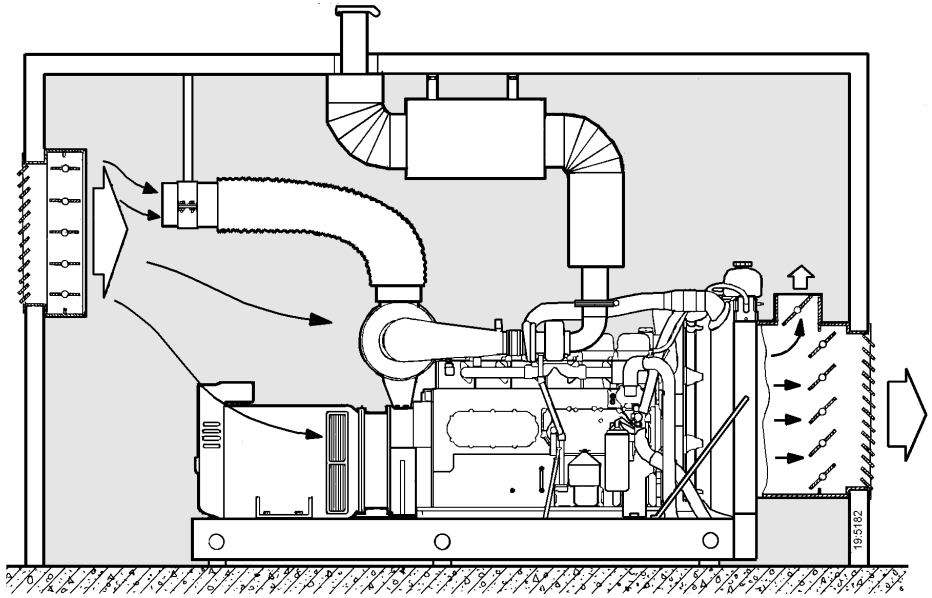
Intake system and ventilation

Industrial engines
DC09, DC13, DC16
OC16



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Changes from the previous issue

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

- Max. permissible vacuum in the intake system has been changed to 40 mbar for 16 litre single-speed engines. See Intake air taken from outside engine room.
- Max. permissible vacuum in the engine compartment for engines without fan (1 mbar) has been removed. 2 mbar now applies to all engines. See Intake air taken from engine room.
- Safety cartridges are no longer included with air cleaners with precleaners. Safety cartridges can instead be purchased as an option. See Air cleaner.
- Clearances for Air cleaners with precleaner and Air cleaners without precleaner have been corrected.
- Section Important data has been added.

Intake air

If the intake line is located close to exhaust pipes or other hot parts, radiation protection should be used to limit unnecessary heating of the intake air.

REQUIREMENT!

The intake air temperature may not exceed the ambient temperature by more than 5°C for Stage IV/Tier 4f engines, or 10°C for other engines.

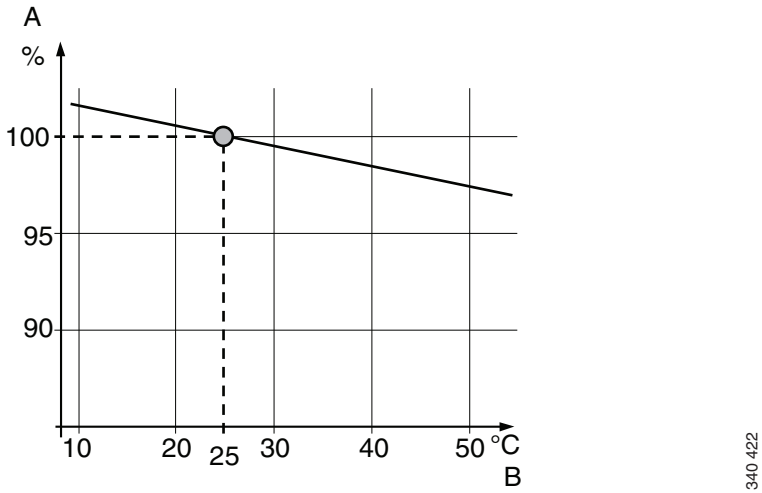
Measure the temperature when the installation is complete. Refer to *01:08 Measuring instructions for installation inspection*.

If the intake air temperature upstream of the turbocharger continuously exceeds 30°C, then engine power may drop. If the engine is enclosed in some manner, make sure that there is an adequate flow of intake air.

The dependence of the engine power on intake air temperature is shown in the chart on the right. This diagram is only valid for DC engines. 100% engine power is shown under actual test conditions at the factory.

Gas engines can be subject to significant power loss if the intake air to the turbocharger has a high temperature in combination with the fuel having a low MN value (knock-sensitive fuel).

The engine air consumption in kg/min at full power and at different engine speeds is indicated in the tables showing the air consumption and radiated heat for the relevant engine type in *01:06 Technical data*.



Engine power dependence on intake air temperature. 100 % at 25°C, 1,000 mbar, engine power setting not corrected.
This diagram is only valid for DC engines.
A = Engine power.
B = Intake air temperature.

