

User's Handbook

Perkins 1000 Series

AA to AH
YA to YD



Chapters

- 1 General information**
- 2 Engine views**
- 3 Operation instructions**
- 4 Preventive maintenance**
- 5 Engine fluids**
- 6 Fault diagnosis**
- 7 Engine preservation**
- 8 Parts and service**
- 9 General data**

The following pages contain a detailed table of contents

Contents

1 General Information

Introduction	5
How to care for your engine	6
Engine identification	7
Perkins companies	8
General safety precautions	9

2 Engine views

Introduction	11
Location of engine parts	11

3 Operation instructions

How to start the engine	13
How to stop the engine	16
Adjustment of the engine speed range	16
Running-in	16
Turbocharged engines	16
Altitude	16

4 Preventive maintenance

Preventive maintenance periods	17
Schedules	18
How to drain the cooling system	20
How to check the specific gravity of the coolant	21
How to check the drive belt(s)	22
How to clean the gauze strainer of the fuel lift pump	23
Fuel pre-filter	23
How to renew the element(s) of the fuel filter	24
How to renew the element(s) of the separate element type	25
How to renew the filter canister of the canister fuel filter	26
How to renew the canister of the quick release fuel filter	27
Atomiser fault	28

How to renew an atomiser	28
How to eliminate air from the fuel system	29
How to renew the lubricating oil of the engine	34
How to renew the canister of the lubricating oil filter	35
How to clean the closed breather system	36
How to clean the integral closed breather system	37
The open breather system	38
Air cleaner	39
Air filter	40
Restriction indicator	40
How to check the valve tip clearances	41

5 Engine fluids

Fuel specification	43
Lubricating oil specification	44
Coolant specification	45

6 Fault diagnosis

Problems and possible causes	48
List of possible causes	49

7 Engine preservation

Introduction	51
------------------------	----

8 Parts and service

Introduction	53
Service literature	53
Training	53
POWERPART recommended consumable products	53

9 General data

Engine	55
------------------	----

1

General Information

Introduction

The Perkins 1000 Series industrial and agricultural engines are the latest developments from Perkins Engines Limited a world leader in the design and manufacture of high performance diesel engines.

More than 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.

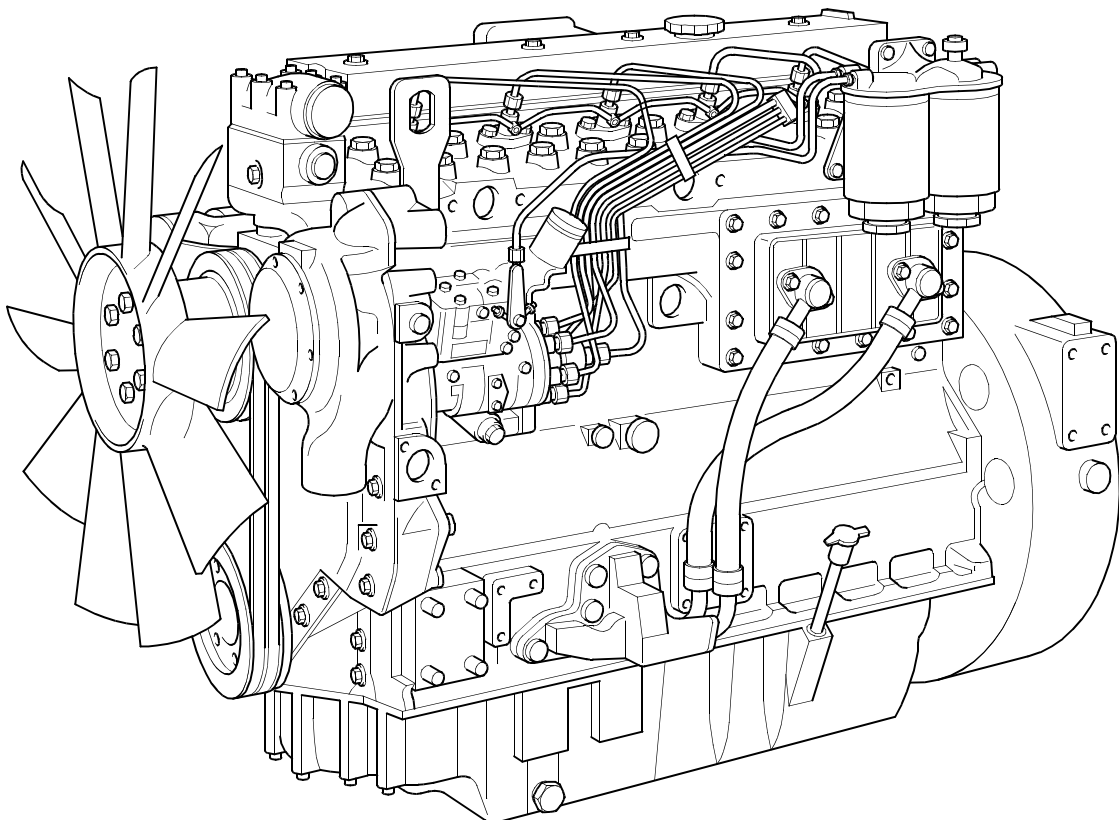
To ensure that you use the relevant information for your specific engine type, refer to "Engine identification" on page 7.

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.



A

A0314

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 8.

The terms "left side" and "right side" apply when the engine is seen from the flywheel end.

Engine identification

The 1000 Series consists of a range of both four and six cylinder engines. Each range has four basic engine types, naturally aspirated, compensated, turbocharged and turbocharged with an intercooler.

There are different model variations within each range. Identification of the various models is by a system of numbers and letters, for example:

1006-60TW

1006	6 cylinder engine
-60	6 litre engine
T	Turbocharged
TW	Turbocharged, but with an air to water intercooler to cool the induction air between the turbocharger and the cylinders.

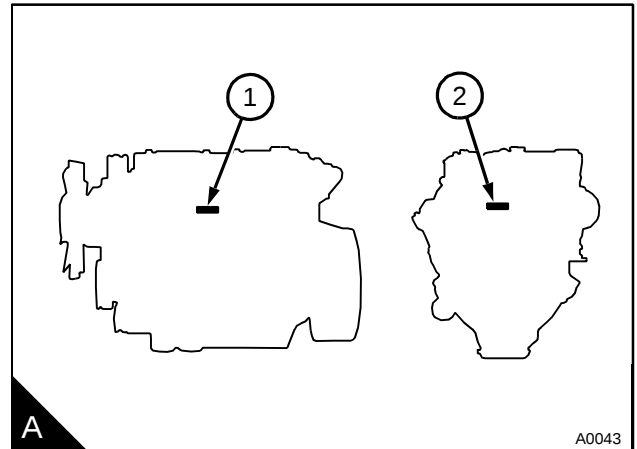
Engines used for generator sets have a similar system of model identification, for example:

1006-60TWG1

1006	6 cylinder engine
-60	6 litre engine
T	Turbocharged
TW	Turbocharged, but with an air to water intercooler
G	Generator set
1	Rating code number

In this handbook, the different engine types are indicated by their code letters, which are the first two letters of the engine number as indicated below:

Code Letters	Engine type
AA	Four cylinder, naturally aspirated.
AB	Four cylinder, turbocharged.
AC	Four cylinder, compensated.
AD	Four cylinder, turbocharged and intercooled.
AG	Four cylinder, naturally aspirated, belt driven coolant pump.
AH	Four cylinder, turbocharged, belt driven coolant pump.
YA	Six cylinder, naturally aspirated.
YB	Six cylinder, turbocharged.
YC	Six cylinder, compensated.
YD	Six cylinder, turbocharged and intercooled



The correct identification of the engine is by the full engine number.

The engine number is stamped on a label (A1) which is fastened to the left side of the cylinder block. Some engines also have the engine number stamped on the rear of the cylinder block (A2). An example of the engine number is:

AB30126U510256N

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 N°, then this number must also be given to your Perkins distributor.

Perkins companies
Australia

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

France

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

Germany

Perkins Motoren GmbH,
Saalaeckerstrasse 4,
63801 Kleinostheim,
Germany.
Telephone: 0049 6027 5010
Fax: 0049 6027 501124

Italy

Motori Perkins S.p.A.,
Via Socrate 8,
22070 Casnate con Bernate (Como), Italy.
Telephone: 0039 031 4633466 / 031 4633488
Fax: 0039 031 565480 / 031 396001

Japan

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

Singapore

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

United Kingdom

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

United States of America

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

Perkins Engines Latin America Inc,
Suite 200,
701, Waterford Way (NW 62nd Avenue),
Miami, FL 33134
U.S.A.
Telephone: 001 305 476 6900
Telex: 32501 Perken G
Fax: 001 305 476 6910

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

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 or auxiliary equipment 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 allow sparks or fire near the batteries (especially when the batteries are 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.
- Ensure that the control lever of the transmission drive is in the "out-of-drive" position before the engine is started.
- Use extreme care if emergency repairs must be made 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 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 debris away from the inlet and outlet ports of the turbocharger and prevent contact with hot surfaces.
- Fit only genuine Perkins parts.

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. Battery posts, terminals and related accessories contain lead and lead compounds. **Wash hands after handling.**

This page is intentionally blank

2

Engine views

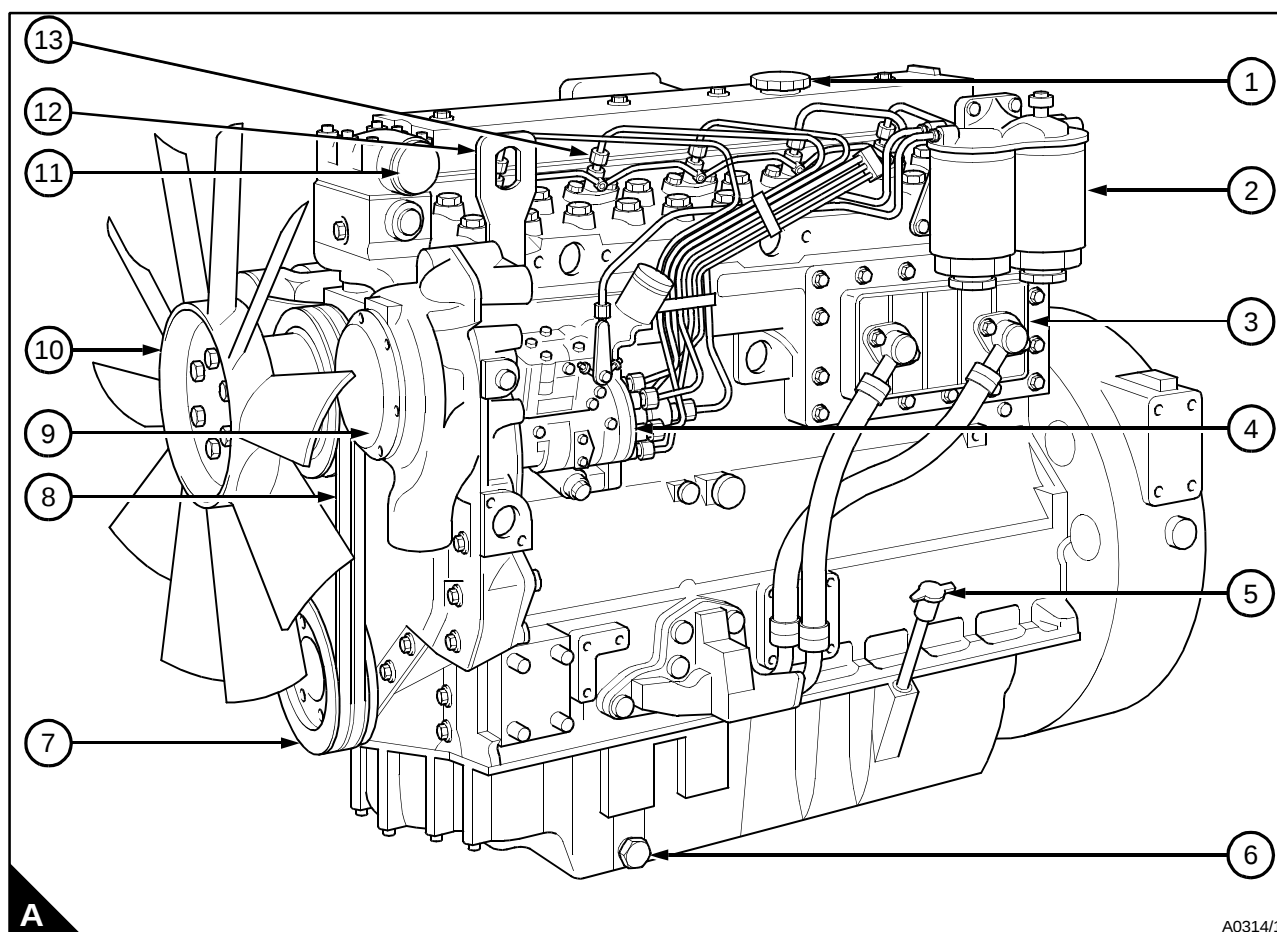
Introduction

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

Location of engine parts

Front and left side of the YB engine (A)

