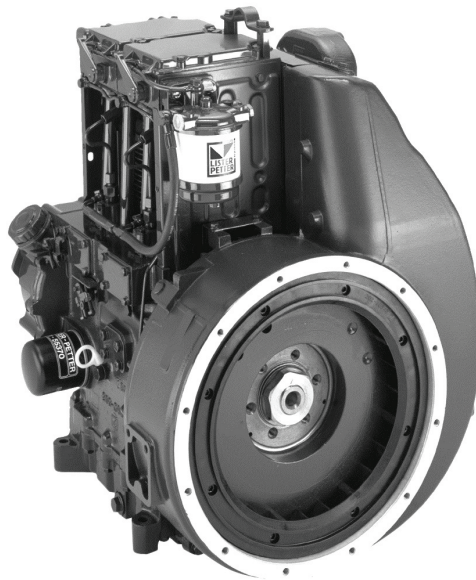




T SERIES

TR ENGINES OPERATORS' HANDBOOK

ORIGINAL INSTRUCTIONS



Associated Publications

Master Parts Manual
Workshop Manual
Technical Information
Arrangement Drawings

P027-08030
P027-08221
P027-09212
P027-08035

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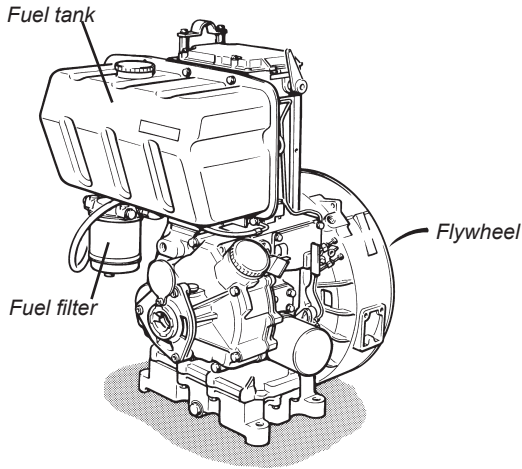
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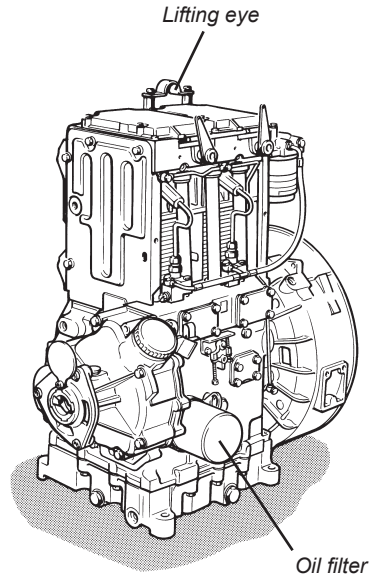
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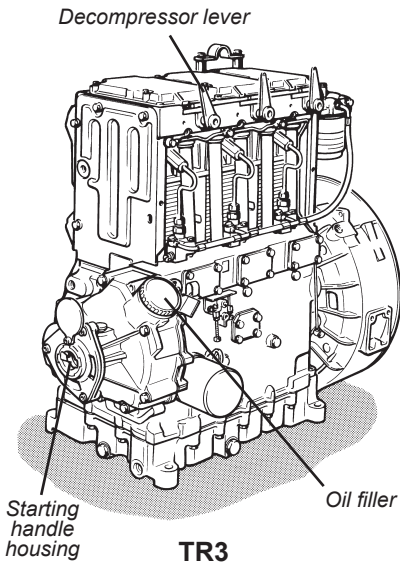
ENGINE FEATURES



TR1



TR2



TR3

Features of the T series air cooled diesel engines.

INTRODUCTION

This handbook explains the operation and routine maintenance of Lister Petter Power Systems T series (TR) air cooled diesel engines.

If your engine is part of a Lister Petter Power Systems generating set, there is a separate operators' handbook for the genset, to explain such features as the control module.

ENGINE IDENTIFICATION

To identify which model of Lister Petter Power Systems T-Series 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 below) to enable the correct maintenance procedures to be carried out. Here is a sample serial number:

07 001234 TR3 A 01

07	Year code (07 = 2007)
001234	Unique engine number
TR3	Engine series
A	Anti clockwise rotation
01	Build number

The illustrations on page 4 show features of the different engine models. When following the instructions in this handbook you will need to be familiar with the parts labelled. (See also table below.)

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 the all 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 or the index 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 5 and 6).

In cases of difficulty, or to obtain spare parts, please consult your local Lister Petter Power Systems distributor or dealer.

RUNNING-IN

To assist running-in all engines are despatched 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.

T SERIES AIR COOLED DIESEL ENGINE MODELS	
TR Model	Characteristic features
TR2	Two cylinders, air cooled, naturally aspirated, direct injection
TR3	Three cylinders, air cooled, naturally aspirated, direct injection
TR4	Four cylinders, air cooled, naturally aspirated, direct injection

1. SAFETY INFORMATION

Read the information in this section carefully and follow all the advice given. Pay especial 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.

