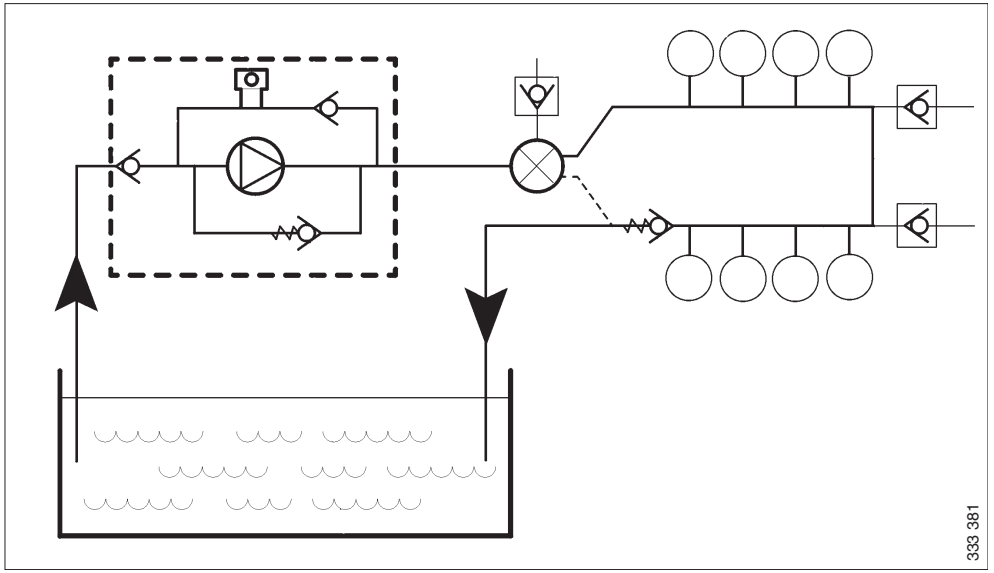
Fuel system

Marine engines
DI09, DI13, DI16



Fuel tank

The illustration shows an example of a marine fuel tank installation.

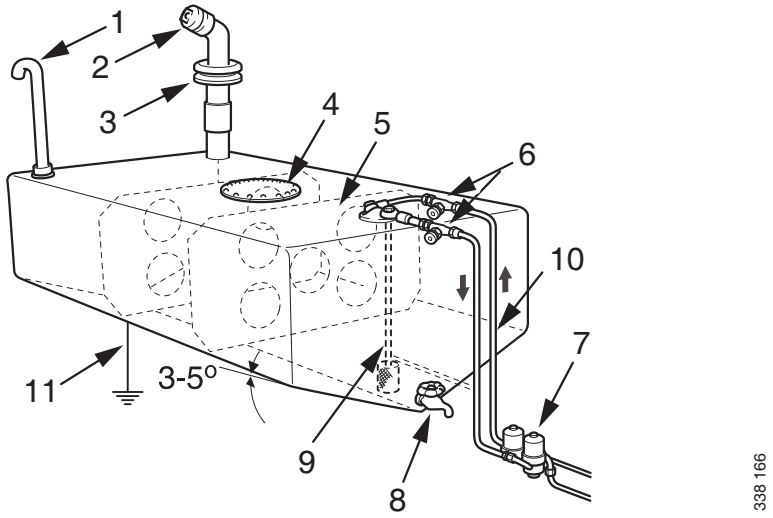
Position

If the fuel tank is placed higher than the engine feed pump, a shut-off cock should be installed in the fuel line to the feed pump. During downtime, this cock should be closed. Maximum permitted fuel level in the fuel tank is 3.5 m in relation to the feed pump.

The fuel tank must not be positioned so low that the vacuum in feed pump suction pipe is greater than 0.3 bar. The risk of air leaks in the suction pipe increases with increased vacuum. See also the section Flow and pressure.

If the fuel tank is mounted so low that the maximum permissible vacuum is exceeded, or if a large fuel tank is required which cannot be mounted close to the engine, a buffer tank must be installed at a suitable distance and height. A feed pump must be fitted directly downstream of the tank. The flow for the auxiliary feed pump must be minimum 15% higher than the flows specified in the Feed pump flow rates section.

