



DELTA Series

DWS4 Engine Operators' Handbook



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Associated Publications

Master Parts Manual P027-08042
Workshop ManualP027-08212
Technical HandbookP027-08244

Disclaimer

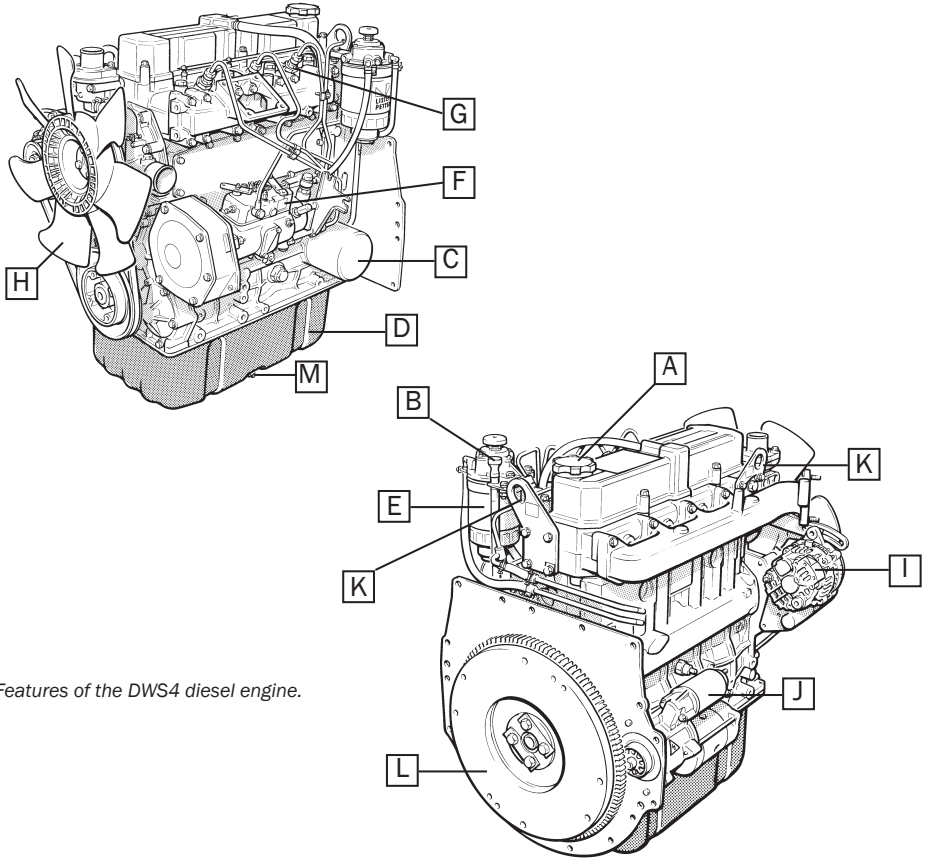
The information, specifications, illustrations, instructions and statements contained within this publication are given with Lister Petter's best intentions and are believed to be correct at the time of going to press.

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Features of the DWS4 diesel engine.

Features of the DWS4 diesel engine.			
A	Oil Filler	H	Radiator Fan
B	Oil Dipstick	I	Alternator
C	Oil Filter	J	Starter Motor
D	Sump	K	Lifting Eye
E	Fuel Filter	L	Flywheel
F	Fuel Pump	M	Drain Plug
G	Fuel Injector		

Introduction

Introduction

The purpose of this handbook is to lay down operating guidelines for the DELTA (DWS4) engine series.

The specification details given apply to a range of engines and not to any one particular engine, in cases of difficulty the user should consult the local Lister Petter Distributor or Dealer for further advice and technical assistance.

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Using this Operators Handbook

It is recommended the individual steps contained in the various maintenance or repair operations are followed in the sequence in which they appear.

When a diesel engine is operating or being overhauled there are a number of

associated practices which may lead to personal injury or product damage.

Your attention is drawn to the symbols shown and described below which are applied throughout this publication.

CAUTION

This caution symbol draws attention to special instructions or procedures which, if not correctly followed, may result in damage to or destruction of equipment.

