



# User's Handbook



**M92B**



# Perkins

## M92B

# Marine Diesel Engine

## User's Handbook

**Four cylinder diesel engine for commercial and pleasure boat applications**



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## General information

### Introduction

The Perkins M92B marine engine is the latest development from Perkins Engines Company Limited together with Wimborne Marine Power Centre. The engine is designed specifically for use in commercial and pleasure boat applications.

Over sixty years of diesel production experience, together with the latest technology, have been applied to the manufacture of your engine to give you reliable and economic power.

Danger is indicated in the text by two methods:

**Warning!** *This indicates that there is a possible danger to the person.*

**Caution:** *This indicates that there is a possible danger to the engine.*

**Note:** Is used where the information is important, but there is not a danger.

## How to care for your engine

**Warning!** Read the “Safety precautions” and remember them. They are given for your protection and must be applied at all times.

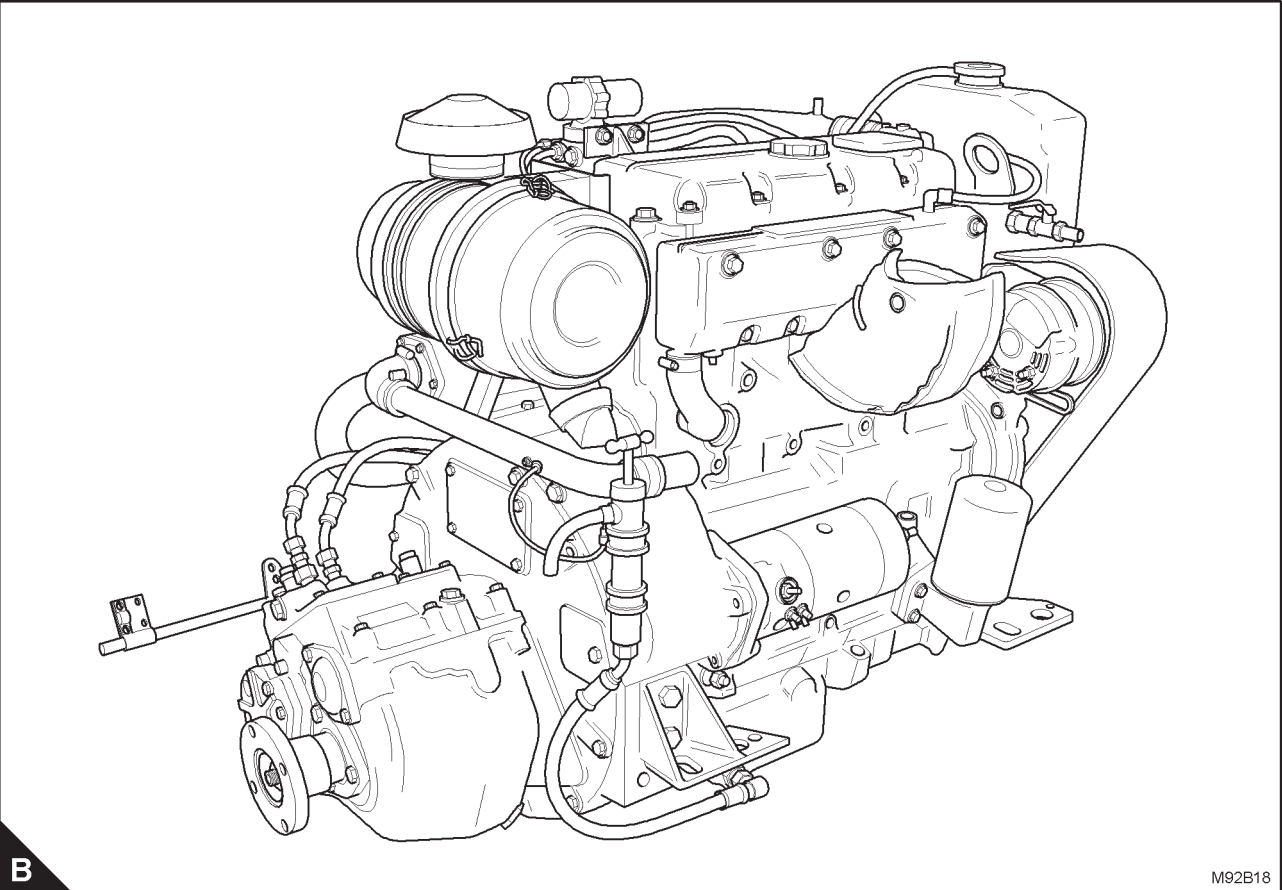
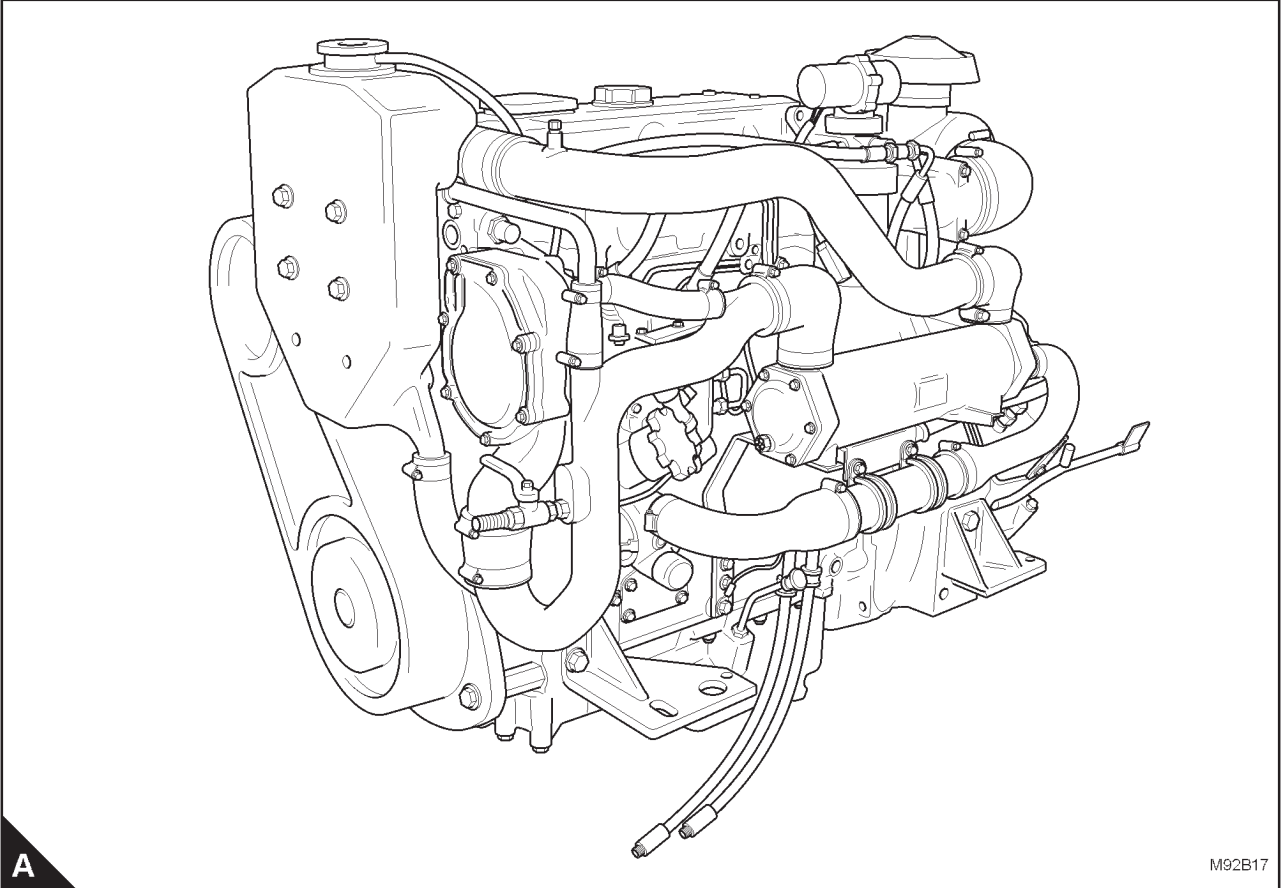
**Caution:** Do not clean an engine while it runs. If cold cleaning fluids are applied to a hot engine, certain components on the engine may be damaged.

This handbook has been written to assist you to maintain and operate your engine correctly.

To obtain the best performance and the longest life from your engine, you must ensure that the maintenance operations are done at the intervals indicated in “Preventative maintenance”. If the engine works in a very dusty environment or other adverse conditions, certain maintenance intervals will have to be reduced. Renew the filter canister and lubricating oil regularly in order to ensure that the inside of your engine remains clean.

Ensure that all adjustments and repairs are done by personnel who have had the correct training. Perkins distributors have this type of personnel available. You can also obtain parts and service from your Perkins distributor. If you do not know the address of your nearest distributor, enquire at [www.perkins.com/Marine](http://www.perkins.com/Marine).

The “left side” and “right side” of the engine apply when the engine is seen from the reverse gearbox end.



## General safety precautions

**These safety precautions are important.** You must refer also to the local regulations in the country of use. Some items only apply to specific applications.

- Only use these engines in the type of application for which they have been designed.
- Do not change the specification of the engine.
- Do not smoke when you put fuel into the tank.
- Clean away fuel which has been spilt. Material which has been contaminated by fuel must be moved to a safe place.
- Do not put fuel into the tank while the engine runs (unless it is absolutely necessary).
- Do not clean, add lubricating oil, or adjust the engine while it runs (unless you have had the correct training; even then extreme care must be used to prevent injury).
- Do not make adjustments that you do not understand.
- Ensure that the engine does not run in a location where it can cause a concentration of toxic emissions.
- Other persons must be kept at a safe distance while the engine, auxiliary equipment or boat is in operation.
- Do not permit loose clothing or long hair near moving parts. **Warning:** *Some moving parts cannot be seen clearly while the engine runs.*
- Keep away from moving parts during engine operation.
- Do not operate the engine if a safety guard has been removed.
- Do not remove the filler cap or any component of the cooling system while the engine is hot and while the coolant is under pressure, because dangerous hot coolant can be discharged.
- Do not use salt water or any other coolant which can cause corrosion in the closed circuit of the cooling system.
- Disconnect the battery terminals before a repair is made to the electrical system.
- Only one person must control the engine.
- Ensure that the engine is operated only from the control panel or from the operators position.
- If your skin comes into contact with high-pressure fuel, obtain medical assistance immediately.
- Diesel fuel and lubricating oil (especially used lubricating oil) can damage the skin of certain persons. Protect your hands with gloves or a special solution to protect the skin.
- Do not wear clothing which is contaminated by lubricating oil. Do not put material which is contaminated with oil into the pockets of clothing.
- Discard used lubricating oil in accordance with local regulations to prevent contamination.
- Ensure that the control lever of the transmission drive is in the “out-of-drive” position before the engine is started.
- Use extreme care if emergency repairs must be made at sea or in adverse conditions.
- The combustible material of some components of the engine (for example certain seals) can become extremely dangerous if it is burned. Never allow this burnt material to come into contact with the skin or with the eyes.
- Always close the seacock before the removal of any component of the raw water circuit.
- Always use a safety cage to protect the operator when a component is to be pressure tested in a container of water. Fit safety wires to secure the plugs which seal the hose connections of a component which is to be pressure tested.
- Do not allow compressed air to contact your skin. If compressed air enters your skin, obtain medical help immediately.
- Turbochargers operate at high speed and at high temperature. Keep fingers, tools and debris away from inlet and outlet ports of the turbocharger and prevent contact with hot surfaces.
- Do not clean an engine while it runs. If cold cleaning fluids are applied to a hot engine, certain components on the engine may be damaged.
- Fit only genuine Perkins parts.

## Engine guarantee

If a claim under guarantee is necessary, the boat owner should make a guarantee claim on the nearest Perkins marine distributor or an approved dealer.

If it is difficult to find a Perkins distributor or an approved dealer, consult the Service Department of Wimborne Marine Power Centre, Wimborne.

M92B engine - identification letters RE

The engine identification number is shown at two locations on the engine: stamped on a plate at the right side of the cylinder block (C1) and shown on a label (D1) fitted to the front of the timing case.

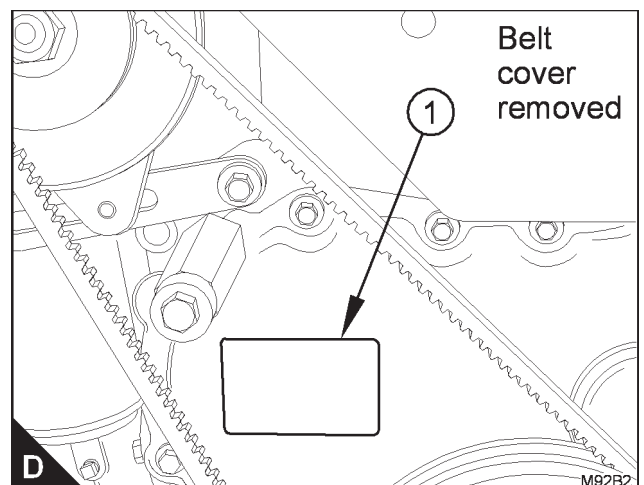
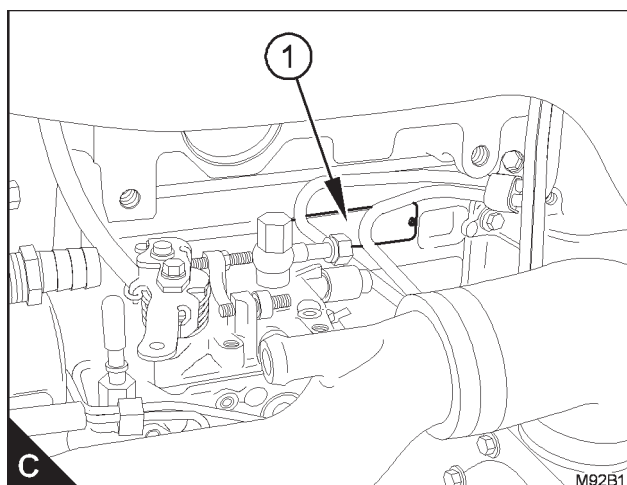
An example of an engine number is: RE51267U123456L.