If a reliable and quick starting response is required, the buffer tank should be positioned adjacent to the engine with the lowest fuel level at the same level as the feed pump. If the fuel tank(s) are built in, the space should be well ventilated. The fuel tank should normally be drained once a year, but this may vary depending on the quality of the fuel.



Example of a fuel tank installation.

1. *Bleed pipe.*
2. *Fuel filler pipe with filler cap.*
3. *Lead-through sleeve of fuel-resistant rubber.*
4. *Inspection hatch.*
5. *Baffle plate.*
6. *Fuel cocks.*
7. *Prefilter.*
8. *Drain tap for sludge and water.*
9. *Suction pipe with strainer.*
10. *Return pipe. Note: For XPI engines, it should enter below the lowest fuel level.*
11. *Ground connection.*

Fuel tank design

The material for the fuel tank should be corrosion-resistant, such as stainless steel or aluminium.

Note:

Some other materials, such as copper or hot dip galvanised sheet steel, are unsuitable for use with diesel fuel.

The fuel tanks must be fully welded, and should have internal baffle plates to prevent the fuel being thrown about in heavy seas. Both fuel filling components and the fuel tank must be grounded to prevent sparking from static electricity. The fuel tank must have the following devices:

- A drain tap for emptying sludge and water that has sunk to the bottom.
- A ventilation or bleed line from the upper part of the fuel tank to the outside of the hull. It should be designed so that water cannot enter and so that fuel cannot run out when the ship is leaning heavily.
- Protection or filter to prevent contaminants entering during filling.
- There must always be a fuel cock in the suction line and in the return line if its outlet in the tank is higher than the outlet from the engine. The return line should be routed to the upper part of the fuel tank.
- Main tanks must be fitted with inspection hatches so that they can be inspected and cleaned inside.

New fuel tanks must be thoroughly cleaned and rinsed internally using clean fuel. They must also be pressure tested to 0.3 bar.

Fuel tanks manufactured from materials which are not resistant to corrosion must be treated externally with corrosion protection. The fuel tanks must not be painted internally nor be zinc-coated or galvanised.

It is important that the fuel tanks are positioned in as cool a location as possible since the return fuel is hot and therefore raises the temperature of the fuel in the fuel tank.

Power correction due to the fuel temperature increase for PDE engines is displayed in the tables in the Fuel grade and power for PDE engines section.

Main tank and buffer tank

If the engine installation has a buffer tank and main tank, these should be designed as follows:

- The main tank must have a sloped bottom or be on a slight incline (about 3-5°) and have a tap at the lowest part for draining condensation.
- The pipe fittings must be connected or routed to approximately 50 mm from the bottom and supplied with a bottom strainer. This applies to both the buffer tank and the main tank.
- The lines to the buffer tank should be as short as possible and should be mounted in such a way that they cannot be exposed to mechanical damage.
- Transfer of fuel from the main tank to the buffer tank should be achieved using an electric pump connected so that it only pumps when the engine is running. This is to prevent the risk of serious leakage when the engine is not running. The electric pump must have an excess capacity of 30-40% in relation to the engine fuel consumption. This is to ensure that the quantity of return fuel is sufficient for lubrication and cooling.
- There must be a return pipe from the buffer tank to the main tank so that any surplus fuel runs back to the main tank.
- For PDE engines, the return pipe from the engine must be routed to the upper part of the buffer tank.
- For XPI engines, the return pipe should enter below the lowest fuel level in the main tank.
- The buffer tank must also be fitted with a drain tap for condensation.

See instructions in the Fuel tank design section for further details.

Fuel pipes

The fuel lines should be routed so that the fuel cannot be heated by radiated heat from the engine.

The dependency of engine power on fuel temperature can be read in the tables in the Fuel grade and power for PDE engines section. Maximum permitted fuel temperature in the inlet pipe is 60°C.

The return line must be routed to the fuel tank or to the buffer tank (if fitted).

Note:

The return line must not be connected to the suction line.

For PDE engines, the return line is normally connected to the upper part of the tank. The return line should normally enter above the maximum fuel level. For PDE engines, the return pipe and suction pipe must have the same diameter.

Note:

For XPI engines, the fuel return line should enter below the lowest fuel level in the fuel tank.

The suction line in the fuel tank should be placed at least 50 mm from the bottom of the fuel tank. This distance also applies to the suction strainer.

