
Perkins Prima Vehicle Engines

Model 80T

USER'S HANDBOOK

4 cylinder turbocharged diesel engine for vehicle applications

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This publication is divided into six chapters:

- 1 General information**
- 2 Engine views**
- 3 Operation instructions**
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1

General information

Introduction

The Perkins Prima 80T vehicle engine is the latest development from the Perkins Group of Companies.

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.

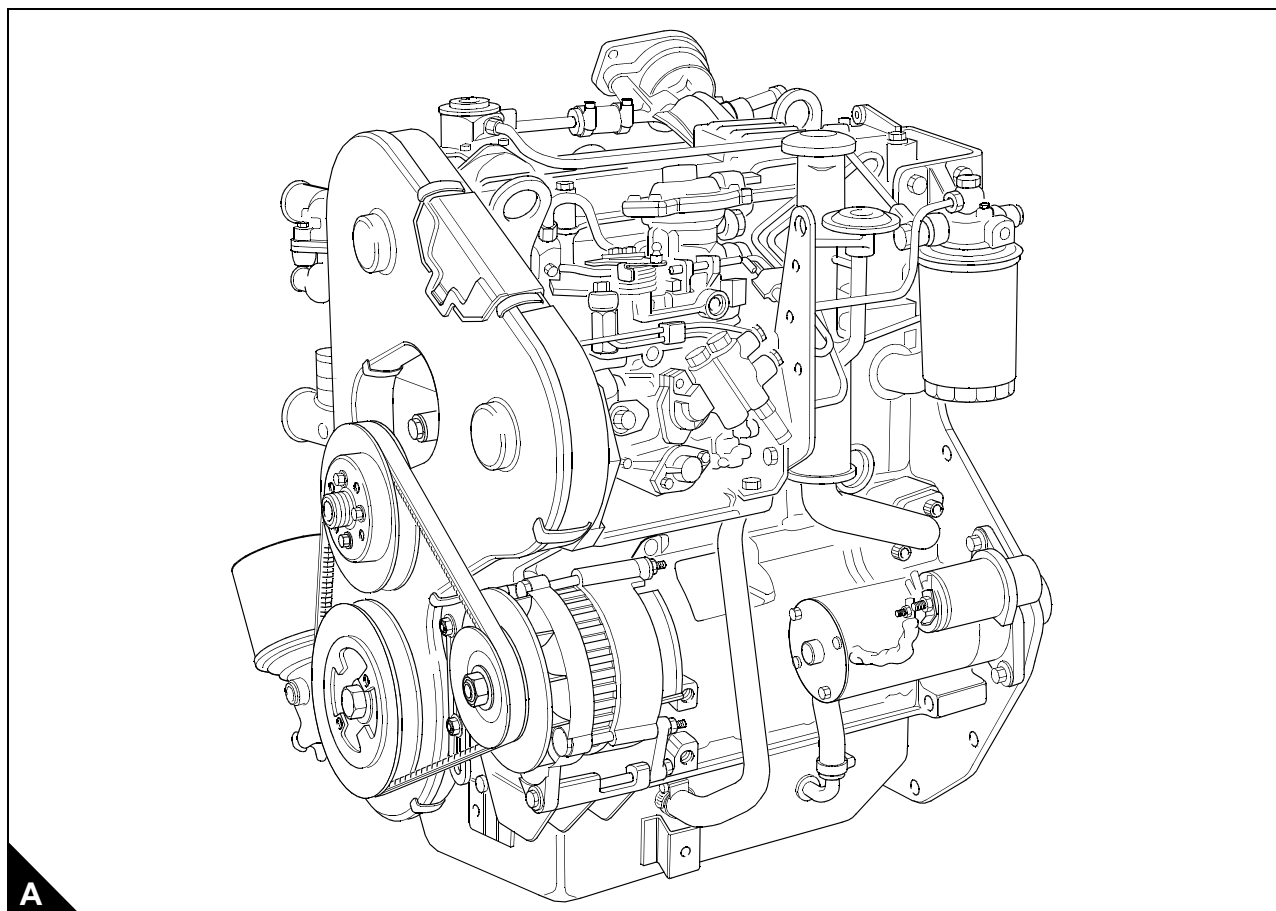
To ensure that you use the relevant information for your specific engine type, refer to "Engine identification" on page 8.

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

Safety precautions

These safety precautions are important.

You must refer also to the local regulations in the country of use. Some items only apply to specific applications.

- Only use these engines in the type of application for which they have been designed.
- Do not change the specification of the engine.
- Do not smoke when you put fuel 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 caution 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 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 coolant circuit.
- 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 operator's 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.
- Discard used lubricating oil in a safe place 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.
- Fit only genuine Perkins parts.

How to care for your engine

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 Chapter 4, 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.

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

Warning! Read the "Safety precautions" on page 2 and remember them. They are given for your protection and must be applied at all times.

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 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 on the dipstick with new and clean lubricating oil or with a correct preservative fluid. POWERPART Lay-Up 2 can be added to the lubricating oil in order to protect it against corrosion during the period in storage. 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, refer to "How to drain the coolant system" on page 19. In order to protect the cooling system against corrosion, it is necessary to fill it with a coolant that has a corrosion inhibitor, refer to "Coolant specification" on page 33.
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, Perkins Sales and Service Limited, Peterborough.*
- 7 Operate the engine for a short period in order to circulate the lubricating oil and the coolant in the engine.
- 8 Clean the engine breather system and seal the end of the breather outlet pipe (if one is fitted).
- 9 Remove the atomisers and spray POWERPART Lay-Up 2 for one to two seconds into each cylinder bore with the piston at BDC.
- 10 Slowly turn the crankshaft one revolution and then fit the atomisers complete with new seat washers.
- 11 Remove the air filter/cleaner. Then, if necessary, remove the pipe(s) installed between the air filter/cleaner and the turbocharger and the induction manifold. Spray POWERPART Lay-Up 2 into the induction manifold and the turbocharger. It is recommended that the spray time for the turbocharger be 50% longer than the spray time for the manifold, which is indicated on the container label. Seal the manifold and the turbocharger with waterproof tape.
- 12 Remove the exhaust pipe. Spray POWERPART Lay-Up 2 into the exhaust manifold and the turbocharger. It is recommended that the spray time for the turbocharger be 50% longer than the spray time for the manifold, which is indicated on the container label. Seal the manifold and the turbocharger with waterproof tape.
- 13 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.
- 14 Seal the vent pipe of the fuel tank or the fuel filler cap with waterproof tape.

Continued

15 Remove the drive belt of the alternator and put it into storage.

16 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 solenoid stop control disconnected until oil pressure is indicated. Oil pressure can be indicated either by a gauge or when a low pressure warning light is extinguished.*

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.

Parts and service

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.

POWERPART consumable products

Perkins have made available the products indicated 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. See "Coolant specification" on page 33.

POWERPART De-icer

Removes frost.

POWERPART Easy Flush

Cleans the cooling system.

POWERPART Hylomar

Universal jointing compound which seals joints.

POWERPART Hylosil

Silicone rubber sealant which prevents leakage through gaps.

POWERPART Lay-Up 1

A diesel fuel additive for protection against corrosion. See "Engine preservation" on page 4.

POWERPART Lay-Up 2

Protects the inside of the engine and of other closed systems. See "Engine preservation" on page 4.

POWERPART Lay-Up 3

Protects outside metal parts. See "Engine preservation" on page 4.

POWERPART Moisture Dispersant and Rust Penetrant

Dries damp equipment and gives protection against corrosion. Passes through dirt and corrosion to lubricate and to assist removal of components.

POWERPART Retaining Compound

Retains components which have a transition fit or an interference fit, for example, pulleys, bushes etc.

POWERPART Studlock

Secures threaded fasteners. Recommended for fasteners which, normally, are not removed.

POWERPART Threadseal

Seals threads and pipe connections. Low pressure systems can be used immediately.

