B-pillar by sliding tab into locating slot.

Tightening torques	
Front seat to floor (M10 fastener)	45 Nm (33 ft-lb)
Seat belt anchor bar to door sill	31 Nm (23 ft-lb)
Seat belt to seat	48 Nm (35 ft-lb)
Seat belt to B-pillar sliding anchor	31 Nm (23 ft-lb)
Seat belt reel to B-pillar bottom	31 Nm (23 ft-lb)
Sliding seat height adjuster to B-pillar	24 Nm (18 ft-lb)

Seat-integrated seat belt system (SGS) (Convertible models)

The front seats of E46 Convertible models are designed with integrated seat belts. In this way, the forces acting on a front seat occupant during a collision are channeled to the reinforced floor.

All belt fastening points move with the seat as it is adjusted. This ensures the best possible body strapping regardless of seat position or occupant size. With the shorter free belt length, the occupant is held more reliably with vehicle deceleration.

The fixed anchor point and the seat belt lock/tensioner are mounted on the seat frame. The upper seat belt guide is attached to the headrest. In this way the belt is optimally positioned regardless of headrest position.

The inertia reel is attached to the inside of the seat backrest. The mechanism is

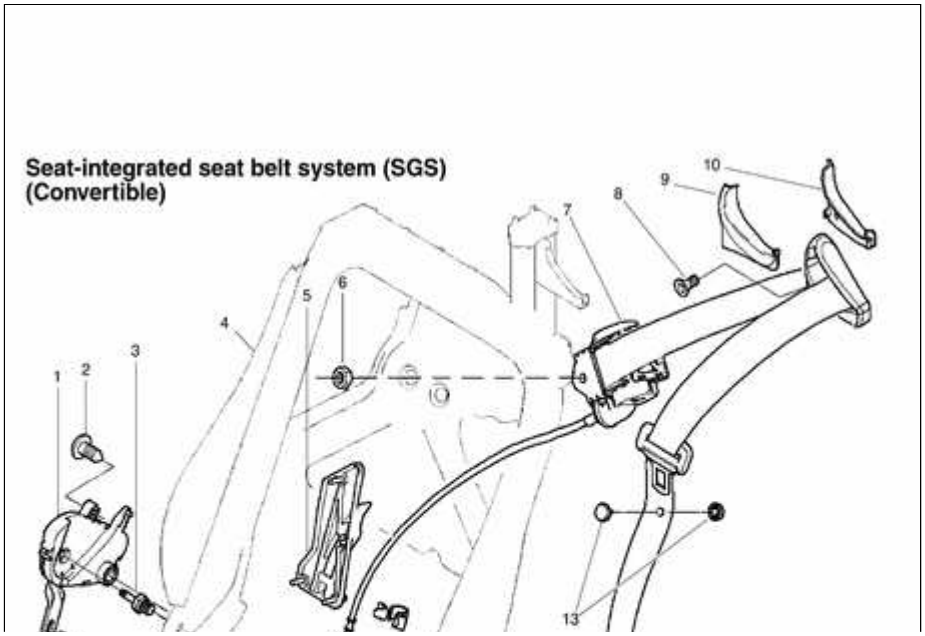
connected to the backrest hinge through a lever and a cable drive (coupler mechanism). As the angle of the backrest is adjusted, the cable drive will change the angle of the inertia lock. In this way the reel is in the proper position for locking at any seat back angle.

The seat belt lock and tensioner on the SGS system is a pyrotechnic device similar to that on other E46 models. When working on SGS belts, be sure to read the warnings and cautions in the procedure for front seat belt tensioner removal and installation, earlier in this group.

Note:

- *SGS seat belt removal can only be carried out with the seat out of the car. See ⇒ 520 Seats.*

- *Once the seat has been removed, the seat backrest must be partially disassembled. The accompanying illustration provides information on SGS component locations and fastener torques.*



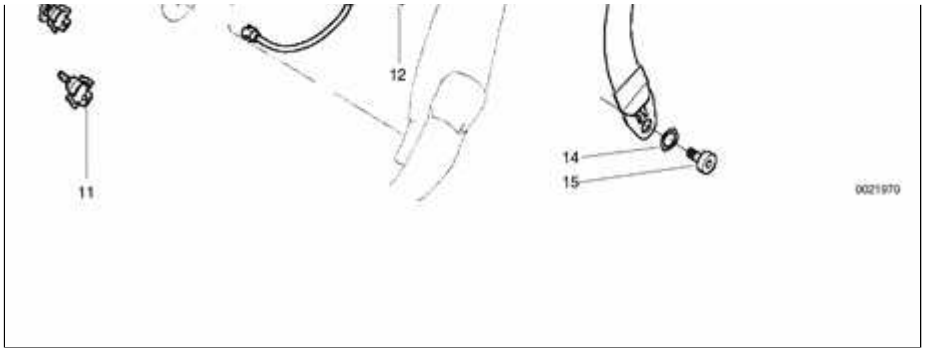
Seat-integrated seat belt system (SGS) (Convertible)

1 - Coupler mechanism

2 - Self-tapping screw M4.2

- tighten to 2.5 Nm (22 in-lb)

3 - Threaded pin



4 - **Front seat backrest**

5 - **Support**

6 - **SGS belt reel mounting nut M10**

- tighten to 39 Nm (29 ft-lb)

7 - **SGS inertia reel assembly**

8 - **Torx bolt M6**

- tighten to 4.5 Nm (40 in-lb)

9 - **Seat belt guide cover, front**

10 - **Seat belt guide cover, rear**

11 - **Connector**

12 - **Clip**

13 - **Seat belt button**

14 - **Bushing**

15 - **Bolt M10 (self-locking, always replace)**

- tighten to 45 Nm (33 ft-lb)

720-3

Rear Seat Belt Assembly

Rear seat belts (Sedan or Coupe models)

- Remove rear parcel shelf to access shoulder belt assembly mounting bolts.

- Remove rear seat cushion to access rear seat belt lock mounting bolts. See ⇒ 520 Seats.

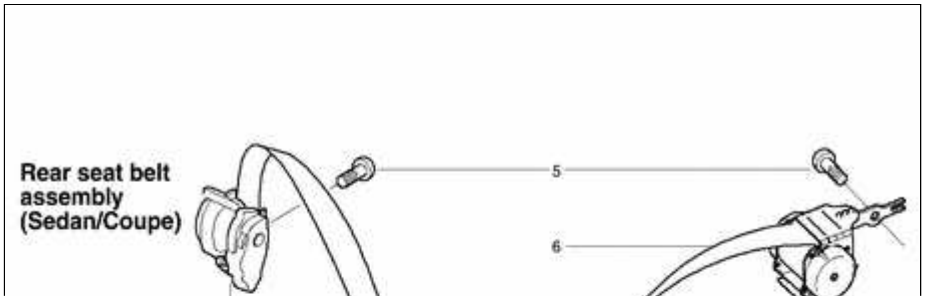
- The accompanying illustration provides information on rear seat belt component locations and fastener torques.

- When installing seat belt lock straps:

♦ Install right lock strap (which is shorter) underneath middle lock strap.

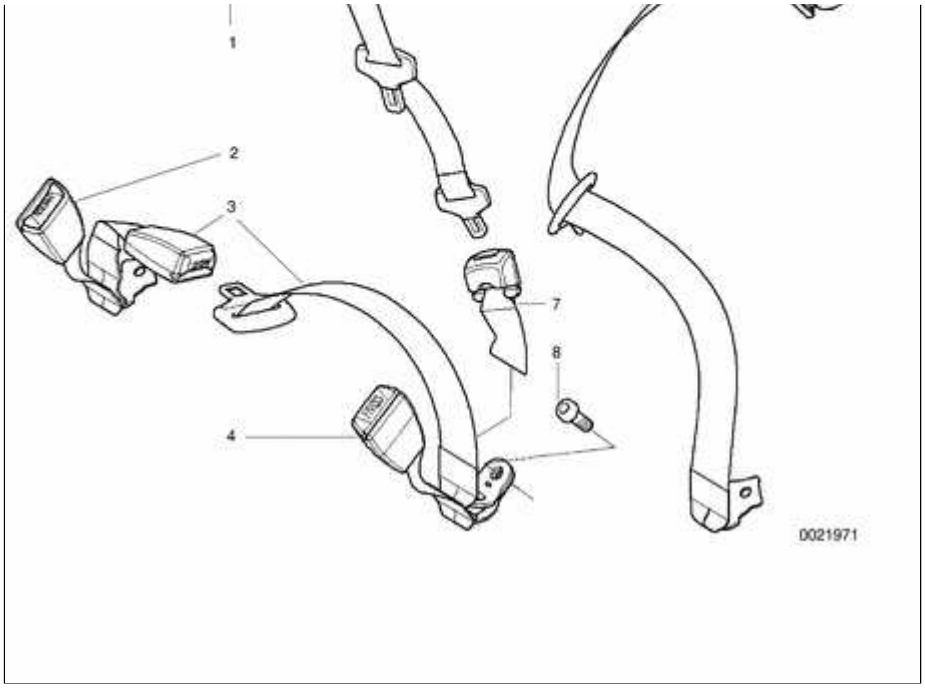
♦ Install left lock strap underneath middle lap belt strap.

♦ Metal strap ends must rest against stop on floor underneath seat.



Rear seat belt assembly (Sedan/Coupe)

1 - Center shoulder belt reel assembly (if



equipped)

2 - **Right shoulder belt lock**

3 - **Lap-belt assembly**

4 - **Left shoulder belt lock**

5 - **Bolt M10**

- tighten to 31 Nm (23 ft-lb)

6 - **Left shoulder belt reel assembly**

7 - **Center shoulder belt lock (if equipped)**

8 - **Bolt M12**

- tighten to 31 Nm (23 ft-lb)

Rear seat belts (Sport Wagon models)

- Center shoulder belt:

- Remove shoulder belt guide trim at top of seat backrest. Feed belt out through slot in trim.

- Working in cargo compartment, partially remove backrest cover to access shoulder belt reel.

- Remove shoulder belt reel mounting bolt inside backrest.

