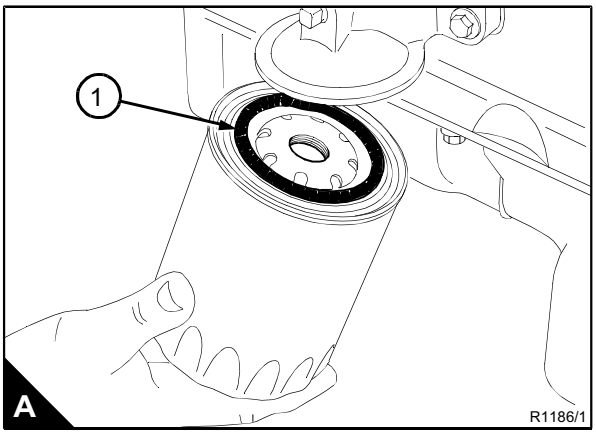
4 If the filter canister is mounted vertically position (A) add clean engine lubricating oil to the new canister. Allow the oil enough time to pass through the filter element.

5 Lubricate the top of the canister seal (A1) with clean engine lubricating oil.

6 Fit the new canister and tighten by hand only. Do not use a strap wrench.

7 Remove the container and discard the old lubricating oil.

8 Operate the engine and check for leakage from the filter. When the engine has cooled, check the oil level on the dipstick and add more oil into the sump, as necessary.



To inspect **Operation 10-11**

Note: For all the clearances, refer to the Data and dimensions for the "Lubrication system" on page 25.

1 Remove the setscrews and remove the cover of the oil pump.

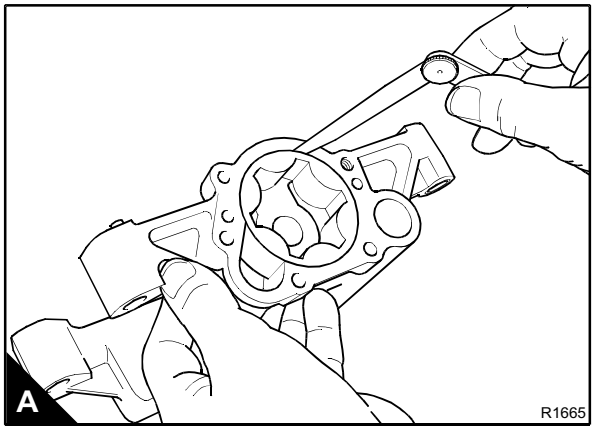
2 Remove the outer rotor and clean all the parts. Check for cracks and any other damage.

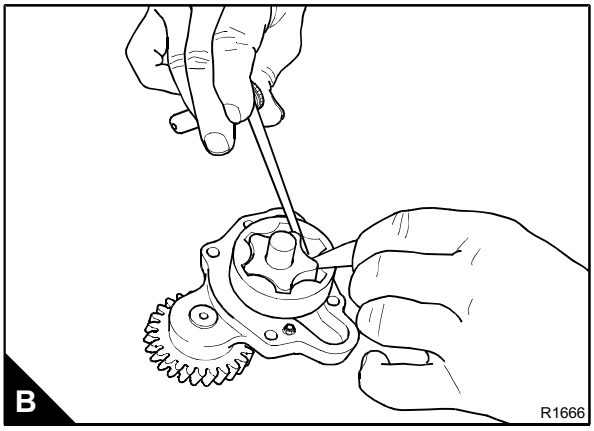
3 Fit the outer rotor, and check the outer rotor to body clearance (A).

4 Check the inner rotor to outer rotor clearance (B).

5 Check the rotor end-float with a straight edge and a feeler gauge.

6 Lubricate the inner and outer rotor with clean engine lubricating oil. Clean the top face of the oil pump and the inner face of the cover. Fit the cover. Tighten the setscrews to 28 Nm (21 lbf ft) 2,9 kgf m.





To identify a faulty atomiser — Operation 11-2

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

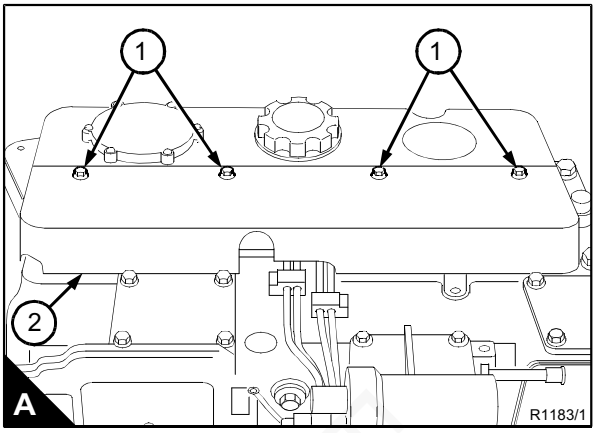
- Engine will not start or is difficult to start
- Not enough power
- Engine misfires or runs erratically
- High fuel consumption
- Black exhaust smoke
- Engine knocks or vibration
- Excessive engine temperature.