Service literature

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

Training

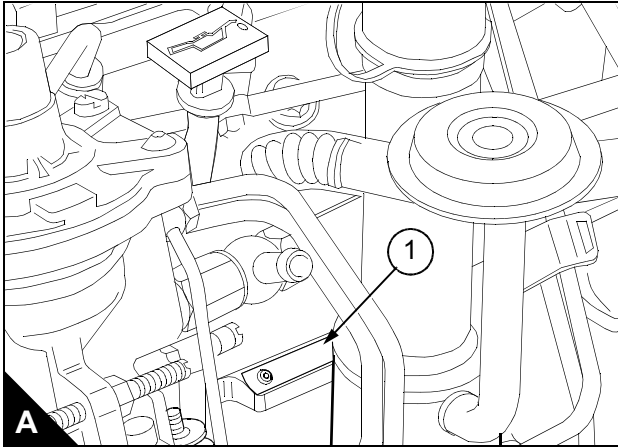
Local training for the correct operation, service and overhaul of engines is available at certain Perkins distributors. If special training is necessary, your Perkins distributor can advise you how to obtain it at the Perkins Customer Training Department, Peterborough, or other main centres.

Engine identification

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. An example of the engine number is **BB50240U501234P**.

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



Engine data

Number of cylinders	4
Cylinder arrangement	In line
Cycle	Four stroke
Induction system	Turbocharged
Combustion system	Direct injection
Nominal bore	84,5 mm (3.33 in)
Stroke	88,9 mm (3.50 in)
Compression ratio	17.2:1
Cubic capacity	1,994 litres (122 in ³)
Firing order	1, 3, 4, 2

Valve tip clearances (hot or cold):

- Inlet	0,25/0,35 mm (0.010/0.014 in)
- Exhaust	0,35/0,45 mm (0.014/0.018 in)

Adjust only if outside the limits of:

- Inlet	0,20/0,40 mm (0.008/0.016 in)
- Exhaust	0,30/0,50 mm (0.012/0.020 in)

Lubricating oil pressure 250 kN/m² (36 lbf/in²) 2,5 kgf/cm²
(minimum at maximum engine speed and normal engine temperature)

Capacity of lubricating oil sump ⁽¹⁾ ⁽²⁾:

- Maximum	5,1 litres (9.0 UK pints) 5.4 US quarts
- Minimum	4,1 litres (7.2 UK pints) 4.3 US quarts

Total oil capacity (approximate) ⁽¹⁾ ⁽²⁾ 6 litres (10.5 UK pints) 6.3 US quarts

Direction of rotation Clockwise from the front

⁽¹⁾ These can vary according to application; fill to the "MAX" mark on the dipstick.