WARNING

This warning symbol draws attention to special instructions or procedures which, if not strictly observed, may result in personal injury.

WARNING

A WARNING SYMBOL WITH THIS TYPE OF TEXT DRAWS ATTENTION TO SPECIAL INSTRUCTIONS OR PROCEDURES WHICH, IF NOT STRICTLY OBSERVED, MAY RESULT IN SEVERE PERSONAL INJURY, OR LOSS OF LIFE.

Running-in

A gradual running-in of a new engine is not necessary. Extended light load running early in the life of the engine may cause detrimental damage to the cylinder bore allowing lubricating oil to enter the exhaust system.

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

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.

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.

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.

1. Safety Information

- 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.

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, coolant concentrate, battery acid, paint and adhesives.

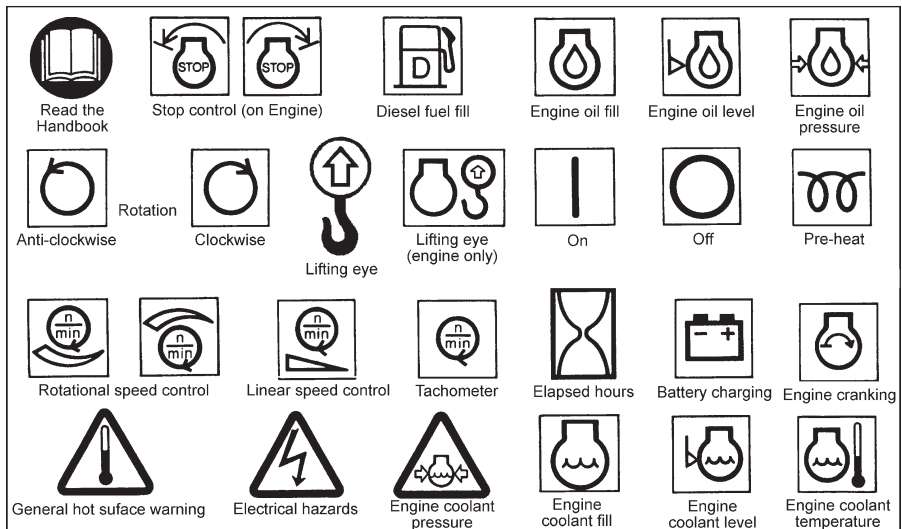
Manufacturers' safety data sheets will provide specific details of the physical and health hazards, safety and emergency procedures and any necessary personal protection equipment required while working with hazardous materials.

- 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.

Fuel and High-Pressure Fluids

- Store fuel and other flammable liquids away from fire hazards.
- Always stop the engine before refuelling.

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



1. Safety Information

- 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 emission-compliant fuel injection pumps. This could be dangerous and invalidates warranty claims. In the USA unauthorised adjustment of emission critical components is prohibited by Federal Law, incurring civil penalty.

- 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 un-sealing 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.
- 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.

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.

1.8.1 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.

1.8.2 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

1. Safety Information

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 ruin 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.

1.9 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.

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 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.
- Check that the radiator is filled to within 13-25 mm (0.5-1.0 in) below the neck of the radiator filler.

- 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

Engine lifting eyes are fitted to DELTA 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.

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

2. Technical Data and Information

2.2 Nomenclature

DWS4: four-cylinder, indirect injection, naturally aspirated water cooled diesel engine.

The Engine Serial Number

The engine serial number is stamped on a plate attached to the engine.

It is necessary to identify the type of engine to enable the correct maintenance procedures, as described later in this publication, to be carried out.

An example number is shown below.