Intake air taken from outside engine room

In engine systems where the engine intake air comes from outside the engine room and is led via a fresh air line to the engine, the vacuum for the intake system should be measured.

The air intake should be located so that the intake air is as clean as possible and so that neither the engine exhaust gases nor heated air from the engine room can mix with the intake air. The air intake should be designed to exclude water, snow and contamination.

The intake air must not contain chemical pollutants, such as CFCs.

REQUIREMENT!

The maximum permissible vacuum in the intake system is 30 mbar. For 16 litre single-speed engines, a vacuum of 40 mbar is permissible. This value includes the vacuum in the new air filter, connected coarse filter and in the fresh air line.

Measure the vacuum when the installation is complete. Refer to *01:08 Measuring instructions for installation inspection.*

The following applies to the fresh air line:

- The fresh air line must not be routed with any sharp bends.
- The inside of the fresh air line must be flat and even.
- If a hose is used as a fresh air line, it must be rigid enough that it does not collapse onto itself.

It is not necessary to check the vacuum in the following cases:

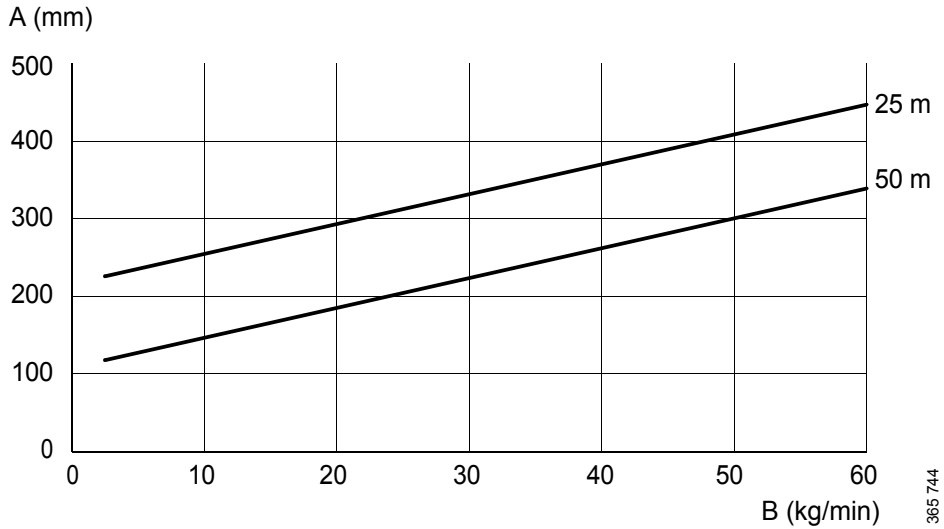
- If the intake system is comprised of air hoses and air pipes from Scania's standard range.
- If the fresh air line is maximum 5 m and has an inside diameter of at least 160 mm for DC09 or 210 mm for DC13 and DC16, respectively.

If the planned fresh air line is longer than 5 m, the required diameter must be calculated as illustrated. The vacuum upstream of the turbocharger must then be measured. Refer to *01:08 Measuring instructions for installation inspection*.

REQUIREMENT!

The total vacuum in the intake system with a blocked air filter must not exceed 65 mbar.

Engine damage will not occur up to 100 mbar, but fuel consumption and smoke will increase. Above 100 mbar there is a risk that the air volume to the engine will be inadequate, resulting in breakdowns.



Calculation of minimum diameter of the intake line.
A = Intake line diameter.
B = Air consumption.

Ventilation of the engine room with fresh air line to the engine

If the intake air to the engine is taken from outside the engine room, it is important to check that the temperature in the engine room does not get too high.

REQUIREMENT!

The temperature in the engine compartment must not exceed 90 °C.

Measure the temperature when the installation is complete. Refer to *01:08 Measuring instructions for installation inspection*.

If the temperature exceeds 90°C, there is a risk of malfunction in the engine electrical components and engine control unit. If there is a risk that the temperature will exceed this value, the engine room must be ventilated.

When dimensioning the engine room ventilation, other air consumers in the engine room must also be considered. The amount of radiated heat emitted by the various engines is indicated in *01:06 Technical data*.

The exhaust pipes should be insulated to reduce the radiated heat in the engine room. See *01:04 Exhaust system*.

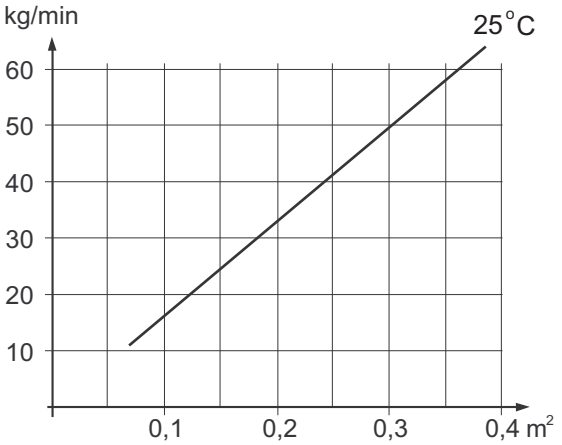
Intake air taken from engine room

When the engine intake air is taken from the engine room, the air intake must be located in the engine room. The opening area should be large enough to ensure that no vacuum arises in the engine room. The air intake should also be designed and positioned so that it cannot be closed or accidentally blocked by water, snow or contaminants.

