

131 Fuel Injection MSV70, MSV80 (N52 Engine)

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GENERAL

This repair group covers service and repair of engine management systems for 5 Series models with N52 engine and Siemens DME MSV70 or MSV80.

See also:

- **020 Maintenance** for air filter, fuel filter and spark plug replacement
- **100 Engine-General** for engine identification and application information
- **120 Ignition System** for ignition coil, camshaft sensor, crankshaft sensor and knock sensor service
- **160 Fuel Tank and Fuel Pump** for fuel pump and fuel pump relay service, fuel pressure tests and fuel pressure regulator replacement
- **180 Exhaust System** for oxygen sensor service
- **ECL Electrical Component Locations**
- **ELE Electrical Wiring Diagrams**
- **OBD On-Board Diagnostics**

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DME applications

DME applications

BMW 5 Series models are equipped with digital motor electronics (DME), also known as Motronic. In these systems, fuel injection and ignition are controlled by an integrated engine control module (ECM). Application information for DME systems is in **Table a**.

Table a. 5 Series engine management applications			
Year, model	Engine code	Engine management	Features
2004-2005			
Sedan: 525i, 530i	M54	Siemens MS 45.1	Double VANOS
Sedan: 545i	N62	Bosch DME ME 9.2 with Valvetronic control module	Valvetronic, VANOS
2006 - 2007			
Sedan, Sports Wagon: 525i, 525xi, 530i, 530xi Sports Wagon	N52	Siemens MSV70	Valvetronic, VANOS
2008 - 2010			
Sedan, Sports Wagon: 528i, 528xi	N52KP	Siemens MSV80	Valvetronic, VANOS
Sedan, Sports Wagon: 535i, 535xi	N54	Siemens MSD80 (to 03 / 2008) MSD81 (from 03 / 2008)	VANOS, turbocharged
2004-2005			
Sedan: 545i	N62	Bosch DME ME 9.2 with valvetronic control unit	Valvetronic, VANOS
2006 - 2010			
Sedan: 550i	N62TU	Bosch DME ME 9.2.2	Valvetronic, VANOS

Warnings and Cautions

WARNING —

- The fuel system is designed to retain pressure even when the ignition is OFF. When working with the fuel system, loosen the fuel lines slowly to allow residual fuel pressure to dissipate. Avoid spraying fuel. Use shop towels to capture leaking fuel.
- Fuel in fuel lines is under pressure (approx. 3 - 5 bar or 45 - 75 psi) and may be expelled forcibly. Do not smoke or work near heaters or other fire hazards. Keep a fire extinguisher handy.
- Unscrew the fuel tank cap to release pressure in the tank before working on fuel lines.
- Plug open fuel lines and fittings.
- Before beginning work on the fuel system, place a fire extinguisher in the vicinity of the work area.
- Work on the fuel system only when engine temperature is below 40°C (104°F).
- Fuel is highly flammable. When working around fuel, do not disconnect wires that could cause electrical sparks. Do not smoke or work near heaters or other fire hazards.
- Wear eye protection and protective clothing to avoid injuries from contact with fuel.
- When working on an open fuel system, wear suitable hand protection, as prolonged contact with fuel can cause illnesses and skin disorders.
- Unscrew the fuel tank cap to release pressure in the tank before working on fuel lines.
- Do not use a work light with an incandescent bulb near fuel. Fuel may spray on the hot bulb causing a fire.
- Make sure the work area is properly ventilated.
- Due to risk of personal injury, be sure the engine is cold before beginning work on engine components.
- The ignition system produces high voltages that can be fatal. Avoid contact with exposed terminals. Use extreme caution when working on a car with the ignition switched ON or the engine running.

131-4 Fuel Injection MSV70, MSV80 (N52 Engine)

Warnings and Cautions

CAUTION—

- Renew fuel system hoses, clamps and O-rings any time they are removed.
- Prior to disconnecting the battery, read the battery disconnection cautions in **001 Warnings and Cautions**.
- Connect and disconnect the DME system wiring and test equipment leads only when the ignition is switched OFF.
- Wait at least 1 minute after switching the ignition OFF before disconnecting engine control module (ECM) connectors. If the connectors are removed before this time, residual power in the system relay may damage the control module.
- Tests or repair procedures in this section may set fault codes (DTCs) in the ECM and illuminate the MIL. After repairs are completed, access and clear DTC memory using a BMW scan tool. See **On-board diagnostics** in this repair group.
- Fuel system cleaners and other chemical additives other than those specifically recommended by BMW may damage catalytic converters, oxygen sensors or other fuel supply components.
- Do not connect any test equipment that delivers a 12-volt power supply to terminal 15 (+) of the ignition coils. The current flow may damage the ECM. Connect test equipment only as specified by BMW or the equipment maker.
- Relay positions can vary. Be sure to confirm relay location and function by identifying the wiring in the socket using the wiring diagrams found in **ELE Electrical Wiring Diagrams**.
- Use a digital multimeter for electrical tests. Use an LED test light for quick tests.

DRIVEABILITY TROUBLESHOOTING

The self-diagnostic DME engine management systems monitor and store diagnostic trouble codes (DTCs). If the malfunction indicator light (MIL) illuminates, it indicates that an emissions-related fault has occurred and that one or more DTCs are stored in the engine control module (ECM).

- If faults arise, or if the MIL is illuminated, begin troubleshooting by connecting BMW scan tool to the OBD II plug under the dashboard.

The capabilities of OBD II software has the potential to save hours of diagnostic time and to help avoid incorrect component replacement and possible damage to system components. See **On-board diagnostics** in this repair group.

Basic engine settings

Idle speed, idle mixture (%CO), and ignition timing are not adjustable. The DME system is adaptive and automatically compensates for changes in the engine due to age, minor wear or small problems such as a disconnected vacuum hose. However, the adaptive range is limited. Once the limits are exceeded, driveability problems become noticeable.

Poor initial driveability may be encountered when the battery is disconnected and reconnected. When the battery is disconnected, ECM adaptive memory may be reset. The system readapts after about ten minutes of driving.

System voltage

Digital motor electronics (DME) requires that the system (battery) voltage be maintained within a narrow range of DC voltage. DC voltage levels beyond or below the operating range, or any AC voltage in the electrical system can cause havoc.

- When troubleshooting an illuminated MIL, make sure the battery is fully charged and capable of delivering all its power to the electrical system. An undercharged battery can amplify AC alternator output ripple.
- To make a quick check of battery charge, measure voltage across battery terminals with all cables attached and ignition OFF. A fully charged battery measures 12.6 volts or slightly more, compared to 12.15 volts for a battery with a 25% charge.

The DME system operates at low voltage and current levels, making it sensitive to small increases in resistance. The electrical system is routinely subject to corrosion, vibration and wear, so faults or corrosion in the wiring harness and connectors are not uncommon.

- Check battery terminals for corrosion or loose cable connections. See **121 Battery, Starter, Alternator**.



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Main grounds

- If a battery cable connection has no visible faults but is still suspect, measure voltage drop across the connection. A large drop indicates excessive resistance, meaning that the connection is corroded, dirty or damaged. Clean or repair and retest. See **600 Electrical System-General** for voltage drop test procedure.
- Visually inspect wiring, connectors, switches and fuses. Loose or damaged connectors can cause intermittent problems, especially small terminals in ECM connectors. Disconnect wiring harness connectors to check for corrosion, and use electrical cleaning spray to remove contaminants.

Main grounds

Good grounds are critical to proper DME operation. If a ground connection has no visible faults but is still suspect, measure the voltage drop across the connection. A large voltage drop means high resistance. Clean or repair the connection and retest.

For voltage drop testing, see **600 Electrical System-General**.

For ground locations, see **ECL Electrical Component Locations**.

On-board diagnostics

Second generation on-board diagnostics (OBD II) software and hardware is incorporated in the engine management systems. The OBD II system monitors components that influence exhaust and evaporative emissions. If a problem is detected, the OBD II system stores the associated diagnostic trouble code (DTC) and condition.

If vehicle emissions levels exceed 1.5 times Federally mandated criteria, the OBD II system illuminates a malfunction indicator light (MIL) in the instrument cluster.

- Scan tool connected to OBD II plug below left dashboard.

Professional diagnostic scan tools available at the time of this printing include the BMW GT1, ISTA and a small number of aftermarket BMW-specific tools.

In addition to professional scan tools, there are inexpensive generic OBD II scan tool software programs and handheld units available. Although these have limited capabilities as compared to the dedicated tools, they are powerful diagnostic tools.

For the DIY owner, a simple aftermarket DTC reader is available through <http://www.peakeresearch.com>. This tool is capable of checking for DTCs as well as switching the illuminated MIL OFF and resetting service indicator lights.

NOTE—

- OBD II DTC memory (including an illuminated MIL) can only be reset using a BMW scan tool or equivalent. Removing the connector from the ECM or disconnecting the battery does not erase DTC memory.

