Perkins 3000 Series

Model 3008SI

USER'S HANDBOOK

8 cylinder spark ignited engines for industrial applications

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1 General information

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3 Operation instructions

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6 Fault diagnosis

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General information

Introduction

The new range of Industrial engines are the latest development from Perkins Engines (Shrewsbury) Limited, a world leader in the design and manufacture of high performance engines.

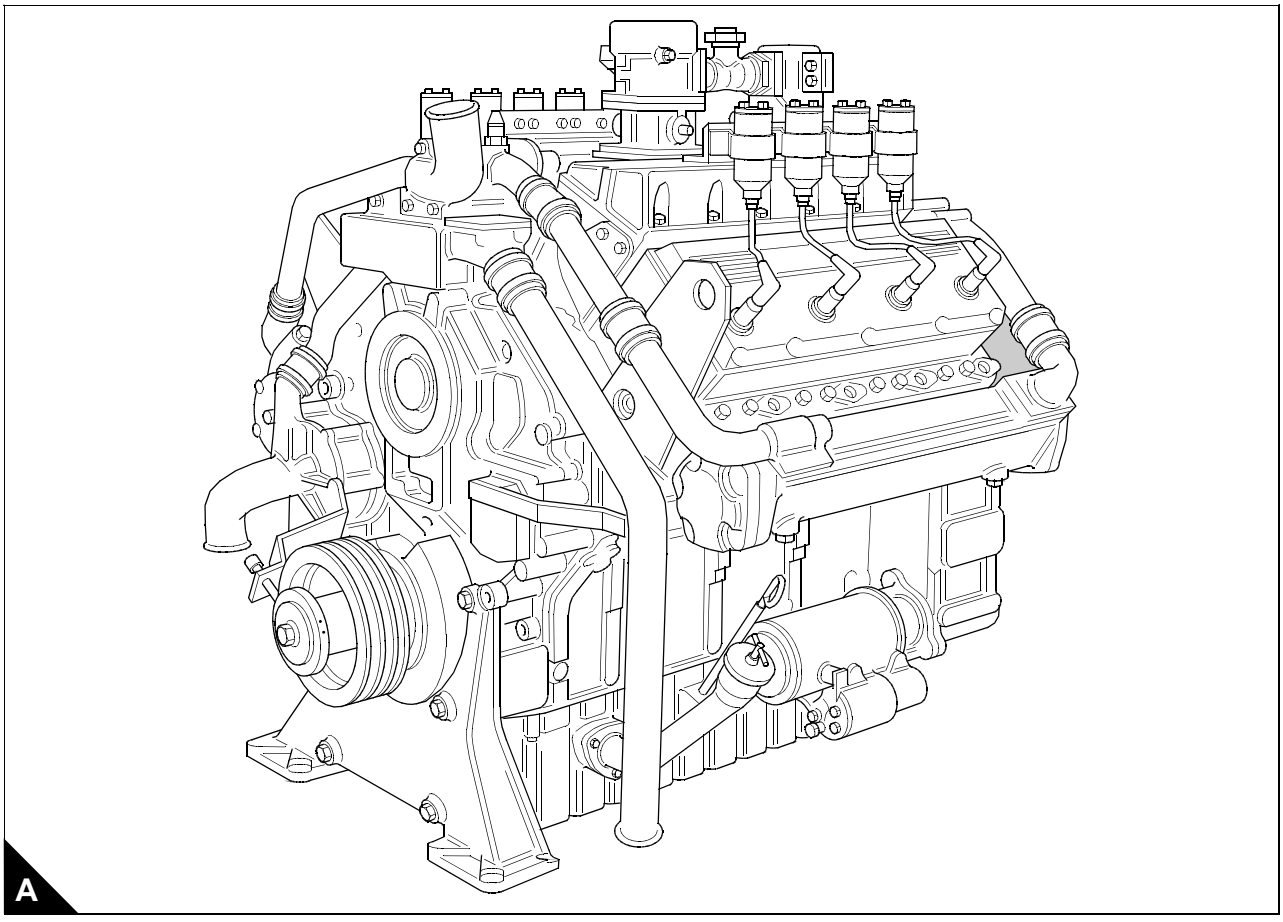
More than fifty years of engine production experience, together with the use of the latest technology, have been used in the manufacture of your engine to give you reliable and economic power.

To ensure that you use the correct information for your specific engine type, refer to "Engine identification" on page 5.

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

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

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



A

Safety precautions

These safety precautions are important.

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

- Do not use salt water or any other coolant which can cause corrosion in the cooling system.
- Do not change the specification of the engine. Do not allow sparks or fire near the batteries (especially when the batteries are on charge) as the gases from the electrolyte are highly flammable. The battery fluid is dangerous to the skin and especially to the eyes.
- Keep away from naked flames, hot exhaust pipes and sparks when working with gaseous fuels and when conducting fuel tests.
- Do not smoke when you are on or near the gas pipes or system.
- If the engine does not to start, check the gas detectors and if they are activated, vent immediately the engine room.
- Do not replenish the gas supply while the engine runs.
- Disconnect the battery terminals before you make a repair to the electrical system.
- Beware of electric shocks from the high tension current in the ignition system. Shocks from this system can propel limbs into moving machinery.
- Never clean, add lubricating oil to, or adjust the engine while it runs (unless you have had the correct training, when extreme caution must be used to prevent injury).
- Lubricating oil (particularly 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.
- Only one person must control the engine.
- Ensure that the engine is operated only from the control panel or from the operator’s position.
- Do not make any adjustments that you do not understand.
- Ensure that the engine is not in a position to cause a concentration of toxic emissions.
- Other people must be kept at a safe distance while the engine is operated.
- Do not permit loose clothing or long hair near parts which move.
- Keep away from parts which move during engine operation.

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

- Do not operate the engine if one or more of the safety guards have been removed.
- Do not remove the coolant caps while the engine is hot and while the coolant is under pressure, because dangerous hot coolant can be discharged.
- The combustable 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.
- Other people must be kept at a safe distance while the engine is operated.
- When the engine is stopped, ensure that the solenoid valves in the gas supply are closed.

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 indicated in Chapter 4, Preventive maintenance.

If the engine works in a very dusty environment or other adverse conditions, certain maintenance intervals will have to be reduced. Renew the filter canisters and lubricating oil regularly in order 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.

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 to the left when seen 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

All new or reconditioned engines leaving the factory have been treated with anti-corrosion inhibitors to Perkins standards. Each engine may be stored under cover, in dry conditions, for a period of up to 12 months from the date of despatch from the factory, without the need for further inhibition.

Should the storage period exceed 12 months, the engine must be thoroughly examined and re- inhibited. For further details contact Perkins Engines (Shrewsbury) Limited.

Parts and service

If a problem occurs 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.

Training

Training courses are available at the factory; for details apply to:

The Customer Training Centre
Perkins Engines (Shrewsbury) Limited
Lancaster Road
Shrewsbury SY1 3NX
England

Service Bulletins

Essential information available since the publication of this manual will be distributed in the form of a Perkins Service Bulletin.

Engine identification

The 3008 engine is a Vee 8 normally aspirated unit. It is supplied in various power ratings, depending on the application and the calorific value of the gas supply.

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: **4E27841U 71961W**, which consists of these codes:

4E	Engine family
27841	Engine number
U	Country of manufacture
71961	Build line number
W	Year of manufacture

Engines produced after August 1994, have a new engine number system. For these engines, a typical engine number is **SIA080131U96227B** which consists of these codes:

SI	Engine application
A	Engine type
08	Number of engine cylinders
0131	Engine specification number
U	Country of manufacture
96227	Build line number
B	Year of manufacture

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

Engine data

General

Type	Liquid cooled, four stroke 8 cylinder spark ignited engine
Cylinder arrangement	90° included angle 'V'
Bore	135 mm (5.315 in)
Stroke	152 mm (5.984 in)
Capacity	17,4 litres (1062 in^3)
Compression ratio	12:1 (Natural gas)
Rotation	Anti-clockwise, viewed on flywheel
Cylinder firing order	A1, B1, B2, A3, B3, A2, A4, B4
Cylinder numbering	From front (fan end) to rear (flywheel end)
Valve tappet clearance:	
Inlet	0,2 mm (0.008 in) cold
Exhaust	0,5 mm (0.020 in) cold
Engine weight	
Dry	1495 kg (3296 lbs)
Wet	1565 kg (3440 lbs)

Cooling system

Coolant capacity	43 litres (9.5 UK gallons), engine only, does not include radiator and associated pipework
System pressure cap setting	Maximum 69 kN/m2 (10 lbf/in^2) to suit installation
Operating temperature (at sea level)	Normal running 78 to 95 °C (172 to 203 °F)
Thermostat	Triple-element wax capsule type with radiator by-pass
Heat exchanger (Oil-to-coolant)	Single unit, baffled and finned tube pack
Coolant pump	Gear driven centrifugal type
Protection switch setting (where fitted)	
Warning	100 °C
Shutdown	106 °C

Fuel system

Gas supply pressure	1,00 to 4,90 kN/m^2 (100 to 500 mm H_2O at full rated flow)
Gas carburettor	Deltec 140 - 11
Zero pressure regulator	Diaphragm type
Governor (optional)	Electronic type

Ignition system

Ignition system type	Digital ignition system (D.I.S.) or Fairbanks Morse IQ250
Primary voltage (D.I.S.)	12 volts
Primary voltage (Fairbanks Morse)	24 volts
Polarity	Negative earth
Control unit (D.I.S.)	Microcircuit based dual firing system utilising the high energy capacitor discharge principle
Control unit (Fairbanks Morse)	Microcircuit based single firing system utilising the high energy capacitor discharge principle
Ignition coil	One per cylinder
Timing method (D.I.S.)	5 inch diameter disc with inserted magnets mounted on the front of the crankshaft or magnets inserted in the engine flywheel
Timing method (Fairbanks Morse)	Two pick-up system: a magnetic pick-up mounted in the flywheel housing counting flywheel gear teeth, and a reset pick-up mounted on the timing case sensing a reluctor pin on the camshaft
Timing sensor (D.I.S.)	'Hall effect' magnetic pick-up type
Timing sensor (Fairbanks Morse)	Magnetic pick-up in the flywheel housing and an active pick- up on the timing case triggered by a metallic reluctor pin
Spark plugs	Resistive long-reach type, RN79G
Spark plug gap	0,38 mm (0.015 in)
High tension leads (D.I.S.)	7 mm silicon insulated copper conductor
High tension leads (Fairbanks Morse)	8 mm silicon insulated copper conductor
Ignition harness	Supplied complete for pick-up sensor and primary wiring
Ignition timing	22° BTDC