The air intake should be located so that the intake air is as clean as possible and so that neither the engine exhaust gases nor heated air from the engine room can mix with the intake air to the engine.

In the chart on the right-hand side, the recommended minimum area for the air intake can be read from the engine air consumption.

If several engines or other air consumers are located in the same engine room, the diameter should be increased correspondingly.



Calculation of minimum air intake area.

REQUIREMENT!

The vacuum in the engine compartment must not exceed 2 mbar.

Measure the vacuum when the installation is complete. Refer to *01:08 Measuring instructions for installation inspection*.

For installations where the engine draws the intake air directly from the engine room, the engine room must normally be equipped with a ventilation system. This system should extract the air heated by radiation etc. in order for the requirement of a low intake air temperature to be met.

If there is a refrigerator compressor in the engine room, it is important that any leakage of refrigerant does not contaminate the intake air.

The radiated heat from the engine exhaust pipe downstream of the engine must also be taken into account. The heat radiation depends on how much of the line is inside the engine room and how much of it is insulated.

There is also additional heat due to efficiency losses in driven units located in the engine room.

The amount of radiated heat emitted by the engine is indicated in the tables showing the radiated heat for the relevant engine type in *01:06 Technical data* .

Ventilation requirements for gas engines

The canopy or room where the engine and gas regulator are installed must have a ventilation flow of at least 1 m^3/second. However, normally the cooling requirement and maximum temperature of the canopy or room require a significantly higher ventilation flow. If the ventilation flow is insufficient, the electric shut-off valves for fuel must be closed immediately.

In order to ensure the ventilation flow, Scania recommends monitoring the functionality of the fan. For example, this can be done with the help of monitors that check the pressure difference across the radiator, or the pressure difference between the intake air entering and outlet air exiting the canopy. The electric shut-off valves for fuel will close if a ventilation flow of less than 0.5 m^3/second is detected when the engine has started.

If the ventilation flow cannot be ensured, a gas monitor should be installed. This is to monitor the gas content of the air and close the electric fuel shut-off valves if a maximum of 10% of the ignition limit (4,400 ppmv) has been attained.

The coordinator must close the electric shut-off valves for fuel if the red engine warning light comes on, because it comes on if the engine control system detects a loss of combustion air.

Air cleaner

The engines are delivered with air cleaners with paper filters. The air cleaner is available with or without integrated self-cleaning precleaner.

If the air cleaner has a precleaner, a safety cartridge can be purchased as an option. This protects the engine from contamination, for example, if the main filter is damaged or when renewing the main filter element. An air cleaner without precleaner is not available with safety cartridge.

Bear in mind the following when installing the air cleaner:

- The air cleaner must be fitted so that it is easily accessible for cleaning and filter renewal.
- The vacuum indicator must be positioned so that it can be read easily.
- In order to be able to remove the filter element, clearance in the air cleaner extension is required. Refer to the subsequent page.
- The intake line between the air cleaner and the turbocharger must be sealed so that no unfiltered air can be drawn into the engine. The intake line must be designed in such a way that it cannot collapse onto itself as a result of a large pressure drop. The intake line should be able to withstand a vacuum of 200 mbar before it collapses onto itself.
- The material and composition of the intake line between the air filter and turbocharger must be such that it cannot release rust or objects that could damage the engine.

An effective self-cleaning prefilter is recommended for particularly dusty environments. Even engine systems exposed to driving snow can require a special type of prefilter.

For such equipment, Scania refers to filter system specialists who can give recommendations about the system which is most suitable for a particular type of engine installation.

It is also important to make sure that any insulation in the engine room and around the exhaust pipes cannot come loose and be drawn into the intake line.

If a non-Scania air filter is used, engine air consumption and filter element pore size must be considered.

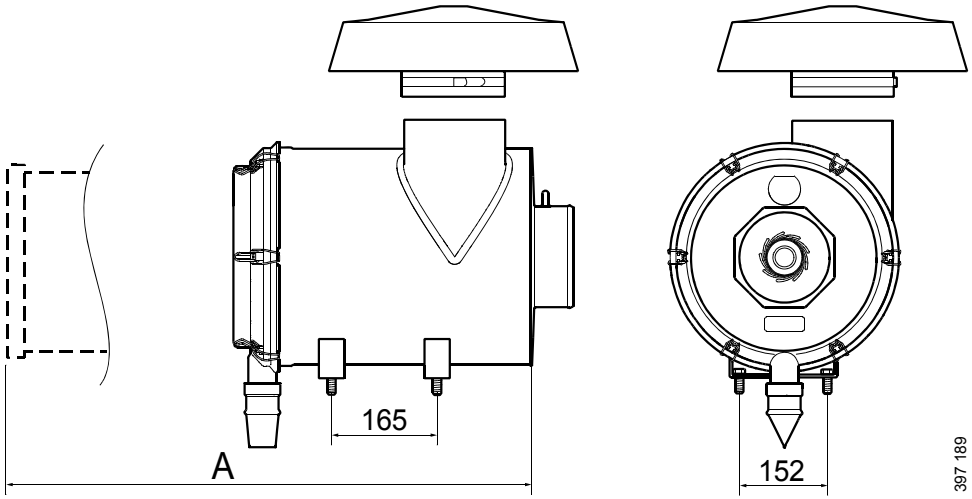
Air cleaners with precleaner

IMPORTANT!