05 001234 DWS4 A 01
 05.....Year code (05 = 2005)
 001234.....Unique engine number
 DWS4 Engine series
 AAnti-clock rotation
 01..... Build number

2. Technical data.

Technical Data		
DELTA series model	DWS4	
Rotation	Anticlockwise (when looking on the flywheel)	
Type of injection	Indirect	
Firing order (number 1 cylinder is at the gear end)	1 - 3 - 4 - 2 (number 1 cylinder is at gear end)	
Electrical system	12 V negative earth	
Starter battery charging	12 V engine-mounted alternator	
Oil pressure	at idle	1.0 bar (14.5 lbf in ²)
	at 1500 r/min	3.0–5.0 bar (43.5–72.5 lbf in ²) with the oil at 60–70 °C (140–158 °F)
Oil sump capacity	litres	10.0
	pints	17.0
	US pints	21.0
Oil capacity between dipstick marks	litres	3.0
	pints	5.3
	US pints	6.3
Total coolant capacity	litres	11.0
	pints	19.3
	US pints	23.2
Engine block coolant capacity	litres	5.5
	pints	9.6
	US pints	11.6

3. Starting and Stopping

3.1 Preliminary Instructions

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

WARNING

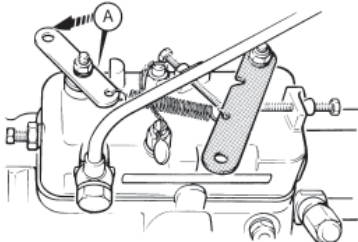
Never attempt to start any diesel engine unless you have been properly trained to do so. Read 1. Safety Information and Precautions. Ensure that you are conversant with the engine controls and the correct starting procedures.

CAUTION

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

WARNING

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



3.1 The rotary fuel pump. A denotes the engine control lever.

3.2 Starting the Engine

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

If the engine fails to start within 30 seconds, release the key and attempt to restart

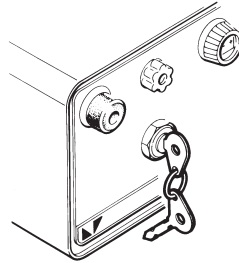


Figure 3.2 Key Start

after allowing sufficient time for all moving parts to stop.

1. Ensure that the engine control lever (on rotary fuel pump only, see figure 3.1, A) is in the start position. On variable speed engines move the speed control to the fast position.
- 2a. For ambient starting temperatures **above** -10°C (14°F) turn the key clockwise and hold it in the **HEAT** position for 10 to 15 seconds before turning it to the **START** position to energise the starter. When the engine is up to speed release the key allowing it to return to the **ON** position.
- 2b. For ambient starting temperatures **below** -10°C (14°F) turn the key clockwise to the **HEAT** position for 30 seconds before turning the key to the **START** position to energise the starter. When the engine is up to speed release the key to allow it to return to the **ON** position.
3. On variable speed engines reduce the engine speed as necessary.

3.3 Stopping the Engine

1. If possible remove the load from the engine.
2. If a variable speed control is fitted, reduce the engine speed.
3. Turn the key to the **STOP** position.

4. Engine Fluids

4.1 Oil Specification

To help 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. *Maintenance - interim schedule*.

All DELTA 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
 DEF2101DMIL-L-2104B
 Straight mineral oils are not suitable, neither are oils of less detergency than specified.

For engines in longrunning installations please consult Lister Petter.

⚠ 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

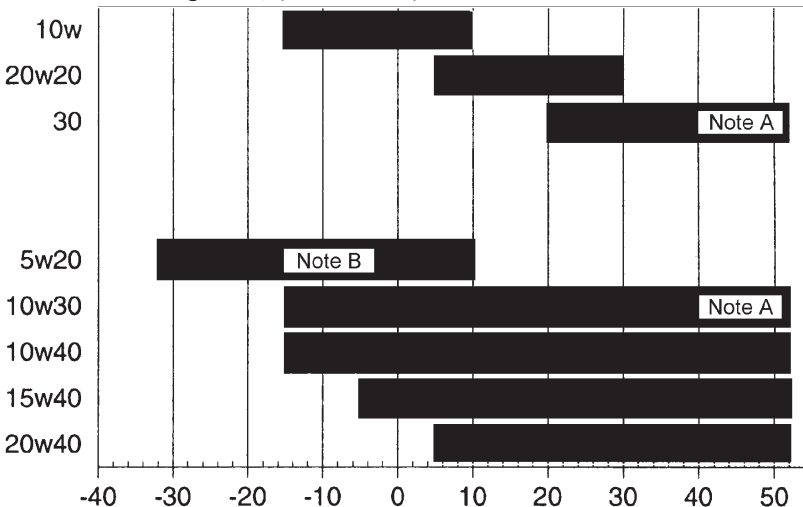
The following chart shows the recommended oil viscosity ranges for various °C ambient temperatures from cold start to maximum running.

