Part No 35943

GB

Perkins®

User's Handbook

700GM

Perkins®

THE HEART OF EVERY GREAT MACHINE

Perkins 700GM
Marine Engine

User's handbook

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General information

Introduction

The 700GM marine engines for on-board generating sets and other auxiliary power units are the latest developments from the business arrangement between Perkins Engines Ltd and Wimborne Marine Power Centre.

Wimborne Marine Power Centre are the managers of the Perkins marine business and all enquires should be made to Wimborne Marine Power Centre; refer to the company address list on page 5.

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.

To ensure that you use the relevant information for your specific engine type, refer to “Engine identification” on page 4.

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 "Preventive 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 Wimborne Marine Power Centre, see page 5.

The "left side" and "right side" of the engine apply when the engine is seen from the flywheel 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 refer 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 in 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 in 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.
- Keep away from moving parts during engine operation. Warning! Some moving parts cannot be seen clearly while the engine runs.
- 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.
- Do not allow sparks or fire near the battery (especially when the battery is on charge) because the gases from the electrolyte are highly flammable. The battery fluid is dangerous to the skin and especially to the eyes.
- 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 and coolant in accordance with local regulations to prevent contamination.
- 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.
- The latest marine engines have a cover fitted to give some protection from the alternator fan and the drive belt. Ensure that this cover is fitted before the engine is started.
- Fit only genuine Perkins parts.

Engine guarantee

If a claim under guarantee is necessary, the 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, refer to the company address list on page 5.

Engine identification

Identification letters GUA

Identification plates

There are two engine identification numbers. One is for the complete marine engine and is stamped on a plate (A) at the rear of the right side of the cylinder block. The other is for the basic engine and is shown on a label (B1) fitted to the front of the timing case.

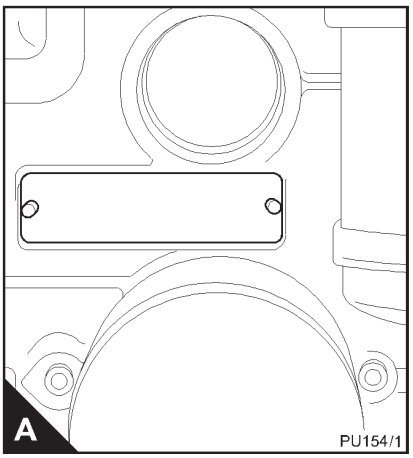
An example of an engine number is: GUA30413U123456F.

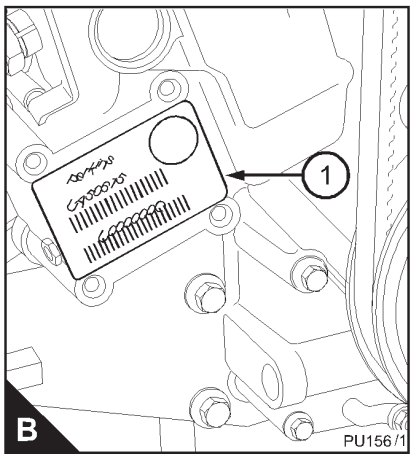
The components of the engine number are as follows:

GUA30413U123456F

GUA	Type code letters
30413	Build list number
U	Built in the UK
123456	Engine serial number
F	Year of manufacture

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





Perkins main dealers

Australia

Allight Pty Ltd (Sydney Office),
41 York Road,
Ingleburn, NSW 2565, Australia.
Telephone: [61](2) 9765 6800
Fax: [61](2) 9765 6899
Email: valcenteno@allight.com
www.alight.com

France

Secodi,
Rue de la Scierie
17000 LA ROCHELLE,
France.
Telephone: [33] (5) 4645 1313
Fax: [33](5) 46 41 83 26
Email: secodilr@secodi.fr
www.secodi.fr

Germany

BU Power Systems GmbH & Co. KG,
Perkinsstraße 1,
49479 Ibbenbüren,
Germany.
Telephone: [49] 5451 5040-0
Fax: [49] 5451 5040-100
Email: service@bu-perkinssabre.de
www.bu-power-systems.de

Italy

Scan Diesel s.r.l.,
Via Coloredo,14,
28069 TRECATE (NO)
Italy.
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Fax: [39] (0321) 777959
Email: info@scandiesel.it
www.scandiesel.it

Japan

Perkins Engines, Inc.,
Sanno Grand Bldg, 8th Floor,
2-14-2 Nagatacho, Chiyoda-ku,
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Telephone: [81] (3) 5157 0571
Fax: Fax: [81] (3) 5157 0572

Singapore

Multico Power Drive Pte Ltd
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Singapore 637643
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Fax: [65] 6 863 6819
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www.multicorporation.net

United Kingdom

Perkins Engines Company Ltd,
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Telex: 32501 Perken G
Fax: 0044 (0) 1733 582240
www.perkins.com

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Perkins Pacific Inc.,
7215 South 228th Street,
Kent, Washington
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USA
Telephone: [1](253) 854 0505
Fax: [1](253) 850 2631
www.pacificdda.com

Perkins Power Corp,
55 Industrial Loop North,
Orange Park,
Florida 32073
U.S.A.
Telephone: [1](904) 278 9919
Fax: [1](904) 278 8088
www.perkinspower.com

The managers of the marine business for Perkins are:

Wimborne Marine Power Centre

Ferndown Industrial Estate
Wimborne
Dorset
BH21 7PW
England
Telephone: 0040 (0) 1202 796000
Fax: 0040 (0) 1202 796001
www.perkins.com/marine.

*This is just a small selection of Perkins dealers. For a more comprehensive list, please see www.perkins.com/marine.

