
Perkins 400 Series

Models HH, HL, HP and HR

USER'S HANDBOOK

3 and 4 cylinder naturally aspirated diesel engines for industrial, construction and agricultural applications

4 cylinder turbo charged diesel engines for industrial, construction and agricultural applications

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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.

- 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 clean, add lubricating oil, put fuel in the tank or adjust the engine while it runs.
- Do not make adjustments that you do not understand.
- Ensure that the engine does not run in a location where it can cause a concentration of toxic emissions.
- Other persons must be kept at a safe distance while the engine or auxiliary equipment is in operation.
- Do not permit loose clothing or long hair near moving parts.
- Keep away from moving parts during engine operation.

Warning! *Some moving parts cannot be seen clearly while the engine runs.*

- Do not operate the engine if a safety guard has been removed.
- Do not remove the filler cap or any component of the cooling system while the engine is hot and while the coolant is under pressure, because dangerous hot coolant can be discharged.
- Do not allow sparks or fire near the batteries (especially when the batteries are on charge) because the gases from the electrolyte are highly flammable. The battery fluid is dangerous to the skin and especially to the eyes.
- Disconnect the battery terminals before a repair is made to the electrical system.
- Only one person must control the engine.
- Ensure that the engine is operated only from the control panel or from the operators position.
- If your skin comes into contact with high-pressure fuel, obtain medical assistance immediately.
- Diesel fuel and lubricating oil (especially used lubricating oil) can damage the skin of certain persons. Protect your hands with gloves or a special solution to protect the skin.
- Do not wear clothing which, is contaminated by lubricating oil. Do not put material, which is contaminated with oil into the pockets of clothing.
- Discard used lubricating oil in accordance with local regulations to prevent contamination.
- The combustible material of some components of the engine (for example some 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.
- 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.
- Do not allow compressed air to contact your skin. If compressed air enters your skin, obtain medical help immediately.

Caution: *Do not clean an engine while it runs. If cold cleaning fluids are applied to a hot engine, certain components on the engine may be damaged.*

- Fit only genuine Perkins parts.

General data

Read this section carefully before the engine is started

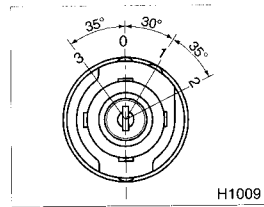
To start the engine

Caution: *Ether starting fluids must not be used with these engines.*

- 1 Move the engine speed control to the maximum speed position.
- 2 Turn the start key counter clockwise to position "3" and hold it there for 6 seconds until the red lamp is illuminated.
- 3 When the red lamp is illuminated, turn the key clockwise to position "2" to engage the starter motor for 20 seconds maximum.
- 4 When the engine starts, release the key, which will return to position "1".
- 5 Set the engine speed control to give an even idle speed.

Note: If the red lamp illuminates rapidly for 2 to 3 seconds, or does not illuminate in 6 seconds, this indicates a fault within the cold start system.

- 6 Turn the start key counter clockwise to position (0) to stop the engine.



To eliminate air from the fuel system

- 1 Loosen the vent screw on the fuel filter.
- 2 Operate the hand primer until fuel, free of air, flows from the vent screw. Tighten the vent screw.
- 3 Loosen the vent screw on the fuel injection pump. Operate the hand primer until fuel, free of air, flows. Tighten the vent screw.
- 4 Attempt to Start the engine using the starter motor for a maximum of 15 seconds, wait for 30 seconds before trying again.

Caution: *When using the starter motor, do not exceed continuous rotation of more than 15 seconds periods. If the engine does not run, on initial rotation, wait for 30 seconds and try again.*

Antifreeze

The coolant must consist of equal quantities of anti freeze and soft water. The corrosion inhibitor in the antifreeze will be diluted if a concentration of less than 50% is used. Concentrations of more than 50% of antifreeze may have an adverse effect on the cooling properties of the coolant.

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. The specification must be at least as good as those specified in "Engine data" on page 5.