Note:

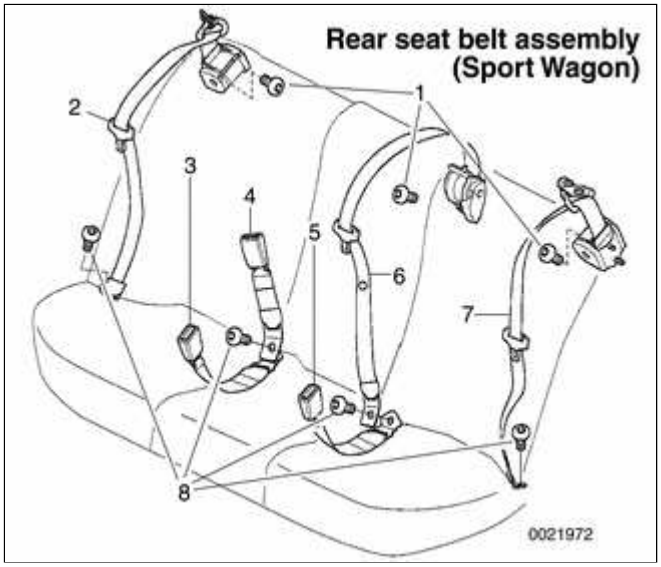
Remove bowden cable from backrest brackets and unhook from backrest release latch. Center seat belt reel can be then be removed.

- Outboard shoulder belt:

- Remove roof-pillar (C-pillar) trim.

- Remove center shoulder belt.

- Lift up rear seat cushion(s) to access rear seat belt lock mounting bolt(s).



The accompanying illustration provides information on rear seat belt component locations and fastener torques.

1 - Bolt M10 -tighten to 31 Nm (23 ft-lb)

2 - Right shoulder belt reel assembly.

3 - Center belt lock

4 - Right belt lock

5 - Left belt lock

6 - Center shoulder belt reel assembly

7 - Left shoulder belt reel assembly

8 - Bolt M12 -tighten to 31 Nm (23 ft-lb)

- When installing seat belt lock straps:

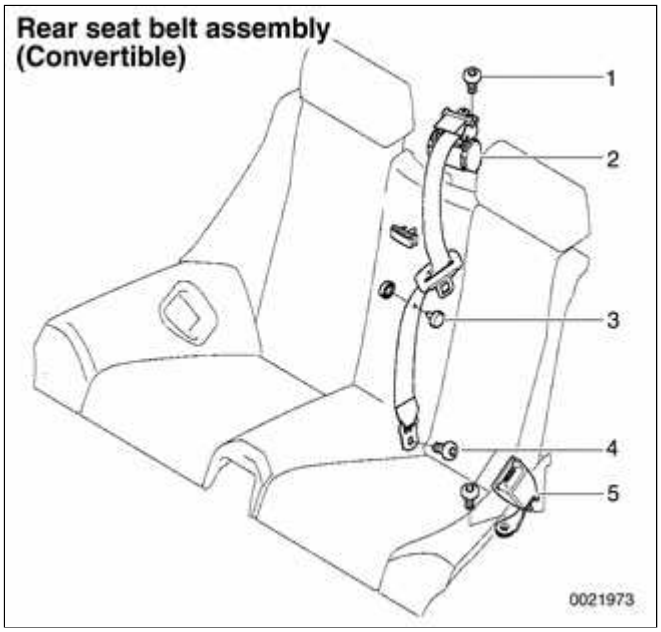
- Install right belt lock strap (which is shorter) underneath center belt lock

strap.

- Install left belt lock strap underneath center lap belt strap.
- Metal strap ends must rest against stop on floor underneath seat.

Rear seat belts (Convertible models)

- Access shoulder belt or seat belt lock mounting bolts:
- Remove center armrest.
- Push shoulder belts toward sides and feed out of top guides.
- Lift seat cushion up and forward to remove.
- Remove lower backrest securing screws located below backrest. Lift backrest straight up and unhook from tabs in back.
- Remove rear head restraints by pulling straight up.
- Remove cover of rollover protection bars for right and left side.
- Open convertible top compartment cover.
- Shoulder belt reels are bolted to convertible top storage compartment.



The accompanying illustration provides information on rear seat belt component locations and fastener torques.

1 - Bolt M10 -tighten to 31 Nm (23 ft-lb)

2 - Left shoulder belt reel assembly.

3 - Seat belt stop button

4 - Left belt lock

5 - Bolt M12 -tighten to 31 Nm (23 ft-lb)

General

This repair group covers airbag components. Airbag system repair and fault diagnosis is not covered here. Diagnostics, component testing, and airbag system repair should be carried out by trained BMW service technicians.

Note:

- *Airbags are also known as the Supplemental Restraint System (SRS). In the E46 cars the occupant safety system is called the Multiple Restraint System (MRS).*

- *Special test equipment is required to retrieve airbag fault codes, diagnose system faults, and reset/turn off the airbag indicator light. The indicator light will remain on until any problem has been corrected and the fault memory has been cleared.*

Individual airbag system components can only be tested electronically when installed in the car. BMW service testers DIS or MoDiC or equivalent must be used for diagnostic work.

Special tools

Most airbag system repairs can be performed with normal shop tools. Use BMW special tool 00 9 321 or equivalent plastic prying tool to pry out plastic interior parts without damage or marring.

➢ Plastic prying tool BMW 00 9 321

Airbag system

The E46 airbag system consists of the following:

- Driver airbag in the center of the steering wheel hub
- Passenger airbag in the right side of the dashboard
- Front side-impact airbags, one in each front door
- Head Protection System (HPS) airbags, one in each front roof pillar (A-pillar)

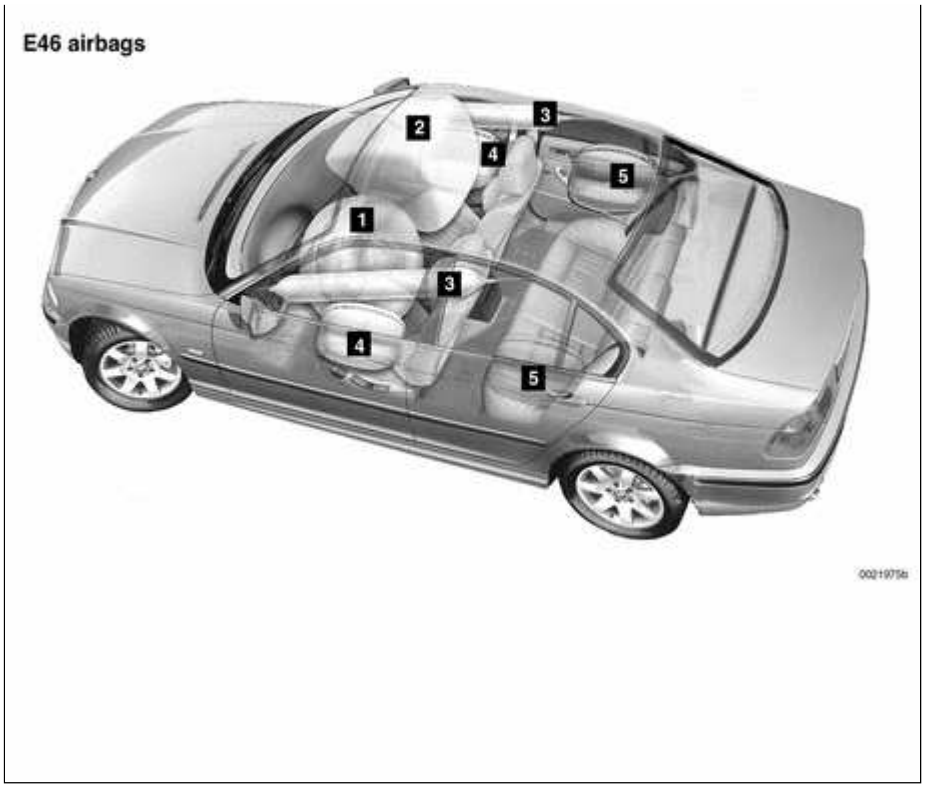
As an option, some cars may be equipped with:

- Rear side-impact airbags, one in each rear door (4-door Sedan or Sport Wagon).

The airbags and seat belts are integrated into the Multiple Restraint System (MRS). The MRS control module is located on the center tunnel, underneath the rug below the parking brake handle.

E46 Airbags

1 - Driver air bag



2 - Passenger airbag

3 - Head Protection System (HPS) airbag

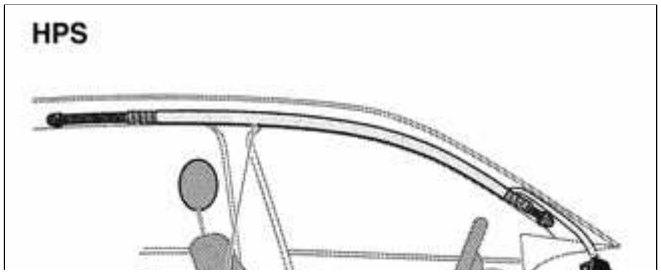
4 - Front door side-impact airbag

5 - Rear door side-impact airbag (optional)

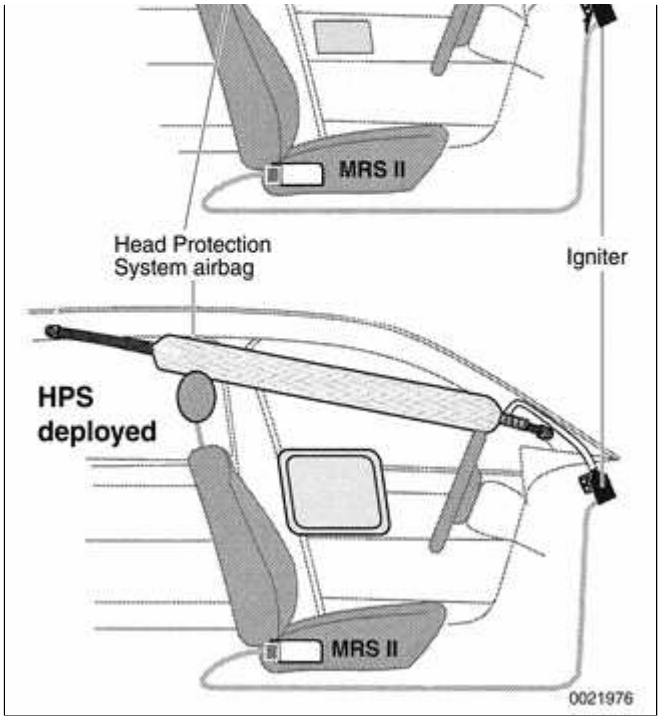
2-stage airbag

Beginning in the 2000 model year (9/1999 production) the front airbags were changed to a 2-stage style airbag. This ensures that the force of airbag inflation is not greater than necessary to provide protection. The airbags are designed to provide "soft" deployment if the acceleration sensor detects a low-speed impact, with a "hard" deployment only in higher speed impacts.