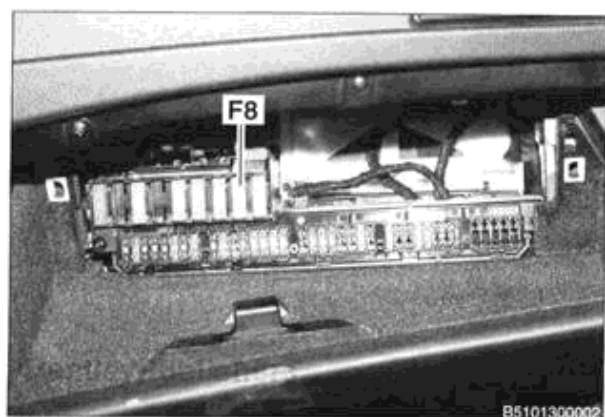
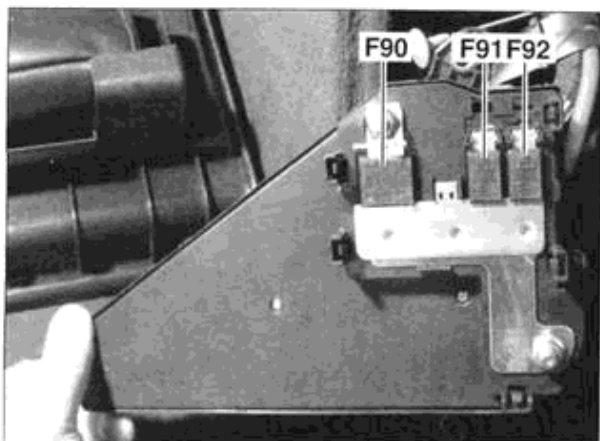


ENGINE MANAGEMENT FUSES AND POWER SUPPLY COMPONENTS

Power supply fuses

See **ECL Electrical Component Locations** for fuse panel access information.

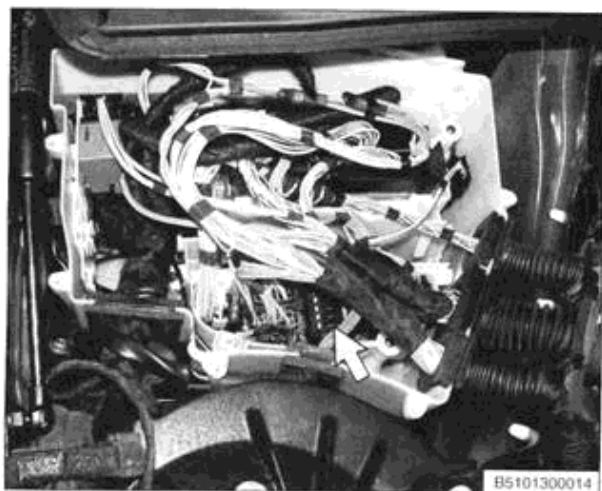
- Rear distribution panel (A46) in trunk, installed in right rear fender:
 - **F90** 200A: Power supply to fuse panel A41a.



- **A41a:** fuse and relay panel behind glove compartment:
 - **F8** 60A:
 - Engine control module (ECM) (A6000)
 - ECM main relay (K6300)
 - Engine electronics fuse carrier (A8680)
 - Engine electronics fuse carrier (A8681)

See **ECL Electrical Component Locations** for specific vehicle fuse locations.

- Engine electronics fuse carrier A8680 (arrow).



131-8 Fuel Injection MSV70, MSV80 (N52 Engine)

DME engine management system description

SIEMENS DME MSV70, MSV80 (N52 ENGINE)

DME engine management system description

The DME manages and monitors the following functions:

Air

- Electronic throttle
- Mass air flow
- Resonance-turbulence intake control
- Valvetronic II

Fuel

- Fuel supply
- Fuel injection

Ignition

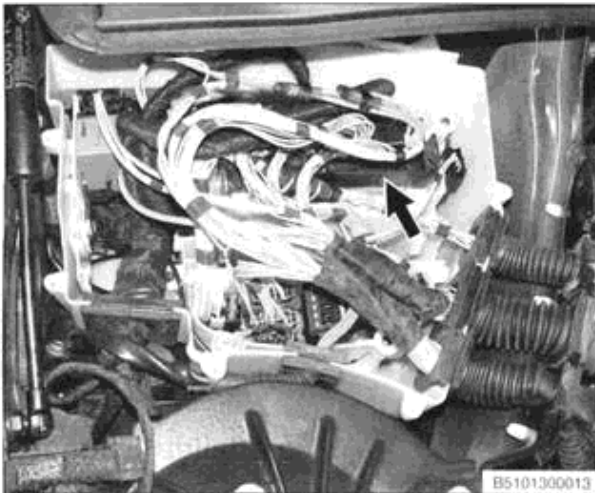
- Direct ignition
- Knock control
- Primary / secondary ignition monitoring

Emissions

- OBD II compliance
- Pre and post-catalyst oxygen sensors
- Electrically heated DME-mapped thermostat
- Misfire detection
- Evaporative emission control and leak detection
- Malfunction indicator light (MIL)

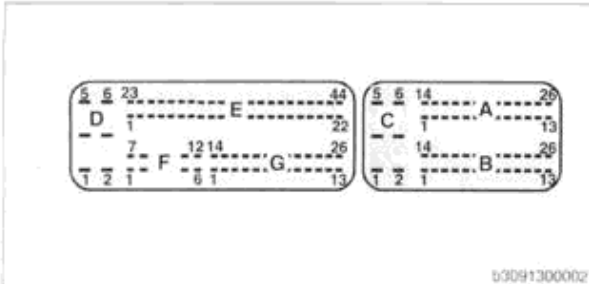
Performance controls

- Dual VANOS control
- Output of injection signal (TI) for fuel economy gauge
- Output of engine rpm (TD) for tachometer
- A/C compressor control
- Electric radiator cooling fan
- CAN-bus communication
- Dynamic stability control (DSC) interface
- CAS (car access system) - EWS 3.3
- Cruise control
- ECM programming



Engine control module (ECM)

- The engine control module (ECM) (**arrow**) is mounted in the electronics box (E-box) at the right rear of the engine compartment.



- The ECM is flash-programmable and features 2 main electrical harness connectors, one with 4 modular connections and the other with 3 for a total of 7 subconnectors and 147 pins.

- A: X60001 (signals)
- B: X60002 (signals)
- C: X60003 (voltage, ground supply)
- D: X60004 (valvetronic)
- E: X60005 (signals)
- F: X60006 (ignition coils)
- G: X60007 (signals)

The EEPROM (chip) in the ECM is coded to the vehicle. The ECM cannot be swapped for testing purposes.

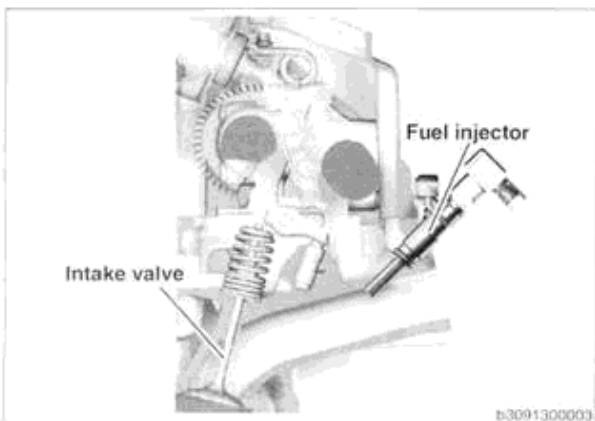
Fuel metering

The ECM meters pressurized fuel by changing the opening time (pulse width) of the fuel injectors. The exact amount of fuel injected is determined by the amount of time the injectors are open. To ensure that injector pulse width is the only factor that determines fuel metering, fuel pump pressure is maintained by a pressure regulator. The injectors are mounted to a common fuel rail.

- The fuel injectors are mounted into a machined bore in the cylinder head. This design allows the fuel injectors to be closely mounted to the intake valves.

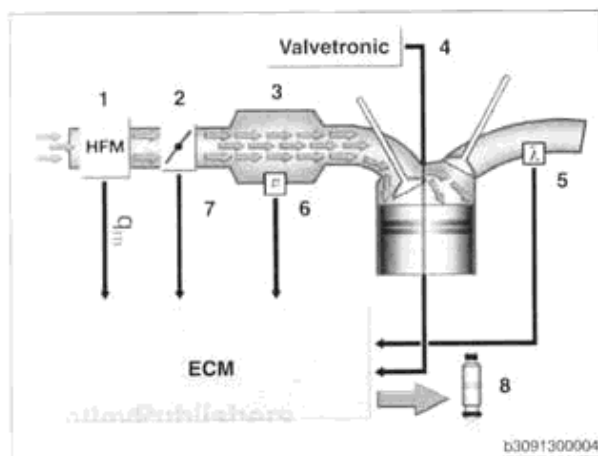
The injectors are a compact design manufactured by Deka with a resistance value of approximately 12 ohms each.

The ECM monitors engine operating conditions to determine injector opening duration. Each injector can be individually controlled for cylinder selective fuel trim.



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DME engine management system description



Air intake

➤ Air entering the engine passes through a pleated paper element in the air filter housing. Intake air mass is then measured by a mass air flow sensor. A reference current is used to heat a thin film in the sensor when the engine is running. The current needed to hold the temperature of the film constant is used to calculate the mass of the intake air.

