

User's Handbook

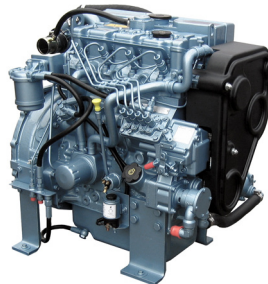
415GM



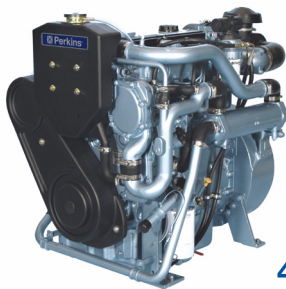
422GM



422TGM



4.4GM



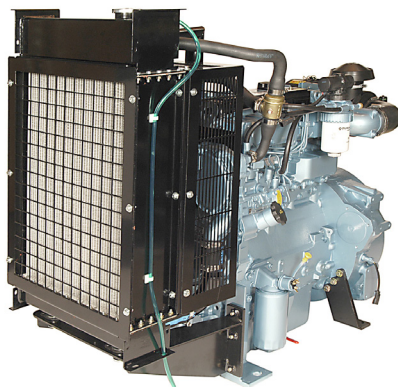
4.4TGM



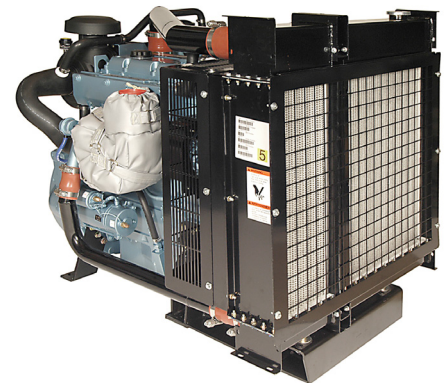
4.4TWGM &
4.4TW2GM



4.4GM & 4.4TGM
Radiator



4.4TWGM & 4.4TW2GM
Radiator



Perkins

415GM

422GM

422TGM

4.4GM

4.4TGM

4.4TWGM

4.4TW2GM

4.4GM Radiator

4.4TGM Radiator

4.4TWGM Radiator

4.4TW2GM Radiator

User's Handbook

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General information

Introduction

These 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.

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".

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.

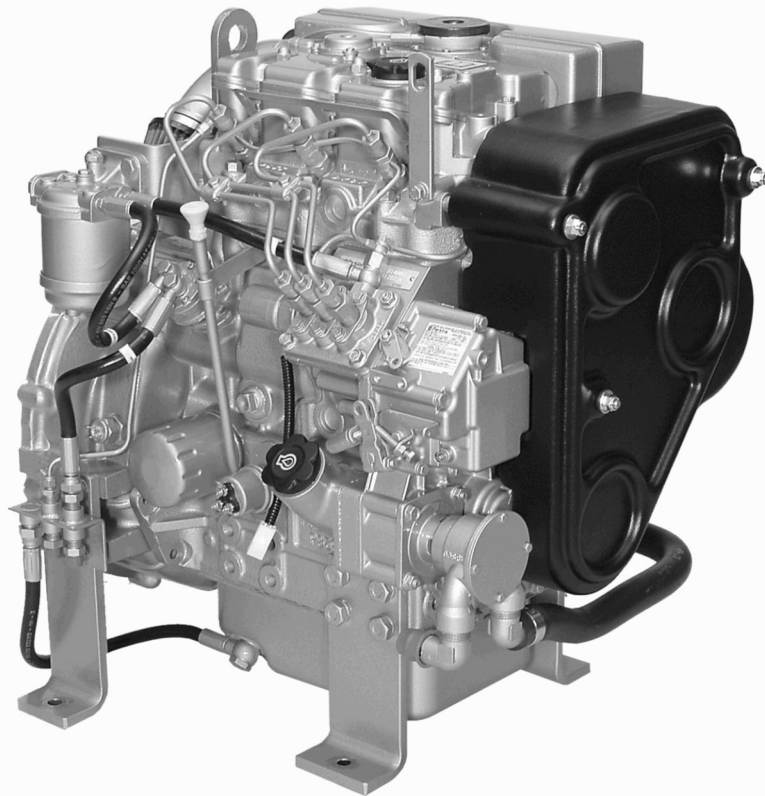
This handbook has been written to assist you to maintain and operate your engine correctly.

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,.

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

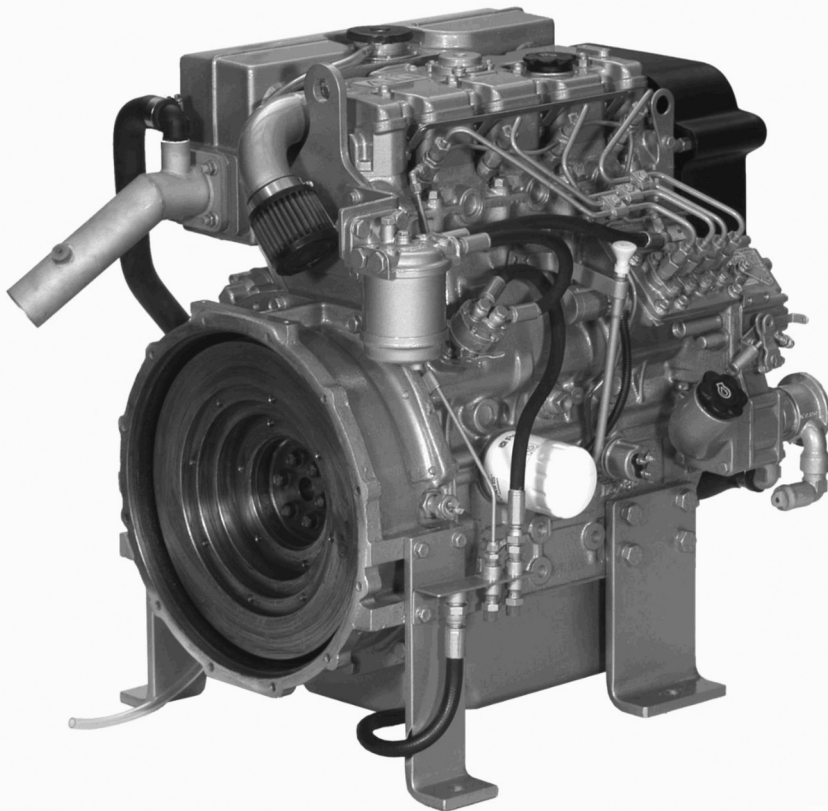
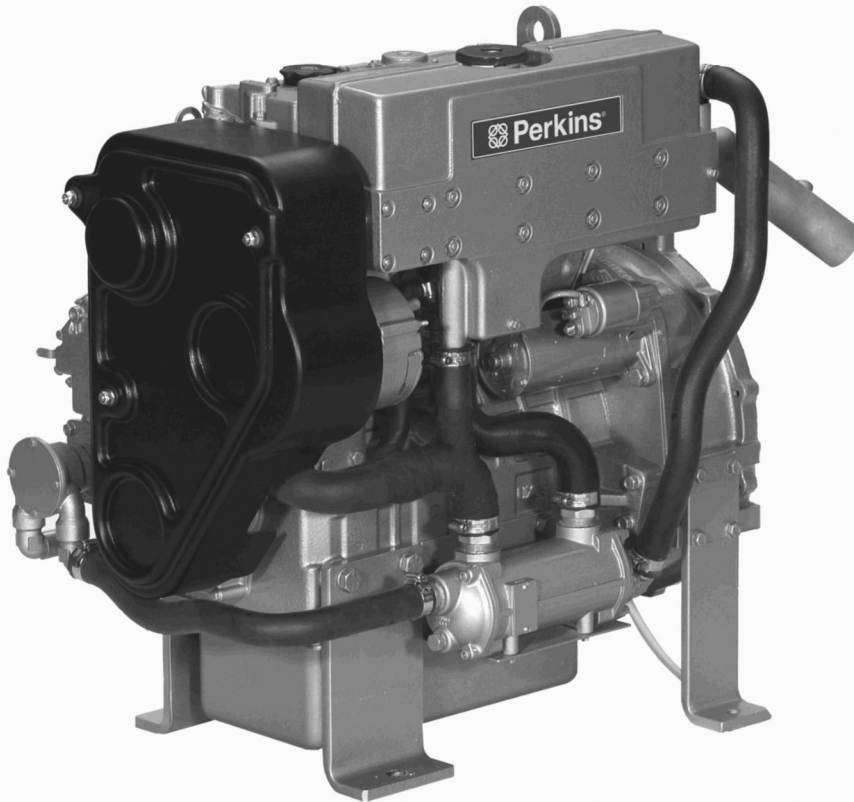
415GM



A

415GM52

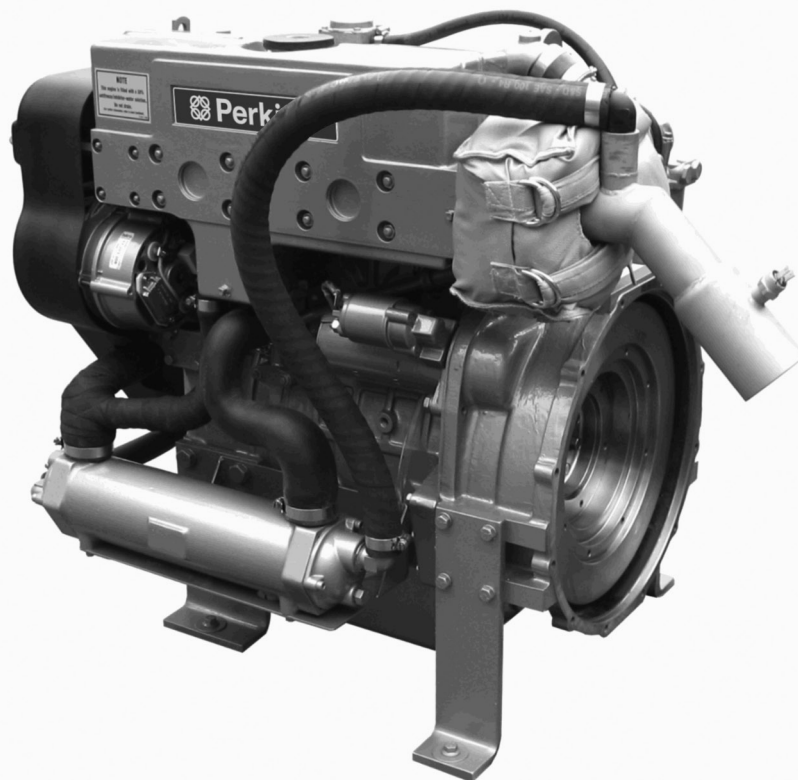
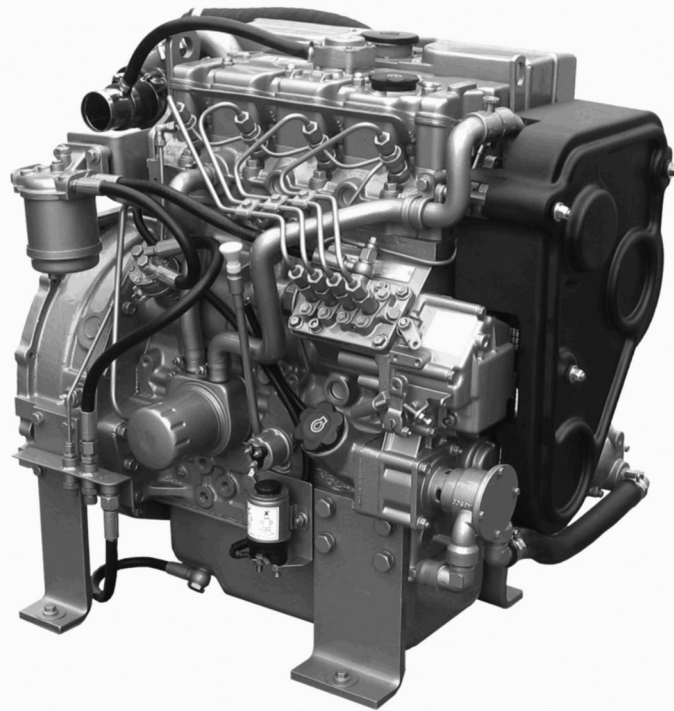
422GM



B

422GM53

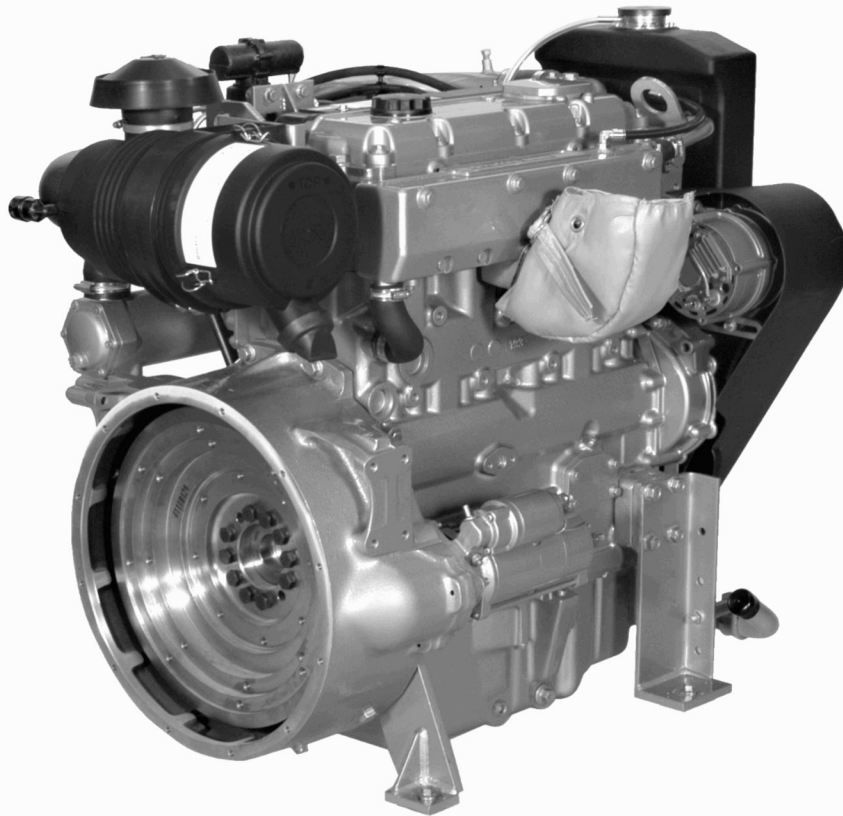
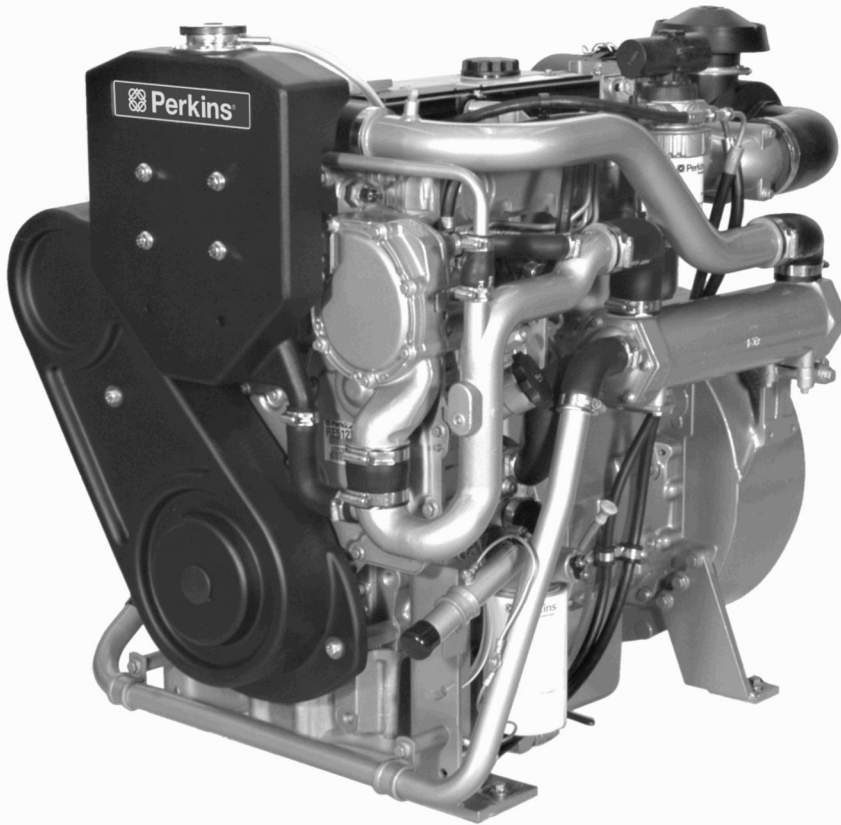
422TGM



C

422TGM54

4.4GM



D

4.401

4.4TGM



E

4.402

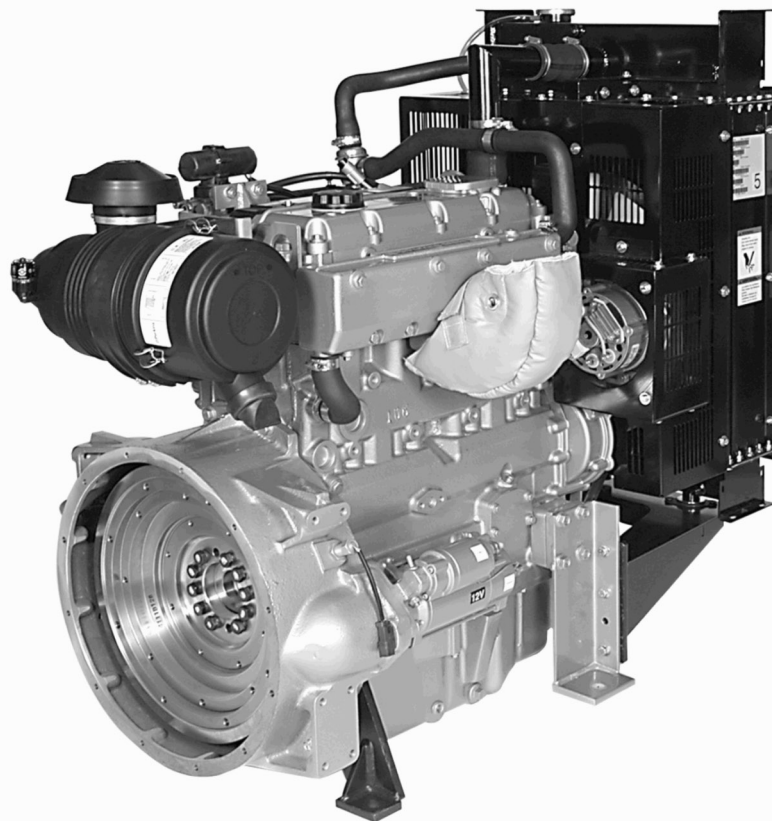
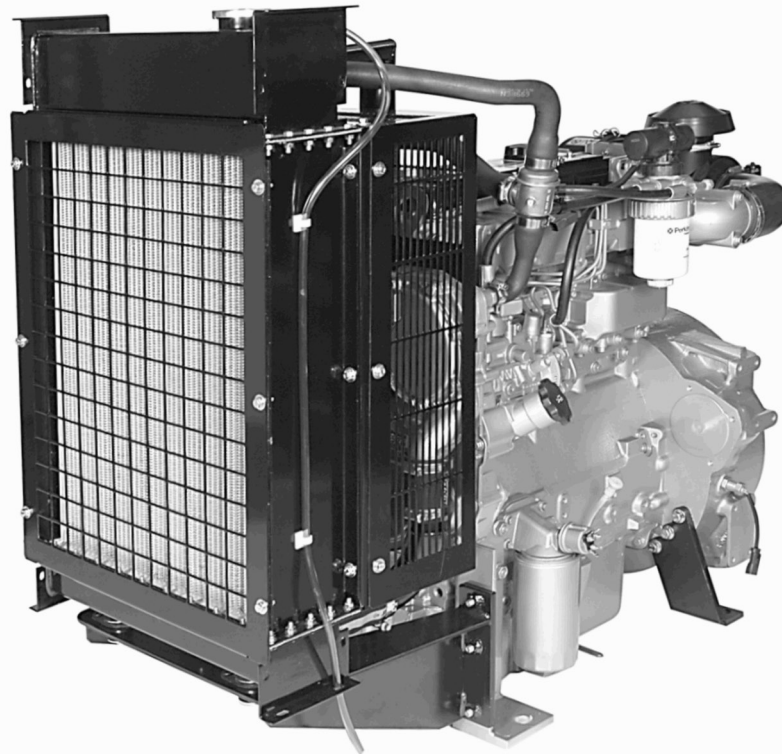
4.4TWGM & 4.4TW2GM



F

4.403

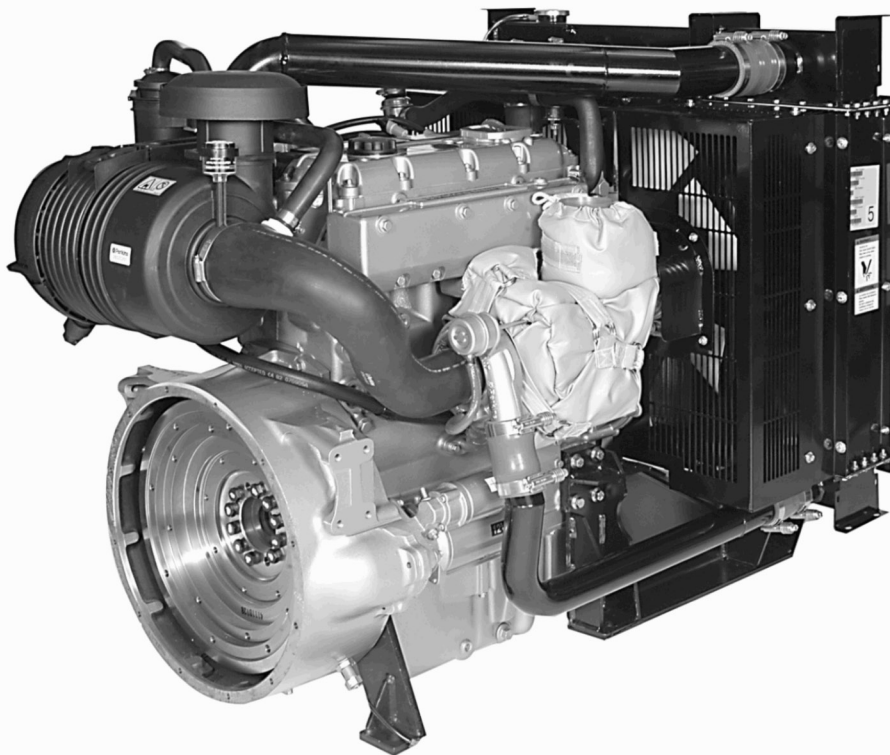
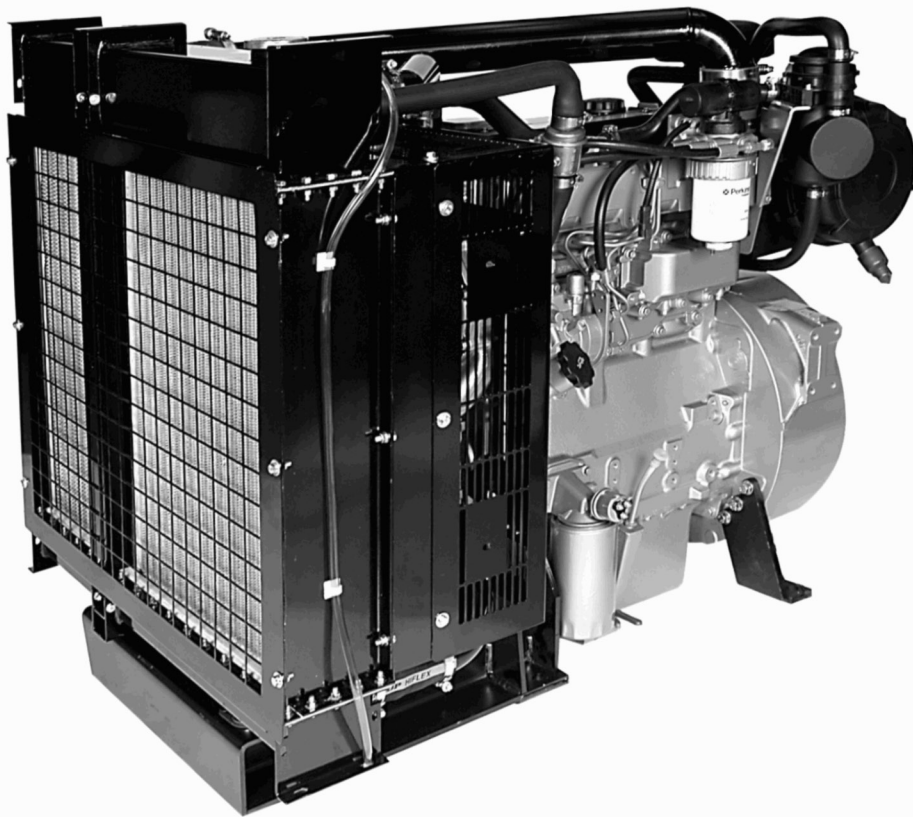
4.4GM & 4.4TGM Radiator
(4.4GM is shown - 4.4TGM is similar)



G

4.4R42

4.4TWGM & 4.4TW2GM Radiator



H

4.4R43

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 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.

Engine identification

- 415GM - identification letters HL
- 422GM - identification letters HP
- 422TGM - identification letters HR
- 4.4GM - identification letters RE
- 4.4TGM - identification letters RG
- 4.4TWGM - identification letters RJ
- 4.4TW2GM - identification letters RJ
- 4.4GM Radiator - identification letters RE
- 4.4TGM Radiator - identification letters RG
- 4.4TWGM Radiator - identification letters RJ
- 4.4TW2GM Radiator - identification letters RJ

The engine identification number is shown at two locations on the engine:

Models 415GM, 422GM and 422TGM: stamped on a plate (I1) at the front right side of the cylinder block under the fuel injection pipes. The other is shown on a label (I2) fitted to the top of the timing case.

Models 4.4GM, 4.4TGM, 4.4TWGM and 4.4TW2GM: stamped on a plate at the right side of the cylinder block (J1) and shown on a label (K1) fitted to the front of the timing case.

Models 4.4GM rad, 4.4TGM rad, 4.4TWGM rad and 4.4TW2GM rad: stamped on a plate at the right side of the cylinder block (L1) and shown on a label (M1) fitted to the front of the timing case.

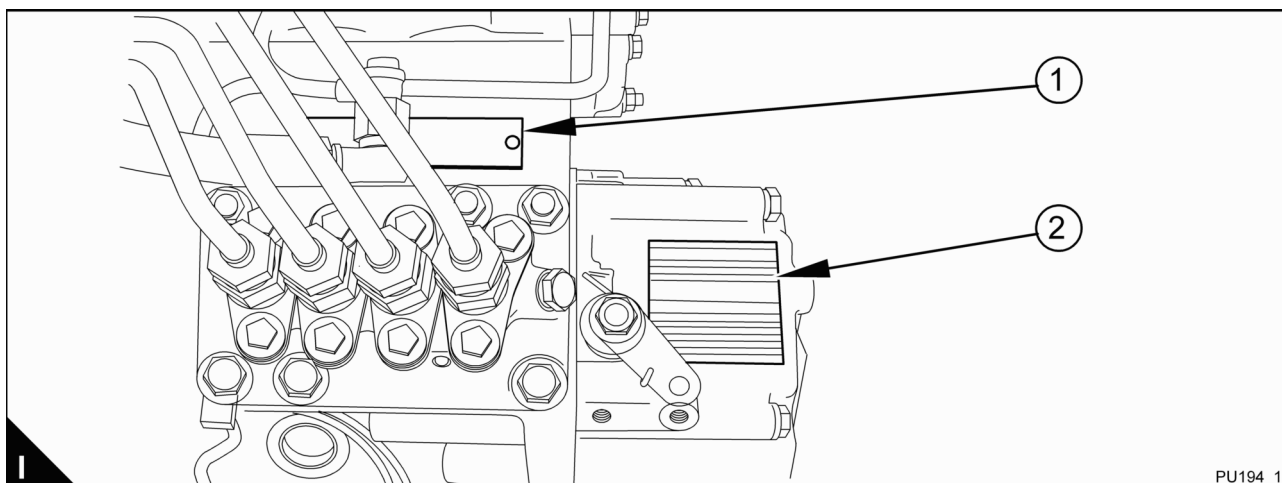
An example of a 4.4TGM Radiator engine number is: RG30879U123456L.

The components of the engine number are as follows:

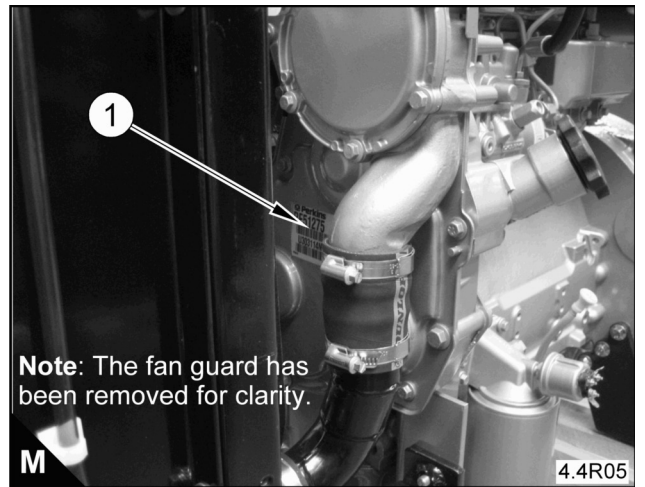
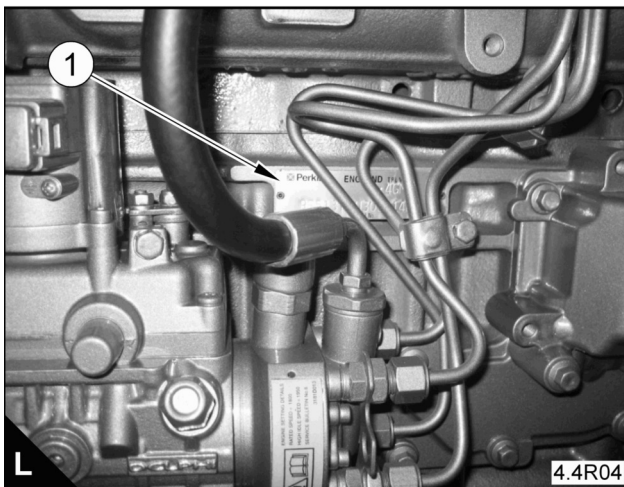
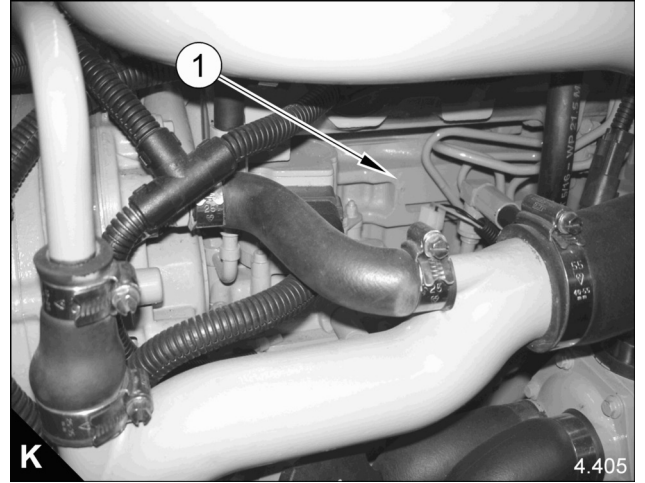
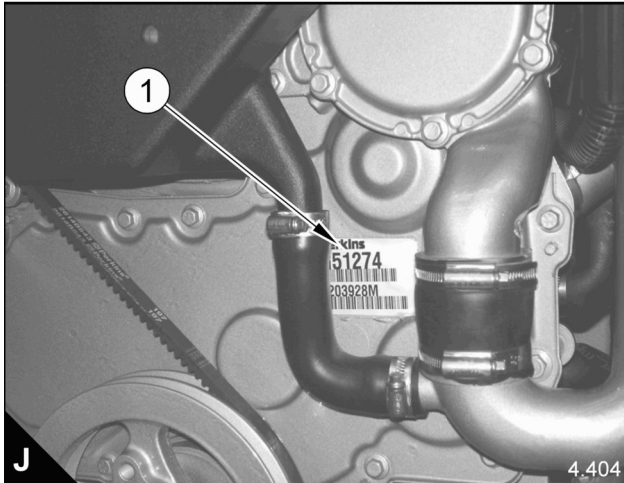
RG30879U123456L

RG	Type code letters
30879	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.