Lubrication system

Type	Wet sump
Oil capacity	Total system 31,2 litres (6.9 UK gallons)
Sump maximum	25 litres (5.5 UK gallons)
Sump minimum	13,6 litres (3.0 UK gallons)
Oil pressure	413 kN/m2 (60 lbf/in^2) at rated speed
Oil filters	Two spin-on expendable canisters with integral by-pass valves operating in parallel
Oil pump	Spur gear type and gear driven by crankshaft
Pressure relief valve	Spring and plunger type housed in oil pump body (Non adjustable)
Protection switch setting	
Warning	172 kN/m^2 (25 lbf/in^2)
Shutdown	124 kN/m^2 (18 lbf/in^2)

Induction system

Air filter	305mm (12 in), 2 stage, dry type
Maximum air intake restriction	
Clean filter	255 mm (10 in H_2O)
Dirty filter	635 mm (25 in H_2O)

Electrical equipment

Type	Insulated return
Alternator	Belt driven, 32 amps and 28 volts
Starter motor	Butec LMS1A 24 volt

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2

Engine views

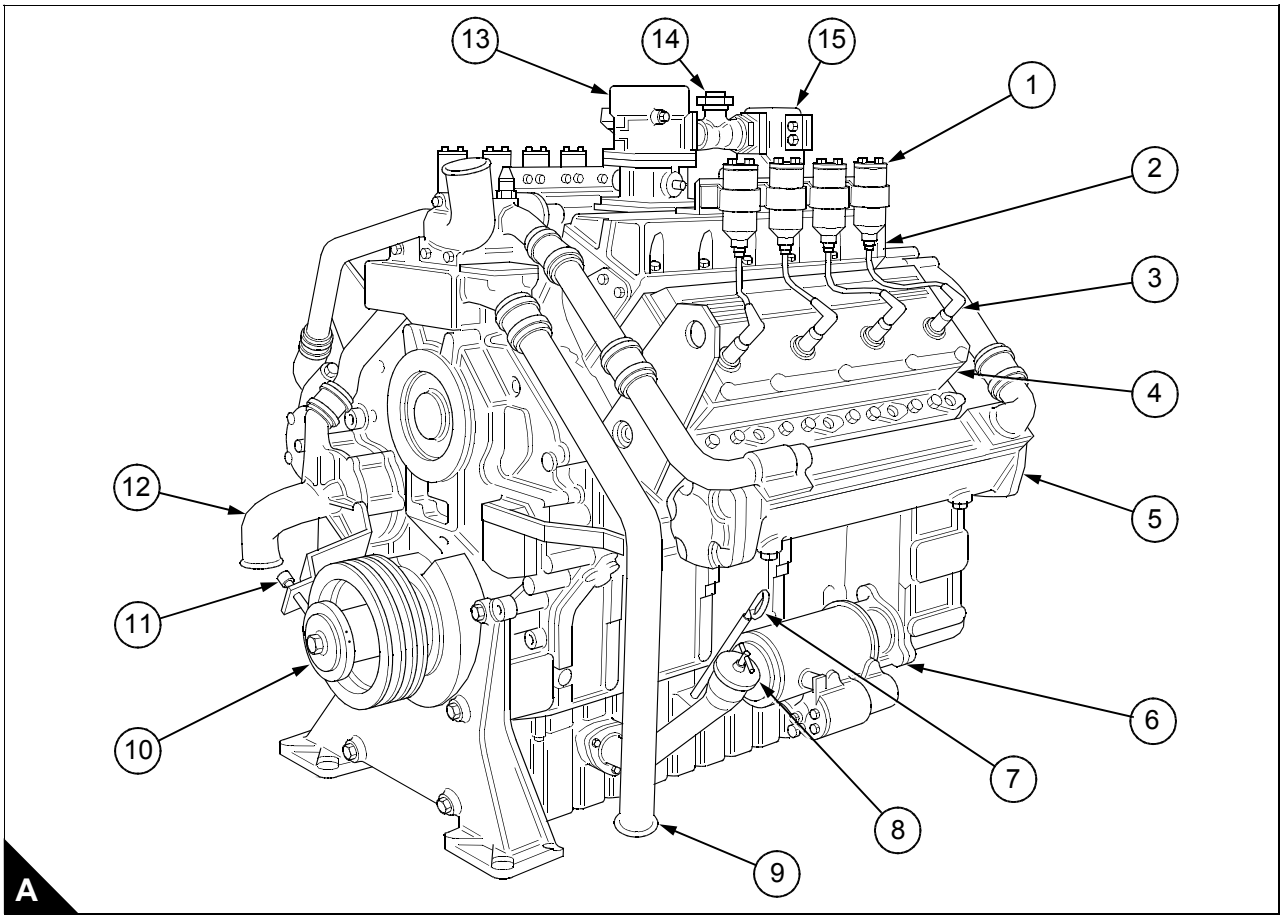
Introduction

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

Location of engine parts

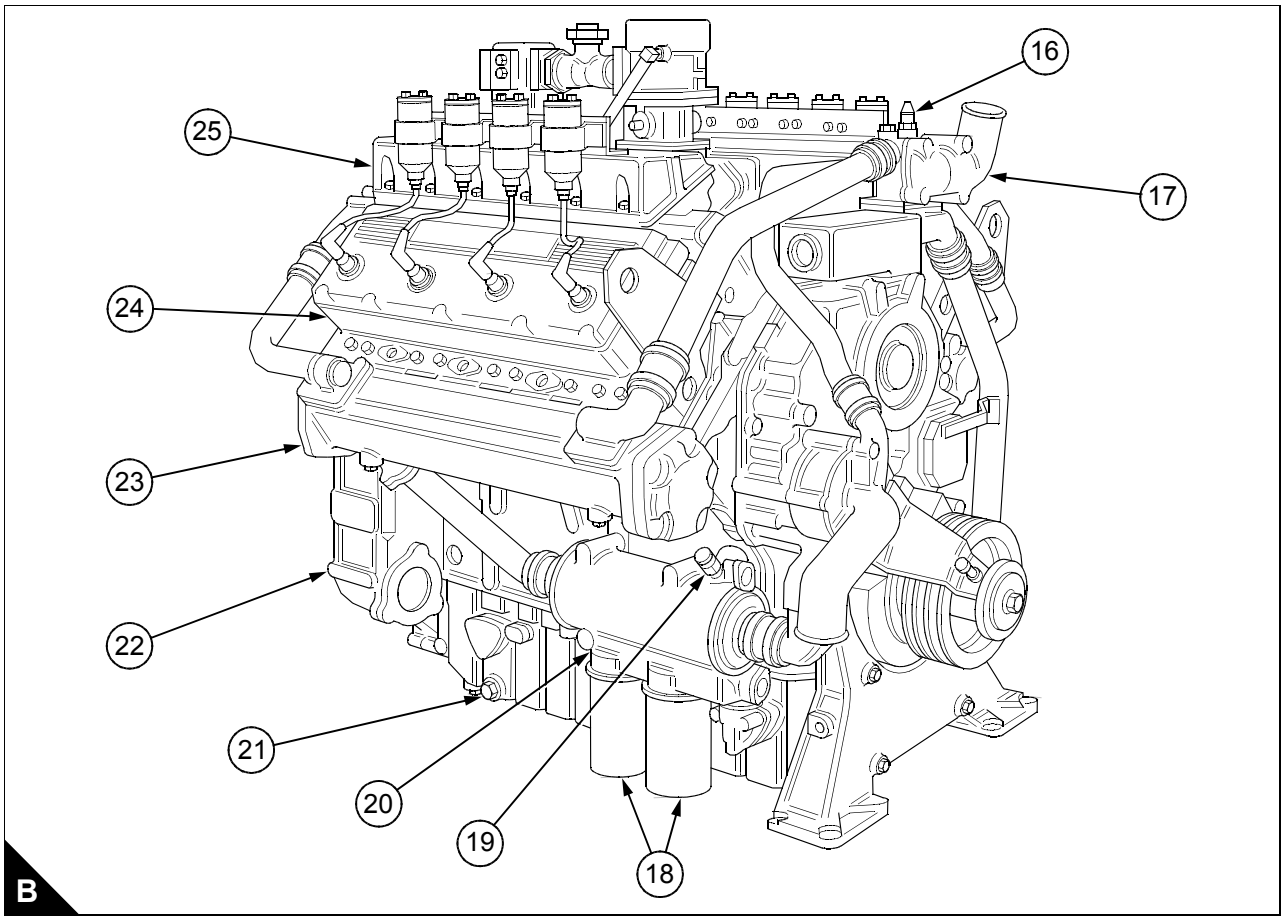
Front and left side view of engine (A)

1 Coil (one per cylinder)
2 Induction manifold
3 Spark plug leads (one per cylinder)
4 Rocker cover
5 Exhaust manifold
6 Starter motor
7 Lubricating oil dipstick and tube
8 Filler cap for lubricating oil
9 Crankcase breather
10 Ignition timing disc
11 Magnetic pick-up
12 Coolant pump
13 Carburettor
14 Mixture adjusting screw (MAS)
15 Gas regulator



Front and right side view of engine (B)

16 High coolant temperature shutdown switch
17 Thermostat housing
18 Oil filter canister (2)
19 Low oil pressure shutdown switch
20 Oil cooler
21 Oil drain plug
22 Flywheel housing
23 Exhaust manifold
24 Rocker cover
25 Induction manifold



3

Operation instructions

Routine procedure with a new or overhauled engine

Gas quality and type will have a major effect on the performance and reliability of the engine. It is imperative that all Perkins spark ignited engines are commissioned by Perkins approved installers, to ensure correct and safe operation of the equipment.

Refer to Chapter 5, Engine systems which gives the safeguards required for the fuel and lubricating oil systems.

1 Check that all wrappings and sealing blanks have been removed.

2 Fit any components removed for storage or transportation.

3 Ensure that all coolant and lubricating oil drain plugs are securely fitted.

4 Dependant on installation, connect the remote control linkages, pressure gauge pipework, air intake duct and electrical wiring.

5 Connect gas supply and exhaust pipework ensuring that all valves and filters are correctly positioned and operating.

6 Fill the coolant system with the approved coolant mixture, see "Coolant specification" on page 34.

7 Fill the sump to the upper mark on the dipstick with the correct grade of lubricating oil, see "Lubricating oil selection" on page 36.

8 Lubricate all control linkages and check for freedom of movement.

Note: Every new or reconditioned engine supplied by Perkins Engines (Shrewsbury) Limited is run in before delivery to the customer.

