

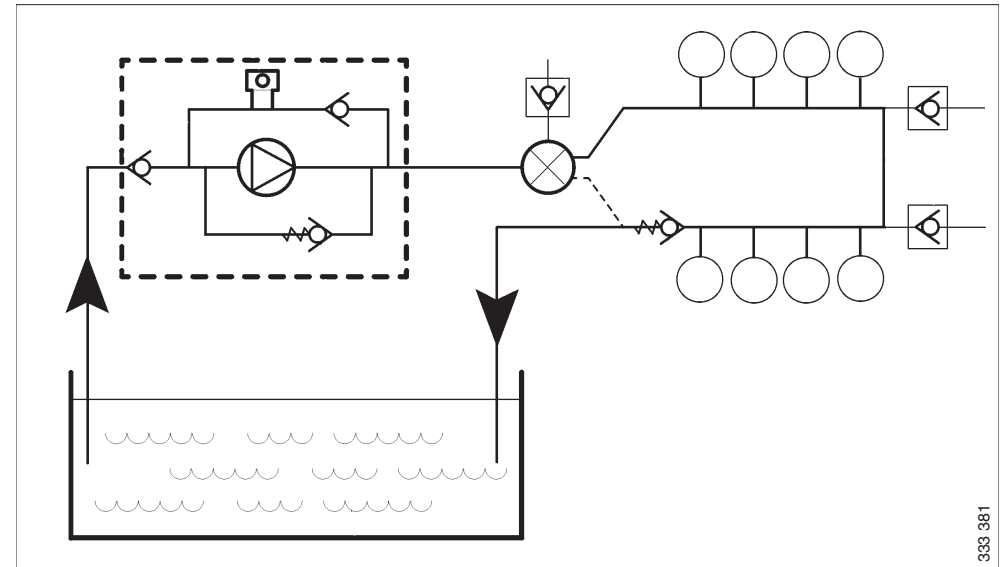


# Installation manual



## Fuel system

**Marine engines  
DI09, DI13, DI16**





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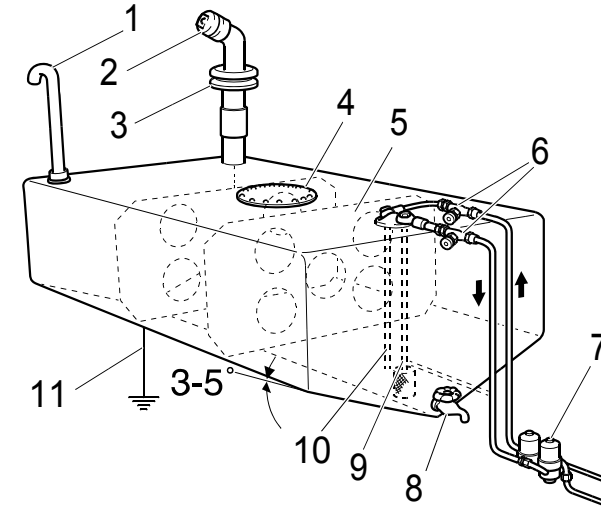
## Changes from the previous issue

The changes made in this document compared with the previous issue are marked with a black line in the left-hand margin. The changes are also described below.

- Information about DI13 XPI has been added.
- An example illustration has been added to the [Main tank and buffer tank](#) section.
- The information in the [Feed pump flow rates](#) section has been made clearer.

## Fuel tank

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



*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. Shut-off cocks.
7. Prefilter.
8. Drain tap for sludge and water.
9. Suction pipe with bottom strainer.
10. Return pipe.
11. Ground connection.



## Position

### Positioned lower than the engine

The fuel tank must not be positioned so low that the vacuum in the feed pump suction pipe exceeds 0.3 bar. The risk of air leaks in the suction pipe increases with increased vacuum.

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. See [Main tank and buffer tank](#). 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.

### Positioned higher than 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. This is to prevent unfiltered fuel entering the engine during maintenance.

To prevent fuel leakage during filter renewal, a shut-off cock must also be installed on the return pipe if the fuel tank is positioned higher than the engine.

Maximum permitted fuel level in the fuel tank is 3.5 m in relation to the feed pump.

