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# SERVICE INFORMATION

## TROUBLESHOOTING ON THE EXHAUST GAS RECIRCULATION SYSTEM

### OF PETROL AND DIESEL ENGINES

Exhaust gas recirculation (EGR) is a tried-and-tested way of reducing emissions: adding exhaust gas reduces the oxygen content in the air-fuel mixture and lowers the combustion temperature in the cylinders. As harmful nitrogen oxides (NO<sub>x</sub>) are predominantly generated at high temperatures and pressures, this means that the emitted NO<sub>x</sub> concentrations can be reduced by up to 50%. The formation of soot particulates is also reduced by approx.

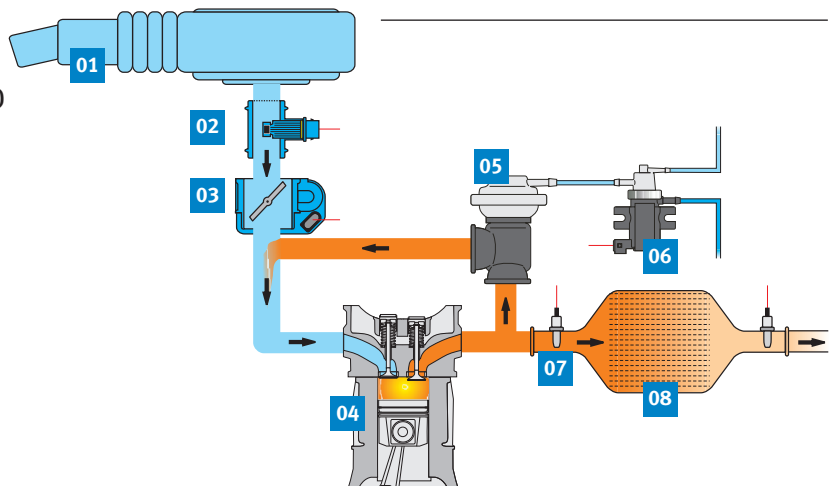
10% in diesel engines. Exhaust gas recirculation is only activated at certain operating points. Generally, for petrol engines it occurs above idling to up to the upper part load; for diesel engines, up to approx. 3000 rpm and medium load.

#### ATTENTION

For troubleshooting advice, see pages 3 and 5.

#### Principle of exhaust gas recirculation (pneumatic)

- 01 Air filter
- 02 Air mass sensor
- 03 Throttle valve/regulating throttle
- 04 Cylinder
- 05 EGR valve (here: pneumatic)
- 06 Pressure transducer
- 07 Lambda sensor (petrol)
- 08 Catalytic converter



EGR at a glance	Diesel engine (all injection types)	Petrol engine (manifold injection)	Petrol engine (direct injection)
<b>Effects</b>	Nitrogen oxides –50% Particulates –10% Fewer hydrocarbons Fewer noises	Nitrogen oxides –40% Fuel consumption –3% Less CO <sub>2</sub>	Nitrogen oxides –50 to 60% Fuel consumption –2% Less CO <sub>2</sub>
<b>Return rates</b>	Max. 65%	Max. 25%	Max. 50% (with stratified charge) Max. 30% (with homogenous operation)
<b>Miscellaneous</b>	EGR cooling is required for vehicles in a higher weight class	EGR cooling in discussion	High EGR rates with high load

All content including pictures and diagrams is subject to change. For assignment and replacement, refer to the current catalogues or systems based on TecAlliance.



## EXHAUST GAS RECIRCULATION (EGR) COMPONENTS

The EGR valve doses the amount of exhaust gas returned. It is installed either at the exhaust manifold or the intake air system. Or it is located in a heat-resistant exhaust pipe which connects the exhaust manifold to the intake air system.

Pneumatic EGR valves are actuated via electric valves using a vacuum: in simple systems with a switchover valve, the EGR valve

only has an open/close function. In systems with a pressure transducer, the EGR valve can be continuously adjusted. The vacuum is taken from the intake manifold or generated by a vacuum pump.

Electric or electromotive EGR valves are controlled directly by the control unit and do not require a vacuum or solenoid valve.



Due to the high return rates involved, EGR valves in diesel vehicles have large opening cross-sections.

- 01** Pneumatic EGR valve
- 02** Pneumatic EGR valve with position detection
- 03** Electric EGR double poppet valve



With EGR valves in petrol engines, the cross sections are much smaller.