PU194_1



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,
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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.,
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Telephone: [39] (0321) 777880
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Email: info@scandiesel.it
www.scandiesel.it

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Multico Building
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Fax: [65] 6 863 6819
Email: mpd@multicorporation.net
www.multicorporation.net

United Kingdom

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

United States of America

Perkins Pacific Inc.,
7215 South 228th Street,
Kent, Washington
WA 98032
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

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

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
Email: Marine@Perkins.com

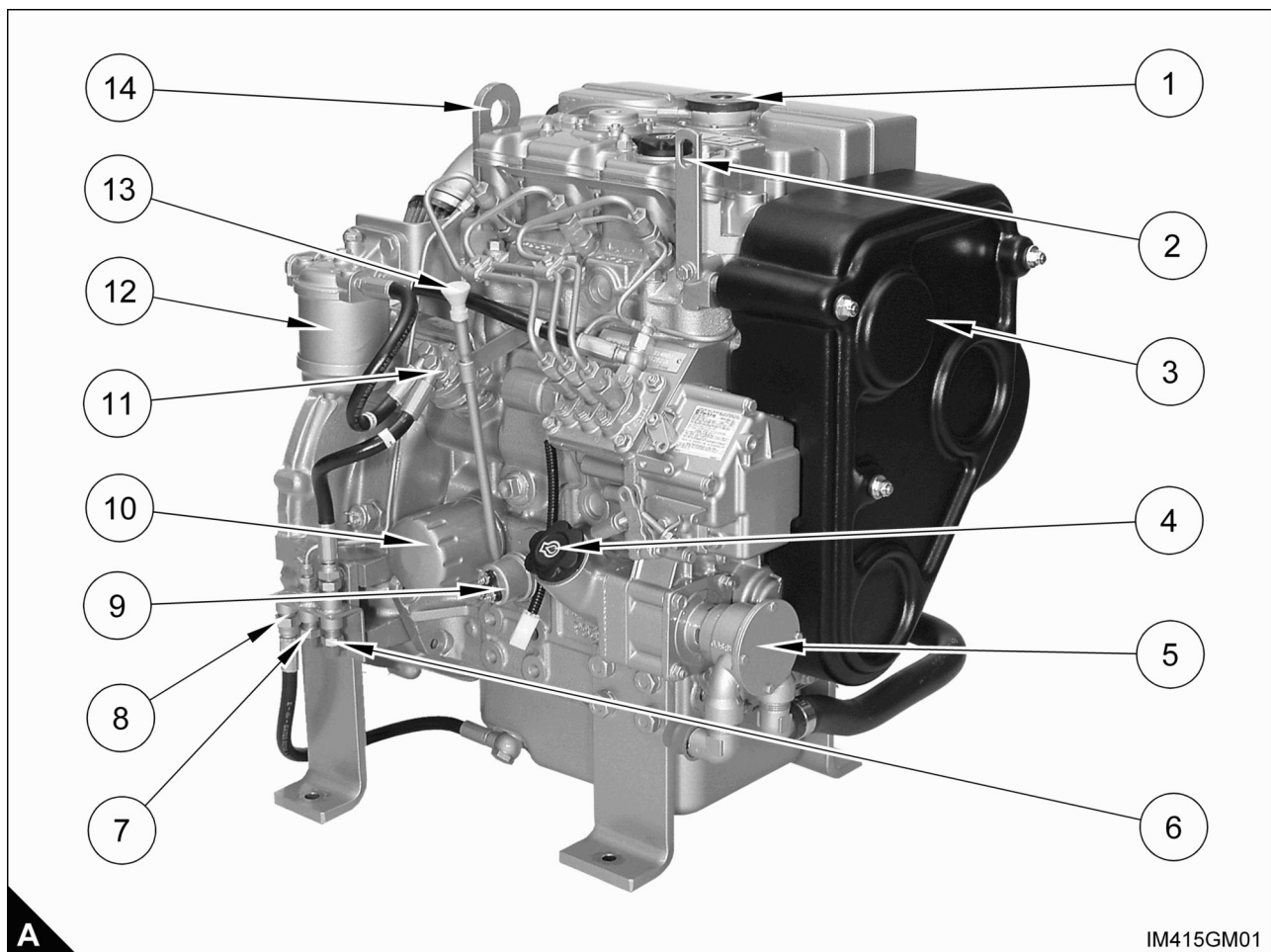
Engine views

Introduction

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

Location of engine parts - 415GM**Front and right side view (A)**

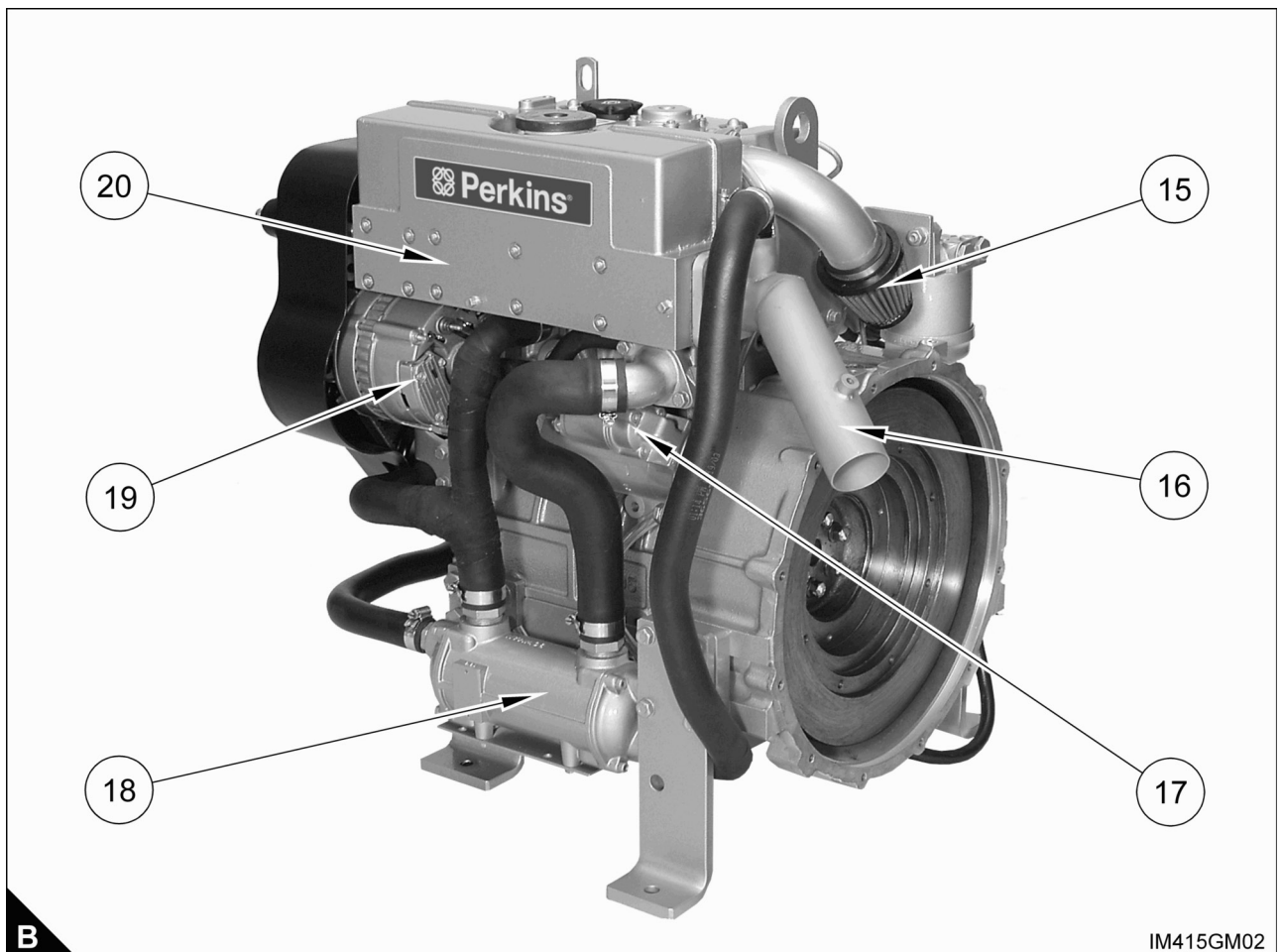
1. Coolant filler cap
2. Front lifting bracket
3. Belt cover
4. Oil filler cap
5. Raw water pump
6. Fuel inlet
7. Excess fuel return
8. Sump drain take-off point
9. Oil pressure switch/sender
10. Oil filter
11. Fuel lift pump
12. Fuel filter
13. Dipstick
14. Rear lifting bracket

**A**

IM415GM01

Rear and left side view (B) - 415GM

15. Air filter
16. Exhaust
17. Starter Motor
18. Raw water cooler
19. Alternator
20. Coolant header tank / cooled exhaust manifold

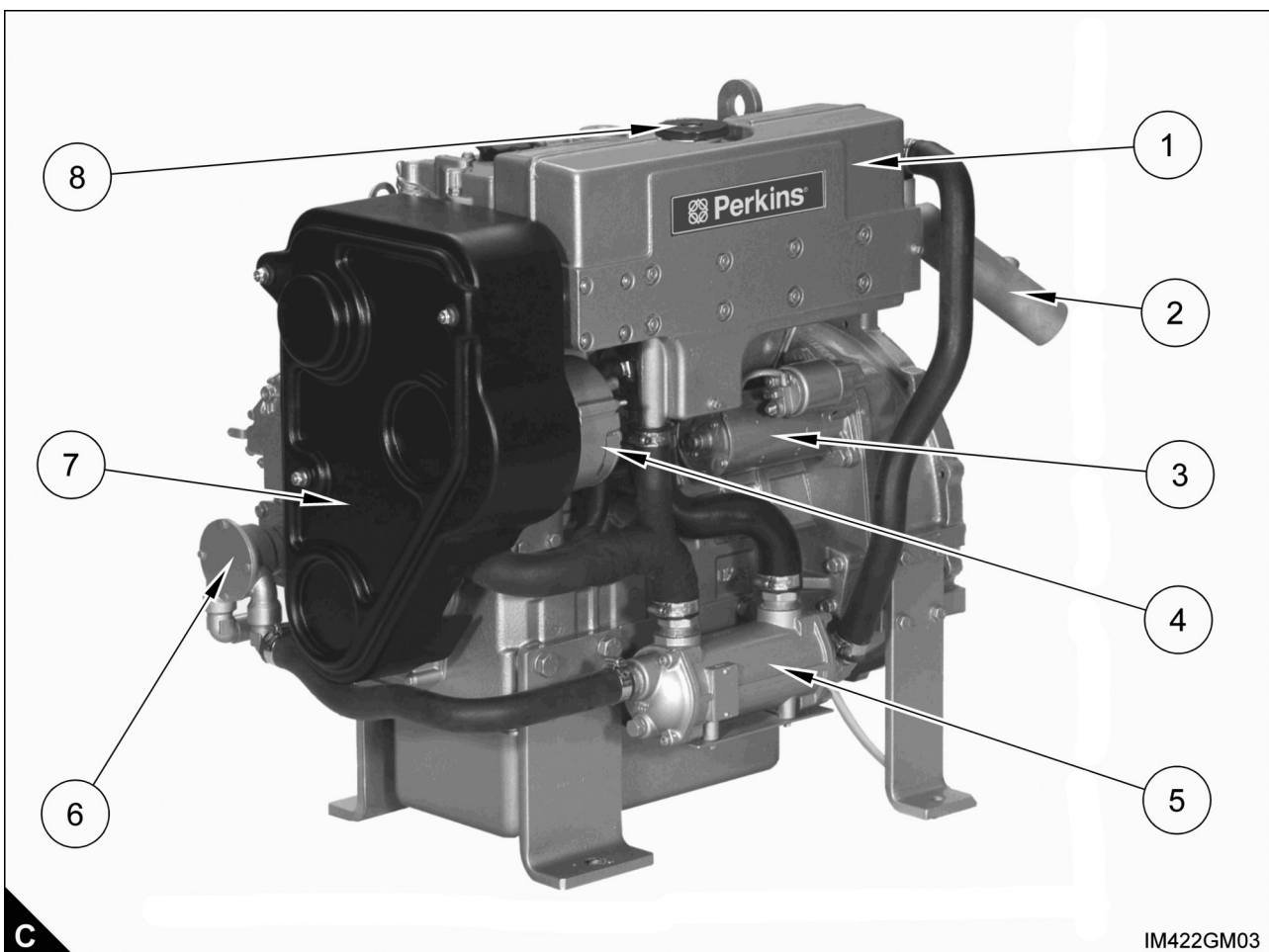


B

IM415GM02

Location of engine parts for the - 422GM**Front and left side view (C)**

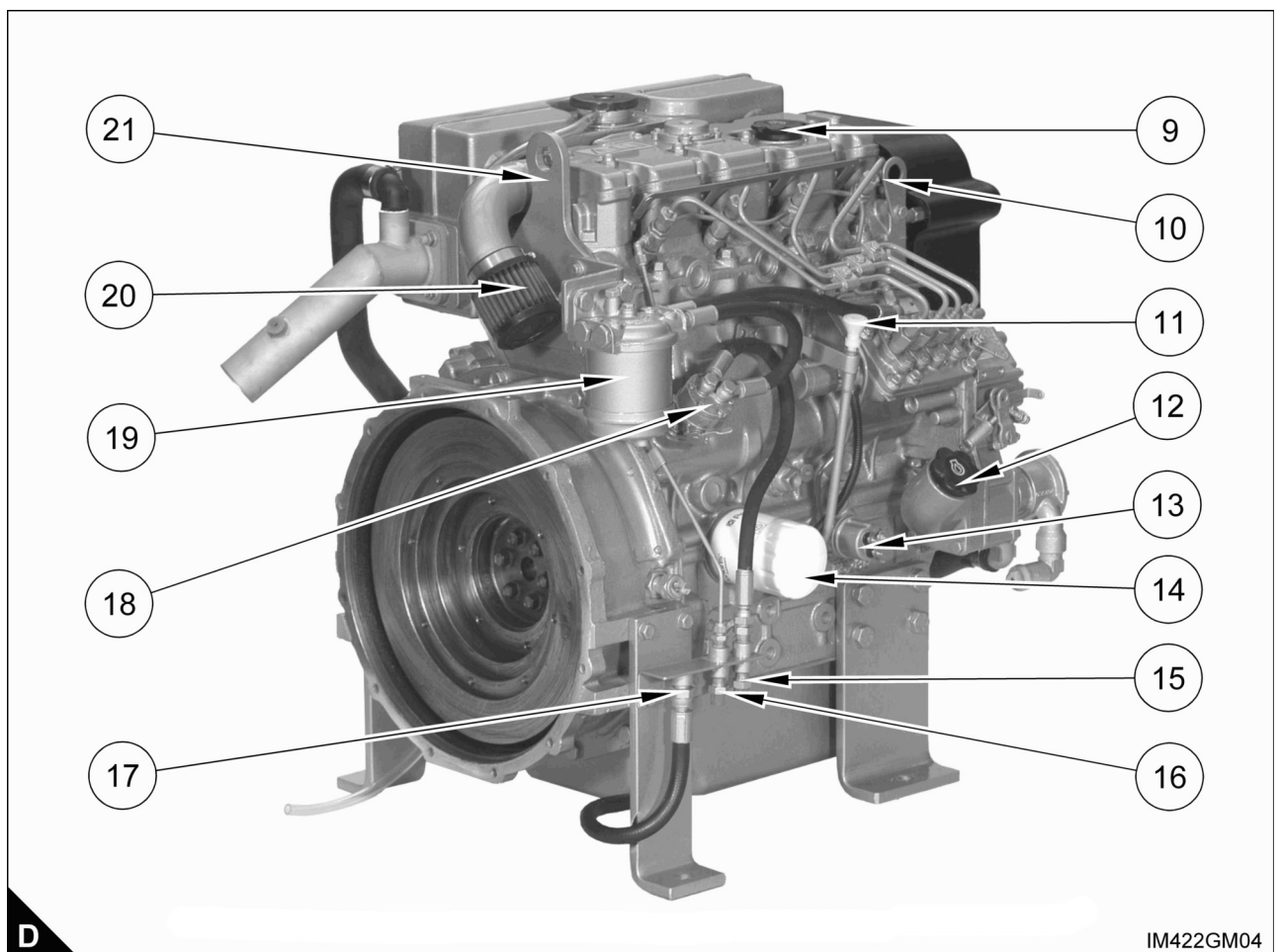
1. Coolant header tank / cooled exhaust manifold
2. Exhaust
3. Starter motor
4. Alternator
5. Raw water cooler
6. Raw water pump
7. Belt cover
8. Coolant filler cap

**C**

IM422GM03

Rear and right side view (D) - 422GM

9. Oil filler cap
10. Front lifting bracket
11. Dipstick
12. Oil filler cap
13. Oil pressure switch/sender
14. Oil filter
15. Fuel inlet
16. Excess fuel return
17. Sump drain take-off point
18. Fuel lift pump
19. Fuel filter
20. Air filter
21. Rear lifting bracket

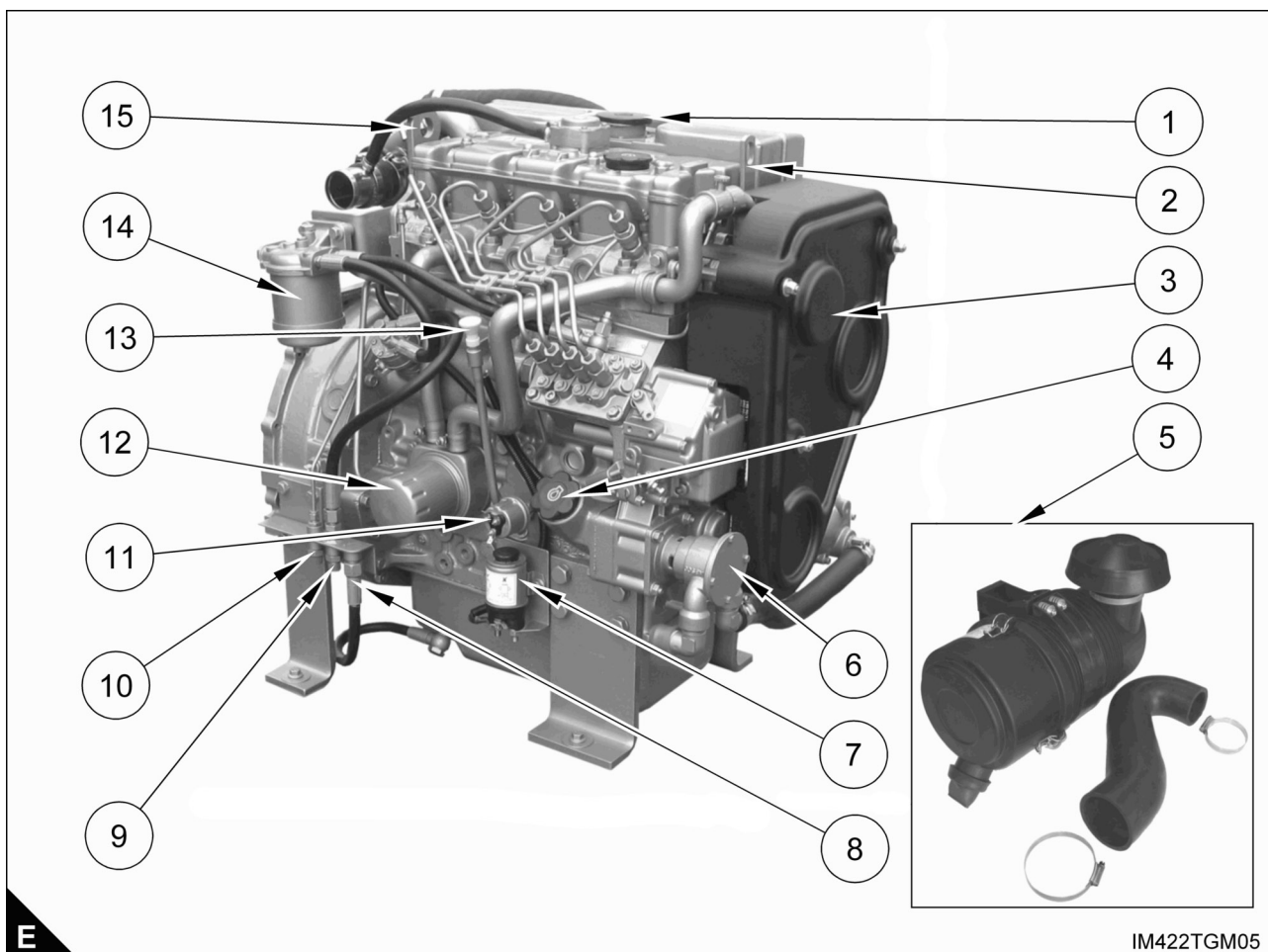


D

IM422GM04

Location of engine parts for the - 422TGM**Front and right side view (E)**

1. Coolant filler
2. Front lifting bracket
3. Belt cover
4. Oil filler cap
5. Air filter kit (supplied loose)
6. Raw water pump
7. Solenoid, negative earth
8. Fuel inlet
9. Excess fuel return
10. Sump drain take-off point
11. Oil pressure switch/sender
12. Oil filter
13. Dipstick
14. Fuel filter
15. Rear lifting bracket

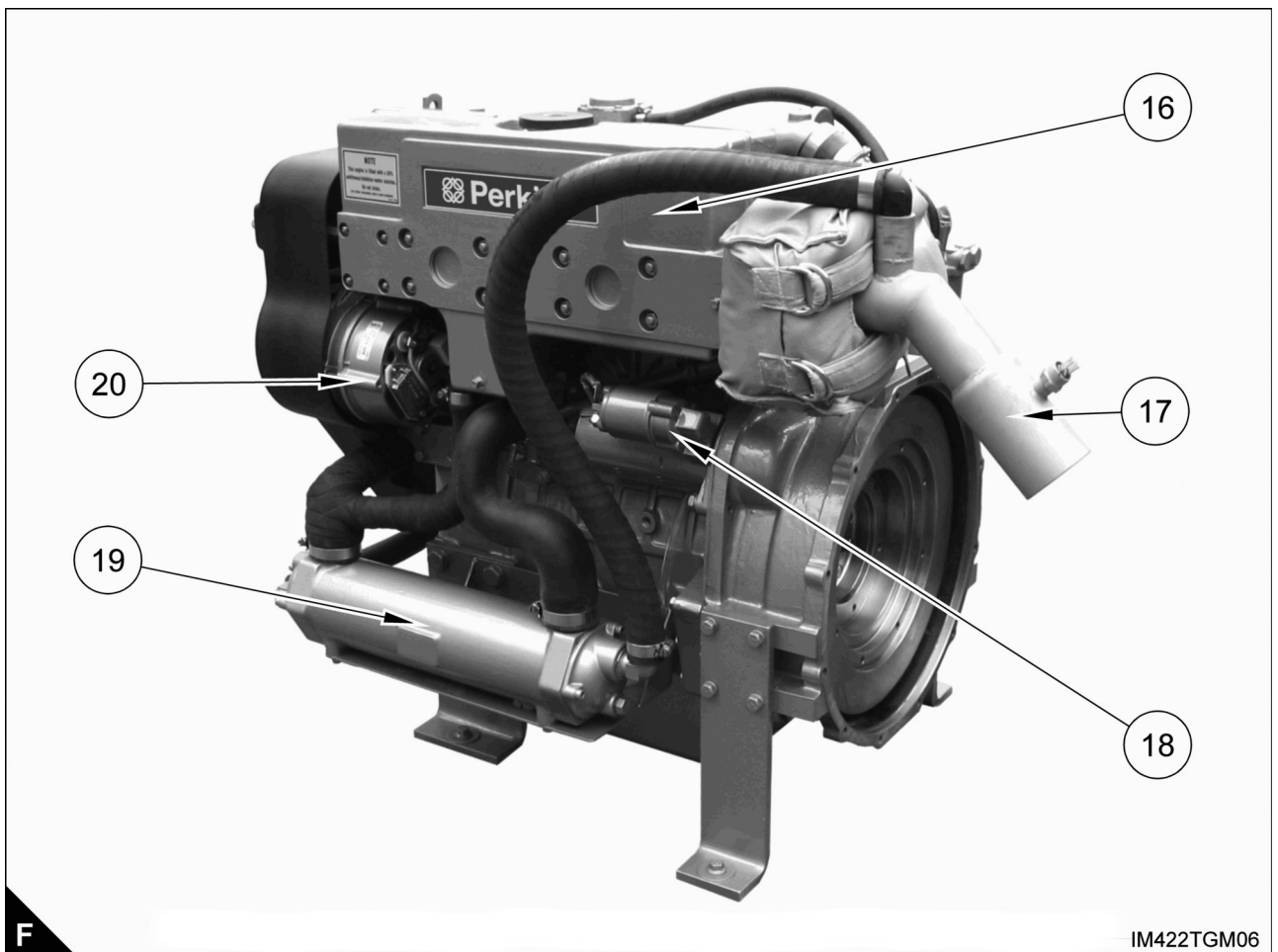


IM422TGM05

E

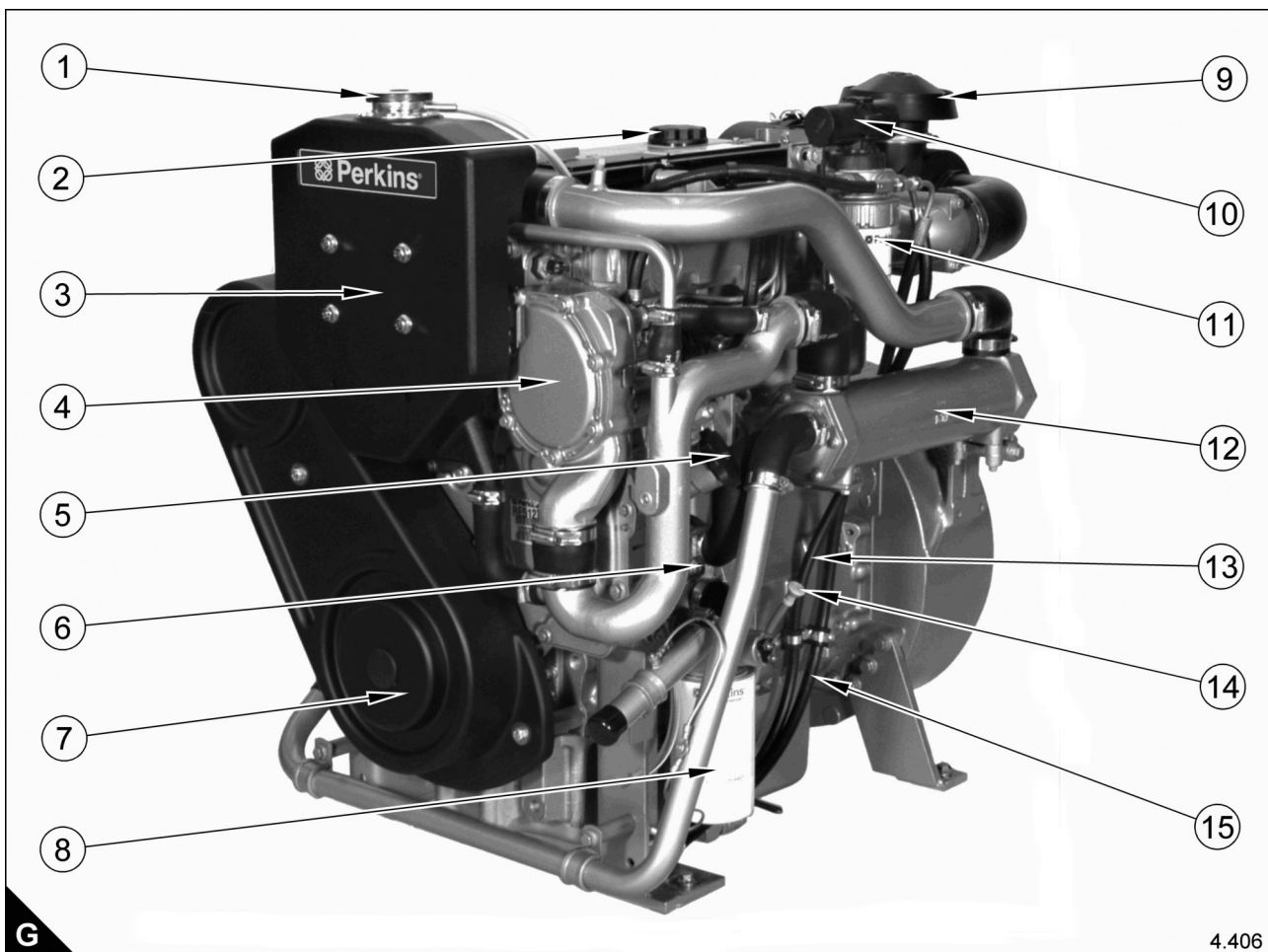
Rear and right side view (F) - 422TGM

- 16. Coolant header tank / cooled exhaust manifold
- 17. Exhaust elbow
- 18. Starter motor
- 19. Raw water cooler
- 20. Alternator