### Other

It is important that the fuel tank is positioned in as cool a location as possible since the return fuel is hot and therefore raises the temperature of the fuel in the tank. If the fuel tank is built in, the space should be well ventilated.

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



## Fuel tank design

The fuel tank must be designed as follows:

- 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.

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Fuel tanks manufactured from materials which are not resistant to corrosion must be treated externally with anti-corrosion paint.

- The fuel tank must not be painted internally nor be zinc-coated or galvanised.
- The fuel tanks must be fully welded.
- The fuel tanks must be equipped with 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.

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

The fuel tank should normally be drained once a year, but this may vary depending on the quality of the fuel.

The fuel tank must have the following devices:

- A drain tap for emptying sludge and water that has sunk to the bottom.  
The reason for this is that the water separated out with the prefilter follows the return fuel back into the fuel tank.
- 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.
- Main tanks must be fitted with inspection hatches so that they can be inspected and cleaned inside.



## 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 should 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 buffer tank must also be fitted with a drain tap for condensation.
- 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.
- An electric feed pump must be fitted directly downstream of the main tank. It must be connected so that it only pumps when the engine is running, to avoid the risk of major leaks when the engine is at a standstill.

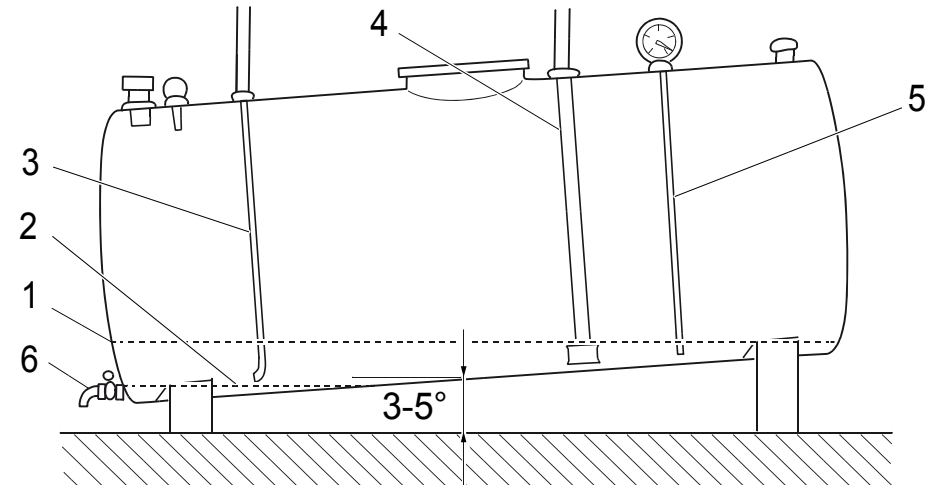
The flow for the electric feed pump must be 30-40% higher than the flows specified in the [Feed pump flow rates](#) section. This is to ensure that the quantity of return fuel is sufficient for lubrication and cooling.

- 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.

### Note:

The return pipe should enter below the lowest fuel level in the main tank. See illustration.

See instructions in the [Fuel tank design](#) section for further details.



1. Lowest fuel level.
2. Level of return line output.
3. Return pipe.
4. Suction pipe with strainer.
5. Fuel gauge.
6. Drain tap.



## Fuel lines

The fuel lines should be designed as follows:

- The fuel lines should be routed so that the fuel cannot be heated by radiated heat from the engine. Maximum permitted fuel temperature in the inlet pipe is 60°C.  
For PDE engines, the dependence of the engine power on the fuel temperature is stated in the table in the [Fuel grade and power for PDE engines](#) section.
- The return pipe from the overflow valve must be routed to the fuel tank or to the buffer tank (if fitted). For PDE engines, the return pipe and suction pipe should have the same diameter.

### Note:

The return pipe should enter below the lowest fuel level in the fuel tank. See previous section.

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

- The suction pipe in the fuel tank must be placed at a sufficient distance from the bottom of the tank, so as not to suck up deposits gathered at the bottom.

- 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.

The recommended minimum inside diameters of fuel lines are shown in the table.

Length of the fuel lines	Minimum inside diameter (mm)	
	PDE engines, DI13 XPI	DI16 XPI
<b>Shorter than 3 m</b>		
Suction pipe	10	14
Return line	10	10
<b>Longer than 3 m</b>		
Suction pipe	12	16
Return line	12	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. The water separating prefilter should be changed at the same intervals as the main filter.