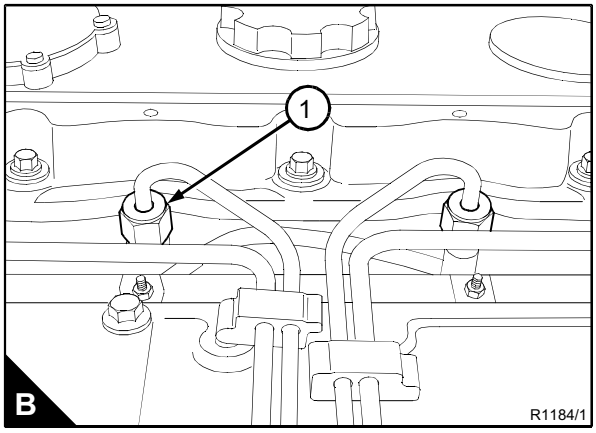
Warnings!

- *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.*

To find the defective atomiser, release the atomiser cover setscrews (A1) and remove the atomiser cover (A2), run the engine at fast idle.

Release and tighten the union nuts (B1) of the high-pressure fuel pipe at each atomiser, one at a time. Do not loosen the union nut more than half a turn. When the union nut of the defective atomiser is released, it has little or no effect on the engine speed.





3 Loosely fit the setscrew (C1) of the support bracket. Ensure that force is not applied to the fuel injection pump.

4 Put the fuel pump gear onto the hub of the fuel pump. The setscrews (B4) for the fuel pump gear should be in the centre of the slots to allow for the removal of backlash. Loosely fit the setscrews.

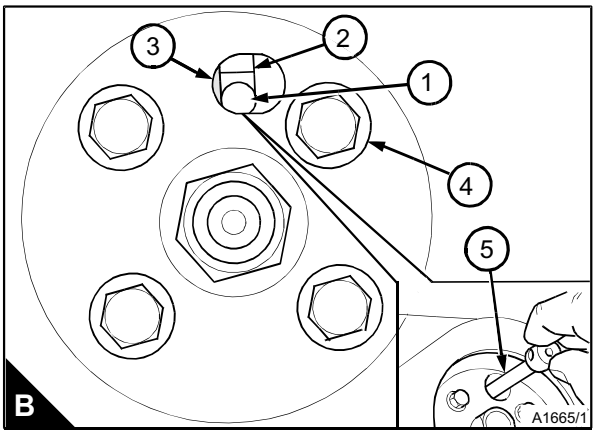
5 Insert the timing pin (B5) through the hole (B3) of the fuel pump gear and the slot of the hub (B2) until it can be pushed fully into the hole (B1) in the body of the fuel injection pump. If the timing pin cannot be pushed into the pump body, check that the engine is correctly set at TDC on the number 1 cylinder, see Operation 8-1.

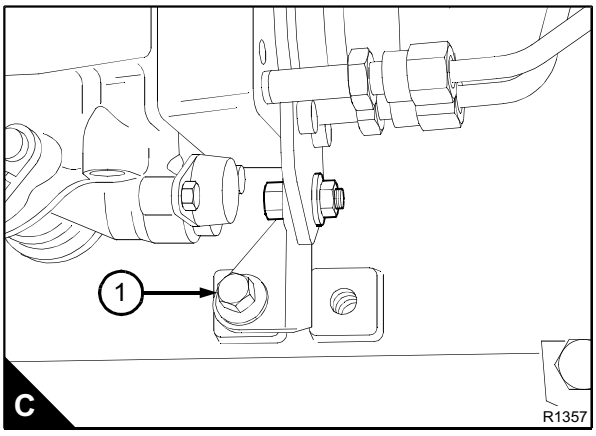
6 Carefully turn the gear counter-clockwise by hand to remove the backlash between the idler gear and the fuel pump gear. Do not rotate the crankshaft or the fuel injection pump shaft. Tighten the setscrews for the fuel injection pump gear to 28 Nm (20 lbf ft) 2,8 kgf m.

7 Remove the timing pin.

8 Fit the timing case cover, see Operation 6-2.

9 Tighten the setscrew (C1) of the support bracket to 44 Nm (32 lbf ft) 4,4 kgf m. Ensure that force is not applied to the fuel injection pump.