Engine views

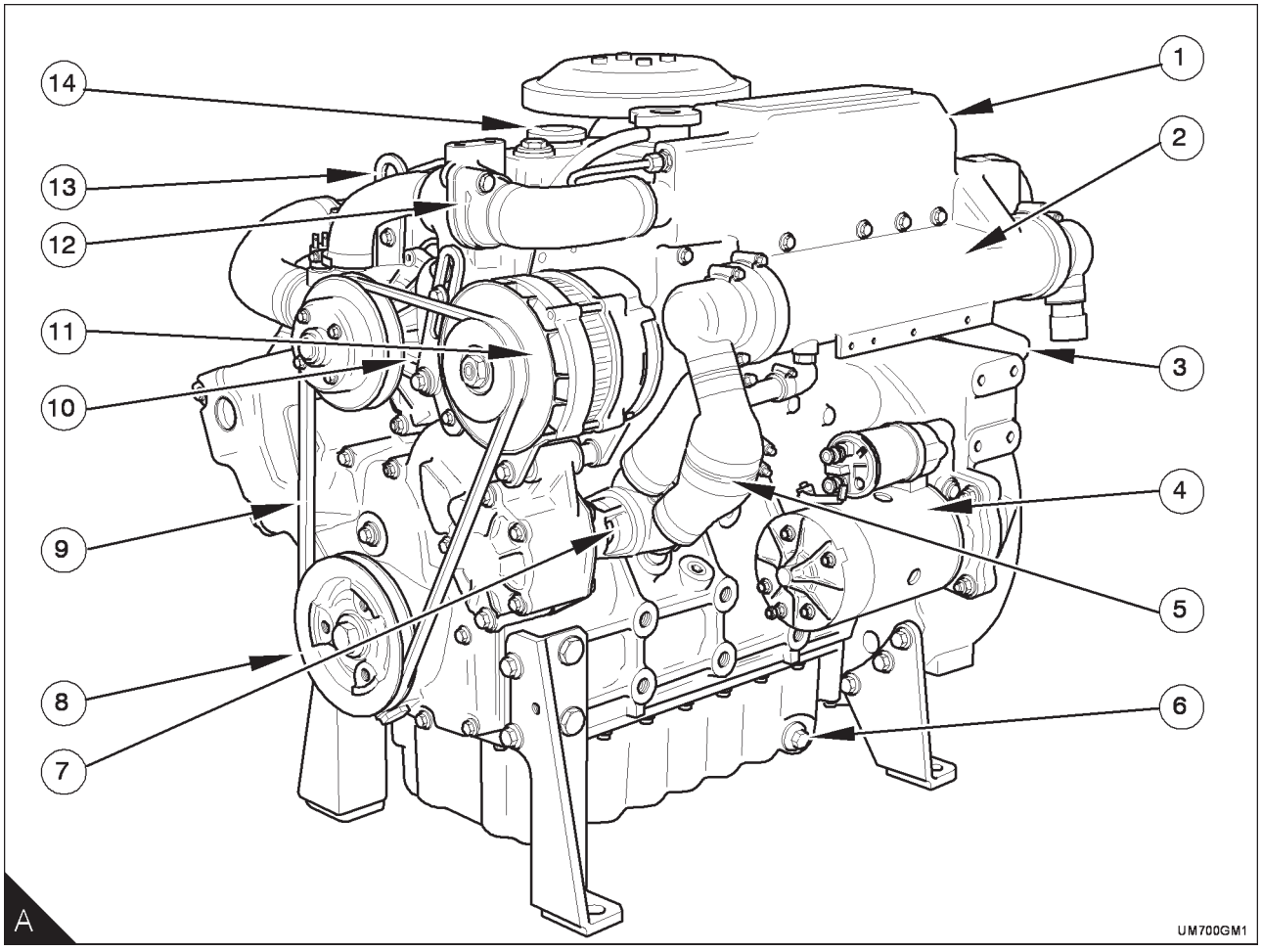
Introduction

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

Location of engine parts

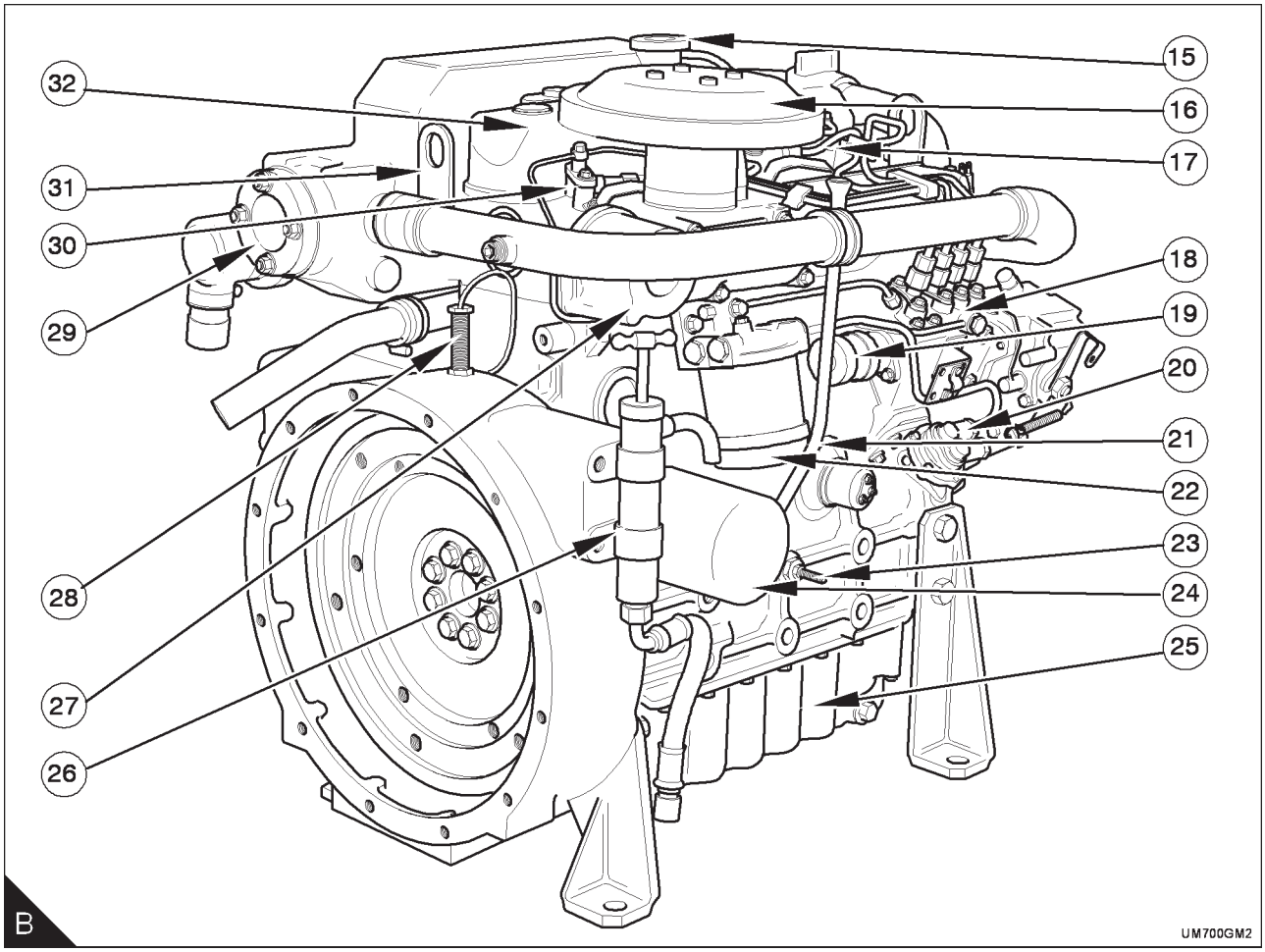
Front and left side view (A)

