OVERVIEW

The G Build engine is specifically designed as a Power generating engine suitable for use in unregulated emissions territories. It is durable, reliable and easy to maintain with oil & filter changes up to 500 hours, dependant on operational conditions. It is designed for continuous operation in ambient temperatures up to 52° (122°F) and a cold start capability down to -32° (-25.6°F).

Note: This engine does not comply with Harmonised International Regulated Emissions Limits.

BASIC ENGINE CHARACTERISTICS

▪ diesel fuelled and approved for operation on biodiesel, that conforms with ASTM D6751 and EN14214, concentrations of up to 20%
▪ direct fuel injection
▪ 4 cylinders
▪ liquid cooled
▪ naturally aspirated

DESIGN FEATURES AND EQUIPMENT

▪ inlet and exhaust manifolds*
▪ fuel lift pump
▪ mechanical governing
▪ self-vent fuel system with individual
▪ fuel injection pumps
▪ fuel /filter/agglomerator
▪ thermostatically controlled cooling system with belt driven coolant pump
▪ radiator with pusher fan and belt guard*
▪ gear driven positive displacement type
▪ lubricating oil pump
▪ spin on full flow lubricating oil filter
▪ high inertia flywheel to SAE J620: 7.5" *
▪ SAE 5 flywheel housing *
▪ 12V Starter motor *
▪ 12V battery charge alternator *
▪ oil pressure and coolant temperature switches *
▪ fuel control solenoid (energised to run)*
▪ skid base packing
▪ operators hand book (English)*

OPTIONAL ITEMS

A range of options are available that allows you to select a specification that matches your requirements; Please consult your Lister Petter Power Systems distributor.
Associated Publications

Master Parts Manual P027-08041
LPWX4 Master Parts Supplement P027-10641
Workshop Manual P027-08240
Technical Handbook P027-08247

⚠️ 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 EQUIPMENT 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 UNDERTAKING 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 press.

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

Whilst every effort is made to ensure the accuracy of the particulars contained within this publication, neither the Manufacturer, the Distributor nor the Dealer shall in any circumstances be held liable for any inaccuracy or the consequences thereof. The information given is subject to the Company's current Conditions of Tender and Sale; is for the assistance of users; and is based upon results obtained from tests carried out at the place of manufacture. This Company does not guarantee that the same results will be obtained elsewhere under different conditions.

Parts that have not been approved by the Lister Petter Power Systems organisation 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.

P027-08270

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2.1 Features of the LPW series diesel engines

- Oil Filter
- Turbocharger
- Lifting Eye
- Radiator Fan (may have 6 blades)
- Radiator Fan
- Inlet Manifold
- Alternator
- Starter Motor
- Exhaust Manifold
- Oil Housing
- Fuel Filter
- Sump Drain Plug
1. INTRODUCTION

This handbook explains the operation and routine maintenance of Lister Petter water cooled diesel engines in the Alpha (LPW, LPWS and LPWX) series. Please note that if your engine is part of a generating set, there is a separate operators' handbook for the genset, to explain such features as the control module.

1.1 USING THIS HANDBOOK

Operating or servicing a diesel engine is potentially dangerous. You must not attempt it unless you have the necessary knowledge and experience. Read each section thoroughly and carefully, taking note of all the information and instructions given. This is for your safety and to ensure the correct maintenance of your engine. For specific aspects of operation and maintenance, use the table of contents (page 3, 4 and 5) to find the section you need. Where instructions are numbered in sequence, they must be followed in that order. This applies in particular to maintenance and repair procedures (sections 6 and 7). In cases of difficulty, or to obtain spare parts, please consult your local Lister Petter distributor or dealer.

1.2 ENGINE IDENTIFICATION

To identify which model of Lister Petter LPWX/LPW(S) diesel engine you are using refer 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 is a sample serial number:

06 001234  LPWS3  A 402

06..............................Year code (06 = 2006)
001234.........................Unique engine number
LPWS3..........................Engine model
A ...............................Anti clockwise rotation
402.............................Build number

The illustrations on page 6 show features of the different engine models. When following the instructions in this handbook you will need to be familiar with the parts labelled.
### 1.3 ENGINE MODELS

<table>
<thead>
<tr>
<th>Model</th>
<th>Characteristic features</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPW2</td>
<td>Two cylinders, water cooled, naturally aspirated, direct injection</td>
</tr>
<tr>
<td>LPW3</td>
<td>Three cylinders, water cooled, naturally aspirated, direct injection</td>
</tr>
<tr>
<td>LPW4</td>
<td>Four cylinders, water cooled, naturally aspirated, direct injection</td>
</tr>
<tr>
<td>LPWT4</td>
<td>Four cylinders, water cooled, direct injection, turbocharged</td>
</tr>
<tr>
<td>LPWX2</td>
<td>Two cylinders, water cooled, naturally aspirated, direct injection</td>
</tr>
<tr>
<td>LPWX3</td>
<td>Three cylinders, water cooled, naturally aspirated, direct injection</td>
</tr>
<tr>
<td>LPWX4</td>
<td>Four cylinders, water cooled, naturally aspirated, direct injection</td>
</tr>
<tr>
<td>LPWS2</td>
<td>Two cylinders, water cooled, naturally aspirated, indirect injection</td>
</tr>
<tr>
<td>LPWS3</td>
<td>Three cylinders, water cooled, naturally aspirated, indirect injection</td>
</tr>
<tr>
<td>LPWS4</td>
<td>Four cylinders, water cooled, naturally aspirated, indirect injection</td>
</tr>
<tr>
<td>LPWST4</td>
<td>Four cylinders, water cooled, naturally aspirated, indirect injection</td>
</tr>
</tbody>
</table>

### 1.4 RUNNING-IN

To assist running-in all engines are dispatched with an initial fill lubricating oil which must be changed after 100 hours. Your engine does not require gradual light-load running-in. Extended light-load running should be avoided, as this could damage the cylinder bore and allow lubricating oil to enter the exhaust system.
2. SAFETY INFORMATION

Read the information in this section carefully and follow all the advice given. Pay special attention to the cautions and warnings demonstrated below, which are used throughout this handbook.

⚠️ CAUTION
This caution draws attention to special information or procedures which must be correctly observed, to avoid damage to, or destruction of, equipment.

⚠️ WARNING
This warning draws attention to special information or procedures which must be strictly observed. Failure to do so may result in personal injury.

⚠️ WARNING
THIS WARNING DRAWS ATTENTION TO SPECIAL INFORMATION OR PROCEDURES WHICH MUST BE STRICTLY OBSERVED. FAILURE TO DO SO MAY RESULT IN SERIOUS INJURY OR DEATH.

2.1 GENERAL SAFETY INFORMATION

Starting and operating any diesel engine is potentially dangerous. Do not attempt to do so unless you have the necessary knowledge and experience. Ensure that anyone attempting to start and operate your diesel engine has been properly trained and instructed in the correct procedures.

⚠️ CAUTION
Follow all safety instructions accurately.

Carefully read and follow all safety information and instructions in this manual. Observe the safety and informative symbols on your engine and equipment.

2.1.1 Emergency Precautions
- Be prepared with suitable equipment and knowledge in case a fire starts.
- Identify a location from which calls to the emergency services can be made if necessary.
- Ensure a third party knows where you are working and when you leave the working area.
2.1.2 General Precautions

- Ensure the engine is securely mounted.
- Ensure that there is a generous supply of cooling and combustion air available.
- Keep the engine and surrounding area clean.
- Some accessories may require guards which must be supplied and fitted by the purchaser. Keep all safety guards in position.
- Do not make any unauthorised modifications as these may affect the safe operation of the engine and put the operator at risk.

2.1.3 Emissions

**WARNING**

MODEL YEAR 2019 ENGINES ONWARDS DO NOT COMPLY WITH U.S. FEDERAL OR EUROPEAN EXHAUST EMISSIONS REGULATIONS FOR NON-ROAD INDUSTRIAL AND MARINE ENGINES.