The components of the engine number are as follows:

RE51267U123456L

RE	Type code letters
51267	Build list number
U	Built in the UK
123456	Engine serial number
L	Year of manufacture

If you need parts, service or information for your engine, you must give the complete engine number to your Perkins distributor.



**Perkins companies****Australia**

Perkins Engines Australia Pty. Ltd,  
Suite 4, 13A Main Street,  
Mornington 3931, Victoria, Australia.  
Telephone: 0061 (0) 597 51877  
Telex: Perkoil AA30816  
Fax: 0061 (0) 0597 1305

**France**

Perkins France S.A.S,  
"Parc des reflets"  
165 Avenue Du Bois de la Pie  
95700 Roissy Charles de Gaulle, France.  
Telephone: 0033 (01) 49 90 7171  
Fax: 0033 (01) 49 90 7190

**Germany**

Perkins Motoren GmbH,  
Saalaeckerstrasse 4,  
63801 Kleinostheim,  
Germany.  
Telephone: 0049 6027 5010  
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**Italy**

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Via Socrate 8,  
22070 Casnate con Bernate (Como), Italy.  
Telephone: 0039 (0) 31 4633466 / 4633488  
Fax: 0039 (0) 31 565480 / 396001

**Japan**

Perkins Engines, Inc.,  
Address Building, 8th Floor,  
2-2-19 Akasaka, Minato-ku,  
Tokyo 107-0052, Japan.  
Telephone: 0081 (0) 3 3560 3878  
Fax: 0081 (0) 3 3560 3877

**Singapore**

Perkins Engines (Asia Pacific) pte Ltd  
20 Harbour Drive  
#07-06A, PSA Vista  
Singapore 117612  
Telephone: (65) 874 7712  
Fax: (65) 874 7722

**United Kingdom**

Perkins Engines Company Ltd,  
Eastfield, Peterborough PE1 5NA,  
England.  
Telephone: 0044 (0) 1733 58 3000  
Telex: 32501 Perken G  
Fax: 0044 (0) 1733 582240

**United States of America**

Perkins International - North America,  
26200 Town Center Drive,  
Suite 280,  
Novi, Michigan 48375  
USA  
Telephone: 001 248 374 3100  
Fax: 001 248 374 3110

**Perkins Engines Latin America Inc,**

Suite 620,  
999, Ponce de Leon Boulevard,  
Coral Gables,  
Florida 33134, U.S.A.  
Telephone: 001 305 442 7413  
Telex: 32501 Perken G  
Fax: 001 305 442 7419

In addition to the above companies, there are Perkins distributors in most countries. Perkins Engines Company Ltd., Peterborough or one of the above companies can provide details.

**The managers of the marine business for Perkins are:****Wimborne Marine Power Centre,**

Ferndown Industrial Estate,  
Wimborne,  
Dorset BH21 7PW,  
England.  
Telephone: 0044 (0) 1202 796000  
Fax: 0044 (0) 1202 796001





## Engine views

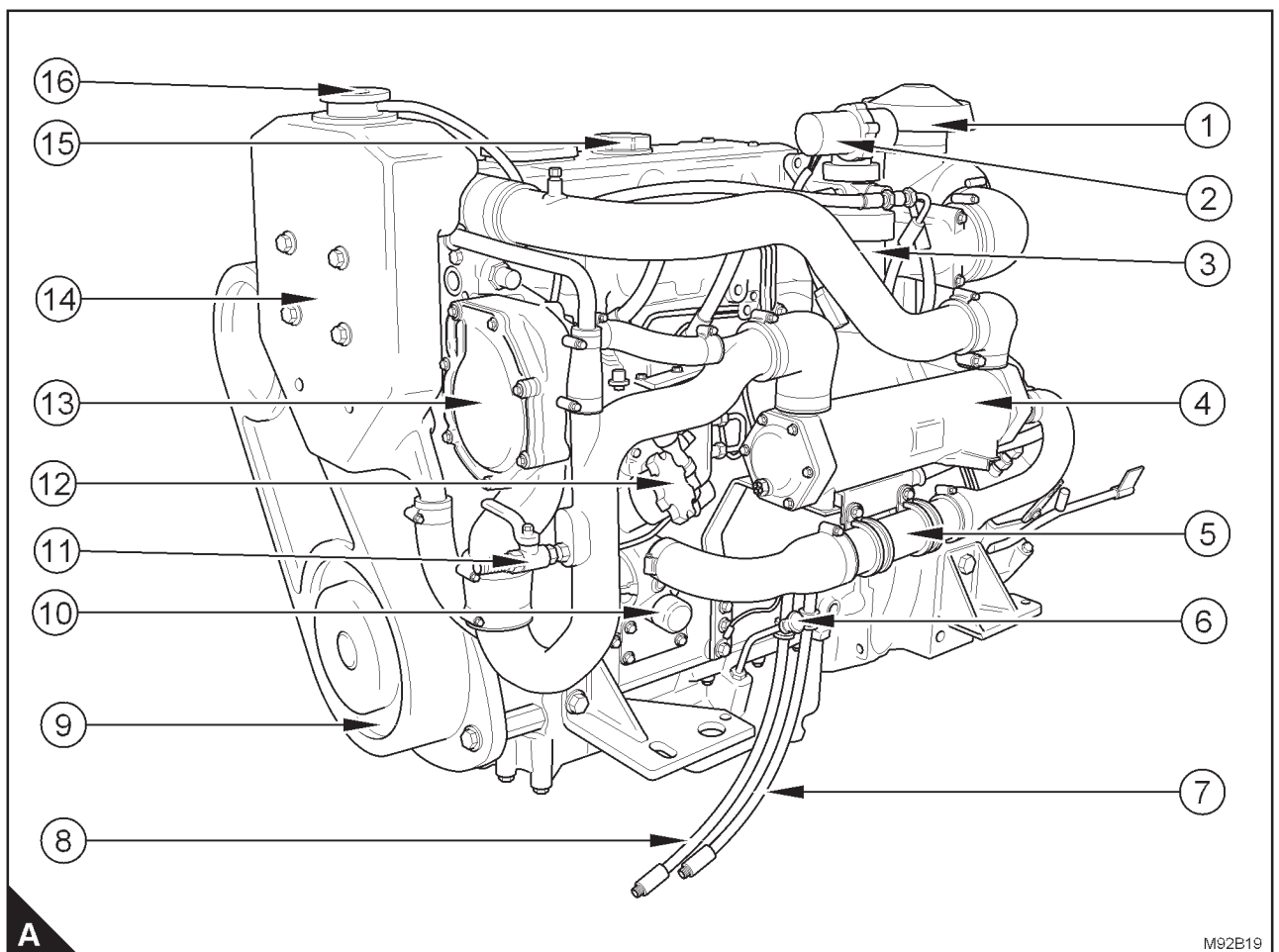
## Introduction

Perkins engines are built for specific applications and the views that follow do not necessarily match your engine's specification.

Location of engine parts

## Front and left side view (A) of the engine

- |                         |                                 |
|-------------------------|---------------------------------|
| 1. Air cleaner          | 9. Belt cover                   |
| 2. Electric fuel pump   | 10. Raw water pump              |
| 3. Fuel filter canister | 11. Calorifier fitting (return) |
| 4. Heat exchanger       | 12. Oil filler cap              |
| 5. Gearbox oil cooler   | 13. Fresh water pump            |
| 6. Dipstick             | 14. Header tank                 |
| 7. Fuel inlet hose      | 15. Oil filler cap              |
| 8. Fuel return hose     | 16. Fresh water filler cap      |

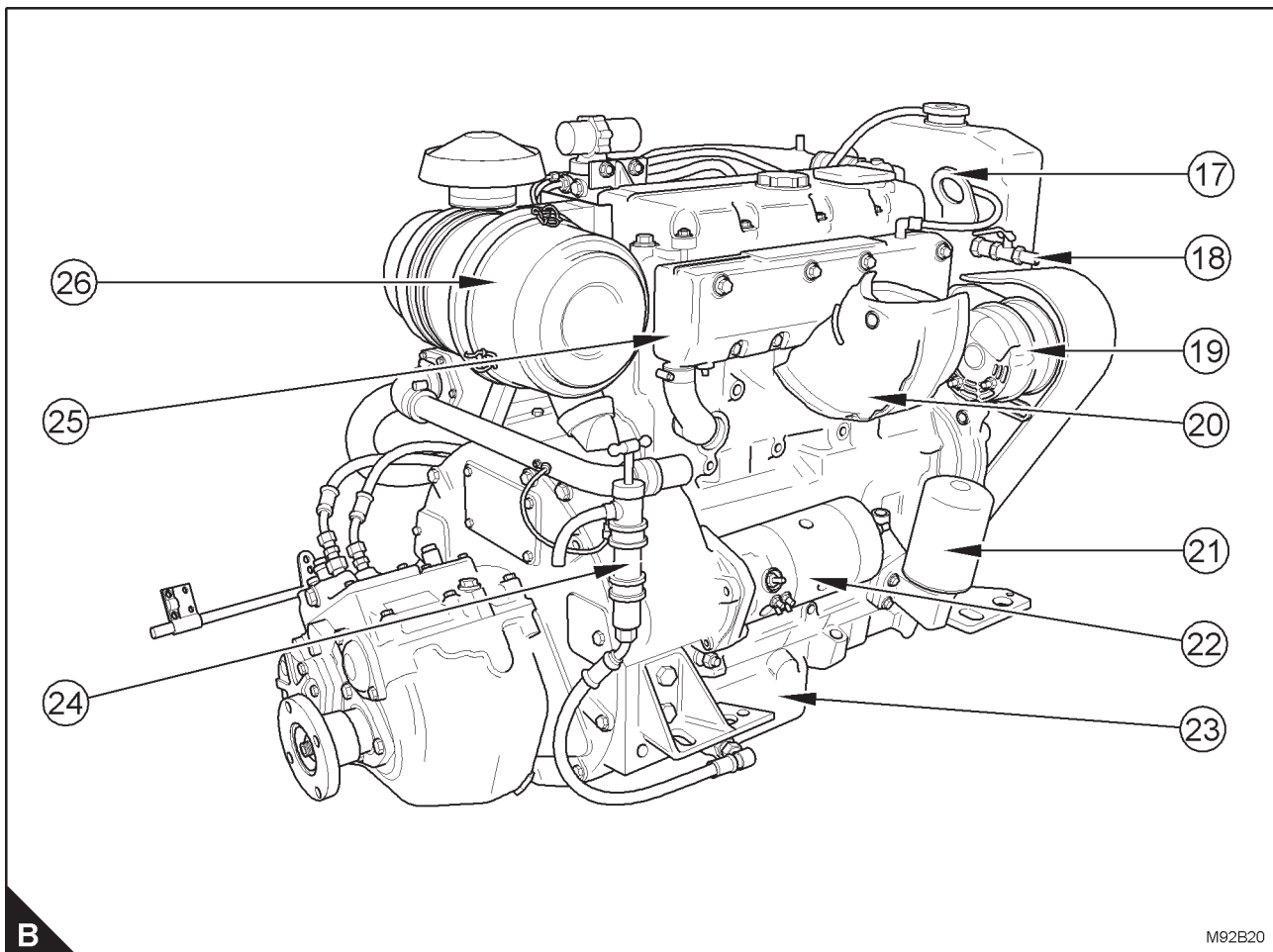


A

M92B19

**Rear and right side view (B) of the engine**

17. Front lifting eye
18. Calorifier fitting (feed)
19. Alternator
20. Exhaust elbow
21. Oil filter
22. Starter
23. Lubricating oil sump
24. Sump pump
25. Exhaust manifold
26. Air filter



## Operation instructions

### How to start the engine

The instrument control panel for single and twin engine installations is shown in figure (A). The switches are protected from the entry of water, but if the control panel is in an exposed location, it should be protected by a cover when not in use.

Below is a description of the instruments and switches on the main panel.

**Panel illumination:** the gauges are always illuminated, press the button (A1) to adjust the level of illumination.

**Engine electrical system / stop switch (A5),** which has two positions:

- OFF: Move the switch lever up to switch off the electrical system
- ON: Move the switch lever down to energise the electrical system.

**Heat / start switch (A4),** which is held up to energise the cold start aid (if one is fitted), or held down to energise the starter motor.

**Stop button (A6)** press the button to stop the engine.

**Warning lamp (A2)** to indicate that there is no electrical charge from the alternator.

**Voltmeter (A3)** to indicate the condition of the batteries and of the alternator.

**Warning lamp (A10)** for high coolant temperature

**Gauge (A9)** to indicate coolant temperature.

**Tachometer (A12)** to indicate the engine speed. The tachometer also has an hourmeter, this can be used to ensure that the engine is maintained at the correct intervals.

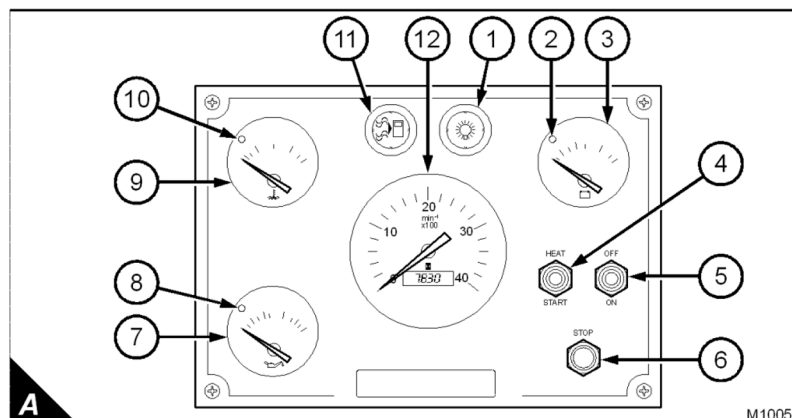
**Warning lamp (A8)** for low lubricating oil pressure.

