

16 01 02 (890)

Diagnosis of fuel tank systems with fuel tank leak diagnosis module (DMTL)

All US models

Situation:

Since model year 1994, all US models have been equipped with a diagnosis-compatible system that checks the fuel supply system for leaks.

A leaking fuel supply system causes increased pollutant emissions and, according to American legislation, must be repaired immediately. The "Service Engine Soon" indicator lamp lights up to alert the driver.

Systems for leak detection are tank systems with leak diagnosis pump (LDP) and fuel tank leak diagnosis module (DMTL). These differ principally in the details listed in Table 1.

LDP	DMTL
Diaphragm pump	Vane pump
Vacuum line necessary for operation of the diaphragm	Compression system
Leak detection from $\varnothing$ 1 mm	Leak detection from $\varnothing$ 0,5 mm
Leak detection at fuel tank by means of external pressure application	Leak detection at fuel tank via test module and/or service function

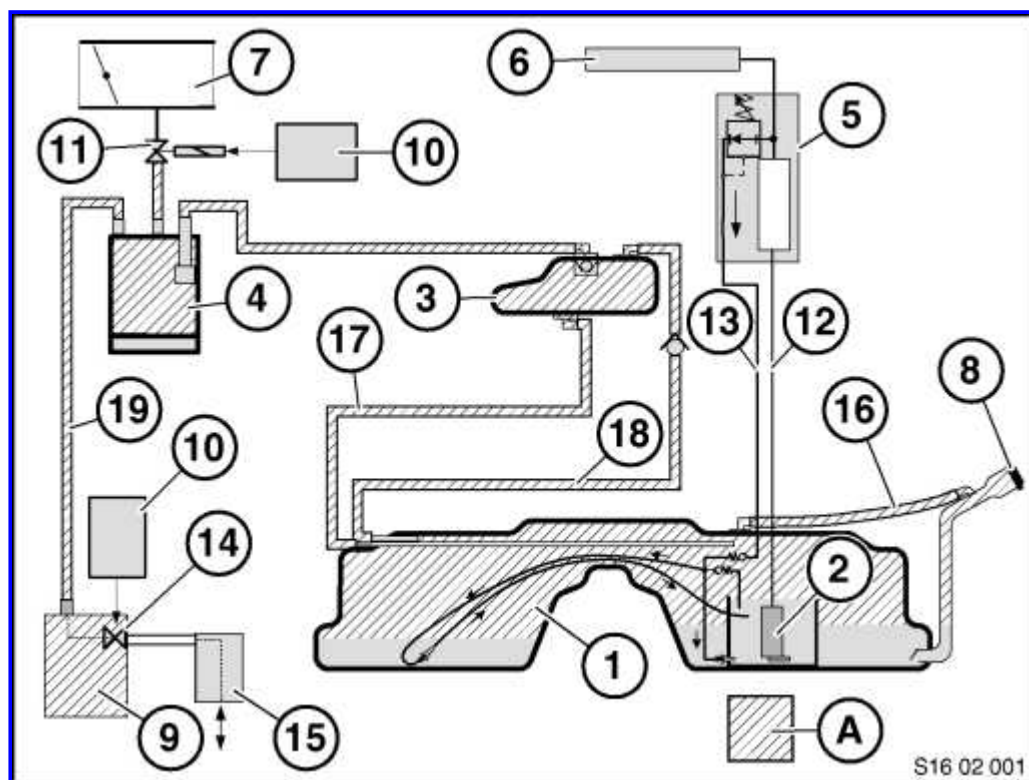


Figure 1: Block diagram of leak check

A	Pressurised components	10	DME control module
1	Tank	11	Fuel evaporation control valve
2	Fuel pump	12	Feed line
3	Expansion tank	13	Return line
4	Activated carbon filter	14	Solenoid valve in DMTL
5	Fuel filter with pressure regulator	15	Dust filter
6	Injection rail	16	Charge/vent line
7	Intake manifold	17	Fuel tank vent line I
8	Fuel filler cap	18	Fuel tank vent line II
9	LDP / DMTL	19	Fuel tank vent line III

1. Leakage test with leak-diagnosis pump (LDP)

US vehicles have an AKF cutoff valve and a tank pressure sensor that are used by the tank vent system diagnosis to enable the DME control unit to detect leaks > 1 mm in the tank and tank vent system.

