



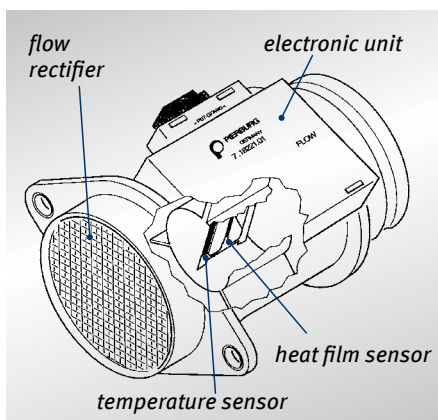
# Air mass sensors

## Troubleshooting, defects and testing

Vehicle	Product	Air mass sensor	
	PIERBURG No.	Replacement for	O.E. No.*
Mercedes Benz Audi, Ford, Seat, Skoda, VW	7.22684.07.0	7.22684.00.0	611 094 0048; A 611 094 0048
	7.22684.08.0	F00C 2G2 056 F00C 2G2 004	06A 906 461; 028 906 461

### Applications

The air mass sensor measures the mass of air inducted by the engine ("air flow mass") with great precision. The signal produced by the air mass sensor is used to calculate the amount of fuel injection and - in the case of diesel engines - also to control the recirculation of exhaust. It is an important component in both the reduction of exhaust and air supply. A defective or dirty air mass sensor can deliver false input signals to the engine's central control unit, which in turn sends false information to other components. In the case of turbo diesels the air mass sensor is subjected to particularly high burden due to the fact that both air flow rate and air speed are very high.



Heat film-mass sensor (earlier models)

### Description of functions

The complete air mass sensor consists of a flow channel ("pipe") in which the induced air-flow is directed past the actual sensor.



Depending on the type of use and vehicle, the air mass sensor is either completely integrated in a tube made of synthetic material, or with the actual sensor as a separate individual plugin module. Both versions (with tube/separate) are termed "air mass sensor".

Earlier models were fitted with a hot-wire sensor element. The hot-wire was "burned free" by pollutants following the short increase in heat after turning off the engine.

Newer models work using a film-like heating resistor on a support, in which case the burn-through procedure does not apply.

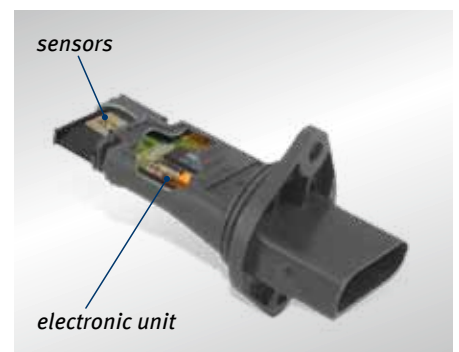
The heat-film sensor is heated to a temperature of approx. 120°C - 180°C above induction temperature (depending on vehicle manufacturer). The inflow of air cools the heat-film sensor. This cooling-down is compensated by a heating current via the electronic controller unit.

This heating current is directly proportional to the amount of air inducted.



Construction types

This method takes into account the density of the air passing by. Newer models with 2 separate measuring bridges are also able to recognize pulsations and back-flow.



Heat film-air mass sensor (newer version, exploded view)

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.

\* The reference numbers given are for comparison purposes only and must not be used on invoices to the consumer.



**Defects and possible causes**

Defects and dirty air mass sensors deliver faulty signals. This can have the following consequences:

- black smoke
- power shortage
- minimal operation

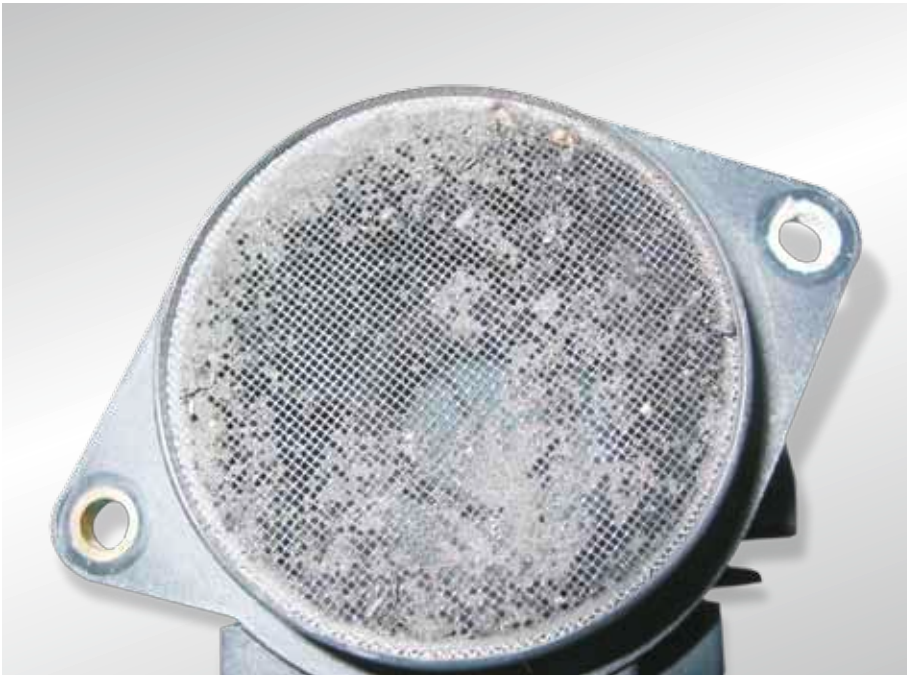
**Possible causes of damage:**

- If the air intake tube is porous, dirt particles can find their way into the inducted air. These collide at high speed with the air mass sensor, destroying the sensitive sensor element.
- Excessive oil spray from the crankcase ventilator can lead to fouling-up of the sensor.

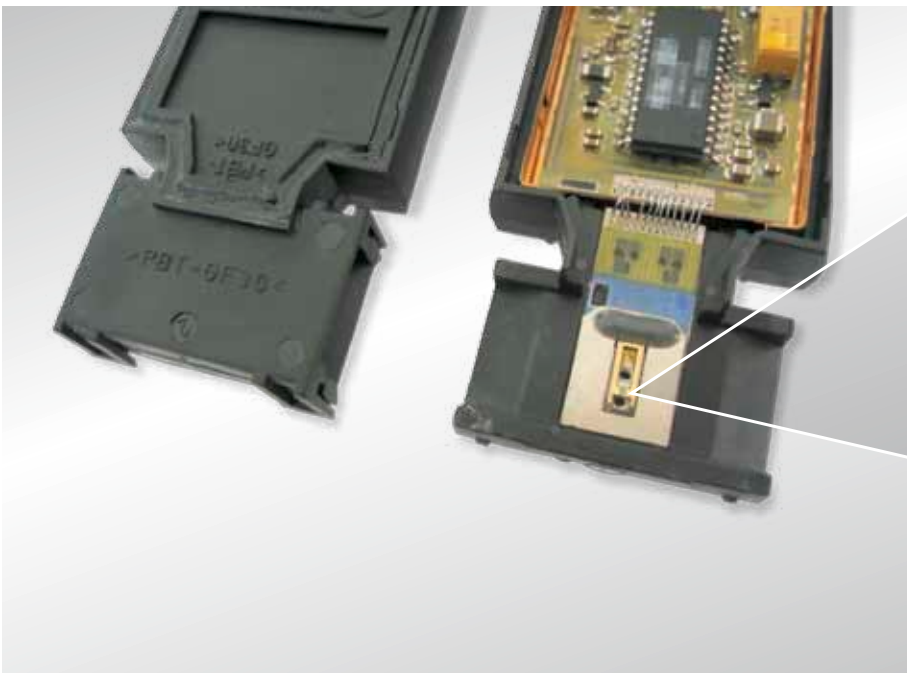
- Bad servicing, for instance uncleanliness when changing air filters, use of wrong or substandard air filters can be the cause of dirt and damage to the air mass sensor.
- Splashed water, for instance from heavy rainfall, can force its way into the clean-air side and damage or dirt-clog the sensor. Salt water caused by winter gritting and melting snow increases this effect.
- Oil particles from oil-covered sport air filters can damage or dirt-clog the sensor.

Other sources can also cause an intact air mass sensor to deliver a false signal:

- defective exhaust-gas recirculation valves
- defective fuel tank ventilation valves
- porosity of induction tract
- clogged air filters



*Clogged air mass sensor*



*Oil spray on the heat-film sensor*



## Air mass sensors and On-Board Diagnosis (“OBD”)

Air mass sensors are monitored by On-Board Diagnosis (“OBD”). These are some of the possible error codes:

Wrong signals from a defective air mass sensor can result in delivery of false information to other components by the engine's central electronic control unit. For this reason the error messages we show here can also be indicative of a defective air mass sensor:

P0100	Air mass- or air flow meter circuit malfunction
P0101	Air mass- or air flow meter range or performance problem
P0102	Air mass- or air flow meter circuit too small
P0103	Air mass- or air flow meter circuit too large
P0104	Air mass- or air flow meter circuit interruptions

P0171	Mixture control (Bench 1) system too lean
P0172	Mixture control (Bench 1) system too rich
⋮	⋮
P0175	Mixture control (Bench 2) system too rich
P0401	AGR-System – flow-rate too low
P0402	AGR-System – flow-rate too high

### Sporadic errors

Not every fault detected by the OBD will result in a warning-lamp lighting up. If an error is detected during the driving cycle that would influence the exhaust, this is stored as an “undefined error” but the warning-lamp will not light up. Warning-lamps are not activated until the same error occurs during the next driving cycle or within a certain time interval. This error is then referred to as “defined” (confirmed) and stored as an OBD error. In addition to the error, further data relating to operation and operating environment are captured and stored as “Freeze Frames”.