⁽²⁾ Excluding oil cooler

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Engine views

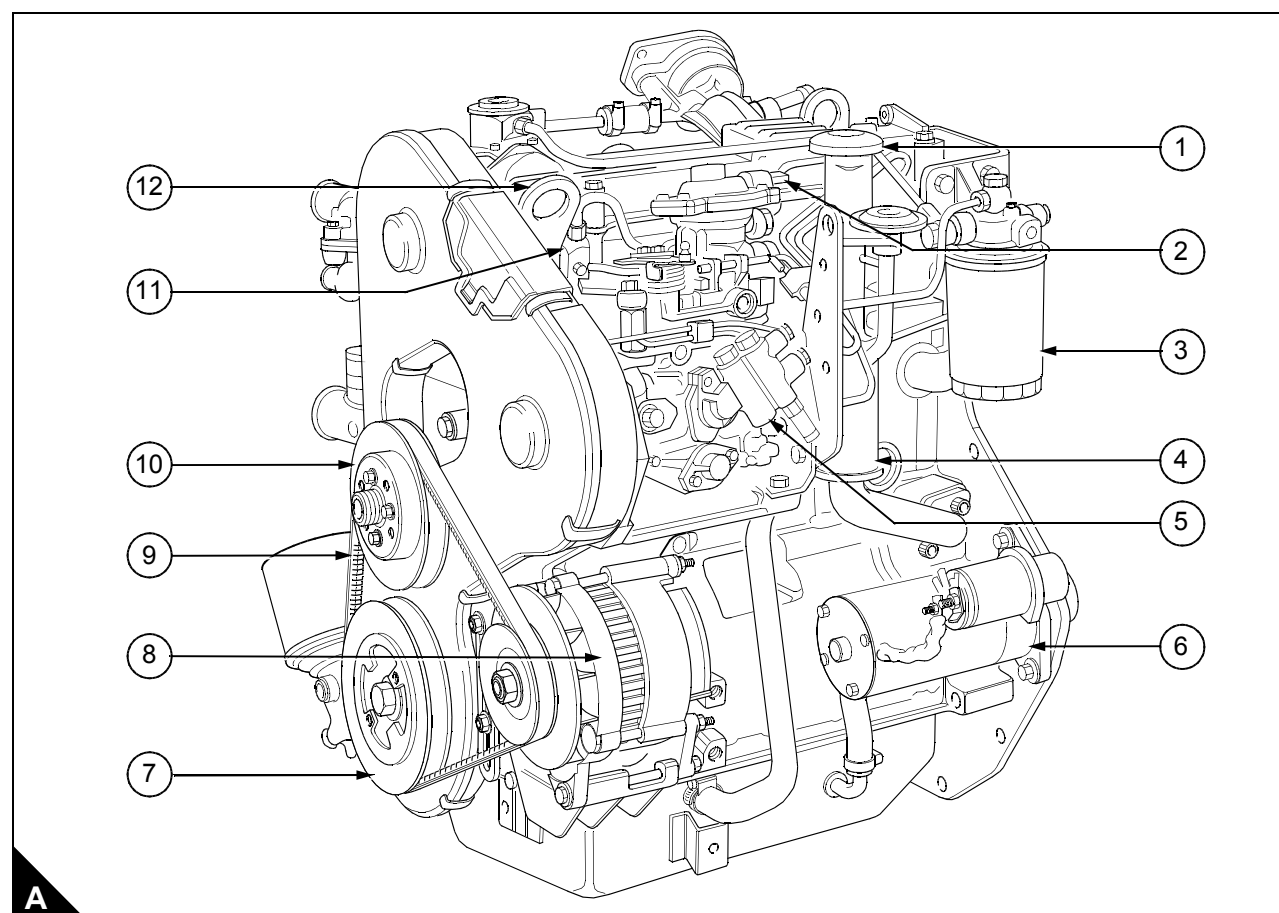
Introduction

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

Location of engine parts

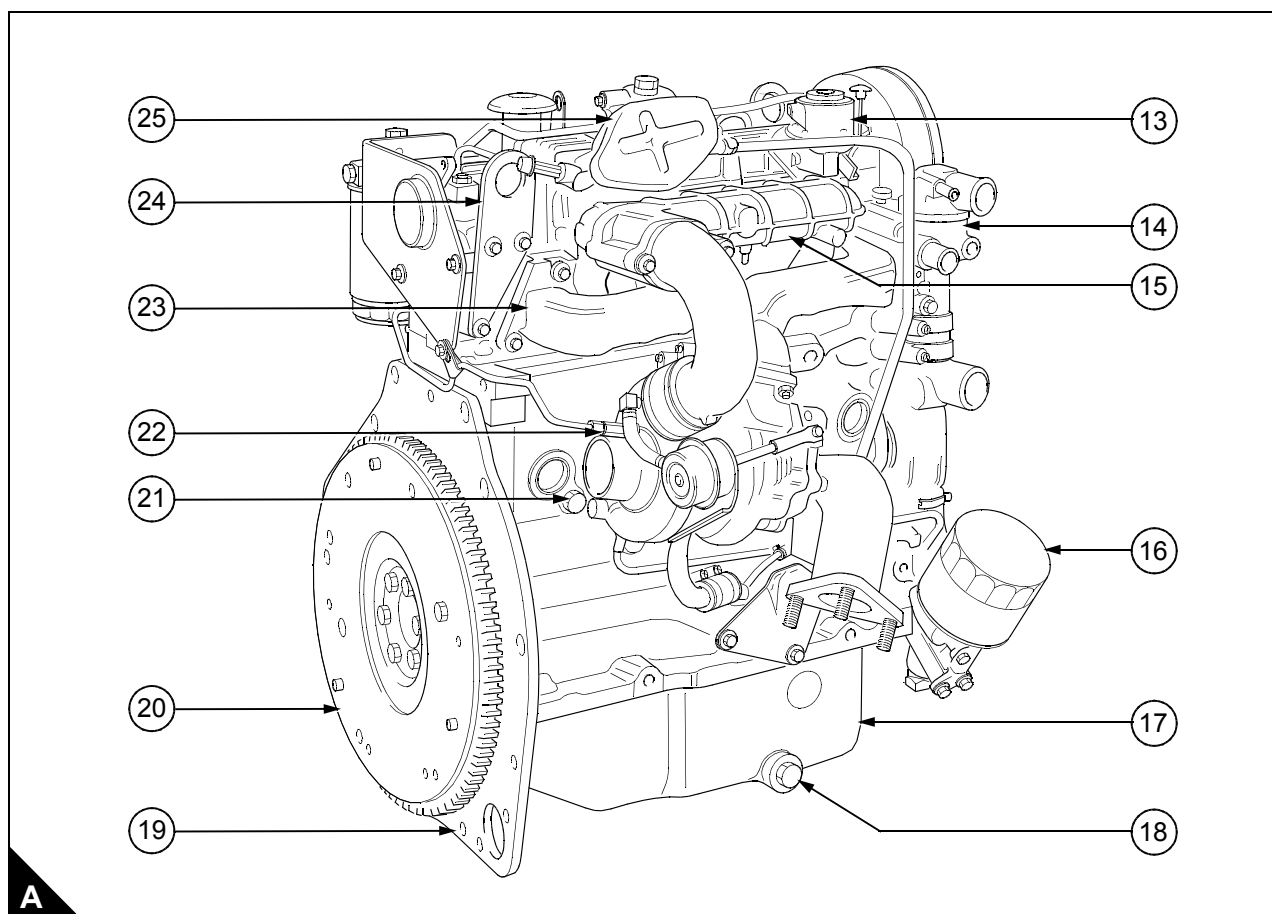
Front and left side view of a Perkins Prima 80T engine

- | | |
|---------------------------------------|-----------------------|
| 1 Filler cap for lubricating oil | 7 Crankshaft pulley |
| 2 Dipstick for engine lubricating oil | 8 Alternator |
| 3 Fuel filter | 9 Drive belt |
| 4 Breather/separator assembly | 10 Water pump pulley |
| 5 Fuel injection pump | 11 Atomiser |
| 6 Starter motor | 12 Front lift bracket |



Rear and right side view of a Perkins Prima 80T engine

- | | |
|-----------------------------------|---------------------------|
| 13 Fuel lift pump | 20 Flywheel |
| 14 Thermostat housing | 21 Drain plug for coolant |
| 15 Induction manifold | 22 Turbocharger |
| 16 Lubricating oil filter | 23 Exhaust manifold |
| 17 Lubricating oil sump | 24 Rear lift bracket |
| 18 Drain plug for lubricating oil | 25 Vacuum pump |
| 19 Engine back plate | |



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. Prima engines are equipped with glow plugs. These electrically operated plugs are fitted into the combustion chamber of each cylinder to provide an easier start. The use of these glow plugs is only necessary in cold conditions.

Always ensure that the vehicle brakes are applied and that the gear lever is in the neutral position before the engine is started.

When a cold engine is started, the fuel injection timing is advanced and the idle speed is increased. As the engine warms up, the idle speed will decrease and the combustion noise will reduce.

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, disconnect the electrical stop control, see "How to renew the canister of the lubricating oil filter" on page 27, and 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 glow plugs

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

1 Adjust the engine speed control to the maximum speed position.

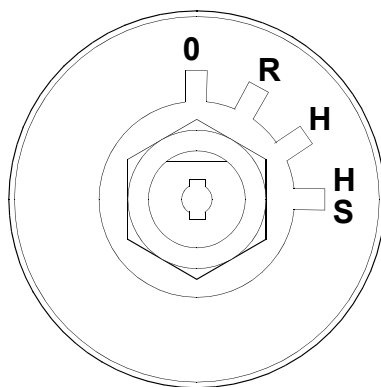
2 If a combined heat/start switch (A) is used; Turn the start key to the "H" position for a maximum period of seven seconds. Turn the start key to the "HS" position to engage the starter motor. When the engine starts, release the start key to the "H" position and hold in this position until the engine runs evenly. When the engine runs evenly, adjust the speed control to get an even idle speed.

If separate heat and start switches are used; Actuate the glow plugs for a maximum period of seven seconds. Engage the starter motor with the glow plugs still actuated. When the engine starts, release the starter switch. Continue to actuate the glow plugs until the engine runs evenly and then adjust the speed control to get an even idle speed.

3 If the engine does not start in 15 seconds, turn the combined heat/start key to the "R" position for 10 seconds or release the separate switches for 10 seconds. Then repeat the start procedure.

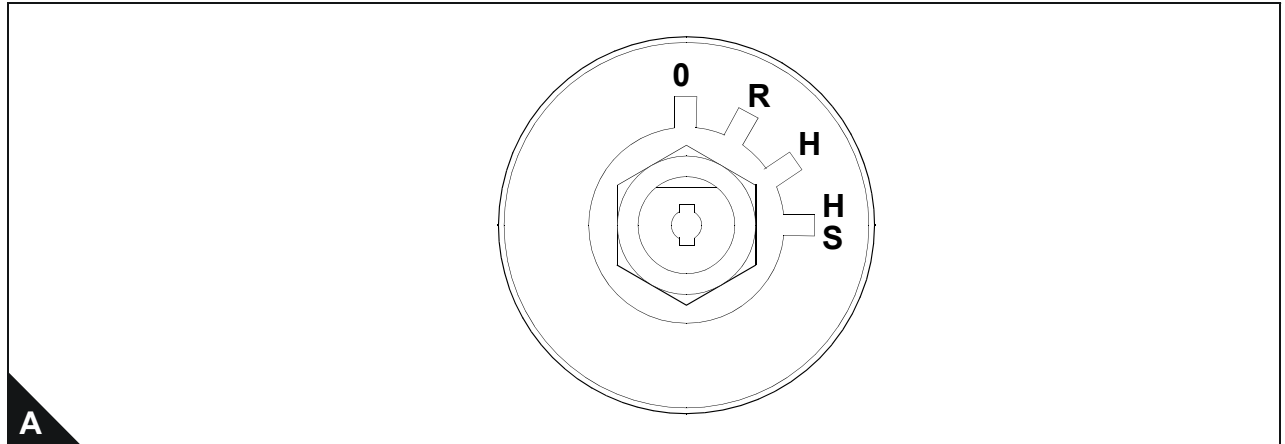
Always ensure that the engine and starter motor are stationary before the starter motor is engaged again.

Caution: Ether type fuels must not be used at the same time as glow plugs and are not necessary for the Prima engine.



