



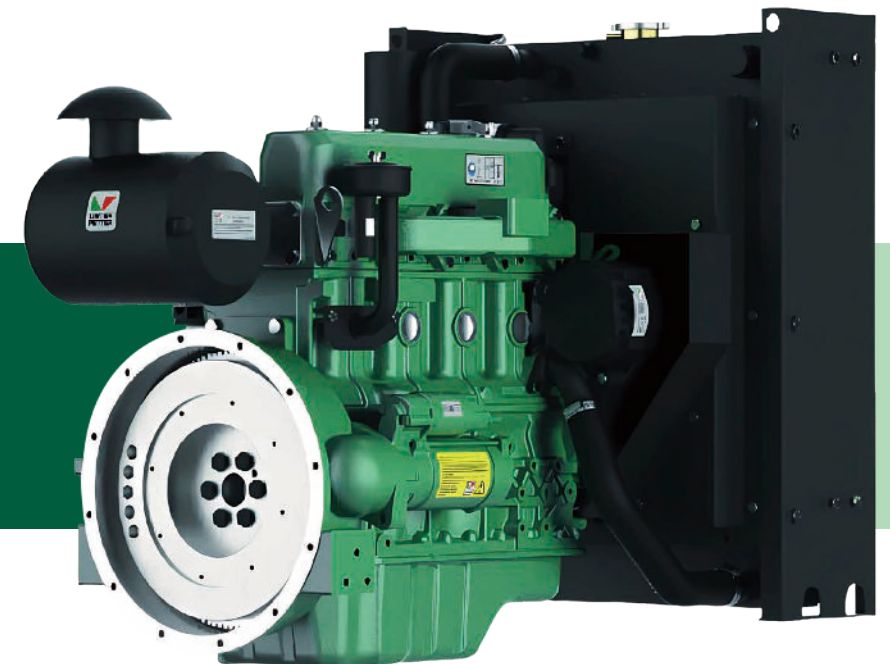
BUILT ON A LEGACY
FOCUSED ON THE FUTURE

STARLITE SERIES

SA315G1, SA423G1, SA427G1
SA430G1, SA432G1, SA432G2
SA435G1, SA441G1, SA441G2

ENGINES OPERATION MANUAL

since 1865



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Associated Publications

Master Parts Manual



WARNING

READ AND UNDERSTAND ALL SAFETY PRECAUTIONS AND WARNING MENTIONED IN THIS MANUAL.



WARNING

IMPROPER OPERATION OR MAINTENANCE PROCEDURES COULD RESULT IN SERIOUS ACCIDENT OR DAMAGE TO THE EQUIUPMENT CAUSING INJURY OR DEATH.



WARNING

NON-COMPLIANCE WITH THESE INSTRUCTIONS MAY INVALIDATE THE WARRANTY.



WARNING

MAKE CERTAIN THAT THE ENGINE CANNOT BE STARTED IN ANY WAY BEFORE UNDETAING ANY MAINTENANCE, PARTICULARLY IN THE CASE OF AUTOMATICALLY STARTING GENERATING SETS.

Statement of Indemnity

The information, specifications, illustrations, instructions and statements contained within this publication are given with our best intentions and are believed to be correct at the time of going to publication.

Our policy is one of continued development and we reserve the right to amend any technical information with or without prior notice.

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Parts that have not been approved by the Lister Petter Engine organization cannot be relied upon for correct material, dimensions or finish. The Company cannot therefore be held responsible for any damage arising from the use of such parts, and the guarantee will be invalidated.

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INTRODUCTION

Your engine should be correctly operated and serviced in accordance with this handbook.

To obtain the best performance and the longest life from your engine you must ensure that maintenance operations are carried out at the intervals indicated in

5. Routine Maintenance. For example, it is essential to renew the filter elements and lubricating oil regularly in order to ensure that the engine components remain clean. If the engine operates in a very dusty environment or other adverse conditions some of the maintenance intervals will be shorter. Ensure that all adjustments and repairs are done by properly trained personnel. Your Lister Petter Engine distributor can assist in this matter and will also supply the genuine Lister Petter Engine parts needed for your engine.

To ensure that you use the correct information for your specific engine type, please refer to the section below.

ENGINE IDENTIFICATION

In this handbook the different engine types are indicated by code letters. The meanings of these codes are as indicated below:

MODELS		
Model Number	Cylinders	Aspiration
SA315G1	3	Natural
SA423G1	4	Natural
SA427G1	4	Natural
SA430G1	4	Natural
SA432G1	4	Natural
SA432G2	4	Turbocharged
SA435G1	4	Turbocharged
SA441G1	4	Turbocharged
SA441G2	4	Turbocharged and intercooled

To identify which model of Lister Petter diesel engine you are using reference to the engine serial number, which is stamped on a plate attached to the engine. It identifies the type and build of the engine (see table below) to enable the correct maintenance procedures to be carried out. Here below is a sample of the serial number:

22 D 123456 SA423 G 1

22.....Year code (22 = 2022)

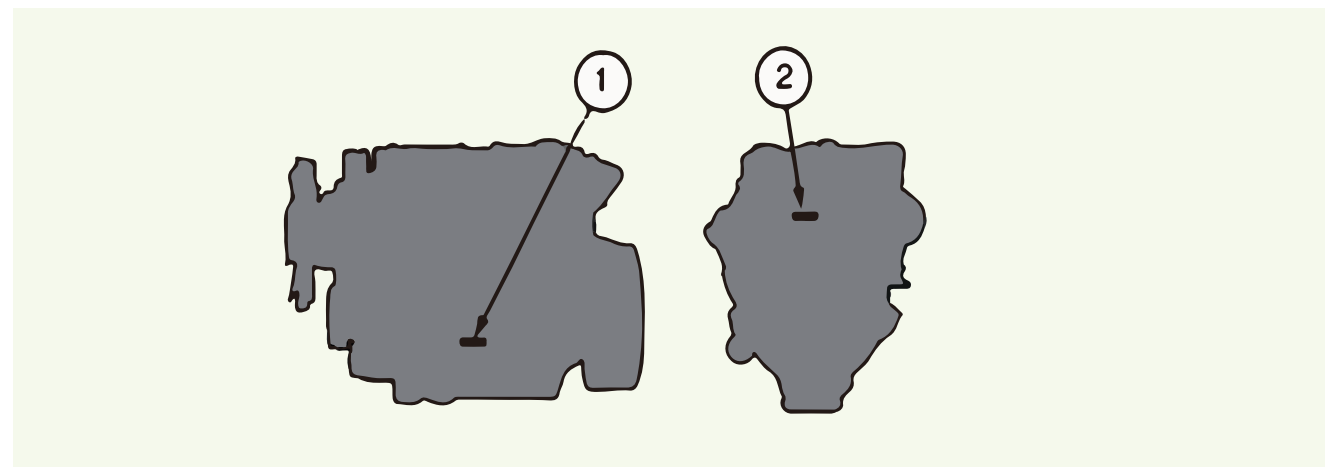
D.....Month code

123456.....Unique engine number

SA423 Engine model

G.....Generator drive
1..... Spectrum code

The engine number is stamped on a label fastened to the left side (1) or rear (2) of the cylinder block (see figure). This should be quoted when requesting parts, service or information from your Lister Petter Engine distributor.



ENGINE LIFTING

In different applications of the engine the maximum dry weight (without coolant or lubricating oil) will vary. The maximum recommended weight of the engines for lifting is as follows:

3-cylinder engines: 420 kg (925 lb)

4-cylinder engines: 500 kg (1100 lb)

6-cylinder engines: 600 kg (1320 lb)

Before lifting the engine, read 1.8 Lifting Precautions.

CARE OF YOUR ENGINE

Your engine must receive the correct routine maintenance as described in section 5. If faults do occur they can usually be diagnosed and corrected using the information in section 6.

In case of queries about your engine or its installation contact your Lister Petter Engine distributor. Your distributor can undertake repairs and will ensure that only the correct parts are fitted and the work is done correctly.

SERVICE LITERATURE

Service manual publications are available from your Lister Petter Engine distributor.

TRAINING

Local training for the correct operation, service and overhaul of engines is available at certain Lister Petter Engine distributors. If special training is necessary, your distributor can advise you how to obtain it.

1. SAFETY INFORMATION AND PRECAUTIONS

Carefully read and follow all safety messages in this manual (some items only apply to specific applications). Familiarize yourself with the safety and informative symbols on your equipment. You must also refer to the local regulations in the country of use.

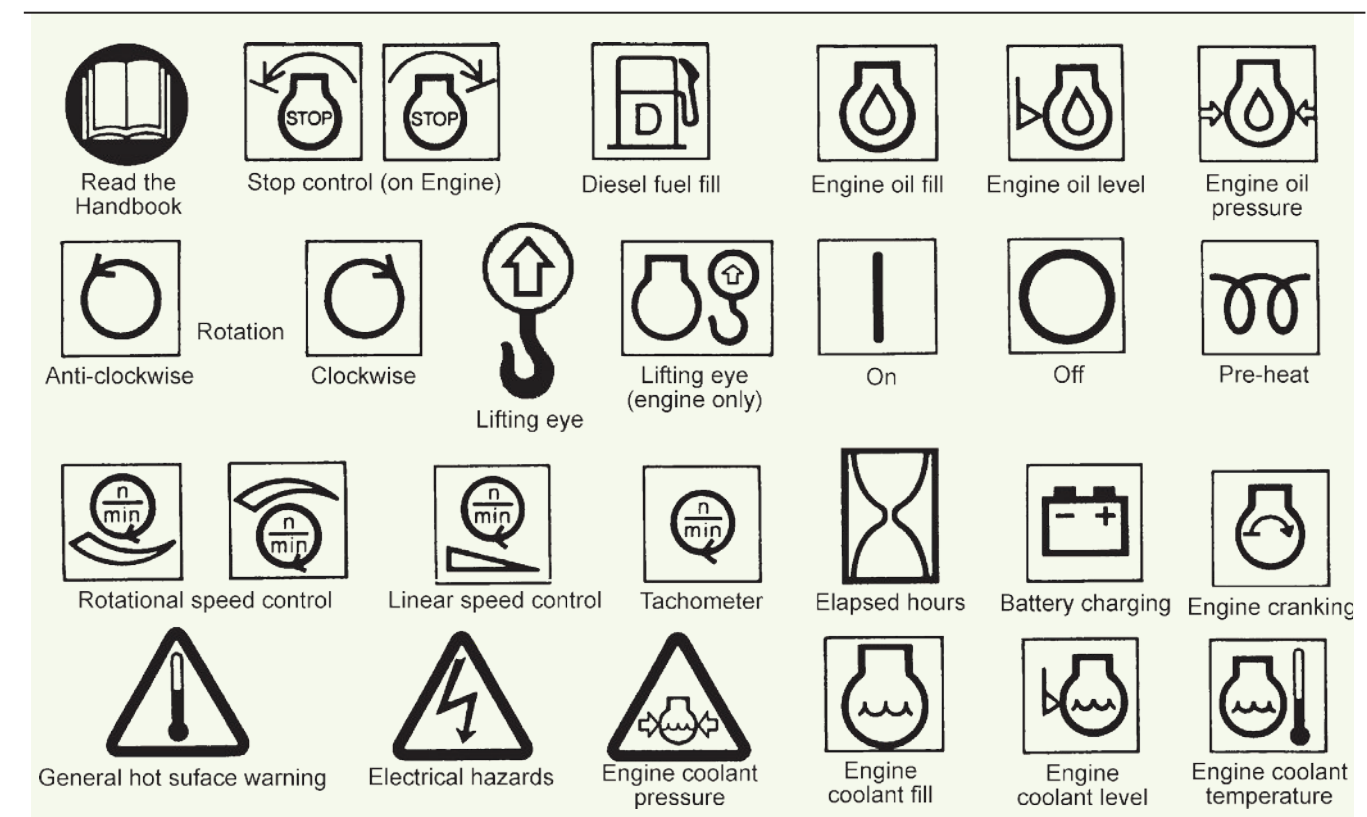
Ensure that you are familiar with the safety symbols used by Lister Petter Engine (Figure 1).

Take especial care when handling potentially hazardous chemicals. These include lubricants, fuel, coolant concentrate, battery acid (see section 1.4 Precautions with Batteries), paint and adhesives.

Manufacturers' safety data sheets will provide specific details of the physical and health hazards, safety and emergency procedures and any necessary personal protection equipment required while working with hazardous materials.

! CAUTION

FOLLOW ALL SAFETY INSTRUCTIONS ACCURATELY.



1.This figure identifies the ISO 8999 symbols currently used by Lister Petter Engine.

1.1 PERSONAL SAFTY

- Ensure that you have access to fire extinguishers and have knowledge of emergency procedures.
- Identify a location from which calls to the emergency services can be made if necessary.
- Ensure that someone knows where you are working and is informed when you leave the working area.
- Wear personal protective clothing and safety equipment appropriate to the work being done.
- Ensure that guards are properly fitted.
- Keep your body and clothing clear of all moving or hot parts.

WARNING

BE AWARE THAT THE FAN CANNOT BE SEEN CLEARLY WHILE THE ENGINE IS RUNNING.