Head protection airbags (HPS)



This protective system covers a large area between the front roof pillar (A-pillar) and the rear section of the roof. A hollow flexible tube about 5 feet long and 1.5 inches in diameter is anchored inside the A-pillar and front roof rail and concealed by interior trim.



Upon severe side impact, a gas generator unit fills the Head Protection System (HPS) tube with inert gas. The expanding tube pops out of the trim to form a straight tube 5.1 inches in diameter and stretched in a straight line from the lower windshield pillar to above the rear door. The inflated tube is located to prevent the front occupant's head from contacting the A-pillar, the B-pillar, or side window. The tube's sloping position allows protection for both short and tall people. The inflated tube is stiff enough to retain much of its effectiveness even if the window is broken. The HPS tube remains inflated for approximately 7 to 8 seconds to extend protection time in case the vehicle encounters additional side impacts during the crash.

Rear side-impact airbags

Similar to the standard-equipment front side-impact airbags, the rear airbags are built into the doors of sedan models. These were offered as a special order option on certain models only. They can be deactivated to protect infants or small children riding in the rear seat. Activation and deactivation can be performed by using either DIS or MoDiC BMW scan tools.

MRS deployment logic

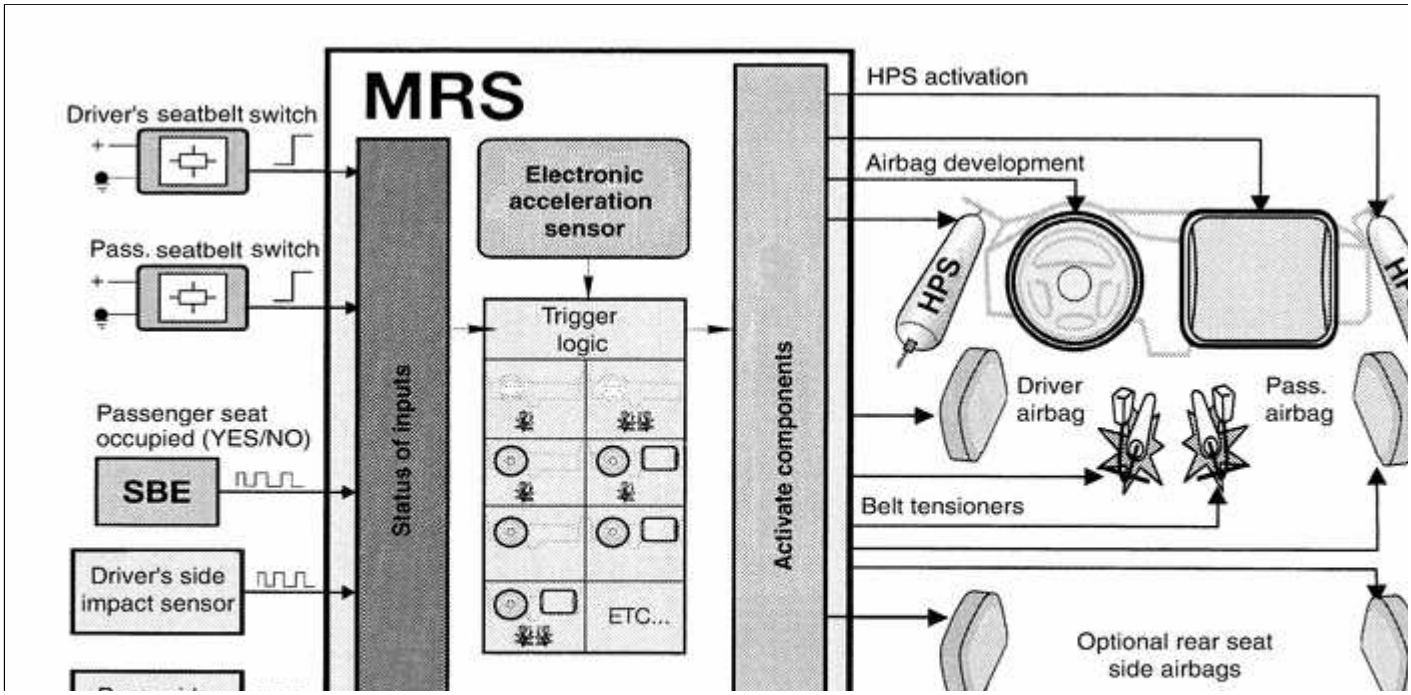
Main sensing and triggering functions for the front-impact airbags and seat belt tensioners are combined into a single MRS control module located above the center tunnel, under the rug, beneath the parking brake handle.

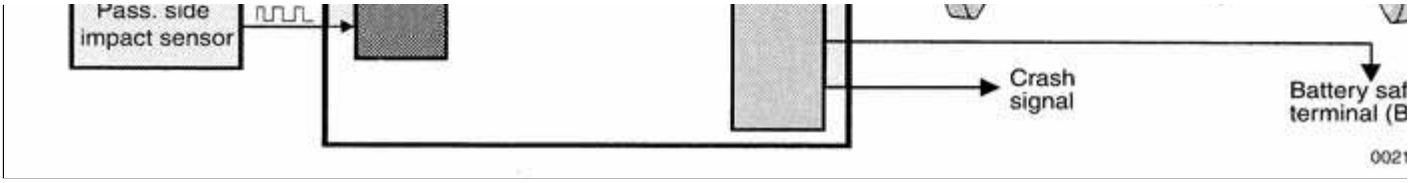
Side-impact and head protection airbags are controlled by separate sensors, one for each side of the vehicle.

MRS deployment logic provides two thresholds for the activation of the safety system, depending upon the severity of impact and whether or not occupants have fastened their seat belts:

- Belts fastened, low impact speed: Lower deployment threshold. Only seat belt pyrotechnic tensioners are deployed.
- Belts fastened, high impact speed: Higher deployment threshold. Tensioners and front-impact airbags are deployed.
- Belts not fastened, low or high impact speed: Airbags are deployed.
- Passenger seat not occupied: Neither belt tensioner nor airbag is deployed on that side.

MRS





Airbag indicator light

The MRS control module detects and stores system status.

The airbag indicator light in the instrument cluster displays the status of the airbag system when the ignition key is in "accessory" or ON positions.

- System normal: Indicator light comes on briefly, then goes out.
- System malfunction: Indicator light fails to come on.
- System malfunction: Indicator light comes on briefly, goes out and lights up again.

The airbag indicator light also comes on if the seat belt pyrotechnic tensioners have been triggered.

Warnings

When servicing airbag equipped cars, the following precautions must be observed to prevent personal injury.

WARNING!

- ***If the airbag indicator light is on, there is a risk that the airbags will not be triggered in case of an accident. Be sure to have the system inspected and repaired***

immediately.

- ***Airbag(s) are inflated by an explosive device. Handled improperly or without adequate safeguards, the system can be very dangerous. Special precautions must be observed prior to any work at or near the airbags.***

- ***The airbag is a vehicle safety system. Serious injury may result if system service is attempted by persons unfamiliar with the BMW MRS II and its approved service procedures. BMW advises that all inspection and service be performed by an authorized BMW dealer.***

- ***Always disconnect the battery and cover the negative (-) battery terminal with an insulator before starting diagnostic, troubleshooting or service work not associated with the airbags, and before doing any welding on the car.***

- ***After disconnecting the battery, wait 5 seconds before beginning work on airbag components.***

- ***If an airbag has been activated due to an accident, BMW specifies that airbag components be replaced. For more information on post-collision airbag service, see an authorized BMW dealer.***

- ***Do not fire an airbag unit prior to disposal. It must be fired by a***

special disposal company or shipped back to BMW in the packaging of the new components.

- ***When removing a fired airbag unit, avoid contact with the skin; wear gloves. In case of skin contact, wash with water.***

- ***Do not allow airbag system components to come in contact with cleaning solutions or grease. Never subject airbag components to temperatures above 167F (75C). When reconnecting the battery, no person should be inside the vehicle.***

- ***Always place an airbag unit that has been removed from its packaging with the padded side facing upward. Do not leave an airbag unit unattended.***

- ***If the airbag unit or airbag control module has been dropped from a height of meter (1 ft.) or more, the airbag unit should not be installed.***

Airbag Electronics

Airbag harnesses and connectors

If airbag connection harnesses show visible signs of wear or damage, they must be replaced or repaired.

- To repair airbag harness:

- Disconnect negative (-) cable from battery and cover negative terminal with insulating material.
- Disconnect harness connector at airbag module or on intermediate plug.
- Cut through one cable, then the other, and repair.

CAUTION!

- ***Do not under any circumstances cut through both wires of an airbag harness at the same time.***
- ***Perform only one repair on an airbag harness wire. If more than one spot is damaged, replace the entire section of harness.***

MRS control module, replacing

- Disconnect negative (-) cable from battery and cover negative terminal with insulating material.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Remove center utility tray between front seats. See ⇒ 513 Interior Trim.

➢ Cut open carpet on top of center tunnel to access MRS II module.

- Remove module mounting nuts and lift up control module. Detach electrical harness connector.

- Installation is reverse of removal.