THEY MAY ONLY BE USED FOR EXEMPT APPLICATIONS E.G. STATIONARY ENGINES AND WITHIN THE FLEXIBILITY CLAUSES DEFINED IN THE EPA AND EUROPEAN REGULATIONS.

IF IN DOUBT, PLEASE CONTACT LISTER PETTER POWER SYSTEMS LIMITED.

**WARNING**

CALIFORNIA PROPOSITION 65 WARNING

DIESEL ENGINE EXHAUST AND SOME OF ITS CONSTITUENTS ARE KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER, BIRTH DEFECTS, AND OTHER REPRODUCTIVE HARM.

2.2 PERSONAL SAFETY

- Wear personal protective clothing and safety equipment appropriate to the work being done.
- Keep clear of moving parts at all times.

**WARNING**

KEEP THE BODY AND CLOTHING CLEAR OF MOVING OR HOT PARTS AT ALL TIMES. CONTACT OF MOVING PARTS WITH UNPROTECTED SKIN CAN CAUSE SEVERE BURNS. ENTANGLEMENT WITH ROTATING EQUIPMENT CAN CAUSE SERIOUS INJURY OR DEATH.
2.3 SAFETY SYMBOLS

This figure identifies the ISO8999 symbols currently used by Lister Petter Power Systems.

- Tie long hair back securely.
- Wear close-fitting clothing.
- Do not wear a necktie, scarf, loose clothing or necklace when working close to a running engine.
- Where possible, remove rings and other jewellery to prevent entanglement in moving parts. These items could also cause a short circuit if any part of the electrical system is being worked on.

**WARNING**

*Prolonged exposure to loud noise can cause impairment, or loss, of hearing.*

- Wear suitable ear protection against objectionable or uncomfortable loud noise.
- To avoid loss of concentration, do not use music or radio headphones while operating an engine.
- When undertaking maintenance, do not work under any plant that is only held by overhead lifting equipment.
- Where appropriate, make sure that guards are properly fitted.
2.4 PRECAUTIONS WITH CHEMICALS

Protect yourself from exposure to hazardous chemicals at all times, as this can cause serious injury. Potentially hazardous chemicals include lubricants, fuel, coolant concentrate, battery acid, 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.

- Handle fluids with care at all times.
- Rectify any fuel, coolant or oil leak as soon as is practicable and clean up any spillages when they occur.
- Remove any build-up of grease, oil or debris.
- If any fluid other than lubricating oil comes into contact with the skin, clean off immediately. In the case of lubricating oil, clean off as soon as is practicable.

2.4.1 Fuel and High Pressure Fluids

- Store fuel and other flammable liquids away from fire hazards.
- Always stop the engine before refuelling.
- Do not overfill the fuel tank.
- When working with fuel do not smoke or work near to heaters or other fire hazards.
- High pressure fluids are extremely hazardous. Never allow any part of the body to come into contact with high-pressure fuel oil, compressed air or hydraulic oil, for example when testing fuel injection equipment.

⚠️ WARNING

*Do not expose pressurised containers to heat, and do not incinerate or puncture them.*

⚠️ WARNING

*NEVER TOUCH OR INGEST HIGH PRESSURE FLUIDS SUCH AS HYDRAULIC OIL, COMPRESSED AIR OR FUEL OIL. THIS COULD LEAD TO SERIOUS INJURY OR DEATH.*
2.5 FUEL SYSTEM PRECAUTIONS

**WARNING**

NEVER ALLOW ANY UNPROTECTED SKIN TO COME INTO CONTACT WITH THE INJECTOR SPRAY AS FUEL MAY ENTER THE BLOODSTREAM WITH FATAL RESULTS.

- When priming or checking the fuel injection pump timing, care must be taken to wipe any spilled fuel from the outside of the engine.
- Always fit a new joint when a union has been disturbed.
- Special care must be taken to see that there is no leakage from the joints of the fuel pipe connection to the pump.
- When tightening or loosening fuel injection pump delivery connections use two spanners to prevent unsealing of fuel pump delivery valve holders.
- When refitting the fuel pipe from the pump to the injector, the connection to the injector must be tightened before the connection to the fuel pump. This procedure will ensure that there is no leakage from these joints.
- It is most important that all fuel joints are tight and leak proof.
- Always fill the fuel tank through a fine strainer. It is best to do this at the end of the engine work period so that any sediment stirred up has time to settle before the engine is used again, and the risk of condensation contaminating the fuel is minimised. If using a can, avoid tipping out the last few drops.
- Funnels are very difficult to keep clean in dusty conditions. Wash them before and after use and wrap them up when not required, or fill the tank direct from a small-mouthed screw-capped can.
- The fuel injection equipment is manufactured to very accurate limits and the smallest particle of dirt will destroy its efficiency.

**WARNING**

Keep the fuel free from water and contaminants.

2.6 PRECAUTIONS WITH FILTERS AND ELEMENTS

- 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, wash your hands thoroughly.

**WARNING**

Do not allow fuel or new or used lubricating oil to come into contact with unprotected skin. It is dangerous and could cause skin irritation.
WARNING

Take careful precautions with filters and elements. The materials used in the manufacture and treatment of some types may cause irritation or discomfort if they come into contact with the eyes or mouth, and they may give off toxic gases if burnt.

2.7 PRECAUTIONS WITH OIL SEALS

Some engines may be fitted with seals or 'O' rings manufactured from Viton or a similar material. When these substances are exposed to abnormally high temperatures, in excess of 400°C (752°F), an extremely corrosive acid is produced.

WARNING

IF AN OIL SEAL CONTAINING VITON (OR SIMILAR MATERIAL) DEGENERATES, IT PRODUCES AN EXTREMELY CORROSIVE ACID THAT CANNOT BE REMOVED FROM THE SKIN. IF YOU SEE SIGNS OF DECOMPOSITION, OR ARE IN DOUBT, WEAR DISPOSABLE HEAVY DUTY GLOVES.

• If in any doubt about an oil seal, always wear disposable heavy duty gloves.

2.8 PRECAUTIONS WITH BATTERIES

Batteries contain hazardous sulphuric acid. Great care therefore needs to be taken when using them.
• Do not smoke near batteries and keep sparks and flames away from them. Do not work near to heaters or other fire hazards.
• Switch off the battery charger before connecting or disconnecting the charger leads. Disconnect the battery negative (earth) lead first and reconnect last.
• Keep the top of the battery well ventilated during charging.
• Never ‘flash’ connections.
• Never use a damaged battery.
• Do not attempt to charge a frozen battery; it may explode. Instead, warm the battery to 16°C (60°F).

WARNING

Take especial care with batteries, which contain highly corrosive sulphuric acid which is poisonous, will burn skin and clothing, and 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 fresh water and seek medical aid.
2.9 PRECAUTIONS WITH ELECTRICAL SYSTEMS

- Ensure that the battery is of sufficient capacity to start the engine down to 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 the engine 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 so as to avoid any possibility of chafing taking place.

Alternator

The following points must be strictly observed when an alternator is fitted, otherwise serious damage can be done.
- Never connect a battery into the system without checking that the voltage and polarity are correct.
- Never remove any electrical cable while the battery is connected in the circuit.
- Never disconnect the battery unless the engine has stopped and all switches are in the off position.
- Always ensure that cables are fitted to their correct terminals.

⚠️ CAUTION

A short circuit or reversal of polarity will destroy diodes and transistors.

- Never ‘flash’ any connection to check the current flow.
- 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.

2.10 WASTE DISPOSAL PRECAUTIONS

- Extreme care must be taken to ensure that waste oil, fuel, filter elements, coolant concentrate, battery electrolyte, solvents or other toxic wastes are disposed of in accordance with local regulations to prevent contamination.
2.11 PRECAUTIONS BEFORE STARTING

**WARNING**
Starting any diesel engine can be dangerous in the hands of inexperienced people. Engine operators must be instructed in the correct procedures before attempting to start any engine.