1.1 GENERAL SAFETY INFORMATION

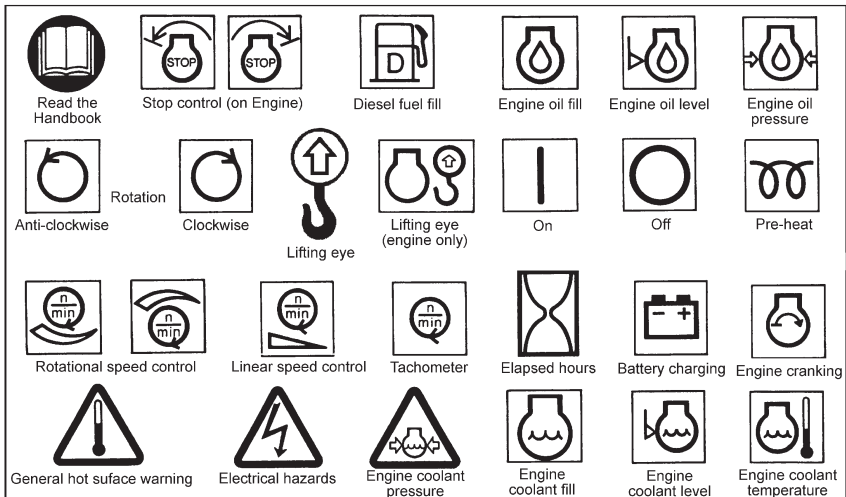
Starting and operating any diesel engine is potentially dangerous. Do not attempt to do so unless you have the necessary knowledge and experience. Ensure that anyone attempting to start and operate your diesel engine has been properly trained and instructed in the correct procedures.

WARNING

Follow all safety instructions accurately.

1. Safety Symbols

This figure identifies the ISO 8999 symbols currently used by Lister Petter Power Systems.



Carefully read and follow all safety information and instructions in this manual.

Observe the safety and informative symbols on your engine and equipment.

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.

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.

1.2 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.

- Tie long hair close to your head.
- 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

Protect yourself against prolonged exposure to loud noise. Failure to do so can cause impairment, or loss, of hearing.

- Wear suitable ear protection against 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 held only by overhead lifting equipment.
- Where appropriate, make sure that guards are properly fitted.

1.3 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, 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 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 comes into contact with the skin, clean off immediately (in the case of lubricating oil, clean off as soon as is practicable).

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.

1.4 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.

⚠ WARNING

Never make unauthorised adjustments to the fuel injection pumps. This could be dangerous and invalidates warranty claims.

- 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.

CAUTION

Keep the fuel free from water and contaminants.

1.5 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.

1.6 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.

1.7 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.
- Before charging the battery warm it to around 16°C (60°F).

WARNING

Never attempt to charge a frozen battery; it may explode.

⚠ 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.

1.8 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

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.

Charge Winding Precautions

- Never connect a battery into the system without checking that the voltage and polarity are correct.
- Always ensure cables are fitted to their correct terminals.

- Never flash any connection to check the current flow.
- Never experiment with any adjustments or repairs to the system.

⚠ CAUTION

Ensure that the battery is correctly connected. Failure to do so could cause short circuit or reversal of polarity, destroying diodes and transistors.

- 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 disconnect the battery and charge windings before commencing any electric welding when a pole strap is directly or indirectly connected to the engine.

1.9 WASTE DISPOSAL PRECAUTIONS

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

⚠ WARNING

To avoid contamination and personal injury, never dispose of toxic or other waste except in accordance with official regulations.

1.10 PRECAUTIONS BEFORE STARTING**⚠ WARNING**

Starting any diesel engine is potentially dangerous. Do not attempt to do so unless you have been properly trained.

- 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.
- 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.

1.11 LIFTING PRECAUTIONS

A lifting eye is fitted to the top of your T Series engine. 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 eye is not damaged and that it is secure.
- The engine lifting eye is suitable for lifting the engine and accessory assemblies originally fitted by Lister Petter Power Systems.

WARNING

Engine lifting eyes must not be used to lift the complete plant.

WARNING

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

1.12 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 personnel using equipment or processes in connection with the maintenance of plant and machinery have received adequate and suitable training.

2. TECHNICAL DATA AND INFORMATION

Table 2 gives technical data for all the engines in the Lister Petter Power Systems T Series.

2.1 COMBUSTION AIR

Engine performance is affected by ambient temperature, which means the temperature of the air entering the engine. The temperature of the combustion air is measured at the air manifold inlet, or the air cleaner. The temperature of the cooling air is measured at the flywheel 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 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.

The engines are able to run satisfactorily at ambient temperatures up to 25°C (77°F) without derating. Above this temperature, the rated power must be reduced in accordance with the relevant standard.

Engines: ISO 3046

Generating Sets: ISO 8528

The maximum permitted ambient temperature is 52°C (125°F).

2.2 COOLING SYSTEM

The engine is air cooled, by means of an integral flywheel fan. The cooling air is distributed by means of a cowling and baffle plates fitted to the cylinder barrels.

2. Technical data for Lister Petter Power Systems T Series engines.

TECHNICAL DATA	
Rotation	Anti clockwise (when looking on the flywheel)
Type of injection	Direct
Cooling	Air
Method of cooling	Integral flywheel fan
Starting	Handstart or 12V starter motor
Electrical system	12V negative earth
Starter battery charging	12V engine-mounted charge-windings
Oil pressure, mean	2.0 bar (29.0lbf in ²)
Engine-mounted fuel tank	13.5 litre; 23.7 pints; 14.2 US quarts
Oil sump capacity	Refer to table 5.6 Oil Sump Capacity (page 21)

3. STARTING AND STOPPING

3.1 PRELIMINARY INSTRUCTIONS

The following operating instructions are of a general nature and should be read in conjunction with, or substituted by, the equipment manufacturers' instructions.

⚠ WARNING

Do not attempt to start any diesel engine unless you have been properly trained. It is dangerous.

Before attempting to start any engine the operator should read 1. *Safety Precautions* and be conversant with the use of the engine controls and the correct starting procedures.

