

Troubleshooting of air supply and exhaust re-circulation (AGR)

M41, M51

Situation:

If complaints are received about a lack of power and low top speed, this means that not enough fuel, or not enough oxygen is entering the cylinders in the combustion cycle. Faults relating to the "fuel system" are described in the Enclosure to

SI 13 01 92 (568).

The following section only deals with factors/components affecting combustion air.

In broad terms, in addition to leaks, three faults can occur in the air supply system.

1. **Sensors:** Inaccurate information from the charge pressure sensor, temperature sensor or mass air flow sensor, although it has no direct influence on the air supply, can cause the DDE control unit to misinterpret air conditions.
2. **Charge pressure:** Charge pressure can be too high or too low, dependent on engine speed.
3. **Exhaust re-circulation:** The AGR valve fails to close or has a leak. This means that exhaust gas can be directed into the combustion air in an uncontrolled manner.

As a result of more stringent emission control legislation, diesel engines can be subdivided into two groups.

- Engines with AGR **control**, EC Level 1
- Engine with AGR **feedback control**, EC Level 2

At present, AGR **control** is available on all M41 engines, all M51 engines in the E34 and the M51 engine in the E36 up to December 1995.

Note:

The E36/M41 variant, although it only has AGR **control** satisfies EC Emission Level 2 because of the favourable vehicle weight.

To satisfy the emission levels specified in EC Level 2, M51 engines in the E36 from 1/96, and all M51 engines in the E39 and E38 are equipped with AGR **feedback control**.

A clear identifying feature on engines with AGR **feedback control**, in addition to the use of a hot-film mass air flow sensor, is the addition of an auxiliary air filter for the electro-pneumatic pressure converter under the coolant expansion tank.

Effect: A lack of air leads to a loss of power and a reduction in top speed (Vmax) combined with "black smoke".

Affected vehicles: E36 with M41 and M51; E34, E38 and E39 with M51

Action: If a customer complaint is received, work through inspection points A-D described below.

Procedure: **A. Visual inspection of charge air circuit and the exhaust turbo-charger (ATL)**

Check components in the charge air circuit for leaks. Traces of oil are additional indicators. Also check the following:

- Charge air hoses for signs of damage - ensure they are correctly seated with no leaks
- If appropriate, check intercooler for signs of mechanical damage (stone chip)
- Check that mass air flow sensor is in correct installation position
- Check exterior of AGR valve for leaks
- Check exhaust re-circulation pipe on manifold and AGR valve

- Version of the exhaust turbo-charger

Only necessary on the M51 engine:

The colour of the manufacturer's label on the compressor housing of the exhaust turbo-charger provides information about correct assignment of exhaust turbo-charger/vehicle series.

Check version of exhaust turbo-charger:

| Colour of manufacturer's label | Vehicle model | Performance variant |
|--------------------------------|--------------------|---------------------|
| <u>LHD vehicles</u> | | |
| Blue | E36 325 td | 85 kW |
| | E34 525 td | 85 kW |
| Orange | E36 325 td /EC II | 85 kW |
| Black, silver (alu) | E36 325 tds | 105 kW |
| | E34 525 tds | 105 kW |
| Pink | E36 325 tds /EC II | 105 kW |
| Lilac | E39 525 tds | 105 kW |
| | E38 725 tds | 105 kW |
| <u>RHD vehicles</u> | | |
| Red | E36 325 td | 85 kW |
| Beige | E36 325 td /EC II | 85 kW |
| Brown | E36 325 tds | 105 kW |
| Grey | E36 325 tds /EC II | 105 kW |
| Blue | E34 525 td | 85 kW |
| Black | E34 525 tds | 105 kW |
| Lilac | E39 525 tds | 105 kW |

If exhaust turbo-chargers are fitted with the wrong colour labels, always check the BMW **item number** on the manufacturer's plate **before replacing** the exhaust turbo-charger.