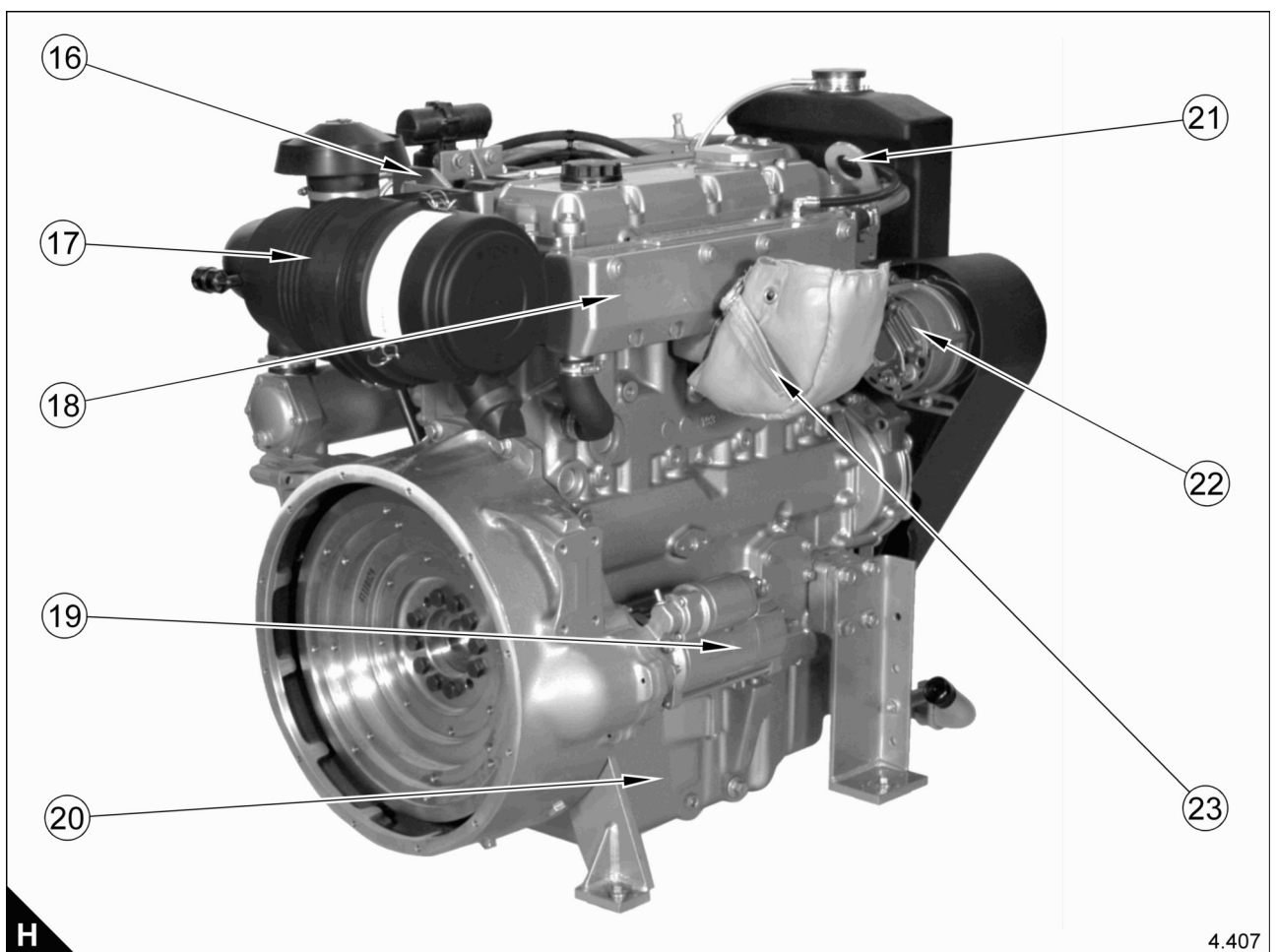
Location of engine parts - 4.4GM**Front and left side view (G) of the engine**

1. Fresh water filler cap
2. Oil filler cap
3. Header tank
4. Fresh water pump
5. Oil filler cap
6. Raw water pump
7. Belt cover
8. Oil filter
9. Air filter
10. Electric fuel pump
11. Fuel filter canister
12. Heat exchanger
13. Fuel return hose
14. Dipstick
15. Fuel inlet hose



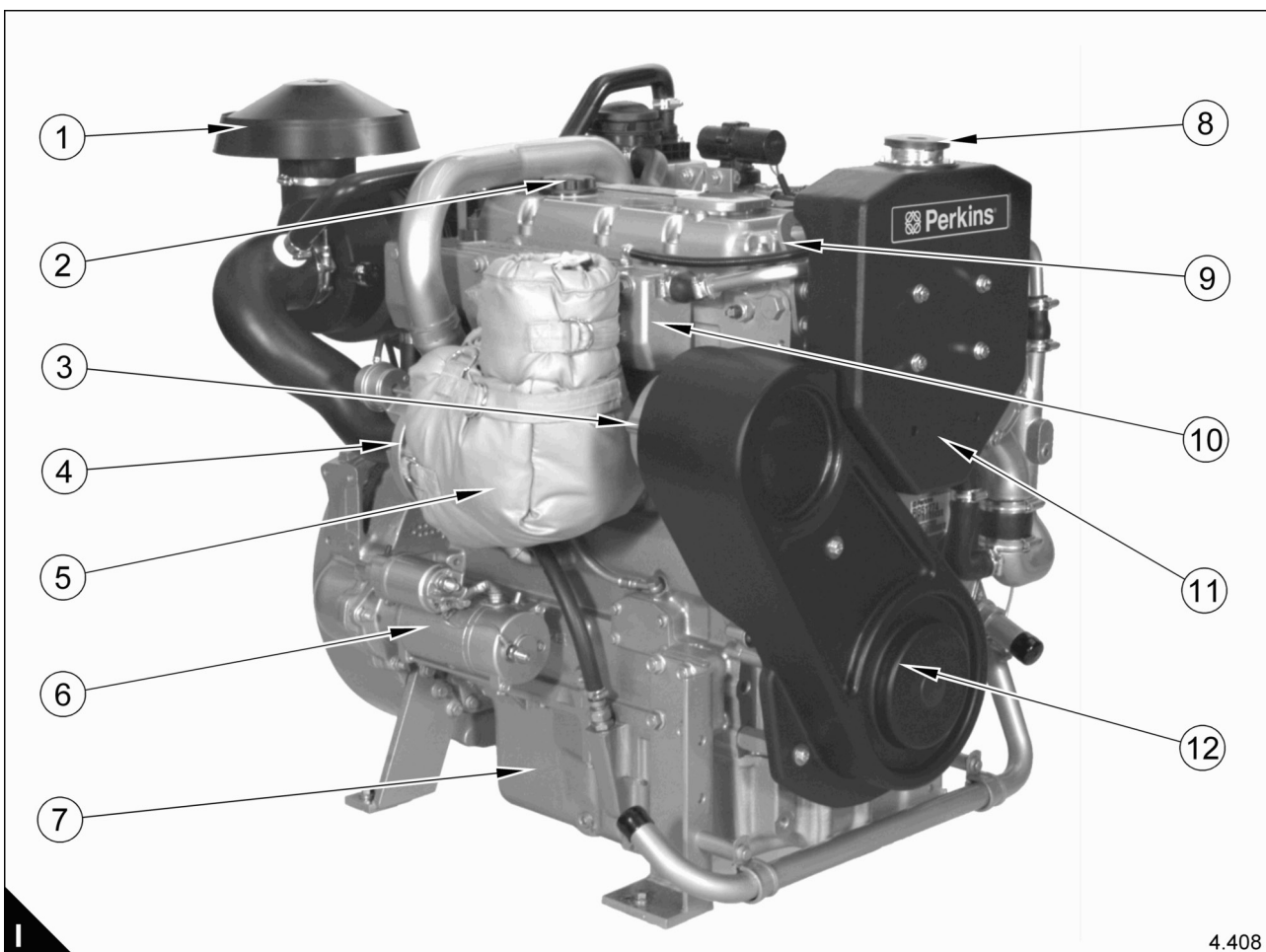
Rear and right side view (H) of the engine

16. Rear lifting eye
17. Air filter
18. Exhaust manifold
19. Starter
20. Lubricating oil sump
21. Front lifting eye
22. Alternator
23. Exhaust elbow



Location of engine parts - 4.4TGM**Front and right side view (I) of the engine**

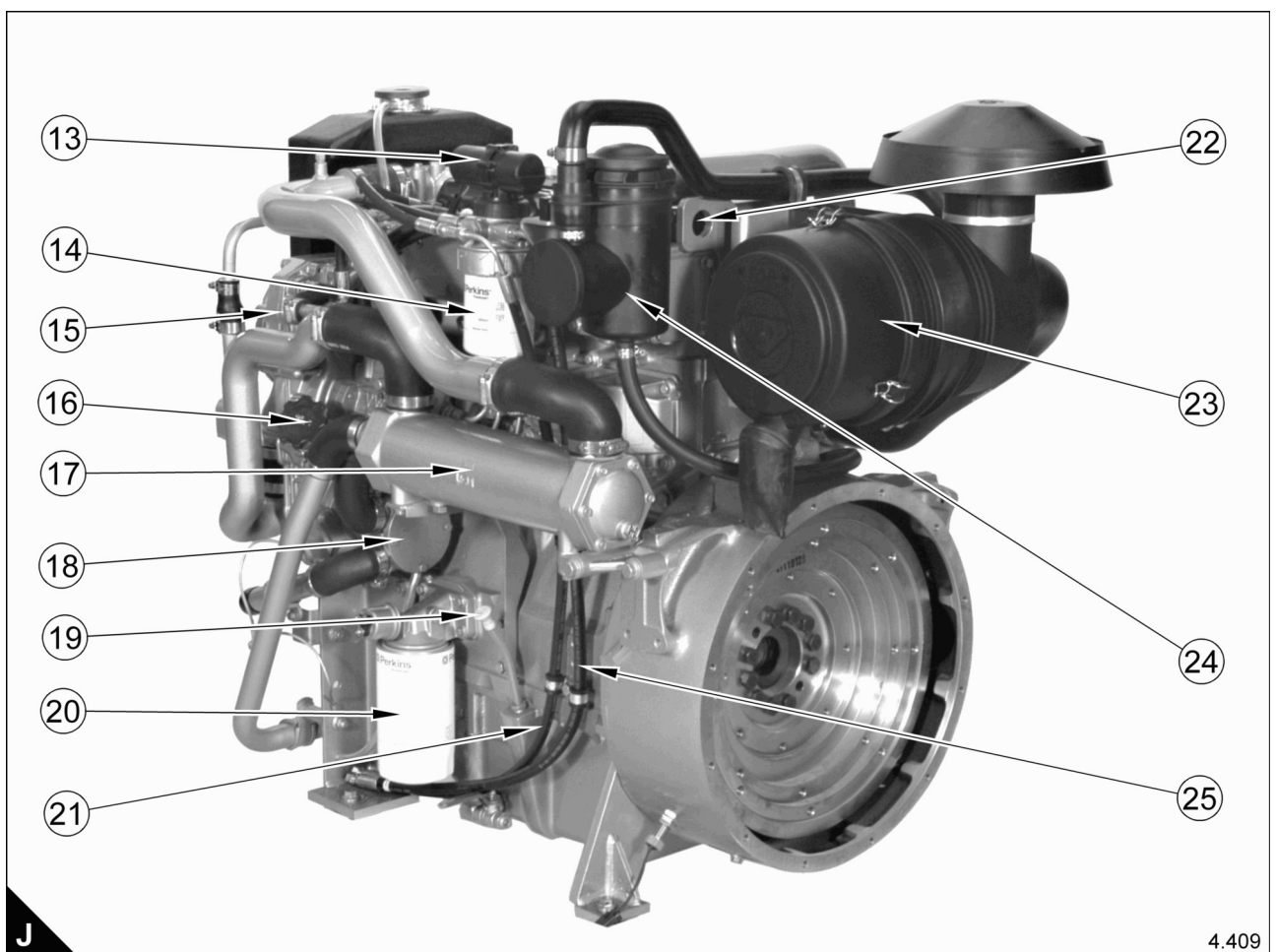
1. Air cleaner
2. Oil filler cap
3. Alternator
4. Turbocharger
5. Exhaust elbow
6. Starter
7. Lubricating oil sump
8. Fresh water filler cap
9. Front lifting eye
10. Exhaust manifold
11. Header tank
12. Belt cover



4.408

Rear and left side view (J) of the engine

13. Electric fuel pump
14. Fuel filter canister
15. Fresh water pump
16. Oil filler cap
17. Heat exchanger
18. Raw water pump
19. Dipstick
20. Oil filter
21. Fuel return hose
22. Rear lifting eye
23. Air filter
24. Breather canister
25. Fuel inlet hose

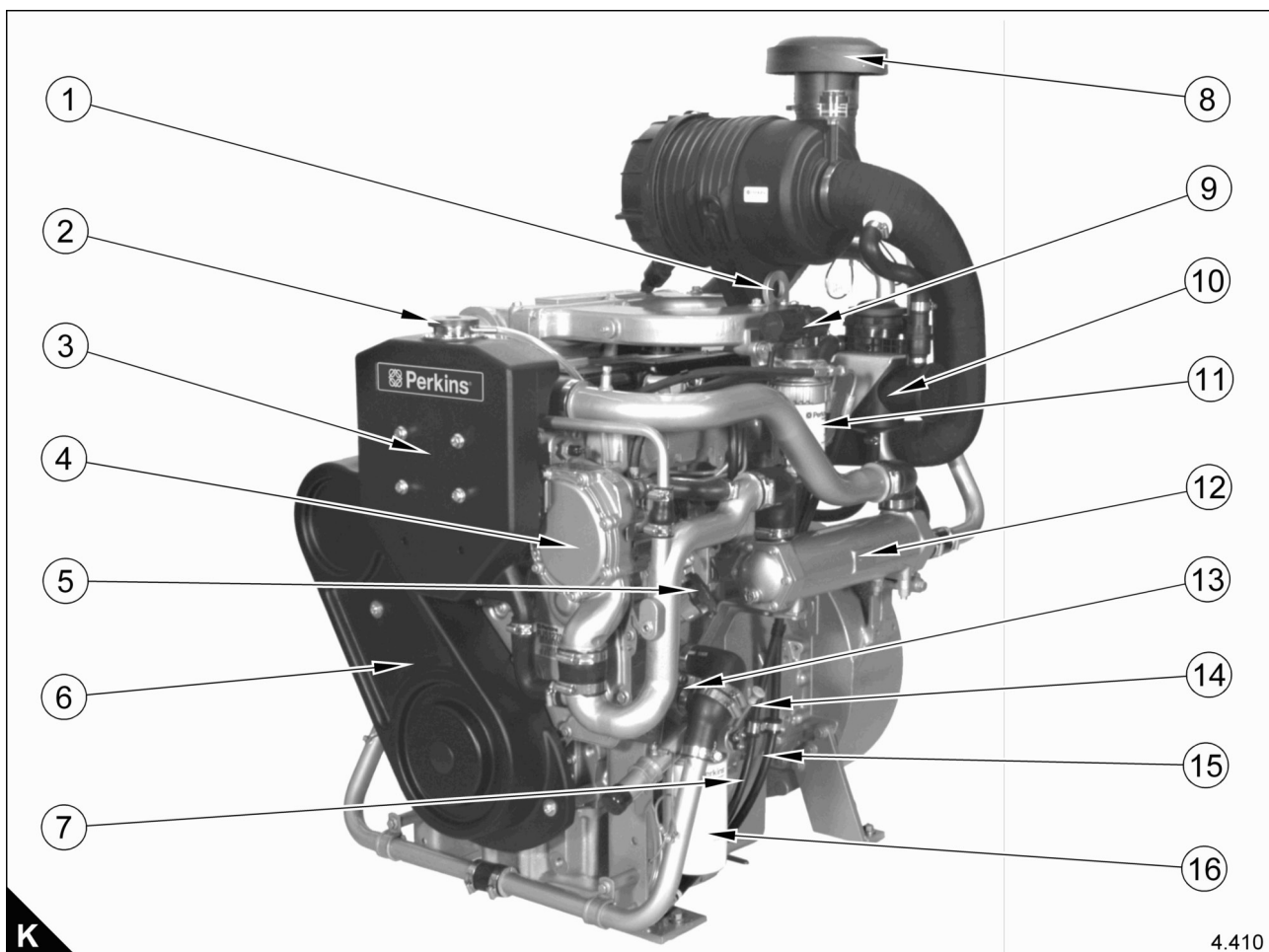


4.409

Location of engine parts - 4.4TWGM and 4.4TW2GM

Front and left side view (K) of the engine

1. Rear lifting eye
2. Fresh water filler cap
3. Header tank
4. Fresh water pump
5. Oil filler cap
6. Belt cover
7. Fuel return hose
8. Air cleaner
9. Electric fuel pump
10. Breather canister
11. Fuel filter canister
12. Heat exchanger
13. Raw water pump
14. Dipstick
15. Fuel inlet hose
16. Oil filter

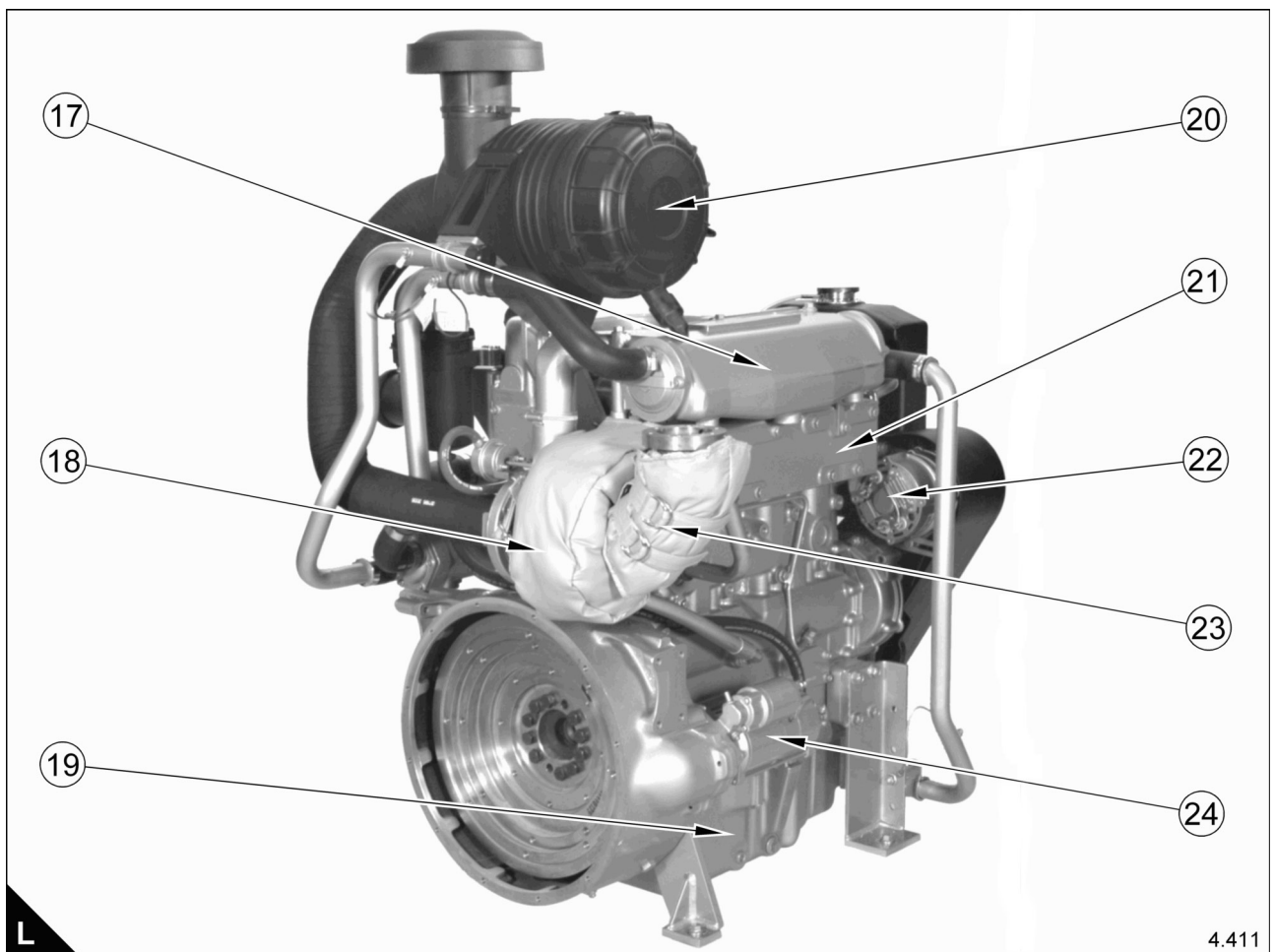


K

4.410

Rear and right side view (L) of the engine

17. Aftercooler
18. Turbocharger
19. Lubricating oil sump
20. Air filter
21. Exhaust manifold
22. Alternator
23. Exhaust elbow
24. Starter

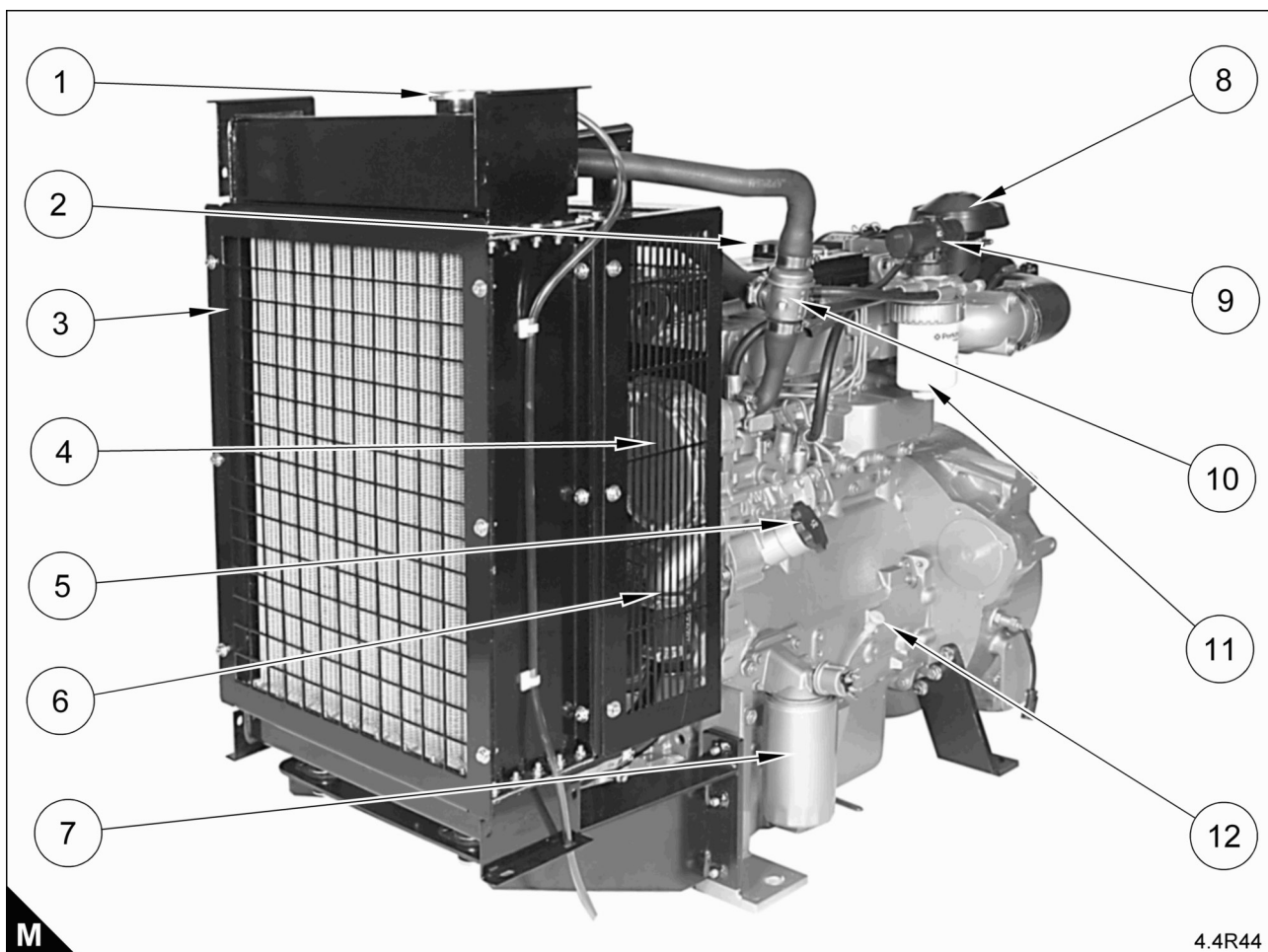


4.411

Location of engine parts - 4.4GM & 4.4TGM Radiator

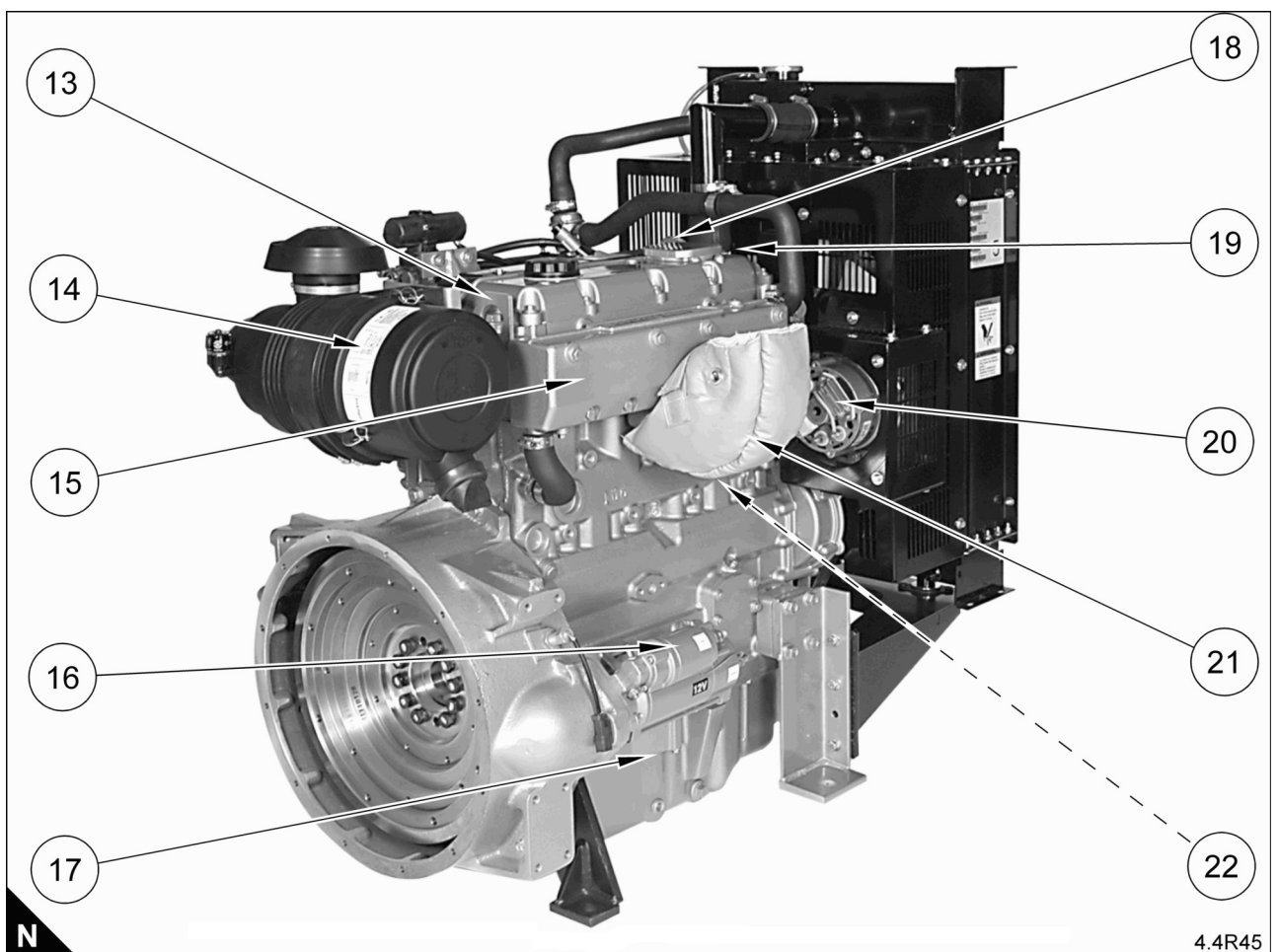
Front and left side view (M) of the engine

1. Fresh water filler cap
2. Oil filler cap
3. Radiator
4. Fresh water pump
5. Oil filler cap
6. Fan guard
7. Oil filter
8. Air filter
9. Electric fuel pump
10. Thermostat (manifold circuit)
11. Fuel filter canister
12. Dipstick



