
Perkins 3000 Series

All 3008 diesel models

USER'S HANDBOOK

3008/CV8 8 cylinder diesel engines for industrial applications

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This publication is divided into six chapters:

- 1 General information**
- 2 Engine views**
- 3 Operation instructions**
- 4 Preventive maintenance**
- 5 Engine fluids**
- 6 Fault diagnosis**

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General information

Introduction

The 3008 heavy duty diesel engine is the latest development from Perkins Engines Company Limited, a world leader in the design and manufacture of high performance diesel engines.

More than fifty years of diesel production experience, together with the use of the latest technology, have been used in the manufacture of your engine to give you reliable and economic power.

To ensure that you use the correct information for your specific engine type, refer to "Engine identification" on page 8.

Danger is indicated in the text by two methods:

Warning! *This indicates that there is a possible danger to the person.*

Caution: *This indicates that there is a possible danger to the engine.*

Note: Is used where the information is important, but there is not a danger.

Safety precautions

These safety precautions are important.

Reference must also be made to the local regulations in the country of operation.

- Only use these engines in the type of application for which they have been designed.
- Do not change the specification of the engine.
- Do not smoke when you put fuel in the tank.
- Clean away fuel which has been spilt. Material which has been contaminated by fuel must be moved to a safe place.
- Do not put fuel in the tank while the engine runs (unless it is absolutely necessary).
- Do not clean, add lubricating oil, or adjust the engine while it runs (unless you have had the correct training; even then extreme caution must be used to prevent injury).
- Do not make adjustments that you do not understand.
- Ensure that the engine does not run in a location where it can cause a concentration of toxic emissions.
- Other persons must be kept at a safe distance while the engine or equipment is in operation.
- Do not permit loose clothing or long hair near moving parts.
- Keep away from moving parts during engine operation.

Warning! *Some moving parts cannot be seen clearly while the engine runs.*

- Do not operate the engine if a safety guard has been removed.
- Do not remove the filler cap of the cooling system while the engine is hot and while the coolant is under pressure, because dangerous hot coolant can be discharged.
- Do not use salt water or any other coolant which can cause corrosion in the closed coolant circuit.
- Do not allow sparks or fire near the batteries (especially when the batteries are on charge) because the gases from the electrolyte are highly flammable. The battery fluid is dangerous to the skin and especially to the eyes.
- Disconnect the battery terminals before a repair is made to the electrical system.
- Only one person must control the engine.
- Ensure that the engine is operated only from the control panel or from the operator's position.
- If your skin comes into contact with high-pressure fuel, obtain medical assistance immediately.
- Diesel fuel and lubricating oil (especially used lubricating oil) can damage the skin of certain persons. Protect your hands with gloves or a special solution to protect the skin.
- Do not wear clothing which is contaminated by lubricating oil. Do not put material which is contaminated with oil into the pockets.
- Discard used lubricating oil in a safe place to prevent contamination.
- Ensure that the control lever of the transmission drive is in the 'out-of-drive' position before the engine is started.
- The combustible material of some components of the engine (for example certain seals) can become extremely dangerous if it is burned. Never allow this burnt material to come into contact with the skin or with the eyes.
- Fuel and oil pipes **must** be inspected for cracks or damage before they are fitted to the engine.
- Fit only genuine Perkins parts.

How to care for your engine

This handbook has been written to assist you to maintain and operate your engine correctly.

To obtain the best performance and the longest life from your engine, you must ensure that the maintenance operations are done at the intervals shown in Chapter , Preventive maintenance periods. If the engine is operated in a very dusty environment or other adverse conditions, certain maintenance intervals will have to be reduced. Renew the filter elements and the lubricating oil regularly to ensure that the inside of your engine remains clean.

Ensure that all adjustments and repairs are done by personnel who have had the correct training. Perkins distributors have this type of personnel available. You can also obtain parts and service from your Perkins distributor.

The left and right sides of the engine are as seen from the rear (flywheel) end. Where reference is made to 'A' and 'B' banks of cylinders: 'A' bank is to the right and 'B' bank is to the left when viewed from the rear end.

Read the "Safety precautions" on page 2 and remember them. They are given for your protection and must be applied at all times.

Engine preservation

Introduction

The recommendations indicated below are designed to prevent damage to the engine when it is withdrawn from service for a prolonged period. Use these procedures after the engine is withdrawn from service. Where necessary protect the engine against frost damage.

Short period storage

- Up to seven days

No treatment is necessary.

- Up to three months

Each week, operate the engine until the normal temperature of operation is reached. If the engine cannot be operated, turn the crankshaft by hand, in the normal direction of rotation (anti-clockwise as seen on the flywheel), a minimum of three revolutions.

Long period storage

If it is necessary to put an engine in storage for a period of between three and twelve months, use this procedure:

- 1 Remove the thermostat from its housing and carefully clean. Apply a silicone grease, such as MS4, to the valve stems of the thermostat and operate the valves by hand to ensure that the grease enters the glands. Fit the thermostat to its housing.
 - 2 Operate the engine until normal temperature of operation is reached. Stop the engine and immediately drain the lubricating oil from the sump and from the canisters of the oil filter (see **Caution** on page 5).
 - 3 Fill the canisters of the oil filter with PX4 corrosion inhibitor and fit the canisters to the filter head (see "How to renew the canisters of the oil filter" on page 27).
 - 4 Fill the sump, to the normal oil level, with PX4 corrosion inhibitor and, once again, run the engine until normal temperature of operation is reached.
 - 5 Stop the engine, disconnect the fuel supply pipe and connect the pipe to a supply of PX4 corrosion inhibitor. Start the engine, while it is still hot, and operate the engine, with no load, for ten minutes. Stop the engine.
 - 6 Disconnect the supply of PX4 corrosion inhibitor from the fuel system and seal the end of the pipe. Drain the fuel filters (see **Caution** on page 5).
- Fasten a label, at a position where it will be seen, to indicate that the fuel system has been disconnected.
- 7 Remove the fuel injectors and put the injectors in a container of PX4 corrosion inhibitor.
 - 8 Set the fuel control lever to the NO FUEL position, remove the rocker covers and disconnect the air inlet pipes from the induction manifolds.
 - 9 Turn the engine by use of the starter and, at the same time, spray PX4 corrosion inhibitor into the manifolds until an emission of vapour is seen from each injector opening. Connect the air inlet pipes.
 - 10 Spray 40 cc of PX4 corrosion inhibitor into each cylinder, through the fuel injector openings. Fit the injectors.

Caution: *The engine must NOT be turned after this operation and a label must be fitted to this effect.*

- 11 Spray PX4 corrosion inhibitor around the valves and around the rocker assemblies. Refit the rocker covers.

Continued

12 Drain the PX4 corrosion inhibitor from the engine sump and from the oil filter canisters. Fit a **NO OIL** label to the oil filler cap.

13 Drain the cooling system and fill with the recommended coolant mixture (see "Coolant" on page 39).

Caution: *The mixture must NOT contain less than 50% inhibited ethylene glycol or propylene glycol, and may contain up to 90% by volume.*

14 Wait for 15 minutes, then drain the coolant mixture completely. Fit a **NO COOLANT** label to the radiator filler cap.

15 Disconnect the exhaust pipe at the turbocharger outlet. Inject 2 grammes of VPI 260 powder into the turbocharger outlet and fit a blanking plug. Do NOT connect the exhaust pipe.

16 Disconnect the air pipes between the air filters and the turbocharger.

17 Inject 2 grammes of VPI 260 powder into the turbocharger.

18 Inject 2 grammes of VPI 260 powder into each paper element type air filter. Other types of air cleaners may be sprayed inside with PX4 corrosion inhibitor or with VPI 260 powder. Fit the air pipes.

19 Spray Crodafluid PM47 onto areas of the engine and auxiliary equipment which are not protected by paint. Ensure that the fuel control linkage is sprayed with Crodafluid PM47.

Warning! *Do NOT spray PM47 into the vent holes of the alternator.*

20 Cover, completely, the alternator and the starter motor in mouldable wax wrapping, and seal with adhesive tape.

21 Seal the air filter inlets, the crankcase breather and all other openings with mouldable wax wrapping and adhesive tape.

22 Remove all drive belts, apply French chalk to the belts and put them in a sealed plastic bag. Fasten the bag to the engine.

23 Fasten to the engine a label that indicates:

- That the exhaust system has been sealed.
- The dates when corrosion inhibitor was applied to the engine and when it must be applied again.

If the engine is to remain in storage for more than one year, the above procedure must be repeated at the end of each period of twelve months.

Removal from storage

To prepare the engine for use, after it has been in storage, refer to Chapter 3, Operation instructions. The information given applies to new engines and to those removed from storage.

Caution: *The canisters of the oil and fuel filters are designed so that when fitted upside down, the lubricating oil or fuel does not drain from the canister, when the engine is stopped.*

To drain a canister, hold the canister over a suitable container, insert a small tool into one of the inlet openings and carefully press open the rubber, non-return seal. During this operation, do not damage the rubber seal or the element of the filter.

Approved products for engine preservation

Component	Product	Manufacturer
Thermostat	MS4 silicone grease	Ambersil Limited Whitney Road Basingstoke Hampshire
Lubrication system	PX4 corrosion inhibitor	Croda Chemicals Limited Churchill Road Doncaster Yorkshire
Fuel system	PX4 corrosion inhibitor	Croda Chemicals Limited
Valves and rocker assemblies	PX4 corrosion inhibitor	Croda Chemicals Limited
Cooling system	Inhibited ethylene glycol or Inhibited propylene glycol	Various
Induction/exhaust systems	PX4 corrosion inhibitor VPI 260 powder	Croda Chemicals Limited Shell Chemicals Limited Stanlow Terminal Ellesmere Port Cheshire
Engine and auxiliaries - outer casing	Crodafluid PM47 Mouldable wax wrapping	Croda Chemicals Limited Carrs Paper Limited Shirley Solihull West Midlands

Parts and Service

Introduction

If problems occur with your engine or with the components fitted to it, your Perkins distributor can make the necessary repairs. Your Perkins distributor will ensure that only the correct parts are fitted and that the work is done correctly.

Certain components can be supplied by your Perkins distributor through the Perkins Exchange Component Programme. These will enable you to reduce the cost of certain repairs.

Service literature

Workshop manuals and other service publications are available from your Perkins distributor at a nominal cost.

Training

Courses on the service and overhaul of the 3000 Series range of engines are available at the Factory. For details, apply to: The Customer Training Centre, Perkins Engines Company Limited, Shrewsbury, SY1 3NX, England.

Service Bulletins

Service procedures and engine design are checked continuously at Perkins. As a result of this development work, it may become necessary to alter the information in manuals and other service publications. Between revisions of the literature, all relevant personnel are provided with full details of changes as they occur. The information is produced as a Service Bulletin; these are supplied to distributors for distribution as necessary.

Engine identification

If you need parts, service or information for your engine, you must give the complete engine number to your Perkins distributor.

The engine number is stamped on the data plate which is fastened to the left side of the crankcase.

For early engines, a typical engine number is: **4B26715U 59426T**, which consists of these codes:

4B	Engine family
26715	Engine number
U	Country of manufacture
59426	Build line number
T	Year of manufacture

Engines made after August 1994, have a new engine number system. For these engines, a typical number is: **SGD 08 0012 U 7261 D**, which consists of these codes:

SG	Engine application
D	Engine type
08	Number of engine cylinders
0012	Engine specification number
U	Country of manufacture
7261	Build line number
D	Year of manufacture

Units such as the fuel injection pump and turbochargers have their own data plates.

Engine data
General

Number of cylinders	8
Cylinder arrangement	90 degree included angle "V"
Cycle	Four stroke
Induction system	Turbocharged and charge cooled
Combustion system	Direct injection
Nominal bore	135 mm (5.315 in)
Stroke	152 mm (5.984 in)
Compression ratio	14.5:1
Cubic capacity	17,4 litres (1062 in ³)
Firing order	A1, B1, B2, A3, B3, A2, A4, B4
Tappet clearances (hot or cold)	
Engines before build line number 8281 (4B 27377 8281 V):	
Inlet	0,4 mm (0.016 in)
Exhaust	0,5 mm (0.020 in)
Engines from build line number 8281 (4B 27377 8281 V):	
Inlet	0,2 mm (0.008 in)
Exhaust	0,5 mm (0.020 in)
Direction of rotation	Anti-clockwise: view on flywheel
Injection timing	As stamped on engine data plate
Dry weight of engine (Approximate)	Electropak (TAG2A): 1725 kg Electropak (TAG3A and TAG4A): 1823 kg Engine only: 1550 kg
Cooling system	
Coolant pump	Centrifugal, gear driven unit
Capacity of coolant system (does not include radiator)	68,2 litres (15 UK gallons)
Coolant system pressure (at normal working temperature)	up to 69 kN/m ² (10 lbf/in ²)
Temperature (normal)	70 to 90 °C
Thermostat	Two, single element, wax capsule type

Fuel system

Type	Low pressure supply to injection pump with through flow return to tank
Injection pump	8 element, in-line unit
Governor	All speed, integral with fuel injection pump
Lift pump	Mechanical, operated by camshaft
Fuel supply pressure	140 to 210 kN/m ² (20 to 30 lbf/in ²)
Fuel injectors	Axial feed, low spring type. Six spray holes
Injection pressure	250 bar (early engines 240 bar)
Main fuel filter	Screw-on type canister
Primary fuel filter/water separator	Centrifugal type

Lubrication system

Type	Wet sump
Capacity of lubricating oil sump	
Maximum	54,5 litres (12 UK gallons)
Minimum	40,9 litres (9 UK gallons)
Early engines:	
Maximum	25,0 litres (5.5 UK gallons)
Minimum	13,6 litres (3 UK gallons)
Total capacity of lubricating oil system	42,5 litres (9.4 UK gallons)
Lubricating oil pressure	
Normal load conditions	413 kN/m ² (60 lbf/in ²)
Minimum at rated speed	345 kN/m ² (50 lbf/in ²)
Pump	Spur gear type, gear driven
Pressure relief valve	Spring loaded plunger, not adjustable
Opening pressure	455 kN/m ² (66 lbf/in ²)
Oil-to-coolant heat exchanger	Multiple tube type
Filters	Two, screw-on type canisters with integral by-pass valves and a lubricating oil by-pass filter
Maximum recommended temperature of sump oil	125 °C