With this system, a vacuum is formed and used to detect a leak. From Model Year 1998 (US 05.97), the vacuum system was replaced by a compression system.

The depression or compression is generated by a leak diagnosis pump bolted to the activated charcoal filter and is approx. 25 hPa. Leak diagnosis takes approx. 100 seconds, depending on the individual vehicle and is performed after nearly every cold start. The air filter at the LDP inlet is also new.

Note:

If this filter becomes extremely soiled, you may encounter problems when refuelling the vehicle. Diagnosis is guaranteed on the complete system (fuel circuit, leak diagnosis pump and reed contact).

1.1 Function description of pressure-leak diagnosis

When the DME control unit performs leak diagnosis, the DME control unit actuates the solenoid valve in the LDP unit. The intake manifold vacuum not reaches the level of the upper pump chamber (6, Fig. 2) and pulls the diaphragm (7, Fig. 2) up against the springs (3, Fig. 2).

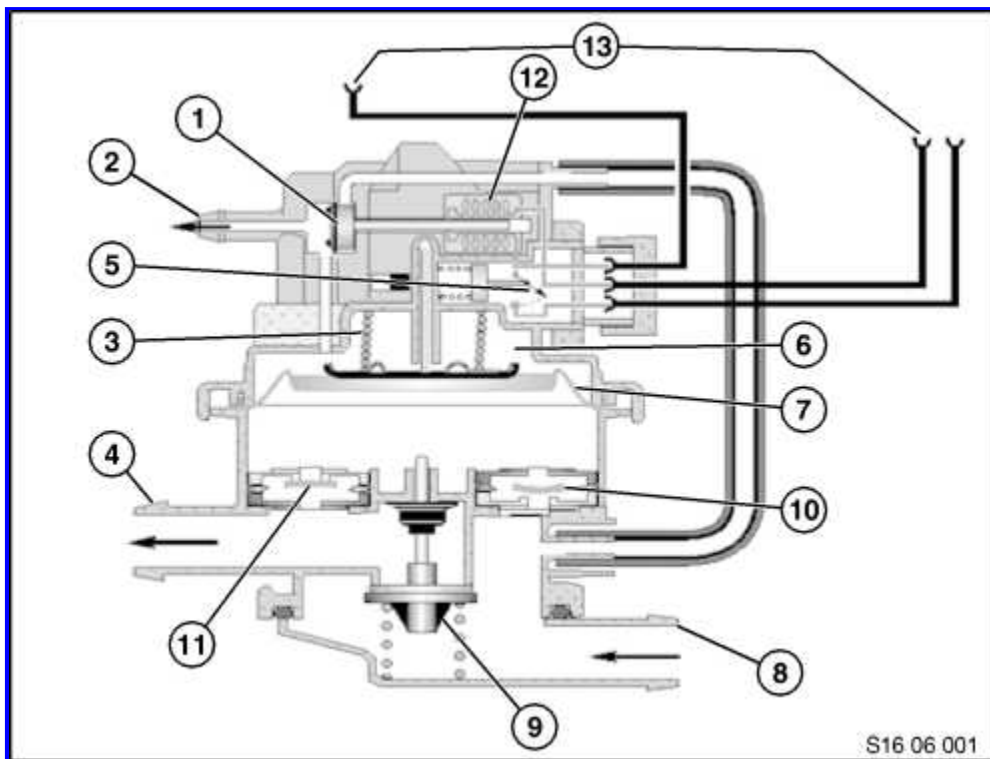


Figure 2: Leak-diagnosis pump (LDP)

1	Vacuum valve	8	Connection to atmosphere via filter
2	Connection to intake manifold vacuum	9	Open/closed valve (mechanical)
3	Spring	10	Intake valve
4	Connection to activated charcoal filter	11	Pressure valve
5	Reed contact	12	Solenoid valve coil
6	Upper pump chamber	13	Electrical connections
7	Diaphragm		