1. Air mass measurement (HFM)
2. Throttle valve
3. Intake manifold
4. Variable intake valve lift (Valvetronic)
5. Residual oxygen measurement in exhaust
6. Intake manifold vacuum
7. Engine speed
8. Injection timing

Idle speed control

➤ The ECM controls Idle speed by varying intake valve lift via the Valvetronic system.

1. Valvetronic motor
2. Return spring
3. Intake camshaft
4. Intermediate lever
5. Intake rocker arm
6. Intake valve

Idle speed is not adjustable. The basic functions and parameters of idle speed control are as follows:

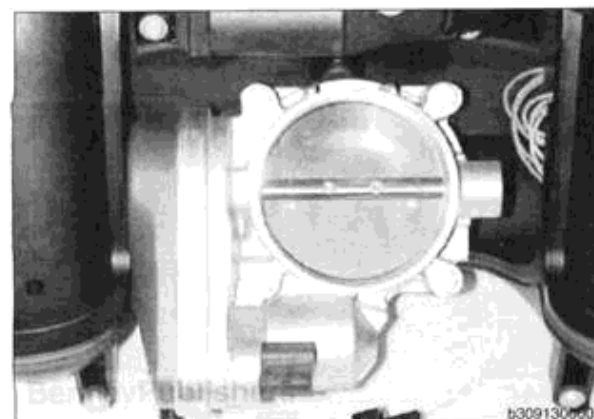
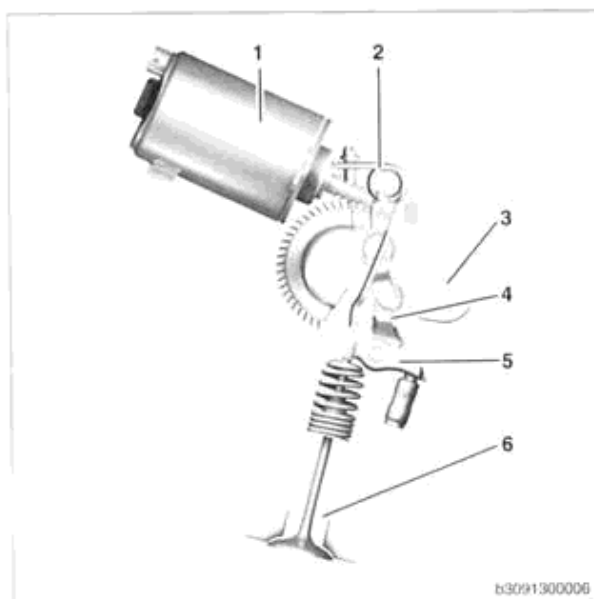
- Control of cold air intake volume.
- Smooth idle speeds regardless of load and inputs.
- Smooth transition from acceleration to deceleration.

Idle speed stabilization is active during the following conditions:

- Engine warm up
- Heating or A/C activation
- Drive gear selected (automatic transmission)
- Varying cooling fan speeds

Throttle control

➤ The throttle module (EDK) is not needed for engine load control. Which is carried out by the Valvetronic function of the ECM. However, the throttle may be slightly closed to allow sufficient manifold vacuum for the crankcase ventilation and canister purge systems.



Knock (detonation) control

Knock sensors monitor and control ignition knock through the ECM. The knock sensors function like microphones and are able to convert mechanical vibration (knock) into electrical signals. The ECM is programmed to react to frequencies that are characteristic of engine knock and adapt the ignition timing point accordingly.

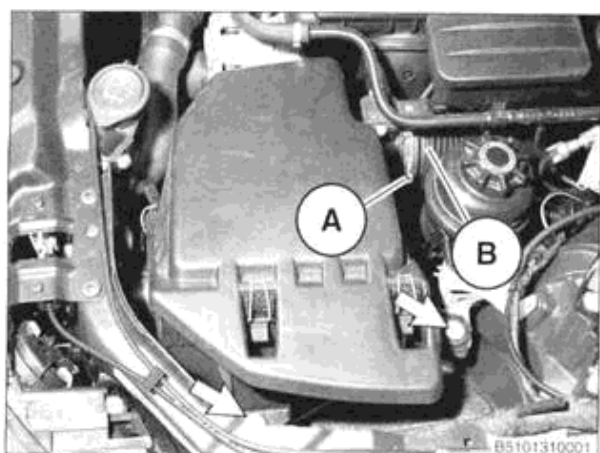
Knock sensor replacement is covered in **120 Ignition System**.

Air filter housing and ducts, removing and installing

For air filter element replacement, see **020 Maintenance**.

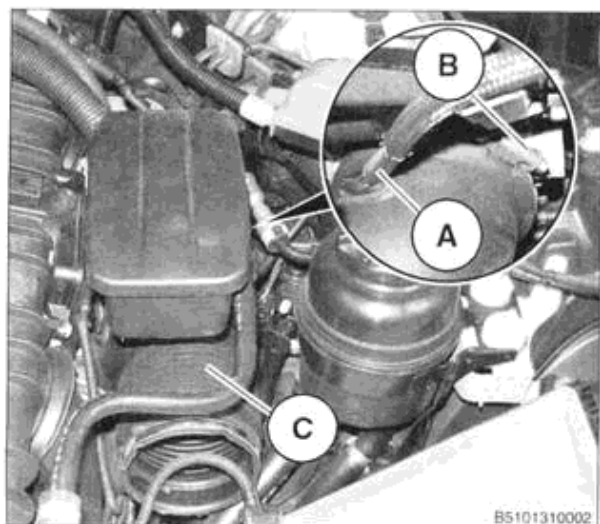
Working at air filter housing:

- Loosen hose clamp (A) at mass air flow sensor and detach air intake duct (B) from filter housing.
- Remove filter housing mounting bolts (arrows) and lift housing out of engine compartment.



Disconnect hose (A) from duct. Loosen duct clamp (B). Remove duct (C) from throttle body.

- Installation is reverse of removal.
- After reinstalling, check and clear fault codes from ECM memory.



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Mass air flow, measurement



Mass air flow, measurement

- 3 Series non-turbo engines utilize two different air mass measurement systems.

Analog mass air flow sensor is used in models produced to 09 / 2006. The sensor, incorporating an electrically heated film in the air flow stream, sends to the ECM a varying voltage (approx. 0.5 - 4.5 volts) representing the mass of the intake air.

The ECM provides operating voltage and ground to the air flow sensor. As air flows through the sensor, the film is cooled. To maintain the film at a constant temperature, additional current is necessary. It is this additional current that is the basis for the input signal.

If there is no output signal from the air flow sensor, the ECM operates the engine using throttle position and engine rpm inputs. A faulty air flow sensor illuminates the MIL.

Digital mass air flow sensor is used in models from 09 / 2006. In this system, a duty cycle signal corresponds to changes in intake air mass. This eliminates the need for signal conversion in the ECM.

- The intake air temperature sensor is integrated into the mass air flow sensor. The sensor is an NTC thermistor which receives a 5 volt reference current and ground from the ECM.

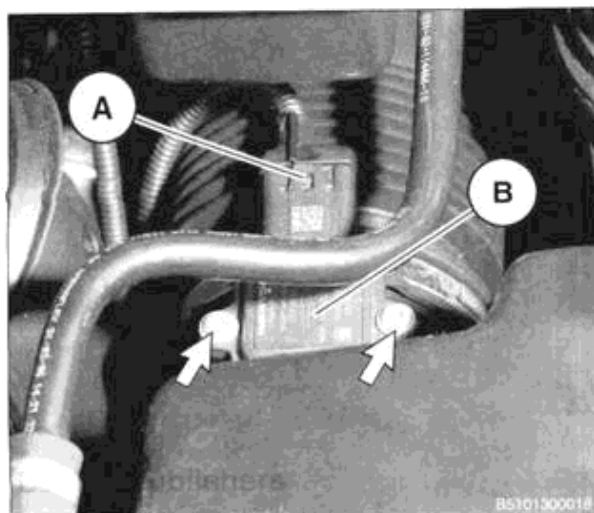
A faulty air flow sensor can produce the following problems:

- Difficult to restart when engine is hot.
- Engine starts then stalls.
- Engine starts and runs only with accelerator pedal depressed.



Mass air flow sensor, replacing

- Switch ignition OFF and remove key.
- Working at left front of engine compartment at air filter housing:
 - Detach mass air flow sensor electrical connector (A).
 - Remove fasteners (arrows).
 - Remove mass air flow sensor (B).
- Check intake ducts for cracks and vacuum leaks.





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- ◀ Installation is reverse of removal.
 - Inspect O-ring (**arrow**) and replace if necessary.
- After reinstalling, check and clear fault codes from ECM memory.

Tightening torques

Mass air flow sensor to housing	3 Nm (26 in-lb)
---------------------------------	-----------------

Throttle housing (EDK), replacing

The throttle housing (EDK) is not used for engine load control. Which is carried out by the valvetronic function of the ECM. However, the throttle may be slightly closed to allow sufficient manifold vacuum for the crankcase ventilation and canister purge systems. There is no mechanical (cable) link between the accelerator pedal and the throttle plate.