⚠ CAUTION

Ether-based cold start aids in aerosol cans must not be used under any circumstances.

Systems may be fitted to allow a measured quantity to be injected into the inlet manifold, but these must be used in accordance with the manufacturers' instructions.

⚠ WARNING

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

3.2 EXCESS FUEL DEVICE

The engines are fitted with an automatic excess fuel device which becomes operative, ready for the next start, when the engine is stopped.

If the engine stops other than by the operation of the engine control (Figure 3.2), the control must be turned anti clockwise to the **STOP** position and released before the device can operate.

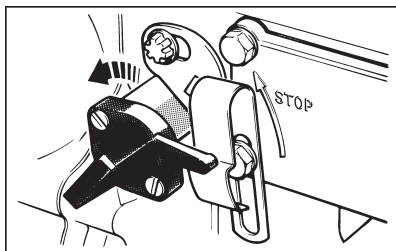


Figure 3.2 The engine control

As the engine runs up to speed the excess fuel device will automatically reset to the normal running position.

3.3 COLD STARTING AID

The cold starting aid may be fitted to the combustion air intake ports and is used when the ambient temperature is below -10°C (14°F).

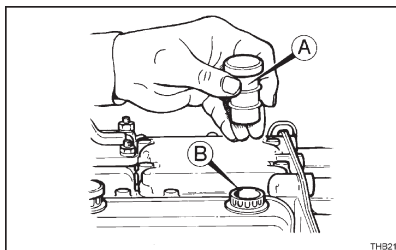


Figure 3.3 Cold start

1. With the fuel turned on, turn the engine for up to 20 revolutions to prime the fuel and lubrication

- systems.
2. Withdraw the plunger (A) and fill one third of the cup (B) with the same type of lubricating oil as used in the engine.
 3. Replace the plunger and inject the oil just before starting the engine.

CAUTION

The device must not be used more than three times in succession during the same attempt to start the engine.

3.4 HAND STARTING

A non-limited kick-back handle (Figure 3.4.1, A) or limited kick-back handle (B) system may be fitted to the engine.

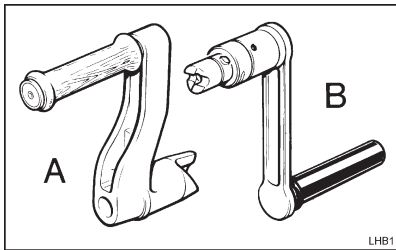


Figure 3.4.1 The two types of starting handle.

WARNING

Do not attempt to use a starting handle if it is damaged in any way.

- The two types of handle are not interchangeable and care must be taken to ensure the correct type is retained with the engine.
- Always use the correct starting handle which has been designed for the engine.
- Ensure there are no burrs on that part of the handle which fits onto the engine.

- Ensure the handle grip is clean, dry and free to turn on its shaft.
- Clean and lightly oil that part of the handle which fits onto the engine.
- Firmly hold the handle grip, **with the thumb on top of the grip**, during the starting procedure.

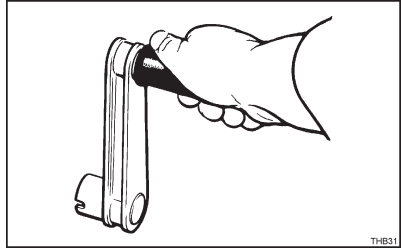


Figure 3.4.2 Holding the starting handle.

To start the engine proceed as follows:

1. Select the excess fuel position by turning the engine control lever anti clockwise to the **STOP** position and releasing it.
2. If a variable speed control lever is fitted move it to the fast position.
3. Move the decompressor lever towards the flywheel.

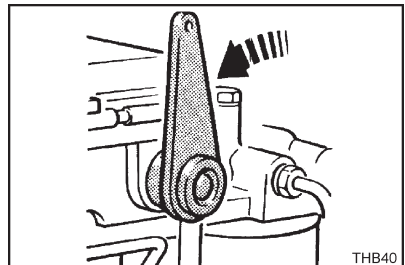


Figure 3.4.3 Moving the decompressor lever towards the flywheel.

4. If the ambient temperature is below -10°C (14°F) refer to 3.3 Cold Starting Aid.

- 5a. **If using a non-limited kick-back handle:** Insert the correct handle (see *Figure 3.4.1, A*) into the starting housing. Slowly rotate the handle in the direction of cranking until it fully engages.
- 5b. **If using a limited kick-back handle:** Swivel the starting-handle housing cover (A) to one side and insert the correct handle, refer to 'B' in *Figure 3.4.1*, into the housing. Slowly rotate the handle in the direction of cranking until it fully engages.
6. If the cold-starting aid was not used turn the engine slowly for up to 20 turns to prime the combustion chamber and lubricating oil system.
7. Firmly hold the handle grip, with the thumb on top of the grip as shown in *Figure 3.4.2*, and crank the engine briskly. When sufficient speed is obtained move the decompressor lever towards the gear end and continue to crank until the engine fires.

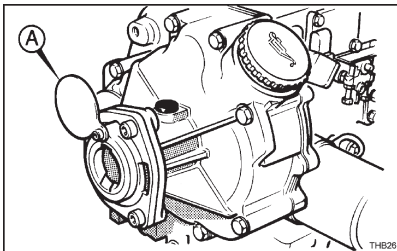


Figure 3.4.4 The starting-handle housing.

8. Retaining a firm grip on the handle, remove it from the housing.

⚠ WARNING

Do not pull the starting handle away from the engine while cranking.