- Tie long hair close to your head.
- Do not wear loose clothing or jewellery.

WARNING

KEEP CLEAR OF ALL ROTATING PARTS. DO NOT WEAR A NECKTIE, A SCARF, LOOSE CLOTHING OR A NECKLACE WHEN WORKING CLOSE TO A RUNNING ENGINE. ENTANGLEMENT WITH ROTATING PARTS COULD CAUSE SERIOUS INJURY OR DEATH.

- Remove rings and other jewellery if working on any part of the electrical system, to avoid causing a short circuit.
- Wear ear protection against loud noise.

WARNING

PROLONGED EXPOSURE TO LOUD NOISE CAN CAUSE IMPAIRMENT OR LOSS OF HEARING.

- To avoid loss of concentration, do not use music earphones while working.

1.2 GENERAL PRECAUTIONS

Engine operators must be instructed in the correct procedures before attempting to start any engine.

WARNING

IT IS DANGEROUS TO PERMIT AN INEXPERIENCED PERSON TO START ANY DIESEL ENGINE.

- Use these engines only in the type of application for which they have been designed.

- Ensure the engine is securely mounted.
- Ensure that the area around the engine is well ventilated.

WARNING

LACK OF VENTILATION CAN RESULT IN THE BUILD-UP OF TOXIC, AND POTENTIALLY FATAL EMISSIONS.

- Only one person must control the engine.
- Other persons must be kept at a safe distance while the engine or equipment is in operation.
- Ensure that the engine is operated only from the control panel or from the operator's position.
- Ensure that the control lever of the transmission drive is in the "out-of-drive" position before the engine is started.
- Fit guards on any accessories that require them (these must be supplied and fitted by the purchaser). Keep all safety guards in position.
- Never attempt to change the specification of the engine as this could affect its safe operation and put the operator at risk.
- Never work under any plant that is only held by overhead lifting equipment.
- Check that the brakes are in good condition before moving mobile equipment.
- While the engine is running never attempt to clean it, add fuel or lubricating oil, or adjust it in any way.
- Keep the engine and surrounding area clean.

WARNING

NEVER ALLOW ANY PART OF THE BODY TO COME INTO CONTACT WITH HIGH PRESSURE FUEL OIL, COMPRESSED AIR OR HYDRAULIC OIL. CONTACT WITH, OR INGESTION OF, THESE SUBSTANCES CAN CAUSE SERIOUS INJURY OR DEATH.

- Handle fluids with care at all times.
- Rectify any fuel, coolant or oil leak as soon as is practicable and clean up any spillages immediately.
- Remove any build-up of grease, oil or debris.
- Wear gloves or use suitable barrier creams when doing anything that could soil your hands.

WARNING

DIESEL FUEL AND LUBRICATING OIL CAN DAMAGE THE SKIN.

WARNING

DO NOT EXPOSE PRESSURIZED CONTAINERS TO HEAT. DO NOT INCINERATE OR PUNCTURE THEM.

- Fit only genuine Lister Petter Engine parts.

1.3 CARE WITH LUBRICATING OIL

- Wear gloves or barrier cream.
- Clean up any spillages.
- Do not wear clothing that is contaminated by lubricating oil. Do not put material that is contaminated with oil into your pockets.
- To prevent environmental contamination, always discard used lubricating oil strictly in accordance with local regulations. Preferably take to a recycling site.

1.4 PRECAUTIONS WITH DIESEL FUEL

- Store fuel and other flammable liquids away from sources of ignition.
- Always switch off the engine before adding fuel.
- Never smoke when you are filling the tank with fuel.
- Do not handle fuel near to heaters or other sources of ignition.
- Do not overfill the fuel tank.
- Clean up any spillages.

WARNING

MATERIAL THAT HAS BEEN CONTAMINATED BY DIESEL MUST BE KEPT AWAY FROM ALL SOURCES OF IGNITION AND SAFELY DISPOSED OF.

- Never attempt to adjust the fuel system while the engine is running or still hot.
- If skin comes into contact with high pressure fuel, obtain medical assistance immediately.

WARNING

HIGH PRESSURE FUEL CAN CAUSE SERIOUS INJURY OR DEATH.

1.5 PRECAUTIONS WITH COOLANT

- 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 cooling circuit.

1.6 PRECAUTIONS WITH BATTERIES

- Batteries contain hazardous sulphuric acid.
- Great care therefore needs to be taken when using them.

WARNING

BATTERY ACID IS HIGHLY CORROSIVE AND POISONOUS, AND WILL BURN SKIN AND CLOTHING. IT WILL CAUSE PERMANENT DAMAGE, INCLUDING BLINDNESS, IF SPLASHED INTO THE EYES.

- If acid accidentally comes into contact with skin, eyes or clothes, flush it away with copious amounts of water and seek medical aid.

WARNING

THE ELECTROLYTE GASES ARE HIGHLY FLAMMABLE.

- Do not smoke near batteries and keep sparks and flames away from them.
- Do not work near to heaters or other fire hazards.
- Disconnect the main battery terminals before making any repair to the electrical system.
- Keep the top of the battery well ventilated during charging.
- Do not attempt to charge a frozen battery; it may explode. Instead, warm the battery to 16°C (60°F).
- Switch off the battery charger before connecting or disconnecting the charger leads. The negative (earth) battery lead must be disconnected first and reconnected last.
- Never use a damaged battery.

battery Charge Alternator

The following points must be strictly observed when an alternator is fitted, otherwise serious damage can be done.

- Never connect a battery to the system without checking that the voltage and polarity are correct.
- Never remove any electrical cable while the battery is connected in the circuit.
- Only disconnect the battery with the engine stopped and all switches in the off position.
- Always ensure that cables are fitted to their correct terminals.

CAUTION

A SHORT CIRCUIT OR REVERSAL OF POLARITY WILL RUIN DIODES AND TRANSISTORS.

- Never 'flash' any connection.
- Never experiment with any adjustments or repairs to the system.
- Always disconnect the battery and alternator before commencing any electric welding when a pole strap is directly or indirectly connected to engine.

1.7 CARE WITH ELECTRICAL SYSTEMS

- Ensure that the battery is of sufficient capacity to start the engine at its minimum operating temperature, taking into account any drag that may be imposed on the engine by the type of transmission that is attached to it.
- Ensure that the battery and all engine wiring cables are of sufficient size to carry the currents required.
- Check that the engine-mounted alternator is of sufficient output to cope with the total electrical load required by the machine to which it is fitted.

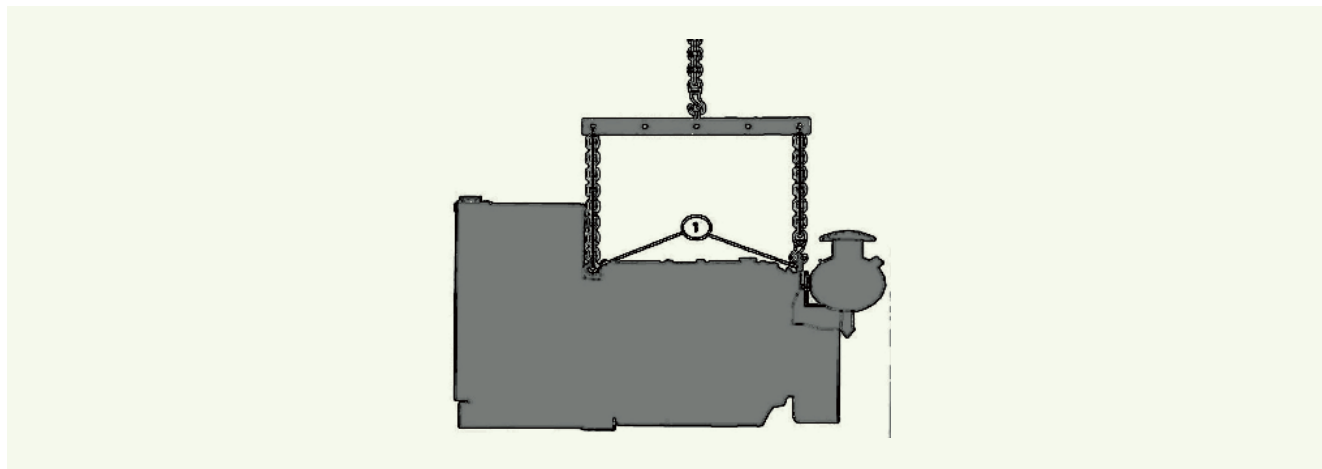
Wiring Cables

Ensure that wiring cables are:

- Bound together in a loom and adequately supported.
- Routed to avoid any hot surfaces, particularly the exhaust system.
- Not in contact with any rough surfaces or sharp corners to avoid chafing.

1.8 LIFTING PRECAUTIONS

The engine lifting eyes are suitable for lifting only the engine and accessory assemblies originally fitted by Lister Petter Engine. They must not be used to attempt to lift an entire generating set.



1.8 Lifting an engine using overhead lifting eyes.



WARNING

DO NOT ATTEMPT TO LIFT THE COMPLETE PLANT USING THE ENGINE LIFTING EYES.

Preparations required before lifting an engine:

- Check that the lifting eyes or lugs are not damaged and ensure they are secure.

Note:

The torque setting for the lifting eyes is 44 Nm (33 ft lb or 4.5 kgf m).

- Use the correct type of lifting appliance with the correct lifting capacity. The lifting appliance shown in Figure 1.8 is recommended for use when lifting vertically and should be connected directly to the lifting eyes.
- In order to protect the rocker cover, ensure there is clearance between the lifting equipment and the cover.



WARNING

DO NOT WORK UNDER ANY PLANT THAT IS HELD ONLY BY OVERHEAD LIFTING EQUIPMENT.

1.9 CARE WITH FILTERS AND ELEMENTS

- The combustion material of some components of the engine (for example certain seals) can become extremely dangerous if burnt. Never allow burnt material to come into contact with the skin or eyes.



WARNING

THE MATERIALS USED IN THE MANUFACTURE AND TREATMENT OF SOME FILTERS AND ELEMENTS MAY CAUSE IRRITATION OR DISCOMFORT. IF THEY COME INTO CONTACT WITH THE EYES OR MOUTH, AND THEY MAY GIVE OFF TOXIC GASES IF THEY ARE BURNT.

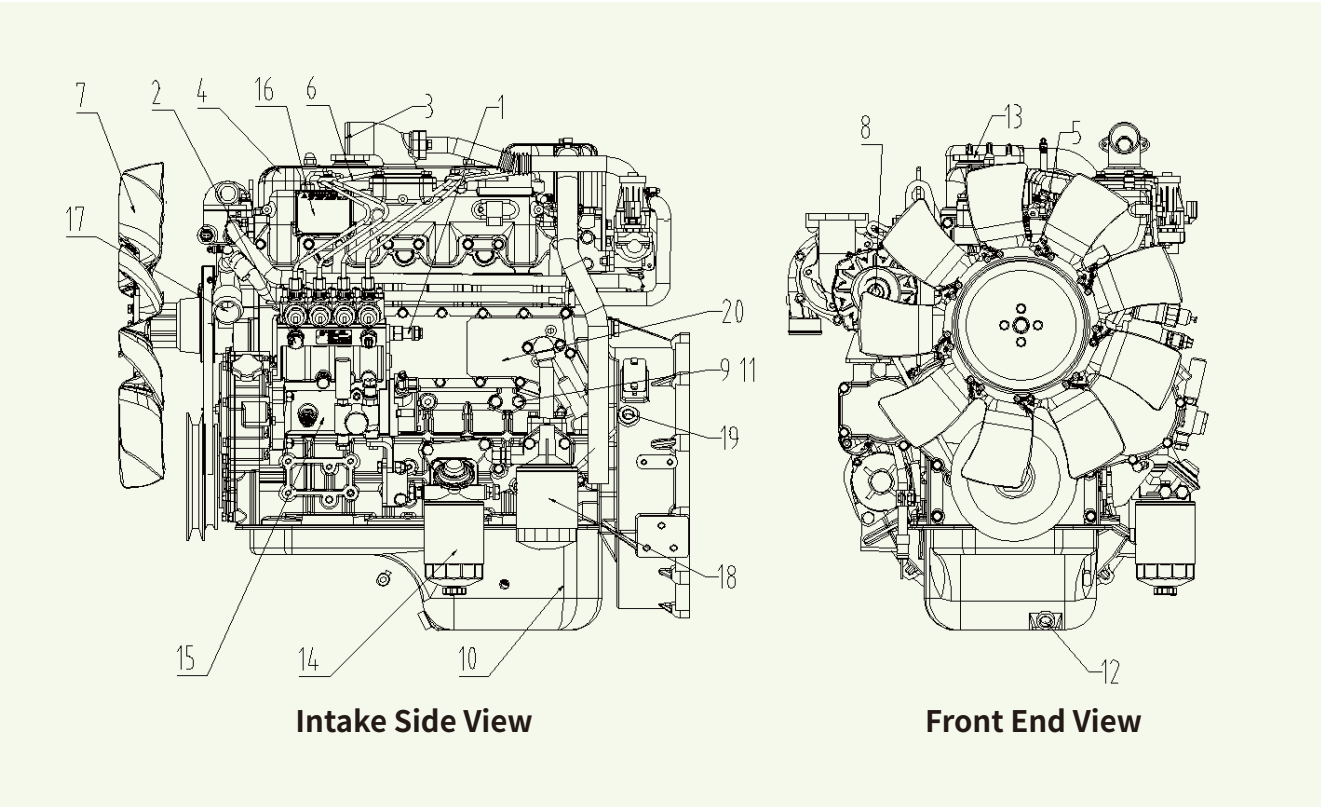
- Used filters and elements contain some of the filtered liquid and should be handled and disposed of with care.
- After handling new or used elements, hands should be thoroughly washed.