Induction/exhaust system

Aspiration	Pressure charged by single or twin turbochargers
Air charge cooler (if fitted)	
TAG	Air-to-air type, integral with radiator
TWG	Air-to-coolant type, integral with induction manifolds
Air filters	Two paper element type or two disposable dry type

Electrical equipment

Alternator	Belt driven, 28 volt 40 amp, with integral regulator
Starter motor	Single, 24 volt - flange mounted
Stop control	Electrical, 24 volt, energised to RUN
Engine protection switches	Coolant temperature switch, set to stop the engine at 106 °C Oil pressure switch, set to stop the engine at 124 kN/m ² (18 lbf/in ²)

2

Engine views

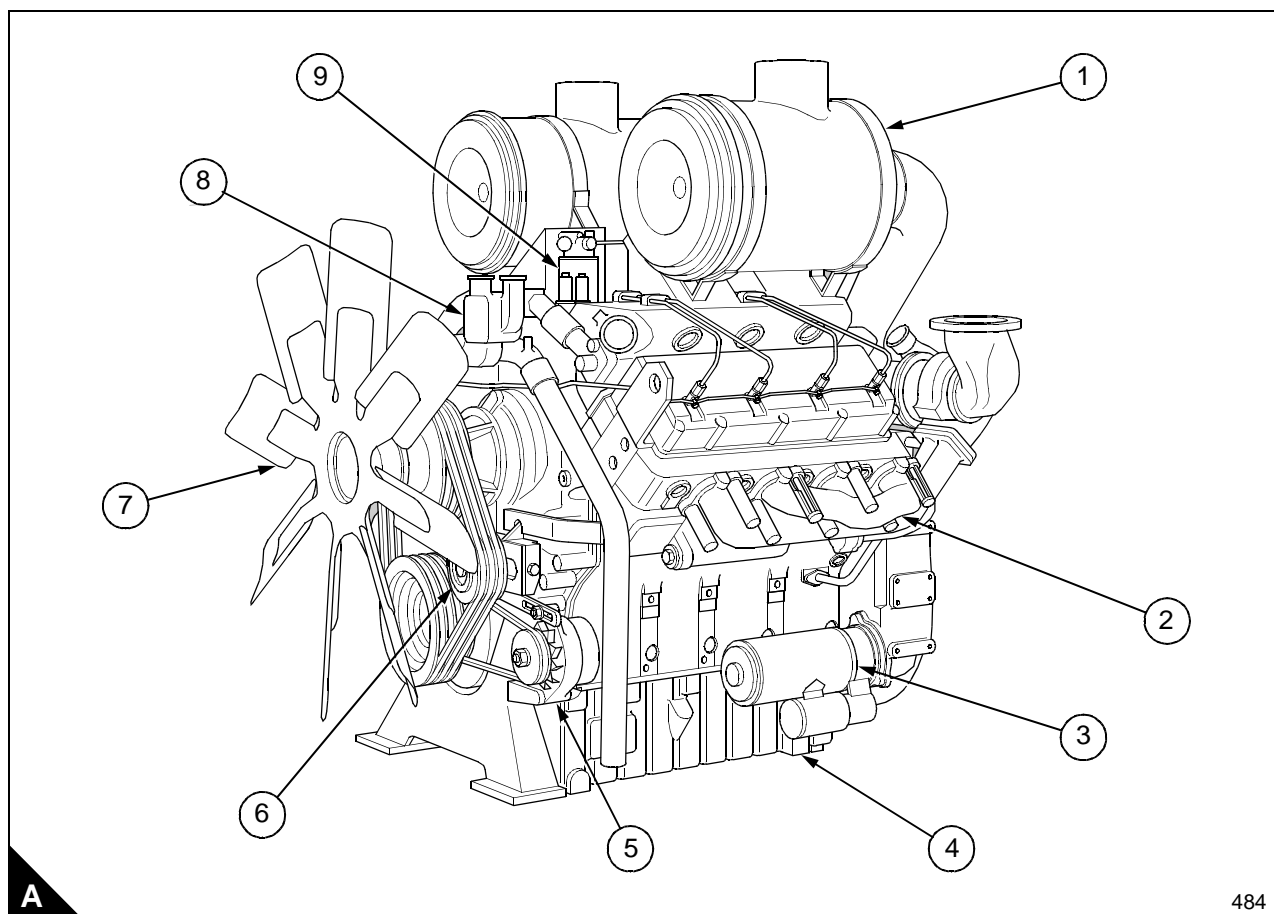
Introduction

Perkins engines are built for specific applications and the views which follow do not necessarily match your engine specification.

Location of engine parts

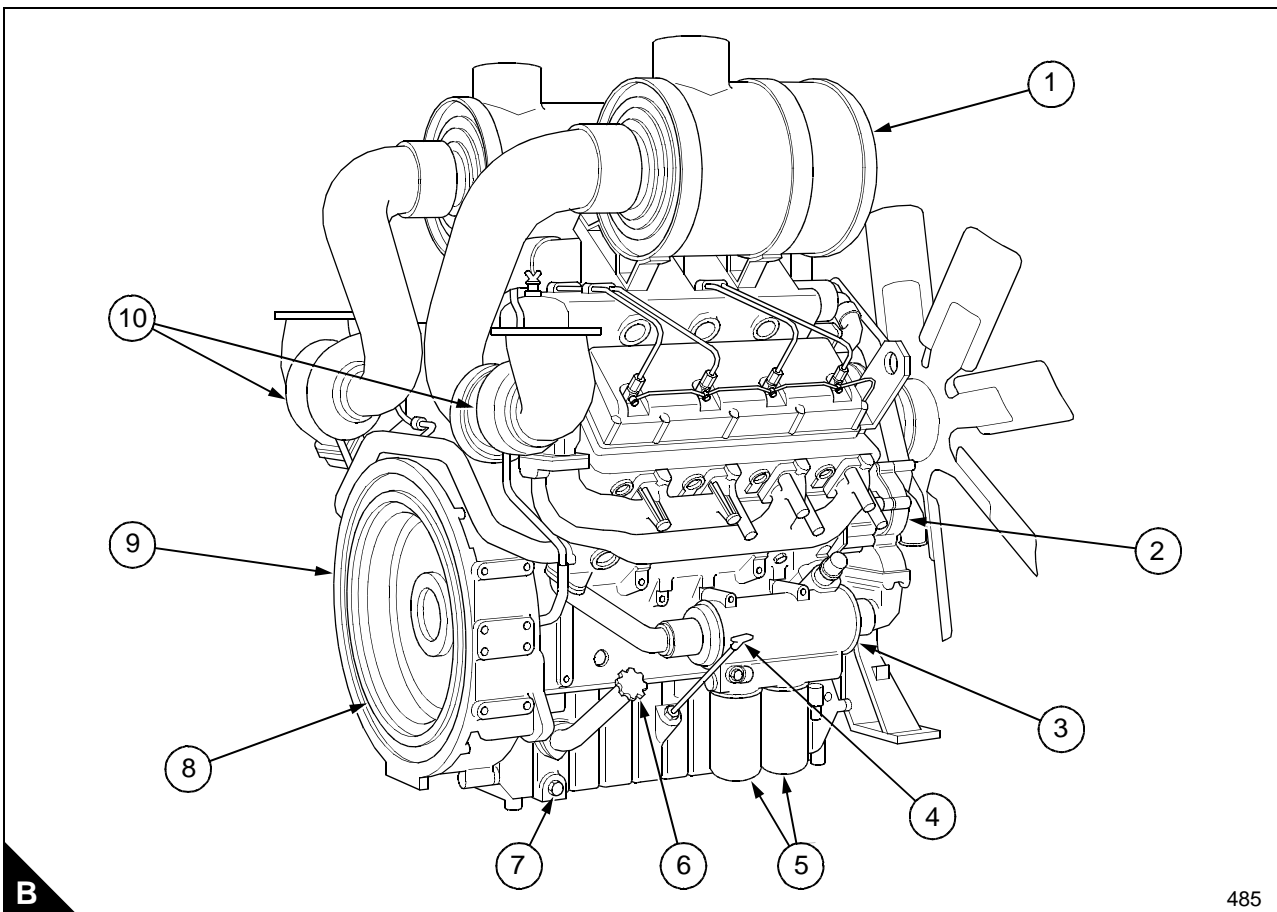
Front and left side view of the 3008 engine (A)

- | | |
|------------------------------------|------------------------------|
| 1 Air cleaner | 7 Fan |
| 2 Exhaust manifold | 8 Coolant thermostat housing |
| 3 Starter motor | 9 Main fuel filter |
| 4 Lubricating oil sump | |
| 5 Alternator | |
| 6 Tensioner pulley for drive belts | |



Rear and right side view of the 3008 engine (B)

- | | |
|---|----------------------------------|
| 1 Air cleaner | 6 Filler cap for lubricating oil |
| 2 Coolant pump | 7 Drain plug for lubricating oil |
| 3 Lubricating oil cooler | 8 Flywheel |
| 4 Lubricating oil dipstick | 9 Flywheel housing |
| 5 Canisters of the lubricating oil filter | 10 Turbochargers |



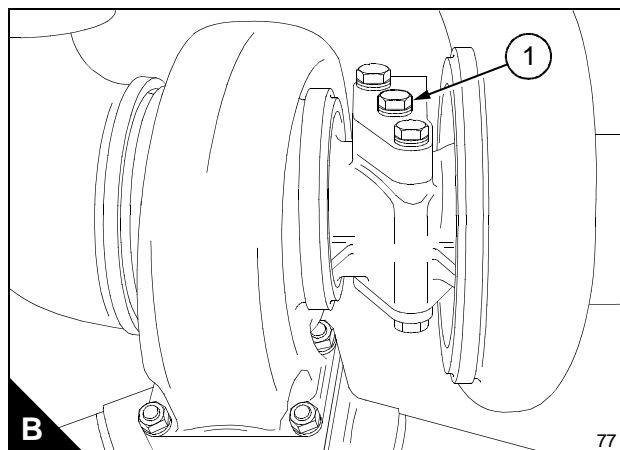
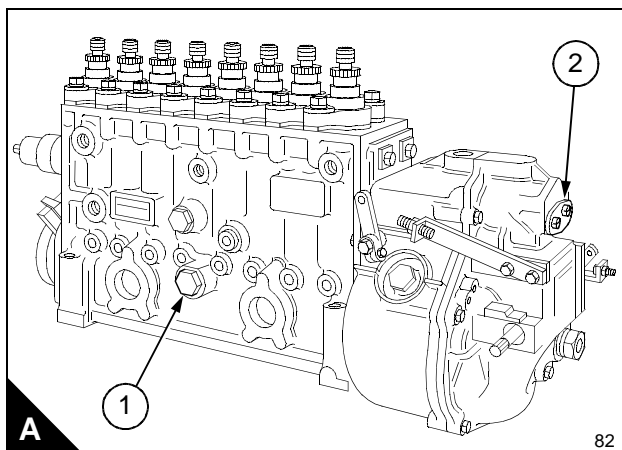
3

Operation instructions

Preparations for a new or an overhauled engine

Every new engine supplied by Perkins Engines Company Limited, Shrewsbury, is run-in before it leaves the factory.

- 1 Check that all protection covers and blanking plugs have been removed.
- 2 Fit all components that were removed for storage or for transport.
- 3 Ensure that drain plugs for coolant and for lubricating oil are securely fitted.
- 4 Where necessary, connect the remote control linkages, the pressure gauge pipes, the air inlet pipes and the wiring loom.
- 5 Connect the fuel pipes.
- 6 Connect the exhaust pipes.
- 7 Fill the fuel tank(s) with the correct grade of fuel (see "Diesel fuel" on page 39).
- 8 Fill the cooling system with the approved coolant mixture (see "Coolant" on page 39).
- 9 Fill the sump to the H mark on the dipstick with the correct grade of lubricating oil (see "Lubricating oil" on page 40).
- 10 Remove the plug (A1) from the side of the injection pump. Remove the plate (A2) from the rear end of the governor and add lubricating oil, of the correct grade (see "Lubricating oil" on page 40), until the level of the oil reaches the hole for the plug (A1).
Fit the plug (A1), fit the plate (A2) and securely tighten.
- 11 Add oil to each turbocharger as follows: Clean the area around the blanking plug (B1) at the top of the turbocharger bearing housing. Remove the plug (B1) and insert 0,2 litre ($\frac{1}{3}$ pint) of engine oil of the correct grade. Fit the plug.
- 12 Eliminate air from the fuel system, see "How to eliminate air from the fuel system" on page 34.
- 13 Lubricate all of the control linkages and check the linkages for free movement.



How to start a new or overhauled engine or an engine which has been in storage

If an engine has been in storage for a period of more than one month or if the fuel injection pump has been removed, lubrication oil must be added to the fuel injection pump, to the governor of the fuel injection pump and to the turbochargers. The procedure is described in steps 10 and 11 of "Preparations for a new or an overhauled engine" on page 13. Use clean engine oil of the same grade and specification as that already in the system.

Start procedure

Ensure that the stop control is in the STOP position and that the speed control lever is in the IDLE position. Press the start button for 10 seconds and wait for 10 seconds, then press it for 20 seconds and wait for 20 seconds. Oil pressure **must** be indicated on the gauge. Move the stop control lever to the RUN position and proceed as for a normal start.

Normal start procedures

Service checks each day before first engine start

- 1 Check that the level of coolant is just at the bottom of the filler extension in the radiator. Fill, if necessary, to the required level with the approved coolant mixture. Find the reason for large losses of coolant.
- 2 Check the engine oil level. With the engine stopped the oil level must be at the H mark on the dipstick. If necessary, add oil of the same grade and specification as that already in the system. Do **not** add more oil than is necessary.
- 3 Check the level in the fuel tank.
- 4 Check the air restriction indicator.