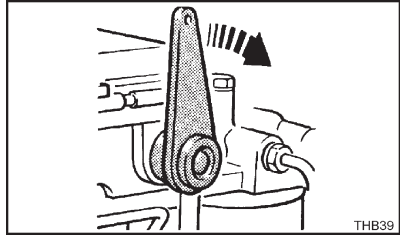


Figure 3.4.5 Moving the decompressor lever towards the gear.

9. If a variable speed control is fitted, reduce the speed as required.

3.5 ELECTRIC STARTING

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

If the engine fails to start within 30 seconds, release the key, or start button, and attempt to restart after allowing sufficient time for all moving parts to stop.

1. Check that the decompressor lever is towards the gear end.
 2. Turn the engine control lever anti clockwise to the **STOP** position and release.
 3. If a variable speed control lever is fitted, move it to the fast position.
 4. If the ambient temperature is below -10°C (14°F) refer to items 2 and 3 in *3.4 Cold Starting Aid*.
- 5a. **If a start key is being used:** Turn the start key clockwise and hold it at position '3', until the engine fires and then release it immediately.

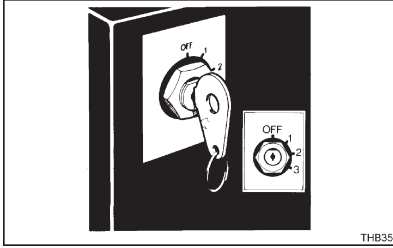


Figure 3.5 The start key.

5b. If a starter button is being used:

Press the starter button until the engine fires and then release it immediately.

6. Turn the engine control lever (see Figure 3.6.3) anti clockwise to the **RUN** position.

7. If a variable speed control is fitted, reduce the speed as required.

3.7 STOPPING THE ENGINE

⚠ WARNING

After prolonged running, metal parts of the stop control may become hot; it is advisable to use suitable hand protection when stopping the engine.

Engines without a fuel-control solenoid:

1. Turn the engine control (Figure 3.2) anti clockwise to the **STOP** position and hold it there until the engine comes to rest.
2. After the engine has stopped turn the start key, if fitted, to the **OFF** position.

⚠ CAUTION

Turning the start key to the OFF position will not stop the engine unless an optional fuel control solenoid is fitted.

Engines with a fuel control solenoid:

1. Turn the key to the **OFF** position (see Figure 3.6.3).

⚠ CAUTION

Never stop the engine by operating the decompressor lever. This could cause valve damage.

4. ENGINE FLUIDS

4.1 OIL SPECIFICATION

To assist engine running-in, all engines are despatched 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 5.2. Maintenance Schedule.

The engines must be run on heavy-duty lubricating oils that at least meet the requirements of one of the following:

- APICC MIL-L-46152B
- DEF2101D MIL-L-2104B

Straight mineral oils are not suitable, neither are oils of less detergency than specified.

Higher specification oils meeting API CD, API CE and API CF-4 are more

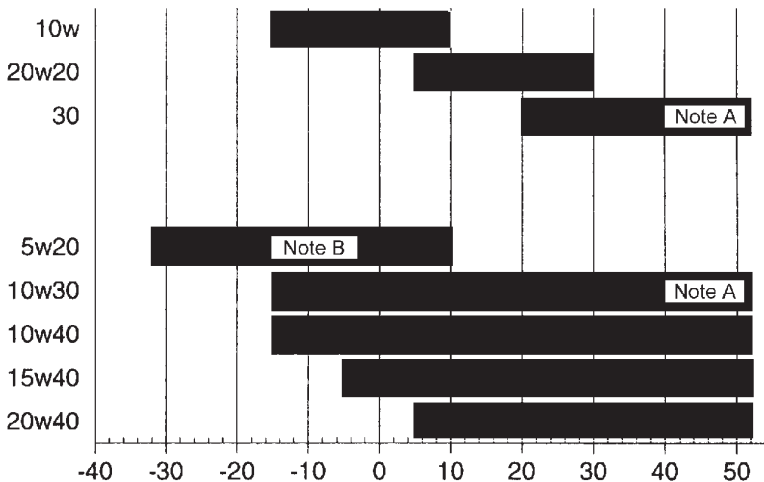
commonly available than API CC. The use of these oils in new engines is acceptable for topping up the first-fill and following the first 100 hours when running-in has been completed.

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%.

The oil must be suitable for 250-hour oil changes without undue degradation, with sump temperatures reaching 150°C (302°F) under severe tropical conditions, and 120°C (248°F) under normal conditions.

For engines in long running installations Lister Petter Power Systems should be consulted.

4.2 The chart shows the recommended oil viscosity grades for different temperature °C ranges. A: intermittent running; B: synthetic oils only. Note: °F = (1.8 x °C) + 32.



⚠ 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.

4.2 OIL VISCOSITY

The chart (*Figure 4.2*) shows the recommended oil viscosity ranges for various ambient temperatures from cold-start to maximum running.

In order to maintain the cold starting characteristics of any recommended grade it is essential that oil changes are made within the Lister Petter Power Systems recommendations.

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

⚠ CAUTION

Do not allow the lubricating oil to become contaminated with fuel as this will adversely affect cold-starting and oil consumption.

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.

4.3 FUEL SPECIFICATION

The fuel used in your engine must be diesel fuel oil which conforms to one of the following:

- BS 2869: 1988 Class A2
- BS EN590: 1995 Class A1
- USA Specification ASTM D-975-77 Grades No. 1-D and 2-D
- BSMA 100 Class M1 for marine use

The fuel must be a distillate and not a residual oil or blend. Vaporising oils are not suitable as fuels for these diesel engines.