1.10 WASTE DISPOSAL

Ensure that waste oil, fuel, filter elements, coolant concentrate, battery electrolyte, solvents and other toxic wastes are disposed of in accordance with official regulations to prevent contamination.

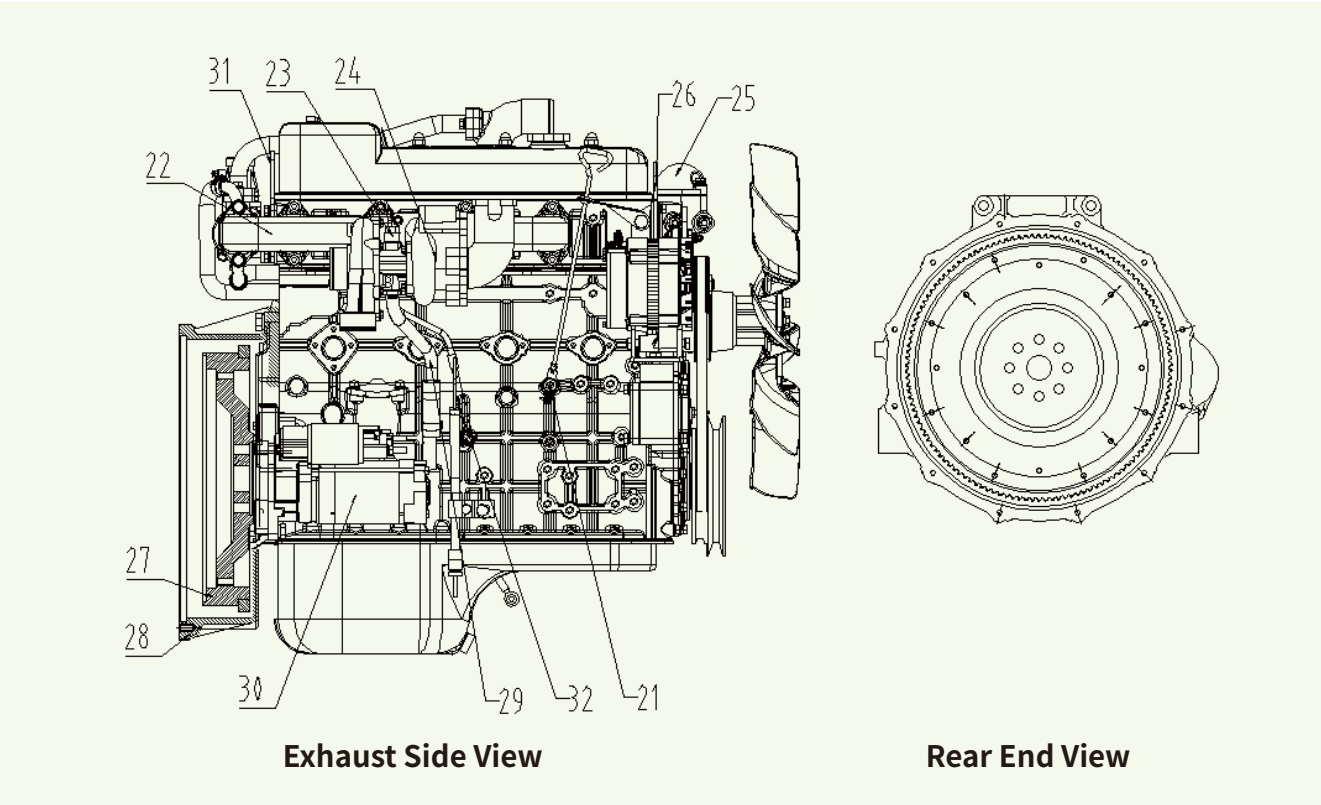
2. ENGINE PARTS AND TECHNICAL DATA

Lister Petter Engine engines are built for many applications. The views which follow do not necessarily match your engine specification.



2.1 Engine 4 cylinder: Exhaust Side and Front End side

1. Fuel return connector	11. Oil temperature gauge connector
2. fuel inlet connector	12. oil drain plug
3. Air inlet connector	13. oil refill port
4. cylinder head cover	14. Fuel filter
5. fuel injector	15. High pressure oil pump
6. High pressure fuel pipe	16. nameplate
7. fan	17. Water pump inlet
8. Generator	18. oil filter
9. oil pressure gauge connector	19. speed sensor
10. oil pan	20. Oil cooler



2.2 Engine 4 cylinder: Intake Side and Rear End side

21. coolant drain plug	27. flywheel
22. exhaust pipe	28. flywheel housing
23. oil inlet pipe for turbocharger	29. oil return pipe for turbocharger
24. turbocharger	30. Starter motor
25. thermostat outlet	31. rear lifting ring
26. Front lifting ring	32. oil ruler

TECHNICAL DATA		
General Engine Data	Engine cycle	4-stroke
	Cylinder arrangement	Inline
	Direction of rotation	Anticlockwise viewed from flywheel end
Induction System	SA315G1, SA423G1, SA427G1, SA430G1, SA432G1	Natural
	SA432G2, SA435G1, SA441G1	Turbocharged
	SA441G2	Turbocharged and intercooled
Bore(nominal)* Stroke	SA315G1	85mm(3.3in)*90mm(3.5in)
	SA423G1	85mm(3.3in)*100mm(3.9in)
	SA427G1	90mm(3.5in)*105mm(4.1in)
	SA430G1	95mm(3.7in)*105mm(4.1in)
	SA432G1, SA432G2	98mm(3.9in)*105mm(4.1in)
	SA435G1	98mm(3.9in)*115mm(4.5in)
	SA441G1, SA441G2	105mm(4.1in)*118mm(4.6in)
Compression Ratio	SA315G1, SA423G1	18.0:1
	SA427G1, SA430G1, SA432G1, SA432G2, SA435G1	18.5:1
	SA441G1, SA441G2	18.0:1
Displacement	SA315G1	1.5 liters (91.5 in3)
	SA423G1	2.3 liters (138.5 in3)
	SA427G1	2.7 liters (164.8 in3)
	SA432G1, SA432G2	3.2 liters (195.3 in3)
	SA435G1	3.5 liters (213.6 in3)
	SA441G1, SA441G2	4.1 liters (250.2 in3)
Firing Order	3-cylinder	1 - 3 - 2
Firing Order	4-cylinder	1 - 3 - 4 - 2
Valve Clearance	Inlet	0.20~0.30mm (SA315G1) 0.30~0.35 mm
	Exhaust	0.25~0.35mm (SA315G1) 0.35~0.40 mm
Oil pressure	@ Idle speed (minimum allowable)	50 kPa
	@ Rated speed (minimum allowable)	200 kPa

3. OPERATING INSTRUCTIONS

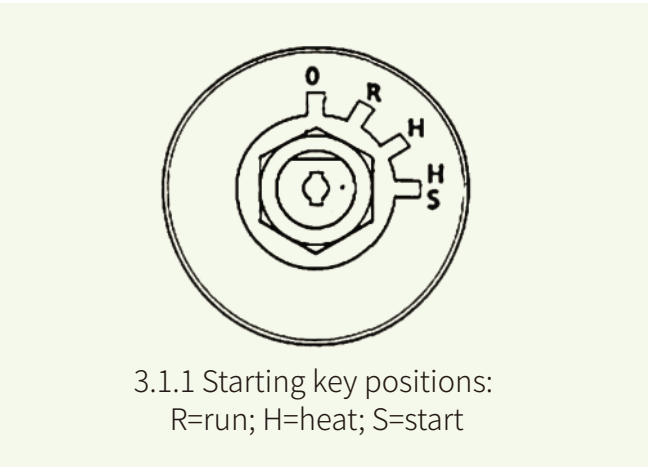
3.1 STARTING THE ENGINE

Several factors affect engine start, for example:

- Battery power
- Starter motor performance
- Lubricating oil viscosity
- Cold start system installation

Diesel engines need a cold start aid in very cold conditions. Normally, your vehicle or your machine will be fitted with the correct equipment for your region of operation.

Lister Petter Engine engines can be equipped with various cold starting systems.



3.1.1 Starting key positions:
R=run; H=heat; S=start



3.1.2 Starting key positions:
R=run; S=start

3.1.1 Starting a Warm Engine

1. If the engine is equipped with a manual stop control, ensure that it is in the run position (**R**).
2. Adjust the engine speed control to the quarter open position.
3. Turn the key to the start position (**HS/S**) to engage the starter motor (Figures 3.1.1 and 3.1.2).
4. Allow the start key to return to position R as soon as the engine starts. Always ensure that the engine and starter motor are stationary before the starter motor is engaged again.

3.1.2 Starting a Cold Engine without Starting Aids

1. If the engine is equipped with a manual stop control, ensure that it is in the run position (**R**).
2. Adjust the engine speed control to the maximum speed position.
3. Turn the start key to the start position (**S**) to engage the starter motor (Figure 3.1.2). Allow the key to return to position R when the engine starts. Adjust the speed control to get an even idle speed.
4. If the engine does not start in 30 seconds, allow the start key to return to the **R** position for another 30 seconds. Then engage the starter motor again for a maximum period of 30 seconds.

3.1.3 Starting a Cold Engine with Starting Aids

1. If the engine is equipped with a manual stop control, ensure that it is in the run position.

- Turn the start key to position **h** and leave there for 15 seconds (Figure 3.1.1).
- Adjust the engine speed control to the maximum speed position.
- Turn the start key to position **hS** to engage the starter motor (Figure 3.1.1). Allow the start key to return to position **R** as soon as the engine starts. Adjust the speed control to get an even idle speed.
- If the engine does not start in 15 seconds, turn the start key to the **h** position and hold it there for 10 seconds then engage the starting motor again.


CAUTION

A SHORT CIRCUIT OR REVERSAL OF POLARITY WILL RUIN DIODES AND TRANSISTORS.

3.2 STOPPING THE ENGINE

According to the equipment fitted, either turn the start key to position **0** or operate the manual stop control. If a manual stop control is used, ensure that the control returns to the run position after the engine has stopped. Also, ensure that the engine start key is turned to the **0** position.


CAUTION

IT IS RECOMMENDED THAT A TURBOCHARGED ENGINE IS RUN AT APPROXIMATELY 1000 R/MIN AT A REDUCED LOAD FOR 2-3 MINUTES BEFORE IT IS SHUT DOWN. THIS ALLOWS THE TURBO-CHARGER TO COOL.

3.3 ADJUSTMENT OF ENGINE SPEED

The idle or maximum speed setting must not be changed by the engine operator as this may damage the engine or transmission.

The warranty of the engine is invalidated if the seals on the fuel injection pump are broken during the warranty period by a person who is not approved by Lister Petter Engine.

3.4 RUNNING-IN

A gradual running-in of a new engine is not necessary.


CAUTION

PROLONGED OPERATION AT LIGHT LOAD DURING THE EARLY LIFE OF THE ENGINE CAN CAUSE LUBRICATING OIL TO ENTER THE EXHAUST SYSTEM.

Maximum load can be applied to a new engine as soon as the engine is put into service and the cool-ant temperature has reached a minimum of 60°C (140°F). The engine will benefit if the load is applied as soon as possible after the engine is put into service.


CAUTION

DO NOT OPERATE THE ENGINE AT HIGH SPEEDS WITHOUT LOAD.


CAUTION

DO NOT OVERLOAD THE ENGINE.

3.5 ALTITUDE

If the naturally aspirated engine is to run at an altitude above 600 m (2000 ft) the fuel delivery can be changed to reduce fuel consumption and smoke. Lister Petter Engine can give the percentage of fuel reduction necessary if details of engine application and ambient conditions are provided. Information for turbocharged engines can be obtained from Lister Petter Engine. Changes to the settings of the fuel injection pump must be made by a Lister Petter Engine distributor or by an approved distributor for the fuel injection pump.

4.ENGINE FLUIDS

4.1 FUEL SPECIFICATION

To get the correct power and performance from your engine, use good quality fuel. The recommended fuel specification for Lister Petter Engine engines is indicated below.

FUEL SPECIFICATION	
Factor	Specification
Cetane Number	50 minimum
Viscosity	2.0 / 4.5 centistoke at 40°C
Density	0.835-0.855 kg/litre
Sulphur	0.2% of mass maximum
Distillation	85% at 350°C

• Cetane Number

This indicates ignition performance. A fuel with a low cetane number can cause starting problems and affect combustion.

• Viscosity

Engine performance can be affected if viscosity (resistance to flow) is outside the given limits.

