

THE DELTA SERIES OPERATORS HANDBOOK

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1. GENERAL INFORMATION

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1 GENERAL INFORMATION

1.1 Introduction

The purpose of this handbook is to lay down operating guidelines for the current Delta Series of engines.

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.

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

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

Whilst every effort is made to ensure the accuracy of the particulars contained within this publication neither the Manufacturer, Distributor or Dealer shall in any circumstances be held liable for any inaccuracy or the consequences thereof.

The information given is subject to the Company's current Conditions of Tender and Sale, and is for the assistance of users and is based upon results obtained from tests carried out at the place of manufacture. This Company does not guarantee that the same results will be obtained elsewhere under different conditions.

1.2 How to Use 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 an 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.

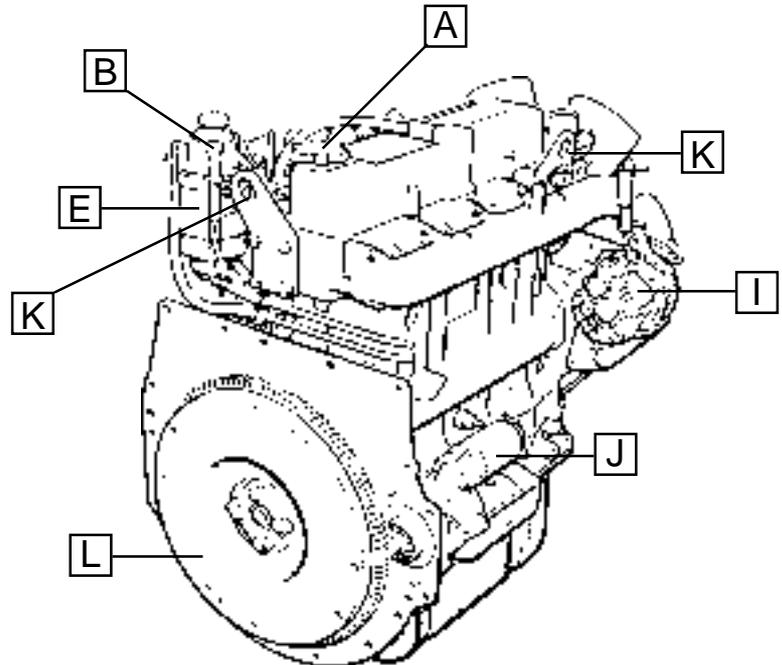
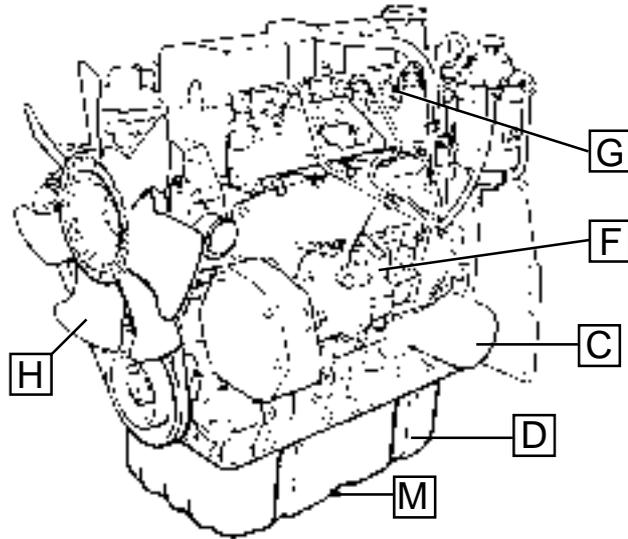
WARNING

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.

Note:

A note is used to draw your attention to additional or important information.

1.3 Engine Features



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		

1 GENERAL INFORMATION

The information contained in this section is intended as a general guide only and does not apply to any particular engine.

It is suggested that the local Lister-Petter Distributor or Dealer be consulted in cases of difficulty or when more comprehensive information is required.

1.4 Safety Precautions

The following safety precautions are of a general nature more specific precautions appear where they are relevant.