- ◀ The accelerator pedal module (PWG) at the pedal assembly communicates pedal position directly to the ECM. The module provides two variable voltage signals (via two Hall sensors) to the ECM for pedal position and rate of movement.

The ECM provides an independent voltage and ground supply for each hall sensor. Each Hall sensor is provided with 5 volts and ground. As the accelerator pedal is moved from rest to full throttle, the sensors produce a variable voltage signal.

The output of the Hall sensors is checked for plausibility. The voltage range of Hall sensor 1 is approximately 0.5 to 4.5 volts. Hall sensor 2 ranges from approximately 0.5 to 2.5 volts.

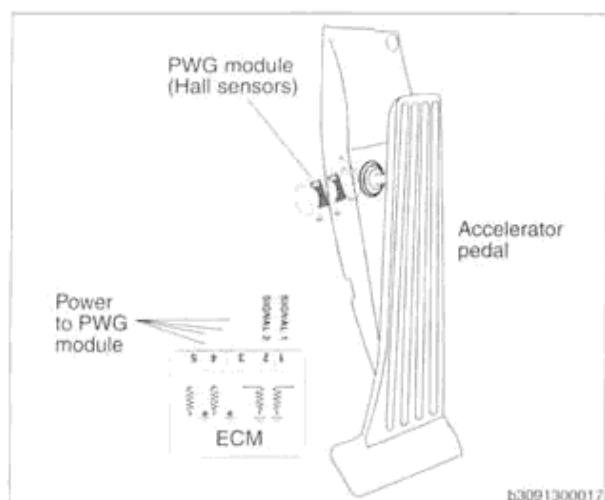
The throttle housing unit is nonadjustable. If found to be faulty, replace as a complete unit.

After replacing the throttle housing, use BMW scan tool or equivalent to reset adaptation values.

CAUTION—

- If the adaptation process is not completed correctly, the engine does not start.

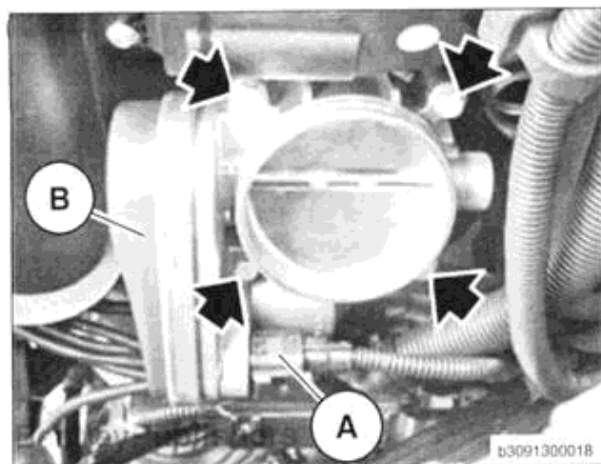
- Switch ignition OFF and remove key.
- Remove air filter housing and air intake ducts. See **Air filter housing and ducts, removing and installing** in this repair group.



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Valvetronic motor, removing and installing



- Working at left side of intake manifold:
- Disconnect electrical connector (A).
 - Remove fasteners (arrows) and remove throttle housing (B).
- Installation is reverse of removal.
- Replace profile gasket (sealing O-ring) between throttle assembly and intake manifold.
- | Tightening torques | |
|-------------------------------------|-----------------|
| Throttle housing to intake manifold | 9 Nm (80 in-lb) |
- Reattach throttle assembly connector with care. It is possible to twist the connector before plugging it in. This can cause damage to the harness and connector.
- After reinstalling, check and clear fault codes from ECM memory. Reset throttle plate adaptation values following scan tool on-screen instructions.

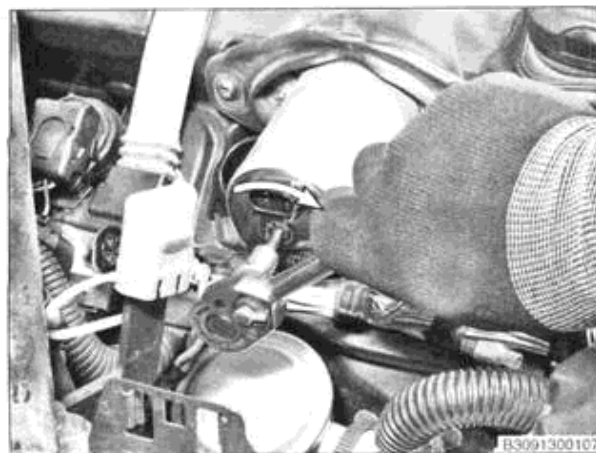
Valvetronic motor, removing and installing

- Switch ignition OFF and remove key.
- Remove upper and lower cabin microfilter housings. See **020 Maintenance**.
- Remove ignition coil cover. See **020 Maintenance**.
- Disconnect battery negative (-) cable.

CAUTION—

- Prior to disconnecting the battery, read the battery disconnection cautions in **001 Warnings and Cautions**.

- Disconnect ignition coil electrical connectors and remove ignition coil overlay harness (arrows).



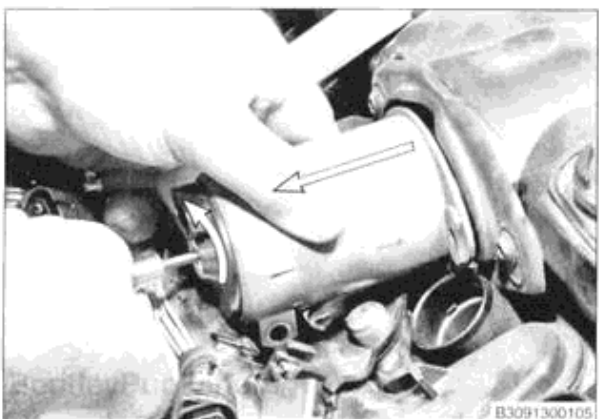
- Gently screw valvetronic motor in clockwise direction (arrow) until you feel resistance of the eccentric shaft stop.

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Fuel rail and injectors, removing and installing



- Remove valvetronic motor fasteners (**arrows**) and Valvetronic motor support bracket fastener (**inset**).



- Gently screw valvetronic motor in counterclockwise direction while sliding motor out of cylinder head cover (**arrow**).

Installation is reverse of removal. Remember to:

- Replace aluminum fasteners.
- Route ignition harness correctly

Tightening torque

Valvetronic motor to cylinder head	4 Nm (2.9 ft-lb)
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- After reinstalling, check and clear fault codes from ECM memory.

Fuel rail and injectors, removing and installing

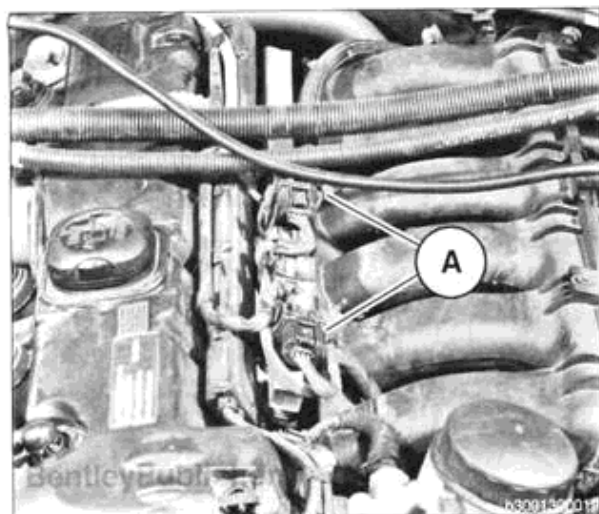
Fuel injectors are electrically controlled solenoid valves that provide precisely metered and atomized fuel into the engine intake ports.

Injectors receive voltage from the DME main relay. The engine control module (ECM) controls injector opening by activating the ground circuit for the injector valve solenoids. The ECM varies the duration (in milliseconds) of injector opening to regulate air / fuel ratio.

- Switch ignition OFF and remove key.
- Remove upper and lower cabin microfilter housing. See **020 Maintenance**.
- Remove ignition coil cover. See **020 Maintenance**.
- For a quick check of injectors, run engine and touch each injector with a screwdriver or stethoscope. You should feel a vibration or hear a buzzing. Switch engine OFF.

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Fuel rail and injectors, removing and installing



- Disconnect battery negative (-) cable.

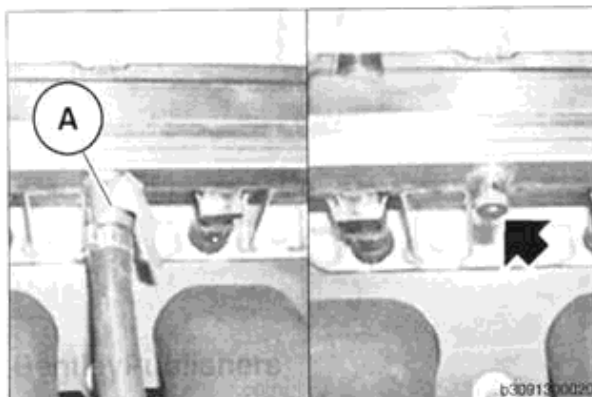
CAUTION—

- Prior to disconnecting the battery, read the battery disconnection cautions in 001 Warnings and Cautions.