• Density

A low-density fuel reduces engine power. A high density fuel increases engine power and exhaust emissions

• **Sulphur**

A high sulphur content (not normally found in Europe, North America or Australasia) can cause engine wear. Where only high sulphur fuels are available, it is necessary to use highly alkaline lubricating oil or to renew the lubricating oil more frequently (see sections 5.1 and 5.9).

• **Distillation**

This is an indication of the mixture of different hydrocarbons in the fuel. A high ratio of lightweight hydrocarbons can affect the combustion characteristics.

4.1.1 Low Temperature Fuels

Special winter fuels may be available for engine operation at temperatures below 0°C. These fuels have a lower viscosity and also limit the wax formation in the fuel at low temperatures. If wax formation occurs, this could stop the fuel flow through the filter.


CAUTION

THE QUALITY OF THE FUEL AFFECTS THE TYPE OF LUBRICATING OIL REQUIRED. SEE 4.1 ABOVE.

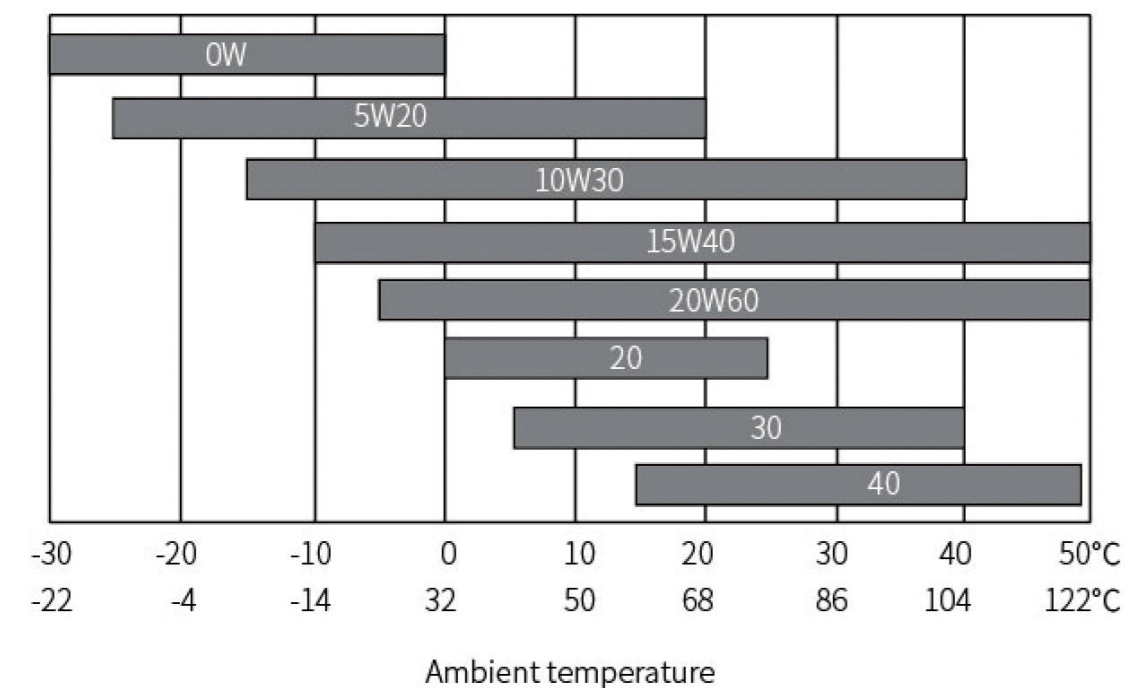
4.2 LUBRICATING OIL SPECIFICATION

Use only a good quality lubricating oil, to the relevant specification, as shown in the following table:

LUBRICATING OIL SPECIFICATION		
Engine Type	Specification	
	API CF4	API CF-4
Naturally Aspirated	•	•(Note 1)
Engines in Heavy Duty Applications		•
Earth moving Equipment		•
Turbocharged		•

Note 1: Not recommended during the first 40 hours of operation, nor for light load applications.

Always ensure that the correct viscosity grade of lubricating oil is used for the ambient temperature range in which the engine will run as shown in Figure 4.2. For advice on adjustments to an engine setting or to the lubricating oil change periods which may be necessary because of the standard of available fuel, consult your nearest Lister Petter Engine distributor.



4.2 Oil viscosity

4.3 COOLANT SPECIFICATION

The quality of coolant used affects the efficiency and life of the cooling system. The recommendations in the table below will help to maintain the cooling system in good condition and to protect it against frost and/or corrosion.

COOLANT SPECIFICATION			
Description	Ethulene (% volume)	Water (% volume)	Solidifying Point (°C)
Antifreeze Fluid	60	40	-55
	55	45	-40
	50	50	-30
	40	60	-22

- If possible, use clean soft water in the coolant mix.

If an antifreeze mixture other than that recommended by Lister Petter Engine is used, it must be ethanediol (ethylene glycol) based with a corrosion inhibitor. It is recommended that the corrosion inhibitor is of the sodium nitrite/ sodium benzoate type. The antifreeze mixture must be an efficient cool agent at all ambient temperatures and it must provide protection against corrosion.

It must also have a specification at least as good as the requirement of the standard BS6580: MOD AL39. Lister Petter Engine antifreeze exceeds the requirements of this standard. The quality of anti-freeze coolant must be checked at least once a year, for example, at the beginning of the cold period. The coolant must be renewed every two years. The antifreeze mixture must contain equal quantities of antifreeze and water. Concentrations of more than 50% antifreeze must not be used as this can affect the performance of the coolant adversely.

When frost protection is not necessary, it is still an advantage to use an approved antifreeze mixture because this gives protection against corrosion and also raises the boiling point of the coolant.


CAUTION

FAILURE TO FOLLOW THE CORRECT COOLANT SPECIFICATION AND PROCEDURES MAY LEAD TO DAMAGE BY FROST OR CORROSION.

If an antifreeze mixture is not used, add the correct mixture of corrosion inhibitor to the water. Renew the mixture of water and corrosion inhibitor every six months or check it according to the inhibitor manufacturer's recommendations.


CAUTION

CERTAIN CORROSION INHIBITOR MIXTURES CAN CAUSE DAMAGE TO SOME ENGINE COMPONENTS. IT IS RECOMMENDED THAT YOU CONSULT THE SERVICE DEPARTMENT AT LISTER PETTER ENGINE CO., LTD. IF A CORROSION INHIBITOR IS TO BE USED.

5. ROUTINE MAINTENANCE

5.1 MAINTENANCE SCHEDULE

Routine maintenance should be undertaken regularly at the intervals stated in Figure 5.1.1. Engines with long daily running times require more frequent maintenance than those with average running times. The intervals are therefore expressed both as running hours and as months. You should undertake the work at whichever limit is reached first.

Maintenance tasks	First service at 50 hours	Daily	250 h or 3 months	500 h or 6 months	1,000 h or 12 months	2,000 h or 2 years
Checking engine periphery	●	●	●	●	●	●
Checking fuel tank	●	●	●	●	●	●
Checking air filter service indicator	●	●	●	●	●	●
Checking primary fuel filter service indicator	●	●	●	●	●	●
Checking oil level	●	●	●	●	●	●
Checking coolant level	●	●	●	●	●	●
Checking electrolyte level	●	●	●	●	●	●
Checking drive belt *	●	●	●	●	●	●
Checking cooling fan	●	●	●	●	●	●
Checking leakage	●	●	●	●	●	●
Checking accessory tighten condition	●	●	●	●	●	●

Excluding water and sediment in oil-water separator	●	●	●	●	●	●
Checking intake system		●	●	●	●	●
Changing lubricating oil and oil filter	●		●	●	●	●
Changing fuel filter (including primaryfilter) **				●	●	●
Priming fuel system				●	●	●
Checking/adjusting valve clearance	●			●	●	●
Checking intercooler and its lines			●	●	●	●
Check antifreeze density				●	●	●
Checking belt tensioner ***	●				●	●
Checking fan bearing	●					●
Checking turbocharger	●					●
Checking vibration damper						●
Changing coolant and cleaning cooling system						●

5.1.1 Maintenance Schedule

*The Belt must be replaced when it has crack or defect(s) that affects its use.

** The replacement period of the primary fuel filter should be shorten properly when it contains a certain amount of foreign particulates and causes difficulty to pump fuel.

***The belt tensioner must be replaced when its pulley doesn’ t spin freely.

Note : If a primary air filter is equipped, clean it every 50 hours’ operation.

The intervals apply only to engines operating under normal conditions and using fuel and lubricating oil that conform to the specifications given in this handbook. If the engine is running in dusty or otherwise adverse conditions, the maintenance intervals must be more frequent. Check also the maintenance periods recommended by the manufacturer of the equipment in which the engine is installed. If these intervals are shorter, you should observe them.

OIL CHANGE PERIODS	
Fuel sulphur content (%)	Oil change period
< 0.5	normal
0.5 - 1.0	0.75% of normal
> 1.0	0.50% of normal

5.1.2 The effect of sulphur content on oil change periods

If there are local regulations affecting the operation of the engine, it may be necessary to adapt the maintenance periods accordingly.

It is advisable to check for leakage and loose components at each service.

5.2 DRAINING THE COOLING SYSTEM

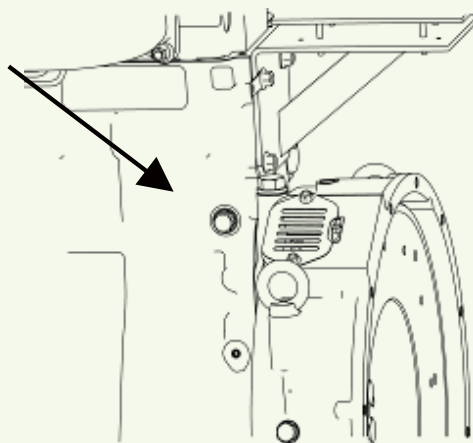
1. Ensure that the engine is on level ground and that it has had time to cool down.

! WARNING

NEVER DRAIN THE COOLANT WHILE THE ENGINE IS STILL HOT AND THE SYSTEM IS UNDER PRESSURE. THIS IS DANGEROUS AND COULD CAUSE INJURY FROM DISCHARGED COOLANT.

2. Remove the filler cap of the cooling system.

3. **Release the drain valve on the water pump and drain the coolant in the diesel engine cooling system.** (see Figure 5.2)



5.2 The locations of the cooling system drain plug

4. Open the tap or remove the drain plug at the bottom of the radiator in order to drain the radiator. If the radiator does not have a tap or a plug, disconnect the hose at the bottom of the radiator.

5. If necessary, flush the system with clean water.

6. Fit the drain plugs and the filler cap. Close the radiator tap or connect the radiator hose.

In order to ensure the engine coolant to be good in cooling and anticorrosion, changing of coolant and cleaning of cooling system is required every 2,000 hours or 2 years, whichever comes.

! WARNING

AT OPERATING TEMPERATURE, ENGINE COOLANT IS HOT AND UNDER PRESSURE, AND COOLANT STEAM CAN CAUSE PERSONAL INJURY. DO NOT REMOVE THE PRESSURE CAP ON THE RADIATOR UNTIL THE ENGINE STOPS AND COOLANT TEMPERATURE GOES BELOW 50°C. SLOWLY UNSCREW THE PRESSURE CAP TO RELEASE THE COOLING SYSTEM PRESSURE.

! WARNING

THE ANTI-RUST ADDITIVE IN THE COOLANT CONTAINS ALKALI, SO AVOID SKIN AND EYE CONTACT TO PREVENT PERSONAL INJURY.

7. Stop the engine and wait until the temperature of coolant falls to below 50°C. Slowly unscrew the pressure cap to release pressure and remove the cap. Loosen the drain cock on the radiator to completely drain the coolant in the radiator.

8. Remove the water drain plug on the engine, scrap the O- ring and completely drain the coolant in the cooling system.

9. Clean the cooling system according to the following steps.

(a). Install and screw up all the drain cocks and plug, and add the sodium carbonate solution (or the mixture of sodium carbonate and water that is available in market) into the cooling system from the coolant filler.

! CAUTION

EACH 23L OF WATER SHOULD BE MIXED WITH 0.5 KG SODIUM CARBONATE. DO NOT USE CAUSTIC CLEANER, OR IT WILL DO HARM TO ALUMINUM PARTS.

! CAUTION

PURGE THE AIR IN THE COOLANT SYSTEM WHILE ADDING THE CLEANING FLUID. POUR THE CLEANING FLUID SLOWLY TO AVOID AIR BLOCK. THE CLEANING FLUID SHOULD BE ADDED UP TO THE BOTTOM OF THE FILLER IN THE RADIATOR AND WAIT FOR ABOUT 3-5 MINUTES FOR A FULL PURGE OF AIR.

(b). Start the engine and keep it running for 5 minutes after the cleaning fluid temperature has gone up to above 80°C, then stop the engine and completely drain the cleaning fluid in the cooling system.

! CAUTION

DURING THE WHOLE CLEANING PROCESS THE PRESSURE CAP SHOULD NOT BE ON AND THE ENGINE RUNS WITHOUT THE CAP ON.

(c). Add clean water into the cooling system

! CAUTION

POUR CLEAN WATER SLOWLY TO AVOID AIR BLOCK. CLEAN WATER SHOULD BE ADDED UP TO THE BOTTOM OF THE FILLER IN THE RADIATOR AND WAIT FOR ABOUT 3-5 MINUTES FOR A FULL PURGE OF AIR.