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.

1.4.1 Before Starting Precautions

- Ensure the engine is free to turn without obstruction.
- Check that the water and lubricating oil levels are correct.
- The radiator should be filled to within 13mm-25mm (0.5-1.0in) below the neck of the radiator filler.
- 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.

1.4.2 Alternator Precautions

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

- Never remove any electrical cable while the battery is connected in the circuit.
- Only disconnect the battery with the engine stopped and all switches in the OFF position.
- Always ensure that cables are fitted to their correct terminals.

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

- Never connect a battery into the system without checking that the voltage and polarity are correct.
- Never flash any connection to check the current flow.
- Never experiment with any adjustments or repairs to the system.
- The battery and alternator must be disconnected before commencing any electric welding when a pole strap is directly or indirectly connected to the engine.

1.4.3 Starter Battery Precautions

- Do not smoke near the batteries.
- Keep sparks and flames away from the batteries.
- Batteries contain sulphuric acid - if the acid has been splashed on the skin, eyes or clothes flush it away with copious amounts of fresh water and seek medical aid.
- Keep the top of the battery well ventilated during charging.
- **Disconnect the battery negative (earth) lead first and reconnect last.**
- Switch off the battery charger before disconnecting the charger leads.
- Never 'flash' connections to check current flow.
- Never experiment with adjustments or repairs to the system.
- A damaged or unserviceable battery must never be used.

1.4.4 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.
- Keep all safety guards in position.
- Keep the body and clothing clear of all moving or hot parts.
- Never allow any part of the body to come into contact with high pressure fuel oil, for example when testing fuel injection equipment.
- Thoroughly clean any lubricating or fuel oil from the skin as soon as practicable after contact.
- Rectify all fuel, water and oil leaks as soon as practicable and clean any spillages when they occur.

1.4.5 Lifting Precautions

The following points must be considered before attempting to lift the engine.

- Ensure the lifting equipment to be used has the correct capacity to lift the engine.
- Suitable lifting equipment designed to give vertical lifts from directly above the two engine lifting eyes must be used.
- Check that the engine lifting eyes are not damaged and that they are secure.
- To prevent damage, ensure there is clearance between the lifting equipment hooks and the engine.
- The lifting eyes fitted to the engine 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.

1.4.6 Waste Disposal Precautions

WARNING

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.

1.5 Safety Symbols

This section identifies the ISO 8999 symbols currently used by Lister-Petter.



Read the Handbook



Stop control (no Engine)



Diesel fuel fill



Engine oil fill



Engine oil level



Engine oil pressure



Anti clockwise

Rotation



Clockwise



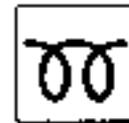
Lifting eye (engine only)



On



Off



Pre-heat



Rotational speed control



Linear speed control



Tachometer



Elapsed hours



Battery charging



Engine cranking



General hot surface warning



Electrical hazards



Engine coolant pressure



Engine coolant fill



Engine coolant level



Engine coolant temperature

1.6 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.

1.6.1 Serial Number Plates

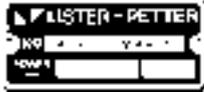


Figure 1.6.1 Non EPA Standard Plate



Figure 1.6.1 EPA Variable Speed Plate



Figure 1.6.2 EPA Constant Speed Plate

Note:

The above plates are not shown to scale.

1.7 Nomenclature

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

1.8 The Engine Variants

The engine will have been assembled to a predetermined Build configuration.

1.9 Rotation

The rotation of all engines is anti-clockwise when looking on the flywheel.

1.10 The Firing Order

The firing order is 1-3-4-2
Number 1 cylinder is at the gear end.

1.11 Valve Clearance

Inlet and exhaust 0.25mm (0.010in).

1.12 The Electrical System

12 volt negative earth with an engine mounted battery charging alternator.

1.13 The Oil Sump Capacity

	litres	pts	US qts
DWS4	10.0	17.6	10.4

The above figures include the oil filter.

CAUTION

Do not overfill with lubricating oil as this may have a detrimental effect on the engine.

