



Electropneumatic valves in motor cars

Technical information

Vehicle	PIERBURG No.	Product
see catalogue/TecDoc CD		Electropneumatic pressure converters (EPW) Electric switch over valves (EUV) Electric transducer (EDW)

In all newer vehicles often several electro-pneumatic valves have been built in. These are small, unobtrusive and frequently fitted within areas of the engine compartment which are difficult to see or access.

The function of the electropneumatic valves within the pneumatic system of the vehicle is equivalent to the function of switches and dimmers in electric circuits. In connection with a pneumatic actuator it is thus possible to operate valves or to control turbochargers, for example.

They offer the following advantages:

- high actuating forces from within a small space
- the necessary low pressure as auxiliary energy is available in almost all vehicles (due to the low-pressure in the intake manifold or generated by a vacuum pump)
- only a small amount of electric power is necessary for the actuating processes

These valves exist in different implementations and are designated differently (see information on page 4). The most commonly used valves of this type are described on the following pages.



Application example: Intake manifold with electropneumatic valves (highlighted in red) as used in Mercedes C Class vehicles

The right of changes and deviating pictures is reserved. Assignment and usage, refer to the each case current catalogues, TecDoc CD respectively systems based on TecDoc.



Electric switch over valve (EUV)

Operation of an EUV is comparable to a switch in an electric circuit: Pressure/low pressure is “switched over” between two connections.

EUVs can be found everywhere in vehicles where engine components (actuators) need to be operated pneumatically.

- Wastegate of many TDI engines
- Throttle valve for exhaust gas return (EGR) in some SDI engines
- Engine water cooler frame in BMW diesel engines
- Hydraulic engine bearings in the VW Phaeton
- Exhaust gas valve at the exhaust post silencer in BMW Otto engines

Newer EUVs may also be driven by means of pulse width modulation (see information on page 3).

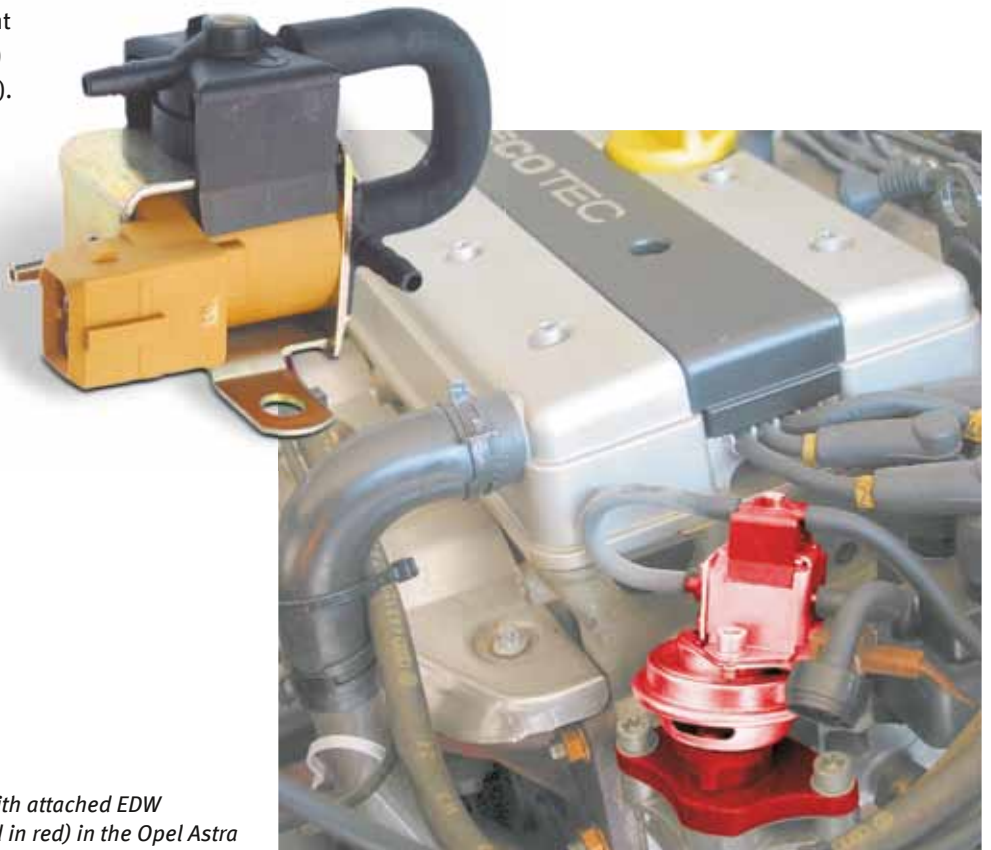
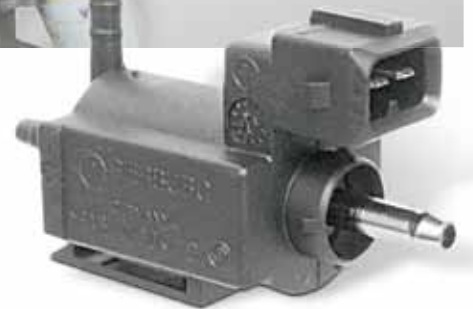
Electric transducer (EDW)