Routine starting

Daily checks before initial start

1 Where a radiator is fitted check that the coolant level is about 76 mm (3 in) below the top of the filler neck, or as otherwise specified in the Equipment Manufacturers Manual. Top up, if necessary, with the correct coolant. Investigate any marked loss of coolant.

2 Check oil level in engine sump. Replenish, as necessary, to UPPER mark on dipstick, using correct grade of oil.

Caution: *Do not overfill.*

Starting procedure

1 Perform the daily service checks given above, then proceed as follows:

2 If fitted, move the gas tap to the “ON” or “OPEN” position.

3 Turn the ignition switch to “ON”, this will open the gas solenoids and open the ignition electrical circuit.

4 Press the starter button, or turn the key further to the “START” position to activate the starter motor. Hold in the “START” position for a period of 3 to 5 seconds when the engine will start.

Note: Should the engine fail to start after three attempts, refer to Chapter 6, Fault diagnosis. Care must be taken to prevent a build-up of gas in a failure to start situation.

Running the engine

The following precautions will help to ensure a long and trouble-free life for the engine.

1 Do not subject the engine to high speeds and loads until working temperature is reached.

2 Avoid long periods of idling or “off- load” running.

3 Do not allow engine speeds to exceed the rated maximum. Over-speeding will shorten engine life and can result in component failure.

Stopping the engine

Run the engine “off- load” for a short period, then move the ignition key to the “OFF” position.

4

Preventive maintenance

Preventive maintenance periods

These preventive maintenance periods are general in application. Check the periods given by the manufacturer of the equipment in which the engine is installed.

The servicing intervals may be reduced at the discretion of operators to suit local conditions but must NOT be extended without the written consent of Perkins Engines (Shrewsbury) Limited as required by the Perkins Guarantee.

It is good maintenance to check for leakage and loose fasteners at each service.

These maintenance periods are only for engines that are operated with coolant, gas and lubricating oil to the specifications given in this handbook.

Schedules

The schedules which follow must be applied at the recommended interval as shown.

Engines in normal use

Engines in this category are those which are in use for a total of more than 400 hours in twelve months. Refer to "Schedule for engines in normal use" on page 14.

Engine in intermittent use

Engines in this category are those which are in use for a total of less than 400 hours in twelve months. Refer to "Schedule for engines in intermittent use" on page 15.

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 500 hours or 12 months

C - Every 1000 hours

A	B	C	Operation
●			Check the amount of coolant in the radiator
●			Check the level of the lubricating oil
●			Check the gas supply pressure
●			Check the lubricating oil pressure at the gauge **(2)**
●			Check the restriction indicator for the air filter. Renew the filter element if the indicator shows red
	●		Check the condition and tension of all drive belts
	●		Check the specific gravity and the pH value of the coolant
	●		Renew the lubricating oil **(3)**
	●		Renew the canisters of the lubricating oil filter and the rotor of the by-pass filter, if fitted
	●		Check that the radiator is clean and free from debris
	●		Check and reset or change the spark plugs
		●	Ensure that the tappet clearances are checked and adjusted, if necessary **(1)(4)**

(1) By a person who has had the correct training.
(2) If fitted.
(3) The selection of suitable lubricants should be made in co-operation with a reputable oil company, who can offer the necessary oil sample analysis support to ensure successful lubrication of spark ignited engines. Analysis results will determine the servicing period which could be less than the 500 hour service period. Refer to Chapter 5, Engine systems for details.
(4) After the first 500 hours on a new and overhauled engine.

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

- Drain and flush the coolant system and renew the coolant mixture.
- Check the condition of the high tension leads.
- Change the air filter element.
- Ensure that the alternator, the starter motor and protection switches are checked or serviced as necessary **(1)**.

Schedule for engines in intermittent use

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

A - Monthly and prior to each start.

B - Every 200 hours or 12 months

A	B	Operation
●		Check the amount of coolant in the radiator
●		Check the level of the lubricating
●		Check the gas supply pressure
●		Start and run the engine until normal operating temperature is attained
●		Check the lubricating oil pressure at the gauge **(2)**
●		Check the restriction indicator for the air filter. Renew the filter element if the indicator shows red
	●	Check the condition and tension of all drive belts
	●	Check the specific gravity and the pH value of the coolant
	●	Renew the lubricating oil **(3)**
	●	Renew the canisters of the lubricating oil filter and the rotor of the by-pass filter, if fitted
	●	Check that the radiator is clean and free from debris
	●	Check and reset or change the spark plugs
	●	Ensure that the tappet clearances are checked and adjusted, if necessary **(1)(4)**

(1) By a person who has had the correct training.
(2) If fitted.
(3) The selection of suitable lubricants should be made in co-operation with a reputable oil company, who can offer the necessary oil sample analysis support to ensure successful lubrication of spark ignited engines. Analysis results will determine the servicing period which could be less than the 500 hour service period. Refer to Chapter 5, Engine systems for details.
(4) After the first 500 hours on a new and overhauled engine.

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

- Drain and flush the coolant system and renew the coolant mixture.
- Check the condition of the high tension leads.
- Change the air filter element.
- Ensure that the alternator, the starter motor and protection switches are checked or serviced as necessary **(1)**.

Coolant level

Remove the filler cap from the radiator and check that the level of the coolant mixture reaches to a point 76 mm (3 in) below the top of the filler neck of the radiator. If necessary, add coolant until the coolant reaches the correct level. 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 check the amount of lubricating oil in the sump using the dipstick.

While the engine runs, the oil level must be above the LOWER mark. With the engine stopped the oil level must be at the UPPER mark on the dipstick.

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

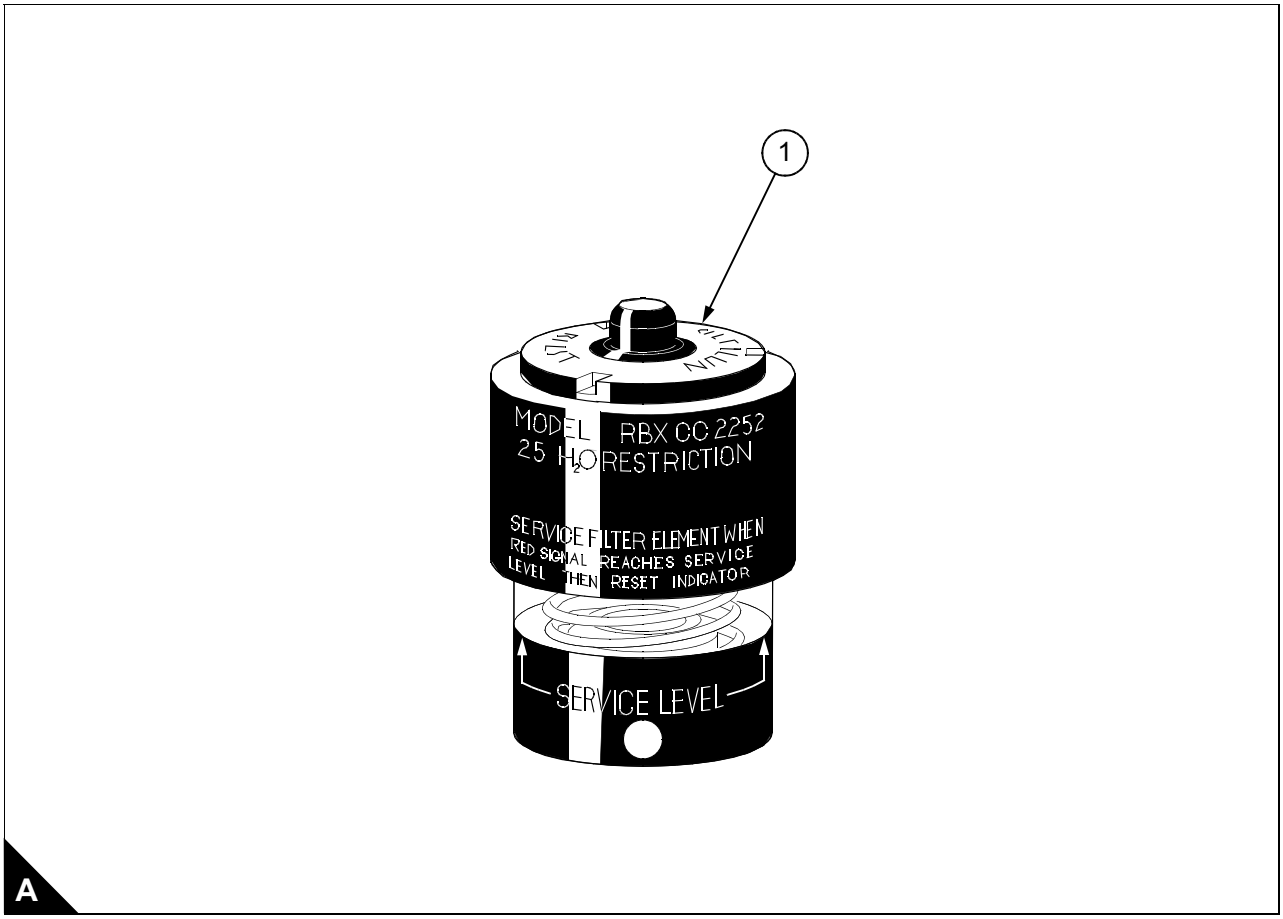
Caution: *Do not overfill.*

Restriction indicator

Each air filter is fitted with an indicator (A1) which gives a visual warning when the filter needs a service.