1.14 Minimum Oil Pressure

The figures given apply when the oil temperature is 60°-70°C (140°-158°F).

At idle:

1.0bar (14.2lbf/in²).

At 1500r/min:

3.0-5.0bar (43.0-71.0lbf/in²).

1 GENERAL INFORMATION

1.15 The Cooling System

Cooling is by a radiator with water circulation being assisted by an engine mounted, centrifugal, belt driven water pump using a single 'V' belt.

1.16 The Coolant Concentrate

A 30% concentration must be maintained under all operating conditions.

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

BS6580 : 1985
MIL-A-11755D
MIL-A-46153/B

To determine the amount of coolant concentrate to be added it will be necessary to calculate the total coolant capacity by adding together the engine, radiator and associated pipework capacities.

WARNING

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

1.17 The Engine Block Coolant Capacity

	litres	pts	US gals
DWS4	5.5	9.7	1.5

1.18 The Radiator Coolant Capacity

There are a number of radiator options available for these engines, including some which may not have been originally fitted by Lister-Petter.

For these reasons it is advisable to ascertain the radiator capacity which must then be added to that given in "1.17 Engine Block Coolant Capacity" before determining the amount of coolant concentrate to be added to maintain a minimum 30% concentration.

An additional amount must also be taken into consideration for the capacity of the hoses on remote radiator applications.

1.19 Ambient Temperature

From the aspect of engine performance, the temperature of the air entering the engine is the only criterion of ambient temperature.

The power developed by the engine, depends on the temperature of the combustion air measured at the air manifold inlet, or the air cleaner, and the temperature of the cooling air as measured at the fan inlet.

The higher of these two temperatures is taken as being "Ambient Temperature" as far as engine ratings are concerned.

The engines are able to run satisfactorily at Ambient temperatures up to 25°C (77°F) without derating. Above this temperature the rated brake horsepower must be reduced in accordance with ISO 3046 Standards. The maximum permitted ambient temperature is 52°C (125°F).

2. FUEL AND OIL SPECIFICATIONS

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2 FUEL AND OIL SPECIFICATIONS

2.1 The Fuel Specification

The engine must only be used with diesel fuel oil which conforms to one of the following:-

- a. BS 2869:1988 Class A2.
- b. BS EN590:1995 Class A1.
- c. USA Specification ASTM D-975-77 Grades No.1-D and 2-D.
- 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 Lister-Petter engines.

The user is cautioned that although the engines may operate on fuels outside the above specifications, such operation may well result in excessive wear and damage.

CAUTION

The fuel injection equipment is manufactured to very accurate limits and the smallest particle of dirt will destroy its efficiency. Fuel free from water and contaminants is of the utmost importance.

2.2 The Oil Specification

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

All subsequent oil changes must be as specified in "4.15 Oil and Filter Change Periods".

1. The temperatures mentioned in the tables are the ambient temperatures at the time when the engine is started. However, if monograde oils are used and running ambient temperatures are significantly higher than starting temperatures, a higher viscosity oil should be selected subject to satisfactory starting performance. Multigrade oils may be used to overcome the problem.
2. Where it is not practical to continually change oils to suit varying ambient temperatures a suitable multigrade oil is recommended to ensure adequate starting performance at the lowest temperature likely to be encountered.
3. Delta Series engines must be run on heavy duty lubricating oils. Straight mineral oils are not suitable, neither are oils of less detergency than specified.
4. API CD, Series 3 or MIL-L-2104C/D oils must be used in 4X90 naturally aspirated engines.

CAUTION

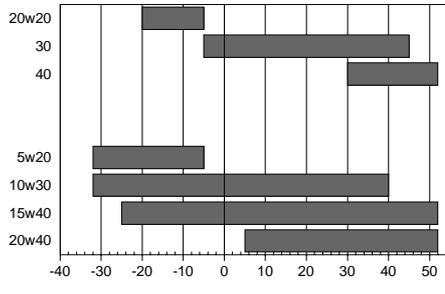
API CD, API CE, API CF-4 or MIL-L-2104C/D/E oils can inhibit the running-in process in new or reconditioned engines and are not suitable for engines running on low duty cycles.