1. Coolant header tank / cooled exhaust manifold
2. Heat exchanger
3. Connection for the raw water inlet
4. Starter motor
5. Strainer
6. Sump drain plug
7. Raw water pump
8. Crankshaft pulley
9. Drive belt
10. Coolant pump
11. Alternator
12. Thermostat housing
13. Front lift bracket
14. Filler cap for the lubricating oil



Rear and right side view (B)

15.Filler cap for coolant circuit
16.Air filter
17.Atomiser
18.Fuel injection pump
19.Electric actuator
20.Fuel lift pump
21.Lubricating oil dipstick
22.Canister for the fuel filter
23.Ground connection for the engine
24.Lubricating oil filter canister
25.Lubricating oil sump
26.Drain pump for the engine lubricating oil
27.Induction manifold
28.Speed sensor
29.Cooled exhaust outlet
30.Glow plug
31.Rear lift bracket
32.Rocker cover



How to start the engine

Several factors affect engine start, for example:

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

Diesel engines need a cold starting aid if they are to start in very cold conditions. The cold start aid fitted to these engines are glow plugs, which are fitted into the combustion chamber of each cylinder and are connected electrically. These engines will start without the aid to temperatures of -10^{O}C (13^{O}F). However, 10 seconds of pre-heat gives a smooth start at temperatures colder than -10^{O}C (13^{O}F).

Preparations for an engine start

1. Ensure that there is more than enough fuel available 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.

How to start a cold engine with the fuelled starting aid
Note: Use this method when the cylinder head temperatures are below approximately 0°C (32°F).

1. Switch on the electrical system.
2. Hold the heat switch in the down position for 15 seconds. Press the start button to engage the starter motor. When the engine starts, release the heat switch. The engine will run up to the set speed, 1500 or 1800 rev/min.
3. If the engine does not start in 15 seconds, hold the heat switch down for 10 seconds and engage the starter motor again. When the engine has started, release the heat switch. 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: *Ether type starting aids must not be used at the same time as the fuelled starting aid.*

How to start a warm engine
1. Switch on the electrical system.
2. Press the start button to engage the starter motor. When the engine starts it will run up to the set speed, 1500 or 1800 rev/min. 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 stop the engine

1. Remove the load from the engine and allow the engine to cool for 2-3 minutes.
2. Switch the engine stop switch to the stop position, refer to the users' handbook of the application manufacturer.

Adjustment of the engine speed range

The idle or the maximum speed settings must not be changed by the engine operator, because this can damage the engine or generator. 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).

The engine will benefit if the load is applied as soon as possible after the engine is put into service.

Cautions:

- Do not operate the engine at high speeds without a load.
- Do not overload the engine.

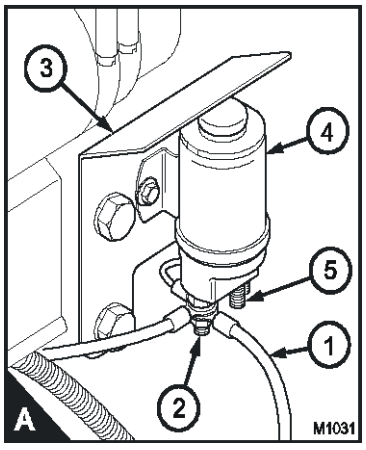
Relay for an insulated negative earth

Note: This relay is available from Wimborne Marine Power Centre as an option.

The battery negative cable (A1) connects to the stud (A2) on the negative earth relay (A4). This grounds the electrics to earth, through terminal (A5) connected through the mounting bracket (A3), while starting the engine or operating glow plugs, if they are fitted.

Angle of operation

The 700GM can operate at 25^{o} contiuous or 35^{o} intermittent in all directions.



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.

Schedules

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

A First service at 25/50 hours
B Every day or every 8 hours
C Every 500 hours or 12 months
D Every 1000 hours
E Every 2000 hours
F Every 3000 hours

A	B	C	D	E	F	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 (2) (3)
●		●				Check the tension and the condition of the drive belt
		●				Check the impeller of the raw water pump
		●				Check the strainer at the raw water pump outlet
	●					Check the sea water strainer
●	●					Drain water from the fuel pre-filter (1)
		●				Renew the element / canister of the fuel filter
					●	Check the atomisers, always renew the clamps (2)
	●					Check the amount of lubricating oil in the sump
	●					Check the lubricating oil pressure at the gauge
		●				Renew the engine lubricating oil (4)
		●				Renew the canister of the lubricating oil filter
			●			Remove and clean the pipe(s) for the engine breather
				●		Renew the engine breather (2)
		●				Clean or renew the element of the air filter
			●			Check all hoses and connections
●			●			Check the valve tip clearances of the engine, and adjust if necessary (2)
		●				Check the audible warning system which protects the engine
			●			Check the alternator, the starter motor etc.(2)
		●				Check the glow plugs (2)

(1)If one is fitted.

(2)By a person who has had the correct training.

(3)Renew the coolant every 6 years. If a coolant inhibitor is used instead of coolant, it should be renewed every 6 months.

(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.

Note: To ensure that the engine runs at maximum efficiency, the operations that follow must be done every 12 months or less. If the raw water is excessively contaminated, these operations should be done more frequently.

- Clean the tube stack of the heat exchanger for the closed circuit coolant

How to drain the coolant circuit

Warnings!