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

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



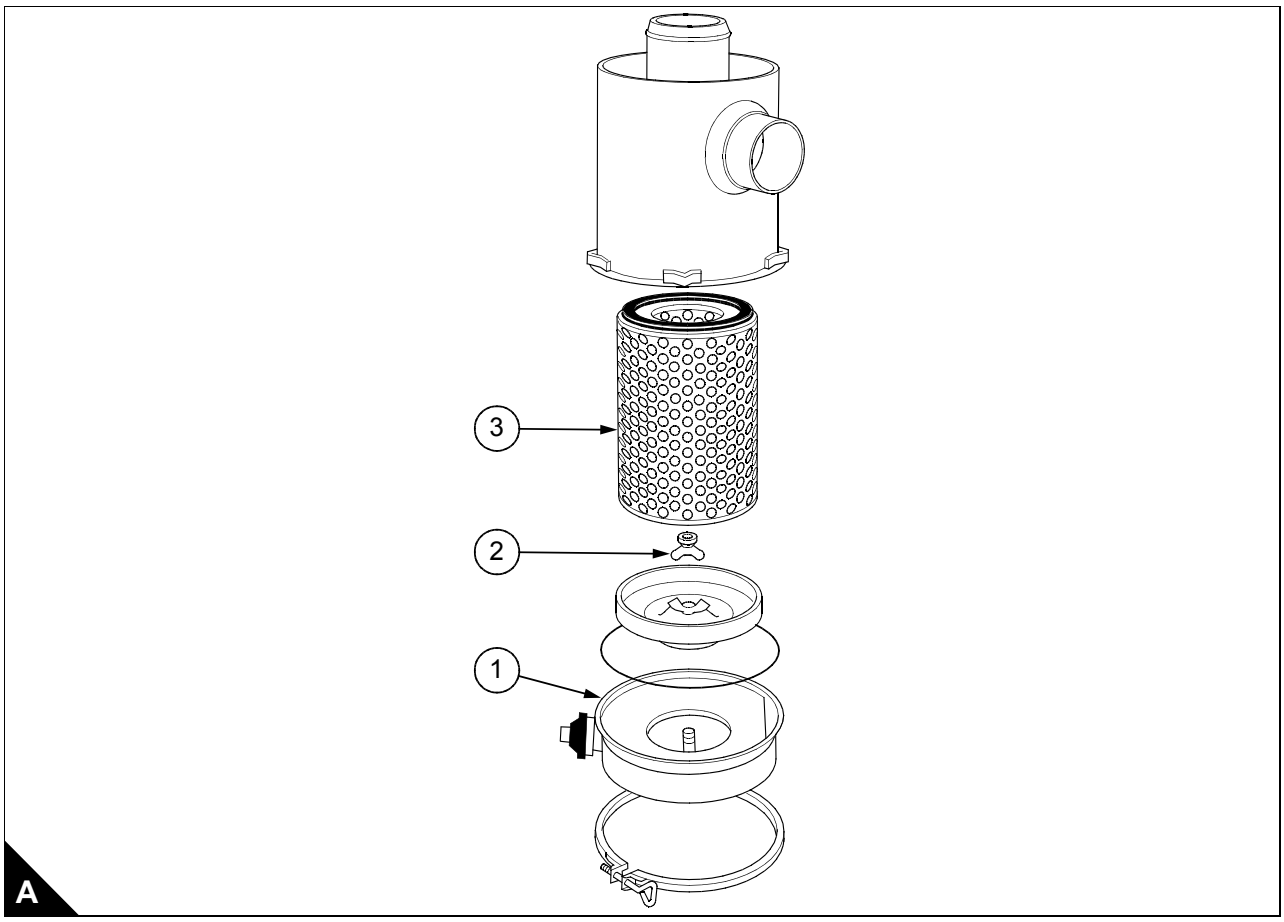
How to renew the air filter elements

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

1 Loosen the clamp and remove the end cover (A1). Remove the wing nut (A2), remove 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.



How to check the drive belts

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.

Check the belt tension at the centre of the longest free length.

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).

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

1 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 belt tension is obtained.

2 Tighten the lock nuts and check the tension of the belts again.

3 Run the engine for 15 minutes and check the belt tension again.

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

How to adjust the tension of the alternator belt

1 Loosen the alternator pivot bolt and the adjustment bolt and move the alternator to obtain the correct belt tension. Tighten the two bolts.

2 Run the engine for 15 minutes and then check the belt tension again.

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

How to renew the fan belts

1 To renew the fan belts, remove the six bolts that fasten 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 pulley grooves 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 To renew the alternator belt remove the fan belts from the crankshaft pulley as given above.

2 Loosen the alternator adjustment bolts and remove the old belt. Check both of the pulley grooves for dirt and for grease, then fit the new belt. Adjust the belt to the correct tension. Fit and adjust the tension of the fan belts.

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 a few drops of the coolant mixture to the clear panel.

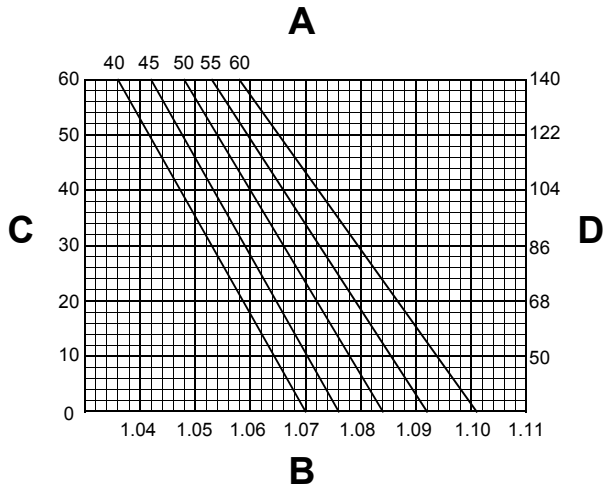
2 Spread the coolant over the full area of the clear panel and close the cover. Hold the refractometer horizontal with the clear panel up and inspect the sample through the viewer.

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. If some of the fluid which was tested earlier remains on the clear panel, the reading of the sample will be affected.*

Protection against frost is as follows:

Antifreeze/water (% by volume)	Protection down to (°C)
50/50	-35
06/40	-40



Specific gravity chart

A = Percentage anti-freeze by volume
B = Specific gravity
C = Mixture temperature in Centigrade
D = Mixture temperature in Fahrenheit

A

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 determined by 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 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 and a new sealing washer and tighten the plug securely.

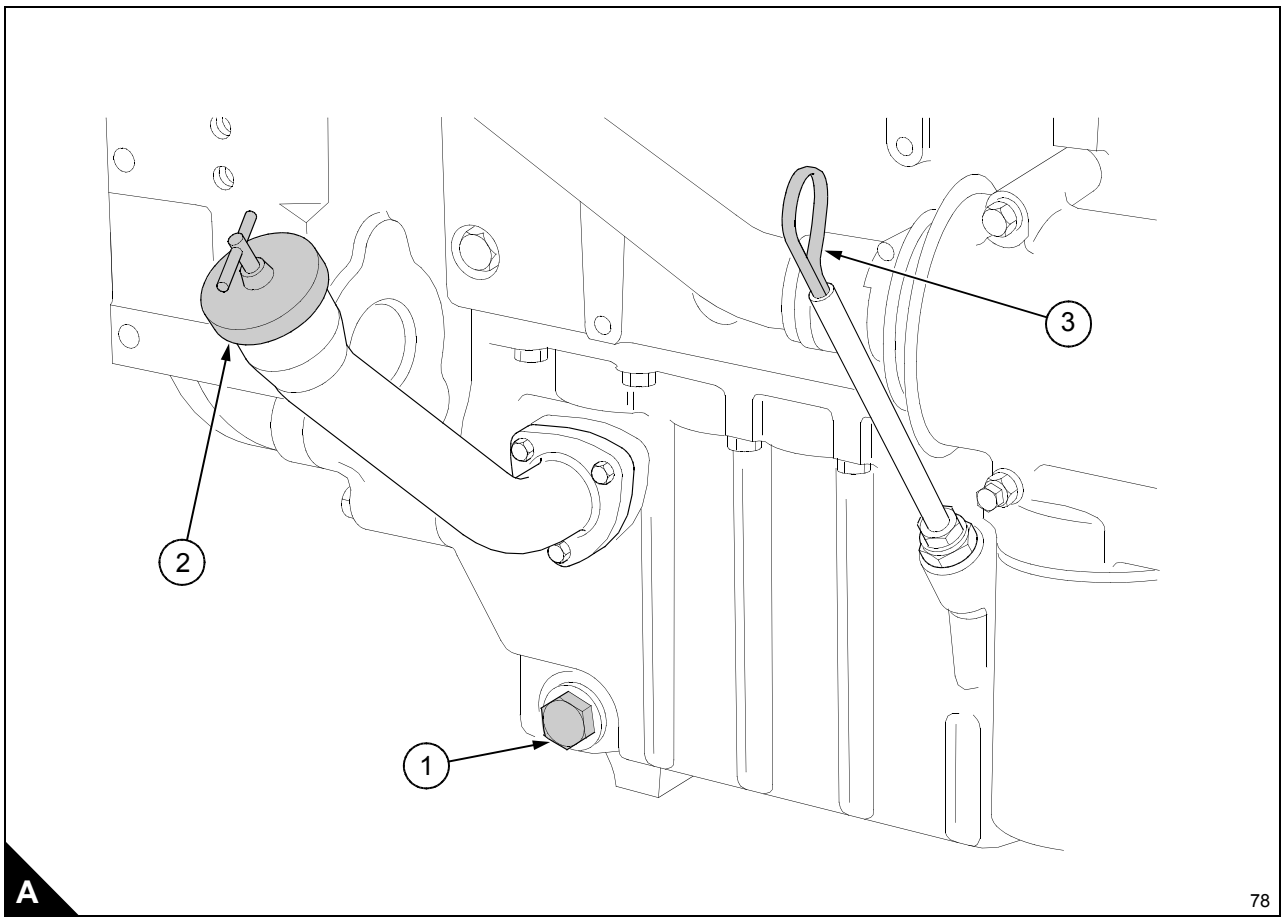
3 Renew all of the oil filter canisters as given below.

4 Clean the area around the oil filler cap (A2) and remove the cap.

5 Fill the sump to the upper mark on the dipstick (A3) with clean new lubricating oil of an approved grade as given in "Lubricating oil selection" on page 36.

Caution: *Do not overfill.*

6 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.