5. For engines in long running installations Lister-Petter should be consulted.

2.3 The Oil Viscosity

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

Before selecting a viscosity grade refer to the 'Notes'.



Notes:

$$^{\circ}F = (1.8 \times ^{\circ}C) + 32.$$

1. SAE 5W-20 oils are recommended on the basis that they are fully synthetic, and are technically suitable for use up to 25°C (77°F). Non synthetic oils at very low temperatures will suffer from wax crystallisation.

Monograde SAE 5W is not normally available as a synthetic oil and therefore is not quoted.

2. 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.

3. 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.

4. Monograde SAE 40 oils are not recommended.

2 FUEL AND OIL SPECIFICATIONS

3. STARTING AND STOPPING

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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

Starting any diesel engine can be dangerous in the hands of inexperienced people.

Before attempting to start any engine the operator should read "1.4 Safety Precautions" and be conversant with the use of 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.

3.2 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 after allowing sufficient time for all moving parts to stop.

1. Move the engine control lever (A) to the start position and on variable speed engines move the speed control to the fast position.

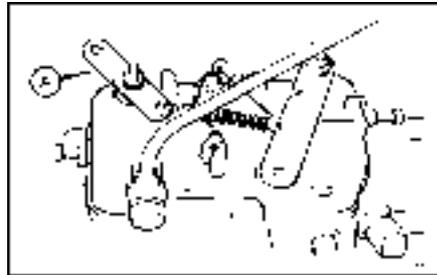


Figure 3.2.1 Engine Control Lever

- 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.

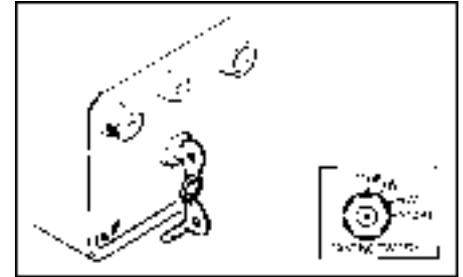


Figure 3.2.2 Key Start

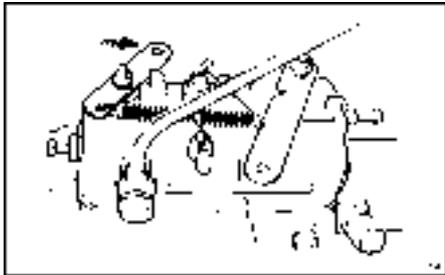
- 2b. For ambient starting temperatures **below** -10°C (14°F) turn the key clockwise to the 'HEAT' position for 30 seconds before turning the key to the 'START' position to energise the starter.

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. Move the engine engine control lever to the stop position.



3.3.1 Engine Control Lever

4. Turn the key to the 'STOP' position.

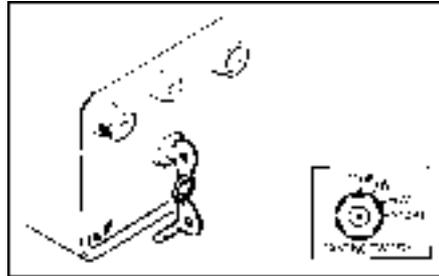


Figure 3.3.2 Key Start

3 STARTING AND STOPPING

4. ROUTINE MAINTENANCE

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4 ROUTINE MAINTENANCE

4.1 Preliminary Instructions

WARNING

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

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.

This work can only be carried out if the necessary hand and service tools are available. When the user has insufficient tools, experience or ability to carry out adjustments, maintenance and repairs this work should not be attempted.

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

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

These recommendations and instructions cover several engine Builds therefore they are of a general nature.

The engine may include optional equipment not specifically covered in this book.