- | | |
|--------------------------------------|-----------------------|
| 1 Filler cap for the lubricating oil | 8 Drive belt |
| 2 Fuel filter | 9 Coolant pump |
| 3 Lubricating oil cooler | 10 Fan |
| 4 Fuel injection pump | 11 Coolant outlet |
| 5 Lubricating oil dipstick | 12 Front lift bracket |
| 6 Drain plug for the lubricating oil | 13 Atomiser |
| 7 Crankshaft pulley | |

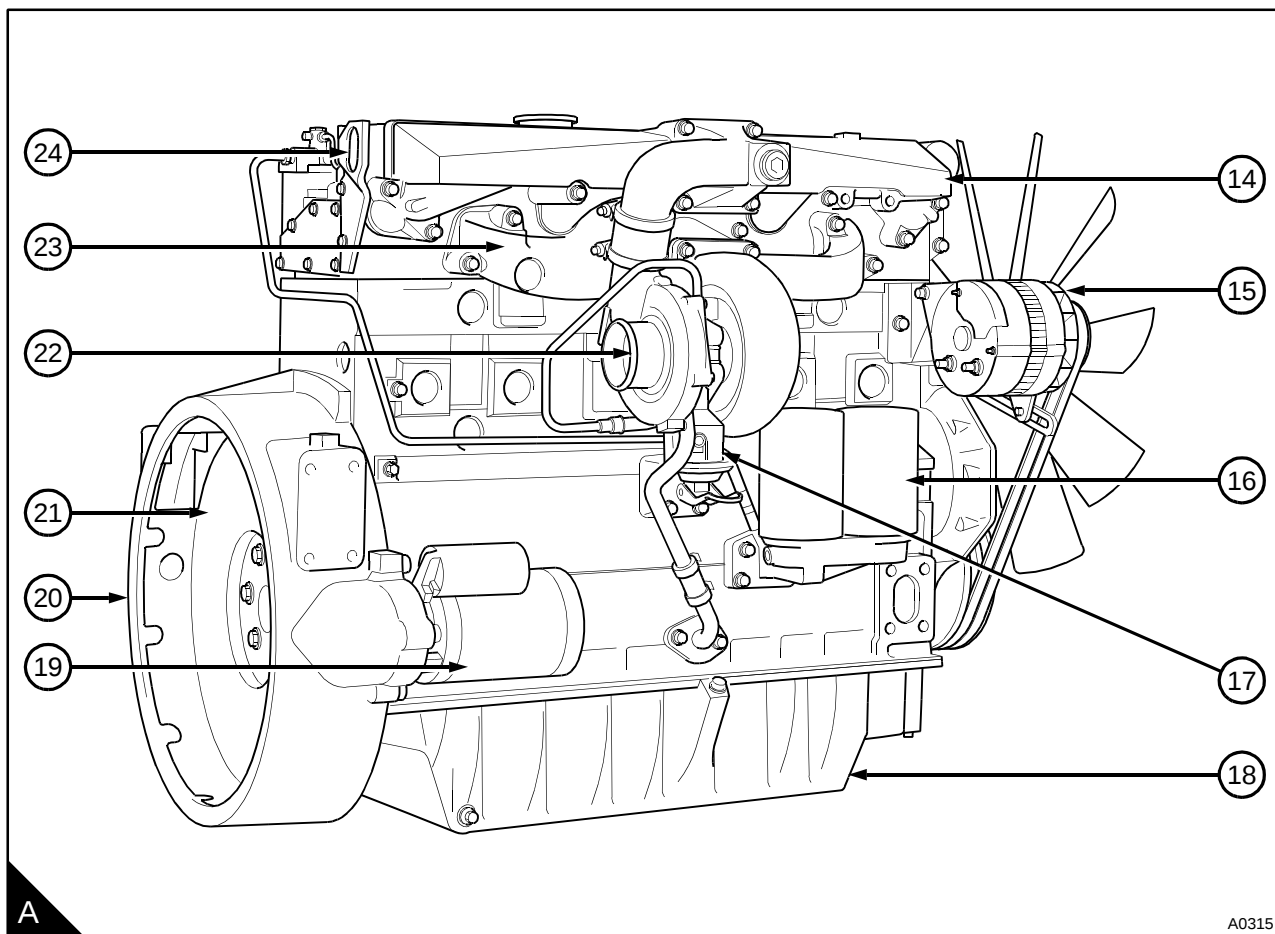


A0314/1

2

Rear and right side of the YB engine (A)

- | | |
|---------------------------|----------------------|
| 14 Induction manifold | 20 Flywheel housing |
| 15 Alternator | 21 Flywheel |
| 16 Lubricating oil filter | 22 Turbocharger |
| 17 Fuel lift pump | 23 Exhaust manifold |
| 18 Lubricating oil sump | 24 Rear lift bracket |
| 19 Starter motor | |



3

Operation instructions

How to start the engine

Several factors affect engine start, for example:

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

Diesel engines need a cold starting aid if they are to start in very cold conditions. Normally, your vehicle or your machine will be fitted with the correct equipment for your region of operation.

Perkins engines can be equipped with various cold starting systems. For the 1000 Series engines these systems are:

Fuelled starting aid

An electrically operated device which ignites a specific amount of diesel fuel in the induction manifold in order to heat the induction air.

Port heaters

These electrical devices are fitted in the induction manifold and heat the induction air. They are operated automatically when the starter motor is engaged. When these devices are fitted, the start procedure for a cold engine is the same as that given for a cold engine start without starting aids.

Start Pilot

A hand pump is used to inject a cold start fluid into the induction manifold through an atomiser. The cold start fluid ignites at a lower temperature than diesel fuel. The cold start fluid is contained in a separate reservoir. Certain models use a push button to actuate a solenoid which releases the cold start fluid from an aerosol container.

KBi

This system uses an aerosol container filled with a cold start fluid. The fluid is released by a solenoid, which is operated by a push button. The cold start fluid is sprayed into the induction manifold through a nozzle. The cold start fluid ignites at a lower temperature than diesel fuel.

Caution: *If the engine is to be run after a period in storage, see "Caution" on page 52.*

3

How to start a warm engine

- 1 If the engine is equipped with a manual stop control, ensure that it is in the "run" position.
- 2 Adjust the engine speed control to the quarter open position.
- 3 Turn the start key to the "HS" or "S" position (A) or (B) to engage the starter motor.
- 4 Allow the start key to return to the "R" position, as soon as the engine starts.

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

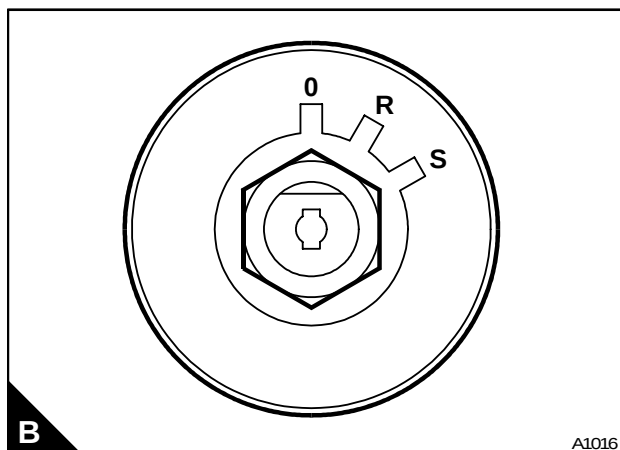
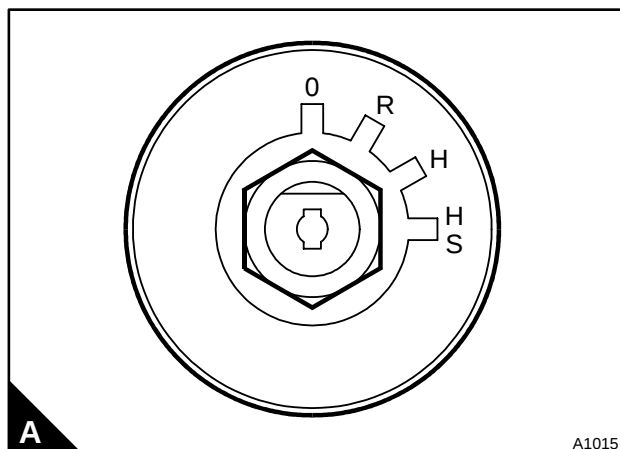
How to start a cold engine without starting aids

- 1 If the engine is equipped with a manual stop control, ensure that it is in the "run" position.
- 2 Adjust the engine speed control to the maximum speed position.
- 3 Turn the start key to the "S" position (B) to engage the starter motor. Allow the key to return to the "R" position, when the engine starts. Then adjust the engine speed control to get an even idle speed.
- 4 If the engine does not start in 30 seconds, allow the start key to the "R" position for another 30 seconds. Then engage the starter motor again for a maximum period of 30 seconds.

How to start a cold engine with the fuelled starting aid

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

- 1 If the engine is equipped with a manual stop control, ensure that it is in the "run" position.
- 2 Turn the start key to the "H" position (A) and keep it there for 15 seconds.
- 3 Adjust the engine speed control to the maximum speed position.
- 4 Turn the start key to the "HS" position in order to engage the starter motor. Allow the start key to return to the "R" position, when the engine starts. Then adjust the engine speed control to give an even idle speed.
- 5 If the engine does not start in 15 seconds, turn the start key to the "H" position and hold it there for 10 seconds. Then engage the starter motor again.



How to start a cold engine with manually operated Start Pilot

Caution: *Start Pilot equipment must not be used with heater type starting aids such as the fuelled starting aid.*

Do not use the hand pump until the starter motor is engaged. The amount of fluid which is necessary for an engine start will be found by experience.

- 1 If necessary, fill the reservoir with fluid. Lift the cover of the reservoir and press the can, head down, onto the filler plug. Hold it squarely until the fluid fills the bowl to the maximum mark.
- 2 If the engine is equipped with a manual stop control, ensure that it is in the "run" position.
- 3 Adjust the engine speed control to the maximum speed position.
- 4 Turn the start key to the "S" position (page 14/B) in order to engage the starter motor. Hold the start key in this position for a maximum of 30 seconds and operate the hand pump during this period. When the engine starts, release the start key to the "R" position and adjust the engine speed control to get an even idle speed.
- 5 If the engine does not start in 30 seconds, allow the start key to return to the "R" position for another 30 seconds. Then engage the starter motor and operate the hand pump again.

In certain conditions, it is necessary to inject a little more fluid after the engine has started in order to ensure that the engine continues to run.

The air filter at the outer end of the pump must be inspected from time to time. If necessary, it must be washed in kerosene.

The inside surface of the cylinder can be lightly lubricated with a thin lubricating oil.

The nozzle can be removed from the induction manifold and washed in kerosene, if necessary. Use the direction mark on the nozzle body to ensure that the nozzle is fitted in its original position.

How to start a cold engine with KBi or electrically operated Start Pilot

Caution: *KBi equipment must not be used with heater type cold starting aids such as the fuelled starting aid.*

- 1 If necessary, renew the screw type canister. Ensure that the sealing washer remains in position when the new canister is fitted. Each container has a safety valve.
- 2 If the engine is equipped with a manual stop control, ensure that it is in the "run" position.
- 3 Adjust the engine speed control to the maximum speed position.
- 4 Turn the start key to the "S" position (page 14/B) in order to engage the starter motor.
- 5 When the engine turns, press the starting aid button for a maximum period of 2 seconds. If the engine does not start after the first 2 second application, keep the starter motor engaged. After 5 seconds, press the button again for 2 seconds.
- 6 Allow the start switch to return to the "R" position, when the engine starts. Then adjust the engine speed control to get an even idle speed. In certain conditions it is necessary to inject a little more fluid after the engine has started, in order to ensure that the engine continues to run.