⚠ CAUTION

Do not attempt to operate the engine on fuels outside the above specifications, as this may result in excessive wear and a loss in engine performance.

The fuel injection equipment is manufactured to very accurate limits, and the smallest particle of dirt will destroy its efficiency.

⚠ WARNING

It is essential to ensure that the fuel is kept free from water and contaminants.

4.4 LOW TEMPERATURE FUELS

Special winter fuels are often available for use at ambient temperatures below 0°C (32°F).

These fuels have a lower viscosity and limit the formation of wax at low ambient temperatures.

⚠ CAUTION

Wax formation can rapidly reduce the flow of fuel through the fuel filter element.

5. ROUTINE MAINTENANCE

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. The recommendations and instructions cover several engine models, therefore they are of a general nature.

WARNING

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

Work can be carried out only if you have had suitable training and experience, and if the necessary hand and service tools are available. Do not attempt to carry out adjustments, maintenance or repairs if you have insufficient tools, experience or ability.

Where accurate measurements or torque values are required they can only be made using calibrated instruments.

CAUTION

Never use makeshift tools or equipment. It is dangerous and could damage your engine.

The engine may include optional equipment not specifically covered in this book. In this case, refer to the manufacturer's instructions.

5.1 INITIAL ATTENTION

To assist engine running-in, all engines are despatched with an initial-fill lubricating oil which must be changed after the engine has completed 100 running hours.

After the engine has run 25 hours, and again after it has run 250 hours, you should attend to the following:

- Check the valve clearances, and adjust if necessary.
- Check and tighten nuts, bolts and unions paying particular attention to the fuel system.
- Check the lubricating oil level and top up if necessary.
- Observe the exhaust at the normal full load. It must be free from soot. A black exhaust means that the engine is overloaded or that the injection equipment is out of order.

Following this initial attention, the normal routine maintenance must be carried out as given in 5.3 *Maintenance Schedule*.

CAUTION

Do not allow the engine to run with a dirty exhaust without investigating the cause as this may result in an engine breakdown.

5.2 GENERAL INSTRUCTIONS

The frequency with which maintenance work should be carried out is given in Section 5.3 below. Detailed instructions on how to service your engine are given in the remaining sections of this chapter.

Before Servicing

Before starting any dismantling procedure read 1. *Safety Information*. 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?

Important Safety 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.
- Never check fuel pumps and injectors unless they have been set off the engine using suitable specialist test equipment.

After Servicing

- Renew nuts and bolts that have been taken from high-stress locations. In particular nuts and/or bolts from the connecting rods should be renewed.
- It is essential to ensure that nuts and bolts are tightened to the torques specified in the Workshop Manual.
- When re-assembling the engine lubricate all moving parts with engine oil.

5.3 MAINTENANCE SCHEDULE

The table on page 21 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. Decarbonising may be required more often if the engine has been running on light loads for long periods.

CAUTION

Long periods of light or no load running early in the engine's life may lead to cylinder bore glazing and high oil consumption.

Oil and Filter Changes

CAUTION

The first oil and filter change must be made at 100 hours, and thereafter every 250 hours.

MAINTENANCE SCHEDULE

Every Day
Check the level and condition of lubricating oil.
Check the level and supply of fuel.
Check for fuel and oil leaks.
Clean or replace the air cleaner if the engine is operating under very dusty conditions.
After the first 100 hours
Change the initial-fill lubricating oil.
Renew the oil filter.
Every 125 hours
Do all the above checks, and the following:
Clean or replace the air cleaner if the engine is operating under moderately dusty conditions.
Check the condition of the battery, if fitted.
Every 250 hours
Do all the above checks, and the following:
Drain the sump and refill with new oil.
Renew the oil filter element.
Clean or replace injectors if exhaust is dirty.
Renew the fuel filter element if the fuel used is not perfectly clean.

MAINTENANCE SCHEDULE
Every 500 hours
Do all the above checks, and the following:
Renew the fuel filter element.
Renew the air cleaner element.
Renew the cartridge agglomerator.
Examine the air induction and exhaust systems for leaks, damage or restrictions.
Check the battery-charge winding systems (see Workshop Manual).
Every 1000 hours
Do all the above checks, and the following:
Check the valve clearances.
Decarbonise the engine if performance has deteriorated.
Replace the fuel-lift pump diaphragm.*
Every 2000 hours
Do all the above checks, and the following:
Decarbonise.
Check the fuel-pump timing.
Every 6000 hours
Do all the above checks, and the following:
Carry out a major overhaul.

*Inspect more frequently if fuel is contaminated. Inspect regularly on engines in low duty cycle applications, for example, standby generating sets.

5.4 CHANGING THE OIL FILTER

Before changing the filter read *1.5 Precautions with Filters and Elements.**

1. Using a suitable strap wrench, unscrew and remove the old filter.
2. Thoroughly clean the crankcase filter housing face.
3. Apply a small amount of clean engine oil to the oil filter sealing joint.
4. Screw on the new oil filter, by hand,

until the sealing joint is just touching the crankcase, and tighten a further half turn.

5. Run the engine and check for any oil leaks.
6. Stop the engine, allow the oil to settle and check the level on the dipstick.
7. Add more oil if necessary.