- Ensure that the engine is free to turn without obstruction.
- Check that the lubricating oil level is correct. The oil sump must be filled to the ‘full’ mark on the dipstick; do not overfill.
- The radiator must be filled to within 13-25 mm (0.5-1.0 in) below the neck of the radiator filler with the correct coolant mixture. See section 5.3.
- Check that the fuel supply is adequate and the system is primed.
- Ensure that the battery is connected, fully charged and serviceable.
- Where possible, disengage the driven equipment while starting.

2.12 LIFTING PRECAUTIONS

Engine lifting eyes are fitted to Alpha and New Alpha engines. The following points must be considered before attempting to lift the engine.

- Ensure any lifting equipment to be used has the correct capacity to lift the engine.
- Ensure that the lifting equipment is designed to give a vertical lift from directly above the engine lifting eye.
- Check that the engine lifting eyes are not damaged and that they are secure.
- The engine lifting eyes are suitable for lifting the engine and accessory assemblies originally fitted by Lister Petter Power Systems.

2.13 PRECAUTIONS BEFORE MAINTENANCE

- Understand the service procedures before commencing any work.
- Ensure all starting devices are removed or isolated before beginning any work on engine or plant.
- Ensure the work area is clean, dry, well ventilated and has adequate lighting.
- Ensure that all persons using equipment or processes in connection with the maintenance of plant and machinery have received adequate and suitable training.
3. TECHNICAL DATA

3.1 TECHNICAL DATA TABLE

<table>
<thead>
<tr>
<th>TECHNICAL DATA</th>
<th>LPW(X)2, LPW(X)3, LPW(X)4</th>
<th>LPW(S)T4</th>
<th>LPWS2, LPWS3, LPWS4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotation</td>
<td>Anti clockwise (when looking on the flywheel)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of injection</td>
<td>Direct</td>
<td>n/a</td>
<td>Indirect</td>
</tr>
<tr>
<td>Firing order:</td>
<td>2 cylinders</td>
<td>1 - 2</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>3 cylinders</td>
<td>1 - 2 - 3</td>
<td>1 - 2 - 3</td>
</tr>
<tr>
<td></td>
<td>4 cylinders</td>
<td>1 - 2 - 3</td>
<td>1 - 2 - 3</td>
</tr>
<tr>
<td>Electrical system</td>
<td>12V negative earth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starter battery charging</td>
<td>12V engine mounted alternator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil pressure</td>
<td>at idle: 1.0 bar (14.5 lbf in²)</td>
<td>2.0 bar (29.0 lbf in²)</td>
<td>2.5 bar (36.3 lbf in²)</td>
</tr>
<tr>
<td></td>
<td>3000 r/min¹</td>
<td>2.5 bar (36.3 lbf in²)</td>
<td>2.0 bar (29.0 lbf in²)</td>
</tr>
<tr>
<td>Oil sump capacity</td>
<td>Refer to table 5.2.3.2: Sump Capacity (page 25).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coolant capacity</td>
<td>Refer to table 5.3.5: Engine Block Coolant Capacity (page 26).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Oil Pressure at 3000 r/min is with the oil at 110°C (230°F).

3.2 COMBUSTION AIR
Engine performance is affected by ambient temperature, which is taken to mean the temperature of the air entering the engine.
The temperature of the combustion air is measured at the air inlet manifold, or the air cleaner, and the temperature of the cooling air is measured at the radiator fan inlet. The higher of these two temperatures is taken as being ambient temperature as far as engine ratings are concerned.
Every effort should be taken to ensure that the air cleaner draws in combustion air at a consistent ambient temperature. Lister Petter Power Systems LPW, LPWX, LPWT, LPWS and LPWST engines are able to run satisfactorily at ambient temperatures up to the standard engine reference condition of 25°C (77°F) without derating. If the combustion air temperature rises above this temperature, the rated power must be reduced in accordance with the relevant standard:
LPW/LPWX/LPWT ISO 3046
LPWS ISO 14396
Generating Sets ISO 8528
The maximum permitted ambient temperature is 52°C (125°F).

3.3 THE COOLING SYSTEM
Cooling is by a radiator with water circulation being assisted by an engine mounted, centrifugal, belt driven water pump using a single belt.
4. OPERATING INSTRUCTIONS

The following information is of a general nature and should be read in conjunction with the manufacturers' instructions for any other equipment you are using.

⚠️ WARNING

Do not attempt to start or operate a diesel engine unless you have been properly trained. Read the safety information in section 2 and the information below on controls and the starting procedures.

⚠️ CAUTION

DO NOT USE ETHER BASED COLD START AIDS UNDER ANY CIRCUMSTANCES.

⚠️ WARNING

DO NOT BREATHE EXHAUST GASSES. THEY CONTAIN CARBON MONOXIDE, A COLOURLESS, ODOURLESS GAS THAT CAN CAUSE UNCONSCIOUSNESS AND DEATH.

⚠️ WARNING

ENSURE ALL ENGINE FLUIDS ARE CHARGED / FILLED TO CORRECT LEVELS IN ACCORDANCE WITH SECTION 5, BEFORE OPERATION.

⚠️ CAUTION

On LPWT4/LPWST4 engines, ensure that the turbocharger housing is full of oil. Failure to do so can result in serious damage to the bearings. Run on ‘No Load’ after starting for 30 seconds to ensure an adequate oil supply to the turbocharger, and for 30 seconds before stopping to allow the heat from the bearing to dissipate.

4.1 GENERAL INFORMATION

Start / Stop Control
The basic engine has a plastic knob fitted to the control. Other variants for automatic or remote operation are available.

Engines not fitted with a fuel control solenoid have a spring clip to hold the engine control in the stop position.
**WARNING**

*Use suitable hand protection when stopping the engine, as the stop control may be hot after prolonged running.*

**Oil Pressure Switch**
If an oil pressure switch bypass button is fitted it must be depressed during engine cranking, and until the engine attains full speed.

**Heater and Glow Plugs**
LPW, LPWX: a 345 W heater plug (A) may be fitted to the inlet manifold.
LPWT4: a 696 W heater plug (A) is fitted in the inlet manifold.
LPWS: a 12v glow plug (B) is fitted in each cylinder and a 696 W heater plug (A) is also fitted in the inlet manifold as standard.

![4.1 Heater and glow plugs - A. Manifold heater plug; B. Cylinder glow plug.](image)

**4.2 KEY START**
Before starting your engine read the cautions, warnings and the general information above.

![4.2.1 Start control](image)

![4.2.2 Key start](image)

**Starting LPW(X) Engines**
1. With reference to *Figure 4.2.1* and 4.2.2, move the engine control lever (A) clockwise until it is against the stop screw (B).
2. On variable speed engines move the speed control to the fast position.
3. Turn the key clockwise to the **START** position. Immediately the engine starts the key must be released and it will return to the **RUN** position due to internal spring.

4. On variable speed engines reduce the engine speed as necessary.

**Starting LPWS Engines**
1. With reference to *Figure 4.2.1 and 4.2.2*, move the engine control lever (A) clockwise until it is against the stop screw (B).
2. On variable speed engines move the speed control to the fast position.
3. For ambient starting temperatures above -10°C (14°F) turn the key clockwise and hold it in the **PREHEAT** position for 5 to 10 seconds before turning it to the **START** position.
   - For ambient starting temperatures below -10°C (14°F) turn the key clockwise to the **PREHEAT** position for 15 to 20 seconds before turning the key to the **START** position.
   - Immediately the engine starts the key must be released and it will return to the **RUN** position due to internal spring.
4. On variable speed engines reduce the engine speed as necessary.