How to stop the engine

Caution: *It is recommended that a turbocharged engine is run at approximately 1000 rev/min at a reduced load for 2-3 minutes before it is shut down. This will allow the turbocharger to cool.*

According to the equipment fitted, either turn the engine start key to the "O" position (page 14/A or B) or operate the manual stop control. If a manual stop control is used, ensure that the control returns to the "run" position after the engine has stopped. Also ensure that the engine start key is turned to the "O" position.

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 transmission. The warranty of the engine can be affected if the seals on the fuel injection pump are broken during the warranty period by a person who is not approved by Perkins.

Running-in

Cautions:

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

A gradual running-in of a new engine or POWER EXCHANGE 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.

Turbocharged engines

Because of the power characteristics of the turbocharged engines it is necessary to maintain a high engine speed when you climb a gradient. To ensure that the engine is not overloaded at low engine speeds engage a lower gear.

Altitude

If the naturally aspirated engine is to run at an altitude above 600 m (2,000 ft), the fuel delivery can be changed to reduce fuel consumption and smoke. Perkins can give the percentage of fuel reduction necessary if details of engine application and ambient conditions are given. Changes to the settings of the fuel injection pump must be made by a Perkins distributor or by an approved distributor for the fuel injection pump.

4

Preventive maintenance

Preventive maintenance periods

These preventive maintenance periods apply to average conditions of operation. Check the periods given by the manufacturer of the equipment in which the engine is installed. Use the periods which are shortest. 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.

4

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 400 hours or 12 months

B Every day or every 8 hours

E Every 2000 hours

C Every 200 hours or 6 months

A	B	C	D	E	Operation
•	•				Check the amount of coolant
			•		Check the concentration of the coolant ⁽²⁾
•		•			Check the tension and the condition of the drive belt
			•		Clean the sediment chamber and the strainer of the fuel lift pump
		•			Check for water in the pre-filter ⁽¹⁾ , (or earlier if your fuel supply is contaminated)
			•		Renew the elements of the fuel filter(s)
				•	Ensure that the atomisers are checked ⁽³⁾
•					Ensure that the idle speed is checked and adjusted, if it is necessary ⁽³⁾
			•		Check Stanadyne fuel injection pump for governor operation ⁽³⁾
	•				Check the amount of lubricating oil in the sump
•	•				Check the lubricating oil pressure at the gauge ⁽¹⁾
•			•		Renew the engine lubricating oil ⁽⁴⁾ ⁽⁵⁾
•			•		Renew the canisters(s) of the lubricating oil filter ⁽⁴⁾
•		•			Renew the canister of the lubricating oil filter (six cylinder naturally aspirated engines with a single filter canister)

⁽¹⁾ If one is fitted.

⁽²⁾ Renew the antifreeze every 2 years. If a coolant inhibitor is used instead of antifreeze, it should be renewed every 6 months.

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

⁽⁴⁾ The lubricating oil and the filter canister(s) must be renewed every 250 hours or 12 months for applications where the engine normally runs at full load for periods of more than 20 minutes, for example: Generating sets or water pumps.

⁽⁵⁾ The oil change interval will change with the amount of sulphur in the fuel (see the table in fuel specification on page 43). The interval to change the canister of the lubricating oil filter is not affected.

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 400 hours or 12 months

B Every day or every 8 hours

E Every 2000 hours

C Every 200 hours or 6 months

A	B	C	D	E	Operation
•	•	•	•	•	- Clean the engine breather system ⁽³⁾ - Clean the air cleaner or empty the dust bowl of the air filter - extremely dusty conditions - normal conditions - Clean or renew the air filter element, if it has not been indicated earlier - Ensure that the turbocharger impeller and turbocharger compressor casing are cleaned ⁽²⁾ - Clean the compressor air filter ⁽¹⁾ - Ensure that the exhauster or compressor ⁽¹⁾ is checked ⁽²⁾ - Ensure that the valve tip clearances of the engine are checked and, if necessary, adjusted ⁽²⁾ - Ensure that the valve tip clearances of the engine are checked and, if necessary, adjusted (high rated engines) ⁽²⁾ - Ensure that the alternator and the starter motor are checked ⁽²⁾

⁽¹⁾ If one is fitted.

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

⁽³⁾ The closed breather assemblies must be cleaned, see page 36 and page 37. The oil separator of the open breather assembly should not be cleaned, but must be renewed at every overhaul of the engine or 8000 hours, see page 38. Refer to your local distributor.

4

How to drain the cooling system

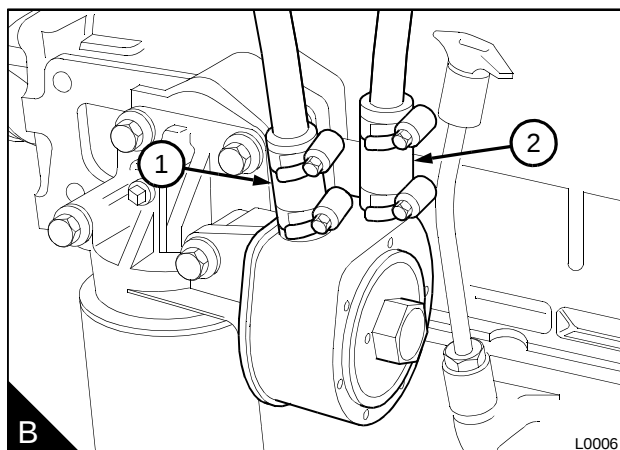
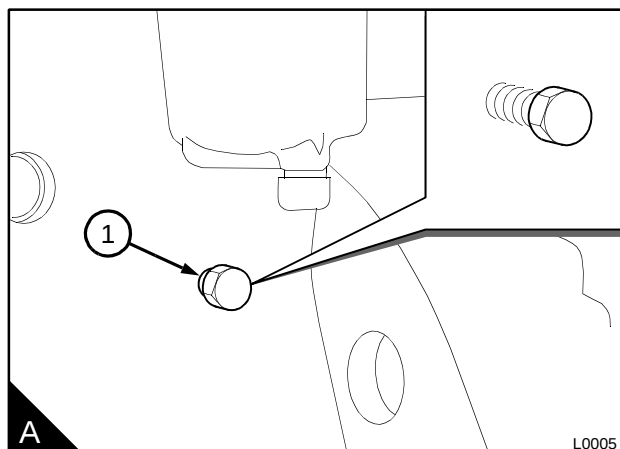
Warnings!

- 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.

- 1 Ensure that the machine is on level ground.
- 2 Remove the filler cap of the coolant system.
- 3 Remove the brass drain plug from the side of the cylinder block (A) in order to drain the coolant. Ensure that the drain hole is not restricted.
- 4 Open the tap or remove the drain plug at the bottom of the radiator in order to drain the radiator. If the radiator does not have a tap or drain plug, disconnect the hose at the bottom of the radiator. If a lubricating oil cooler/filter assembly (B) is fitted, this must also be drained and flushed. To do this disconnect the hoses (B1 and B2) at the top of the cooler and flush the oil cooler through the outlet connection (B1) until clean water runs from the inlet (B2).
- 5 Flush the coolant system with clean water.

Caution: If the coolant system is to remain empty temporarily after it is flushed, 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 water jacket when the machine is moved.

- 6 Fit the hoses to the top of the cooler and tighten the clips.
- 7 Fit the drain plugs and the filler cap. Close the radiator tap or connect the radiator hose.



How to check the specific gravity of the coolant

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.

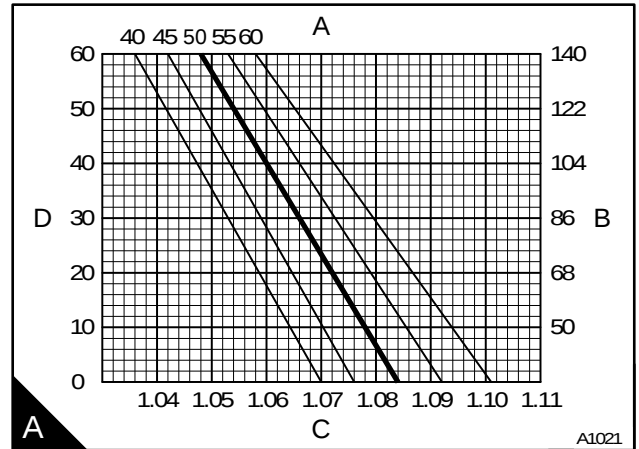
For mixtures which contain inhibited ethylene glycol:

- 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 60 °C (140 °F).
- 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.

Note: If it is necessary to fill or replenish the coolant system in service, mix the coolant to the correct strength before it is added to the coolant system. Perkins POWERPART antifreeze with a concentration of 50% will give protection against frost to a temperature of -35 °C (-31 °F). It will also give protection against corrosion. This is especially important when there are aluminium components in the coolant system.



Specific gravity chart

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

4

How to check the drive belt(s)

Renew a belt if it is worn or damaged. If twin belts are fitted, they must be renewed together.

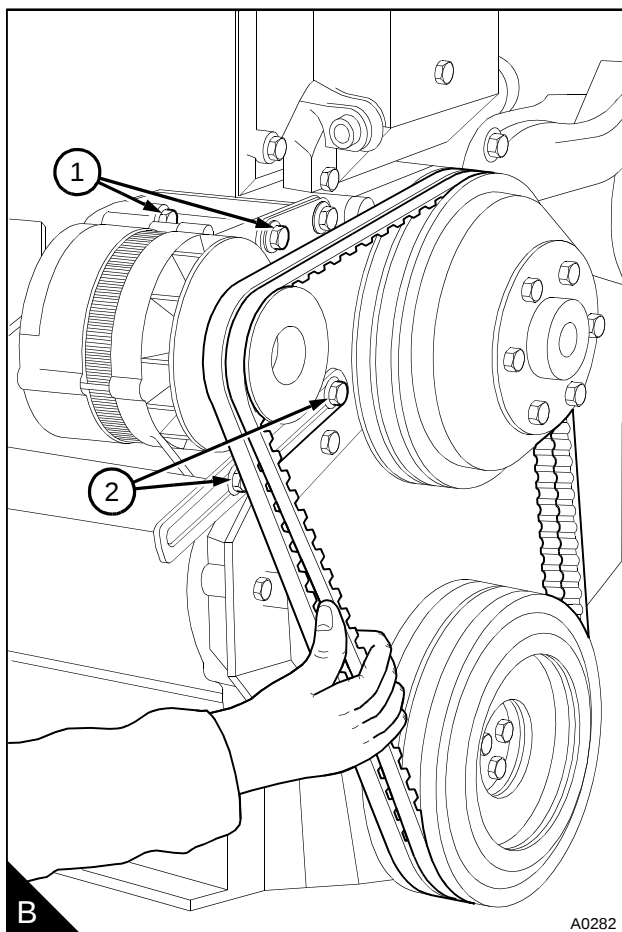
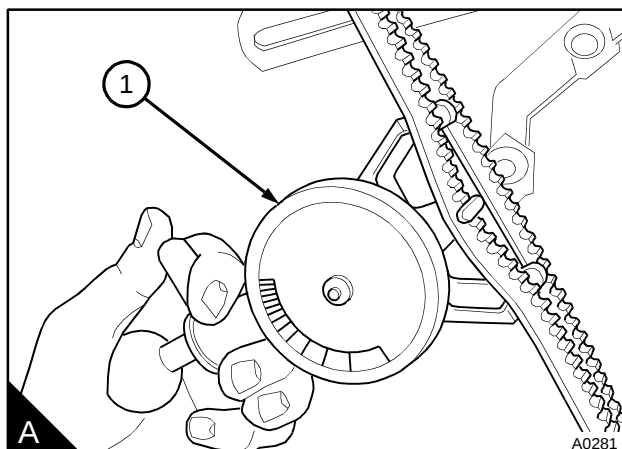
To ensure maximum belt life, it is recommended that a belt tensioner gauge is used to check the belt tension. Fit the gauge (A1) at the centre of the longest free length and check the tension. If a "Burroughs" gauge is used, the correct tension is 355 N (80 lbf) 36 kgf. If the tension is 220 N (50 lbf) 22 kgf or below, adjust it 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 (B). With moderate thumb pressure - 45N (10 lbf) 4,5 kgf - the correct deflection of the belt is 10 mm (3/8 in).