Rear and right side view (N) of the engine

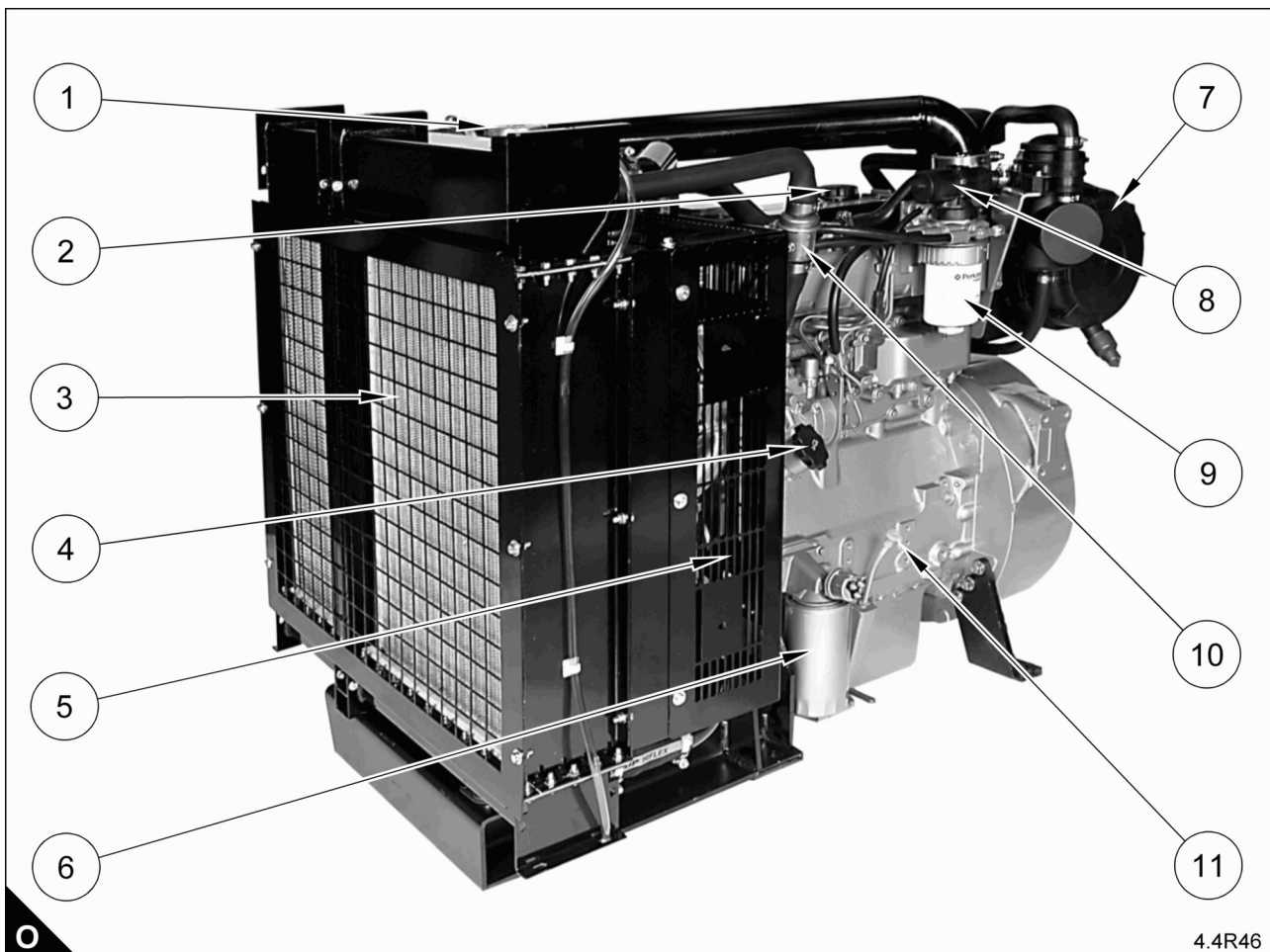
13. Rear lifting eye
14. Air filter
15. Exhaust manifold
16. Starter
17. Lubricating oil sump
18. Front lifting eye
19. Thermostat (cylinder head)
20. Alternator
21. Exhaust elbow
22. Turbocharger (4.4TGM Radiator only - not shown)

**N**

4.4R45

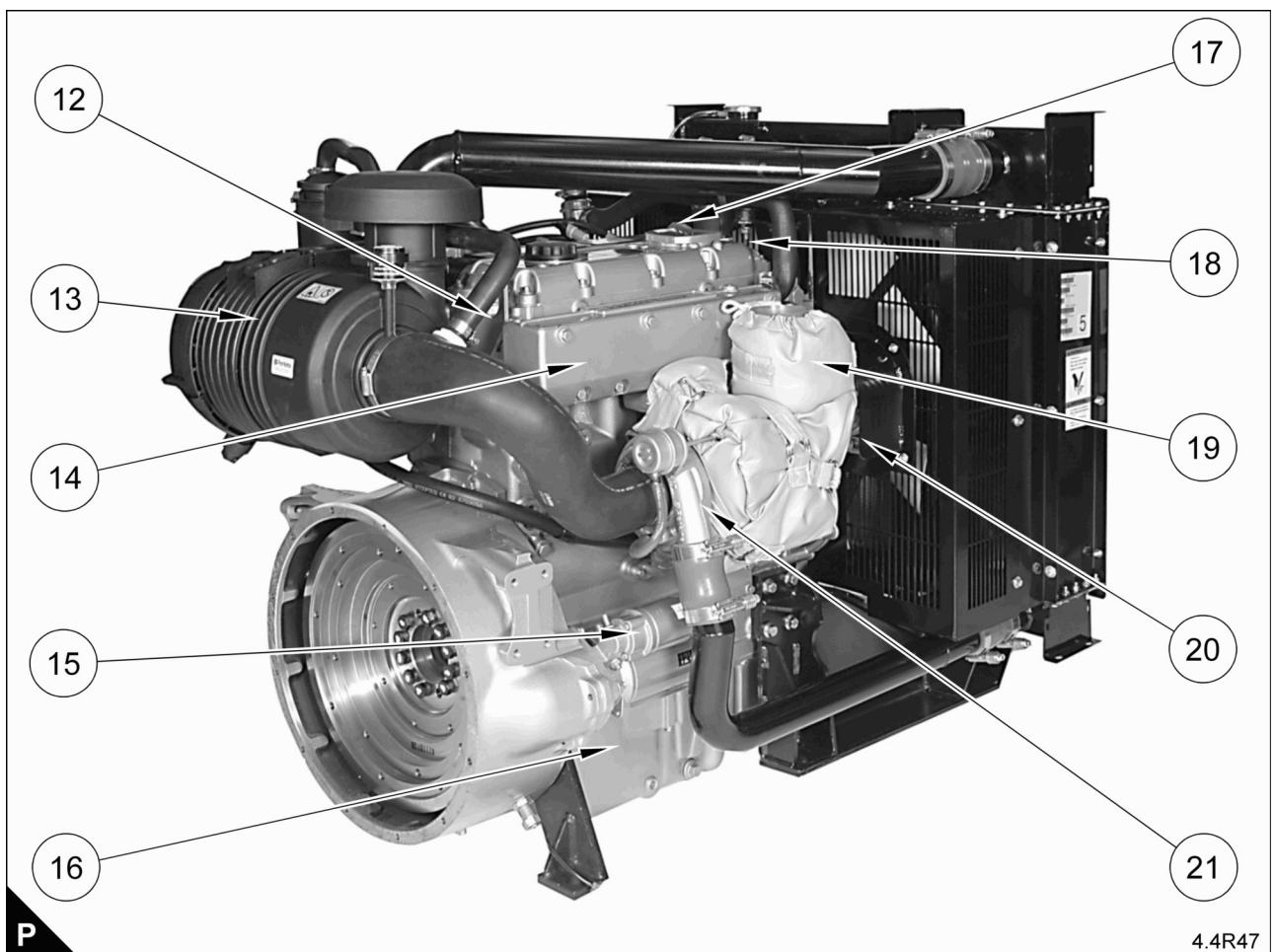
Location of engine parts - 4.4TWGM and 4.4TW2GM Radiator**Front and left side view (O) of the engine**

1. Fresh water filler cap
2. Oil filler cap
3. Radiator
4. Oil filler cap
5. Fan guard
6. Oil filter
7. Air filter
8. Electric fuel lift pump
9. Fuel filter canister
10. Thermostat (manifold circuit)
11. Dipstick



Rear and right side view (P) of the engine

12. Rear lifting eye
13. Air filter
14. Exhaust manifold
15. Starter
16. Lubricating oil sump
17. Front lifting eye
18. Thermostat (cylinder head)
19. Exhaust elbow
20. Alternator
21. Turbocharger



Operation instructions

Models - 415GM, 422GM & 422TGM, 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.

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

1. Switch on the electrical system.
2. Hold the heat switch in the down position for 10 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 10 seconds, hold the heat switch down for a further 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.*

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 without a load.*
- *Do not overload the engine.*

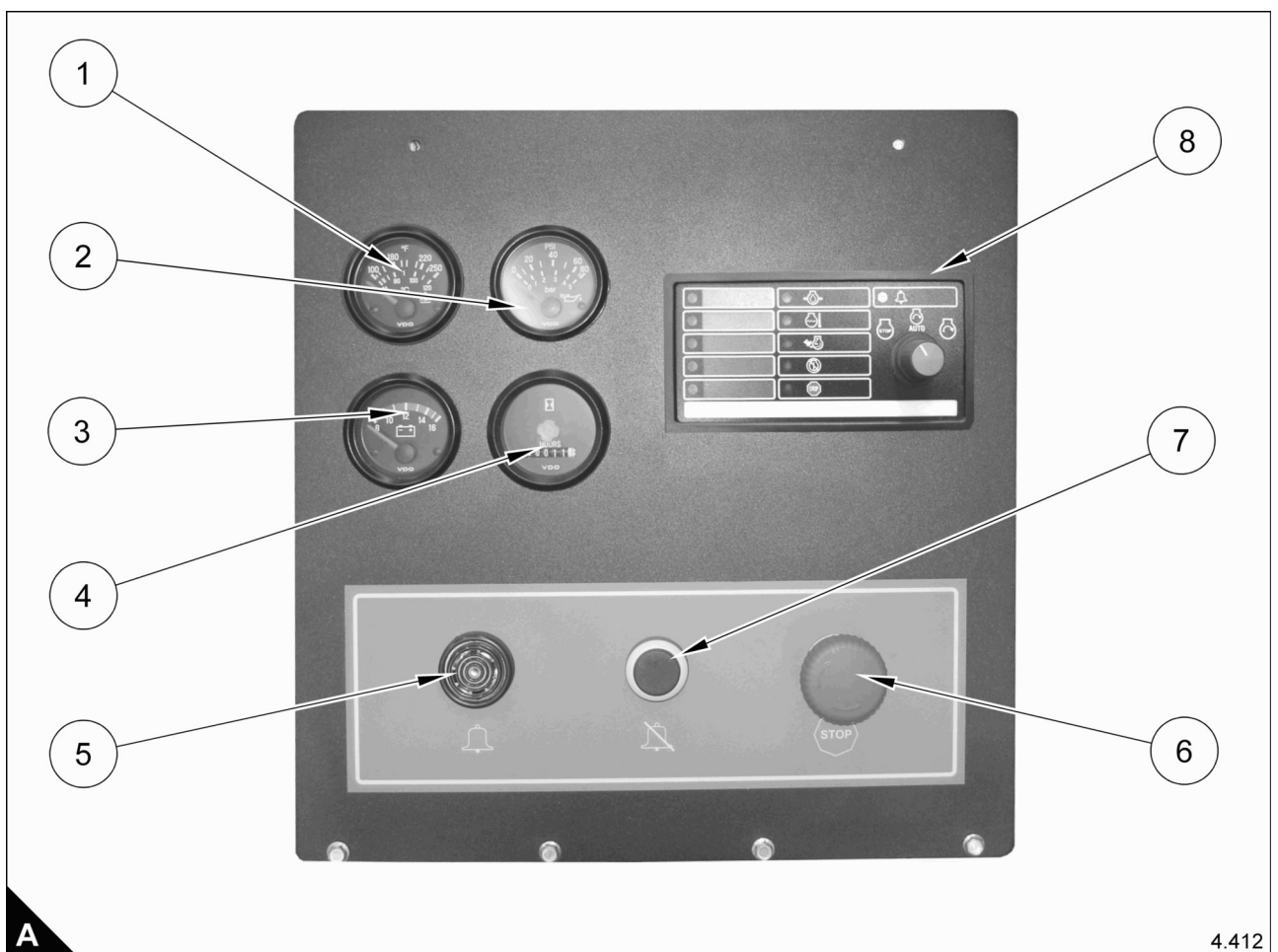
Angle of operation

The 415GM, 422GM and 422TGM can operate at 25° continuous or 35° intermittent in all directions.

Models - 4.4GM, 4.4TGM, 4.4TWGM, 4.4TW2GM, 4.4GM rad, 4.4TGM rad, 4.4TWGM rad & 4.4TW2GM rad, control panel (optional)**Oil pressure gauge (A1)**

Shows engine oil pressure. The oil pressure will be greatest after a cold engine is started. If the gauge reading is fluctuating and the load has become stable, perform the following steps:

- Remove the load.
- Check and maintain oil level.



Temperature gauge (A2)

Shows the engine water temperature. The engine should operate within the range of 78°C (172°F) to 90°C (194°F). The temperature may vary according to load. However it should never exceed the boiling point for the pressurised system that is being used. The temperature is regulated by the engine thermostats in the system. Do not operate the engine if there are no thermostats fitted in the engine. If the engine is operating and a high water temperature reading is observed, perform the following steps:

- Reduce the load
- Inspect the engine for coolant leaks.
- Determine if the engine should be shutdown.

Note: If the water temperature sensor is not fully submerged because of low water level, the temperature reading will be false.

DC voltmeter (A3)

Shows the voltage of the starting system.

Hourmeter (A4)

Shows the total operating hours of the engine. The meter is powered whenever the engine is running.

Audible alarm (A5)

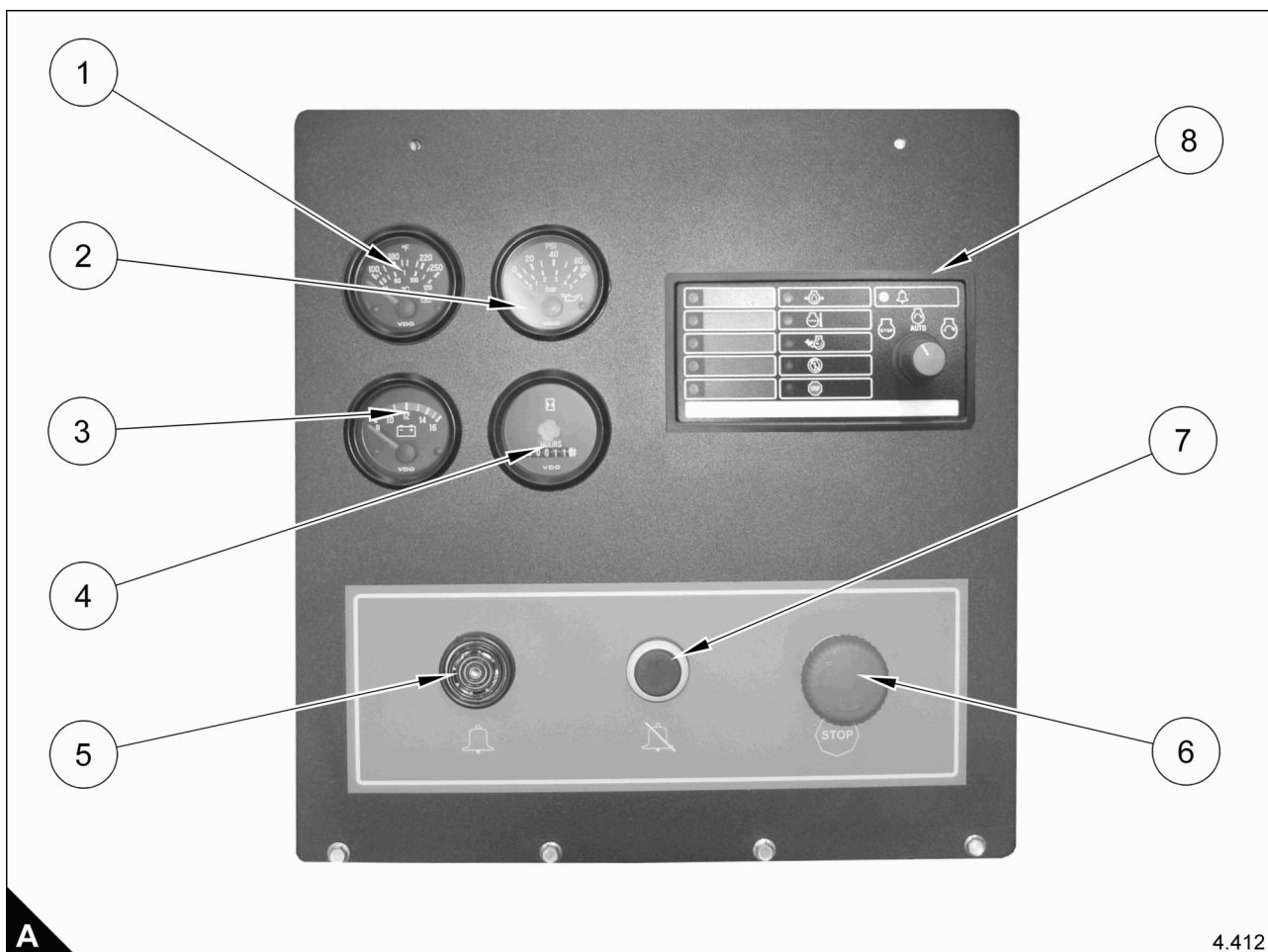
This activates when one of the fault indicators is illuminated. The alarm can be silenced by pressing the alarm mute switch (A7).

Emergency stop button (A6)

This is used to shut down the engine during an emergency situation.

Alarm mute switch (A7)

This switch is used to silence the alarm.

Control module (A8)

Control module (optional)

The control panel (B) has six indicators (B3 to B8) that correspond to certain fault conditions. An indicator illuminates when the corresponding problem exists. Each indicator has a label that identifies the problem. The Engine Control Switch (B12) must be turned to the OFF/RESET position (B9) in order to turn off the indicators and to reset the control panel. The panel also incorporates two spare indicators.

Programmable indicators (B1)

The control panel is programmed in order to alert the operator to various conditions, ie - Engine Running, Not in Auto and Emergency Stop

Note: See separate manual supplied with the unit.

Indicators (B2)

These are not used.

Indicator for the oil pressure (B3)

This indicates when the engine oil pressure has fallen below the low limit of the oil pressure switch.

Indicator for the coolant temperature (B4)

This lights when the engine water temperature has risen above the upper limit of the water temperature switch.

Indicator for engine overspeed (B5)

This lights when the control board detects that the engine speed has exceeded the overspeed set point.

Indicator for the alarm (B6)

This indicator lights as a warning when the control module has received any signals that have been programmed to light with the alarm. When the indicator flashes, there is a shut down fault.

Indicator for engine overcrank (B7)

This lights when the engine fails to start due to the limit for cranking being exceeded.

Indicator for emergency stop (B8)

This lights when the stop push button has been pressed.

Stop/Reset position (B9)

When the Engine Control Switch (B12) is in this position, the fault indicators are reset and the engine shuts down immediately.

Automatic start position (B10)

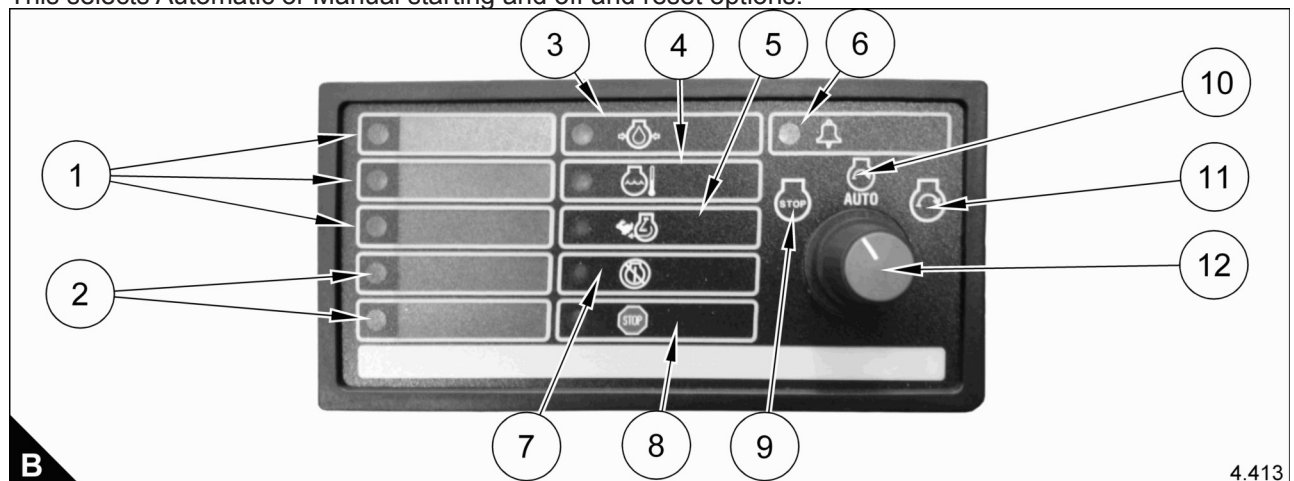
When the Engine Control Switch (B12) is in this position, the engine will start automatically when the remote initiate contact is closed or will shutdown when opened.

Manual start position (B11)

When the Engine Control Switch (B12) is in this position, the engine will start and will continue to run until the position is changed.

Engine control switch (B12)

This selects Automatic or Manual starting and off and reset options.



4.413

Engine wiring harness (optional equipment)

The engine wiring harness is designed to convey information to and from the engine control panel. Within the harness is a circuit breaker and a negative earth fuse to protect the wiring in the event of a short circuit as well as control relays.

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 control panel and thus the starting of the engine.

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

Within the control box are four 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.

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 control panel.

Engine circuit variations due to system damage

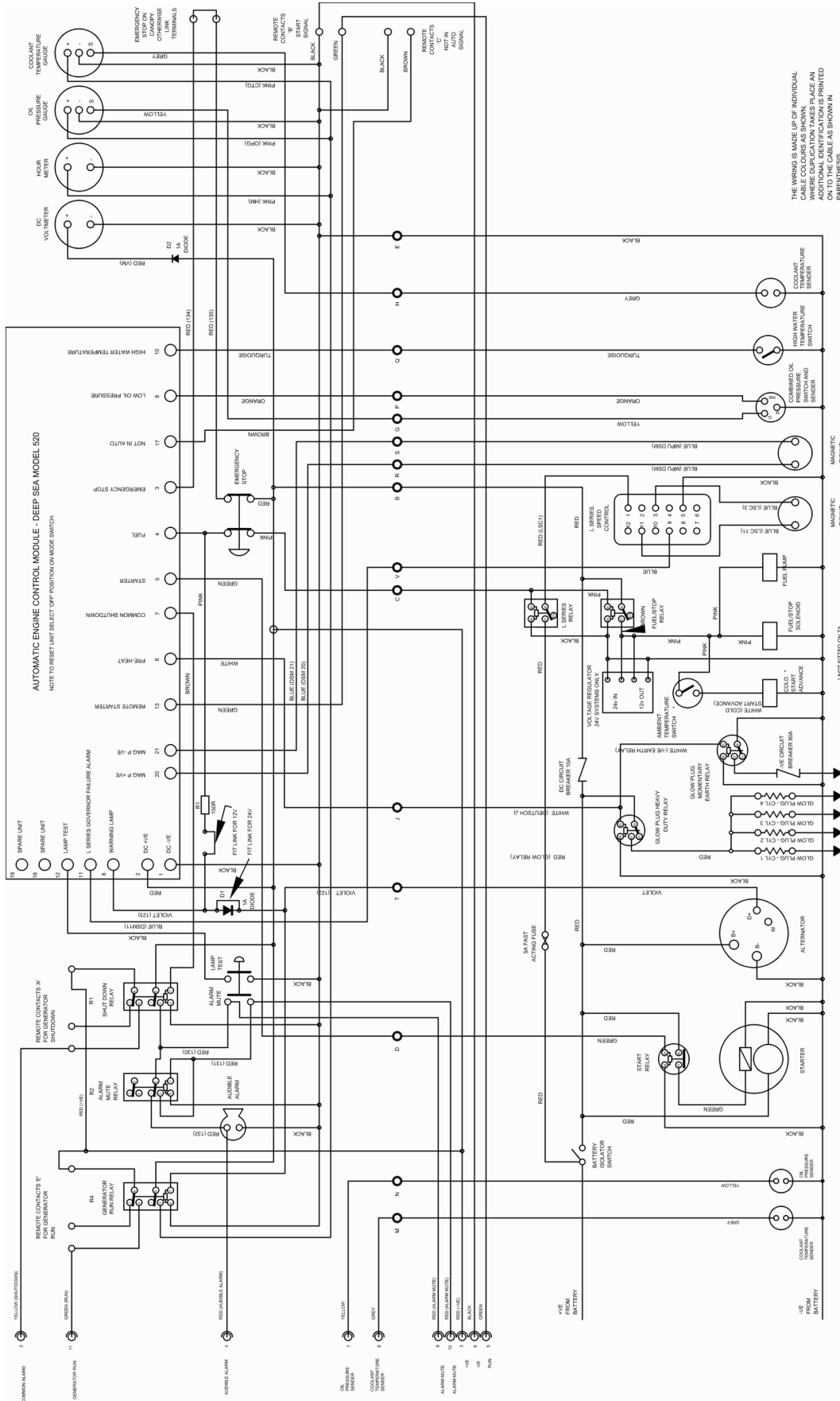
24V engines - Engines with 24V systems will have fitted a 24V to 12V converter (unit coloured black) to operate the 12V fuel lift pump.

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

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

Standard DC circuits

Information derived from 04-1006-1



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 can affect engine startup, 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°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 the amount of coolant in the radiator.
4. Check the amount of lubricating oil in the sump.

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

Engine starting with the optional control panel - local operation

Use the following procedure in order to start the engine.

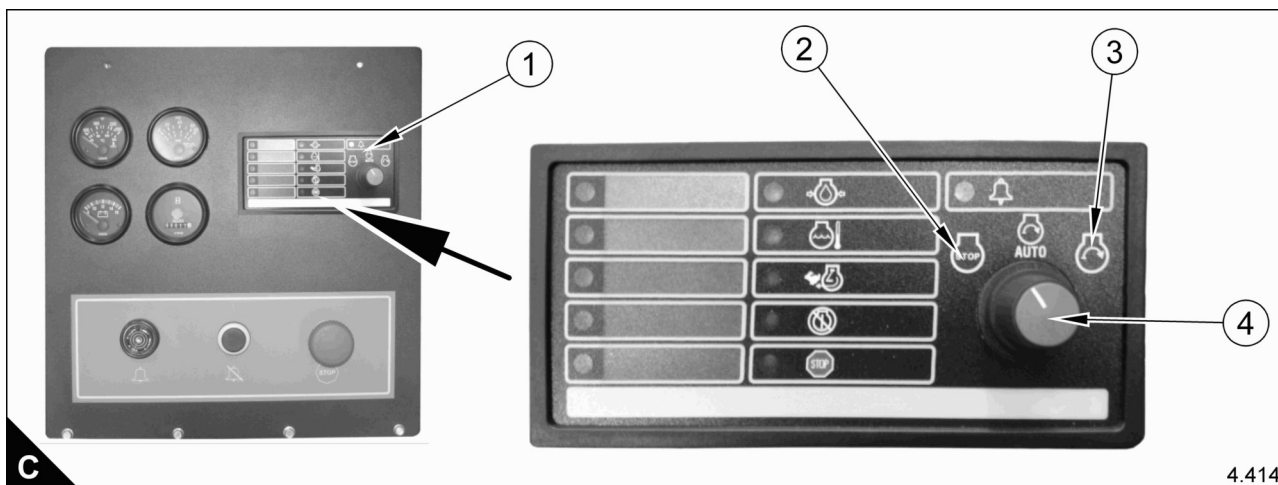
1. Turn the engine control switch (C4) to the manual start position (C3)
2. If the preheat timer is configured, it will be initiated. After the timer has expired, the engine will begin to crank.

Note: When the engine starts, the starter motor is disengaged and is locked out.

3. If the engine did not start, then the control module (C1) will permit the starter motor to cool down for a predetermined amount of time. Once this time has elapsed, the engine will crank.

Note: The "Failed to Start" fault will be displayed after three unsuccessful attempts to start the engine and an LED indicator will flash. In this situation, the engine control switch (C4) must be moved to the Stop/Reset position (C2). Determine the reason that the engine failed to start before making further attempts.

4. After the engine has started, the fault protection timer is activated, which allows the engine to stabilise before the fault protection system is activated. When the timer has expired, the fault protection is available. The generator load may now be applied to the engine.



How to stop the engine

Stopping the engine

Cautions:

- Stopping the engine immediately after it has been working under load can result in overheating and accelerated wear of the engine components.
- If the engine has been running at high loads, run at low load for at least three minutes to reduce and stabilise the internal engine temperature before stopping the engine.
- Avoiding hot engine shutdowns will maximise turbocharger shaft and bearing life where fitted.

Standard control panel - manual operation

1. Turn the engine control (D3) to the AUTO position (D2). When the remote stop delay timer expires, the engine will stop.

Note: If the remote start signal is removed with the control in manual start mode, the engine will continue to run until the engine control switch (D3) is turned to the AUTO position (D2) and the remote stop delay timer expires.

2. Turn the engine control switch (D3) to Stop/Reset (D1).

Standard control panel - automatic operation

1. Remove the remote start signal. When the remote stop delay timer expires, the engine will stop.
2. Turn the engine control switch (D3) to Stop/Reset (D1).

Note: The engine will stop immediately if the engine control switch (D3) is turned to the Stop/Reset position (D1).

Adjustment of engine speed range

Note: Any adjustment to the engine speed is not permitted. Any interference with the fuel pump will invalidate emission compliance of the engine and warranty.

Running-in

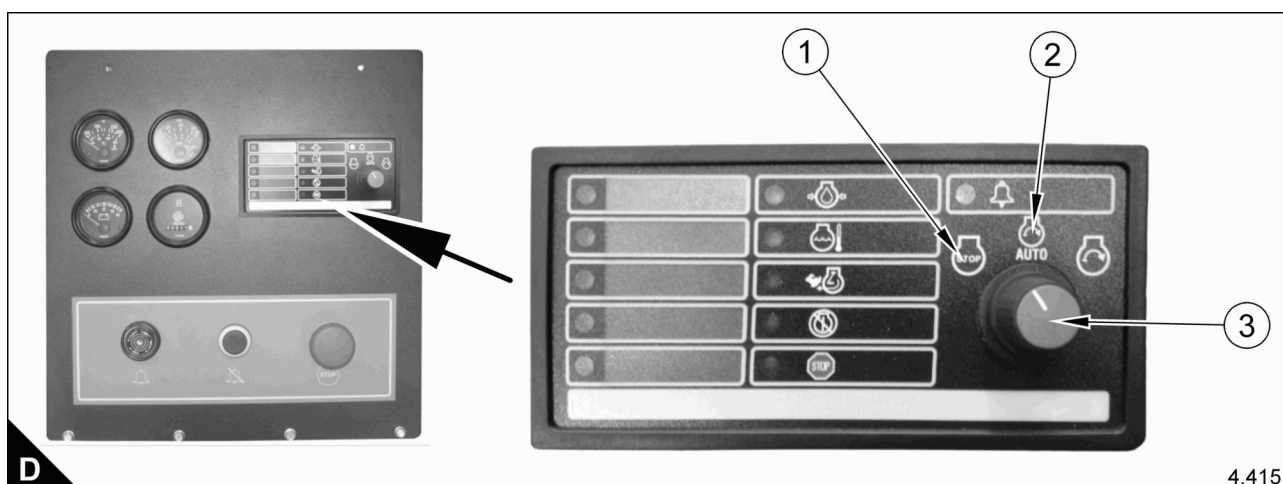
A gradual running-in of a new engine is not necessary. Prolonged operation at light loads during the early life of the engine can cause lubricating oil to enter the exhaust system. Maximum load can be applied to a new engine as soon as the engine is put into service and the coolant temperature has reached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

Cautions:

- The engine will benefit if the load is applied as soon as possible after the engine is put into service.
- Do not overload the engine.