- The engine should receive regular attention during the first 50 hours of its life from new and after a major overhaul.
- Long periods of light or 'no load' running early in the engine's life may lead to cylinder bore glazing and high oil consumption.
- The instructions given in "4.16 Maintenance Schedule" are based on average operating conditions and cover the minimum requirements to keep an engine running at peak performance with trouble free operation.
- Under very dusty conditions, air cleaners, 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.
- Before carrying out any maintenance work on an engine it is advisable to remove the battery.
The battery and alternator must be disconnected before commencing any electric welding when a pole strap is directly or indirectly connected to the engine.
- It is essential to ensure that nuts and bolts are tightened to the torques specified in the Workshop Manual.
- When re-assembling an engine lubricate all moving parts with engine oil.
- 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.
- The fuel injector can only be checked and set off the engine using suitable specialist test equipment.

WARNING

ON NO ACCOUNT ALLOW ANY UNPROTECTED SKIN TO COME INTO CONTACT WITH THE INJECTOR SPRAY AS THE FUEL MAY ENTER THE BLOOD STREAM WITH FATAL RESULTS.

WARNING

*SOME ENGINES MAY BE FITTED WITH SEALS OR 'O' RINGS MANUFACTURED FROM 'VITON' OR A SIMILAR MATERIAL. WHEN EXPOSED TO ABNORMALLY HIGH TEMPERATURES, IN EXCESS OF 400°C (752°F), AN EXTREMELY CORROSIVE ACID IS PRODUCED WHICH CANNOT BE REMOVED FROM THE SKIN.
IF SIGNS OF DECOMPOSITION ARE EVIDENT, OR IF IN DOUBT, ALWAYS WEAR DISPOSABLE HEAVY DUTY GLOVES.*

4.2 Precautions for Filters and Elements

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

WARNING

Fuel and new or used lubricating oil may cause skin irritation

WARNING

The materials used in the manufacture and treatment of some filters and elements may cause irritation or discomfort if they come into contact with the eyes or mouth and they may give off toxic gasses if they are burnt.

WARNING

Care must be taken to ensure that waste fuel, oil, filter elements, acid and coolant concentrate, where applicable, are disposed of in accordance with local regulations to prevent contamination.

4.3 Initial Attention

To help assist engine running-in, DWS4 engines are despatched with an initial fill lubricating oil which must be changed after 100 hours. The oil filter must also be changed for the first time after 100 hours.

All subsequent oil and filter changes must be as specified in "4.15 Oil and Filter Change Periods".

It is recommended that the following receive attention after the engine has run 50 hours and again after 250 hours.

- Check and tighten nuts, bolts and unions paying particular attention to the fuel system.
- Check the drive belt tension.
- Check the lubricating oil level and top up if necessary.
- Check the radiator coolant level and top up if necessary. A minimum 30% coolant concentration must be maintained at all times.

4 ROUTINE MAINTENANCE

4.4 Drive Belt Tension

It is important that the tension of the 'Vee' drive belt is checked after:

- a. After the first 50 hours running.
- b. After an overhaul.
- c. After a new belt has been fitted.
- d. As specified in "4.16 Maintenance Schedule".

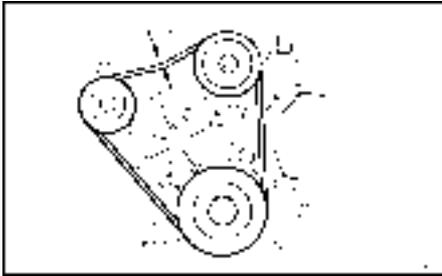


Figure 3.4.2 Checking Belt Tension

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.

4.5 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).

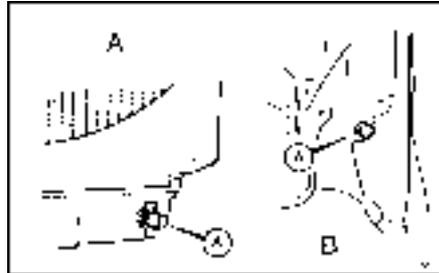


Figure 4.5.1 Drain Plugs
A - Radiator
B - Cylinder Block

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

4.6 Flushing the Cooling System

a. 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.

b. 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.

