

User's Handbook

4GM



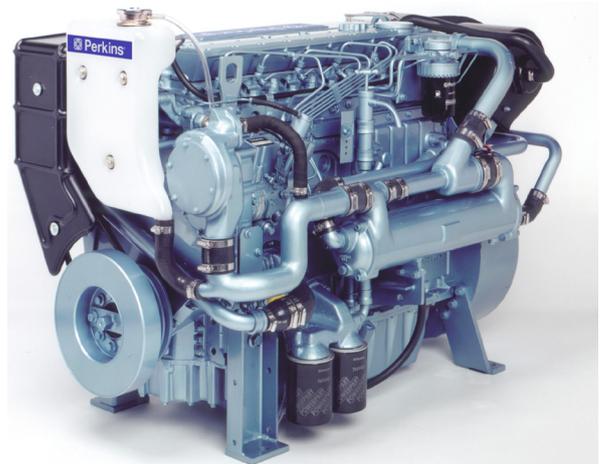
4TGM



6TG2AM



6TWGM



Perkins

Marine Gen Set Power

User's handbook

- | | |
|--------|---|
| 4GM | 4 cylinder, naturally aspirated, diesel engine for marine on-board generating set |
| 4TGM | 4 cylinder, turbocharged, diesel engine for marine on-board generating set |
| 6TG2AM | 6 cylinder, turbocharged, diesel engine for marine on-board generating set |
| 6TWGM | 6 cylinder, turbocharged, intercooled, diesel engine for marine on-board generating set |

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General information

Introduction

The 4GM, 4TGM, 6TG2AM and 6TWGM marine engines for on-board generating sets and other auxiliary power units are the latest developments from the business arrangement between Perkins Engines Ltd and Wimborne Marine Power Centre.

Wimborne Marine Power Centre are the managers of the Perkins marine business and all enquires should be made to Wimborne Marine Power Centre; refer to the company address list on page 6.

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

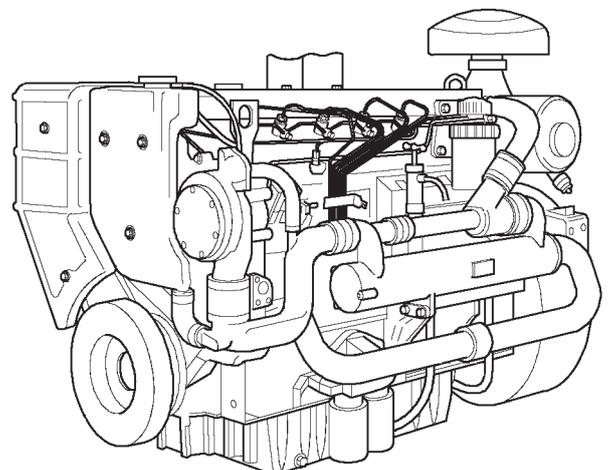
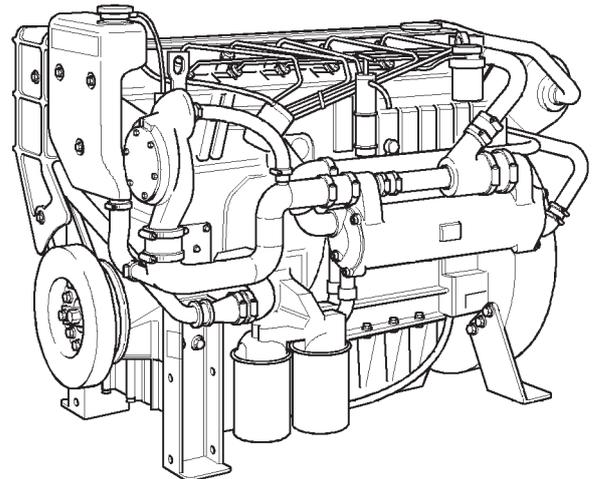
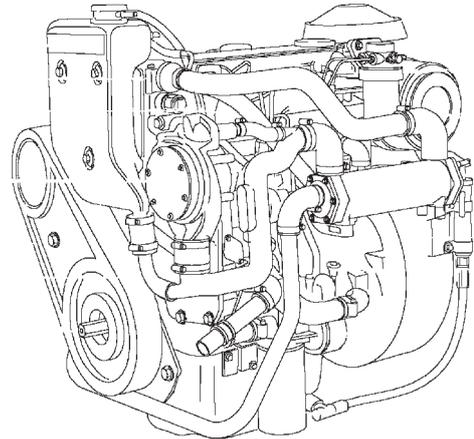
To ensure that you use the relevant information for your specific engine type, refer to "Engine identification" on page 5.

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 canisters 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 one of the Perkins companies listed on page 6.

When reference is made to the “left side” and “right side” of the engine, this is as seen from the flywheel end.

General safety precautions

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

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

Engine guarantee

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

If it is difficult to find a Perkins distributor or an approved dealer, consult the Service Department of Wimborne Marine Power Centre, refer to the company address list on page 6.

Engine identification

The 4GM engine consists of four different types:

- Naturally aspirated, heat exchanger cooled, rated at 1500 rev/min.
- Naturally aspirated, heat exchanger cooled, rated at 1800 rev/min.
- Naturally aspirated, keel cooled, rated at 1500 rev/min.
- Naturally aspirated, keel cooled, rated at 1800 rev/min.

The 4TGM and 6TG2AM engine consists of four different types:

- Turbocharged, heat exchanger cooled, rated at 1500 rev/min.
- Turbocharged, heat exchanger cooled, rated at 1800 rev/min.
- Turbocharged, keel cooled, rated at 1500 rev/min.
- Turbocharged, keel cooled, rated at 1800 rev/min.

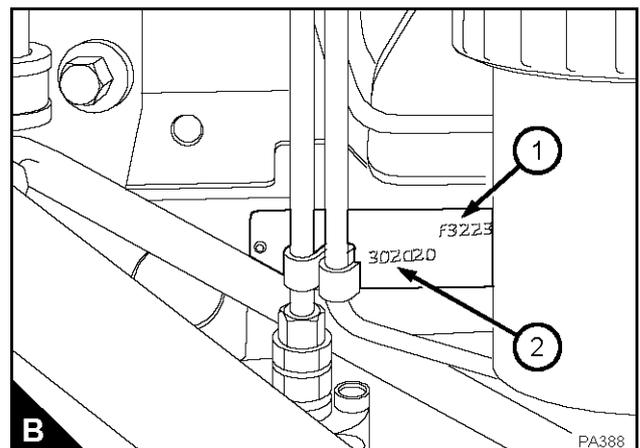
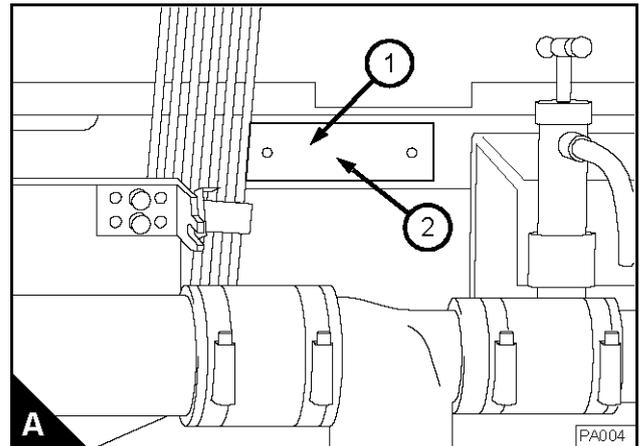
The 6TWGM engine consists of four different types:

- Turbocharged, intercooled, heat exchanger cooled, rated at 1500 rev/min.
- Turbocharged, intercooled, heat exchanger cooled, rated at 1800 rev/min.
- Turbocharged, intercooled, keel cooled, rated at 1500 rev/min.
- Turbocharged, intercooled, keel cooled, rated at 1800 rev/min.

The engine number is stamped on a label fitted to the left side of cylinder block, (A2) for 6 cylinder engines and (B2) for 4 cylinder engines.

An example of the engine number is:
YB30196U123456A

If you need parts, service or information for your engine, you must give the complete engine number to your Perkins distributor. If there is a number in the area of the label marked TPL No (A1) or (B1), then this number must also be given to your Perkins distributor. This number refers to the build specification fitted to the engine before it leaves the factory. Examples of this number are SGS027 and SGS028.



Perkins main dealers**Australia**

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Telephone: [61](2) 9765 6800
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The managers of the marine business for Perkins are:**Wimborne Marine Power Centre**

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www.perkins.com/marine.

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

Engine views

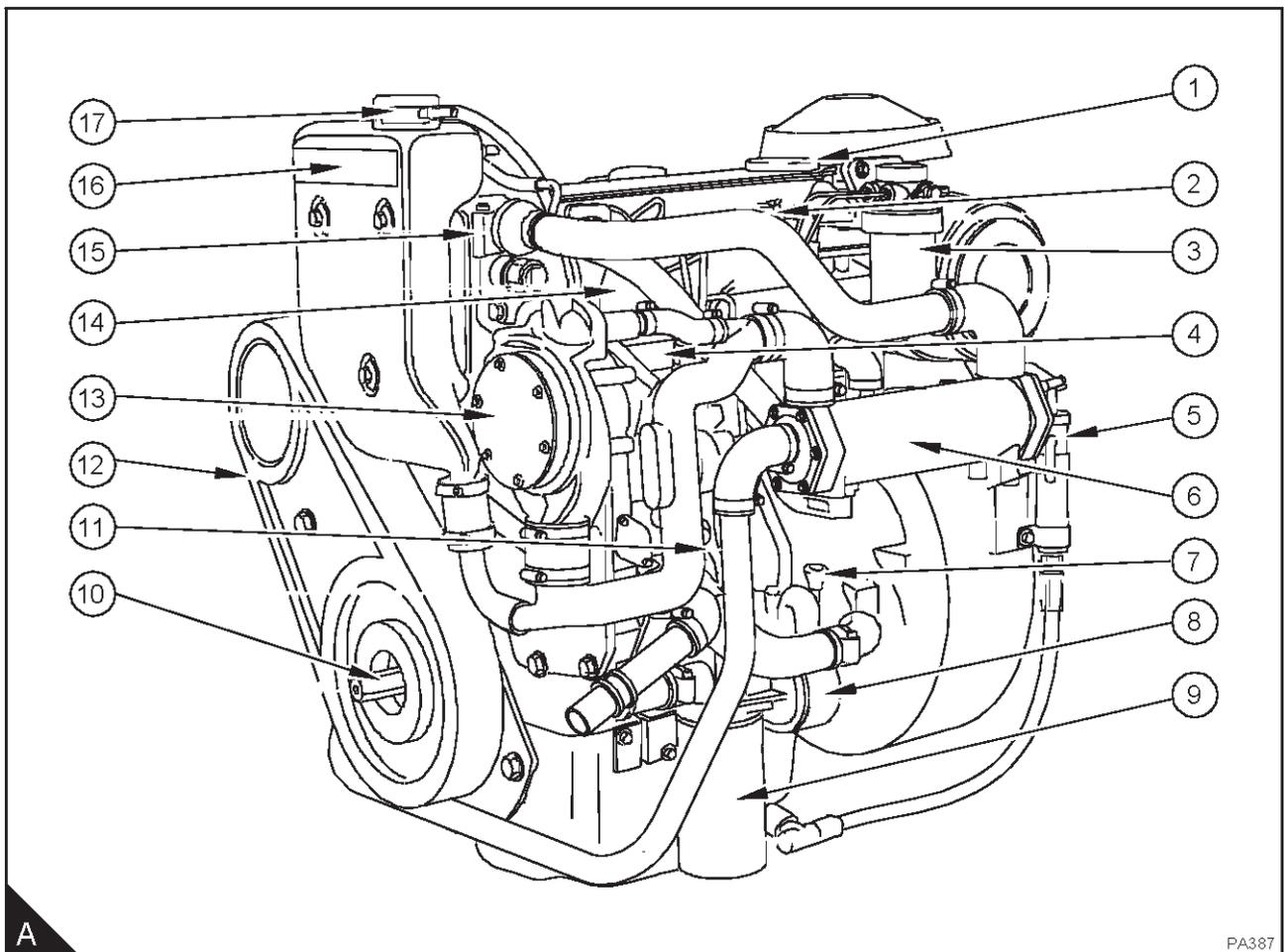
Introduction

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

Location of engine parts - 4 cylinder turbocharged engines

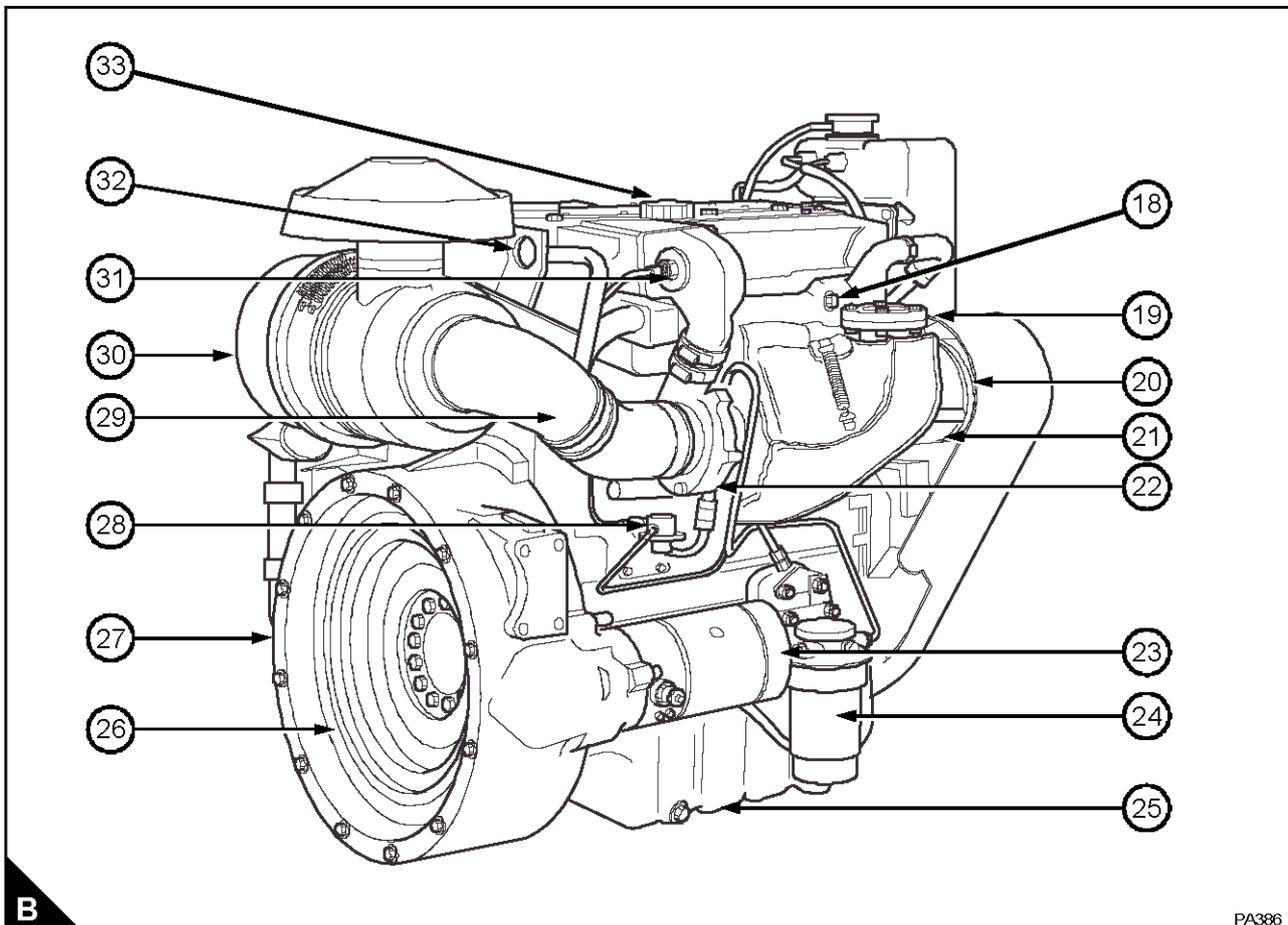
Front and left side (A)