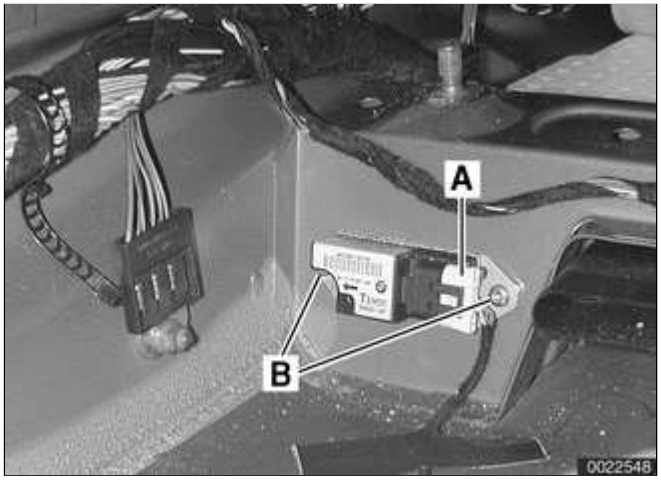
♦ Be sure that MRS module ground cable is attached to the module mounting stud.

Side-impact crash sensor, removing and installing

- Make sure ignition key is OFF.

- Remove front seat. See ⇒ 520 Seats.

➢ Remove plastic door sill trim by lifting to release clips at one end, then sliding off. Fold up carpet towards rear seat floor. If necessary, remove floor level heater duct.



- Remove electrical harness connector from crash sensor (**A**). Remove sensor retaining screws (**B**) and remove sensor. Note direction of sensor arrow before removing.

- Installation is reverse of removal.

Note:

Arrow on sensor must point to door sill.

Airbags

Driver airbag, removing and installing

- Disconnect negative (-) cable from battery and cover negative terminal with insulating material.

WARNING!

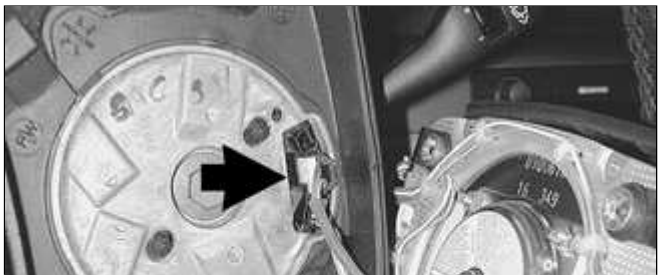
After disconnecting the battery, wait 5 seconds before beginning work on airbag components.

CAUTION!

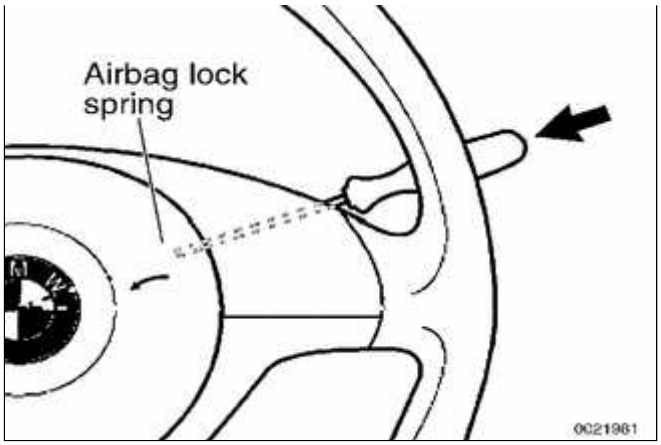
Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

➢ Multifunction (MFL) steering wheel:

- ♦ Working behind steering wheel, completely loosen Torx screws (T30) while holding airbag in place.
- ♦ Support airbag unit to prevent it from falling out.



➢ Carefully lift airbag unit off steering wheel and disconnect harness connector (**arrow**) from rear of airbag unit.



- Sport steering wheel:
  - Insert screwdriver through opening in rear of steering wheel and push against spring tension to release airbag unit lock.
  - Repeat procedure on other side of steering wheel.
  - Lift off airbag unit and detach electrical harness connectors.

WARNING!

- ***Store the removed airbag unit with the horn pad facing up. If stored facing down, accidental deployment could propel it violently into the air, causing injury.***
- ***Once an airbag is removed, the car must not be driven.***
- ***Do not connect the battery with the airbag disconnected. A fault code will be stored, setting off the airbag indicator light. Special tools are needed to reset the fault memory.***
- ***Once the airbag unit is installed and all other service procedures have been completed, start the engine and check that the airbag indicator light goes out. If***

the indicator light stays on, the airbag system will not function as designed. Have the system diagnosed and repaired by an authorized BMW dealer.

- Installation is reverse of removal.

- MFL steering wheel: Torque airbag using specification listed below.

- Sport steering wheel: Press airbag unit mounting pins into spring locks in steering wheel until they snap in firmly.

CAUTION!

Do not pinch airbag harness in center of steering wheel when installing airbag.

Tightening torque	
Airbag to steering wheel (MFL)	8 Nm (71 in-lb)

Passenger airbag, removing and installing

- Disconnect negative (-) cable from battery and cover negative terminal with insulating material.

WARNING!

After disconnecting the battery, wait 5 seconds before beginning work on airbag components.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection

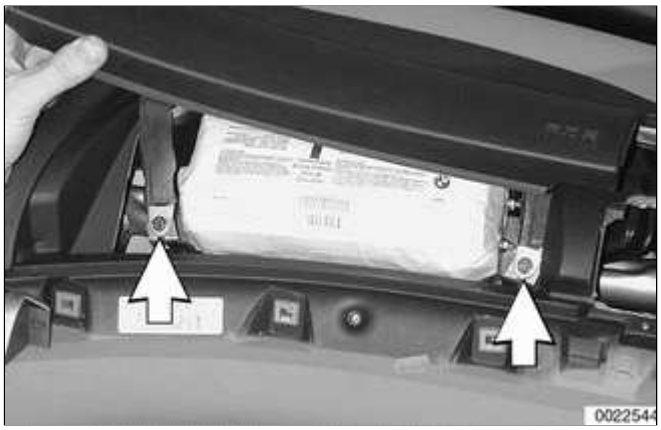
cautions given at the front of this manual on page viii.

- Pry gently at right dashboard trim to remove.

CAUTION!

To avoid marring interior trim, work with a plastic prying tool.

  - Remove right dashboard fresh air outlet mounting screws and pull outlet out of dash.



- Lift cover from top of passenger side airbag on dashboard.

  - Remove cover strap retaining bolts (**arrows**) to detach cover completely from dashboard.

CAUTION!

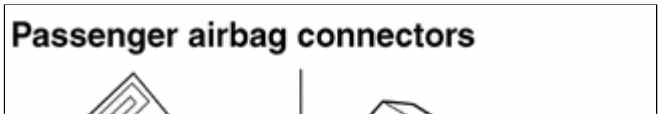
The plastic retainer at the right end of the cover may snap during removal. Be sure to have extra retainers on hand for reassembly

- Remove airbag mounting bolts (**arrows**).

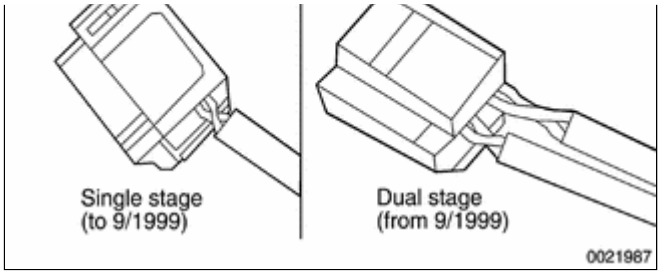
  - Lift airbag and disconnect electrical harness connector. Remove airbag.

WARNING!

Store the removed airbag unit with the soft pad facing up. If stored facing down, accidental deployment could propel it violently into the air, causing injury.



- Early E46 cars (through production date 9/1999) were equipped with a



single stage airbag, identified by having only one wire loom in the harness connector. Later production two stage airbags are supplied by two wire looms in the connector plug. The two kinds of airbags are NOT interchangeable.

- Installation is reverse of removal. Make sure wiring harness is not pinched when installing airbag unit in dashboard.

Tightening torques	
Airbag cover strap to dashboard (M6)	9 Nm (7 ft-lb)
Passenger air bag to dashboard (M8)	22 Nm (16 ft-lb)

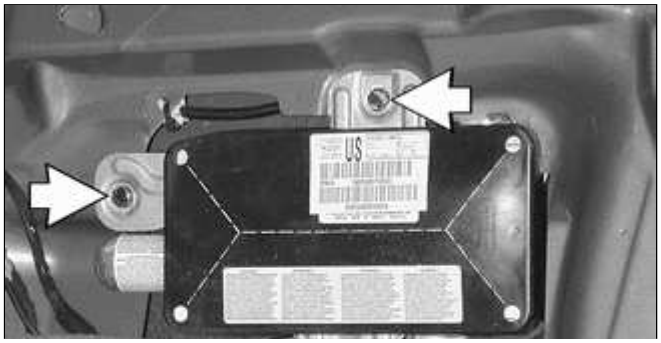
Door mounted side-impact airbag, removing and installing

- Disconnect negative (-) cable from battery and cover negative terminal with insulating material.

CAUTION!

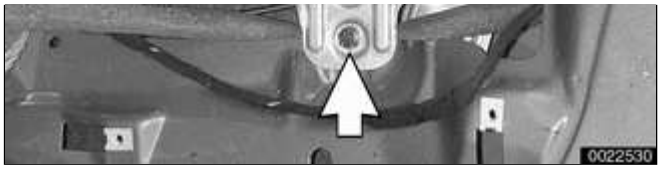
Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

- Remove inside door panel as described in ⇒ 411 Doors.



➢ Front door airbag:

- Remove airbag mounting bolts (**arrows**).
- Turn over airbag unit and cut off electrical harness wire tie.



- Detach harness connector.

CAUTION!

When removing and installing the airbag unit, pay attention to the routing of the electrical harness to avoid kinks or breaks in the wire.

- Rear door airbag:

- Detach electrical harness connector.

- Remove mounting bolts and remove airbag from door.

- Installation is reverse of removal.

- Route electrical harnesses as they were before.

- Use new wire ties as necessary.

- Use new self-locking mounting bolts.