Caution: *Do not use salt water or any other coolant that can cause corrosion in the closed cooling circuit.*

Altitude

The engine will run correctly up to an altitude of 600 m (2000 ft). If the engine is to be operated permanently at an altitude above this, the fuel consumption and exhaust emissions may become excessive. Contact the Perkins Application Department.

Turbo charged engines

Because of the power characteristics of the turbo charged engine it is necessary to maintain a high engine speed when climbing a gradient. To ensure that the engine is not overloaded at low engine speeds select a lower gear

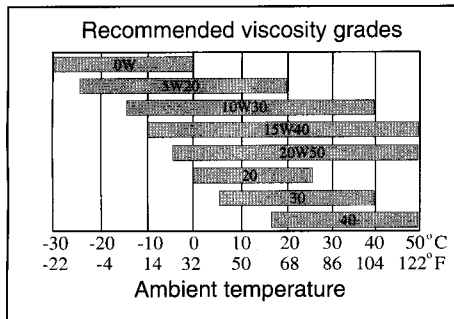
Adjustment of the engine speed

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

Adjustment of the engine maximum speed setting can only be made by a Perkins approved representative to within the limits specified on the emissions compliance label. In these cases a red coloured tamper evident cap will be fitted after adjustment.

Engine data

Engine type	403C-11	403C-15	404C-22	404C-22T
Engine code	HH	HL	HP	HR
Number of cylinders	3	3	4	4
Cylinder arrangement	In-line			
Cycle	Four stroke			
Induction system	Naturally aspirated			Turbo charged
Combustion system	Indirect injection			
Cubic capacity	1,131 litres (69 in ³)	1,496 litres (91 in ³)	2,216 litres (135 in ³)	2,216 litres (135 in ³)
Bore	77 mm (3.0 in)	84 mm (3.3 in)	84 mm (3.3 in)	84 mm (3.3 in)
Stroke	81 mm (3.1 in)	90 mm (3.5 in)	100 mm (3.9 in)	100 mm (3.9 in)
Capacity of the lubricating oil sump and filter				
Maximum	4,9 litres (8.6 pints)	6,0 litres (10.5 pints)	10,6 litres (18.6 pints)	10,6 litres (18.6 pints)
Minimum	3,4 litres (5.9 pints)	4,5 litres (7.9 pints)	8,9 litres (15.6 pints)	8,9 litres (15.6 pints)
Lubricating oil specification	Use only good quality oil that meets, either of the following API CH4 or ACEA E5			
Coolant system capacity engine only	1,9 litres	2,6 litres	3,6 litres	3,6 litres
Coolant specification	Clean soft water with 50% anti freeze concentration ethanediol base / ethylene glycol, corrosion inhibitor to BS 6580 : 1992 or ASTM D 3306-89 or AS 2108-1977			
Diesel fuel specification	See page 6			
Direction of rotation	Clockwise from the front			
Compression ratio	23 : 1	22.5 : 1	23.3 : 1	23.3 : 1
Valve clearances cold intake/exhaust	0,2 mm (0.0078 in)			



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 above chart.

Fuel specification

To get the correct power and performance from the engine, use good quality fuel. The recommended fuel specification for Perkins engines is shown below:

Cetane number:	45 minimum
Viscosity:	2.0 / 4.5 centistokes at 40 °C (104 °F)
Density:	0,835 / 0,855 kg/litre
Sulphur:	0.2% of mass, maximum
Distillation:	85% at 350 °C (662 °F)

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 limits, engine performance can be affected.

Density: low 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 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 (32 °F). These fuels limit the formation of wax in the fuel oil at low temperatures. If wax forms in the fuel oil, this could stop the flow of fuel oil through the filter.

Aviation kerosene and R.M.E. type fuels

These fuels may be used, but can effect the engine performance and ability to start. The only aviation fuels that are permitted for use with these engines are: JP5, JP8 and JET-A if 5% spindle oil is added. Aviation fuel JP4 is not recommended. For more information on aviation fuels refer to the Perkins Application Department.