- | | |
|--|--|
| 1. Crankcase breather | 10. Engine crankshaft rotation adaptor |
| 2. Atomiser | 11. Raw water pump |
| 3. Fuel filter | 12. Cover for the drive belt |
| 4. Fuel injection pump | 13. Closed circuit water pump |
| 5. Drain pump for the engine lubricating oil | 14. Front lift bracket |
| 6. Heat exchanger for the closed circuit coolant | 15. Thermostat housing |
| 7. Dipstick for the engine lubricating oil | 16. Coolant header tank |
| 8. Cooler for the engine lubricating oil | 17. Filler cap for coolant header tank |
| 9. Lubricating oil filter | |



Rear and right side (B)

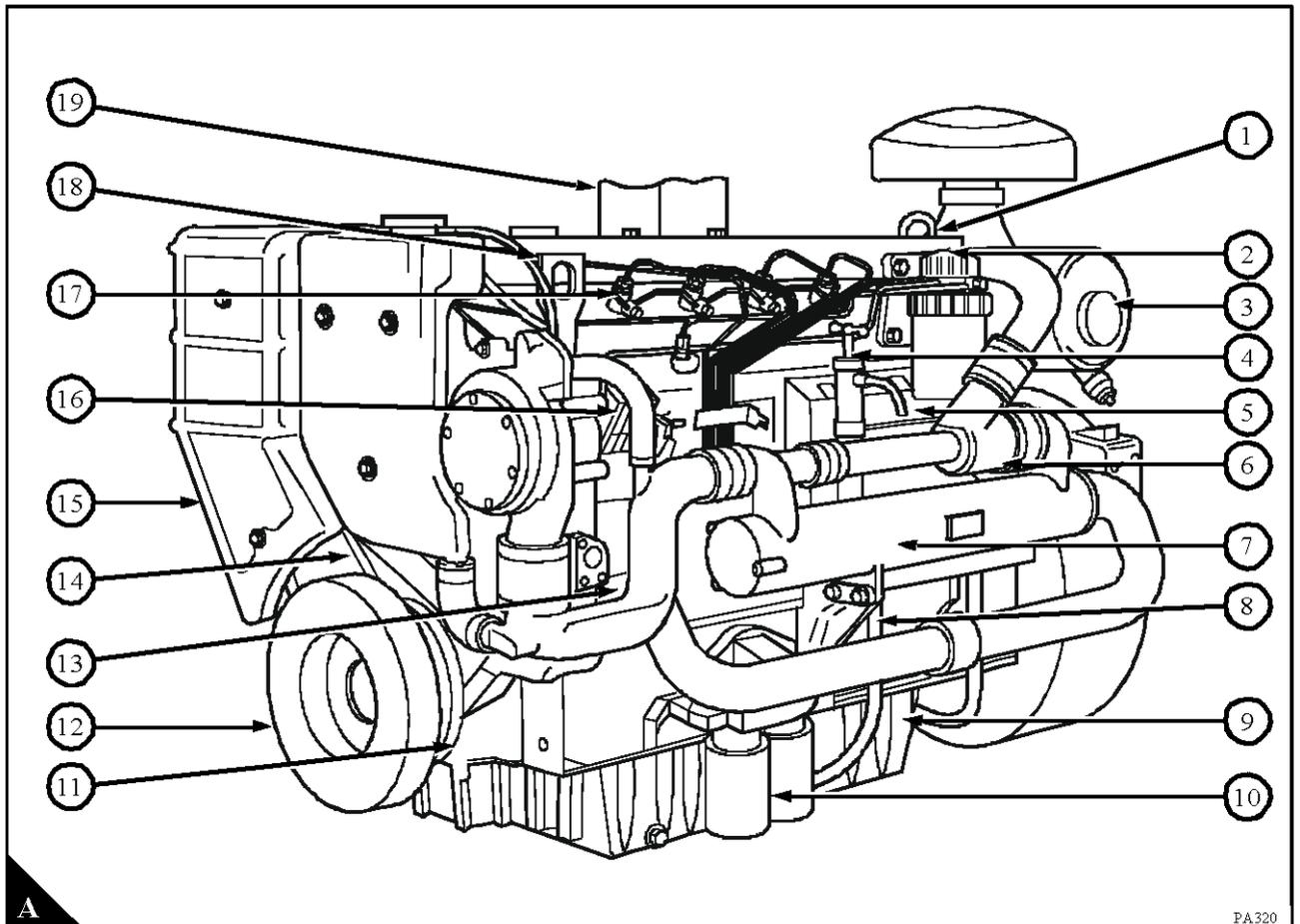
- 18.Cooled exhaust manifold assembly
- 19.Exhaust outlet
- 20.Drive belt for alternator
- 21.Alternator
- 22.Turbocharger
- 23.Starter motor
- 24.Fuel pre-filter
- 25.Sump for the engine lubricating oil
- 26.Flywheel
- 27.Flywheel housing
- 28.Fuel lift pump
- 29.Restriction indicator for the air filter (fitted to the rear of filter body)
- 30.Air filter
- 31.Fuelled starting aid
- 32.Rear lift bracket
- 33.Filler cap for the engine lubricating oil



Location of engine parts - 6 cylinder turbocharged engines

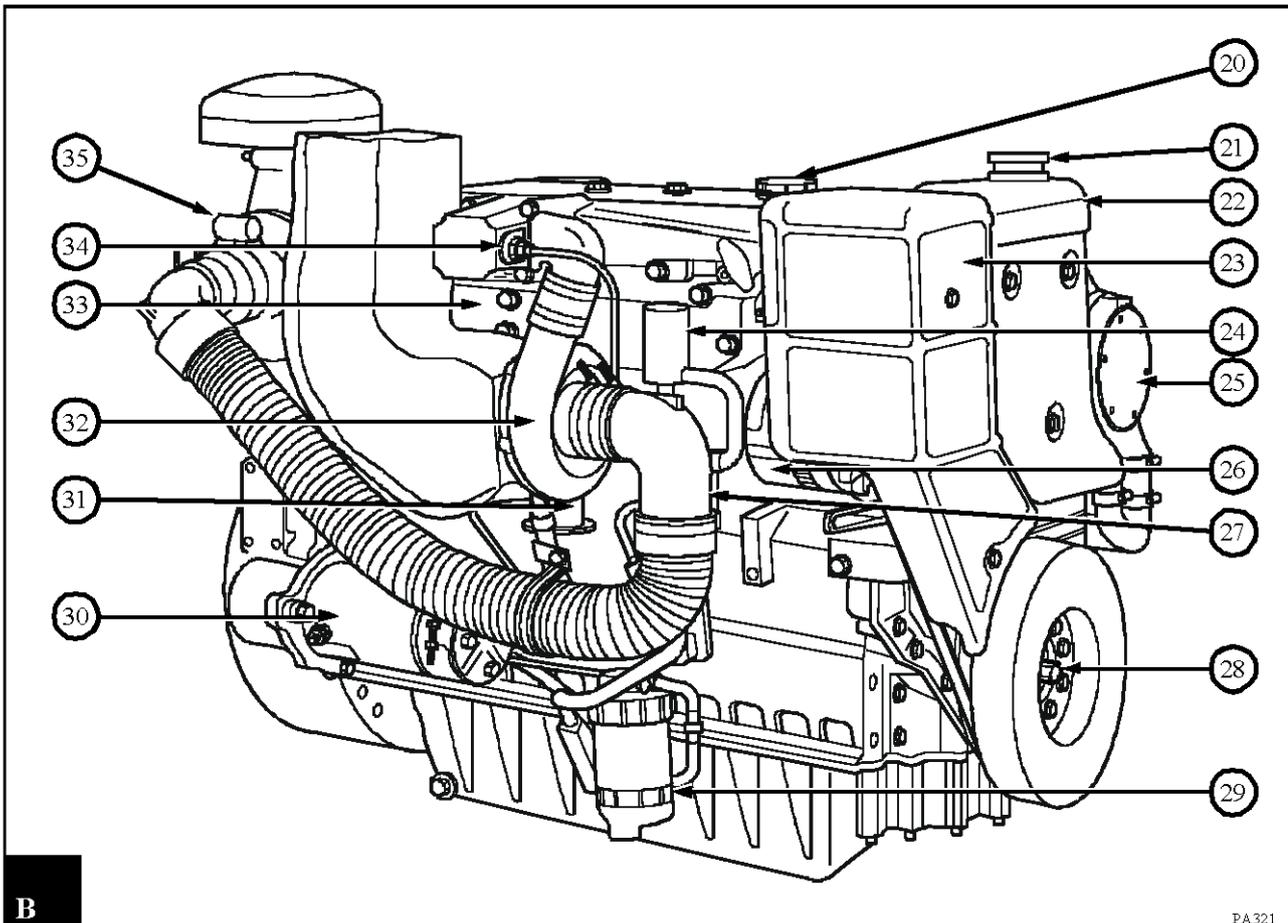
Front and left side (A)

1. Rear lift bracket
2. Fuel filter
3. Air filter
4. Drain pump for the engine lubricating oil
5. Cooler for the engine lubricating oil
6. Thermostat housing
7. Heat exchanger for the closed circuit coolant
8. Dipstick for the engine lubricating oil
9. Sump for the engine lubricating oil
10. Lubricating oil filter
11. Crankshaft pulley
12. Crankshaft damper
13. Raw water pump
14. Drive belt for alternator
15. Cover for the drive belt
16. Fuel injection pump
17. Atomiser
18. Front lift bracket
19. Exhaust outlet



Front and right side (B)

- 20. Filler cap for the engine lubricating oil
- 21. Filler cap for coolant header tank
- 22. Coolant header tank
- 23. Electrical housing
- 24. Oil separator for the crankcase breather
- 25. Closed circuit water pump
- 26. Alternator
- 27. Crankcase breather
- 28. Device to rotate the crankshaft
- 29. Fuel pre-filter
- 30. Starter motor
- 31. Fuel lift pump
- 32. Turbocharger
- 33. Cooled exhaust manifold assembly
- 34. Fuelled starting aid
- 35. Restriction indicator for the air filter

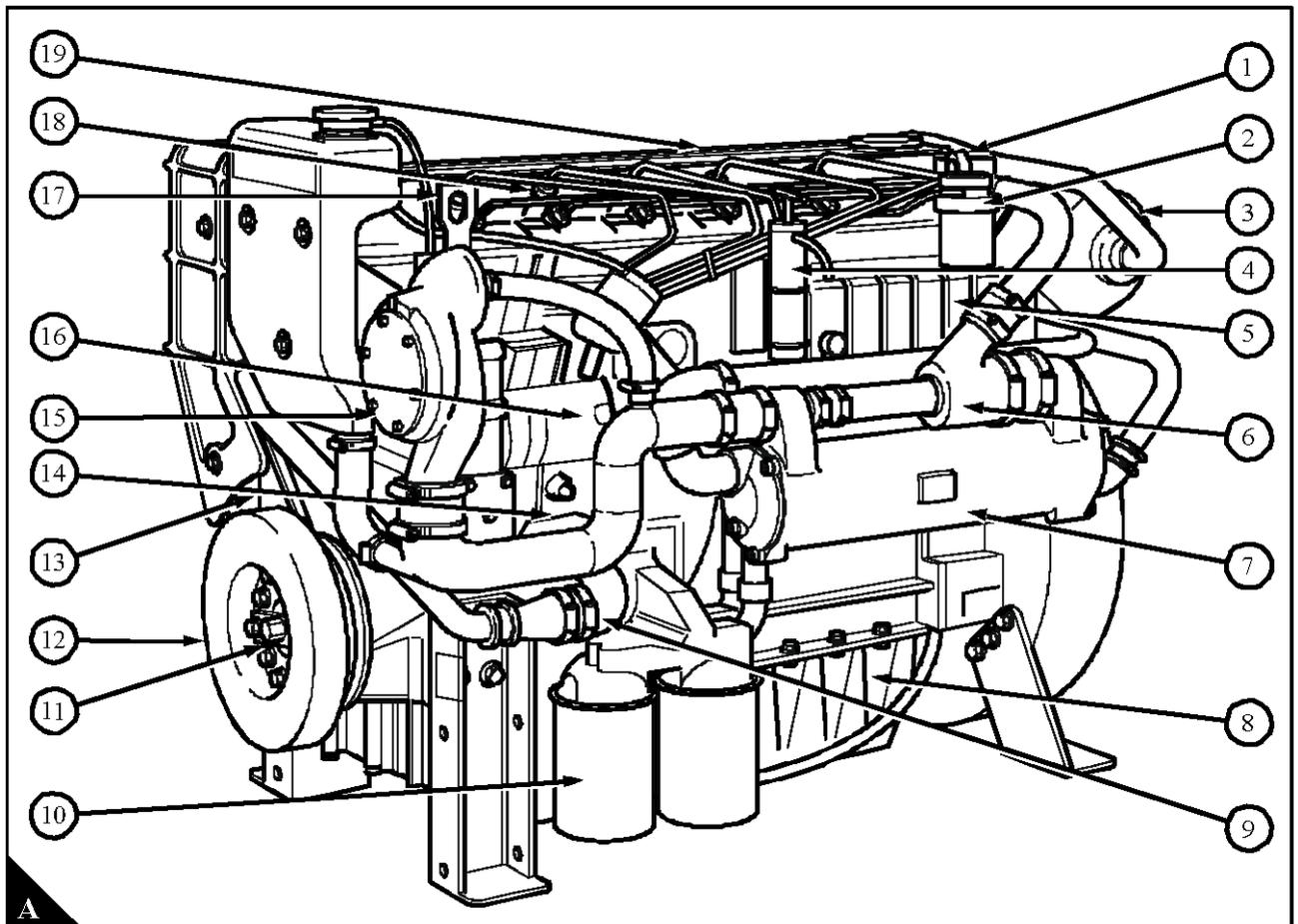
**B**

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Location of engine parts - 6 cylinder turbocharged, intercooled engines