- 04** Electric EGR valve with connection to the coolant circuit
- 05** Pneumatic EGR valve
- 06** Electric EGR valve



Pneumatic EGR valves are actuated using electric valves.



The air mass sensor is required in diesel engines to regulate the exhaust gas recirculation, for example.



In diesel vehicles, the difference in pressure between the exhaust and intake side is not sufficient for the high exhaust gas recirculation rates. As a result "regulating throttles" are placed in the intake manifold to generate the vacuum required.



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## TROUBLESHOOTING ADVICE

The most common causes of faults in the EGR system are stuck or carbonised EGR valves. In addition to harmful gases, the returned exhaust gas also contains soot particulates – this applies to diesel vehicles in particular. Carbon deposits and sticking are often the result. From a certain point, the strength of the EGR valve is no longer enough – it can no longer open or remains stuck in an open position. This causes jerking, irregular idling and a lack of power.

The causes of extremely oily intake or charge air may be faults in the crankcase ventilation, worn bearings, a blocked oil return line on the turbocharger, worn valve stem seals and guides, the use of an unsuitable engine oil grade or an engine oil level that is too high. Unusually high deposits may also be caused by faults in the injection.

Even though EGR valves are designed for the high temperatures in the exhaust tract, there may occasionally be heat damage on the valve. The causes of this may be incorrect actuation, exhaust gas back pressure that is too high, or a blow-off valve (wastegate valve) in the turbocharger that does not open. The system may also have been manipulated (“tuning”) to increase the boost pressure.

In the case of pneumatic EGR valves, the cause of faults may be found in the entire area of the vacuum control (vacuum pump, vacuum lines, solenoid valves).

Electric EGR valves and solenoid valves can mostly be actuated by the engine tester via an actuator diagnosis. A functioning valve switching can easily be heard when the engine is stopped.

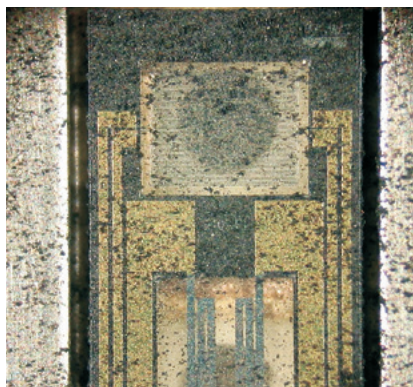
If, following damage, a new EGR valve is installed but the vehicle still behaves as if the valve had not been changed, the map data necessary for operation must be “learnt” again. This can be achieved during a relatively long test run or by a special engine tester program point, for example “basic settings”.

### **ATTENTION**

We advise against cleaning the EGR components! If a component is already faulty, no improvement will be achieved by cleaning it. If functional components are treated in this way, they may be damaged by the cleaning process. A faulty component should always be replaced with a new one.



As EGR valves do not become sooty of their own accord, the cause of the soot must be sought.



Salt and dirt can damage the sensor of an air mass sensor – or at least distort the measurements, which in turn can have an effect on the EGR.



Whether pneumatic EGR valves or a pressure transducer like here – the function can easily be checked using a vacuum hand pump.

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**TROUBLESHOOTING IN EXHAUST GAS RECIRCULATION  
PROBLEM DUE TO EGR VALVE**

