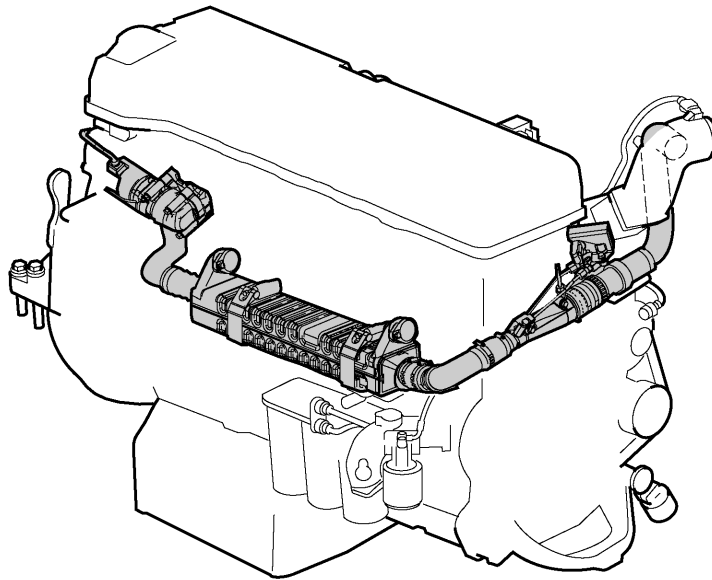


EGR System
Design and Function
D16F

EGR System, Design and Function



W2005836

This information covers design and function of the Exhaust Gas Recirculation (EGR) system on a Volvo D16F engine.

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Note: Information is subject to change without notice. Illustrations are used for reference only, and may differ slightly from the actual engine version. However, key components addressed in this information are represented as accurately as possible.

Design and Function

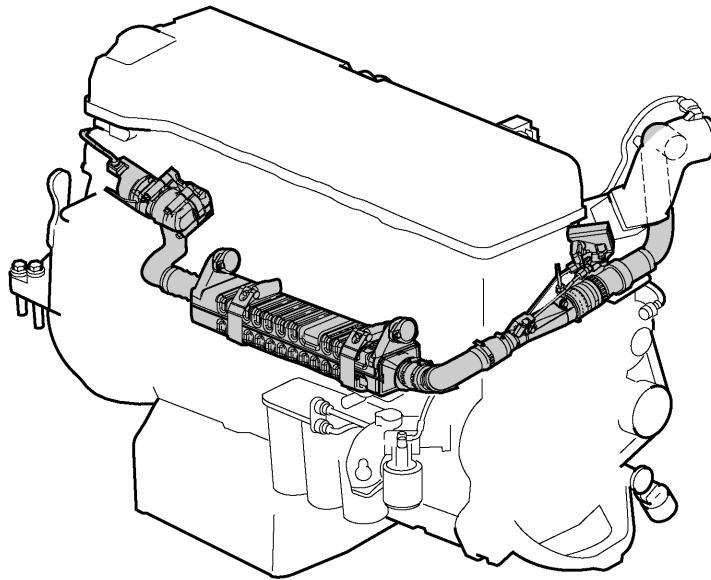
Exhaust Gas Recirculation System

Nitrous oxide (NOx) emission levels increase with combustion chamber temperatures. The primary function of the Exhaust Gas Recirculation (EGR) system is to cool exhaust gas and recirculate exhaust gases back to the combustion chamber to lower the combustion temperature, thereby reducing nitrous oxide (NOx) emissions.

A portion of the exhaust gas is redirected by the EGR valve from the exhaust manifold into the EGR cooler.