**Gauge (A7)** to indicate the lubricating oil pressure of the engine.

**Warning lamp (A11)** for water in the fuel.

**Audible warning device,** which operates if the engine has low lubricating oil pressure or high coolant temperature. The audible warning device is situated behind the control panel.

**Caution:** If the audible warning device operates, the warning light(s) on the relevant main panel will indicate the engine affected. Reduce the speed of the engine affected to idle and, if necessary, stop the engine.



## Basic control panel

The basic control panel shown in figure (B). The switches are protected from the entry of water, but if the control panel is in an exposed location, it should be protected by a cover when not in use.

Below is a description of the instrument and switches on the auxiliary panel.

**Caution:** *If the audible warning device operates, the warning light(s) on the relevant main panel will indicate the engine affected. Reduce the speed of the engine affected to idle and, if necessary, stop the engine.*

**Audible warning device**, which operates if the engine has low lubricating oil pressure or high coolant temperature.

**Engine electrical system / stop switch** (B5), which has two positions:

- OFF: Move the switch lever up to switch off the electrical system
- ON: Move the switch lever down to energise the electrical system.

**Tachometer** (B7) to indicate the engine speed.

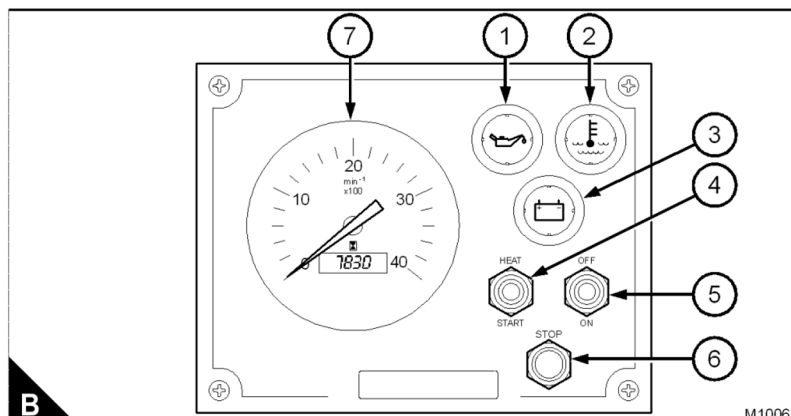
**Heat / start switch** (B4), which is held up to energise the cold start aid (if one is fitted), or held down to energise the starter motor.

**Stop button** (B6) press the button to stop the engine.

**Warning lamp** (B3) to indicate that there is no electrical charge from the alternator.

**Warning lamp** (B2) for high coolant temperature.

**Warning lamp** (B1) for low lubricating oil pressure.



## Engine Wiring Harness,

The engine wiring harness is designed convey information to and from the engine instrument / control panel. Within the harness is a circuit breaker and a –ve earth fuse to protect the wiring in the event of a short circuit as well as control relays, all of which are housed in an enclosure adjacent to the alternator.

Access to the circuit breaker is from the outside of the control box. This can be used to isolate the control system during servicing. The 10A breaker protects the control system to the panel(s). Interruption of this will inhibit the instrument / control panel and thus the starting of the engine.

The momentary connection of the –ve line to earth is protected by an 80A fuse located within the enclosure adjacent to the 10A breaker.

Within the control box are 4 relays. Three are high current relays designed to control the operation of the starter and the glowplugs. During the operation of the glowplugs a negative earth relay momentarily grounds the engine to negative. The fourth relay controls the fuel lift pump stop solenoid and cold start advance solenoid.

In addition to monitoring the engine oil pressure and engine coolant temperature the wiring harness also connects to a cold start advance solenoid which operates through a temperature switch which opens above 40°C to 50°C

The fuel is delivered to the fuel injection pump via an electric fuel lift pump. This commences operation in tandem with the stop solenoid when the engine circuit switch is operated on the instrument / control panel.

Engine circuit variations due to system voltage.

12v Engines - Engines with 12v systems will have fitted a 12v to 24v inverter (Unit colour red) to operate the 24v insulated stop solenoid and 24v cold start advance solenoid.

24v Engines - Engines with 24v systems will have fitted a 24v to 12v converter (Unit colour black) to operate the 12v fuel lift pump.

Care should be taken to ensure that there is adequate ventilation around the voltage converter / inverter to ensure that does not overheat.

**Warning!** *On no account may any additional load be placed on either the inverter or converter as this may cause the unit to fail.*

Where one engine is required to charge two sets of batteries then one option is to fit a split charge relay. This should be connected as follows:

Fit one side of the coil to the charge warning lamp terminal on the alternator. (Ind – violet cable in harness) The other side of the coil is connected to the negative connection on the alternator.

The relay contacts are connected with one side going to the positive side of the alternator and the other side going to the positive on the second battery. It is important to ensure that the relay and cables are of sufficient size to handle the maximum alternator output.

## How to start the engine

Use only this procedure to start the engine; it has been designed to protect the engine and the environment.

Several factors affect engine start, for example:

- The power of the batteries
- The performance of the starter motor
- The viscosity of the lubricating oil
- The installation of a cold start system.

Diesel engines need a cold starting aid if they are to start in extremely cold conditions. These engines are fitted with glow plugs as standard and are only necessary in ambient temperatures colder than  $-5^{\circ}\text{C}$

Before the engine is started the operator should understand fully the controls and their use.

Preparations for an engine start

1. Ensure that there is more than enough fuel in the tank for the voyage.
2. Ensure that the fuel supply control (if fitted) is in the open position.
3. Check that the seacock strainer is clean.
4. Open the seacock.
5. Check the amount of coolant in the header tank.
6. Check the amount of lubricating oil in the sump, and in the reverse gearbox.
7. Ensure that the control lever for the reverse gearbox is in the neutral position..

### How to start a cold engine in cold conditions

**Caution:** *Ether type fuels must not be used.*

**Note:** Use this method when the ambient temperature is colder than  $-5^{\circ}\text{C}$  ( $23^{\circ}\text{F}$ ).

1. Switch on the electrical system.
2. Check that the reverse gearbox is in neutral. Adjust the engine speed control to the minimum speed position.
3. Hold the lever of the heat/start switch in the up position for 15 seconds. Hold the lever of the heat/start switch in the down position to engage the starter motor. When the engine starts, release the lever. Adjust the engine speed control to give an even idle.
4. Check that water comes out of the end of the exhaust pipe or out of the separate discharge outlet.
5. If the engine does not start in 15 seconds, allow the starter motor to cool for 30 seconds. When the engine has started, adjust the engine speed control to get an even idle speed. Check that water comes out of the end of the exhaust pipe or out of the separate discharge outlet.

Always ensure that the engine and starter motor are stationary before the starter motor is engaged again.

### How to start a warm engine, or if the ambient temperature is hotter than $-5^{\circ}\text{C}$ ( $23^{\circ}\text{F}$ ).

1. Switch on the electrical system.
2. Check that the reverse gearbox is in neutral. Adjust the engine speed control to the minimum speed position.
3. Hold the start switch down to engage the starter motor. When the engine starts, adjust the engine speed control to give an even idle speed. Check that water comes out of the end of the exhaust pipe or out of the separate discharge outlet.

Always ensure that the engine and starter motor are stationary before the starter motor is engaged again.

**Caution:** *Do not run the electric fuel lift pump for more than 60 seconds without fuel. The fuel pump can be permanently damaged as it relies on the fuel for lubrication.*

## How to stop the engine

1. Adjust the engine speed control to the minimum speed position. Ensure that the control lever for the reverse gearbox is in the neutral position. If the engine has operated at high load for a long period of time, allow the engine to cool for one to two minutes.
2. Press the stop button until the engine stops. Release the stop switch or rotate the switch to the off position.

## Adjustment of engine speed range

The idle or maximum speed settings must not be changed by the engine operator, because this can damage the engine or the transmission. The warranty of the engine can be affected if the seals on the fuel injection pump are broken during the warranty period by a person who is not approved by Perkins.

## Running-in

A gradual running-in of a new engine is not necessary. Prolonged operation at light loads during the early life of the engine can cause lubricating oil to enter the exhaust system. Maximum load can be applied to a new engine as soon as the engine is put into service and the coolant temperature has reached a minimum of 60°C (140°F).

### **Cautions:**

- *The engine will benefit if the load is applied as soon as possible after the engine is put into service.*
- *Do not operate the engine at high speeds without a load.*
- *Do not overload the engine.*

## Angle of tilt

For yachts with auxiliary engines, it may be necessary to use the engine during operation against the wind. In these conditions, an angle of tilt (port or starboard) up to 25° continuous operation or 35° intermittent operation is permissible.

### Free rotation of the propeller shaft or “trailing”

The propeller shaft of both the Newage PRM 500D and the Hurth 45 A reverse gearboxes can be allowed to turn continuously with the control lever in the neutral position.

The recommendations of the manufacturer of the reverse gearbox must be followed.

### Operation of the lever for gear selection

#### Newage PRM 500D reverse gearbox (C)

For same-as-crankshaft rotation, move the lever to the position (C1).

To put the reverse gearbox into neutral, move the lever to the centre position (C2).

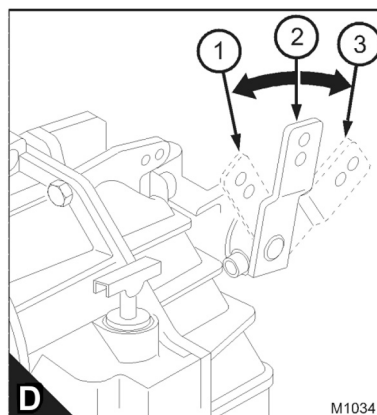
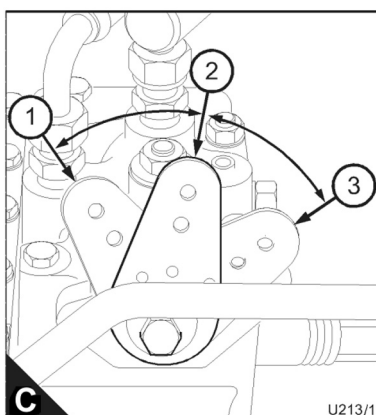
For opposite-to-crankshaft rotation, move the lever to the position (C3).

#### Hurth 45 A (D)

For same-as-crankshaft rotation, move the lever to the position (D3).

To put the reverse gearbox into neutral, move the lever to the position (D2).

For opposite-to-crankshaft rotation, move the lever to the position (D1).





## Emergency procedures

### If the engine stops

1. Check that the fuel supply valve (if fitted) is in the open position.
2. Check the fuel pre-filter (if fitted) and the fuel filters for water. If a warning light for water in the fuel is fitted, and it is illuminated, water has entered the pre-filter. Water must be removed before the engine is operated. Drain any water found and fit new filters.
3. Check the amount of fuel in the tank. If the engine has run until the tank is empty, there may be dirt or air in the fuel pipes. Change the fuel filter, see section 4. Fill the tank. Eliminate air from the system, see section 4.
4. Start the engine again. If the engine still will not start, check that the cables and contacts of the stop solenoid are in good condition.

### If there is a reduction in engine speed or a loss of power

1. Check that the propeller is free of debris.
  2. Check that the induction system is not restricted and that the engine compartment has a good supply of air.
  3. Check that the fuel pre-filter or the fuel filter elements are not restricted or contaminated by water. If a warning light for water in the fuel is fitted, and it is illuminated, water has entered the pre-filter. Water must be removed before the engine is operated. Drain any water found and fit new filters.
- If the warning lamp / audible warning for high coolant temperature operates

**Warning!** Do not remove the filler cap while the engine is still hot and the system is under pressure, because dangerous hot coolant can be discharged.

1. Reduce the engine speed to idle. Stop the engine if there is a leakage of steam or coolant from the engine.
2. Check that the coolant level is correct after the engine has cooled.
3. Check the seacock and strainer to ensure that there is not a restriction to the supply of water to the cooling system.
4. Check the raw water pump operation. Check the impeller.

**Note:** Coolant leakage can be stopped temporarily with adhesive tape, hose and hose clips.

### If a high-pressure fuel pipe is broken or has a crack

**Warning!** Ensure that fuel does not spray onto the skin. Stop the engine if there is a leakage of high-pressure fuel.

1. Stop the engine.
2. Remove the broken pipe from the engine.
3. Connect the end of the pipe that is not broken to the fuel injection pump. Put the broken end of the pipe into a suitable container.
4. Operate the engine at a reduced speed on the remainder of the cylinders. Empty the container at regular intervals.

### If leakage occurs from a low pressure fuel pipe

Temporarily stop the leak with a hose and hose clips.

### If leakage of lubricating oil occurs:

1. Stop the engine immediately and try to find the cause.
2. If the main flow can be reduced, put a suitable container under the leakage point.
3. Fill the engine with new lubricating oil at the same rate as the loss of oil and frequently check the lubricating oil pressure.



## Preventive maintenance

### Preventive maintenance periods

These preventive maintenance periods apply to average conditions of operation. Check the periods given by the manufacturer of the boat in which the engine is installed. If necessary, use the shorter periods. When the operation of the engine must conform to the local regulations these periods and procedures may need to be adapted to ensure correct operation of the engine.

It is good preventive maintenance to check for leakage and loose fasteners at each service.

These maintenance periods apply only to engines that are operated with fuel and lubricating oil which conform to the specifications given in this handbook.

Use the procedures in this section to maintain your engine in accordance with the preventive maintenance schedule.

**Schedules**

The schedules which follow must be applied at the interval (hours or months) which occur first.

