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Indirect charge air cooling circuit

General

The efficiency of the engine can be further increased by increasing the air density by means of a separate charge air cooling circuit that is independent from the engine cooling circuit.
The components of the indirect charge air cooling system fulfil the requirements that need to be mastered for increasing engine performance with reduced emissions: a higher charge air pressure with a higher air density and a reduced intake temperature.
The charge air cooler design continues to enable a so-called "downsizing" with consequential reduction of the fuel consumption; moreover it is robust and withstands an ever-increasing charge air pressure.
The NOx emissions arising during combustion are clearly reduced by improved cooling of the charge air. This contributes to the maintenance of the existing and future emission standards for passenger and commercial vehicles.

Fig. 1

Design/mode of operation

The charge air cooling circuit consists of the following main components: Charge air coolant cooler (Fig. 1), low temperature coolant cooler (Fig. 2) and the coolant pump (Fig. 3).
In an indirect charge air cooler, the charge air is not cooled by air as is usual, but by a fluid coolant, a water-glycol mixture as is also used for engine cooling. The charge air waste heat is first transferred to the coolant and then discharged to the ambient air in a low temperature coolant cooler. This system has the advantage that a situation-related tempering of the compacted intake air is possible via variable charge air cooling. This in turn contributes to an optimum

Fig. 2

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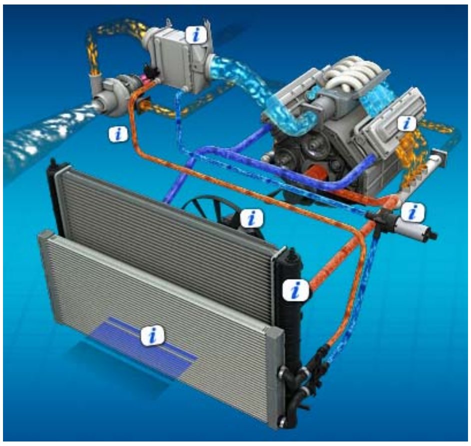
operating temperature of the engine. For diesel engines it additionally leads to an accelerated regeneration of the particulate filter.
The installation position of charge air coolers can be almost freely chosen. Due to the low construction volume, the intake tract and the charge air cooler can form a unit. The low temperature cooler is situated in the front end of the vehicle. It requires considerably less space than the conventional charge air cooler. Furthermore, the voluminous charge air lines are no longer required.


Fig. 3

The charge air cooler is supplied with the cooled coolant coming from the low temperature cooler via the charge air coolant pump
The hot air compressed by the turbocharger is cooled down upon flowing through the charge air coolant cooler by transferring the waste heat to the coolant.
The coolant heated up in this way is then forwarded from the charge air coolant cooler to the low temperature coolant cooler.
The heated air coming from the charge air coolant cooler is directed through the low temperature coolant cooler and cooled down by the airstream.
The cooled coolant is forwarded to the charge air coolant cooler by means of the coolant pump.



Effects in the event of failure / causes

Indirect charge air coolant cooler

A failure may become noticeable as follows:

- Increase in the combustion temperature
- Loss of engine power
- Increase of NOx emissions

- Loss of coolant
- Noises (false air)

The causes of a defect may be:

- Interior contamination (corrosion, foreign bodies)
- Loss of coolant
- Damaged/blocked coolant connections
- Damaged/loose charge air lines

Low temperature coolant cooler

A failure may become noticeable as follows:

- Loss of engine power
- Increase in the combustion temperature
- Increase of NOx emissions
- Loss of coolant

Possible causes of a defect may be:

- Loss of coolant
- Damaged/blocked coolant connections
- External damage (stone chipping/accident)
- Reduced air flow (surface soiled)
- Interior contamination (corrosion, foreign bodies)

Electric coolant pump

A failure may become noticeable as follows:

- Loss of coolant
- Noises
- Insufficient power

The causes of a defect may be:

- Leaks
- Blockages (corrosion, sealant)
- Electrical faults (short circuit, interruption, actuation)