



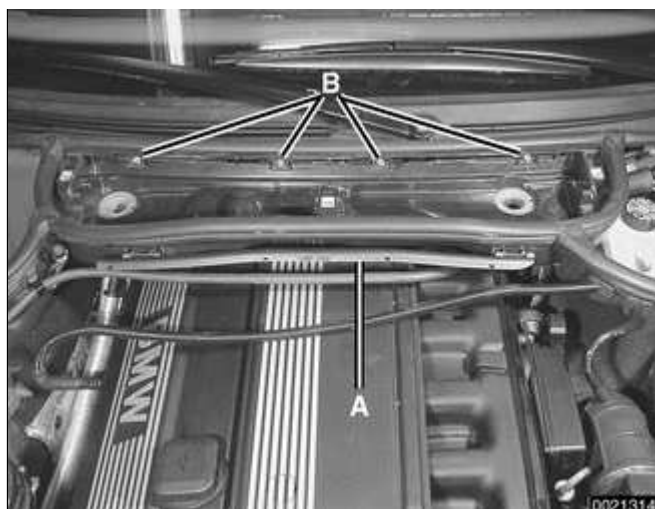
- ◆ Park car on level ground with engine off.
- ◆ Level is correct if it is between **MIN** and **MAX** marks on dipstick.
- ◆ If level is below **MIN** mark, start engine and add fluid to reservoir to bring level up.
- ◆ Stop engine and recheck level.
- ◆ Hand-tighten reservoir cap.

Power steering fluid

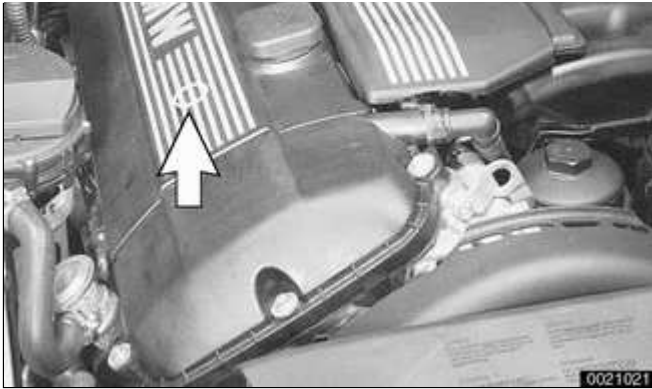
Recommended fluid	Dexron III® ATF
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Spark plugs, replacing

E46 engines use a "coil-over" configuration, with one ignition coil above each spark plug.



- ✦ Remove microfilter housing:
 - ◆ Remove microfilter for interior ventilation. See ⇒ [Ventilation microfilter, replacing](#)
 - ◆ Open wiring harness loom (**A**), remove harness and lay aside.
 - ◆ Unfasten screws (**B**) and take off lower microfilter housing.
- ✦ Remove engine cover over ignition coils:
 - ◆ Remove oil filler cap.



- ◆ Remove plastic trim covers (**arrows**).
- ◆ Remove cover hold down bolts.



- ✦ Remove ignition coil grounding harnesses (**arrows**).



- ✦ Remove ignition coils:
 - ◆ Pull up on spring clips to disconnect ignition coil harness connectors.
 - ◆ Remove coil mounting bolts. Remove coils.
 - Remove spark plugs.
 - Installation is reverse of removal, bearing in mind the following:
 - ◆ Lightly lubricate new spark plug threads with copper-based anti-seize compound.
 - ◆ Thread plugs into cylinder head by hand to prevent cross-threading.

- ◆ Be sure to reinstall coil grounding harness.

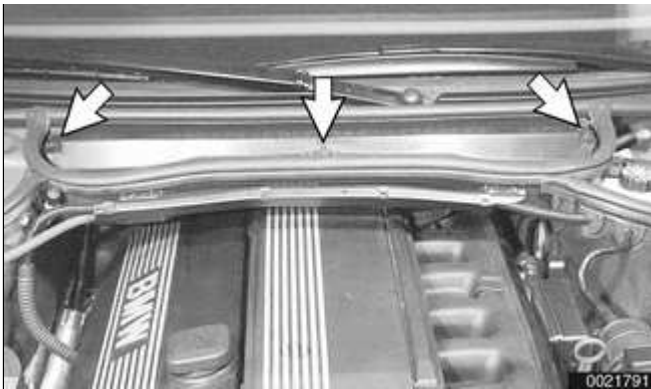
Spark plug recommendations

Bosch	FGR7 DQP
NGK	BKR6 EQUIP

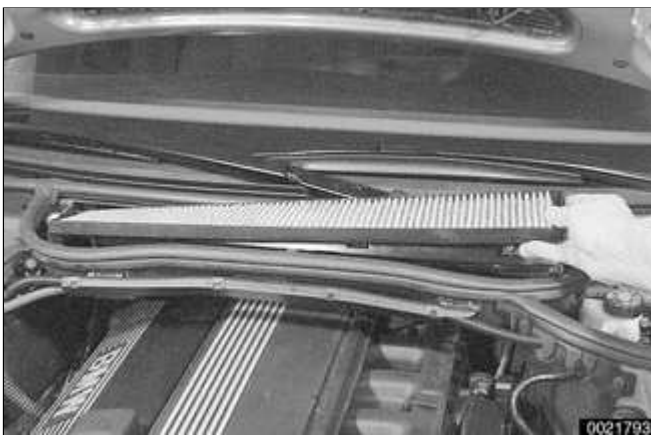
Tightening torque

Spark plug to cylinder head	25 Nm (18 ft-lb)
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Ventilation microfilter, replacing



- ✦ Working at cowl housing inside engine compartment, twist microfilter cover retainers (**arrows**) 90° each and pull cover up.



- ✦ Pull filter out and replace.

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Other Mechanical Maintenance

Battery, checking and cleaning

The battery is located in the right side of the luggage compartment. Simple maintenance of the battery and its terminal connections will ensure maximum starting performance, especially in winter when colder temperatures reduce battery power.

Note:

Design characteristics of the convertible body cause vibrations in the trunk area. Therefore, E46 Convertibles require a special battery designed for constant vibration. When replacing the battery, be sure the replacement is designed specifically for the Convertible.