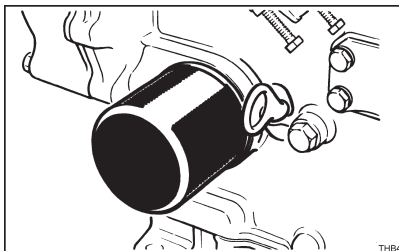


Figure 5.4 Changing the oil filter

5.5 DRAINING THE OIL SUMP

Before draining the oil read *1.5 Precautions with Filters and Elements.*

1. If possible run the engine immediately before draining the oil.
2. Place a suitable container under the drain plug (A).
3. Remove the drain plug and drain the sump.
4. Clean and coat the threads of the drain plug with Hylomar PL32/M or Three Bond 1110B.
5. Replace the drain plug taking care not to overtighten it.

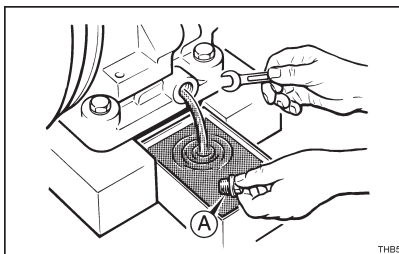


Figure 5.5.1 Oil drain

5.6 FILLING THE OIL SUMP

- 1.Ensure that the new oil meets the correct specification and viscosity, as given in 4. *Engine Fluids*. Check the quantity of oil required in Table 5.6 below.
- 2.Fill the sump through the oil filler (Figure 5.5.2) to the upper mark on the dipstick (B).

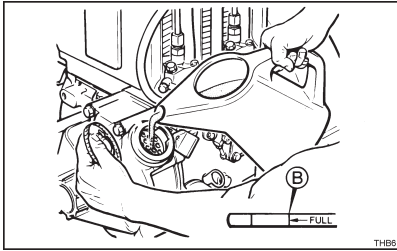


Figure 5.5.2 The oil filler

- 3.Start the engine, run it for a few minutes to circulate the oil and check that the drain plug does not leak.
- 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.

Table 5.6

Oil Sump Capacity (figures exclude the filter)			
	TR1	TR2	TR3
litres	2.7	4.0	6.0
pints	4.7	7.0	10.5
US quarts	2.8	4.2	6.3

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.

5.7 CHANGING THE FUEL TANK FILTER

The fuel filter is an essential part of the engine. The engine must never be run without a filter, and the element should be renewed every 500 hours, or more frequently if for any reason the fuel is dirty.

Before changing the filter element read 1.5 *Precautions with Filters and Elements*.

- 1.Remove the retaining plug (A).
- 2.Remove the old element (B) and the joints (C).
- 3.Fit a new element and new joints.
- 4.Replace and tighten the retaining plug (A).
- 5.Prime the fuel system.
- 6.Run the engine and check for fuel leaks.

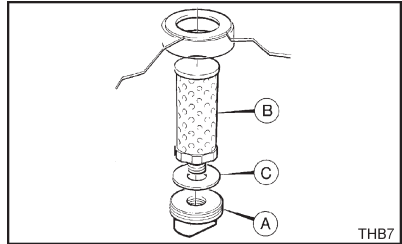


Figure 5.7 The fuel tank internal filter

5.8 CHANGING THE FUEL FILTER

- 1.Unscrew and remove the retaining bolt (A) from the element bowl.
- 2.Remove the element (B) and discard it.
- 3.Discard the three joints (C).
- 4.Fit new joints to the element adapter, the retaining bolt and the filter head.
- 5.Fit the new element onto the adapter.

6. Replace the element bowl and retaining bolt.
7. Fill the fuel tank and prime the fuel system.

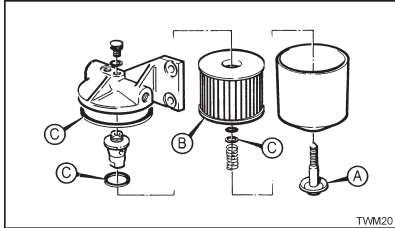


Figure 5.8 The fuel filter

5.9 CARTRIDGE AGGLOMERATOR

The cartridge agglomerator is an essential part of the engine and should be renewed every 500 hours, or more frequently if for any reason the fuel is dirty.

Before changing the agglomerator read *1.5 Precautions with Filters and Elements*. A strap wrench is required to remove the agglomerator from the engine but it must not be used to fit a replacement.

1. Drain the water from the agglomerator by unscrewing the drain tap (C) sufficiently to allow the water to drain.
2. Using a suitable strap wrench unscrew the cartridge (A) from the head (B).
3. Screw a new cartridge onto the head and hand-tighten it.
4. Prime the fuel system.
5. Run the engine and check for fuel leaks.

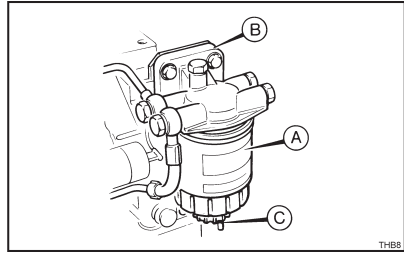


Figure 5.9 The cartridge agglomerator

5.10 PRIMING THE FUEL SYSTEM

If a self-venting fuel system is fitted, it should not be necessary to manually prime it.

1. Fill the tank with fuel.
2. Vent the fuel filter through the bleed screw (A) until a full air-free flow of fuel is obtained.
3. Vent the fuel at each pump in turn through the bleed screws (B) starting with the pump nearest to the fuel tank.

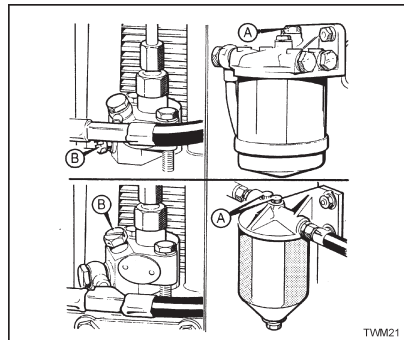


Figure 5.10 Priming the fuel system

5.11 MEDIUM DUTY AIR CLEANER

The standard air cleaner is fitted to the air manifold adaptor by a jubilee clip. The snout is normally fitted lying horizontal and pointing towards the

gear end although the cleaner itself can be rotated through 360°.