Before selecting a viscosity grade please note the following:

- 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.
- An oil change is recommended immediately if the engine fails to reach its normal cold start cranking speed due to excessive oil viscosity.
- Fuel dilution of the lubricating oil will adversely affect cold starting and oil consumption.
- SAE 40 oils may be used at up to 52°C (126°F) but oil consumption may be affected. 15W-40 and 20W-40 multi-grades are recommended for continuous full-load operation at this temperature.

4.2 Recommended oil viscosity grades for different temperature ranges.

Note A: intermittent running; note B; synthetic oils only.



Note: °F = (1.8 x °C) + 32.

4. Engine Fluids

4.3 Fuel Specification

The engine must only be run on diesel fuel oil that 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 unsuitable.

CAUTION

Do not attempt to operate your engine on fuels outside the above specifications as this may result in excessive wear and damage.

WARNING

Ensure that the fuel is free from water and contaminants.

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.

4.4 Coolant Concentrate

The coolant concentrate should comply with one of the following specifications:

BS6580 : 1985

MIL-A-11755D

MIL-A-46153/B

A 40% concentration must be maintained under all operating conditions. The amount of coolant concentrate required is thus 40% of the total coolant capacity (combining the engine, radiator and associated pipework); see 2.1 *Technical Data*.

WARNING

Coolant concentrate must not be allowed to come into contact with the skin. Observe the manufacturers' instructions and precautions.

5. Routine Maintenance

Before starting any maintenance or dismantling procedure on your DELTA engine please read *1. Safety Information and Precautions*. You should be able to answer "yes" to the following questions:

- 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 spare parts?



WARNING

NEVER ATTEMPT TO UNDERTAKE ANY MAINTENANCE PROCEDURES ON A DIESEL ENGINE UNLESS YOU HAVE HAD THE NECESSARY TRAINING.



WARNING

BEFORE STARTING ANY WORK, READ THE SAFETY INFORMATION GIVEN IN SECTION 1. FAILURE TO FOLLOW THE CORRECT PROCEDURES COULD CAUSE SERIOUS INJURY OR EVEN DEATH.

5.1 General Information

The engine should receive regular attention, especially during the first 50 hours of its life from new and after a major overhaul. Refer to the instructions given in *5.13 Maintenance Schedule*. These are based on average operating conditions and cover the minimum requirements to keep your DELTA engine running at peak performance with trouble-free operation.

- Under very dusty conditions, air clean-

ers, lubricating oil and fuel filters will require more frequent attention.

- Decarbonising may be required more often if the engine has been running on light loads for long periods.

CAUTION

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

- Remove the battery before carrying out any maintenance work.
- Disconnect the battery and alternator before commencing any electric welding when a pole strap is directly or indirectly connected to the engine.
- Always 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.
- Renew nuts and bolts that have been taken from high stress-locations, particularly those from the connecting rods.
- The fuel injector can only be checked and set off the engine using suitable specialist test equipment.

The following recommendations and instructions are of a general nature and may not include optional equipment fitted to the engine. For more detailed information refer to the Workshop Manual, or consult your Lister Petter Distributor.

5.2 Maintenance Schedule

The table on the next page lists the regular maintenance procedures that must be undertaken, and how frequently.

5. Routine Maintenance

Maintenance Schedule

At all times

Continuously monitor engine performance.

Daily

Check the level and condition of lubricating oil.

Check the coolant level.

Check the level and supply of fuel.

Examine the cooling fan for damage.

Ensure all guards are firmly attached and are not damaged.

Clean the air cleaner if the engine is operating under very dusty conditions.