Problem	Possible cause	Remedy
<ul style="list-style-type: none"> <li>• Irregular idling</li> <li>• Jerking</li> <li>• Lack of power</li> <li>• Limp home function</li> <li>• MIL illuminated/fault code set</li> <li>• Lack of power in lower engine speed range or in cold running range (petrol)</li> <li>• Lack of power in upper engine speed range (diesel)</li> </ul>	<p>In general: carbonised/stuck EGR valve</p> <ul style="list-style-type: none"> <li>• Poor, unclean combustion</li> <li>• Errors in the engine management</li> <li>• Frequent short-distance drives</li> <li>• Leaking in the vacuum system</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Defective solenoid valves</li> <li>• Faults in vacuum system</li> </ul> <hr/> <p>Extremely oily intake or charge air:</p> <ul style="list-style-type: none"> <li>• Faults in the crankcase ventilation</li> <li>• Engine oil level too high</li> <li>• Poor engine oil grade</li> <li>• Worn valve stem seals and guides</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Air mass or other sensor signal faulty</li> </ul>	<ul style="list-style-type: none"> <li>• Check engine control</li> <li>• Check software version of the engine control unit</li> <li>• Avoid purely short-distance drives</li> <li>• Replace valve</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Check function, electrical actuation and tightness of the vacuum system</li> <li>See below: "Vacuum system"</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Check oil separator, engine exhaust valve</li> <li>• Check pistons, piston rings, cylinders, valve stem seals and guides for wear</li> <li>• Check turbocharger for blocked oil return line</li> <li>• Perform correct oil and oil filter replacement</li> </ul> <hr/> <ul style="list-style-type: none"> <li>• Check that sensors achieve set-point values; replace if necessary</li> </ul>
<ul style="list-style-type: none"> <li>• P0401 "Flow rate too low"</li> <li>• P0103 "Air mass too high"</li> </ul>	<ul style="list-style-type: none"> <li>• EGR valve does not open or is not actuated</li> <li>• EGR system has been shutdown (vehicle no longer complies with ABE)</li> </ul>	<ul style="list-style-type: none"> <li>• Check connections and actuation</li> </ul>
<ul style="list-style-type: none"> <li>• P0402 "Flow rate too high"</li> <li>• P0102 "Air mass too low"</li> </ul>	<ul style="list-style-type: none"> <li>• EGR valve does not close/is constantly open</li> <li>• Uncontrolled, constant EGR</li> </ul>	<ul style="list-style-type: none"> <li>• Replace EGR valve</li> <li>• Check connections and actuation</li> </ul>
<ul style="list-style-type: none"> <li>• EGR valve has temperature damage, visible discolouration, fusion (petrol)</li> </ul>	<ul style="list-style-type: none"> <li>• Incorrect actuation</li> <li>• Exhaust gas back pressure too high</li> <li>• Turbocharger blow-off valve does not open</li> </ul>	<ul style="list-style-type: none"> <li>• Replace EGR valve</li> <li>• Check actuation of the EGR valve</li> <li>• Check exhaust gas back pressure</li> <li>• Check turbocharger blow-off valve (wastegate) and its actuation</li> </ul>
<ul style="list-style-type: none"> <li>• New EGR valve is not working</li> <li>• High idling after installation</li> </ul>	<ul style="list-style-type: none"> <li>• New EGR valve was not adapted</li> </ul>	<ul style="list-style-type: none"> <li>• Perform basic setting for the EGR valve using the engine tester</li> </ul>

ABE = general vehicle operating licence; EGR = exhaust gas recirculation; MIL = malfunction indicator lamp



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## TROUBLESHOOTING IN EXHAUST GAS RECIRCULATION PROBLEM DUE TO AIR MASS SENSOR

Problem	Possible cause	Remedy
<ul style="list-style-type: none"> <li>• Sawing engine</li> <li>• Engine misfires</li> <li>• Limp home function</li> <li>• Decreasing braking power</li> </ul>	<ul style="list-style-type: none"> <li>• Defective hoses (porous, rodent attack)</li> <li>• Leaking connections at pneumatic valves</li> <li>• Leaking non-return valves/vacuum reservoir</li> <li>• Defective/porous diaphragms or seals on pneumatic actuators</li> <li>• Leakage in intake manifold</li> </ul>	<ul style="list-style-type: none"> <li>• In the event of damage, check all components in the vacuum system for leaks and replace the damaged part</li> </ul>

## TROUBLESHOOTING IN EXHAUST GAS RECIRCULATION PROBLEM DUE TO VACUUM SYSTEM/SOLENOID VALVE

Problem	Possible cause	Remedy
<ul style="list-style-type: none"> <li>• P0401 "Flow rate too low"</li> <li>• Black smoke</li> <li>• Lack of power</li> <li>• Limp home function</li> </ul>	Air mass sensor damaged/dirty due to <ul style="list-style-type: none"> <li>• Dirt particles in the intake air</li> <li>• Leakages in the intake air system, splash water</li> <li>• Air filter replacement was not clean</li> <li>• Blocked air filter</li> <li>• Oil-wetted sports air filter</li> </ul>	<ul style="list-style-type: none"> <li>• Avoid ingress of water and particles in the intake air system</li> </ul>
	<ul style="list-style-type: none"> <li>• Damaged turbocharger</li> </ul>	<ul style="list-style-type: none"> <li>• Check turbocharger</li> </ul>