1. Gain access to the paper element by undoing the cruciform-headed screw in the centre of the main body of the filter casing, or by releasing the three cover clips (A).
2. Lift off the cover (B).
3. Lift out the element (C).
4. If the element is dirty fit a new one.
5. Replace the cover and clips, or the screw.

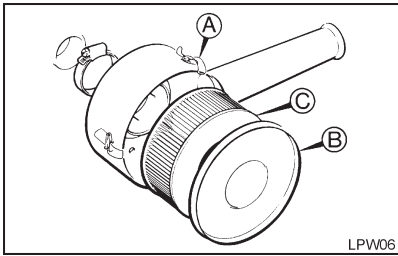


Figure 5.11 Medium duty air cleaner

5.12 CYCLONIC AIR CLEANER

If your engine has a cyclonic air cleaner it may be engine-mounted or remote mounted. The air cleaner mounting bracket bolts are torqued to 21.0Nm (15.5 lbf ft).

Service the air cleaner as follows:

1. Release the cover clips and remove the end cap.
2. Remove the outer element (A) and clean or replace it as necessary.
3. Replace the element.
4. Replace the cover with the inlet facing downwards.

CAUTION

After the outer element (A) has been cleaned three times the inner element (B) must be replaced. Do not attempt to clean the inner element.

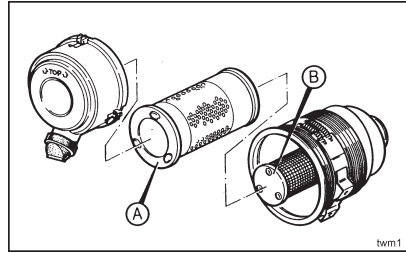


Figure 5.12 Cyclonic type air cleaner

5.13 VALVE CLEARANCE ADJUSTMENT

The valve clearance for both inlet and exhaust valves must be set with the engine cold.

VALVE CLEARANCE		
	GO	NOT GO
mm	0.15	0.20
in	0.006	0.008

1. Remove the cylinder head cover.
2. Ensure that the cylinder head nuts are correctly tightened.
3. Turn the engine until the piston is at TDC position on the firing stroke for the cylinder being worked on.
4. Slacken the locknut (A) and adjust the screw (B) until the correct clearance has been obtained.

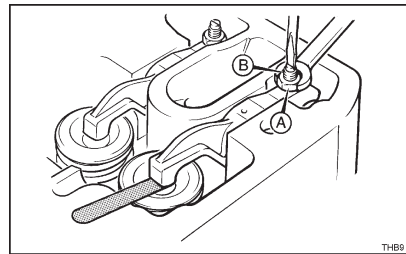


Figure 5.13 Valve clearance

5. Tighten the locknut whilst restraining the adjusting screw, and re-check to ensure that the clearance is correct.
6. Repeat for the remaining valve.
7. Replace the rocker cover, taking care to ensure that the decompressor lever, if fitted, is vertical.

5.14 DECOMPRESSOR ADJUSTMENT

This adjustment should only be made when the valve clearance is correctly adjusted.

1. Remove the cylinder-head cover.
2. Turn the engine until the piston is at TDC position on the firing stroke for the cylinder being worked on.
3. Slacken the locknut (A) and adjust the screw (B) until it just touches the exhaust valve rocker when the lever is vertical.
4. Turn the screw half a turn clockwise so that it travels towards the rocker.
5. Tighten the locknut whilst restraining the adjusting screw.
6. Replace the rocker cover, taking care to ensure the decompressor lever is vertical.

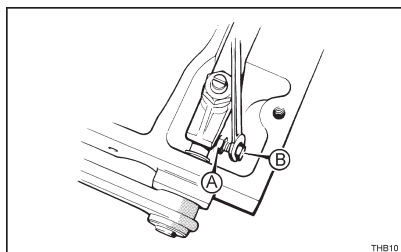


Figure 5.14 Decompressor lever

5.15 CHECKING THE BATTERY

1. Wear protective gloves and goggles.

2. Clean the top of the battery filler-plug area.
3. Remove the filler plugs and check that the electrolyte level is 6.0-9.0mm (0.25-0.37in) above the tops of the separators.
4. If necessary top up with distilled water. To prevent freezing 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 SULPHURIC ACID WHICH CAN CAUSE SEVERE BURNS AND PRODUCE EXPLOSIVE GASES. IF ACID IS SPLASHED ON THE SKIN, EYES OR CLOTHES, FLUSH WITH COPIOUS AMOUNTS OF FRESH WATER AND SEEK IMMEDIATE MEDICAL AID.

5.16 LONG TERM ENGINE STORAGE

The following routine should be carried out when it is known that the engine will not be required for some months. If the procedure is not carried out the engine should be run on full load for approximately 45 minutes once a month.

CAUTION

AS A DIRECT RESULT OF COMBUSTION, THE LUBRICATING OIL MAY CONTAIN HARMFUL ACIDS. OIL SHOULD NOT BE LEFT IN THE SUMP IF IT IS KNOWN THAT THE ENGINE WILL NOT BE USED FOR EXTENDED PERIODS.

Preparing the Engine for Storage

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 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 the engine clearly stating what steps have been taken to inhibit the engine during storage.