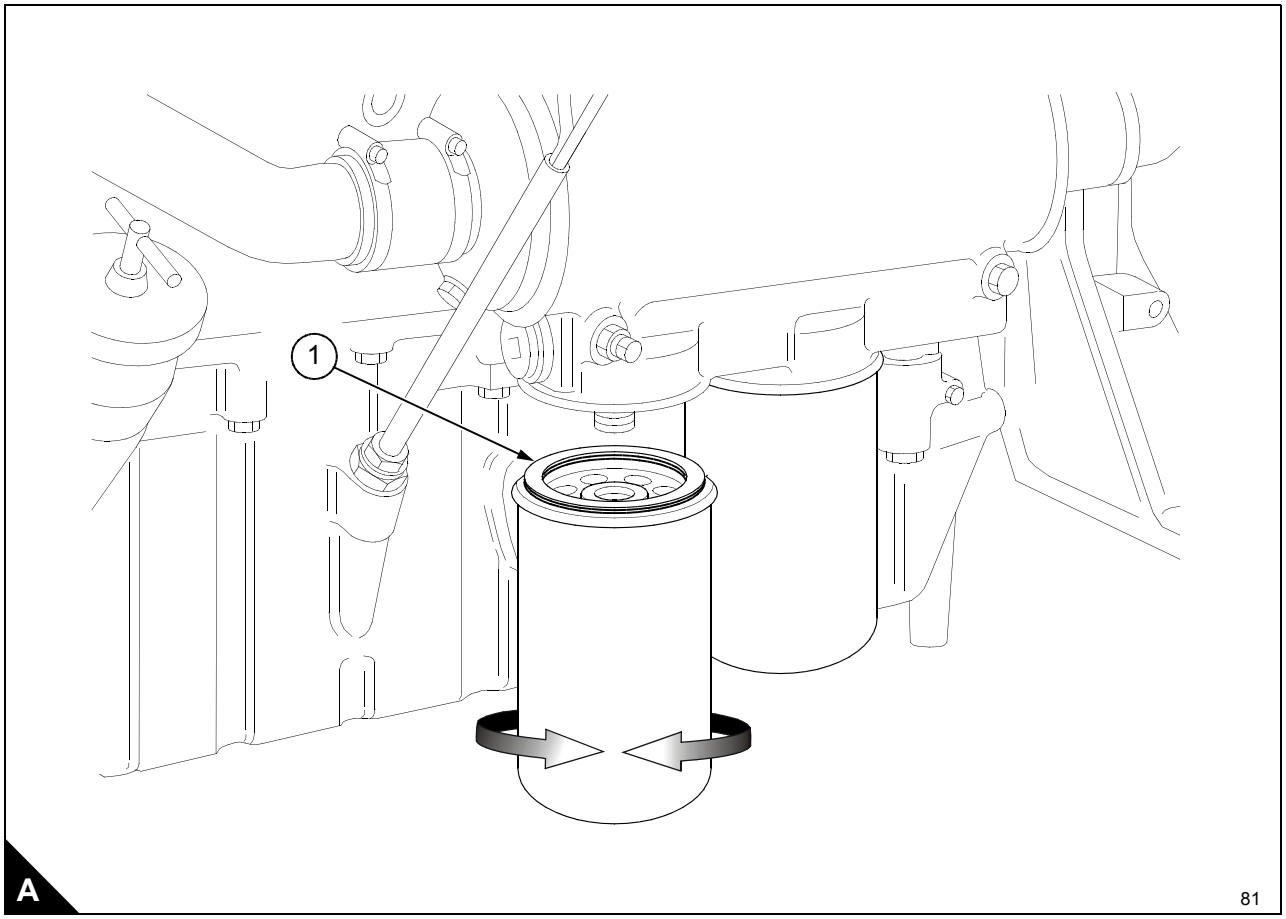
2 Check that the sealing rings (A1) are correctly fitted to the new canisters and clean the contact faces of the filter head.

3 Fill the new canisters with a clean approved grade of lubricating oil.

4 Lubricate the top of each canister seal with clean lubricating oil.

5 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 $1^{1}/_{4}$ turns, by hand.

Caution: *Do not overtighten.*



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

Some engines are fitted with a by-pass filter. It is NOT an alternative.

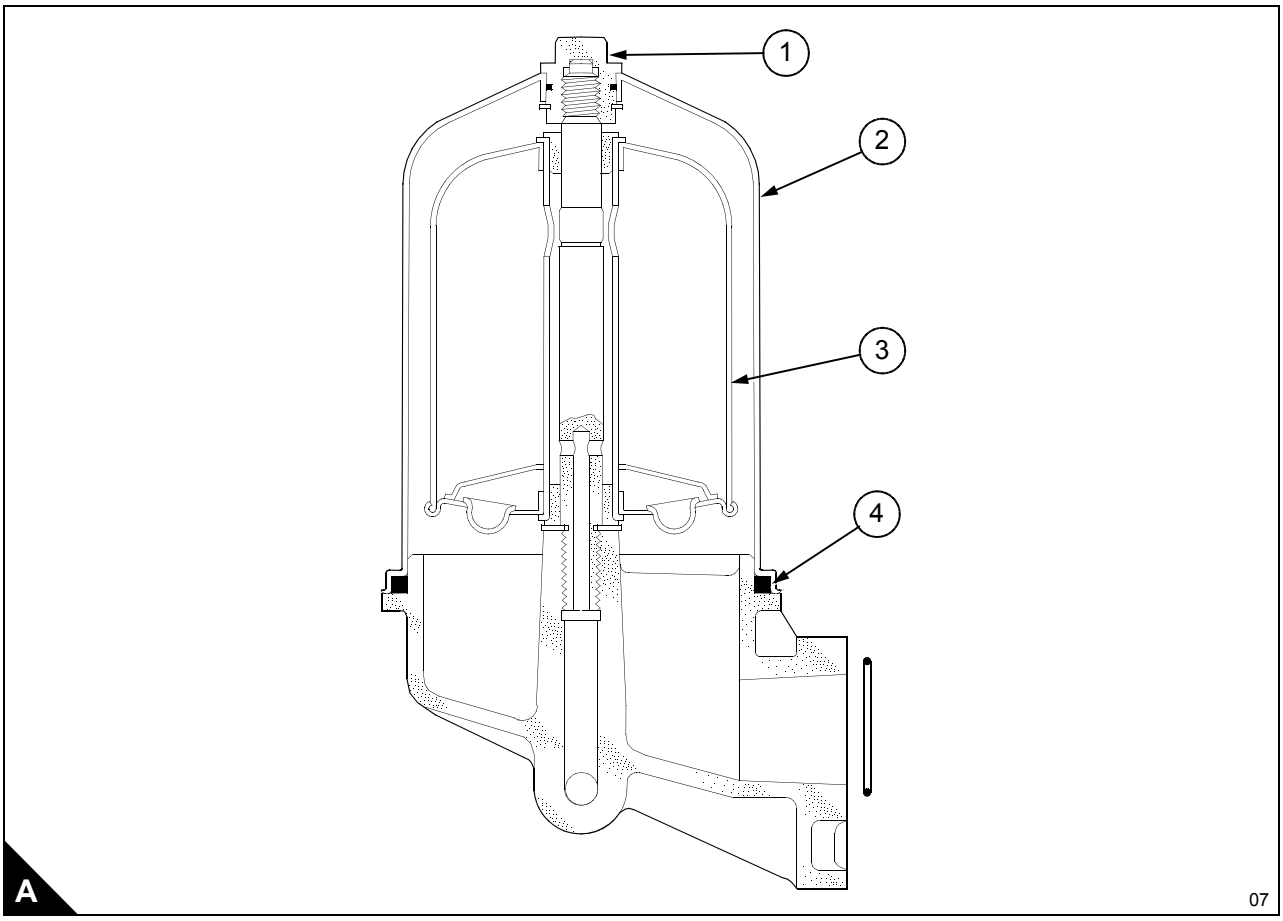
1 Clean the area around the by-pass filter. Remove the filter bowl (A2), remove and discard the rotor (A3).

2 Remove the seal (A4). Clean the seal recess in the filter bowl and the seat contact face on the housing.

3 Fit a new seal to the seal face of the housing and apply a light smear of clean engine oil to the face of the seal.

4 Fit a new rotor to the spindle and ensure that it can rotate freely. Fit the 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.



Spark plug change procedure

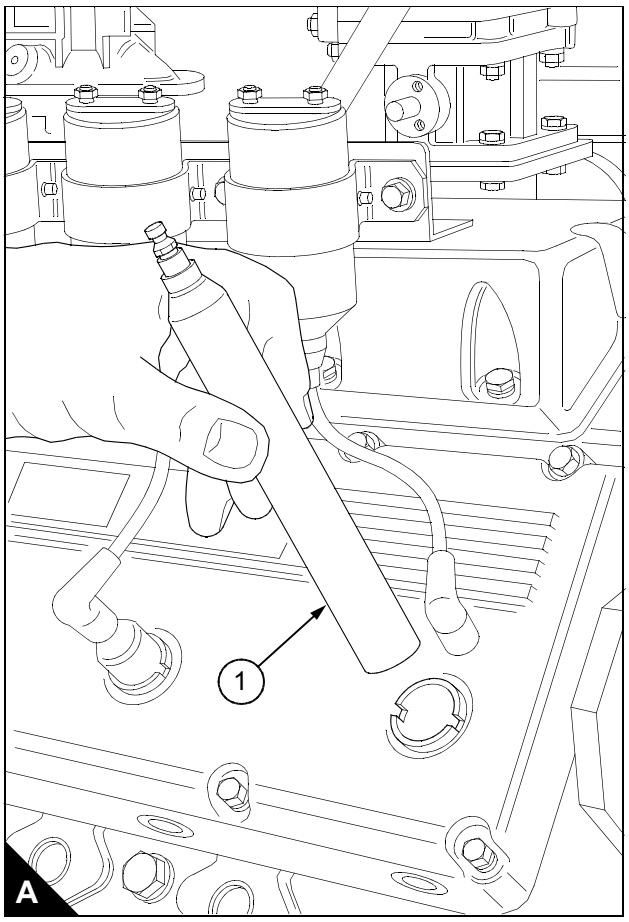
1 Disconnect the spark plug leads. Note that each cylinder has its own ignition coil so the high tension plug leads cannot be wrongly connected.

2 Remove the spark plug extension (A1), unscrew the spark plug by the use of a 14 mm plug socket spanner of no more than 26 mm outside diameter. Clean the spark plug and its thread, or replace the spark plug. Set the spark plug gap to 0,38 mm (0.015 in).

3 Apply anti-seize compound to the threads of the spark plugs. Fit the spark plugs and tighten to a torque of 30 Nm (22 lbf ft) or finger-tight and then a further 90° of a turn.

4 Insert the spark plug extension (A1) and ensure it is attached firmly to the spark plug terminal.

5 Connect the spark plug leads.



How to check the tappet clearances

The tappet clearance is measured between the rocker levers and the top of the valve bridge pieces. Check and adjust the tappet clearances in the sequence which follows, while the spark plugs are removed for service.

Caution: *Numbers A1 and B1 cylinders are at the front of the engine.*

Tappet clearances (cold)	
Inlet	0,2 mm (0.008 in)
Exhaust	0,5 mm (0.020 in)

1 Remove the plug leads.

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 clearances of the valves of number B3 cylinder and adjust them, if it is necessary (A).

When the clearance has been set, tighten the lock nut to a torque load of 40 Nm (30 lbf ft).

4 Set the valves of number B1 cylinder as indicated above for number A1 cylinder, then check/adjust the clearances of the valves of number A2 cylinder.