Battery cables should be tight. The terminals, the cable clamps, and the battery case should be free of the white deposits that indicate corrosion and acid salts. Even a thin layer of dust containing conductive acid salts can cause battery discharge.

- To remove battery corrosion:
 - ◆ Disconnect battery cables.
Disconnect negative (-) cable first.
 - ◆ Remove battery from trunk.
 - ◆ Clean terminal posts and cable clamps with a wire brush.

- ◆ Clean main chassis ground terminal next to battery. Corrosion can be washed away with a baking soda and water solution that will neutralize acid. Apply solution carefully, though, since it will also neutralize acid inside battery.
- ◆ Reconnect cable clamps, positive (+) cable first.
- ◆ Lightly coat outside of terminals, hold down screws, and clamps with petroleum jelly, grease, or a commercial battery terminal corrosion inhibitor.

WARNING!

- ◆ ***Prior to disconnecting the battery, read the battery disconnection cautions given at the front of this manual on page viii.***
- ◆ ***Battery acid is extremely dangerous. Take care to keep it from contacting eyes, skin, or clothing. Wear eye protection. Extinguish all smoking materials and do not work near any open flames.***

Battery electrolyte should be maintained at the correct level just above the battery plates and their separators. The correct level is approximately 5 mm (1/4 in.) above the top of battery plates or to the top of the indicator marks (if applicable). The battery plates and the indicator marks can be seen once the filler caps are removed. If the electrolyte level is low, replenish it by adding distilled water

only.

Note:

The original equipment battery in E46 models is maintenance free. The original electrolyte will normally last the entire service life of the battery under moderate climate conditions.

Battery, replacing



✦ The original equipment BMW battery is equipped with a built-in hydrometer "magic eye" (**arrow**). Battery condition is determined by the color of the eye:

- ◆ Green: Adequate charge
- ◆ Black: Inadequate charge; recharge
- ◆ Yellow: Defective battery; replace

Batteries are rated by ampere hours (Ah), the number of hours a specific current drain can be sustained before complete discharge, or by cold cranking amps (CCA), the number of amps available to crank the engine in cold weather conditions. In general, replacement batteries should always be rated equal or higher than the original battery.

CAUTION!

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

The battery is held in place by a single hand screw and plate. A secure battery hold-down is important in order to prevent vibrations and road shock from

damaging the battery.

Note:

- ◆ *Always disconnect the negative (-) cable first, and connect it last. While changing the battery, clean away any corrosion in or around the battery tray.*
- ◆ *Design characteristics of the convertible body cause vibrations to oscillate in the trunk area. Therefore, the convertible model uses a special battery and battery retaining mechanism designed for this constant vibration.*
- ◆ *More battery and charging system information is in ⇒ [121 Battery, Alternator, Starter](#).*

Brake fluid, replacing

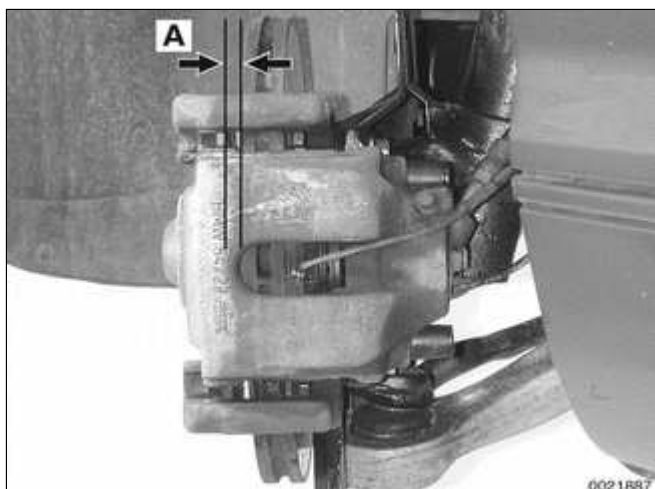
BMW strictly recommends replacing the brake fluid every two years. This will help protect against corrosion and the effects of moisture in the fluid.

Note:

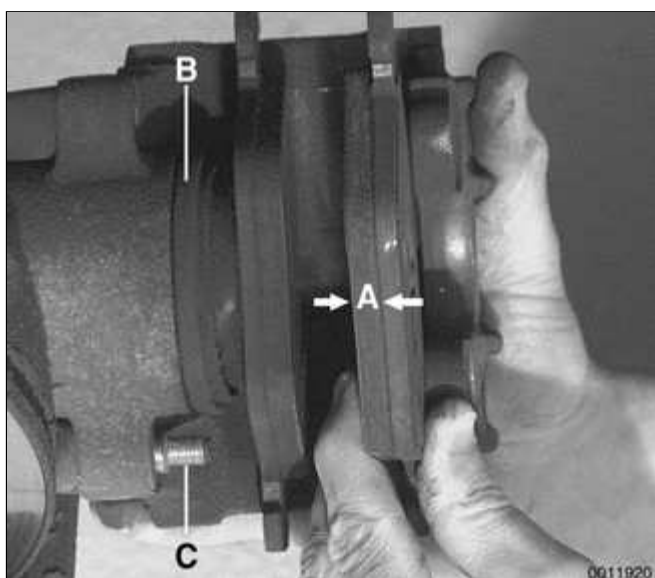
See ⇒ [340 Brakes](#) for brake fluid flushing procedures.

Brake pad/rotor wear, checking

All E46 cars are fitted with disc brakes at all four wheels. Although the brakes are equipped with a brake pad warning system, the system only monitors one wheel per axle. It is recommended that pad thickness should be checked whenever the wheels are off or brake work is being done.



- ✦ Disc brake pad wear can be checked through opening in caliper:
 - ◆ Measure distance (A) of brake pad "ear" to brake rotor. See ⇒ [340 Brakes](#). Compare to specification below.



- ✦ Unbolt caliper from steering arm to properly inspect:
 - ◆ Brake pad thickness (A)
 - ◆ Brake rotors
 - ◆ Condition of caliper seal (B)
 - ◆ Condition of caliper slider bolts (C)

Note:

Brake caliper removal and installation procedures are given in ⇒ [340 Brakes](#).