In multi-engine installations, the fuel system should be divided into at least two independent systems so that a fault in one of the fuel lines does not cause all engines to stop.

The fuel lines should not be made of copper as there is a risk of oxidation due to condensation. The sulphur content in the fuel can also have a negative effect on the copper.

Minimum inside diameter of fuel lines

PDE engines

Type of fuel pipe	Fuel pipe length	
	Shorter than 3 m, min. inner diam. (mm)	Longer than 3 m, min. inner diam. (mm)
Suction pipe	10	12
Return pipe	10	12

XPI engines

Type of fuel pipe	Fuel pipe length	
	Shorter than 3 m, min. inner diam. (mm)	Longer than 3 m, min. inner diam. (mm)
Suction pipe	14	16
Return pipe	10	12

Fuel filter

PDE and XPI engines

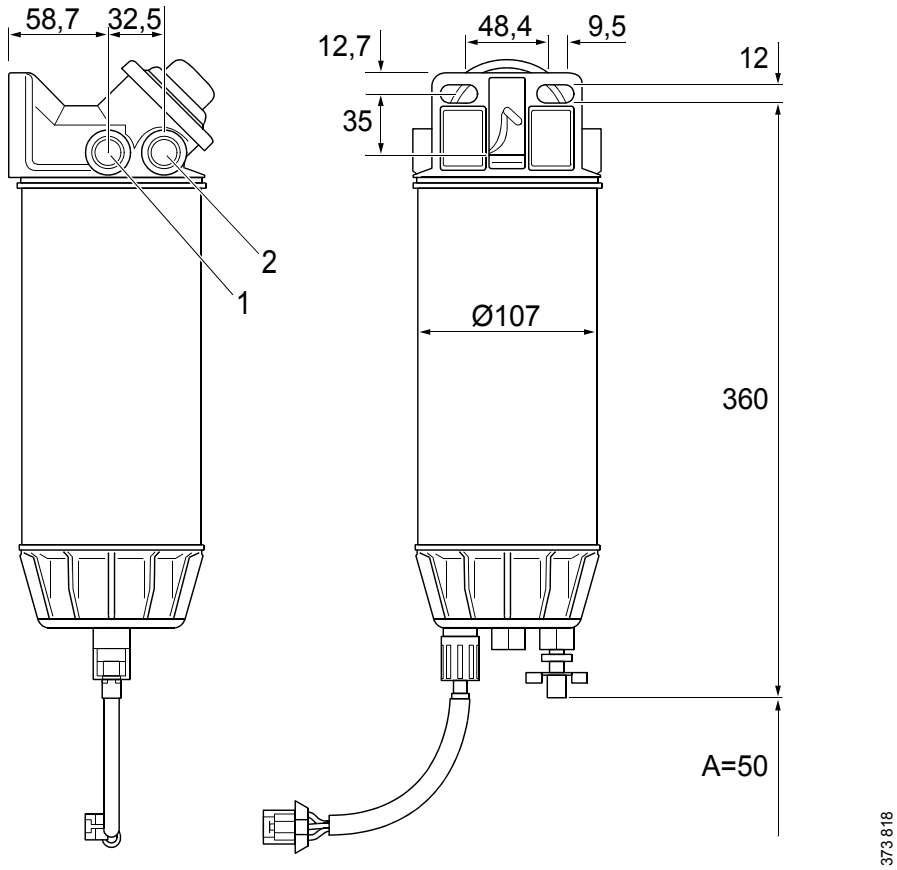
The engines are equipped with an engine-mounted fuel filter. PDE engines also have the option of commutative engine-mounted fuel filters which can be renewed during operation.

All engines must also be fitted with a water separating prefilter. PDE engines require one prefilter XPI engines require two prefilters, see next section. All connections on the suction side of the feed pump must be thoroughly sealed so that no air is drawn in during operation.

The water separating prefilter should be changed at the same intervals as the main filter.

The prefilter should not be installed directly on the engine. If the fuel tank is positioned higher than the engine, a shut-off cock must be installed on the fuel pipe to the feed pump, to prevent fuel running out into the hull during maintenance.

Information about how the single prefilter connector is connected is available in *03:01 Electrical system*.