Air cleaners with precleaners must be fitted horizontally with the drain pipe pointing downwards.

Air filters with precleaner are available in three different sizes for DC engines: 13, 15 and 18 inches. They can be ordered with or without rain protection.

A = free space required for prefilter renewal (mm).	
13 inches	900
15 inches	1,010
18 inches	1,120



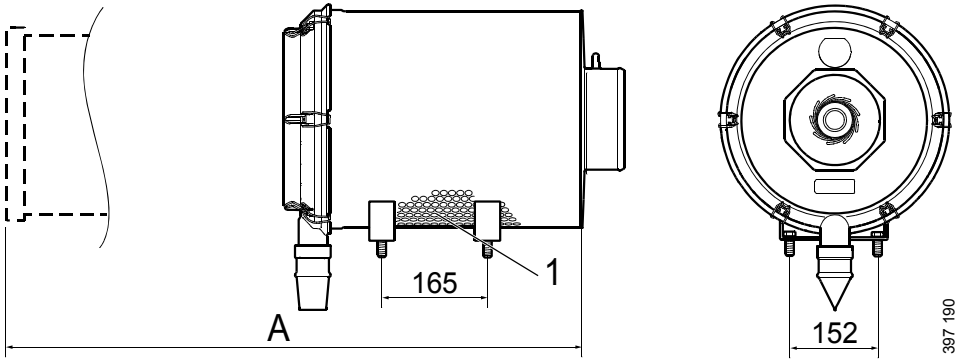
Air cleaners without precleaner

IMPORTANT!

Air cleaners without precleaners must be fitted horizontally with the air intake (1) pointing downwards. The air cleaner may also be fitted vertically, but only if it is fitted indoors or in such a way that water cannot get into the air filter. The cover should then face downwards.

Air filters without precleaner are available in two different sizes for DC engines: 13 inch and 15 inch.

A = free space required for prefilter renewal (mm).	
13 inches	900
15 inches	1,010



Crankcase ventilation

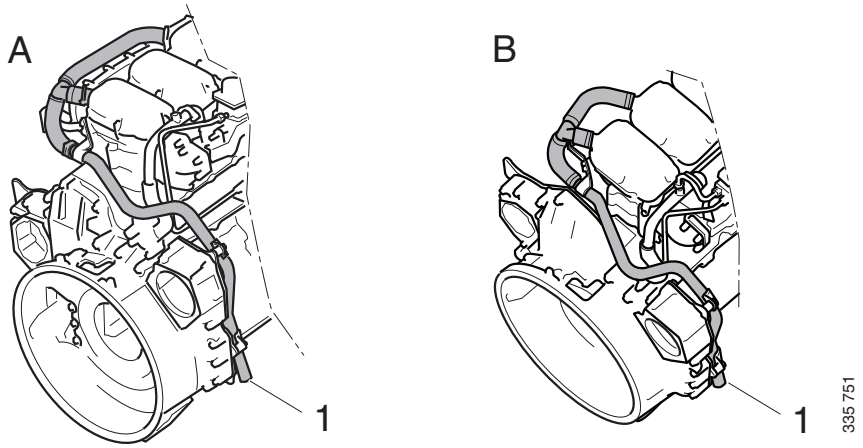
Open crankcase ventilation

If the engine is located in an enclosed space, crankcase gases should be led out of the engine room. This is especially important when the engine is equipped with a driving fan, since the crankcase gases will otherwise settle on the radiator, binding dirt and dust, which reduces the cooling effect.

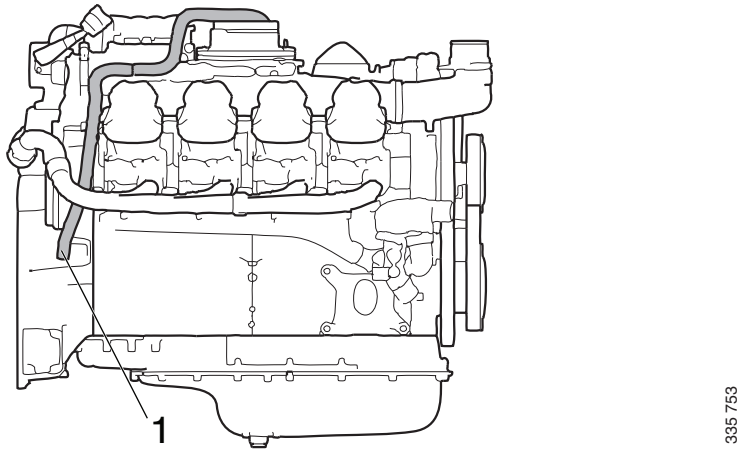
The crankcase ventilation pipe (1) has a diameter of 32 mm.

