

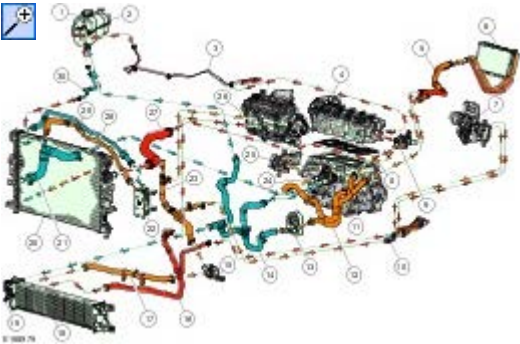
Description and Operation

Complete Cooling System

The 1.5L GTDi EcoBoost engine uses two separate cooling systems:

- The engine cooling system
- The CAC (charge air cooler) cooling system

These systems operate independently of one another, but share a common expansion tank. Due to the complexity of the entire cooling system, it is best to focus on the cooling subsystems individually:



Item	Description
1	Pressure relief cap
2	Expansion tank
3	Expansion tank-to-engine hose
4	Cylinder head
5	Heater hose assembly
6	Heater core
7	Turbocharger
8	Cylinder head gasket
9	Coolant outlet adapter
10	Turbocharger tube assembly
11	Cylinder block
12	Heater outlet hose assembly
13	Oil cooler
14	Expansion tank return hose assembly
15	Charge air cooler coolant pump
16	Charge air cooler outlet hose
17	Charge air cooler feed hose
18	Charge air cooler radiator
19	Charge air cooler coolant temperature sensor
20	Radiator
21	Lower radiator hose
22	Transmission oil cooler
23	Charge air cooler inlet hose
24	Thermostat housing
25	Coolant pump
26	Charge air cooler
27	Upper radiator hose
28	Transmission cooler outlet hose
29	Transmission cooler inlet hose
30	Expansion tank-to-radiator hose

Engine Cooling System

The engine cooling system uses a mechanically driven coolant pump incorporating a electromagnetic drive clutch to

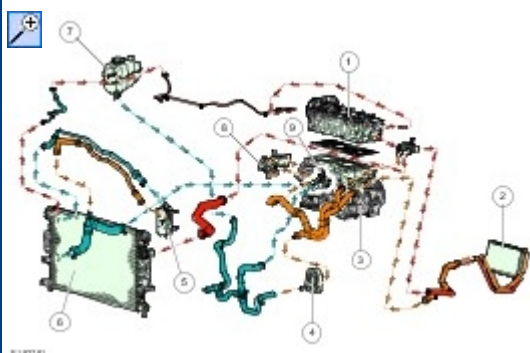
circulate coolant through the engine. Coolant flow to the radiator is controlled by a thermostat which is mounted to the cylinder block flange located at the rear of the water pump.

The engine cooling system also provides coolant for the climate control system heater core, and the engine oil cooler.

Additional airflow through the radiator is provided by electric cooling fans.

The main components of the engine cooling system are:

- Mechanical coolant pump with electromagnetic clutch
- Thermostat
- ECT (engine coolant temperature) sensor
- Radiator
- Heater core
- Engine oil cooler
- Electric cooling fans
- Expansion tank and cap



Item Description

- | Item | Description |
|------|-------------------------|
| 1 | Cylinder head |
| 2 | Heater core |
| 3 | Cylinder block |
| 4 | Engine oil cooler |
| 5 | Transmission oil cooler |
| 6 | Radiator |
| 7 | Expansion tank |
| 8 | Mechanical coolant pump |
| 9 | Thermostat |

Charge Air Cooling System

The CAC cooling system is quite different to that fitted to other turbocharged engines. It features a water to air charge air cooler which is integrated into the engine's inlet manifold and it has separate coolant system to cool the charge air.

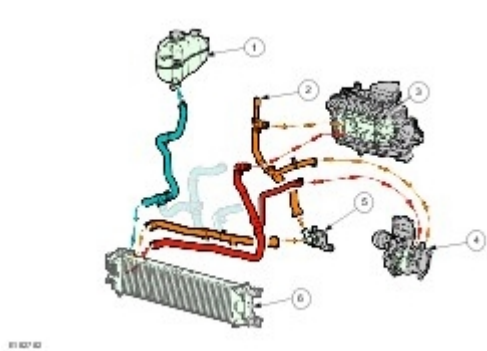
The coolant system for the CAC cooler, even though it shares the expansion tank with the engine coolant system, functions independently of the engine's cooling system having it's own radiator, coolant pump, and temperature sensor

NOTE: The CAC cooling system also supplies coolant to the TC (turbocharger)

The main components of the charge air cooling system are:

- CAC
- CAC cooling system radiator
- Electric coolant pump
- Bleed valve
- Coolant temperature sensor





Item	Description
1	Expansion tank
2	Bleed valve
3	CAC
4	TC
5	Electric coolant pump
6	CACcooling system radiator

Cooling System Components

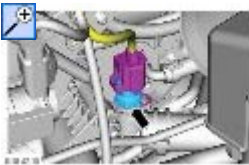
Thermostat



The thermostat controls the coolant flow to the radiator. It is installed in the thermostat housing which is mounted to the cylinder block flange located at the rear of the water pump.