How to start a cold engine in temperate conditions

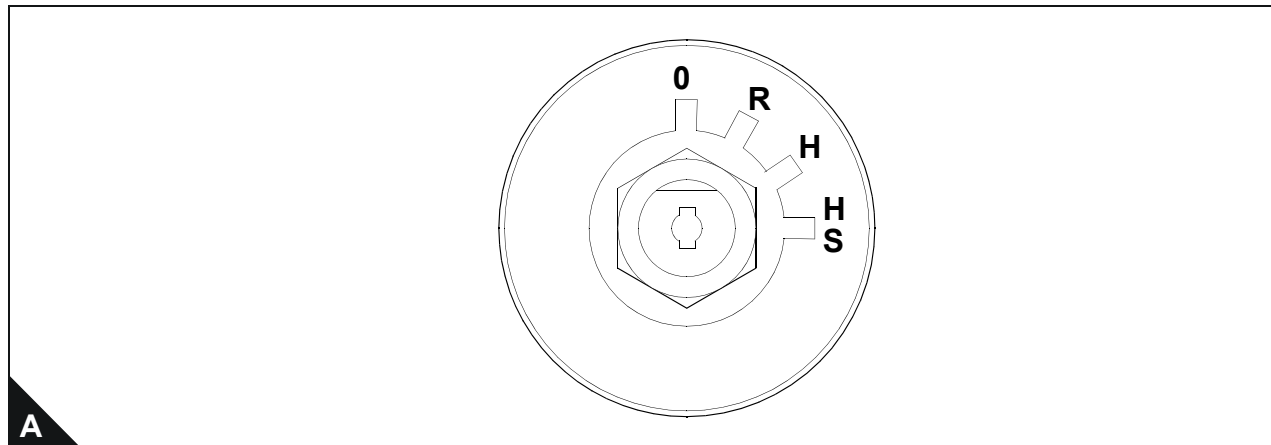
- 1 Adjust the engine speed control to the maximum speed position.
- 2 Turn the start key to the "HS" position (A) to engage the starter motor. Allow the start key to return to the "R" position, when the engine starts. Then adjust the engine speed control to get an even idle speed.
- 3 If the engine does not start in 20 seconds, turn the start key to the "R" position and hold it there for another 20 seconds. Then engage the starter motor again for a maximum period of 20 seconds. If the engine still does not start, use the start procedure with glow plugs.



How to start a warm engine

- 1 Adjust the engine speed control to the quarter open position.
- 2 Turn the start key to the "HS" position (A) to engage the starter motor.
- 3 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 stop the engine

Turn the start key of the combined heat/start switch to the "O" position or turn off the engine control switch.

Adjustment of the engine speed range

The idle or 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

A gradual running-in of a new engine or a POWER EXCHANGE engine is not necessary. Prolonged operation at light loads during the early life of the engine is not recommended.

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).

Caution: *Do not operate the engine at high speeds without a load.*

Altitude

If the engine is to run at a high altitude, 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 of the fuel injection pump.

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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 vehicle 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 (miles or months) which occur first.

- | | | | |
|----------|---|----------|--------------------------------|
| A | First service at 500/1000 miles | E | Every 24000 miles or 24 months |
| B | Every week | F | Every 36000 miles or 36 months |
| C | Every 6000 miles or 6 months ⁽¹⁾ | G | Every 48000 miles or 48 months |
| D | Every 12000 miles or 12 months | H | Every 72000 miles or 36 months |

A	B	C	D	E	F	G	H	Operation
●	●		●					Check the amount of coolant
			●					Check the concentration of the coolant ⁽²⁾
●			●		●			Check the drive belt of the alternator
			●					Renew the drive belt of the alternator
							●	Check the timing belt tension
	●							Renew the timing belt
						●		Drain water from the fuel 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 filter
	●							Lubricate the throttle cable
●	●							Check the amount of lubricating oil in the sump
●		●	●					Check the lubricating oil pressure at the gauge ⁽³⁾
●		●	●					Renew the engine lubricating oil
●			●					Renew the canister of the lubricating oil filter
					●			Check the idle speed (cold and hot), and adjust if it is necessary ⁽⁴⁾
				●				Clean the engine breather system
				●				Renew the air filter element
						●		Ensure that the valve tip clearances of the engine are checked and, if necessary, adjusted ⁽⁴⁾
						●		Ensure that the alternator, the starter motor, and the turbocharger, etc. are checked ⁽⁴⁾
						●		Check operation of glow plug and cold start advance mechanism ⁽⁴⁾

⁽¹⁾ Start / stop operation only.

⁽²⁾ Renew the coolant every 2 years.

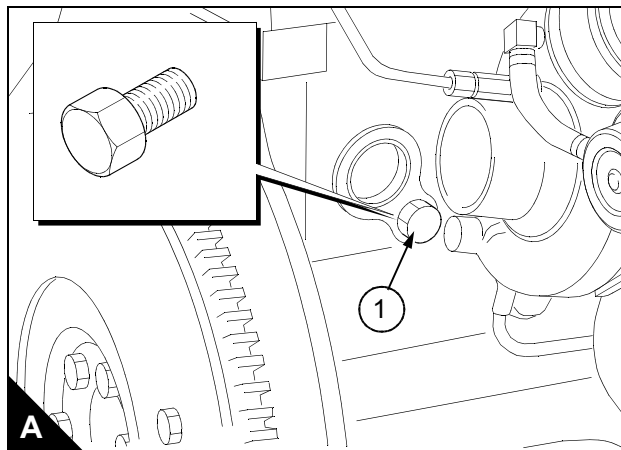
⁽³⁾ If there is one fitted.

⁽⁴⁾ By a person who has had the correct training.

How to drain the coolant system

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.

- 1 Ensure that the machine is on level ground.
- 2 Remove the filler cap of the cooling system.
- 3 Remove the drain plug from the right side of the cylinder block (A1). Ensure that the drain hole is not restricted.
- 4 Open the tap or remove the drain plug at the bottom of the radiator. If the radiator does not have a tap or a drain plug, disconnect the hose at the bottom of the radiator.
- 5 If necessary, flush the system with clean water.
- 6 Fit the drain plugs and the filler cap. Close the radiator tap or connect the radiator hose.



How to check and adjust the drive belt of the alternator

To check

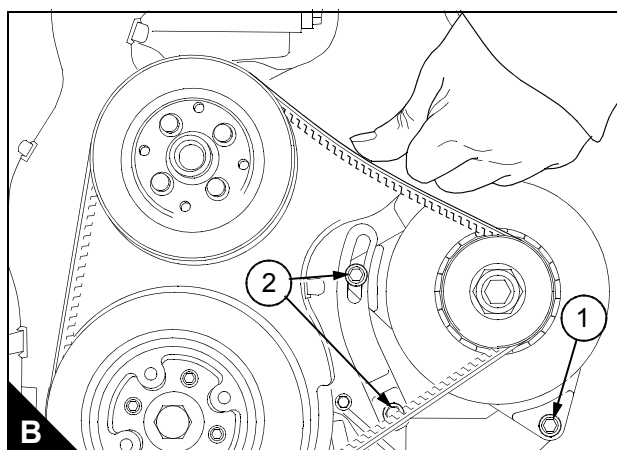
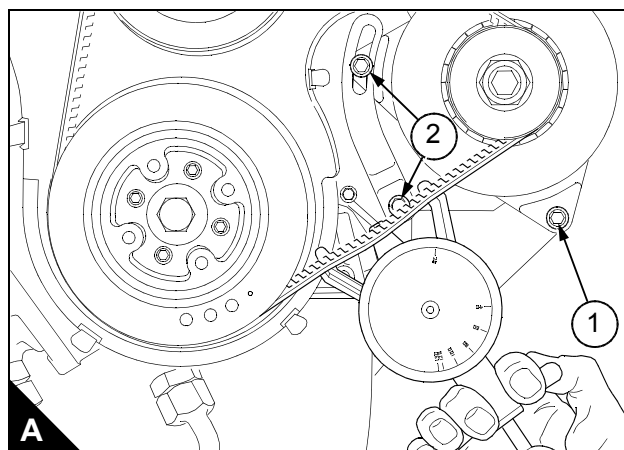
Renew the belt if it is worn or damaged.

To ensure maximum belt life, it is recommended that a belt tensioner gauge is used to check the belt tension.