Caution: *If a fuel injection pump or turbocharger has been removed from an engine, it must be primed with clean engine oil of the correct grade before the engine is first started. See steps 10 and 11 of "Preparations for a new or an overhauled engine" on page 13.*

Variable speed engines

Perform the daily service checks then proceed as follows:

- 1 Turn on the fuel supply.
- 2 Move the stop control to the RUN position.
- 3 Move the speed control lever to the maximum speed position.
- 4 Press the start button and release it when the engine starts.
- 5 Move the speed control lever to the idle position.

Constant speed engines

Perform daily service checks then proceed as follows:

- 1 Turn on the fuel supply.
- 2 Move the stop control to the RUN position.
- 3 Press the start button and release it when the engine starts.

How to start the engine in low ambient temperatures

An excess fuel device, within the fuel injection pump, works as a starting aid when ambient temperatures are below 0 °C.

Before the engine is started, push, fully in, the control rod of the excess fuel device. When the starter button is pressed and the engine starts, the control rod automatically returns to its original position.

Caution: *The excess fuel device must not be used at the same time as other cold starting aids as the extra fuel will make the engine more difficult to start.*

Precautions

The precautions that follow will help to ensure a long and fault-free life for the engine:

Variable speed engines

- 1 Do not operate the engine at high speeds and loads until the coolant has reached a minimum temperature of 78 °C.
- 2 Do not allow the engine to run at idle speed for prolonged periods.
- 3 Do not exceed the maximum no load speed.
- 4 Never allow an engine to continue to run if the oil pressure is below 170 kN/m² (25 lbf/in²) at rated speed.
- 5 Fill the fuel tank(s) at the end of each day to prevent condensation.

Constant speed engines

- 1 Do not operate the engine with a full load until the coolant has reached a minimum temperature of 78 °C.
- 2 Do not allow the engine to run with no load for prolonged periods.
- 3 Maintain full fuel tanks to prevent condensation.

How to stop the engine

Variable speed engines

- 1 Put the gear lever into the NEUTRAL position.
- 2 Operate the engine at approximately 800 rev/min for 3 minutes to allow the turbochargers to reduce speed and temperature.
- 3 Move the stop control to the STOP position.

Constant speed engines

- 1 Operate the engine for 3 minutes at idle speed with no load to allow the turbochargers to reduce speed and temperature.
- 2 Move the switches for the engine protection devices to the OFF position.
- 3 Move the stop control to the STOP position.
- 4 Turn off the fuel supply.

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4

Preventive maintenance

Preventive maintenance periods

These preventive maintenance periods apply to average conditions of operation. Check the periods given by the manufacturer of the equipment in which the engine is installed. If necessary, use the shorter periods. When the operation of the engine must conform to the local regulations, these periods and procedures may need to be adapted to ensure correct operation of the engine.

The service intervals can be reduced for operation in adverse conditions. The intervals must not be extended unless Perkins Engines Company Limited have approved the changes as indicated in the Perkins Warranty. It is good preventive maintenance to check for leakage and loose fasteners at each service. These maintenance periods apply only to engines that are operated with fuel and lubricating oil which conform to the specifications given in this handbook.

Schedule for engines in normal use

The preventive maintenance operations must be applied at the interval (hours or months) which occurs first.

- A Every 10 hours or daily
- B Every 400 hours or 12 months
- C Every 1,200 hours or 24 months

A	B	C	Operation
●			Check the amount of coolant
●			Check the level of the lubricating oil
●			Check the restriction indicators for the air filters and, when necessary, renew the filter elements
●			Drain the water/sediment from the primary fuel filter
	●		Check the condition and the tension of all drive belts
	●		Check the specific gravity and the pH value of the coolant
	●		Renew the lubricating oil
	●		Renew the canisters of the lubricating oil filter and renew the rotor of the by-pass filter
	●		Renew the canister of the main fuel filter
	●		Clean the primary fuel filter
	●		Ensure that the mounting nuts for the turbochargers are tightened securely
	●		Check that the air charge cooler and the radiator are clean and free from debris
		●	Check the timing of the fuel injection pump
		●	Check that the drive coupling bolts of the fuel injection pump are tightened to 120 Nm (88 lbf ft)
		●	Ensure that the fuel injectors are checked and corrected or renewed, if necessary ⁽¹⁾
		●	Ensure that the tappet clearances are checked and adjusted, if necessary ⁽¹⁾

⁽¹⁾ By a person who has had the correct training.

In addition to the operations listed above, the operations listed below must be applied at 12 month intervals:

- Drain and flush the coolant system and renew the coolant mixture
- Check the turbochargers, ensure that they are checked and corrected, if necessary ⁽¹⁾
- Ensure that the alternator is checked and corrected if necessary ⁽¹⁾

Schedule for engines in intermittent use

For engines which are in use for a total of less than 400 hours in every twelve months, the schedule below must be used:

The preventive maintenance operations must be applied at the interval (hours or months) which occurs first.

- A Monthly
- B Every 200 hours or 12 months
- C Every 1,000 hours or 24 months

A	B	C	Operation
●			Check the amount of coolant
●			Check the level of the lubricating oil
●			Check the restriction indicators for the air filters and, when necessary, renew the filter elements
●			Start and run the engine with 30% load (minimum), until normal temperature of operation is reached
●			Drain the water/sediment from the primary fuel filter
	●		Check the condition and the tension of all drive belts
	●		Check the specific gravity and the pH value of the coolant
	●		Renew the lubricating oil
	●		Renew the canisters of the lubricating oil filter and renew the rotor of the by-pass filter
	●		Renew the canister of the main fuel filter
	●		Clean the primary fuel filter
	●		Ensure that the mounting nuts for the turbochargers are tightened securely
		●	Check the timing of the fuel injection pump
		●	Check that the drive coupling bolts of the fuel injection pump are tightened to 120 Nm (88 lbf ft)
		●	Ensure that the fuel injectors are checked and corrected or renewed, if necessary ⁽¹⁾
		●	Ensure that the tappet clearances are checked and adjusted, if necessary ⁽¹⁾

⁽¹⁾ By a person who has had the correct training.

In addition to the operations listed above, the operations listed below must be applied at 12 month intervals:

- Drain and flush the coolant system and renew the coolant mixture
- Check the turbochargers, ensure that they are checked and corrected, if necessary ⁽¹⁾
- Ensure that the alternator is checked and corrected, if necessary ⁽¹⁾
- Check that the air charge cooler and the radiator are clean and free from debris

Coolant level

Remove the filler cap from the radiator and check that the level of the coolant mixture just touches the bottom of the filler tube inside the radiator. If necessary, add coolant until the level of the coolant reaches the filler tube. Fit the filler cap.

Caution: *If coolant is added to the system during service, it must consist of the same original mixture as used to fill the system.*

Warning! *On a hot engine release the filler cap carefully as the system will be under pressure.*

Lubricating oil level

At the periods given in the service schedule use the dipstick to check the amount of lubricating oil in the sump. While the engine runs, the oil level must be above the L mark. With the engine stopped the oil level must be at the H mark on the dipstick.

If necessary, put more oil into the sump. Use the same grade and specification as that already in the system.

Caution: *Do not overfill.*

Air filter

Restriction indicator

Each air filter is fitted with an indicator (B) which gives a visual warning when the filter needs a service.

When the red warning indicator is seen through the clear panel after the engine has stopped, the air filter element must be renewed.

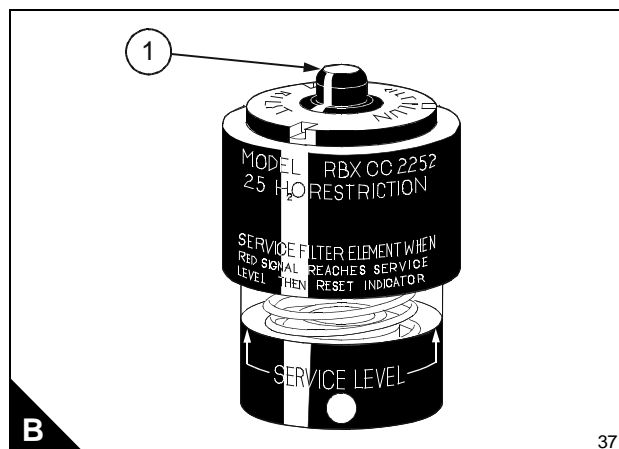
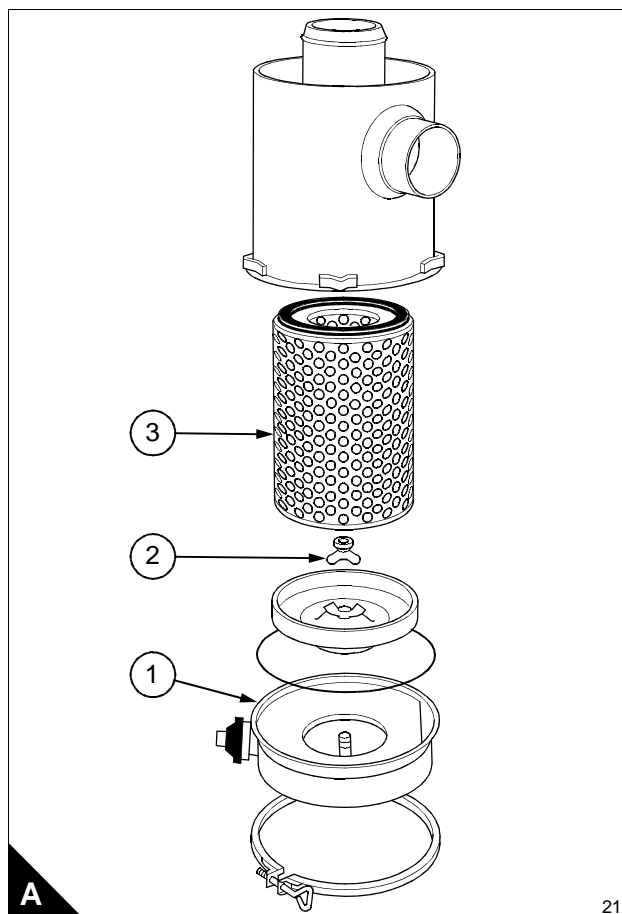
After a clean element has been fitted, press the reset button on the restriction indicator.

How to renew the elements of the air filters

The two air filters (A) contain paper elements. These must not be washed. Renew the paper elements as follows:

- 1 Loosen the clamp and remove the end cover (A1). Remove the wing nut (A2), withdraw and discard the filter element (A3).
- 2 Clean, thoroughly, the inside of the casing of the air filter. Fit a new filter element and fit the end cover.
- 3 Reset the restriction indicator.

Repeat this procedure for the other air filter.



How to drain the primary fuel filter

- 1 Remove the drain plug from the base of the filter bowl and allow any water or sediment to drain from the unit.
- 2 Fit the drain plug and tighten it securely.

How to check the drive belts

Check all drive belts and renew a belt if it is worn or damaged. Where more than one belt is used between two pulleys, all of the belts must be renewed together. Maximum belt life will be obtained only if the belts are kept at the correct tensions.

Check the belt tension at the centre of the longest free length, for example, position (A3) to check the alternator drive belt. Use a 'Gates "Krikit" V-belt tension gauge' or similar tool to check the tension of the belts.

The correct tension for all belts is **400 to 489 N** (90 to 100 lbf). Where more than one belt is used between two pulleys, check/adjust the tension on the tightest belt.

Note: When new belts are fitted they must be checked again after the engine has been run for 15 minutes and, if necessary, adjusted to the correct tension.

How to adjust the tension of the fan belts

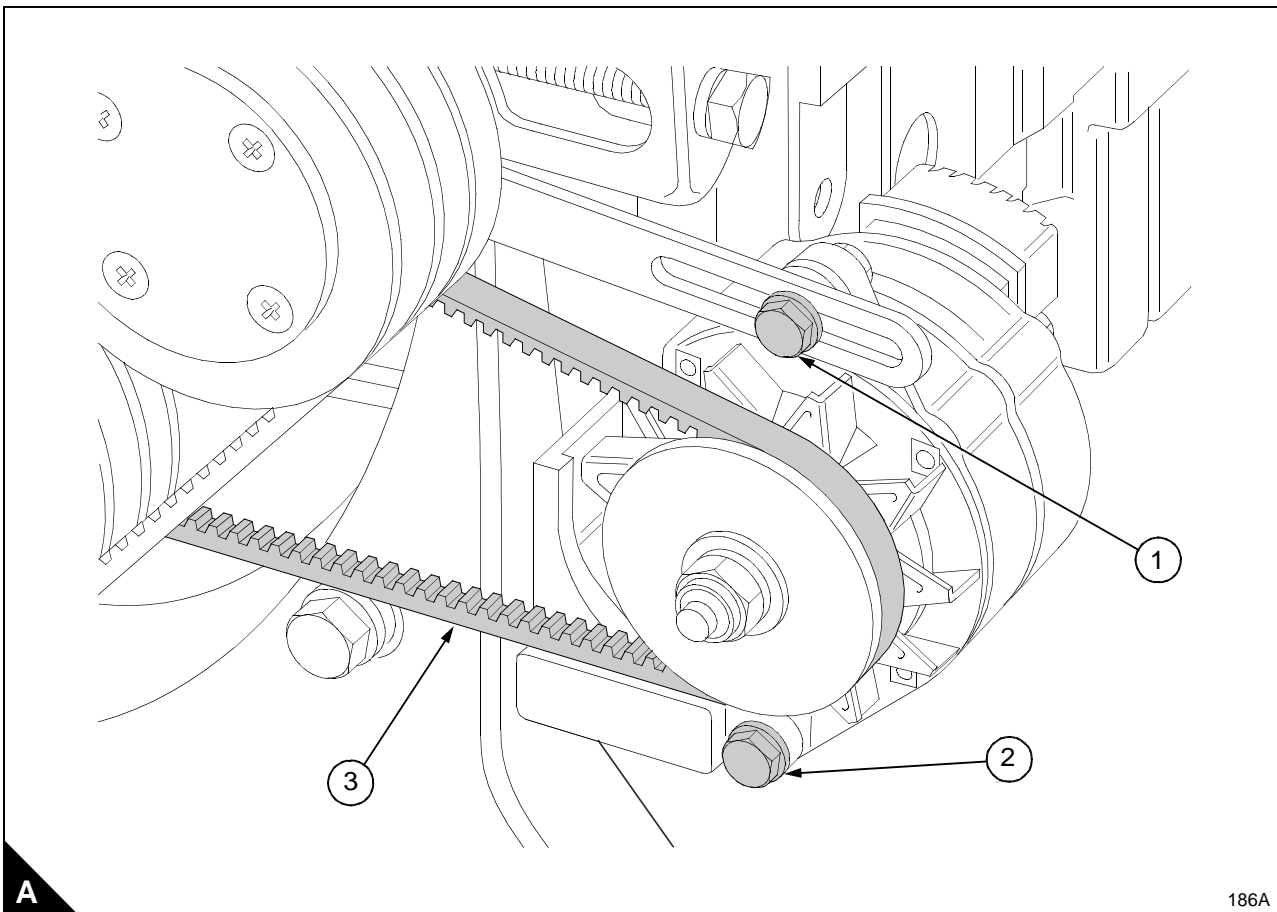
Loosen the lock nuts on the adjustment bolt, loosen the large lock nut on the belt tensioner and turn the adjustment bolt until the correct tension is obtained. Tighten the lock nuts and check the tension of the belts again. Run the engine for 15 minutes and then check the belt tension again.