When the diaphragm (7, Fig. 2) is pulled up, a suction or pump effect is created under the diaphragm. Suction/pressure valves allow the oscillations of the diaphragm to create a pressure of approx. 25 hPa in the tank vent system, through the activated charcoal filter to the fuel filler cap. The oscillations of the diaphragm, i.e. the frequency, is measured by the reed contact (5, Fig. 2). The principle of pressure leakage diagnosis is based on a measurement of the repumping frequency needed by the leak diagnosis pump:

- Repumping frequency greater than nominal value: System **leaking**
- Repumping frequency less than nominal value: System **not leaking**

2nd leakage check in OBD II (on-board diagnosis) with fuel tank leak diagnosis module (DMTL)

This test procedure is able to detect leaks as small as > 0.5 mm in the fuel supply system. It thus constitutes a significant improvement in terms of protecting the environment.

Start criterion	Start condition
Engine	OFF
Last engine standstill	> 5 h
Duration of current journey	> 10 min
Fuel level	$> 15\%$ and $< 85\%$
Ambient temperature	$> 4\text{ }^{\circ}\text{C}$ and $< 35\text{ }^{\circ}\text{C}$
Altitude above mean sea level	< 2500 m
Battery voltage	> 11.0 V and < 14.5 V

Table 2: Start conditions for diagnosis

2.1 Function description of fuel tank leak diagnosis module check

Once all start conditions listed in Table 2 are satisfied, the DMTL will automatically start a tank leak measurement (OBD diagnosis).

The actual tank leak measurement comprises two phases: **reference leak measurement** and **tank leak measurement**.

2.1.1 Reference leak measurement

During the reference leak measurement, the vane pump blows air through the so-called reference leak ($\varnothing 0.5$ mm).

The power intake of the pump is measured and serves as the reference current during subsequent leak diagnosis. The strength of this pump current is approx. 20 mA to 30 mA.

This initial procedure takes place within the DMTL only and no other parts are affected. This phase serves as a self-test for the DMTL.

If the current for the reference leak measurement is outside a certain tolerance, the DMTL will be detected as faulty and the fault memory entry shown in Table 3 will be stored in the DME as an **internal DMTL fault**.

DME variant	Manufacturer	Fault in plain text
MS43	Siemens	142 "Module fault DMTL"
MS45	Siemens	27CD "Module fault DMTL"
MSV70	Siemens	2A17 "DMTL system fault"
MSV80	Siemens	2A17 "DMTL system fault"

MSD80	Siemens	2A17 "DMTL system fault"
ME9.2.2	Bosch	2A17 "DMTL system fault"
MED9.2.2	Bosch	2A17 "DMTL system fault"
ME9.2.3	Bosch	2A17 "DMTL system fault"
MSS65	Siemens / BMW	2776 "DMTL pump"

Table 3: Internal DMTL fault during reference leak measurement

2.1.2 Tank leak measurement

Fig. 1 shows the components of the fuel supply system, to which pressure is applied.

Pressure is applied to the components of the fuel supply system during the tank leak measurement procedure.

- The internal solenoid valve in the DMTL (14, Fig. 1) closes the line to the atmosphere
- The DMTL pump is activated

As a result, the fuel supply system is now a closed system (from the DMTL valve up to the fuel evaporation control valve) and the pressure is increased in the entire fuel system.

During the tank leak measurement, the pump's current draw is measured. An algorithm in the DME control unit compares the power intake of the reference leak measurement and of the tank leak measurement.

If the current draw during the tank leak measurement is lower than that recorded during the reference leak measurement, the fuel supply system is detected as free of leaks. A leak of > 0.5 mm must be present for the DME to store a fault.

DME variant (engine)	Minor leak error > 0.5 mm (fault in plain text)	Major leak error > 1,0 mm (fault in plain text)
MS43	8F "Fuel tank leak diagnosis with DMTL"	
MS45	27CC "DMTL: leak"	
MSV70	2A16 "Extremely minor leak"	2A15 "Minor leak"
MSV80	2A16 "Extremely minor leak"	2A15 "Minor leak"
MSD80	2A16 "Extremely minor leak"	2A15 "Minor leak"
ME9.2.2	2A16 "Extremely minor leak"	2A15 "Minor leak"

	leak"	
MED9.2.2	2A16 "Extremely minor leak"	2A15 "Minor leak"
ME9.2.3	2A16 "Extremely minor leak"	2A15 "Minor leak"
MSS65	27C3 "DMTL leak detection"	2779 "DMTL leak detection"

Table 4: Fault in tank leak measurement

Note:

Diagnosis will be interrupted if you start refuelling while diagnosis is in progress.