The following points are important for external ventilation of crankcase gases:

- The crankcase gases must not be led to outlet ducts for engine room ventilation or exhaust gases.
- The crankcase ventilation lines from multiple engines must not be joined to form a single pipe.
- The crankcase ventilation line should be made from pipe or oil-resistant hose, connected to the ventilation pipe on the engine.
- When the crankcase ventilation line is extended in cold environments, it must be designed to ensure that condensation cannot freeze in the hose. The extension of a crankcase ventilation line may need to be insulated.
- When the crankcase ventilation line is extended, the extension must be designed to ensure that no pockets are formed. It must also have a continuous downward slope so that it can neither freeze nor can oil accumulations form resulting in too high a pressure in the crankcase.
- Any crankcase ventilation pipe with its outlet outside the engine room must be protected so that no water or contaminants can get into the crankcase.
- If pipe is used, there should be a flexible, oil-resistant line between the engine and pipe to absorb the engine movements.
- If hose is used, it must be clamped so that no sharp kinks are formed.
- The crankcase ventilation pipe outlet must not be positioned where there is a risk of it becoming blocked.



Open crankcase ventilation
A. DC09.
B. DC13.



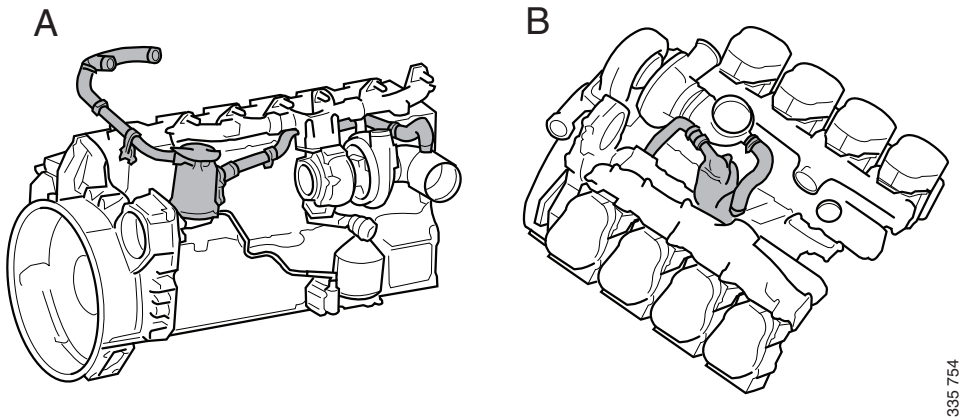
Open crankcase ventilation, DC16

Closed crankcase ventilation

For certain engine systems, external ventilation of crankcase gases could be extensive and expensive. This applies, for example, to generator sets in large buildings where very long evacuation pipes are required. Gas engines always have closed crankcase ventilation.

When there are special requirements for closed crankcase ventilation, e.g. for environmental reasons, it is permissible to allow the crankcase gases to be led to the intake line between the air filter and the turbocharger.

It is not permissible to lead the crankcase gases to the intake upstream of the engine air filter.



Closed crankcase ventilation
A. DC09, DC13
B. DC16, OC16

Connection to turbocharger

Cleanliness requirements

IMPORTANT!

Observe the utmost cleanliness when installing all parts from the air filter up to the turbocharger. If foreign particles enter the turbocharger, this could quickly lead to impaired performance and breakdown.

Do not remove the protection from the turbocharger inlet pipes and charge air pipe before they are connected.

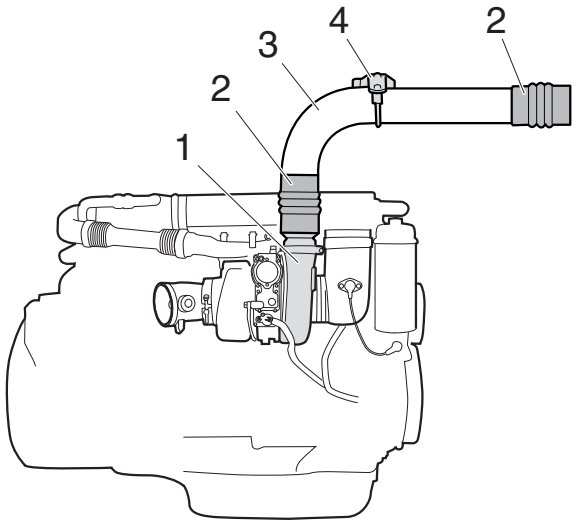
Charge air pipe

The installation of the charge air pipe recommended by Scania for DC engines is shown in the illustration.

IMPORTANT!

Position a flexible hose as close to the turbocharger connection as possible to reduce forces and torques.

The weight of the charge air pipe must not put any load on the turbocharger. Therefore, support the charge air pipe downstream of the turbocharger connection with a sturdy bracket.



Recommended installation of charge air pipe, DC engines.