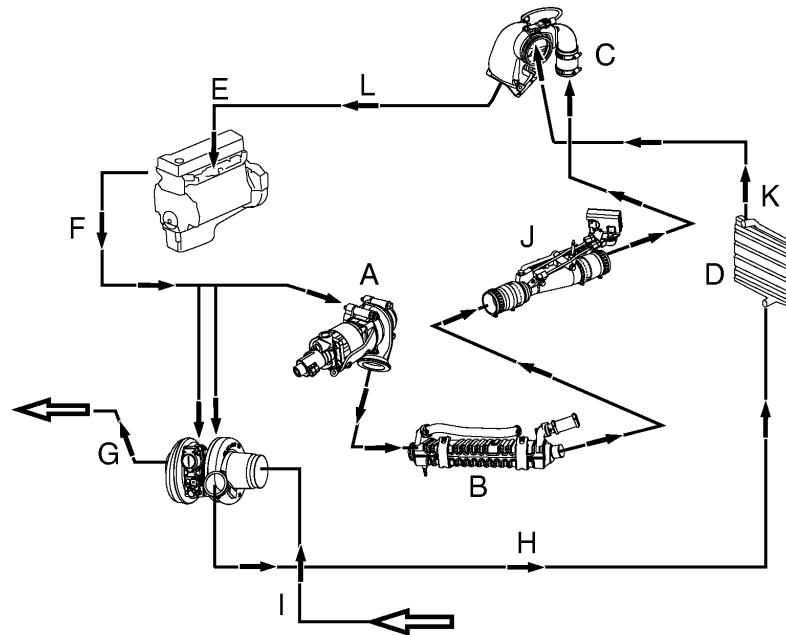
Cooled EGR gases flow into the mixing chamber, where they mix with the intake air that has been cooled through the charge air cooler. From the mixing chamber, the combined EGR gases and intake air flow into the intake manifold.

The amount of recirculated EGR gases is controlled by the EGR valve and depends on differential pressure measured at the EGR venturi pipe, engine RPM, engine load and coolant temperature. Maximum EGR flow is used under high engine loads.



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Overview



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A	EGR valve
B	EGR cooler
C	Mixing chamber
D	Charge air cooler
E	Intake manifold
F	Exhaust gases from exhaust manifold

G	Main exhaust
H	Charge air
I	Air inlet
J	EGR venturi pipe
K	Cooled charge air
L	Charge air/exhaust gas mixture

A portion of the exhaust gas is redirected by an EGR valve (A) from the exhaust manifold into the EGR cooler (B).

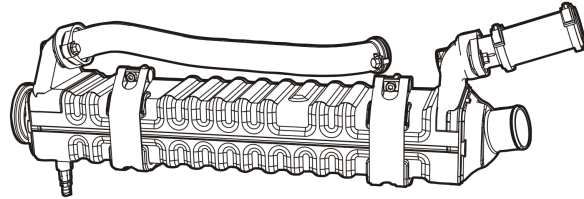
Cooled EGR gases flow into the mixing chamber (C), where they mix with intake air that has been cooled through the charge air cooler (D). From the mixing chamber, the combined EGR gases and intake air flow into the intake manifold (E).

The amount of recirculated EGR gases is controlled by the EGR valve and depends on differential pressure measured at the EGR venturi pipe, engine RPM, engine load, and coolant temperature. Maximum EGR flow is used under high engine loads.

System Components

EGR Cooler

The EGR cooler is cooled by engine coolant and contains a series of internal pipes with vanes that allow the EGR gases to cool before they reach the mixing chamber. These vanes cause the gases to swirl, creating a higher cooling efficiency while reducing deposits.



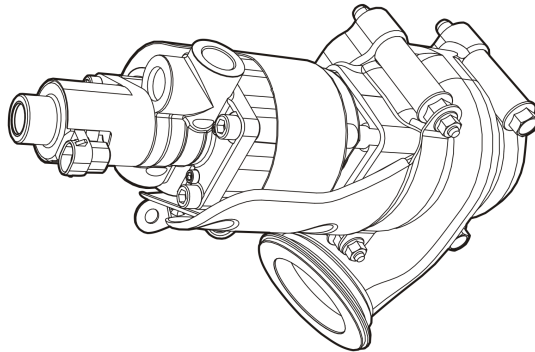
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EGR Valve

The engine uses one EGR valve to control the amount of gases being recirculated. This valve is a poppet-type valve, operated by hydraulic pressure from the engine oil system which meters exhaust gas from the exhaust manifold into the EGR circuit. The hydraulic pressure is controlled by a solenoid within the valve assembly reacting to signals from the engine ECU. An internal spool valve diverts hydraulic fluid, applying pressure to precisely position the EGR poppet valve for control of the exhaust gas circulated through the engine. The poppet valve has two sealing surfaces on a common shaft to draw gases from the front and the rear sections of the manifold simultaneously.

This valve is cooled by the engine oil lubrication system which provides oil that flows through the valve to cool it.

The EGR valve is located on the exhaust manifold for reliable response and to maintain good turbocharger efficiency. This location also protects the EGR cooler from exhaust pulses at high pressure, e.g., during engine braking.