**Starting LPWT Engines**
1. With reference to *Figure 4.2.1 and 4.2.2*, move the engine control lever (A) clockwise until it is against the stop screw (B).
2. On variable speed engines move the speed control to the fast position.
3. For ambient starting temperatures above -10°C (14°F) turn the key clockwise and hold it in the **PREHEAT** position for 10 to 15 seconds before turning it to the **START** position.
   - For ambient starting temperatures below -10°C (14°F) turn the key clockwise to the **PREHEAT** position for 15 to 20 seconds before turning the key to the **START** position.
   - Immediately the engine starts the key must be turned anti-clockwise and held in the **PREHEAT** position until engine has attained full speed.
4. When the engine has attained full speed release the key and it will return to the **RUN** position due to internal spring.
5. On variable speed engines reduce the engine speed as necessary.

**4.3 FAILURE TO START**
Should the engine fail to start within 30 seconds, release the key and, after allowing sufficient time for all moving parts to stop, attempt to restart.
4.4 STOPPING OF ENGINE

⚠️ CAUTION
It is recommended that LPWT4 and LPWST4 engines run on 'No Load' for 30 seconds before stopping to allow the heat from the turbocharger bearing to dissipate.

1. If possible, remove the load from the engine.
2. If a variable speed control is fitted reduce the engine speed.
3. On engines fitted with a fuel control solenoid turn the key to the OFF position. On engines not fitted with a fuel control solenoid move the engine control lever anti clockwise into the STOP position (figure 4.4.1) and turn the key to the OFF position.

⚠️ CAUTION
Turning the key to the OFF position alone will not stop the engine unless a fuel control solenoid is fitted.

4.4.1 Stop Control
5. ENGINE FLUIDS

5.1 FUEL

5.1.1 Fuel Specification
The engine must be used only with diesel fuel oil that conforms to one of the following:
• BS 2869:1988 Class A2;
• BS 2869 Red Diesel (with the oxidation stability of EN 590);
• EN590:1995 Class A1;
• EN 590 Diesel Fuel Types – Auto/C0/C1/C2/C3/C4;
• USA Specification ASTM D-975-77 Grades 1-D and 2-D;
• ASTM D975-05 Class 2-D, US DF1, US DF2, US DFA;
• Jis k2204 (1992) Grades 1, 2 & 3 & Special Grade 3;
• BSMA 100 Class M1 for marine use.
The fuel must be a distillate and not a residual oil or blend.
Vapourising oils are not suitable as fuels for Lister Petter Power Systems engines.

5.1.2 LPWs Bio
LPWS Bio is a specially developed engine range that will run on B100 (100% biofuel) as well as on those fuels specified above.

⚠️ CAUTION
Although the engines may operate on fuels outside of the above specifications, such operation may result in excessive wear and damage.

⚠️ CAUTION
It is of the utmost importance to keep fuel free from water and other contaminants. The fuel injection equipment is manufactured to very accurate limits, and the smallest particle of dirt will destroy its efficiency.

5.2 LUBRICATING OIL

5.2.1 Oil Specification
To assist running-in, all engines are dispatched with an initial fill lubricating oil which must be changed, with the filter, after the first 100 hours.
All subsequent oil changes must be as specified in 6. Routine Maintenance.
• The temperatures cited in Figure 5.3.2.1 are the ambient temperatures at the time when the engine is started (see 3.2 Combustion Air). If monograde oils are used and running ambient temperatures are significantly higher than starting temperatures, a higher viscosity oil should be selected, subject to satisfactory
starting performance. Multigrade oils may be used to overcome the problem.

- Where it is not practical to continually change the oils to suit varying ambient temperatures, a suitable multigrade oil is recommended to ensure adequate starting performance at the lowest temperature likely to be encountered.
- The engines must be run on heavy-duty lubricating oils that at least meet the requirements of one of the following:
  - API CC MIL-L-46152B
  - DEF2101D MIL-L-2104B
- Straight mineral oils are not suitable, neither are oils of less detergency than specified.

**Note:**
Higher specification oils meeting API CD, API CE and API CF-4 are more commonly available than API CC. The use of these oils is acceptable for topping up the ‘first fill’ and following the first 100 hours when running-in has been completed.

These oils are particularly suited to engines running at a high load factor, or in conjunction with high ambient temperatures. They must also be used where the sulphur content of the fuel exceeds 0.5%.

**CAUTION**

_API CD, API CE, API CF-4 or MIL-L-2104C/D/E oils can inhibit the running-in process in new or reconditioned engines and are not suitable for engines running on low duty cycles._

**CAUTION**

_Do not use Oil Specification greater than API CF-4 as they could damage the cylinder bore and allow oil to enter the exhaust system._

- The oil must be suitable for 250 hour oil changes without degradation, with sump temps reaching 150°C (302°F) under severe tropical conditions, and 120°C (248°F) under normal conditions.
- For engines running in long-running installations Lister Petter Power Systems should be consulted.

### 5.2.2 Oil Viscosity

*Figure 5.2.2.1 shows the recommended oil viscosity ranges for various °C ambient temperatures from cold start to maximum running.*

Non-synthetic oils at very low temperatures will suffer from wax crystallisation, so synthetic oils are recommended for these conditions. SAE 5W-20 oils are recommended on the basis that they are fully synthetic and are technically suitable for use up to 25°C (77°F) (monograde SAE 5W is not normally available as a
synthetic oil therefore does not appear in the chart). SAE 30 and 10W-30 oils may be used at up to 52°C (126°F), but oil consumption may be affected. 10W-40, 15W-40 and 20W-40 multigrades are recommended for continuous full-load operation at this temperature (monograde SAE 40 oils are not recommended).

In order to maintain the cold-starting characteristics of any recommended grade it is essential that oil changes are made within the Lister Petter recommendations (see 6. Routine Maintenance).

An oil change is recommended immediately if the engine fails to reach its normal cold start cranking speed owing to excessive oil viscosity.

CAUTION

Dilution of the lubricating oil with fuel will adversely affect cold starting and will increase oil consumption.
### 5.2.3 Oil Capacities

#### CAPACITY BETWEEN DIPSTICK MARKS

<table>
<thead>
<tr>
<th></th>
<th>LPW2</th>
<th>LPW3</th>
<th>LPW4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LPWX2</td>
<td>LPWX3</td>
<td>LPWX4</td>
</tr>
<tr>
<td></td>
<td>LPWS2</td>
<td>LPWS3</td>
<td>LPWS(T)</td>
</tr>
<tr>
<td>All builds except 28, 51, 52, 57, 58, 59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>litres</td>
<td>0.90</td>
<td>0.95</td>
<td>1.20</td>
</tr>
<tr>
<td>pints</td>
<td>1.58</td>
<td>1.67</td>
<td>2.11</td>
</tr>
<tr>
<td>US gallons</td>
<td>0.24</td>
<td>0.25</td>
<td>0.32</td>
</tr>
</tbody>
</table>

**Builds 28, 51, 52, 57, 58, 59**

|                      |      |      |       |
| litres               | 1.50 | 1.75 | 2.20 |
| pints                | 2.64 | 3.08 | 3.87 |
| US gallons           | 0.39 | 0.46 | 0.58 |

#### SUMP CAPACITY

(Figures exclude the filter)

<table>
<thead>
<tr>
<th></th>
<th>LPW2</th>
<th>LPW3</th>
<th>LPW4</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>LPWX2</td>
<td>LPWX3</td>
<td>LPWX4</td>
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<tr>
<td></td>
<td>LPWS2</td>
<td>LPWS3</td>
<td>LPWS(T)</td>
</tr>
<tr>
<td>All builds except 28, 51, 52, 57, 58, 59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>litres</td>
<td>3.00</td>
<td>3.75</td>
<td>5.50</td>
</tr>
<tr>
<td>pints</td>
<td>5.28</td>
<td>6.60</td>
<td>9.68</td>
</tr>
<tr>
<td>US gallons</td>
<td>0.79</td>
<td>0.99</td>
<td>1.45</td>
</tr>
</tbody>
</table>

**Builds 28, 51, 52, 57, 58, 59**

|                      |      |      |       |
| litres               | 5.85 | 8.25 | 11.5  |
| pints                | 10.29| 14.52| 20.23 |
| US gallons           | 1.55 | 2.18 | 3.03  |

### 5.2.4 Engine Operation

Excessive periods of idling or repeated cold starts should be avoided, as they will cause dilution of the oil by fuel, requiring more frequent oil changes and dangerously lowering the flash point of the oil.