After the first 100 hours

Change the initial-fill lubricating oil and oil filter.

Every 250 hours

Do all the above, and the following:

Check all external nuts, bolts and unions for tightness.

Renew the oil filter element.

Drain the sump and refill with new oil of the correct type and specification.

Check the battery condition and terminal posts for corrosion.

Every 500 hours

Do all the above, and the following:

Renew the air cleaner element.

Check the valve rocker clearances.

Every 1000 hours

Do all the above, and the following:

Lubricate the cooling system water pump.

Clean and check, and if necessary replace, the fuel injector nozzles.

Every 2000 hours

Do all the above, and the following:

Replace the cooling system drive belt, irrespective of its condition.

Every 6000 hours

Check the compression.

Decarbonise, and overhaul if necessary.

Every 12 Months

Drain, flush and refill the cooling system, adding new coolant concentrate to a 40% concentration. The coolant capacity is given in 2.1 Technical Data.

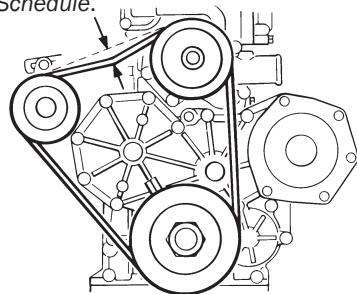
Every 2 Years

Check the coolant hoses and replace them if they are swollen or perished.

5.3 Drive Belt Tension

The tension of the 'V' drive belt must be checked:

- After the first 50 hours running.
- After an overhaul.
- After a new belt has been fitted.
- As specified in 5.2 Maintenance Schedule.



5.3 Checking belt tension.

Proceed as follows:

1. Slacken the two alternator lower pivot bolt nuts and the two alternator adjuster arm retaining bolts.
3. Hold the alternator outwards as far as possible by hand until thumb pressure will deflect the belt a distance of approximately 12.0mm (0.5in).
4. Tighten the alternator pivot and adjusting arm bolt nuts.

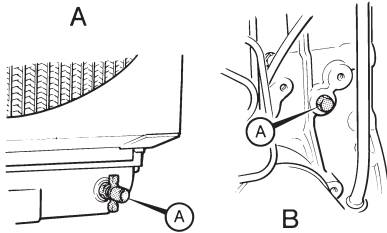
5.4 Cooling System

5.4.1 Draining the Cooling System

⚠ WARNING

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

1. Place a suitable container under both the radiator and cylinder block drain plugs (A)



5.4. Drain plugs: A, radiator; B, cylinder block.

2. Open, or remove the drain plugs.
3. Remove the radiator filler cap.
4. Allow sufficient time for the system to drain.

Radiator

1. With the top and bottom hose, or drain plug, removed from the radiator flush the radiator through the filler with clean fresh water, preferably using a hose pipe, until clean water emerges from the bottom.
2. Replace the hoses and drain plug.

Cylinder Block

1. With the cylinder block drain plug and the top hose from the radiator removed, flush the engine block with clean fresh water, preferably using a hose pipe, until clean water emerges from the drain plug.
2. Replace the hose and drain plug.

5.4.2 Filling the Cooling System

The coolant capacity details are given in 2. *Technical Data*.

1. When the engine is operating at temperatures up to 35°C (95°F) or at high speeds and duty factors.

⚠ CAUTION

Under some circumstances an airlock can occur when filling the system causing a false level indication.

1. Replace all the hoses and drain plugs.
2. Refill the system with clean fresh water, and coolant concentrate to a minimum 40% concentration, while bleeding air from the system at a suitable point. The radiator should be filled to within 13.0mm-25.0mm (0.5-1.0in) below the neck of the radiator filler.