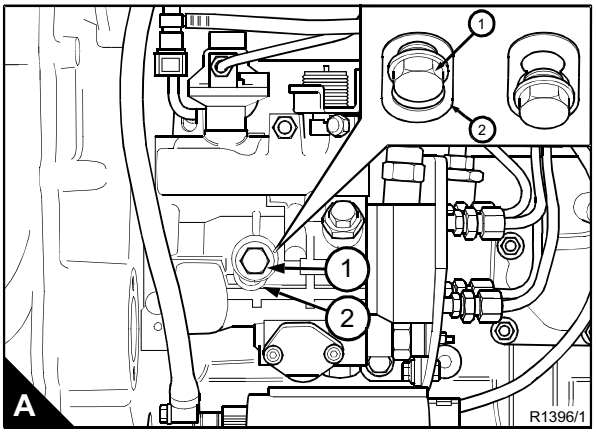
Continued

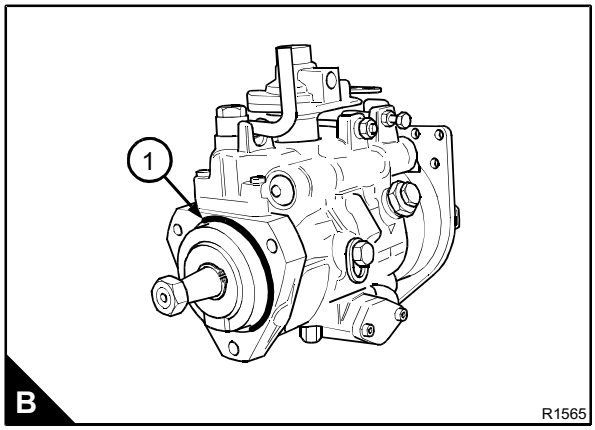
***Cautions*:**

- *The engine must be set to TDC number 1 cylinder, compression stroke before the pump is fitted, see Operation 8-1.*
- *Do not unlock the shaft of the fuel injection pump until the fuel pump gear is fitted.*
- *A new fuel injection pump will be supplied with the pump shaft in the locked position. The drive shaft of the pump must not be turned without the spacer (A2) in position under the locking screw (A1).*

1 Fit a new 'O' ring (B1) to the pump flange. Lightly lubricate the 'O' ring with clean engine lubricating oil.

2 Fit the pump into position in the timing case, fit the three washers and setscrews, then tighten the setscrews to 25 Nm (18 lbf ft) 2,5 kgf m.





Continued

Caution: *Do not damage the sealing face of the coolant seal housing during removal of the seal.*

4 To remove the coolant seal (C4), it will be necessary to break the seal and use an extractor to remove the centre sleeve of the seal from the body of the shaft. This will loosen the grip of the seal on the shaft. To remove the body of the seal, drill three 3,175 mm (0.125 in) holes through the top of the coolant seal 120° apart. Fit three 25,4 mm (1.00 in) self-tapping screws. Insert a suitable lever through the coolant inlet of the pump body and gradually and evenly apply the lever under the head of each self-tapping screw to remove the seal. Discard the seal.

Caution: *Do not damage the sealing face of the oil seal housing during removal of the seal.*

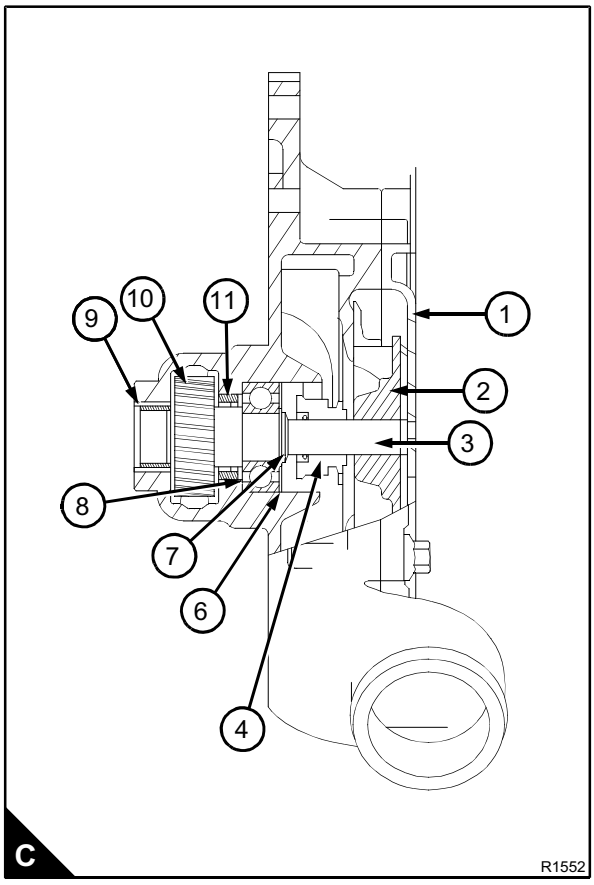
5 Remove and discard the circlips (C6) (C7).