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 not be installed directly on the engine and a shut-off cock should be fitted before the filter.

The 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.

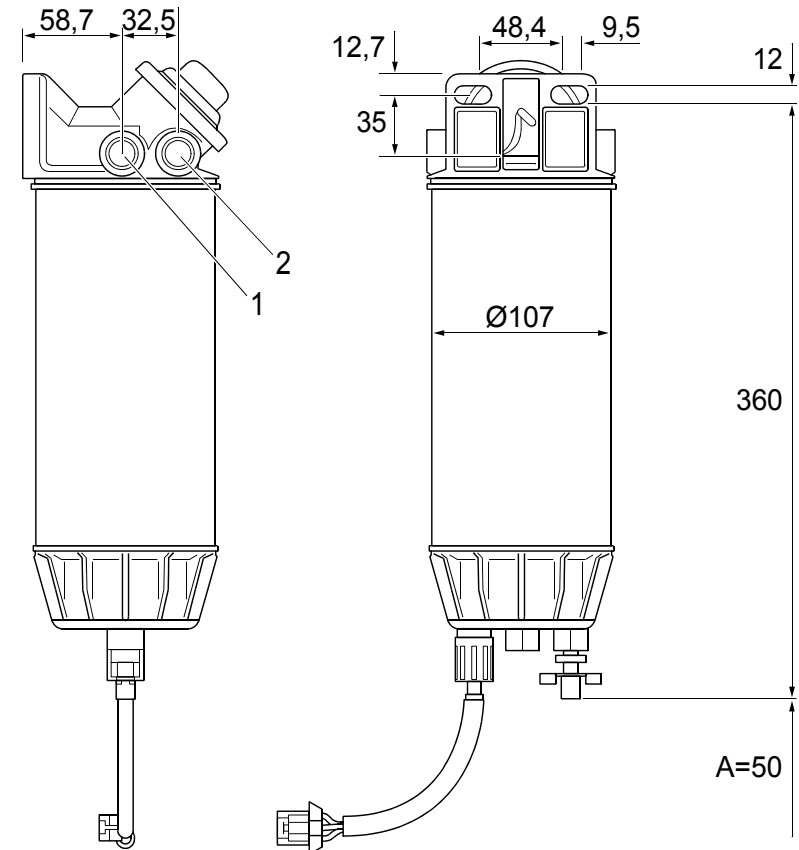
The prefilters should not be installed higher than the feed pump, because that results in an unnecessarily high suction height, making the engine more difficult to start.

In multi-engine installations, there should be extra fuel filters between each engine and the fuel tank.



#### REQUIREMENT!

Measure the fuel vacuum when the installation is complete. Refer to 02:08 Measuring instructions for installation inspection.



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.