4.7 Filling the Cooling System

The coolant capacity and coolant concentrate details are given in "Section 1. General Information".

CAUTION

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

1. Ensure all the hoses and drain plugs, have been replaced.
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.

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

4.8 Changing the Oil Filter

The full flow filter is a spin-on cartridge type located on the gear end cover.

Only approved filters should be used as these have high temperature joints, adequate filter paper characteristics and a rigid case.

Other filters may have the same external dimensions and thread as the genuine one, but may fail in service.

The oil filter should be changed as specified in "4.16 Maintenance Schedule".

Before changing the filter read "4.2 Precautions for 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.

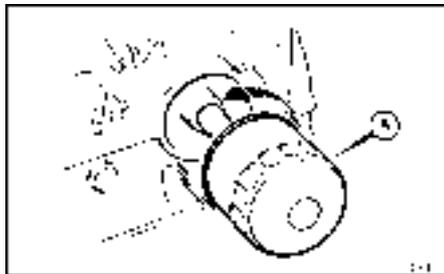


Figure 4.8.1 Oil Filter

4 ROUTINE MAINTENANCE

4.9 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 "4.15 Oil and Filter Change Periods".

Before draining the oil read "4.2 Precautions for Filters and Elements".

1. Remove the oil filler cap.
2. Remove the drain plug and allow the oil to run into a suitable container.

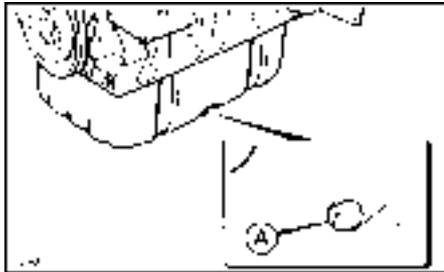


Figure 4.9.1 Oil Drain Plug

3. Clean the drain plug threads and coat them with Hylomar PL/32, Loctite 572 or Hylogrip 760, replace the plug and tighten it to 39.0Nm (29.0lbf ft)..

4.10 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 (A) on the top of the valve rocker cover to the upper mark on the dipstick.

The capacity is given in "1.13 Oil Sump Capacity".

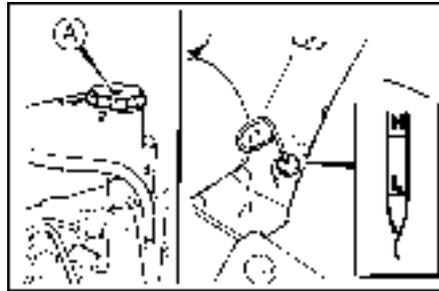


Figure 4.10.1 Oil Filler

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.

4.11 Replacing the Fuel Filter

Water can be drained from the filter by gently unscrewing (A) a few turns.

The fuel filter should be changed as specified in "4.16 Maintenance Schedule".

Before changing the fuel filter read "4.2 Precautions for Filters and Elements".

1. Loosen the bleed screw (A) to drain the fuel.
2. Disconnect the water level sensor (B).
3. Using a suitable strap wrench, unscrew the cartridge (C) from the filter head (D).

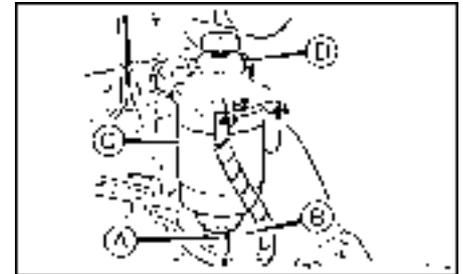


Figure 4.11.1 Fuel Filter

4. Screw a new cartridge securely onto the head and hand tighten it.
5. Replace the sensor (B) and ensure the drain screw (A) is tight.
6. Prime the fuel system.
7. Start the engine and run it for a few minutes to check for leaks.

4.12 Priming the Fuel Filter

CAUTION

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

1. Ensure there is sufficient fuel.
2. Release the bleed screw (A) on the head and operate the priming pump (B)
3. Tighten the bleed screw when no further air bubbles are expelled.