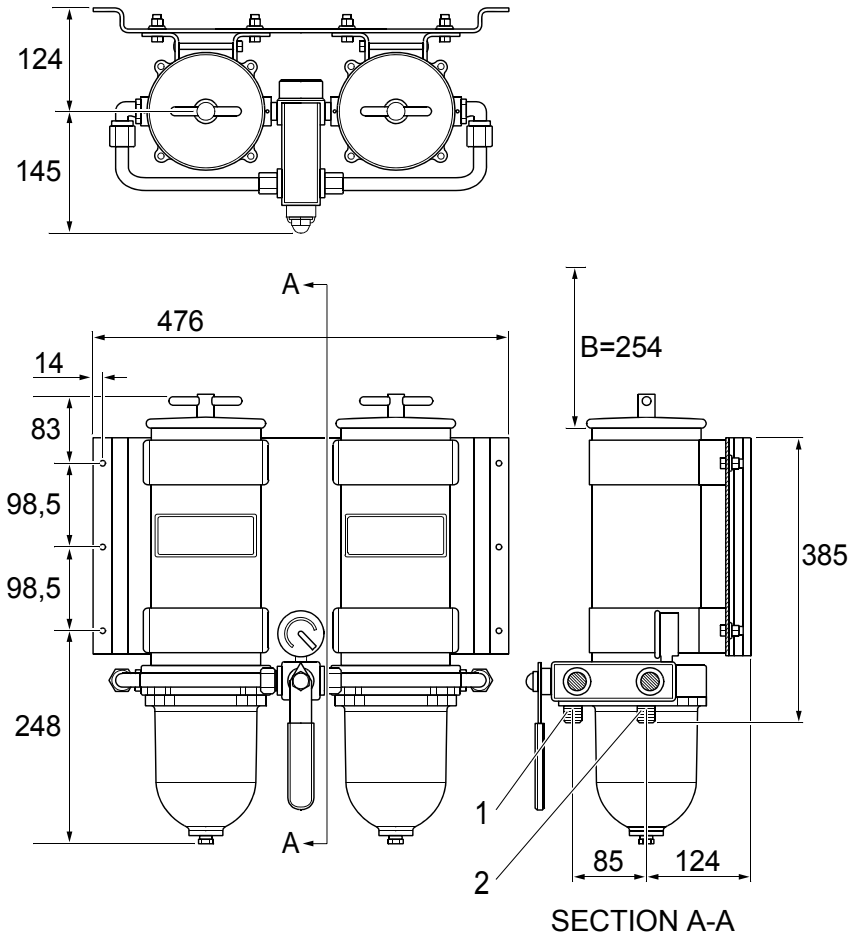


Single water separating prefilter.
1. Outlet, SAE 8 P ¾" 16 UNF 2B.
2. Intake, same dimensions as outlet.
A = Free space required for prefilter renewal.

It is also possible to install prefilters which are commutative. It is possible to renew commutative fuel filters with the engine running by switching off one filter at a time. These prefilters have a water separator and an indicator, which show when it is time to renew the filters.

Note:

Always renew both filters at the same time.



Commutative water separating prefilter.
1. Intake, 7/8 14 UNF 2B straight thread with SAE J514 male JIC 37°.
2. Outlet, same dimensions as the intake.
B = Free space required for prefilter renewal.

PDE engines

PDE engines require one water separating prefilter.

Permitted water separating prefilters for PDE engines

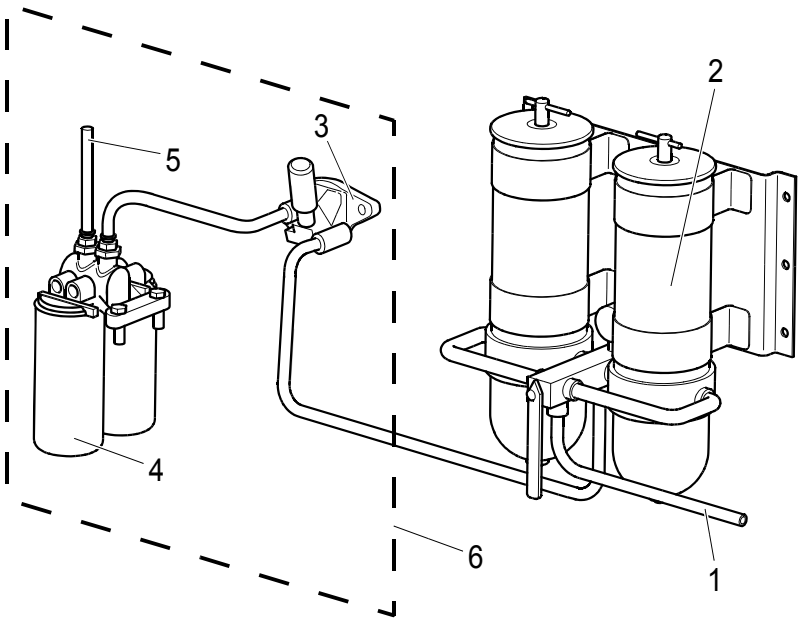
- Single prefilter from Scania.
- Commutative prefilter from Scania.
- Prefilter from external supplier.