Check the tension of new belts every week for four weeks and then at the intervals specified in the service schedule.

How to adjust the tension of the alternator belt

Loosen the alternator pivot bolt (A2) and the adjustment bolt (A1). Move the alternator to obtain the correct belt tension. Tighten the two bolts. Run the engine for 15 minutes and then check the belt tension again.

Check the tension of new belts every week for four weeks and then at the intervals specified in the service schedule.

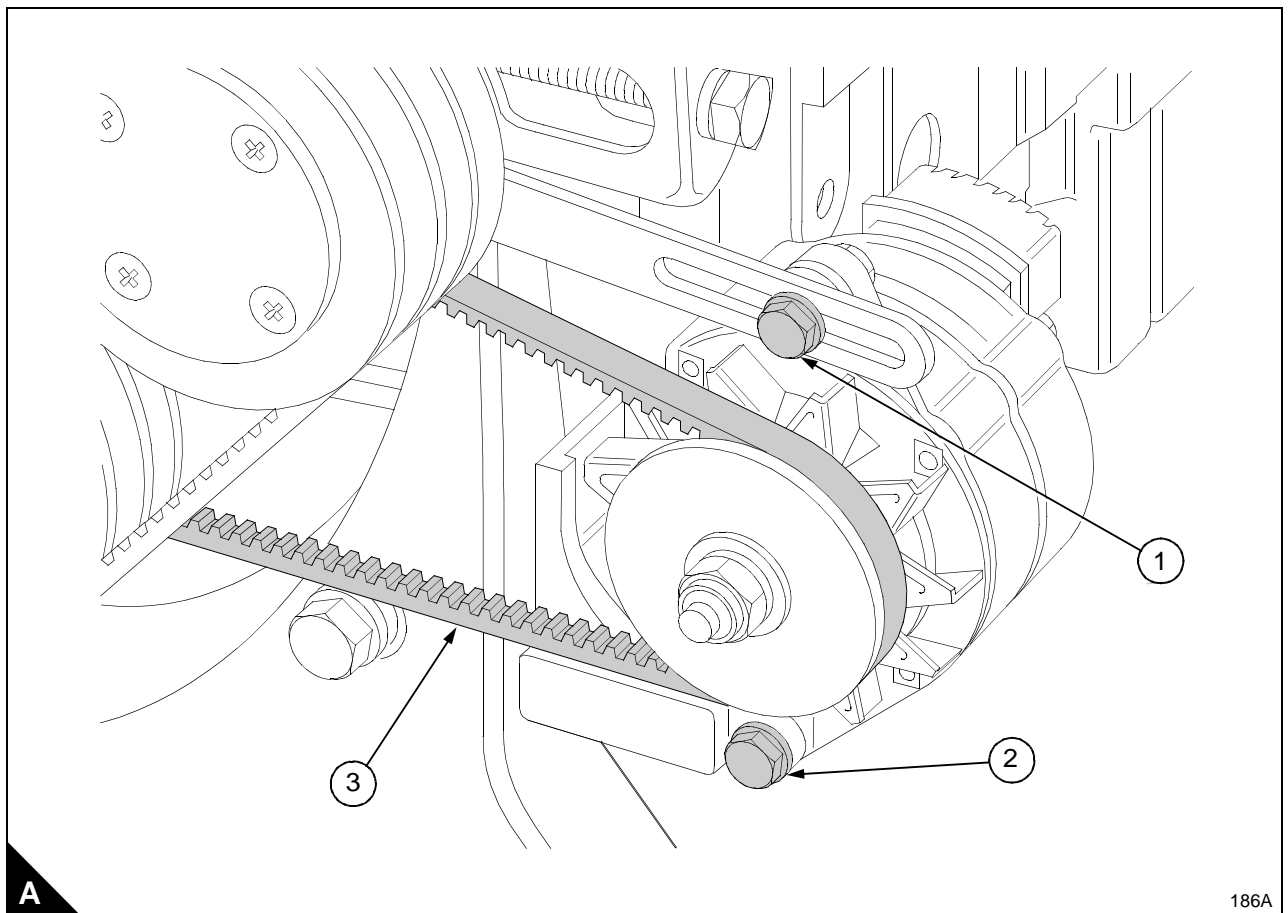


How to renew the fan belts

- 1 Remove the six bolts which secure the fan to the pulley and push the fan forward into the radiator cowl.
- 2 Loosen the belt tensioner and remove the old belts. Ensure that the grooves of the pulley are free from grease and dirt and fit a new set of belts.
- 3 Fit the fan and tighten the bolts securely. Adjust the fan belts to the correct tension.

How to renew the alternator belt

- 1 Remove the fan belts from the crankshaft pulley as given above.
- 2 Loosen the alternator adjustment bolts (A1 and A2) and remove the old belt. Ensure that the grooves of the pulley are free from grease and dirt and fit a new belt.
- 3 Adjust the belt to the correct tension, then fit and adjust the fan belts as given above.



How to check the specific gravity of the coolant

Drain some coolant from the cooling system after the engine has been stopped and before the formation of sediment. Proceed as follows:

For mixtures which contain inhibited ethylene glycol

- 1 Put a hydrometer, and a reliable thermometer, into the antifreeze mixture and check the readings on both instruments.
- 2 Compare the readings obtained with the chart and adjust the strength of the mixture as necessary.

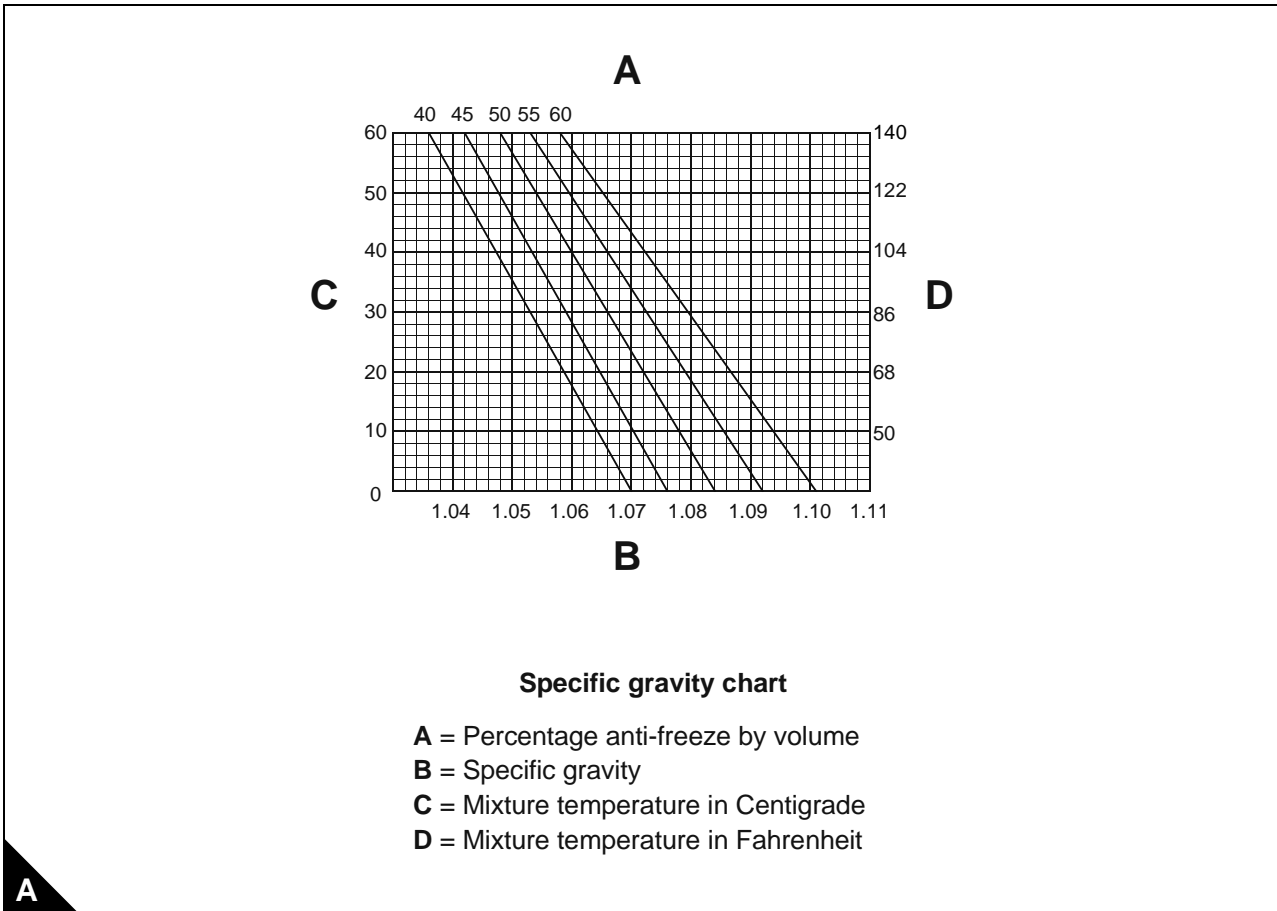
For mixtures which contain inhibited propylene glycol:

- 1 Open the cover of the refractometer, check that the clear panel is clean and use a small syringe to apply three or four drops of the coolant mixture to the clear panel.
- 2 Spread the coolant over the full area of the clear panel and close the cover. Hold the refractometer horizontally with the clear panel at the top and inspect the sample through the viewer.
- 3 Compare the reading with the chart in the instructions; adjust the strength of the mixture as necessary.

Caution: The clear panel must be cleaned thoroughly before use. Some of the fluid which was tested earlier can remain on the clear panel and this will affect the reading of the sample.

Protection against frost is as follows:

Antifreeze/water (% by volume)	Protection down to (°C)
50/50	-35
60/40	-40



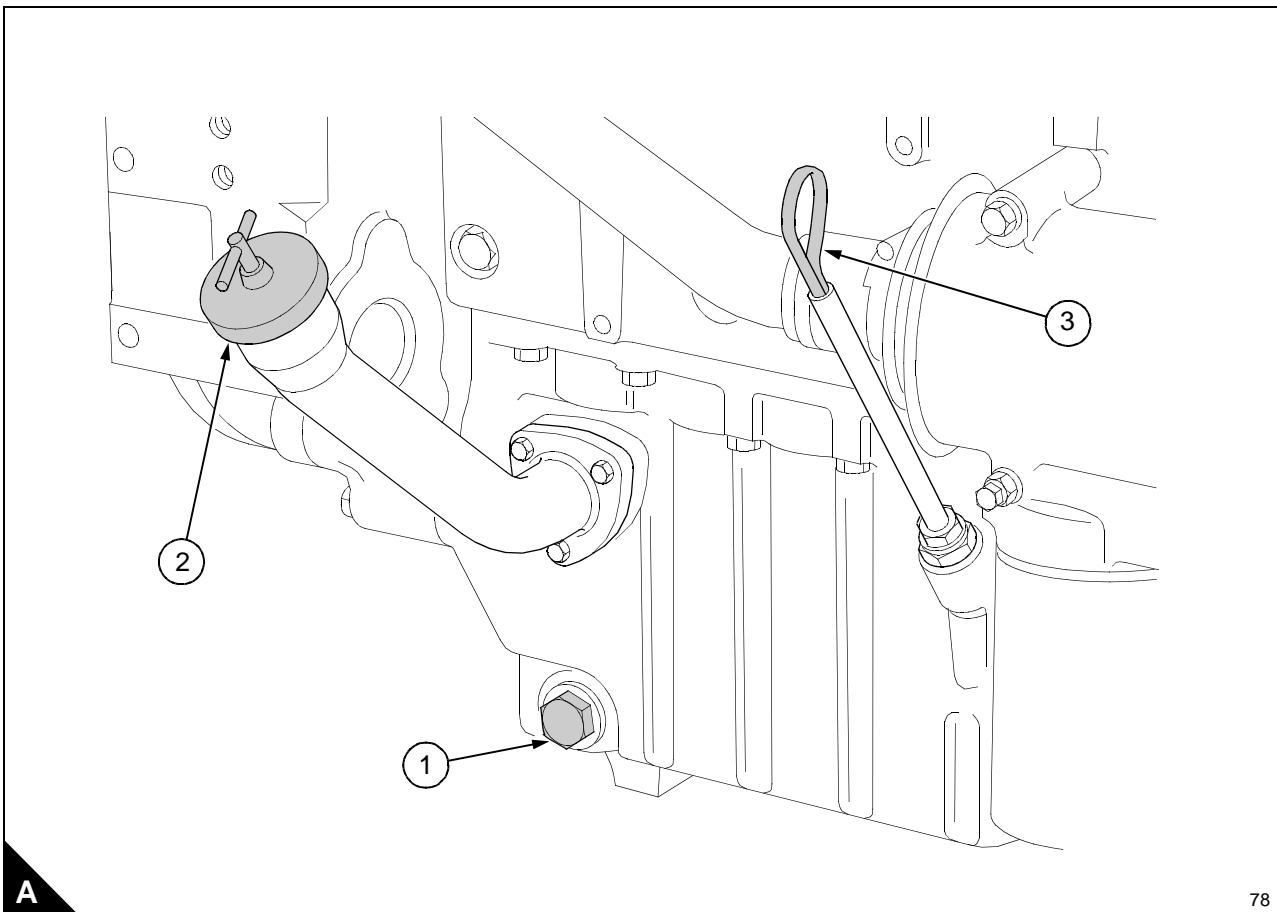
How to check the pH value of the coolant

The pH value of the coolant must not be less than pH7 or more than pH9.5. The pH value can be found by the use of a pH meter or test papers, which are available from pharmaceutical manufacturers.