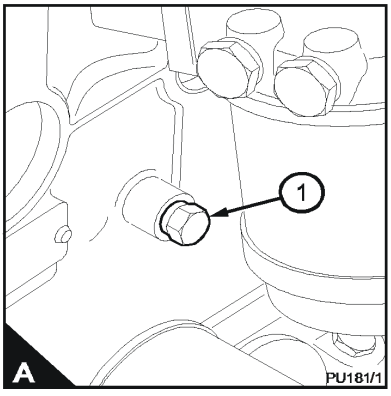
- *Do not drain the coolant while the engine is still hot and the system is under pressure because dangerous hot coolant can be discharged.*
- *Discard used coolant in a safe place and in accordance with local regulations.*

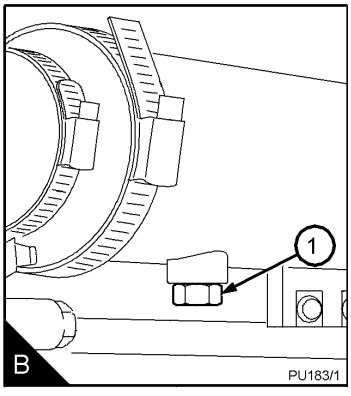
1. Remove the filler cap of the coolant circuit.
2. Remove the drain plug (A1) from the cylinder block and the drain plug (B1) from the heat exchanger. Ensure that the drain holes are not restricted.
3. After the system has been drained, fit the filler cap and the drain plugs.
4. Fasten a label in a 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 coolant 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 through 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 coolant mixture and check the readings on both instruments. Compare the readings with the chart (A).

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.

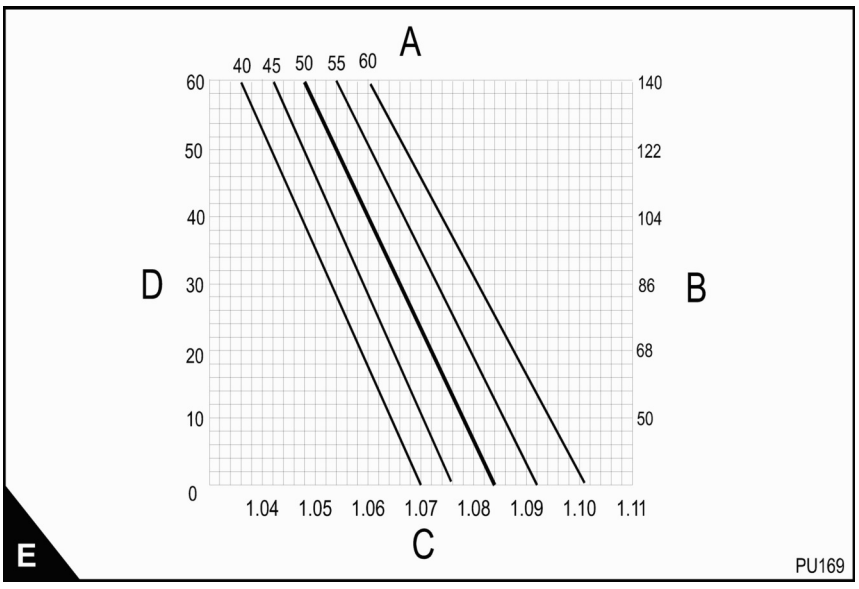
A coolant to water ratio of 50:50 should be used even in warm ambient temperatures, in order to maintain the concentration of the corrosion inhibitor in the coolant.

Specific gravity chart
A = Percentage coolant by volume

B = Mixture temperature in Fahrenheit

C = Specific gravity

D = Mixture temperature in Celsius.

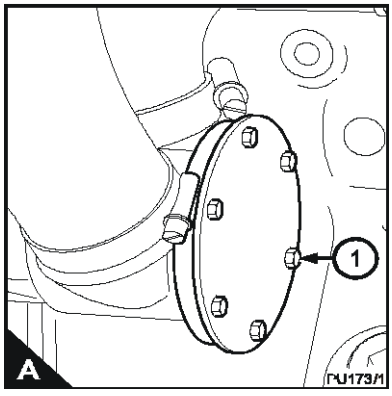


How to drain the raw water system

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 coolant 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 coolant to the raw water system for engine preservation purposes.*

1. Ensure that the seacock is closed.
2. Loosen the six setscrews (A1) of the cover for the raw water pump.
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.

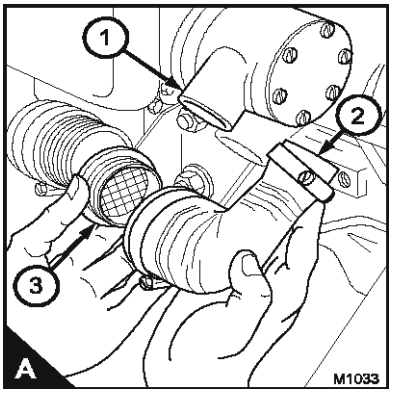
Caution: *When the raw water system is to be used again, ensure that the seacock is open.*



How to clean the strainer for the raw water pump

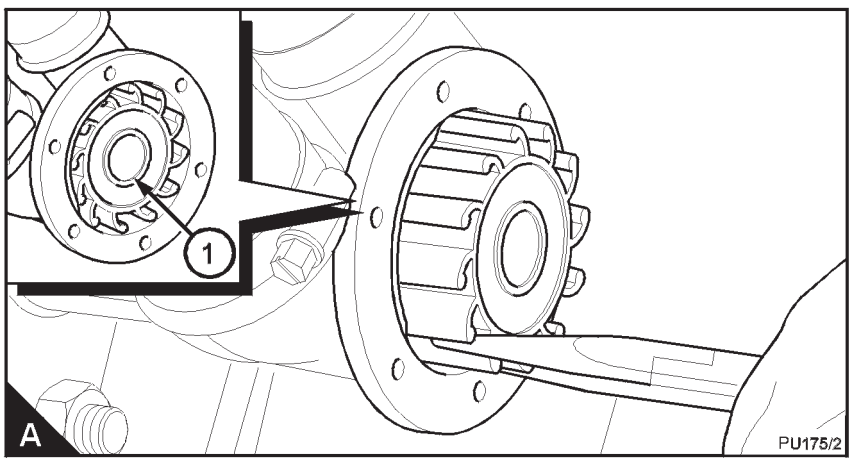
The strainer for the raw water pump is fitted in the outlet hose for the raw water pump. The purpose of the strainer is to protect the engine heat exchanger from debris.