Angle of tilt

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



D

4.415

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. Fill the tank. Eliminate air from the system.
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 induction system is not restricted and that the engine compartment has a good supply of air.
2. 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 load on the engine. 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.

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

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.

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, Models

Preventive maintenance periods - 415GM, 422TGM & 422TGM

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, models - 415GM, 422GM & 422TGM

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

- A Every day or every 8 hours
- B Every 500 hours or 12 months
- C Every 1000 hours
- D Every 2000 hours
- E Every 3000 hours

A	B	C	D	E	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
		•			Renew alternator drive belt
	•				Check the impeller of the raw water pump
•					Check the sea water strainer
	•				Check heat exchanger end caps for signs of corrosion
•					Drain water from the fuel pre-filter ⁽¹⁾
	•				Renew the element / canister of the fuel filter
			•		• Check the atomisers ⁽²⁾
				•	• Ensure the turbocharger impeller and turbocharger impeller casing are cleaned ⁽²⁾
•					Check the amount of lubricating oil in the sump
	•				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.

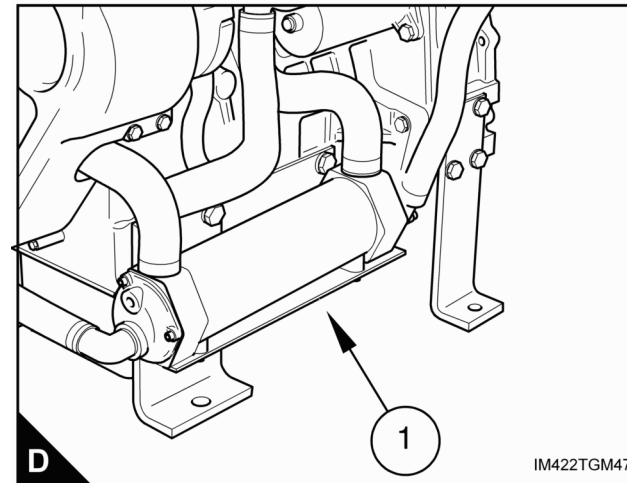
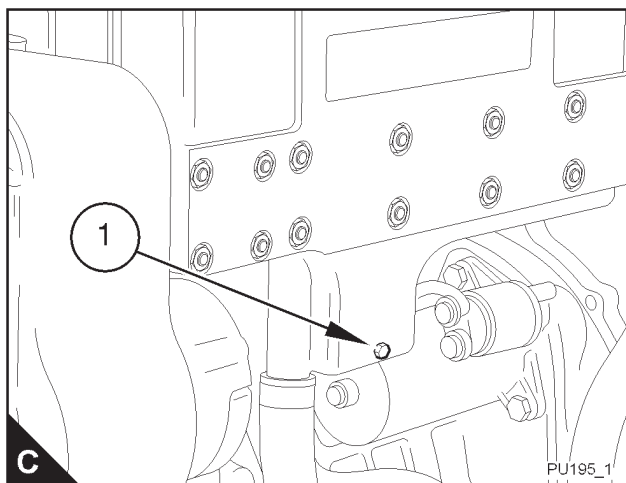
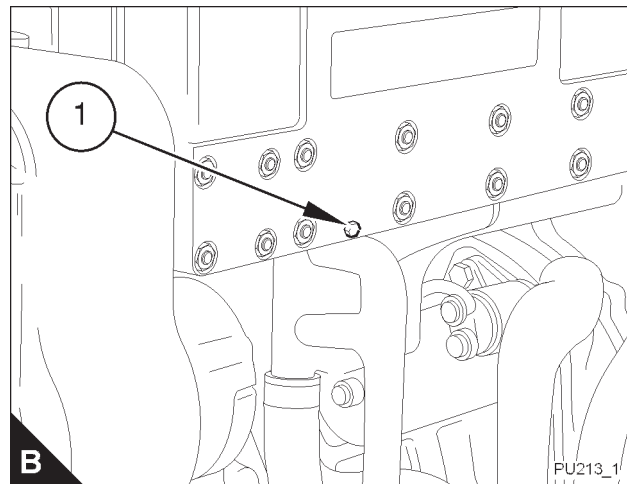
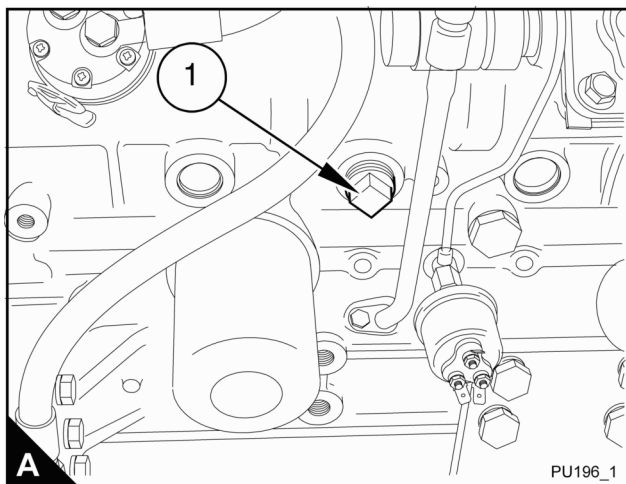
1. Remove the filler cap of the coolant circuit.
2. Remove the drain plug (A1) from the cylinder block which is situated in the same place on all the engines and the drain plug from the heat exchanger, (B1) on the 415GM and (C1) on the 422GM/422TGM. Ensure that the drain holes are not restricted. Also, on the 422TGM, remove the drainplug on the raw water cooler (D1).
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 prior to the storage period. See "Coolant specification" 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 (E).

7. Adjust the strength of the mixture as necessary.

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.

Note: 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.

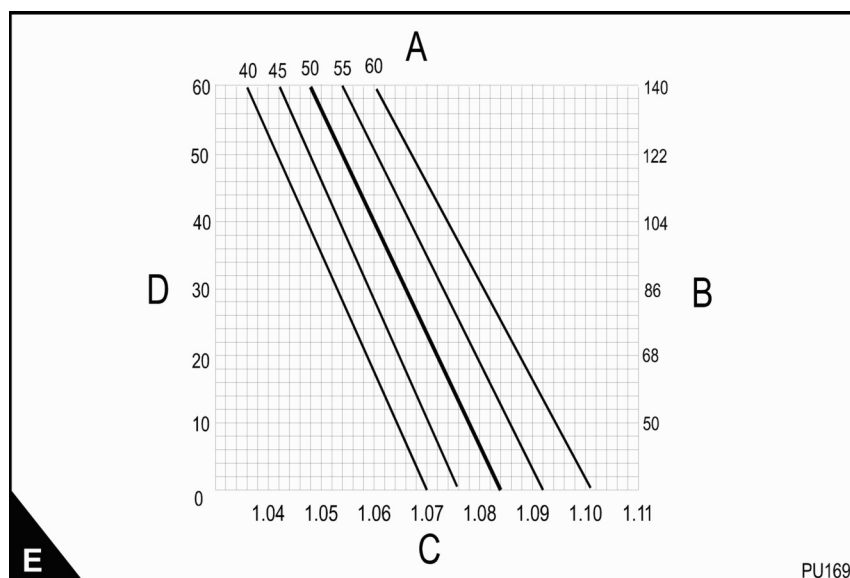
Specific gravity chart

A = Percentage coolant by volume

B = Mixture temperature in Fahrenheit

C = Specific gravity

D = Mixture temperature in Celsius.

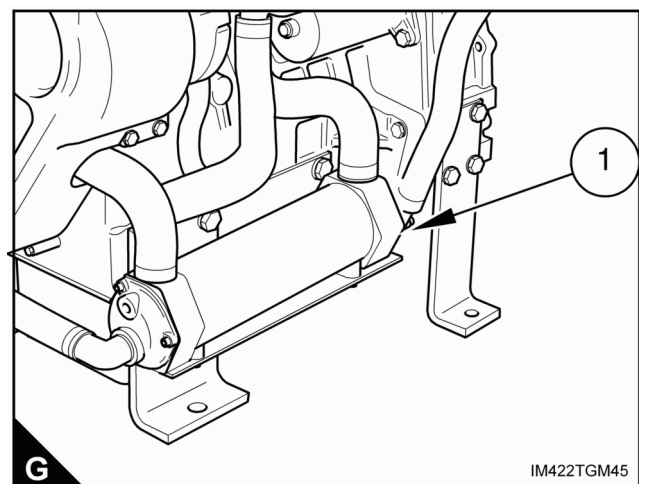
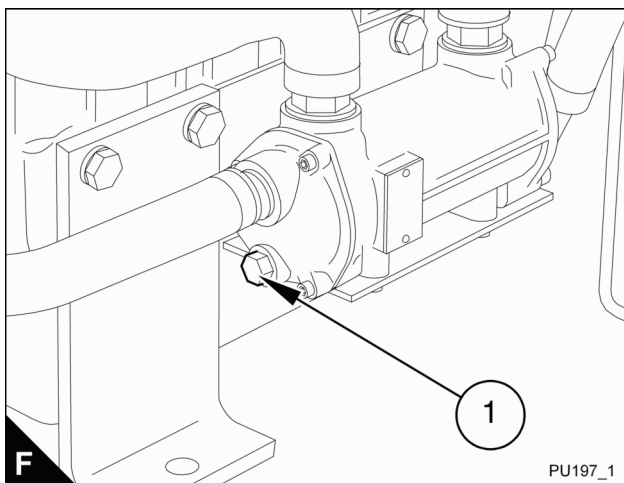


How to drain the raw water system

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” for details of the correct coolant to be used.

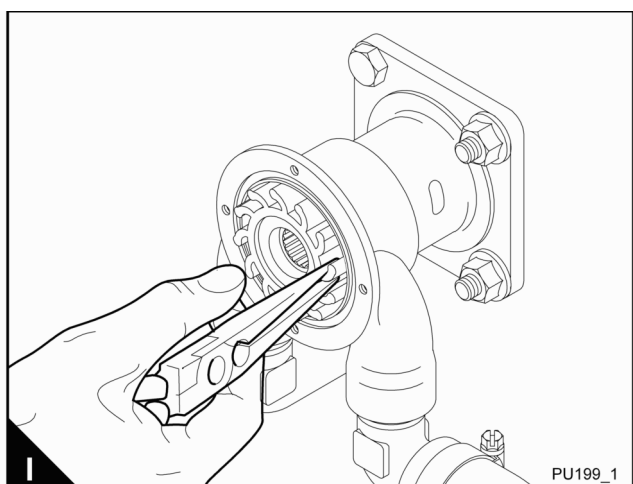
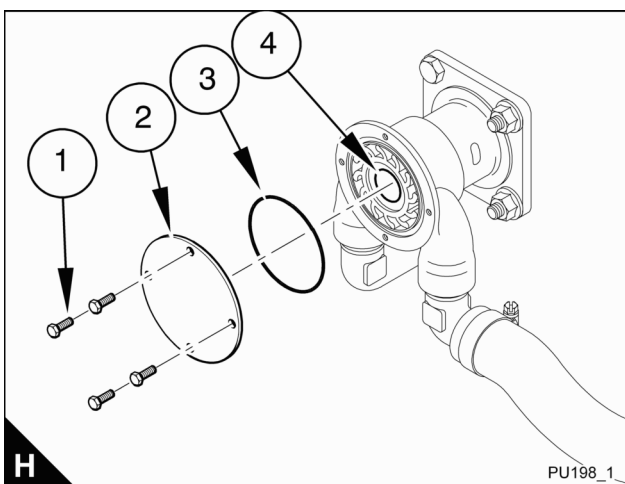
1. Ensure that the seacock is closed.
2. Remove the drain plug on the 415GM and 422GM (F1) or 422TGM (G1) from the raw water cooler.
3. After the system has been drained, refit the drain plug.

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



How to check the impeller of the raw water pump

1. Ensure that the seacock is closed.
2. Release the four setscrews (H1) which fasten the end plate (H2) of the raw water pump and remove the plate and 'O' ring (H3). 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 (H4) and then pull the impeller from the shaft (I).
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. Apply Spherol 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.
6. Gease a new 'O' ring (H3), insert into the pump body groove.
7. Fit the end plate (H2) and tighten the end plate screws.
8. Open the seacock.



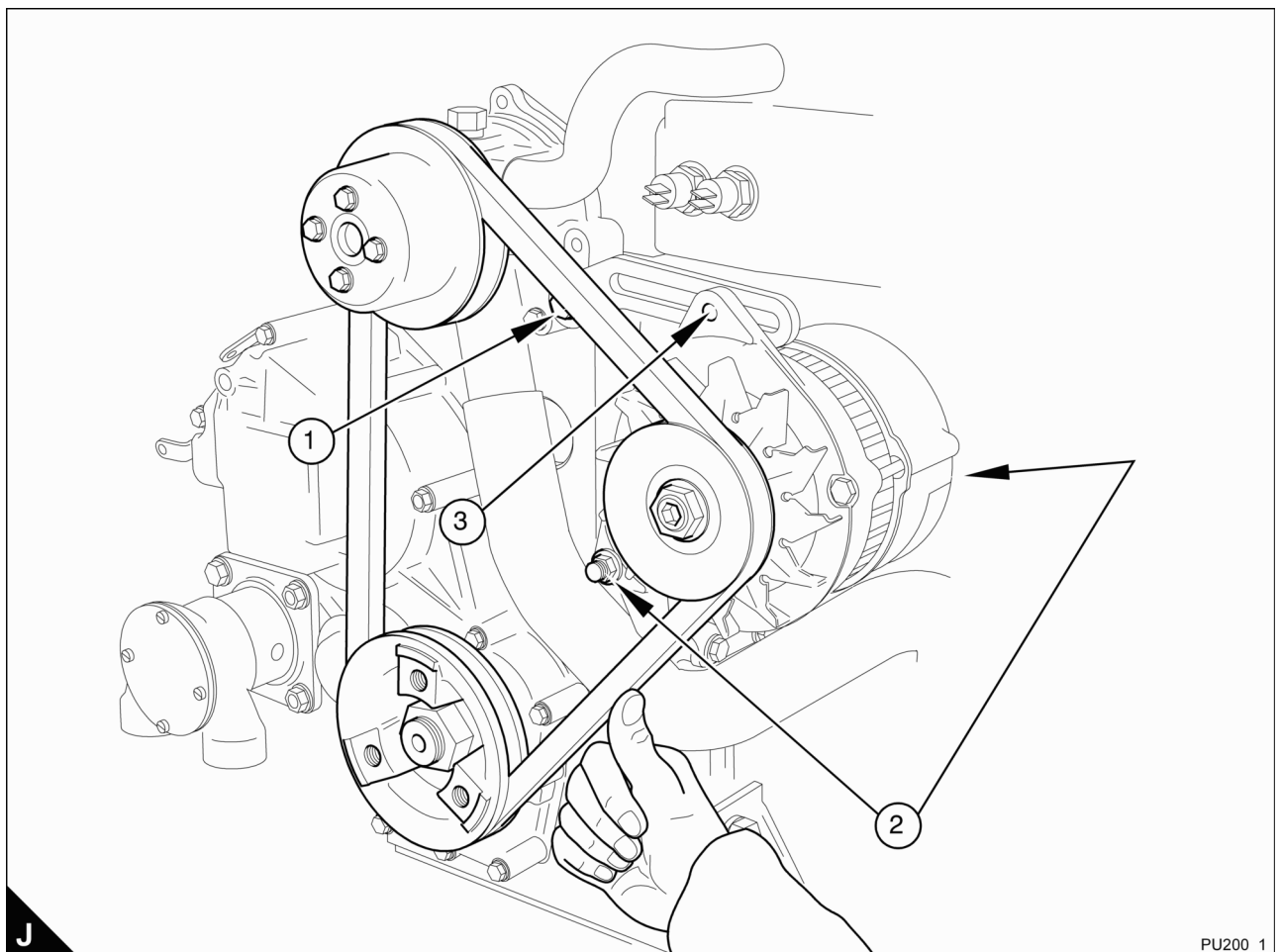
How to check the drive belt

Press down the belt with the thumb at the centre of the longest free length and check the deflection (J). 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.*
1. Loosen the adjusting strap pivot setscrew (J1) and the pivot fasteners (J2) of the alternator and loosen the setscrew (J3) of the adjusting strap.
 2. Change the position of the alternator to give the correct tension. Tighten the pivot fasteners of the alternator, and the setscrews of the adjusting strap.
 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 (K1) which is fitted through the filter head above the centre of the element.
3. Lower the bottom cover (K6) and the filter element (K4).
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 (K2) and (K5) and the 'O' ring (K3) 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.

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.

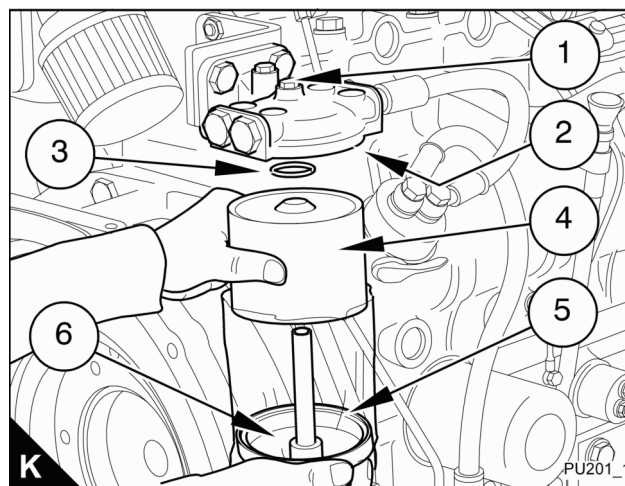
Atomiser fault

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. 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

- Use only deep sockets for this operation.
- Connections should be blanked off until assembly.
- Washer (L1) has two small holes 180° apart.
- Discard old washer (L2), on assembly fit new nozzle washer.

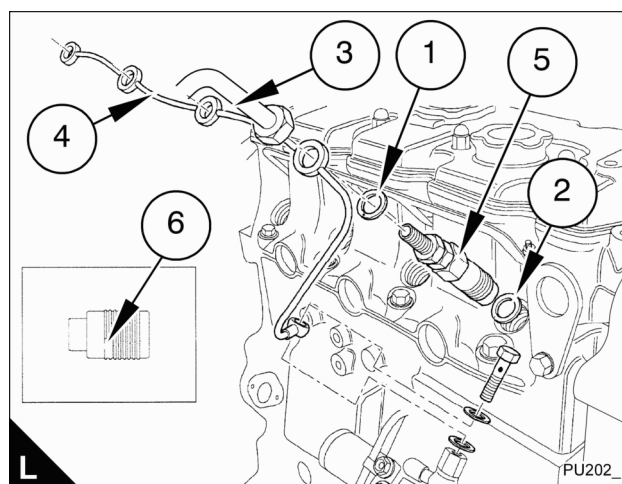
Note: If the atomisers or injection pipes are replaced it is essential that the fuel adjustment screw is not altered from the original settings. The maximum no load speed must be checked after assembly.

1. Clean thoroughly the area around the atomiser to be removed.
2. Remove the union nuts of the high-pressure pipe (L3) from the atomiser and from the fuel injection pump. Do not bend the pipe. If necessary, remove the pipe clamps.
3. Remove the fuel leak-off pipe (L4).
4. Remove the atomiser (L5) and the washer.
5. Before fitting the atomiser, clean and dry the male and female threads of the atomiser and the cylinder head head.
6. Apply a 2 mm (0.08 in) bead of sealant POWERPART universal jointing compound, part number 1861117, to extend 6 mm (0.24 in) along the first two threads of the atomiser (L6).
7. Fit the atomiser into the cylinder head with a new washer (L2). Tighten to 64 Nm (47 lbf ft) 6,5 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.
8. Fit the high-pressure fuel pipe and tighten the union nuts to 23 Nm (16.9 lbf ft) 2,3 kgf m. If necessary, fit the pipe clamps.
 9. Renew the sealing washers (L1) and fit the leak-off pipe. Tighten the banjo bolts to 27 Nm (19.9 lbf ft) 2,7 kgf m.
 10. Eliminate air from the fuel system.
 11. Operate the engine and check for leakage of fuel and air.

Illustration shows 422GM and 422TGM, 415GM is similar



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:

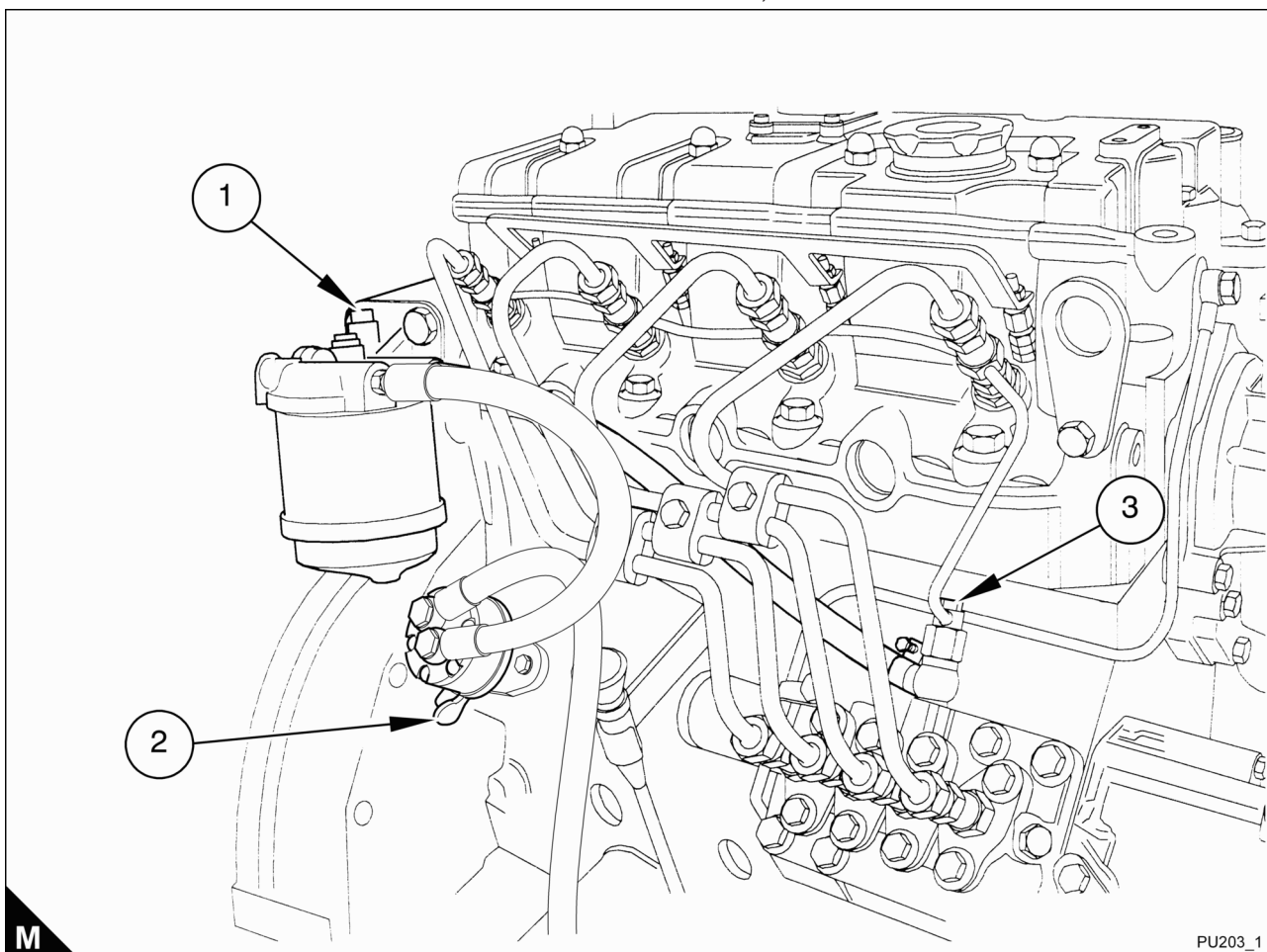
- The fuel tank is drained during normal operation.
- The low-pressure fuel pipes are disconnected.
- A part of the low-pressure fuel system leaks during engine operation.

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. When using the starter motor, do not exceed continuous rotation of more than 15 seconds periods. If the engine does not run, on initial rotation, wait for 30 seconds and try again. Connections should be blanked off until assembly.

1. Loosen the vent screw on the fuel filter (M1).
2. Operate the hand primer (M2) until fuel, free of air, flows from the vent screw. Tighten the vent screw (A1). If the hand primer does not work, rotate the engine half to one revolution and try again.
3. Loosen the vent screw on the fuel injection pump (M3). Operate the hand primer (M2) until fuel, free of air, flows. Tighten the vent screw (M3).
4. Attempt to start the engine using the starter motor for a maximum of 15 seconds, wait for 30 seconds before trying again. If the hand primer does not work, turn the engine half to one revolution to ensure correct operation.

Illustration shows 422GM and 422TGM, 415GM is similar.



How to renew the lubricating oil

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

Warning! Do not adjust the oil level while running.

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

1. Use a spanner (N1) to release the union nut on the bracket for the fuel connection and sump drain.
2. Connect the pipe to a sump drain pump (O1). Pump the lubricating oil into a suitable container with a capacity of approximately 11 litres (19 pints), the lubricating oil should be drained while it is still hot.
3. Disconnect the pipe from the pump and reconnect the pipe to the bracket. Tighten the connection. Remove the container of used lubricating oil.
4. Clean the area around the filler cap on top of the rocker cover and remove the cap.

Caution: These engines are fitted with a 'closed' crankcase breather system. Any necessary oil additions to the sump must be carried out with the engine stationary. Under no circumstances must oil additions be carried out with an engine running as oil could enter the 'closed' crankcase breather system causing the engine speed to increase rapidly without control.

It is important to ensure the correct level of lubricating oil is not exceeded in the sump. If there is too much oil in the sump the excess must be drained to the correct level. An excess of engine oil in the sump can enter the 'closed' crankcase breather system, which could cause the engine speed to increase rapidly without control.

5. Add slowly, 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 (P2) and ensure that the lubricating oil is to the full mark (P1). The oil level must not be above the full mark. If it is, the engine could be damaged.
6. Fit the filler cap and ensure that the dipstick is fitted correctly in the dipstick tube.
7. 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.

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

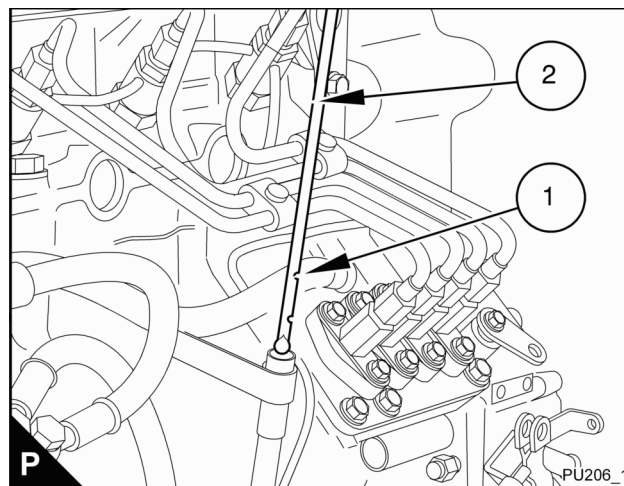
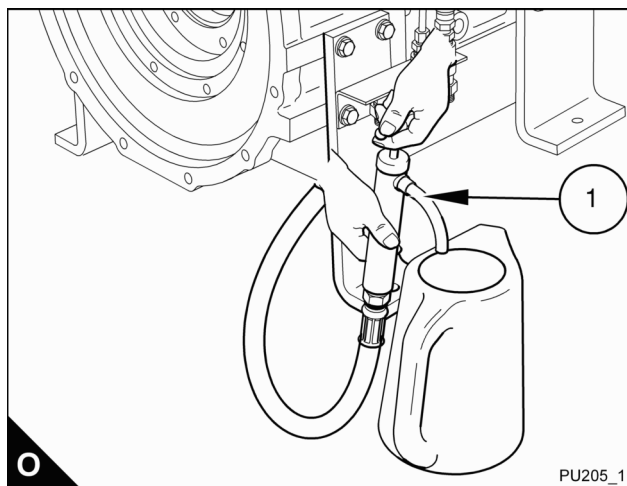
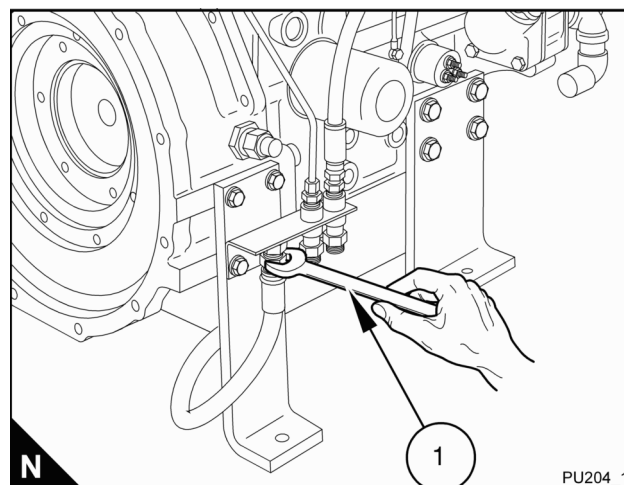


Illustration shows 422GM and 422TGM, 415GM is similar.