- A** First service at 25/50 hours                      **D** Every 500 hours or 12 months                      **G** Non-scheduled maintenance
- B** Every day or every 8 hours                      **E** Every 1000 hours
- C** Every 250 hours or 12 months                      **F** Every 2000 hours

A	B	C	D	E	F	G	Operation
	•						Check the amount of coolant in the header tank
	•						Check the engine for leakage of oil and coolant
			•				Check the specific gravity of the coolant <sup>(2)</sup>
•		•					Check the tension and the condition of the drive belt
			•				Check the impeller of the raw water pump
	•						Check the sea water strainer
			•				Clean the sediment chamber and the strainer of the fuel lift pump
•	•						Drain water from the fuel pre-filter <sup>(1)</sup>
			•				Renew the element of the fuel filter
						•	Atomiser maintenance <sup>(2) (5)</sup>
•							Ensure that the idle speed is checked and adjusted, if it is necessary <sup>(2)</sup>
	•						Check the amount of lubricating oil in the sump
	•						Check the lubricating oil pressure at the gauge
			•				Renew the engine lubricating oil <sup>(4) (6)</sup>
			•				Renew the canister of the lubricating oil filter <sup>(6)</sup>
	•						Check the amount of lubricating oil in the reverse gearbox
•		•					Renew the lubricating oil in the reverse gearbox <sup>(6)</sup>
						•	Renew the engine breather <sup>(2) (7)</sup>
			•				Renew the element of the air filter
			•				Check all hoses and connections
				•			Check the valve tip clearances of the engine, and adjust if necessary <sup>(2)</sup>
			•				Check the audible warning system which protects the engine
						•	Ensure that the alternator, the starter motor, etc. are checked <sup>(2)</sup>
			•				Check the engine mounts
				•			Inspect the electrical system for signs of damage <sup>(2)</sup>

(1) If one is fitted.  
 (2) By a person who has had the correct training.  
 (3) Renew the antifreeze every 2 years.  
 (4) The oil change interval will change with the amount of sulphur in the fuel (see the table and the Fuel Specification in section 5). The interval to change the canister of the lubricating oil filter is not affected.  
 (5) Regular maintenance of the atomisers is not necessary.  
 (6) Refer to Wimborne Marine Power Centre for approval to extend intervals.  
 (7) Renew the complete engine breather assembly at major engine service or 8000 hours.

## How to fill the coolant circuit

**Warning!** If coolant is to be added to the circuit during service, allow the engine to cool before the coolant is added. Remove the filler cap slowly as dangerous coolant could be discharged if the coolant is still hot and the system is under pressure.

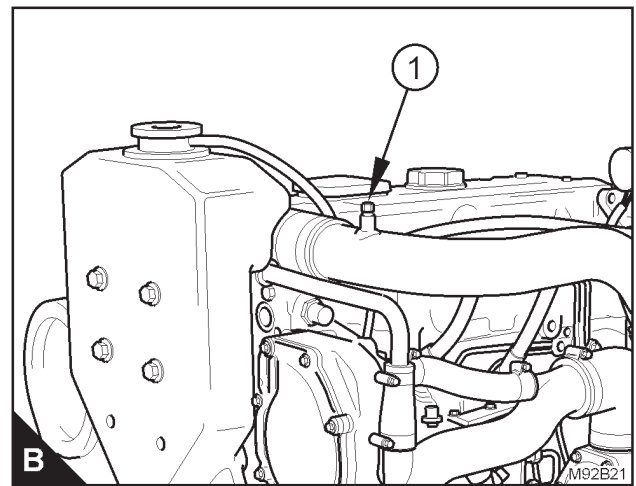
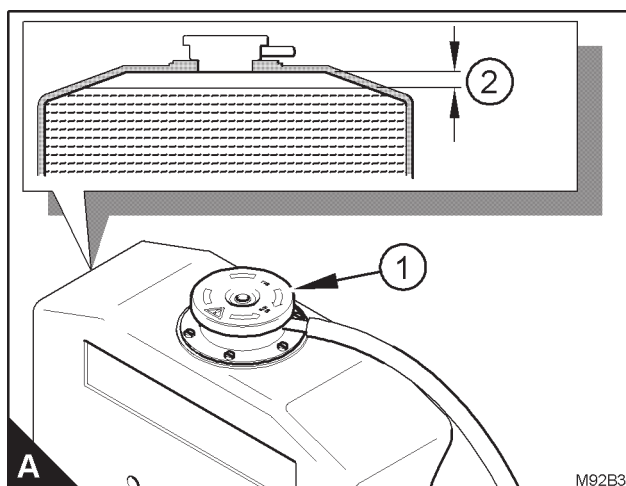
Do not put too much coolant in the coolant circuit. There is a relief valve in the filler cap which will open and release hot coolant if too much coolant is added.

**Caution:** If coolant is added to the circuit during service, it must consist of the same original mixture as used to fill the system. See "Coolant specification" in section 5 for details of the correct coolant to be used in the circuit.

1. Remove the filler cap (A1) of the header tank and slowly fill the coolant system until the coolant level is approximately 12 mm (0.5 in) (A2) below the neck of the filler tube.

**Note:** It is necessary to vent air from the system during initial fill, or if the system has been completely drained. To vent air, remove the plug (B1)

2. Fit the filler cap.
3. Start the engine. When it has reached its normal temperature of operation, stop it.
4. Carefully remove the filler cap of the header tank and add coolant until the level of the coolant is correct.
5. Fit the filler cap.



## How to drain the coolant circuit

### Warnings!

- Do not drain the coolant while the engine is still hot and the system is under pressure because dangerous hot coolant can be discharged.
- Discard used coolant in a safe place and in accordance with local regulations.

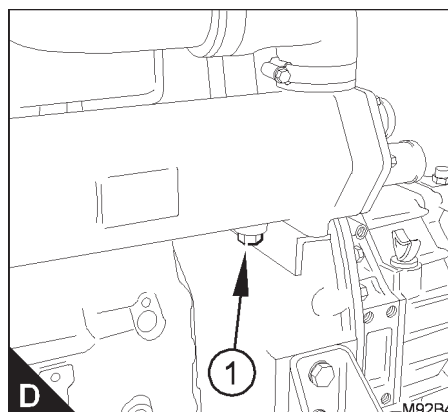
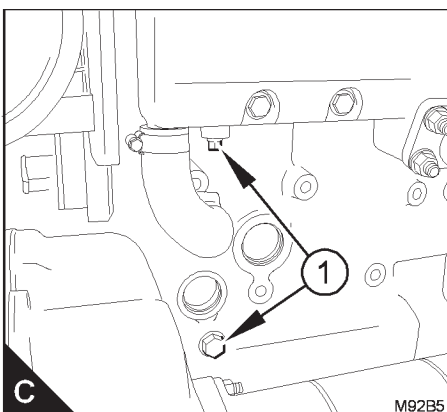
1. Remove the filler cap of the coolant circuit.
2. Remove the drain plug (C1) from the side of the cylinder block and the drain plug (D1) from the heat exchanger. Ensure that the drain holes are not restricted.
3. After the system has been drained, fit the filler cap and the drain plugs.
4. Fasten a label in a suitable place to indicate that the coolant system has been drained.

**Caution:** The closed circuit system cannot be drained completely. If the coolant is drained for engine preservation purposes or for protection from frost, the coolant system must be filled again with an approved antifreeze mixture. See "Coolant specification" in section 5 for details of the correct coolant to be used in the circuit.

### Engines fitted with keel coolers

The coolant capacity and the method used to drain the coolant circuit of an engine connected to a keel cooler will vary in different applications.

Use the instructions given by the keel cooler manufacturer to drain and renew the engine coolant when a keel cooler is fitted.



## How to check the specific gravity of the coolant

For mixtures which contain inhibited ethylene glycol:

1. Operate the engine until it is warm enough to open the thermostat. Continue to run the engine until the coolant has circulated the cooling system.
2. Stop the engine.
3. Allow the engine to cool until the temperature of the coolant is below 140°F (60°C).

**Warning!** Do not drain the coolant while the engine is still hot and the system is under pressure because dangerous hot coolant can be discharged.

4. Remove the filler cap of the cooling system.
5. Drain some coolant from the cooling system into a suitable container.
6. Use a special coolant hydrometer that will check the temperature and the specific gravity of the coolant, follow the manufacturer's instructions.

**Note:** If a special coolant hydrometer is not available, put a hydrometer and a separate thermometer into the antifreeze mixture and check the readings on both instruments. Compare the readings with the chart (E).

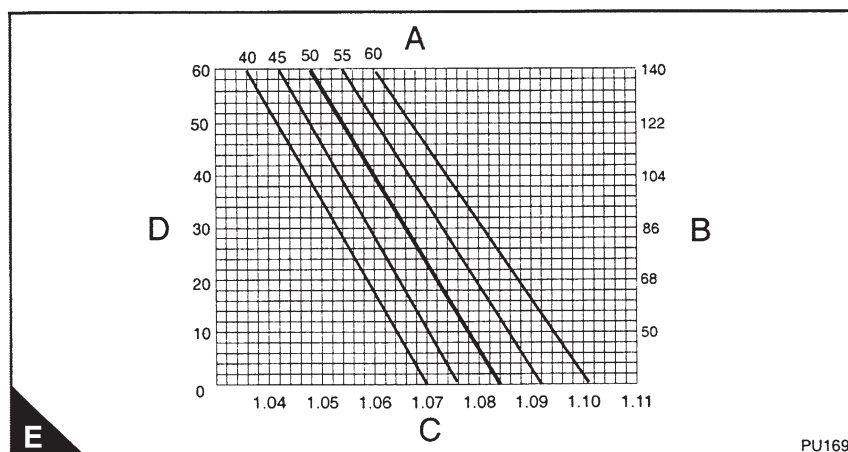
### Specific gravity chart

- A** = Percentage antifreeze by volume
- B** = Mixture temperature in Fahrenheit
- C** = Specific gravity
- D** = Mixture temperature in Celsius

7. Adjust the strength of the mixture as necessary.

**Note:** If it is necessary to fill or replenish the coolant system in service, mix the coolant to the correct strength before it is added to the coolant system.

**Caution:** An antifreeze to water ratio of 50:50 should be used even in warm ambient temperatures, in order to maintain the concentration of the corrosion inhibitor in the antifreeze.



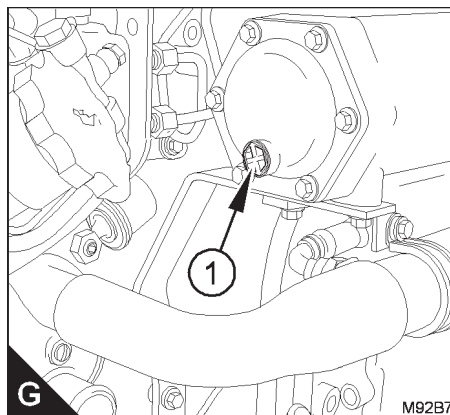
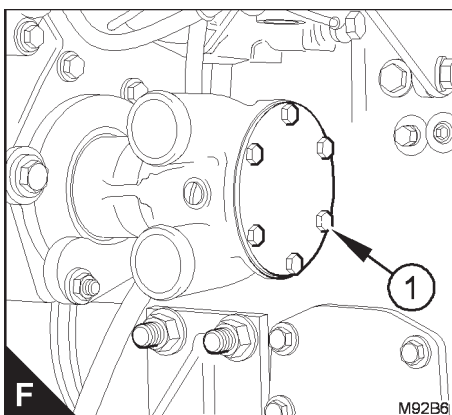
## How to drain the raw water system

**Caution:** The raw water system cannot be drained completely. If the system is drained for engine preservation purposes or for protection from frost, the system must be filled again with an approved antifreeze mixture. See "Coolant specification" in section 5 for details of the correct coolant to be used. See section 7 for details of how to add antifreeze to the raw water system for engine preservation purposes.

1. Ensure that the seacock is closed.
2. Loosen the six setscrews (F1) of the cover for the raw water pump and withdraw slightly the cover.
3. Rotate the crankshaft to ensure that the raw water pump is empty.
4. Tighten the six setscrews of the cover for the raw water pump (If necessary replace joints).

**Caution:** When the raw water system is to be used again, ensure that the seacock is open.

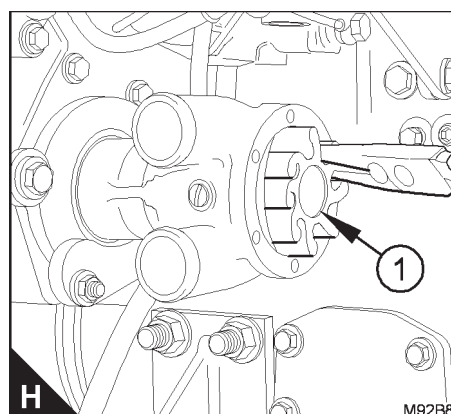
5. Remove the drain plug (G1) and drain the heat exchanger. Refit the drain plug.





## How to check the impeller of the raw water pump

1. Ensure that the seacock is closed.
2. Release the six setscrews which fasten the end plate of the raw water pump and remove the plate. When the end plate of the raw water pump is removed, some raw water will flow from the pump.
3. Remove the rubber end cap (H1) and then pull the impeller from the shaft.
4. Clean the contact surfaces of the pump body and the end plate.
5. Inspect the rubber impeller for excessive wear or for damage and renew it, if necessary. If pieces have broken off the impeller blades, it is necessary to remove them from the system to avoid damage later. To do this:
  6. Remove the outlet hose from the raw water pump. Remove the end cap of the oil cooler for the reverse gearbox.
  7. Remove any debris and check that the open ends of the tubes in the oil cooler are clear of broken pieces of impeller blades.
  8. Fit the outlet hose to the raw water pump and the end cap to the oil cooler for the reverse gearbox and tighten the hose clips. Replenish the coolant circuit .
  9. Apply Spheerol SX2 grease or liquid soap to the blades of the impeller and fit the impeller into the housing with the blades bent counter-clockwise (H). Fit the rubber end cap.
  10. Apply POWERPART jointing compound, part number 1861117 to a new joint and fit it to the body with the wide area of the joint over the eccentric plate in the body. Fit the end plate and tighten the end plate screws.
  11. Open the seacock.