If these limits are exceeded the pH value may be adjusted by the addition of a corrosion inhibitor to the same specification as that already in use. If this is not possible, the system must be drained, flushed and filled with new coolant.

How to renew the engine lubricating oil

- 1 Operate the engine until it is warm.
 - 2 Stop the engine, remove the sump drain plug (A1) and drain the lubricating oil from the sump. Fit the drain plug, complete with a new sealing washer, and tighten the plug to a torque of 47 Nm (35 lbf ft). If the plug is fitted to a steel insert, tighten the plug to a torque of 115 Nm (85 lbf ft).
 - 3 Renew both of the oil filter canisters as given below.
 - 4 Clean the area around the oil filler cap (A2) and remove the cap. Fill the sump to the H mark on the dipstick (A3) with clean new lubricating oil of an approved grade as given in "Lubricating oil" on page 40.
- Caution:** Do not overfill.
- 5 Operate the engine and check for leakage from the filter canisters. When the engine has cooled, check the oil level on the dipstick and put more oil into the sump, if necessary.

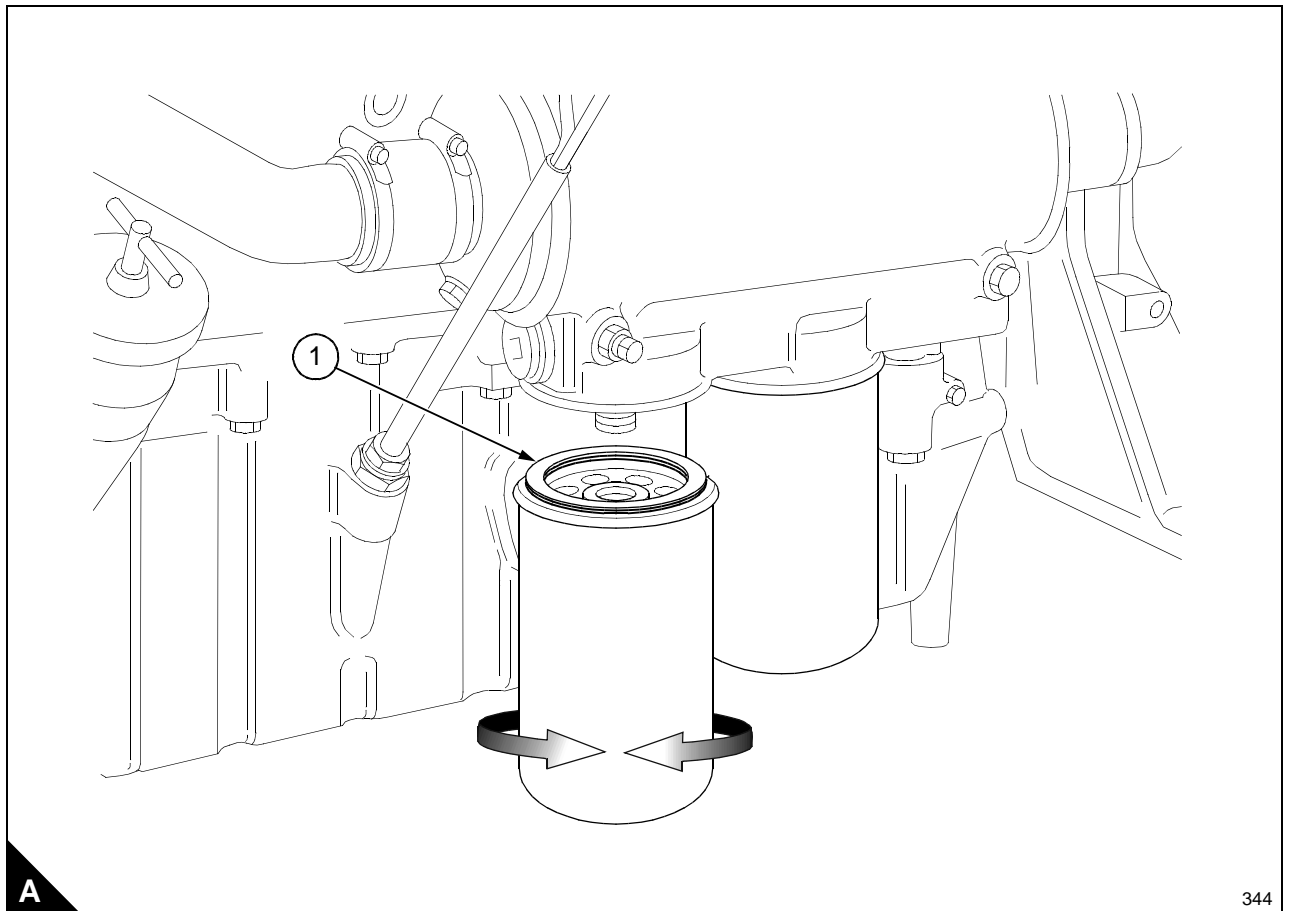


How to renew the canisters of the oil filter

Two screw-on type canisters are fitted to the filter head which is integral with the bottom of the engine oil cooler.

- 1 Put a tray under the canisters and use a strap wrench to remove each canister.
- 2 Check that the sealing rings (A1) are correctly fitted to the new canisters and clean the contact faces of the filter head.
- 3 Lubricate the top of each canister seal with clean engine lubricating oil and fill each canister with the approved grade of lubricating oil.
- 4 To install the new canisters use this procedure: Tighten the canisters, on their adaptors, until the sealing rings are in contact with the face of the filter head, then turn the canisters a further $1\frac{1}{4}$ turns.

Caution: Do not overtighten.

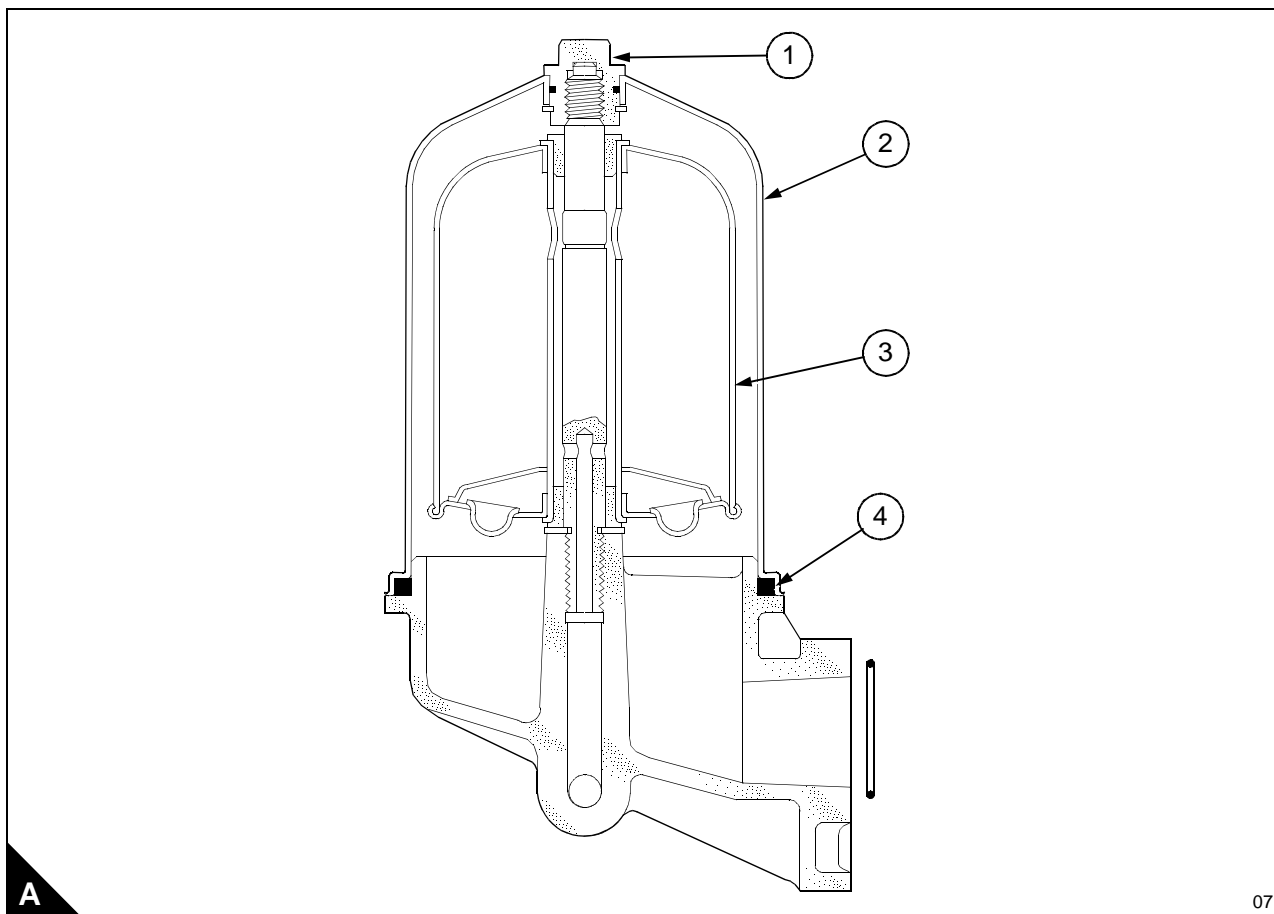
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How to renew the rotor of the by-pass filter for lubricating oil

Some engines are fitted with an extra filter for lubricating oil: a by-pass filter. The rotor of the bypass filter must be renewed at the periods given in the relevant schedule.

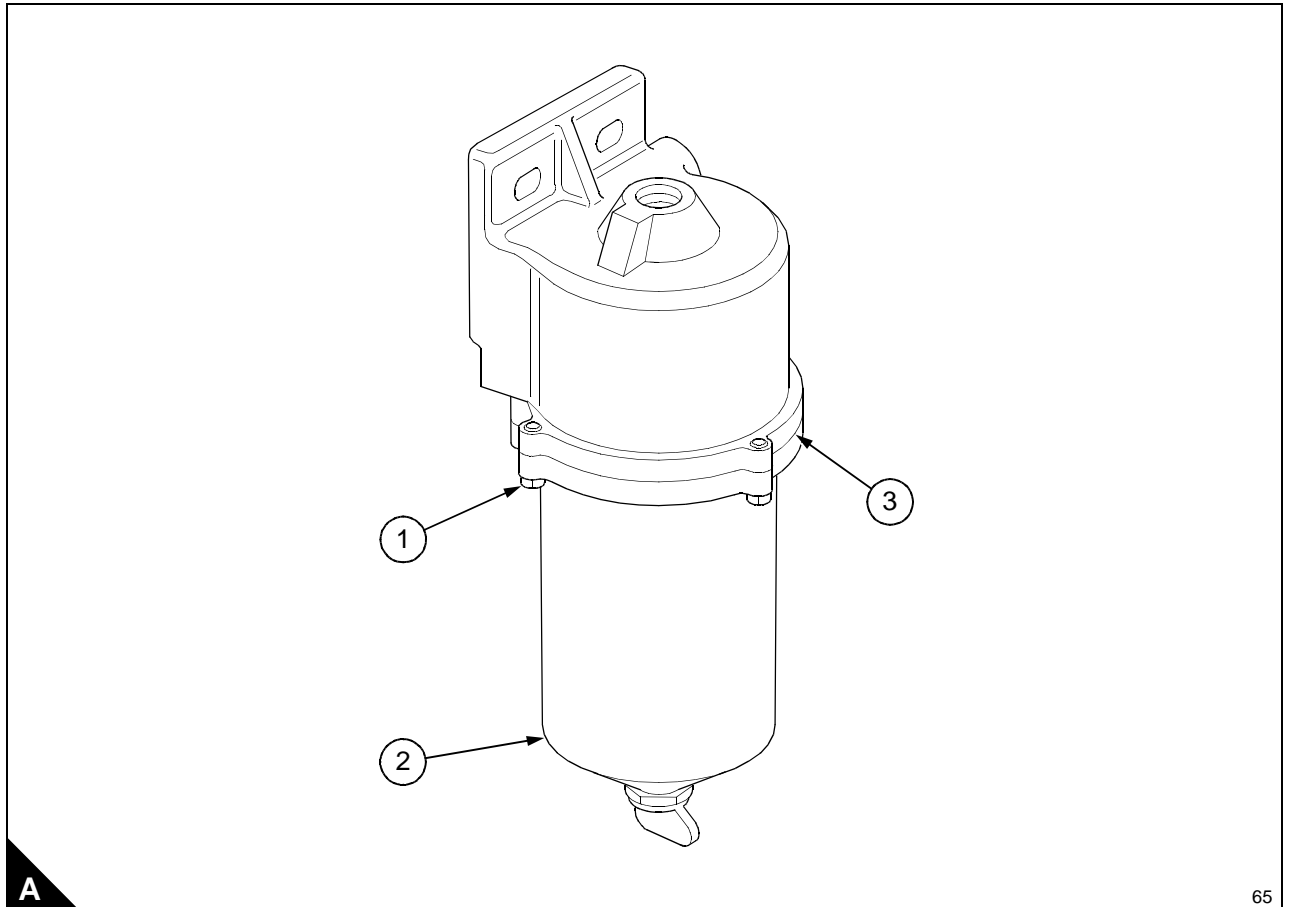
- 1 Clean the area around the by-pass filter. Remove the filter bowl (A2), remove and discard the rotor (A3).
- 2 Remove the seal (A4) from the filter bowl, clean the seal recess in the filter bowl and the contact face for the seal on the housing.
- 3 Fit a new seal over the seal face of the housing and lubricate the face of the seal with clean engine lubricating oil.
- 4 Fit a new rotor to the spindle and ensure that it can rotate freely. Fit the filter bowl and tighten the nut (A1) to a torque of 20 Nm (15 lbf ft).
- 5 Operate the engine and check for leakage from the by-pass filter.