1. *Turbocharger*
2. *Flexible hose*
3. *Charge air pipe*
4. *Bracket*

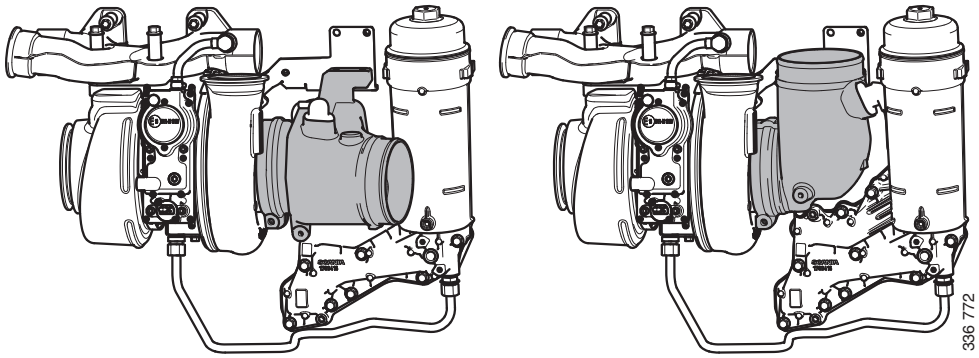
Stage IV/Tier 4f engines

Inlet pipe for connection to turbocharger

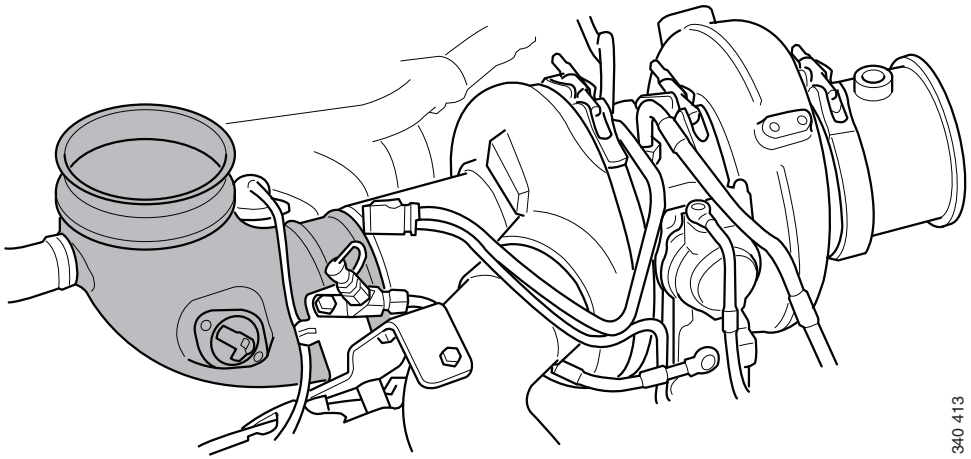
The Scania inlet pipes for connection to the turbocharger must be used on all engines certified according to Stage IV/Tier 4f. The inlet pipes are available in two different versions for DC09 and DC13, and in one version for DC16.

Combined sensor T4000 for measuring atmospheric pressure and temperature is positioned in each version of the inlet pipe.

Tightening torque for the clamp joint connected to the turbocharger: 20 Nm. Applies only to DC09 and DC13.



Inlet pipes for DC09 and DC13.