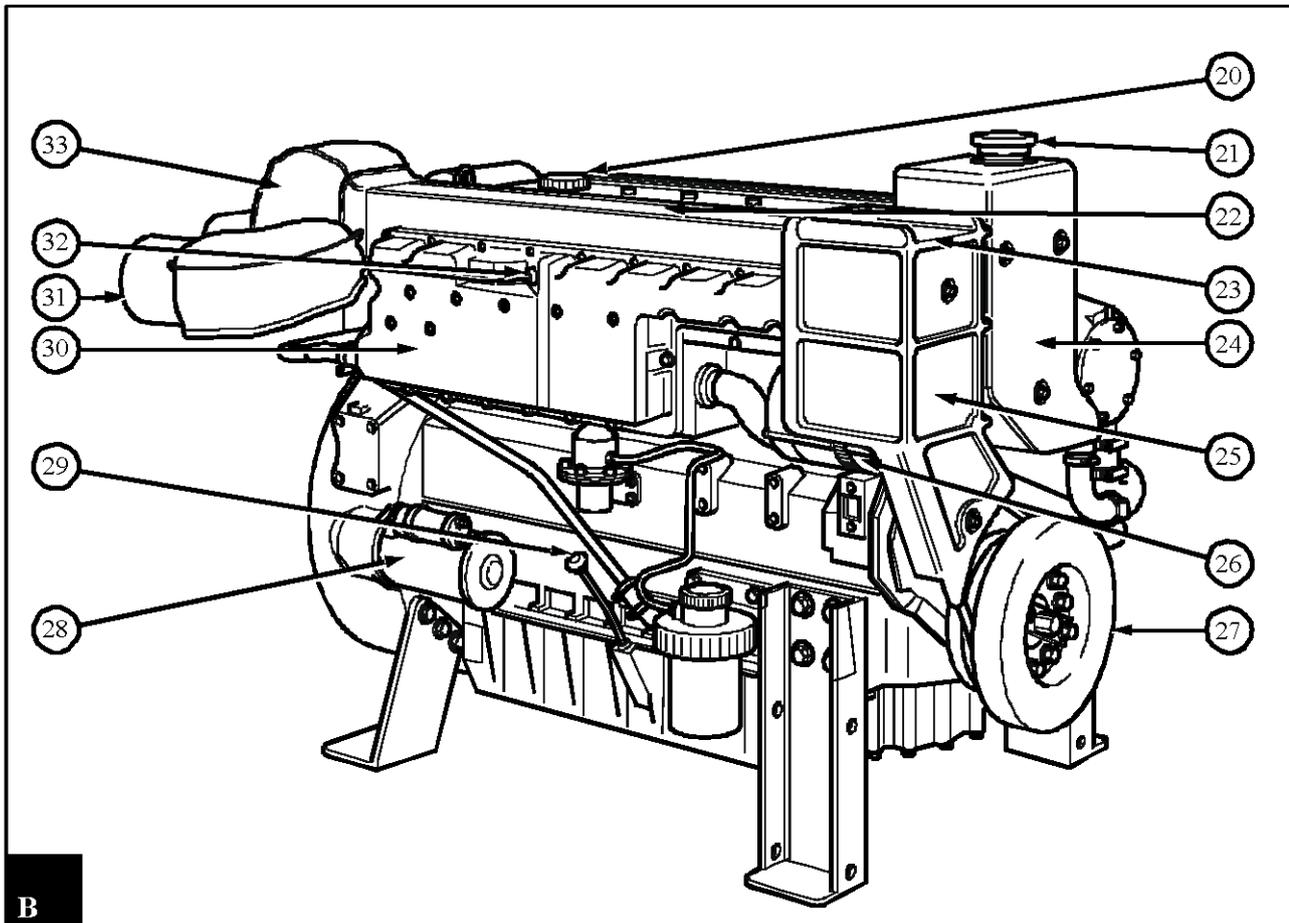
Front and left side view (A)

1. Rear lift bracket
2. Fuel filter
3. Air filter
4. Drain pump for the engine lubricating oil
5. Cooler for the engine lubricating oil
6. Thermostat housing
7. Heat exchanger for the closed circuit coolant
8. Sump for the engine lubricating oil
9. Strainer for the raw water pump
10. Lubricating oil filter
11. Device to rotate the crankshaft
12. Crankshaft damper
13. Drive belt for alternator
14. Raw water pump
15. Coolant pump for the closed circuit
16. Fuel injection
17. Front lift bracket
18. Atomiser
19. Crankcase breather



Front and right side view (B)

- 20. Filler cap for the engine lubricating oil
- 21. Filler cap for the coolant header tank
- 22. Cooled manifold assembly
- 23. Electrical housing
- 24. Coolant header tank
- 25. Cover for drive belt
- 26. Alternator
- 27. Crankshaft pulley
- 28. Starter motor
- 29. Dipstick for the engine lubricating oil
- 30. Air charge cooler assembly
- 31. Exhaust outlet
- 32. Fuelled starting aid
- 33. Turbocharger



Operation instructions

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 is a fuelled starting aid. This electrically operated device ignites a specific amount of diesel fuel in the induction manifold in order to heat the induction air.

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.

Caution: *If the engine has not run for a long period (four weeks or more), ensure that there is lubricating oil at the turbocharger. To do this, hold the engine stop switch in the "STOP" position; operate the starter motor until the oil warning light goes out or a pressure is indicated on the oil pressure gauge.*

How to start a cold engine with the fuelled starting aid

Note: Use this method when the cylinder head temperatures are approximately 0°C (32°F).

1. Switch on the electrical system.
2. Hold the heat switch in the down position for 15 seconds. Press the start button to engage the starter motor. When the engine starts, release the heat switch. The engine will run up to the set speed, 1500 or 1800 rev/min.
3. If the engine does not start in 15 seconds, hold the

heat switch down for 10 seconds and engage the starter motor again. When the engine has started, release the heat switch. Check that water comes out of the end of the exhaust pipe or out of the separate discharge outlet. Always ensure that the engine and starter motor are stationary before the starter motor is engaged again.

Caution: *Ether type starting aids must not be used at the same time as the fuelled starting aid.*

How to start a warm engine

1. Switch on the electrical system.
2. Press the start button to engage the starter motor. When the engine starts it will run up to the set speed, 1500 or 1800 rev/min. Check that water comes out of the end of the exhaust pipe or out of the separate discharge outlet.

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

How to stop the engine

Caution: *It is recommended that a turbocharged engine is run at a reduced load for 2-3 minutes before it is shut down. This will allow the turbocharger to cool.*

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

Adjustment of the engine speed range

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

Running-in

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

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

Cautions:

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

Preventive maintenance

Preventive maintenance periods

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

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

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

Schedules

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

- A** First service at 20/40 hours
- B** Every day or every 8 hours
- C** Every week
- D** Every 250 hours or 6 months
- E** Every 400 hours or 12 months
- F** Every 2000 hours or 2 years

A	B	C	D	E	F	Operation
●	●					Check the amount of coolant in the header tank
	●					Check for oil and coolant leaks
●					●	Check the specific gravity of the coolant (1) (2)
	●					Check the condition of the drive belt for the alternator
●				●		Check the tension of the drive belt for the alternator (3)
				●		Check the impeller of the raw water pump
		●				Drain water from the fuel pre-filter (or earlier if your fuel supply is contaminated)
				●		Clean the sediment chamber and the strainer of the fuel lift pump
				●		Renew the elements of the fuel pre-filter and the fuel filter
					●	Ensure that the atomisers are checked (2)

(1) Renew the antifreeze every 6 years (see the coolant specification in section 5). If a coolant inhibitor is used instead of antifreeze, it should be renewed every 6 months.

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

(3) If one is fitted.

Schedules

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

- | | |
|---------------------------------------|---------------------------------------|
| A First service at 20/40 hours | D Every 250 hours or 6 months |
| B Every day or every 8 hours | E Every 400 hours or 12 months |
| C Every week | F Every 2000 hours or 2 years |

A	B	C	D	E	F	Operation
	●					Check the amount of lubricating oil in the sump
	●					Check the lubricating oil pressure at the gauge
●				●		Renew the engine lubricating oil, 4 cylinder engines (1)
●			●			Renew the engine lubricating oil, 6 cylinder engines (1)
				●		Renew the canister of the lubricating oil filter, 4 cylinder engines
			●			Renew the canister of the lubricating oil filter, 6 cylinder engines
				●		Clean or renew the air filter element, 6TWGM
					●	Renew the engine breather system, 6TWGM (2)
					●	Renew the engine breather system, 4 cylinder engines (2)
				●		Renew the air filter element, if not indicated earlier
					●	Renew the secondary air filter element, 4 cylinder engines.
				●		Check the engine mounts
				●		Check all hoses and connections
●					●	Ensure the valve tip clearances of the engine are checked and, if necessary, adjusted (3)
					●	Ensure the turbocharger impeller and the turbocharger compressor casing are cleaned (3)
					●	Ensure the alternator, the starter motor, and the turbocharger, etc. are checked (3)
				●		Check the condition of the crankshaft damper

(1) The oil change interval will change with the amount of sulphur in the the fuel (see the fuel specification in section 5). The interval to change the canister of the lubricating oil filter is not affected.

(2) The valve for the breather system must be renewed every 4000 hours.

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

Note: To ensure that the engine runs at maximum efficiency the operations which follow must be done every 12 months or less. If the raw water is excessively contaminated, clean more frequently the tube stack of the heat exchanger for the closed circuit coolant and the tube stack of the heat exchanger for the closed circuit coolant. Refer to the workshop manual for instructions.

How to fill the coolant circuit

Warning!

- If coolant is to be added to the circuit during service, allow the engine to cool before the coolant is added. Remove the filler cap slowly as dangerous coolant could be discharged if the coolant is still hot and the system 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 (A3) of the header tank and slowly fill the coolant system until the coolant level is just below the pipes (A1) inside the header tank.

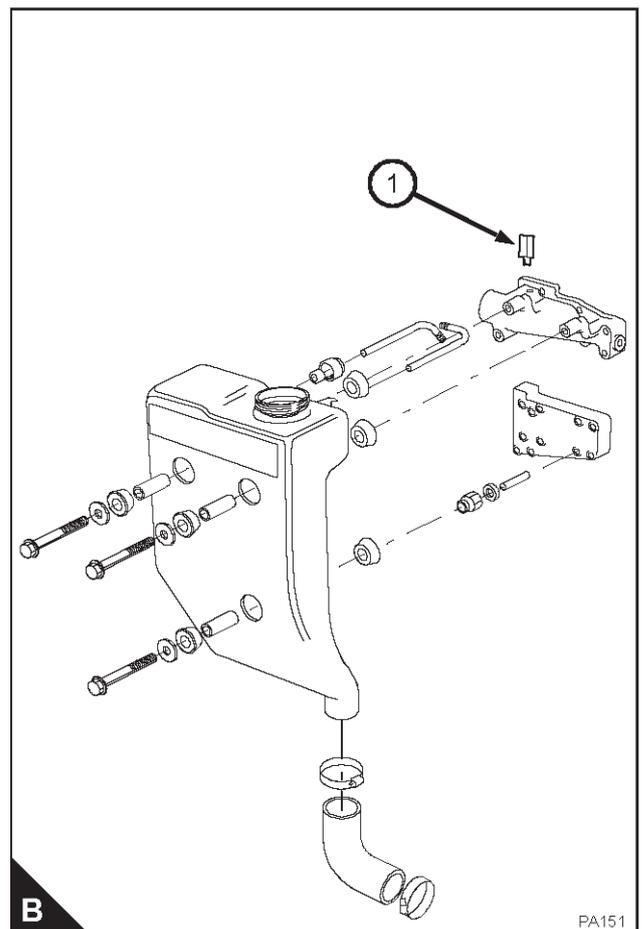
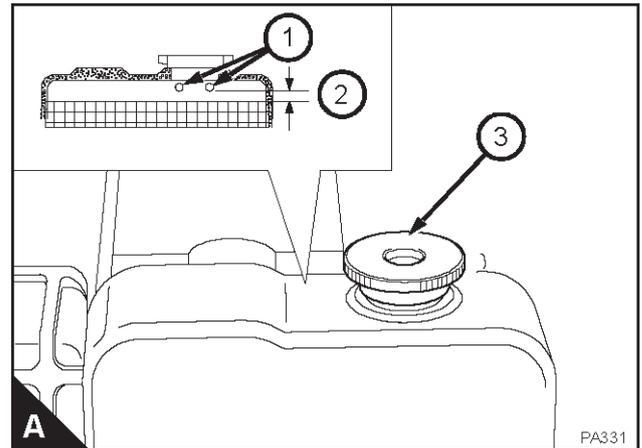
Note: It is not necessary to vent air from the system except where the engine is installed with the front of the engine more than 10° higher than the rear. For this type of installation a vent plug (B1) is fitted to the top of the water outlet adaptor at the front of the cylinder head. This plug must be removed to eliminate air from the cylinder block when the coolant system is filled.

2. Wait for five to ten minutes and check the coolant level, add coolant if necessary. Fit the filler cap.
3. Start the engine. When it has reached its normal temperature of operation, stop it and let it cool.
4. Remove the filler cap of the header tank and add coolant until the level of the coolant (A2) is between 25 mm (1.00 in) and 40 mm (1.50 in) below the bottom of the pipes (A1). Fit the filler cap.

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 if a keel cooler is fitted.



How to drain the coolant circuit

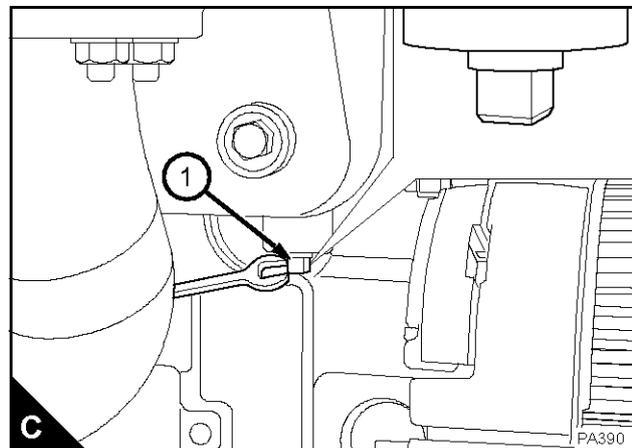
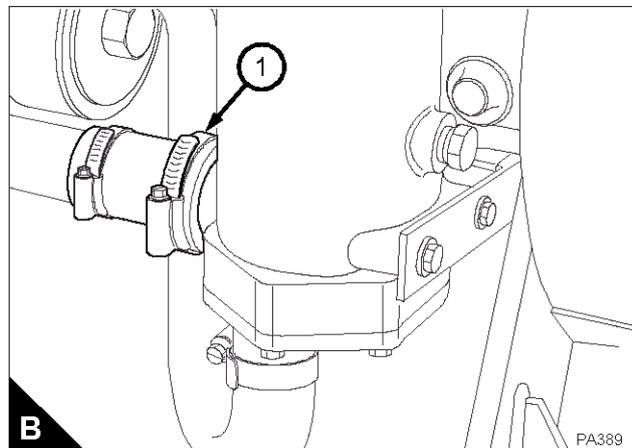
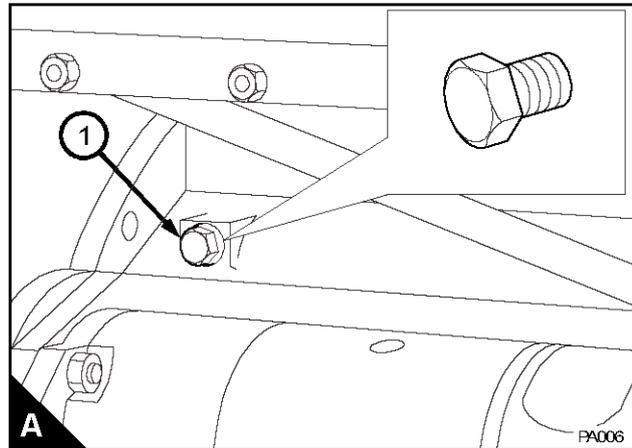
Warnings!