If the faults listed in Tables 2 and 3 are diagnosed twice in succession, an entry will be stored in the DME. The "Service Engine Soon" indicator light comes on, prompting the customer to drive to a workshop for diagnosis and leak detection.

A fault relating to fuel tank leak detection very often occurs in connection with the fuel filler cap not fitted or closed correctly.

The so-called **"Check Filler Cap" or "Check Gas Cap"** function has been introduced to prompt the customer to check the fuel filler cap.

3. Check Filler Cap / Check Gas Cap function

The Check Filler Cap / Check Gas Cap function is a prompt to the driver in the event that the fuel filler cap was not replace or closed properly after refuelling.

This function usually runs after every refuelling and gives a warning message in the instrument cluster. This gives the driver the opportunity to close the fuel filler cap correctly before the system starts a leak check.

The key difference between this function and the OBD II leak check is that with the CFC / CGC, the MIL indicator light (or "Service Engine Soon" indicator light) is not actuated.

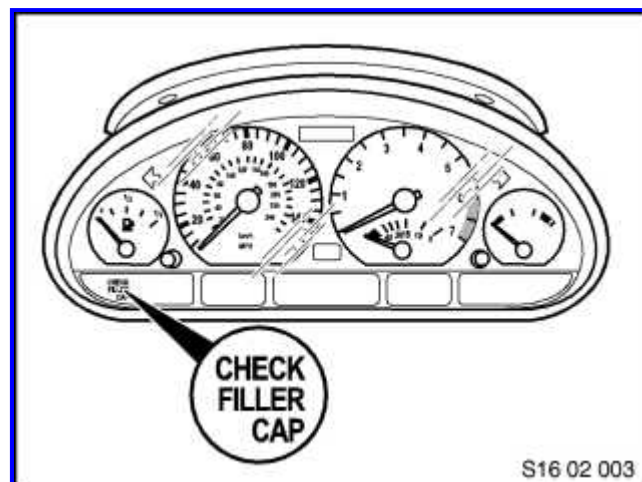


Figure 3:

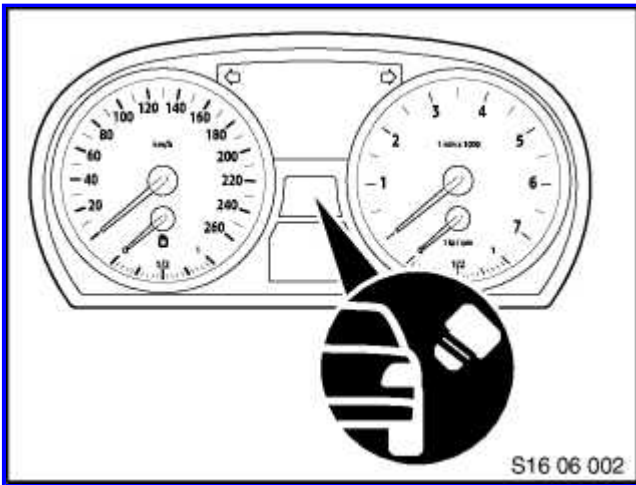
"Check Filler Cap" indicator lamp.

Phase-in September 2001

Figure 4:

"Check Filler Cap I" indicator lamp.

Phase-in September 2003

Figure 5:

"Check filler cap II" indicator lamp.

Phase-in September 2004

Procedure:

Case 1. Internal DMTL fault (see Table 3)

Proceed as follows if such an internal DMTL fault is stored in the fault memory:

1. Clear the fault memory
2. Check whether the fuel filler cap is fitted correctly
3. Work through test module:
 - Complete vehicle
 - Drive
 - Engine control
 - Fuel tank system test
 - Fuel tank leak diagnosis module (DMTL)

This test module carries out a reference measurement and a fuel tank measurement and simultaneously checks the function of the DMTL pump.