(d). Start the engine and keep it running for 5 minutes after the water temperature has gone up to above 80°C, then stop the engine and completely drain the clean water in the cooling system.

! CAUTION

IF THE DISCHARGED WATER IS STILL DIRTY, CLEAN THE COOLING SYSTEM AGAIN ACCORDING TO THE ABOVE STEPS UNTIL DISCHARGED WATER BECOMES CLEAN.

10. After cleaning, tighten all water drain cocks on the radiator and air compressor and use a new O-ring and tighten the plug on the engine to 45 N·m.

11. Add coolant. Fill the cooling system with the specified coolant, and the total engine cooling system volume is as follows:

! CAUTION

ENGINE COOLANT CAPACITY LISTED ABOVE REFERS TO THE COOLANT VOLUME IN THE ENGINE COOLING SYSTEM. THE ACTUAL AMOUNT SHOULD REFER TO THE VEHICLE OR EQUIPMENT DATA.

! CAUTION

ADD COOLANT SLOWLY TO AVOID AIR BLOCK. COOLANT SHOULD BE ADDED UP TO THE BOTTOM OF THE FILLER IN THE RADIATOR OR MEET THE REQUIREMENT OF VEHICLE OR EQUIPMENT MANUFACTURER. WAIT FOR ABOUT 3-5 MINUTES FOR A FULL PURGE OF AIR.

12. Install the pressure cap on the radiator, start and run the engine until coolant temperature goes up to 80°C, then stop the engine and check the cooling system for leakage.

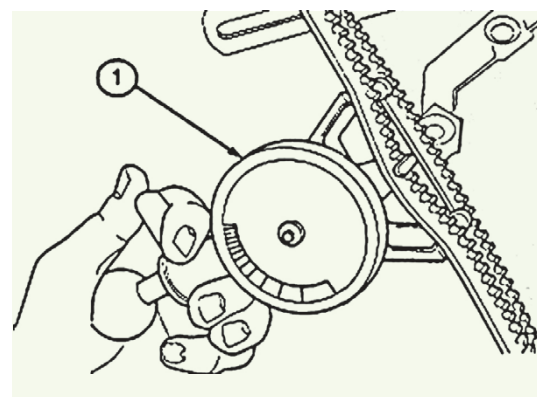
13. Stop the engine and wait until the coolant temperature falls to below 50°C. Then open the pressure cap and recheck the coolant level. Supplement properly, if necessary.

5.3 CHECKING THE DRIVE BELTS

Always renew the belt if it is worn or damaged.

If twin belts are fitted, they must be renewed together.

To ensure maximum belt life, it is recommended that a belt tensioner gauge is used to check the belt tension. Fit the gauge (Figure 5.3) at the center of the longest free length and check the tension. If a Burroughs gauge is used, the correct tension is 355N (80 lbf or 36 kgf). If the tension is below 220N (50 lbf or 22 kgf) adjust to 355N as indicated below.



5.3 Using the belt tensioner gauge

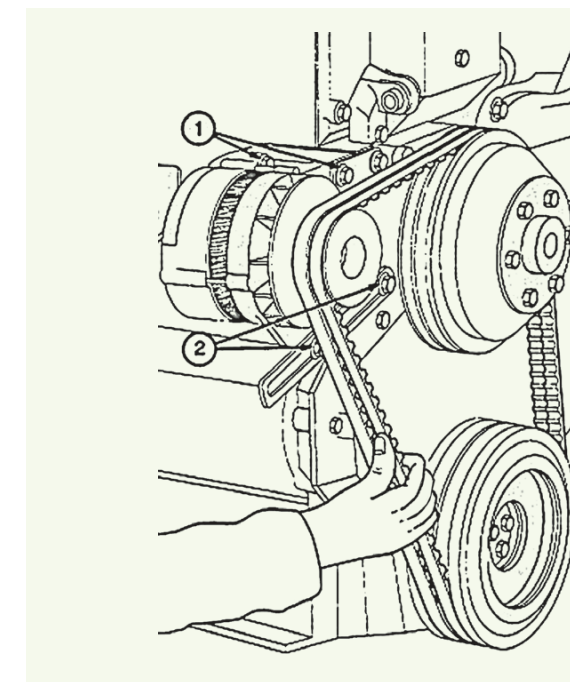
If a gauge is not available, press down the belt with a thumb at the center of the longest free length and check the deflection (Figure 5.3). With moderate thumb pressure, 45N (10 lbf or 4.5 kgf), the correct deflection is 10 mm 3/8 in).

If twin belts are fitted, check and if necessary adjust the tension on the tighter belt.

5.3.1 Adjusting the belt Tension

Refer to Figure 5.3.1 below.

1. Loosen the pivot fasteners of the alternator (1) and also the adjustment link fasteners (2).



5.3.1 Checking drive belt tension without a gauge.

(1) Pivot fasteners of alternator;
(2) Adjustment link fasteners.

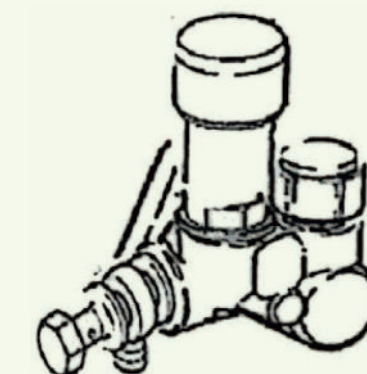
2. Change the position of the alternator to give the correct tension, tighten the pivot fasteners of the alternator and the adjustment link fasteners.

3. Check the belt tension again to ensure that it is still correct. If a new belt is fitted, the belt tension must be checked again.

5.4 CLEANING THE FUEL LIFT PUMP

Refer to Figure 5.4.

1. Remove the fuel lift pump and place into clean fuel.
 2. Carefully wash all sediment from the lift pump body.
 3. Clean the gauze strainer, joint and cover.
 4. Assemble the lift pump. Ensure that the lift pump body and the cover are fitted together correctly because leakage at this point will let air into the fuel system.
- If fitted, refit the heat shield.



5.4 The fuel lift pump

5. Eliminate the air from the fuel system through the filter vent point (see section 5.8).

5.5 CHECKING THE FUEL PRE-FILTER

Some engines are fitted with a pre-filter of the same main type as the fuel filter element (see 5.6 below). This will normally be fitted between the fuel tank and the engine and is connected to the main filter but before the fuel lift pump. Both elements must be removed at the same time.

Check the fuel bowl for water at regular intervals and drain as necessary.

5.6 RENEWING THE FEUL FILTER ELEMENT

There are three fuel filter element types in use (see Figure 5.6).

1. Separate Type

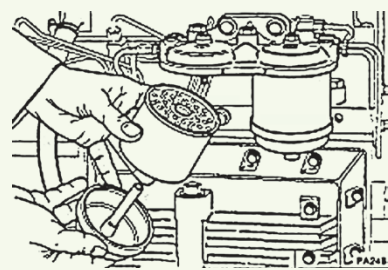
The filter element is held between the filter head and the bottom cover.

2. Canister Type

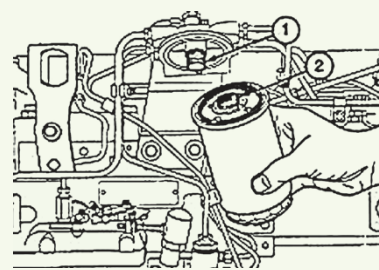
The filter element has an internal thread at the top and is fastened to a threaded adaptor in the filter head.

3. Quick Release Canister Type

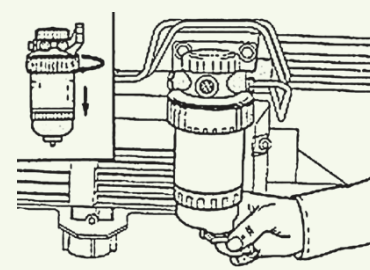
This has been introduced on certain engines.



A. Separate type element



B. Canister type element



C. Quick release element

5.6 Fuel filter element types



CAUTION

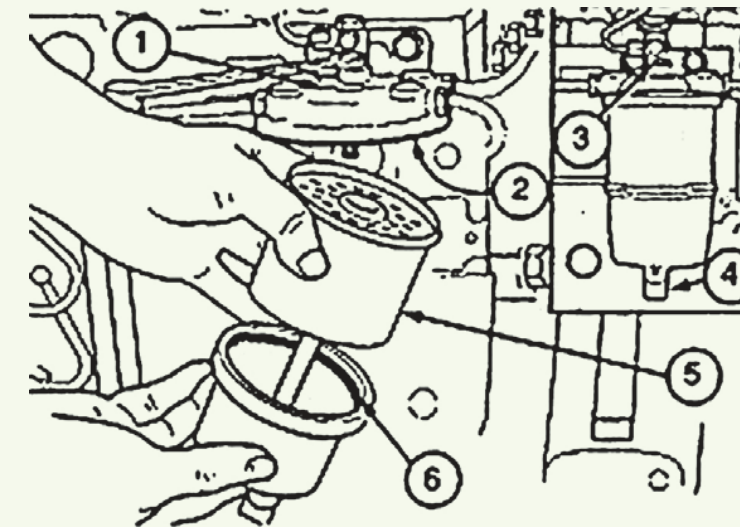
IT IS IMPORTANT THAT ONLY GENUINE LISTER PETTER FUEL FILTER ELEMENTS ARE USED. THE WRONG ELEMENT CAN DAMAGE THE FUEL INJECTION PUMP.

5.6.1 Renewing A Separate Type Fuel Filter Element

Refer to Figure 5.6.1.

The filter can have one or two elements.

When twin elements are fitted both the elements must be renewed at the same time.



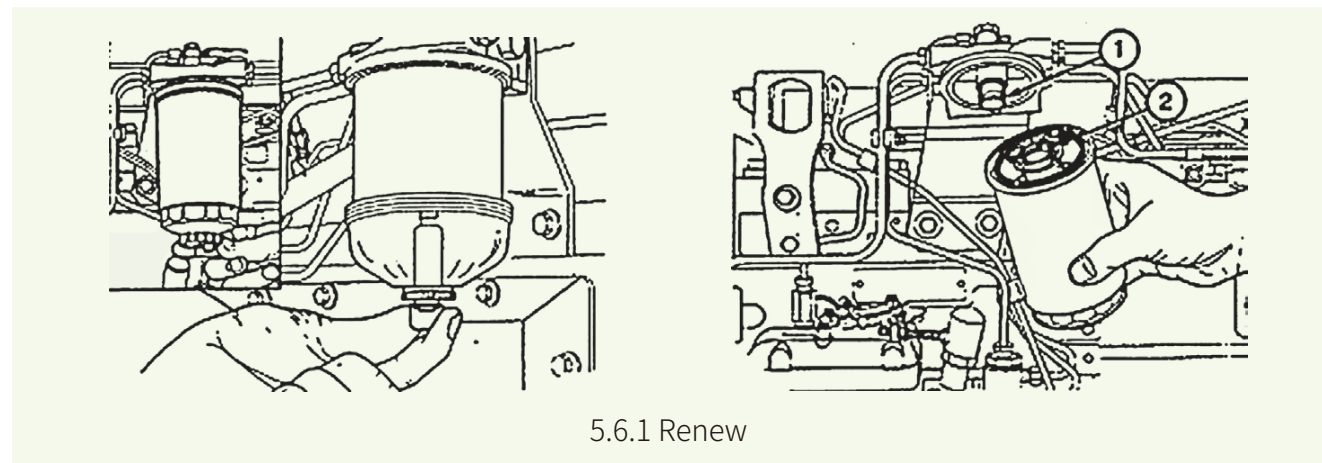
5.6.1 Renewing a separate type element

1. Clean the outside surfaces of the fuel filter assembly. If a drain tap is fitted to the bottom of the filter bowl, drain the fuel from the filter.
2. Hold the bottom cover of the filter element and release the set screw which is fitted through the filter head above the center of each element
3. Lower the bottom cover of the filter.
4. Remove the element and discard it.
5. Clean the inside surfaces of the filter head and cover.
6. Renew the seals and lightly lubricate them with clean fuel.
7. Put the bottom cover under the new element and hold the element square to the filter head. Ensure the element is fitted in the center against the joint in the filter head. With the assembly in this position, engage and tighten the set screw.
8. Eliminate the air from the fuel filter (see Section 5.8).