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

Note: Ensure that the drain holes are not restricted.

1. Remove the coolant filler cap (on page 17/A3). Remove the drain plug (A1) from the cylinder block.
2. For 4 cylinder engines: Remove the hose (B1) from the heat exchanger.
3. Remove the drain plug from the coolant jacket of the exhaust manifold (C1).
4. For 6 cylinder engines: Remove the drain plug (on page 19/B1) from the heat exchanger for the coolant system.
5. Remove the drain plug (on page 19/C1) from the cooled manifold assembly. Ensure that the drain holes are not restricted.
6. After the system has been drained, fit the filler cap and the drain plugs.
7. 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.



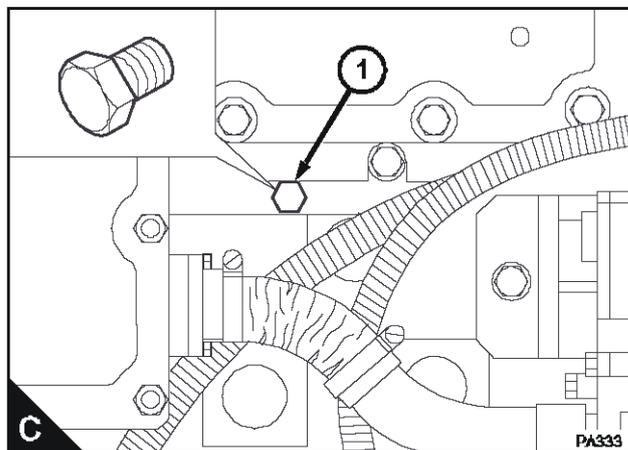
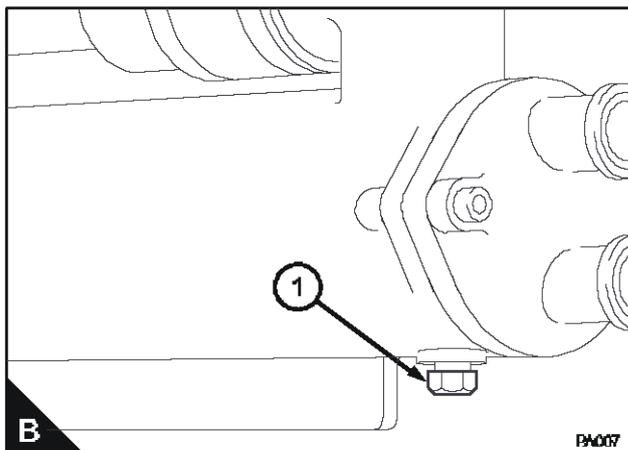
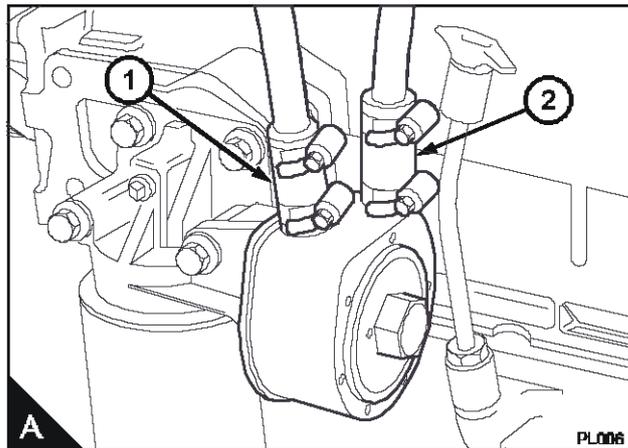
8. If a cassette oil cooler (A) is fitted to the filter head, then this must also be drained and flushed. To do this, disconnect the hoses (A1 and A2) at the top of the cooler and flush the cooler through the outlet connection (A1) until clean water runs from the inlet (A2).

Caution: If the coolant system is to remain empty temporarily after it is flushed with clean water, drain the oil cooler and fill it with 165 ml (1/3 pint) of antifreeze. This will protect the oil cooler against frost if any clean water drains down from the coolant jacket if the craft is moved.

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. Ensure that the machine is on level ground.
2. 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.
3. Stop the engine.
4. 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.

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

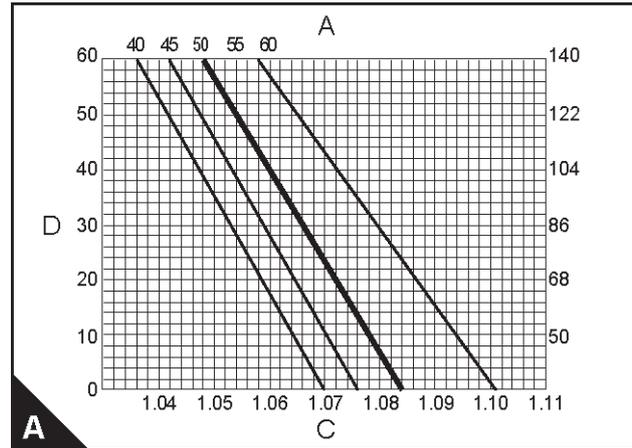
Note: If a special coolant hydrometer is not available, put a hydrometer and a separate thermometer into the antifreeze mixture and check the readings on both instruments. Compare the readings with the chart (A).

8. 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.

Protection against frost is as follows:

Antifreeze/water (% by volume)	Protection down to (°C)
50/50	-35
60/40	-40



Specific gravity chart

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

How to drain the raw water circuit

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.

Engines fitted with heat exchangers

1. Ensure that the seacock is closed.
2. Disconnect both hoses (A1) at the raw water pump.
3. For four cylinder engines: Remove the hose (B1) from the heat exchanger.
4. Rotate the crankshaft to ensure that the raw water pump is empty.
5. Fit the hose to the heat exchanger.

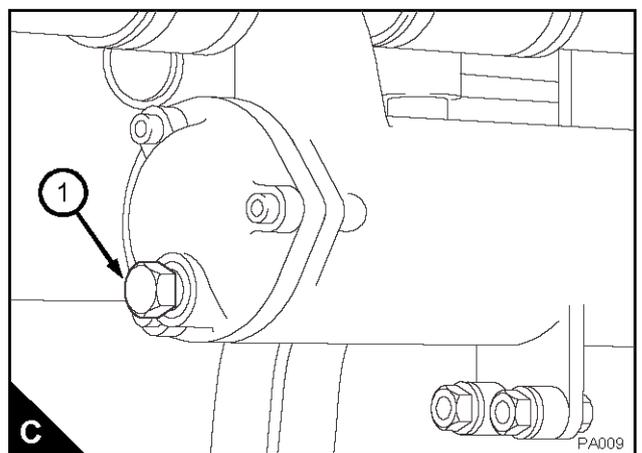
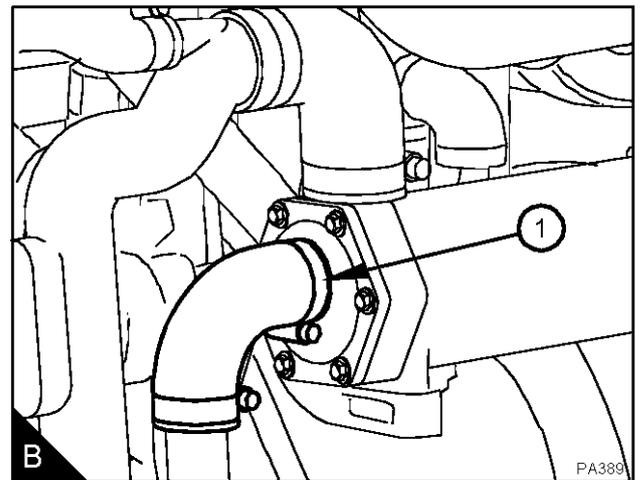
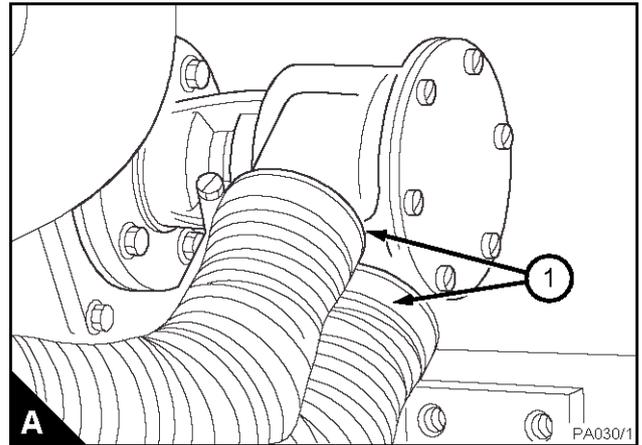
For six cylinder engines: Remove the drain plug (C1) from the front cover of the heat exchanger for the coolant system. Ensure that the drain hole is not restricted.

Rotate the crankshaft to ensure that the raw water pump is empty.

Fit the drain plug to the heat exchanger.

5. Connect the hoses at the raw water pump and tighten the clips.

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



How to check the drive belt of the alternator

Note: The guard shown in (A) is for the four cylinder engine.

Warning! All engines have a guard (A3) fitted to give protection from the alternator fan and the drive belt. Ensure that this guard is fitted before the engine is started.

Renew the drive belt (A1) if it is worn or damaged.

To ensure maximum belt life, it is recommended that a belt tensioner gauge, part number 21825686, is used to check the belt tension. Fit the gauge (B) at the centre of the longest free length and check the tension. If a belt tensioner gauge is used, the correct tension is 355 N (80 lbf) 36 kgf. If the tension is 220 N (50 lbf) 22 kgf or below, adjust the tension to 355 N (80 lbf) 36 kgf as indicated below.

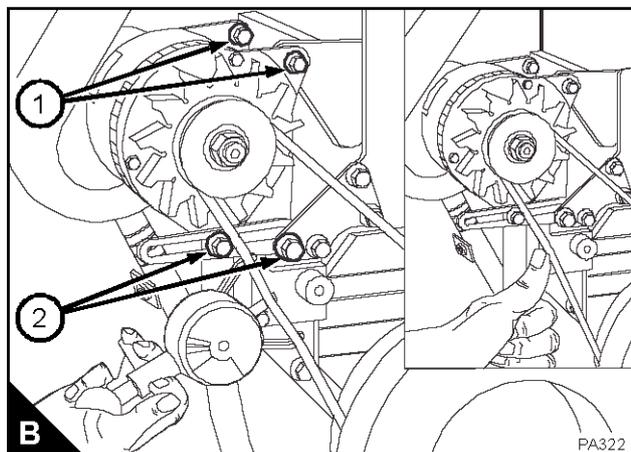
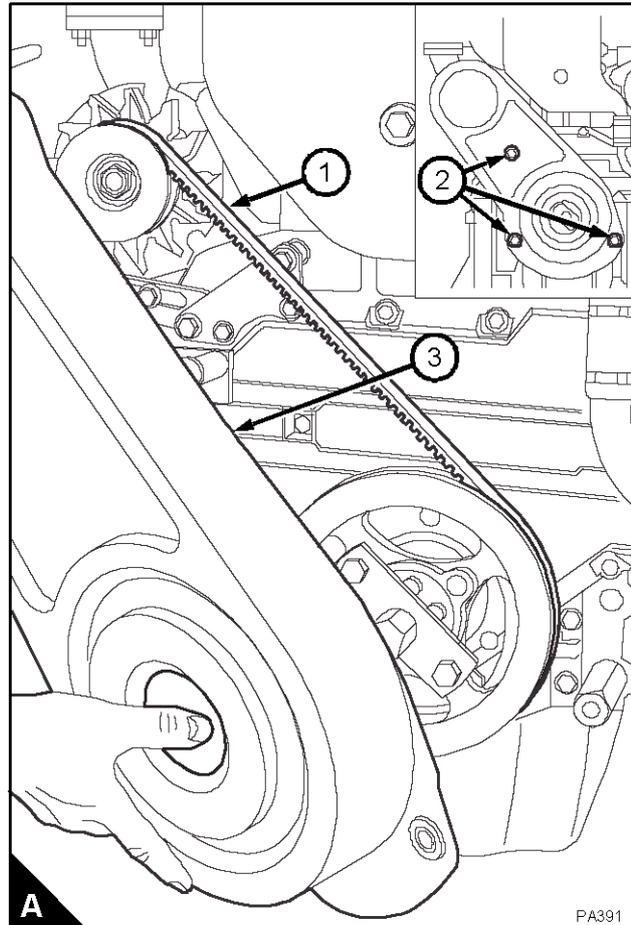
If a gauge is not available, press down the belt with the thumb at the centre of the longest free length and check the deflection. With moderate thumb pressure - 45 N (10 lbf) 4,5 kgf - the correct deflection of the belt is 10 mm (3/8 in).

How to adjust the belt tension

1. Release the setscrews (A2) which secure the guard for the drive belt to the engine and carefully remove the guard.
2. Loosen the pivot fasteners (B1) of the alternator and the adjustment link fasteners (B2).
3. Change the position of the alternator to give the correct tension. Tighten the pivot fasteners of the alternator and the adjustment link fasteners.
4. Check the belt tension again to ensure that it is still correct

Note: If a new belt is fitted, the belt tension must be checked again after the first 20 hours of operation.

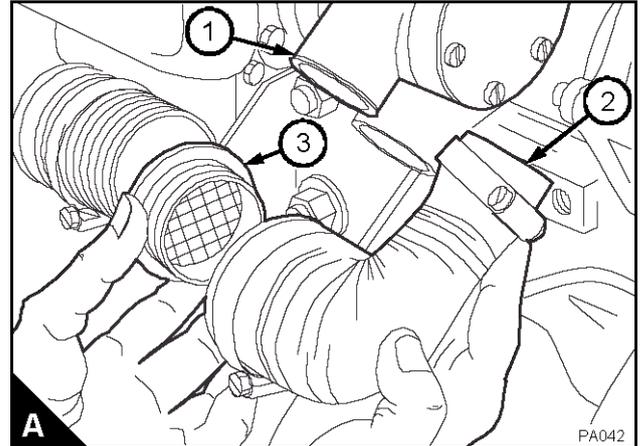
5. Fit the guard for the drive belt to the engine and fasten the two setscrews..