Brake pad lining minimum thickness	
Front or rear pad Dimension A	3.0 mm (0.12 in.)

Front or rear pad Dimension A	3.0 mm (0.12 in.)
----------------------------------	-------------------

Brake system, inspecting

Routine maintenance of the brake system includes maintaining the brake fluid in the reservoir, checking brake pads for wear, checking parking brake function, and inspecting the system for fluid leaks or other damage:

- ◆ Check that brake hoses are correctly routed to avoid chafing or kinking.
- ◆ Inspect unions and brake calipers for signs of fluid leaks.
- ◆ Inspect rigid lines for corrosion, dents, or other damage.
- ◆ Inspect flexible hoses for cracking.
- ◆ Replace faulty hoses or lines, see ⇒ [340 Brakes](#).

WARNING!

Incorrect installation or overtightening hoses, lines, and unions may cause chafing or leakage. This can lead to partial or complete brake system failure.

Parking brake, checking

The parking brake system is independent of the main braking system and may require periodic adjustment depending on use. Adjust the parking brake if the brake lever can be pulled up more than 8 clicks. Check that the cable moves freely. A description of the parking brake and parking brake adjustment can be found in ⇒ [340 Brakes](#).

Note:

The parking brake may lose some of its effectiveness if it is not used frequently. This is due to corrosion build-up on the parking brake drum. To remove corrosion, apply the parking brake just until it begins to grip, then pull the lever

up one more stop (click). Drive the car approximately 400 meters (1,300 ft.) and release the brake. To recheck the adjustment of the parking brake see ⇒ [340 Brakes](#).

Clutch fluid, checking

The hydraulic clutch and the brake system share the same reservoir and the same brake fluid. Clutch fluid level and brake fluid level are checked at the same time.

Note:

- ◆ See ⇒ [340 Brakes](#) for more information.
- ◆ See ⇒ [210 Clutch](#) for information on the clutch and the hydraulic clutch operating system.

Drive axle joint (CV joint) boots, inspecting

CV joint protective boots must be closely inspected for cracks and any other damage that will allow contaminants to get into the joint. If the rubber boots fail, the water and dirt that enter the joint will quickly damage it.

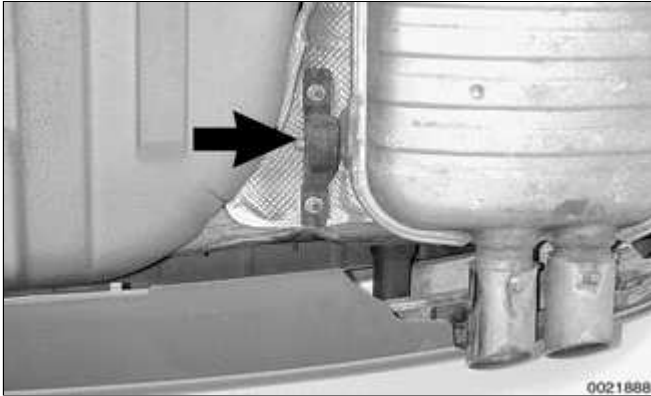
Note:

Replacement of the CV joint boots and inspection of the joints are described in ⇒ [311 Front Axle Final Drive](#) and ⇒ [331 Rear Axle Final Drive](#).

Exhaust system, inspecting

Exhaust system life varies widely according to driving habits and

environmental conditions. If short-distance driving predominates, the moisture and condensation in the system will not fully dry out. This will lead to early corrosion damage and more frequent replacement.



⚡ Scheduled maintenance of the exhaust system is limited to inspection:

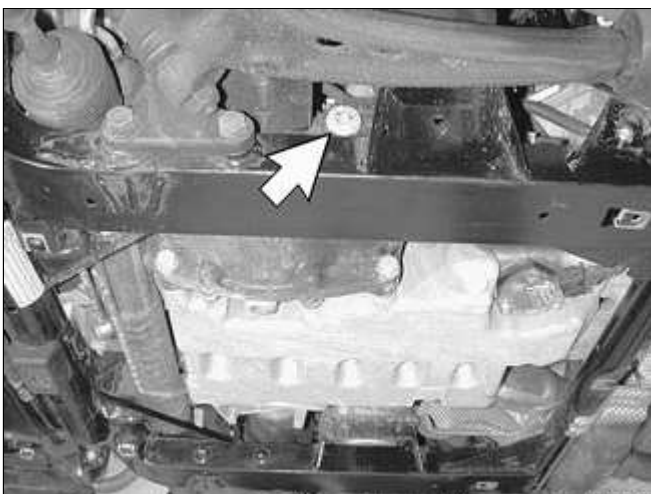
- ◆ Check to see that all the hangers (**arrow**) are in place and properly supporting the system and that the system does not strike the body.
- ◆ Check for restrictions due to dents or kinks.
- ◆ Check for weakness or perforation due to rust.

Note:

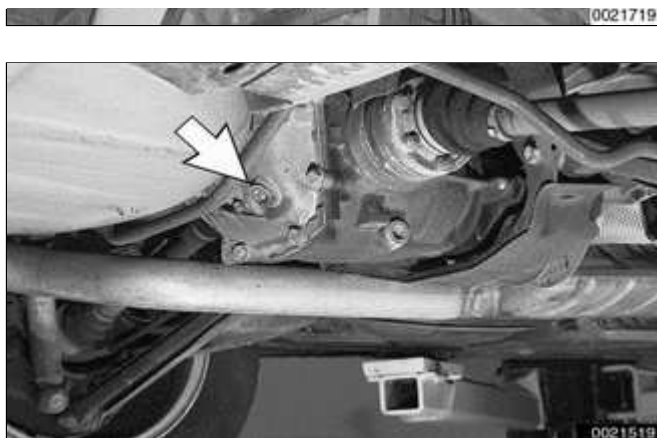
Alignment of the system and the location of the hangers are described in ⇒ [180 Exhaust System](#).

Differential oil level, checking

The differential units in E46 models are filled with lifetime oil that ordinarily does not need to be changed.



- ⚡ All wheel drive models: Check front differential fluid level at front differential filler plug (**arrow**).