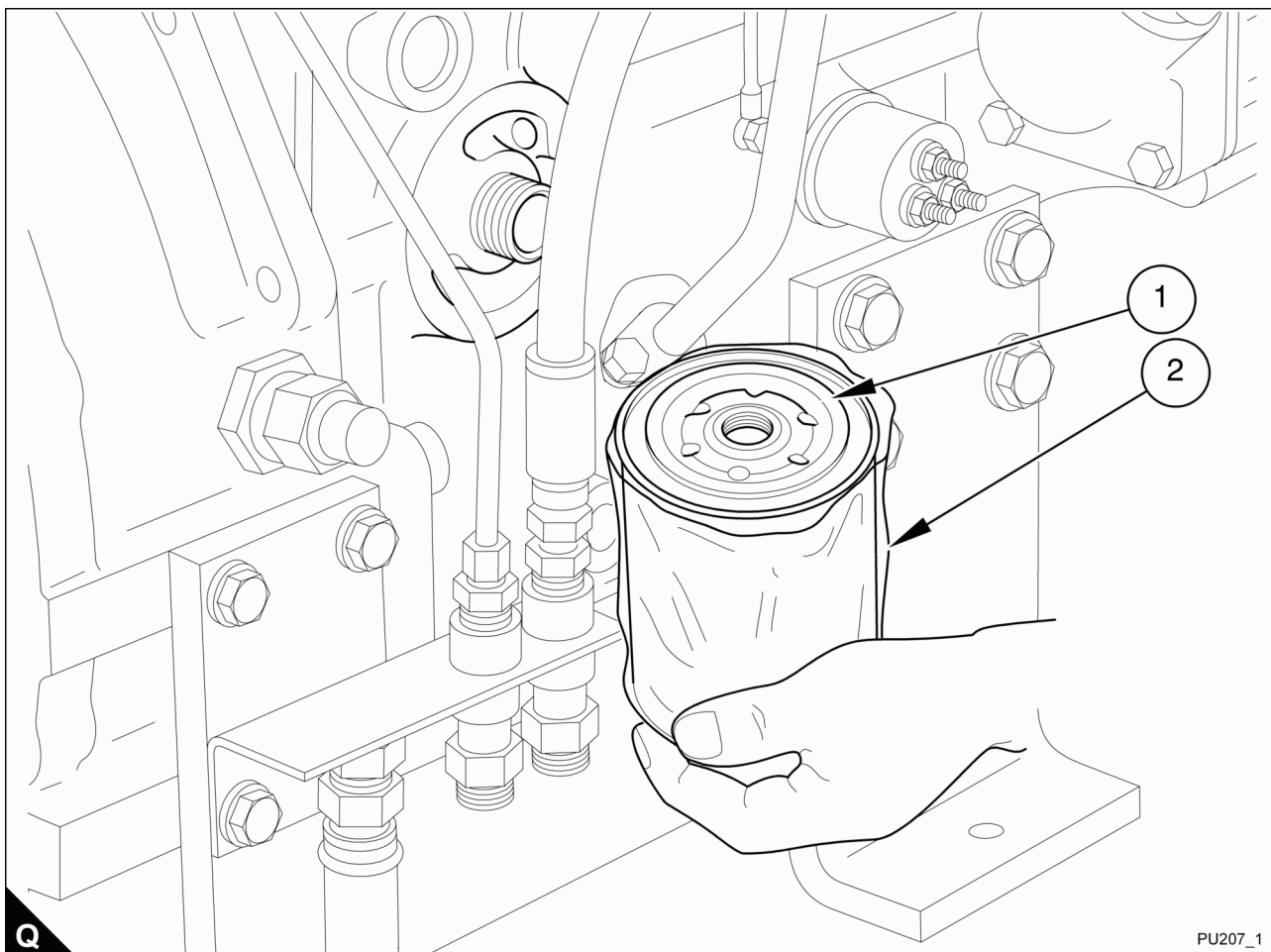
How to renew the canister of the lubricating oil filter

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 (Q2) 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 (Q1) 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 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 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

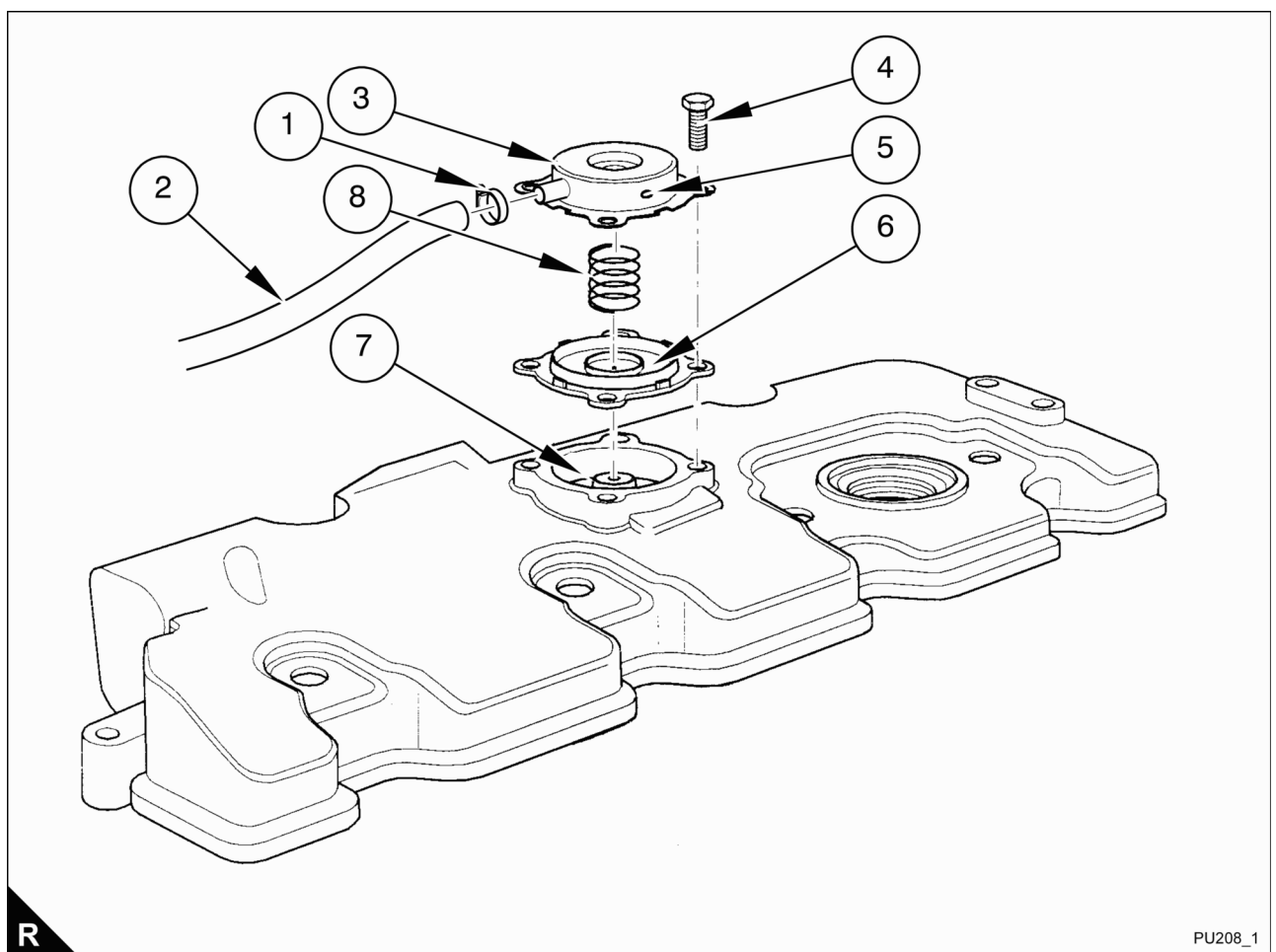
The breather assembly should be renewed every 2000 hours.

Caution: Ensure that the components of the breather assembly are fitted in their correct position (R1 - R6). If they are incorrectly fitted, the engine may be damaged.

1. **422TGM only** - Undo the clip (R1) and detach the hose (R2).
2. Release the four setscrews (R4) and remove the breather cover (R3), the spring (R8) and the diaphragm assembly (R6).

Caution: It is important that the area around the vent hole (R3) is clean.

3. Clean the breather cavity (R7) in the rocker cover.
4. Clean the breather in clean diesel fuel.
5. Fit the breather assembly into the cavity in the rocker cover, ensuring that the breather cover, diaphragm and spring are assembled correctly and that the vent hole (R5) faces towards the flywheel.
6. Tighten the four setscrews.

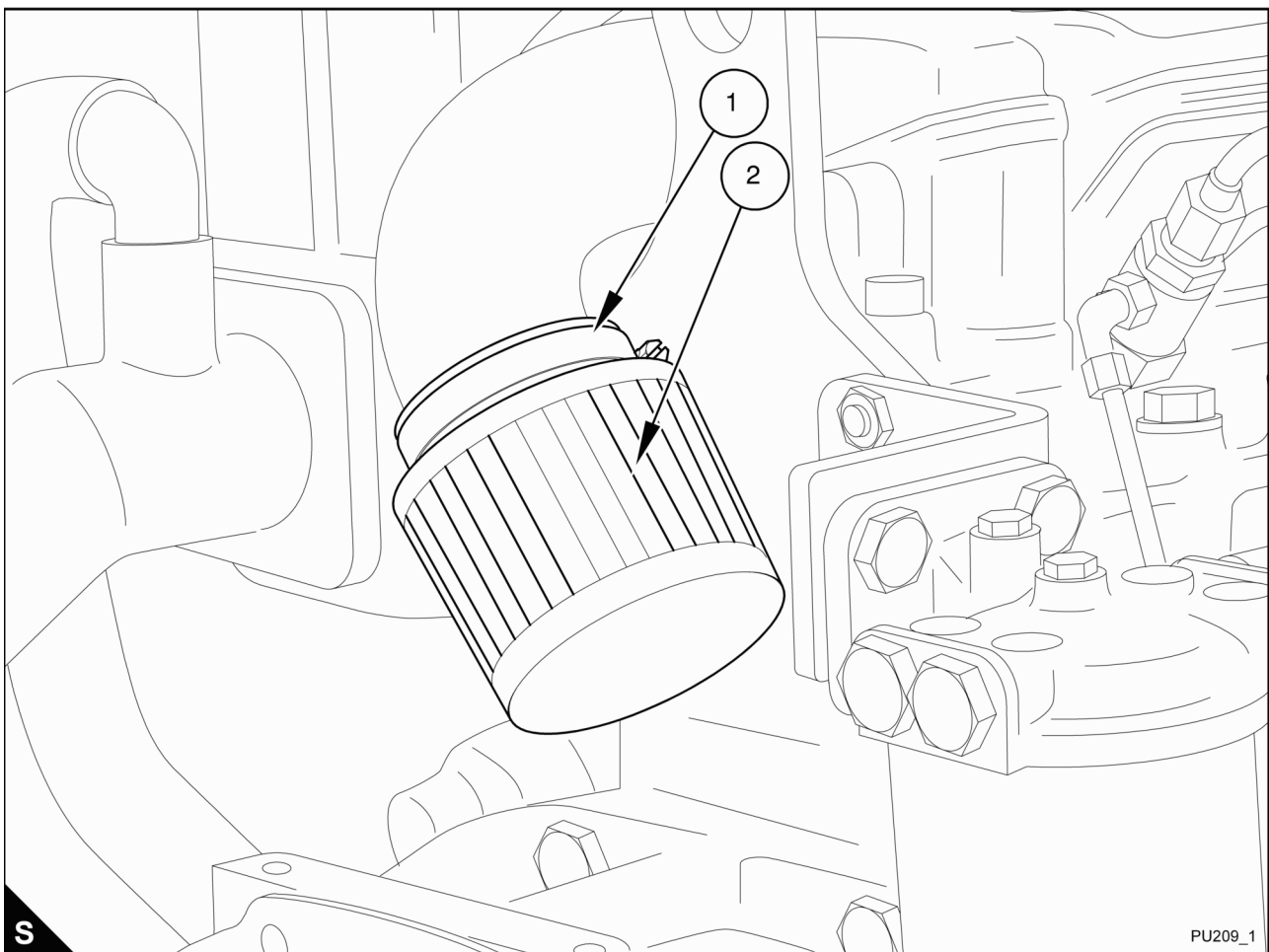


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How to renew the element of the air filter - 415GM and 422GM

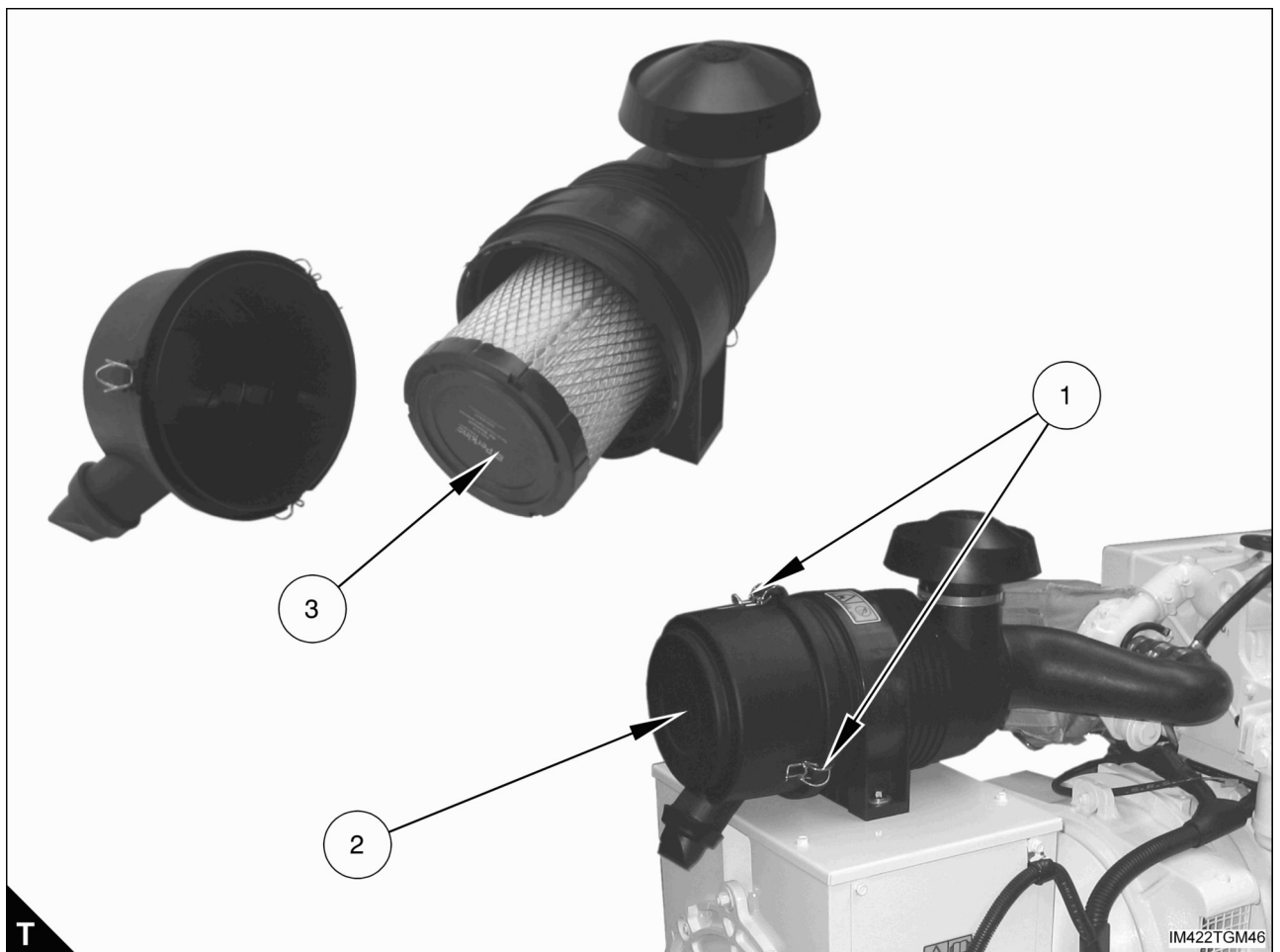
1. Release the hose clip (S1) and remove the air filter assembly (S2).
2. Fit a new filter element.
3. Tighten the hose clip.



How to renew the element of the air filter - 422TGM

1. Release the three clips (T1) and remove the end cover (T2).
2. Remove the filter element (T3).
3. Fit a new filter element.

The illustration shows the air filter fitted to customers alternator



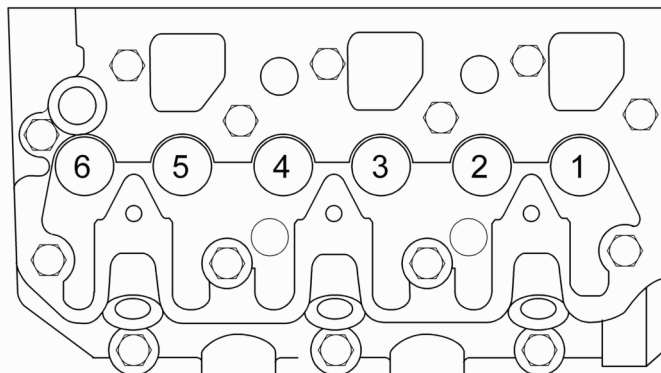
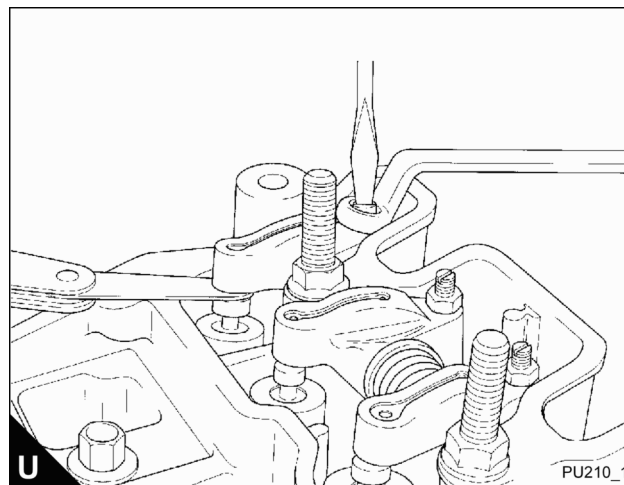
How to set the valve tip clearances - 415GM

Notes:

- The valve tip clearance is checked with a feeler gauge between the top of the valve stem and the rocker lever (U), with the engine cold. The correct clearance for both the inlet and the exhaust valves is 0,20 mm (0.0078 in). Tighten the valve adjustment nuts to 14Nm (10.3 lbf ft) 1,4 kgf m.
- The arrangement of the valves is shown in (V). Valve numbers (V1) and (V2) 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 (V1) has just opened and the valve (V2) has not closed completely. Check the clearances of the valves (V3) and (V6) and adjust them, if necessary.
 3. Rotate the crankshaft in a clockwise direction until the valve (V3) has just opened and the valve (V4) has not closed completely. Check the clearances of the valves (V2) and (V5) and adjust them, if necessary.
 4. Rotate the crankshaft in a clockwise direction until the valve (V5) has just opened and the valve (V6) has not closed completely. Check the clearances of the valves (V1) and (V4) 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.

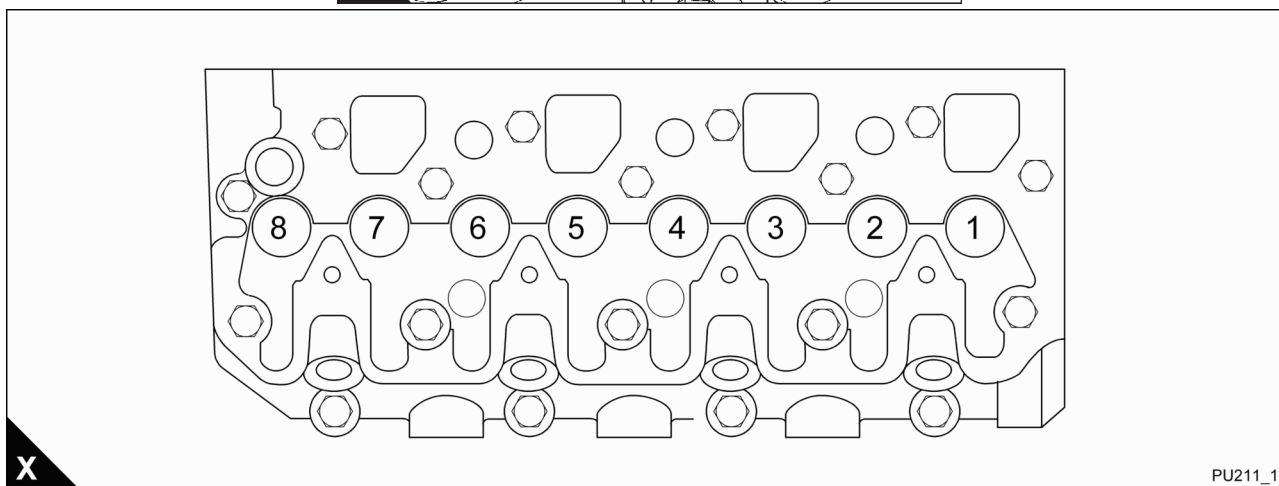
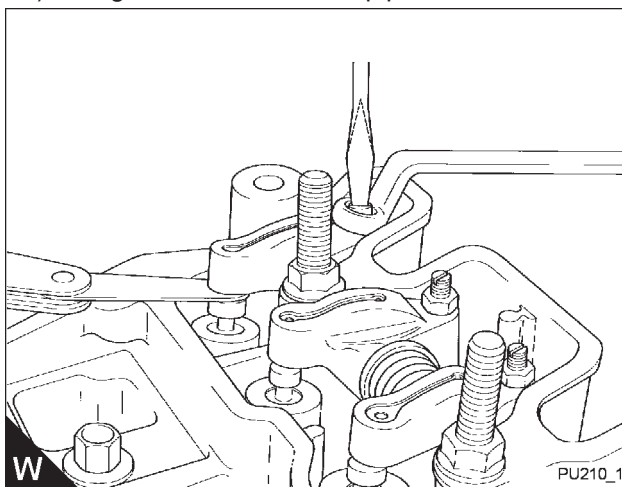
5. Fit the rocker cover. Ensure that the cap nuts, washers and the rubber seals are fitted correctly. Tighten the cap nuts to 11 Nm (8 lbf ft) 1,1 kgf m. Fit the breather pipe.



How to set the valve tip clearances - 422GM and 422TGM

Notes:

- The valve tip clearance is checked with a feeler gauge between the top of the valve stem and the rocker lever (W), with the engine cold. The correct clearance for both the inlet and the exhaust valves is 0,20 mm (0.0078 in). Tighten the valve adjustment nuts to 14Nm (10.3 lbft ft) 1,4 kgf m.
 - The arrangement of the valves is shown in (X). Valve numbers (X1) and (X2) 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 (X7) has just opened and the valve (X8) has not closed completely. Check the clearances of the valves (X1) and (X2) and adjust them, if necessary.
 3. Rotate the crankshaft in a clockwise direction until the valve (X3) has just opened and the valve (X4) has not closed completely. Check the clearances of the valves (X5) and (X6) and adjust them, if necessary.
 4. Rotate the crankshaft in a clockwise direction until the valve (X1) has just opened and the valve (X2) has not closed completely. Check the clearances of the valves (X7) and (X8) and adjust them, if necessary.
 5. Rotate the crankshaft in a clockwise direction until the valve (X5) has just opened and the valve (X6) has not closed completely. Check the clearances of the valves (X3) and (X4) 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

(1) Also available in the On-board spares kit.

Preventive maintenance periods - 4.4GM, 4.4TGM, 4.4TWGM, 4.4TW2GM, 4.4GM rad, 4.4TGM rad, 4.4TWGM rad & 4.4TW2GM rad.

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 - 4.4GM, 4.4TGM, 4.4TWGM, 4.4TW2GM.

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 ⁽²⁾
•		•					Check the tension and the condition of the drive belt
•		•					Check hose and clips
			•				Check the impeller of the raw water pump
	•						Check the sea water strainer, where applicable
•	•						Drain water from the fuel pre-filter ⁽¹⁾
			•				Renew the element of the fuel filter
						•	Atomiser maintenance ^{(2) (5)}
	•						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
			•				Renew the engine breather elements
						•	Renew the engine breather ^{(2) (6)}
			•				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
						•	Ensure that the alternator, the starter motor, etc. are checked ⁽²⁾
			•				Check the engine mounts
				•			Inspect the electrical system for signs of damage ⁽²⁾

(1) If one is fitted.
 (2) By a person who has had the correct training.
 (3) Renew the antifreeze every 6 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, see page 39.
 (6) Renew the complete engine breather assembly at major engine service or 8000 hours.

Schedules - 4.4GM rad, 4.4TGM rad, 4.4TWGM rad & 4.4TW2GM rad.

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 radiator
	•						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 hose and clips
•	•						Drain water from the fuel pre-filter ⁽¹⁾
			•				Renew the element of the fuel filter
						•	Atomiser maintenance ^{(2) (5)}
	•						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
			•				Renew the engine breather elements
						•	Renew the engine breather ^{(2) (6)}
			•				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
					•		Ensure that the alternator, the starter motor, etc. are checked ⁽²⁾
			•				Check the engine mounts
			•				Inspect the electrical system for signs of damage ⁽²⁾

(1) If one is fitted.
 (2) By a person who has had the correct training.
 (3) Renew the antifreeze every 6 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) Renew the complete engine breather assembly at major engine service or 8000 hours.

How to fill the coolant circuit - 4.4GM, 4.4TGM, 4.4TWGM, 4.4TW2GM.

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.

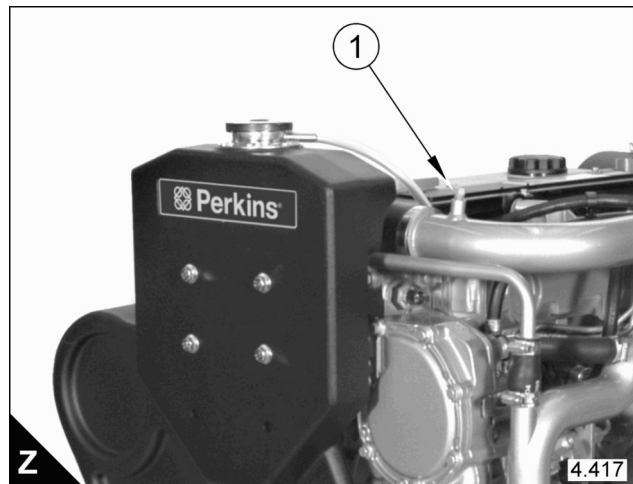
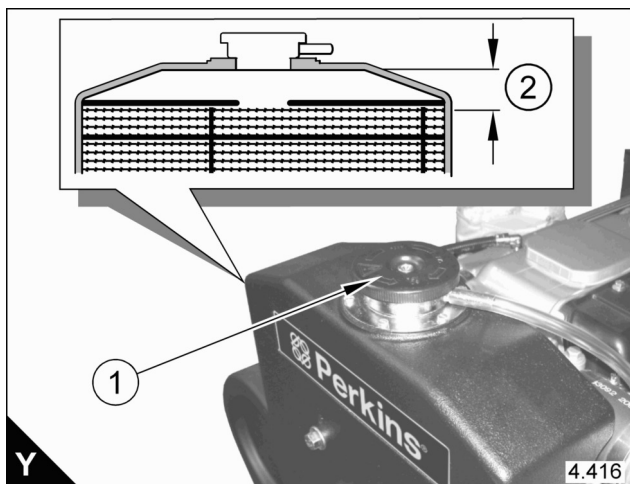
Do not put too much coolant in the coolant circuit. There is a relief valve in the filler cap which will open and release hot coolant if too much coolant is added.

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 (Y1) of the header tank and slowly fill the coolant system until the coolant level is just below the level of the baffle (Y2).

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 (Z1)

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.

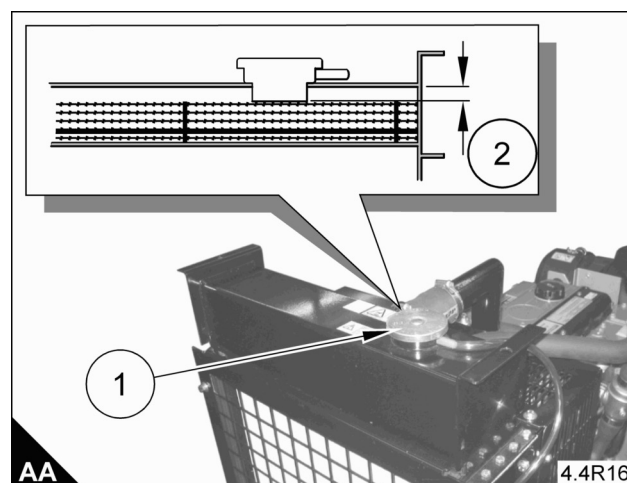


How to fill the coolant circuit - 4.4GM rad, 4.4TGM rad, 4.4TWGM rad & 4.4TW2GM rad.

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" for details of the correct coolant to be used in the circuit.

1. Remove the filler cap (AA1) of the radiator and slowly fill the coolant system until the coolant level is just below the level of the filler neck (AA2).
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 radiator and add coolant until the level of the coolant is correct.
5. Fit the filler cap.

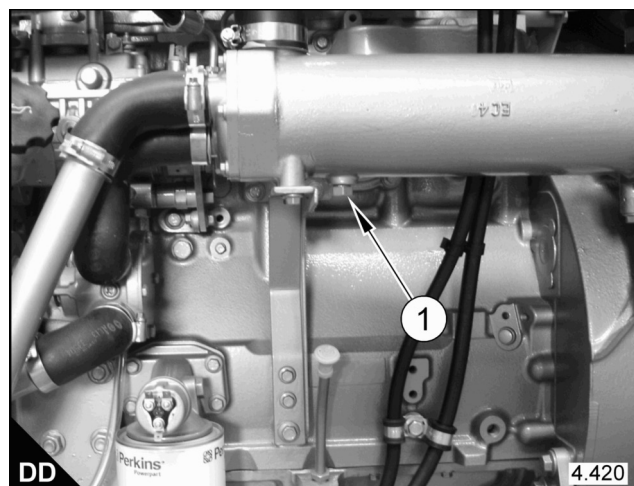
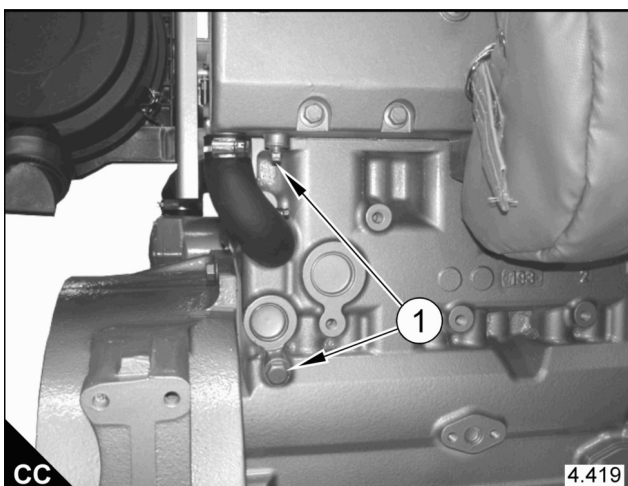
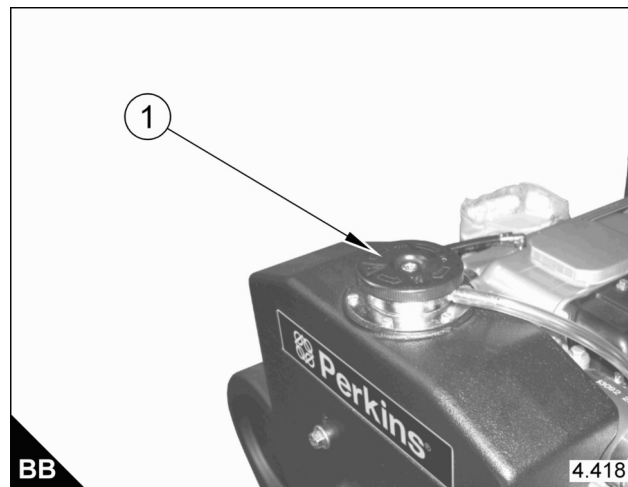


How to drain the coolant circuit - 4.4GM

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 (BB1).
 2. Remove the drain plugs (CC1) from the side of the cylinder block and the heat exchanger (DD1). 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.