1. Ensure that the sea cock is closed.
2. Release the hose clip at the connection (A1) of the raw water pump and on each side of the strainer (A3). Remove the hose (A2). This illustration shows a typical example.
3. Remove the strainer and wash it in clean water. If there is debris in the strainer from the impeller of the raw water pump, check the impeller, see page 19.
4. Put the strainer into position and fit the hose. Tighten the hose clips.
5. Open the sea cock.



How to check the impeller of the raw water pump

1. Ensure that the seacock is closed.
2. Release the six setscrews (A1 page 17) 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 (A1) 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, check the strainer for the raw water pump, see page 18.
6. 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 (A). Fit the rubber end cap.
7. Apply jointing compound 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.
8. Open the seacock.



How to check the drive belt

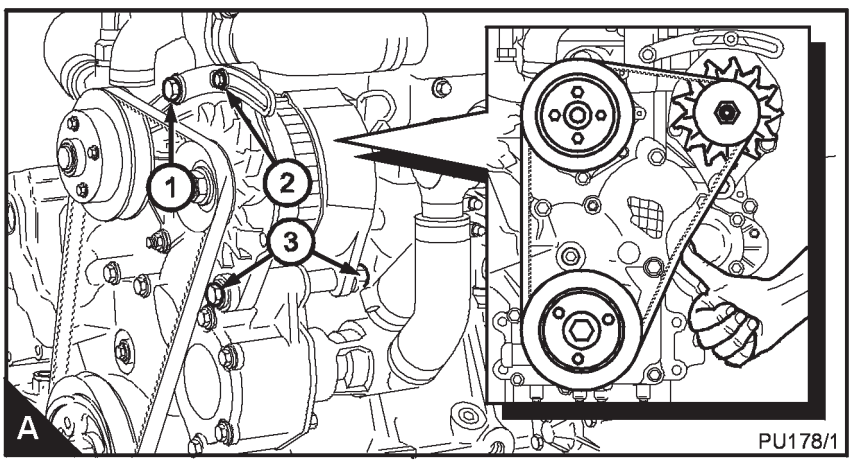
Press down the belt with the thumb at the centre of the longest free length and check the deflection (A). With moderate thumb pressure - 45N (10 lbf) 4,5 kgf - the correct deflection of the belt is 10 mm (3/8 in).

How to adjust the belt tension

Cautions:

- *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.*
- *Do not loosen the setscrew (A1). If this setscrew is loosened, the thermostat housing to cylinder head seal could be broken and result in a leakage of coolant.*

1. Loosen the pivot fasteners (A3) of the alternator and loosen the setscrew (A2) 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 element and fuel 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.
2. Put the filter assembly within a plastic bag; the bag should fit loosely over the filter to retain spilt fuel. Hold the bottom cover of the filter element and release the setscrew (A1) which is fitted through the filter head above the centre of the element.
3. Lower the bottom cover (A6) and the filter element (A4).
4. Remove the element from the bag and discard it in accordance with local regulations. Remove the bottom cover from the bag and discard safely the bag and any spilt fuel.
5. Clean the inside surfaces of the filter head and the cover.
6. Renew the seals (A2) and (A5) and the 'O' ring (A3) and lightly lubricate them with clean fuel.
7. Put the bottom cover under the new element and hold the element squarely to the filter head. Ensure that the element is fitted in the centre against the 'O' ring in the filter head. With the assembly in this position, engage and tighten the setscrew.
8. Eliminate the air from the fuel filter, see page 23.

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.

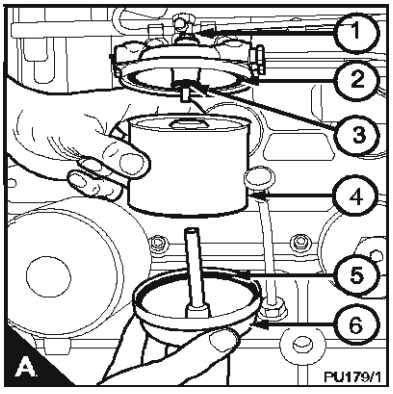
Atomiser fault

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.*

An atomiser fault can cause an engine misfire.

In order to find which atomiser is defective, operate the engine at a fast idle speed. Loosen and tighten the union nut of the high-pressure fuel pipe at each atomiser. When the union nut of the defective atomiser is loosened, it has little or no effect on the engine speed.



How to renew an atomiser

Cautions:

- *A new clamp (A5) must be used every time an atomiser is fitted to the engine.*
- *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.*
- *Use a separate spanner to prevent movement of the outlets of the fuel injection pump when the high-pressure pipes are released or tightened.*
- *When the atomiser is fitted into the cylinder head, ensure that the sharp edges do not damage the "O" ring.*

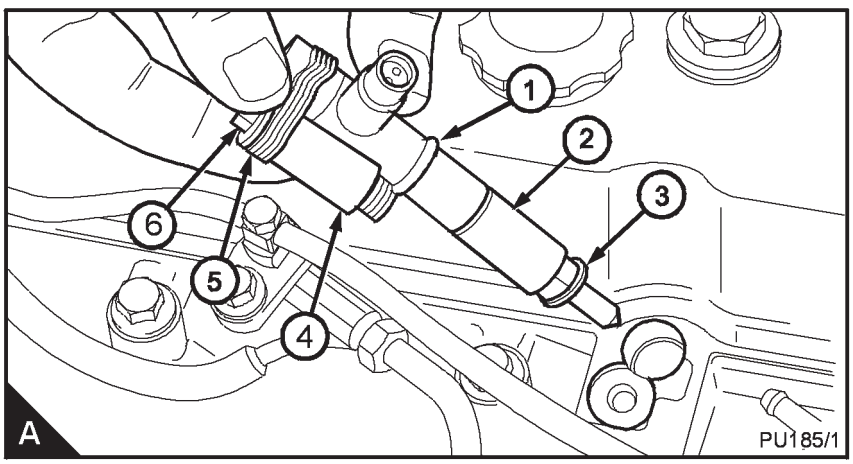
Note: Identification letters for the atomiser are shown on the nozzle holder (A2).