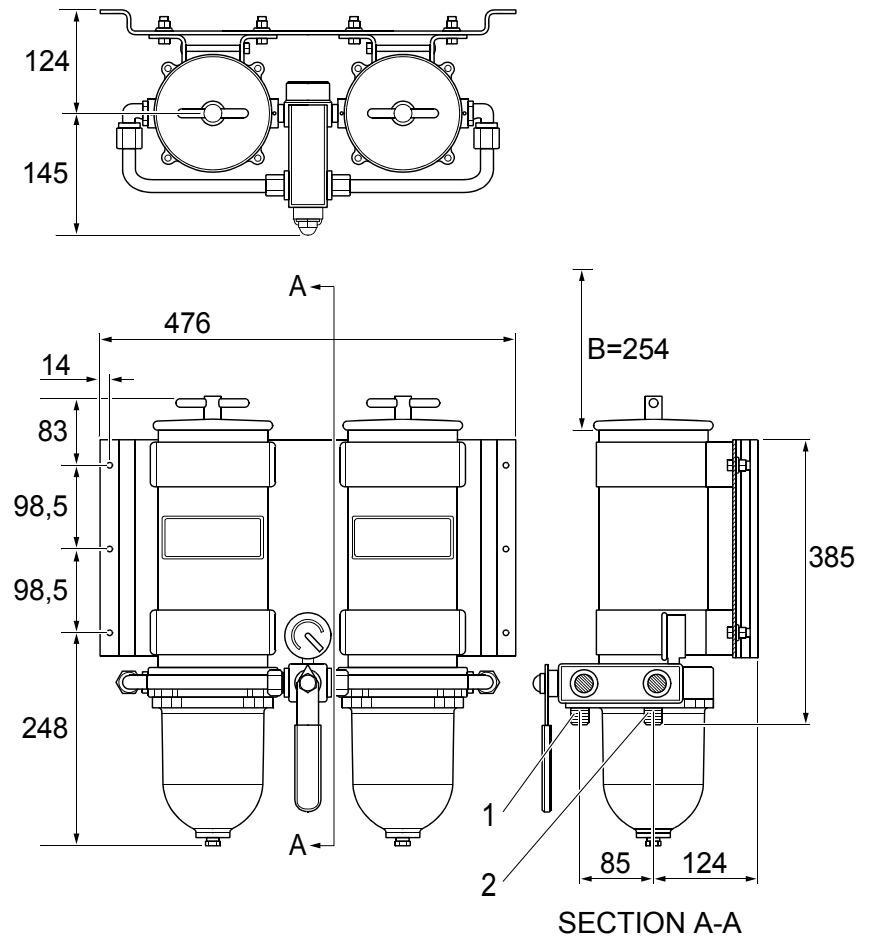


Information about how the single prefilter harness-to-harness connector is connected is available in *03:01 Electrical system*.

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.*



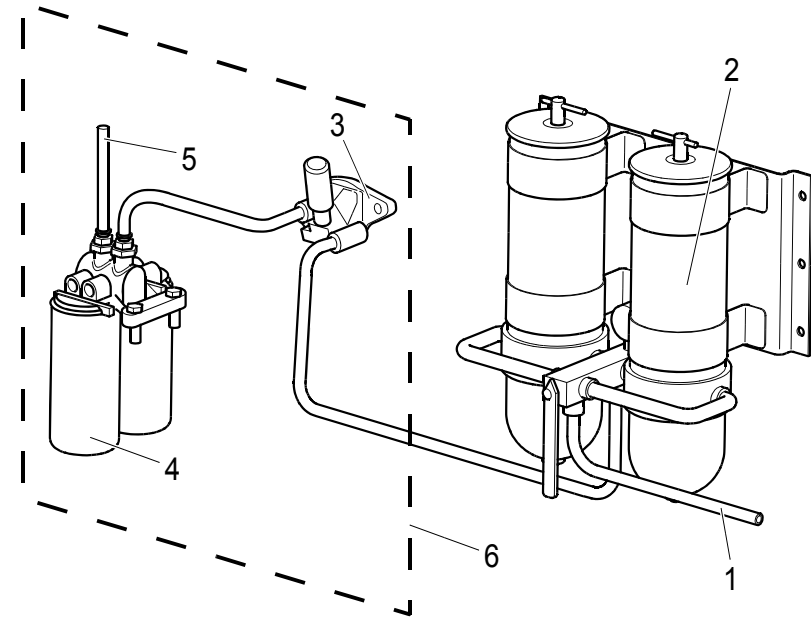
## PDE engines

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 with a cleaning efficiency of a maximum of 30 micrometres is recommended.



*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. The prefilters should be positioned at the same height as the engine.