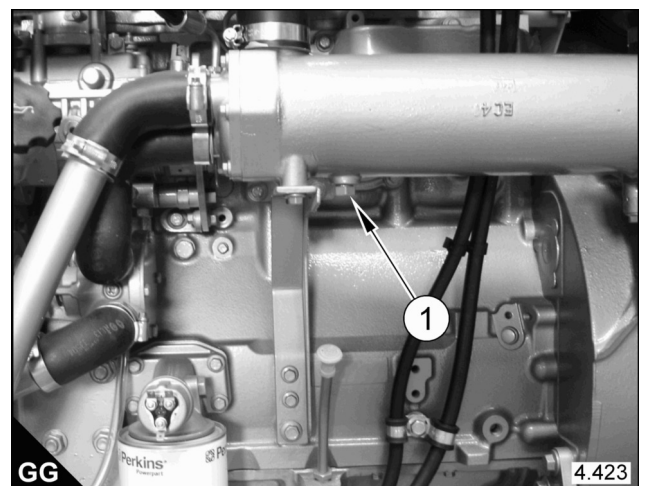
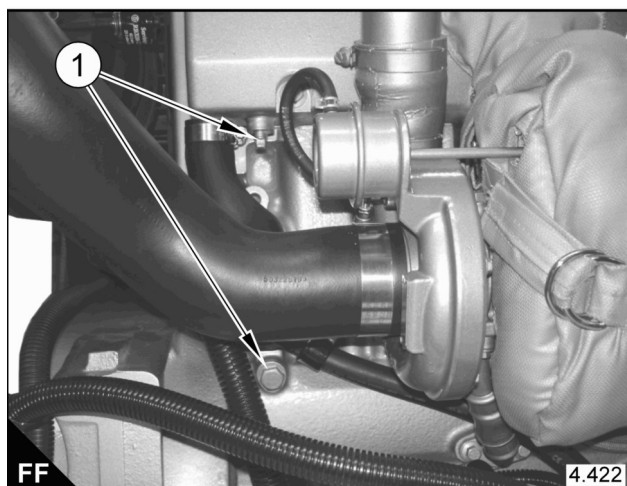
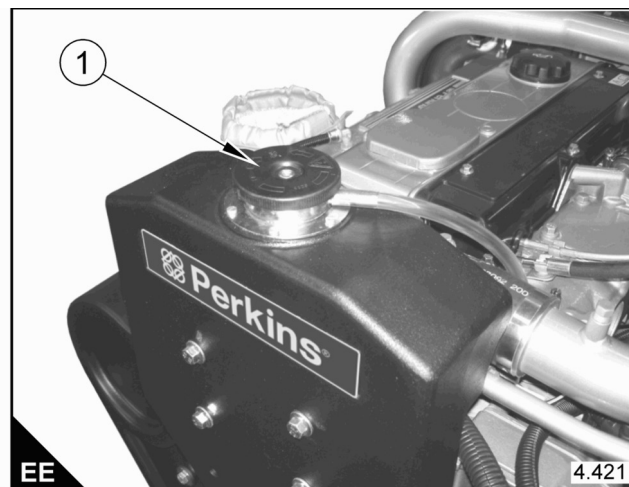


How to drain the coolant circuit - 4.4TGM

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 (EE1).
 2. Remove the drain plugs (FF1) from the side of the cylinder block and the heat exchanger (GG1). 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.



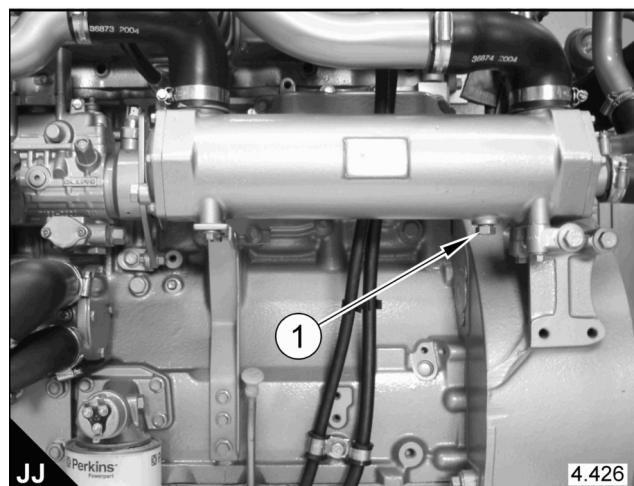
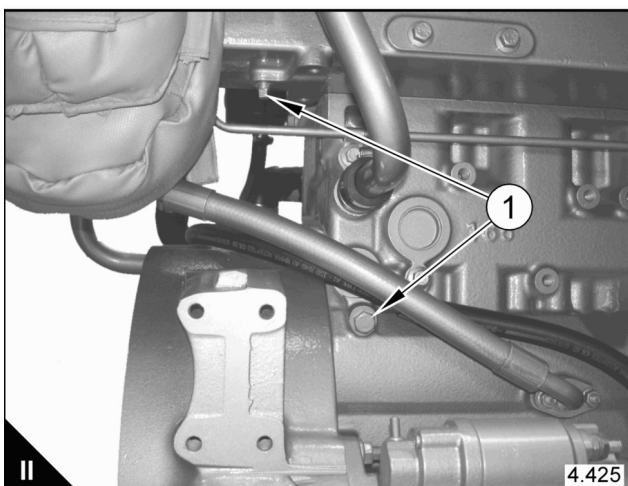
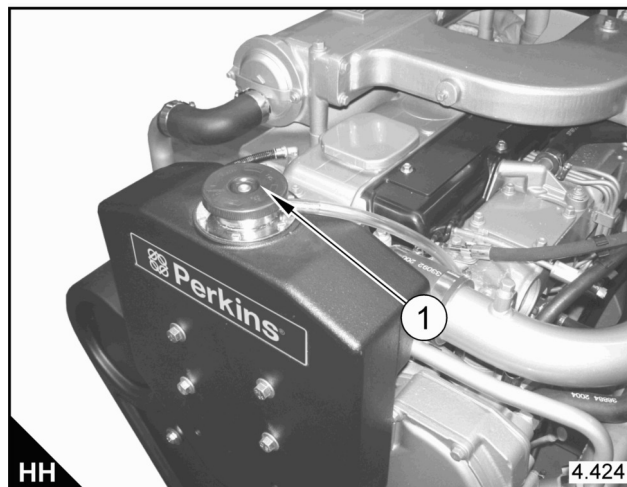
How to drain the coolant circuit - 4.4TWGM & 4.4TW2GM

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 (HH1).
2. Remove the drain plugs (II1) from the side of the cylinder block and the heat exchanger (JJ1). 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.

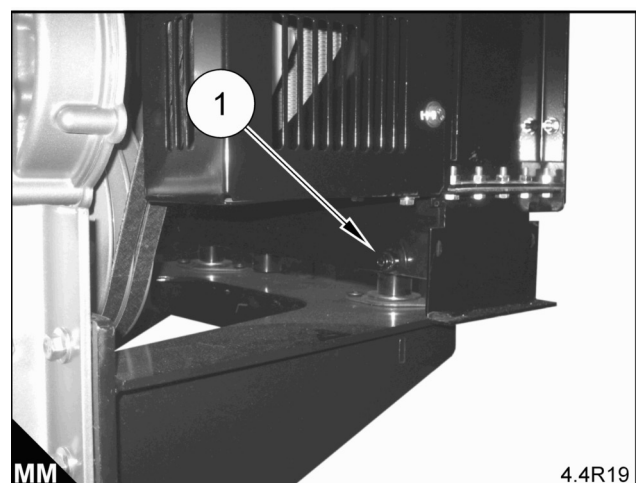
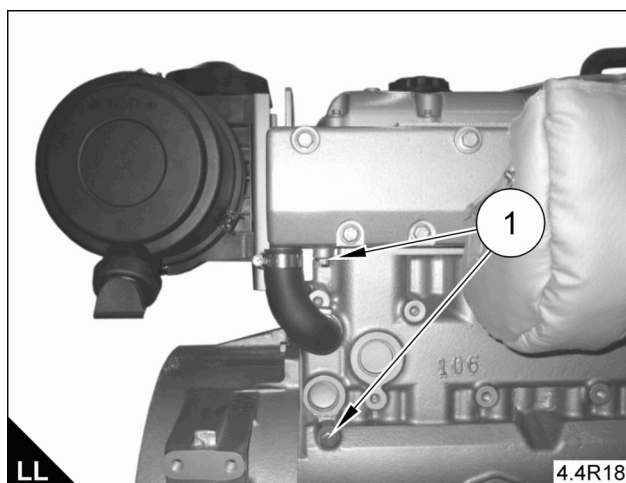
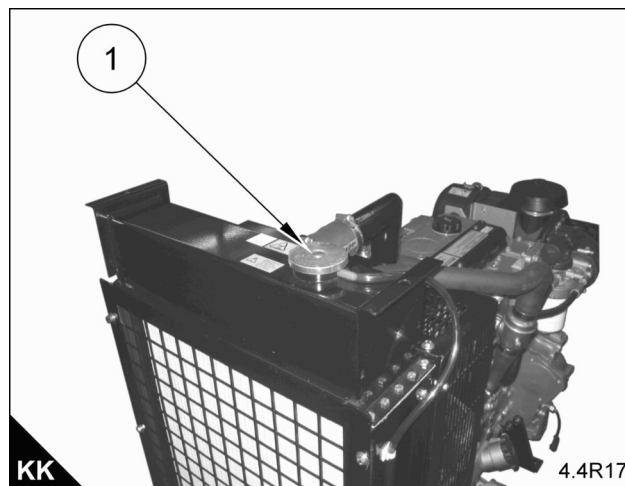


How to drain the coolant circuit - 4.4GM & 4.4TGM rad.

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 on top of the radiator (KK1).
 2. Remove the drain plugs (LL1) from the side of the cylinder block and the manifold.
 3. Remove the drain plug (MM1) from the bottom of the radiator.
 4. After the system has been drained, fit the filler cap and the drain plugs.
 5. Fasten a label in a suitable place to indicate that the cooling 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 cooling system must be filled again with an approved antifreeze mixture. See "Coolant specification" for details of the correct coolant to be used in the circuit.

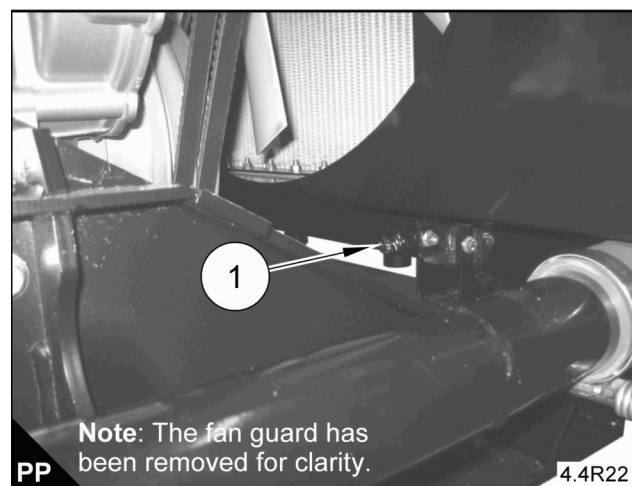
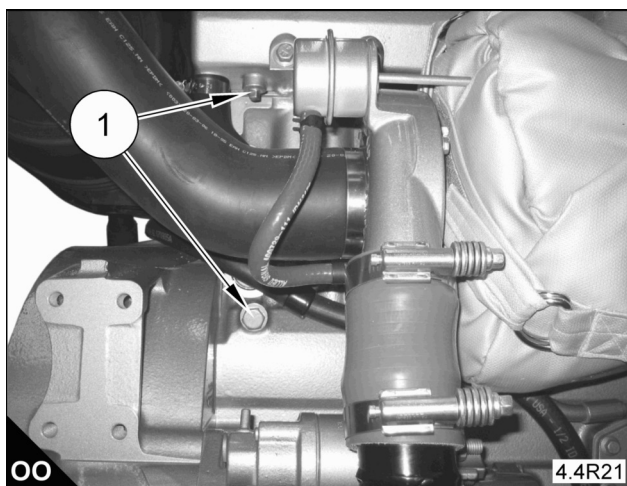
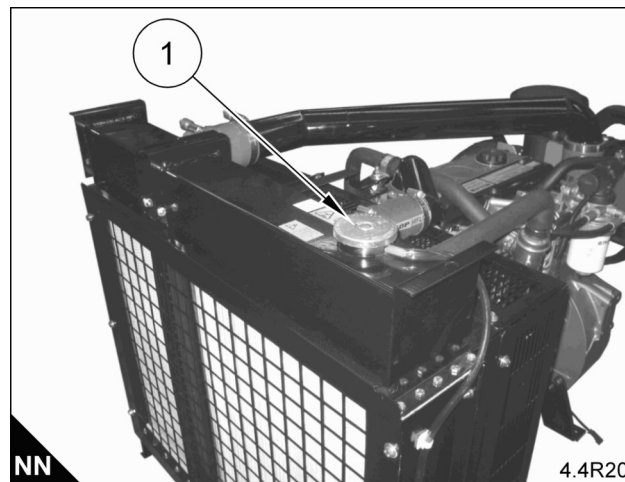


How to drain the coolant circuit - 4.4TWGM & 4.4TW2GM rad.

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 on top of the radiator (NN1).
 2. Remove the drain plugs (OO1) from the side of the cylinder block and the manifold.
 3. Remove the drain plug (PP1) from the bottom of the radiator.
 4. After the system has been drained, fit the filler cap and the drain plugs.
 5. Fasten a label in a suitable place to indicate that the cooling 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 cooling system must be filled again with an approved antifreeze mixture. See "Coolant specification" 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 (H).

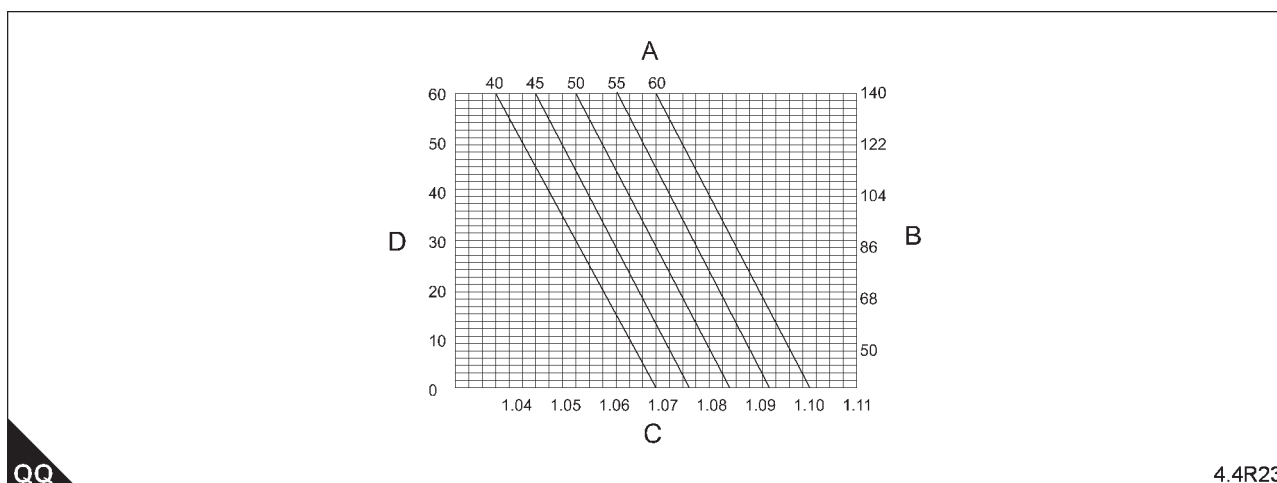
Specific gravity chart

- 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 cooling system in service, mix the coolant to the correct strength before it is added to the cooling 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.



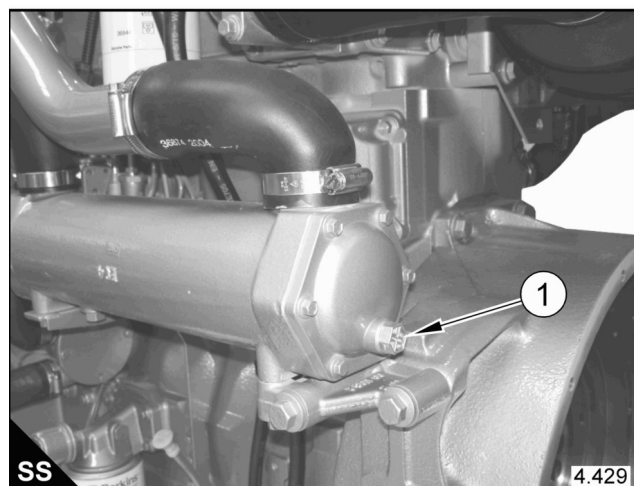
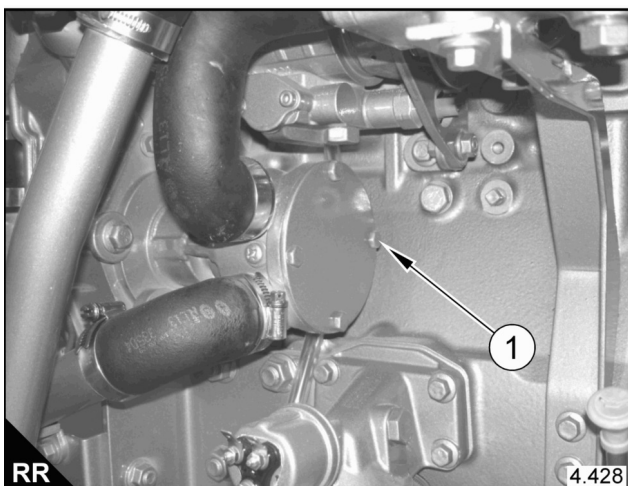
How to drain the raw water system - 4.4GM & 4.4TGM

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 four setscrews (RR1) of the cover for the raw water pump and withdraw the cover slightly.
3. Rotate the crankshaft to ensure that the raw water pump is empty.
4. Tighten the four 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 (SS1) and drain the heat exchanger. Refit the drain plug.



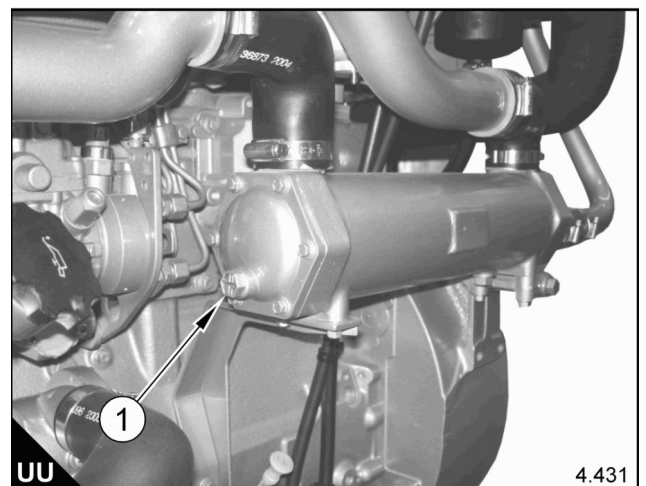
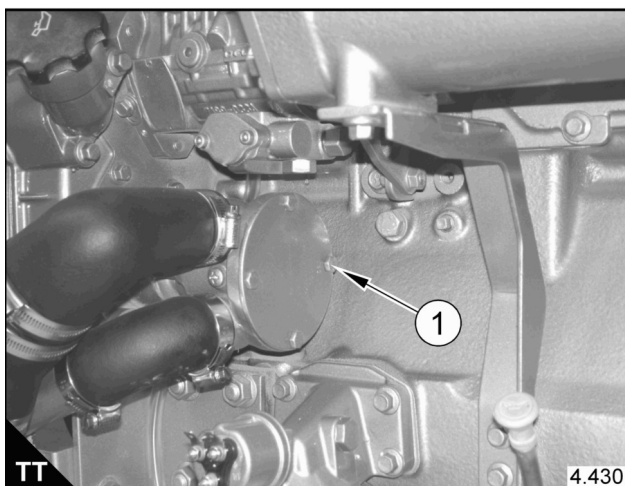
How to drain the raw water system - 4.4TWGM & 4.4TW2GM

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 four setscrews (TT1) of the cover for the raw water pump and withdraw the cover slightly.
3. Rotate the crankshaft to ensure that the raw water pump is empty.
4. Tighten the four setscrews of the cover for the raw water pump (If necessary replace the 'O' ring).

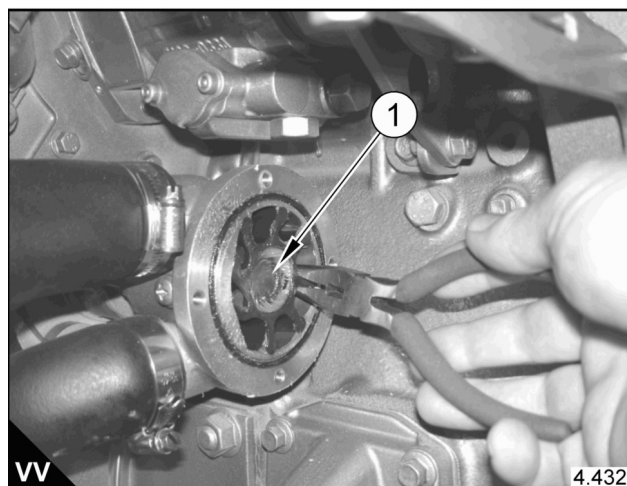
Caution: When the raw water system is to be used again, ensure that the seacock is open.

5. Remove the drain plug (UU1) and drain the heat exchanger. Refit the drain plug.



How to check the impeller of the raw water pump - 4.4GM, 4.4TGM, 4.4TWGM & 4.4TW2GM

1. Ensure that the seacock is closed.
2. Release the four 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 (VV1) 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.
6. Remove the outlet hose from the raw water pump. Remove any debris and check for broken pieces of impeller blades.
7. Fit the outlet hose to the raw water pump and tighten the hose clips. Replenish the coolant circuit.
8. 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 (VV). Fit the rubber end cap.
9. Renew 'O' ring seal if necessary. Fit the end plate making sure that the 'O' ring remains seated in the groove and tighten the end plate screws.
10. Open the seacock.



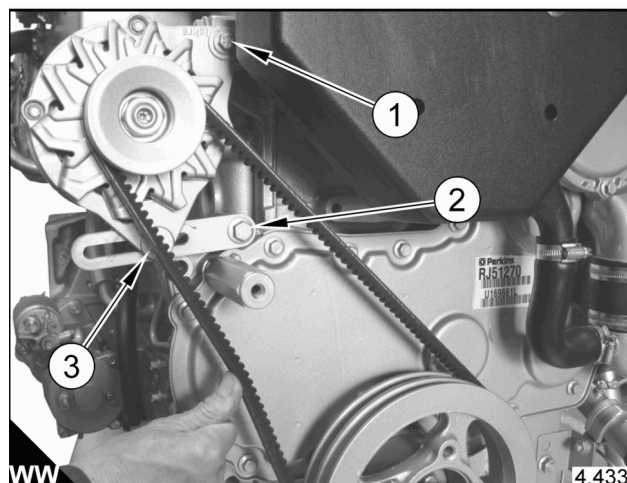
How to check the drive belt - 4.4GM, 4.4TGM, 4.4TWGM & 4.4TW2GM

Press down the belt with the thumb at the centre of the longest free length and check the deflection (R). 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

Caution: 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 (WW1) of the alternator and loosen the setscrews (WW2) and (WW3) of the adjustment link.
2. Change the position of the alternator to give the correct tension. Tighten the pivot fastener of the alternator and the setscrews 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.



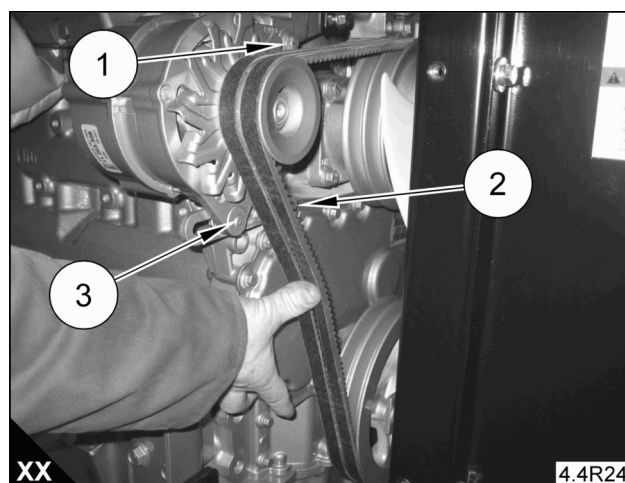
How to check the drive belt - 4.4GM rad, 4.4TGM rad, 4.4TWGM rad & 4.4TW2GM rad

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

How to adjust the belt tension

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

1. Loosen the pivot fastener (XX1) of the alternator and loosen the setscrews (XX2) and (XX3) of the adjustment link.
2. Change the position of the alternator to give the correct tension. Tighten the pivot fastener of the alternator and the setscrews of the adjustment link.
3. Check the belt tension again to ensure that it is still correct. If new belts are fitted, the belt tension must be checked again after the first 25 hours of operation.



How to renew the element of the fuel filter - 4.4GM, 4.4TGM, 4.4TWGM & 4.4TW2GM

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

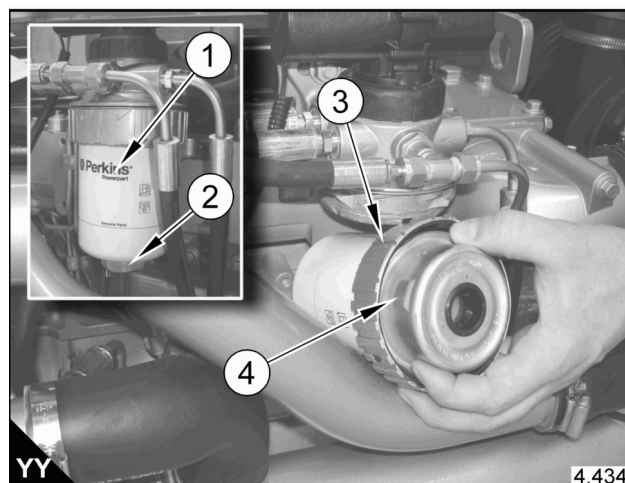
Caution: It is important that only the genuine Perkins parts are used. The use of wrong parts could damage the fuel injection equipment.

1. Thoroughly clean the outside surfaces of the fuel filter assembly (YY1).
2. Loosen the drain device (YY2) at the bottom of the filter canister and drain the fuel into a suitable container.
3. Turn the clamping ring (YY3) to the left to free the filter.
4. Ensure that the inside of the filter head is clean
5. Ensure the locating nodes (YY4) 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.



How to renew the element of the fuel filter - 4.4GM rad, 4.4TGM rad, 4.4TWGM rad & 4.4TW2GM rad.

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

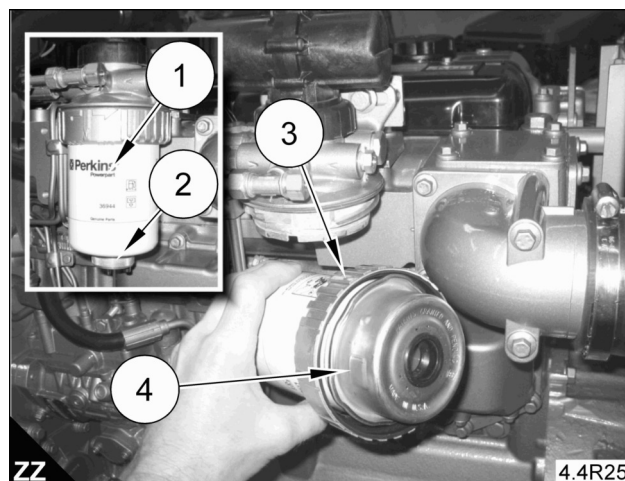
Caution: It is important that only the genuine Perkins parts are used. The use of wrong parts could damage the fuel injection equipment.

1. Thoroughly clean the outside surfaces of the fuel filter assembly (ZZ1).
2. Loosen the drain device (ZZ2) at the bottom of the filter canister and drain the fuel into a suitable container.
3. Turn the clamping ring (ZZ3) to the left to free the filter.
4. Ensure that the inside of the filter head is clean
5. Ensure the locating nodes (ZZ4) 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 (optional)

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

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:

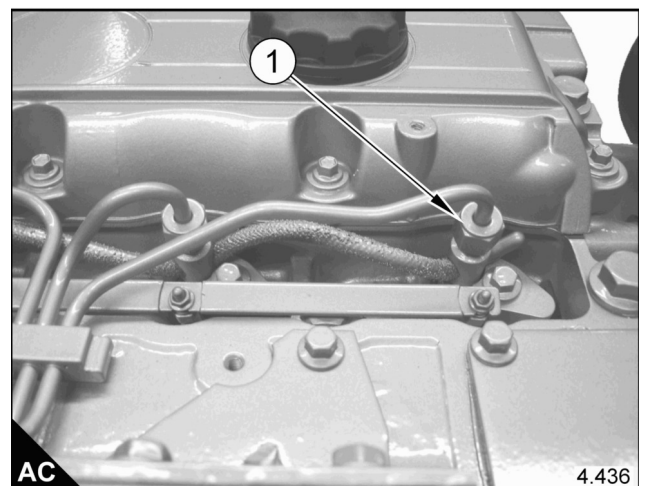
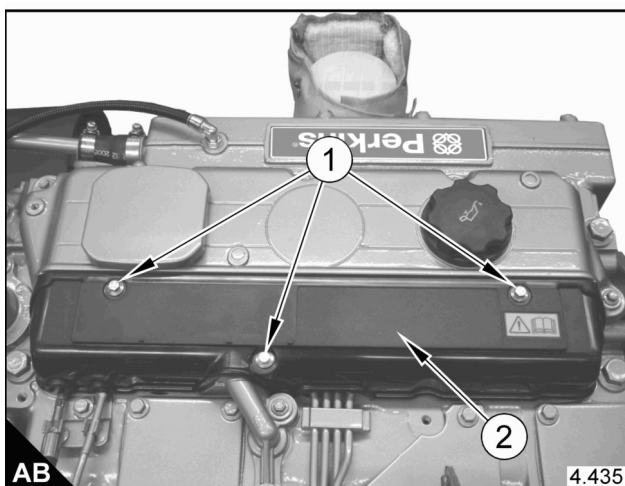
- Engine will not start or is difficult to start
- Not enough power
- Engine misfires or runs erratically
- High fuel consumption
- Black exhaust smoke
- Engine knocks or vibrates excessively
- Excessive engine temperature.