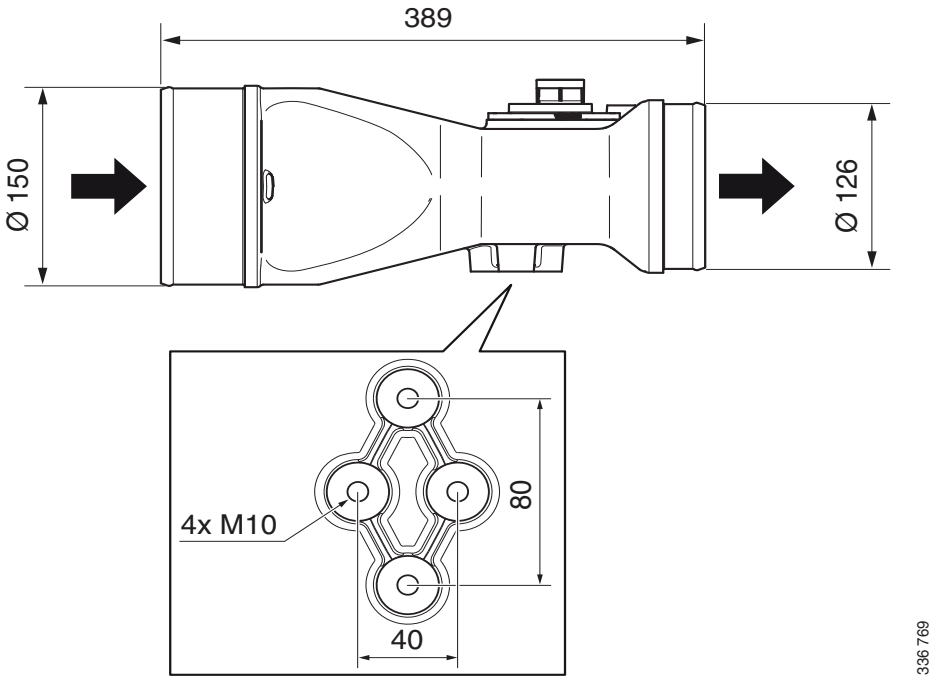


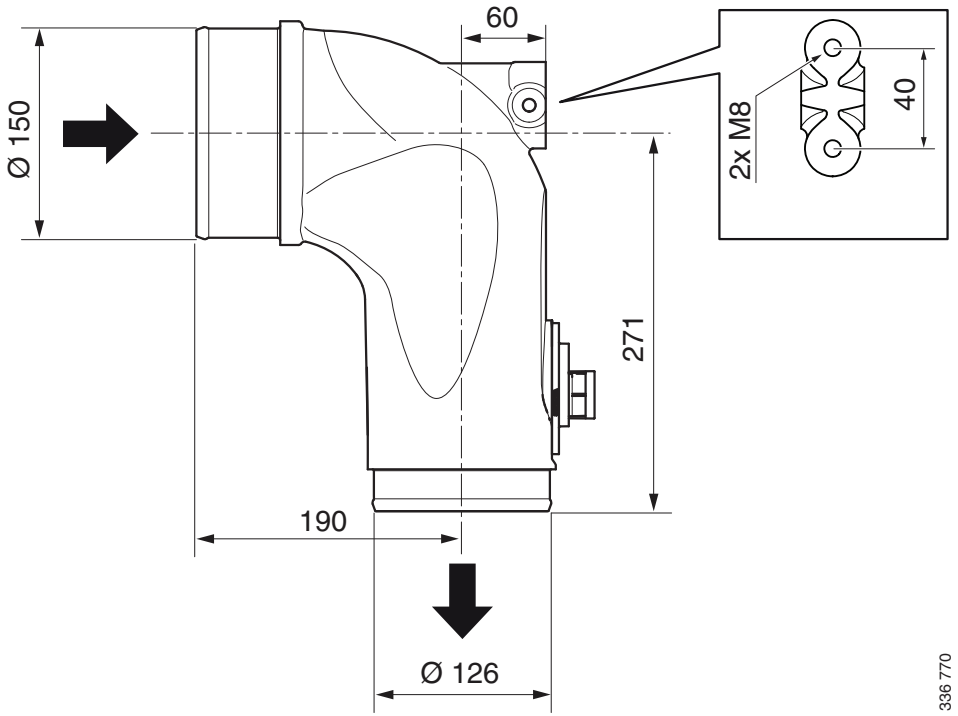
Inlet pipe for DC16.

Mass flow sensor pipe

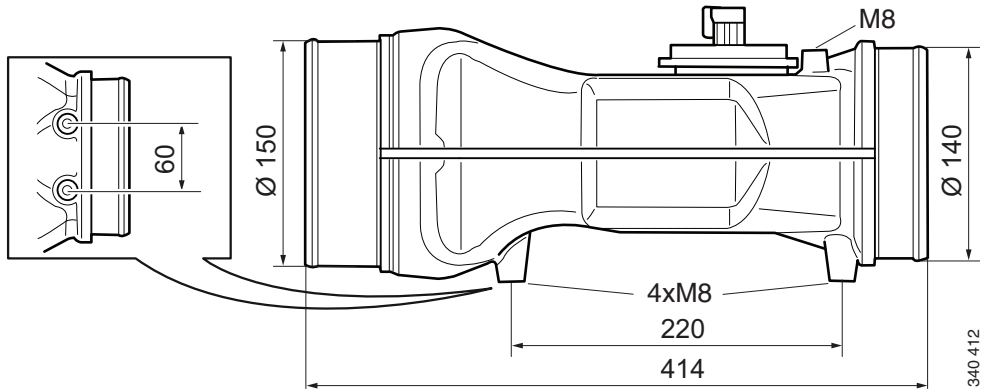
All engines certified according to Stage IV/Tier 4f are supplied with an inlet pipe with a mass flow sensor T126. The mass flow sensor pipes are available in 2 different versions for DC09 and DC13, and in 1 version for DC16.

The dimensions and air direction for the mass flow sensor pipes are shown in the illustrations below.





Mass flow sensor pipes for DC09 and DC13

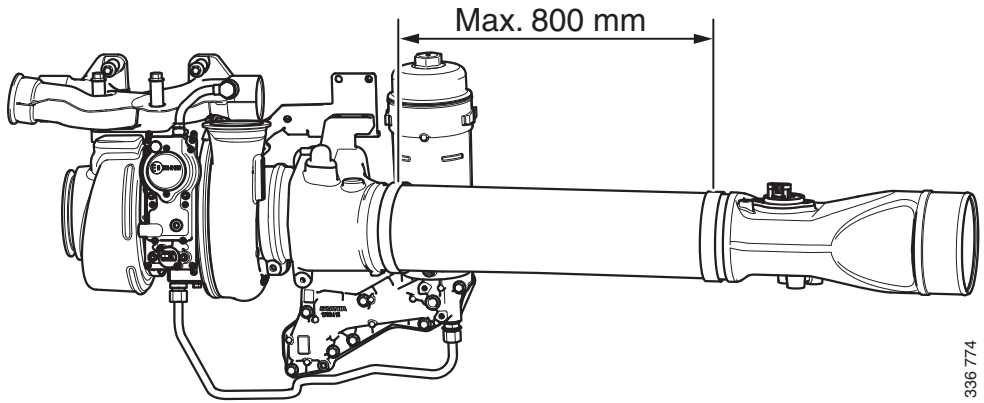


Mass flow sensor pipe for DC16

In order to get the best possible measured value when measuring the mass flow, the following recommendations for the installation of all types of mass flow sensor pipes apply:

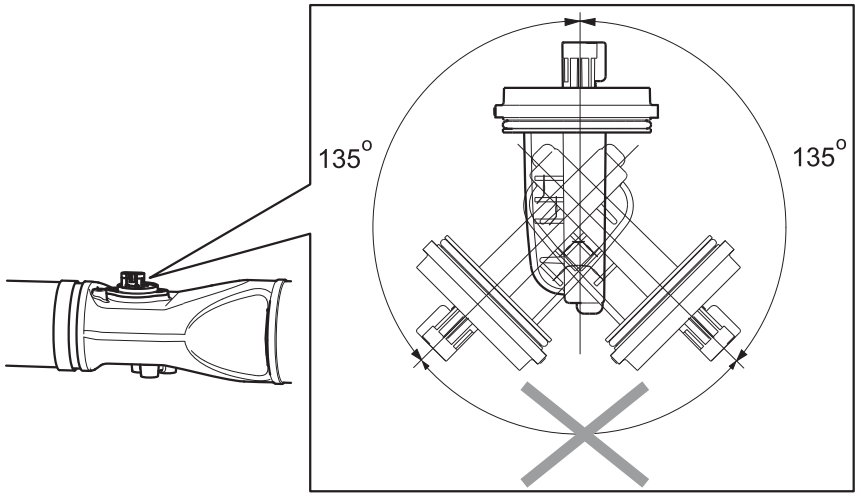
- Install the mass flow sensor pipe as near to the turbocharger as possible.
- Use pipes between the turbocharger and the mass flow sensor pipe as far as possible.
- Make pieces of hose as short as possible.
- Maximum distance between the inlet pipe and mass flow sensor pipe is 800 mm. This applies to all combinations of inlet pipes and mass flow sensor pipes.
- Use hose which is rigid enough that it does not collapse onto itself.
- Support the mass flow sensor pipe so that the weight of the pipe is not resting on the turbocharger.

Tightening torque for hose clamps: 5 Nm.

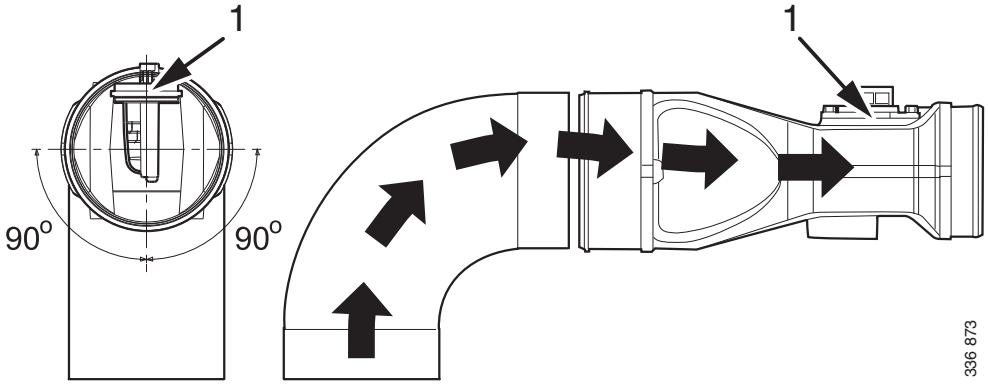


Maximum distance between the inlet pipe and mass flow sensor pipe

- The switch of the mass flow sensor must not be on the underside of the mass flow sensor pipe where it may come into contact with condensation and dirt. See illustration.



- If a pipe bend is installed upstream of the mass flow sensor pipe, the outer radius of the pipe bend must be on the same side as the measuring body of the mass flow sensor ±90°. The airflow must hit the measuring body of the mass flow sensor (1).



The relationship between the pipe bend and mass flow sensor pipe if a pipe bend is installed upstream of the mass flow sensor pipe

Important data

Max. recommended temperature for engine intake air	30°C
Requirements which must be met for the fresh air line so that the vacuum does not need to be checked	Length: max. 5 m Inner diameter: at least 210 mm.
Maximum permissible vacuum in the intake system with cleaned or new filter	
16 litre single-speed engines	40 mbar
Other engines	30 mbar
Maximum permissible vacuum in the intake system with blocked filter	65 mbar
Maximum temperature in the engine compartment when the intake air is taken from outside the engine compartment	90°C
Max. permissible vacuum in engine compartment (pressure difference)	2 mbar