If twin belts are fitted, check/adjust the tension on the tighter belt.

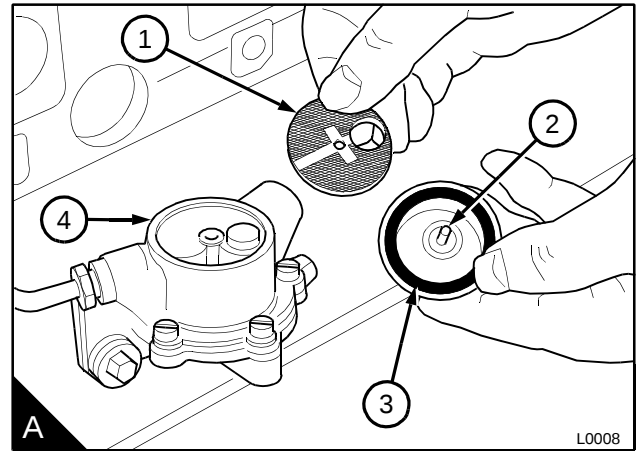
How to adjust the belt tension

- 1 Loosen the pivot fasteners (B1) of the alternator and the adjustment link fasteners (B2).
- 2 Change the position of the alternator to give the correct tension. Tighten the pivot fasteners of the alternator and the adjustment link fasteners.
- 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 20 hours of operation.



How to clean the gauze strainer of the fuel lift pump

- 1** Release the fastener (A2) and remove the cover and the joint (A3) from the top of the fuel lift pump (A4). Remove the gauze strainer (A1). On some turbocharged engines, it will be necessary to remove the small heat shield which is fitted above the pump.
- 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. Fit the heat shield, if one is fitted.
- 5** Eliminate the air from the fuel system through the filter vent plug, see page 30.



Fuel pre-filter

If a pre-filter is fitted between the fuel tank and the engine. Check the filter bowl for water at regular intervals and drain as necessary, see page 18.

4

How to renew the element(s) of the fuel filter

There are three types of fuel filter in use:

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

Cautions:

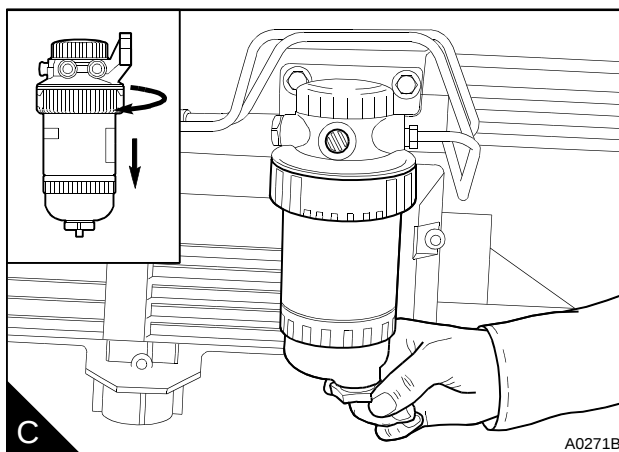
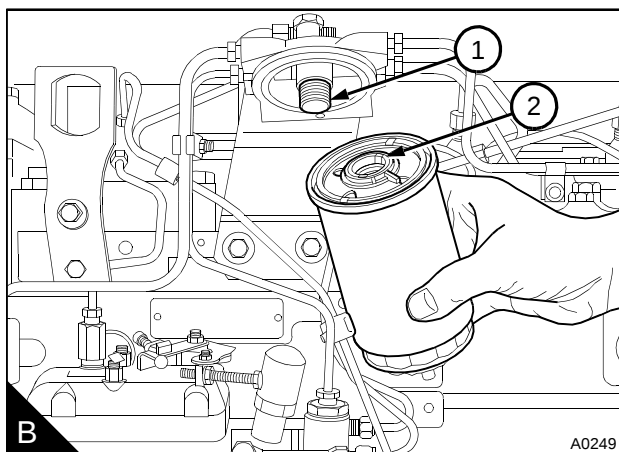
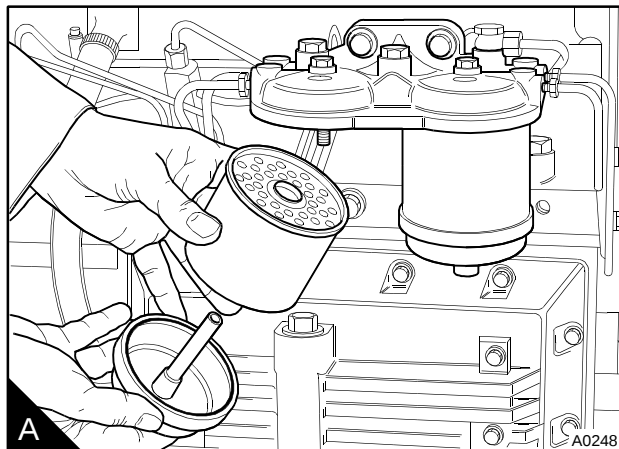
- It is important that only the genuine Perkins parts are used. The use of a wrong canister or element can damage the fuel injection pump.
- Do not allow dirt to enter the fuel system. Before a connection is disconnected, clean thoroughly the area around the connection. After a component has been disconnected, fit a suitable cover to all open connections.
- The pre-filter and main filter canisters must be renewed at the same time.

The separate element type where the filter element is held between the filter head and the bottom cover (A).

The canister type where the filter element has an internal thread (B2) at the top and is fastened to a threaded adaptor (B1) in the filter head (B).

A fuel filter with a quick release canister (C) has been introduced on certain engines. Some engines are fitted with a pre-filter of the same type. This filter is fitted next to the main filter, but connected in the fuel system before the fuel lift pump; both of the filter elements must be renewed at the same time.

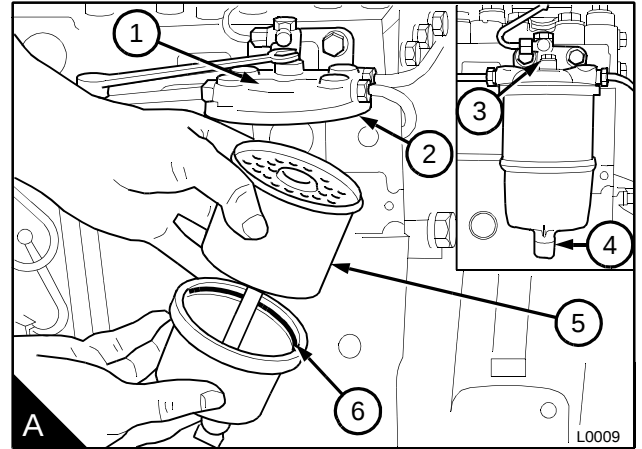
The filter can have one or two elements. When twin elements are fitted, both of the elements must be renewed at the same time.



How to renew the element(s) of the separate element type

Caution: It is important that only the genuine Perkins fuel filter element is used. The use of a wrong element can cause damage to the fuel injection pump.

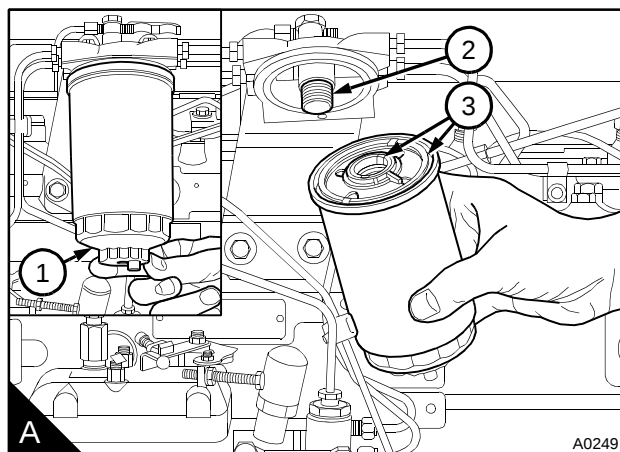
- 1 Clean the outside surfaces of the fuel filter assembly. If a drain tap (A4) is fitted to the bottom of the filter bowl, drain the fuel from the filter.
- 2 Hold the bottom cover of the filter element and release the setscrew (A3) which is fitted through the filter head (A1) above the centre of the element.
- 3 Lower the bottom cover of the filter.
- 4 Remove the element (A5) and discard it.
- 5 Clean the inside surfaces of the filter head and of the cover.
- 6 Renew the seals (A2) and (A6) 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 joint in the filter head. With the assembly in this position, engage and tighten the setscrew.
- 8 Eliminate the air from the fuel system, see page 29.



4

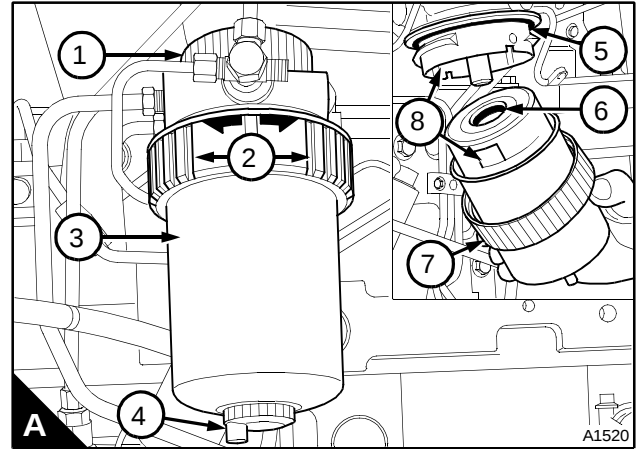
How to renew the filter canister of the canister fuel filter

- 1 Thoroughly clean the outside surfaces of the fuel filter assembly.
- 2 Loosen the drain device at the bottom of the filter (A1) and allow the water/fuel to drain into a suitable container.
- 3 Use a strap wrench or similar tool to loosen the filter canister and remove the canister.
- 4 Ensure that the threaded adaptor (A2) is secure in the filter head and that the inside of the head is clean.
- 5 Lubricate lightly the top seals (A3) of the new canister with clean fuel. Fit the new canister to the filter head and tighten, by hand only.
- 6 Eliminate the air from the fuel system, see page 29.



How to renew the canister of the quick release fuel filter

- 1** Thoroughly clean the outside surfaces of the filter assembly.
 - 2** Loosen the drain device (A4) , if one is fitted, at the bottom of the canister and allow the water/fuel to drain into a suitable container.
- Note:** If the filter does not have a drain device fitted release the cap (A1) on top of the filter head. Remove the nylon insert to lower the level of the fuel in the filter canister. This will prevent fuel spill when the clamp ring is released.
- 3** Unscrew the sediment bowl at the bottom of the canister, if one is fitted.
 - 4** Support the filter canister and rotate the clamp ring (A2) to the left, see the direction arrow, and remove the clamp ring.
 - 5** Remove the canister from the filter head by a direct pull downwards, and discard the old canister (A3). Retain the clamp ring.
 - 6** Ensure the filter head is clean and that the seals (A5) and (A6) are in good condition or renew them. Align the spline (A8) with the groove in the filter head and push the new canister fully into the filter head.
 - 7** Support the canister, fit the clamp ring (A7) and rotate it to the right, see the direction arrow, to fasten the canister to the filter head.
 - 8** If a sediment bowl is fitted, remove the bowl and thoroughly clean the cover 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 and fit the bowl to the canister and tighten by hand only.
 - 11** If it was removed, fit the nylon insert used to lower the level of the fuel in the filter canister and fasten the cap.
 - 12** Eliminate the air from the fuel system, see page 29.



Atomiser fault

Warnings!

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

An atomiser fault can cause an engine misfire.