### 5.3 COOLANT

#### 5.3.1 Engine Cooling System

The cooling system contains many different materials e.g. cast iron, aluminium, copper, solder, rubber (various types). To prevent deterioration of these materials it is essential to use a very good quality coolant. **Untreated water is not suitable and invalidates warranty.** It is essential that the water is treated with an additive that gives the necessary protection for both temperature and corrosion inhibitor.

#### 5.3.2 Coolant Specification

**WARNING**

ALWAYS STOP THE ENGINE AND ALLOW THE PRESSURIZED SYSTEM TO COOL BEFORE REMOVING THE FILLER CAP. AVOID SKIN CONTACT WITH COOLANT BY WEARING GLOVES.
The specification of the coolant concentrate should comply with one of the following:
- BS6580: 1985
- MIL-A-11755D
- MIL-A-46153/B

### 5.3.3 Water Quality
The water to be mixed with the additive must be de-ionized or distilled water having the following characteristics:
- Chlorides less than 80PPMV (PPMV = parts per million by volume)
- Sulphates less than 80PPMV
- Total hardness less than 200PPMV
- pH of water between 7 to 7.5 (neutral to slightly alkaline)

### 5.3.4 Additives to Water
Due to the complexity of the cooling system it is necessary to use an additive that contains a balanced package of antifreeze and corrosion inhibiter. A 50/50 mix of antifreeze and de-ionized or distilled water should be used at all times, even in areas where frost is unlikely. Under no circumstances should an additive containing nitrites, borates, phosphates, chromates, nitrates or silicates be used, as they are not compatible with the materials used in the cooling system. When mixing the antifreeze with the water always follow the manufacturer’s recommendation to add the antifreeze in the correct proportion before introducing it to the engine cooling system. Adding water to antifreeze can lead to the formation of a gel in the mixture, which can cause blockage of water passages and subsequent local overheating.

### 5.3.5 Coolant Capacity

<table>
<thead>
<tr>
<th>ENGINE BLOCK COOLANT CAPACITY</th>
<th>LPW2</th>
<th>LPW3</th>
<th>LPW4</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPW2/LPWX/LPWS2</td>
<td>2.1</td>
<td>2.5</td>
<td>3.0</td>
</tr>
<tr>
<td>litres</td>
<td>3.7</td>
<td>4.4</td>
<td>5.3</td>
</tr>
<tr>
<td>pints</td>
<td>0.55</td>
<td>0.66</td>
<td>0.79</td>
</tr>
<tr>
<td>US gallons</td>
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</tbody>
</table>

**Coolant Capacity: Radiator**
There are a number of radiator options available for LPW, LPWX, LPWT and LPWS engines, including some which may not have been originally fitted by Lister Petter Power Systems.
For these reasons it is advisable to ascertain the radiator capacity which must then be added to that given in the table above under Engine Block before determining the amount of coolant concentrate to be added to maintain a 50% concentration. The capacity of hoses on remote radiator applications must also be taken into consideration.

5.3.6 Maintenance of Coolant
The coolant mixture should be regularly replaced in operating engines at least once a year. In engines used for standby duty it is essential to maintain the coolant mixture at the correct alkalinity level i.e. the pH should not increase above 7.5. A hydrometer only shows the proportion of antifreeze, not the degree of corrosion protection.

⚠️ WARNING

FAILURE TO FOLLOW THE ABOVE RECOMMENDATIONS MAY RESULT IN DAMAGE TO THE ENGINE, AND WILL INVALIDATE THE ENGINE WARRANTY.
6. ROUTINE MAINTENANCE

6.1 GENERAL
This section is designed primarily for use by trained technicians but it does contain sufficient information, illustrations and detail to allow the operator to perform basic maintenance work.

⚠️ WARNING
Routine maintenance must be performed by qualified personnel who are conversant with the hazards of oil, fuel, electricity and machinery.

This work can be carried out only if the necessary hand and service tools are available. When the user has insufficient tools, experience or ability to carry out adjustments, maintenance and repairs this work should not be attempted. Where accurate measurements or torque values are required they can only be made using calibrated instruments.

⚠️ CAUTION
Under no circumstances should makeshift tools or equipment be used, as there use may adversely affect safe working procedures and engine operation.

These recommendations and instructions cover several engine models, therefore they are of a general nature. The engine may include optional equipment not specifically covered in this book.

6.2 BEFORE STARTING
Before starting any dismantling procedure read 1. Safety Information and Precautions. Consider the following:
- Do you know and understand the engine and all the related systems?
- Do you have sufficient electrical and mechanical knowledge and skills to understand the symptoms?
- Do you have suitable electrical diagnostic equipment available?
- Do you have, or have access to, the necessary Lister Petter Power Systems spare parts?

6.3 IMPORTANT INSTRUCTIONS
- Remove the battery before carrying out any maintenance work on an engine.
- Disconnect the battery and alternator before commencing any electric welding when a pole strap is directly or indirectly connected to the engine.
- Fuel pumps and injectors can only be checked and set off the engine using suitable specialist test equipment.
## 6.4 MAINTENANCE SCHEDULE

The following table sets out the frequency with which maintenance and servicing tasks should be performed. This is the minimum frequency required to keep your engine running at peak performance with trouble-free operation.

The instructions are based on average operating conditions. Air cleaners, lubricating oil and fuel filters will require more frequent attention if conditions are very dusty. De carbonising may be required more often if the engine has been running on light loads for long periods.

A - Daily  
B – Every 125 Hours or 1 Month  
C – Every 250 Hours or 3 Months  
D – Every 500 Hours or 6 Months  
E – Every 1000 Hours or 12 Months  
F – Every 2000 Hours or 24 Months  
G – Every 12 Months  
H – Every 24 Months

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th><strong>OPERATION</strong></th>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>Check the level and condition of lubricating oil.</td>
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<td></td>
<td>Check the coolant level.</td>
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<td></td>
<td>Check level and supply of fuel.</td>
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<td></td>
<td>Check for fuel, coolant and oil leaks.</td>
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<td>Examine the radiator cooling fan for damage.</td>
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<td></td>
<td>Clean the air filter element if the engine is operating under very dusty conditions.</td>
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<td>Clean the air filter element if the engine is operating under moderately dusty conditions.</td>
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<td></td>
<td>Check the serviceability of the battery.</td>
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<td></td>
<td>Change the lubricating oil. LPWT &amp; LPWS(T) engines operating above 35°C ambient temperature.</td>
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<td></td>
<td>Renew the oil filter. LPWT &amp; LPWS(T) engines operating above 35°C ambient temperature.</td>
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<td>Check the condition and tension of radiator fan drive belt.</td>
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<td></td>
<td>Check the radiator fins for contamination or blockage.</td>
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<td></td>
<td>Clean injector nozzles if exhaust is dirty.</td>
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<td></td>
<td>Renew the fuel filter element if the fuel is not perfectly clean.</td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>F</td>
<td>G</td>
<td>H</td>
<td>OPERATION</td>
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<td></td>
<td>Change the lubricating oil. LPW(X) engines operating above 35°C ambient temperature and LPWT and LPWS(T) engines operating below 35°C ambient temperature.</td>
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<td></td>
<td>Renew the oil filter. LPW(X) engines operating above 35°C ambient temperature. LPWT &amp; LPWS(T) engines operating below 35°C ambient temperature.</td>
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<td></td>
<td>Renew the fuel filter element.</td>
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<td></td>
<td>Renew the air filter element.</td>
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<td></td>
<td></td>
<td>Check the air induction system for leaks, damage and restrictions.</td>
</tr>
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<td></td>
<td></td>
<td>Change the lubricating oil. LPW(X) engines operating below 35°C ambient temperature.</td>
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<td></td>
<td>Renew the oil filter. LPW(X) engines operating below 35°C ambient temperature.</td>
</tr>
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<td></td>
<td></td>
<td>Clean the crankcase breather canister and hoses. LPWT4.</td>
</tr>
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<td></td>
<td>Check all external nuts, bolts and unions for tightness.</td>
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<td></td>
<td></td>
<td>Ensure that all guards are firmly attached and are not damaged.</td>
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<td></td>
<td></td>
<td>Replace the fuel lift pump diaphragm.</td>
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<td></td>
<td></td>
<td>Drain and clean the engine mounted fuel tank, if fitted.</td>
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<td></td>
<td></td>
<td></td>
<td>Check the engine and speed controls for free movement.</td>
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<td></td>
<td></td>
<td></td>
<td>Clean and check the fuel injector nozzles, if necessary replace.</td>
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<td></td>
<td></td>
<td>Replace the radiator fan drive belt, irrespective of its condition.</td>
</tr>
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<td>•</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Check the lubricating oil pressure.</td>
</tr>
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<td></td>
<td></td>
<td>Drain, flush and refill the cooling system. Adding new coolant concentrate to a 50% concentration. See section 4.3</td>
</tr>
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<td>•</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>Replace the coolant hoses, irrespective of their condition.</td>
</tr>
</tbody>
</table>
6.5 LUBRICATING OIL
Check the lubricating oil daily using the dipstick, and top up when necessary with oil of the correct type and specification (see section 5.2 Oil Lubricating Oil). See Table 5.2.3.1 for the capacity between the dipstick marks of all engines in the LPW range. Change the lubricating oil and filter for the first time at 100 hours and then as specified in 6.4. Maintenance Schedule.