- ✦ Check rear differential oil level at rear differential filler plug (**arrow**).
- Check lubricant level with car on a level surface:
 - ◆ Remove oil filler plug.
 - ◆ Level is correct when fluid just reaches edge of filler hole.
 - ◆ If necessary, top up fluid.
 - ◆ Install and tighten oil filler plug when oil level is correct.

The differential should be filled with a special BMW lubricant available through an authorized BMW dealer.

Note:

- ◆ *Use a 14 mm or 17 mm Allen socket to remove the drain plug.*
- ◆ *If the car is raised in the air, it should be level.*

Tightening torques	
Front differential filler plug to housing	65 Nm (48 ft-lb)
Rear differential filler plug to housing	70 Nm (52 ft-lb)

Fuel filter, replacing

The fuel filter is located beneath the center of the car, approximately under

the driver's seat. A protective cover must be removed to access the filter.



- ✦ Fuel filter for M52 TU engine is shown in illustration.



- ✦ E46 cars with M54 engine are equipped with a fuel filter that has a built in fuel pressure regulator.
 - Disconnect battery negative (-) cable.
 - Drain fuel filter from inlet side into a container and inspect drained fuel. Check for rust, moisture and contamination.
 - When replacing fuel filter:
 - ◆ Clamp filter inlet and outlet hoses to lessen fuel spillage.
 - ◆ Loosen center clamping bracket and hose clamps on either end of filter.
 - ◆ Note arrow or markings indicating direction of flow on new filter.
 - ◆ Install new filter using new hose clamps.

WARNING!

Fuel will be expelled when the filter

is removed. Do not smoke or work near heaters or other fire hazards. Keep a fire extinguisher handy.

CAUTION!

Clean thoroughly around the filter connections before removing them.

Note:

When installing fuel filter cover, take care to reinstall foam rubber seal in front of cover correctly to prevent flooding of filter with rain splash water.

Fuel tank and fuel lines, inspecting

Inspect the fuel tank, fuel lines, and fuel system for damage or leaks. Check for fuel leaks in the engine compartment or fuel odors in the passenger compartment. Check for faulty flexible fuel lines by bending them. If any leaks are present, fuel should be expelled. Check for any evaporative emissions hoses that may have become disconnected, checking carefully at the charcoal canister and evaporative emissions purge system.

WARNING!

When checking for fuel leaks, the engine must be cold. A hot exhaust manifold or exhaust system could cause the fuel to ignite or explode causing serious personal injury. Ventilate the work area and clean up spilled fuel immediately.

Note:

See ⇒ [130 Fuel Injection](#) and ⇒ [160 Fuel Tank and Fuel Pump](#) for component locations and additional information.

Suspension, front, inspecting

Inspection of the front suspension and steering includes a check of all moving parts for wear and excessive play. Inspect ball joint and tie-rod rubber seals and boots for cracks or tears that could allow the entry of dirt, water, and other contaminants.

On All wheel drive models check front differential fluid level and check CV joint boots for cracks.

Note:

See ⇒ [310 Front Suspension](#) and ⇒ [331 Rear Axle Final Drive](#)

Suspension, rear, inspecting

Differential and rear drive axle service consists of checking and changing the gear oil, inspecting for leaks, and checking the rear drive axle rubber boots for damage.

The areas where leaks are most likely to occur are around the drive shaft and drive axle mounting flanges.

Note:

For more information on identifying oil leaks and their causes, see ⇒ [330 Rear Suspension](#) and ⇒ [311 Front Axle Final Drive](#).

Tires, checking inflation pressure

Correct tire pressures are important to handling and stability, fuel economy, and tire wear. Tire pressures change with temperature. Pressures should be checked often during seasonal temperature changes. Correct inflation

pressures can be found on the driver's door pillar and in the owner's manual. Note that tire pressures should be higher when the car is more heavily loaded.

WARNING!

Do not inflate any tire to a pressure higher than the tire's maximum inflation pressure listed on the sidewall. Use care when adding air to warm tires. Warm tire pressures can increase as much as 4 psi (0.3 bar) over their cold pressures.

Tires, rotating

BMW does not recommend tire rotation. Due to the car's suspension design, the front tires begin to wear first at the outer shoulder and the rear tires begin to wear first at the middle of the tread or inner shoulder. Rotating the tires may adversely affect road handling and tire grip.

Transmission service, automatic

The automatic transmission is not equipped with a dipstick. Therefore, checking the ATF level is an involved procedure which includes measuring and maintaining a specified ATF temperature during the checking procedure.

Note:

For more complete ATF service information, including checking ATF level and ATF filter replacement procedures, see ⇒ [240 Automatic Transmission](#).

Transmission service, manual

Manual transmission service consists of inspecting for leaks and checking the fluid.

Evidence of transmission leaks is likely to be seen around the driveshaft mounting flange and at the bottom of the bellhousing.

Note:

For more information on identifying oil leaks and their causes, see ⇒ [230 Manual Transmission](#) and ⇒ [210 Clutch](#).

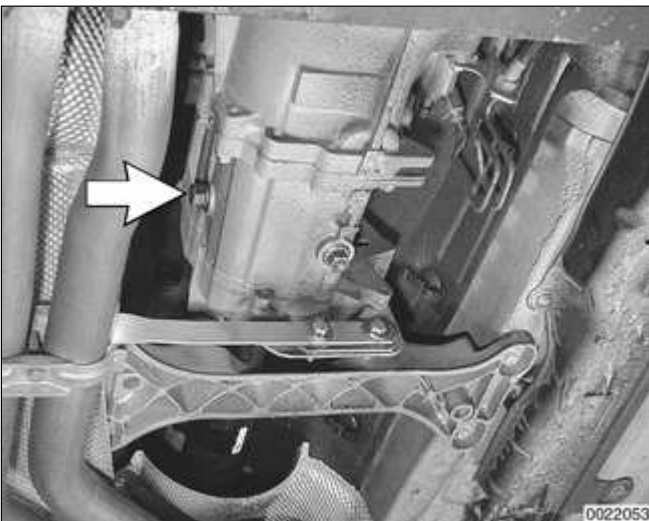
Transmission fluid, checking and filling (manual transmission)

The manual transmission in E46 models is filled with lifetime oil that ordinarily does not need to be changed.