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

How to renew an atomiser

Cautions:

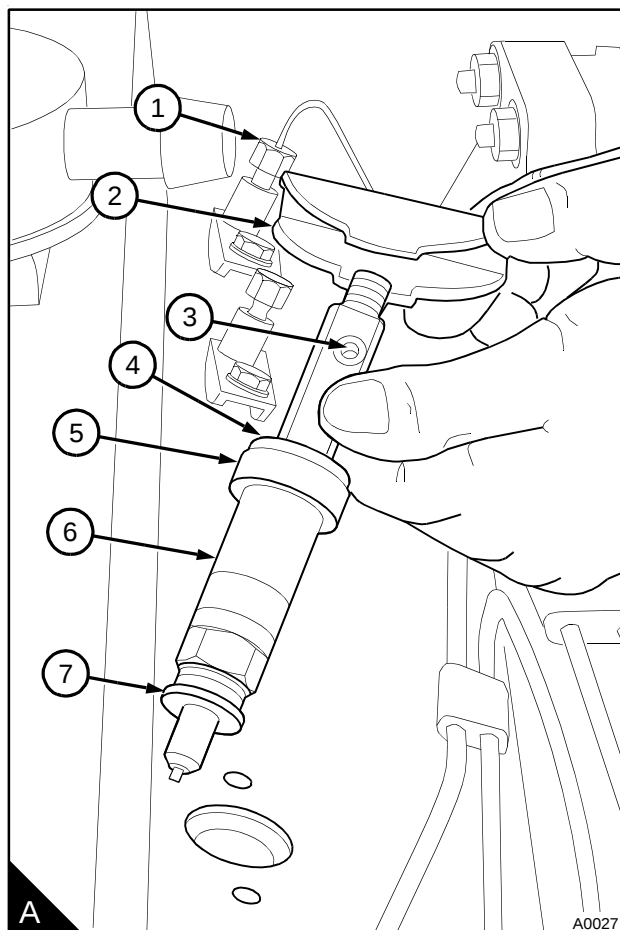
- Atomisers must be removed and fitted by a person with the correct training.
- Do not allow dirt to enter the fuel system. Before a connection is disconnected, clean thoroughly the area around the connection. After a component has been disconnected, fit a suitable cover to all open connections.

- 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 (A6). 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 27 Nm (20 lbf ft) 2,8 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

There are two methods to eliminate air from the fuel system according to the type of fuel injection pump fitted:

The standard method is used where the fuel injection pump has vent screws (A1/2) and (B1).

The self-vent method is used where the fuel injection pump has a self-vent feature. These pumps have a vent pipe (C1) fitted between a connection in the top of the pump and the atomiser leak-off pipe. Vent screws are not fitted to these pumps.

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

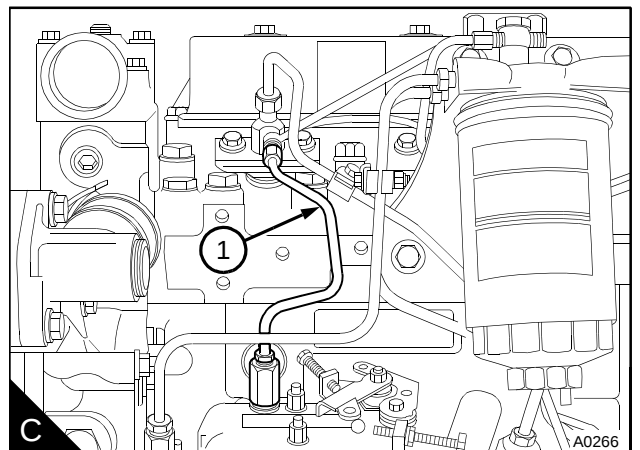
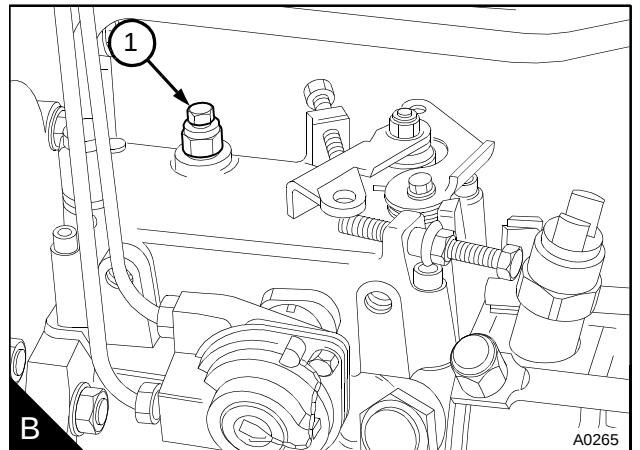
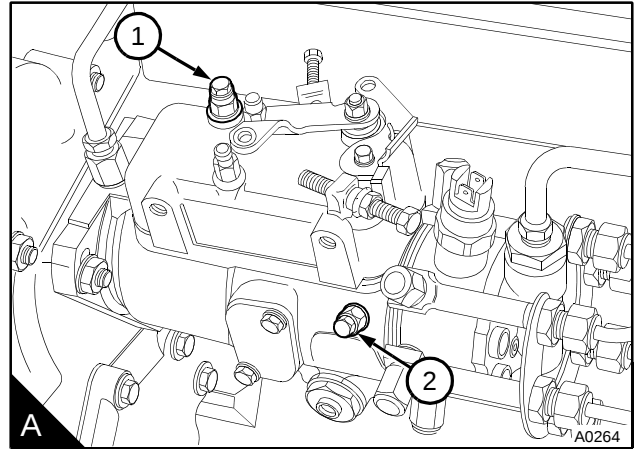
Air can enter the system if:

- 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.

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

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.



4

Standard method to eliminate air from the fuel system

1 Loosen the vent plug on the top of the twin element fuel filter (A1). If a single element filter is used, loosen the banjo connection bolt which is fitted on the top of the filter (B1).

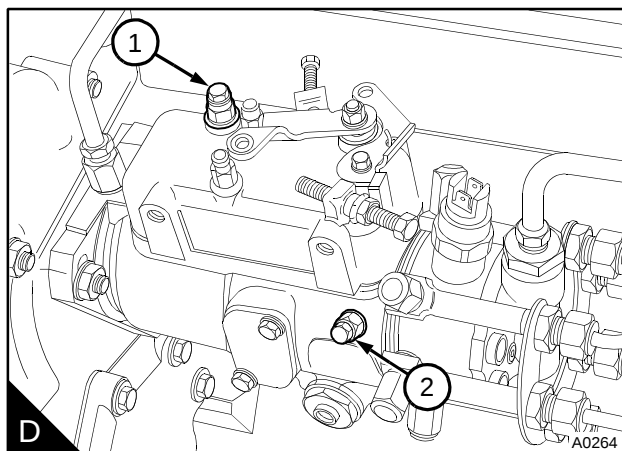
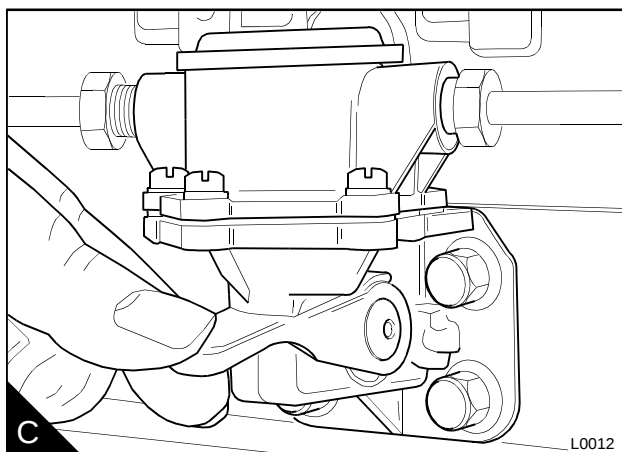
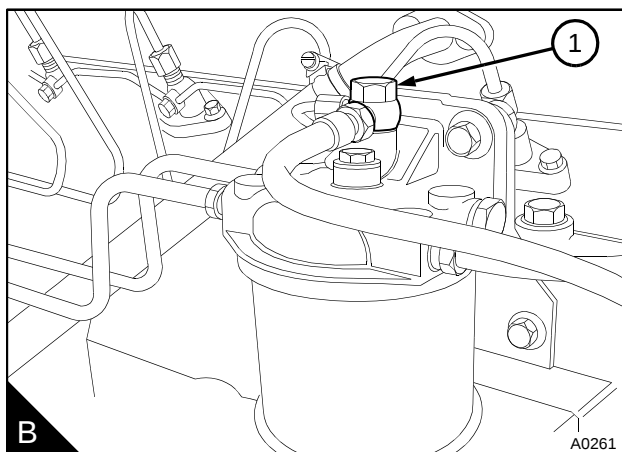
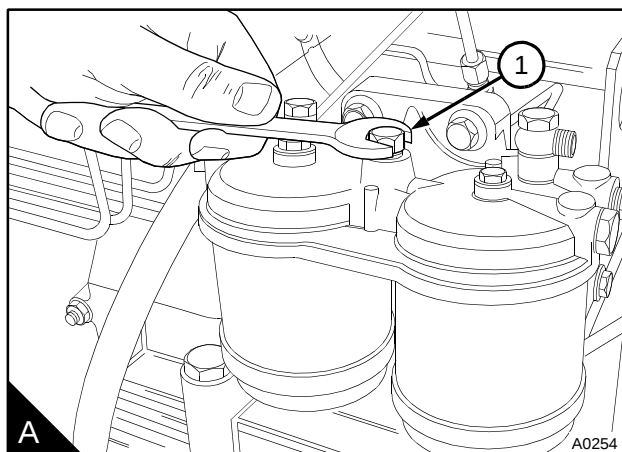
2 Operate the priming lever on the fuel lift pump (C) until fuel, free from air, comes from the filter vent point. Tighten the vent plug or banjo connection bolt.

Note: If the cam for the fuel lift pump is at the point of maximum lift, it will not be possible to operate the priming lever. In this situation, the crankshaft must be rotated one turn.

3 Ensure that the manual stop control is in the "run" position. If an electrical stop control is used, turn the start key to the "R" position.

4 Loosen the vent screw in the lock screw (D2) for the hydraulic head. Operate the priming lever of the fuel lift pump until fuel, free from air, comes from the vent screw. Tighten the vent screw. Loosen the vent screw (B1) on the governor cover. Operate the priming lever of the fuel lift pump until fuel, free from air, comes from the vent screw. Tighten the vent screw.

Continued



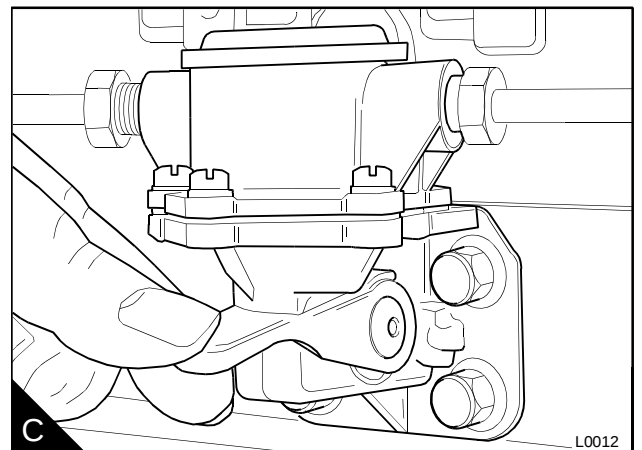
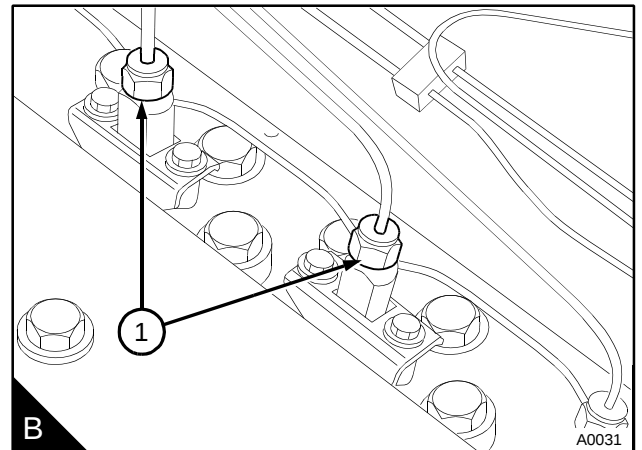
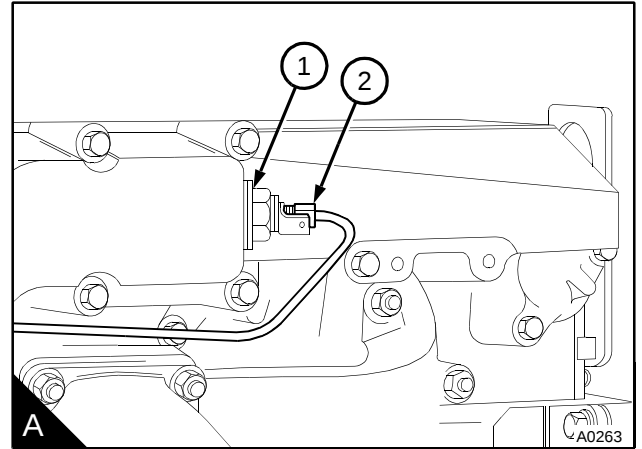
Caution: Use a spanner on the flats (A1) of the fuelled starting aid to prevent its movement when the union nut (A2) is loosened and tightened.