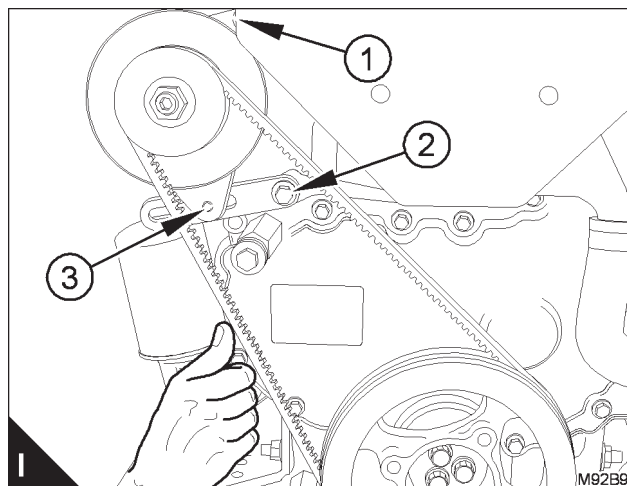
### How to check the drive belt

Press down the belt with the thumb at the centre of the longest free length and check the deflection (I). With moderate thumb pressure - 45N (10 lbf) 4,5 kgf - the correct deflection of the belt is 10 mm (3/8 in).

### How to adjust the belt tension

The alternator is driven by a drive belt of a specific design. Use only a Perkins POWERPART drive belt. If this is not done, an early failure of the belt may occur.

1. Loosen the pivot fastener (I1) of the alternator and loosen the setscrews (I2) and (I3) of the adjustment link.
2. Change the position of the alternator to give the correct tension. Tighten the pivot fasteners of the alternator and the setscrew of the adjustment link.
3. Check the belt tension again to ensure that it is still correct. If a new belt is fitted, the belt tension must be checked again after the first 25 hours of operation.



## How to renew the element of the fuel filter

**Warning!** Discard the used canister and fuel oil in a safe place and in accordance with local regulations.

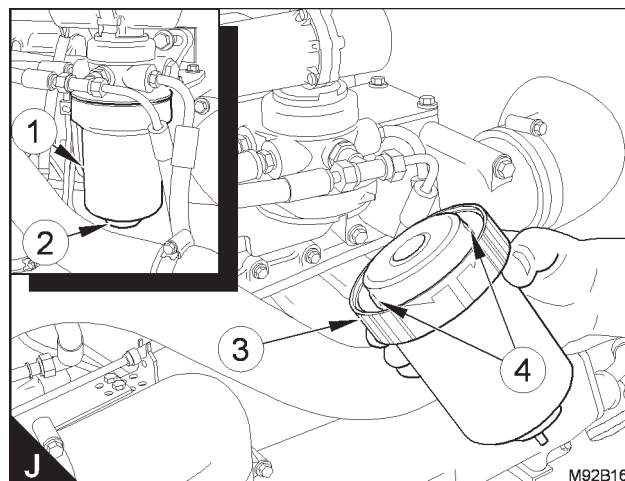
**Caution:** It is important that only the genuine Perkins parts are used. The use of wrong parts could damage the fuel injection equipment.

1. Thoroughly clean the outside surfaces of the fuel filter assembly (J1).
2. Loosen the drain device (J2) at the bottom of the filter canister and drain the fuel into a suitable container.
3. Turn the clamping ring (J3) to the left to free the filter.
4. Ensure that the inside of the filter head is clean
5. Ensure the locating nodes (J4) are in the correct position to slot into the filter head.
6. Turn the clamping ring to the right to lock in position.
7. Eliminate the air from the fuel filter.

### Fuel pre-filter

This will normally be fitted between the fuel tank and the engine. Check the filter bowl for water at regular intervals and drain as necessary.

**Caution:** Do not run the electric fuel lift pump for more than 60 seconds without fuel. The fuel pump can be permanently damaged as it relies on the fuel for lubrication.



## Atomiser maintenance

**Caution:** A faulty atomiser must be renewed by a person who has had the correct training.

### Atomiser faults

**Caution:** A faulty atomiser must be renewed by a person who has had the correct training.

Regular maintenance of the atomisers is not necessary. The atomiser nozzles should be renewed and not cleaned, and renewed only if an atomiser fault occurs. Some of the problems that may indicate that new nozzles are needed are listed below:

Engine will not start or is difficult to start

Not enough power

Engine misfires or runs erratically

High fuel consumption

Black exhaust smoke

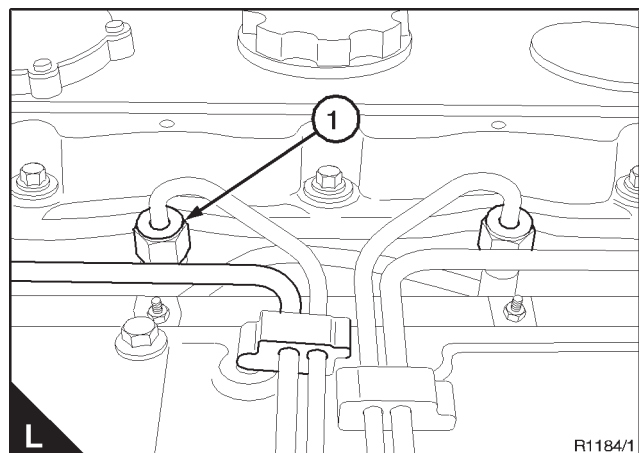
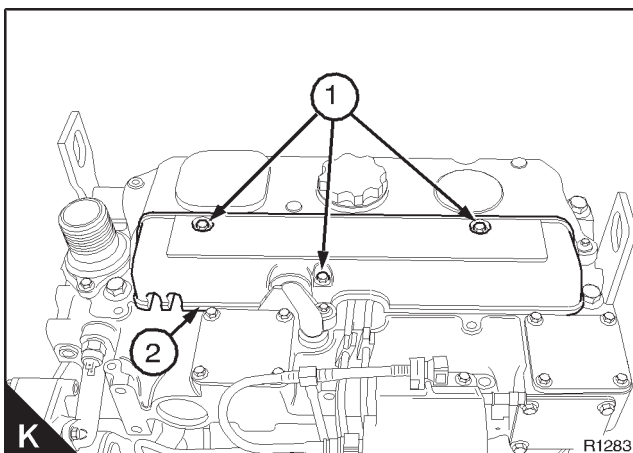
Engine knocks or vibrates excessively

Excessive engine temperature.

### Warnings!

- If your skin comes into contact with high-pressure fuel, obtain medical assistance immediately.
- Keep away from moving parts during engine operation. Some moving parts cannot be seen clearly while the engine runs.

Remove the atomiser cover setscrews (K1) and remove the atomiser cover (K2). In order to find which atomiser is defective, operate the engine at fast idle speed. Loosen and tighten the union nuts (L1) of the high-pressure fuel pipe at each atomiser. Do not loosen the union nut more than half a turn. When the union nut of the defective atomiser is released, it has little or no effect on the engine speed.



## How to remove and to fit an atomiser

### How to remove

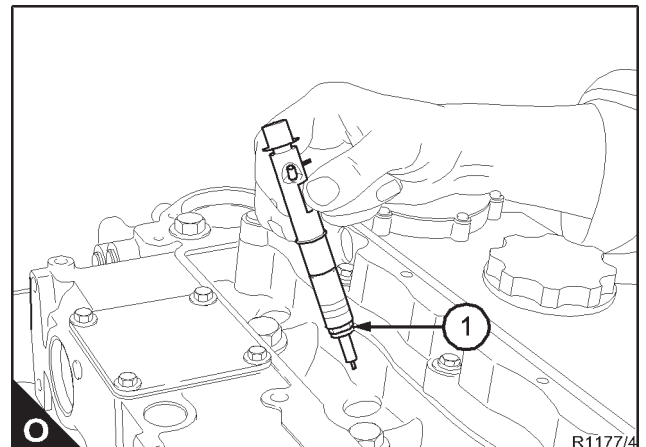
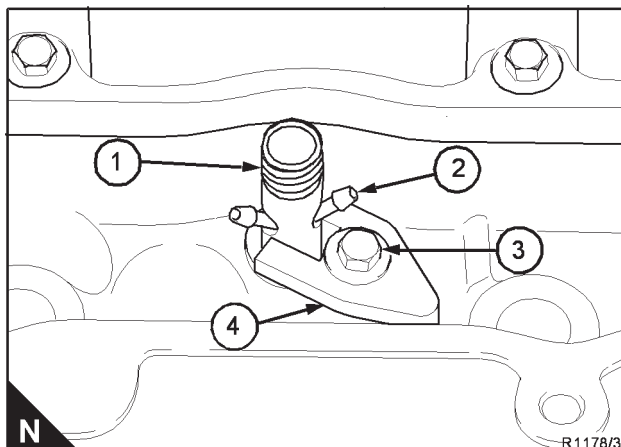
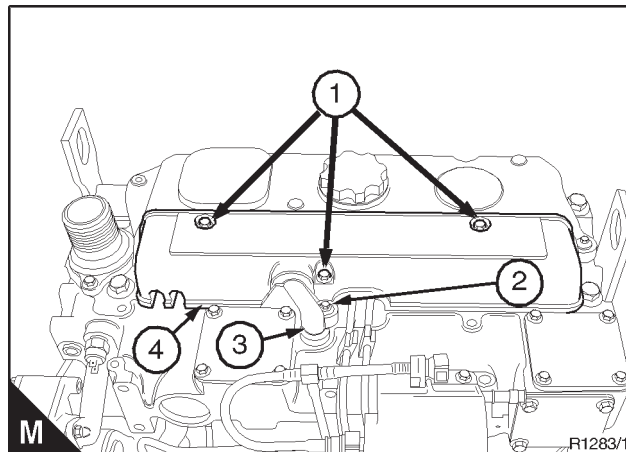
**Warning!** The combustible material of some components of the engine (for example certain seals) can become extremely dangerous if it is burned. Never allow this burnt material to come into contact with the skin or with the eyes.

### Cautions:

- Atomisers must be removed and fitted by a person with the correct training.
- Do not allow dirt to enter the fuel system. Before a connection is disconnected, clean thoroughly the area around the connection. After a component has been disconnected, fit a suitable cover to all open connections.

1. Release the atomiser cover setscrews (M1) and remove the atomiser cover (M2).
2. Release the fastener (M2) and remove the breather pipe (M3).
3. Remove the fuel leak-off hose from the connection (N2).
4. Remove the union nuts of the high-pressure pipe from the atomiser (N1) and from the fuel injection pump. Do not bend the pipe. If necessary, remove the pipe clamps. Fit a plastic cap to cover all open connections.
5. Remove the setscrew (N3) and remove the clamp (N4) from the cylinder head.
6. Remove the atomiser and its seat washer (O1) from its recess in the cylinder head.

**Caution:** Remove and discard the seat washer (O1). If the original seat washer remains in the recess, the nozzle protrusion will be incorrect when a new seat washer is added.



## How to fit

1. Remove all covers and caps from the component and connections.
2. Put a new seat washer into the seat recess in the cylinder head.

**Note:** Some new atomiser's have the seat washer (P3) fitted on the atomiser.

3. Ensure that the atomiser seal (P2) is not damaged. Apply a small amount of clean fuel oil to the seal.

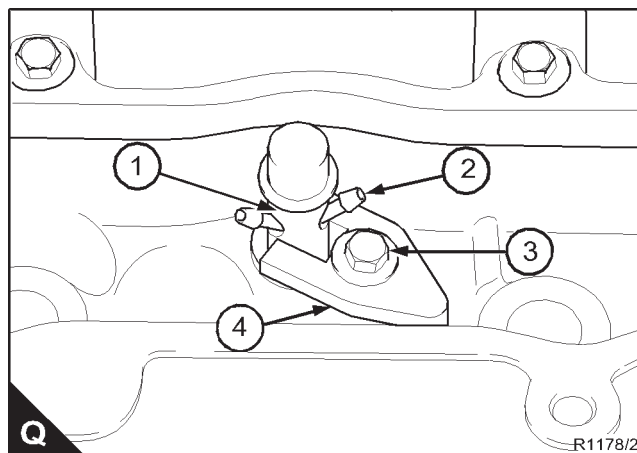
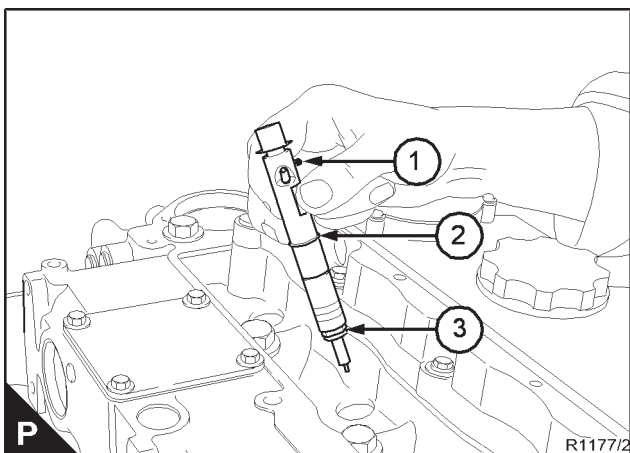
### **Cautions:**

- The atomiser must be fitted so that the pin or the union (P1) faces away from the atomiser clamp (Q4).
- If fitted the leak-off hose is a push fit and will need replacing if the hose leaks.

4. Put the atomiser (Q1) into its recess in the cylinder head.
5. Fit the clamp (Q4) and the setscrew (Q3). Tighten the setscrew to 35 Nm (26 lbf ft) 3,5 kgf m.

**Caution:** Do not tighten the union nuts of the high-pressure pipes more than the recommended torque tension. If there is a leakage from the union nut, ensure that the pipe is correctly aligned with the atomiser inlet. Do not tighten the atomiser union nut more, as this can cause a restriction at the end of the pipe. This can affect the fuel delivery.

6. Remove the plastic cap, fit the high-pressure fuel pipe and tighten the union nuts to 30 Nm (22 lbf ft) 3,0 kgf m.
7. If removed earlier, fit the clamps to the high pressure fuel pipes.
8. Where necessary, fit the fuel leak-off hose to the connectors (Q2).
9. Check the "O" ring on the breather pipe and replace if necessary. Apply a small amount of clean engine oil to the "O" ring and fit the breather pipe into the rocker cover. Tighten the fastener to 9 Nm (7 lbf ft) 0,9 kgf m. Fit the breather hose and clip if fitted.
10. If removed, fit the crossover pipe.
11. Run the engine and check for leakage of fuel and air. Correct any leakage.
12. Stop the engine.
13. Refit the atomiser cover and tighten the setscrews to 6 Nm (4 lbf ft) 0,6 kgf m.