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 all the atomisers and have them tested by a specialist.

Remove the atomiser cover setscrews (AB1) and remove the atomiser cover (AB2). In order to find which atomiser is defective, operate the engine. Loosen and tighten the union nuts (AC1) 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

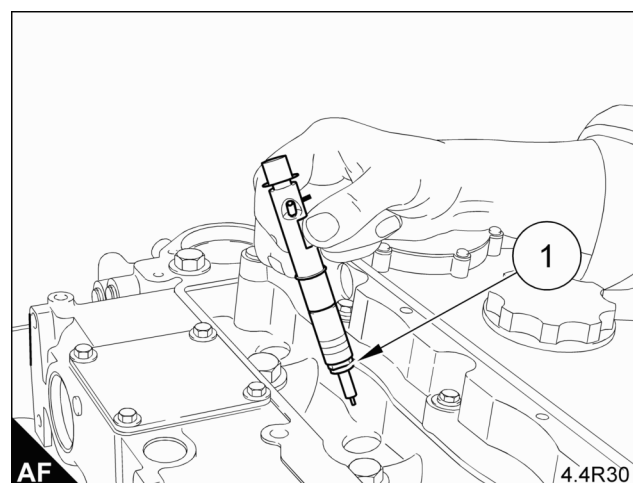
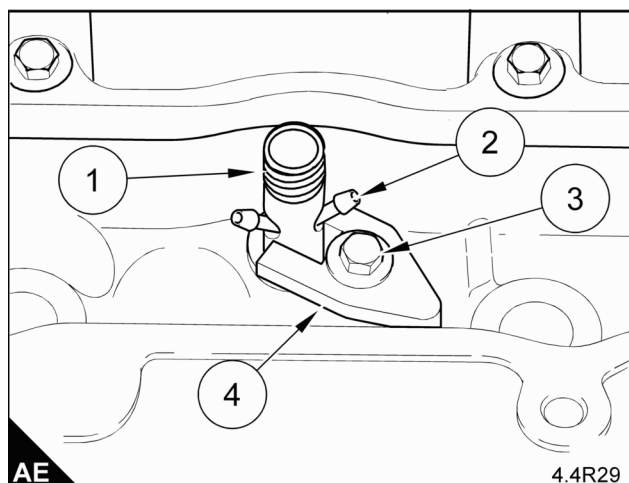
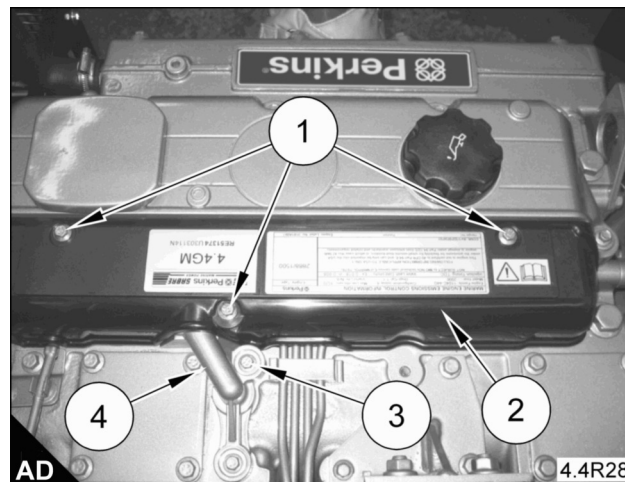
Warning! The combustible material of some components of the engine (for example certain seals) can become extremely dangerous if it is burned. Never allow this burnt material to come into contact with the skin or with the eyes.

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 (AD1) and remove the atomiser cover (AD2).
2. Release the fastener (K3) and remove the breather pipe (AD4).
3. Remove the fuel leak-off hose from the connection (AE2).
4. Remove the union nuts of the high-pressure pipe from the atomiser (AE1) 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 (AE3) and remove the clamp (AE4) from the cylinder head.
6. Remove the atomiser and its seat washer (AF1) from its recess in the cylinder head.

Caution: Remove and discard the seat washer (AF1). 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

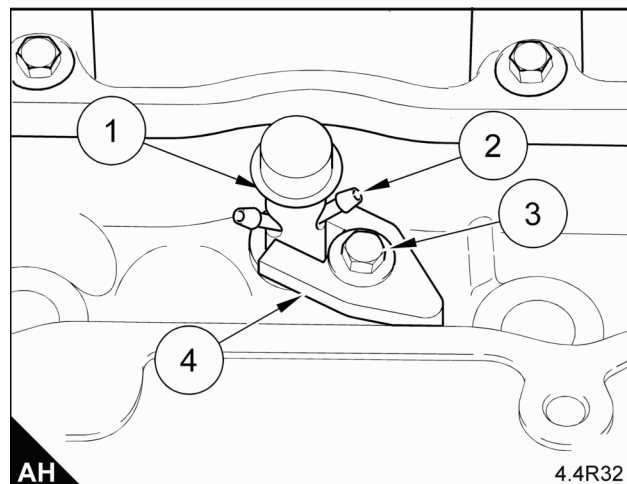
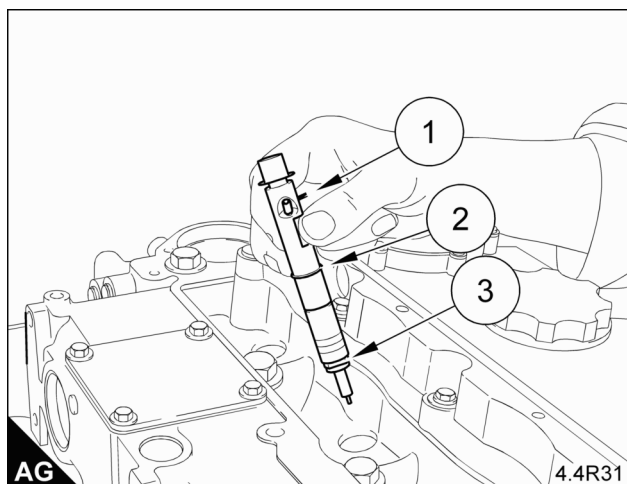
1. Remove all covers and caps from the component and connections.
2. Put a new seat washer into the seat recess in the cylinder head.

Note: Some new atomiser's have the seat washer (AG3) fitted on the atomiser.

3. Ensure that the atomiser seal is not damaged. Apply a small amount of clean fuel oil to the seal (AG2).
 - The atomiser must be fitted so that the pin or the union (AG1) faces away from the atomiser clamp (AH4).
 - If fitted the leak-off hose is a push fit and will need replacing if the hose leaks.
4. Put the atomiser (AH1) into its recess in the cylinder head.
5. Fit the clamp (AH4) and the setscrew (AH3). 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 (AH2).
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

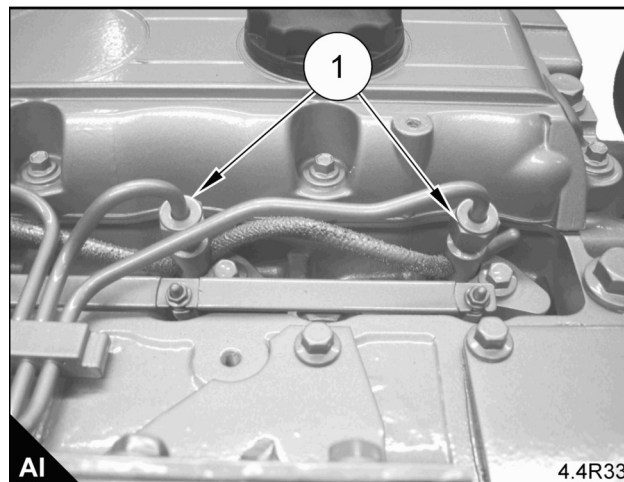
Cautions:

- 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 no load.

1. Remove the atomiser cover.
2. Loosen the high pressure pipes (AI1) at the atomisers.
3. Switch the control panel to energise the electric lift pump for 30 to 60 seconds.

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.

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.



How to renew the lubricating oil

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

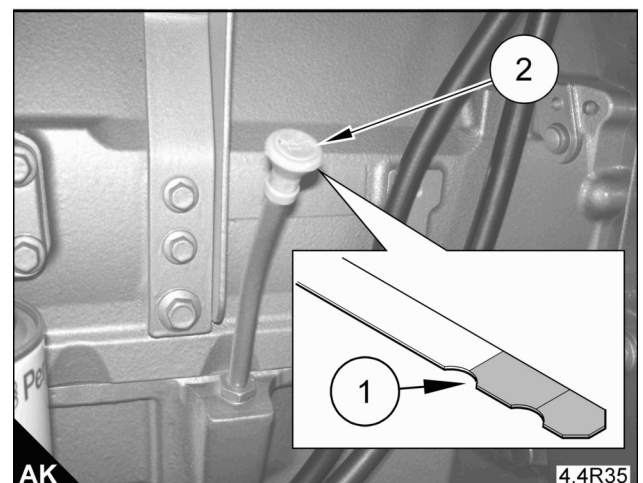
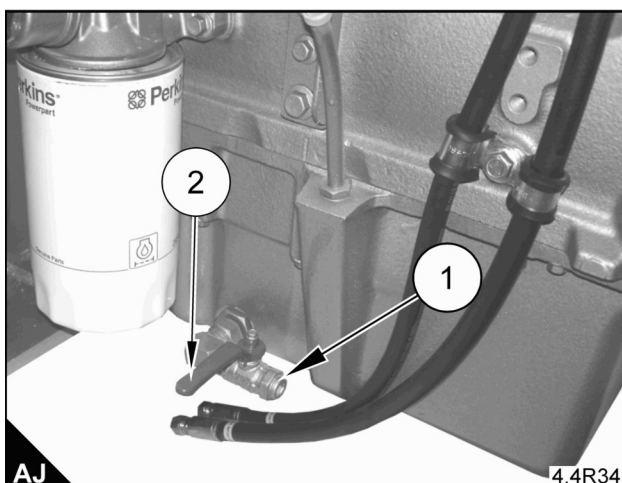
Warning! Do not adjust the oil level while running.

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

1. Drain 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 3/8" NPTF plug (AJ1) from the tap and attach a length of hose (with a sump pump if available), to the container.
3. Open the tap (AJ2) and allow the oil to drain out.
4. Remove the container of used lubricating oil, close the tap and replace the plug.
5. Clean the area around the filler cap on top of the rocker cover and remove the cap.

Caution: All these engines are fitted with a 'closed' crankcase breather system. Any necessary oil additions to the sump must be carried out with the engine stationary. Under no circumstances must oil additions be carried out with an engine running as oil could enter the 'closed' crankcase breather system causing the engine speed to increase rapidly without control. It is important to ensure the correct level of lubricating oil is not exceeded in the sump. If there is too much oil in the sump the excess must be drained to the correct level. An excess of engine oil in the sump can enter the 'closed' crankcase breather system, which could cause the engine speed to increase rapidly without control.

6. Add slowly, new and clean lubricating oil (Data section) of an approved specification to the engine. Allow the oil enough time to pass to the sump, remove the dipstick (AK2) and ensure that the lubricating oil is to the full mark (AK1). 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.



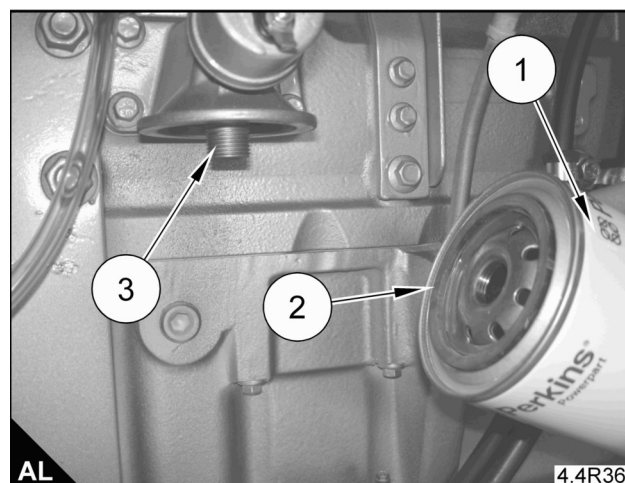
How to renew the canister of the lubricating oil filter

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 (AL1). Put a suitable container under the filter assembly to retain spilt oil. Remove and discard safely the canister.
3. Clean the contact face of the filter housing.
4. Lubricate the seal (AL2) on top of the canister with clean engine lubricating oil.
5. Fit the new canister and tighten by hand until the seal contacts the oil filter housing. 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 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 full mark 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.



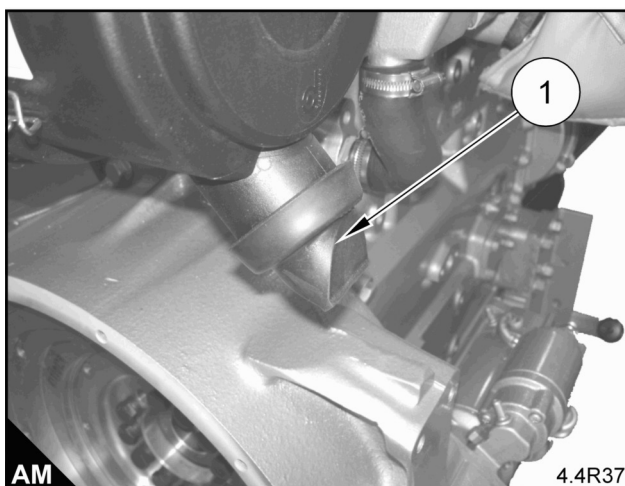
Air filter

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 (AM1) 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 (AN) 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.

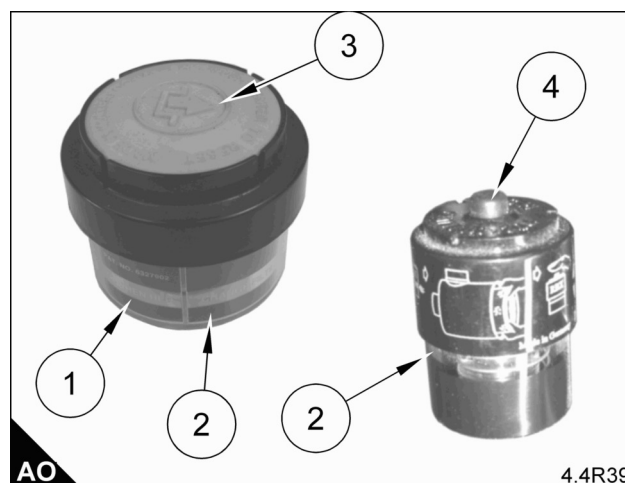


Restriction indicator

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

When the red warning indicator (AO1) is seen through the clear panel (AO2) 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 (AO3) or the button (AO4) of the restriction indicator to reset the red warning indicator.



How to check the valve tip clearances

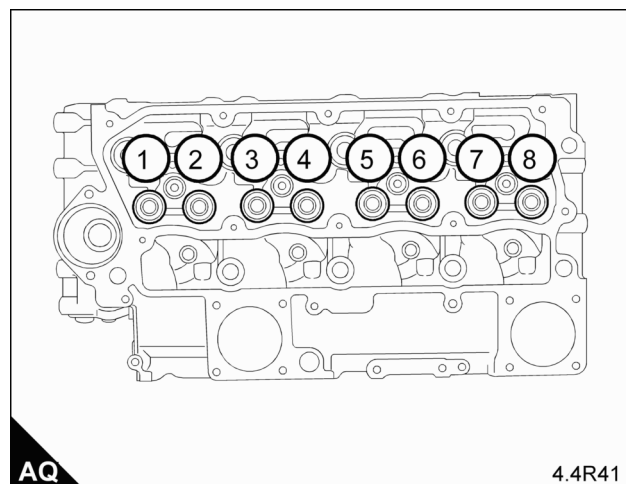
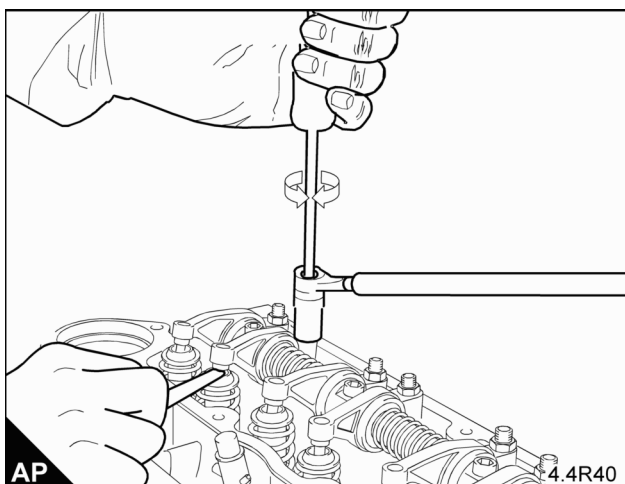
The valve tip clearances are checked between the top of the valve stem and the rocker lever (AP), with the engine cold. The correct clearance for inlet valves is 0,20 mm (0.008 in) and 0,45 mm (0.018 in) for exhaust valves. The valve positions are shown at (AQ). Slacken the locknut and adjust the gap by turning the adjustment screw in or out to achieve the correct gap. Re-tighten the locknut, ensuring the adjustment screw is held from moving.

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 (AQ7) of number 4 cylinder has just opened and the exhaust valve (AQ8) of the same cylinder has not closed completely. Check the clearances of the valves (AQ1 and AQ2) of number 1 cylinder and adjust them, if necessary.
2. Set the valves (AQ3 and AQ4) of number 2 cylinder as indicated above for number 4 cylinder. Then check / adjust the clearances of the valves (AQ5 and AQ6) of number 3 cylinder.
3. Set the valves (AQ1 and AQ2) of number 1 cylinder. Then check / adjust the clearances of the valves (AQ7 and AQ8) of number 4 cylinder.
4. Set the valves (AQ5 and AQ6) of number 3 cylinder. Then check / adjust the clearances of the valves (AQ3 and AQ4) 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



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

A small hacksaw, with extra blades

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: 2.0/4.5 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.

Lubricating oil specification

Use only a good quality lubricating oil that is not less than the specification API-CG4/CH4 or ACEA-E3/E5.

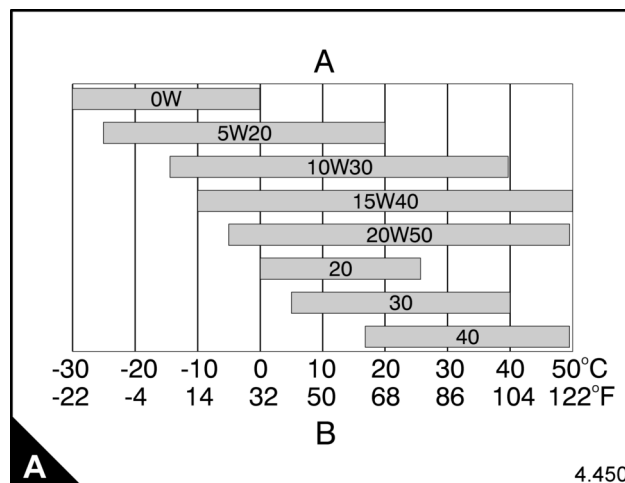
Caution: The type of lubricating oil to be used may be affected by the quality of the fuel which is available. For further details, see "Fuel specification".

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, Wimborne Marine Power Centre 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' or Powerpart ELC, part number 21820181

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.

Caution: *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 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, 69
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, 64, 65, 66, 67, 68	34, 36, 37, 39, 52, 55, 56, 57, 68, 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. 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. Insufficient coolant in circuit.
67. Restriction in the heat exchanger or the oil cooler.
68. Fault in raw water pump.
69. 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 models - 415GM, 422GM, 422TGM, 4.4GM, 4.4TGM, 4.4TWGM & 4.4TW2GM

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 coolant 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 coolant 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 Spherol 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.
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.
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.

Procedure models - 4.4GM rad, 4.4TGM rad, 4.4TWGM rad & 4.4TW2GM rad

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. Remove the atomisers and spray POWERPART Lay-Up 2 for one to two seconds into each cylinder bore with the piston at BDC.
9. Slowly turn the crankshaft one revolution and then fit the atomisers, complete with new seat washers.
10. Spray POWERPART Lay-Up 2 into the induction manifold. Seal the manifold and breather outlet with waterproof tape.
11. Remove the exhaust pipe. Spray POWERPART Lay-Up 2 into the exhaust manifold. Seal the manifold with waterproof tape.
12. 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.
13. Seal the vent pipe of the fuel tank or the fuel filler cap with waterproof tape.
14. Remove the alternator drive belt and put it into storage.
15. In order to prevent corrosion, spray the engine with POWERPART Lay-Up 3. Do not spray the area inside the alternator cooling fan.

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.

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 Extended Life Coolant (ELC) Protects the cooling system against frost and corrosion. Part number 21820181

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

415GM

Number of cylinders.....	3
Cylinder arrangement.....	In line
Cycle.....	Four stroke
Induction system:.....	Naturally aspirated
Combustion system.....	Indirect injection
Nominal bore.....	84,0 mm (3.31 in)
Stroke.....	90,0 mm (3.54 in)
Compression ratio.....	22.5:1
Cubic capacity.....	1496cc
Firing order.....	1, 2, 3
Valve tip clearances (cold).....	0,20 mm (0.0078 in)
Lubricating oil pressure (maximum engine speed and normal engine temperature).....	200 kPa (29 lbf/in ²) 2,0 kgf/cm ²
Capacity of a typical lubricating oil system: ⁽¹⁾	
- includes oil filter.....	6,2 litres (10.9 pints)
- sump only.....	6,0 litres (10.6 pints)
Typical coolant capacity (engine only):.....	8 litres (14.1 pints)
Direction of rotation.....	Clockwise from the front
Battery.....	One 12V, 540A SAE or 340A IEC
Weight of the engine (wet):.....	258 kg (569 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.

422GM

Number of cylinders.....	4
Cylinder arrangement.....	In line
Cycle.....	Four stroke
Induction system:.....	Naturally aspirated
Combustion system.....	Indirect injection
Nominal bore	84,0 mm (3.31 in)
Stroke	100,0 mm (3.94 in)
Compression ratio	23.3:1
Cubic capacity	2216 cc
Firing order	1, 3, 4, 2
Valve tip clearances (cold).....	0,20 mm (0.0078 in)
Lubricating oil pressure (maximum engine speed and normal engine temperature)	200 kPa (29 lbf/in ²) 2,0 kgf/cm ²
Capacity of a typical lubricating oil system: ⁽¹⁾	
- includes oil filter.....	10,6 litres (18.7 pints)
- sump only.....	10,2 litres (18.0 pints)
Typical coolant capacity (engine only):.....	9 litres (15.8 pints)
Direction of rotation	Clockwise from the front
Battery	One 12V, 540A SAE or 340A IEC
Weight of the engine (wet):.....	258 kg (569 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.

422TGM

Number of cylinders.....	4
Cylinder arrangement.....	In line
Cycle.....	Four stroke
Induction system:.....	Turbocharged
Combustion system.....	Indirect injection
Nominal bore	84,0 mm (3.31 in)
Stroke	100,0 mm (3.94 in)
Compression ratio	23.3:1
Cubic capacity	2216 cc
Firing order	1, 3, 4, 2
Valve tip clearances (cold).....	0,20 mm (0.0078 in)
Lubricating oil pressure (maximum engine speed and normal engine temperature)	200 kPa (29 lbf/in ²) 2,0 kgf/cm ²
Capacity of a typical lubricating oil system: ⁽¹⁾	
- includes oil filter.....	10,6 litres (18.7 pints)
- sump only	8,2 litres (14.4 pints)
Typical coolant capacity (engine only):.....	9 litres (15.8 pints)
Direction of rotation	Clockwise from the front
Battery	One 12V, 540A SAE or 340A IEC
Weight of the engine (wet):.....	267 kg (589 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.

4.4GM

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	19.3:1
Cubic capacity	4,4 litres (269.00 in ³)
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) .207 kPa (30 lbf/in ²) 2,1 kgf/cm ²	
Capacity of a typical lubricating oil system: ⁽¹⁾	
- includes oil filter.....	8,5 litres (15 pints)
- sump only.....	7.5 litres (13.2 pints)
Typical coolant capacity (engine only).....	16.5 litres (29 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 engine (dry)	462 kg (1019 lb)

⁽¹⁾The sump capacity will vary according to the installation angle. Do not exceed the "Full" mark on the dipstick, see "Caution" on page 43.

4.4TGM

Number of cylinders.....	4
Cylinder arrangement.....	In line
Cycle.....	Four stroke
Induction system.....	Turbocharged
Combustion system.....	Direct injection
Nominal bore	105,00 mm (4.13 in)
Stroke	127,0 mm (5.00 in)
Compression ratio	18.3
Cubic capacity	4,4 litres (269.00 in ³)
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) .207 kPa (30 lbf/in ²) 2,1 kgf/cm ²	
Capacity of a typical lubricating oil system: ⁽¹⁾	
- includes oil filter.....	8,5 litres (15 pints)
- sump only	7.5 litres (13.2 pints)
Typical coolant capacity (engine only).....	16.5 litres (29 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 engine (dry)	478 kg (1054 lb)

⁽¹⁾ The sump capacity will vary according to the installation angle. Do not exceed the "Full" mark on the dipstick, see "Caution" on page 43.

4.4TWGM

Number of cylinders.....	4
Cylinder arrangement.....	In line
Cycle.....	Four stroke
Induction system.....	Turbocharged/aftercooled
Combustion system.....	Direct injection
Nominal bore	105,00 mm (4.13 in)
Stroke	127,0 mm (5.00 in)
Compression ratio	19.3
Cubic capacity	4,4 litres (269.00 in ³)
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) .	207 kPa (30 lbf/in ²) 2,1 kgf/cm ²
Capacity of a typical lubricating oil system: ⁽¹⁾	
- includes oil filter.....	8,5 litres (15 pints)
- sump only.....	7.5 litres (13.2 pints)
Typical coolant capacity (engine only).....	16.5 litres (29 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 engine (dry)	495 kg (1092 lb)

⁽¹⁾ The sump capacity will vary according to the installation angle. Do not exceed the "Full" mark on the dipstick, see "Caution" on page 43.

4.4TW2GM

Number of cylinders.....	4
Cylinder arrangement.....	In line
Cycle.....	Four stroke
Induction system.....	Turbocharged/aftercooled
Combustion system.....	Direct injection
Nominal bore	105,00 mm (4.13 in)
Stroke	127,0 mm (5.00 in)
Compression ratio	19.3
Cubic capacity	4,4 litres (269.00 in ³)
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) .	207 kPa (30 lbf/in ²) 2,1 kgf/cm ²
Capacity of a typical lubricating oil system: ⁽¹⁾	
- includes oil filter.....	8,5 litres (15 pints)
- sump only	7.5 litres (13.2 pints)
Typical coolant capacity (engine only).....	16.5 litres (29 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 engine (dry)	495 kg (1092 lb)

⁽¹⁾ The sump capacity will vary according to the installation angle. Do not exceed the "Full" mark on the dipstick, see "Caution" on page 43.

4.4GM Radiator

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	19.3:1
Cubic capacity	4,4 litres (269.00 in ³)
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)	
.....	207 kPa (30 lbf/in ²) 2,1 kgf/cm ²
Capacity of a typical lubricating oil system: ⁽¹⁾	
- includes oil filter.....	8,5 litres (15 pints)
- sump only.....	7.5 litres (13.2 pints)
Typical coolant capacity (engine only).....	17.5 litres (31 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 engine (dry)	495 (1091) kg (lb)

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

4.4TGM Radiator

Number of cylinders.....	4
Cylinder arrangement.....	In line
Cycle.....	Four stroke
Induction system.....	Turbocharged
Combustion system.....	Direct injection
Nominal bore	105,00 mm (4.13 in)
Stroke	127,0 mm (5.00 in)
Compression ratio	18.23
Cubic capacity	4,4 litres (269.00 in ³)
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)	
.....	207 kPa (30 lbf/in ²) 2,1 kgf/cm ²
Capacity of a typical lubricating oil system: ⁽¹⁾	
- includes oil filter.....	8,5 litres (15 pints)
- sump only	7.5 litres (13.2 pints)
Typical coolant capacity (engine only).....	17.5 litres (31 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 engine (dry)	511 (1127) kg (lb)

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

4.4TWGM Radiator

Number of cylinders.....	4
Cylinder arrangement.....	In line
Cycle.....	Four stroke
Induction system.....	Turbocharged/aftercooled
Combustion system.....	Direct injection
Nominal bore	105,00 mm (4.13 in)
Stroke	127,0 mm (5.00 in)
Compression ratio	18.23
Cubic capacity	4,4 litres (269.00 in ³)
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)	
.....	207 kPa (30 lbf/in ²) 2,1 kgf/cm ²
Capacity of a typical lubricating oil system: ⁽¹⁾	
- includes oil filter.....	8,5 litres (15 pints)
- sump only.....	7.5 litres (13.2 pints)
Typical coolant capacity (engine only) ⁽²⁾	17.5 litres (31 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 engine (dry)	543 (1197) kg (lb)

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

(2) For engines built after July 2013, the radiator is larger and has a bigger capacity. Please refer to Wimborne Marine Power Centre for more information.

4.4TW2GM Radiator

Number of cylinders.....	4
Cylinder arrangement.....	In line
Cycle.....	Four stroke
Induction system.....	Turbocharged/aftercooled
Combustion system.....	Direct injection
Nominal bore	105,00 mm (4.13 in)
Stroke	127,0 mm (5.00 in)
Compression ratio	18.23
Cubic capacity	4,4 litres (269.00 in ³)
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)	
.....	207 kPa (30 lbf/in ²) 2,1 kgf/cm ²
Capacity of a typical lubricating oil system: (1)	
- includes oil filter.....	8,5 litres (15 pints)
- sump only.....	7.5 litres (13.2 pints)
Typical coolant capacity ⁽²⁾	17.5 litres (31 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 engine (dry)	543 (1197) kg (lb)

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

(2) For engines built after July 2013, the radiator is larger and has a bigger capacity of 20 litres. Please refer to Wimborne Marine Power Centre for more information.

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.



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Marine Power

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

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