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EGR Valve Function

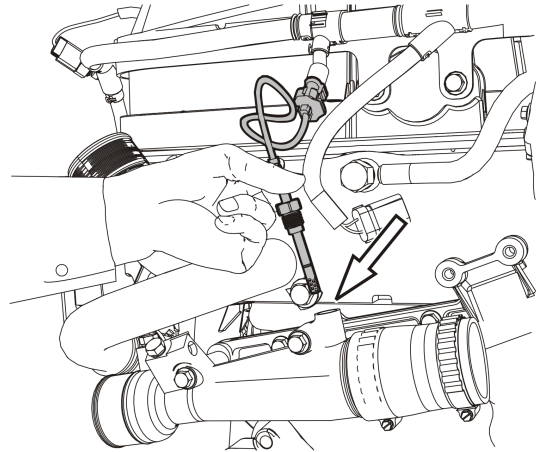
The EGR valve is normally closed with the engine coolant temperature below 50°C (122°F).

EGR valve opening occurs when engine coolant temperature is greater than 55°C (131°F), the engine load is greater than 15%, and the engine RPM is greater than 1000. The valve opens approximately 95% when these conditions are met.

For idle EGR, the engine coolant must be greater than 55°C (131°F), with the accelerator and clutch pedal at rest (manual transmission).

Temperature Sensor

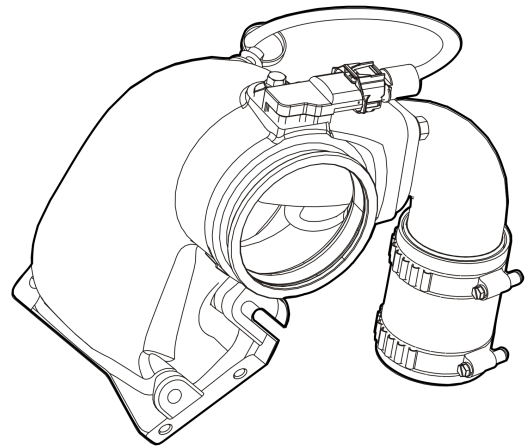
The EGR temperature sensor is now located in the venturi housing located at the front of the engine. The temperature sensor provides exhaust gas temperature information to the ECU. If temperature is excessive, or if temperature remains above high for more than 30 minutes within an hour, the ECU will limit power to protect the engine.



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EGR Mixer

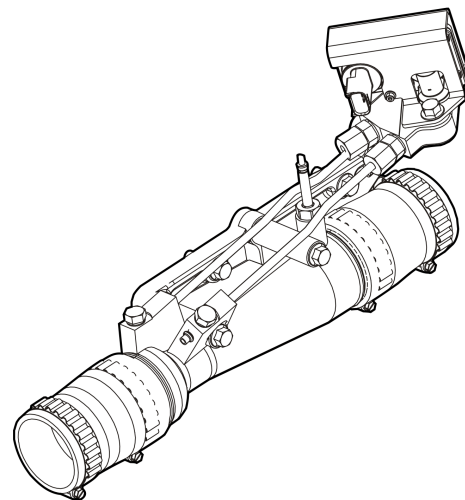
The EGR mixer is the meeting point for the cooled, recirculating exhaust gas and outside air from the charge air cooler. At this point, the combined gases pass into the inlet manifold and on to the combustion chamber.



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EGR Venturi Pipe

The venturi system replaces the Mass Flow system used on previous Volvo engines. The venturi creates high and low pressure areas in the EGR gas flow which the Delta P sensor monitors. These Delta P readings, plus other factors, allow the engine ECU to control very precise EGR valve functions. The engine ECU actuates the EGR valve open and closed positions as needed based in part on these signals.



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System Protection

Condensation

Engine corrosion can occur if exhaust gases are allowed to condense in the intake manifold. Corrosive substances can accompany the intake air and cause damage to intake valves and seats, piston rings, and cylinder liners. This means that the EGR valves are closed when the coolant temperature in the cylinder head is below 50°C (122°F).

To protect engine components from corrosion, the EGR flow is stopped in conditions where condensation might occur or where there is a risk of condensation. The engine ECU evaluates RPM and torque load, ambient temperature, inlet manifold temperature, and EGR demand. With these inputs, the EECU calculates the dewpoint in the inlet manifold and limits the EGR opening to constantly stay above the dewpoint.

To further protect the engine from wear particles, the intake manifold and mixing chamber are surface-treated to resist corrosion.

Diagnostics

The engine ECU monitors the EGR valve for short circuit, open circuit, abnormally high current, and will also detect a valve stuck in the open or closed position. If the ECU detects an EGR valve is stuck, fault codes will be set and engine power will be reduced.