Not more than 5% R.M.E. in mineral oil diesel fuel is allowed.

Running in

Do not operate a new engine at overload or rapid speed changes. Prolonged operation at light loads at low speed can cause lubricating oil to enter the exhaust system. Do not operate the engine at overload or rapid load change without allowing the engine to warm up, the coolant temperature should have reached a minimum of 60 °C (140 °F).

CALIFORNIA Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects and other reproductive harm.

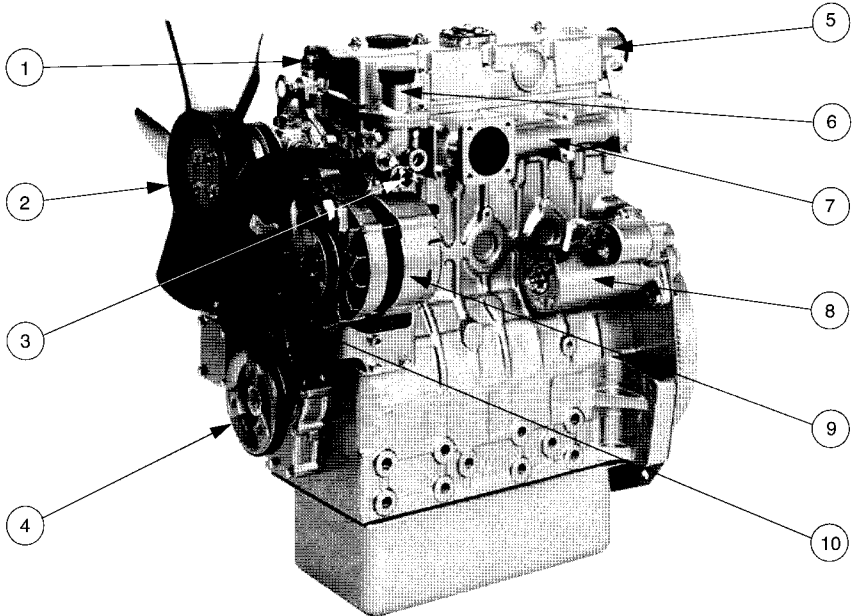
Location of engine parts

Introduction

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

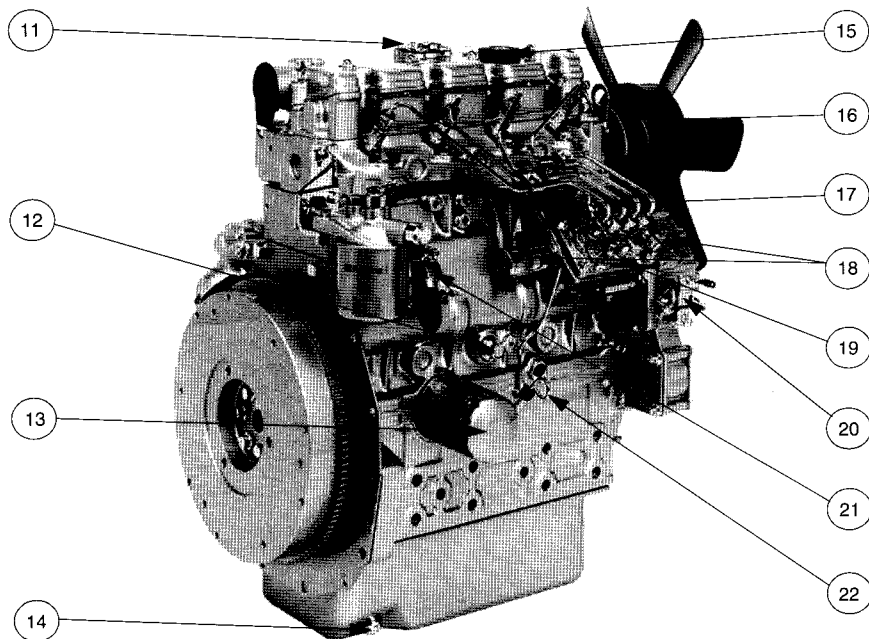
Left side

- 1 Lubricating oil pressure switch option L0101 or L0103
- 2 Fan
- 3 Coolant temperature switch
- 4 Crankshaft pulley
- 5 Induction manifold
- 6 Coolant outlet
- 7 Exhaust manifold
- 8 Starter motor
- 9 Alternator
- 10 Drive belt