5 If the pipe to the fuelled starting aid has been drained, loosen the union nut (A2) at the fuelled starting aid and operate the lift pump (C) until fuel, free from air, comes from the connection. Tighten the union nut at the starting aid. Use a spanner on the hexagon of the fuelled starting aid to prevent its movement when the union nut is loosened and tightened.

6 Loosen the union nuts (B1) of the high-pressure pipes at two of the atomisers. 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.

7 The engine is now ready to start.

If the engine runs correctly for a short time and then stops or runs roughly, check for air in the fuel system. If there is air in the fuel system, there is probably a leakage in the low pressure system.



4

Self-vent method

Fuel injection pumps used on some Lucas and all Stanadyne fuel injection pumps will automatically remove air from the fuel system. Vent screws are not fitted to these pumps.

Caution: Although these fuel injection pumps will eliminate air automatically, use the procedure that follows to remove air from the fuel system if the system is drained or a major component is removed:

Ensure that fuel has been added to the tank or that the leakage has been corrected.

1 Loosen the vent plug (A1) on the top of the filter head.

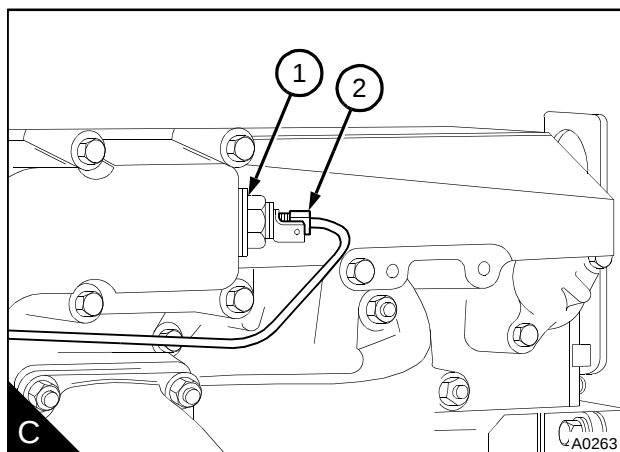
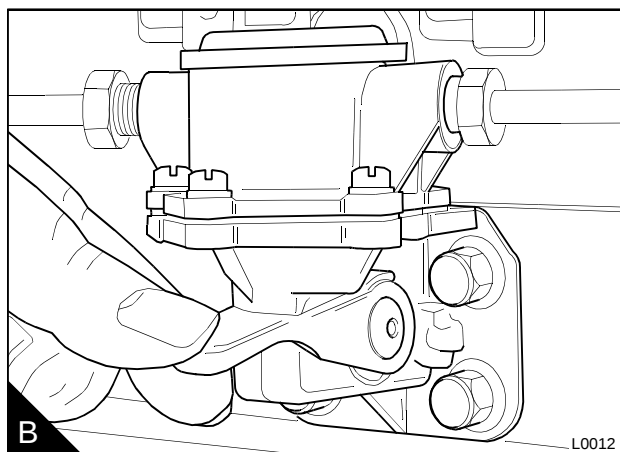
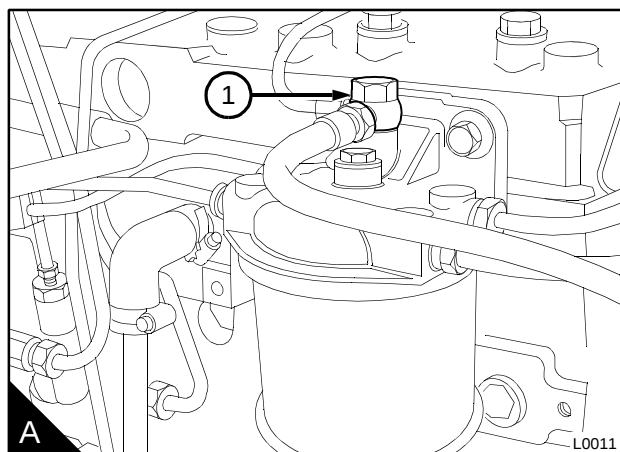
2 Operate the priming lever on the fuel lift pump (B) until fuel, free from air, comes from the filter vent point. Tighten the vent plug.

Note: If the cam for 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.

Caution: Use a spanner on the flats (A1) of the fuelled starting aid to prevent its movement when the union nut (A2) is loosened and tightened.

3 If the pipe to the fuelled starting aid has been drained, loosen the union nut (C2) at the fuelled starting aid and operate the lift pump (C) until fuel, free from air, comes from the connection. Tighten the union nut at the starting aid. Use a spanner on the hexagon of the fuelled starting aid to prevent its movement when the union nut is loosened and tightened.

Continued



Cautions:

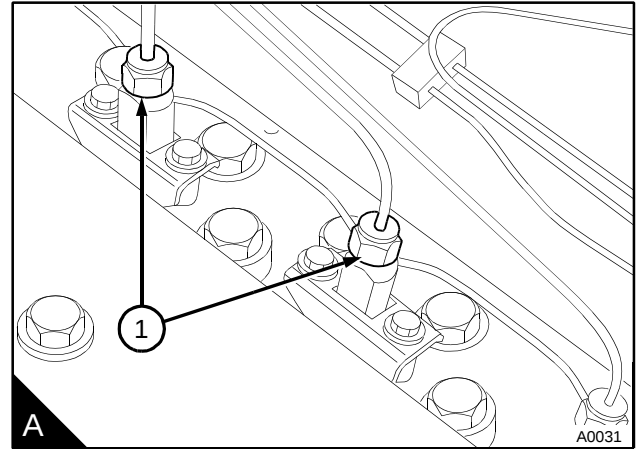
- Do not tighten the union nuts of the high-pressure pipes more than the recommended torque tension. If there is a leakage from the union nut, ensure that the pipe is correctly aligned with the atomiser inlet. Do not tighten the atomiser union nut more, as this can cause a restriction at the end of the pipe. This can affect the fuel delivery.
- Damage to the fuel injection pump, battery and starter motor can occur if the starter motor is used excessively to eliminate air from the fuel system.

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

5 Put the electrical system switch (page 14/A) to the "ON" position. Ensure that the manual stop control, if one is fitted, is in the "run" 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.

6 The engine is now ready to start.

If the engine runs correctly for a short time and then stops or runs roughly, check for air in the fuel system. If there is air in the fuel system, there is probably a leakage in the low-pressure system.



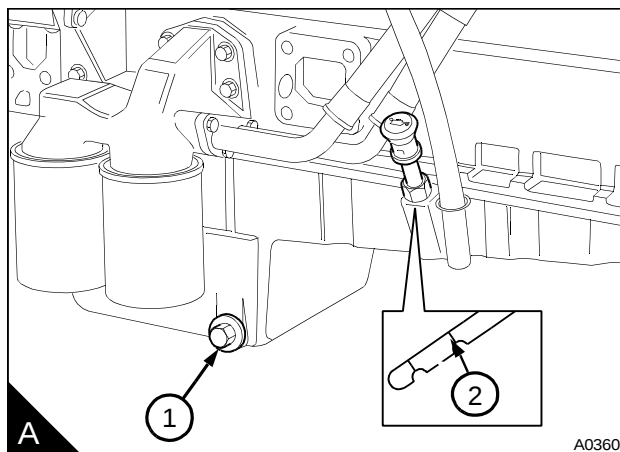
4

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.

Caution: Ensure that the application is on a level surface to ensure an accurate reading on the dipstick.

- 1 Operate the engine until it is warm.
- 2 Stop the engine, remove the sump drain plug (A1) and its "O" ring and drain the lubricating oil from the sump. Ensure that the "O" ring is not damaged. Fit the drain plug and its "O" ring and tighten the plug to 34 Nm (25 lb ft) 3,5 kgf m.
- 3 Fill the sump to the mark (A2) on the dipstick with new and clean lubricating oil of an approved grade, see page 44.



How to renew the canister of the lubricating oil filter

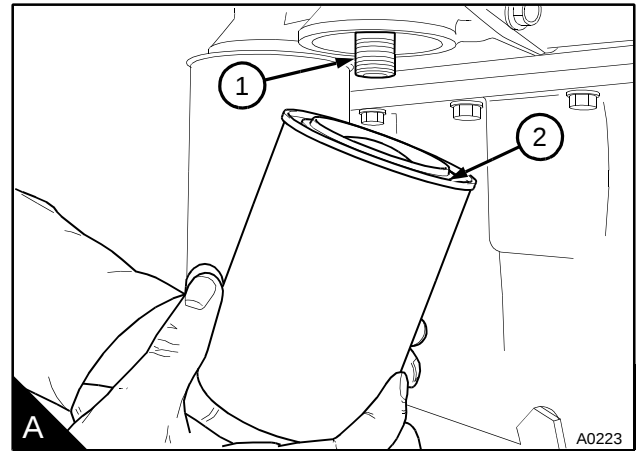
Warning! Discard the used canister and lubricating oil in a safe place and in accordance with local regulations.

Cautions:

- The canister contains a valve and special tube to ensure that lubricating oil does not drain from the filter. Therefore, ensure that the correct Perkins POWERPART canister is used.
- Ensure that the application is on a level surface to ensure an accurate reading on the dipstick.

The filter can have one or two canisters. When two canisters are fitted, both must be renewed at the same time.

- 1 Put a tray under the filter to retain spilt lubricating oil.
- 2 Remove the filter canister with a strap wrench or similar tool. Ensure that the adaptor (A1) is secure in the filter head. Discard the canister.
- 3 Clean the filter head.
- 4 Add clean engine lubricating oil to the new canister. Allow the oil enough time to pass through the filter element.
- 5 Lubricate the top of the canister seal (A2) with clean engine lubricating oil.
- 6 Fit the new canister and tighten it by hand until the seal contacts the filter head. Tighten the canister a further 1/2 to 3/4 of a turn by hand. Do not use a strap wrench.
- 7 Ensure that there is lubricating oil in the sump. On turbocharged engines ensure that the engine will not start and operate the starter motor until oil pressure is obtained. To ensure that the engine will not start, either put the manual stop control in the "stop" position or disconnect the electrical stop control of the fuel injection pump. Oil pressure is indicated when the warning light is extinguished or by a reading on the gauge.
- 8 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.



4

How to clean the closed breather system

Warning! Do not direct compressed air at your skin, if compressed air enters your skin obtain medical help immediately

Note: The procedure below refers only to the closed breather shown in (A) and (B).

1 Release the hose clips and remove the breather valve (A2).

2 Release the short setscrew (A3) and the long setscrew (A5) and remove the oil separator (A4).

3 Wash the oil separator with approved cleaning fluid and dry it with low pressure air.

Caution: Do not put the breather valve completely into the cleaning fluid.

4 The breather valve does not normally need to be cleaned. If the inside of the breather valve is to be cleaned, insert a safe approved cleaning fluid into the valve through the pipe at the bottom. Drain the fluid from the breather valve. Dry the breather valve with low pressure air.