- ◀ Working above engine, detach oxygen sensor connectors (A) and unclip wiring harness from holder.

CAUTION—

- Be sure to mark oxygen sensor connectors so that they can be reassembled as before.

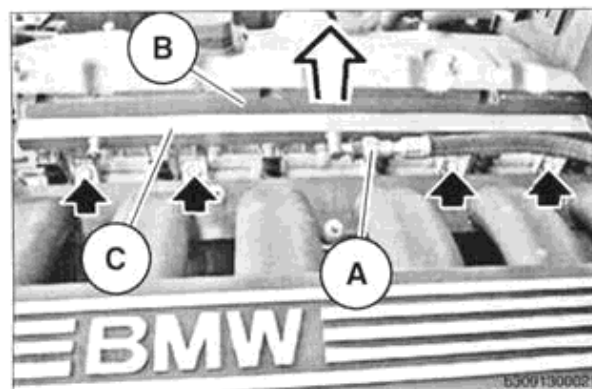


- ◀ Unscrew schrader valve cap (arrow) from fuel rail. Connect air line adapter (A) to fitting.

- Unscrew fuel tank cap to release pressure.
- Using a brief burst of compressed air (maximum of 3 bar or 43.5 psi), blow fuel back into fuel tank.

WARNING—

- Fuel in the fuel line is under pressure (approx. 3 - 5 bar or 45 - 75 psi) and may be expelled forcibly. Do not smoke or work near heaters or other fire hazards. Keep a fire extinguisher handy.
- Unscrew the fuel tank cap to release pressure in the tank before working on the fuel line.
- Plug open fuel lines and fittings.



- ◀ Working above engine:

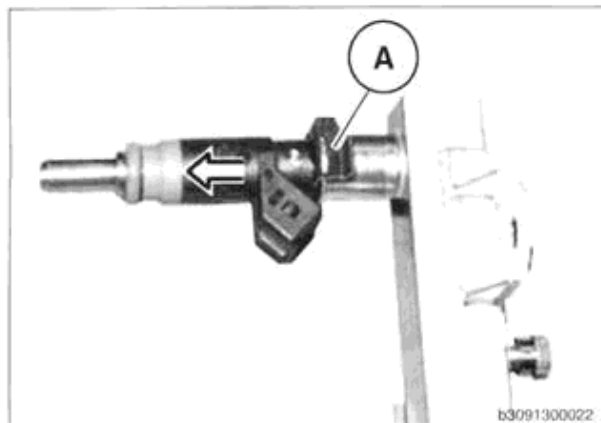
- Remove and detach fuel line (A).
- Disconnect connector strip (B) in direction of arrow.
- Remove fasteners (arrows).
- Remove fuel rail (C).

WARNING—

- Wrap a clean shop towel around fitting before disconnecting. Residual fuel pressure is present in the fuel line.

Fuel Injection MSV70, MSV80 (N52 Engine) 131-17

Intake manifold, removing and installing



- Remove individual injectors:
 - Pry retaining clip from injector (A).
 - Pull injector from rail (arrow).
- Installation is reverse of removal. Remember to:
 - Fit new sealing O-rings when installing injectors. For ease of installation, lightly lubricate O-rings with assembly lubricant.
 - Check that injector electrical connections are correctly fitted and that injectors are fully seated prior to installing fuel rail mounting bolts.
 - Replace wire ties.

Tightening torque

Fuel rail to cylinder head	10 Nm (7 ft-lb)
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- After reinstalling, check and clear fault codes from ECM memory.

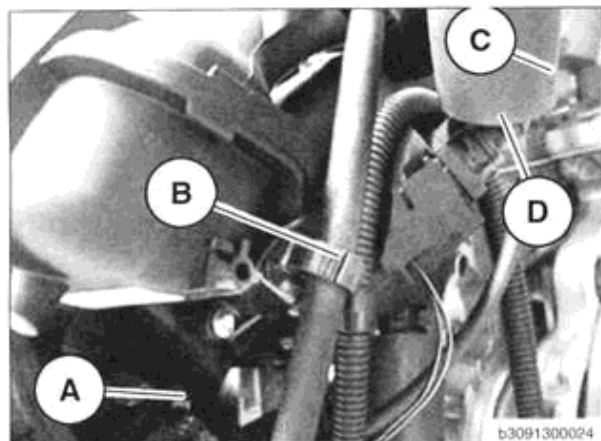
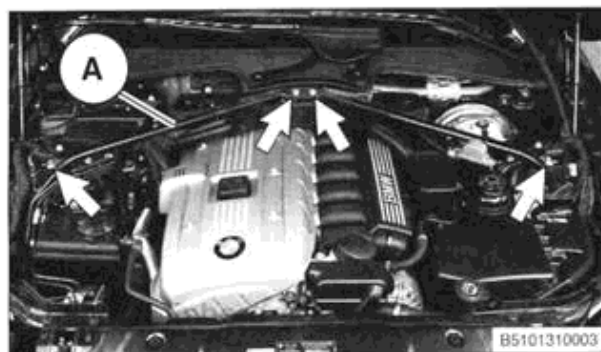
Intake manifold, removing and installing

- Disconnect battery negative (-) cable in cargo compartment.

CAUTION—

- Prior to disconnecting the battery, read the battery disconnection cautions in 001 Warnings and Cautions.

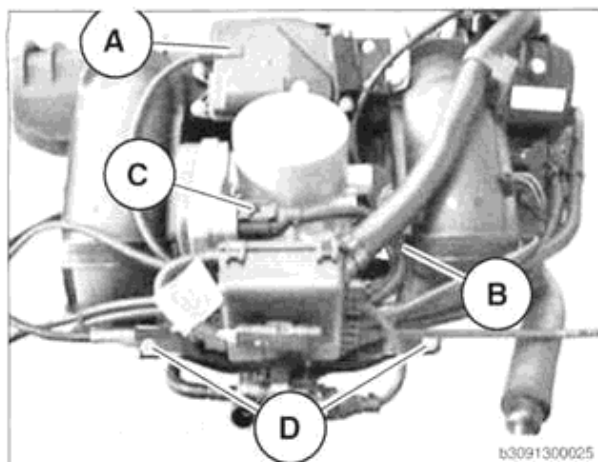
- Remove upper engine covers. See 020 Maintenance.
- Remove air filter housing and air intake ducts. See Air filter housing and ducts, removing and installing in this repair group.
- Remove and discard tension strut fasteners (arrows). Remove tension strut (A).



- Working at left side and underneath intake manifold:
 - Open harness holder (B).
 - Disconnect electrical connector (A).
 - Release both crankcase breather connections (C,D).

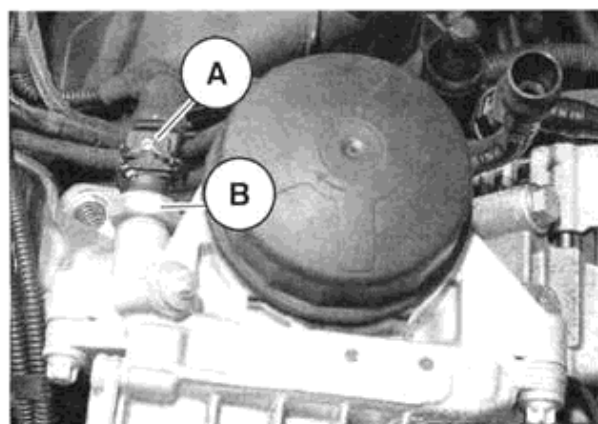
131-18 Fuel Injection MSV70, MSV80 (N52 Engine)

Intake manifold, removing and installing

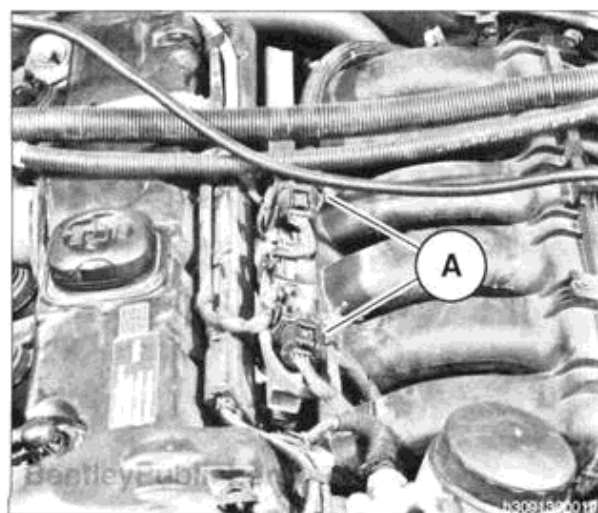


Working at left side and underneath intake manifold:

- Disconnect electrical connectors (A,C).
- Remove fasteners (D).
- Detach engine wiring harness (B) from intake manifold and lay aside.



Disconnect electrical connector (A) at oil pressure switch (B).