### First filtering step (pos. 2 in illustration), permitted water separating prefilters

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

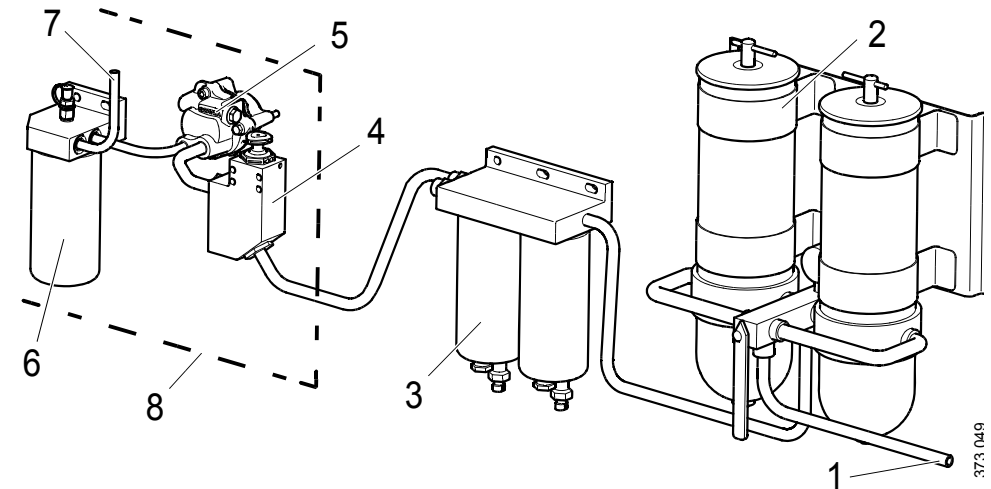
If a prefilter from an external supplier is installed in the first filtering stage, a prefilter with a cleaning efficiency of 20-30 micrometres is recommended.

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

- Only the accompanying 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.



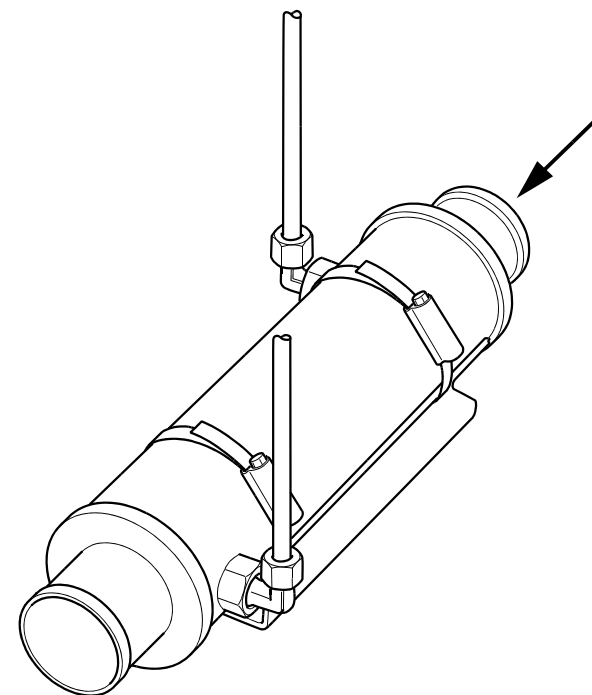
*Fuel filter installation on XPI engines.*

1. From fuel tank.
2. Water separating prefilter, 20-30 micrometres.
3. Water separating prefilter from Scania. For DI13 XPI, a single filter is used for this step.
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.



*Seawater-cooled fuel cooler.*

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## Feed pump flow rates

The feed pump flow rates shown in the diagram apply at normal working pressure. Normal working pressure is 9 to 10 bar for XPI engines and 4-6 bar for PDE engines.

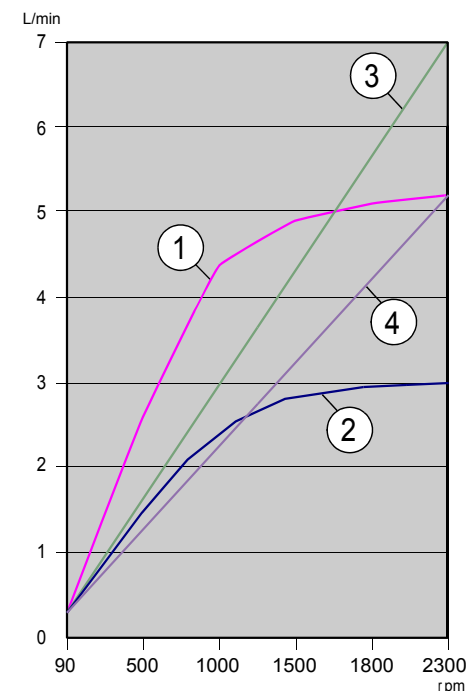
The external fuel system should be designed so that any vacuum in the feed pump suction line due to static suction height, flow resistance in fuel lines or additional fuel filters is no greater than 0.3 bar. How the test is carried out is described in 02:08 *Measuring instructions for installation inspection*.