- ✦ Check manual transmission oil level at transmission filler plug (**arrow**). Make sure car is on level surface.

Note:

Transmission fluid level checking and replacement procedures are covered in ⇒ [230 Manual Transmission](#).



Wheels, aligning

BMW recommends checking the front and rear alignment once a year and

whenever new tires are installed.

Note:

See ⇒ [320 Steering and Wheel Alignment](#) for a more detailed discussion of alignment requirements and specifications.

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Body and Interior Maintenance

Body and hinges, lubricating

The door locks and lock cylinders can be lubricated with an oil that contains graphite.

The body and door hinges, the hood latch, and the door check rods should be lubricated with SAE 30 or SAE 40 engine oil. Lubricate the seat runners with multipurpose grease. Do not apply any oil to rubber parts. If door weatherstrips are sticking, lubricate them with silicone spray or talcum powder. The hood release cable should be lubricated as well.

The use of winter lock de-icer sprays should be kept to an absolute minimum, as the alcohol in the de-icer will wash the grease out of the lock assemblies, and may cause the locks to corrode internally, or become difficult to operate.

Exterior washing

The longer dirt is left on the paint, the greater the risk of damaging the glossy finish, either by scratching or by the chemical effect dirt particles may have on the painted surface.

Do not wash the car in direct sunlight. If the engine hood is warm, allow it to cool. Beads of water not only leave spots when dried rapidly by the sun or heat from the engine, but also can act as small magnifying glasses and burn spots into the finish. Wash the car with a mixture of lukewarm water and a car

wash product. Rinse using plenty of clear water. Wipe the body dry with a soft cloth towel or chamois to prevent water-spotting.

Interior care

Dirt spots can usually be removed with lukewarm soapy water or a dry foam cleaner. Use spot remover for grease and oil spots. Do not pour the liquid directly on the carpet or fabric, but dampen a clean cloth and rub carefully, starting at the edge of the spot and working inward. Do not use gasoline, naphtha, or other flammable substances.

Leather upholstery and trim

Leather upholstery and trim should be periodically cleaned using a slightly damp cotton or wool cloth. The idea is to get rid of the dirt in the creases and pores that can cause brittleness and premature aging. On heavily soiled areas, use a mild detergent (such as Woolite[®]) or other specially formulated leather cleaners. Use two tablespoons to one quart of cold water. Dry the trim and upholstery completely using a soft cloth. Regular use of a good quality leather conditioner will reduce drying and cracking of the leather.

Polishing

Use paint polish only if the finish assumes a dull look after long service. Polish can be used to remove tar spots and tarnish, but afterwards a coat of wax should be applied to protect the clean finish. Do not use abrasive polish or cleaners on aluminum trim or accessories.

Seat belts

Dirt and other abrasive particles will damage seat belt webbing. If it is necessary to clean seat belts, use a mild soap solution. Bleach and other strong cleaning agents may weaken the belt webbing and should be avoided.

WARNING!

Do not clean the seat belt webbing using dry cleaning or other chemicals. Allow wet belts to dry before allowing them to retract.

The condition of the belt webbing and the function of the retractor mechanisms should be inspected.

Note:

See ⇒ [720 Seat Belts](#) for seat belt inspection information.

Special cleaning

Tar spots can be removed with a bug and tar remover. Never use gasoline, kerosene, nail polish remover, or other unsuitable solvents. Insect spots also respond to tar remover. A bit of baking soda dissolved in the wash water will facilitate their removal. This method can also be used to remove spotting from tree sap.

Washing chassis

Periodic washing of the underside of the car, especially in winter, will help prevent accumulation of road salt and rust. The best time to wash the underside is just after the car has been driven in wet conditions. Spray the chassis with a powerful jet of water.

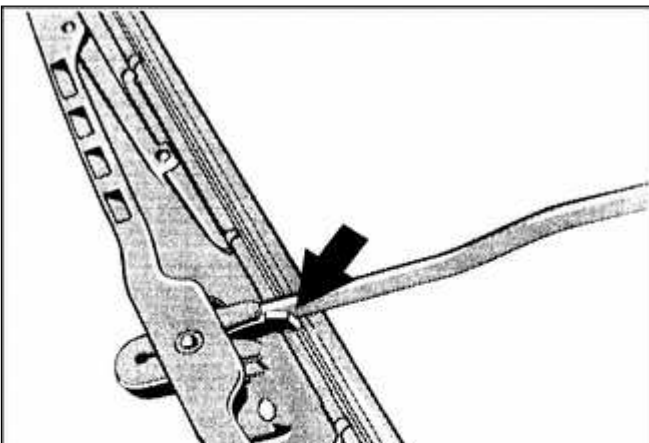
Commercial or self-service car washes may not be best for this, as they may recycle the salt-contaminated water.

Waxing

For a long-lasting, protective, and glossy finish, apply a hard wax after the car has been washed and dried. Use carnauba or synthetic based products. Waxing is not needed after every washing. You can tell when waxing is required by looking at the finish when it is wet. If the water coats the paint in smooth sheets instead of forming beads that roll off, a new coat of wax is needed. Wax should not be applied to black trim pieces, rubber, or other plastic parts.

Windshield wiper blade maintenance

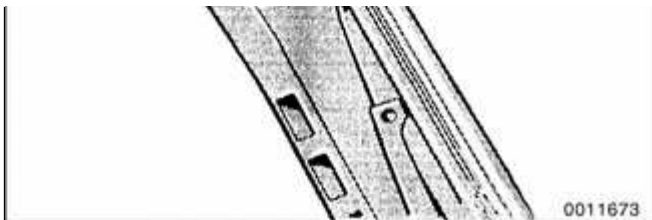
Common problems with the windshield wipers include streaking or sheeting, water drops after wiping, and blade chatter. Streaking is usually caused when wiper blades are coated with road film or car wash wax. Clean the blades using soapy water. If cleaning the blades does not cure the problem, they should be replaced. BMW recommends replacing the wiper blades twice a year, before and after the cold season.