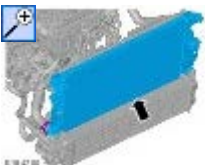
The thermostat is a wax pellet type thermostat that is immersed in coolant. The thermostat starts to open at 82°C and is fully open at 97°C, allowing coolant to flow through the radiator.

Engine Coolant Temperature Sensor



The ECT sensor measures the temperature of the system's coolant. It is located on the water connection outlet housing which is mounted to the back of the cylinder head.

Radiator



The engine cooling system radiator cools engine coolant. The radiator is mounted at the front of the engine compartment.

Heater Core





The heater core uses hot engine coolant to heat the vehicle cabin. The heater core is mounted in the heater box. The heater core is an aluminium finned heat exchanger. Coolant flow to the heater core is constant and the cabin temperature is controlled internally in the heater box by blend doors.

Engine Oil Cooler



The oil cooler will use coolant to heat or cool engine oil depending on engine temperature. The engine oil cooler is mounted to the side of the engine block.

On engine warm up coolant will heat up more rapidly than engine oil. The warmer coolant will heat the engine oil increasing its viscosity and reducing friction during the warm up phase. Once the engine is at operating temperature engine oil will normally be hotter than coolant. At this stage the coolant cools the hotter engine oil.

NOTE: Coolant flow through the engine oil cooler is constant.

Electric Cooling Fans



Electric cooling fans provide additional airflow through the radiator to prevent overheating at low road speeds or when the vehicle is stationary. The electric cooling fans are mounted to the inside of the radiator.

The electric cooling fans speed can be variably controlled by the PCM (powertrain control module) depending on engine coolant temperature. The electric cooling fans only operate when required and the higher the coolant temperature is the faster the fans will spin.

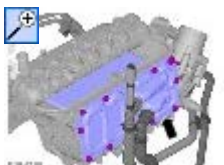
Expansion Tank and Cap



The expansion tank is a coolant reservoir which has a cap with an integrated pressure relief valve. The expansion tank and cap is located in the engine compartment.

NOTE: The expansion tank and cap is used for both the engine and charge air cooling circuits.

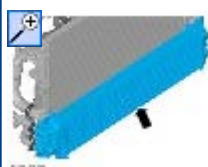
Charge Air Cooler



The CAC cools the incoming charge air from the turbocharger. Cooling the charge air increases its density which adds additional gains in power and torque to turbocharging. The CAC is integrated into the inlet manifold.

The **CAC** in the 1.5L EcoBoost GTDi is different to other engines. It is a water to air intercooler which means that it uses coolant to cool the hot charge air. It's operation is similar to an engine radiator however instead of using air to cool coolant it is using coolant to cool air.

Charge Air Cooling System Radiator



The **charge air cooling system radiator** cools the hot coolant which exits the **CAC**. The **CAC** radiator is mounted at the front of the engine in front of the engine radiator and is independent of the engine radiator. Having an independent radiator for the charge air system allows for cooler charge air temperatures as compared to cooling the charge air with the engine coolant system. Cooler charge air temperatures result in increased engine power and torque as well as efficiency.

NOTE: When the engine is at its operating temperature the charge air cooling system radiator will be cooler than the engine's radiator.

Charge Air Cooling System Electric Coolant Pump



The **charge air cooling system electric coolant pump** circulates coolant throughout the charge air cooling system and is mounted to the engine's oil pan at the flywheel end of the engine.

The electric coolant pump is required for the charge air cooling system as it functions independently from the engine's cooling system and circulates coolant from the charge air cooling system's radiator to both the charge air cooler and turbocharger. The heated coolant then returns to the cooling system's radiator.

Charge Air Cooling System Bleed Valve



The **charge air cooling system bleed valve** is used to purge air from the charge air cooling system after cooling system repairs or coolant replacement and is located at the charge air cooler hoses at the inlet manifold.

Charge Air Coolant Temperature Sensor



The **charge air cooling system coolant temperature sensor** measures the temperature of the system's coolant. It is located on the LH side of the charge air system radiator.

NOTE: The charge air cooling system also supplies coolant to the turbocharger.