6 Put the impeller end of the pump body face down on a suitable press. Press the drive gear end of the shaft through the gear (C10) and the pump body until the shaft (C3) and ball bearing assembly (C8) are released from the pump. Discard the bearing and the shaft. The gear will also be released through the side of the housing.

7 Inspect the gear for wear or other damage and renew it, if necessary.

8 Put the impeller end of the pump body face down on a press and use a suitable mandrel to engage the outer face of the oil seal (C11). Press out the oil seal and discard it.

9 With the impeller end of the pump body face down on a press, use a suitable mandrel to engage the outer race of the needle roller bearing (C9). Press out the bearing and discard it.



To remove and to fit — Operation 13-3

Warning! *The flywheel housing is heavy, use lift equipment or get help to assist with the lift operation before removal of the flywheel housing fasteners.*

To remove

1 Remove the starter, see Operation 14-7, and the flywheel, see Operation 13-1.

2 Release the housing setscrews and with a soft face hammer, hit carefully the housing to remove it from the dowels.

To fit

1 Ensure that the rear face of the cylinder block and the faces of the housing are clean and free from damage. Ensure that the location dowels are fitted correctly. If a felt seal is fitted to the rear flange of the sump, renew the seal.

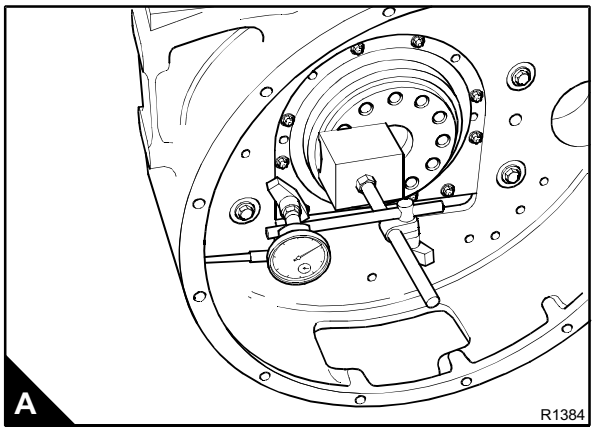
2 Fit the housing onto the dowels and lightly tighten the setscrews.

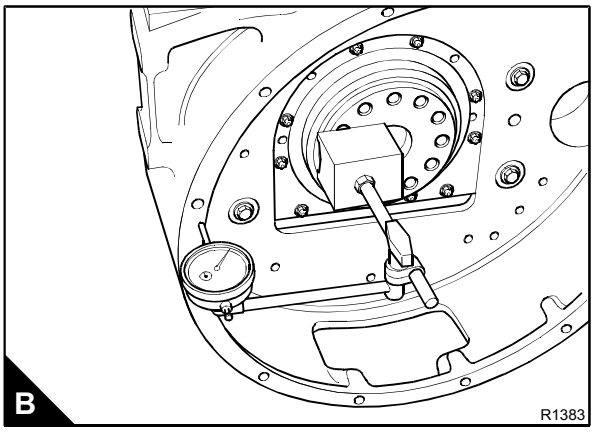
3 Check the housing concentricity with a dial test indicator (A). The run-out limit is given in the relevant Data and dimensions for the "Flywheel and housing" on page 27. If any adjustment is necessary, it must be made on the housing and the concentricity checked again.

4 Tighten the setscrews to the torque recommended in "Specific torque values" on page 31.

5 Check the housing alignment (B). The maximum tolerance is given in the relevant Data and dimensions for the "Flywheel and housing" on page 27. Any necessary adjustment must be made on the housing and not on the cylinder block.

6 Fit the flywheel, see Operation 13-1 and the starter motor, see Operation 14-7.





To maintain the brush gear and the commutator **Operation 14-8**

Repairs to the starter motor are not recommended. Your Perkins Dealer/Distributor has specialist equipment and personnel with the correct training to repair your starter motor.

To test on the engine **Operation 14-9**

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.

To remove and to fit the speed and timing sensor **Operation 14-16**

Warning! *The 'O' ring (B1) fitted to the speed and timing sensor is made of "Viton", see the safety precautions for "Viton seals" on page 8.*

Note: The engine speed and timing sensor is not adjustable. The sensor and securing bracket is a single unit and should not be dismantled. The sensor must be fitted so that the securing bracket (A2) is fully against the machined surface of the cylinder block.