- To replace wiper blade, depress retaining tab (**arrow**) and slide blade out of arm.

On older cars, check the tension spring that holds the wiper to the glass. Replace the wiper arm if the springs are weak.

Drops that remain behind after wiping are caused by oil, road film, or diesel exhaust coating the windshield. Use an



alcohol or ammonia solution, or a non-abrasive cleanser to clean the windshield.

Wiper blade chatter may be caused by dirty or worn blades, by a dirty windshield, or by bent or twisted wiper arms. Clean the blades and windshield as described above. Adjust the wiper arm so that there is even pressure along the blade, and so that the blade is perpendicular to the windshield at rest. Lubricate the wiper linkage with a light oil. The linkage is located under the hood on the driver's side. If the problem persists, the blades are excessively aged or worn and should be replaced.

Note:

See ⇒ [611 Wipers and Washers](#) for more information.

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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:

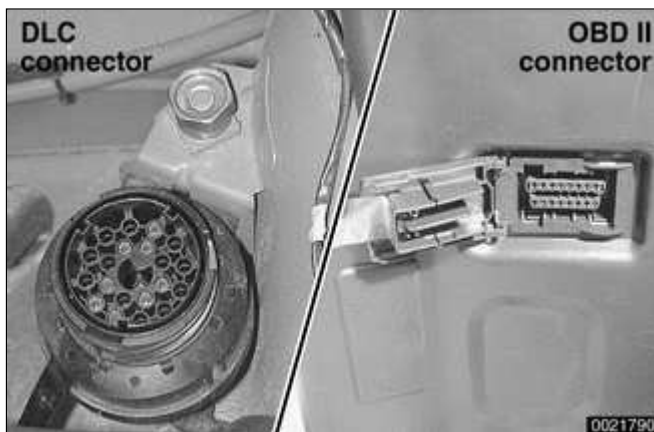
In order to automatically clear a catalyst damaging fault from memory, the condition under which the fault occurred must be evaluated for 80 consecutive drive cycles without the fault reoccurring.

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 actuators 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 40°C), 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 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 160°F and at least 40°F 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 been 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".

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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.

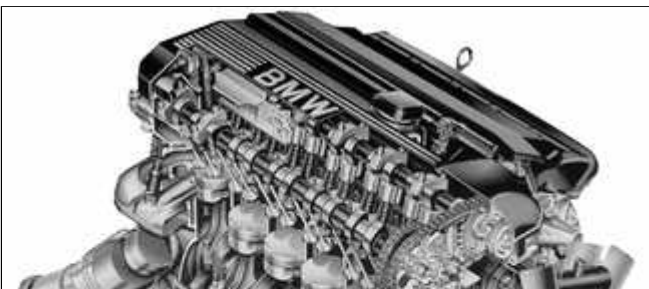
General

This section covers system descriptions and general information on engines and engine management systems. Also covered is basic engine troubleshooting.

For specific repair procedures, refer to the appropriate repair group:

- ◆ ⇒ [110 Engine Removal and Installation](#)
- ◆ ⇒ [113 Cylinder Head Removal and Installation](#)
- ◆ ⇒ [116 Cylinder Head and Valvetrain](#)
- ◆ ⇒ [117 Camshaft Timing Chains](#)
- ◆ ⇒ [119 Lubrication System](#)
- ◆ ⇒ [120 Ignition System](#)
- ◆ ⇒ [130 Fuel Injection](#)
- ◆ ⇒ [170 Radiator and Cooling System](#)

Engine



- ✦ M52 TU 6-cylinder engine is a technical update (hence the designation TU) of the earlier 2.8 liter M52 engine. The main 'technical update' for M52 TU was the addition of double VANOS.

In model year 2001, the M54 (2.5 and



3.0 liter) engines were introduced. This engine incorporates all the technical features of the M52 TU engines with addition of fully electronic throttle control and enhanced emission controls.

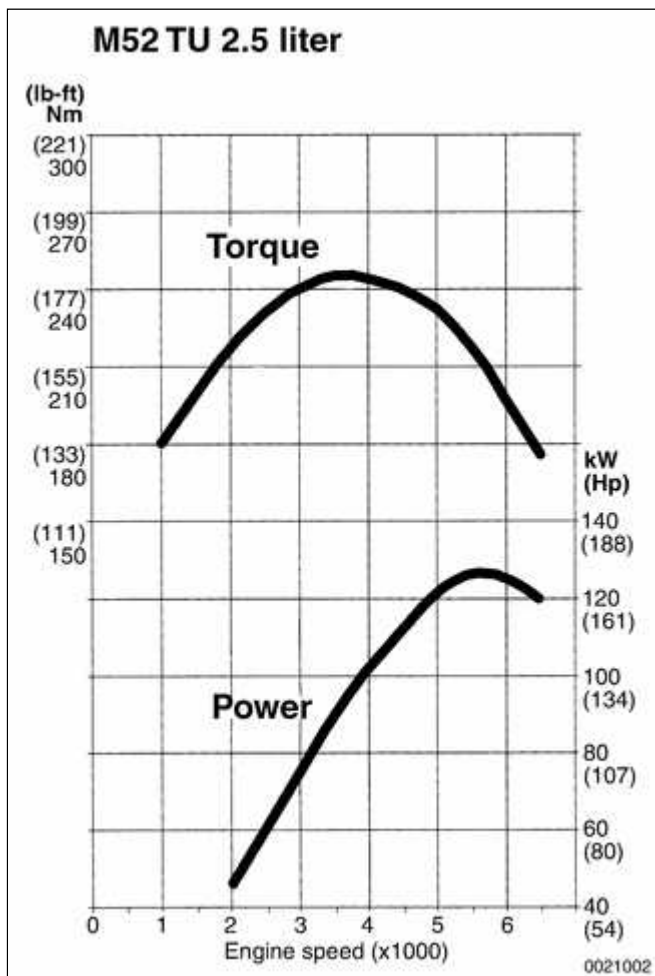
⇒ [Table a. Engine specifications](#) lists engine specifications for the vehicles covered by this manual.