Note:

Note: The item number is not always identical to the part number!

| Type | Performance | Item number |
|---------------------|-------------|-------------|
| <u>LHD vehicles</u> | | |
| E36 325 td | 85 kW | 2 243 396 |
| E36 525 td | 85 kW | 2 243 396 |
| E36 325 td /EC II | 85 kW | 2 246 665 |
| E36 325 tds | 105 kW | 2 243 579 |
| E34 525 tds | 105 kW | 2 743 398 |
| E36 325 tds /EC II | 105 kW | 2 246 666 |
| E39 525 tds | 105 kW | 2 246 144 |
| E38 725 tds | 105 kW | 2 246 144 |
| <u>RHD vehicles</u> | | |
| E36 325 td | 85 kW | 2 245 202 |
| E36 325 td /EC II | 85 kW | 2 246 668 |

| | | |
|--------------------|--------|-----------|
| E36 325 tds | 105 kW | 2 245 203 |
| E36 325 tds /EC II | 105 kW | 2 246 670 |
| E34 525 td | 85 kW | 2 245 146 |
| E34 525 tds | 105 kW | 2 245 147 |
| E39 525 tds | 105 kW | 2 246 144 |

B. Check sensors

Check that electrical wires and plug contacts on the mass air flow sensor, intake air temperature sensor, electrical changeover valve and/or AGR pressure converter and charge pressure sensor are conducting electrical power.

- Interrogate fault memory
- Check vacuum line between AGR valve and electrical changeover valve and/or pressure converter for leaks and ensure it is correctly routed. Pull off hose and blow through with compressed air to remove any oil residue which may have entered in the form of oil vapour from the crankcase breather.
- Check function of pressure converter:
With the engine at operating temperature, pull vacuum hose off AGR valve. The DDE activates the AGR valve on a 20 sec. cycle. With the engine at raised idle speed, you can check for vacuum build up with your finger.
Comment:
Exhaust re-circulation is switched off when:
 1. There is a fault in the needle movement sensor (injector nozzle with sensor, cylinder 3 or 4)
 2. There is a defect in the DDE control unit with AGR feedback control or its output stage
 3. There is a fault in mass air flow sensor
 4. Speed sensor on engine not operating in plausible manner
- Check charge pressure line between manifold for intake air and charge pressure sensor for leaks and ensure it is correctly routed (e.g. no sharp bends). Pull off hose and blow through with compressed air to remove any oil residue which may have entered in the form of oil vapour from the crankcase breather.
- Check function of charge pressure sensor:
With engine at idle speed, interrogate charge pressure measuring value with a status query to the DDE control unit. The DDE measures absolute pressure values, not overpressure values! The displayed value must be approximately the same as ambient pressure (approx. 1000 hPa), because no significant level of charge pressure develops at idle speed. If this is not the case and if there is no defect in the electrical system, replace the charge pressure sensor.
- Only on vehicles without a hot-film mass air flow sensor:
Unclip charge temperature sensor from manifold and check for contamination. Now read off the charge air temperature: it should be the same as ambient temperature. If the temperature display is not plausible, and if there is no fault in the electrical system, replace the temperature sensor.

C. Charge pressure measurement

Charge pressure is measured at two defined engine speed points. The first measuring point is at 3000 rpm where there is a high and stable charge pressure level. The second measuring point is at 4000 rpm by which time the pressure release valve on the exhaust turbo-charger (wastegate valve) must have opened.

If measurements are performed at any other engine speeds, this will give rise to incorrect diagnoses.

Note:

At excessive engine speeds, the M41 and M51 engines exhibit a slight downwards trend in their charge pressure characteristics.

Preparation:

- Check air filter insert for contamination and replace if necessary.
- Assess performance and exhaust smoke characteristic at top speed on road or rolling-road test rig
=> there may be no need to perform a charge pressure measurement.
- Connect an overpressure gauge between the intake air manifold and charge pressure sensor by inserting a T-piece to the charge air measuring hose. The MoDiC is not suitable for this measurement because its response characteristics are too slow.
- Measure charge pressure at full throttle (i.e. accelerator pedal fully depressed) at the aforementioned inspection speeds in a middle gear.
Measurements conducted while the vehicle is stationary with "the accelerator pedal depressed" do not provide accurate information due to the inertia of the exhaust turbo-charger as it comes up to speed. For this reason, under load, maintain the prevailing engine speed by braking with the left foot for at least 3 secs. with a precision of +/- 200 rpm.