5 Set the valves of number B2 cylinder, then check/adjust the clearances of the valves of number A4 cylinder.

6 Set the valves of number A3 cylinder, then check/adjust the clearances of the valves of number B4 cylinder.

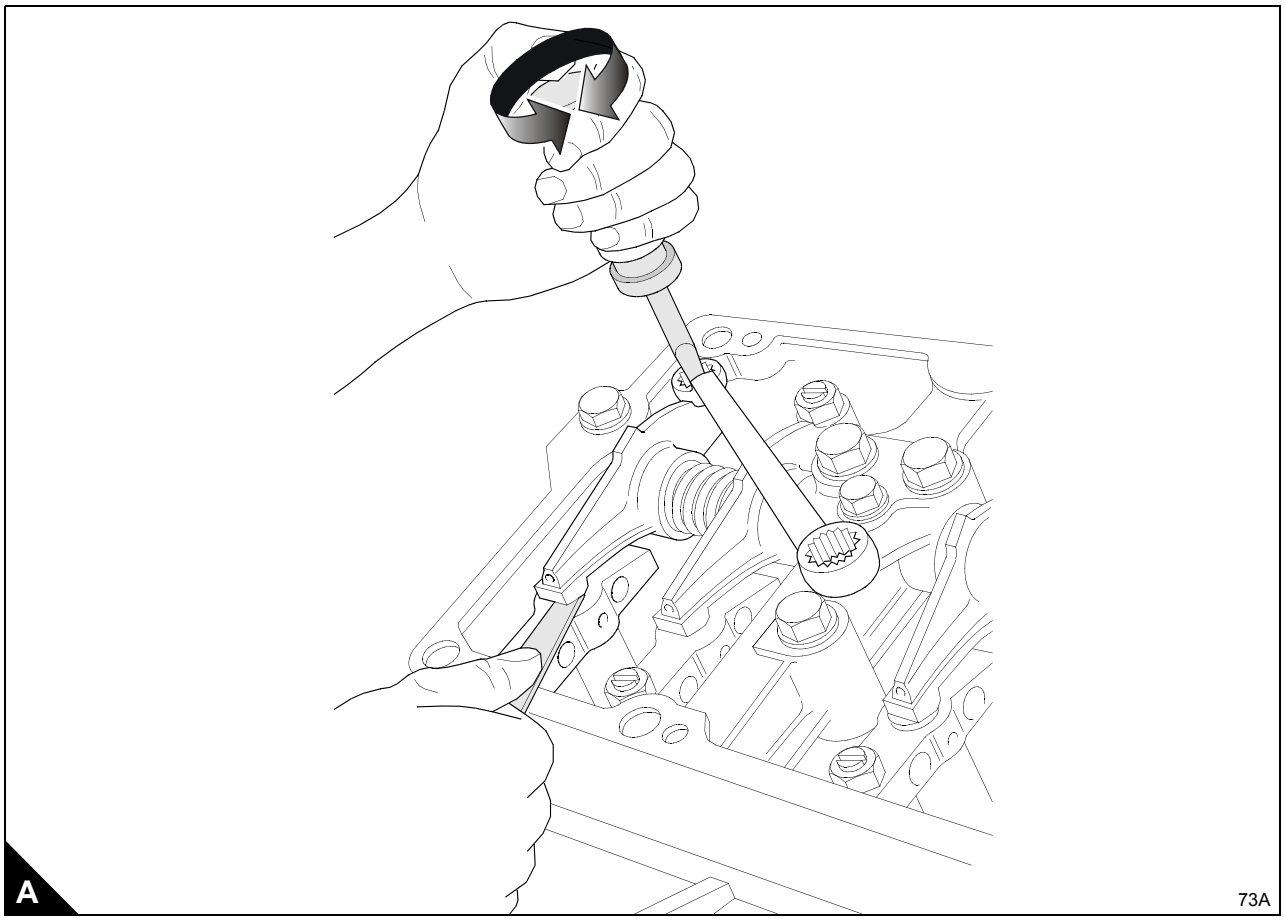
7 Set the valves of number B3 cylinder, then check/adjust the clearances of the valves of number A1 cylinder.

8 Set the valves of number A2 cylinder, then check/adjust the clearances of the valves of number B1 cylinder.

9 Set the valves of number A4 cylinder, then check/adjust the clearances of the valves of number B2 cylinder.

10 Set the valves of number B4 cylinder, then check/adjust the clearances of the valves of number A3 cylinder.

Valve bridge pieces do not normally require adjustment between each service, but if adjustment is necessary, refer to "How to check the tappet clearances" on page 26.



How to adjust the valve bridge pieces

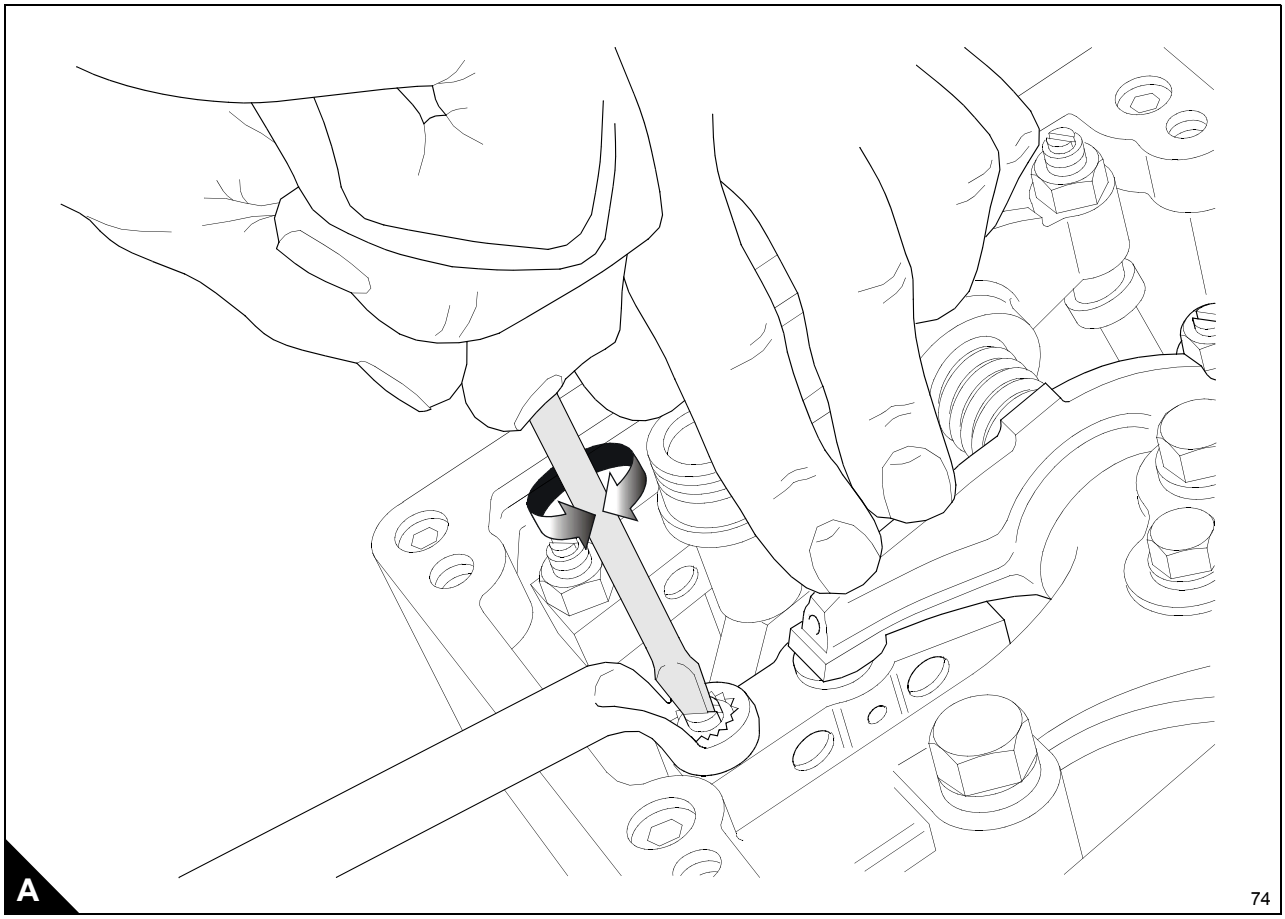
Valve bridge pieces do not normally require adjustment between each service, but if adjustment is necessary, use the procedure that follows:

1 With the valves closed (as for tappet clearance adjustment), loosen the lock nut and the adjustment screw on the faulty unit. 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).

2 Hold the adjustment screw in this position with a screwdriver and tighten the lock nut to a torque loading 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.

3 Check the tappet clearances after the bridge pieces have been adjusted.

4 Apply oil to the rocker levers, to the valve bridges and to the valve springs. Fit new ‘O’ rings to the holes for the spark plug sleeves in the top face of rocker covers. Fit the plugs, plug extension and plug leads.



Alternator

At the periods specified in the service schedule clean the outside of the alternator and ensure that all 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 Remove carefully the filler cap from the radiator, especially if the engine is hot.

3 Remove the coolant drain plugs from the front left side the rear right side of the engine and the radiator. Ensure that the drain holes are not restricted.

4 Flush the system with clean water.

5 Refit the engine drain plugs and fit a new sealing washer.

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 the drain taps/plugs.

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 with the filler cap removed until the coolant reaches the normal temperature of operation, then operate the engine at maximum rated speed for 10 minutes.

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

4 Allow the engine to cool, fit the plugs and close the taps. Fill the system and open the taps to allow a minimum of 5 litres (1 Imp. gallon) of coolant to drain from the system. Close the taps and add coolant to the correct level.

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 or fit the plugs. Fill the system with the correct coolant mixture.

Note: 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.