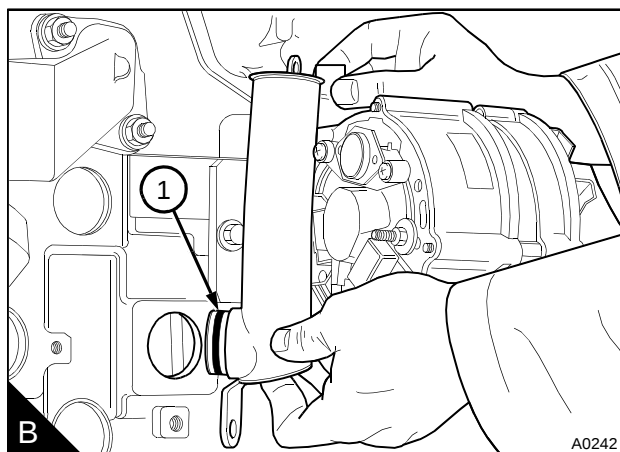
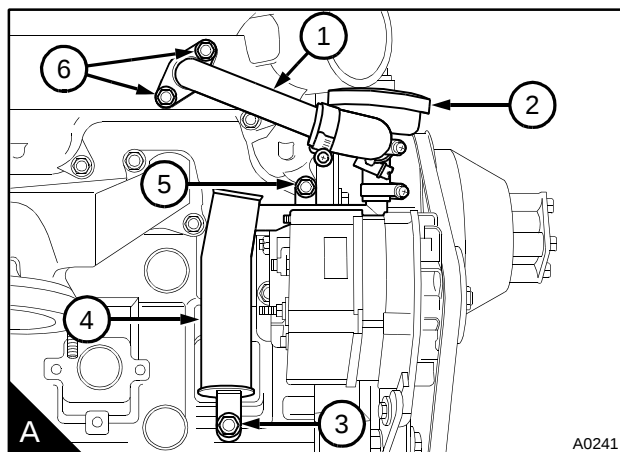
5 Check that the inside of the upper pipe (A1) is clean. If the pipe is not clean, release the flange setscrews (A6) and remove the pipe. Wash the pipe with kerosene and dry it with low pressure air.

6 Ensure that the contact faces of the upper pipe flange and the induction manifold are clean.

7 Fit the upper pipe complete with a new joint and tighten the flange setscrews.

8 Renew the "O" ring (B1) at the bottom of the oil separator. Clean the bore in the cylinder block for the "O" ring of the oil separator. Lightly lubricate the "O" ring and fit the oil separator to the cylinder block. Fit the setscrews for the oil separator in their correct positions and tighten them.

9 Fit the breather valve and tighten the hose clips.



How to clean the integral closed breather system

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

Note: The procedure below refers only to the closed breather shown in (A).

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 every 4000 hours.

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.

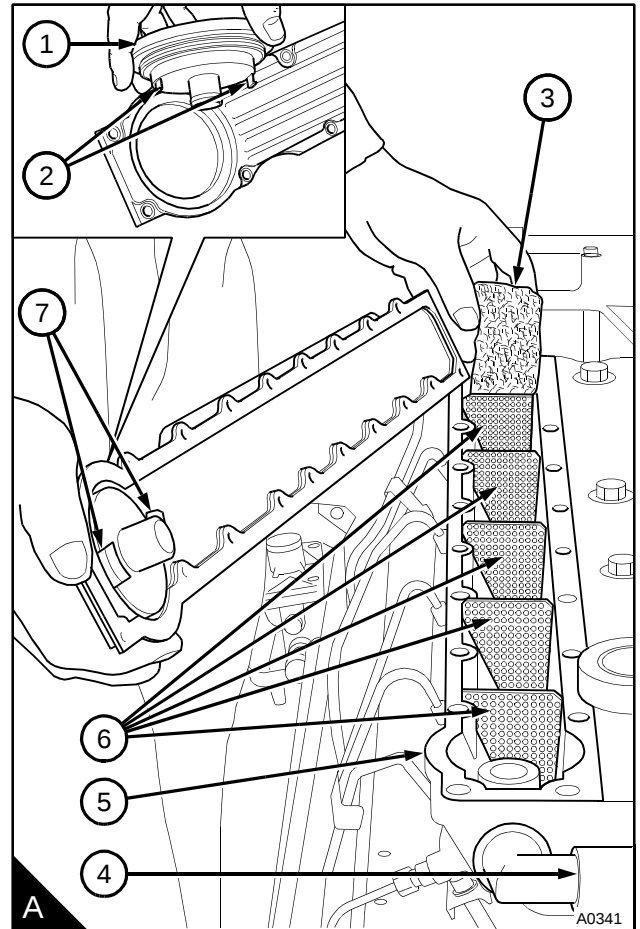
2 Renew and fit the gauze filter into the breather body.

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.

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.



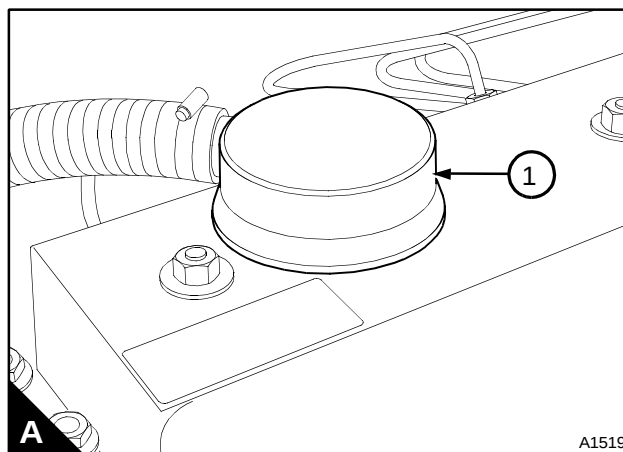
5 Check that there is no restriction in the breather pipe or the breather hose. Fit the breather hose to the cover and tighten the clip.

4

The open breather system

Some engines have an open breather system that has an oil separator (A1) fitted to the rocker cover.

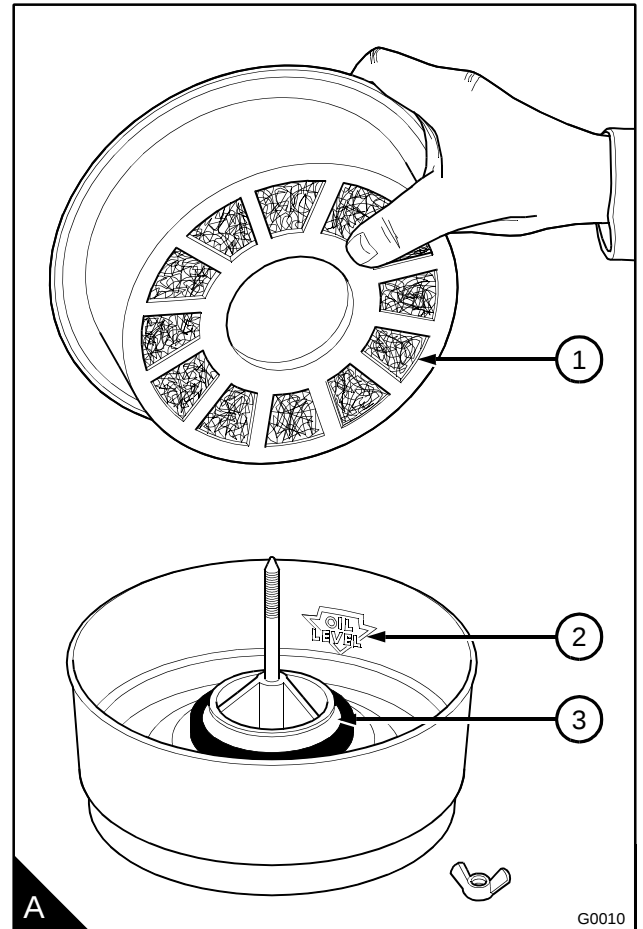
The oil separator should not be dismantled or cleaned, but must be renewed at every engine overhaul or 8000 hours. Refer to your local distributor.



Air cleaner

Caution: Do not use gasoline to clean the air cleaner.

A typical wet type air cleaner is shown at (A). The wet type air cleaner must be drained at a suitable interval. The container and element (A1) must be cleaned with kerosene or with another suitable fluid. Do not use gasoline. Check that the seal (A3) is not damaged and renew it, if necessary. Fill to the indicated level (A2) with clean engine lubricating oil.



4

Air filter

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

Certain air filters have a separate dust bowl (A1) which must be cleaned at intervals. The amount of dust in the bowl shows if it has been removed at the correct time for the conditions of operation. Do not let dust completely fill the bowl, because this will reduce the life of the filter element (A2).

Certain air filters have automatic dust valves (B1) 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 (C) is fitted, it will indicate precisely when the air filter element needs service. 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.

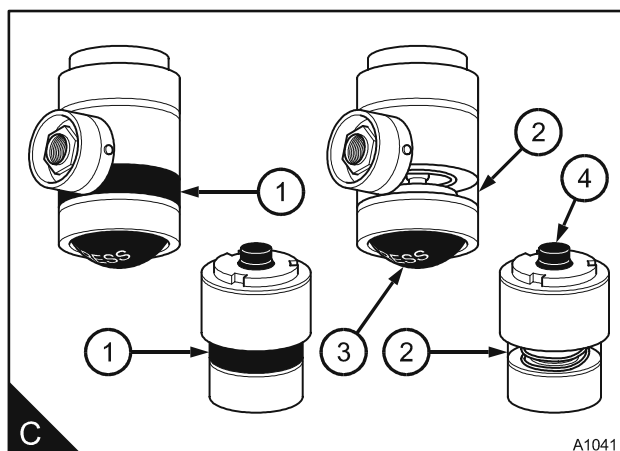
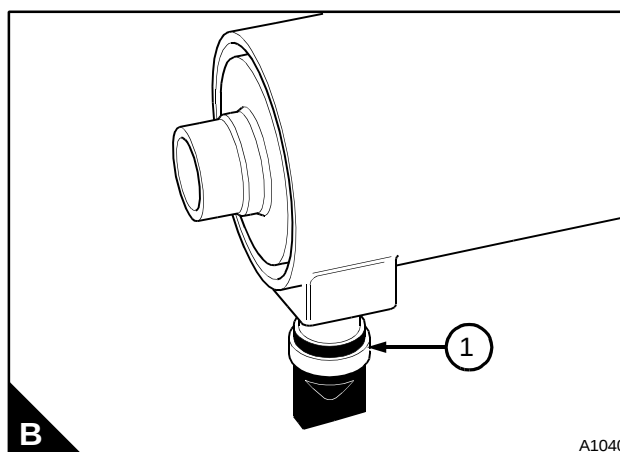
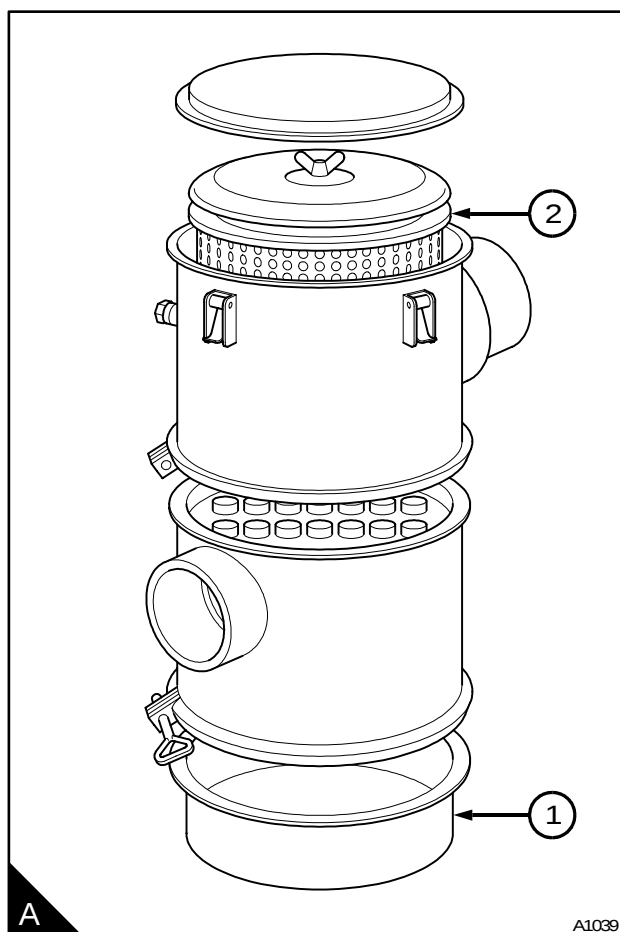
The filter element must be cleaned or renewed according to the manufacturers recommendations.

Restriction indicator

The restriction indicator for these engines must work at a pressure difference of 508/558 mm (20/22 in) of water gauge. It is fitted on the air filter outlet or between the air filter and the induction manifold.

When the red warning indicator (C1) is seen through the clear panel (C2) 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 (C3) or the button (C4) of the restriction indicator to reset the red warning indicator.



