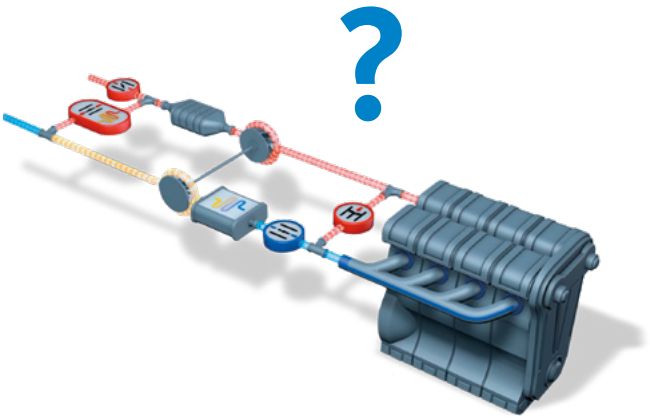
PRODUCT **INFORMATION**

HIGH-PRESSURE / LOW-PRESSURE EXHAUST GAS RECIRCULATION

WHAT IS THE DIFFERENCE?

Raw emissions from engines are continually being reduced with technical measures. But as the emission limit values keep getting tighter and tighter, the technologies in non-engine measures need to keep improving as well.



Exhaust gas recirculation (EGR) has proven to be a successful method of emission control. In the case of conventional high-pressure EGR, exhaust gas is removed immediately after the cylinder and mixed with the intake air. Additional low-pressure EGR is now commonly used to achieve the stricter limit values as of Euro 6 / Tier 2.

But what is the difference?
The table below provides a quick overview. Further information can be found on the following pages.

	High-pressure EGR	Low-pressure EGR
Inlet pressure into the EGR section	high (up to approx. 3.5 bar)	low (up to approx. 1.3 bar)
Inlet temperature into the EGR section	very high (up to approx. 950°C)	high (up to approx. 800°C)
Pressure difference Δp over the EGR section	high (up to approx. 1.5 bar)	low (up to approx. 0.3 bar)
Cyclical pressure fluctuations	high	low
Exhaust gas composition	Removal before exhaust gas after-treatment	Removal after exhaust gas after-treatment

EXHAUST GAS RECIRCULATION – AN OVERVIEW

In the case of exhaust gas recirculation, a certain amount of exhaust gas is mixed with the intake air. This means that less oxygen reaches the cylinder, leading to a lower combustion temperature. As a result, the amount of nitrogen oxides in the exhaust gas can be reduced by up to 50%. In petrol engines, this can also reduce carbon dioxide emissions and fuel consumption.

There are various positions for exhaust gas removal:

INTERNAL EGR

- Valve overlapping means that some exhaust gas remains in the combustion chamber or is sucked back into the cylinder from the outlet duct.
- The timing of the intake and exhaust valves is changed by means of adjustable cams.

EXTERNAL EGR

- Exhaust gas is removed outside the cylinder head on the exhaust gas side and is fed back via lines or ducts to the fresh air side through an external valve.
- This provides the opportunity for additional exhaust gas cooling by an optional cooler with / without bypass flap.

There are two types of external EGR:

HIGH-PRESSURE EGR

The exhaust gas is

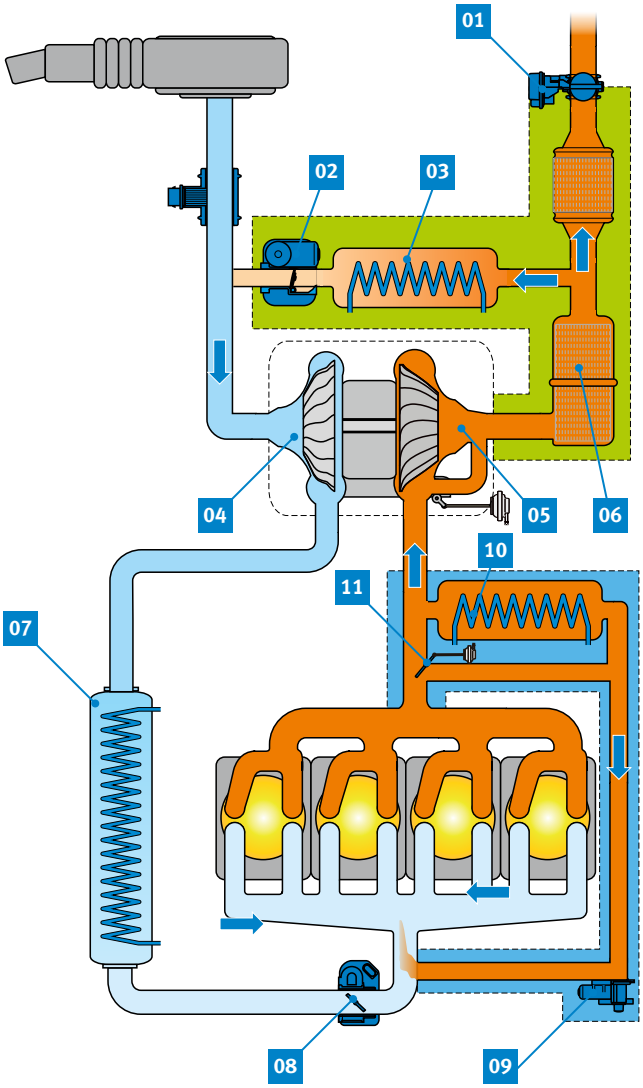
- removed immediately after the cylinders, upstream of the turbocharger turbine and
- fed back to the fresh air side after the throttle valve.