Tightening torque	
Side-impact airbag to door	8.5 Nm (75 in-lb)

Head protection airbag (HPS) components

Replacement of a head protection airbag (HPS) is an extensive operation. Replacement includes removal of the following components:

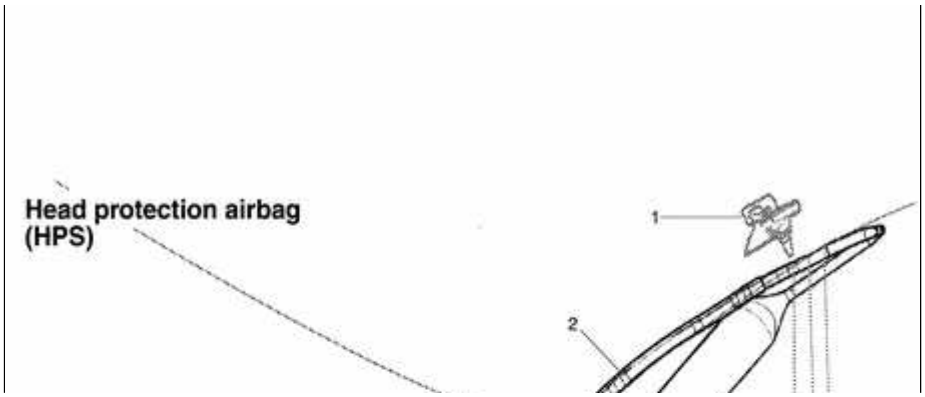
- Complete dashboard
- Complete headliner
- Windshield pillar (A-pillar) trim
- Door pillar (B-pillar) trim

- Before starting work on the HPS airbag, disconnect negative (-) cable from battery and cover negative terminal with insulating material.

CAUTION!

Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.

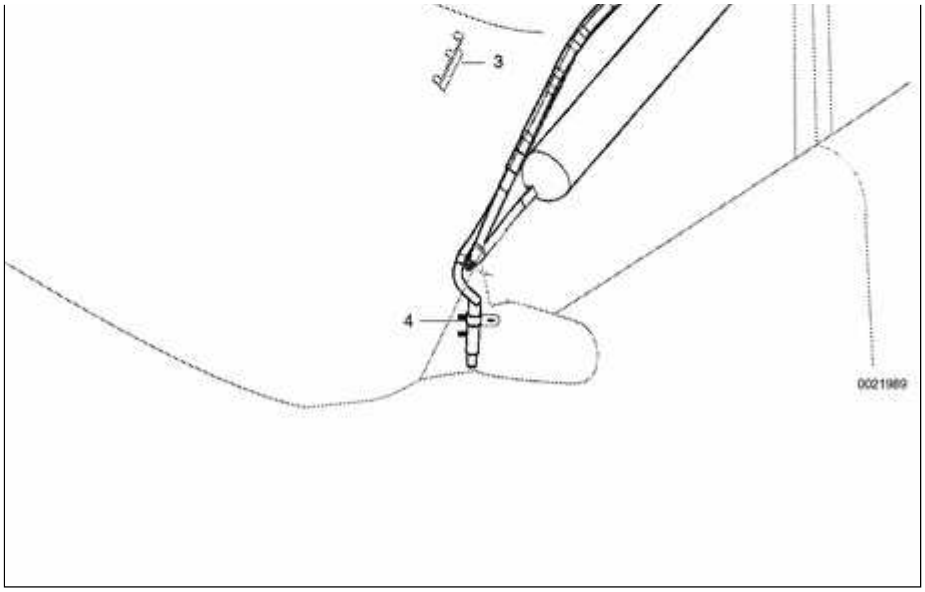
Tightening torque	
HPS airbag to body	11 Nm (8 ft-lb)
HPS airbag mounting bracket to A or B-pillar	2.5 Nm (22 in-lb)
HPS gas generator to dashboard reinforcement M6 self-tapping screw	4 Nm (35 in-lb)



Head protection airbag (HPS)

1 - B-pillar deflection plate

2 - Head protection airbag



3 - **Cable holder**

4 - **Gas generator**

5 - **Self-tapping screw M6**

- tighten to 4 Nm (35 in-lb)

On-Board Diagnostics (OBD II)

OBD II is an acronym for On-Board Diagnostics II, the second generation of on-board self-diagnostic equipment requirements. These standards were originally mandated for California vehicles. Since 1996 they have been applied to all passenger vehicles sold in the United States.

On-board diagnostic capabilities are incorporated into the hardware and software of the engine control module (ECM) to monitor virtually every component that can affect vehicle emissions. OBD II works to ensure that the vehicles remain as clean as possible over their entire life.

Each emission-influencing component is checked by a diagnostic routine to verify that it is functioning properly. If a problem or malfunction is detected, the OBD II system illuminates a warning light on the instrument panel to alert the driver. This malfunction indicator light (MIL) will display the phrase "Check Engine" or "Service Engine Soon."

The OBD II system also stores important information about the detected malfunction so that a repair technician can accurately find and fix the problem.

Note:

- *Specialized OBD II scan tool equipment is needed to access the fault memory and OBD II data.*

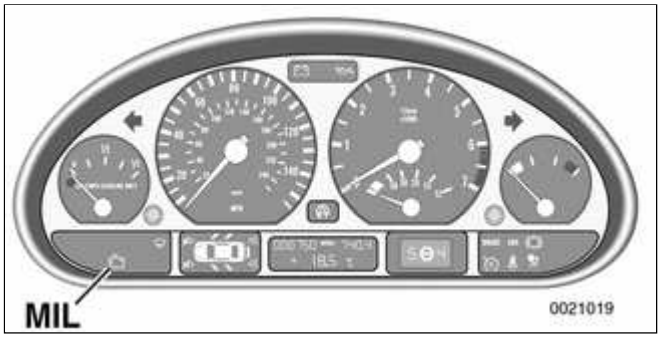
- *The OBD II fault memory (including the MIL) can only be*

reset using the special scan tool. Removing the connector from the ECM or disconnecting the battery will not erase the fault memory.

The extra hardware needed to operate the OBD II system consists mainly of the following:

- Additional oxygen sensors downstream of the catalytic converters
- Fuel tank pressure sensor and device to pressurize fuel storage system
- Several engine and performance monitoring devices
- Standardized 16-pin OBD II connector under the dash
- Upgraded components for the federally required 100,000 mile or 10 year reliability mandate

Malfunction Indicator Light (MIL)



The OBD II system is designed to illuminate the Malfunction Indicator Light (MIL) when emission levels exceed 1.5 times the Federal standards.

Note:

On model year 1999 and 2000 cars, the MIL is labeled Check Engine. On model year 2001 cars, the MIL is labeled Service Engine Soon.

The MIL will come on under the following conditions.

- An engine management system fault is detected for two consecutive OBD II drive cycles.
- A catalyst damaging fault.
- A component malfunction (such as catalyst deterioration) causes emissions to exceed 1.5 times OBD II standards.
- Manufacturer-defined specifications are exceeded.
- An implausible input signal is generated.
- Misfire faults occur.
- A leak is detected in evaporative system.
- The oxygen sensors observe no purge flow from purge valve/evaporative system.
- The engine control module (ECM) fails to enter closed-loop operation within specified time.
- The engine control module (ECM) or automatic transmission control module (TCM) enters "limp home" operation mode.
- Key is in "ignition on" position before cranking (bulb check function).

Additional information, MIL:

- A fault code is stored within the ECM upon the first occurrence of a fault in the system being checked.
- Two complete consecutive drive cycles with the fault present illuminate the MIL. The exception to the two-fault requirement is a catalyst damaging fault, which will turn the light on immediately.
- If the second drive cycle was not complete and the specific function was not checked as shown in the example, the ECM counts the third drive cycle as the next consecutive drive cycle. The MIL is illuminated if the function is checked and the fault is still present.
- Once the MIL is illuminated it will remain illuminated unless the specific function has been checked without fault through three complete consecutive drive cycles.
- The fault code will be cleared from memory automatically if the specific function is checked through 40 consecutive drive cycles without the fault being detected.

Note:

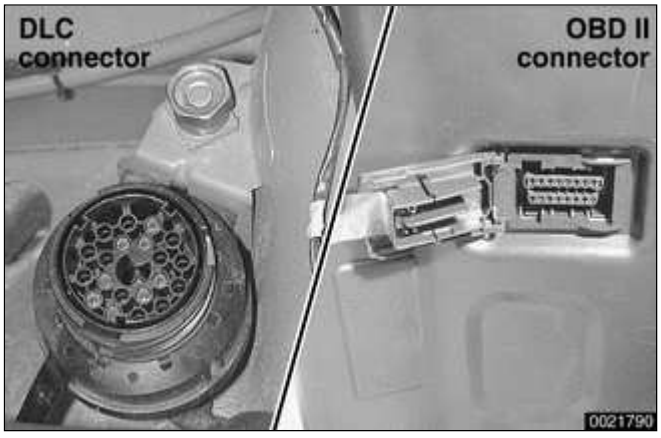
In order to automatically clear a catalyst damaging fault from memory, the condition under which the fault occurred must be evaluated for 80 consecutive drive cycles without the fault reoccurring.

With the use of a universal or 'generic' scan tool connected to the DLC (Diagnostic Link Connector), diagnostic trouble codes (DTCs) can be obtained, along with the conditions associated with the illumination of the engine service light. Using a more advanced or BMW-dedicated scan tool, additional 'proprietary' information is normally available.

Scan tool and scan tool display

Owing to the advanced nature of OBD II adaptive strategies, all diagnostics need to start with a scan tool. The aftermarket scan tools can be connected to either the 16-pin OBD II Data Link Connector (DLC) or the BMW 20-pin DLC in the engine compartment. Data from the OBD II DLC may be limited, depending on scan tool and vehicle.

OBD II standards mandate that the 16-pin DLC must be located within three (3) feet of the driver and must not require any tools to be exposed. The communication protocol used by BMW is ISO 9141.



Starting with June 2000 production, the 20-pin BMW diagnostic port (**Data Link Connector** or **DLC**) which was previously located in the engine compartment has been deleted. All diagnostic, coding and programming functions are incorporated into the **OBD II** diagnostic port, located under left side of dashboard.

Note:

- *On cars built up 06-2000: when accessing emissions related DTCs through the 16-pin OBD II DLC, the BMW 20-pin DLC cap must be*

installed.