Coolant Concentration	
Ambient Temperature	Concentration
Down to -20°C	40%
Between -20°C and -30°C	50%
Between -30°C and -45°C	60%
$^{\circ}\text{F} = (1.8 \times ^{\circ}\text{C}) + 32$	

3. Run the engine for a short time and check the coolant level.

5.5 Oil and Oil Filter

5.5.1 Oil and Filter Change Periods

To assist engine running-in, DWS4 engines are despatched with an initial-fill lubricating oil. This oil, and the oil filter, must be changed after the first 100 hours, with all subsequent oil and filter changes being made every 250 hours.¹

Before changing the lubricating oil or oil filter:

- Refer to 2.1 *Technical Data* for the oil capacity.
- Read 1.5 *Precautions with Filters and Elements*.
- Ensure the new oil is of the correct type and viscosity as given in 4. *Engine Fluids*.

5. Routine Maintenance

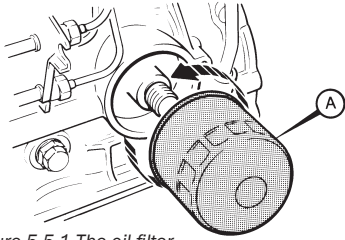


Figure 5.5.1 The oil filter

5.5.2 Draining the Oil Sump

The sump is fitted with one drain plug located on the oil filter side of the crankcase.

If the engine has been run immediately before draining, the warm oil will drain quicker.

The oil should be changed as specified in *Oil and Filter Change Periods*.

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

1. Remove the oil filler cap.
2. Remove the drain plug (A) and allow the oil to run into a suitable container.
3. Clean the drain plug threads and coat them with Hylomar PL/32M, Loctite 572 or Hylogrip 760, replace the plug and tighten it to 39.0Nm (29.0lbf ft).

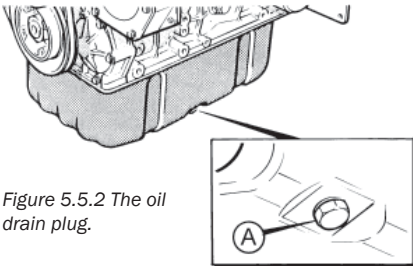


Figure 5.5.2 The oil drain plug.

5.5.3 Filling the Oil Sump

CAUTION

Do not overfill with oil. The oil must only be poured into the filler at a rate which enables it to drain into the crankcase.

1. Ensure the drain plug is fitted.
2. Fill the sump through the oil filler (figure 5.5.3, A) on the top of the valve rocker

cover to the upper mark on the dipstick.

The capacity is given in the table in 2. *Technical Data and Information*.

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 and check the level on the dipstick.
 5. Add more oil if necessary.
- Check the lubricating oil daily using the dipstick, and top up when necessary with oil of the correct type and specification (see section 4.2 *Oil Specification*). Table 2. *Technical Data* gives the capacity between the dipstick marks of all engines in the DELTA range.

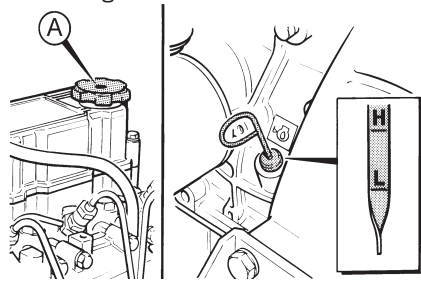


Figure 5.5.3 The oil filler.

5.5.4 Changing the Oil Filter

The oil filter should be changed as specified in 5.2 *Maintenance Schedule*. The full flow filter is a spin-on cartridge type located on the gear end cover.

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

1. Use a band-type gripping tool to remove the filter (A) 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 until the rubber joint just makes contact with the crankcase facing.
4. Screw the filter on a further quarter to half of 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.

5.6 Replacing the Fuel Filter

Please note that the DELTA engine has two fuel filter arrangements, dependent on the type of fuel pump fitted (rotary fuel pump or inline fuel pump).

5.6.1 Rotary Fuel Pump

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

1. Loosen the drain screw, C (figure 5.6.1) to drain the fuel.
2. Using a suitable strap wrench, unscrew the cartridge (A) from the filter head (B).
3. Screw a new cartridge securely on to the head and tighten it.
4. Prime the fuel system.

Priming the Fuel System

CAUTION

Care must be taken to contain any spilt fuel while carrying out this procedure.