If a prefilter from an external supplier is installed, a filter of a maximum of 30 micrometres is recommended.

The prefilter should not be installed higher than the feed pump, because that results in an unnecessarily high suction height, making the engine more difficult to start. In multi-engine installations, there should be extra fuel filters between each engine and the fuel tank.

Note:

All water separating prefilters must be fitted before the feed pump and must be low in relation to the fuel tank so that the fuel is forced into the filter. This prevents air being sucked into the filter during draining.



Fuel filter installation on PDE engines.

1. *From fuel tank.*
2. *Water separating prefilter, maximum 30 micrometres.*
3. *Feed pump with hand pump.*
4. *Main fuel filter.*
5. *To injector.*
6. *Engine-mounted components.*

XPI engines

XPI engines require two water separating prefilters.

First filtering stage (pos. 2 in illustration), permitted water separating prefilter

- Single prefilter from Scania.
- Commutative prefilter from Scania.
- Prefilter from external supplier.

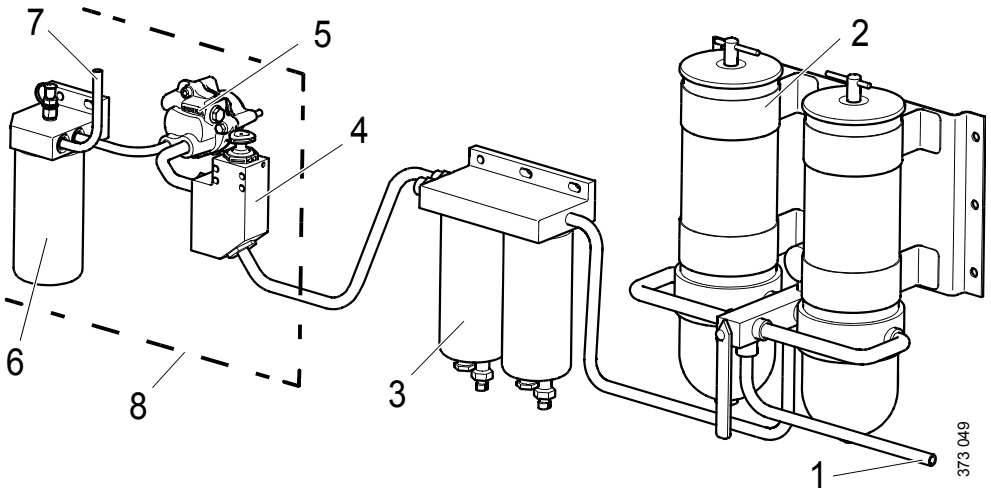
If a prefilter from an external supplier is installed in the first filtering stage, a prefilter of 20-30 micrometres is recommended.

Second filtering stage (pos. 3 in illustration), permitted water separating prefilter

- Only the accompanying double prefilter from Scania may be used.

Note:

If no prefilter is installed in the first filtering stage, the renewal interval for the Scania double prefilter in the second filtering stage reduces considerably.