1. Clean thoroughly the area around the atomiser to be removed.
2. Remove the fuel leak-off pipe.
3. Remove the union nuts of the high-pressure pipe from the atomiser and from the fuel injection pump. Do not bend the pipe. If necessary, remove the pipe clamps.
4. Remove the setscrew (A6) of the atomiser clamp and remove the clamp (A5), the spacer (A4), the atomiser and its seat washer (A3).
5. Put the new atomiser in position together with a new seat washer and a new 'O' ring (A1). Fit the atomiser into the cylinder head with a new clamp, the spacer, and engage the screw. Ensure that the atomiser is not tilted and tighten the setscrew to 22 Nm (16 lbf ft) 2,2 kgf m.

Cautions:

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

6. Fit the high-pressure fuel pipe and tighten the union nuts to 27 Nm (20 lbf ft) 2,8 kgf m. If necessary, fit the pipe clamps.
7. Renew the sealing washers and fit the leak-off pipe. Tighten the banjo bolts to 9 Nm (7 lbf ft) 0,9 kgf m.
8. Eliminate air from the fuel system, see page 23.
9. Operate the engine and check for leakage of fuel and air.



How to eliminate air from the fuel system

Caution: *When air is to be eliminated from the fuel system, only use the starter motor to start the engine after air has been eliminated from the low-pressure side of the fuel system.*

If air enters the fuel system, it must be eliminated before the engine can be started.

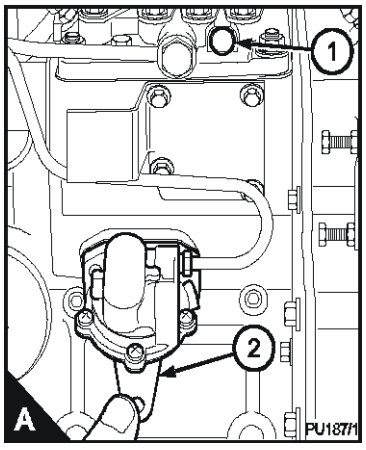
Air can enter the system if:

- The fuel tank is drained during normal operation.
- The low-pressure fuel pipes are disconnected.
- A part of the low-pressure fuel system leaks during engine operation.

In order to eliminate air from the fuel system, proceed as follows:

Caution: *Do not allow fuel from the engine to contaminate the engine compartment. Put a drip tray under the engine and discard old fuel in accordance with local instructions.*

1. Loosen the vent plug (A1) on the side of the fuel injection pump.
2. Operate the priming lever (A2) of the fuel lift pump until fuel, free from air, comes from the vent point. Tighten the vent plug.
3. Switch on the electrical system from the control panel.
4. Operate the starter motor for intervals of 15 seconds until the engine starts. It is important to allow the electrical components to cool for 30 seconds between each 15 second interval of operation. If the engine runs correctly for a short time and then stops or runs roughly, check for air in the fuel system. If there is air in the fuel system, there is probably a leakage in the low pressure system. Stop the engine and switch off the electrical system. Check for air leaks.



How to renew the lubricating oil

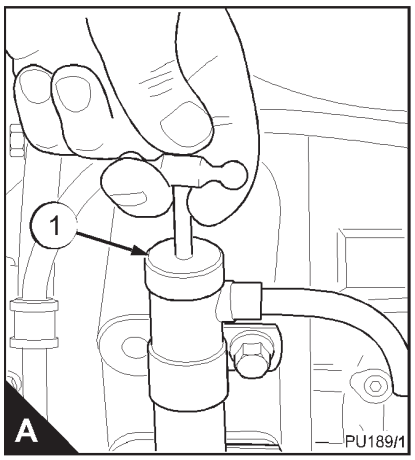
Warning! *Discard the used lubricating oil in a safe place and in accordance with local regulations.*

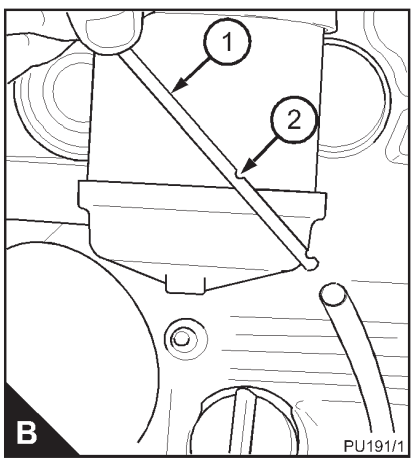
Note: Renew the filter canister when the lubricating oil is renewed.

1. Connect a suitable hose to the outlet of the sump drain pump (A1).
2. Put the free end of the hose into a suitable container with a capacity of approximately 10 litres (17.5 pints).
3. Use the drain pump to empty the sump. If possible, the lubricating oil should be drained while it is still hot.
4. When the sump is empty, remove the container of used lubricating oil.
5. 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 (B2) on the dipstick (B1) as this can have an adverse affect on on the performance of the engine. Excess lubricating oil must be drained from the sump.*

6. Add slowly, approximately 9 litres (16 pints) of new and clean lubricating oil of an approved specification to the engine, see page 32. Allow the oil enough time to pass to the sump, remove the dipstick (B1) and ensure that the lubricating oil is to the full mark (B2). The oil level must not be above the full mark. If it is, the engine could be damaged.
7. Fit the filler cap and ensure that the dipstick is fitted correctly in the dipstick tube.
8. 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.





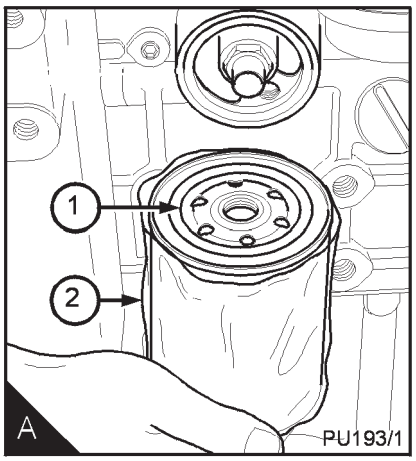
How to renew the canister of the lubricating oil filter

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. Put a plastic bag (A2) over the filter canister; the bag should fit loosely over the filter to retain spilt oil. Remove and discard safely the canister and the plastic bag that will contain the spilt oil.
3. Lubricate the seal (A1) on top of the canister with clean engine lubricating oil.
4. 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.
5. 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.