Electric pressure transducers represent an intermediate step in the development from the electric switch over valve (EUV) to the electropneumatic converter (EPW). They consist of an EUV with attached pressure limiter.

The pressure limiter generates an approximately constant low pressure. The integrated EUV is driven by the engine controller using pulse width modulation and thus controls a pneumatic EGR valve, for example.



At the controlled intake manifold in the Opel Astra already two EUVs have been fitted (highlighted in red). One controls through the actuator above it (highlighted in red) the intake manifold throttles; the other switches the secondary air shut-off valve (not shown)



EGR valve with attached EDW (highlighted in red) in the Opel Astra



Electropneumatic pressure converter (EPW)

Electropneumatic pressure converters are used in large numbers in exhaust gas return systems (AGR) and VTG chargers (“Variable Turbo Geometry”, turbochargers with adjustable guide vanes). Their operation resembles that of a “dimmer” in an electric circuit. From the low pressure and the atmospheric pressure, a mixed pressure (control pressure) is generated within the EPW through which the pneumatic actuators can be adjusted in a continuously variable manner.

EPWs are driven by means of pulse width modulation.

Frequently several EPWs have been built into a vehicle.

For identification purposes at the workshops, the vehicle manufacturers frequently use different colours for head section and body of an EPW.



Pulse width modulation (PWM)

In order to drive the newer types of electropneumatic valves by the engine controller, a control current is necessary.

However, this control current is not DC but is instead a current which is clocked at a constant frequency (“pulse width modulation”).

The switch on duration of a pulse is here termed “duty cycle”.

Depending on whether the current or the duty cycle is used as the command variable, such an electropneumatic valve is designated as being “current controlled” or “duty cycle controlled” (respectively “clock controlled”).



EPW and VTG charger (highlighted in red) in the Audi A4 TDI



Customer complaints

Since electropneumatic valves are used in many systems of a vehicle, the symptoms which indicate a malfunctioning or failed valve can be highly varied:

- Insufficient power
- Turbo lag in the case of turbochargers
- Black smoke
- Jerkiness
- Emergency operation (in case of a malfunctioning valve in the EGR system)

Electropneumatic valves are monitored by the ODB (on board diagnosis system) not as to their operation but instead as to continuity, short-circuit and short-circuit to ground. For this reason failures are not reliably detected and malfunctions are frequently attributed to other components.

Possible causes

- The most frequent causes why a valve is malfunctioning or has failed are water and dirt which have entered into the system of the controlling low-pressure. This may happen through leaky hose joints or broken hose connections.
- High ambient temperatures can cause intermittent malfunctions.
- In rare cases malfunctions are caused by confused connection hoses.
- A defective vacuum pump may deliver an insufficient low pressure for properly driving the valves.

For this reason an expert with system know-how is required in such cases who will not only rely on an error message and simply only replace a (possibly) wrong component but who will instead scrutinise the indicated error and determine the causes.



Checking an EPW using a manually operated vacuum pump (VW Golf IV)

Testing

The leak tightness of an electropneumatic valve can easily be checked with a manually operated low-pressure generating pump. A simple electric test of an electropneumatic valve will in many cases be possible with a commercially available multirange meter.

Further details as to usage, testing of, and diagnosis information on the respective valves can be found in the following PIERBURG Service Information leaflets (SI)
For EUV: SI 0050, SI 0051
For EDW: SI 0027
For EPW: SI 0065, SI 0076

Many designations
The different vehicle manufacturers and also the manufacturers of the valves use in part quite differing designations for their components. Given in the following is a selection of alternative designations with respect to the designations used by PIERBURG in each case:

Electropneumatic pressure converter (EPW, DW)

- Electropneumatic pressure transducer
- Pressure transducer (VW, BMW)

Electric switch over valve (EUV)

- Switch over valve
- Solenoid valve for charging pressure limiting N75 (VW)
- Solenoid switch-over valve (VW)
- Electric valve (BMW)

Electric transducer (EDW, DW)

- Pressure transducer
- Valve (VW)
- Electric valve (BMW)