⚠️ CAUTION
Continuous operation under heavy loads in ambient temperatures above 35°C (95°F) causes the oil to deteriorate more quickly.

6.5.1 Draining the Oil Sump
Before draining the oil read 2.6 Precautions with Filters and Elements and 2.7 Precautions with Oil Seals.
The oil sump drain plugs are located on the oil filter side and the gear end of the crankcase. It is better if the engine has been run immediately before draining, as the warm oil will drain more quickly.
1. Remove the oil filler cap.
2. Remove the drain plug and allow the oil to run into a suitable retainer.
3. Clean the drain plug threads and coat them with Hylomar PL32/M, Loctite 572 or Hylogrip 760.
4. Replace the plug and tighten it.

6.5.2 Refilling the Oil Sump
Table 5.2.3.2 gives the sump capacity (excluding the filter) of all engines in the LPW range.

![The oil filler (A) and dipstick handle](image)

1. Ensure the new oil meets the correct specification and viscosity, as given in 4.2 Oil Specification.
2. Fill the sump through the oil filler (A) to the upper mark on the dipstick.
3. Start the engine and run it for a few minutes to circulate the oil.
4. Stop the engine and allow time for the oil to drain down. Check the level on the dipstick.
5. Add more oil if necessary.
CAUTION

Do not overfill with oil. If a cylinder head oil filler is fitted the oil must only be poured into the filler at a rate which enables it to drain into the crankcase. If the oil is poured in too quickly it can flood the crankcase breather holes and escape into the inlet manifold and cylinders.

6.5.3 Changing the Oil Filter
The full flow filter is a spin-on cartridge type located on the crankcase door. Only approved filters should be used, as these have high temperature resistant joints, adequate filter paper characteristics and a rigid case. Other filters may have the same external dimensions and thread as the genuine one but may fail in service.

Before changing the filter read 2.6 Precautions with Filters and Elements.
1. Use a band-type gripping tool to remove the filter from the engine.
2. Lightly grease or oil the face of the rubber joint on the new filter.
3. Screw the new filter onto the crankcase filter adaptor, or filter mounting bracket facing, until the rubber joint just makes contact with the crankcase facing of mounting bracket.
4. Screw the filter on a further quarter to half a turn.
5. Start the engine and run it for a few minutes to circulate the oil.
6. Stop the engine and allow time for the oil to drain down and check the level on the dipstick.
7. Add more oil if necessary.

6.6 COOLING SYSTEM
6.6.1 Draining the Cooling System

WARNING

The cooling system is pressurized and extreme care must be taken when removing the radiator cap if the engine is hot.

1. Place a suitable container under the radiator bottom hose if the coolant is to be retained.
2. Slacken the clips of the hose and slide the hose off.
3. Remove the radiator filler cap.
4. Allow sufficient time for the system to drain.

6.6.2 Flushing the Cooling System
1. With the bottom hose removed, flush the radiator through the filler with clean fresh water, preferably using a hose pipe, until clean water emerges.
2. With the top and bottom hoses removed from the engine, flush the engine
through the top hose with clean fresh water, preferably using a hose pipe, until clean water emerges.
3. Replace the hoses.

6.6.3 Filling the Cooling System

**CAUTION**

*Under some circumstances an air lock can occur when filling the system, causing a false level indication.*

1. Ensure the hoses have been replaced.
2. Refill the system with clean fresh water and coolant concentrate to a 50% concentration while bleeding air from the system at a suitable point. Refill the cooling system with de-ionized or distilled water, adding new coolant concentrate to a 50% concentration, See 5.3. The radiator should be filled to within 13.0-25.0mm (0.5-1.0 in) below the neck of the radiator filler.
3. Run the engine for a short time and check the coolant level.

6.7 FUEL SYSTEM

6.7.1 Priming the Fuel System

1. Ensure there is sufficient fuel.
2. Figure 6.7.1.1 shows the two types of filter. Release the bleed screws (A) on the filter and re-tighten when no further air bubbles are expelled.
3. On variable speed engines move the speed control to the fast position.
4. Move the engine stop/run control from the stop to the run position (Figure 4.2.1).
5. Operate the fuel-lift pump by hand

6.7.2 Changing the Agglomerator

Before starting, read 2.6 *Precautions with Filters and Elements* and study Figure 6.7.2.1

1. Before removing the agglomerator cartridge (A) from the agglomerator head (B) you should first drain the water from the agglomerator by unscrewing the drain tap (C).
2. Using a suitable strap wrench, unscrew the cartridge (A) from the head (B).

![Image of agglomerator: cartridge (A); head (B); drain tap (C).]

6.7.2.1 The agglomerator: cartridge (A); head (B); drain tap (C).

3. Screw a new cartridge onto the head and hand tighten it.

6.7.3 Changing the Fuel Filter
The element should be renewed every 500 hours, or more frequently if for any reason the fuel is known to be dirty.
Before changing the filter read 2.6 Precautions with Filters and Elements.
1. Isolate the fuel supply or drain the tank.
2. Unscrew the centre bolt (A) of the filter assembly.
3. Discard the old element (B) and fit a replacement.
4. Fill the fuel tank and prime the system (see 6.7.1 Priming the Fuel System).
5. Run the engine and check to see that no fuel is leaking from the filter.

![Image of fuel filter: The centre bolt is denoted by A and the old element by B]

6.7.3 Changing the fuel filter. The centre bolt is denoted by A and the old element by B

6.8 RADIATOR FAN DRIVE BELT
The tension of the drive belt (see Figure 6.8.1) must be checked:
1. After the first 50 hours;
2. Every 250 hours;
3. After an overhaul when the belt is refitted or replaced.
4. The drive belt must be replaced every 2000 hours, irrespective of its condition.
When a new belt is correctly fitted and tensioned, a force (F) of 31.0-33.5 N (7.0-7.5 lbf) is required to deflect it a distance (d) of 3.5mm (0.14in).
On subsequent checking and adjustment a force (F) of 22.0-24.0N (5.0-5.4lbf) is required to deflect it a distance (d) of 3.5mm (0.14 in).

6.8.1 Checking drive belt tension. F denotes force and d denotes distance.

6.9 AIR CLEANER

Every effort should be taken to ensure that the air cleaner draws in combustion air at the prevailing ambient temperature.

Any increase in combustion air temperature above the standard engine reference condition of 25°C (77°F) will incur an engine derate factor.