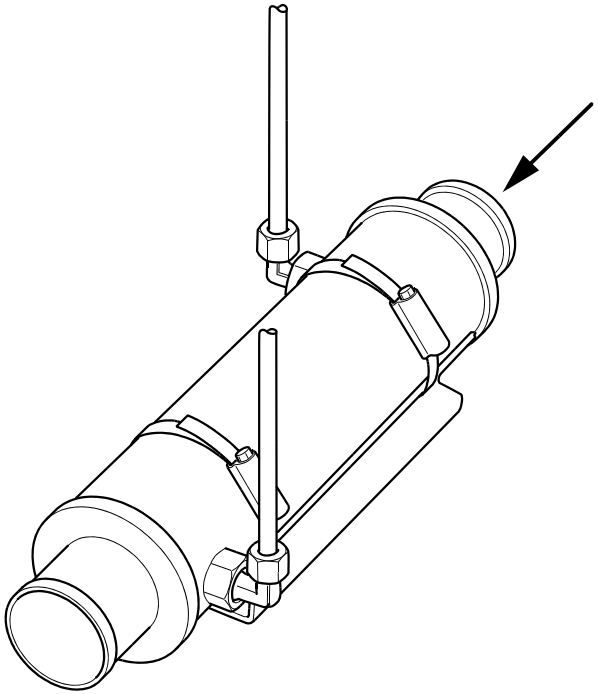


Fuel filter installation on XPI engines.

1. *From fuel tank.*
2. *Water separating prefilter, 20-30 micrometres.*
3. *Double water separating prefilter from Scania.*
4. *Hand pump.*
5. *Feed pump.*
6. *Main fuel filter.*
7. *To high pressure pump.*
8. *Engine-mounted components.*

Fuel cooler

If there is a risk of the fuel being heated up due to the routing of fuel lines, a fuel cooler can be connected in the sea water circuit upstream of the sea water pump.



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Seawater-cooled fuel cooler.

Feed pump flow rates

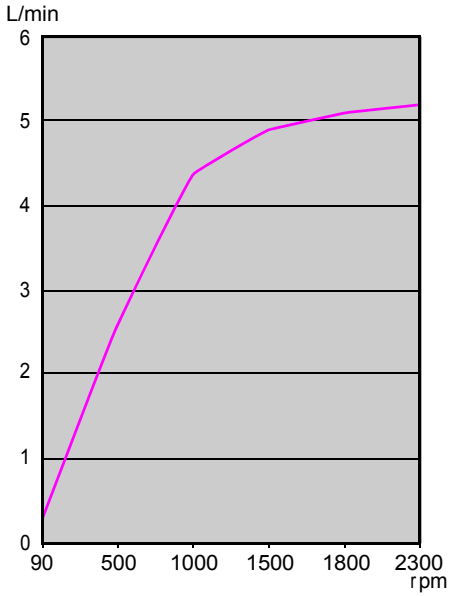
PDE engines

The feed pump flow rates shown in the table apply at normal working pressure (4-6 bar).

Engine speed (rpm)	DI09, DI13 (l/hour)	DI16 (l/hour)
500	91	135
1,200	220	340
1,500	271	380
1,800	325	400
1,900	362	400
2,100	380	400
2,200	398	400
2,300	417	400

XPI engines

The feed pump flow rates shown in the diagram apply at normal working pressure.



Feed pump flows for DI16 XPI.

Flow and pressure

The external fuel system should be designed so that any vacuum in the feed pump suction line due to static suction height, flow resistance in fuel lines or additional fuel filters is no greater than 0.3 bar. Measurement must be carried out at the feed pump intake. Refer to *02:08 Measuring instructions for installation inspection*.

PDE engines

If the filter becomes blocked, pressure in the feed pump could rise. To prevent malfunction, back pressure downstream of the feed pump must not exceed 10 bar, which is the maximum capacity of the feed pump.

An overflow valve with an opening pressure of approx. 6 bar is fitted on the fuel manifold. It ensures that the feed pump is always filled with fuel, which ensures that the engine can start.

XPI engines

The prefilter should be positioned at the same height as the engine.

Return flow at full pressure in the fuel manifold and max. power

0.5-5 l/min

Maximum permitted back pressure in the return pipe

0.35 bar

Risk of fire

When working on the fuel system and handling diesel, observe the normal regulations for handling flammable substances:

- Any source of ignition must be kept away from or be screened from the flammable material or area. Examples of circumstances that could cause ignition are
  - welding
  - smoking
  - grinding with grinding machines
  - sparks from static discharge or electrical equipment.
- The ventilation in the engine compartment must be satisfactory for the evacuation of fuel vapours.
- Be careful when filling the fuel tank with fuel. If the fuel tank is close to the engine, the engine should be switched off and allowed to cool.

WARNING!

Heated diesel constitutes a risk of explosion!