Cautions:

- *Do not fill the sump past the notch (B2 page 24) on the dipstick.*
- *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.*

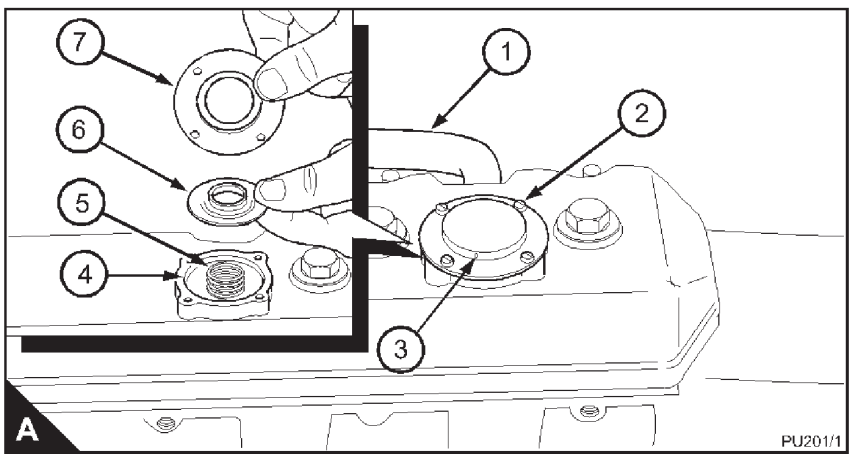


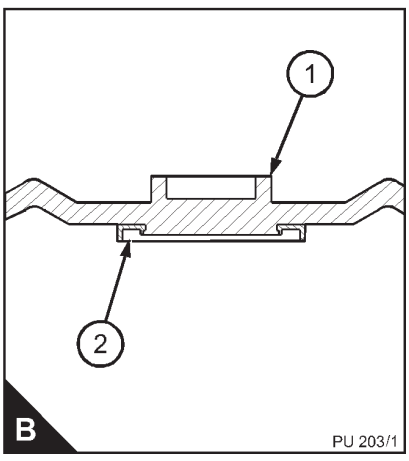
How to renew the engine breather assembly

Cautions:

- It is important that the area around the vent hole (A3) is kept clean and the vent hole is not restricted.
- Ensure that the pipe (A1) does not contact other components as this may cause the failure of the pipe.
- Ensure that the components of the breather assembly are fitted in their correct positions (A). If they are fitted incorrectly, the engine can be damaged.

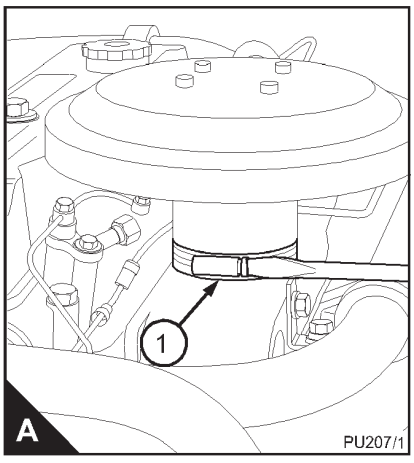
1. Remove the rocker cover.
2. Release the four setscrews (A2) and remove the breather cover (A7).
3. Remove the diaphragm and location ring assembly (A6). Remove the spring (A5).
4. Release the clips that retain the breather pipe and remove the breather pipe (A1).
5. Clean the breather cavity (A4) in the rocker cover, the passage through the rocker cover, the breather pipe and the vent hole (A3). Ensure that they are not restricted.
6. Fit a new spring into the cavity in the rocker cover.
7. Fit a new location ring (B2) onto the new diaphragm (B1) and fit this assembly onto the spring. Ensure that the location ring is on the spring (A5).
8. Fit the breather cover, fit and tighten the four setscrews.
9. Fit the breather pipe and tighten the clips.
10. Fit the rocker cover and tighten the cap nuts to 11 Nm (8 lbf ft) 1,1 kgf m.

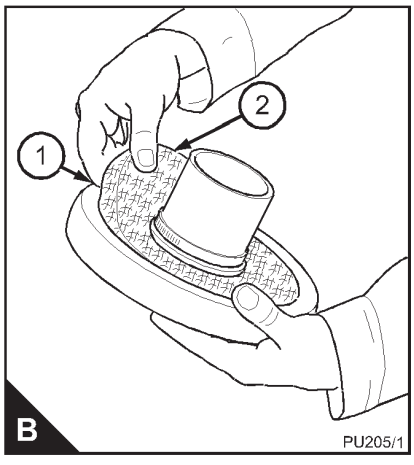




How to renew the element of the air filter

1. Release the hose clip (A1) and remove the air filter assembly.
2. Remove the filter element (B2) from inside the filter assembly (B1).
3. Fit a new filter element and fit the filter assembly to the engine.
4. Tighten the hose clip.





How to set the valve tip clearances

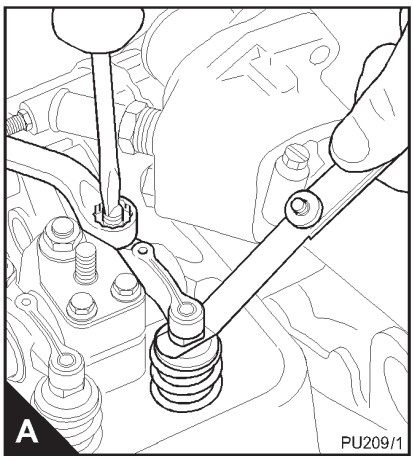
Notes:

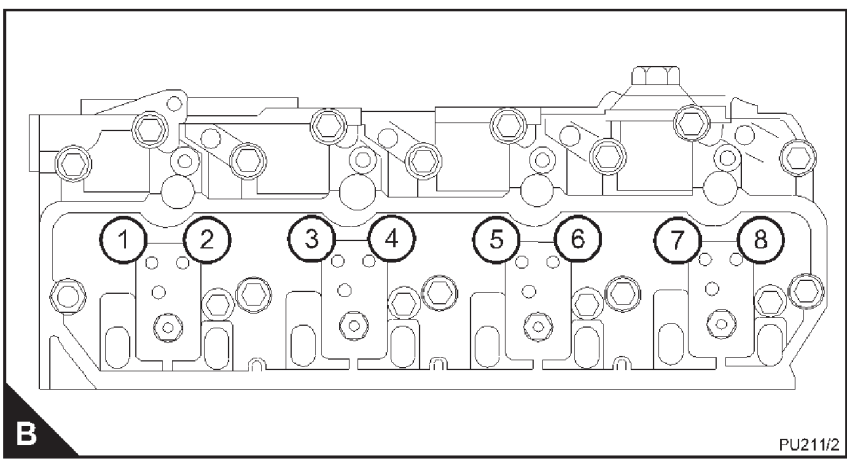
- The valve tip clearance is checked with a feeler gauge between the top of the valve stem and the rocker lever (A), with the engine cold. The correct clearance for both the inlet and the exhaust valves is 0,35 mm (0.014 in).
- The arrangement of the valves is shown in (B). Valve numbers (B1) and (B2) are for number 1 cylinder which is at the front of the engine.
- Clockwise rotation is when seen from the front of the engine.