Returning the Engine to Service

1. Refer to the appropriate sections for the relevant detailed instructions as necessary to complete this work.
2. Remove the tie-on labels and all the protective coverings from openings and apertures.
3. Fill the fuel tank.
4. Refill the lubricating-oil sump with new oil of the correct specification and viscosity.
5. Remove the batteries from store. If they are still fully charged reconnect them to the engine.
6. Coat the terminals with petroleum jelly.
7. Start the engine and check for fuel and oil leaks before applying load.

6. TROUBLESHOOTING

6.1 PRELIMINARY INFORMATION

Troubleshooting mechanical engine problems can be difficult. The list of problems in this section is of a general nature as it covers the basic engine; your particular application may be different. A comprehensive list of problems and the methods of correction is given in the Workshop Manual. If you are in any doubt, contact your local Lister Petter Power Systems distributor.

Before starting any dismantling procedure please read 1. Safety Information. The following should be considered:

- 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?

6.2 METHOD OF TROUBLESHOOTING

Use the tables to find out probable causes of problems, together with recommended solutions.

1. Diagnose the problem by eliminating the easiest things first.
2. Before starting to remove or dismantle any components double-check your observations.
3. During dismantling keep all cylinder-related items together in their respective groups and correct order to ensure they are refitted in their original places.
4. In the case of electrical problems always check the battery first.

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

TROUBLESHOOTING		
Battery will not charge	Loose or corroded connections.	Clean and tighten the connections.
	Worn-out battery.	Replace the battery.
	Loose alternator drive belt.	Replace or re-tension the drive belt.
Overheating	Radiator fan belt too slack.	Adjust belt tension.
	Overload.	Reduce the load.
	Lubricating oil level too low.	Refill the sump.
	Recirculation of exhaust gases or cooling air.	Redesign exhaust and ventilation system.
Engine stops	Lack of fuel.	Check the system. Refill the tank.
	Air in the fuel system.	Prime the fuel filter.
	Water in the fuel system.	Drain, flush, refill and prime the fuel system.
	Choked fuel filter.	Replace the filter.
	Choked air filter.	Dismantle and clean the cap and element.
	Overload.	Reduce the load.
	Overheating.	See Overheating section.
	Loss of compression.	Check the piston rings and the valves.
	Loss of electrical supply to the fuel pump solenoid.	Check the electrical feed.
Automatic shutdown, if protective devices are fitted.	Investigate the cause and rectify.	
Lack, or loss, of power	Loss of compression.	Check the piston rings and the valves.
	Choked air filter.	Dismantle and clean the cap and element.
	Choked exhaust system.	Dismantle and clean.
	Overload.	Reduce the load.
	Choked fuel filter.	Replace the filter.
	Worn engine.	Give the engine a major overhaul.
Undercharging	Excessive electrical load from added accessories.	Remove accessories or fit higher output alternator.
	Poor electrical connections to alternator or battery.	Inspect, clean and rectify the cause.
	Faulty battery.	Test and recharge or replace.
	Faulty alternator.	Test and if necessary replace.
Overcharging	Faulty alternator.	Test and if necessary replace.
Battery requires excessive amounts of water	Battery case leaking.	Clean surrounding area and replace the battery.
	Defective battery.	Test or replace the battery.
	Battery charging rate is too high.	Check the alternator output or battery charging system.

7. MAINTENANCE RECORD

Your Lister Petter Power Systems T Series 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 5. *Routine Maintenance*, and their correct frequency as described

in 5.3 *Maintenance Schedule*. Details of the maintenance work carried out during the first 5000 hours, except the daily checks, must be recorded in the spaces allocated in this section: pages 30-34 for routine servicing and pages 35-39 for non-routine servicing.

7.1 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

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

7.2 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

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

8. WARRANTY

On receipt of your engine please fill in the section on page 41. This information will be required in the event of a claim under your two-year warranty, according to the conditions set out below.

8.1 STANDARD WARRANTY COVER

The standard warranty includes two-year/5000-hour cover for all non-serviceable¹ components, parts and labour, beginning on the date of delivery to the original retail purchaser, and is transferable. It is subject to the conditions set out below in *8.3 Conditions of Warranty* and the limitations set out in *8.4 Limitations of Warranty*.

8.2 EXTENDED WARRANTY COVER

In order to extend the warranty period beyond the initial two year period you must register the engine with a Lister Petter Power Systems dealer within 28 days of receipt. A list of dealers is available at www.listerpetter.com

The extended warranty gives five-year/5000-hour cover, beginning on the date of delivery to the original retail purchaser, and is transferable. It includes the following:

Years 1 and 2: all non-serviceable¹ components, parts and labour.

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.*

Year 3: core engine², parts and labour.

Year 4: core engine, parts and labour.

Year 5: core engine, parts only.

8.3 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 *7. 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 *4. 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 *7. 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.

Continued

- Evidence will be required of engine hours run and should be entered in *7.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 Power Systems Applications Department.
- Long term light load and cold engine running invalidate the warranty.

8.4 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*).

8.5 PURCHASE AND REGISTRATION DETAILS OF YOUR ENGINE

Please fill in the section below with your purchase and registration details. This information will be required in the case of a claim under warranty.

8.6 REPAIRS UNDER WARRANTY

Lister Petter Power Systems must be contacted and authorisation given before any warrantable work is commenced.

8.7 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:.....

Date Registered with Lister Petter Power Systems:.....

Plant Type:.....

Plant Number:.....

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.

***T SERIES ENGINES OPERATORS' HANDBOOK,
P027-08265, EDITION 4, OCTOBER 2017***
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