How to clean the strainer for the raw water pump (6TWGM model)

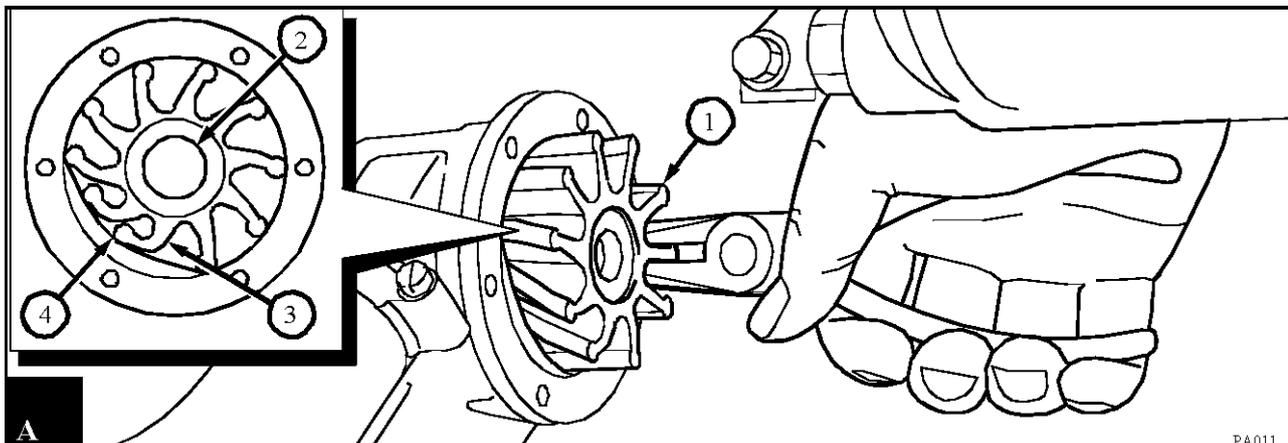
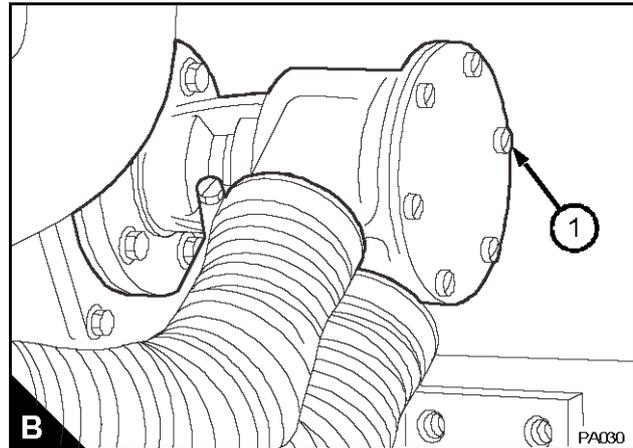
The strainer for the raw water pump is fitted in the outlet hose for the raw water pump. The purpose of the strainer is to protect the air charge cooler from debris. The strainer is fitted only to turbocharged engines.

1. Ensure that the seacock is closed.
2. Release the hose clip at the outlet connection (A1) of the raw water pump and on each side of the strainer (A3). Remove the hose (A2).
3. Remove the strainer and wash in clean water. If there is debris in the strainer from the impeller of the raw water pump, check the impeller.
4. Put the strainer into position and fit the hose. Tighten the hose clips.
5. Open the seacock.



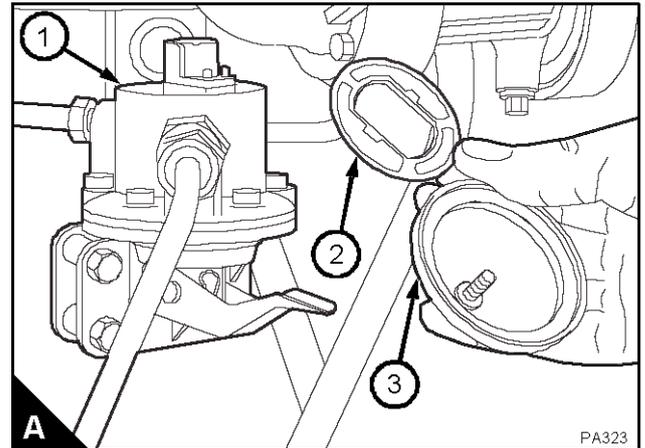
How to check the impeller of the raw water pump

1. Ensure that the seacock is closed.
2. Release the six screws (B1) 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 impeller (A1), remove the rubber end cap (A2) 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.
6. Apply Castrol Spheerol SX2 grease to the blades of the new impeller and fit the impeller into the housing with the blades bent clockwise (A3). Fit the rubber end cap.
7. Apply jointing compound to a new joint and fit it to the body with the wide area of the joint over the eccentric plate (A4) in the body. Fit the end plate and tighten the end plate screws.
8. Open the seacock.



How to clean the gauze strainer of the fuel lift pump

1. Remove the cover complete with the joint (A3) from the top of the fuel lift pump (A1) and remove the gauze strainer (A2).
2. Wash carefully all of the sediment from the lift pump body.
3. Clean the gauze strainer, the joint and the cover.
4. Assemble the lift pump. Use a good joint and ensure that the lift pump body and the cover are fitted together correctly because leakage at this point will let air into the fuel system.
5. Eliminate the air from the fuel system through the filter vent point, see page 30.



How to renew the canister of the fuel filter

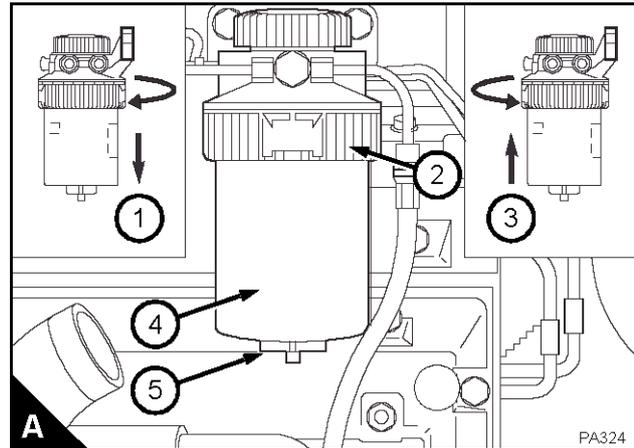
Warning! Discard the used element or canister and fuel oil in a safe place and in accordance with local regulations.

Cautions:

- It is important that only the genuine Perkins parts are used. The use of a wrong canister or element can damage the fuel injection pump.
- 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.

- The pre-filter and main filter canisters must be renewed at the same time.

1. Thoroughly clean the outside surfaces of the filter assembly.
2. Loosen the drain device (A5), if one is fitted, at the bottom of the canister and allow the water/fuel to drain into a suitable container.
3. Support the filter canister and rotate the clamp ring (A2) counter-clockwise and remove the clamp ring.
4. Remove the canister from the filter head by a direct pull downwards (A1), and discard the old canister (A4).
5. Ensure the filter head is clean. Ensure that the filter head and canister seals (on page 27/A2 and A3) are fitted and in good condition. Push the new canister (A3) fully into the filter head.
6. Support the canister, fit the clamp ring (A2) and rotate it clockwise to fasten the canister to the filter head.
7. Eliminate the air from the fuel pre-filter and fuel filter (see page 30).



How to renew the element of the fuel pre-filter

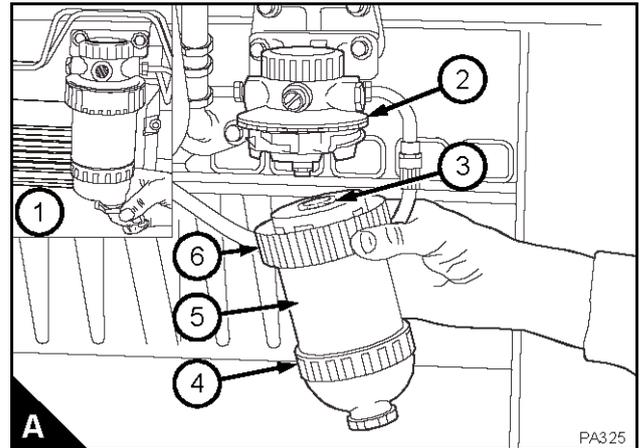
The fuel pre-filter (A) is fitted before the fuel lift pump on the right hand side of the engine. Check the filter bowl for water at regular intervals and drain from the sediment bowl (A1) as necessary.

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

Cautions:

- It is important that only the genuine Perkins parts are used. The use of a wrong canister or element can damage the fuel injection pump.
- 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.
- The pre-filter and main filter canisters must be renewed at the same time.

1. Thoroughly clean the outside surfaces of the filter assembly.
2. Loosen the drain device (A1) at the bottom of the canister and allow the water/fuel to drain into a suitable container.
3. Screw the sediment bowl (A4) counter-clockwise to release the bowl.
4. Support the filter canister and rotate the clamp ring (A6) counter-clockwise and remove the clamp ring.
5. Remove the canister from the filter head by a direct pull downwards, and discard the old canister (A5).
6. Ensure the filter head is clean. Ensure that the seals (A2) and (A3) are fitted and in good condition. Push the new canister fully into the filter head.
7. Support the canister, fit the clamp ring and rotate it clockwise to fasten the canister to the filter head.
8. If necessary, dismantle the sediment bowl and thoroughly clean the inside of the bowl.
9. Check the two 'O' ring seals of the sediment bowl for damage and renew if necessary.
10. Clean the threads of the sediment bowl, fit the bowl to the canister and tighten by hand only.
11. Eliminate the air from the fuel pre-filter and fuel filter, see page 30.



PA325

Atomiser fault

Warning!

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

An atomiser fault can cause an engine misfire.

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

How to renew an atomiser

Cautions:

- 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.

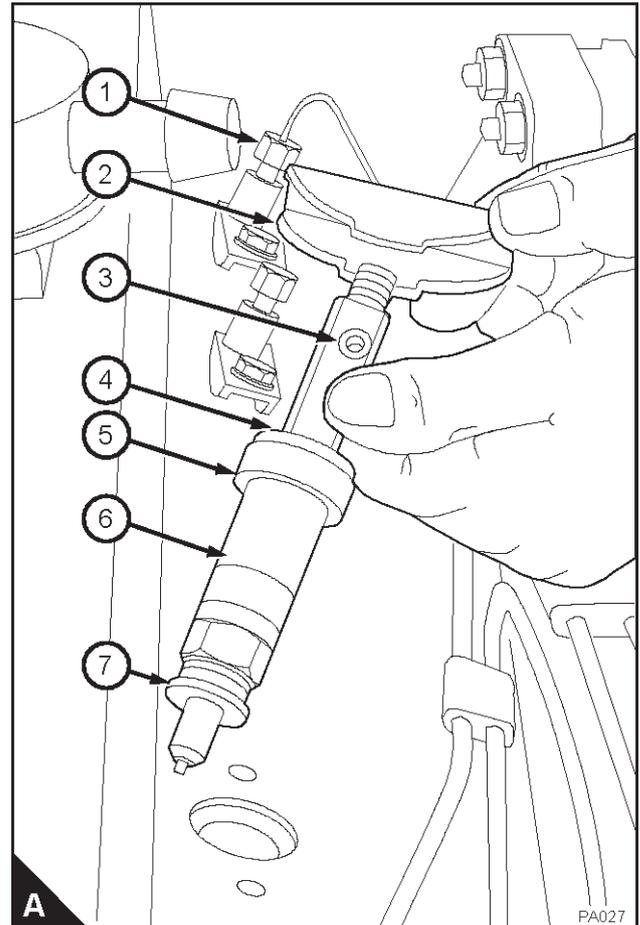
1. Remove the fuel leak-off pipe.
2. Remove the union nuts (A1) of the high-pressure pipe from the atomiser and from the fuel injection pump. Do not bend the pipe. If necessary, remove the pipe clamps.
3. Remove the atomiser setscrews and remove the clamp (A2), the atomiser (A6) and its seat washer (A7). Remove the dust seal (A5) and the spacer (A4) and fit the spacer and a new dust seal onto the new atomiser.

Caution: Remove and discard the seat washer (A7). If the original seat washer remains in the recess for the atomiser, the nozzle protrusion will be incorrect when a new seat washer is added.

4. Put the new atomiser in position with its spacer, new dust seal and a new seat washer, ensure that the fuel leak-off connection (A3) is not toward the engine. Position the clamp and engage the atomiser setscrews. Ensure that the atomiser is not tilted and tighten the setscrews for the clamp evenly and gradually to 12 Nm (9 lbf ft) 1,2 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.

5. Fit the high-pressure fuel pipe and tighten the union nuts to 22 Nm (16 lbf ft) 2,2 kgf m. If necessary, fit the pipe clamps.
6. Renew the sealing washers and fit the leak-off pipe. Tighten the banjo bolt to 9,5 Nm (7,0 lbf ft) 1,0 kgf m.
7. Operate the engine and check for leakage of fuel and air.



How to eliminate air from the fuel system

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

Air can enter the system if:

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

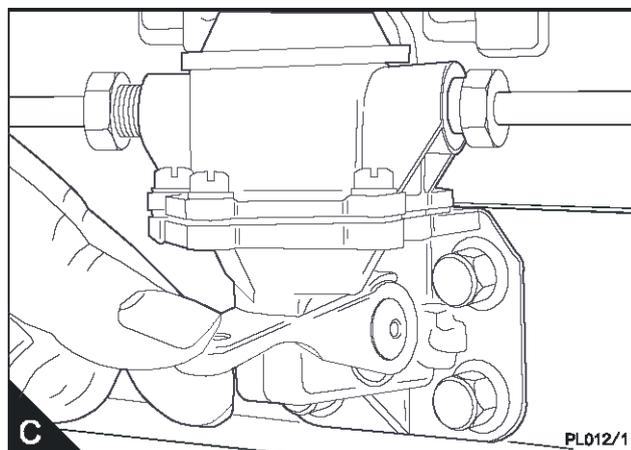
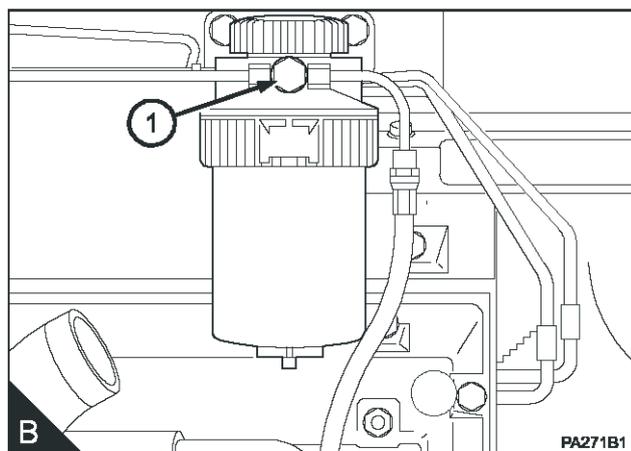
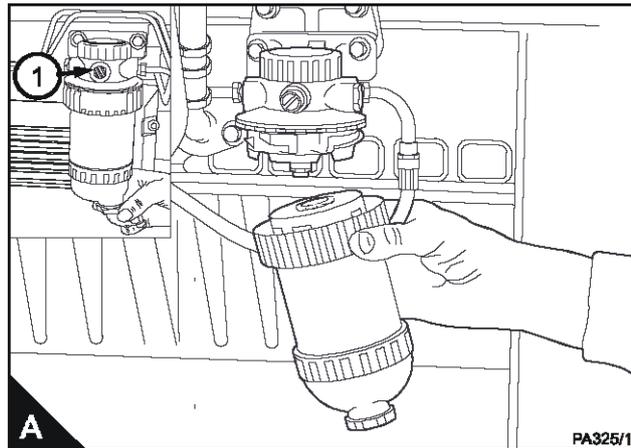
In order to eliminate air from the fuel system, proceed as follows:

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

1. Loosen the vent plug (A1) on the filter head for the pre-filter.
2. Operate the priming lever on the fuel lift pump (C) until fuel, free from air, comes from the filter vent point. Tighten the vent plug.
3. If the drive cam of the fuel lift pump is at the point of maximum cam lift, it will not be possible to operate the priming lever. In this situation, the crankshaft must be rotated one turn.
4. Loosen the banjo bolt (B1) on the filter head for the filter.
5. Operate the priming lever on the fuel lift pump (C) until fuel, free from air, comes from the filter vent point. Tighten the vent plug.