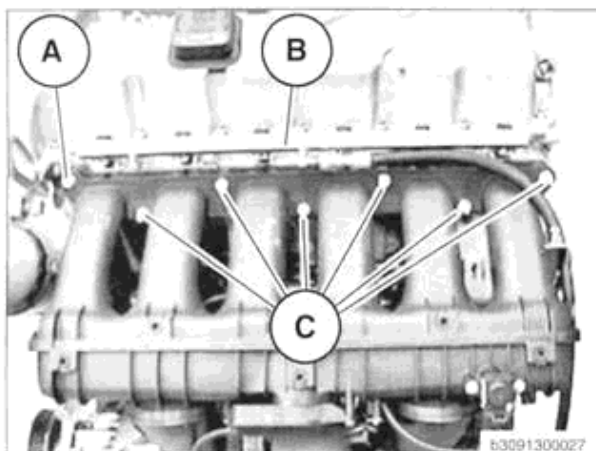
Working above engine, detach oxygen sensor connectors (A) and unclip wiring harness from holder.

CAUTION—

- Be sure to mark oxygen sensor connectors so that they can be reassembled as before.

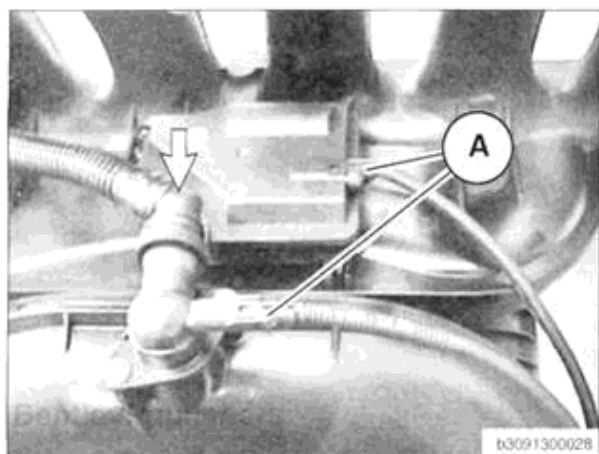
Fuel Injection MSV70, MSV80 (N52 Engine) 131-19

Intake manifold, removing and installing



Working above engine:

- Remove and lay fuel rail (B) aside. Do not disconnect fuel line.
- Remove fastener (A).
- Remove nuts (C).



Raise intake manifold approximately 10 cm (4 in). Working underneath:

- Disconnect electrical connector (A).
- Release fuel tank vent line (arrow) behind throttle valve assembly.
- Raise and remove intake manifold.

CAUTION—

- Plug open intake ports to prevent parts or debris from falling into the engine intake.

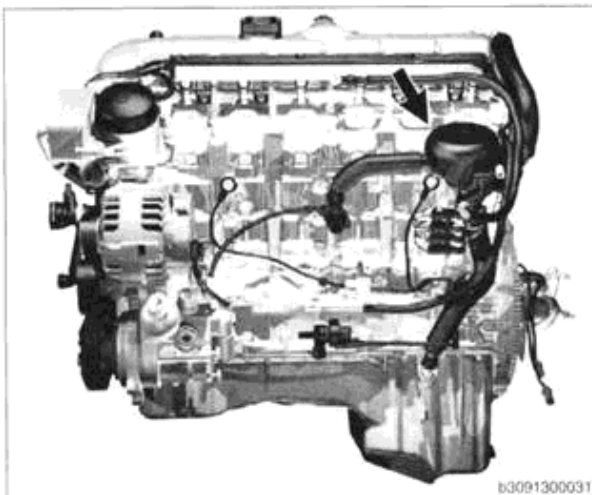
— Installation is reverse of removal. Remember to replace all seals.

Tightening torque

Manifold to cylinder head	15 Nm (11 ft-lb)
Tension strut to body (M8) replace fasteners	30.5 Nm (22.4 ft-lb)

131-20 Fuel Injection MSV70, MSV80 (N52 Engine)

Crankcase breather valve



Crankcase breather valve

N52 engine crankcase is ventilated by either a breather valve under the intake manifold or a breather valve integrated in the cylinder head cover. Engines with a metal cylinder head cover utilize an external breather valve, engines with a plastic valve cover utilize an internal breather valve.

External crankcase breather

- The crankcase ventilation system has an electrically heated crankcase breather valve. The pressure control valve and cyclonic oil separator are combined into one unit. The assembly is located under the intake manifold (**arrow**).

The pressure control valve varies the vacuum applied to the crankcase breather depending on engine load. The valve is balanced between spring pressure and the amount of manifold vacuum.

At idle when the intake manifold vacuum is high, vacuum reduces the valve opening, allowing a small amount of crankcase vapors to be drawn into the intake manifold.

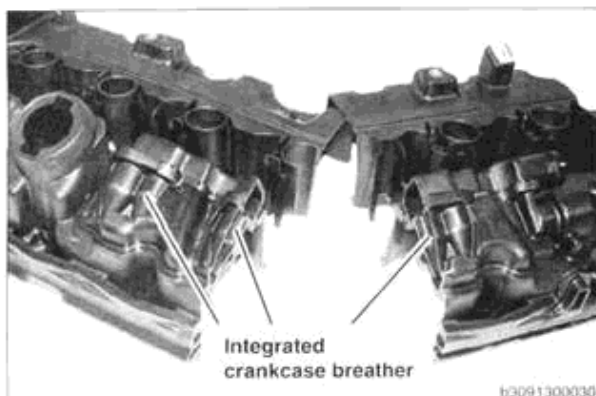
At part to full load conditions when intake manifold vacuum is lower, the spring opens the valve and additional crankcase vapors are drawn into the intake manifold.

Crankcase breather heating

- Integrated into the design of the crankcase breather valve is an electric heating system (**arrow**) designed to prevent moisture buildup. Moisture buildup can eventually lead to ice at low ambient temperatures leading to malfunctions of the crankcase breather valve. The crankcase breather valve is insulated by a protective foam covering to provide additional shelter from low ambient temperatures.

The heating elements are integrated into the crankcase ventilation valve and hose assemblies. There is a junction point on the intake manifold which provides a connection point for the individual heating elements.

There is also a heating element located on the centrally located port on the intake manifold. This port is also provided with a separate heating circuit controlled by a PTC thermistor. For wiring schematic **ELE Electrical Wiring Diagrams**.



Integrated crankcase breather

- ◀ The internal crankcase ventilation system is integrated into the plastic cylinder head cover. The crankcase breather valve is part of the cylinder head cover and is not serviceable as a separate component.

Oil separation is carried out via a labyrinth system and two cyclone separators incorporated into the cylinder head cover. By having the system components integrated into the cylinder head cover, the crankcase gases are heated by the engine rather than an electric heater as on the external system. However, there is still one electric heating element at the manifold inlet. Once the liquid oil is separated from the crankcase vapors, the oil is allowed to drain back through check valves back into the engine.

If the diaphragm valve in the breather housing leaks, full intake vacuum may be applied to the crankcase, resulting in excessive oil consumption, irregular idle, whistling or howling noises or oil smoke in the exhaust.

Crankcase pressure specifications for N52 engines

The pressure control valve sets the following pressure range:

- N52 24 to 28 mbar
- N52K 28 to 32 mbar

Deviation to the current ambient pressure: +20 mbar to -60 mbar

A faulty crankcase breather valve causes significant deviations from the specified value:

- Crankcase ventilation clogged: Ambient pressure +100 mbar
- Crankcase ventilation internal leak: ambient pressure -170 mbar

To gain access to external breather valve, remove throttle housing. See **Throttle housing, removing and installing** in this repair group.

To replace internal breather valve. Replace cylinder head cover. See **113 Cylinder Head, Removal and Installation**.

131-22 Fuel Injection MSV70, MSV80 (N52 Engine)

Engine coolant temperature (ECT) sensor, replacing

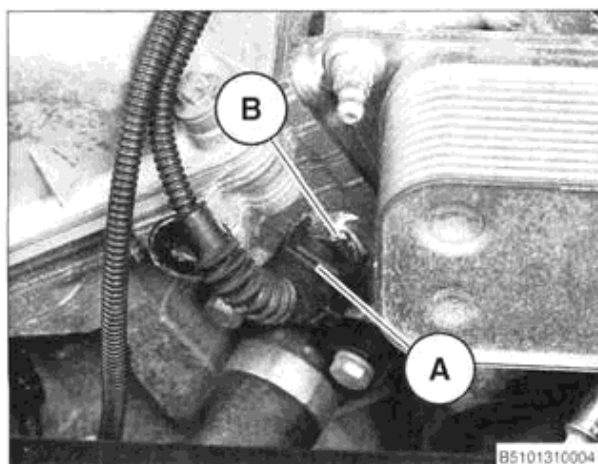
Engine coolant temperature (ECT) sensor, replacing

The engine coolant temperature (ECT) sensor is an NTC (negative temperature coefficient) sensor. As coolant temperature rises, resistance through the sensor decreases.

The ECM varies ignition timing and air / fuel mixture based on engine coolant temperature. The ECT sensor is supplied a 5 volt reference voltage. The voltage drop across the sensor varies as the coolant temperature (sensor resistance) changes.