Fuel grade and power for PDE engines

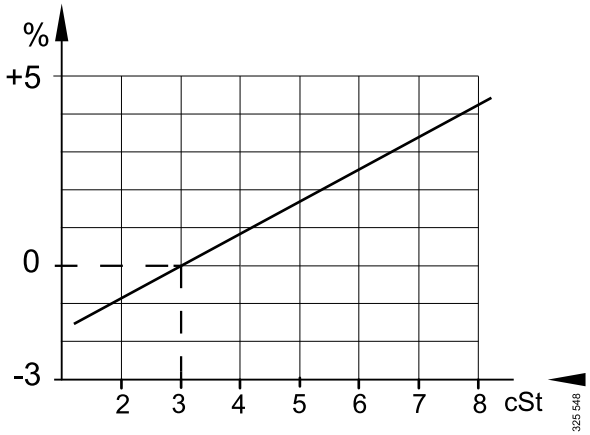
Different fuel properties such as viscosity, density and temperature influence the power available from the engine. See the charts on the next page.

The listed engine power assumes fuel with a density of 0.84 kg/dm^3 and specific calorific value of 42,700 kJ/kg at a fuel temperature of 15°C.

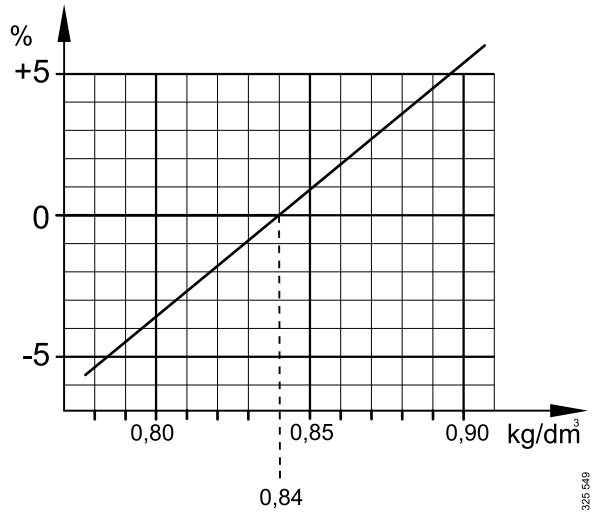
Since it is difficult to measure the exact calorific value for the fuel in question, viscosity, density and temperature can be used instead to obtain a corrected engine power as a percentage for each of the properties.

The read corrected engine powers as a percentage from the figures must first be added together to obtain the final corrected engine power. Multiply this with Scania's specified engine power to obtain the corrected engine power in kW. Then add or subtract from Scania's specified engine power to obtain the corrected engine power within the given tolerances.

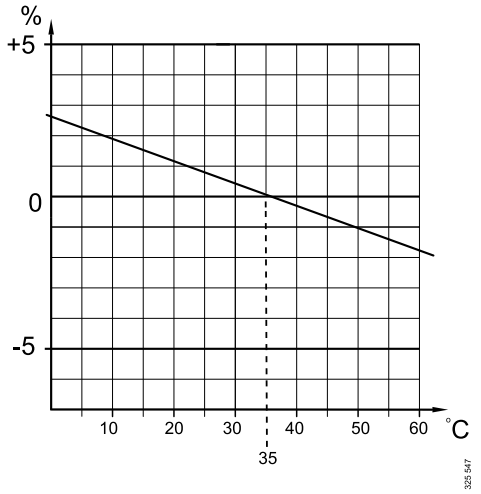
If you have measured the current engine power for a particular engine instead and wish to convert it to normal power, change the sign in front of the corrected engine power in the charts.



Engine power dependence on viscosity of fuel. Normal value is 3 cSt at 40°C.



Engine power dependence on density of fuel. Normal value is 0.84 kg/dm³ at 15°C.



Engine power dependence on the fuel temperature. The reference temperature is 35°C.

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Important data

Maximum vacuum in the feed pump suction line using a cleaned or new filter	0.3 bar
Max. backpressure downstream of the feed pump when the filter is blocked	10 bar
Max. fuel temperature upstream of the feed pump	60°C
Max. fuel level above feed pump	3.5 m
Engine power dependence on viscosity of fuel	See the chart on the previous page
Engine power dependence on density of fuel	See the chart on the previous page
Engine output dependence on fuel temperature	See the chart on the previous page
Normal fuel pressure	4-6 bar