How to fill the coolant system

Fill the system slowly, with the approved coolant mixture, until the coolant reaches to a point 76 mm (3 in) below the top of the filler neck of 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! *On a hot engine release the filler cap carefully as the system will be under pressure.*

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5

Engine systems

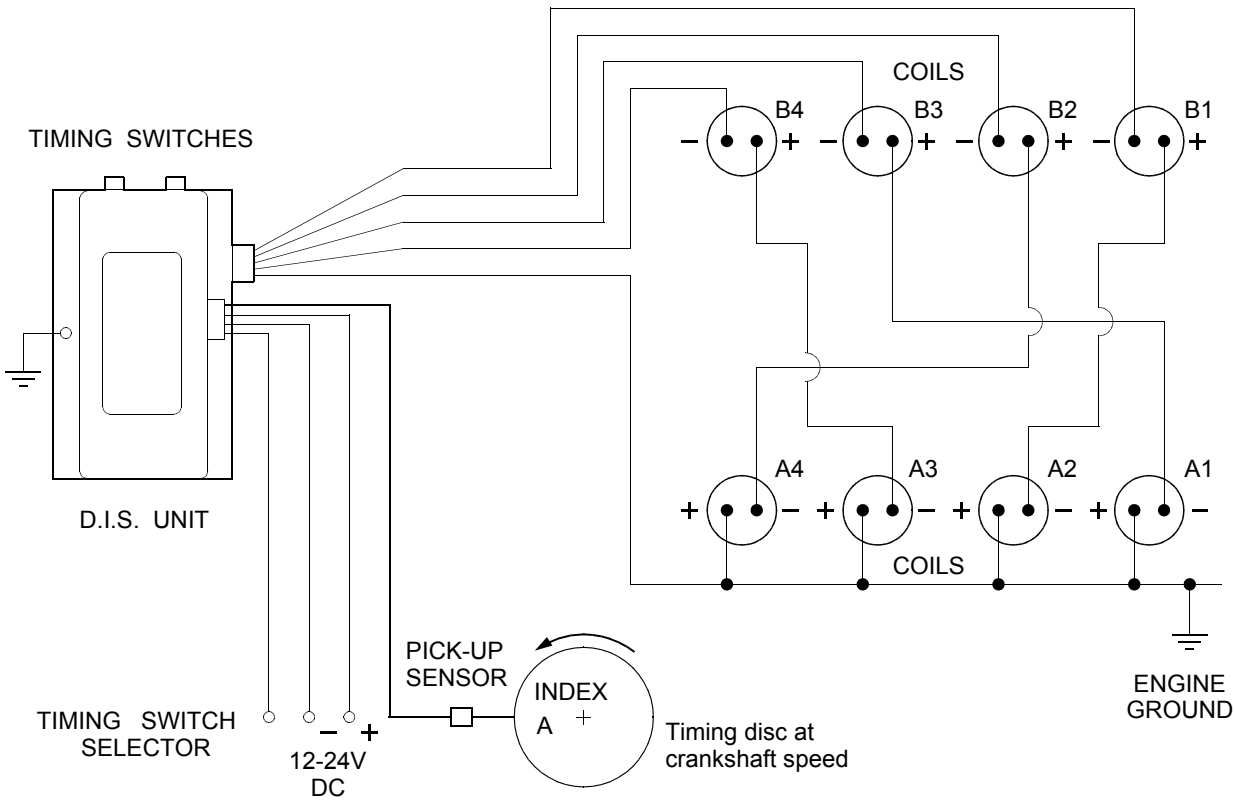
Ignition system - D.I.S. type

The system fitted to early Perkins 3008 spark ignited engine is a dual firing arrangement, i.e. each cylinder is fired every revolution (on both the exhaust and compression strokes). A crankshaft mounted timing disc produces timing signals by the action of magnetic inserts passing a ‘Hall' effect pickup sensor.

Later engines have the magnetic inserts in the flywheel and the pickup sensors located in the flywheel housing.

In addition to the four timing magnets a further single magnet trails 15° after the No 1 cylinder magnet. The D.I.S (digital ignition system) unit recognises this as the index signal that another revolution has started.

The D.I.S unit steps up the 24 volt supply to more than 300 volts and uses this voltage to charge up an energy storage capacitor. Signals from the rotating trigger magnets are processed in the D.I.S unit logic circuits and cause the stored energy to be discharged through the low tension circuits of the individual ignition coils. The sequencing and timing of these events is therefore a product of both the trigger magnets and the D.I.S unit logic.



D.I.S. IGNITION SYSTEM WIRING DIAGRAM

A

Ignition system - Fairbanks Morse type

Later engines are fitted with a 24 volt Fairbanks Morse IQ250 ignition system.

Description

The 24 volt battery is the source of the electrical power; the system is controlled by the Ignition Control Module (ICM).

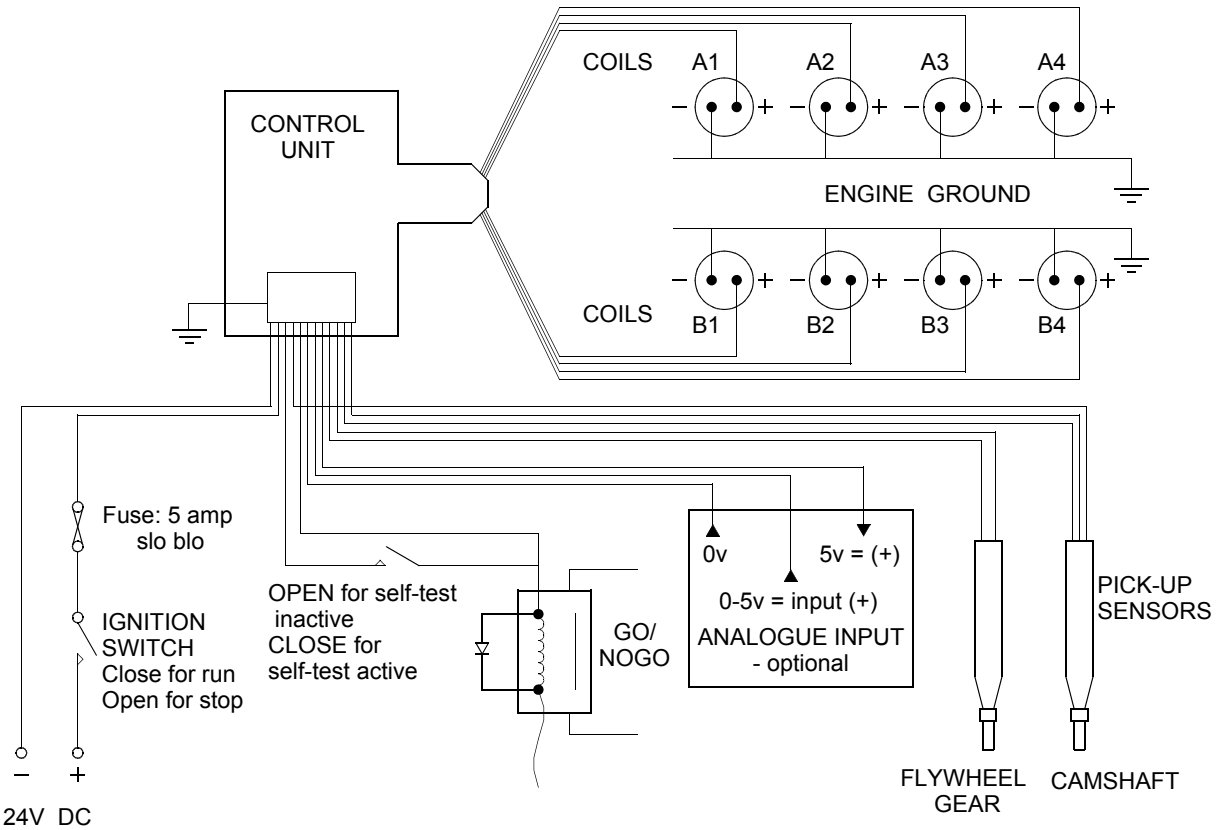
The teeth on the engine flywheel generate alternating current as they pass the sensor in the flywheel housing; this current is transmitted to the ICM.

A sensor, sited at the timing case, senses the reluctor pin attached to the camshaft; the sensor is supplied with 24 volt DC and the reluctor pin completes the circuit as it passes the sensor and the 24 volt current is returned to the ICM thus indicating the start of a new cycle.

The ICM processes the information and transmits precision timed voltage in correct sequence to each coil.

The coil increases the electrical voltage and transmits it along the high tension leads to the appropriate spark plug.

An option exists to have variable timing by use of the analogue input.



IQ250 IGNITION SYSTEM WIRING DIAGRAM

A

Fuel system

Introduction

To ensure safe and consistent operation of a gas powered spark ignited engine it is important to pay particular attention to the fuel supply system. In some locations gas engine installations are subject to mandatory requirements. Please discuss proposed installations with the appropriate authorities.

This chapter is intended as a guide to successful installation, and cannot cover every possible hazard. It is the installers responsibility to consider and avoid possible hazardous conditions at any given installation.

In general these recommendations are based on the “British Gas Code of Practice for Natural Gas Fuelled Spark Ignition Engines” - publication IM/17. They will also apply to operation on other types of hydrocarbon gaseous fuels, i.e. landfill, bio-gas and wellhead gases. With bio-gas and wellhead gases there may be additional requirements in terms of gas treatment, dual starting etc. which must be considered at the installation stage.

Standard equipment

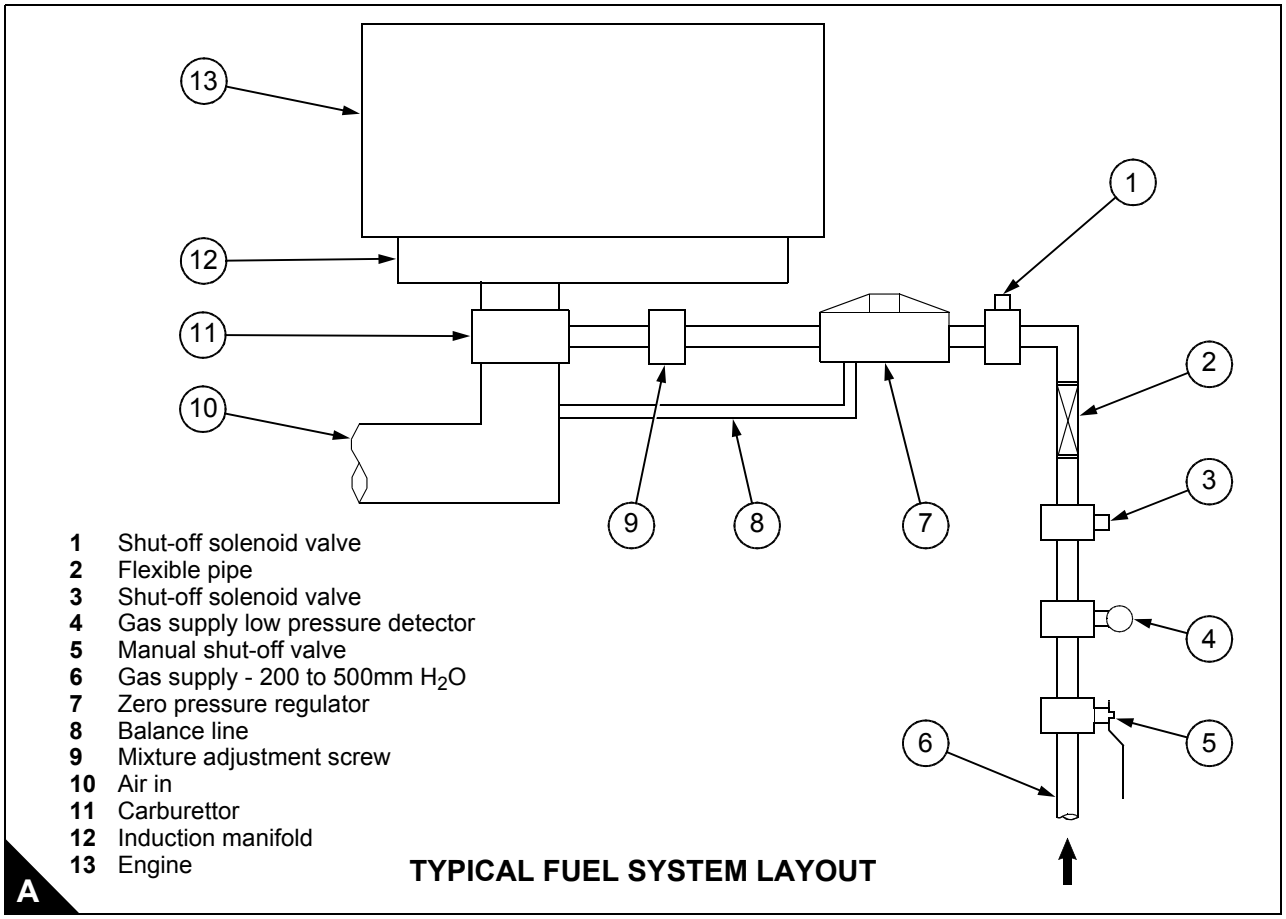
In their basic form Perkins spark ignited engines will be supplied with a carburettor and zero pressure regulator fitted as standard.