5.6.2 Renewing A Canister Type Fuel Filter Element

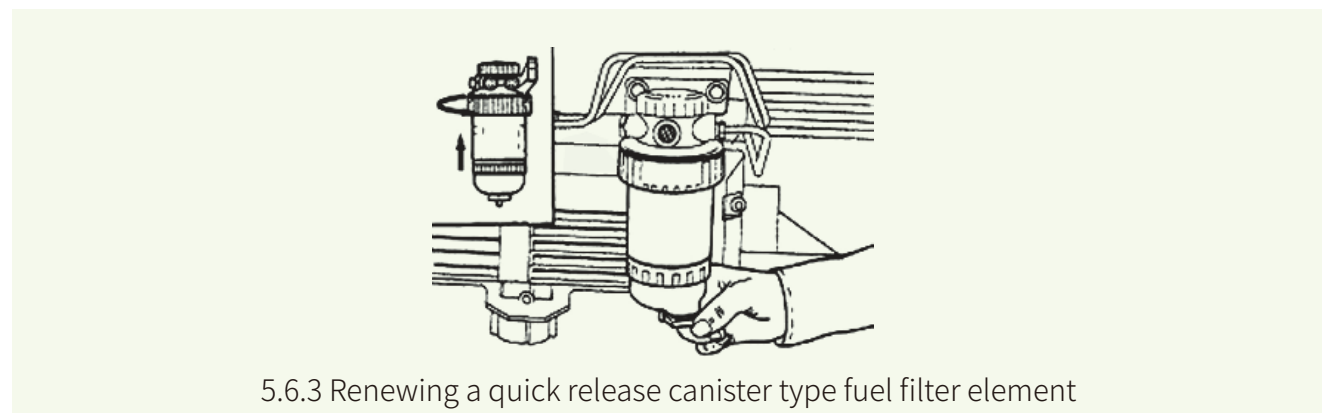
Refer to Figure 5.6.2.

1. Clean the outside surfaces of the fuel filter assembly.
2. Loosen the drain device at the bottom of the filter and allow the water / fuel to drain into a suitable container.
3. Use a strap wrench or similar tool to loosen the filter canister and remove the canister.
4. Ensure that the threaded adaptor is secured in the filter head and that the inside of the head is clean.
5. Lubricate lightly the top seals between the new canister and the filter head (1, 2) and tighten by hand only.
6. Eliminate the air from the fuel filter (see Section 5.8).



5.6.3 Renewing A Quick Release Canister Type Fuel Filter Element

Refer to Figure 5.6.3.



1. Clean the outside surfaces of the fuel filter assembly.
2. Loosen the drain device at the bottom of the filter and allow the water / fuel to drain into a suitable container.
3. Turn the sediment bowl (if fitted) to the left, and remove.
4. Turn the clamp ring to the left and remove.
5. Remove the canister from the filter head (1) by pulling directly downwards. Discard the old canister.
6. Ensure the filter head is clean and push the new canister fully into the filter head (see arrow).
7. Fit the clamp ring and turn it fully to the right to fasten the canister to the filter head.
8. Remove the cover of the sediment bowl and clean thoroughly.
9. Check the two 'O' ring seals of the sediment bowl cover for damage, and replace if necessary.
10. Clean the threads of the sediment bowl fastener. To secure the bowl to the canister, turn the bowl fully to the right. Tighten by hand only.
11. Eliminate the air from the fuel filter (see Section 5.7).

5.7 ELIMINATING AIR FROM THE FUEL SYSTEM

If air enters the fuel system, it must be eliminated before the engine can be started. Air can enter the system if:

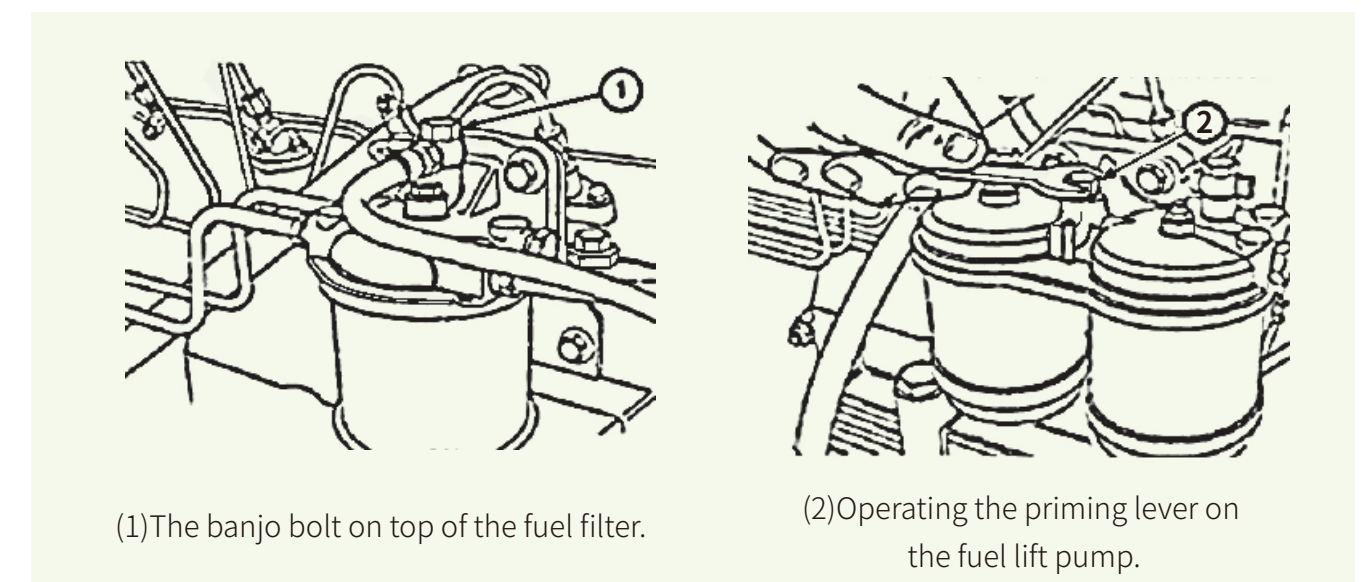
- The fuel tank is drained during normal operation.
- The low pressure fuel pipes are disconnected or damaged / broken.
- A part of the low pressure fuel system leaks during engine operation.

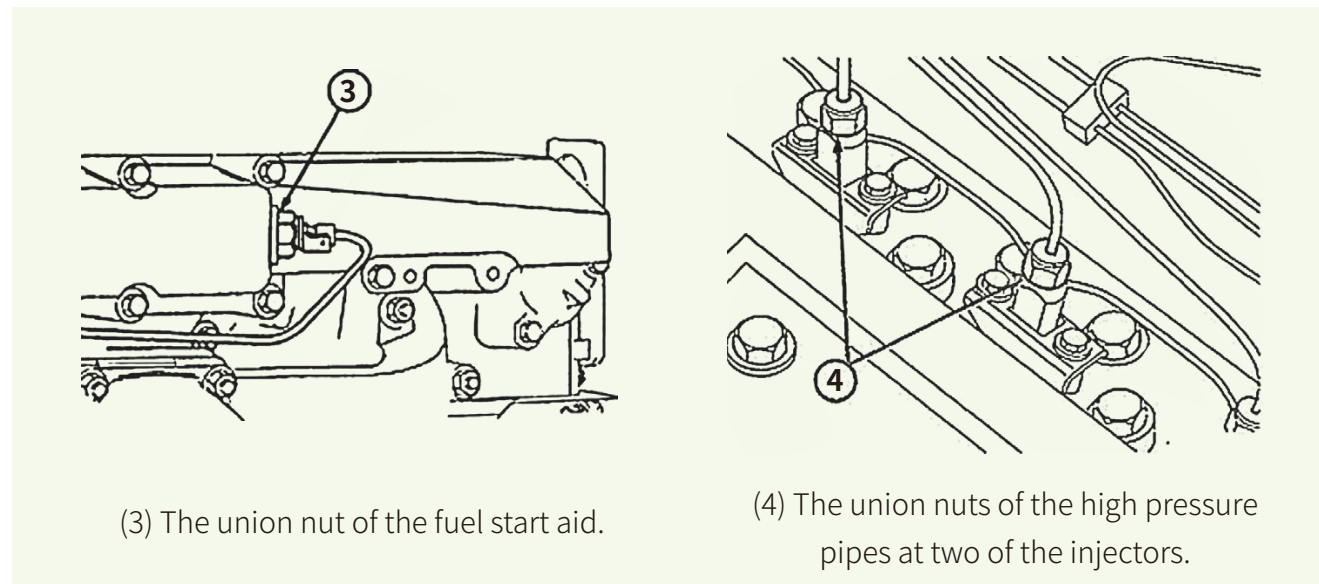
To eliminate air from the fuel system, use one of the following procedures depending on the fuel system vent set up on your engine.

5.7.1 Standard Method

Refer to Figure 5.7.1.

1. Loosen the vent plug on top of the twin element fuel filter, or, if there is only one fuel filter element the banjo bolt which is fitted on the top of the filter (1).
2. Operate the priming lever on the fuel lift pump until air free fuel flows from the filter venting point (2). Tighten the vent plug of the banjo connection bolt. If the drive cam of the fuel lift pump is at point of maximum cam lift it will not be possible to operate the priming lever. In this situation, the crankshaft must be turned one revolution.
3. Ensure that the manual stop control is in the run position. If an electrical stop control is used turn the start key to the **R** position.
4. For engine codes AA and VA, loosen the vent screw in the lock screw of the hydraulic head and the vent screw on the governor cover of the fuel injection pump.
5. Operate the priming lever of the fuel lift pump until fuel flows from the vent screws, then re-tighten the vent screws.
6. Loosen the union nut (3) at the fuel start aid (Figure 5.8.1b) and operate the lift pump until fuel freely flows from the connection. Re-tighten the union nut.
7. Loosen the union nuts (4) of the high pressure pipes at two of the injectors (Figure 5.7.1c). Operate the starter motor until air free fuel flows from these connections, and re-tighten.





5.7.1 Standard method of eliminating air from the fuel system

CAUTION

DO NOT TIGHTEN THE NUTS OF THE HIGH PRESSURE PIPES MORE THAN THE RECOMMENDED TORQUE. IF THERE IS A LEAKAGE FROM THE UNION NUT, ENSURE THAT THE PIPE IS CORRECTLY ALIGNED WITH THE INJECTOR INLET. DO NOT TIGHTEN THE UNION NUT MORE, AS THIS CAN CAUSE A RESTRICTION AT THE END OF THE PIPE WHICH IN TURN WILL AFFECT THE FUEL DELIVERY TO THE ENGINE.

8. The engine is now ready to start. If the engine runs correctly for a short time then stops or runs roughly, check for air in the fuel system. If there is air in the fuel system, there is probably a leak in the low pressure section of the fuel system.

5.7.2 Method Using In-Line PB Type Injection Pump

Refer to Figure 5.7.2 and to the Appendix.

1. Loosen the vent plug on the top of the fuel filter (1) by turning it two or three turns. Operate the fuel lift pump until fuel flows without air. Re-tighten the plug.
2. Loosen the connecting screw on the housing at the driving side (2). Operate the fuel lift pump until fuel flows without air from the loosened joint. Re-tighten the connecting screws.
3. Loosen the connecting nut on the fuel start aid (3). Operate the fuel lift pump until air free fuel flows from the loosened joint. Re-tighten the connecting nut. Use a spanner to prevent the connecting nut from moving (4).
4. Ensure that the stop controller is in the run position and the speed controller is at the maximum speed position. Operate the starter motor. After starting the engine, decrease the engine speed. If after a short period of normal running the engine stops or runs roughly it may be because there is a leak in the low pressure section of the fuel system. Check this and rectify if necessary.

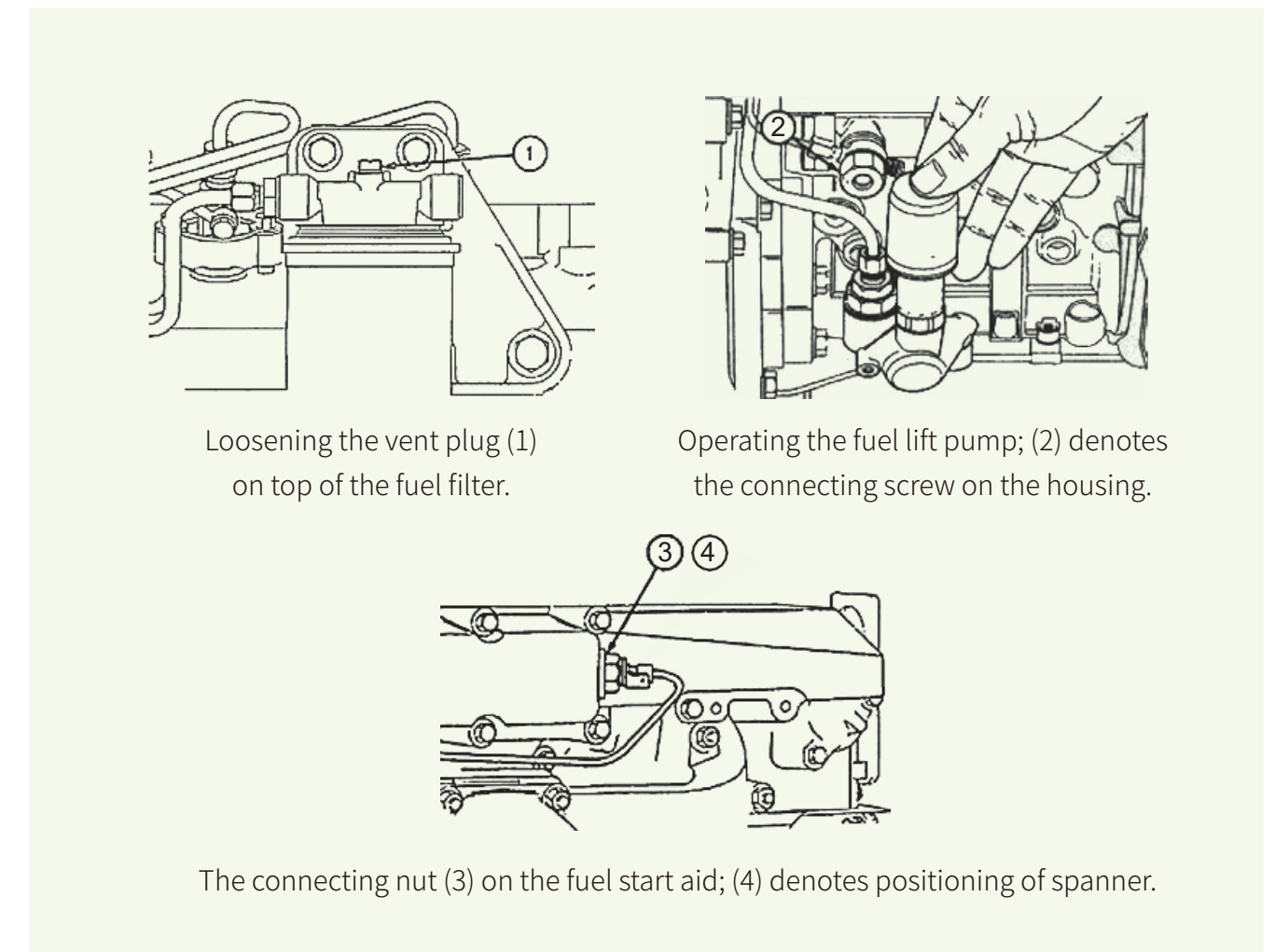


Figure 5.7.2 Eliminating air from the fuel system using an in-line PB type injection pump.