Table a. Engine specifications

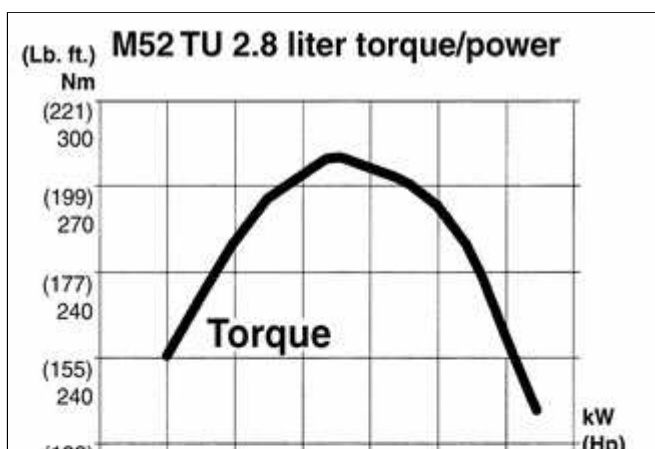
Model year	Engine code	No. of cylinders	Displacement cc (cu. in.)	Bore/stroke	Compression ratio	Torque lb-ft/rpm	Horsepower Hp/rpm
323i 1999 - 2000	M52 TU B25	6	2494 (152.2)	84 mm (3.307 in.) 75 mm (2.953 in.)	10.5: 1	181/3,500	170/5,500
325i/Ci/xi 2001	M54 B25	6	2494 (152.2)	84 mm (3.307 in.) 75 mm (2.953 in.)	10.5: 1	175/3,500	184/6,000
328i/Ci 1999 - 2000	M52 TU B28	6	2793 (170.4)	84 mm (3.307 in.) 84 mm (3.307 in.)	10.2: 1	206/3,500	193/5,500
330i/Ci/xi 2001	M54 B30	6	2979.3 (181.8)	84 mm (3.307 in.) 89.6 mm (3.528 in.)	10.2: 1	214/3,500	225/5,900

Model year	Engine code	No. of cylinders	Displacement cc (cu. in.)	Bore/stroke	Compression ratio	Torque lb-ft/rpm	Horsepower Hp/rpm
				in.)			