Caution: Use a spanner to hold the body (B1 on page 31) of the fuelled starting aid to prevent its movement when the union nut is loosened and tightened.

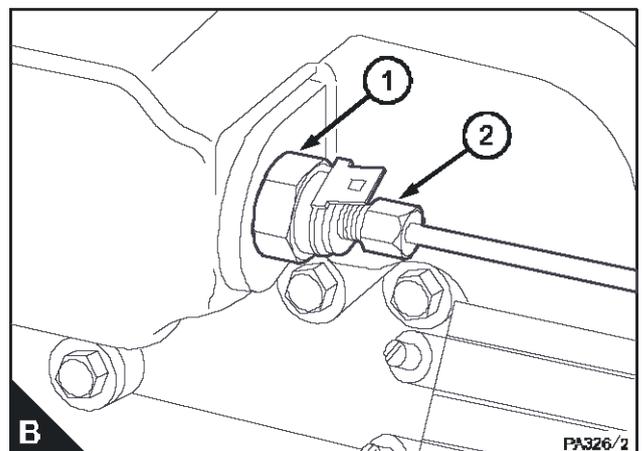
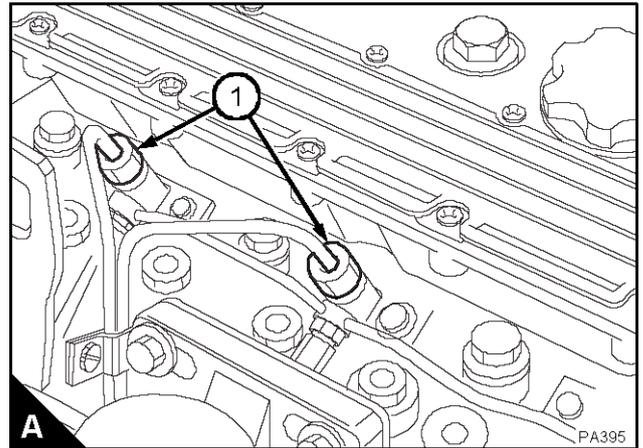
5. If the pipe to the fuelled starting aid has been drained, loosen the union nut (B2 on page 31) at the fuelled starting aid and operate the lift pump until fuel, free from air, comes from the connection. Tighten the union nut at the starting aid.



6. Loosen the union nuts (A1) of the high-pressure pipes at two of the atomisers.

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.

7. Put the electrical system switch to the "ON" position. Operate the starter motor until fuel, free from air, comes from the pipe connections. Tighten the high-pressure pipe connections to 27 Nm (20 lbf ft) 2,8 kgf m. Return the switch to the "OFF" position.
8. The engine is now ready to start.
9. If the engine runs correctly for a short time and then stops or runs roughly, check for air in the fuel system. If there is air in the fuel system, there may be a leakage in the low pressure system.



How to renew the lubricating oil of the engine

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

Warning! All these engines are fitted with a 'closed' crankcase breather system.

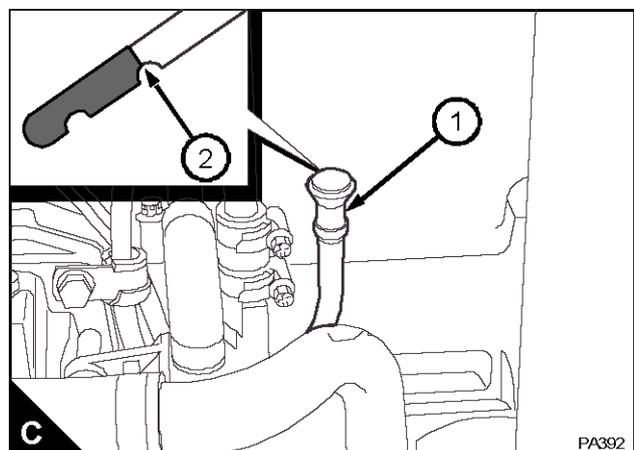
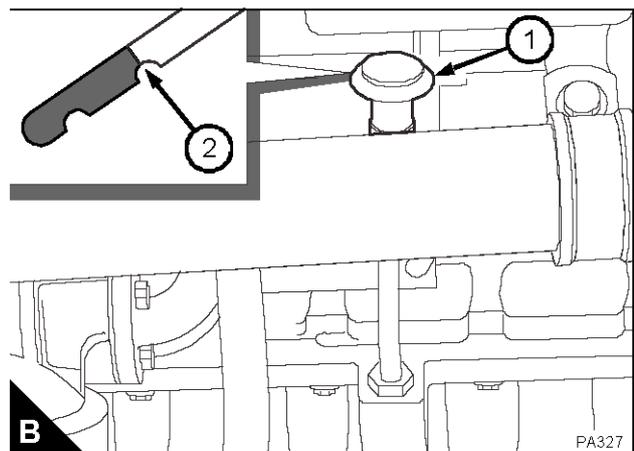
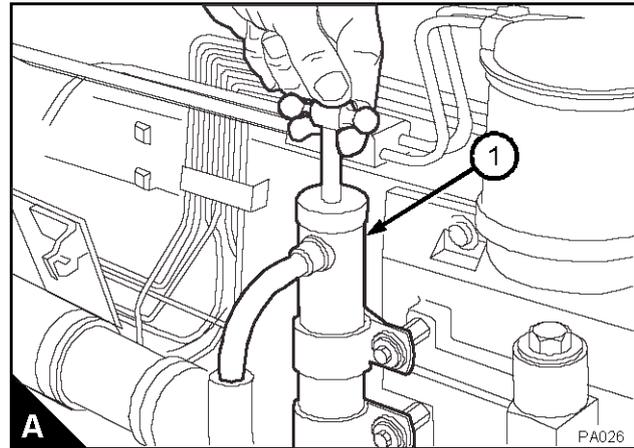
Any necessary oil additions to the sump must be carried out with the engine stationary.

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.

1. Connect a suitable hose to the outlet of the sump drain pump (A1). Put the free end of the hose into a suitable container with a capacity of at least 18 litres (32 UK pints) 19 US quarts. Use the drain pump to empty the sump. If possible, the lubricating oil should be drained while it is still hot.
2. Clean the area around the filler cap on top of the rocker cover. Remove the cap and add slowly approximately: For 6 cylinder engines 15 litres (26.4 UK pints) 15.8 US quarts, for 4 cylinder engines 8,1 litres (14.25 UK pints) 8.5 US quarts of new and clean lubricating oil of an approved specification (see page 44) to the engine. Allow the oil enough time to pass to the sump. Remove the dipstick (B1) for 6 cylinder engines or (C1) for four cylinder engines and ensure that the lubricating oil is to the full mark (B2) or (C2). Do not exceed the full mark on the dipstick. Fit the filler cap and ensure that the dipstick is fitted correctly in the dipstick tube.

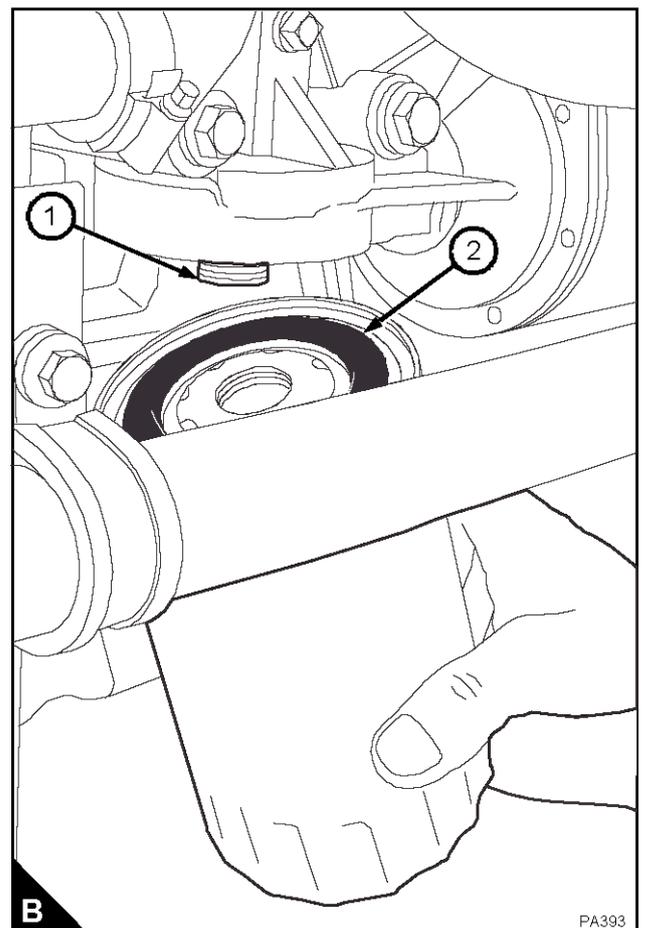
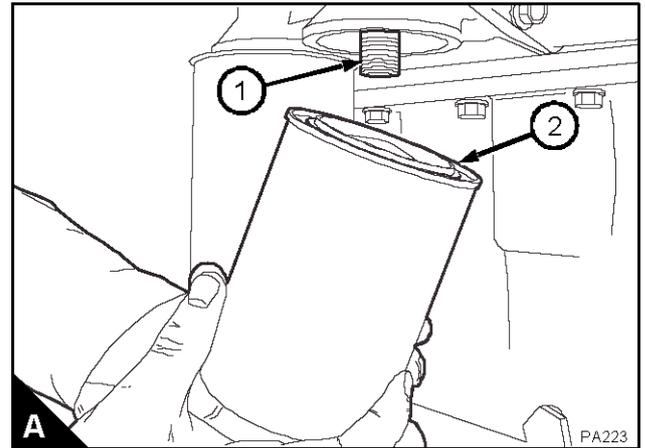
Note: Renew the filter canisters when the lubricating oil is renewed.



How to renew the canisters of the lubricating oil filter

1. Put a tray under the filter to retain spilt lubricating oil.
2. Remove the filter canister with a strap wrench or similar tool. To release the canister, turn it clockwise. Ensure that the adaptor (A1) for 6 cylinder engines and (B1) for four cylinder engines is secure in the filter head. Then discard the canister.
3. Clean the filter head.
4. Lubricate the top of the canister seal (A2) or (B2) with clean engine lubricating oil.
5. Fit the new canister and tighten it counter-clockwise by hand only. Do not use a strap wrench.
6. Ensure that there is lubricating oil in the sump. With the stop switch held in the "STOP" position, operate the starter motor until the oil pressure warning light is extinguished or there is a reading on the gauge.
7. Operate the engine and check for leakage from the filter. When the engine has cooled, check the oil level on the dipstick and put more oil into the sump, if necessary.

Caution: 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

6TWGM and 4 cylinder engines (closed breather)

Caution: Do not use excessive force to remove the hose (A4) from the breather outlet pipe.

1. Release the hose clip and carefully remove the hose from the breather outlet.
2. Remove the rocker cover.

Caution: Ensure that the lever does not damage the cover.

3. Release the fasteners and carefully remove the breather cover from the breather body. A suitable lever may be necessary to release the cover from the body of the breather. Ensure that the lever does not damage the cover. Discard the joint (A5).

Caution: Do not clean the breather valve or the gauze filter. The breather valve (A1) and the gauze (A3) must be renewed in accordance with the schedules on page 15.

4. Release the clips (A2) from the clip retainers (A7) and push the breather valve out of the breather cover. Discard the breather valve.
5. Remove and discard the gauze.

Warning! Do not allow compressed air to contact your skin. If compressed air enters your skin, obtain medical help immediately.

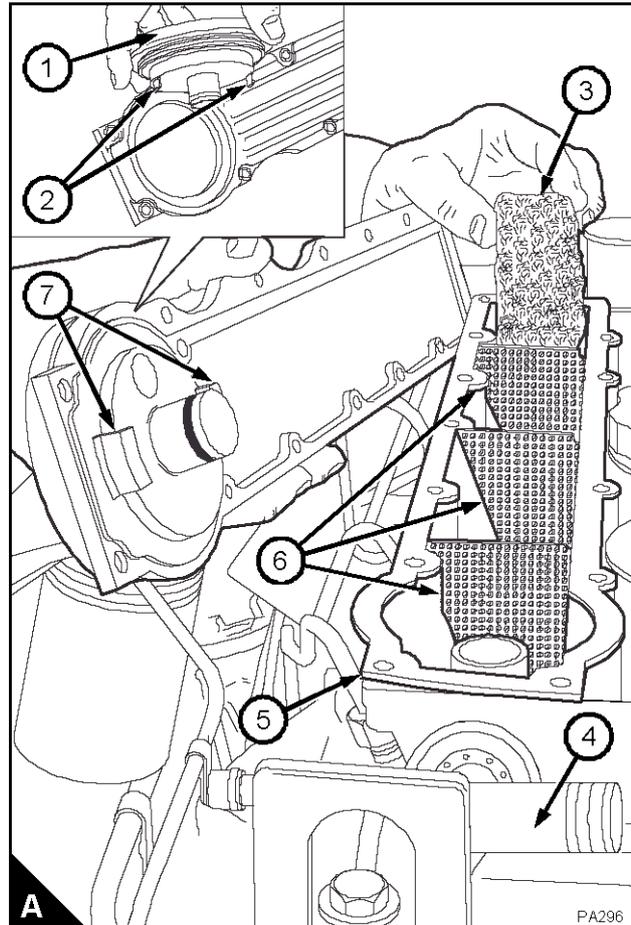
6. Wash the body of the breather, the cover, the baffle plates (A6) and the breather pipe, every 2000 hours of operation. Use an approved kerosene cleaning fluid and dry them with compressed air at low pressure.
7. Ensure that the holes at the bottom of the baffle plates in the breather body are not restricted. If necessary, clean the holes.