CAUTION

ANY WASTE FUEL MUST BE COLLECTED AND DISPOSED OF IN A RESPONSIBLE MANNER AND IN ACCORDANCE WITH LOCAL AUTHORITY GUIDELINES.

5.8 CHANGING THE LUBRICATION OIL

Refer to Figure 5.8.

1. Operate the engine until the coolant temperature reaches 60°C.
2. Stop the engine, remove the sump drain plug (Figure 5.9) and O-ring and drain the lubricating oil from the sump.
3. Ensure the O-ring is not damaged. Fit the O-ring and drain plug back into the sump and tighten to a torque of 34 Nm (25 lbf ft or 3.5 kgfm).

4. Fill the sump to the MAX mark on the dipstick (Figure 5.9) with new, clean lubricating oil of an approved grade (see 4.Engine Fluids).

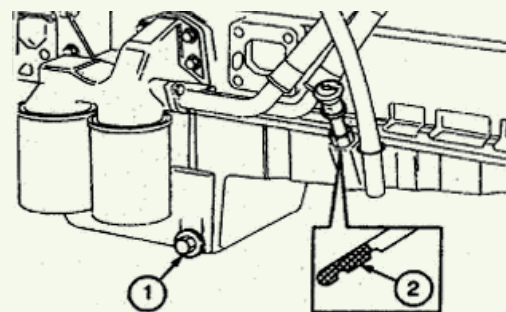


Figure 5.8 The oil sump, showing drain plug (1) and dipstick (2).

5.9 REPLACING THE OIL FILTER CANISTER

Refer to Figure 5.9.

The filter can have a single or double canister. If two canisters are fitted they must both be replaced at the same time.

! CAUTION

THE CANISTER CONTAINS A VALVE AND SPECIAL TUBE TO ENSURE THAT LUBRICATING OIL DOES NOT DRAIN FROM THE FILTER. THEREFORE, ENSURE THAT THE CORRECT LISTER PETTER CANISTER IS USED.

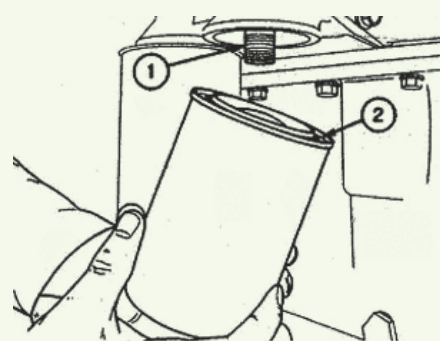


Figure 5.9 Replacing the oil filter canister: (1) the adaptor; (2) the canister.

1. Place a tray under the filter to collect spilled lubricating oil.
2. Remove the filter canister with a strap wrench or similar tool. Ensure that the adaptor (Figure 5.9) is secure in the filter head, and then discard the canister.
3. Clean the filter head .
4. Add clean lubricating oil to the new canister. Allow the oil enough time to pass through the filter element.

5. Lubricate the top of the canister seal with clean lubricating oil.
6. Fit the new canister and tighten it by hand only. Do NOT use a strap wrench.
7. Ensure that there is lubricating oil in the sump. On turbocharged engines, ensure that the engine will not start and operate the starter motor until oil pressure is obtained. To ensure that the engine will not start, either put the manual stop control in the stop position or disconnect the electrical stop control of the fuel injection pump. Oil pressure is indicated when the warning light is extinguished or by reading a gauge.
8. Operate the engine and check for leakage from the filter. When the engine has cooled, check the oil level on the dipstick and put more oil into the sump if necessary.

5.10 CHECKING INTERCOOLER AND ITS LINES

Perform visual check on the air inlet and outlet chambers of the intercooler for crack, perforation or other damages, and of the air inlet and outlet pipes of the intercooler for sealing-off and other damages. Replace the intercooler if necessary.

Perform visual check on the hoses of air inlet and outlet pipes and water inlet and outlet pipes (water-to-air cooler) for crack and check the clamps for looseness. Replace the hose(s) if any fault is found, and tighten clamp screws if looseness is found.

5.11 SERVICING THE AIR CLEANER

A typical wet type air cleaner is shown in Figure 5.11. The wet type air cleaner must be drained regularly.

1. The container and element (1) must be cleaned with kerosene or with another suitable fluid. Do NOT use gasoline.
2. Check that the seal (2) is not damaged. Renew it if necessary.
3. Fill to the indicated level (3) with clean engine lubricating oil.

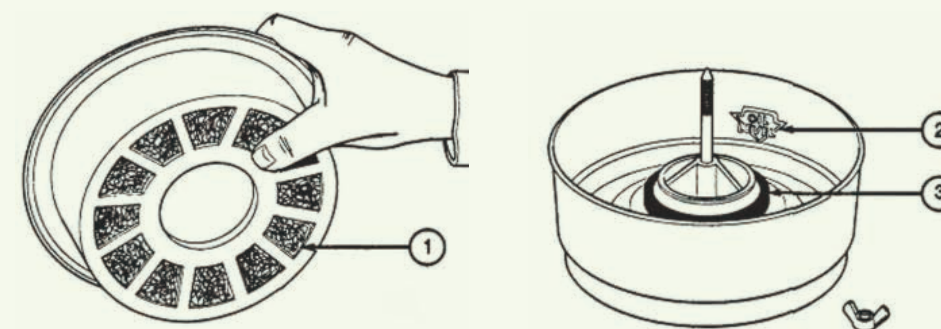


Figure 5.11 A typical wet type air cleaner.

5.11.1 Air Filter

Environmental conditions have an important effect on the frequency at which the air filter needs service. Refer to Figure 5.11.1.

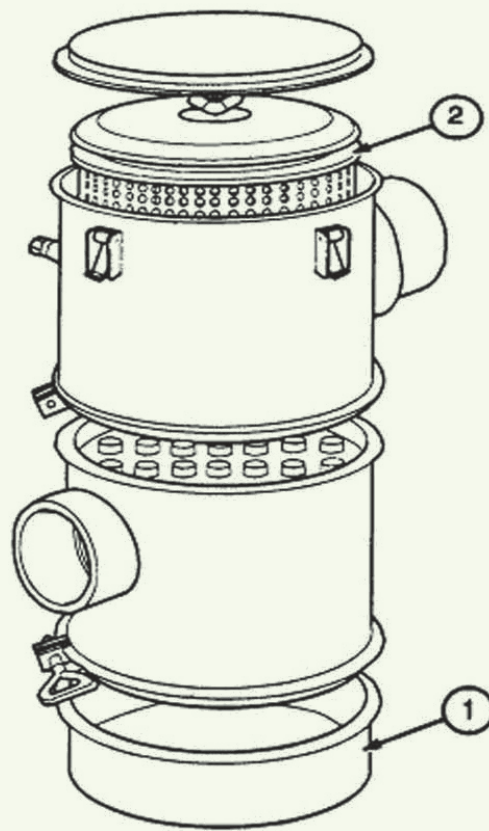


Figure 5.11.1 The air filter, showing the dust bowl (1) and element (2)

Certain air filters have a separate dust bowl (1) which must be cleaned at intervals. Do not let dust completely fill the bowl as this will reduce the life of the filter element (2). The amount of dust in the bowl indicates whether it has been removed early enough for the conditions of operation.

Certain air filters have automatic dust valves through which dust is expelled from the filter (Figure 5.11.2). The rubber dust valve (1) must be kept clean. Ensure that the sides of the valves close completely together and that they can separate freely.

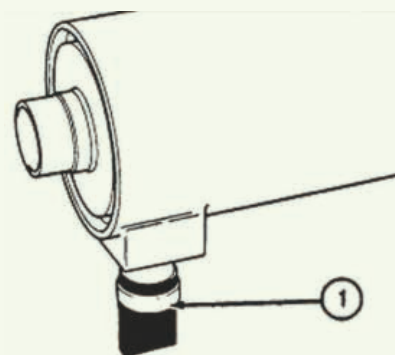


Figure 5.11.2 Air filter with dust valve (1)

If a restriction indicator is fitted (see below) it will indicate precisely when the air filter element needs servicing. This prevents the premature removal of the filter, which is an unnecessary expense, or late removal which can cause loss of power. The filter element must be cleaned or renewed according to the manufacturer's recommendations.

5.11.2 Restriction Indicator

The restriction indicator for these engines must work at a pressure difference of 508 / 558 mm (20/22 in) of water gauge.

It is fitted on the outlet pipe of the air cleaner.

Refer to Figure 5.11.3. When the red warning light (1) is seen through the clear panel (2) after the engine has stopped, the air filter element must be removed for service.

After a clean element has been fitted, press the rubber bottom (3) of the button

(4) of the restriction indicator to reset the red warning indicator.

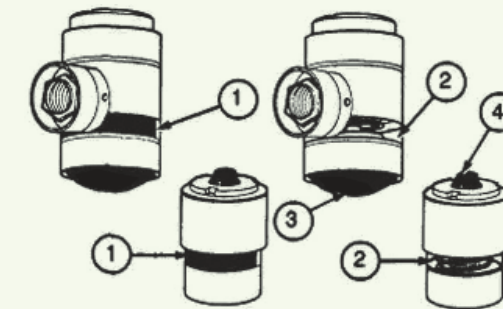


Figure 5.11.3 Restriction indicator: (1) warning light; (2) clear panel; (3) rubber base; (4) button

5.12 CHECKING VALVE CLEARANCES

The valve clearances are checked between the top of the valve stem and the rocker lever (Figure 5.12) with the engine hot or cold.

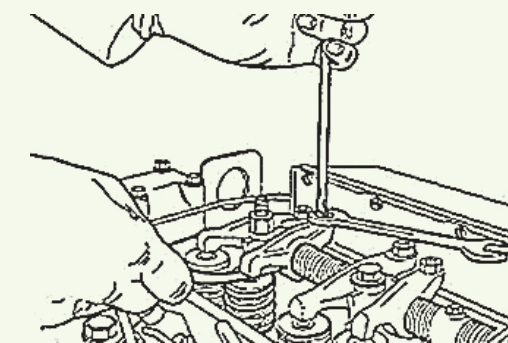


Figure 5.12 Checking valve clearances

Note: Number 1 cylinder is at the front of the engine.

5.12.1 Three Cylinder Engines

Valve clearance adjustment:

Valve clearance shall affect engine performance. It should be checked and adjusted according to technical maintaining stipulation. The intake valve cooling clearance is of 0.20-0.25mm,the exhaust valve cooling clearance is of 0.25-0.30mm. The adjusting procedure as following:

1. Make the first cylinder piston stop at T.D.C. position when the "0" mark on crankshaft pulley is aligned with the arrow mark on gear case cover,
2. Then check and adjust valve clearance of the first valve (count from the engine front end) by inserting a valve clearance gauge.
3. Turn the crankshaft 180° subject to the cylinder working order 1 – 3 - 2 to adjust every valve clearance.

5.12.2 Four Cylinder Engines

The sequence of valves from number 1 cylinder is shown in the table below: Number 1 cylinder is at the front of the engine (fan and gear end). The correct cooling clearances are 0.30~0.35 mm for inlet valves and 0.35~0.40 mm for exhaust valves.

VALVE POSITIONS								
Cylinder and Valve Number	1		2		3		4	
	1	2	3	4	5	6	7	8
Valve: I=Inlet; E=Exhaust	I	E	E	I	I	E	E	I

The valve positions are shown in Figure 5.12.1.