If the fault is stored again in the fault memory after this test module, the DMTL must be replaced, please refer to Repair Instructions RA 16 13 015.

Important:

On no account open the DMTL!

Note:

Do not use lubricants during assembly.

After replacing the DMTL, clear the fault memory and once again work through the test module specified above.

If the repair has been carried out correctly, the test module will not store a fault entry.

If, after replacing the DMTL, a leak is detected in the system, it is highly likely that a leak was caused during the replacement procedure.

Note:

It is recommended to work through the above test module after **all** repairs to the fuel supply system.

Case 2. Fault during tank leak detection (see Table 4)

Fuel tank faults indicate a leak in the fuel supply system or incorrect operation of the fuel filler cap.

Important:

The most common causes of a fuel tank leak fault are:

- Fuel filler cap fitted crooked or not correctly
- Fuel filler cap not turned as far as it will go to the end stop (the end stop is indicated by a clearly audible "click")
- Retaining strap for fuel filler cap trapped between the filler cap itself and the fuel filler neck

Note:

Also refer to Service Information SI 16 02 99 (501) with regard to the fault patterns listed above.

Proceed as follows if a tank leak fault is stored in the fault memory:

1. Clear the fault memory
2. Check whether the fuel filler cap is fitted correctly
3. Work through test module:
 - Complete vehicle
 - Drive
 - Engine control
 - System diagnosis
 - DMTL system test
 - For further details, please refer to Repair Instructions 16 00 102 (M54).

If a leak is detected in the fuel supply system on completion of the test module this leak will be caused by the fuel filler cap not being closed correctly.

Important:

The costs in connection with the above causes are not incurred by any technical defects in the system and no warranty claims for reimbursement will be accepted.

A **fuel tank leak test** must be carried out if the fuel supply system is found to be leaking.

Case 3. Tank leak search

The fuel tank leak test procedure is described in Repair Instructions 16 00 510.

With the "DMTL pump actuation" service function, the internal solenoid valve (14, Fig. 2) in the DMTL closes the line to atmosphere and the DMTL pump is subsequently activated.

As a result, the fuel supply system is a closed system and pressure is built up.

The leak can now be found with the aid of a leak detector.

Important:

1. **External pressure must not** be applied to systems with DMTL because, in this case, the DMTL valve is not closed and a leak will inevitably be detected.
2. During the above service function, the DMTL pump runs uninterrupted for **approx. 15 minutes**. After this, the DME switches the DMTL pump off. If necessary, the test module can be repeated after a short waiting period.

Probable leak points:

- Fuel filler cap screwed on crooked or not up to the stop (8, Fig. 2)
- Fuel level sensor left or right leaking (replace sealing ring)
- Connection between fuel filler pipe and fuel tank
- Connections of filler vent line or of fuel tank vent lines I and II (16, 17, 18, Fig. 2)

Unlikely but possible leak points:

- DMTL solenoid valve
- Fuel evaporation control valve
- Connection between DMTL and activated carbon filter (19, Fig. 2)
- Pressure relief valve in the fuel filler cap
- Mating between fuel cap and fuel filler neck

Note:

If a repair was previously carried out on the fuel supply system, the leak will probably be at the repair location.

Important:

1. The **pressure relief valve** in the fuel filler cap can only be checked as described in Repair Instructions RA 16 11 130.
2. If the **mating between the fuel cap and the fuel filler neck** is leaking, the fuel cap and the fuel filler pipe (both!) must be replaced.

Case 4. Leak detector

The following devices can be used for leak detection purposes:

- Devices that respond to ultrasound
- Devices that respond to hydrocarbon hydrates

Part number of the device recommended by BMW (responds to hydrocarbon hydrates): 81 34 0 144 422.

Important:

Since, during normal vehicle operation, the vent line and the fuel evaporation control valve are subjected to fuel vapours (fuel residue remains on the line and valve), **leaks at the fuel evaporation control valve** cannot be detected effectively with devices that react to hydrocarbon hydrates.