- *Professional diagnostic scan tools available at the time of this printing include the BMW factory tools (DISplus and MoDiC) and a small number of aftermarket BMW-specific tools. The CS2000 from Baum Tools Unlimited, the Retriever from Assenmacher Specialty Tools, and the MT2500 from Snap-On Tools are examples of quality OBD scan tools.*

- *In addition to the professional line of scan tools, inexpensive `generic' OBD II scan tool software programs and handheld units are readily available. These tools do have limited capabilities, but they are nonetheless powerful diagnostic tools. These tools read live data streams and freeze frame data as well as a host of other valuable diagnostic data.*

- *For the do-it-yourself owner, simple aftermarket DTC readers are also available. These inexpensive BMW-only tools are capable of checking for DTCs as well as turning off the illuminated MIL and resetting the service indicator lights.*

Diagnostic monitors

A diagnostic monitor is an operating strategy that runs internal tests and checks a specific system, component or function. This is similar to computer self tests.

Completion of a drive cycle ensures that all monitors have completed their

required tests. The ECM must recognize the loss or impairment of the signal or component and determine if a signal or sensor is faulty based on 3 conditions:

- Signal or component shorted to ground
- Signal or component shorted to B+
- Signal or component missing (open circuit)

The OBD II system must monitor all emission control systems that are on-board. Not all vehicles have a full complement of emission control systems. For example, a vehicle may not be equipped with secondary air injection, so naturally no secondary air readiness/function code would be present.

OBD II requires monitoring of the following:

- Oxygen sensor monitoring
- Catalyst monitoring
- Misfire monitoring
- Evaporative system monitoring
- Secondary air monitoring
- Fuel system monitoring

Monitoring these emissions related functions is done using DME input sensors and output accouters based on preprogrammed data sets. If the

ECM cannot determine the environment or engine operating conditions due to missing or faulty signals it will set a fault code and, depending on conditions, illuminate the MIL.

Oxygen sensor monitoring: When drive conditions allow, response rate and switching time of each oxygen sensor is monitored. In addition, the heater function is also monitored. The OBD II "diagnostic executive" knows the difference between upstream and downstream oxygen sensors and reads each one individually.

All oxygen sensors are monitored separately. In order for the oxygen sensor to be effectively monitored, the system must be in closed loop operation.

Catalyst monitoring: This strategy monitors the two heated oxygen sensors per bank of cylinders. It compares the oxygen content going into the catalytic converter to the oxygen leaving the converter.

The diagnostic executive knows that most of the oxygen should be used up during the oxidation phase and if it sees higher than programmed values, a fault will be set and the MIL will illuminate.

Misfire detection: This strategy monitors crankshaft speed fluctuations and determines if a misfire occurs by variations in speed between each crankshaft sensor trigger point. This strategy is so finely tuned that it can even determine the severity of the misfire.

The diagnostic executive must determine if misfire is occurring, as well as other pertinent misfire information.

- Specific cylinder(s)
- Severity of the misfire event
- Emissions relevant or catalyst damaging

Misfire detection is an on-going monitoring process that is only disabled under certain limited conditions.

Secondary air injection monitoring: Secondary air injection is used to reduce HC and CO emissions during engine warm up. Immediately following a cold engine start (-10 to 40ï¿½C), fresh air/oxygen is pumped directly into the exhaust manifold. By injecting oxygen into the exhaust manifold, catalyst warm-up time is reduced.

System components:

- Electric air injection motor/pump
- Electric motor/pump relay
- Non-return valve
- Vacuum/vent valve
- Stainless steel air injection pipes
- Vacuum reservoir

The secondary air system is monitored via the use of the pre-catalyst oxygen sensors. Once the air pump is active and air is injected into the system, the signal at the oxygen sensor will reflect a lean condition. If the oxygen sensor signal does not change, a fault will be

set and identify the faulty bank(s). If after completing the next cold start a fault is again present, the MIL will be illuminated.

Fuel system monitoring: This monitors receives high priority. It looks at the fuel delivery needed (long/short term fuel trim) for proper engine operation based on programmed data. If too much or not enough fuel is delivered over a predetermined time, a DTC is set and the MIL is turned on.

Note:

Fuel trim refers to adjustments to base fuel schedule. Long-term fuel trim refers to gradual adjustments to the fuel calibration adjustment as compared to short term fuel trim. Long term fuel trim adjustments compensate for gradual changes that occur over time.

Fuel system monitoring monitors the calculated injection time (ti) in relation to engine speed, load, and the pre-catalytic converter oxygen sensor(s) signals as a result of residual oxygen in the exhaust stream.

The diagnostic executive uses the precatalyst oxygen sensor signal as a correction factor for adjusting and optimizing the mixture pilot control under all engine operating conditions.

Evaporative system monitoring: This monitor checks the sealed integrity of the fuel storage system and related fuel lines.

This monitor has the ability to detect very small leaks anywhere in the system. A pressure test is be performed on the EVAP system on a continuous basis as the drive cycle allows.

On MS 42.0 cars, a leak detection pump (LDP) is used to pressurize and

check system integrity. On MS 43.0 cars, a more sophisticated DMTL (Diagnostic Module - Leak Detection) pump is used.

Drive cycle

The OBD II drive cycle is an important concept in understanding OBD II requirements. The purpose of the drive cycle is to run all of the emission-related on-board diagnostics over on a broad range of driving conditions.

The drive cycle is considered completed when all of the diagnostic monitors have run their tests without interruption. For a drive cycle to be initiated, the vehicle must be started cold and brought up to 160ï¿½F and at least 40ï¿½F above its original starting temperature.

Once the drive cycle is completed, the system status or inspection/maintenance (I/M) readiness codes are set to "Yes."

System status codes will be set to "No" in the following cases:

- The battery or ECM is disconnected.
- The ECM's DTCs have been erased after completion of repairs and a drive cycle has not be completed.

A scan tool can be used to determine if on-board diagnosis is complete as well as the status of the I/M codes. All required tests must be completed before the I/M readiness codes will be set to "Yes".

Readiness codes

BMW Fault Codes (DTCs)

Below is a comprehensive listing of BMW DTCs and the corresponding SAE P-codes.

Table a. Diagnostic trouble codes (DTCs)

BMW code	P-code	Fault type and function	Signal type and range	Explanation
1		Ignition coil cyl.2	Input analog timing (100 mV)	DME initiates secondary ignition for each cylinder then looks for feedback through shunt resistor in harness to determine if ignition actually occurred.
2		Ignition coil cyl.4	Input analog timing (100 mV)	DME initiates secondary ignition for each cylinder then looks for feedback through shunt resistor in harness to determine if ignition actually occurred.
3		Ignition coil cyl.6	Input analog timing (100 mV)	DME initiates secondary ignition for each cylinder then looks for feedback through shunt resistor in harness to determine if ignition actually occurred.
5	P0202	Injector circuit cyl. 2	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
6	P0201	Injector circuit cyl. 1	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.

BMW code	P-code	Fault type and function	Signal type and range	Explanation
8	P0101	Mass air flow circuit range/perf.	Input analog (0-5V)	Failed signal range check against predefined diagnostic limits.
10		Engine coolant temp. circuit range/perf.	Input analog (0-5V)	Signal range is checked against predefined diagnostic limits within specific engine operations.
11		Coolant temp. coolant outlet	Input analog (0-5V)	Signal range is checked against predefined diagnostic limits within specific engine operations.
14	P0111	Intake air temp. range/performance	Input analog (0-5V)	Signal range is checked against predefined diagnostic limits within specific engine operations.
18	P1397	Exhaust cam position sensor malfunction	Input analog phase shift (0-5V)	Internal check of phase shift from camshaft sensor - should change during every crankshaft revolution.Phase shift occurs due to 2:1 relationship between camshafts.
19	P1529	VANOS solenoid activation, exhaust	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
21	P1525	VANOS solenoid activation, intake	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
22	P0203	Injector circuit cyl. 3	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.

BMW code	P-code	Fault type and function	Signal type and range	Explanation
23	P0206	Injector circuit cyl. 6	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
24	P0204	Injector circuit cyl. 4	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
25	P0135	Oxygen sensor heater pre-cat (Bank1)	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
27	P1550	Idle control valve closing coil	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
29		Ignition coil cyl.1	Input analog timing (100 mV)	DME initiates secondary ignition for each cylinder then looks for feedback through shunt resistor in harness to determine if ignition actually occurred.
30		Ignition coil cyl.3	Input analog timing (100 mV)	DME initiates secondary ignition for each cylinder then looks for feedback through shunt resistor in harness to determine if ignition actually occurred.
31		Ignition coil cyl.5	Input analog timing (100 mV)	DME initiates secondary ignition for each cylinder then looks for feedback through shunt resistor in harness to determine if ignition actually occurred.

BMW code	P-code	Fault type and function	Signal type and range	Explanation
33	P0205	Injector circuit cyl. 5	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
35	P1453	Secondary air injection pump	Output digital on/off (active low)	TDME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
36	MS 43	Main relay malfunction	Input analog (0-12V)	Signal range check between DME ignition analog input and main relay power circuit analog input.
38	MS 43	Clutch switch faulty	Input digital (0-12V)	Plausibility check of clutch switch and DME internal values such as load and engine speed.
39		Brake light switch, and brake light plausibility test	Input digital (0-12V)	When brake light switch is active, brake light test switch must be also active. If not, fault is stored.
40		Brake light switch, pedal sensor plausibility test	Input digital / analog (0-12V / 0-5V)	If pedal sensor is showing angle greater than "limp home angle" and additionally brake light switch is active, fault is stored.
42		Multi functional steering wheel, redundant code	Input binary stream (0-12V)	Every signal from cruise control switch is transferred redundantly. A fault is set whenever two redundant information paths are showing a different status.
43		Multi functional steering wheel, control switch	Input binary stream (0-12V)	When status from cruise control showing set/accelerate and deceleration are same time, fault is set.