Fit the gauge at the centre of the free belt length between the crankshaft pulley and the alternator pulley and check the tension (A).

If a Burroughs gauge is used, the correct tension is 355 N (80 lbf) 36 kgf. If the tension is equal to, or less than, 267 N (60 lbf) 27 kgf, 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 ($\frac{3}{8}$ in).



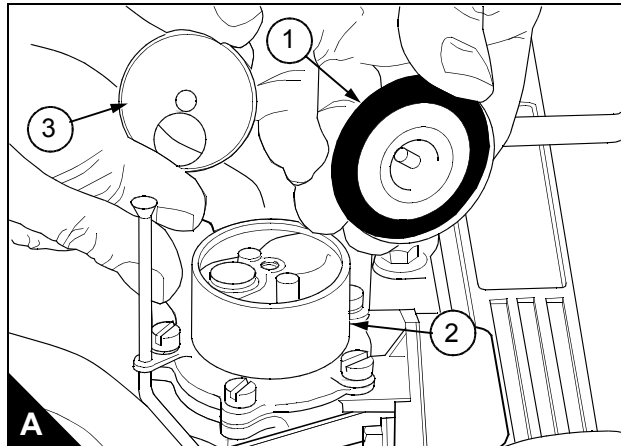
To adjust the belt tension

- 1 Loosen the pivot fasteners (A1/B1) of the alternator and the adjustment link fasteners (A2/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.

Note: If a new belt is fitted, set the initial tension to 440 N (100 lbf) 45 kgf or to a 6 mm ($\frac{1}{4}$ in) deflection. The belt tension must be checked again after the first 20 hours of operation, to ensure that the tension is 355 N (80 lbf) 36 kgf or that the deflection is 10 mm ($\frac{3}{8}$ in).

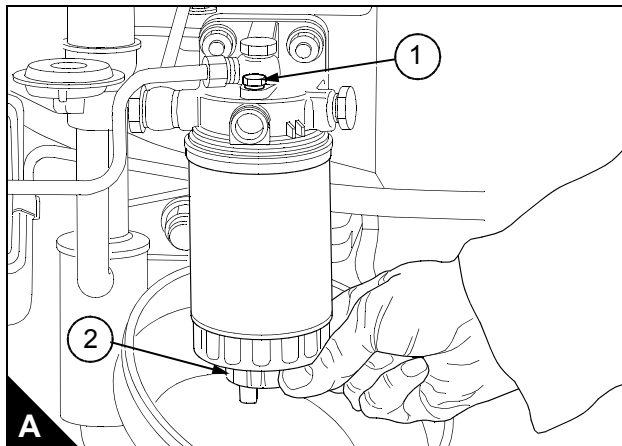
How to clean the gauze strainer of the fuel lift pump

- 1 Remove the cover and joint (A1) from the top of the fuel lift pump (A2) and remove the gauze strainer (A3).
- 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 "How to eliminate air from the fuel system" on page 25.



How to drain water from the fuel filter

- 1 Loosen by two or three turns, the vent screw which is fitted in the top of the filter (A1).
- 2 Loosen the drain device at the bottom of the filter (A2) and allow the water/fuel to drain into a suitable container. If there is no water in the fuel, close the drain device.
- 3 Eliminate the air from the fuel filter, see "How to eliminate air from the fuel system" on page 25.



How to renew the canister of the fuel filter

1 Thoroughly clean the outside surfaces of the fuel filter assembly. Loosen the vent screw at the top of the filter and drain the fuel into a suitable container.

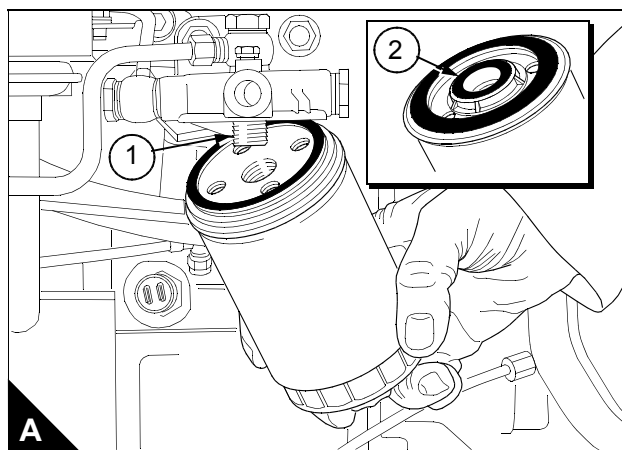
2 Use a strap wrench or similar tool to loosen the filter canister and remove the canister (A).

3 Ensure that the threaded adaptor (A1) is secure in the filter head and that the inside of the head is clean. Ensure that the seal (A2) which is supplied with the new canister is in position on the top of the canister.

4 Lubricate lightly the top seal of the new canister with clean fuel. Fit the new canister to the filter head and tighten, by hand only.

5 Eliminate the air from the fuel filter, see "How to eliminate air from the fuel system" on page 25.

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



Atomiser fault

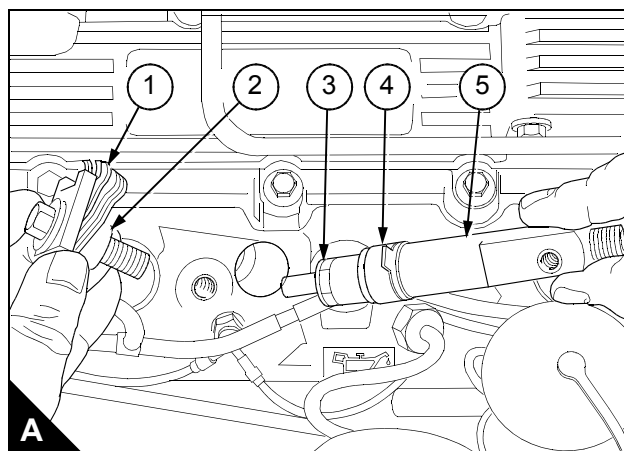
An atomiser fault can cause an engine misfire.

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.

Warning! Ensure that the fuel does not spray onto the skin.

How to renew an atomiser

- 1 Remove the fuel leak-off pipe.
- 2 Remove the union nuts of the high-pressure fuel pipe from the atomiser and from the fuel injection pump. Hold the pump outlet with a spanner to prevent movement while the union is released at the pump. Do not bend the pipe. If necessary, remove the pipe clamps.
- 3 Release the clamp setscrew of the atomiser. Remove the clamp assembly (A1) and the spacer (A2). Remove the atomiser (A5) and its seat washer (A3).
- 4 Check the clamp assembly for damage or distortion and, if necessary, renew the assembly. Renew the atomiser seat washer.
- 5 Ensure that the atomiser location ring (A4) is in position in the cylinder head and put the new atomiser and seat washer into position with the leak off connection not towards the engine. Ensure that the atomiser is not tilted and fit the clamp assembly and the spacer with the arms of the clamp fitted squarely on the shoulders of the atomiser. Tighten the clamp setscrew to 43 Nm (32 lbf ft) 4,4 kgf m.
- 6 Fit the high-pressure fuel pipe and tighten the union nuts to 20 Nm (15 lbf ft) 2,0 kgf m. Hold the pump outlet with a spanner to prevent movement while the union nut is tightened at the pump. If necessary, fit the pipe clamps.
- 7 Operate the engine and check for leakage of fuel and air.



How to eliminate air from the fuel system

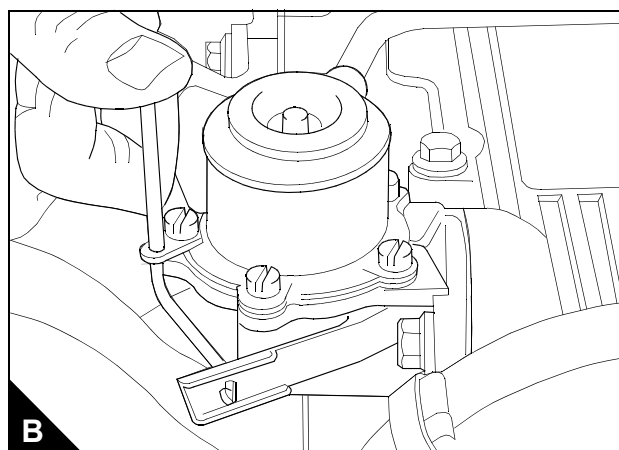
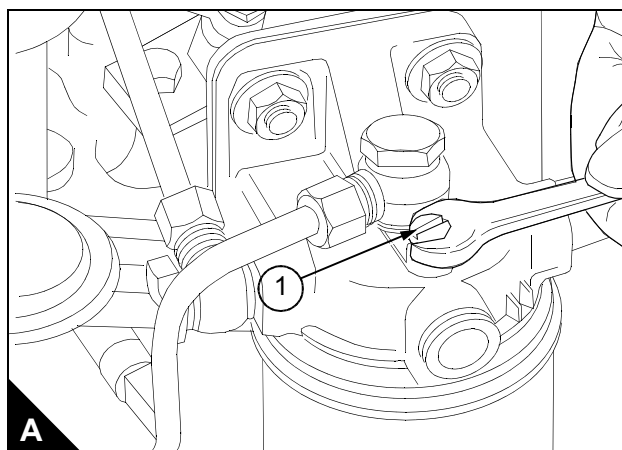
If air enters the fuel system, it must be eliminated before the engine can be started.

Air can enter the system if:

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

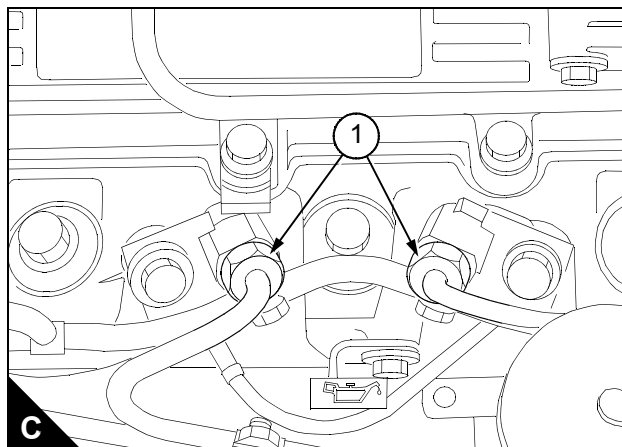
In order to eliminate air from the fuel system, proceed as follows:

- 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 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 turned one revolution.

- 3 Loosen the union nuts (C1) of the high-pressure pipes at two of the atomisers.



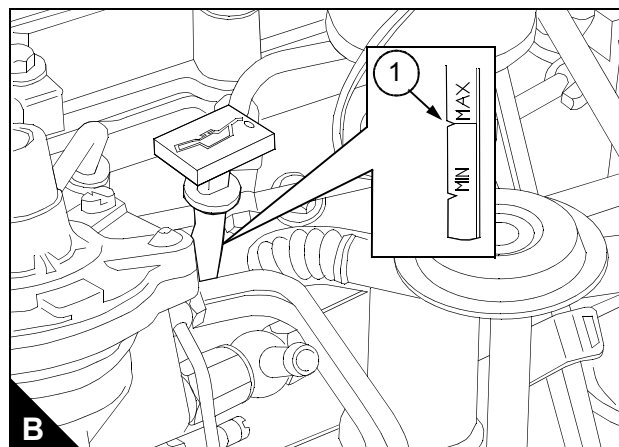
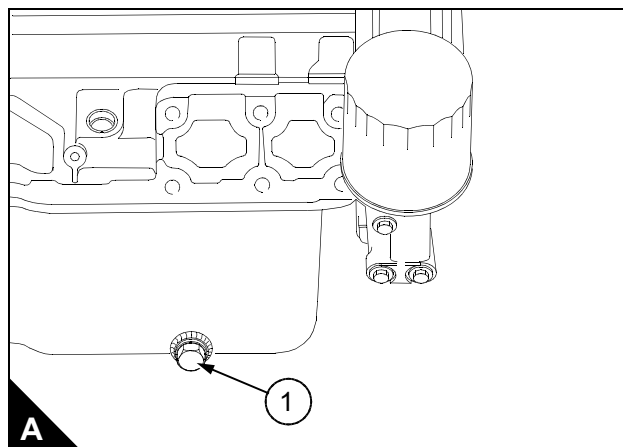
- 4 Operate the starter motor until fuel, free from air, comes from the pipe connections. If a separate starter switch is used, ensure that the switch for the engine electrical system is in the "on" position for this operation.
- 5 Tighten the high-pressure pipe connections.
- 6 The engine is now ready 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.

How to renew the lubricating oil of the engine

- 1 Operate the engine until it is warm.
- 2 Stop the engine, remove the sump drain plug (A1) and its washer and drain the lubricating oil from the sump. Ensure that the washer is not damaged. Fit the drain plug and its washer and tighten the plug to 43 Nm (32 lbf ft) 4,4 kgf m.
- 3 Clean the area around the filler cap. Remove the cap and fill the sump to the "MAX" mark on the dipstick (B1) with new and clean lubricating oil of an approved grade, see "Lubricating oil specification" on page 32. Do not exceed the "MAX" mark on the dipstick. Fit the filler cap and ensure that the dipstick is fitted correctly in the dipstick tube.

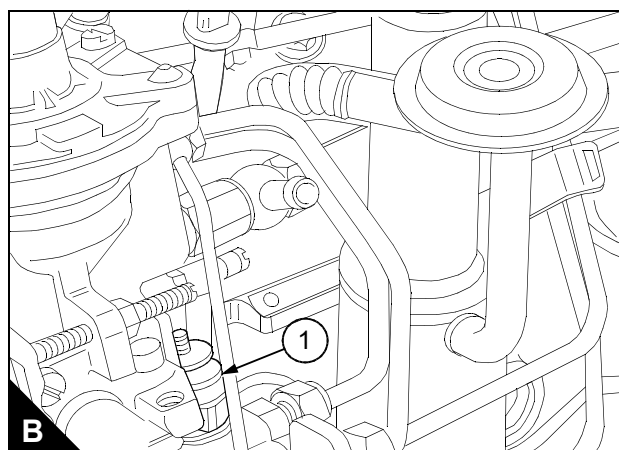
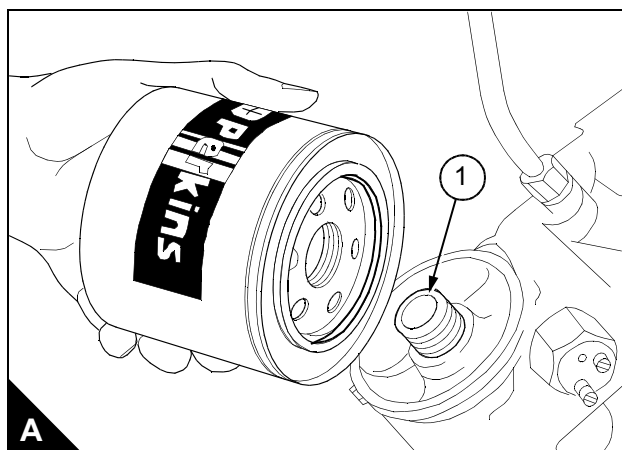
Note: Renew the canister of the lubricating oil filter when the lubricating oil is renewed.



How to renew the canister of the lubricating oil filter

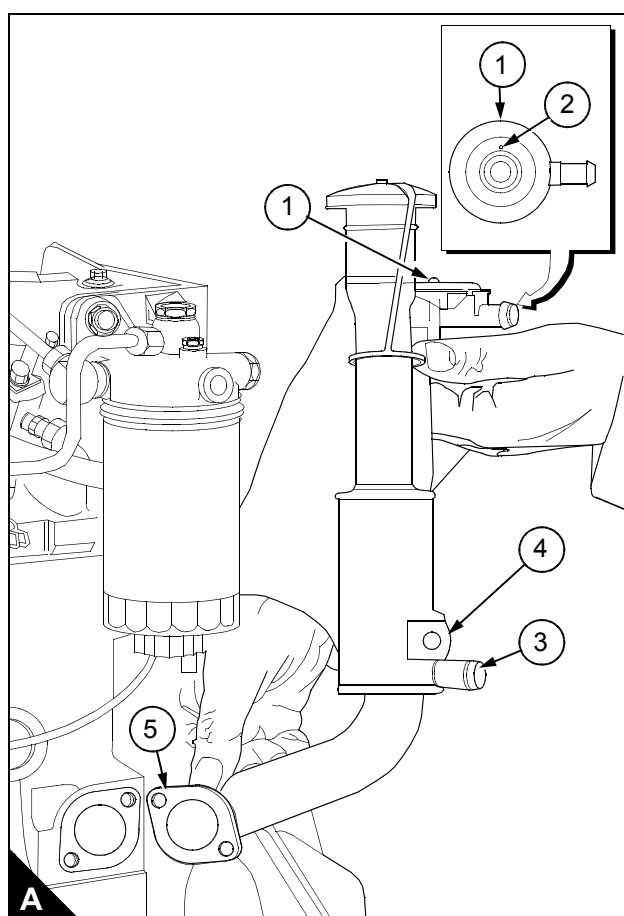
- 1 Put a tray under the filter to retain spilt lubricating oil.
- 2 Remove the filter canister with a strap wrench or similar tool. Ensure that the adaptor (A1) is secure in the filter head. Then discard the canister.
- 3 Clean the filter head.
- 4 Add clean engine lubricating oil to the new canister. Allow the oil enough time to pass through the filter element.
- 5 Lubricate the top of the canister seal with clean engine lubricating oil.
- 6 Fit the new canister and tighten it by hand only. Do not use a strap wrench.
- 7 Ensure that there is lubricating oil in the sump. Disconnect the electrical stop control (B1) and operate the starter motor until oil pressure is obtained. Oil pressure is indicated when the warning light is extinguished or by a reading on the oil pressure gauge. Connect the electrical stop control.
- 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.

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 clean the engine breather

- 1 If necessary, disconnect and remove the starter motor.
- 2 Disconnect the hoses from the breather valve (A1) and from the filler/separator assembly (A3).
- 3 Release the setscrew from the bracket (A4), the cap screws from the flange (A5) and remove the filler/separator assembly from the engine. Remove the breather valve (A1) from the assembly.
- 4 Wash the filler/separator assembly in kerosene and dry it with low pressure air.
- 5 Seal the small hole (A2) in the top cover of the breather valve with a waterproof tape. Wash the valve in kerosene and dry it with low pressure air. Remove the waterproof tape.
- 6 Ensure that the bores of the pipes are clean.
- 7 Ensure that the contact faces of the filler tube flange and the cylinder block are clean.
- 8 Fit the breather valve to the filler/separator assembly and fit the assembly to the engine complete with a new joint. Tighten the flange cap screws and then the clamp setscrew.
- 9 Connect the hoses to the breather valve and to the filler/separator.
- 10 If necessary, fit and connect the starter motor.



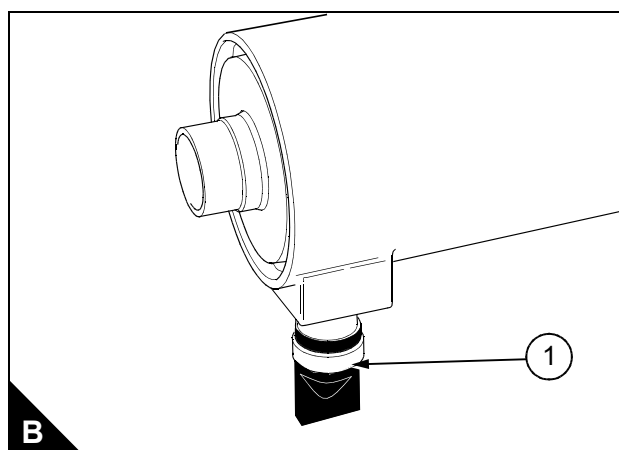
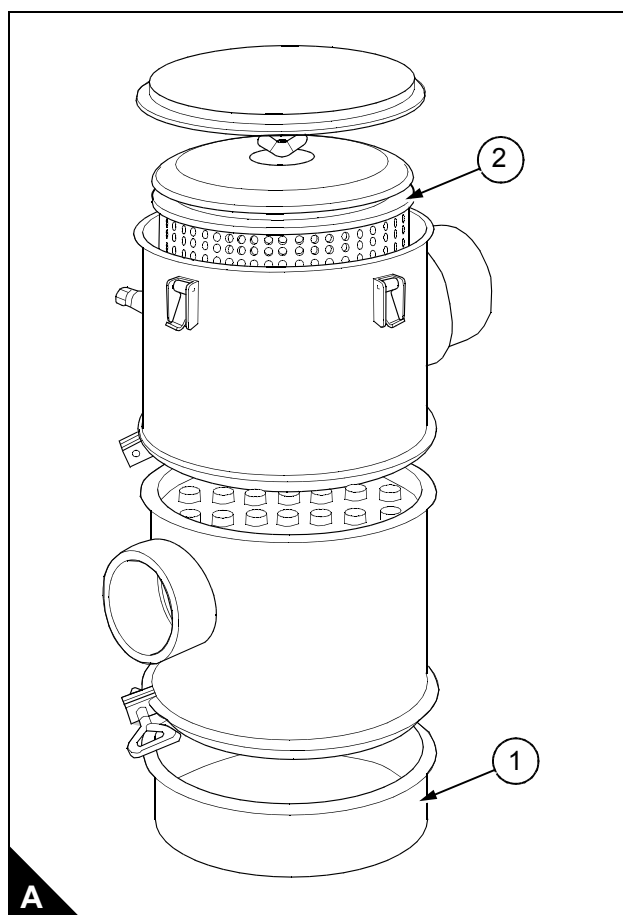
Air filter

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.

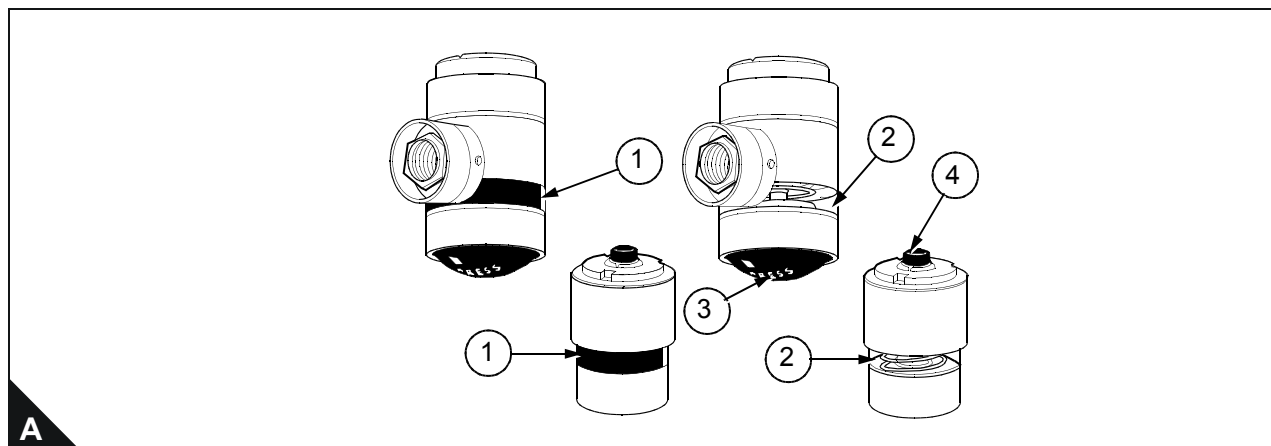
If a restriction indicator is fitted, see "Restriction indicator" on page 30, it will indicate precisely when the air filter element needs service. This prevents the premature removal of the filter element which causes extra cost or late removal of the element which can cause loss of engine power. The filter element must be cleaned or renewed according to the manufacturer's recommendations



Restriction indicator

The restriction indicator for these engines must work at a pressure difference of 381 mm (15 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 (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 button (A3) or the button (A4) of the restriction indicator to reset the red warning indicator.



How to check the glow plugs

Equipment needed:

- 12V/6W test lamp
- 50-0-50 ammeter
- 0-20 voltmeter

- 1** Check the test lamp between the battery positive terminal and earth to ensure that the lamp will illuminate.
- 2** To check the electrical supply, connect the test lamp between the terminal of the glow plug that is farthest away from the electrical supply and earth. Press the glow plug button and the lamp will illuminate if there is an electrical supply.
- 3** Disconnect the wires from the glow plugs.
- 4** To check the continuity of each glow plug, connect the test lamp to the battery positive and to the glow plug terminal. The lamp will illuminate if there is continuity.
- 5** To check the operation of the glow plug, connect the ammeter in series between the supply wire and the terminal of the glow plug and connect the voltmeter between the terminal of the glow plug and earth. Press the glow plug button and check the ammeter and voltmeter readings. With a 12V supply, an initial current of approximately 27A will be indicated but this will be reduced to approximately 14A after approximately 10 seconds. The voltmeter reading after this time will be approximately 11-12 volts. If the ammeter reading is low, renew the glow plug. If there is no voltmeter reading, there is probably a fault in the supply wire or the button switch.
- 6** Remove the test equipment and fit the glow plug wires.

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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	50 minimum
Viscosity	2.5/4.5 centistokes at 40 °C
Density	0,835/0,855 kg/litre
Sulphur	0.5% 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.

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

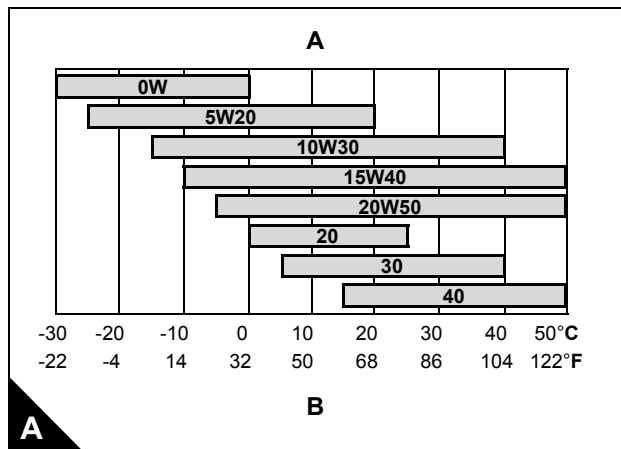
Special winter fuels may be available for engine operation at temperatures below 0 °C. These fuels have a lower viscosity and also limit the wax formation in the fuel at low temperatures. If wax formation occurs, this could stop the fuel flow through the filter.

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.

Lubricating oil specification

Use only a good quality lubricating oil which is not less than the specification APICD/SE or CCMCPD2.

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



Viscosity chart

A = Recommended viscosity grades

B = Ambient temperature

Coolant specification

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

If the correct procedures are not used, Perkins cannot be held responsible for frost or corrosion damage.

- 1** If it is possible, use clean soft water in the coolant.
- 2** The only antifreeze which is recommended for this engine is the latest Perkins POWERPART Antifreeze, part number 21825166 (1 litre), 21825167 (5 litres), 21825168 (25 litres) or 21825169 (205 litres). This antifreeze contains a corrosion inhibitor which is especially suitable for this type of engine.
- 3** The coolant system must be filled with equal quantities of antifreeze and water (50% concentration) and the same mixture must be used if coolant is added during service. The concentration must be checked once a year (at the start of the cold period) and the coolant renewed every two years.

Caution: *An antifreeze which contains the correct inhibitor, must be used at all times.*

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6

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	33, 34, 35, 37, 38, 42, 43, 44
The engine is difficult to start	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19	33, 35, 37, 38, 40, 42, 43, 44
Not enough power	8, 9, 10, 11, 12, 13, 16, 17, 18, 19, 20, 21	33, 35, 37, 38, 39, 42, 43, 44, 61, 63, 64
Misfire	8, 9, 10, 12, 13, 15, 20	33, 35, 36, 37, 38, 39, 40, 41, 43
High fuel consumption	11, 13, 15, 17, 18, 19, 21	33, 35, 36, 37, 38, 39, 40, 42, 43, 44, 63
Black exhaust smoke	11, 13, 15, 17, 19, 21	33, 35, 36, 37, 38, 39, 40, 42, 43, 44, 61, 63
Blue or white exhaust smoke	4, 15, 21, 22	35, 37, 38, 39, 42, 44, 45, 52, 58, 62
The pressure of the lubricating oil is too low	4, 23, 24, 25	46, 47, 48, 50, 51, 59
The engine knocks	9, 13, 15, 17, 20, 22	35, 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	33, 36, 38, 40, 41, 44, 52, 60
Vibration	13, 18, 20, 26, 27	33, 38, 39, 40, 41, 44, 52, 54
The pressure of the lubricating oil is too high	4, 24	49
The engine temperature is too high	11, 13, 15, 19, 26, 28, 29, 31, 32	33, 35, 37, 39, 52, 55, 56, 57, 64
Crankcase pressure	30	39, 42, 44, 45, 52
Bad compression	11	36, 37, 39, 40, 42, 43, 44, 45, 53, 60
The engine starts and stops	10, 11, 12	

List of possible causes

- 1 Battery capacity low.
- 2 Bad electrical connections.
- 3 Fault in starter motor.
- 4 Wrong grade of lubricating oil.
- 5 Starter motor turns engine too slowly.
- 6 Fuel tank empty
- 7 Fault in stop 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 Too much oil or oil of a wrong specification issued in wet type air cleaner.
- 23 Not enough lubricating oil in sump.
- 24 Defective gauge.
- 25 Dirty lubricating oil filter element.
- 26 Fan damaged
- 27 Fault in engine mounting or flywheel housing.
- 28 Too much lubricating oil in sump.
- 29 Restriction in air or water passages of radiator.
- 30 Restriction in breather system.
- 31 Insufficient coolant in system.
- 32 Drive belt for water pump is loose.
- 33 Fault in fuel injection pump.
- 34 Broken drive on fuel injection pump.
- 35 Timing of fuel injection pump is incorrect.
- 36 Tappet clearances are 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.
- 45 Valve stems and/or guides are worn.
- 46 Crankshaft bearings are worn or damaged.

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- 47** Lubricating oil pump is worn.
 - 48** Relief valve does not close.
 - 49** Relief valve does not open.
 - 50** Relief valve spring is broken.
 - 51** Fault in suction pipe of lubricating oil pump.
 - 52** Piston is damaged.
 - 53** Piston height is incorrect.
 - 54** Flywheel housing or flywheel is not aligned correctly.
 - 55** Fault in thermostat or thermostat is of an incorrect type.
 - 56** Restriction in coolant passages.
 - 57** Fault in water pump.
 - 58** Valve stem seal is damaged.
 - 59** Restriction in sump strainer.
 - 60** Valve spring is broken.
 - 61** Turbocharger impeller is damaged or dirty.
 - 62** Lubricating oil seal of turbocharger leaks.
 - 63** Induction system leaks.
 - 64** Turbocharger waste-gate does not work correctly.

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