Right side

- 11 Engine breather
- 12 Coolant drain plug
- 13 Lubricating oil filter
- 14 Lubricating oil drain plug
- 15 Lubricating oil filler cap
- 16 Atomiser
- 17 Engine identification label
- 18 Mechanical stop control (electrical stop control at rear of pump)
- 19 Fuel injection pump
- 20 Speed control lever
- 21 Fuel lift pump
- 22 Lubricating oil dipstick



Engine breather

To renew the engine breather assembly (closed system)

The breather assembly (A1, A3 and A4) should be renewed every 2000 hours by a person who has had the correct training.

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

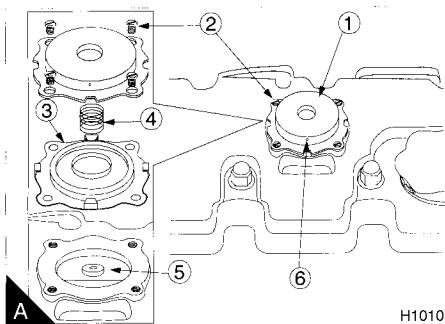
1 Release the four setscrews (A2) and remove the breather cover (A1), the spring (A4) and the diaphragm assembly (A3).

Caution: It is important that the area around the vent hole (A6) is clean.

2 Clean the breather cavity (A5) in the rocker cover.

3 Fit a new breather assembly into the cavity in the rocker cover, ensuring that the breather cover, diaphragm and spring are assembled correctly.

4 Tighten the four setscrews.



Service schedule

Preventive maintenance periods

The preventive maintenance periods in the "Maintenance schedule" on page 10 apply to average conditions of operation. Check the periods given by the manufacturer of the equipment in which the engine is installed. Use the periods that are shortest. When the operation of the engine must conform to the local regulations these periods and procedures may need to be adapted to ensure correct operation of the engine.

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

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

Maintenance schedule

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

- | | |
|---------------------------------------|--------------------------------------|
| A Every day or every 8 hours | B Every 250 hours or 6 months |
| C Every 500 hours or 12 months | D Every 1000 hours |
| E Every 2000 hours | F Every 3000 hours |

A	B	C	D	E	F	Operation
●						Check the coolant level
	●					Check concentration of the coolant ⁽¹⁾
	●					Check the tension and condition of the drive belt
			●			Renew the alternator drive belt
●						Drain water from the pre-filter (if fitted)
		●				Renew fuel filter canister
				●		Check atomisers for performance ⁽²⁾
●						Check the level of the engine lubricating oil
		●				Renew the engine lubricating oil (fill slowly, ensure correct quantity is used) ⁽³⁾
		●				Renew the engine oil filter
●						Clean the air filter and empty the dust bowl of the air filter in extremely dusty conditions
		●				Renew the air filter and empty the dust bowl of the air filter in normal conditions
			●			Clean the turbocharger impeller casing and turbocharger compressor casing ⁽²⁾
			●			Check the valve clearances of the engine, if necessary, adjust ⁽²⁾
			●			Check all hoses and hose connections
				●		Renew the engine breather
				●		Check the alternator and the starter motor ⁽²⁾
				●		Inspect the electrical system for security of cables and wear
●						Check and correct any leaks or engine damage

(1) Renew the antifreeze every 2 years. If a corrosion inhibitor is used instead of antifreeze, it should be renewed every 6 months. Ensure the correct quantity is used.

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

(3) The oil change interval will be affected if the load factor is greater than 40% or the incorrect specification oil is used. If you are unsure of how to calculate the load factor for the application contact your nearest Perkins distributor. Refer to "Engine data" on page 5 for the correct oil specification.