1. Turn the ignition system on to activate the electric fuel pump and fuel control solenoid.

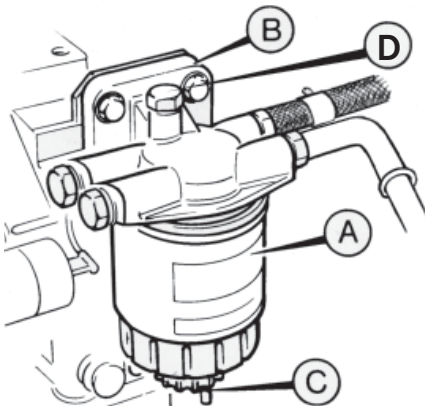


Figure 5.6.1 The fuel filter.

2. Open the bleed screw (D) on top of the filter head.
3. Close the bleed screw when no further air bubbles are expelled.
4. Open the bleed screw, E (figure 5.6.2) on the side of the rotary fuel pump.
5. Close the bleed screw when no further air bubbles are expelled.
6. Start the engine and run for a few minutes to ensure that there are no fuel leaks.

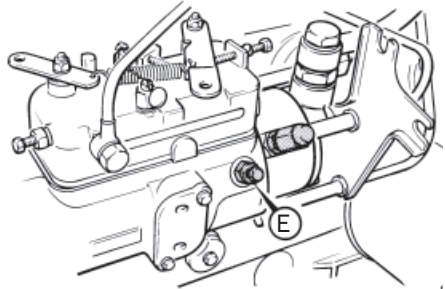


Figure 5.6.2 The rotary fuel pump.

5.6.2 Inline Fuel Pump

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

1. Using a suitable strap wrench, unscrew the cartridge, A (figure 5.6.3) from the filter head (B).

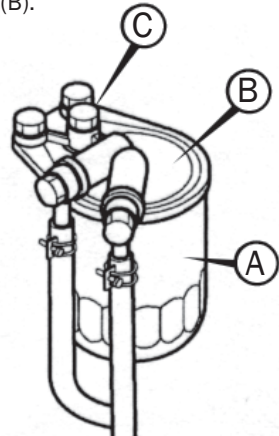


Figure 5.6.3. The filter for the inline fuel injection pump.

2. Screw a new cartridge securely on to the head and tighten it.
3. Prime the fuel system.

5. Routine Maintenance

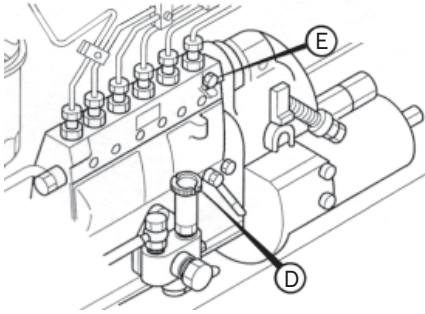


Figure 5.6.4. The inline fuel injection pump.

Priming the Fuel System

CAUTION

Care must be taken to contain any spilt fuel while carrying out this procedure.

1. Open the bleed screw, C (figure 5.6.3) on top of the filter head.
2. Loosen the priming cap (D) of the fuel feed pump by turning it anticlockwise, then move it up and down.
3. Tighten the bleed screw (C) when no further air bubbles are expelled.
4. Open the bleed screw (E) on the fuel injection pump.
5. Move the priming pump cap up and down.
6. Tighten the bleed screw (E) when no further air bubbles are expelled.
Before tightening the last bleed screw, lock the priming pump cap down by turning it clockwise while pushing it down.¹
7. If all the bleed screws are tightened before the priming pump is locked down the fuel pressure in the system may make it impossible to return the priming pump to its original position.

5.7 Servicing the Air Cleaner

The cyclonic air cleaner should receive regular maintenance as specified in 5.2 *Maintenance Schedule*.

1. Regularly remove the dust cap, A (5.7) and empty out all the dust.
2. Access to the paper element (B) is gained

by undoing the three spring clips (C) and removing the end cap (D).

3. Remove the element.
4. The element can be cleaned 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. Replace the element, end cover and dust cap.