If the ECT sensor input is faulty or not plausible, the MIL is illuminated when OBD II fault criteria are exceeded. The ECM assumes a substitute value (80° C / 176°F) to maintain engine operation. The ignition timing is set to a safely conservative basic setting.

The ECT sensor is located in the left front of the engine near oil filter housing.



➤ With engine fully cooled off, disconnect ECT sensor connector (A).

- Unscrew ECT sensor (B) from cylinder head. Be prepared to catch small amount of coolant.
- Installation is reverse of removal:
 - Use new copper sealing washer when installing sensor.
 - Replace lost coolant.

Tightening torque

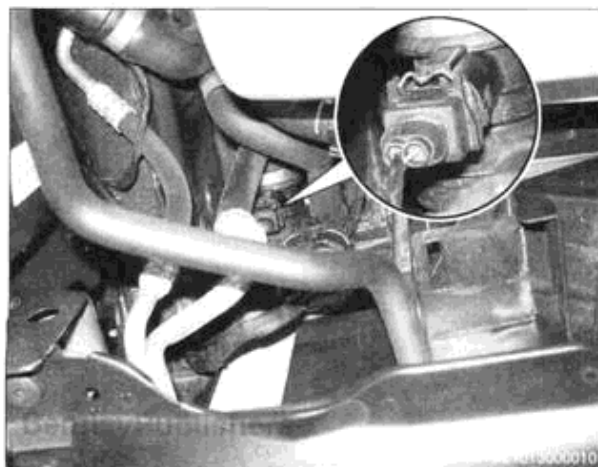
Temperature sensor to cylinder head	18 Nm (13 ft-lb)
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- After reinstalling, check and clear fault codes from ECM memory.

Radiator outlet coolant temperature sensor

➤ N52 engine to 03 / 2007: Radiator outlet temperature sensor (inset) is NTC (negative temperature coefficient) sensor. As coolant temperature rises, resistance through sensor decreases.

ECM varies cooling fan speed based on radiator outlet coolant temperature. Radiator outlet coolant temperature sensor is supplied a 5 volt reference voltage. Voltage drop across sensor varies as coolant temperature (sensor resistance) changes.



DME main relay, testing

The DME main relay is energized via the ECM and supplies battery positive (B+) power to the following:

- ECM
- Ignition coils
- Tailpipe flap
- Mass air flow sensor
- Fuel tank leak detection pump (DMTL)
- Crankshaft sensor
- Camshaft sensors
- Evaporative emissions valve
- Crankcase breather valve heater
- Oil condition sensor
- Variable intake manifold (DISA) controllers
- Electric coolant pump
- Thermostat
- Oxygen sensor heaters

If the DME main relay is faulty, the engine does not start.

- With ignition off, remove DME main relay (**K6300**) in electronics box (E-box) at right rear of engine compartment.

NOTE—

- Relay locations can vary. Confirm relay identification by matching wiring colors and terminal numbers. See **ELE Electrical Wiring Diagrams**.

- Check for voltage at terminal **6** of relay socket (corresponds to terminal **30** on relay).

— If battery voltage is present, continue testing.

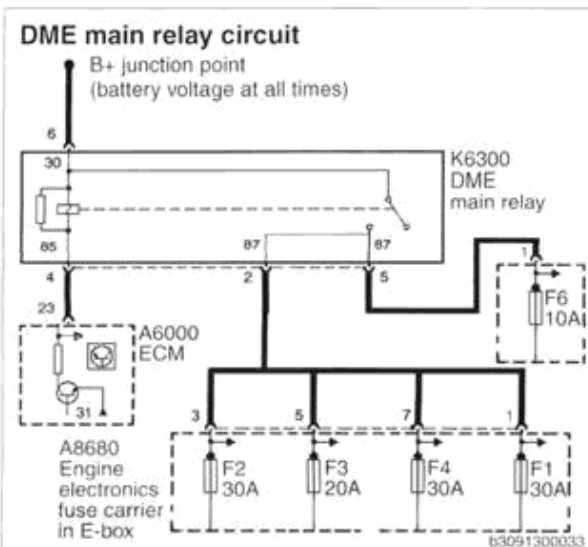
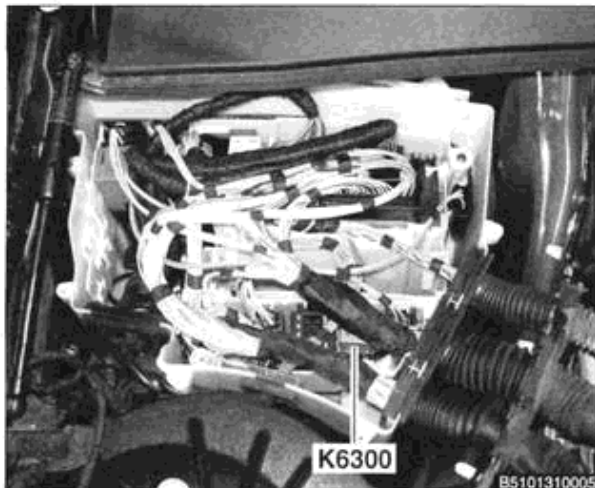
— If battery voltage is not present, check the following:

- Large red wire in relay socket
- A2076 (battery positive junction) in E-box, right rear of engine compartment
- Fuse F8 in fuse and relay panel behind glove compartment. See **Power supply fuses** in this repair group.
- See **ELE Electrical Wiring Diagrams** for more details

— Check for ground at relay socket **4** (corresponds to terminal **85** on relay).

— If ground is present, continue testing.

— If ground is not present, signal from ECM is missing. Check wire between relay and ECM 44 pin connector X60005. See **ECM pin assignments** in this repair group.



131-24 Fuel Injection MSV70, MSV80 (N52 Engine)

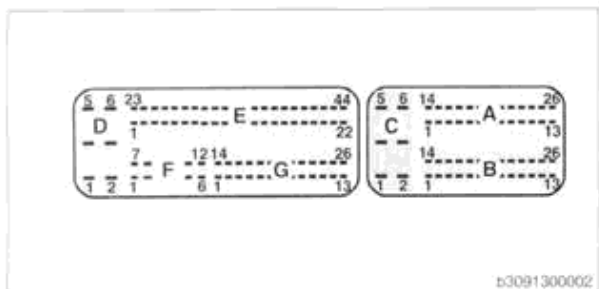
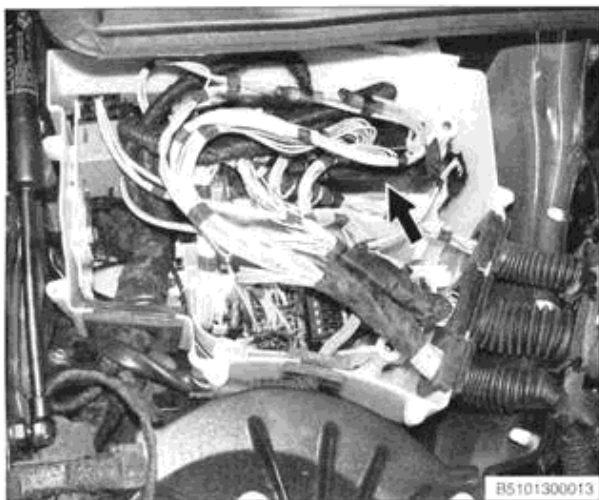
DME main relay, testing

- If no faults are found:
 - Check ECM grounding.
 - ECM may be defective.
- With ignition ON and relay installed, check for battery voltage at relay sockets **2** and **5** (correspond to terminals **87** on relay).

NOTE —

- *In some models there is only one terminal 87.*

- If battery voltage is present, relay has energized and is functioning correctly.
- If battery voltage is not present and all earlier tests are OK, relay is faulty. Replace.
- If no faults are found during relay testing but power is not reaching ECM or other components, check fuses in engine electronics fuse carrier (A8680) in E-box and Front fuse panel (A41). See **Power supply fuses** in this repair group.
- When finished testing, check and clear fault codes from ECM memory.



ECM pin assignments

➤ The engine control module (ECM) (**arrow**) is located in the right rear of the engine compartment in the E-box.

➤ The ECM has 2 main electrical harness connectors, one with 4 modular connections and the other with 3 for a total of 7 sub connectors and 147 pins.

- **A:** X60001 (signals)
- **B:** X60002 (signals)
- **C:** X60003 (voltage, ground supply)
- **D:** X60004 (valvetronic)
- **E:** X60005 (signals)
- **F:** X60006 (ignition coils)
- **G:** X60007 (signals)

ECM pin assignments for non-turbo engines are given in **Table b**. This information can be helpful when diagnosing faults to or from the ECM.

Generally, absence of voltage or continuity means there is a wiring or connector problem. Test results with incorrect values do not necessarily mean that a component is faulty. Check for loose, broken or corroded connections and wiring before replacing components. For engine management system electrical schematics, see **ELE Electrical Wiring Diagrams**.

When making checks at the ECM, use a break-out box to allow tests to be made with the connector attached to the ECM. This prevents damage to the small terminals in the connector. As an alternative, the connector housing can be separated so that electrical checks can be made from the back of the connector.