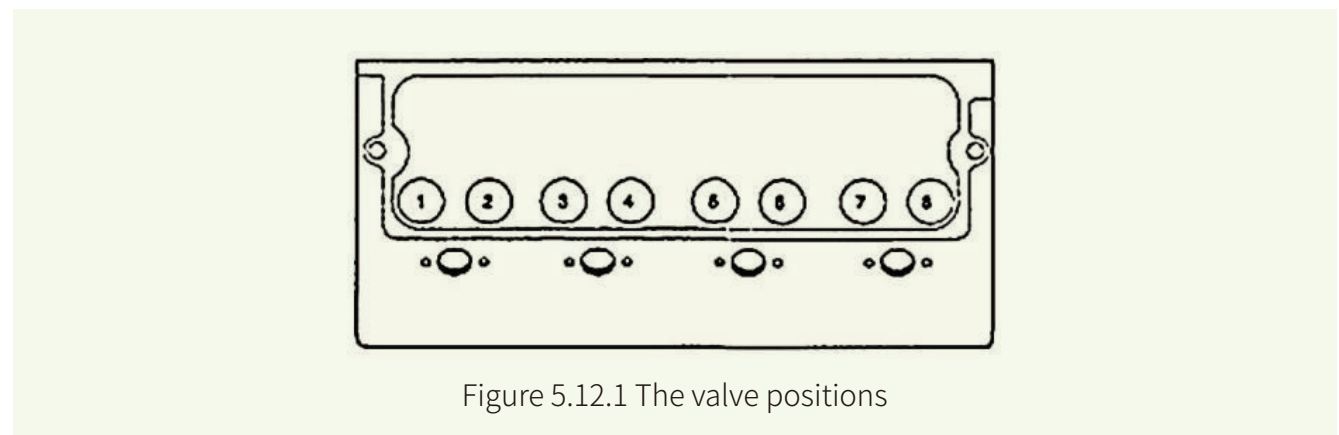


Figure 5.12.1 The valve positions

1. Rotate the crankshaft in the normal direction of rotation until the inlet valve (8) of number 4 cylinder has just opened and the exhaust valve (7) of the same cylinder has not closed completely. Check the clearances of the valves (1 and 2) of number 1 cylinder and adjust them, if necessary.
2. Set the valves (3 and 4) of number 2 cylinder as indicated above for number 4 cylinder. Then check and adjust the clearances of the valves (5 and 6) of number 3 cylinder.

3. Set the valves (1 and 2) of number 1 cylinder. Then check and adjust the clearances of the valves (7 and 8) of number 4 cylinder.
4. Set the valves (5 and 6) of number 3 cylinder. Then check and adjust the clearances of the valves (3 and 4) of number 2 cylinder.

6. FAULT DIAGNOSIS

6.1 PROBLEMS AND POSSIBLE CAUSES

See table below, in conjunction with 6.2 Code List of Possible Causes opposite

FAULT DIAGNOSIS		
Problem	Possible Cause	
	Checks by Operator	Checks by Workshop Personnel
The starter motor turns the engine too slowly	1, 2, 3, 4	None
The engine does not start	5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 17	33, 34, 35,36, 37, 41, 42, 43
The engine is difficult to start	5, 6, 7, 8, 9, 10, 11, 12,13, 14, 15, 16, 17, 19	33, 35, 36, 37, 39, 41, 42, 43
Not enough power	8, 9, 10, 11, 12, 13, 16,17, 18, 19, 20, 21, 31	33, 35, 36, 37, 38, 41, 42, 43, 60, 62, 63
Misfires	8, 9, 10, 12, 13, 15, 20, 22	33, 35, 36, 37, 38, 39, 40, 42
High fuel consumption	11, 13, 15, 17, 18, 19, 21, 22	33, 35, 36, 37, 38, 39, 41, 42, 43, 62
Black exhaust smoke	11, 13, 15, 17, 19, 21, 22	33, 35, 36, 37, 38, 39, 41, 42, 43, 60, 62
Blue or white exhaust smoke	4, 15, 21, 23, 31	35, 36, 37, 38, 41, 43, 44, 51, 52, 61
Low lubricating oil pressure	4, 24, 25, 26	45, 46, 47, 49, 50, 58
The engine knocks	9,13,15,17,20,22,23	35, 36, 39, 41, 43, 45, 51, 52, 59
The engine turns erratically	7,8,9,10,11,12,13,15, 16, 18, 20, 22, 23	33, 37, 39, 40, 43, 51, 59
Vibration	13, 18, 20, 27, 28	33, 37, 39, 40, 43, 51, 53
High lubricating oil pressure	4, 25	48
High engine temperature	11, 13, 15, 19, 27, 29, 30, 32	33, 35, 36, 38, 51, 54, 55, 56, 63

See table below, in conjunction with 6.2 Code List of Possible Causes opposite.

6.2 CODE LIST OF POSSIBLE CAUSES

Checks by the Operator

1. Battery of low capacity
2. Bad electrical connections
3. Fault within the starter motor
4. Wrong grade of lubricating oil
5. Starter motor turning engine too slowly
6. Fuel tank empty
7. Fault in stop control
8. Restriction in fuel pipe
9. Fault in fuel lift pump
10. Dirty fuel filter element
11. Restriction in air filter / cleaner or induction system
12. Air in fuel system
13. Fault in injector or incorrect type of fuel injector
14. Cold start system used incorrectly
15. Fault in cold start system
16. Restriction in fuel tank vent
17. Wrong type or grade of fuel used
18. Restricted movement of engine speed control
19. Restriction in exhaust pipe
20. Engine temperature too high
21. Engine temperature too low
22. Incorrect valve clearance
23. Too much (or wrong type of) oil used in a wet-type air cleaner
24. Not enough lubricating oil in sump
25. Defective gauge
26. Dirty lubricating oil filter element
27. Fan damaged
28. Fault in engine mounting of flywheel housing
29. Too much lubricating oil in sump
30. Restriction in air or water passages of radiator
31. Restriction in breather pipe
32. Insufficient coolant in system

Checks by Workshop Personnel

33. Fault in fuel injection pump
34. Broken drive on fuel injection pump
35. Timing of fuel injection pump is incorrect
36. Valve timing is incorrect
37. Bad compression
38. Cylinder head gasket leaks
39. Valve stem sticking
40. Wrong high-pressure pipes
41. Worn cylinder bores
42. Leakage between valves and seats
43. Piston rings are not free or are worn or broken
44. Valve stems and/or guides are worn
45. Crankshaft bearings are worn or damaged
46. Lubricating oil pump is worn
47. Relief valve does not close
48. Relief valve does not open
49. Relief valve spring is broken
50. Fault in suction pipe of lubricating oil pump
51. Piston is damaged
52. Piston height is incorrect
53. Flywheel housing or flywheel is not aligned correctly
54. Fault in thermostat, or incorrect type
55. Restriction in coolant passages
56. Fault in water pump
57. Valve stem seal (if fitted) is damaged
58. Restriction in sump strainer
59. Valve spring is broken
60. Turbocharger impeller is damaged or dirty
61. Lubricating oil seal of turbocharger leaks
62. Induction system leaks (turbocharged engines only)
63. Turbocharger waste-gate (if fitted) does not work correctly

7. ENGINE STORAGE

If the engine is to be withdrawn from service for a prolonged period you must follow the procedures below to ensure that damage does not occur.

7.1 PREPARING THE ENGINE FOR STORAGE

1. Completely clean the outside of the engine.
2. When a preservative fuel is to be used, drain the fuel system and fill it with the preservative fuel. If preservative fuel is not used, the system can be kept full with normal fuel but the fuel must be discarded at the end of the storage period together with the fuel filter element(s).
3. Operate the engine until warm then correct any leakage of fuel, oil or air. Stop the engine and drain the lubricating oil from the sump.
4. Renew the canister(s) of the lubricating oil filter.
5. Fill the sump to the mark on the dipstick with new, clean lubricating oil.
6. Drain the cooling system (see 5.2). In order to protect the cooling system from corrosion fill it with an approved antifreeze mixture.
7. Operate the engine for a short period in order to circulate the lubricating oil and coolant in the engine.
8. Clean the engine breather pipe.
9. Remove the air filter. If necessary, remove the pipe(s) installed between the air filter and induction manifold or turbocharger. Seal the manifold with waterproof tape.
10. Seal the exhaust manifold and air pipe of the fuel tank with water proof tape.
11. Disconnect the battery. Put the battery into safe storage in a fully charged condition and protect the terminals against corrosion.
12. Remove the drive belts and put them into storage.

If the above procedure is carried out correctly, there should be no damage due to corrosion.

Lister Petter Engine are not responsible for damage which may occur when an engine is in storage after a period of service.

7.2 RETURNING THE ENGINE TO SERVICE

After a period in storage, before the engine is started, operate the starter motor with the engine stop control in the stop position until oil pressure is indicated (oil pressure can be indicated either by a gauge or when a low pressure warning light is extinguished). If a solenoid stop control is used on the fuel injection pump it must be disconnected for this operation.

8. MAINTENANCE RECORD

Your Lister Petter Engine must be properly maintained using the intervals and procedures described in this manual. You must be familiar with the routine tasks set out in 5.Routine Maintenance, and their correct frequency set out in 5.1 Maintenance Schedule.

Details of the maintenance work carried out on the engine during the first 5000 hours, except the daily checks, must be recorded in the spaces allocated in this section: pages 40-43 for routine maintenance and pages 44-47 for non-routine maintenance (see 9.3 Conditions of Warranty). If you purchase an extended warranty you must keep records for the entire period of the warranty.

It is also recommended that you continue to keep records beyond the warranty period, to enable you to keep track of work that has been done on the engine.

8.1 ROUTINE MAINTENANCE

Hours run	Work done by	Details of service	Distributor / Dealer Stamp	Date

Hours run	Work done by	Details of service	Distributor / Dealer Stamp	Date

Hours run	Work done by	Details of service	Distributor / Dealer Stamp	Date

Hours run	Work done by	Details of service	Distributor / Dealer Stamp	Date

8.2 NON-ROUTINE MAINTENANCE

Hours run	Work done by	Details of service	Distributor / Dealer Stamp	Date

Hours run	Work done by	Details of service	Distributor / Dealer Stamp	Date

Hours run	Work done by	Details of service	Distributor / Dealer Stamp	Date

Hours run	Work done by	Details of service	Distributor / Dealer Stamp	Date

9. WARRANTY

On receipt of your engine please fill in the section on page 53. This information will be required in the event of a claim under warranty, according to the conditions set out below.

9.1 STANDARD WARRANTY COVER

The standard warranty includes 2 year / 2000 hour cover for all non-serviceable¹ components, parts and labor, beginning on the date of delivery to the original retail purchaser, and is transferable. It is subject to the conditions set out below in 9.3 Conditions of Warranty and the limitations set out in 9.4 Limitations of Warranty.

9.2 CONDITIONS OF WARRANTY

For the warranty to be valid, servicing must be carried out in accordance with 5. Routine Maintenance and with the timings set out in 5.3 Maintenance Schedule. Detailed records of servicing must be kept; see 8. Maintenance Record. Servicing must be by approved dealers or competent engineers.

- The maintenance record must be completed.
- Oils and other fluids must be to the specifications/grades given in 4.Engine Fluids or as instructed in the Workshop Manual.
- Only genuine Lister Petter Engine service parts must be used.
- When Lister Petter Engine parts are purchased from a dealer, this must be noted, with the dealer's stamp, in 8. Maintenance Record, and receipts for the parts must be retained. The dealer is authorized to stamp the maintenance record only following the sale of genuine parts, to a competent engineer, intended to be used on the warrantable Lister Petter Engine engine.
- Evidence will be required of engine hours run and should be entered in 8. Maintenance Record. Evidence of equipment used to record engine hours may be requested in the event of a warranty claim. If no hour recorder is fitted, twelve hours per calendar day will be used as a basis for the hours-run calculation.
- The installation should be in accordance with data supplied by the Lister Petter Engine Applications Department.
- Long term light load and cold engine running will invalidate the warranty.

Notes:

1. Serviceable items (unless defective) include, but are not limited to: air filters, fuel filters, oil filters, injector nozzles, drive belts and lubricants and coolants (unless used on an authorized repair).
2. The term 'core engine' excludes the radiator/heat exchanger, starter motor and starting systems, alternator, water pump, exhaust, fan belts, oil seals and fuel injection equipment.
3. This warranty gives the purchaser specific legal rights; the purchaser may also have other rights, which vary by country or state.

9.3 LIMITATIONS OF WARRANTY

- The seller does not accept responsibility for any business costs or other losses which may result from the warrantable failure.

- The seller is not responsible for failures resulting from misapplication, abuse or neglect, including: operating with inadequate cooling; the use of non-approved or contaminated fuels or lubricants; lack of, or incorrect, maintenance; incorrect repair; improper storage; incorrect starting, stopping or operating procedures; the use of non-approved parts; fair wear and tear; and serviceable items (see note 1).

9.4 REPAIRS UNDER WARRANTY

Lister Petter Engine must be contacted and authorization given before any warrantable work is commenced.

9.4.1 Contact Details

Warranty@listerpetter.com
www.listerpetter.com

Engine Serial Number:

Purchased from:

Purchase Date:

Plant Type:

Plant Number: