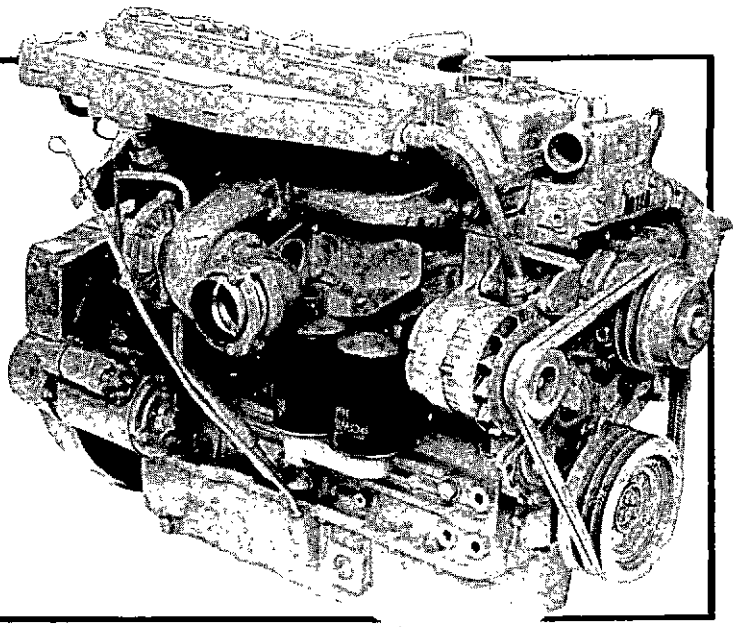
Perkins
• USERS HANDBOOK

6.3544 Series



6.3544
T6.3544
6.3724

Perkins
Engines

Vehicle registration/application	**Date of purchase**
Engine number	**Date of installation**
Owner's or operator's name and address	**Perkins distributor's name and address**

USERS HANDBOOK

6.3544 Series Diesel Engines

6.3544, T6.3544, 6.3724

Publication 201 TPD 0587 1180

May 1987
Perkins Engines Ltd.,
Peterborough, England.


This publication is written in
Perkins Approved Clear English
PACE

Contents

General information

Introduction

This handbook has been written to give you assistance in the correct maintenance and operation of your engine.

To get the best performance and longest life from your engine, you must have the maintenance operations done at the periods shown in Preventive Maintenance. If the engine operates in very dusty or other adverse conditions, some maintenance periods will have to be reduced. Keep your engine clean inside by regular filter element and lubricating oil changes.

Ensure that all adjustments and repairs are done by personnel who have had the correct training. Perkins Distributors have these personnel available. You can also get parts and other service from your Perkins Distributor. If you do not know the location of your nearest distributor, check with one of the Perkins companies given on page 8.

The left and right hand side of the engine are as seen from the rear, (see fig. 1).

Read and remember the safety precautions. These are given for your protection and must be used at all times.

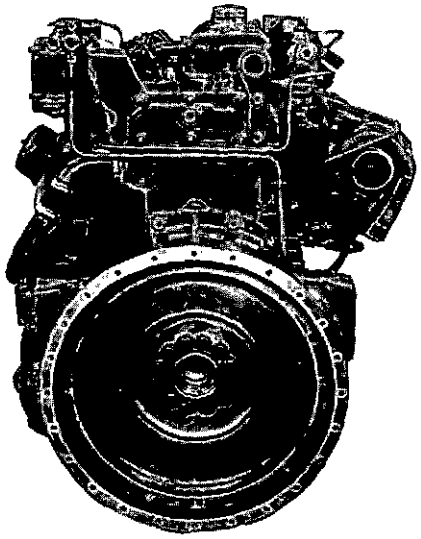


Fig. 1 Definition of left and right hand side of engine.

Safety precautions

THESE SAFETY PRECAUTIONS ARE IMPORTANT. Reference must also be made to the local regulations in the country of operation.

- Do not use these engines in marine applications.
- Do not change the specification of the engine.
- Do not smoke when you put fuel in the tank.
- Clean away any fuel which has fallen and move material which has fuel contamination to a safe place.
- Do not put fuel in the tank during engine operation (unless really necessary).
- Never clean, lubricate or adjust the engine during operation (unless you have had the correct training when extreme caution must be used to prevent injury).
- Do not make any adjustments you do not understand.
- Ensure the engine is not in a position to cause a concentration of toxic emissions.
- Persons in the area must be kept clear during engine and equipment or vehicle operation.
- Do not permit loose clothing or long hair near parts which move.
- Keep away from parts which turn during operation. Note that fans can not be seen clearly while the engine runs.
- Do not run the engine with any safety guards removed.
- Do not remove the radiator cap while the engine is hot and the coolant is under pressure as dangerous hot coolant can be discharged.
- Do not use salt water in the cooling system or any other coolant which can cause corrosion.
- Keep sparks or fire away from batteries (especially while during charge) or combustion can occur. The battery fluid can burn and is also dangerous to the skin and especially the eyes.
- Disconnect the battery terminals before you make a repair to the electrical system.
- Only one person must be in control of the engine.
- Ensure the engine is only operated from the control panel or operators position.
- If your skin comes into contact with high pressure fuel, get medical assistance immediately.
- Diesel fuel can cause skin damage to some persons. Use protection on the hands (gloves or special skin protection solutions).
- Do not move equipment unless the brakes are in good condition.
- Ensure that the transmission drive control is in "out of drive" position before the engine is started.
- Fit only correct Perkins parts.

The Perkins **CARE**CARD system is only applicable where the Perkins distributor is responsible for the engine service.

When you receive your new equipment, give all the relevant details to your Perkins distributor who will provide a **CARE**CARD (see Fig. 2) and instructions for its use.

Each time you need service or information, give the **CARE**CARD to your distributor. This will enable the distributor to provide the correct service and ensure that genuine Perkins parts are used. The distributor will also ensure that you obtain the best performance from your Perkins engine at all times.

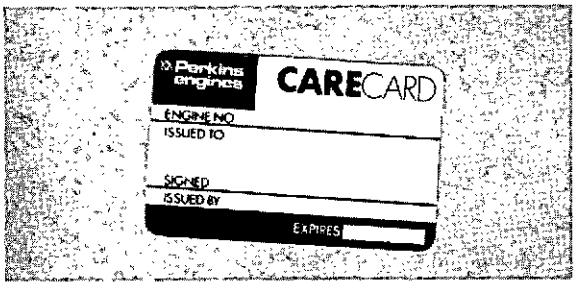


Fig. 2 CARECARD

Engine identification

There are three engine types in the 6.3544 Series. These are the T6.3544, 6.3544 and 6.3724 engines.

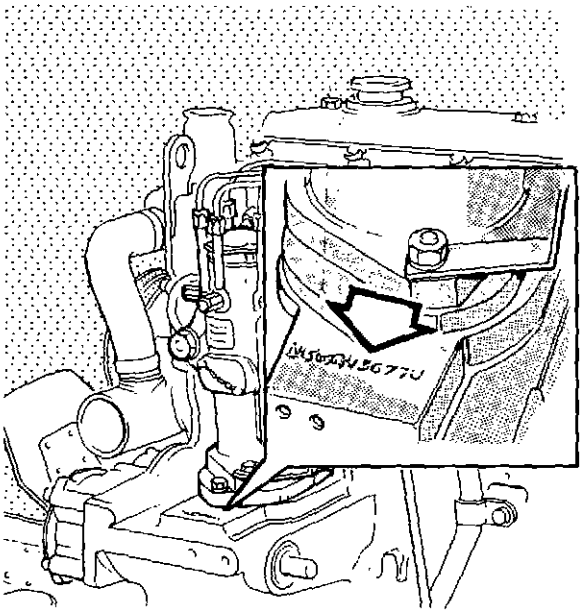


Fig. 3 Engine number position

The first two letters of the engine number give an indication of the engine type as shown below:

TU – T6.3544 engine (Turbocharged)
TW– 6.3544 engine
TV – 6.3724 engine

The engine number is stamped on a machined pad on the auxiliary drive housing next to the fuel injection pump, (see fig. 3).
A typical engine number is: TW30028U512345J.

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

Perkins companies

Australia
Suite 2, 364 Main Street
Mornington 3931, Victoria, Australia.
Telephone: 059-751877
Telex: AA30816

France
Moteurs Perkins S.A.,
9-11 Avenue Michelet,
93407 Saint Ouen, Cedex, France.
Telephone: (1) 42-23-20-00
Telex: 642924F
Cable: Perkoil Paris

Germany
Perkins Motoren G.m.b.H.,
8752 Kleinostheim, Postfach 1180,
West Germany.
Telephone: Kleinostheim 06027 5010
Telex: 4188869A PER D

Italy
Motori Perkins S.p.A.,
Via Gorizia 15, P.O. Box 12,
22070 Portichetto/Luisago (Como), Italy.
Telephone: (031) 927364
Telex: 380658 Perkit I
Cable: Perkoil Portichetto

Japan
Massey Ferguson Perkins Engines K.K.,
Reinanzaka Building, 6th Floor,
14-2 Akasaka, 1-chome, Minato-ku,
Tokyo 107, Japan.
Telephone: (03) 586 7377
Telex: Perkoil J2424823
Cable: Perkoil
Fax: (03) 582-1596

Singapore
Perkins Engines Asia Pacific,
130 Hillview Avenue,
Singapore 2366.
Telephone: 7605722
Telex: RS 37729
Fax: 7602025

United Kingdom
Perkins Engines Limited,
Eastfield, Peterborough PE1 5NA, England.
Telephone: (0733) 67474
Telex: 32501 Perken G
Cable: 'Perkoil' Peterborough

Perkins Engines (Shrewsbury) Limited,
Sentinel Works, Shrewsbury
SY1 4DP, England.
Telephone: (0743) 52262
Telex: 35171/2 PESL G

U.S.A.
Perkins Engines Inc.,
P.O. Box 697,
32500 Van Born Road, Wayne,
Michigan 48184, U.S.A.
Telephone: (313) 595 9600
Telex: 234002 Perken Wane
Cable: Perken Wane

Perkins Engines Latin America Inc.,
P.O. Box 697,
32500 Van Born Road, Wayne,
Michigan 48184, U.S.A.
Telephone: (313) 595 9600
Telex: 234002 Perken Wane
Cable: Perken Wane

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

Engine views

Perkins engines are made for specific applications and the views which follow are not necessarily correct for your engine specification.

1. Alternator pulley
2. Thermostat housing
3. Lubricating oil filler cap
4. Fuel oil filter
5. Rocker cover
6. Atomiser
7. Breather pipe
8. Fuel injection pump (CAV)
9. Lubricating oil dipstick
10. Engine number position
11. Lubricating oil filter
12. Lubricating oil sump
13. Fan
15. Crankshaft pulley and vibration damper
16. Fan belts
17. Water pump
27. Sump drain plug

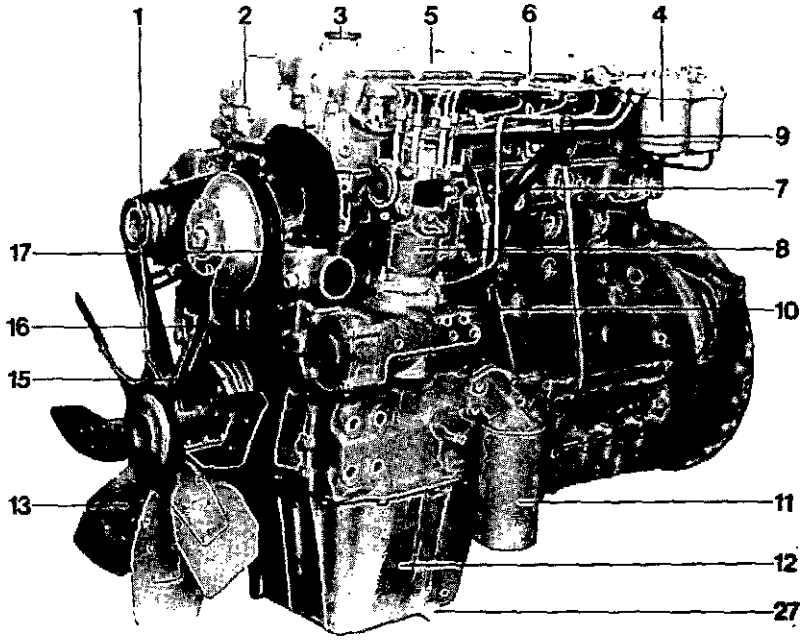


Fig. 4 Front/left side of 6.3544 engine

12. Lubricating oil sump
14. Starter motor
18. Induction manifold
19. Exhaust manifold
20. Thermostart
21. Fuel lift pump
22. Flywheel housing
23. Fuel pipe from lift pump to fuel filters.
25. Cylinder block drain plug
29. Alternator

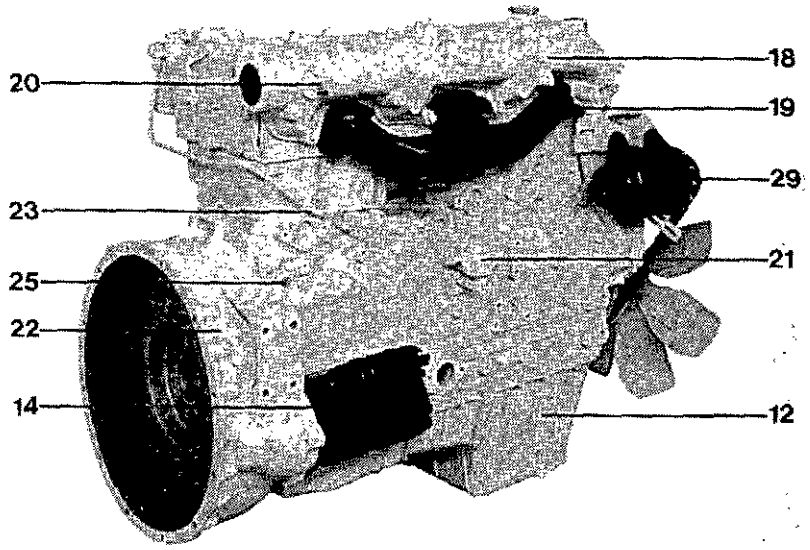


Fig. 5 Rear/right side of the 6.3544 engine

24. Rear lift bracket
25. Cylinder block drain plug
26. Turbocharger
28. Lubricating oil pipe to turbocharger
30. Lubricating oil drain from turbocharger

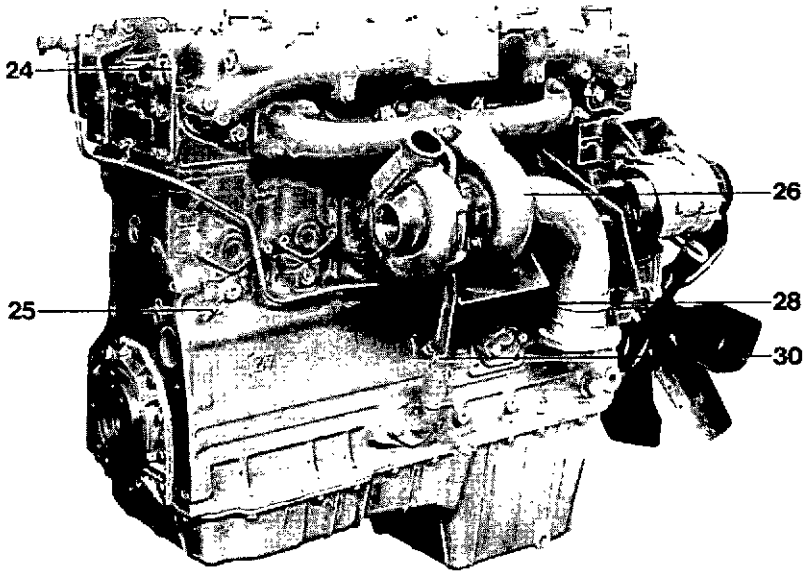


Fig. 6 Rear/right side of T6.3544 engine

3. Lubricating oil filler cap
4. Fuel oil filter
10. Engine number position
11. Lubricating oil filter
24. Rear lift bracket
27. Sump drain plug
31. Fuel injection pump (Bosch)
32. Lubricating oil cooler
33. Front lift bracket

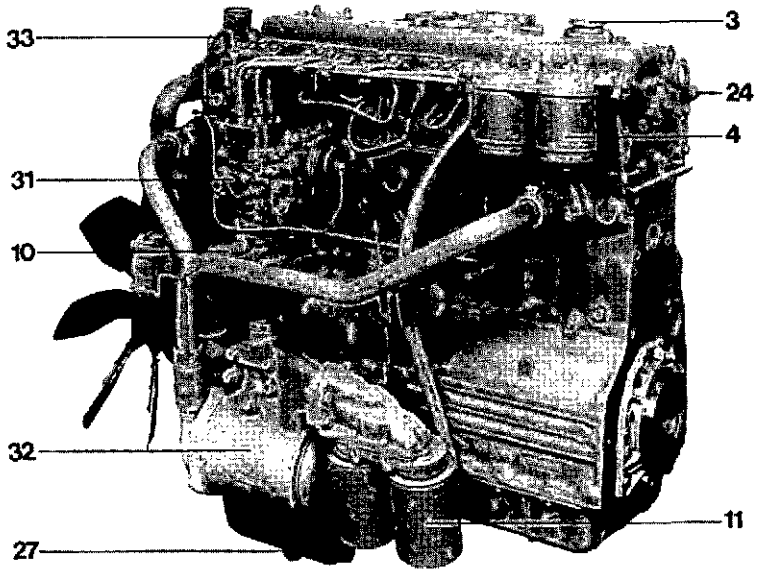


Fig. 7 Rear/left side of T6.3544 engine

3. Lubricating oil filler cap
4. Fuel oil filter
5. Rocker cover
7. Breather pipe
8. Fuel injection pump (CAV)
10. Engine number position
15. Crankshaft pulley
16. Fan belts
22. Flywheel housing
32. Lubricating oil cooler
33. Front lift bracket

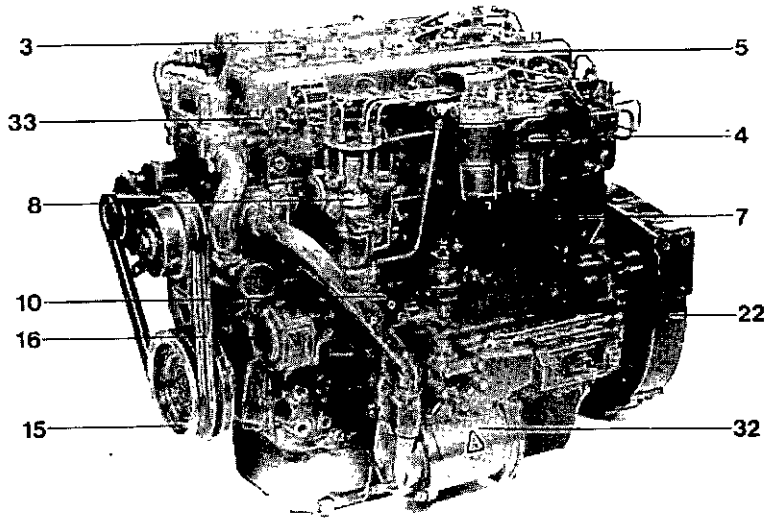


Fig. 8 Front/left side of T6.3544 charge cooled engine

11. Lubricating oil filter
12. Lubricating oil sump
14. Starter motor
19. Exhaust manifold
23. Fuel pipe from lift pump to fuel filters
24. Rear lift bracket
25. Cylinder block drain plug
26. Turbocharger
29. Alternator
30. Lubricating oil drain from turbocharger
34. Air charge cooler

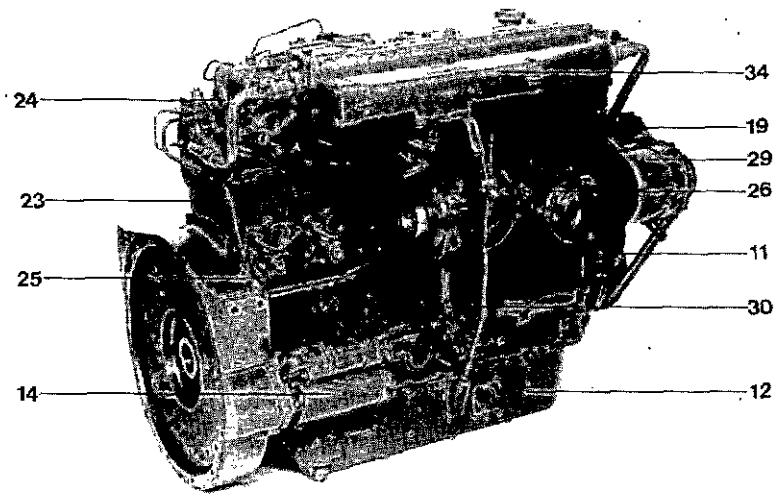


Fig. 9 Rear/right side of T6.3544 charge cooled engine

Engine data

	6.3544	T6.3544	6.3724
No. of cylinders	Six	Six	Six
Cycle	Four stroke	Four stroke	Four stroke
Combustion system	Direct injection	Direct injection	Direct injection
Nominal bore	98,43 mm (3.875 in)	98,43 mm (3.875 in)	101 mm (3.975 in)
Stroke	127 mm (5 in)	127 mm (5 in)	127 mm (5 in)
Compression ratio	16 : 1	15.5 : 1	16 : 1
Cubic capacity	5,8 litres (354 in^3)	5,8 litres (354 in^3)	6 litres (372 in^3)
Firing order	1, 5, 3, 6, 2, 4	1, 5, 3, 6, 2, 4	1, 5, 3, 6, 2, 4
Valve tip clearance			
Inlet: Hot or cold	0,20 mm (0.008 in)	0,20 mm (0.008 in)	0,20 mm (0.008 in)
Exhaust: Hot or cold	0,45 mm (0.018 in)	0,45 mm (0,018 in)	0,45 mm (0.018 in)
Turbocharger boost pressure (measured at induction manifold)*		76-93 kN/m^2 (11-13.5 lbf/in^2) 0,80 - 0,95 kgf/cm^2	

Lubricating oil pressure: 207 kN/m^2 (30 lbf/in^2) 2, 1 kgf/cm^2 minimum at maximum engine speed and normal engine temperature.

Direction of rotation: Clockwise from the front.

*Variable, according to application, load and speed.

To start the engine

There are several factors which affect engine start, for example:

The power of the batteries
Performance of the starter motor
Viscosity of the lubricating oil
Installation of a cold start system

Diesel engines need a cold starting aid when they are to operate in very cold conditions. Your vehicle or machine will normally be fitted with the correct equipment for your area of operation.

Different systems of cold starting aids can be installed on Perkins diesel engines and they are:

Thermostart

An electrically operated device which heats the induction air. This device burns a controlled amount of diesel fuel.

Start Pilot

A hand pump discharges the cold start fluid into the induction manifold through an atomiser. The cold start fluid is held in a separate reservoir.

KBi

The cold start fluid is held in an aerosol container. It is released by a push button operated solenoid and sprayed into the induction manifold by a nozzle.

To start a warm engine:

1. Ensure that the stop control (where fitted) is in the 'run' position.
2. Adjust the engine speed control to the maximum speed position.
3. Turn the start key to the 'S' or 'HS' position (see fig. 10) to engage the starter motor.
4. As soon as the engine starts, release the start key to the 'R' position.
5. Adjust the engine speed control.
6. If the engine does not start in 15 seconds, release the start key to the 'R' position. Do not engage the starter motor again until 10 to 15 seconds have passed.

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

Engine start procedure with Thermostart

1. Where a separate stop control is installed, ensure it is in the 'R' (run) position.
2. Turn the start key to the 'H' (heat) position (see fig. 10) and hold it there for 20 seconds.
3. Adjust the engine speed control to the maximum speed position.

4. Turn the start key to the 'HS' (heat/start) position to engage the starter motor. As the engine starts, release the start key to the 'R' position and adjust the engine speed control to give a smooth idle speed.

5. If the engine does not start in 15 seconds, return the start key to the 'H' position for 10 seconds and then engage the starter motor again.

Engine start procedure with Start Pilot

The Start Pilot hand pump must not be used until the starter motor is engaged.

Experience will show how much fluid is needed for each engine start.

1. Where necessary, charge the reservoir with fluid. Raise the cover of the reservoir, press the can, head down on the filler plug and hold squarely until fluid fills the bowl up to the maximum mark.
2. Ensure that the stop control (where fitted) is in the 'run' position.
3. Adjust the engine speed control to the maximum speed position.
4. Turn the key to the 'HS' position (see fig. 10) to engage the starter motor for a maximum of 30 seconds and operate the Start Pilot pump during this period. As the engine starts release the start key to the 'R' position and adjust the engine speed control to give a smooth idle speed.

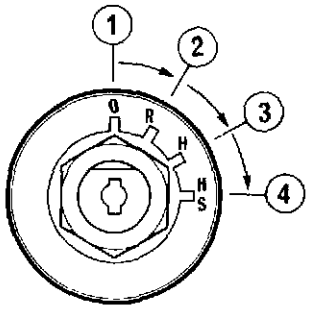
Start Pilot equipment must not be used with heat type starting aids such as Thermostart.

5. If the engine does not start during the first 30 seconds, disengage the starter motor for another 30 seconds and then engage the starter motor again and operate the Start Pilot hand pump.

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

Thin lubricating oil can be applied to the pump cylinder.

The nozzle in the induction manifold can be removed and washed in kerosene, when necessary.



1. Off.
2. Run.
3. Heat.
4. Heat and start.

Fig. 10 Heat/start switch

Engine start procedure with KBi

1. Where necessary, renew the screw type canister. A safety valve is integral with the container.

2. Ensure that the stop control (where fitted) is in the 'run' position.

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

4. Engage the starter motor.

5. As the engine turns, press the KBi 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 and after 5 seconds press the KBi button again for 2 seconds.

   In some conditions, it is necessary to give another application of KBi fluid after the engine has started to ensure that the engine continues to run.

KBi equipment must not be used with heat type cold starting aids such as Thermostart.

To stop the engine

Either turn the engine start key to the 'O' position (fig. 10) or operate the separate stop control. Where a separate stop control is used, ensure that the control is returned to the 'run' position after the engine has stopped and the engine start key is turned to the 'O' position.

Engine speed adjustment

The idle or maximum speed settings must not be changed by the engine operator as this can damage the engine or transmission. If the seals on the fuel injection pump are broken during the warranty period by a person who is not approved by Perkins Engines Ltd., it can have an effect on the warranty.

Running-in procedure

A gradual running-in of a new or Power Exchange engine is not necessary. Extended light load operation during the early life of the engine is not recommended.

Full load can be applied to a new or Power Exchange engine as soon as the engine is put into service and the coolant temperature is at a minimum of 60°C (140°F).

Do not run the engine at high no load speeds.

Do not apply an overload to the engine.

T6.3544 vehicle applications
Because of the power characteristics of the turbocharged T6.3544 it is necessary to keep a high engine speed when you drive up a gradient.

Do not put an overload on the engine at low engine speed, change to a lower gear to increase the engine speed.

Altitude

If the naturally aspirated engine is to operate at an altitude higher than 600 m (2,000 ft), the fuel delivery can be changed to reduce smoke and fuel consumption. Perkins Engines Ltd. can give the percentage of fuel reduction needed if details of engine application and ambient conditions are given. Information for turbocharged engines is available from Perkins Engines Ltd. Any change to the fuel injection pump settings must be made by a Perkins distributor or an approved fuel pump distributor.

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. Fuel with a low cetane number can cause cold start problems and affect combustion.

Viscosity is the resistance to flow and, if this is outside the limits, engine performance can be affected.

Density: Lower density will reduce engine power, higher density will increase engine power and exhaust smoke.

Sulphur: High sulphur content (not normally found in Europe, North America or Australasia) can cause engine wear. Where only high sulphur fuels are available, it will be necessary to use a highly alkaline lubricating oil in the engine or to reduce the lubricating oil change interval.

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.

Aviation kerosene fuels

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. Aviation fuels are more flammable than diesel fuel and need careful storage and management.

If you need advice on any adjustment to the engine or to the lubircating oil change periods which may be necessary because of the standard of available fuel, consult your nearest Perkins distributor or the Technical Service Department at one of the addresses on page 8.

Lubricating oil specification

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

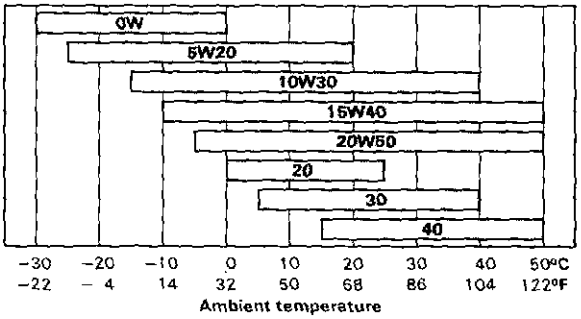
Attention: The type of lubricating oil used may be affected by the quality of the fuel oil which is used. For further details see "Fuel specification" on this page.

Engine type	Specifications	
	API CC/SE MIL - L - 46152 CCMC D1	API CD/SE MIL - L - 2104C CCMC D2
Naturally aspirated	•	• (1)
Naturally aspirated engines in heavy duty earthmoving equipment		•
Turbocharged		•

(1) Not recommended for the first 800/1600 km (500/1000 miles) or 25/50 hours of operation.

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 below.

Recommended SAE viscosity grades



Coolant specifications

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.

2 If an antifreeze mixture, other than Perkins POWERPART, is used to prevent frost damage, it must have an ethanediol base (ethylene glycol) with a corrosion inhibitor. It is recommended that the corrosion inhibitor is of the sodium nitrite or sodium benzoate type. The antifreeze mixture must be an efficient coolant at all ambient temperatures and it must provide protection against corrosion. It must also have a specification at least as good as the requirements of the standards below:

United Kingdom: BS 6580: 1985: "Specification for corrosion inhibiting, engine coolant concentrate (antifreeze)."
United States of America: ASTM D3306-74: "Ethylene Glycol Base Engine Coolant."
Australia: AS 2108-1977: "Antifreeze Compounds and Corrosion Inhibitors for Engine Cooling Systems."

Perkins POWERPART antifreeze exceeds the requirements of the above standards.

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

The antifreeze must consist of equal quantities of antifreeze and water. Concentrations of more than 50% of antifreeze must not be used because these can affect adversely the performance of the coolant.

3 When frost protection is not necessary, it is still an advantage to use an approved antifreeze mixture because this gives the necessary protection against corrosion and also raises the boiling point of the coolant.

If an antifreeze is not used, a correct mixture of corrosion inhibitor must be added to the water.

Renew the mixture of water and corrosion inhibitor every six months or check it according to the inhibitor manufacturer's recommendations.

Attention: Certain corrosion inhibitor mixtures contain soluble oil which can have an adverse effect on certain types of water hose.

To drain the cooling system

1. Ensure the vehicle or machine is on level ground.
2. Remove the radiator filler cap.
3. Remove the drain plug from either side of the cylinder block (see fig. 11) to drain the engine. Ensure that the drain hole does not have any restriction.
4. Open the tap or remove the drain plug at the bottom of the radiator to drain the radiator. If a tap or plug is not fitted to the radiator, disconnect the bottom radiator hose.
   Where fitted, the lubricating oil cooler and air compressor (if water cooled) must be drained (see figs. 12, 13, 14, and 15).
5. Where necessary, flush the system with clean water.
6. Fit the drain plugs and radiator cap. Where necessary, close the radiator tap or connect the radiator hose.
7. Put 250 ml (1/2 pint) of antifreeze, without water, into the oil cooler for protection against frost if water drains down when the machine is moved.

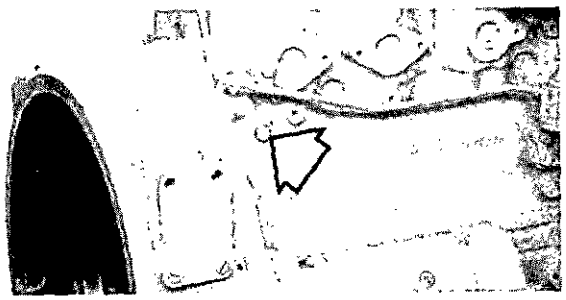
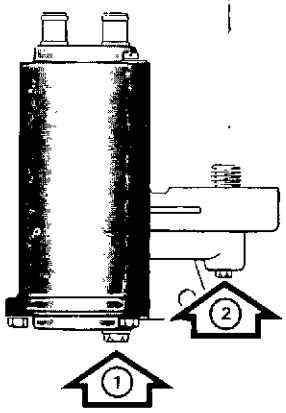
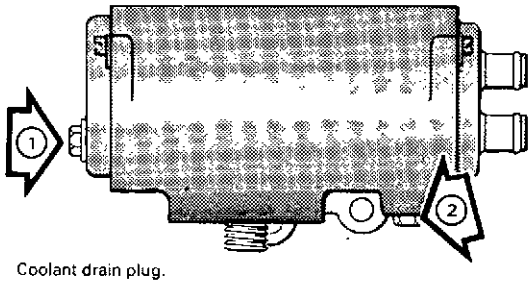


Fig. 11 Cylinder block drain plug



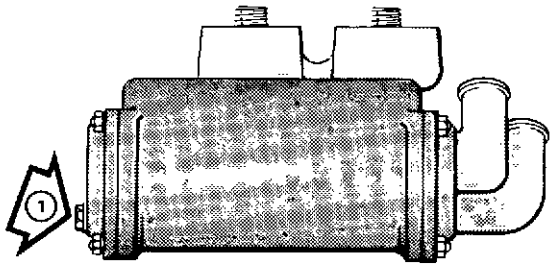
1. Coolant drain plug.
2. Lubricating oil drain plug.

Fig. 12 Lubricating oil cooler, naturally aspirated engines, right side mounting



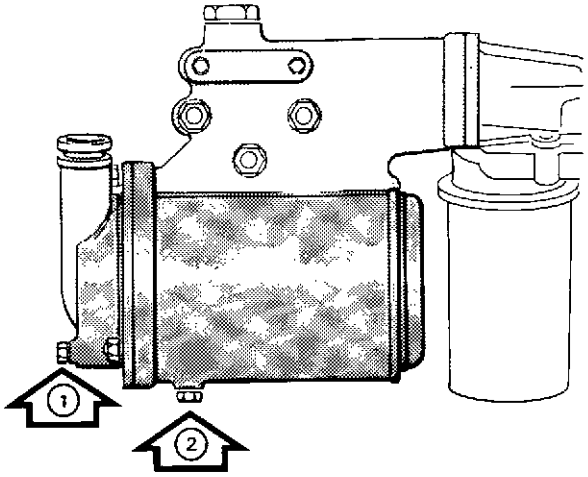
1. Coolant drain plug.
2. Lubricating oil drain plug.

Fig. 13 Lubricating oil cooler, naturally aspirated engines, left side mounting



1. Coolant drain plug.

Fig. 14 Lubricating oil cooler, turbocharged engines, right side mounting



1. Coolant drain plug.
2. Lubricating oil drain plug.

Fig. 15 Lubricating oil cooler, turbocharged engines, left side mounting

Air charge coolers

Where air charge coolers are fitted to turbocharged engines, the air vent screw (see fig. 16) must be removed when it is necessary to drain or fill the cooling system.

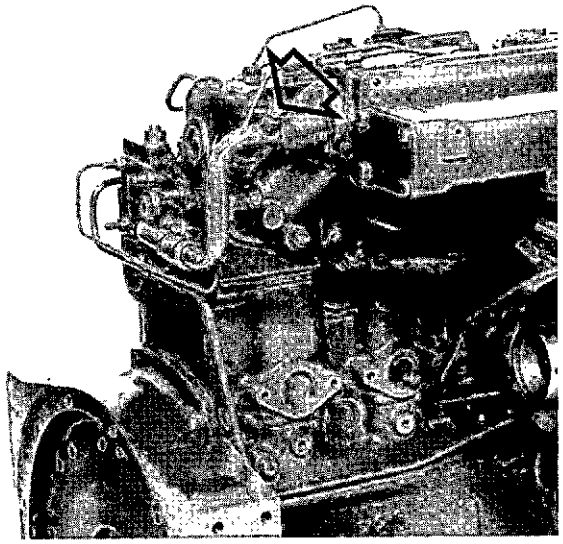


Fig. 16 Air charge-cooler vent screw

Preventive maintenance

These preventive maintenance periods are general in application. Check the periods given by the manufacturer of the equipment in which the engine is installed and, where necessary, use the shorter periods. These periods and procedures must also be adapted to ensure correct operation for any local vehicle or machine regulations.

On stop/start short distance operation the hours run are more important than the distance.

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

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

Schedules

The schedules which follow must be done at the interval (kilometres, miles, hours or months) which occurs first.

Daily or every 8 Hours

Check amount of coolant.
Check amount of lubricating oil in the sump.
Check lubricating oil pressure (where a gauge is installed).
In extreme dust conditions, clean dust bowl of air filter (where fitted).

Every 7500 km (5,000 miles), 250 hours or 4 months

Renew the lubricating oil.
Renew the lubricating oil filter canister(s).
Clean the air cleaner, or empty the dust bowl of the air filter.
Inspect the drive belt.
Check for water in the fuel pre-filter (where fitted) and drain as necessary.
Clean the compressor air filter (if fitted).

Every 15000 km (10,000 miles), 500 hours or 12 months

Clean the lift pump gauze strainer.
Clean or renew the air filter element (if not indicated earlier).
Renew the element of the single bowl fuel filter.

Every 30000 km (20,000 miles), 1,000 hours

Renew the elements of the double bowl fuel filter.
Clean the turbocharger impeller and casing, and the lubricating oil drain pipe.

Every 90000 km (60,000 miles) 2,500 hours

Have the accessory equipment (starter motor, alternator, exhauster, etc.) checked.
Check and, if necessary, adjust the valve tip clearances.
Have the atomisers checked.
Renew the closed circuit breather element (naturally aspirated engines only).

Post delivery service

The service procedures given below must be done at the first 800/1600 km (500/1,000 miles), 25/50 hours of operation.

1. Run the engine until it is warm. Stop the engine and drain the lubricating oil from the sump. Fill the sump to the 'full' mark on the dipstick with clean new lubricating oil to an approved grade.
2. Renew the canister of the lubricating oil filter.
3. Adjust the valve tip clearances (see page 29).
4. Check the tension of the alternator/water pump drive belt.
5. Check that all fasteners are tight.
6. Run the engine and check for fuel, coolant and lubricating oil leakage.
7. If necessary, get a trained person to adjust the idle speed.

Air charge cooler – T6.3544

To ensure maximum efficiency the air charge cooler radiator must be checked to ensure nothing prevents the flow of air through the radiator. It is dangerous to stop the flow of air through any part of the radiator to raise the temperature in the driver's cab.

Air filter (dry)

Environment conditions have an important effect on the *frequency at which the air filter will need service.*

Some air filters have a separate dust bowl that has to be cleaned at intervals. The amount of dust in the bowl will *show if it has been removed at the correct time for the* conditions of operation. Do not let the bowl get full of dust as this will reduce the life of the filter element.

Some air filters have automatic dust valves through which dust is discharged from the filter. The rubber dust valve must be kept clean and checked to ensure that the sides of the valves close together, but will come apart freely.

Where a restriction indicator is installed, it will give a positive indication that the air filter element needs service. This will prevent the early removal of the filter element which causes extra cost or late element removal which can cause loss of engine power.

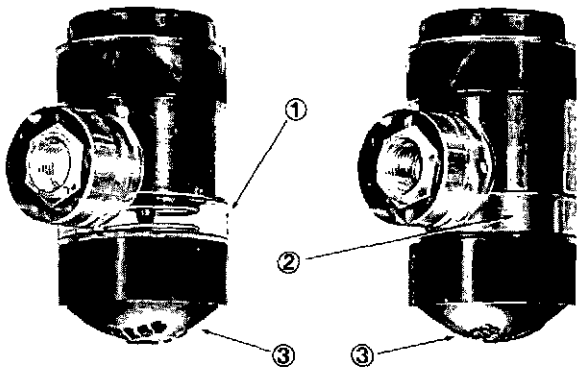
The filter element must be cleaned or renewed according to the manufacturer's recommendations.

Air cleaner (wet)

The wet type air cleaner must be drained at a suitable interval and the container and element cleaned with a suitable fluid or kerosene. Do not use gasolene. Fill with clean engine lubricating oil to the indicated level.

Restriction indicator

The restriction indicator for these engines must be the type that operates at a pressure difference of 558 mm (22 in) of water gauge. It is installed on the air filter outlet or between the air filter and the induction manifold.



1. Clear panel. 2. Red panel. 3. Rubber bottom.

Fig. 17 Restriction indicator

When the red warning indicator (see fig. 17, item 2) is seen through the clear panel (1) 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 (3) of the restriction indicator to reset the red warning indicator.

To renew the lubricating oil filter canister

1. Put a tray under the filter to hold any lubricating oil drops.
2. Remove the filter canister (see fig. 18) with a strap wrench or similar tool and discard the canister.
3. Clean the filter head.
4. Add clean engine lubricating oil to the new canister. Give the oil time to fill the canister through the filter element.
5. Lubricate the top of the canister seal with clean engine lubricating oil.
6. Install the new canister and tighten it by hand only. Do not use a strap wrench.
7. After lubricating oil has been added to the sump, run the engine and check for leakage from the filter.

Note: The canister has a valve inside to ensure that lubricating oil does not drain from the filter and a special tube is fitted, so ensure that the correct Perkins POWERPART canister is used.

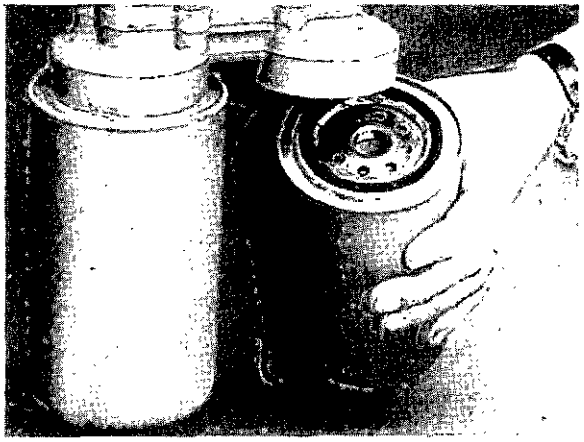


Fig. 18 Lubricating oil canister

To check the fan belt(s)

Renew the belt if it is worn or damaged.

With thumb pressure, press the fan belt down at the centre of the longest free length and check the movement (see fig. 19). The belt movement must be 10 mm ($^3/_8$ in).

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

To adjust the belt tension:

1. Loosen the dynamo/alternator mounting bolt(s) and the adjustment lever bolts.

2. Change the dynamo/alternator position to give the correct tension and tighten the dynamo/alternator and adjustment lever bolts.

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 800 km (500 miles) or 25 hours of operation.

Where two belts are fitted, they must be renewed together.

To check the valve tip clearances

These are checked between the top of the valve stem and the rocker lever (see fig. 20). The correct clearance for the inlet valves is 0,20 mm (0.008 in) and for the exhaust valves it is 0,45 mm (0.018 in).

No. 1 cylinder is at the front of the engine.

1. Turn the crankshaft in the normal direction of rotation, until the inlet valve of No. 6 cylinder has just opened and the exhaust valve of the same cylinder has not fully closed. Check the clearances of No. 1 *cylinder valves and adjust if necessary.*

2. With No. 2 cylinder valves set as given above for No. 6 cylinder, check/adjust clearances of No. 5 cylinder valves.

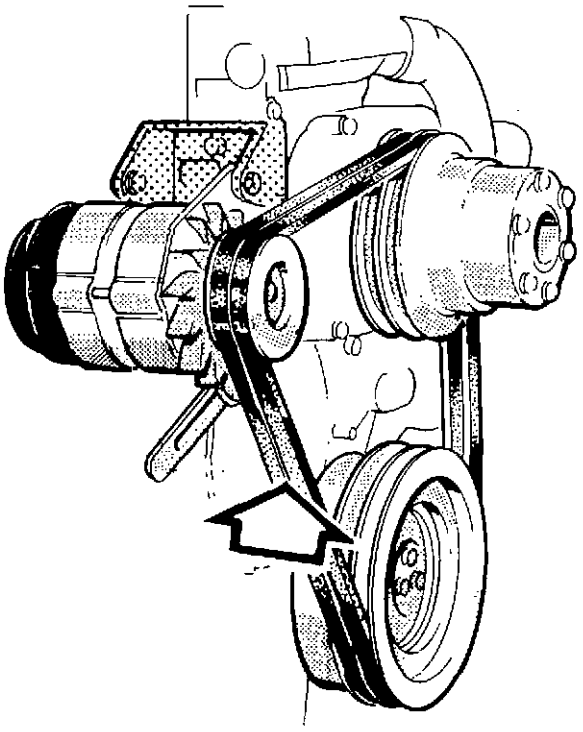


Fig. 19 To check fan belt tension

3. With No. 4 cylinder valves set, check/adjust clearances of No. 3 cylinder valves.

4. With No. 1 cylinder valves set, check/adjust clearances of No. 6 cylinder valves.

5. With No. 5 cylinder valves set, check/adjust clearances of No. 2 cylinder valves.

6. With No. 3 cylinder valves set, check/adjust clearances of No. 4 cylinder valves.

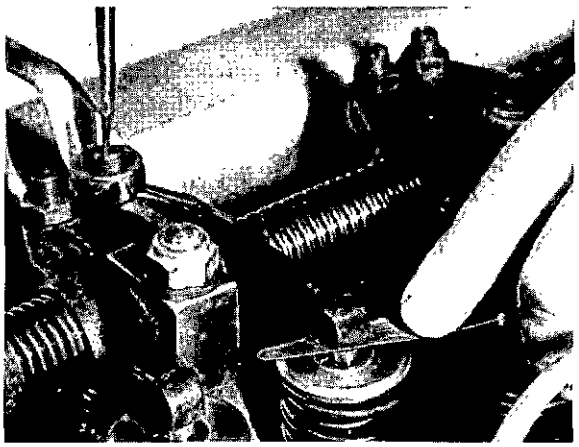


Fig. 20 To check valve tip clearance

To renew a fuel filter element

1. Clean the outside of the fuel filter element.
2. Loosen the setscrew in the centre of the each filter.
3. Lower the filter bottom cover (see fig. 21).

Fig. 21 To renew a fuel filter element

4. Remove the element and discard.

5. Before you put the new element in position, clean the top and bottom filter covers.

6. If the joints are not in good condition, renew them.

7. Put the base on the bottom of the new element and assemble it squarely to the filter head so that the element fits in the centre against the joint in the filter head.

8. Hold in this position and fit the setscrew in the centre of the filter head.

9. Eliminate air from the fuel system, (see below).

To eliminate the 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 fuel system if:

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

Note: When the drive cam for the fuel lift pump is at the point of maximum lift, it will not be possible to operate the priming lever. If this occurs, the crankshaft must be turned through one revolution.

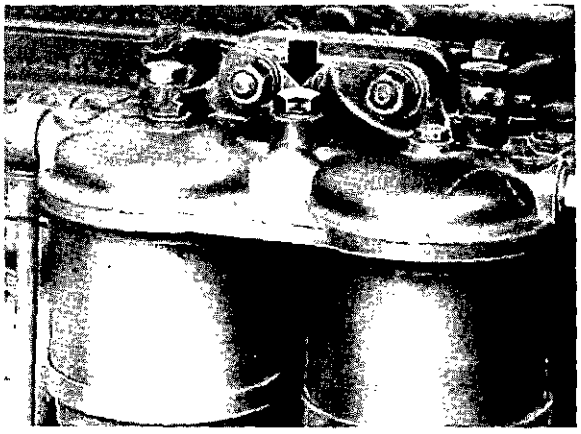


Fig. 22 Fuel filter vent screw

Fuel system with CAV fuel injection pump

Eliminate air from the fuel system as follows:

1. Loosen the vent screw, if fitted, on the top of the fuel filter(s) (see fig. 22). If a single element filter is used, loosen the banjo connection bolt which is fitted on the top of the filter.

2. Operate the priming lever on the fuel lift pump (see fig. 24) until fuel, free of air, comes from the filter vent point. Tighten the vent screw or the banjo connection bolt.

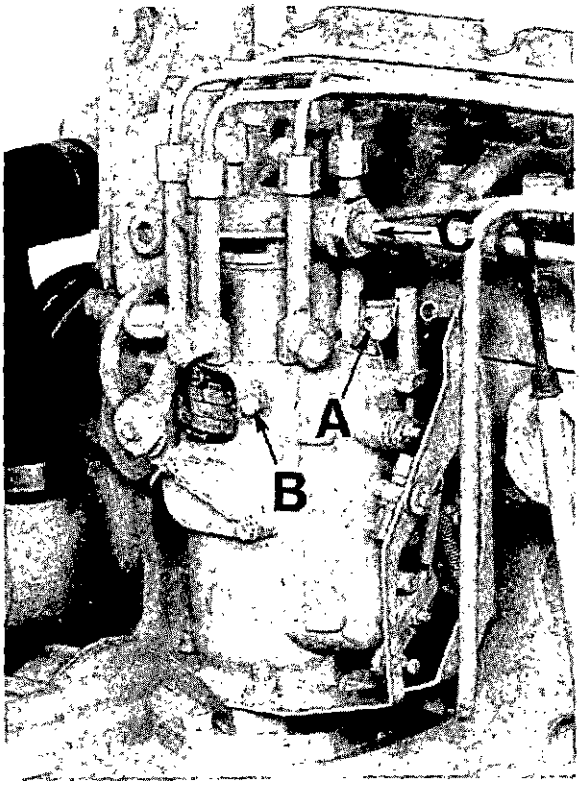


Fig. 23 CAV fuel injection pump vent screws

3. Loosen the union nut 'C' at the inlet pipe of the fuel injection pump (see fig. 23) and operate the priming lever until fuel, free of air, comes from around the nut. Tighten the union nut 'C'.

4. Ensure that the stop control is in the run position. If an electrical stop control is used, turn the key of the start switch to the 'R' position.

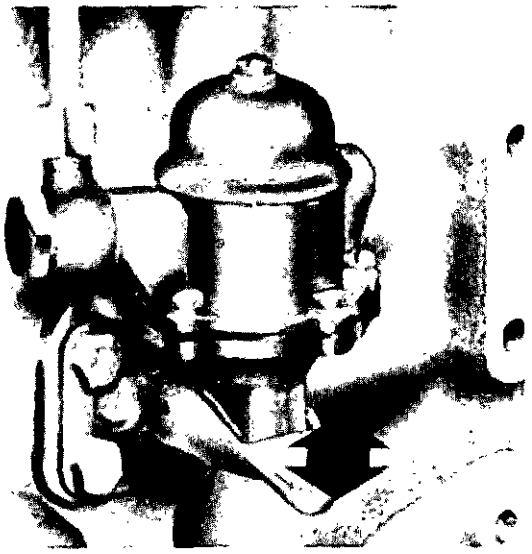


Fig. 24 Fuel lift pump

5. Loosen the vent screws on the fuel injection pump at 'A' and 'B' (see fig. 23). Operate the priming lever of the fuel lift pump (see fig. 24) until fuel, free of air, comes from vent screw 'B'. Tighten the vent screw. Continue to operate the priming lever until fuel, free of air, comes from vent screw 'A'. Tighten the vent screw.
6. If the fuel pipe to the Thermostart cold start aid has been drained, loosen the union nut at the cold start aid and operate the priming lever until fuel, free of air, comes from the connection. Tighten the union nut at the cold start aid.
7. Loosen the high pressure pipe connections at two of the atomisers. Operate the starter motor until fuel, free of air, comes from the pipe connections. Tighten the high pressure pipe connections.
8. 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.

Fuel system with Bosch fuel injection pump

Eliminate air from the fuel system as follows:

1. Loosen the vent screw, if fitted, on the top of the fuel filter(s) (see fig. 22). If a single element filter is used, loosen the banjo connection bolt which is fitted on the top of the filter.

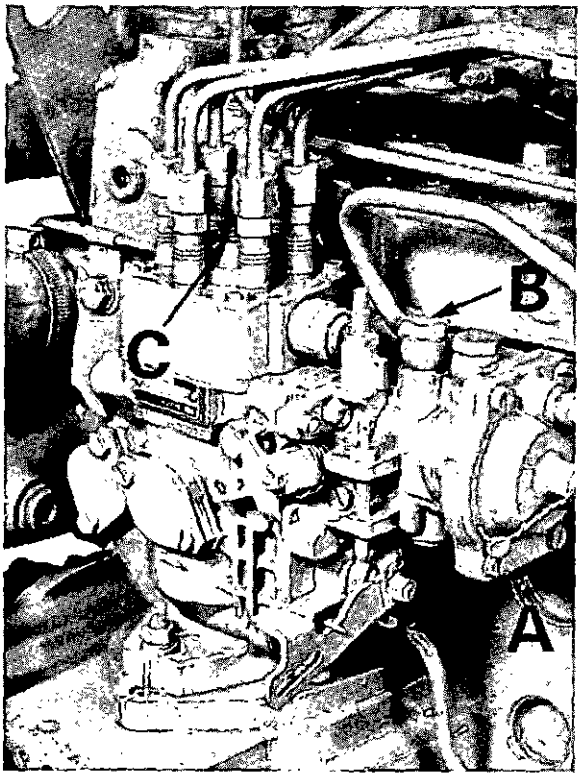


Fig. 25 Bosch fuel injection pump vent screws

2. Operate the priming lever on the fuel lift pump (see fig. 24) until fuel, free of air, comes from the filter vent point. Tighten the vent screw or the banjo connection bolt.
3. Loosen the inlet connection 'A' and the outlet connection 'B' (see fig. 25) of the fuel injection pump. Operate the priming lever of the fuel lift pump (see fig. 24) until fuel, free of air, comes from connection 'A'. Tighten the connection. Continue to operate the priming lever until fuel, free of air, comes from the connection 'B'. Tighten the connection.
4. Ensure that the stop control is in the run position. If an electrical stop control is used, turn the key of the start switch to the 'R' position.
5. Clean the top of the fuel injection pump around the centre plug 'C' (see fig. 25) a *maximum* of half a turn. Operate the priming lever on the fuel lift pump (see fig. 24) until fuel, free of air, comes from around the plug. Tighten the plug.
6. If the fuel pipe to the Thermostart cold start aid has been drained, loosen the union nut at the cold start aid and operate the priming lever until fuel, free of air, comes from the connection. Tighten the union nut at the cold start aid.
7. Loosen the high pressure pipe connections at two of the atomisers. Operate the starter motor until fuel, free of air, comes from the pipe connections. Tighten the high pressure pipe connections.
8. 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.

Atomiser fault

An atomiser fault can be shown by an engine misfire.

To find which atomiser is at fault, run the engine at a fast idle speed and loosen and tighten the high pressure fuel pipe union at each atomiser. When the union nut of the atomiser at fault is loosened, it will have little or no effect on the engine speed. Do not let the fuel spray on to your skin.

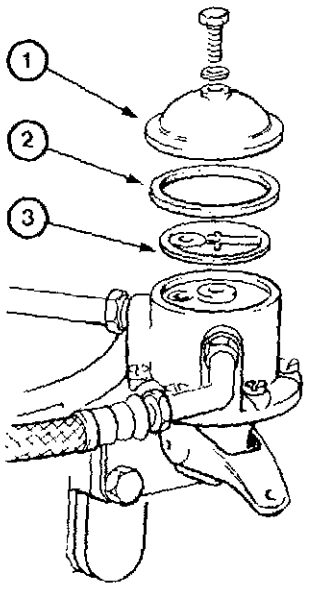
To renew an atomiser

1. Remove the fuel leak off pipe.
2. Remove the high pressure pipe union nuts from the atomiser and fuel injection pump and release the pipe.
3. Remove the atomiser flange nuts/setscrews and remove the atomiser and seat washer.
4. Put the new atomiser with the spacer, new dust seal and new seat washer in position. The rigid spacer must always be fitted above the rubber dust seal.
   Seat washers for naturally aspirated engines are 2,03 mm (0.080 in) thick and for turbocharged engines they are 0,71 mm (0.028 in) thick. Ensure the atomiser is not tilted and tighten the flange nuts/setscrews evenly by small amounts to 16 Nm (12 lbf ft) 1,7 kgf m.

5. Fit the high pressure fuel pipe and tighten the nut to 20 Nm (15 lbf ft) 2,1 kgf m.
6. Fit the leak off pipe.
7. Run the engine and check for fuel and air leakage.

To clean the gauze strainer in the lift pump

1. Remove the cover and joint (see fig. 26) from the top of the fuel lift pump and remove the gauze strainer.
2. Carefully wash any sediment from the lift pump.
3. Clean the gauze strainer, joint and cover.
4. Assemble the lift pump. Ensure that a good joint is made between the lift pump body and the cover because any leakage here will let air into the fuel system.
5. Loosen the vent screw on top of the fuel filter. If a single element filter is used, loosen the banjo connection bolt. Operate the priming lever of the fuel lift pump until fuel, free of air, comes from the vent point. Tighten the vent screw or the banjo connection bolt.



1. Cover. 2. Joint. 3. Gauze filter.

Fig. 26 Fuel lift pump

Closed circuit breather vent valve

This is fitted between the cylinder head cover and induction manifold on naturally aspirated engines only.

To clean, seal the small breather hole in the top face and wash the unit in gasolene or kerosene. If air pressure is used to dry the unit, you must only use low pressure, because high pressure will damage the unit.

Protection of an engine not in service

The recommendations given below are to ensure that damage is prevented when an engine is removed from service for an extended period. Use these procedures immediately the engine is removed from service. The instructions for the use of POWERPART products are given on the outside of each container.

1. Thoroughly clean the outside of the engine.

2. Where a preservative fuel is to be used, drain the fuel system and fill 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 charged with normal fuel but this will have to be drained and discarded at the end of the storage period together with the fuel filter.

3. Run the engine until it is warm. Correct any fuel, lubricating oil or air leakage. Stop the engine and drain the lubricating oil sump.

4. Renew the lubricating oil filter canister.

5. Fill the sump to the full mark on the dipstick with clean new lubricating oil or with a correct preservative fluid. POWERPART Lay-Up 2 can be added to the lubricating oil to give protection against corrosion during the period in storage. If a preservative fluid is used, this must be drained and normal lubricating oil used when the engine is returned to service.

6. Drain the cooling system, see page 22. To give protection against corrosion, it is better to fill the cooling system with a coolant that has a corrosion inhibitor, see 'Engine coolant' on page 21. If frost protection is needed, use an antifreeze mixture. If no frost protection is needed, use water with an approved corrosion inhibitor mixture.

7. Run the engine for a short period to send the lubricating oil and coolant around the engine.

8. Clean out the engine breather pipe where fitted and seal the end of the pipe.

9. Remove the atomisers and spray POWERPART Lay-Up 2 into each cylinder bore. If this is not available, clean engine lubricating oil will give a degree of protection. Spray into the cylinder bores 140 ml (1/4 pint) of lubricating oil divided evenly between the six cylinders.

10. Slowly turn the crankshaft one revolution and then install the atomisers complete with new seat washers and new dust seals.

11. Remove the air filter and any pipe installed between the air filter and induction manifold. Spray POWERPART Lay-Up 2 into the induction manifold. Seal the manifold with waterproof tape.

12. Remove the exhaust pipe. Spray POWERPART Lay-

Up 2 into the exhaust manifold. Seal the manifold with waterproof tape.

13. Remove the lubricating oil filler cap. Spray POWERPART Lay-Up 2 around the rocker shaft assembly. Fit the filler cap.

14. Disconnect the battery and put it into safe storage in a fully charged condition. Before the battery is put into storage, give the battery terminals a protection against corrosion. POWERPART Lay-Up 3 can be used on the terminals.

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

16. Remove the fan belt and put it into storage.

17. To prevent corrosion, spray the engine with POWERPART Lay-Up 3. Do not spray inside the alternator cooling fan area.

Note: Before the engine is started after a period in storage, operate the starter motor with the engine stop control in the 'off' position until oil pressure shows on the oil pressure gauge or the oil warning light goes out. If a solenoid stop control is used, this will have to be disconnected for this operation.

If the engine protection is done correctly according to the above recommendations, no corrosion damage will normally occur. Perkins Engines Ltd. are not responsible for any damage that occurs in relation to a service storage period.

Fault diagnosis

Problem	Possible causes
Starter motor turns engine too slowly	1, 2, 3, 4
Will not start	5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 31, 32, 33
Difficult to start	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 24, 29, 31, 32, 33
Not enough power	8, 9, 10, 11, 12, 13, 14, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 31, 32, 33, 61, 63, 64
Misfire	8, 9, 10, 12, 13, 14, 16, 18, 19, 20, 25, 26, 28, 29, 30, 32
High fuel consumption	11, 13, 14, 16, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29, 31, 32, 33, 64
Black exhaust	11, 13, 14, 16, 18, 19, 20, 22, 24, 25, 27, 28, 29, 31, 32, 33, 61, 64
Blue/white exhaust	4, 16, 18, 19, 20, 25, 27, 31, 33, 34, 35, 45, 56, 62
Low lubricating oil pressure	4, 36, 37, 38, 39, 40, 42, 43, 44, 58
Engine knocks	9, 14, 16, 18, 19, 22, 26, 28, 29, 31, 33, 35, 36, 45, 46, 59
Runs erratically	7, 8, 9, 10, 11, 12, 13, 14, 16, 20, 21, 23, 26, 28, 29, 30, 33, 35, 45, 59
Vibration	13, 14, 20, 23, 25, 26, 29, 30, 33, 45, 47, 48, 49
High lubricating oil pressure	4, 38, 41
Engine temperature too high	11, 13, 14, 16, 18, 19, 24, 25, 45, 47, 50, 51, 52, 53, 54, 57
Crankcase pressure	25, 31, 33, 34, 45, 55, 60
Bad compression	11, 19, 25, 28, 29, 31, 32, 33, 34, 46, 59
Starts and stops	10, 11, 12

Code list of possible causes

1. Battery capacity low.
2. Bad electrical connections.
3. Fault in starter motor.
4. Wrong grade of lubricating oil.
5. Low engine speed from starter motor.
6. Fuel tank empty.
7. Stop control fault.
8. Restriction in fuel pipe.
9. Fault in fuel lift pump.
10. Dirty fuel filter element.
11. Restriction in air filter or induction system.
12. Air in fuel system.
13. Fault in fuel injection pump.
14. Fault in atomisers or not correct type.
15. Cold start equipment not used correctly.
16. Fault in cold start equipment.
17. Broken fuel injection pump drive.
18. Fuel injection pump timing not correct.
19. Valve timing not correct.
20. Bad compression.
21. Restriction in fuel tank vent.
22. Type or grade of fuel not correct.
23. Restriction of engine speed control movement.
24. Restriction in exhaust pipe.
25. Cylinder head gasket leaks.
26. Engine temperature too high.
27. Engine temperature too low.
28. Valve tip clearances not correct.
29. Valves not free.
30. Wrong high pressure pipes.
31. Worn cylinder bores.
32. Valves and seats do not seal correctly.
33. Piston rings not free or are worn or broken.
34. Valve stems and/or guides worn.
35. Wet type air cleaner too full or wrong oil used.
36. Crankshaft bearings worn or damaged.
37. Not enough lubricating oil in the sump.
38. Gauge not correct.
39. Lubricating oil pump worn.
40. Relief valve not free to close.
41. Relief valve not free to open.
42. Relief valve spring broken.
43. Fault in suction pipe of lubricating oil pump.
44. Dirty lubricating oil filter element.
45. Piston damaged.
46. Piston height not correct.
47. Fan damaged.
48. Fault in engine mounting (housing).
49. Flywheel housing or flywheel not aligned correctly.
50. Fault in thermostat or wrong type.
51. Restriction in coolant passages.
52. Water pump drive belt loose.
53. Restriction in radiator.
54. Fault in water pump.
55. Restriction in breather pipe.
56. Damaged valve stem oil seals (where used).
57. Not enough coolant in system.
58. Restriction in sump strainer.
59. Valve spring broken.
60. Fault in exhauster or vacuum pipe leakage.
61. Turbocharger impeller damage, or dirty impeller.
62. Turbocharger lubricating oil seal leaks.
63. Turbocharger boost control pipe leaks.
64. Induction system leaks (turbocharged engines).

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 page 21.

POWERPART De-Icer

Removes frost.

POWERPART Easy Flush

Cleans the cooling system.

POWERPART Easy Seal

Stops leakages from the cooling system.

POWERPART Foam Action Gasket Remover

Allows easy and rapid removal of old gaskets and joints.

POWERPART Hylomar

Universal jointing compound which seals joints.

POWERPART Hylosil

Silicone rubber sealant which prevents leakage through gaps.

POWERPART Inhibitor

Protects cooling system against corrosion when antifreeze is not used.

POWERPART Lay-Up 1

A diesel fuel additive for protection against corrosion. See page 36.

POWERPART Lay-Up 2

Protects the inside of the engine and of other closed systems. See page 36.

POWERPART Lay-Up 3

Protects outside metal parts. See page 37.

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.

Examples of service assistance

Service

If any problems occur with your engine or the components fitted to 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 some repairs.

Extended warranty

The engine warranty period can be extended to two years. For details get in contact with your nearest Perkins distributor.

Service literature

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

Training

Local training on correct engine operation, overhaul and service is available at some Perkins distributors. If special training is needed, your Perkins distributor can give details of how to get this at the Product Education Department, Peterborough, or other main centres.

Parts illustrations

The illustrations which follow are a guide for your assistance in the purchase of Perkins service parts. A list of the reference numbers and parts descriptions is given on pages 54 and 55.

There can be differences in the shape of similar components in different engine applications.

Many years of experience and development has ensured that Perkins parts are of the highest quality and standard. Use correct Perkins parts which are available from all Perkins distributors in the world.

To ensure you get the correct parts when you order, give the complete engine number, the machine or vehicle description, name and serial number.

Note: Perkins Engines Ltd. can not supply an operator direct. To purchase the correct Perkins parts, give an order to your Perkins distributor.