To remove

1 Disconnect the electrical connector from the sensor.

2 Remove the setscrew (A1) that secures the sensor to the cylinder block.

3 Carefully remove the sensor (A3) from the cylinder block. Do not use a lever, this can cause damage to the sensor.

4 Discard the 'O' ring (B1).

To fit

1 Ensure that the sensor body and the bore in the cylinder block are clean and free from oil and dirt.

2 Fit a new 'O' ring to the sensor in the first groove (B1). Apply a small amount of clean engine oil to the 'O' ring.

Note: The second groove (B2) in the sensor is not used.

3 Push the sensor fully into the bore of the cylinder block (A). Do not use the setscrew to pull the sensor into position. Align the hole in the sensor bracket to the hole in the cylinder block and loosely fit the setscrew (A1).

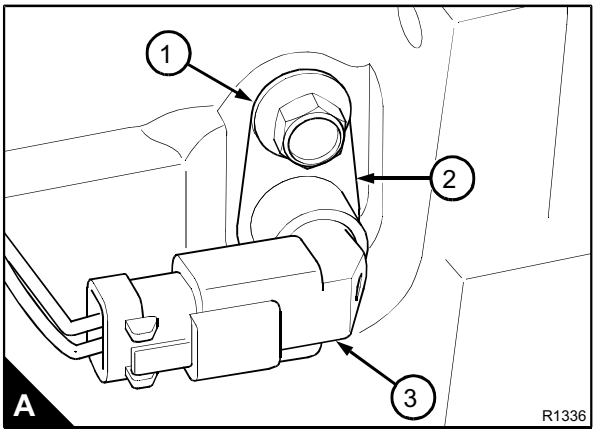
4 Tighten the setscrew to 22 Nm (16 lbf ft) 2,2 kgf m.

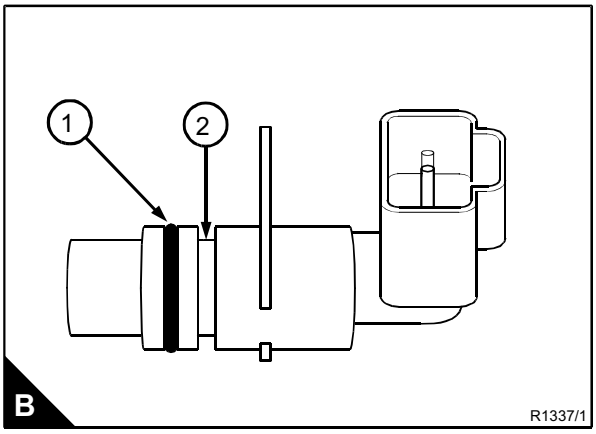
5 Check that the sensor bracket is fitted fully against the machined surface of the cylinder block.

6 Check that the connector seal is in place, that it is clean and is not damaged. Renew the seal if it is damaged.

7 Carefully fit the electrical connector to the sensor to ensure that the connector pins are not bent during this operation.

8 Lightly pull the harness connector to ensure that it is locked to the sensor connector.





To insert a pin or socket into a connector.

***Cautions*:**

- *Do not bend the wires directly from the rear of the connector as distortion of the rear seal will result, and this will allow water to enter the connector. (See illustration on page 245).*
- *Ensure that all ECM and MIC connector holes that are not used by a wire to a socket or a pin, are closed by a blanking plug to ensure a waterproof seal. The blanking plugs must be inserted into the connector so that the head of the blanking plug is pushed against, but not into, the connector end seal. (See illustration on page 245).*

Notes:

- The procedure is the same for Diagnostic, ECM and MIC connectors.
- New pins and sockets are supplied with a short length of wire fitted.
- Any pin or socket holes that are not used in the connector must have blanking plugs fitted.

1 Hold the wire (D1) approximately 25,4 mm (1.0 inch) behind the pin or socket.

2 Hold the connector with the rear of the connector towards you.

3 Push the pin or socket (E1) or socket through the connector rear seal.

4 Push the pin or socket (F2) into the connector until the pin or socket is against the locking mechanism (F1).

5 Push the pin or socket (F3) until the locking mechanism (F4) is in position behind the pin or socket.

6 Carefully pull on the wire to test that the pin or socket is locked in position. If the pin or socket pulls out of the connector, repeat the procedure from stage 1.

Caution: *After the repair of Diagnostic, ECM and MIC connectors, ensure that the seals are fitted and are correctly in position as damage to the connector body can result if they are not.*