## How to eliminate air from the fuel system

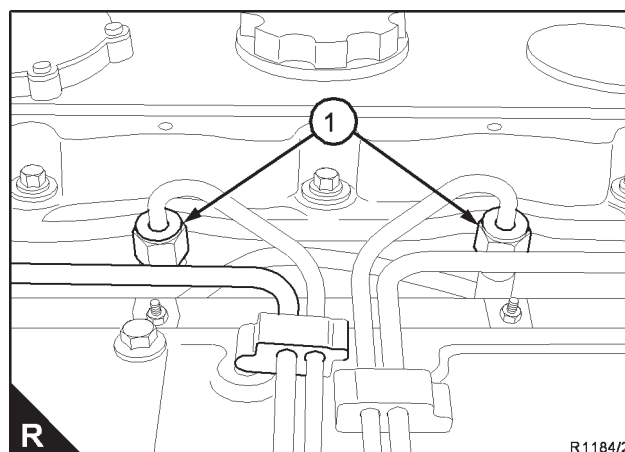
### **Cautions:**

- Under no circumstances should any attempt be made to remove the electric fuel lift pump from the filter head as it is not a serviceable item.
- Do not operate the engine until the air is eliminated from the fuel injection pump.
- After the air is eliminated, operate the engine at low idle for two minutes.

The Bosch VE fuel injection pumps will not vent automatically.

1. Remove the atomiser cover.
2. Loosen the high pressure pipes (R1) at the atomisers.
3. Switch the control panel to energise the electric lift pump for 30 to 60 seconds.
4. Operate the starter motor until fuel free from air comes from the connections.
5. Tighten the union nuts to 30 Nm (22 lbf ft) 3,0 kgf m.
6. Start the engine and check for leaks.
7. Fit the atomiser cover and tighten its setscrews.

**Caution:** Do not run the electric fuel lift pump for more than 60 seconds without fuel. The fuel pump can be permanently damaged as it relies on the fuel for lubrication.



## How to renew the lubricating oil

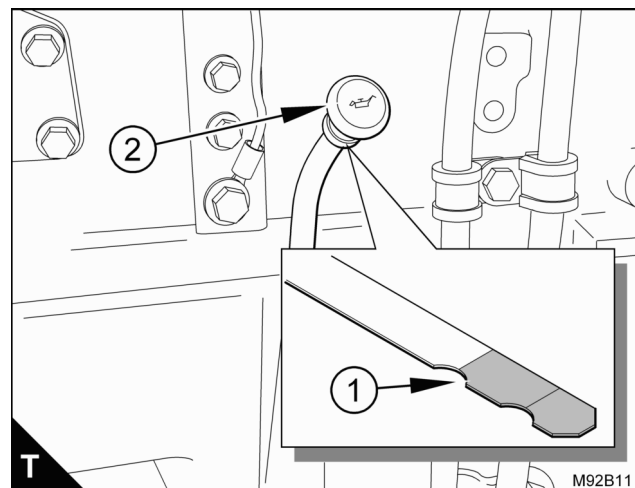
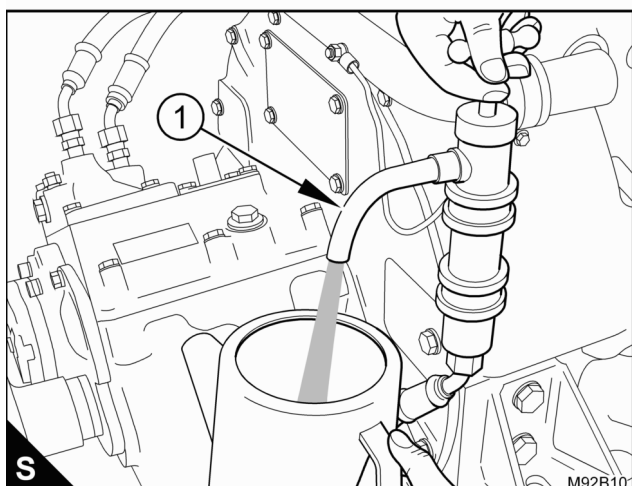
**Warning!** Discard the used lubricating oil in a safe place and in accordance with local regulations.

**Note:** Renew the filter canister when the lubricating oil is renewed.

1. Using the sump drain pump (S1). Pump the lubricating oil into a suitable container with a capacity of approximately 10 litres (17.5 pints), the lubricating oil should be drained while it is still hot.
2. Remove the container of used lubricating oil.
3. Clean the area around the filler cap on top of the rocker cover and remove the cap.

**Caution:** Do not fill the sump past the notch (T1) on the dipstick (T2) as this can have an adverse affect on on the performance of the engine. Excess lubricating oil must be drained from the sump. An excess of lubricating oil could enter the engine breather valve. This could cause the engine speed to increase rapidly without control.

4. Add slowly, approximately 7,0 litres (15.8 pints) of new and clean lubricating oil of an approved specification to the engine. Allow the oil enough time to pass to the sump, remove the dipstick (T2) and ensure that the lubricating oil is to the full mark (T1). The oil level must not be above the full mark. If it is, the engine could be damaged.
5. Fit the filler cap and ensure that the dipstick is fitted correctly in the dipstick tube.
6. Start the engine and check for lubricating oil leakage. Stop the engine. After 15 minutes check the oil level on the dipstick and, if necessary, put more lubricating oil into the sump.





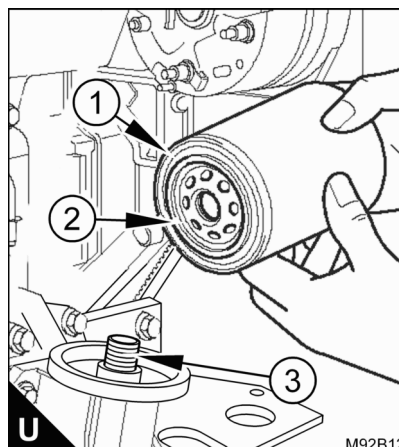
## How to renew the canister of the lubricating oil filter

**Warning!** Discard the used canister and lubricating oil in a safe place and in accordance with local regulations.

1. Clean thoroughly the outside surfaces of the oil filter.
2. Use a strap wrench or similar tool to just loosen the filter canister (U1). Put a suitable container under the filter assembly to retain spilt oil. Remove and discard safely the canister. Ensure that the adaptor (U3) is secure in the lubricating oil cooler.
3. Clean the contact face of the lubricating oil cooler.
4. Lubricate the seal (U2) on top of the canister with clean engine lubricating oil.
5. Fit the new canister and tighten by hand until the seal contacts the cylinder block. Tighten the canister a further 1/2 to 3/4 of a turn by hand only. Do not use a strap wrench.
6. Ensure that there is lubricating oil in the sump. Start the engine and run at idle speed until oil pressure is obtained. Check for leakage from the filter. Stop the engine. After 15 minutes check the oil level on the dipstick and, if necessary, put more lubricating oil into the sump.  
Do not fill the sump past the notch on the dipstick.

### **Cautions:**

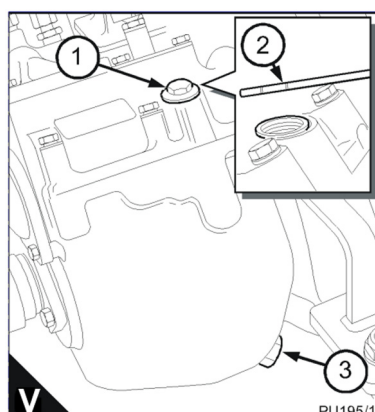
- The canister contains a valve and special tube to ensure that lubricating oil does not drain from the filter.
- Therefore, ensure that the correct Perkins POWERPART canister is used.



## How to renew the lubricating oil of the Newage PRM 500D reverse gearbox

**Caution:** In service the lubricating oil of these reverse gearboxes should be checked with the lubricating oil cold. Always check the lubricating oil level before the transmission is used.

1. Put a suitable container with a capacity of at least 3 litres (5 pints) under the reverse gearbox. Remove the drain plug (V3) and its sealing washer and drain the oil from the reverse gearbox.
2. Inspect the sealing washer for the plug and, if necessary, renew it. Fit the drain plug and its sealing washer. Tighten the plug.
3. Rotate the hexagonal head of the dipstick (V1) counter-clockwise to release the dipstick and remove it from the dipstick / filler tube. Ensure that the sealing washer is not lost. Add lubricating oil of the correct specification through the dipstick / filler tube, see section 9 for the correct quantity and specification.
4. Ensure that the sealing washer is on the dipstick. Fit the dipstick fully into the dipstick / filler tube. Rotate the hexagonal end of the dipstick clockwise until the dipstick is tight in the tube.
5. Ensure that the reverse gearbox is in neutral (lever in the centre position). Start the engine to allow the lubricating oil in the reverse gearbox to circulate around the system, approximately 15 seconds. Stop the engine and wait approximately two minutes.
6. Remove and clean the dipstick. Insert and tighten the dipstick finger tight into the dipstick / filler tube, then immediately remove the dipstick to check the oil level. Check that the oil is at the full mark (V2) and, if necessary, add more lubricating oil.
7. Ensure that the sealing washer is on the dipstick. Fit the dipstick fully into the dipstick / filler tube. Rotate the hexagonal end of the dipstick clockwise until the dipstick is tight in the tube.



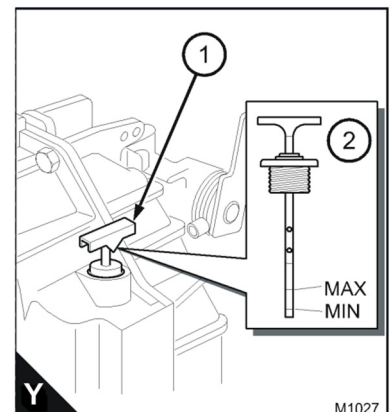
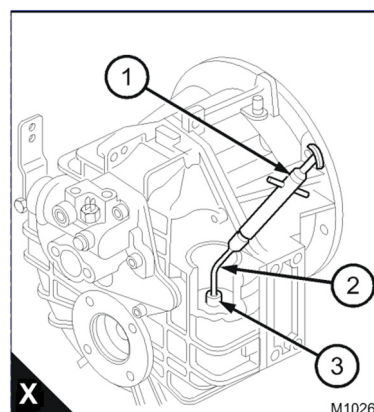
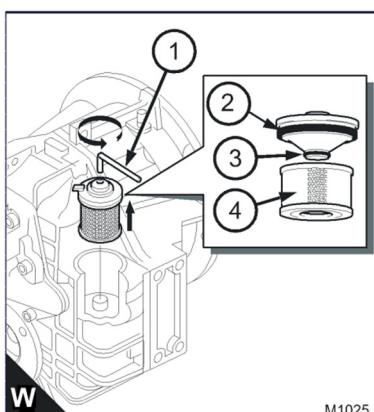
## How to renew the lubricating oil of the ZF 45 A reverse gearbox

**Note:** When the lubricating oil of the reverse gearbox is renewed, the filter element should also be renewed.

1. Turn the filler cap (W1) counter-clockwise with a 6 mm Allen Key (W2) and remove the cap together with the filter that is fitted to the cap.
2. As there is no drain plug, the lubricating oil must be removed with a pump (X1). Connect a hose (X2) to the pump. Push the hose into the suction tube (X3) and down to the bottom of the housing. Operate the pump to remove the lubricating oil; approximately 2,0 litres (3.3 pints) 2.1 US quarts.
3. The outside diameter of the hose must not be more than 16,0 mm (0.625 in).
4. Add 2,0 litres (3.3 pints) 2.1 US quarts of ATF transmission fluid, see Section 9.
5. Pull the filter element (X4) off the filler cap. Fit the new 'O' rings (X2) and (X3) and push a new filter element onto the filler cap.
6. Fit the filter and filler cap assembly and turn the Allen Key clockwise to fasten the filler cap.
7. Turn the handle of the dipstick (Y1) counter-clockwise to release the dipstick. Remove the dipstick. Clean the dipstick and check the level of the lubricating oil. The level should be between the minimum and the maximum marks (Y2). Add more lubricating oil if necessary. Insert the dipstick and turn the handle clockwise to fasten it.
8. With the gear lever in the neutral position, run the engine at idle speed for a few minutes. This will ensure that the lubricating oil has circulated around the oil cooler and its pipes. Stop the engine and check the oil level again. Add more oil, if necessary. Insert and fasten the dipstick.

**Caution:** Some oil could flow back from the oil filter after the engine is stopped. This could cause the oil level to be over the maximum mark on the dipstick. If this occurs do not remove the excess oil.

**Note:** In service the level of the oil can be checked with the oil hot or cold. Always check the oil level before the transmission is used.