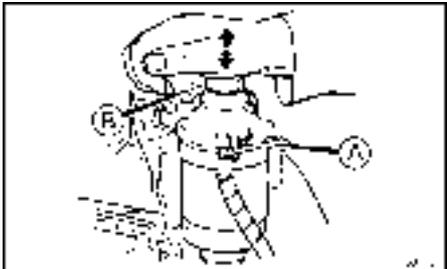


Figure 4.12.1 Priming the Fuel Filter

4.13 The Cyclonic Air Cleaner

The air cleaner should receive regular maintenance as specified in "4.16 Maintenance Schedule".

1. Regularly remove the dust cap (A) and empty all the dust.

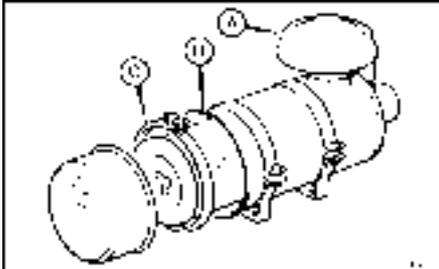


Figure 4.13.1 Cyclonic Type Air Cleaner

2. Access to the paper element (B) is gained by undoing the clamp (C) and removing the end cover.
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.

4.14 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 protective gloves and goggles.
3. Clean the top of the battery filler plug area.
4. Remove the filler plugs and check that the electrolyte level is 6.0-9.0mm (0.25-0.37in) 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 GASSES. IF THE ACID HAS BEEN SPLASHED ON THE SKIN, EYES OR CLOTHES FLUSH WITH COPIOUS AMOUNTS OF FRESH WATER AND SEEK IMMEDIATE MEDICAL AID.

4 ROUTINE MAINTENANCE

4.15 Oil and Filter Change Periods

Before attempting to change the lubricating oil or filter:

- a. Read "4.2 Precautions for Filters and Elements".
- b. Ensure the new oil meets the correct specification as given in "4.2 The Oil Specification".

Ambient Temperature	Periods in Hours
When the engine is new (first fill oil)	100
Up to 35°C (see Note)	250

35°C = 95°F

Note:

The oil and filter change periods, given in hours, apply when engines are not operating at temperatures exceeding 35°C (95°F) or at high speeds and duty factors.

4.16 Maintenance Schedule

Also refer to "4.15 Oil and Filter Change Periods".

Daily
Check the coolant level.
Check the supply and level of fuel.
Check the level and condition of the lubricating oil.
Clean the air cleaner if the engine is operating in very dusty conditions.

Every 125 Hours
The above and the following items.
Clean the air cleaner if the engine is operating in moderately dusty conditions.
Check for fuel, coolant and oil leaks.
Check the serviceability of the battery.

Every 250 Hours
The above and the following items.
Check the condition and tension of the radiator drive belt.
Check the radiator fins for contamination or blockage.
Renew the fuel filter element if the fuel is not perfectly clean.

Every 500 Hours
The above and the following items.
Renew the fuel filter element.
Renew the air cleaner element.
Check the valve clearances.
Check the air induction system for leaks, damage and restrictions.

Every 1000 Hours
The above and the following items.
Lubricate the water pump.
Check all external nuts, bolts and unions for tightness.
Ensure that all guards are firmly attached and not damaged.
Replace the fuel lift pump diaphragm; see Note:
Clean the fuel injector nozzles if the exhaust is dirty.

Every 2000 Hours
The above and the following items.
Decarbonise, if performance has deteriorated, renewing all joints and seals as necessary.
Clean and check, or replace, the fuel injector nozzles.
Check the radiator fins and radiator fan blades for damage.
Replace the radiator fan drive belt irrespective of condition.
Check the lubricating oil pressure.
Renew the air cleaner element.

Every 6000 Hours
The previous items and give the engine a major overhaul, if necessary.

Every Year
Drain, flush and refill the cooling system adding new coolant concentrate to a 40% concentration.

Every Two Years
Replace the coolant hoses irrespective of their condition.