6.9.1 Light Duty Air Cleaner

The snout is normally fitted lying horizontally and pointing towards the gear end, although the cleaner itself can be rotated through 360°.

1. Release the three cover clips (A).
2. Lift off the cover (B).
3. Lift out the element (C).
4. Fit a new element.
5. Replace the cover and clips

6.9.2 Cyclonic Air Cleaner

A cyclonic air cleaner can be remote or engine-mounted over the flywheel housing. In either case it is connected to the engine by a molded rubber hose secured by jubilee clips.

1. Regularly remove the dust cap (A) and empty out all the dust.
2. Gain access to the paper element by undoing the two over-centre clips (B).
3. Remove the element.
4. Clean the element by directing a low pressure compressed air nozzle up and down the pleats from inside the element.
5. Inspect the element for damage by placing a suitable light source inside it. If the element is found to have any holes it must be replaced.

6.10 BATTERY
Check the battery as follows.
1. Wear protective gloves and goggles.
2. Clean the top of the filler-plug area.
3. Remove the filler plugs and check that the electrolyte level is 6.0-9.0 mm (0.25-0.37 in) above the tops of the separators.
4. If necessary, top up with distilled water. In cold weather distilled water should only be added immediately before running the engine.
5. Replace and tighten the filler plugs.
6. Check that the terminal connections are tight; petroleum jelly will help to protect them from corrosion.

⚠️ CAUTION
BATTERIES CONTAIN SULPHIRIC ACID WHICH CAN CAUSE SEVERE BURNS AND PRODUCE EXPLOSIVE GASES. IF ACID IS SPLASHED ON SKIN, EYES OR CLOTHES FLUSH WITH COPIOUS AMOUNTS OF FRESH WATER AND SEEK MEDICAL AID.

6.11 LONG TERM ENGINE STORAGE
If the engine is not required for a period of a few weeks it should be run on full load for approximately 45 minutes once a month.
If the engine will not be required for some months, prepare it for storage as follows.
CAUTION

As a direct result of combustion the lubricating oil may contain harmful acids and therefore it should not be left in the sump if it is known that the engine will not be used for extended periods.

1. Replace the fuel in the tank with a small supply of suitable inhibition fluid.
2. Drain the lubricating oil from the sump and refill with new oil.
3. Run the engine for a period to circulate the oil through the system and to ensure the inhibition fluid is passed through the fuel pumps and injectors.
4. Stop the engine, drain the cooling system and drain the lubricating oil from the sump. The crankshaft should not be turned until the engine is again required for service. The inhibition fluid should be left in the fuel system.
5. Seal all openings on the engine with tape.
6. Remove the batteries and store them fully charged after coating the terminals with petroleum jelly.
7. Grease all external bright metal parts and the speed control linkage.
8. Tie labels on to the engine, clearly stating what steps have been taken to inhibit the engine during storage.

6.11.1 Returning the engine to service

Refer to the appropriate sections for the relevant detailed instructions necessary to complete this work.
1. Remove the tie-on labels and all the protective coverings from openings and apertures.
2. Check the drive belt for deterioration and correct tension.
Check to ensure that the drive-belt pulley grooves are free from corrosion.
3. Fill the fuel tank.
4. Refill the cooling system, adding new coolant to a 40% concentration.
5. Refill the oil sump with new oil of the correct specification and viscosity.
6. Remove the batteries from store and recharge them if necessary. Reconnect them to the engine. Coat the terminals with petroleum jelly.
7. Start the engine and check for coolant, fuel and oil leaks before applying load.
7. TROUBLESHOOTING

7.1 GENERAL
When an engine does not operate as expected it can be difficult to diagnose the cause. Table 7.3 in this chapter suggests a number of possible causes of various problems, together with recommended solutions. The operator should check carefully which of these applies in a particular case. Many of the suggested solutions can be carried out by the operator, guided by section 6. Routine Maintenance. Where indicated1 you should seek assistance from an experienced engineer (who must refer to the Workshop Manual). The list is of a general nature as it covers the basic engine; your particular application may be different. Before starting any maintenance procedure please read 2. Safety Information and Precautions, taking especial note of 2.9.

7.2 METHOD OF FAULT DIAGNOSIS
1. Diagnose the problem by checking and eliminating the easiest causes first. In the case of electrical problems always check the battery first.
2. Double check your observations.
3. Carry out the recommended solution, or request an engineer to do this.
A comprehensive list of problems and the methods of correction is given in the Workshop Manual. If you are in any doubt, contact your Lister Petter Power Systems distributor.

7.3 TROUBLE SHOOTING TABLE

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause</th>
<th>Solution</th>
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</thead>
<tbody>
<tr>
<td>Difficulty starting or failure to start</td>
<td>Incorrect starting procedure.</td>
<td>Refer to section 3.</td>
</tr>
<tr>
<td></td>
<td>Unsuitable lubricating oil or fuel.</td>
<td>Refer to section 4.</td>
</tr>
<tr>
<td></td>
<td>No fuel in the tank or the filter is choked.</td>
<td>Refill the tank and prime the fuel system or replace the filter.</td>
</tr>
<tr>
<td></td>
<td>Air in the fuel system.</td>
<td>Prime the fuel system.</td>
</tr>
<tr>
<td></td>
<td>Water or dirt in the fuel system.</td>
<td>Drain, flush, refill and prime the fuel system.</td>
</tr>
<tr>
<td></td>
<td>Faulty injector or pump.</td>
<td>Replace the injector or pump or have it serviced.</td>
</tr>
<tr>
<td></td>
<td>Discharged battery or poor battery connections.</td>
<td>Recharge or replace the battery. Check the terminals are tight.</td>
</tr>
<tr>
<td></td>
<td>Fuel control solenoid not energised.</td>
<td>Check the shutdown devices of the electrical system.1</td>
</tr>
<tr>
<td>Starter motor does not operate</td>
<td>Loose or corroded connections.</td>
<td>Clean and tighten the connections.</td>
</tr>
<tr>
<td></td>
<td>Worn out battery.</td>
<td>Replace the battery.</td>
</tr>
<tr>
<td></td>
<td>Faulty starter panel or connections.</td>
<td>Adjust the connections and / or replace the panel.</td>
</tr>
</tbody>
</table>