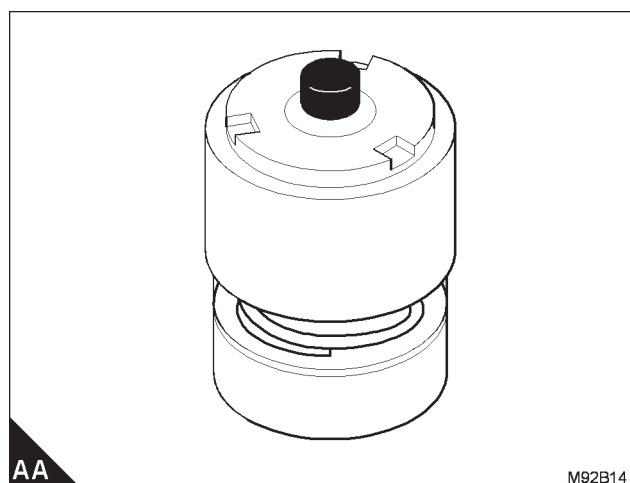
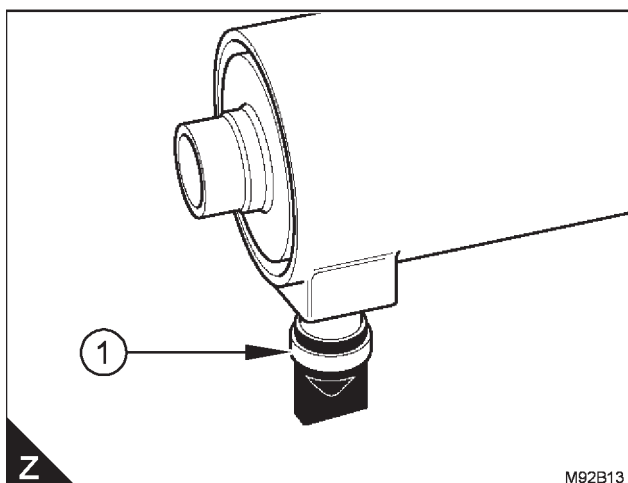
## Air filter

**Caution:** Do not operate the engine if there is a blockage in the air filter or the induction hose. This can cause lubricating oil to enter the cylinders through the breather valve.

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

Air filters have automatic dust valves (Z1) through which dust is expelled from the filter. The rubber dust valve must be kept clean. Ensure that the sides of the valves close completely together and that they can separate freely.

If a restriction indicator (AA) is fitted, it will indicate precisely when the air filter element needs replacement. This prevents the premature removal of the filter element which causes extra cost or late removal of the element which can cause loss of engine power. The filter element must be renewed according to the manufacturers recommendations.

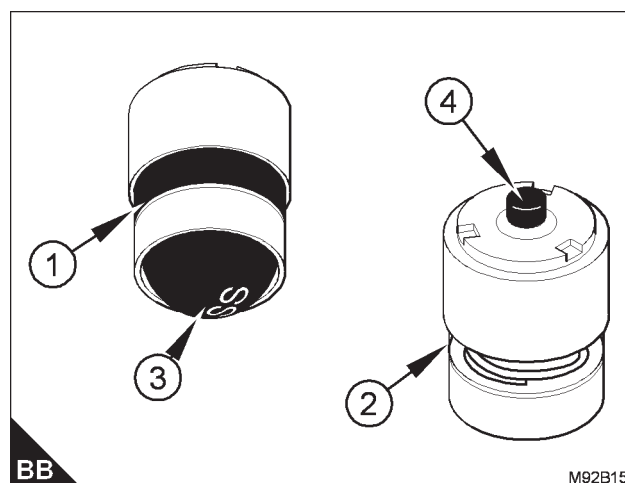


## Restriction indicator

The restriction indicator is fitted on the air filter outlet or between the air filter and the induction manifold.

When the red warning indicator (BB1) is seen through the clear panel (BB2) after the engine has stopped, the air filter element must be removed for service.

After a clean element has been fitted, press the rubber bottom (BB3) or the button (BB4) of the restriction indicator to reset the red warning indicator.



## How to check the valve tip clearances

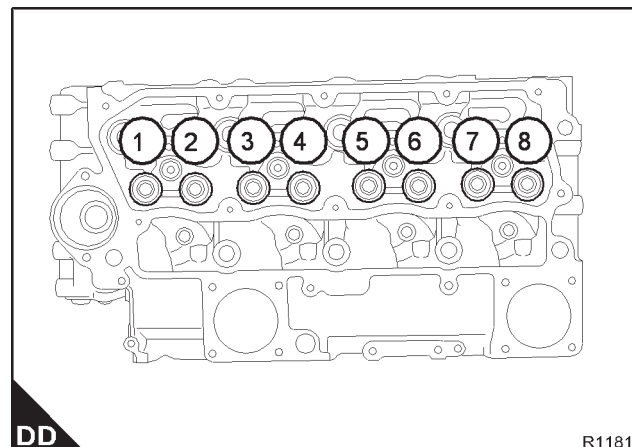
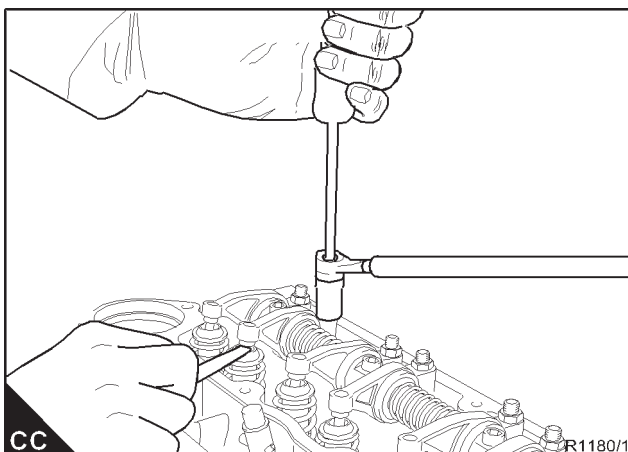
The valve tip clearances are checked between the top of the valve stem and the rocker lever (CC), with the engine cold. The correct clearance for inlet valves is 0,20 mm (0.008 in) and 0,45 mm (0.018 in) for exhaust valves. The valve positions are shown at (DD).

The sequence of valves from number 1 cylinder is shown in the table below.

**Note:** Number 1 cylinder is the furthest cylinder from the flywheel end of the engine.

1. Rotate the crankshaft in the normal direction of rotation until the inlet valve (DD7) of number 4 cylinder has just opened and the exhaust valve (DD8) of the same cylinder has not closed completely. Check the clearances of the valves (DD1 and DD2) of number 1 cylinder and adjust them, if necessary.
2. Set the valves (DD3 and DD4) of number 2 cylinder as indicated above for number 4 cylinder. Then check / adjust the clearances of the valves (DD5 and DD6) of number 3 cylinder.
3. Set the valves (DD1 and DD2) of number 1 cylinder. Then check / adjust the clearances of the valves (DD7 and DD8) of number 4 cylinder.
4. Set the valves (DD5 and DD6) of number 3 cylinder. Then check / adjust the clearances of the valves (DD3 and DD4) of number 2 cylinder.

Cylinder and valve number	1		2		3		4	
	1	2	3	4	5	6	7	8
Valve I = Inlet E = Exhaust	I	E	I	E	I	E	I	E



## Seacock strainer

The seacock strainer must be cleaned regularly, especially if there is a large amount of small debris in the water.

## Corrosion

This can occur when two different metals are in contact near to, or in, sea water. For example, a brass or bronze pipe fitted into aluminium can cause rapid corrosion. For this reason, special precautions are necessary when an engine is installed. In this situation, some components will be connected to a sacrificial anode fitted to the hull. Specialist manufacturers will advise on the maintenance of these anodes.

## Supplementary tools

A general tool kit and an on-board spares kit are available from your Perkins distributor. It is recommended that the tools and other parts, listed below, are also retained on-board:

Wire, 20 SWG (1 mm in diameter)

Insulation tape

Jointing compound

Magnet (keep this away from the compass)

Mechanical fingers

Self-gripping wrench

Suitable lagging material

Rubber olives for the low-pressure fuel system 1

A small hacksaw, with extra blades

Negative line protection fuse, rated at 80 amperes 1

1 Also available in the On-board spares kit.

## Power take-off

A power take-off is available, which is either belt driven off the crankshaft pulley, or driven axially off the crankshaft pulley, for details refer to:

### Wimborne Marine Power Centre

22 Cobham Road  
Ferndown Industrial Estate,  
Wimborne,  
Dorset BH21 7PW  
Tel: (44) (0)1202 796000  
Fax: 44) (0)1202 796001





## Engine fluids

### Fuel specification

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

Cetane number: 45 minimum

Viscosity: 2.5/4.5 centistokes at 40°C

Density: 0,835/0,855 kg/litre

Sulphur: 0.2% of mass, maximum

Distillation: 85% at 350°C

**Cetane number** indicates ignition performance. A fuel with a low cetane number can cause cold start problems and affect combustion.

**Viscosity** is the resistance to flow and engine performance can be affected if it is outside the limits.

**Density:** A lower density reduces engine power, a higher density increases engine power and exhaust smoke.

**Sulphur:** A high amount of sulphur (not normally found in Europe, North America or Australasia) can cause engine wear. Where only high sulphur fuels are available, it is necessary to use a highly alkaline lubricating oil in the engine or to renew the lubricating oil more frequently, see table below.

Fuel sulphur content (%)	Oil change interval
<0.5	Normal
0.5 to 1.0	75% of normal
>1.0	50% of normal

**Distillation:** This is an indication of the mixture of different hydrocarbons in the fuel. A high ratio of light-weight hydrocarbons can affect the combustion characteristics.

### Low temperature fuels

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

If you need advice on adjustments to an engine setting or to the lubricating oil change periods which may be necessary because of the standard of the available fuel, consult your nearest Perkins distributor or Wimborne Marine Power Centre,

## Lubricating oil specification

Use only a good quality lubricating which is not less than the specification below:

Engines should use a good quality lubricating oil to the minimum specification of:

API CG-4

API CH-4

ACEA E3

ACEA E5

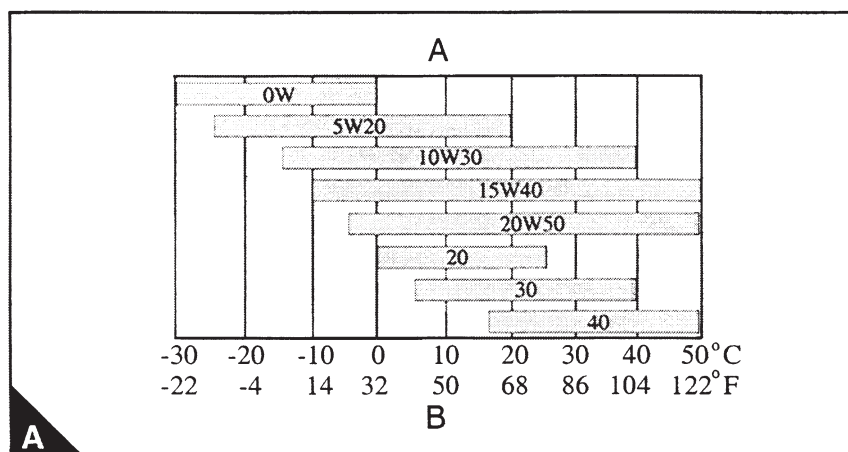
The type of lubricating oil to be used may be affected by the quality of the fuel which is available..

Always ensure that the correct viscosity grade of lubricating oil is used for the ambient temperature range in which the engine will run as shown in the chart (A).

### Viscosity chart

**A** = Recommended viscosity

**B** = Ambient temperature



## Coolant specification

The quality of the coolant which is used can have a great effect on the efficiency and life of the cooling system. The recommendations indicated below can help to maintain a good cooling system and to protect it against frost and/or corrosion.

If the correct procedures are not used, Engines Ltd cannot be held responsible for damage caused by frost or corrosion, or for loss of cooling efficiency.

The correct coolant/anti-freeze to use is 'Extended Life Coolant'.

<b>Extended Life Coolant</b>
Qty: 5 litres – Part No 60061
Qty: 25 litres – Part No 60062

The coolant mixture must be a 50/50 mix with clean water.

'Extended Life Coolant' has a service life of 6000 service hours or 6 years which ever is sooner.

'Extended Life Coolant' should not be mixed with other products.

Unlike many protective coolants, 'Extended Life Coolant' does not coat components with a protective layer to prevent corrosion. Instead it uses virtually non-depleting corrosion inhibitors.

An alternative to 'Extend Life Coolant' is Havoline (XLC) Extended Life Coolant/Anti-freeze.

**Caution:** *Using a coolant/anti-freeze which coats components with a protective layer to prevent corrosion may impair t.he efficiency of the cooling system and lead to the engine overheating.*

An anti-freeze which contains the correct inhibitor must be used at all times to prevent damage to the engine by corrosion, because of the use of aluminium in the coolant circuit.

If frost protection is not necessary, it is still extremely important to use an approved anti-freeze mixture because this gives a protection against corrosion and also raises the boiling point of the coolant.

**Note:** If combustion gases are released into the coolant circuit, the coolant must be renewed after repair of the fault.



## Fault diagnosis

## Problems and possible causes

Engine problem	Possible causes	
	Checks by the user	Checks by the workshop personnel
The starter motor turns the engine too slowly	1, 2, 3, 4	
The engine does not start	5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 17	34, 35, 36, 37, 38, 42, 43, 44
The engine is difficult to start	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19	34, 36, 37, 38, 40, 42, 43
Not enough power	8, 9, 10, 11, 12, 13, 16, 18, 19, 20, 21	34, 36, 37, 38, 39, 40, 41, 43, 63
Misfire	8, 9, 10, 12, 13, 15, 20, 22	34, 36, 37, 38, 39, 40, 41, 43
High fuel consumption	11, 13, 15, 17, 18, 19, 23, 22	34, 36, 37, 38, 39, 40, 42, 43, 44, 63
Black exhaust smoke	11, 13, 15, 17, 19, 21, 22	34, 36, 37, 38, 39, 40, 42, 43, 44, 63
Blue or white exhaust smoke	4, 15, 21, 23	36, 37, 38, 39, 42, 44, 45, 52, 58, 61, 62
The pressure of the lubricating oil system is too low	4, 24, 25, 26	46, 47, 48, 50, 51, 59,
The engine knocks	9, 13, 15, 17, 20, 22, 23	36, 37, 40, 42, 44, 46, 52, 53, 60
The engine runs erratically	8, 9, 10, 11, 12, 13, 15, 16, 18, 20, 22, 23	36, 38, 40, 41, 44, 52, 60,
Vibration	13, 18, 20, 27, 28	36, 38, 39, 40, 41, 44, 52, 54
The pressure of the lubricating oil system is too high	4, 25	49
The engine oil temperature is too high	11, 13, 15, 19, 27, 29, 30, 32, 65, 66, 67, 68	34, 36, 37, 39, 52, 55, 56, 57, 69
Crankcase pressure	31, 33	39, 42, 44, 45, 52, 61
Bad compression	11, 22	37, 39, 40, 42, 43, 44, 45, 53, 60
The engine starts and stops	10, 11, 12	

Reverse gearbox problem	Possible causes	
	Checks by the user	Checks by the workshop personnel
Delay of gear engagement <sup>(1)</sup>	70, 71	
No transmission	72	75
The boat does not reach maximum speed <sup>(2)</sup>	73, 74	75, 76, 77

(1) Propeller rotates only after a delay of several seconds or only after engine speed is increased.