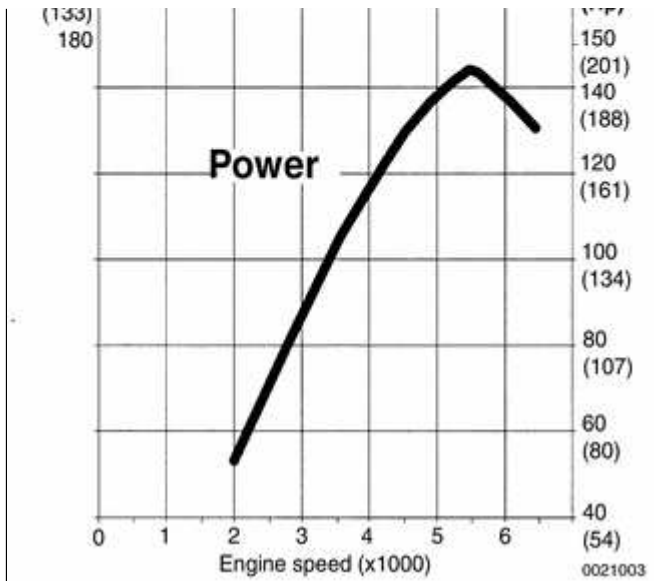
Torque/power graphs



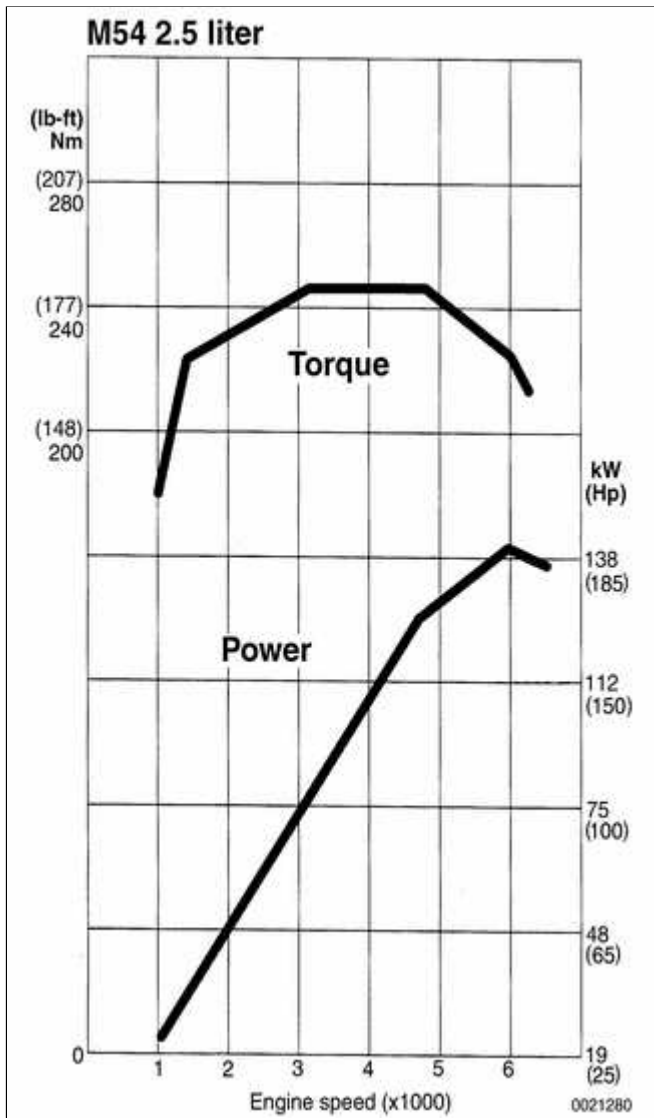
◀ M52 TU 2.5 liter



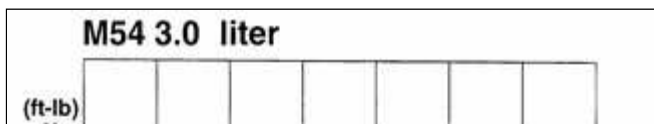
◀ M52 TU 2.8 liter

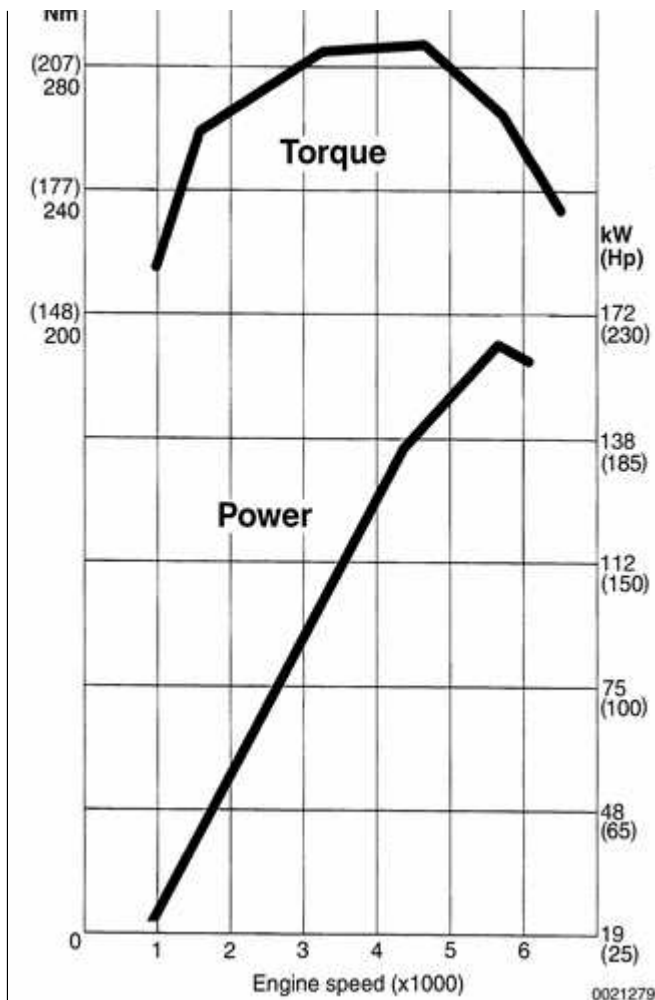


◀ M54 2.5 liter



◀ M54 3.0 liter





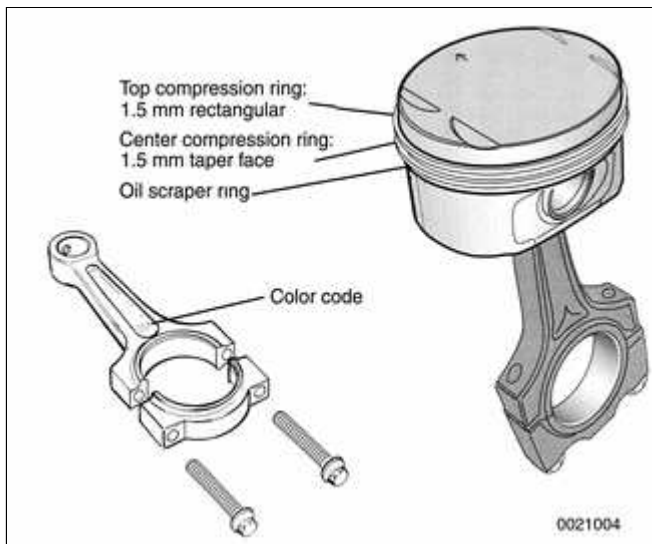
Cylinder block and crankshaft

The cylinder block is cast aluminum alloy (AlSi9Cu3) with cast iron cylinder liners. The cylinders are exposed on all sides to circulating coolant.

The counterweighted crankshaft rotates in replaceable split-shell main bearings. Oilways drilled into the crankshaft provide bearing lubrication. Oil seals pressed into alloy seal housings are installed at both ends of the crankshaft.

The 2.5 liter crankshaft is cast iron. The 2.8 and 3.0 liter engines use a forged steel crankshaft to accommodate the higher torque. The crankshaft for the 3.0 liter engine is adapted from the S52 M3 engine.

Connecting rods and pistons

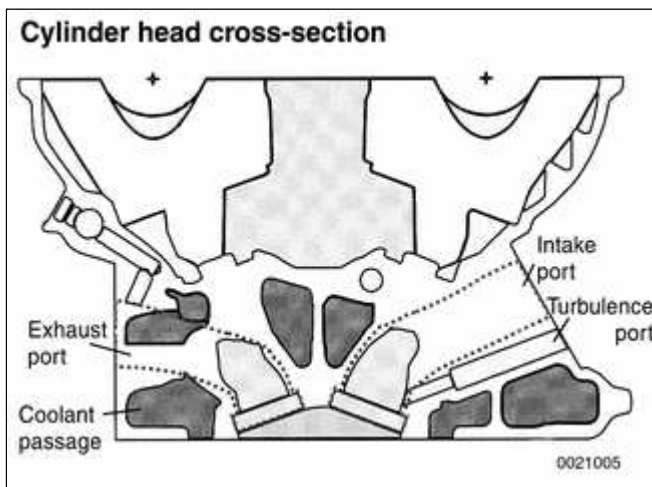


- ✦ The forged steel connecting rods use replaceable split-shell bearings at the crankshaft end and solid bushings at the piston pin end.

The pistons are of the three-ring type with two upper compression rings and a lower one-piece oil scraper ring. Full-floating piston pins are retained with circlips.

The 2.8 and 3.0 liter engines use a graphite coating on the piston skirts to reduce friction and noise.

Cylinder head and valvetrain



- ✦ Cooling passages in the cylinder head are designed for optimum coolant circulation, allowing the head to operate at lower temperatures than the cylinder block.

The aluminum cylinder head uses chain-driven double overhead camshafts and four valves per cylinder. The cylinder head employs a crossflow design for greater power and efficiency. Intake air enters the combustion chamber from one side while exhaust gasses exit from the other.

Oilways in the head provide lubrication for the camshafts and valvetrain.

Valve clearance is set by self-adjusting (zero-lash) hydraulic lifters for reduced valve noise and the elimination of routine valve adjustment.

Exhaust manifolds