The warning-lamp may also extinguish if an error does not reoccur within a certain time-frame.

Stored data can be accessed from the vehicle’s diagnostic port (interface) using a motor-tester or a reading device (“Scan Tool”):

- confirmed (defined) errors in mode 3
- sporadic errors in mode 7
- operational data (“Freeze Frames”), in which an error occurred, in mode 2



Further information about OBD and the reading of error codes can be found in our brochure “Service Tips & Infos – Emission control & OBD”.

If the OBD displays a sporadic error in the air mass sensor, this does not necessarily mean that the sensor is defective.

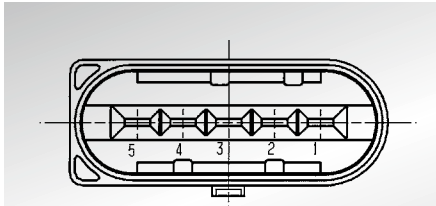
Dampness, oil spray, or protection often produce an incorrect measuring result, and this will be interpreted by the OBD as an error.

The reason for these sporadic errors and their origins can be found in the previously-described cases.

Before installing a new air mass sensor, testing of the already installed air mass sensor should have priority.



## Testing



**Connector assignment**  
 1 TF (option)  
 2 vehicle supply voltage  $U_{Bat}$   
 3 ground  
 4 reference voltage  $U_{Ref}$   
 5 UA (output signal)

When making an error diagnosis, the first step is to read the error code using a motor-tester or scan tool.

Please note that:

The OBD will recognise a defective part or defective function, but will not necessarily recognise the actual cause of malfunction or error.

In most areas of application, electrical faults in the wire harness or in the component itself are prestored as errors. They have to be traced using suitable testing methods.

**!** If the ignition is switched on, make sure not to disconnect or connect any of the plug connectors. The ensuing power spikes can destroy electronic components.

**!** Never clean the air mass sensor with compressed air. This can destroy the sensor.



Details of how to test the air mass sensor 7.18221.51.0 (replaces 7.18221.01.0) can be found in Service Information SI 0017/A.

Testing of the air mass sensor can be done in various ways:

### Checking current potential

- Pull the plug from the air mass sensor.
- Turn on the ignition.
- Measure current on the plug.



The following electrical potential should be there (see illustration: Connector assignment):

- between pin 2 and vehicle ground: 12 Volt (vehicle supply voltage).
- between pin 4 and pin 3: 5 Volt (sensor voltage).

If these voltage levels are not reached, all wiring and plugs involved should be checked for short-circuits, and the gaps and contacts occasionally checked over.



Testing can be done using a voltmeter or oscilloscope.

### Testing the low end of the sensor curve requirements:

- AGR system is functioning properly.
- Air filter is clean.
- Minimum RPM are reached based on AU figures.

Note: AU (Abgasuntersuchung) = German exhaust emission test.



If no special test cable is available then the measuring instrument should be connected to the clamps (rear side of plug) using suitable test pods. Take care not to clamp onto the wiring!

- Turn on the ignition.
- With the engine switched off, measure the output voltage between pin 5 and pin 3.

If the output voltage is 1.00 +/- 0.02 Volt when air current is zero, then the air mass sensor is almost always functioning correctly.

If there is a risk of false results caused by air currents (wind), then both ends of the measuring tube should be suitably shielded.

If the output voltage lies outside this tolerance level, the air mass sensor should be replaced.

### Testing reaction

- When the 1-Volt level is reached, blow gently into the air mass sensor.

The output voltage level should now rise, corresponding to the amount blown in. If this does not happen, then the sensor is defective and must be replaced.

### Measurement of working resistance

- Turn on the engine. control (set-) point (with warm engine in neutral gear): 1.2 - 1.6 Volt.

The air mass sensor delivers voltage-measurement from about 1.0 to 4.4 Volt between idle and fullthrottle.

- Increase the RPM to governed speed by using the accelerator. Signal voltage between 3.8 and 4.4 Volt must be reached.

If this is not the case, the air mass sensor must be replaced.