1. Requires an experienced engineer.
## TROUBLESHOOTING

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery will not charge</td>
<td>Loose or corroded connections.</td>
<td>Clean and tighten the connections.</td>
</tr>
<tr>
<td></td>
<td>Worn-out battery.</td>
<td>Replace the battery.</td>
</tr>
<tr>
<td></td>
<td>Loose alternator drive belt.</td>
<td>Replace or re-tension the drive belt.</td>
</tr>
<tr>
<td>Engine speed unstable</td>
<td>Poor quality fuel.</td>
<td>Drain, flush, and prime the fuel system.</td>
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<tr>
<td></td>
<td>Fuel system restriction.</td>
<td>Replace fuel filter.</td>
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<td></td>
<td>Restriction in induction system.</td>
<td>Replace air cleaner element.</td>
</tr>
<tr>
<td></td>
<td>Fault in fuel lift pump.</td>
<td>Replace diaphragm and / or pump.¹</td>
</tr>
<tr>
<td>Overheating</td>
<td>Radiator fan belt too slack.</td>
<td>Adjust belt tension.</td>
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<tr>
<td></td>
<td>Overload.</td>
<td>Reduce the load.</td>
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<td></td>
<td>Lubricating oil level too low.</td>
<td>Refill the sump.</td>
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<td></td>
<td>Recirculation of exhaust gases or cooling air.</td>
<td>Redesign exhaust and ventilation system.¹</td>
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<td></td>
<td>Radiator cooling fins blocked.</td>
<td>Clean the fins of all obstruction.</td>
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<td></td>
<td>Low level of coolant.</td>
<td>Check for leaks and refill.</td>
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<tr>
<td></td>
<td>Cooling system obstructed.</td>
<td>Drain, flush and refill the system.</td>
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<tr>
<td>Engine stops</td>
<td>Lack of fuel.</td>
<td>Check the system.¹ Refill the tank.</td>
</tr>
<tr>
<td></td>
<td>Air in the fuel system.</td>
<td>Prime the fuel filter.</td>
</tr>
<tr>
<td></td>
<td>Water in the fuel system.</td>
<td>Drain, flush, refill and prime the fuel system.</td>
</tr>
<tr>
<td></td>
<td>Choked fuel filter.</td>
<td>Replace the filter.</td>
</tr>
<tr>
<td></td>
<td>Choked air filter.</td>
<td>Dismantle and clean the cap and element.</td>
</tr>
<tr>
<td></td>
<td>Overload.</td>
<td>Reduce the load.</td>
</tr>
<tr>
<td></td>
<td>Overheating.</td>
<td>See Overheating section.</td>
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<tr>
<td></td>
<td>Loss of compression.</td>
<td>Check the piston rings and the valves.¹</td>
</tr>
<tr>
<td></td>
<td>Loss of electrical supply to the fuel pump solenoid.</td>
<td>Check the electrical feed.¹</td>
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<tr>
<td></td>
<td>Automatic shutdown, if protective devices are fitted.</td>
<td>Investigate the cause and rectify.¹</td>
</tr>
<tr>
<td>Lack, or loss, of power</td>
<td>Loss of compression.</td>
<td>Check the piston rings and the valves.¹</td>
</tr>
<tr>
<td></td>
<td>Choked air filter.</td>
<td>Dismantle and clean the cap and element.</td>
</tr>
<tr>
<td></td>
<td>Poor quality fuel.</td>
<td>Drain, flush, refill and prime the fuel system.</td>
</tr>
<tr>
<td></td>
<td>Choked exhaust system.</td>
<td>Dismantle and clean.¹</td>
</tr>
<tr>
<td></td>
<td>Overload.</td>
<td>Reduce the load.</td>
</tr>
<tr>
<td></td>
<td>Choked fuel filter.</td>
<td>Replace the filter.</td>
</tr>
<tr>
<td></td>
<td>Worn engine.</td>
<td>Give the engine a major overhaul.¹</td>
</tr>
<tr>
<td>Undercharging</td>
<td>Excessive electrical load from added accessories.</td>
<td>Remove accessories or fit higher output alternator.¹</td>
</tr>
<tr>
<td></td>
<td>Poor electrical connections to alternator or battery.</td>
<td>Inspect, clean and rectify the cause.</td>
</tr>
<tr>
<td></td>
<td>Faulty battery.</td>
<td>Test and recharge or replace.</td>
</tr>
<tr>
<td></td>
<td>Faulty alternator.</td>
<td>Test and if necessary replace.</td>
</tr>
</tbody>
</table>

¹ Requires an experienced engineer.
## TROUBLESHOOTING

<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overcharging</td>
<td>Faulty alternator.</td>
<td>Test and if necessary replace.</td>
</tr>
<tr>
<td>Battery requires excessive amounts of water</td>
<td>Battery case leaking.</td>
<td>Clean surrounding area and replace the battery.</td>
</tr>
<tr>
<td></td>
<td>Defective battery.</td>
<td>Test or replace the battery.</td>
</tr>
<tr>
<td></td>
<td>Battery charging rate is too high.</td>
<td>Check the alternator output and battery charging system.¹</td>
</tr>
</tbody>
</table>

1. Requires an experienced engineer.
8. MAINTENANCE RECORD

Your Lister Petter Power Systems engine must be properly maintained using the timings and procedures described in this manual. You must be familiar with the routine tasks set out in 6. Routine Servicing, and their correct frequency as described in 6.4 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 41-42 for routine maintenance and pages 43-44 for records of non-routine maintenance.

8.1 ROUTINE MAINTENANCE

<table>
<thead>
<tr>
<th>Hours run</th>
<th>Work done by</th>
<th>Details of service</th>
<th>Distributor / Dealer Stamp</th>
<th>Date</th>
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### 8.2 NON-ROUTINE MAINTENANCE

<table>
<thead>
<tr>
<th>Hours run</th>
<th>Work done by</th>
<th>Details of service</th>
<th>Distributor / Dealer Stamp</th>
<th>Date</th>
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<td>Details of service</td>
<td>Distributor/Dealer Stamp</td>
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</table>
9. WARRANTY

9.1 GENERAL
On receipt of your engine please fill in the section on page 46. This information will be required in the event of a claim under your two-year warranty, according to the conditions set out below.

9.2 STANDARD WARRANTY COVER
The standard warranty includes two-year / 2000-hour (or 1000-hour for 3600 r/min engines) cover for all non-serviceable components, parts and labour, beginning on the date of invoice 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.

9.3 CONDITIONS OF WARRANTY
For the warranty to be valid, servicing must be carried out in accordance with 6. Routine Maintenance and with the timings set out in 6.4 Maintenance Schedule. Detailed records of servicing must be kept; see 8. Maintenance Record. Servicing must be by approved dealers or competent engineers. The conditions of warranty are:

• The maintenance record must be completed.
• Oils and other fluids must be to the specifications/grades given in 5. Engine Fluids or as instructed in the Workshop Manual.
• Only genuine Lister Petter Power Systems service parts must be used.
• When Lister Petter Power Systems 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 authorised 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 Power Systems 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 the Lister Petter Power Systems Applications Department.
• Long term light load and cold engine running will invalidate the warranty.

9.4 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).
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 authorised 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.

9.5 PURCHASE DETAILS OF YOUR ENGINE
Please fill in the section below with your purchase details. This information will be required in the case of a claim under warranty.

9.6 REPAIRS UNDER WARRANTY
• Lister Petter Power Systems must be contacted and authorisation given before any warrantable work is commenced.

9.7 CONTACTING LISTER PETTER POWER SYSTEMS

Head Office
Lister Petter Power Systems Limited Unit 14 Estuary Court
Broadmeadow Industrial Estate Teignmouth
TQ14 9FA
T: +44(0)1285 702211

Production Facility
Lister Petter Power Systems Limited
Units 13-15 Quadrant Distribution Centre
Hardwicke
Gloucester
GL2 2RN

sales@listerpetter.com
www.listerpetter.com

Engine Serial Number: ...........................................................
Purchased from: ..............................................................
Purchase Date: ..............................................................
Plant Type: .................................................................
Plant Number: ..............................................................
OVERVIEW
The G Build engine is specifically designed as a Power generating engine suitable for use in unregulated emissions territories. It is durable, reliable and easy to maintain with oil & filter changes up to 500 hours, dependant on operational conditions. It is designed for continuous operation in ambient temperatures up to 52° (122°F) and a cold start capability down to -32° (-25.6°F).

Note:
This engine does not comply with Harmonised International Regulated Emissions Limits.

BASIC ENGINE CHARACTERISTICS
▪ diesel fuelled and approved for operation on biodiesel, that conforms with ASTM D6751 and EN14214, concentrations of up to 20%
▪ direct fuel injection
▪ 4 cylinders
▪ liquid cooled
▪ naturally aspirated

DESIGN FEATURES AND EQUIPMENT
▪ inlet and exhaust manifolds*
▪ fuel lift pump
▪ mechanical governing
▪ self-vent fuel system with individual
▪ fuel Injection pumps
▪ fuel /filter/agglomerator
▪ thermostatically controlled cooling system with belt driven coolant pump
▪ radiator with pusher fan and belt guard*
▪ gear driven positive displacement type
▪ lubricating oil pump
▪ spin on full flow lubricating oil filter
▪ high inertia flywheel to SAE J620: 7.5” *
▪ SAE 5 flywheel housing *
▪ 12V Starter motor *
▪ 12V battery charge alternator *
▪ oil pressure and coolant temperature switches *
▪ fuel control solenoid (energised to run)*

OPTIONAL ITEMS
A range of options are available that allows you to select a specification that matches your requirements; Please consult you Lister Petter Power Systems distributor.