How to clean the primary fuel filter

- 1 Remove the three bolts (A1) and remove the filter bowl (A2).
- 2 Clean all of the components with paraffin and dry them with a compressed air jet.
- 3 Fit the bowl to the filter head, together with a new sealing ring. Align the clamp ring (A3) and fasten it with the three bolts.

Early engines can be fitted with filters that have elements which can be cleaned. These elements should be removed, cleaned with fuel oil and dried with a compressed air jet.



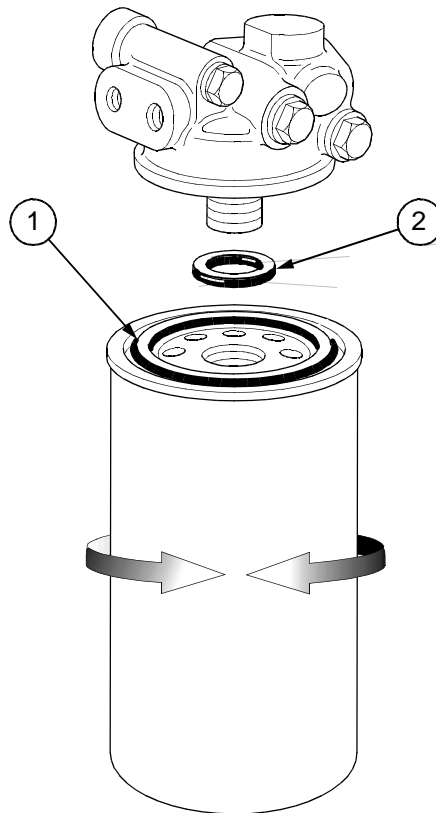
How to renew the canister of the main fuel filter

The main fuel filter is at the front of the engine on the 'A' bank side. For current engines, the fuel filter is fitted to the 'A' bank induction manifold.

- 1 Clean the area around the filter and remove the fuel filter canister. If necessary, use a strap wrench. Discard the canister.
- 2 Check that the sealing ring (A1) is fitted correctly to the new canister and clean the contact face of the filter head.
- 3 Lubricate the top of the canister seal (A1) with clean fuel oil and renew the sealing ring (A2) on the adaptor.
- 4 To install the new canister use this procedure: Tighten the canister on its adaptor, until the sealing ring is in contact with the face of the filter head, then turn the canister a further $1\frac{1}{4}$ turns by hand or to a torque of 20 Nm (15 lbf ft).

Caution: Do not overtighten.

After the fuel filter canister has been renewed, turn on the fuel supply. Eliminate air from the low pressure fuel system as given in "How to eliminate air from the fuel system" on page 34.

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How to check/adjust the timing of the fuel injection pump

If it becomes necessary to check and adjust the timing of the fuel injection pump, the procedure that follows is recommended:

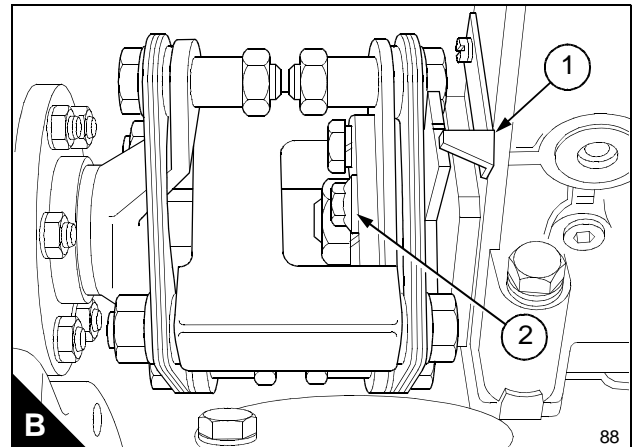
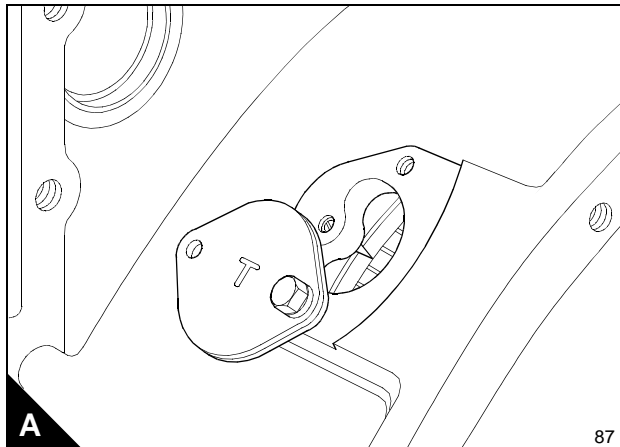
1 Fasten the stop lever in the "STOP" position. Remove the high pressure fuel pipes and the rocker cover from the cylinder head of 'B' bank and remove the timing pointer cover from the flywheel housing (A). Turn the engine by hand, in the normal direction of rotation, until the relevant number for injection timing aligns with the pointer (see the engine data plate) with the valves on 'B1' cylinder closed ('B1' piston at TDC on its compression stroke).

Check that the timing mark on the fuel injection pump hub aligns with the pointer (B1).

2 If the timing mark on the hub does not align with the pointer, check that the drive shaft of the fuel injection pump and the couplings are secure and are not damaged, then proceed as follows:

Set the flywheel timing as stamped on the engine data plate and loosen the bolts (B2) which fasten the drive coupling to the hub of the injection pump. Turn the hub in the normal direction of rotation, by hand, to just past the timing position, then carefully turn the hub back until the timing mark and the pointer align; tighten the bolts.

Turn the engine in reverse direction for a quarter of a revolution and then forward, in the normal direction of rotation, until the flywheel timing pointer is again aligned with the correct timing point (stamped on the engine data plate). Check that the timing marks of the fuel injection pump are correctly aligned.



Fuel injector fault

A fuel injector fault can cause an engine misfire.

In order to find which injector is defective, operate the engine at a fast idle speed. Loosen and tighten the union nut of the high-pressure fuel pipe at each injector. When the union nut of the defective injector is loosened, it has little or no effect on the engine speed.

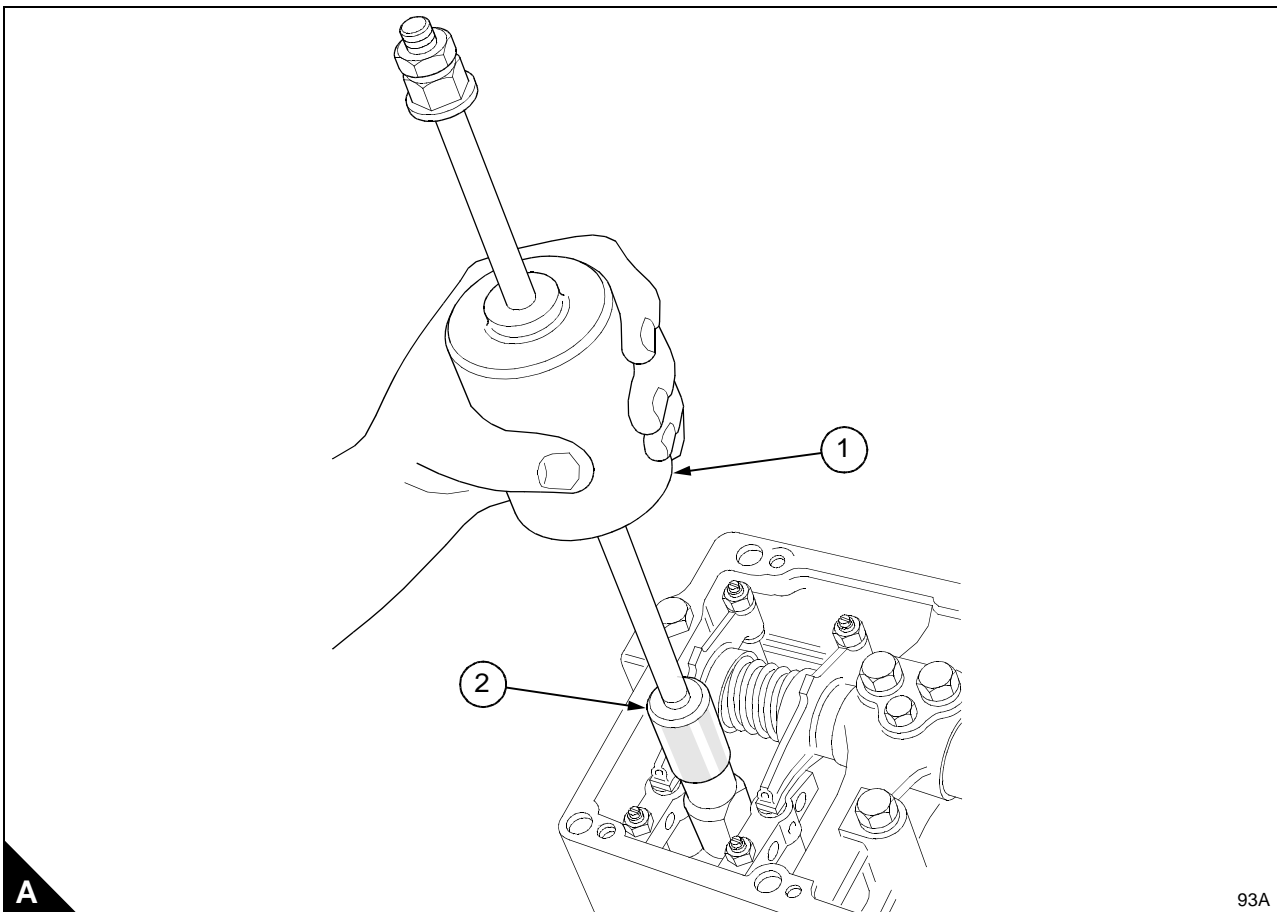
Warning! Ensure that the fuel does not spray onto your skin.

How to remove the fuel injectors

1 Disconnect and remove the high-pressure pipes and the spill pipes. Remove the relevant pedestal rocker cover. For early engines, remove the spill connection.

2 Release the relevant clamp and withdraw the fuel injector. To remove a tight fuel injector, use the Slide Hammer, 21825 849 (A1) and the relevant Adaptor (A2): 21825 854 for M18 threads or 21825 860 for M14 threads.

Caution: Ensure that the copper fuel injector sleeve is not loosened in the cylinder head during the use of the slide hammer.



How to correct the fuel injector sleeves

To improve the condition of the injector sleeves, use the Reamer/facer tool for the injector sleeve. Grease must be applied to both of the cutters before use, to retain carbon and metal particles. Do not remove more metal than is absolutely necessary to correct the seat face. The maximum permissible depth of the seat face, measured from the top face of the cylinder head, is 104,25 mm (4.104 in).

Note: The Reamer/facer tool is assembled from these tools: 21825 765, 21825 767 and 21825 768.

How to fit the fuel injectors

- 1 Check that the new injector is fitted with a new 'O' ring seal in the machined groove near to the top of the stem.
- 2 Fit the injector. DO NOT use a sealing washer between the injector and the seating face of the injector sleeve. If relevant, fit the spill connection, use a new copper sealing washer and new outer rubber seal. Tighten the spill connection to a torque load of 27 Nm (20 lbf ft). Fit the injector clamp and tighten the socket cap screw to 60 Nm (44 lbf ft).
- 3 Clean the joint faces of the rocker cover and fit the cover, complete with a new gasket. Tighten the cover bolts evenly and gradually to 21 Nm (15 lbf ft).
- 4 Fit the high pressure fuel pipes, tighten the nuts to a torque of 25 Nm (18 lbf ft) for engines which are fitted with the S3000 fuel injection pump and to a torque of 45 Nm (33 lbf ft) for engines which are fitted with the S7100 fuel injection pump.
- 5 Fit the spill pipes, complete with new copper sealing washers, and eliminate air from the high pressure system as given in "How to eliminate air from the fuel system" on page 34.
- 6 Run the engine and check for leaks.

How to eliminate air from the fuel system

If air enters the fuel system, the injection pump pressure may become insufficient to operate the injector valves and the engine may stop, misfire or fail to start.

To eliminate air from the system, use the relevant procedure which follows:

Low pressure system

- 1 Loosen the banjo bolt (A1), at the low pressure relief valve, by one or two turns and operate the priming plunger (B1) of the fuel lift pump. When fuel, free from air, flows from the relief valve, tighten the banjo bolt.
- 2 Clean away fuel that has been spilled.

High pressure system

Air in the high pressure system must be released at the injectors.

- 1 Move the stop control to the RUN position and use the starter to turn the engine. Loosen the nut of the high pressure fuel pipe at one of the injectors. When fuel, free from air, is released, tighten the nut.

Caution: Do not overtighten.

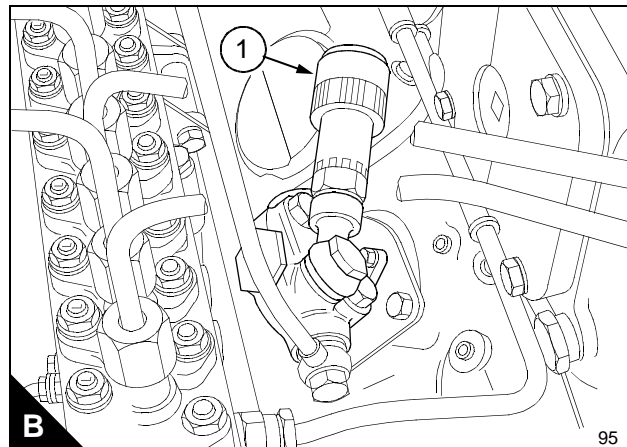
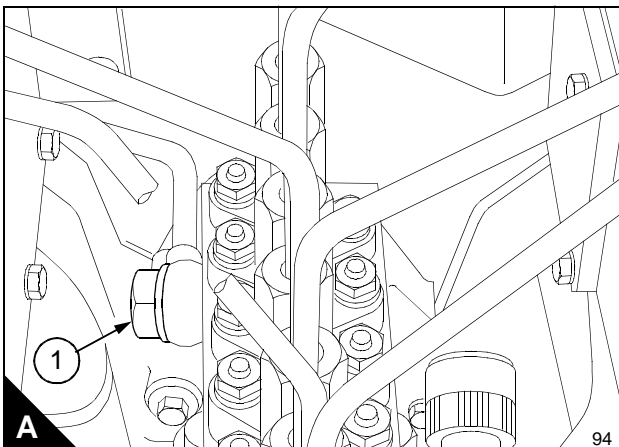
- 2 Repeat the procedure at the remaining injectors.