To assemble

1. Fit the baffle plates into the grooves in the breather body.
2. Renew and fit the gauze filter into the breather body.
3. Renew and fit the new valve into the breather cover. Ensure that the clips are engaged correctly.

Note: The breather valve is renewed every 4000 hours, refer to the schedule on page 15.

4. Renew the joint, which is fitted dry. Put the cover



and valve assembly into position on the breather body. Loosely fit the fasteners. Tighten the fasteners gradually and evenly to 3 Nm (2.2 lbf ft) 0.3 kgf m.

Caution: Do not use excessive force to fit the hose to the breather outlet pipe.

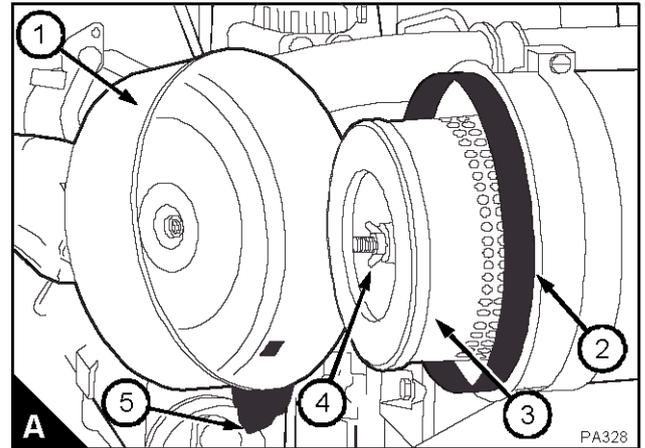
5. Check that there is no restriction in the breather pipe or the breather hose. Fit the breather hose to the cover and tighten the clip.

Air filter

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

The air filter has a dust bowl (A1) or (B1) which must be cleaned. Do not allow dust to fill the bowl, because this will reduce the life of the filter element (A3) or (B3).

An automatic dust valve (A5) or (B4) is fitted through which dust is expelled from the filter. The rubber dust valve must be kept clean.

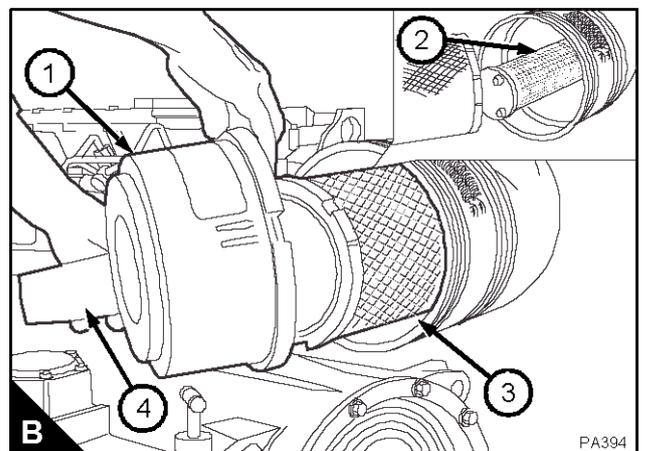


How to renew the element of the air filter

1. Release the dust bowl (A1) or (B1).
2. Release the fastener (A4) and remove the element (A3) from the filter body. Discard the element. Some elements (B3) are a push fit into the filter body and do not have a fastener.

Note: Some filters have a secondary element (B2) fitted.

3. Clean the dust bowl and the inside of the air filter body. Ensure that the dust seal (A2) is not damaged.
4. Fit a new element into the body and tighten the fastener.
5. Ensure that the sides of the dust valve (A5) or (B4) close completely together and that they can separate freely, if necessary renew the dust valve.
6. Fit the dust bowl.

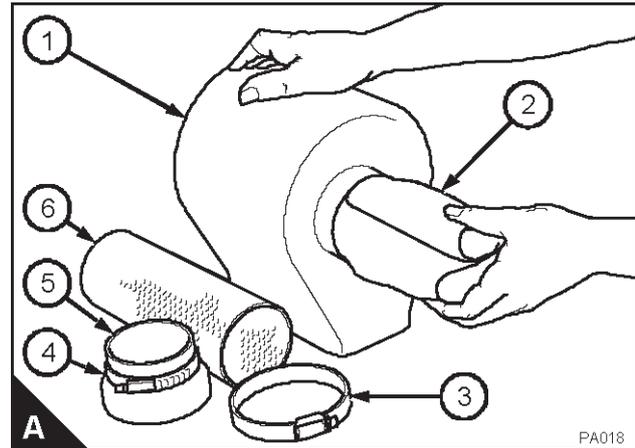


A restriction indicator is fitted to the filter, it will indicate when the air filter element needs service. This prevents late removal of the element which can cause loss of engine power, see page 48.

Caution: The filter element(s) must be renewed according to the maintenance schedule, see page 15, or earlier if the restriction indicator operates.

How to clean the air filter (6TWGM model)

1. Release the clip (A4) at the turbocharger and the bracket which supports the air filter and remove the air filter.
2. Release the clip (A3) and remove the adaptor (A5).
3. Remove the support tube (A6) and the filter element (A2) from the body (A1) of the air filter. Either wash the element in a solution of soap and water or renew it.
4. Clean the body and the support tube with a clean rag.
5. Fit a new element into the body of the filter through the hole in the body (A). Fit the support tube into the centre of the element and ensure that the end of the tube is engaged in the recess in the filter body. Fit the adaptor to the body and tighten the clip.
6. Fit the filter assembly to the turbocharger and fit the support bracket for the filter. Tighten the clip at the turbocharger.

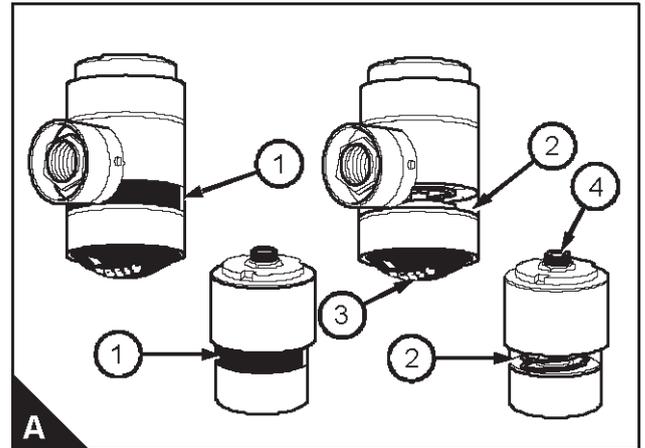


Restriction indicator

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

When the red warning indicator (A1) is seen through the clear panel (A2) 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 (A3) or the button (A4) of the restriction indicator to reset the red warning indicator.



How to check the valve tip clearances

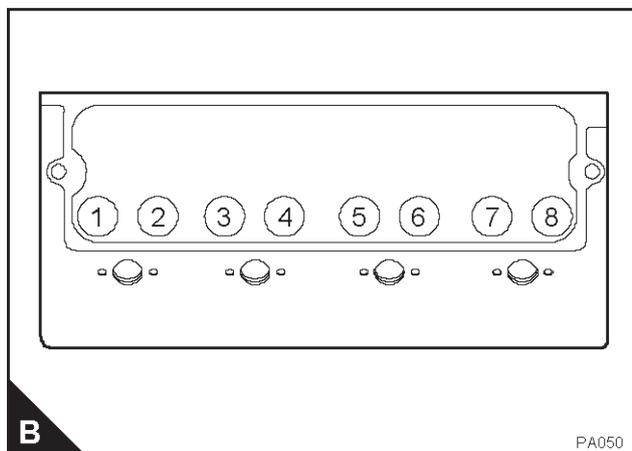
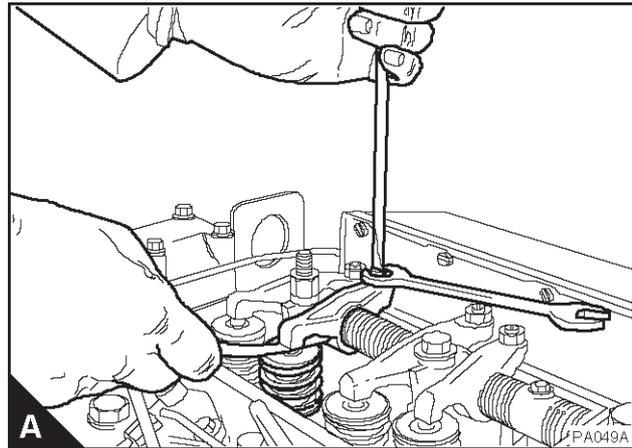
These are checked between the top of the valve stem and the rocker lever (A), with the engine hot or cold. The correct clearance for inlet valves is 0,20 mm (0.008 in) and 0,45 mm (0.018 in) for exhaust valves. The valve positions are shown at (B).

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

Note: Number 1 cylinder is at the front of the engine.

Four cylinder engines

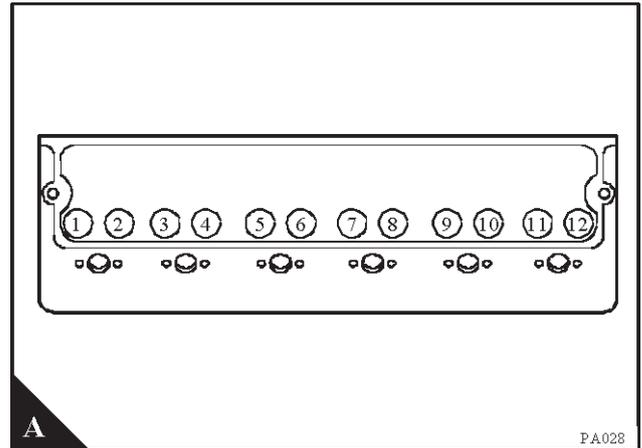
1. Rotate the crankshaft in the normal direction of rotation until the inlet valve (B8) of number 4 cylinder has just opened and the exhaust valve (B7) of the same cylinder has not closed completely. Check the clearances of the valves (B1 and B2) of number 1 cylinder and adjust them, if necessary.
2. Set the valves (B3 and B4) of number 2 cylinder as indicated above for number 4 cylinder. Then check / adjust the clearances of the valves (B5 and B6) of number 3 cylinder.
3. Set the valves (B1 and B2) of number 1 cylinder. Then check / adjust the clearances of the valves (B7 and B8) of number 4 cylinder.
4. Set the valves (B5 and B6) of number 3 cylinder. Then check / adjust the clearances of the valves (B3 and B4) 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	E	I	I	E	E	I

Six cylinder engines

1. Rotate the crankshaft in the normal direction of rotation until the inlet valve (A12) of number 6 cylinder has just opened and the exhaust valve (A11) of the same cylinder has not closed completely. Check the clearances of the valves (A1 and A2) of number 1 cylinder and adjust them, if necessary.
2. Set the valves (A3 and A4) of number 2 cylinder as indicated above for number 6 cylinder. Then check / adjust the clearances of the valves (A9 and A10) of number 5 cylinder.
3. Set the valves (A7 and A8) of number 4 cylinder. Then check / adjust the clearances of the valves (A5 and A6) of number 3 cylinder.
4. Set the valves (A1 and A2) of number 1 cylinder. Then check / adjust the clearances of the valves (A11 and A12) of number 6 cylinder.
5. Set the valves (A9 and A10) of number 5 cylinder. Then check / adjust the clearances of the valves (A3 and A4) of number 2 cylinder.
6. Set the valves (A5 and A6) of number 3 cylinder. Then check / adjust the clearances of the valves (A7 and A8) of number 4 cylinder.



Cylinder and valve number	1		2		3		4		5		6	
	1	2	3	4	5	6	7	8	9	10	11	12
Valve I = Inlet E = Exhaust	I	E	E	I	I	E	E	I	I	E	E	I

How to check the condition of the viscous damper

6 cylinder engines

Caution: A viscous damper (A1) should be renewed if there is impact damage to the outer casing or if there is leakage of the viscous fluid from the cover plate.

Check the area around the holes for the damper fasteners (A3) for cracks and general wear if the damper has become loose in service.

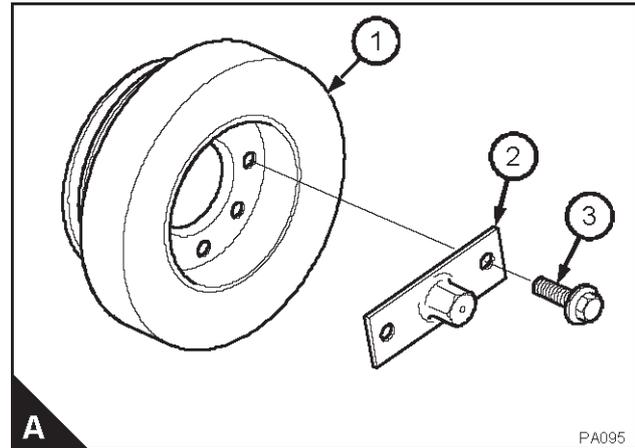
Check that the fasteners for the viscous damper are tightened correctly:

Tighten the M12 setscrews to 85 Nm (63 lb ft)

8,7 kgf m.

Tighten the two M12 setscrews which secure the device to rotate the crankshaft (A2) to 85 Nm (63 lb ft) 8,7 kgf m.

If it is necessary to renew the viscous damper refer to the workshop manual.



Seacock strainer

The seacock strainer must be cleaned regularly.

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 parts 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 (1mm 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

Extra blades for a small hacksaw.

Engine fluids

of the available fuel, consult your nearest Perkins distributor or one of the companies listed on page 6.

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 effect combustion.

Viscosity is the resistance to flow and engine performance can be effected 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.

Percentage of sulphur in the fuel (%)	Oil change interval
<0,5	Normal
0,5 to 1,0	0,75 of normal
1,0>	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

Lubricating oil specification

Use only a good quality oil which is not less than the specification given below.

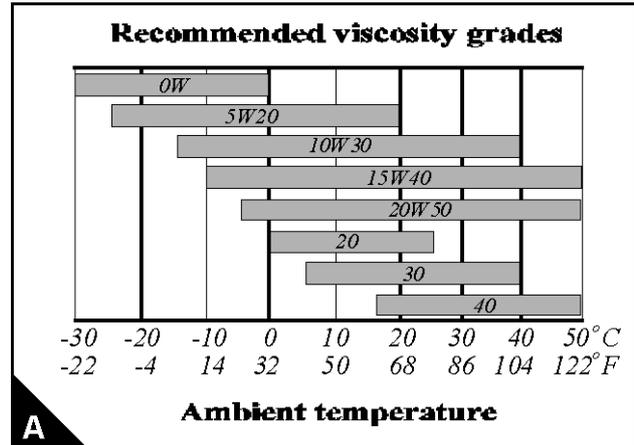
Naturally aspirated engines should use ACEA E1 or API CD. They can also use ACEA E2 or API CF4, but not for the first 20 to 40 hours of operation or for light load applications.

Turbocharged, non-intercooled engines should use ACEA E2 or API CF4.

Turbocharged, intercooled engines should use ACEA E3 or API CG4 (SHPD oil).

The type of lubricating oil to be used may be affected by the quality of the fuel which is available. For further details see "Fuel specification" on page 43.