The purpose of the carburettor is to mix the fuel gas and air in the correct ratio and, in conjunction with the governor, control the flow of the air/fuel mixture to the engine cylinders.

The ratio of air-to-gas mixed by the carburettor is determined by the difference in pressure of air and gas supplied to the carburettor.

The air-to-gas pressure differential is maintained by the gas pressure regulator. See scheme below.

The function of the balance line on naturally aspirated engines is to allow the regulator to sense actual air inlet pressure. This prevents variations in air-to-fuel ratio due to air filter restriction in service.



1 Shut-off solenoid valve
2 Flexible pipe
3 Shut-off solenoid valve
4 Gas supply low pressure detector
5 Manual shut-off valve
6 Gas supply - 200 to 500mm H_2O
7 Zero pressure regulator
8 Balance line
9 Mixture adjustment screw
10 Air in
11 Carburettor
12 Induction manifold
13 Engine

TYPICAL FUEL SYSTEM LAYOUT

A

Coolant specification

1 The coolant approved for use in all engines manufactured by Perkins Engines (Shrewsbury) Limited is a mixture of 50% inhibited ethylene glycol or 50% inhibited propylene glycol and 50% clean fresh ‘soft' water.

Mixtures containing methanol are not approved. Anti-freeze mixtures supplied by most major Chemical and Oil companies are suitable, but the Operator is responsible for obtaining the Manufacturer's assurance that the ethylene glycol or propylene glycol products they supply have an inhibitor performance level suitable for a multi-metal cooling system.

2 If anti-freeze is not available, and there is no likelihood of ambient temperatures below 10°C, then clean fresh ‘soft' water may be used, treated with 1% by volume of PE(S)L inhibitor, in the cooling system. This proportion is the equivalent of 0,5 litre of inhibitor to 50 litres or 11 UK gallons of water. The inhibitor is available in bottles under Part No. OE 45350 (1,0 litre).

Caution: *The use of any other product may cause serious problems in the cooling system, and the use of insufficiently inhibited coolant mixtures may lead to erosion and/or corrosion of aluminium or cast iron components in the system.*

Gas specification

Perkins spark ignited engines are available to run on Natural gas, Sewage gas and Land-fill Site gas.

It is essential for successful operation that the lubricating oil is correctly specified for the type of gas used. It is necessary that the composition of the gas is known by Gas Analysis before the lubricating oil selection is made. The impurity levels in sewage gas or land-fill site gas can be grouped (Bio gas) as shown in the table at the bottom of the page.

For gases having a methane content of less than 90%, it will be necessary to apply a correction factor, to the figures in the table, to account for increased gas consumption (and therefore contaminants) to achieve the required power. The correction factor is:

Methane content	90%	80%	70%	60%	50%
Correction factor	1.0	1.12	1.25	1.43	1.66

Hence it will be seen that a gas of methane content of ‘say' 70% and H_2S value of 500 ppm is in effect (500 x 1.25) which equals 625 ppm in the engine and requires oils suitable for Aggressive Bio Gas. See Perkins Power Genset Installation Manual (Supplement for Gas engines) for full details.

The selection of suitable lubricants should be made in conjunction with a reputable oil company who should be able to make regular oil analyses to ensure that the oil selected is performing satisfactorily.

For Natural gas or Bio gases where the impurity levels are within the range in column 1 in the table below, the oil and filter change periods will be based on 500 hours. It is important that this drain interval is confirmed by regular oil analysis. With the use of Natural Gas extended drain periods may be possible depending on the rate of depletion of the lubricating oil additives.

For Aggressive Bio Gases where the impurity levels are within the range in column 2 it is necessary to specify lubricating oils having higher additive levels. The oil change period will depend on the level of impurities in the fuel and the reserve alkalinity of the lubricating oil. During the first 1000 hours of engine life, it will be necessary to conduct oil analyses at least every 100 hours to establish the depletion trend, from which the oil change period can be correctly established.

	Normal Bio Gas	**Aggressive Bio Gas**	**Gas Treatment Required**
Total Chlorine	Below 50 ppm	50-100 ppm	Above 100 ppm
Total Fluorine	Below 25 ppm	25-50 ppm	Above 50 ppm
Hydrogen Sulphide	Below 500 ppm	500-1000 ppm	Above 1000 ppm

Lubricating oil selection

The following is a list of the products of oil companies who can offer the necessary oil sample analysis support, to ensure the successful lubrication of gas engines.

Company	Natural Gas	Normal Bio Gas	Aggressive Bio Gas
Agip	Geum 30 Geum 40	Geum BG 30 Geum BG 40	
BP	Energol ICDG 30 Energol ICDG 40	Vanellus MCS-3 30 Vanellus MCS-3 40	
Caltex	RPM Gas Engine Oil HDAX 30 and 40	RPM Gas Engine Oil SAE 30 and SAE 40	
Castrol	Castrol NG 30	Castrol NG30M	
Century	Centlube Supreme G30 Centlube Supreme G40	Centlube Supreme G30 Centlube Supreme G40	
Chevron	Gas Engine Oil HDAX SAE30 and SAE400	Gas Engine Oil SAE30 and SAE40	
Esso	Essolube G30 Estor Super 15W/40	Essolube PX40 Estor Super 15W/40	
Kuwait	Q8 EL-3396 SAE40	Q8 EL-3167 SAE40	
Millers	Millgas 30 Millgas 40	Millgas S 30 Millgas S 40	
Mobil	Pegasus 480 SAE40	Pegasus 489 SAE40	Pegasus 446 SAE40
Morris	Ring-Free NG30		
Shell	Mysella T 30	Mysella T 30	
Texaco	Geotex HD 30 Geotex HD 40	Geotex HD 30 Geotex HD 40	

It is explicit in the PE(S)L Guarantee that an engine must be operated with approved fuel, lubricant and coolant, and maintained in accordance with the engine Servicing Schedule.

Condemnation levels for oil sample analysis

The following levels are intended as a guide for both operator and oil companies. In case of doubt, it should always be remembered that a change of oil is a very cheap alternative to an engine failure.

Viscosity increase

SAE grade	Viscosity CSt at 100 °C	
	New oil	Used oil
30	9.3 - 12.5	14.4 max
40	12.5 - 16.3	19.0 max

Insolubles % wt 0.3 micron filter - 1% max

TBN and TAN - For used oil analysis the ASTM D664 gives the most meaningful results. When the TBN has dropped to $^1/_3$ the new oil value, the oil should be changed. When the TAN reading has increased to the same level as the used oil TBN reading, the oil should be changed.

Oxidation and Nitration - assessed by infra-red analysis. Limits to be advised by the individual oil company.

Element	Limit max ppm	Comment
Water	5000	Above these limits indicates coolant leak into the engine. Source of leak needs to be rectified and the oil changed
Glycol, sodium and boron	30	
Silicon	30	Values in excess of 20 ppm usually indicate contamination of air intake system
Iron	100	
Aluminium	20	
Chromium	10	
Molybdenum	10	
Copper	40	On new engines, high levels of Cu, without high Pb, may indicate oil cooler washing and is not a potential problem
Lead	30	
Tin	10	

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6

Fault diagnosis

Problems and possible causes

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

Code list of possible causes

1 Battery capacity low
2 Bad electrical connections
3 Fault in the starter motor
4 Wrong grade of lubricating oil
5 The starter motor turns the engine too slowly
6 Gas tap off
7 Gas solenoid inoperative
8 Regulator needs adjustment
9 Throttle is closed
10 Insufficient gas pressure
11 Restriction in the air filter
12 Insufficient gas flow
13 Faulty spark plugs
14 Faulty control unit
15 Coil(s) faulty
16 Damaged or "tracking" high tension leads
17 Faulty pick-up disc or flywheel magnets (if fitted)
18 Restricted movement of the engine speed control
19 Restriction in the exhaust pipe
20 The engine temperature is too high
21 The engine temperature is too low
22 Wrong tappet clearances
23 Wet type air cleaner is too full or wrong type of oil is used
24 Not enough lubricating oil in the sump
25 Fault in gauge
26 Dirty lubricating oil filter element
27 Damage to fan or raw water pump (if fitted)
28 Fault in engine mounting or flywheel housing
29 Too much lubricating oil in the sump
30 Damage to fan or restriction in passages of heat exchanger if fitted
31 Restriction in breather pipe
32 Not enough coolant in system
33 Mixture too rich
34 Mixture too lean
35 Incorrect quality of gas
36 Regulator diaphragm faulty
37 Incorrect valve timing
38 Bad compression
39 Leakage past the cylinder head gasket
40 Valves are not free
41 Air locks in cooling system
42 Worn cylinder bores
43 Leakage past the valves and seats
44 Piston rings are not free or are worn or broken
45 Valve stems and/or guides are worn
46 Crankshaft bearings are worn or damaged

47 Lubricating oil pump is worn
48 Relief valve is not free to close
49 Relief valve is not free to open
50 Relief valve spring is broken
51 Fault in suction pipe of lubricating oil pump
52 Piston damage
53 Wrong piston fitted
54 Flywheel housing or flywheel is not aligned correctly
55 Fault in thermostat or the engine thermostat is of wrong type
56 Restriction in engine coolant passages
57 Fault in coolant pump
58 Damage to valve stem oil seals (where they are fitted)
59 Restriction in sump strainer
60 Valve spring is broken
61 Incorrect ignition timing

Warning! *If the engine does not to start, check the gas detectors and if they are activated, vent immediately the engine room.*

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