CAUTION—

- Wait at least one minute after switching the ignition OFF before removing the connector from the ECM. If the connector is removed before this time, residual power in the system relay may damage the ECM.
- Connect or disconnect the control module connector and meter probes with the ignition OFF.

131-26 Fuel Injection MSV70, MSV80 (N52 Engine)

ECM pin assignments

Table b. Siemens DME MSV70 MSV80 ECM pin assignments

Connector X60001 26-pin (signals)

Pin	Type	Component or function	Note
1	input/output	Signal PT-CAN low	Powertrain CAN-bus
2	input	Start signal	Car access system
3	input/output	BSD signal	Battery sensor
4	input	Brake light signal	Brake light switch
5	output	Exhaust flap signal	Exhaust flap
6	input	Radiator outlet temperature sensor signal	Temperature sensor at radiator outlet
7	input	Accelerator pedal module signal	Accelerator pedal module
8	output	Electric fan signal	Electric engine cooling fan
9	output	Radiator shutter solenoid	Signal
10	ground	Accelerator pedal module	Accelerator pedal module
11	output	Accelerator pedal module supply voltage	Accelerator pedal module
12	-	Not used	
13	-	Not used	
14	input/output	Signal PT-CAN high	Powertrain CAN-bus
15	input	EWS signal to 03/2007 PA bus signal from 03/2007	Car access system
16	input	Brake light test signal	Brake light switch
17	input	Right rear wheel speed sensor signal	Connector X10186 (right rear wheel speed sensor)
18	input	Clutch switch signal	Clutch switch module
19	input	Radiator outlet temperature sensor signal	Temperature sensor at radiator outlet
20	input	Accelerator pedal module signal	Accelerator pedal module
21	input/output	TD signal	TD signal connector
22	input	Not used to 03/2007 Signal RXIN	Car access system
23	ground	Accelerator pedal module	Accelerator pedal module
24	output	Accelerator pedal module supply voltage	Accelerator pedal module
25	-	Not used	
26	output	E-box fan signal	E-box fan

Connector X60002 26-pin (signals)

Pin	Type	Component or function	Note
1	input	Wake up signal, terminal 15	Terminal 15 wake up connector
2	-	Not used	
3	-	Not used	
4	-	Not used	
5	input	Oxygen sensor signal	Bank 2 sensor 1
6	input	Oxygen sensor signal	Bank 1 sensor 1

Connector X60002 26-pin (signals) (continued)

Pin	Type	Component or function	Note
7	input	Oxygen sensor signal	Bank 2 sensor 1
8	input	Oxygen sensor signal	Bank 1 sensor 1
9	input	Oxygen sensor signal	Bank 2 sensor 1
10	ground	Oxygen sensor	Bank 1 sensor 1
11	ground	Oxygen sensor	Bank 2 sensor 1
12	input	Oxygen sensor heating	Bank 1 sensor 1
13	input	Oxygen sensor heating	Bank 2 sensor 1
14	-	Not used	
15	input	DMTL valve signal	Diagnosis module for fuel tank leakage
16	input	DMTL pump signal	Diagnosis module for fuel tank leakage
17	input	DMTL heating signal	Diagnosis module for fuel tank leakage
18	input	Oxygen sensor signal	Bank 1 sensor 1
19	input	Oxygen sensor signal	Bank 2 sensor 2
20	input	Oxygen sensor signal	Bank 1 sensor 2
21	-	Not used	
22	-	Not used	
23	ground	Oxygen sensor	Bank 1 sensor 2
24	input	Oxygen sensor	Bank 2 sensor 2
25	input	Oxygen sensor	Bank 2 sensor 2
26	output	Oxygen sensor	Bank 1 sensor 2

Connector X60003 6-pin (voltage, ground supply)

Pin	Type	Component or function	Note
1	input	Terminal 30	B+ potential distributor
2	input	Terminal 87	Fuse F03
3	ground	Ground	Ground point
4	ground	Ground	Ground point
5	ground	Ground	Ground point
6	ground	Ground	Ground point

Connector X60004 6-pin (valvetronic)

Pin	Type	Component or function	Note
1	input	Terminal 87	VVT relay
2	input	Terminal 87	VVT relay
3	output	Valvetronic actuator signal	Valvetronic actuator timing actuator
4	output	Valvetronic actuator signal	Valvetronic actuator timing actuator
5	output	Valvetronic actuator signal	Valvetronic actuator timing actuator
6	output	Valvetronic actuator signal	Valvetronic actuator timing actuator

131-28 Fuel Injection MSV70, MSV80 (N52 Engine)

ECM pin assignments

Connector X60005 44-pin (signals)			
Pin	Type	Component or function	Note
1	-	Not used	
2	-	Not used	
3	-	Not used	
4	-	Not used	
5	-	Not used	
6	-	Not used	
7	-	Not used	
8	-	Not used	
9	-	Not used	
10	-	Not used	
11	-	Not used	
12	output	Crankcase breather valve heating activation	Crankcase breather valve heating relay
13	output	DME main relay activation	DME main relay
14	output	Throttle valve voltage supply	Throttle valve
15	input	Throttle valve signal	Throttle valve
16	input	Throttle valve signal	Throttle valve
17	-	Not used	
18	output	DISA changeover valve signal	DISA controller 2
19	input	Knock sensor signal	Knock sensor
20	input	Knock sensor signal	Knock sensor
21	-	Not used	
22	-	Not used	
23	output	Fuel tank vent valve signal	Fuel tank vent valve
24	-	Not used	
25	output	Mass air flow sensor voltage supply	Mass air flow sensor
26	input	Mass air flow sensor signal	Mass air flow sensor
27	ground	Mass air flow sensor	Mass air flow sensor
28	input	Intake air temperature sensor signal	Intake air temperature sensor
29	input	Crankshaft position sensor signal	Crankshaft position sensor
30	ground	Crankshaft position sensor	Crankshaft position sensor
31	output	Intake manifold pressure sensor voltage supply	Intake manifold pressure sensor
32	ground	Intake manifold pressure sensor	Intake manifold pressure sensor
33	input	Intake manifold pressure sensor signal	Intake manifold pressure sensor
34	-	Not used	
35	input/output	BSD signal	BSD signal connector
36	input	Throttle valve signal	Throttle valve
37	input	Throttle valve signal	Throttle valve

Connector X60005 44-pin (signals) (continued)

Pin	Type	Component or function	Note
38	ground	Throttle valve	Throttle valve
39	-	Not used	
40	output	DISA changeover valve signal	DISA controller 1
41	input	Knock sensor signal	Knock sensor
42	input	Knock sensor signal	Knock sensor
43	-	Not used	
44	-	Not used	

Connector X60006 12-pin (ignition coils)

Pin	Type	Component or function	Note
1	output	Ignition coil signal	Ignition coil signal 1
2	output	Ignition coil signal	Ignition coil signal 2
3	output	Ignition coil signal	Ignition coil signal 3
4	output	Ignition coil signal	Ignition coil signal 4
5	output	Ignition coil signal	Ignition coil signal 5
6	output	Ignition coil signal	Ignition coil signal 6
7	-	Not used	
8	-	Not used	
9	-	Not used	
10	-	Not used	
11	-	Not used	
12	-	Not used	

Connector X60007 26-pin (signals)

Pin	Type	Component or function	Note
1	output	Fuel injector signal	Fuel injector 1
2	output	Fuel injector signal	Fuel injector 2
3	output	Fuel injector signal	Fuel injector 3
4	input	Engine coolant temperature signal	Engine coolant temperature sensor
5	output	Intake VANOS solenoid signal	Intake VANOS solenoid
6	input	Eccentric shaft sensor signal	Eccentric shaft sensor
7	input	Eccentric shaft sensor signal	Eccentric shaft sensor
8	input	Eccentric shaft sensor signal	Eccentric shaft sensor
9	input	Eccentric shaft sensor signal	Eccentric shaft sensor
10	ground	Wire shielding	Eccentric shaft sensor
11	input	Camshaft position sensor 1 signal	Camshaft position sensor 1
12	input	Camshaft position sensor 2 signal	Camshaft position sensor 2
13	input	Oil pressure switch signal	Oil pressure switch

131-30 Fuel Injection MSV70, MSV80 (N52 Engine)

ECM pin assignments

Connector X60007 26-pin (signals) (continued)			
Pin	Type	Component or function	Note
14	output	Fuel injector signal	Fuel injector signal 4
15	output	Fuel injector signal	Fuel injector signal 5
16	output	Fuel injector signal	Fuel injector signal 6
17	ground	Engine coolant temperature sensor	Engine coolant temperature sensor
18	output	Exhaust VANOS solenoid signal	Exhaust VANOS solenoid
19	input	Thermostat signal	Thermostat
20	ground	Eccentric shaft sensor	Eccentric shaft sensor
21	output	Eccentric shaft sensor voltage supply	Eccentric shaft sensor
22	input	Eccentric shaft sensor signal	Eccentric shaft sensor
23	output	Valvetronic actuator relay signal	Valvetronic actuator relay
24	ground	Camshaft position sensor 1	Camshaft position sensor 1
25	ground	Camshaft position sensor 2	Camshaft position sensor 2
26	input/output	BSD signal	Electric coolant pump