1. Disconnect the breather pipe from the rocker cover and remove the three cap nuts, steel washers and rubber seals. Lift off the rocker cover.
2. Rotate the crankshaft in a clockwise direction until the valve (B7) has just opened and the valve (B8) has not closed completely. Check the clearances of the valves (B1) and (B2) and adjust them, if necessary.
3. Rotate the crankshaft in a clockwise direction until the valve (B3) has just opened and the valve (B4) has not closed completely. Check the clearances of the valves (B5) and (B6) and adjust them, if necessary.
4. Rotate the crankshaft in a clockwise direction until the valve (B1) has just opened and the valve (B2) has not closed completely. Check the clearances of the valves (B7) and (B8) and adjust them, if necessary.
5. Rotate the crankshaft in a clockwise direction until the valve (B5) has just opened and the valve (B6) has not closed completely. Check the clearances of the valves (B3) and (B4) and adjust them, if necessary.

Caution: *If the outer cap nuts for the rocker cover are overtightened, the stud and plate assembly for the rocker pedestal may be damaged.*

6. Fit the rocker cover. Ensure that the cap nuts, washers and the rubber seals are fitted correctly. Tighten the cap nuts to 11 Nm (8 lbf ft) 1,1 kgf m. Fit the breather pipe.





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

Start circuit fuse, rated at 40 amperes [1]

Heat circuit fuse, rated at 40 amperes [1]

Panel circuit fuse, rated at 10 amperes [1]

Negative line protection fuse, rated at 10 amperes [1]

Fast fuse, rated at 85 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

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 the 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, see page 5.

Aviation kerosene fuels

These fuels are not approved for use in this engine.

Lubricating oil specification

Use only a good quality lubricating oil that is not less than the specification API CC or ACEA E1. API CD or ACEA E2 can be used, but is not recommended during the first 25 to 50 hours nor for light load applications.

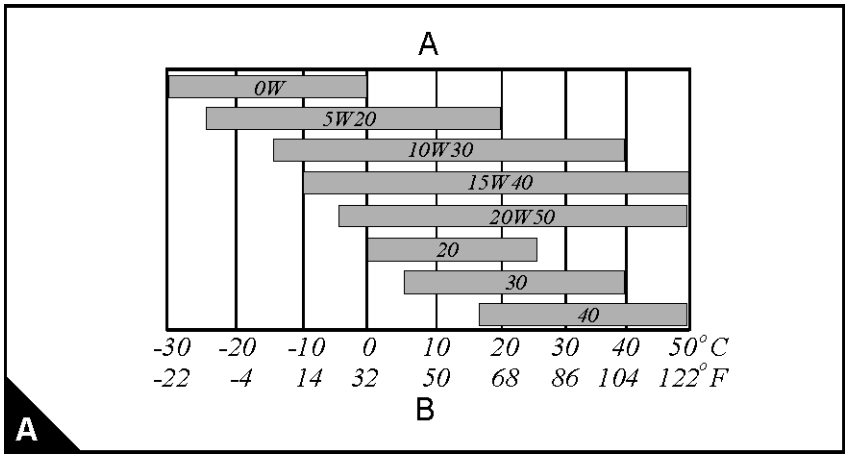
Caution: *The type of lubricating oil to be used may be affected by the quality of the fuel which is available. For further details, see "Fuel specification" on page 31.*

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’.

Extended Life Coolant
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.

Using a coolant/anti-freeze which coats components with a protective layer to prevent corrosion may impair the 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 coolant/antifreeze mixture because this gives a protection against corrosion and also raises the boiling point of the coolant.

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

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
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, 70
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, 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, 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	

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. Not used.
28. Fault in engine mounting or flywheel housing.
29. Too much lubricating oil in sump.
30. Restriction in the water passages of the heat exchanger.
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. Propeller damaged.
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. Restriction in the exhaust system

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, see page 15. In order to protect the cooling system against corrosion, fill it with an approved coolant mixture because this gives protection against corrosion, see page 38.

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, see page 5.*

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 coolant mixture, see page 38.*

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 bottom of its stroke.
11. Slowly turn the crankshaft one revolution and then fit the atomisers, complete with new seat washers and clamps.
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.

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.*

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

How to add coolant to the raw water system for engine preservation purposes

Before coolant 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 coolant.
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 coolant 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 coolant through the open top of the strainer.
4. Operate the engine for several minutes. During this period, change the containers around, pour the coolant/water solution from the container at the outlet (hose end) into the strainer.
5. When the coolant 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.

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 Coolant
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....97,0 mm (3.82 in)
Stroke....100,0 mm (3.94 in)
Compression ratio....17.5:1
Cubic capacity....2,9 litres (183 in^3)
Firing order....1, 3, 4, 2
Valve tip clearances (cold)....0,35 mm (0.014 in)
Lubricating oil pressure (maximum engine speed and normal engine temperature)....420 kPa (61 lbf/in2) 4,3 kgf/cm^2
Capacity of a typical lubricating oil system: (1)
- includes oil filter....9,4 litres (16.5 pints)
- sump only....9 litres (15.8 pints)

Typical coolant capacity (engine only):....8,75 litres (15.4 pints
Direction of rotation....Clockwise from the front
Battery....One 12V, 540A SAE or 340A IEC
Weight of the engine (wet):....277 kg (611 lb)

(1)The capacity of the sump will vary according to the installation angle. Fill to the “Full” mark on the dipstick. Do not exceed the “Full” mark, see “Caution” on page 24.

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

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