Warning! Ensure that fuel does not spray onto your skin.

- 3 If the engine starts during this operation but runs erratically, continue to eliminate air from each injector until the high pressure system is free from air or until the engine runs correctly.

- 4 Return the stop control to the STOP position.

- 5 Clean away any fuel that has been spilled.



How to check the tappet clearances

The tappet clearance is measured between the rocker levers and the top of the valve bridge pieces. See "Engine data" on page 9 for the size of the clearances.

Each valve bridge piece controls two valves. An adjustment screw and lock nut is fitted to each bridge piece to ensure that equal force is applied to both valves from the rocker arm.

Before the tappet clearances are adjusted, the valve bridge pieces **MUST** be checked and adjusted if necessary.

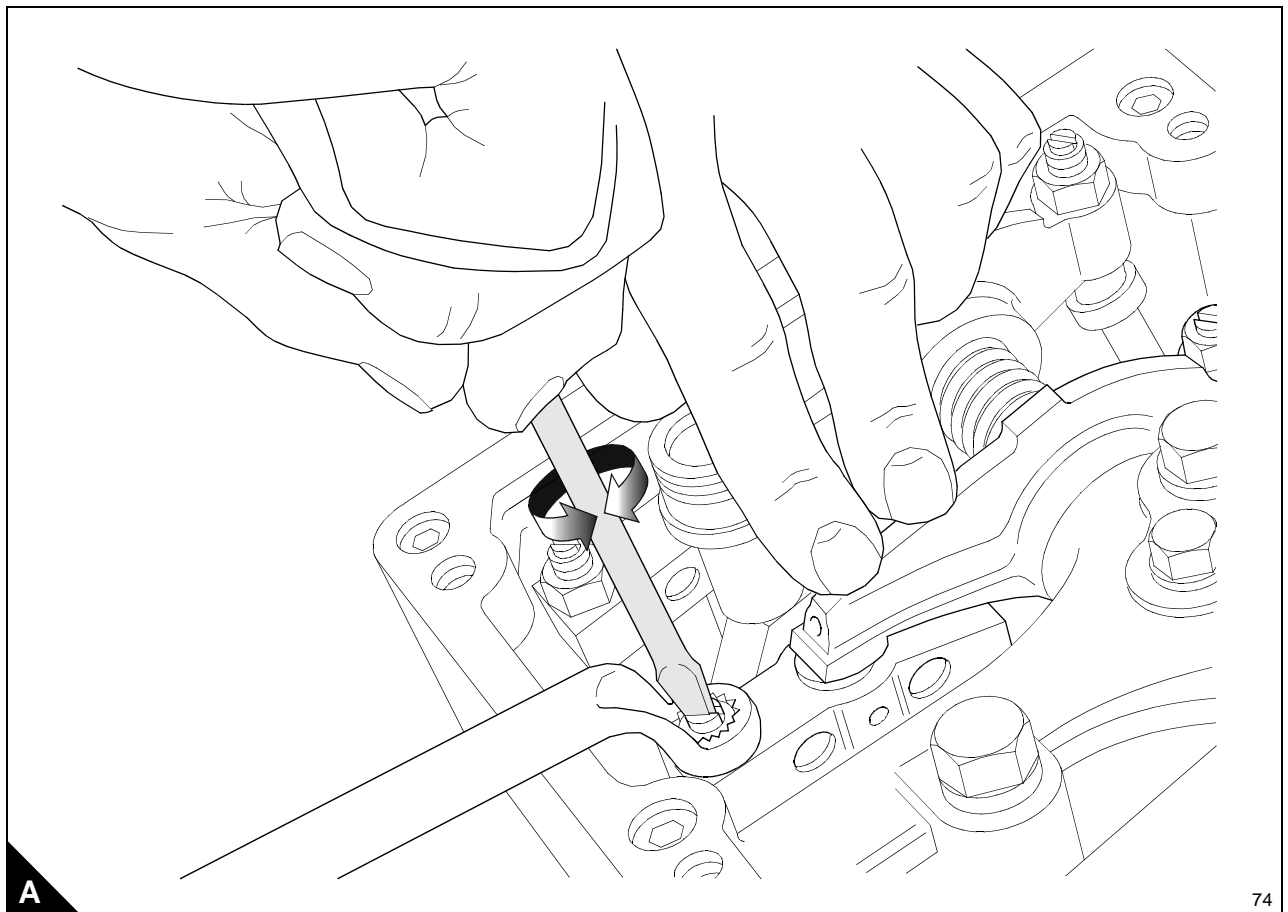
Check and adjust the valve bridge pieces and tappet clearances while the fuel injectors are removed for service.

Caution: Numbers A1 and B1 cylinders are at the front (fan end) of the engine.

- 1 Remove the air filters, the high pressure fuel pipes and the fuel injector leak-off pipes.
- 2 Remove the rocker covers.
- 3 Turn the crankshaft in the normal direction of rotation until the inlet valve of number A1 cylinder has just opened and the exhaust valve of the same cylinder has not closed completely.

Check the valve bridge pieces of number B3 cylinder and adjust them as follows:

Loosen the lock nut and the adjustment screw on the relevant bridge piece. Use the rocker lever to apply pressure to the bridge piece, then turn the adjustment screw until it is just in contact with the tip of the valve stem (A). Hold the adjustment screw in this position with a screwdriver and tighten the lock nut to a torque of 40 Nm (30 lbf ft). Use a torque wrench with a ring spanner adaptor. Note that the reading on the torque wrench must be adjusted to compensate for the extra length caused by the ring spanner adaptor.



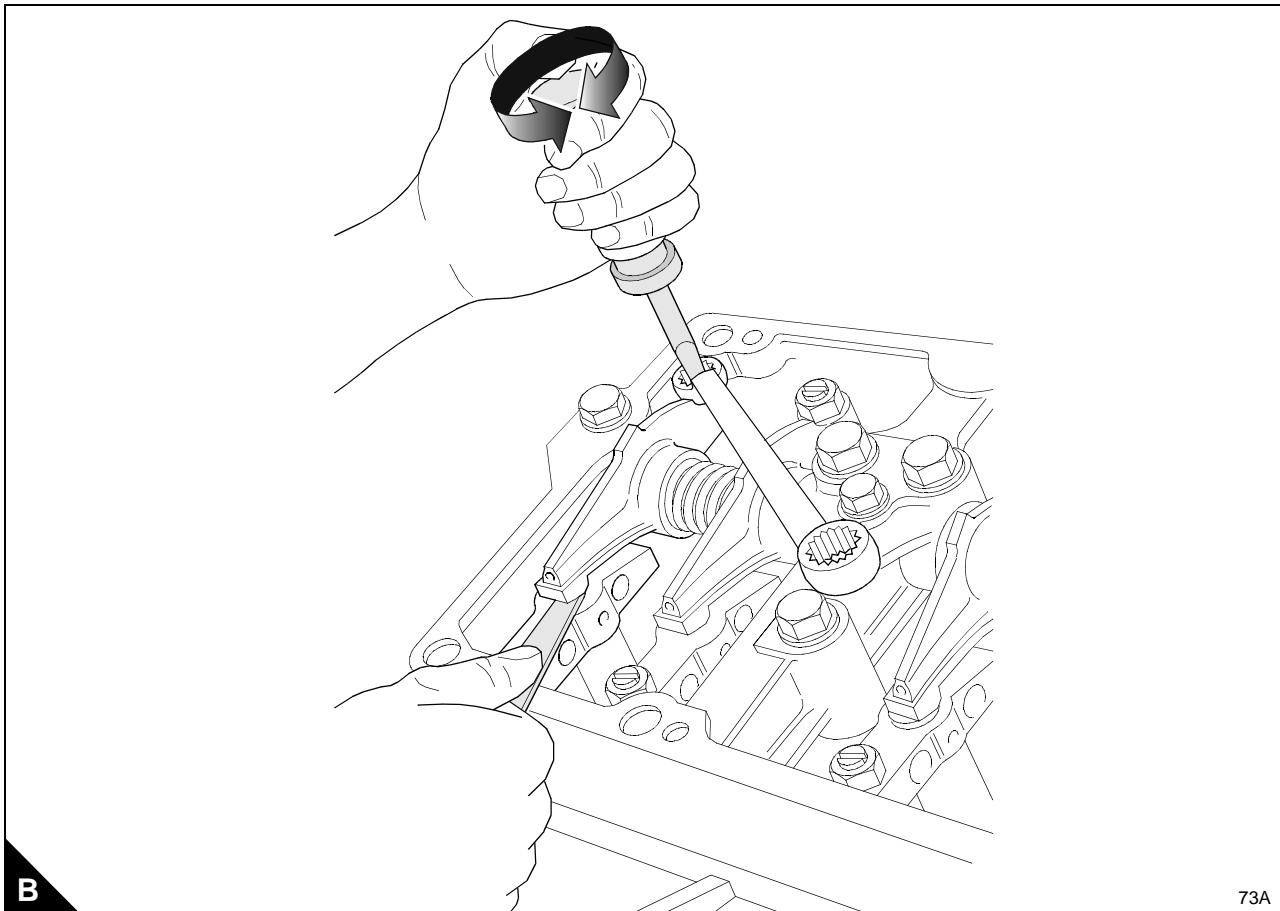
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Check the tappet clearance AFTER the bridge pieces have been adjusted. When the clearance has been set (B), tighten the lock nut to a torque of 40 Nm (30 lbf ft).

4 Set the valves of number B1 cylinder, as indicated above for number A1 cylinder, and check/adjust the bridge pieces and tappet clearances of the valves for A2 cylinder. Continue to check/adjust the valve bridge pieces and tappet clearances which remain. Use the sequence below.

5 When all of the bridge pieces and tappet clearances have been checked/adjusted, apply oil to the rocker levers, the bridge pieces and valve springs. Fit the rocker covers, the fuel pipes and the air filters.

Valves set of cylinder No	Check/adjust cylinder No
A1	B3
B1	A2
B2	A4
A3	B4
B3	A1
A2	B1
A4	B2
B4	A3



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Turbochargers

At the periods given in the service schedule, disconnect and remove the pipes from between the air filters and the turbochargers. Turn, rapidly, the rotor assembly of each turbocharger, check for freedom of movement and for sounds of interference.

Deposits must not be removed from the turbine wheels nor the compressor wheels or the balance of the assemblies will be adversely affected.

Alternator

At the periods specified in the service schedule clean the outside of the alternator and ensure that the ventilation holes are clean. Contamination near to the diodes can cause sparks and must be removed with an approved cleaning fluid. A recommended fluid is Electronic Cleaning Fluid, Grade 8-23, available in aerosol containers or in larger quantities from Applied Chemicals Limited, Uxbridge, Middlesex.

The alternator must be checked and corrected, if necessary, by a person who has had the correct training, at the periods given in the service schedule.

How to drain the coolant system

Drain and flush the coolant system every 12 months or less.

The system must be drained as soon as possible after the engine is stopped and before any deposits in the coolant have fallen to the bottom.

- 1 Ensure that the engine is level.
- 2 Carefully remove the header tank filler cap, especially if the engine is hot.

Warning! Take care during removal of the filler cap as the coolant system will be under pressure.

- 3 Remove the coolant drain plugs from the front left side and the rear right side of the engine, and remove the radiator drain plug. The radiator drain plug is fitted to the bottom pipe between the radiator and the engine. Ensure that the drain holes are not restricted.
- 4 Flush the system with clean water.
- 5 Fit the engine and radiator drain plugs.
- 6 Fit a 'coolant drained' label if the coolant system is not to be filled immediately.

How to clean the coolant system

The coolant system must be drained and flushed through with clean water until it flows clear from all of the drain taps.

If the system has become contaminated, it must be cleaned. Use clean water with 1% of Symperonic 'N'. This is equivalent to 10ml/litre or 45 ml/UK gallon.

- 1 Fill the system with clean water, at the same time add the necessary amount of Symperonic 'N' at the filler cap.
- 2 Operate the engine until the coolant reaches the normal temperature of operation, then operate the engine at maximum rated speed for 10 minutes.

Caution: *In very cold ambient conditions, the thermostat may not open to allow full circulation of the cleaning fluid. If this occurs the engine must be operated on load. The thermostat is open when the pipe between the thermostat housing and the radiator is hot. If the pipe is cool, the thermostat valve is closed.*

- 3 Stop the engine and drain immediately the coolant from all of the drain taps or plugs.

Warning! *Take care during removal of the filler cap as the coolant system will be under pressure.*

- 4 Allow the engine to cool, then fill the system with clean water. Allow a minimum of 5 litres (1 UK gallon) to drain from the system before the drain taps are closed.

- 5 Operate the engine as in step 2, but maintain maximum speed for 5 minutes only.

- 6 Repeat steps 3, 4 and 5.

- 7 Drain the system completely and close the drain taps. Fill the system with the correct coolant mixture.

How to fill the coolant system

Fill the system slowly, with the approved coolant mixture, until the coolant is just in contact with the bottom of the filler extension tube in the radiator. Operate the engine until the coolant reaches the normal temperature of operation. Stop the engine, check the coolant level and, if necessary, add extra coolant.

Warning! *Take care during removal of the filler cap as the coolant system will be under pressure.*

5

Engine fluids

Diesel fuel

Diesel fuel must conform to the specifications given below:

On highway

BS EN 590 1997 - maximum sulphur content 0.05%; minimum cetane number 49 and minimum cetane index 46.

Low sulphur fuels must conform to a lubricity performance such that when tested using HFRR (CEC F-06-A96) the wear scar meets a maximum of 460 microns.

Off highway

BS 2869: Part 2 1998 Class A2 - maximum sulphur content 0.20%; minimum cetane number 45 and minimum cetane index 45.

The use of fuels which do not conform to the above standards can cause damage and/or reduced engine life and could affect the warranty. Further details can be obtained from the Service Department at Perkins Engines Company Limited, Shrewsbury.

