

Delphi Liquid Cooled Charge Air Coolers

Delphi Liquid Cooled Charge Air Coolers (LCCACs) include a portfolio of liquid cooled heat exchangers that offer flexibility in their installation and help vehicle manufacturers to meet future targets for reduced CO₂ emissions and improved fuel economy. These liquid cooled charge air coolers cool the compressed air going to the engine and are integrated with the air intake and exhaust systems. LCCACs are an addition to Delphi's existing range of air cooled charge air coolers, covering a wide range of advanced powertrain cooling applications for global vehicle manufacturers of both gasoline and diesel engines.

Delphi LCCACs have high design flexibility to meet packaging constraints with several available options:

- Tube and center
- Tube and shell
- Plate type



Plate type Delphi Liquid Cooled Charge Air Cooler for gasoline engines

In order to combine reduced CO₂ emissions, improved fuel economy and maximum driver satisfaction, vehicle manufacturers are turning to downsized engines, boosted by turbo- or super-charging, to give the performance feel of a larger engine with the emissions and fuel savings of a smaller one. Because boosting compresses the air entering the engine (the charge), it significantly increases the charge temperature, which greatly reduces combustion efficiency, eroding the performance improvement. This issue can be addressed by introducing a charge cooler into the intake system.

After the air compression process that occurs in a turbo- or super-charged engine, cooling the engine intake air with a coolant-to-air heat exchanger offers many benefits over conventional air-to-air charge air coolers. Delphi LCCACs are designed to cool this air to further improve its density, allowing more air mass flow to the engine. This makes the combustion more efficient, resulting in better engine performance, lower exhaust emissions and fuel economy.

► Benefits

- Contribute to fuel economy and emissions reduction
 - High thermal capacity helps to limit NO_x peak emissions during transient driving conditions
 - During partial load conditions, coolant flow can also be limited to reduce charge air density allowing a greater opening of the throttle valve, which helps to reduce engine-pumping losses
- Increased performance and improved engine response
 - Engine response time during acceleration is improved because of the smaller volume of air between the induction device and engine and the high-transient thermal capacity of the liquid cooled system (high torque at low RPM)
 - Smaller volume of intake air between the boosting device and the engine in a liquid cooled system can pick up speed more quickly and the intake air stays cooler during acceleration because a liquid cooled charge cooler heats up more slowly

- Flexibility in installation
 - Allows the coolers to be incorporated into the ducting between the boosting device and the engine or integrated into the intake manifold, minimizing air-pressure losses through the cooler and improving engine bay layout
 - Can be implemented stand alone everywhere in the engine
- Superior engine bay packaging
 - Heat exchangers can be modified for specific applications to fit any size and shape of engine
 - Compact
 - Eliminates large diameter elastomeric tubing needed to route the charge air to and from the cooler

▶ **Typical Applications**

Delphi Liquid Cooled Charge Air Coolers are designed for the intake systems of both gasoline and diesel engines. They can be applied to most turbocharged/supercharged engines, from small cars to light duty trucks. Delphi's wide range of heat exchangers can be modified for specific applications to fit any size and shape of engine, allowing for greater automaker flexibility and packaging.

▶ **The Delphi Advantage**

Delphi has developed technical expertise in powertrain cooling systems, including engine development and simulation capabilities. In addition to liquid and air-to-air charge air coolers, Delphi offers other powertrain cooling technologies, including:

- Condensers
- Oil coolers
- Powertrain cooling modules
- Radiators

Delphi offers compact, cost effective powertrain cooling solutions to meet higher emissions and performance targets, through its global manufacturing footprint.