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).



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'.

Extended Life Coolant
Qty: 5 litres – Part No 60061
Qty: 25 litres – Part No 60062

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

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

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

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

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

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

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

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

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

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	32, 33, 34, 36, 37, 41, 42, 43
The engine is difficult to start	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19	32, 34, 36, 37, 39, 41, 42, 43
Not enough power	8, 9, 10, 11, 12, 13, 16, 17, 18, 19, 20, 21	32, 34, 36, 37, 38, 41, 42, 43, 60, 62
Misfire	8, 9, 10, 12, 13, 15, 20	32, 34, 35, 36, 37, 38, 39, 40, 42
High fuel consumption	11, 13, 17, 18, 19, 21	32, 34, 35, 36, 37, 38, 39, 41, 42, 43, 62
Black exhaust smoke	11, 13, 17, 19, 21	32, 34, 35, 36, 37, 38, 39, 41, 42, 43, 60, 62
Blue or white exhaust smoke	4, 15, 21	34, 36, 37, 38, 41, 43, 44, 51, 57, 61
The pressure of the lubricating oil is too low	4, 22, 23, 24	45, 46, 47, 49, 50, 58
The engine knocks	9, 13, 15, 17, 20	34, 35, 36, 39, 41, 43, 45, 51, 53, 59
The engine runs erratically	7, 8, 9, 10, 11, 12, 13, 15, 16, 18, 20	32, 35, 37, 39, 40, 43, 51, 59
Vibration	13, 18, 20, 25	32, 37, 38, 39, 40, 43, 51, 53
The pressure of the lubricating oil is too high	4, 23	48
The engine temperature is too high	11, 13, 15, 19, 26, 28, 29, 30, 31	32, 34, 36, 38, 51, 54, 55, 56, 63
Crankcase pressure	27	38, 41, 43, 44, 51
Bad compression	11	35, 36, 38, 39, 41, 42, 43, 52, 59
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 control.
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. Fault in 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. Not enough lubricating oil in sump.
23. Defective gauge.
24. Dirty lubricating oil filter element.
25. Fault in engine mounting or flywheel housing.
26. Too much lubricating oil in sump.
27. Restriction in breather system.
28. Restriction in seacock or raw water strainer.
29. Insufficient coolant in circuit.
30. Restriction in heat exchanger or oil coolers.
31. Drive belt for water pump is loose.
32. Fault in fuel injection pump.
33. Broken drive on fuel injection pump.
34. Timing of fuel injection pump is incorrect.
35. Valve tip clearances are incorrect.
36. Valve timing is incorrect.
37. Insufficient compression.
38. Cylinder head gasket leaks.
39. Valves are not free.
40. Wrong high-pressure pipes.
41. Worn cylinder bores.
42. Leakage between valves and seats.
43. Piston rings are not free or they are worn or broken.
44. Valve stems and/or guides are worn.
45. Crankshaft bearings are worn or damaged.
46. Lubricating oil pump is worn.
47. Relief valve does not close.
48. Relief valve does not open.
49. Relief valve spring is broken.
50. Fault in suction pipe of lubricating oil pump.
51. Piston is damaged.
52. Piston height is incorrect.
53. Flywheel housing or flywheel is not aligned correctly.
54. Fault in thermostat or thermostat is of an incorrect type.
55. Restriction in coolant passages.
56. Fault in water pump.
57. Valve stem seal is damaged.
58. Restriction in sump strainer.
59. Valve spring is broken.
60. Turbocharger impeller is damaged or dirty.
61. Lubricating oil seal of turbocharger leaks.
62. Induction system leaks (turbocharged engines).
63. Fault in raw water pump.

Engine preservation

Introduction

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

Procedure

1. Completely clean the outside of the engine.
 2. When a preservative fuel is to be used, drain the fuel system and fill it with the preservative fuel. POWERPART Lay-Up 1 may be added to the normal fuel to change it to a preservative fuel. If preservative fuel is not used, the system may 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 proprietary preservative fluid instead of the lubricating oil. If a preservative fluid is used, this must be drained and the lubricating oil sump must be filled to the correct level with normal lubricating oil at the end of the storage period.
 6. Drain the coolant circuit, see page 18. 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, refer to company address list on page 6.*
7. Operate the engine for a short period in order to circulate the lubricating oil and the coolant in the engine.

8. Close the seacock and drain the raw water cooling system.

Caution: *The raw water system cannot be drained completely. If the system is drained for engine preservation purposes or for protection from frost, the system must be filled again with an approved antifreeze mixture, see page 45.*

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 Castrol Spheroil SX2 grease or glycerine.

Caution: *The raw water pump must never run in a dry condition because this will damage the impeller blades.*

10. Remove the atomisers and spray POWERPART Lay-Up 2 for one to two seconds into each cylinder bore with the piston at BDC. Slowly turn the crankshaft one revolution and then fit the atomisers, complete with new seat washers and new dust seals.
11. Spray POWERPART Lay-Up 2 into the induction manifold. Seal the manifold with waterproof tape.
12. Remove the exhaust pipe. Spray POWERPART Lay-Up 2 into the exhaust manifold. Seal the manifold with waterproof tape.
13. If the lubricating oil filler is fitted onto the rocker cover, remove the filler cap. If the lubricating oil filler is not fitted onto the rocker cover, remove the rocker cover. Spray POWERPART Lay-Up 2 around the rocker shaft assembly. Fit the filler cap or rocker cover.
14. Disconnect the battery. Then put the battery into safe storage in a fully charged condition. Before the battery is put into storage, protect its terminals against corrosion. POWERPART Lay-Up 3 can be used on the terminals.
15. Seal the vent pipe of the fuel tank or the fuel filler cap with waterproof tape.
16. Remove the alternator drive belt and put it into storage.
17. In order to prevent corrosion, spray the engine with POWERPART Lay-Up 3. Do not spray the area inside the alternator cooling fan.

Caution: After a period in storage, but before the engine is started, operate the starter motor with the stop switch held in the "STOP" position until oil pressure is indicated. Oil pressure is indicated when the low pressure warning light is extinguished. If a solenoid stop control is used on the fuel injection pump, it must be disconnected for this operation.

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 antifreeze to the raw water system for engine preservation purposes

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

1. Obtain two empty, clean containers each with a capacity of approximately 9,0 litres (2 UK gallons) 9.6 US quarts. Also obtain 4,5 litre (1 UK gallon) 5 US quarts of POWERPART antifreeze.
2. Remove the hose from the connection on the exhaust elbow and put the end of the hose into one of the empty containers.

***Caution:** Do not operate the starter motor for periods longer than 15 seconds. Excessive use of the starter motor will discharge the battery and could damage the starter motor.*

3. Remove the hose to the inlet of the raw water pump, and fit a suitable hose to the inlet of the pump and put it into the container of antifreeze. Close the seacock. Disconnect the electrical stop control and operate the starter motor for 15 seconds until the antifreeze has been circulated through the raw water system into the empty container.
4. Allow the starter motor to cool and repeat the operation. During this period, change the containers around, move the container with the antifreeze/water solution from the exhaust elbow outlet (hose end) to the raw water pump inlet hose.
5. When the antifreeze is mixed thoroughly and has been circulated through the raw water system, stop the engine and fit the hose connections to the raw water pump and the exhaust elbow. The raw water system contains antifreeze and the engine should not be run until the engine is used again.

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

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 Perkins Customer Training Department, Peterborough, or other main centres.

On-board parts 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. The instructions for the use of each product are given on the outside of each container. These products are available from your Perkins distributor.

POWERPART Antifreeze

Protects the cooling system against frost and corrosion.

POWERPART Easy Flush

Cleans the cooling system. Part number 21825001.

POWERPART Gasket and flange sealant

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

POWERPART Gasket remover

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

POWERPART Griptite

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

POWERPART Hydraulic threadseal

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

POWERPART Industrial grade super glue

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

POWERPART Lay-Up 1

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

POWERPART Lay-Up 2

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

POWERPART Lay-Up 3

Protects outside metal parts. Part number 1734115.

POWERPART Metal repair putty

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

POWERPART Pipe sealant and sealant primer

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

POWERPART 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

4GM and 4TGM engines

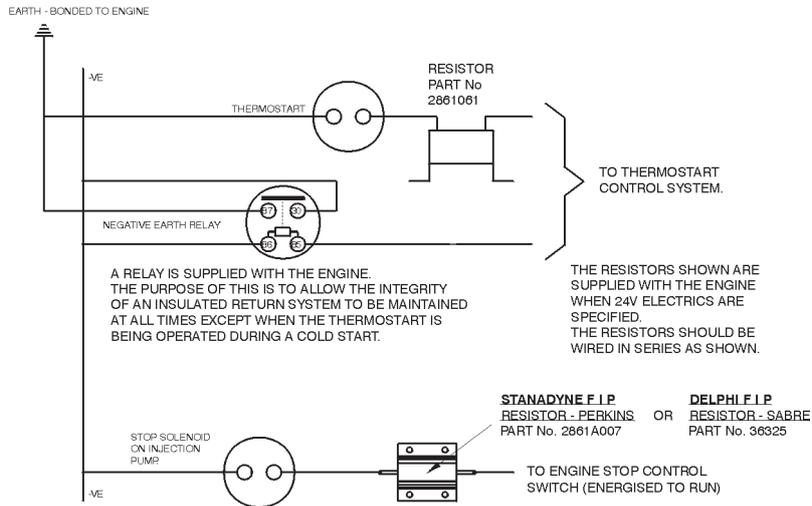
Number of cylinders.....	4
Cylinder arrangement.....	Vertical In line
Cycle.....	Four stroke
Induction system:	
- 4GM.....	Naturally aspirated
- 4TGM	Turbocharged
Combustion system.....	Direct injection
Nominal bore	100 mm (3.937 in)
Stroke	127 mm (5.000 in)
Compression ratio	16.0:1
Cubic capacity	4 litres (243 in ³)
Firing order	1, 3, 4, 2
Direction of rotation	Clockwise from the front
Maximum angle of engine tilt (all directions)	25°
Valve tip clearances (hot or cold):	
- Inlet.....	0,20 mm (0.008 in)
- Exhaust	0,45 mm (0.018 in)
Lubricating oil pressure	
(minimum at maximum engine speed and normal engine temperature)	280 kN/m ² (40 lbf/in ²) 2,5 kgf/cm ²
Maximum capacity of lubricating oil sump:.....	8,1 litres (14.25 UK pints) 8.5 US quarts
Coolant capacity (closed circuit).....	18 litres (31.5 UK pints) 19 US quarts
Weight (wet)	
- 4GM.....	448 Kg (988 lbs)
- 4TGM	455 Kg (1003 lbs)
Battery	12V or 24V negative earth

6TG2AM and 6TWGM engines

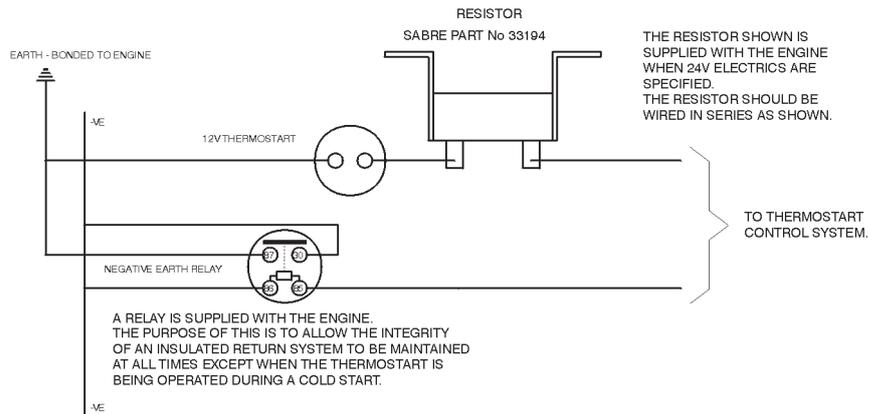
Number of cylinders.....	6
Cylinder arrangement.....	Vertical In line
Cycle.....	Four stroke
Induction system 6TG2AM.....	Turbocharged
Induction system 6TWGM.....	Turbocharged and Intercooled
Combustion system.....	Direct injection
Nominal bore.....	100 mm (3.937 in)
Stroke.....	127 mm (5.000 in)
Compression ratio.....	16.0:1
Cubic capacity.....	6 litres (365 in ³)
Firing order.....	1, 5, 3, 6, 2, 4
Direction of rotation.....	Clockwise from the front
Maximum angle of engine tilt (all directions).....	25°
Valve tip clearances (hot or cold):	
- Inlet.....	0,20 mm (0.008 in)
- Exhaust.....	0,45 mm (0.018 in)
Lubricating oil pressure	
(minimum at maximum engine speed and normal engine temperature)	280 kN/m ² (40 lbf/in ²) 2,5 kgf/cm ²
Capacity of lubricating oil sump:	
- Maximum.....	15,0 litres (26.4 UK pints) 15.8 US quarts
- Minimum.....	13,0 litres (23 UK pints) 13.7 US quarts
Coolant capacity (closed circuit).....	24 litres (42.2 UK pints) 25.4 US quarts
Weight (wet).....	626 Kg (1380 lbs)
Battery.....	12V or 24V negative earth

Electrical diagrams

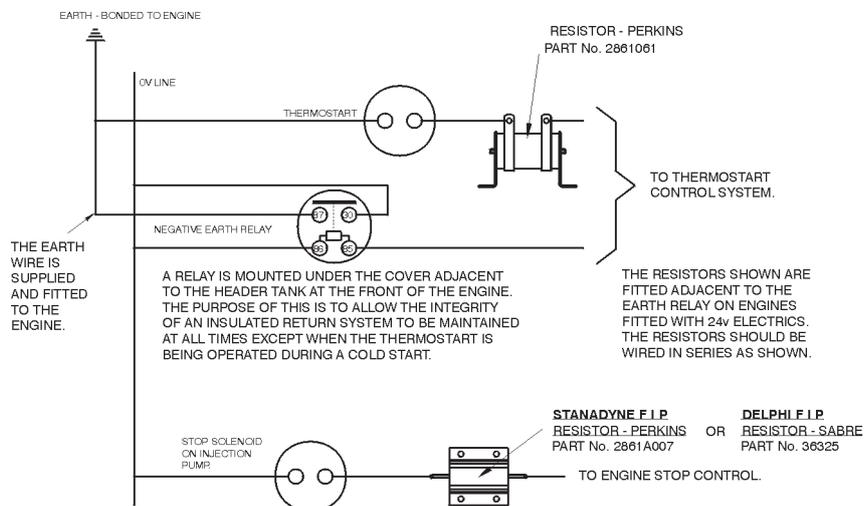
Earth relay and resistors



CIRCUIT DIAGRAM - EARTH RELAY AND RESISTORS FOR THE 4GM & 4TGM ENGINES.



CIRCUIT DIAGRAM TO SUIT WIRING OF THERMOSTART AND EARTH RELAY FOR THE 6TWGM ENGINE.



CIRCUIT DIAGRAM - EARTH RELAY AND RESISTORS FOR THE 6TG2AM ENGINE.

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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