The table below gives the maximum feed pump flow to the high pressure pump and maximum return flow to the fuel tank.

	Engine type	Feed pump flow	Return flow
1.	DI16 XPI	5 l/min	2 l/min
2.	DI13 XPI	3 l/min	1 l/min
3.	DI16 077M PDE	6.75 l/min	6.70 l/min
4.	Other PDE engines	5 l/min	4.95 l/min

The maximum permissible back pressure in the return line is 0.35 bar for all engines.

For PDE engines, Scania recommends that the same pipe dimensions are used on the suction line and return line. See the [Fuel lines](#) section.



Feed pump flow rates.

1. DI16 XPI.
2. DI13 XPI.
3. DI16 077M PDE.
4. Other PDE engines.



### 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!

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## Fuel grade and power for PDE engines

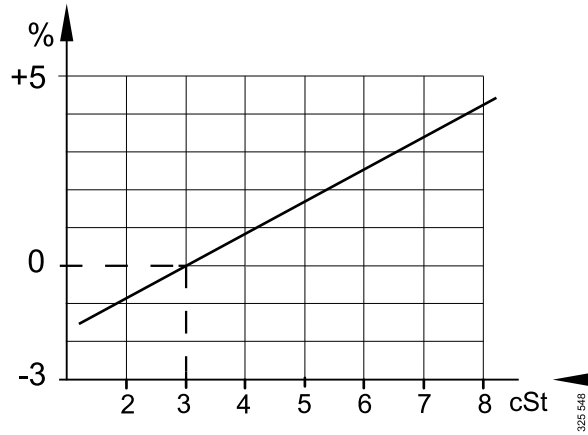
Different fuel properties such as viscosity, density and temperature influence the power available from the engine. See the charts on the next page.

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

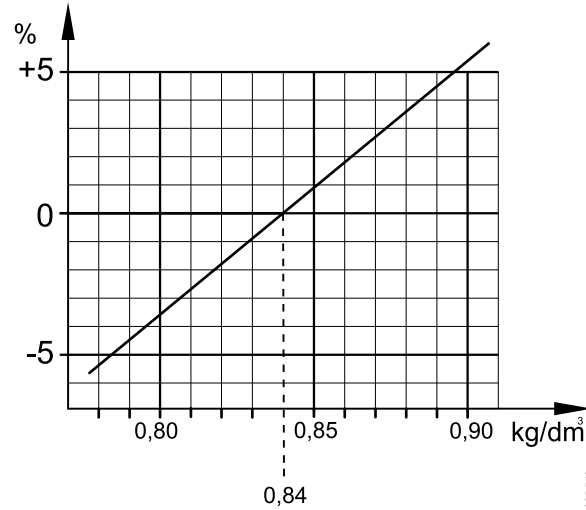
Since it is difficult to measure the exact calorific value for the fuel in question, viscosity, density and temperature can be used instead to obtain a corrected engine power as a percentage for each of the properties.

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.

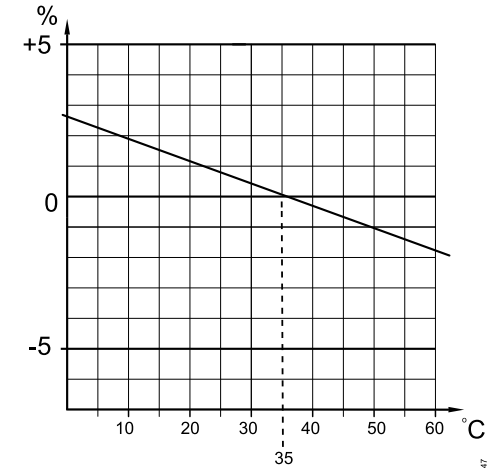
If you have measured the current engine power for a particular engine instead and wish to convert it to normal power, change the sign in front of the corrected engine power in the charts.



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.





## Important data

Maximum vacuum in the feed pump suction line using a cleaned or new filter	0.3 bar
Max. fuel level above feed pump	3.5 m
Max. fuel temperature upstream of the feed pump	60°C
Normal fuel pressure, PDE engines	4-6 bar
Normal fuel pressure, XPI engines	9-10 bar
Maximum permitted back pressure in the return pipe	0.35 bar
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