(2) Temperature of the reverse gearbox is high.

**List of possible causes**

1. Battery capacity low.
2. Bad electrical connections.
3. Fault in starter motor.
4. Wrong grade of lubricating oil.
5. Starter motor turns engine too slowly.
6. Fuel tank empty.
7. Fault in stop solenoid, contacts or cables.
8. Restriction in a fuel pipe.
9. Fault in fuel lift pump.
10. Dirty fuel filter element.
11. Restriction in air induction system.
12. Air in fuel system.
13. Faulty atomisers or atomisers of an incorrect type.
14. Cold start system used incorrectly.
15. Fault in cold start system.
16. Restriction in fuel tank vent.
17. Wrong type or grade of fuel used.
18. Restricted movement of engine speed control.
19. Restriction in exhaust pipe.
20. Engine temperature is too high.
21. Engine temperature is too low.
22. Incorrect valve tip clearances.
23. Too much oil or oil of wrong type is used in wet type air cleaner, if one is fitted.
24. Not enough lubricating oil in sump.
25. Defective gauge.
26. Dirty lubricating oil filter element.
27. Fan damaged.
28. Fault in engine mounting or flywheel housing.
29. Too much lubricating oil in sump.
30. Restriction in air or water passages.
31. Restriction in breather pipe.
32. Insufficient coolant in system.
33. Vacuum pipe leaks or fault in exhauster.
34. Fault in fuel injection pump.
35. Broken drive on fuel injection pump.
36. Timing of fuel injection pump is incorrect.
37. Valve timing is incorrect.
38. Bad compression.
39. Cylinder head gasket leaks.
40. Valves are not free.
41. Wrong high-pressure pipes fitted.
42. Worn cylinder bores.
43. Leakage between valves and seats.
44. Piston rings are not free or they are worn or broken.
45. Valve stems and/or guides are worn.

46. Crankshaft bearings are worn or damaged.
47. Lubricating oil pump is worn.
48. Relief valve does not close.
49. Relief valve does not open.
50. Relief valve spring is broken.
51. Fault in suction pipe of lubricating oil pump.
52. Piston is damaged.
53. Piston height is incorrect.
54. Flywheel housing or flywheel is not aligned correctly.
55. Fault in thermostat or thermostat is of an incorrect type.
56. Restriction in coolant passages.
57. Fault in water pump.
58. Valve stem seal is damaged.
59. Restriction in sump strainer.
60. Valve spring is broken.
61. Breather assembly worn or broken.
62. Vent hole for breather valve is restricted.
63. Leakage in the induction system.
64. Spare.
65. Drive belt for water pump is loose.
66. Restriction in the sea cock or the raw water strainer.
67. Insufficient coolant in circuit.
68. Restriction in the heat exchanger or the oil cooler.
69. Fault in raw water pump.
70. Movement of control lever of reverse gearbox is not equal in both directions.
71. Insufficient movement of control cable for reverse gearbox.
72. Control cable for reverse gearbox is not free, radii are too small or cable is broken.
73. Wrong type of lubricating oil in reverse gearbox.
74. A lubricating oil cooler is needed for the reverse gearbox for conditions of operation.
75. Worn or broken drive components.
76. Incorrect size of propeller or not correctly matched.
77. Propeller damaged





## Engine preservation

### Introduction

The recommendations indicated below are designed to prevent damage to the engine when it is withdrawn from service for a prolonged period. Use these procedures after the engine is withdrawn from service. The instructions for the use of POWERPART products are given on the outside of each container.

### Procedure

1. Completely clean the outside of the engine.
2. When a preservative fuel is to be used, drain the fuel system and fill it with the preservative fuel. POWERPART Lay-Up 1 can be added to the normal fuel to change it to a preservative fuel. If preservative fuel is not used, the system can be completely filled with normal fuel but the fuel must be drained and discarded at the end of the storage period together with the fuel filter canister.
3. Operate the engine until it is warm. Then correct leakages of fuel, lubricating oil or air. Stop the engine and drain the lubricating oil from the sump.
4. Renew the canister of the lubricating oil filter.
5. Fill the sump to the full mark with new and clean lubricating oil and add POWERPART Lay-up 2 to the oil to protect the engine against corrosion. If POWERPART Lay-Up 2 is not available, use a correct preservative fluid instead of the lubricating oil. If a preservative fluid is used, this must be drained and the lubricating oil sump must be filled to the correct level with normal lubricating oil at the end of the storage period.
6. Drain the coolant circuit. In order to protect the cooling system against corrosion, fill it with an approved antifreeze mixture because this gives protection against corrosion.  
**Caution:** *If protection against frost is not necessary and a corrosion inhibitor is to be used, it is recommended that you consult the Service Department, Wimborne Marine Power Centre*
7. Operate the engine for a short period in order to circulate the lubricating oil and the coolant in the engine.
8. Close the seacock and drain the raw water cooling system.  
**Caution:** *The raw water system cannot be drained completely. If the system is drained for engine preservation purposes or for protection from frost, the system must be filled again with an approved antifreeze mixture.*
9. Remove the impeller from the raw water pump and put the impeller in a dark place for storage. Before the impeller is fitted at the end of the storage period, lubricate lightly the blades and each end of the impeller and the inside of the pump with Spheerol SX2 grease or glycerine.  
**Caution:** *The raw water pump must never run in a dry condition because this can damage the impeller blades.*
10. Remove the atomisers and spray POWERPART Lay-Up 2 for one to two seconds into each cylinder bore with the piston at BDC.
11. Slowly turn the crankshaft one revolution and then fit the atomisers, complete with new seat washers.
12. Spray POWERPART Lay-Up 2 into the induction manifold. Seal the manifold and breather outlet with waterproof tape.
13. Remove the exhaust pipe. Spray POWERPART Lay-Up 2 into the exhaust manifold. Seal the manifold with waterproof tape.
14. Disconnect the battery. Then put the battery into safe storage in a fully charged condition. Before the battery is put into storage, protect its terminals against corrosion. POWERPART Lay-Up 3 can be used on the terminals.
15. Seal the vent pipe of the fuel tank or the fuel filler cap with waterproof tape.
16. Remove the alternator drive belt and put it into storage.

17. In order to prevent corrosion, spray the engine with POWERPART Lay-Up 3. Do not spray the area inside the alternator cooling fan.

18. If the transmission is not to be used for at least a year, fill the reverse gearbox completely with its normal lubricating oil. This will have to be drained and the normal amount of new lubricating oil added when the engine is returned to service.

**Caution:** *After a period in storage, but before the engine is started, operate the starter motor with the stop solenoid disconnected until oil pressure is indicated. Oil pressure is indicated when the low pressure warning light is extinguished. Connect the stop solenoid.*

If the engine protection is done correctly according to the above recommendations, no corrosion damage will normally occur. Perkins or Wimborne Marine Power Centre are not responsible for damage which may occur when an engine is in storage after a period in service.

### How to add antifreeze to the raw water system for engine preservation purposes

Before antifreeze is added to the raw water system the system should be flushed out with fresh water. To do this operate the engine for one to two minutes with the seacock closed and with a supply of fresh water through the open top of the raw water strainer.

1. Obtain two empty, clean containers each with a capacity of approximately 9,0 litres (2 UK gallons) 9.6 US quarts. Also obtain 4,5 litre (1 UK gallon) 5 US quarts of POWERPART antifreeze.
2. Remove the hose from the raw water connection on the exhaust elbow and put the end of the hose into one of the containers.
3. Remove the cover from the top of the raw water strainer, and with the seacock closed, add some antifreeze through the open top of the raw water strainer. Start the engine and run the engine at idle speed, then continue to add the remainder of the antifreeze through the open top of the strainer.
4. Operate the engine for several minutes. During this period, change the containers around, pour the antifreeze/water solution from the container at the outlet (hose end) into the strainer.
5. When the antifreeze is mixed thoroughly and has been circulated through the raw water system, stop the engine. Fit the top of the raw water strainer.
6. Connect the hose to the raw water connection on the exhaust elbow.
7. Put a label on the engine to make the operator aware that antifreeze is in the raw water system and must be drained before the seacock is opened and the engine operated.

## Parts and service

### Introduction

If problems occur with your engine or with the components fitted onto it, your Perkins distributor can make the necessary repairs and will ensure that only the correct parts are fitted and that the work is done correctly.

### Service literature

Workshop manuals, installation drawings and other service publications are available from your Perkins distributor at a nominal cost.

### Training

Local training for the correct operation, service and overhaul of engines is available at certain Perkins distributors. If special training is necessary, your Perkins distributor can advise you how to obtain it at the Wimborne Marine Power Centre, Wimborne, Dorset.

### On-board spares kit

The contents of this kit has been carefully prepared to ensure that it is correct for the original engine specification and the owner's / operator's needs.

### POWERPART recommended consumable products

Perkins have made available the products recommended below in order to assist in the correct operation, service and maintenance of your engine and your machine. The instructions for the use of each product are given on the outside of each container. These products are available from your Perkins distributor.

#### POWERPART Antifreeze

Protects the cooling system against frost and corrosion.

#### POWERPART Easy Flush

Cleans the cooling system. Part number 21825001.

#### POWERPART Gasket and flange sealant

To seal flat faces of components where no joint is used. Especially suitable for aluminium components. Part number 21820518.

#### POWERPART Gasket remover

An aerosol for the removal of sealants and adhesives. Part number 21820116.

#### POWERPART Griptite

To improve the grip of worn tools and fasteners. Part number 21820129.

#### POWERPART Hydraulic threadseal

To retain and seal pipe connections with fine threads. Especially suitable for hydraulic and pneumatic systems. Part number 21820121.

#### POWERPART Industrial grade super glue

Instant adhesive designed for metals, plastics and rubbers. Part number 21820125.

**POWERPART Lay-Up 1**

A diesel fuel additive for protection against corrosion. Part number 1772204.

**POWERPART Lay-Up 2**

Protects the inside of the engine and of other closed systems. Part number 1762811.

**POWERPART Lay-Up 3**

Protects outside metal parts. Part number 1734115.

**POWERPART Metal repair putty**

Designed for external repair of metal and plastic. Part number 21820126.

**POWERPART Pipe sealant and sealant primer**

To retain and seal pipe connections with coarse threads. Pressure systems can be used immediately. Part number 21820122.

**POWERPART Radiator stop leak**

For the repair of radiator leaks. Part number 21820127.

**POWERPART Retainer (high strength)**

To retain components which have an interference fit. Currently Loctite 638. Part number 21820638.

**POWERPART Safety cleaner**

General cleaner in an aerosol container. Part number 21820128.

**POWERPART Silicone adhesive**

An RTV silicone adhesive for application where low pressure tests occur before the adhesive sets. Used for sealing flange where oil resistance is needed and movement of the joint occurs. Part number 21826038.

**POWERPART Silicone RTV sealing and jointing compound**

Silicone rubber sealant which prevents leakage through gaps. Currently Hylosil. Part number 1861108.

**POWERPART Stud and bearing lock**

To provide a heavy duty seal to components that have a light interference fit. Part number 21820119 or 21820120.

**POWERPART Threadlock and nutlock**

To retain small fasteners where easy removal is necessary. Part number 21820117 or 21820118.

**POWERPART Universal jointing compound**

Universal jointing compound which seals joints. Currently Hylomar. Part number 1861117.

## General data

**Engine**

Number of cylinders.....	4
Cylinder arrangement.....	In line
Cycle.....	Four stroke
Induction system.....	Naturally aspirated
Combustion system.....	Direct injection
Nominal bore.....	105,00 mm (4.13 in)
Stroke.....	127,0 mm (5.00 in)
Compression ratio.....	18.23:1
Cubic capacity.....	4,4 litres (269.00 in <sup>3</sup> )
Firing order.....	1, 3, 4, 2
Valve tip clearances (hot or cold)	
Inlet.....	0,20 mm (0.008 in)
Exhaust.....	0,45 mm (0.018 in)
Lubricating oil pressure (max engine speed and normal engine temperature).....	a minimum of 207 kPa (30 lbf/in <sup>2</sup> ) 2,1 kgf/cm <sup>2</sup>
Capacity of a typical lubricating oil system: <sup>(1)</sup>	
- includes oil filter.....	8,5 litres (15 pints)
- sump only.....	7 litres (12.3 pints)
Typical coolant capacity (engine only).....	8,75 litres (15.4 pints)
Direction of rotation.....	Clockwise from the front
Battery:	
12V system.....	One 12V, 520A to BS3911
24V system.....	Two 12V, 440A to BS3911
Weight of the M92B engine (wet).....	423 kg (933 lb)
Weight of the engine with a PRM 500D reverse gearbox.....	504 kg (1111 lb)
Weight of the engine with a ZF 45 A reverse gearbox.....	460 kg (1014 lb)

(1) The sump capacity will vary according to the installation angle. Do not exceed the "Full" mark on the dipstick.

**Reverse gearbox**

## Newage PRM 500D

- Lubricating oil capacity <sup>(1)</sup> .....	2,5 litre (4.40 pints)
- Lubricating oil specification.....	Engine lubricating oil API CD or ACEA E2

## ZF 45 A

- Lubricating oil capacity <sup>(1)</sup> .....	2,0 litre (3.52 pints)
- Lubricating oil specification.....	ATF oil

(1) The reverse gearbox capacity will vary according to the installation angle of the transmission. The oil capacity given does not include the oil cooler or the pipes for the oil cooler.



**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.



**Perkins®**  
**Marine Power**

All information in this document is substantially correct at time of printing and may be altered subsequently.

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