BMW code	P-code	Fault type and function	Signal type and range	Explanation
45		Multi functional steering wheel, toggle-bit	Input binary stream (0-12V)	Every 0.5 sec. a message that includes a toggle bit (toggles between 0->1 and 1->0) is transmitted. Change bit is monitored to indicate proper function.
47	MS 43	Torque monitoring level 1	DME internal values logical	
48	MS 43	Internal control module	DME HW test memory	
49		ECU internal test	DME HW test	
50	P1145 MS 42	Running losses valve (3/2), final stage	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
	MS 43	ECU internal test	DME HW test	
51	MS 43	ECU internal test	DME HW test	
52		Rear exhaust valve flap	Output digital steady (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
53	P1509	Idle control valve opening coil	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
55	P0155	Oxygen sensor heater pre-cat (Bank 2)	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
56		Ignition feedback, interruption at	Input analog (32V)	Check for correct signal voltage. If voltage is 32V

BMW code	P-code	Fault type and function	Signal type and range	Explanation
		shunt resistor		(limitation voltage) then secondary ignition voltage is detected and shunt resistor may be faulty.
57	P0325	Knock sensor 1 circuit, (Bank 1) circuit continuity	Input analog amplitude (13-19kHz)	Plausibility check between knock sensor amplitude during knocking with internal knock detection mapped DME values.
59	P0330	Knock sensor 2 circuit, (Bank 2) circuit continuity	Input analog amplitude (13-19kHz)	Plausibility check between knock sensor amplitude during knocking with internal knock detection mapped DME values.
61	P0141	Oxygen sensor heater post-cat (Bank 2)	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
62	P0412	Secondary air injection system switching valve	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
65	P0340	Intake cam position sensor, malfunction	Input analog phase shift 0-5V	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
68		EVAP system, purge control valve circuit	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
69		Relay fuel pump	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output

BMW code	P-code	Fault type and function	Signal type and range	Explanation
				transistor and component exists.
74		AC compressor relay	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
79	P0161	Oxygen sensor heater post-cat (Bank 1)	Output digital pulse width (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
83	P0335	Crankshaft position sensor, malfunction	Input digital (0-12V)	Checks for correct signal pattern and correct number of expected flywheel teeth.
100	P0601	Internal control module, memory check sum or communication	DME internal values logical	Internal hardware test of RAM, ROM, and Flash Prom.
103	P1519	VANOS faulty reference value intake	DME internal values logical	Maximum VANOS adjustment angle, checked at every engine start must be within a specified limit.
104	P1520	VANOS faulty reference value exhaust	DME internal values logical	Maximum VANOS adjustment angle, checked at every engine start must be within a specified limit.
105	P1522	VANOS stuck (Bank 1) intake	DME internal values	Monitoring of a desired VANOS adjustment within a predefined diagnostic time limit.
106	P1523	VANOS stuck (Bank 2) exhaust	DME internal values	Monitoring of a desired VANOS adjustment within a predefined diagnostic time limit.
109	P1580	Motor throttle valve pulse width not plausible	Output digital pulse width (0-12V)	Throttle position control algorithm checks for problems with mechanical coupling

BMW code	P-code	Fault type and function	Signal type and range	Explanation
				spring within motor throttle body.
110	P1542	Pedal sensor potentiometer 1	Input analog (0-5V)	Failed signal range check against predefined diagnostic limits.
111	P1542	Pedal Sensor Potentiometer 2	Input analog (0-5V)	Failed signal range check against predefined diagnostic limits.
112	P0120 MS 42	Motor throttle valve potentiometer 1	Input analog (0-5V)	Failed signal range check against predefined diagnostic limits.
	MS 43	Throttle position sensor 1	Input analog (0-5V)	Failed signal range check against predefined diagnostic limits.
113	P0120	Motor throttle valve potentiometer 2	Input analog (0-5V)	Failed signal range check against predefined diagnostic limits.
114	P1580 MS 42	Motor throttle valve final stage	DME internal test	Final stage inside DME (special H-bridge), will set internal flag whenever a short to ground, a short to battery voltage or a disconnection occurs.
	MS 43	A second pedal sensor range check failure is determined	DME internal values logical	If pedal sensor malfunction is determined, followed by a second malfunction, a signal is sent.
115	P1623 MS 42	Output voltage 5V for potentiometer operation 1	DME internal (5V)	Check for proper 5 volts supply to potentiometers is possible within a predefined voltage limit.
	MS 43	Range check for throttle position adaptation	Input analog (0-5V)	Range check for closed position of throttle sensors.
116	P1623	Output voltage for potentiometer operation 2	DME internal (5V)	Check for proper 5 volts supply to potentiometers is possible within a predefined voltage limit.

BMW code	P-code	Fault type and function	Signal type and range	Explanation
117	P1542	Pedal sensor potentiometer plausibility	Input analog (0-5V)	If there is a difference greater than specified between two redundant signals from potentiometer, fault will be set.
118	P0120 MS 42	Motor throttle feedback potentiometer plausibility	Input analog (0-5V)	If there is a difference greater than specified between two redundant signals from potentiometer, fault will be set.
	MS 43	Throttle position sensor 1; plausibility check sensor 1 to mass air flow meter	DME internal values	Signal range is checked against predetermined diagnostic limits. Rationality check with mass air flow meter.
119	P1580 MS 42	MDK, throttle mechanical sticking	DME internal test	Throttle doesn't reach desired opening angle within a specified time.
	MS 43	Throttle position sensor 2; plausibility check sensor 1 to mass air flow meter	DME internal values	Signal range is checked against predetermined diagnostic limits. Rationality check with mass air flow meter.
120	P1542 MS 42	Pedal sensor/ motor throttle valve potentiometer not plausible	DME internal values logical motor	Signal from motor throttle valve potentiometer must be equal signal from pedal sensor potentiometer plus any adaptive values.
	MS 43	Plausibility check between brake switch and pedal sensor	Input digital / analog	Plausibility check between constant pedal value and brake switch. First pedal value must be constant and for next step brake switch must be active.
122	P1101	Oil temp. sensor malfunction	Input analog (0-5V)	Signal range is checked against predefined diagnostic limits and calculated temperature.
123	P1622	Electric thermostat control, final stage	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a

BMW code	P-code	Fault type and function	Signal type and range	Explanation
				disconnection between output transistor and component exists.
124	P1593	DISA, range/perf.	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
125		Coolant fan, final stage	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
126	P1470 MS 42	LDP-magnetic valve	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
	MS 43	DMTL valve	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
127		Fuel pump	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
128		EWS signal not present or faulty	Input binary stream bit data (0-12V)	During time out check no signal was present within specific time or faulty information from serial interface (parity, overrun, etc.).
130		CAN time out (ASC1)	Input binary stream bit data (0-12V)	CAN message between DME/EGS not received within expected time.

BMW code	P-code	Fault type and function	Signal type and range	Explanation
131		CAN time out (instr 2)	Input binary stream bit data (0-12V)	CAN message between DME/EGS not received within expected time.
132		CAN time out (instr 3)	Input binary stream bit data (0-12V)	CAN message between DME/EGS not received within expected time.
133		CAN time out (ASC3)	Input binary stream bit data (0-12V)	CAN message between DME/EGS not received within expected time.
135	MS 43	Limp home position adaptation necessary	DME internal values logical	Limp home position must be in specified range. If range is exceeded, a fault is set.
136	MS 43	Motor throttle valve open / closing test failed	DME internal values logical	From limp home mode position, throttle valve will be open, afterwards it must fall back into limp home position. If fall back position is not in specified range, fault is set.
140	P1475	LDP reed-switch not closed	Input digital on/off (0-12V)	With shut off valve open and no pressure on system, reed contact should be closed, showing a "high signal". If not the case in beginning of every diagnostics check, a signal is sent.
140	MS 43	DMTL pump final stage	Output digital on/off (active low)	DME final stage will set flag whenever a short to ground, a short to battery voltage or a disconnection between output transistor and component exists.
141	P1477	EVAP: reed switch not closed, doesn't open or doesn't close	Input digital on/off (0-12V)	Within predetermined time LDP reed switch signal must change from high to low or from low to high or LDP reed switch is "low" for longer than predetermined time.
142	P1477	EVAP: reed switch not closed, doesn't open or doesn't close	Input digital on/off (0-12V)	Within predetermined time LDP reed switch signal must change from high to low or from low to high or LDP reed

BMW code	P-code	Fault type and function	Signal type and range	Explanation
				switch is "low" for longer than predetermined time.
142	MS 43	DMTL module fault	DME internal values logical	
143	P1476	EVAP: clamped tube check	Input digital frequency (0-12V)	Frequency of LDP pumps reed switch is lower then predetermined limit. Volume of leak is determined to be too small (i.e. pinched or restricted hose)
146	MS 43	Range check voltage supply pedal sensor 2 and throttle position sensors	DME internal input analog	Supply voltage for sensors must be within a specified range.
147	MS 43	Range check voltage supply pedal sensor 2 and throttle position sensors	DME internal input analog	Supply voltage for sensors must be within a specified range.
149	P1140	Motor throttle feedback potentiometer and air mass sensor signal not plausible	Input analog (0-5V)	Signal from motor throttle valve potentiometer must be suitable to signal from air mass sensor. A fault is set if difference exceeds specified limit.
150	P0130	Oxygen sensor pre-cat (Bank 1), short to battery volt.	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal has to be within a predetermined range (0.1V -1V) or a fault will set.
151	P0130	Oxygen sensor pre-cat (Bank 1), short to ground	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.
152	P0130	Oxygen sensor pre-cat (Bank 1), disconnection	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical disconnection exist

BMW code	P-code	Fault type and function	Signal type and range	Explanation
				on input line.
153	P0150	Oxygen sensor pre-cat (Bank 2), short to battery volt.	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.
154	P0150	Oxygen sensorpre-cat (Bank 2), short to ground	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.
155	P0150	Oxygen sensor pre-cat (Bank 2), disconnection	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical disconnection exist on input line.
156	P0136	Oxygen sensor post-cat (Bank 1), short to battery volt.	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.
157	P0136	Oxygen sensor Post Cat. (Bank 1), short to ground	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.
159	P0156	Oxygen sensor Post Cat. (Bank 2), short to battery volt.	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.
160	P0156	Oxygen sensor post-cat (Bank 2), short to ground	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical shorts exist on input line. Voltage signal must be within a predetermined range (0.1V -1V) or fault will set.