LOW-PRESSURE EGR

The exhaust gas is

- removed downstream of the turbocharger turbine or only after the exhaust treatment systems and
- fed back upstream of the turbocharger compressor.

An exhaust gas flap provides the necessary exhaust gas back pressure if the pressure difference is not sufficient for the required EGR mass flow rates. The exhaust gas is also cooled by a special low-pressure EGR cooler.



Exhaust gas recirculation (schematic)

01 Exhaust gas flap
02 Low-pressure EGR valve
03 Low-pressure EGR cooler
04 Turbocharger (compressor)
05 Turbocharger (turbine)
06 Particulate filter
07 Charge air cooler
08 Throttle valve / regulating throttle
09 High-pressure EGR valve
10 High-pressure EGR cooler
11 Bypass flap

High-pressure area
Low-pressure area

LOW-PRESSURE EGR

Low-pressure EGR represents the state of the art with regard to diesel engines.

The advantages of adding low-pressure EGR to high-pressure EGR include:

- Higher performance / efficiency of the turbine
- Larger EGR map
- More homogeneous mixing of exhaust gas with fresh air via the compressor
- Resulting in lower NO_x and particulate emissions
- Improved EGR cooling (through EGR and charge air cooler)

The disadvantages compared to high-pressure EGR include:

- Longer paths and additional components
- Possible hazard due to soiling or damage to the turbocharger compressor, e.g. through droplet impact

The low-pressure EGR valves from Pierburg generally consist of a centrally positioned flap (“butterfly”) in an aluminium pressure die-cast housing. The integrated actuating drive usually consists of a DC electric motor and a two-stage spur gear unit. Tried-and-tested assembly groups from existing throttle valve and EGR valve product lines – which have already proved their worth over years of series production – were used when designing the low-pressure valves.

The low-pressure EGR combi valve simultaneously assumes the tasks of the low-pressure EGR valve and an intake air throttle. The throttling results in a pressure gradient in relation to the intake side, causing the exhaust gas to flow into the area in front of the compressor in a controlled manner. As a combined component, the low-pressure combi valve is not only more cost-effective, but also offers the benefit of a lower weight.

Low-pressure EGR valve (butterfly)

Low-pressure EGR combi valve

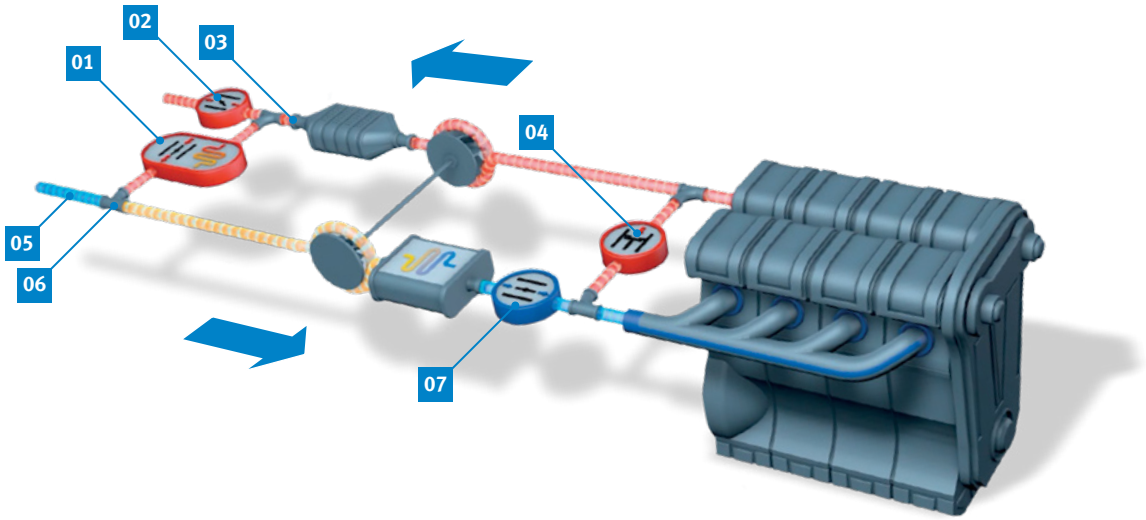
NOTE

Typical damage in the area of the low-pressure EGR includes:

- Leakages in the exhaust gas lines or the coolant line
- Leakages in or on the EGR cooler
- Low-pressure EGR valve leaks / does not open or close
- Electrical actuation of the servo motor defective

EXHAUST GAS RECIRCULATION AND PIERBURG

There's a reason why Pierburg is represented as the OEM in a large number of modern vehicles with EGR valves and EGR coolers. The corrosion and temperature-resistant materials used in the Pierburg products guarantee lasting function under the harshest conditions, e.g. aggressive exhaust gas condensate, temperatures up to 700°C and pressures up to 3 bar.



01 **EGR VALVES (LP)**

02 **EXHAUST GAS FLAPS**

03 **EXHAUST GAS SENSORS**

04 **EGR VALVES AND EGR COOLERS (HP)**

05 **AIR MASS SENSORS**

06 **EGR COMBI VALVES (LP)**

07 **THROTTLE VALVES / REGULATING THROTTLES**