How to check the valve tip clearances

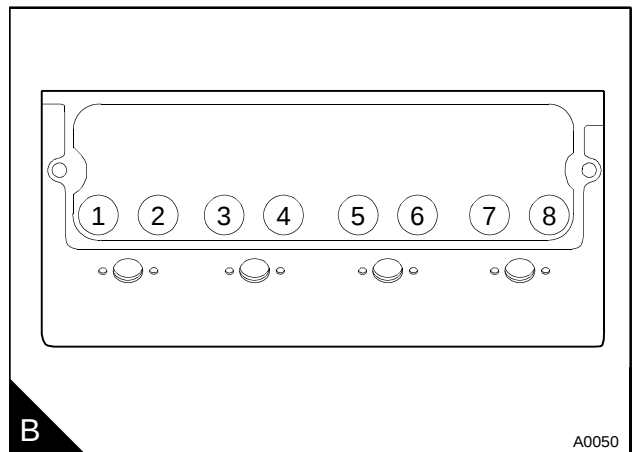
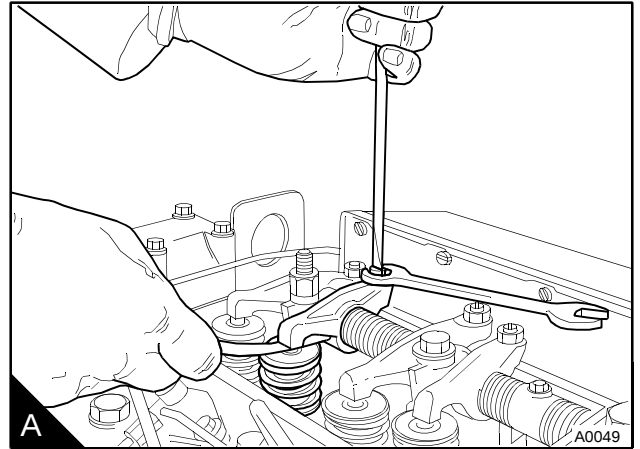
These are checked between the top of the valve stem and the rocker lever (A), with the engine hot or cold. The correct clearance for inlet valves is 0,20 mm (0.008 in) and 0,45 mm (0.018 in) for exhaust valves. The valve positions are shown at (B).

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.

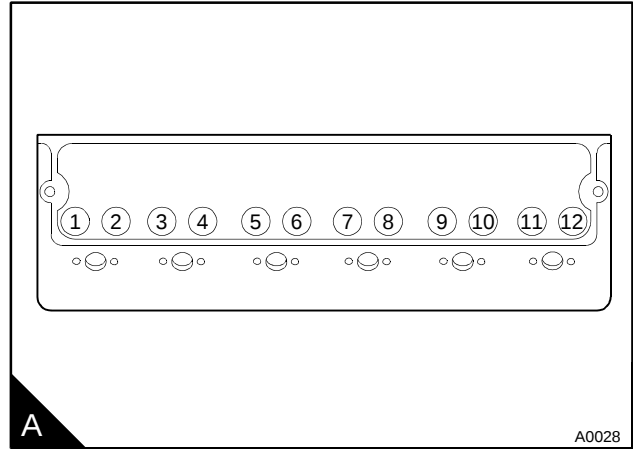


Cylinder and valve number	1		2		3		4	
	1	2	3	4	5	6	7	8
Valve I = Inlet E = Exhaust	I	E	E	I	I	E	E	I

4

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 (A4 and A3) 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 (A8 and A7) 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

5

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 sulphur content (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 of the available fuel, consult your nearest Perkins distributor or one of the companies listed on page 8.

Aviation kerosene fuels

Caution: *Aviation kerosene fuels are more flammable than diesel fuel and need careful storage and careful management.*

These fuels can be used but they can affect engine performance. It is recommended that you consult the Perkins Technical Service Department at Peterborough, especially if JP4 fuel is to be used.

5

Lubricating oil specification

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 available fuel, consult your nearest Perkins distributor or the Technical Service Department of one of the companies listed on page 8.

Use only a good quality lubricating oil to the relevant specification as shown in the table below.

Caution: The type of lubricating oil to be used may be affected by the quality of the fuel which is available. For further details see "Fuel specification" on page 43 and the preventive maintenance schedules on page 18.

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) and in the table below.

Lubricating oil specification

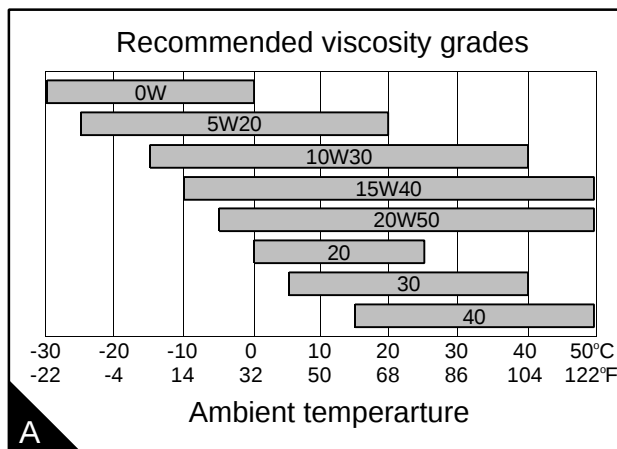
Naturally aspirated engines:

- ACEA E1 or E2
- API CC, CD or CF

Turbocharged engines:

- ACEA E2 or E3⁽¹⁾
- API CE, CF4 or CG4⁽¹⁾

(1) For use in heavy duty applications with a lubricating oil change period of 250 hours, see page 18.



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, Perkins cannot be held responsible for damage caused by frost or corrosion.

Caution: *An antifreeze 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 antifreeze mixture because this gives a protection against corrosion and also raises the boiling point of the coolant.*
- *If the approved antifreeze mixture is not available, add a correct mixture of corrosion inhibitor to the water. If the correct inhibitor is not used, the engine will be damaged by corrosion. If there is doubt about the corrosion inhibitor to be used, It is recommended that you consult the Perkins Service Department, Peterborough, see the address on page 8.*

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

The antifreeze which is recommended for this engine is the latest POWERPART Antifreeze, see page 53. This antifreeze contains the correct corrosion inhibitor which is especially suitable for this engine.

If it is possible, use clean soft water in the coolant.

The quality of the antifreeze coolant must be checked at least once a year, for example, at the beginning of the cold period. The coolant must be renewed every two years.

Caution: The antifreeze mixture must consist of equal quantities of antifreeze and water. The corrosion inhibitor in the antifreeze will be diluted if a concentration of less than 50% of antifreeze is used. Concentrations of more than 50% of antifreeze may have an adverse effect on the performance of the coolant.

This page is intentionally blank

6

Fault diagnosis

Continued

6

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	34, 35, 36, 37, 38, 40, 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, 44
Not enough power	8, 9, 10, 11, 12, 13, 16, 17, 18, 19, 20, 21	34, 36, 37, 38, 39, 42, 43, 44, 61, 63, 64
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, 21, 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, 61, 63
Blue or white exhaust smoke	4, 15, 21, 23	36, 37, 38, 39, 42, 44, 45, 52, 58, 62
The pressure of the lubricating oil 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	7, 8, 9, 10, 11, 12, 13, 15, 16, 18, 20, 22, 23	34, 38, 40, 41, 44, 52, 60
Vibration	13, 18, 20, 27, 28	34, 38, 39, 40, 41, 44, 52, 54
The pressure of the lubricating oil is too high	4, 25	49
The engine temperature is too high	11, 13, 15, 19, 27, 29, 30, 32	34, 36, 37, 39, 52, 55, 56, 57, 64
Crankcase pressure	31, 33	39, 42, 44, 45, 52
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

- | | |
|---|--|
| <ol style="list-style-type: none"> 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 filter/cleaner or 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 Valve tip clearances are incorrect. 23 Too much oil or oil of wrong specification used in wet type oil cleaner. 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 of radiator. 31 Restriction in breather pipe. 32 Insufficient coolant in system. 33 Vacuum pipe leaks or fault in exhaust. 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. 42 Worn cylinder bores. 43 Leakage between valves and seats. 44 Piston rings are not free or they are worn or broken. | <ol style="list-style-type: none"> 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 (if there is one fitted). 59 Restriction in sump strainer. 60 Valve spring is broken. 61 Turbocharger impeller is damaged or dirty. 62 Lubricating oil seal of turbocharger leaks. 63 Induction system leaks (turbocharged engines). 64 Turbocharger waste-gate does not work correctly (if there is one fitted). |
|---|--|

This page is intentionally blank

7

Engine preservation

Introduction

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

Procedure

- 1** Completely clean the outside of the engine.
- 2** When a preservative fuel is to be used, drain the fuel system and fill it with the preservative fuel. POWERPART Lay-Up 1 can be added to the normal fuel to change it to a preservative fuel. If preservative fuel is not used, the system can be kept full with normal fuel but the fuel must be drained and discarded at the end of the storage period together with the fuel filter element(s).
- 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(s) of the lubricating oil filter.
- 5** Fill the sump to the full mark on the dipstick 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 cooling system, on page 20. In order to protect the cooling system against corrosion, fill it with an approved antifreeze mixture because this gives a protection against corrosion, on page 45.
Caution: *Certain corrosion inhibitor mixtures could cause damage to some engine components. It is recommended that you consult the Perkins Service Department, Peterborough.*
- 7** Operate the engine for a short period in order to circulate the lubricating oil and the coolant in the engine.
- 8** 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.

9 Clean the engine breather pipe (if one is fitted) and seal the end of the pipe.

10 Remove the atomisers and spray POWERPART Lay-up 2 for one to two seconds into each cylinder bore with the piston at BDC.

11 Slowly turn the crankshaft one revolution and then fit the atomisers with new seat washers and new dust seals.

12 Remove the air filter. Then, if necessary, remove the pipe(s) installed between the air filter and induction manifold or turbocharger. Spray POWERPART Lay-Up 2 into the induction manifold or turbocharger. It is recommended that the spray time for the turbocharger is 50% longer than the spray time for the manifold, which is indicated on the container label. Seal the manifold or the turbocharger with waterproof tape.

13 Remove the exhaust pipe. Spray POWERPART Lay-Up 2 into the exhaust manifold or the turbocharger. It is recommended that the spray time for the turbocharger is 50% longer than the spray time for the manifold, which is indicated on the container label. Seal the manifold or the turbocharger with waterproof tape.

14 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.

15 Seal the vent pipe of the fuel tank or the fuel filler cap with waterproof tape.

Continued

16 Remove the drive belts and put them 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.

8

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.

Certain components can be supplied by your Perkins distributor through the Perkins POWER EXCHANGE system. These will enable you to reduce the cost of certain repairs.

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 Perkins Customer Training Department, Peterborough, or other main centres

POWERPART recommended consumable products

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

POWERPART Antifreeze

Protects the cooling system against frost and corrosion. Part number 21825166.

POWERPART Easy Flush

Cleans the cooling system. Part number 21820122.

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.

Continued

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.

9

General data

Engine

Number of cylinders

- AA, AB, AC, AD, AG, AH..... 4

- YA, YB, YC, YD..... 6

Cylinder arrangement.....In line

Cycle..... Four stroke

Induction system

- AA, AG, YA..... Naturally aspirated

- AB, AH, YB..... Turbocharged

- AC, YC.....Altitude compensated

- AD, YD..... Turbocharged, intercooled

Combustion system.....Direct injection

Nominal bore..... 100 mm (3.937 in)

Stroke..... 127 mm (5.00 in)

Compression ratio

- AA, AG, YA, YC..... 16.5:1

- AB, AC, AD, AH, YB, YD..... 16.0:1

Cubic capacity

- AA, AB, AC, AD, AG, AH..... 4 litres (243 in³)

- YA, YB, YC, YD..... 6 litres (365 in³)

Firing order

- AA, AB, AC, AD, AG, AH..... 1, 3, 4, 2

- YA, YB, YC, YD..... 1, 5, 3, 6, 2, 4

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)

Engines without piston cooling jets.....207 Kpa (30 lbf/in²) 2,1 kgf/cm²

Engines with piston cooling jets.....280 Kpa (40 lbf/in²) 2,5 kgf/cm²

Direction of rotation.....Clockwise from the front