Note:
It is recommended that the fuel lift pump diaphragm is inspected at more frequent intervals if it is known the fuel is contaminated. It should also be inspected at regular intervals on engines in low duty cycle applications; for example, stand-by generating sets.

4 ROUTINE MAINTENANCE

4.17 Fault Finding

This section is intended as a guide only. If in difficulty refer to the Workshop Manual or consult any Lister-Petter Distributor or Dealer.

Difficult Starting

Unsuitable lubricating oil (too heavy).
Engine control lever in the stop position.
Incorrect fuel.
No fuel in the tank.
Choked fuel filter.
Air lock in the fuel system.
Discharged battery.
Poor battery connections.

Excessive Carbon Deposits

Choked air filter.
Choked exhaust system.
Unsuitable fuel oil.
Unsuitable lubricating oil.
Continuous idling.

White Exhaust Smoke

Water entering the cylinder.
Faulty fuel pump - refer to Lister-Petter

Light Blue Exhaust Smoke

Generally as a result of light load.

Heavy Blue Exhaust Smoke

Lubricating oil passing the piston rings due to: Stuck, worn or broken rings. Worn cylinder bore. Overfull oil sump.

Black Exhaust Smoke

Overload.
Choked air filter.
Inlet temperature too high.
Unsuitable fuel, or water in it.

Engine Stops

Lack of fuel.
Air or water in the fuel system.
Choked air or fuel filter.
Overload.
Overheating.
Loss of compression.
Loss of electrical supply to the fuel pump solenoid.
Automatic shutdown, if protective devices are fitted.

Loss of Power

Loss of compression.
Choked air filter.
Choked exhaust system.
Fuel injector dirty.
Choked fuel filter.
Worn engine.

Overheating

Radiator fan belt too slack.
Overload.
Lubricating oil level too low.
Radiator fan inlet obstructed.
Recirculation of exhaust gasses or cooling air.
Radiator cooling fins blocked.
Low level of coolant.
Cooling system obstructed.

5. PARTS AND SERVICE

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5 PARTS AND SERVICE

5.1 Associated Publications

Workshop Manual P027-08212

Master Parts Manual P027-08042

Various technical/sales leaflets are available for DWS4 engines; please contact your Lister-Petter Distributor or Dealer for details.

5.2 Data on CD Rom

Please contact Lister-Petter for details.

5.3 Training

Comprehensive training in the correct operation, service and overhaul procedures of engines is available at the Lister-Petter International Product Training Centre.

Please contact Lister-Petter for details.

5.4 The Importance of Using Genuine Parts

Parts that have not been approved by the Lister-Petter organisation cannot be relied upon for correct material, dimensions or finish.

This Company cannot therefore, be responsible for any damage arising from the use of such parts and the guarantee may be invalidated.

When purchasing parts or giving instructions for repairs users should, in their own interests, always specify Genuine Lister-Petter Parts.

5.5 If Problems Occur

If problems occur with your engine, or any of the Lister-Petter approved accessories fitted to it, your local Lister-Petter Distributor should be consulted.

There are Lister-Petter Distributors in most countries of the world and details of these can be obtained from any one of the companies listed, or direct from the Lister-Petter website www.lister-petter.co.uk

5.6 Lister-Petter Companies

United Kingdom

Lister-Petter Limited
Dursley
Gloucestershire
GL11 4HS England
Tel: +44 (0)1453 544141
Fax: +44 (0)1453 546732
E-mail: sales@lister-petter.co.uk
<http://www.lister-petter.co.uk>

United States of America

Lister-Petter Inc.
815 E. 56 Highway
Olathe
Kansas 66061 USA
Tel: +1 913 764-3512
Fax: +1 913 764-5493
E-mail: lpinfo@lister-petter.com
<http://www.lister-petter.com>

France

Lister-Petter France
1, Avenue de L'escouvrier
Zone d'activites
95842 Sarcelles Cedex
France
Tel: +33 (0)1 39330420
Fax: +33 (0)1 34195760
E-mail: commercial@lister-petter-france.fr

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