BMW code	P-code	Fault type and function	Signal type and range	Explanation
160	MS 43	Throttle valve position controller	DME internal values logical	
161	MS 43	Throttle valve position controller	DME internal values logical	
162	MS 43	Throttle valve position controller	DME internal values logical	
168	MS 43	Throttle valve position, throttle sticking	DME internal test calculated	
169		MDK final stage shut off	DME internal test	This fault indicates problem on pedal sensor, throttle potentiometer or throttle. A separately stored fault code indicates problem.
171	P0601	System has been shut down due to safety controller	DME internal test	Safety controller has shut down motor throttle valve function due to not plausible MDK input values.
172	P1542	Pedal sensor potentiometer short between two potentiometer paths	DME internal check	5 volts for potentiometers are switched on within a specific time pattern.
173	P0120	Motor throttle valve potentiometer contact short	Rationality check	Motor throttle valve potentiometer
174	P0120	Motor throttle valve potentiometer adaptation of idle end position	Input analog (0-5V)	Signal for idle position must be within a specified range. If range is exceeded, fault is set.
175		Pedal sensor potentiometer 1 adaptation of the idle end position	Input analog (0-5V)	Signal for idle position must be within a specified range. If range is exceeded, fault is set.
176	P1542	Pedal sensor potentiometer 2 adaptation of the idle end position	Input analog (0-5V)	Signal for idle position must be within a specified range. If range is exceeded, fault is set.

BMW code	P-code	Fault type and function	Signal type and range	Explanation
188	P1132	Oxygen sensor heater, pre-cat (Bank 1), insufficient	Output digital pulse width (active low)	DME internally calculated heater power is checked against predefined diagnostic limits.
189	P1133	Oxygen sensor heater, pre-cat (Bank 2), insufficient	Output digital pulse width (active low)	DME internally calculated heater power is checked against predefined diagnostic limits.
190	P1186	Oxygen sensor-heater, post-cat (Bank 1), insufficient	Output digital pulse width (active low)	DME internally calculated heater power is checked against predefined diagnostic limits.
191	P1187	Oxygen sensor heater, post-cat (Bank 2), insufficient	Output digital pulse width (active low)	DME internally calculated heater power is checked against predefined diagnostic limits.
197	MS 43	Signal range check	DME internal analog input	
202	P0170	Fuel trim (Bank 1), O2 control limit	DME internal values logical	Controller for lambda is too long beyond a min. or a max.
203	P0173	Fuel Trim (Bank 2), O2 control limit	DME internal values logical	Controller for lambda is too long beyond a min. or a max.
204	P0505	Idle control system, idle speed not plausible	DME internal values logical	Functional check between actual engine speed (RPM) and predetermined RPM exceeds maximum deviation of +200/-100 RPM.
208		EWS, engine speed check not ok	DME internal test	Engine speed signal is transferred by EWS to DME. Fault is set if transferred signal is not reflecting engine speed due to input problem in EWS.
209		EWS, content of message	Input binary stream bit data (0-12V)	Content of binary message received from EWS invalid.
210		Ignition feedback, faulty (>2 cylinders)	Input analog timing (100 mV)	Check for correct signal timing after each ignition has been initiated by feedback

BMW code	P-code	Fault type and function	Signal type and range	Explanation
				signal. If more than two ignition signals are not recognized than there might be a problem in feedback line.
211	P1510	Idle control valve stuck	DME internal values logical	Functional check against a calculated value by monitoring flow though air mass meter to determine if idle valve is mechanically stuck open. Tested during closed throttle.
214	P0500	Vehicle speed sensor	Input digital frequency (0-12V)	Signal range is checked against predefined diagnostic limits. No vehicle speed is observed after specific time when compared to engine speed and load equivalent to moving vehicle.
215	P0136	Oxygen sensor post-cat (Bank 1), disconnection	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical disconnection exist on input line.
216	P0136	Oxygen sensor post-cat (Bank 2), disconnection	Input analog (0-5V)	Oxygen sensor signal range is checked to determine if electrical disconnection exist on input line.
217	P0505	CAN time out (EGS1)	Input digital binary information(0-12V)	CAN message between DME/EGS was not received within expected time.
219		CAN-chip, bus off	Input digital binary information (0-12V)	Hardware test determines if CAN bus is off line. Data transmission is disturbed.
220	P1184	Oxygen sensor post-cat (Bank 1) slow response time	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor stays in rich or lean state. If it remains there too long in either, fault will set.
221	P1185	Oxygen sensor post-cat (Bank 2) slow response time	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor stays in rich or lean state. If it remains there too long in either fault will set.

BMW code	P-code	Fault type and function	Signal type and range	Explanation
222	P0125	Insufficient coolant temp. to permit closed loop operation	Input analog (0-5V)	Comparison of actual coolant temperature against calculated DME value which varies with load signal.
223	P1180	Oxygen sensor post-cat (Bank 1), switching time slow	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor takes to switch from rich to lean and vice versa. If too long, fault will set.
224	P1181	Oxygen sensor post-cat (Bank 2), switching time slow	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor takes to switch from rich to lean and vice versa. If too long, fault will set.
225	P1192	Post-cat sensor (Bank 1); trim control	Input analog (0-5V)	Rationality check for O2 control adaptation with post catalyst sensor bank 1.
226	P0193	Post-cat sensor (Bank 2); trim control	Input analog (0-5V)	Rationality check for O2 control adaptation with post catalyst sensor bank 2.
227	P0188	Fuel trim (Bank 1), O2 control adaptation limit	DME internal values logical	Range control of adaptation values.
228	P0189	Fuel trim (Bank 2), O2 control adaptation limit	DME internal values logical	Range control of adaptation values.
229	P0133	Oxygen sensor pre-cat (Bank 1, slow response time	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor takes to switch from rich to lean and vice versa. If too long, fault will set.
230	P0153	Oxygen sensor pre-cat (Bank 2), slow response time	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor stays in its rich or lean state. If it remains there too long in either fault will set.
231	P1178	Oxygen sensor pre-cat (Bank 1), switch time too slow	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor takes to switch from rich to lean and vice versa. If it takes too long to

BMW code	P-code	Fault type and function	Signal type and range	Explanation
				switch fault will set.
232	P0179	Oxygen sensor pre-cat (Bank 2), switch time too slow	Input analog (high is lean) (0-5V)	Checks amount of time oxygen sensor takes to switch from rich to lean and vice versa. If it takes too long to switch fault will set.
233	P0420	Catalyst efficiency (Bank 1), below threshold	Input analog (0-5V)	Compares value of pre-cat oxygen sensor to value of post-cat oxygen sensor to measure oxygen storage capability / efficiency of catalytic converter. Post-cat oxygen sensor must be relatively lean.
234	P0430	Catalyst efficiency (Bank 2), below threshold	Input analog (0-5V)	Compares value of pre-cat oxygen sensor to value of post-cat oxygen sensor to measure oxygen storage capability / efficiency of catalytic converter. Post-cat oxygen sensor must be relatively lean.
235	P1190	Pre-cat sensor (Bank 1):trim control	Input analog (high is rich) (0-1V)	Rationality check for O2 control adaptation with pre-cat sensor bank 1
236	P1191	Pre-cat sensor (Bank 2):trim control	Input analog (high is rich) (0-1V)	Rationality check for O2 control adaptation with pre-cat sensor bank 2
238	P0301	Cyl. 1 misfire detected	DME internal values logical	Crankshaft speed/acceleration is monitored by crank sensor. Time for each cylinder combustion is compared against avg. of others. If time for cylinder 1 is longer, fault will set.
239	P0302	Cyl. 2 misfire detected	DME internal values logical	Crankshaft speed/acceleration is monitored by crank sensor. Time for each cylinder combustion is compared against avg. of others. If time

BMW code	P-code	Fault type and function	Signal type and range	Explanation
				for cylinder 2 is longer, fault will set.
240	P0303	Cyl. 3 misfire detected	DME internal values logical	Crankshaft speed/acceleration is monitored by crank sensor. Time for each cylinder combustion is compared against avg. of others. If time for cylinder 3 is longer, fault will set.
241	P0304	Cyl. 4 misfire detected	DME internal values logical	Crankshaft speed/acceleration is monitored by crank sensor. Time for each cylinder combustion is compared against avg. of others. If time for cylinder 4 is longer, fault will set.
242	P0305	Cyl. 5 misfire detected	DME internal values logical	Crankshaft speed/acceleration is monitored by crank sensor. Time for each cylinder combustion is compared against avg. of others. If time for cylinder 5 is longer, fault will set.
243	P0306	Cyl. 6 misfire detected	DME internal values logical	Crankshaft speed/acceleration is monitored by crank sensor. Time for each cylinder combustion is compared against avg. of others. If time for cylinder 6 is longer, fault will set.
244		Segment timing faulty, flywheel adaptation	Input analog (0-5V)	Flywheel segments are monitored during deceleration to establish baseline for misfire calculation. If segments are too long/short (bad flywheel) and exceed limit, fault will be set.

BMW code	P-code	Fault type and function	Signal type and range	Explanation
245	P1423	Secondary air injection (Bank 1), flow too low	Input analog (0-5V)	Checks to see if oxygen sensor reacts to increase in unmetered airflow generated by secondary air pump operation. Oxygen sensor must sense lean condition or fault will set.
246	P1421	Secondary air injection (Bank 2), flow too low	Input analog (0-5V)	Checks to see if oxygen sensor reacts to increase in unmetered airflow generated by secondary air pump operation. Oxygen sensor must sense lean condition or fault will set.
247	P1432	Secondary air valve stuck open	Input analog (0-5V)	Checks to see if oxygen sensor reacts to increase in unmetered airflow generated by secondary air pump operation. Oxygen sensor must sense lean condition or fault will set.
248	P1184	Post-cat sensor; signal after decel phase not plausible; (Bank 1)	Input analog (0-5V)	Signal is checked for a lean signal in decel and a transition between lean to rich after decel
249	P1185	Post-cat sensor; signal after decel phase not plausible; (Bank 2)	Input analog (0-5V)	Signal is checked for a lean signal in decel and a transition between lean to rich after decel
250	P0440	Functional check purge valve	Input analog (0-5V)	This functional check looks for reaction of oxygen sensor signal during canister purging. Oxygen sensor, air flow meter and RPM values must react to purging of canister.