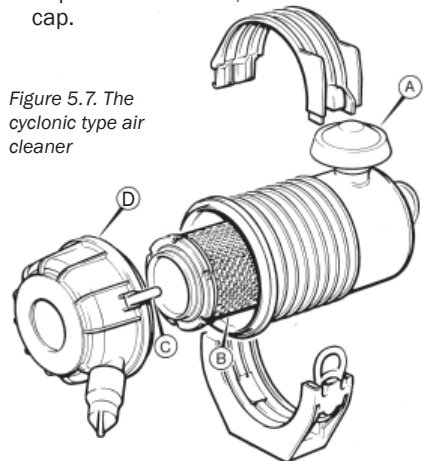


Figure 5.7. The cyclonic type air cleaner

5.8 Checking the Battery

1. Check that the terminal connections are tight; petroleum jelly will help to protect them from corrosion.

The following instructions do not apply to 'no-maintenance' or 'sealed' batteries.

2. Wear suitable protective gloves and eye protection.
3. Clean the top of the battery filler plug area.
4. 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.
5. If necessary top up with distilled water. In cold weather distilled water should only be added immediately before running the engine.
6. Replace and tighten the filler plugs.

WARNING

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

5.9 Long-Term Engine Storage

The following routine should be carried out when it is known the engine will not be required for some months.

If the following 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 and therefore it should not be left in the sump if it is known 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 the engine clearly stating what steps have been taken to inhibit the engine during storage.

5.10 Returning the Engine to Service

Refer to the appropriate sections for the relevant detailed instructions as 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 the drive belt pulley grooves are corrosion free.
3. Fill the fuel tank.
4. Refill the cooling system, adding new coolant concentrate to a 40% concentration.
5. Refill the lubricating oil sump with new oil of the correct specification and viscosity.
6. Remove the batteries from store. If they are still fully charged 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.

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 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 diagnos-

tic equipment available?

- Do you have, or have access to, the necessary Lister Petter spare parts?

6.2 Method of Troubleshooting

Use the tables below and on page 24 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.
	Fuel control solenoid not energised.	Check the shutdown devices or the electrical system.
Starter motor does not operate	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.
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.

Troubleshooting		
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.
	Radiator cooling fins blocked.	Clean the fins of all obstruction.
	Low level of coolant.	Check for leaks and refill.
	Cooling system obstructed.	Drain, flush and refill the 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 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 and replace the battery.
	Battery charging rate is too high.	Check the alternator output or battery charging system.

7. Maintenance Record

Your Lister Petter 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. *Engine Servicing*, and their correct frequency as described in 5.13 *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 24–31 for routine maintenance and pages 32–5 for records of non-routine maintenance.

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

7. Maintenance Record: Routine Servicing

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

7. Maintenance Record: Routine Servicing

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

7. Maintenance Record: Routine Servicing

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

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

7. Maintenance Record: Routine Servicing

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

7. Maintenance Record: Non-Routine Servicing

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

7. Maintenance Record: Non-Routine Servicing

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

7. Maintenance Record: Non-Routine Servicing

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

7. Maintenance Record: Non-Routine Servicing

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

8. Warranty

On receipt of your engine please fill in the section on page 30. 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 dealer within 28 days of receipt. A list of dealers is available at www.lister-petter.co.uk.

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.

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 service parts must be used.
- When Lister Petter 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 engine.
- 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.

Continued

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.*

- The installation should be in accordance with data supplied by the Lister Petter Applications Department.
- Long-term light-load and cold-engine running will 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 must be contacted and authorisation given before any warrantable work is commenced.

8.7 Contacting Lister Petter

Lister Petter Limited, Dursley GL11 4HS, England; telephone +44 (0)1453 546732; website www.lister-petter.co.uk.

Engine Serial Number:

Purchased from:

.....

.....

Purchase Date:.....

Date Registered with Lister Petter:

Plant Type:

Plant Number:

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CALIFORNIA

Proposition 65 Warning

Engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

**DELTA (DWS4) Engine Operators' Handbook
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