Nominal values for charge(over)pressure at full throttle for 3000 and 4000 rpm:

| | | |
|-----|--------|------------------|
| M51 | 105 kW | 950 - 1150 mbar |
| | 85 kW | 750 - 900 mbar |
| M41 | 66 kW | 1000 - 1250 mbar |

If pressure is above or below this level, check:

- Is the wastegate mechanism jammed?
- Is there a leak in the wastegate pressure hose (between compressor housing and wastegate diaphragm)?
- Is the end float on the wastegate actuating rod too high? (> 0.15 mm)

Important:

The actuating rod on the wastegate valve is pre-set and sealed in the factory and must not be changed under any circumstances. For this reason, no components can be obtained for the exhaust turbo-charger. If the seal lacquer is damaged, all warranty applications will be rejected.

If charge pressure is adjusted beyond the tolerance band as a "tuning" measure, the DDE issues the fault message "range exceeded." This activates a back-up program which deliberately reduces fuel injection quantity, thereby reducing engine power. This entails a risk of damage to the engine.

Only if pressure is too low:

if no defect can be found on the wastegate mechanism, replace the exhaust turbo-charger.

Note:

When installing an exhaust turbo-charger, maintain standards of strict cleanliness. After fitting a new exhaust turbo-charger, run engine at idle speed for approx. 5 minutes to enable the engine oil pressure to build up to a level where the exhaust turbo-charger is well lubricated. Any attempt to run the engine straight up to top speed as the exhaust turbo-charger enters service can damage this unit.

D. Check AGR valve and intake air manifold

1. Remove and check AGR valve
 - If the AGR valve can be pressed in easily there may be a broken spring
=> replace the AGR valve
 - AGR valve fails to close due to heavy oil/soot deposits on valve stem and/or

valve seat
=> clean AGR valve.

2. Also remove intake air manifold and check whether the intake cross-sections are obstructed by soot deposits. Clean the manifold if it is heavily contaminated.

Important:

Vehicle running malfunctions as a result of clogged plastic intake systems are to date unknown, as due to the smooth surface quality of these intake systems only a thin deposit of soot particles is possible. **Therefore, the plastic intake systems of all E36 M41, E38 M51, E39 M51 and E36 M51 from 01/96 should never be cleaned in an immersion bath!**

Note:

We recommend the cleaning agent "BMW Diesel soot cleaning agent" BMW PN: 83 11 9 407 944.
Refer to Enclosure for product description and handling instructions.

Parts:

| | |
|--|---|
| BMW Diesel soot cleaning agent 10 litre container | PN 83 11 9 407 944 |
| Part number for exhaust turbo-charger | Refer to current EPC catalogue, precisely indicating the affected vehicle version |

Reimbursement:

Material and labour costs incurred can be claimed through the usual warranty channels subject to current warranty terms as follows:
If the vehicle is outside its warranty period, only point D "Check AGR valve and manifold" can be invoiced.

Defect code

11 71 90 76 00

This Defect Code has not been recorded in the official Defect Code Catalogue but has been listed in the computer system. This will enable warranty claims to be processed.

| | |
|----------------|---|
| Job number | see Flat Rate Manual |
| Labour | see Flat Rate Manual |
| Warranty type | 1 |
| Warranty stage | 1 (within vehicle warranty) 2 (outside vehicle warranty) |

The time components spend in the immersion cleaning unit is not reimbursed under warranty.

Due to the fact that BMW Diesel soot cleaning agent can be re-used several times, the warranty can only cover 25% of the quantity required.

For the net value, refer to sublet code 4.

AGR valves and intake air manifolds only replaced because they are contaminated are no longer recognised under warranty.

Reimbursement is restricted to 4 years/200 000 km and limited to

December 1997.