Coolant

Coolant mixture

The coolant approved for use in all diesel engines manufactured by PE(S)L is a mixture of 50% inhibited ethylene glycol, **or** inhibited propylene glycol, and 50% clean soft water.

Mixtures which contain methanol are **NOT** approved.

The corrosion inhibitor in the anti-freeze or coolant concentrate, must be based on sodium nitrite, sodium benzoate, sodium borate, sodium metasilicate and benzotriazole.

Amines or phosphates must not be used. If operators are in doubt, they should consult their source of supply.

In addition, all products which are used should conform to BS 6580-1992.

For marine engines and engines which have aluminium water-cooled exhaust manifolds, only 'BASF 007/400F' or Perkins anti-freeze are approved. The Perkins anti-freeze, part numbers 21825 166 (1 litre) and 21825 167 (5 litre), can be obtained from the Perkins worldwide distributor network.

Caution: Do NOT use salt water or any other coolant which can cause corrosion in the closed coolant circuit.

Corrosion inhibitor

If anti-freeze is not available and is not required then clean soft water, with 1% of PE(S)L corrosion inhibitor, may be used. This ratio is equivalent to 0,5 litres of corrosion inhibitor to 50 litres (11 UK gallons) of water. The corrosion inhibitor is available from the Perkins worldwide distributor network, part number 21825 735 (1 litre). The use of this product should be controlled in accordance with the manufacturer's instructions. For CHP (combined heat and power) sets an alternative inhibitor, part number OE45765, is recommended at a strength of 3%.

Continued

Water quality

Soft water means de-ionised water, distilled water, rain water, or water from a mains supply which has a maximum combined chloride and sulphate level of 150 mg/litre and a maximum total hardness of 250 mg/litre.

- 1 If soft water is not used, the cooling system may be affected by the formation of hard deposits which can cause the engine to overheat. This is especially important for engines which have coolant added frequently.
- 2 The use of products which are not approved for the cooling system may cause serious problems. Coolant mixtures with insufficient corrosion inhibitor can cause erosion and/or corrosion of the cooling system components.

Lubricating oil

1 Viscosity - Perkins Engines Company Limited recommend the use of SAE15W/40 for all engines that work in ambient temperatures above -15 °C (5 °F). Below -15 °C (5 °F) and down to -20 °C (-4 °F) the use of a 10W/30 oil is recommended. Down to -30 °C (-22 °F) a 5W/40 fully synthetic oil is recommended. For engines which operate in arctic conditions, below -30 °C (-22 °F), contact the Service Department at Perkins Engines Company Limited, Shrewsbury.

2 Performance Specification - For heavy duty operation, base load, or extended drain (Eagle Tx only), super high performance oils (SHPD) must be used. These oils exceed the requirements of ACEA E3 and are listed in the 'preferred' columns of the tables on the following pages.

For light duty operation, oils which exceed the requirements ACEA E2 may be used. These oils are listed in the 'acceptable' columns of the tables on the following pages.

It is recommended that the operator uses oils shown in the 'preferred' columns as these give the greatest protection.

Recommended oils for Europe

Below is a list of oils recommended by Perkins Engines Company Limited, Shrewsbury. The operator must ensure that the oil used conforms to the above requirements.

Manufacturer of lubricating oil	Preferred multi-grade oils which conform to ACEA E3	Acceptable multi-grade oils which conform to ACEA E2
AGIP	Sigma Turbo 15W/40 Blitum T 15W/40	Universal Multifleet 15W/40 Master Super Turbo SHPD 15W/40
BP	Vanellus C3 Extra 15W/40 Vanellus FE Extra 10W/40 Vanellus HT 10W/40 Vanellus HT Extra 10W/40	Vanellus C3 Multi-grade 15W/40
CALTEX	ONLY AVAILABLE IN FAR EAST, MIDDLE EAST, SOUTHERN AND EASTERN AFRICA AND AUSTRALASIA	
CASTROL	Syntruck 5W/40 Dynamax 10W/40 Turbomax 15W/40	RX Super Plus 15W/40
CHEVRON	Delo XLD 15W/40 Delo SHP 15W/40	Delo 500 15W/40
ELF	Performance EXPERTY 10W/40 Performance TROPHY DX 15W/40	Performance Super D 15W/40 Performance 3D 15W/40
ESSO	Essolube XTS 501 Essolube XT 401	Essolube XTS 301 Essolube XT 301
FINA	Kappa First 5W/30 Kappa Extra 15W/40 Kappa Ultra 10W/40	Kappa Supra 15W/40
FUCHS	Turbolene HPE 15W/40 Titan Unic Plus 10W/40 Titan Cargo MC 10W/40	Titan Formel Plus 15W/40 Turbolene D 15W/40 Turbolene D Plus 15W/40
KUWAIT	Q8T 700 15W/40 Q8T 710 15W/40 Q8T 800 10W/40	Q8T 500 15W/40
MILLERS	Multifleet XPD 15W/40 Truckmaster Global XD 15W/40 Truckmaster XHFE 10W/40	Maxifleet MP 15W/40 Suprex 15W/40
MOBIL	Delvac 1 SHC 5W/40 Delvac XHP 15W/40 Delvac HP 15W/40	Delvac MX 15W/40
MORRIS	XHD Plus 15W/40 XHD FE 10W/40 Ring Free Ultra 10W/40	Duplex CDX 15W/40 XHD 15W/40
SHELL	Rimula Ultra 5W/30 Rimula Super 15W/40	Rimula X 15W/40 Rimula TX 15W/40
SUN	Super HPD 15W/40	Forza 15W/40
TEXACO	URSA Super TDX 10W/40 URSA Super TD 15W/40	URSA Super LA 15W/40
TOTAL	Rubia TIR 8600 10W/40 Rubia TIR 6400 15W/40	Rubia 4400 15W/40 Rubia XT 15W/40

Recommended oils for remainder of the world

Below is a list of oils recommended by Perkins Engines Company Limited, Shrewsbury. The operator must ensure that the oil used conforms to the above requirements.

Manufacturer of lubricating oil	Mono-grade oils which conform to ACEA E2	Preferred multi-grade oils which conform to ACEA E3	Acceptable multi-grade oils which conform to ACEA E2
AGIP		Sigma Turbo 15W/40 Blitum T 15W/40	Universal Multifleet 15W/40 Master Super Turbo SHPD 15W/40
BP	Vanellus C3 30 Vanellus C3 40	Vanellus C3 Extra 15W/40 Vanellus FE Extra 10W/30	Vanellus C3 multi-grade 15W/40
CALTEX	Delo SHP SAE 30 and SAE 40 Delo 600 SAE 30 and SAE 40 Delo 350 SAE 30 and SAE 40	Delo XLD multi-grade SAE 10W/40	Delo SHP multi-grade SAE 15W/40 Delo 600 multi-grade SAE 15W/40 Delo 350 multi-grade SAE 15W/40
CASTROL		Syntruck 5W/40 Dynamax 10W/40 Turbomax 15W/40	RX Super Plus 15W/40
CHEVRON	Delo 1000 Marine SAE 30 or 40	Delo 400 multi-grade SAE 15W/40	RPM Heavy Duty Motor oil 15W/40
ELF	Performance Super D SAE 30 and 40 Performance 3D SAE 30 and 40	Performance TROPHY DX 15W/40	Performance Super D 15W/40 Performance 3D 15W/40
ESSO	Essolube X 301 SAE 30 Essolube X 301 SAE 40 Essolube XD 3+ SAE 30 Essolube XD 3+ SAE 40	Essolube XT 431 Essolube XD 3 Extra+	Essolube XT 331 Essolube XD 3+
FINA	Kappa Super 30 Kappa Super 40	Kappa First 5W/30 Kappa Extra 15W/40 Kappa Ultra 10W/40	Kappa Supra 15W/40
KUWAIT	Q8T 500 SAE 30 Q8T 500 SAE 40	Q8T 700 15W/40 Q8T 710 15W/40 Q8T 800 10W/40	Q8T 500 15W/40
MOBIL	Delvac 1430 Delvac 1330	Delvac 1 SHC 5W/40 Delvac XHP 15W/40 Delvac HP 15W/40	Delvac MX 15W/40
MORRIS	XHD SAE 30 or 40	XHD Plus 15W/40 XHD FE 10W/40	Duplex CDX 15W/40 XHD 15W/40
SHELL	Rimula X 30 Rimula X 40	Rimula Ultra 5W/30 Rimula Super 15W/40	Rimula X 15W/40 Rotella TX 15W/40
SUN	Super HPD 40	Super HPD 15W/40	Forza 15W/40
TEXACO	URSA Super LA 30 URSA Super LA 40	URSA Super TDX 10W/40 URSA Super TD 15W/40	URSA Super LA 15W/40
TOTAL	Rubia FP 40	Rubia TIR 8600 15W/40 Rubia TIR 6400 15W/40	Rubia 4400 15W/40 Rubia XT 15W/40

Warranty

The engine must be operated with the approved fuel, lubricant and coolant, and maintained in accordance with the service schedule or the warranty can become invalid.

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Fault diagnosis

Problems and possible causes

Problem	Possible causes	
	Checks by the user	Checks by service personnel
The starter motor turns the engine too slowly	1, 2, 3, 4	
The engine will not start	5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 17	34, 35, 36, 37, 38, 42, 43, 44
The engine is difficult to start	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19	34, 36, 37, 38, 40, 42, 43, 44, 64
Not enough power	8, 9, 10, 11, 12, 13, 16, 17, 18, 19, 20, 21	34, 36, 37, 38, 39, 42, 43, 44, 61, 63, 64
Misfire	8, 9, 10, 12, 13, 15, 20, 22	34, 36, 37, 38, 39, 40, 41, 43
High fuel consumption	11, 13, 15, 17, 18, 19, 21, 22	34, 36, 37, 38, 39, 40, 42, 43, 44, 63, 64
Black exhaust smoke	11, 13, 15, 17, 19, 21, 22	34, 36, 37, 38, 39, 40, 42, 43, 44, 61, 63, 64
Blue or white exhaust smoke	4, 15, 21, 23	36, 37, 38, 39, 42, 44, 45, 52, 58, 62
The pressure of the lubricating oil is too low	4, 24, 25, 26	46, 47, 48, 50, 51, 59
The engine knocks	9, 13, 15, 17, 20, 22, 23	36, 37, 40, 42, 44, 46, 52, 53, 60
The engine runs erratically	7, 8, 9, 10, 11, 12, 13, 15, 16, 18, 20, 22, 23	34, 38, 40, 41, 44, 52, 60
Vibration	13, 18, 20, 27, 28	34, 38, 39, 40, 41, 44, 52, 54
The pressure of the lubricating oil is too high	4, 25	49
The engine temperature is too high	11, 13, 15, 19, 27, 29, 30, 32	34, 36, 37, 39, 52, 55, 56, 57
Crankcase pressure	31, 33	39, 42, 44, 45, 52
Bad compression	11, 22	37, 39, 40, 42, 43, 44, 45, 53, 60
The engine starts and stops	10, 11, 12	6, 7, 8, 9, 10, 12, 16, 34, 35

Code list of possible causes

- 1 The battery capacity is low.
- 2 A bad electrical connection.
- 3 A fault in the starter motor.
- 4 The wrong grade of lubricating oil.
- 5 The starter motor turns the engine too slowly.
- 6 The fuel tank is empty.
- 7 A fault in the stop control.
- 8 A restriction in a fuel pipe.
- 9 A fault in the fuel lift pump.
- 10 A dirty element of the fuel filter.
- 11 A restriction in the air filter or the induction system.
- 12 There is air in the fuel system.
- 13 A fault in the fuel injectors, or the fuel injectors are of the wrong type.
- 14 The cold start system is not used correctly.
- 15 A fault in the cold start system.
- 16 A restriction in the vent of the fuel tank.
- 17 The wrong type or grade of fuel has been used.
- 18 A restriction in the movement of the engine speed control.
- 19 A restriction in the exhaust pipe.
- 20 The engine temperature is too high.
- 21 The engine temperature is too low.
- 22 The tappet clearances are incorrect.
- 23 Too much oil, or oil of a wrong specification is used in a wet type air cleaner.
- 24 Not enough lubricating oil in the sump.
- 25 A defective gauge.
- 26 A dirty element of the lubricating oil filter.
- 27 The fan is damaged.
- 28 A fault in the mountings of the engine or the flywheel housing.
- 29 Too much lubricating oil in the sump.
- 30 A restriction in the air passages or in the water passages of the radiator.
- 31 A restriction in the breather.
- 32 There is insufficient coolant in the system.
- 33 A fault in the exhauster, or there is a leakage in the vacuum pipe.
- 34 A fault in the fuel injection pump.
- 35 A broken drive on the fuel injection pump.
- 36 The timing of the fuel injection pump is incorrect.
- 37 The valve timing is incorrect.
- 38 There is bad compression.
- 39 The cylinder head gasket leaks.
- 40 The valves are not free.
- 41 Wrong high-pressure pipes.
- 42 The cylinder bores are worn.
- 43 A leakage between the valves and the seats.
- 44 The piston rings are not free, or they are worn or damaged.
- 45 The valve stems and/or the guides are worn.
- 46 The crankshaft bearings are worn or damaged.

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- 47 The lubricating oil pump is worn.
 - 48 The relief valve does not close.
 - 49 The relief valve does not open.
 - 50 The spring of the relief valve is broken.
 - 51 A fault in the suction pipe of the lubricating oil pump.
 - 52 A piston is damaged.
 - 53 The piston height is incorrect.
 - 54 The flywheel housing, or the flywheel, is not aligned correctly.
 - 55 A fault in the thermostat or the thermostat is of a wrong type.
 - 56 A restriction in the coolant passages.
 - 57 A fault in the water pump.
 - 58 There is damage to the oil seals (if they are fitted) of the valve stems.
 - 59 A restriction in the sump strainer.
 - 60 A valve spring is broken.
 - 61 The impeller of the turbocharger is damaged or is dirty.
 - 62 Leakage of lubricating oil from the oil seal of the turbocharger.
 - 63 The induction system leaks (turbocharged engines).
 - 64 Damaged or defective waste-gate (if fitted).

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