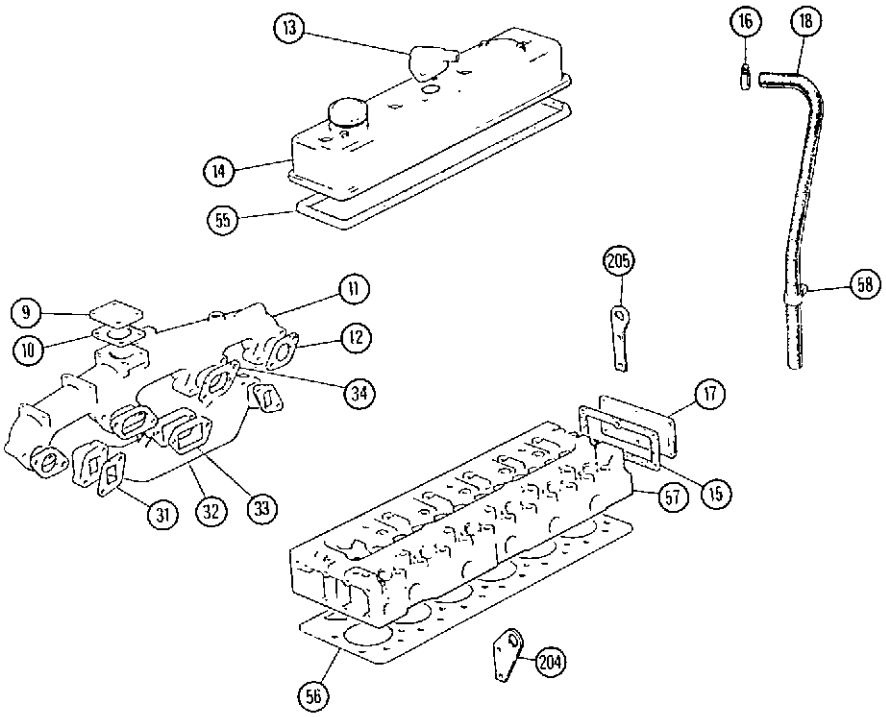


Fig. 27 Cylinder head arrangement

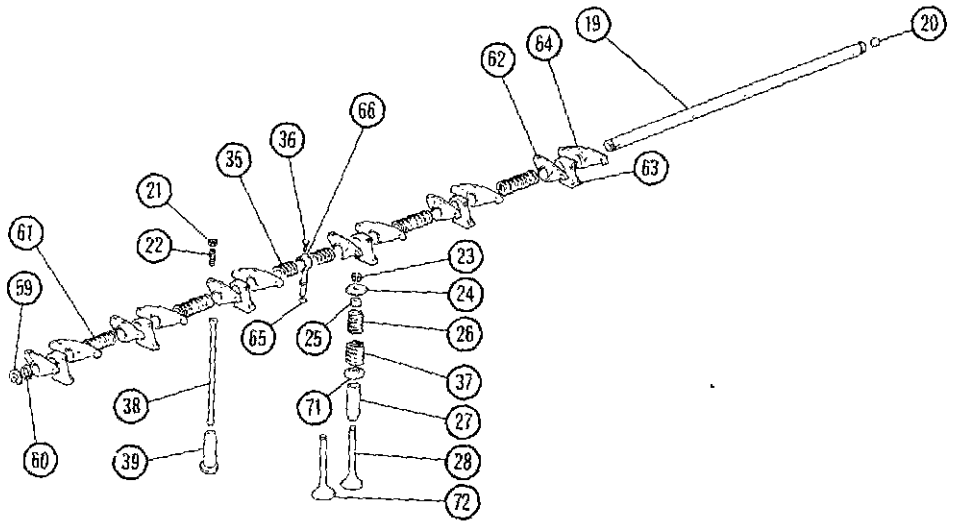


Fig. 28 Valves and rocker assembly

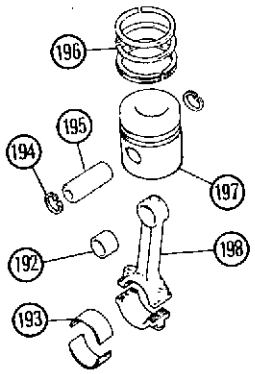


Fig. 29 Piston and connecting rod

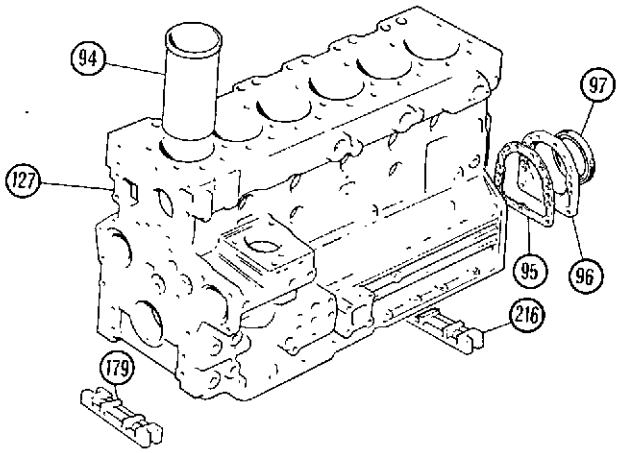


Fig. 30 Cylinder block assembly

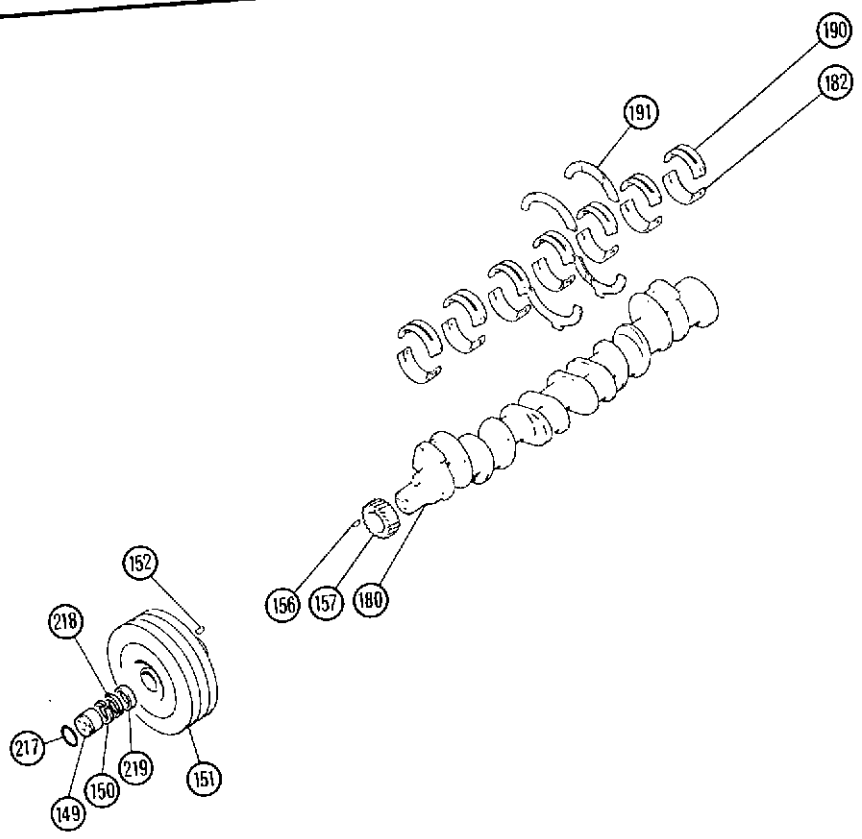


Fig. 31 Crankshaft assembly and pulley

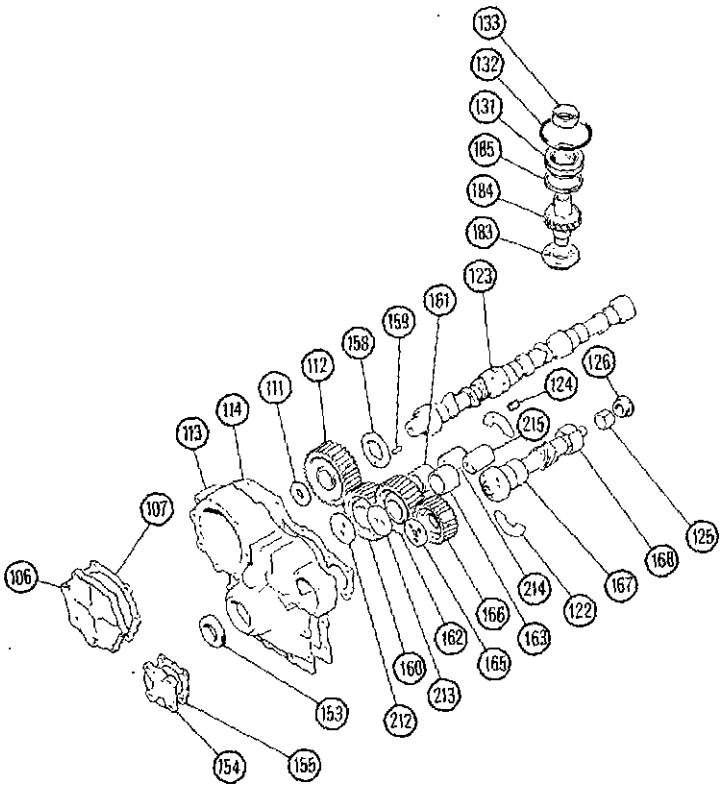


Fig. 32 Timing case and drive arrangement

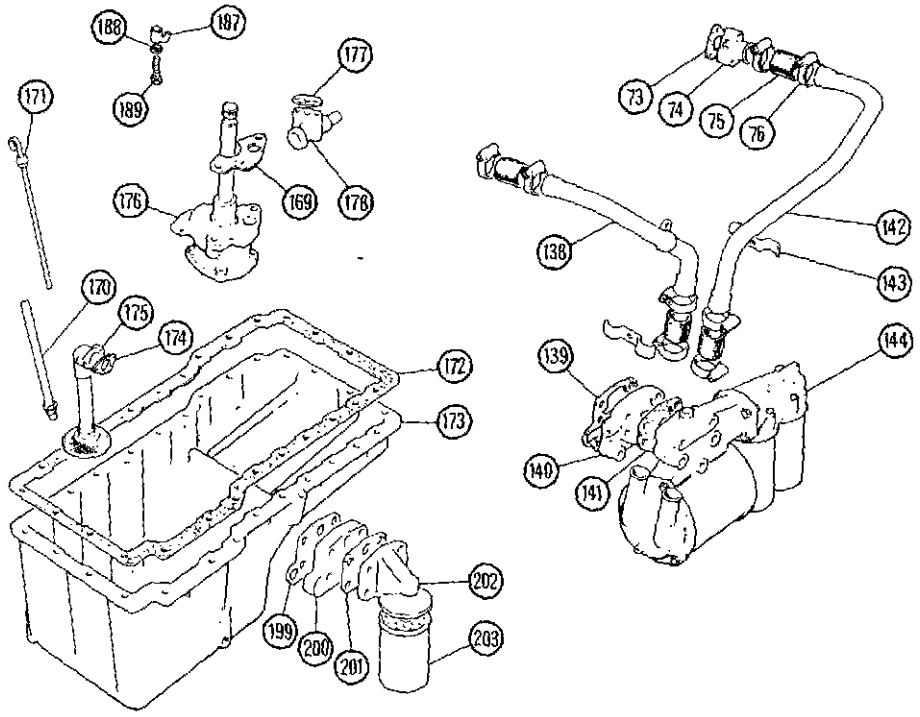


Fig. 33 Lubrication system components

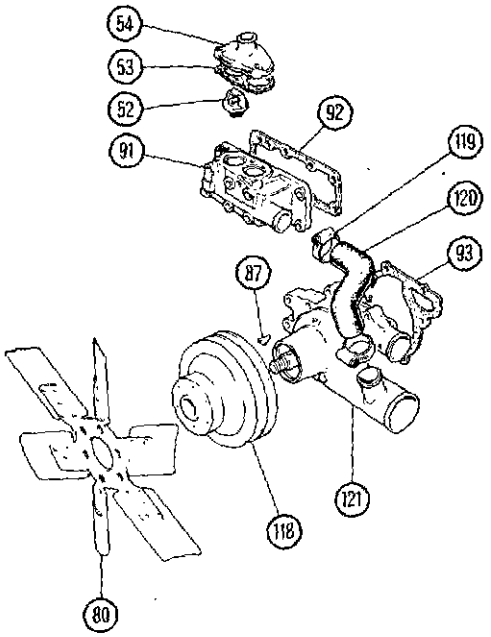


Fig. 34 Cooling system components

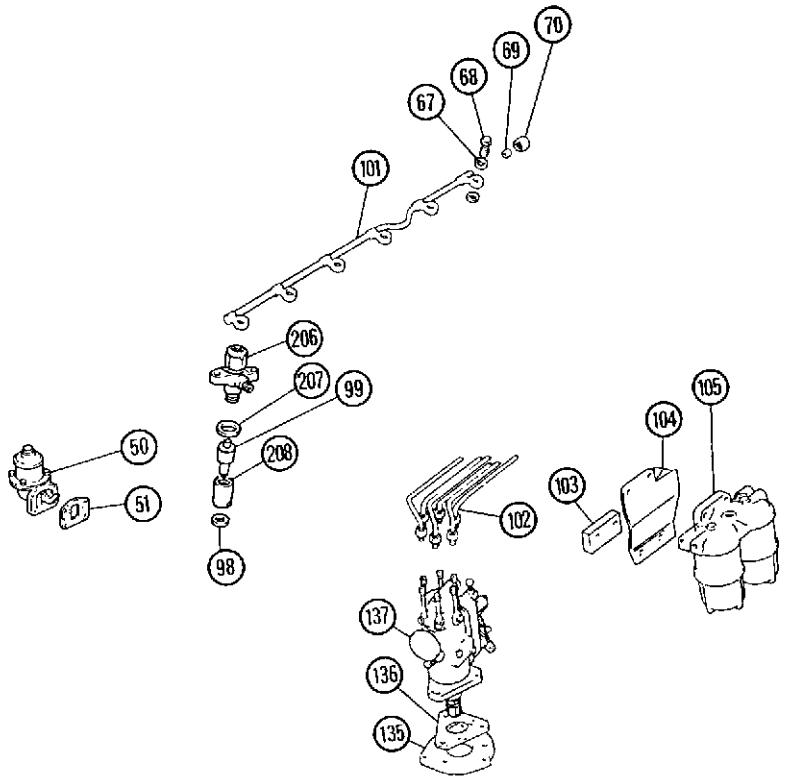


Fig. 35 Fuel system components

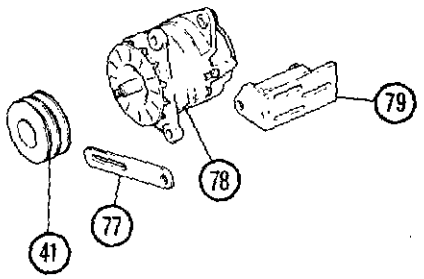


Fig. 36 Alternator and brackets

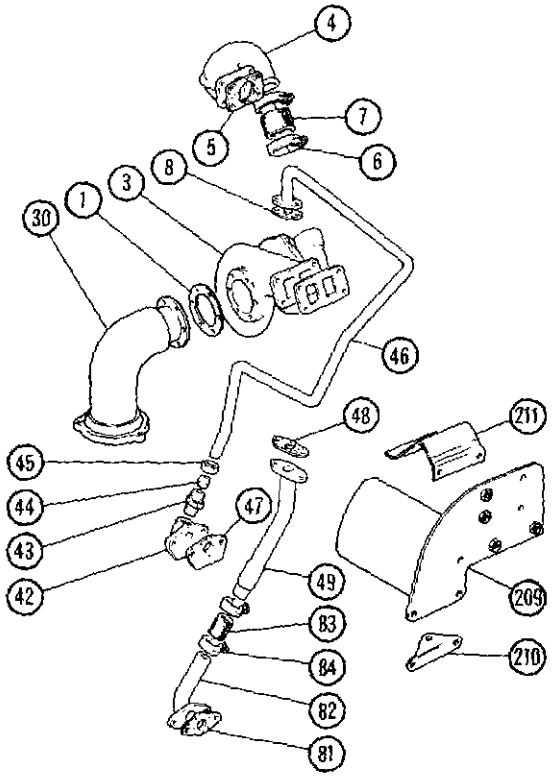


Fig. 37 Turbocharger system

Part descriptions

To be used with the illustrations given on pages 43 to 53.

1. Joint
3. Turbocharger
4. Elbow
5. Joint
6. Clip
7. Hose
8. Joint
9. Plate
10. Joint
11. Induction manifold
12. Joint
13. Breather flange
14. Rocker cover
15. Joint
16. Clip
17. Plate
18. Breather pipe
19. Rocker shaft
20. Plug
21. Lock nut
22. Adjustment screw
23. Collet
24. Valve spring cap
25. Seal
26. Valve spring (inner)
27. Valve guide
28. Valve (exhaust)
30. Elbow
31. Joint
32. Exhaust manifold
33. Joint
34. Joint
35. Spring
36. Screw
37. Valve spring (outer)
38. Push rod
39. Tappet
41. Pulley
42. Flange
43. Union
44. Olive
45. Nut
46. Pipe
47. Joint
48. Joint
49. Pipe and flange
50. Fuel lift pump
51. Joint
52. Thermostat
53. Joint
54. Outlet connection
55. Joint
56. Gasket
57. Cylinder head
58. Clip
59. Circlip
60. Washer
61. Spring
62. Rocker lever
63. Bracket
64. Rocker lever
65. 'O' ring
66. Banjo connection and pipe
67. Washer
68. Banjo bolt
69. Olive
70. Nut
71. Spring seat
72. Valve (inlet)
73. Joint
74. Flange
75. Hose
76. Clip
77. Adjustment link
78. Alternator
79. Bracket
80. Fan
81. Joint
82. Elbow
83. Hose
84. Clip
87. Key
91. Thermostat housing
92. Joint
93. Joint
94. Cylinder liner
95. Joint
96. Seal housing
97. Seal
98. Seat washer
99. Nozzle assembly
101. Leak-off pipe
102. Fuel pipes
103. Spacer
104. Bracket
105. Fuel filter
106. Cover
107. Joint
111. Washer
112. Camshaft gear
113. Timing case
114. Joint
118. Pulley
119. Clip
120. Hose
121. Water pump
122. Thrust washer
123. Camshaft
124. Dowel
125. Bush
126. Seal
127. Cylinder block
131. Thrust collar (upper)
132. 'O' ring
133. Bush
135. Adaptor plate
136. Joint
137. Fuel injection pump
138. Pipe
139. Joint
140. Adaptor
141. Joint
142. Pipe
143. Clip
144. Filter/cooler assembly
149. Thrust block
150. Tapered ring (outer)
151. Pulley
152. Key
153. Seal
154. Cover
155. Joint
156. Key
157. Crankshaft gear
158. Thrust plate
159. Dowel
160. Idler gear
161. Bush
162. Idler gear
163. Bush
165. Plate
166. Fuel injection pump gear
167. Shaft
168. Bush

170. Tube
171. Dipstick
172. Joint
173. Sump
174. Joint
175. Strainer assembly
176. Lubricating oil pump
177. Joint
178. Relief valve
179. Bridge piece
180. Crankshaft
182. Bearing (lower)
183. Thrust collar (lower)
184. Shaft
185. Ring
187. Piston cooling jet
188. Washer
189. Setscrew (union)
190. Bearing (upper)
191. Thrust washers
192. Bush
193. Big end bearings
194. Circlip
195. Gudgeon pin
196. Piston rings
197. Piston
198. Connecting rod
199. Joint
200. Adaptor
201. Joint
202. Filter head
203. Filter canister
204. Lift bracket
205. Lift bracket
206. Atomiser body
207. Sealing washer
208. Nozzle cap nut
209. Heat shield
210. Bracket
211. Heat shield
212. Plate
213. Plate
214. Hub
215. Hub
216. Bridge piece
217. 'O' ring
218. Tapered ring (inner)
219. Spacer

Latest information

Introduction

The purpose of this page is to enable important information to be added to this handbook after publication.

Perkins
USERS HANDBOOK

All information in this handbook is substantially correct at the time of printing but may be altered subsequently by the Company.

Perkins
Engines

Perkins Engines Limited
Peterborough PE1 5NA England
Printed in England by Peterborough Central Printers Ltd.